

# Si5344-D EVALUATION BOARD USER'S GUIDE

#### Description

The Si5344-D-EVB is used for evaluating the Si5344 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 "SI5344-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.)

#### Features

- Powered from USB port or external power supply
- Onboard 48 MHz XTAL or Reference SMA Inputs allow holdover mode of operation on the Si5344.
- ClockBuilder<sup>®</sup> Pro (CBPro) GUI-programmable VDD supply allows device to operate from 3.3, 2.5, or 1.8 V.
- CBPro GUI-programmable VDDO supplies allow each of the 10 outputs to have its own supply voltage selectable from 3.3, 2.5, or 1.8 V
- CBPro GUI-controlled voltage, current, and power measurements of VDD and all VDDO supplies.
- Status LEDs for power supplies and control/status signals of Si5344

 SMA connectors for input clocks, output clocks, and optional external timing reference clock

#### Si5344-D Evaluation Board



## 1. Functional Block Diagram

Below is a functional block diagram of the Si5344-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" or Section "9. Installing ClockBuildPro (CBPro) Desktop Software" for more information.

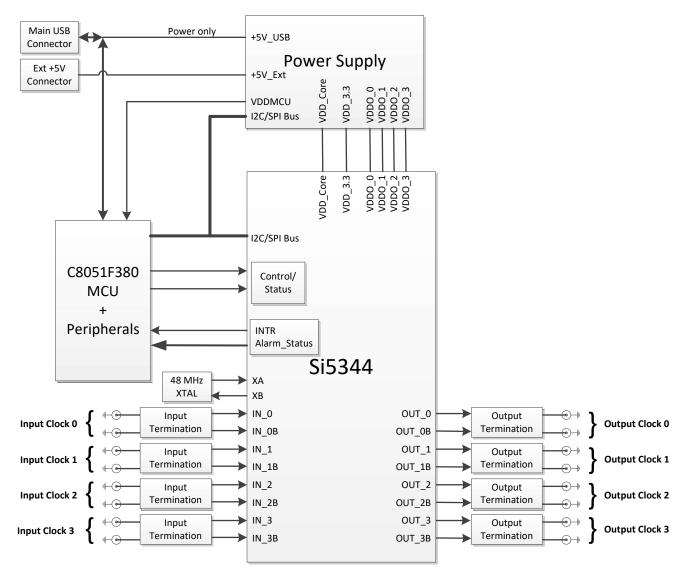


Figure 1. Si5344-EB Functional Block Diagram



# 2. Si5344-D-EVB Support Documentation and ClockBuilder<sup>®</sup> Pro Software

All Si5344 schematics, BOMs, User's Guides, and software can be found on-line at the following link:

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

## 3. Quick Start

- 1. Install ClockBuilder Pro desktop software: http://www.silabs.com/CBPro
- 2. Connect a USB cable from the Si5344-D-EB to the PC where the software is installed.
- 3. Confirm jumpers are installed as shown in Table 1.
- 4. Launch the ClockBuilder Pro Software.
- 5. You can use ClockBuilder Pro to create, download, and run a frequency plan on the Si5344-D-EB.
- 6. For the Si5344 data sheet go here: http://www.silabs.com/timing



# Si5344-D-EVB

## 4. Jumper Defaults

Location	Туре	I = Installed 0 = Open		Location	Туре	I = Installed 0 = Open		
JP1	2 pin	I		JP14	2 pin	0		
JP2	2 pin	I		JP15	2 pin	0		
JP3	2 pin	I		JP16	3 pin	all open		
JP4	2 pin	I		JP17	3 pin	all open		
JP5	3 pin	1 to 2		JP18	2 pin	0		
JP6	2 pin	0		JP19	2 pin	0		
JP7	2 pin	0		JP20	3 pin	all open		
JP8	2 pin	0		JP21	3 pin	all open		
JP9	2 pin	0		JP22	2 pin	0		
JP10	2 pin	0		JP23	2 pin	0		
JP11	2 pin	0		JP24	3 pin	all open		
JP12	2 pin	0		J17	5x2 Hdr	All 5 installed		
JP13	2 pin	0						
*Note: Refer to	*Note: Refer to the Si534-D-EB Schematics for the functionality associated with each jumper.							

Table 1. Si5344-D-EB Jumper Defaults



## 5. Status LEDs

Location	Silkscreen	Color	Status Function Indication
D5	INTRB	Blue	DUT Interrupt
D7	LOLB	Blue	DUT Loss of Lock
D8	LOSXAXBB	Blue	DUT Loss of Reference
D11	+5V MAIN	Green	Main USB +5V present
D12	READY	Green	MCU Ready
D13	BUSY	Green	MCU Busy

Table 2. Si5344-D-EB Status LEDs

D11 is illuminated when USB +5V supply voltage is present. D12 and D13 are status LEDs showing on-board MCU activity.

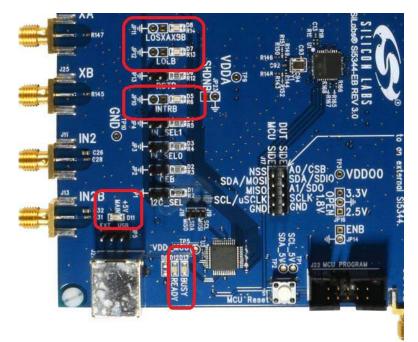


Figure 2. Status LEDs



## 6. External Reference Input (XA/XB)

An external reference (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 Si5344-D-EB can also accommodate an external reference clock instead of a crystal. To evaluate the device with a REFCLK, C93 and C94 must be populated and the XTAL removed (see Figure 3). The REFCLK can then be applied to J25 and J26.

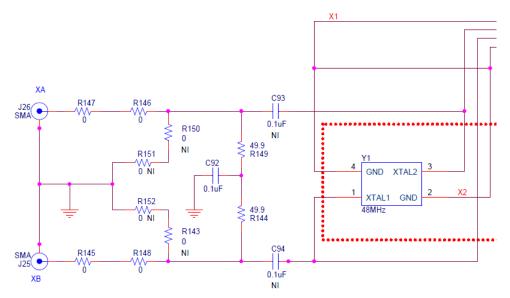


Figure 3. External Reference Input Circuit



## 7. Clock Input Circuits (INx/INxB and FB-IN/FB-INB)

The Si5344-D-EB has eight SMA connectors (IIN0/IN0B – IN2/IN2B and IN3(FB\_IN)/IN3B(FB\_INB)) for receiving external clock signals. All input clocks are terminated as shown in Figure 4.

Input clocks are ac-coupled and 50  $\Omega$  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 Si5344 data sheet.

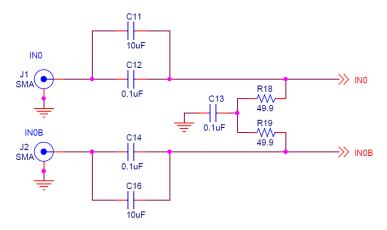


Figure 4. Input Clock Termination Circuit



## 8. Clock Output Circuits (OUTx/OUTxB)

Each of the eight outputs (four differential pairs) is ac-coupled to its respective SMA connector. The output clock termination circuit is shown in Figure 5. The output signal has no dc bias. If dc coupling is required, the ac coupling capacitors can be replaced with a resistor of appropriate value. The Si5344-D-EB provides pads for optional output termination resistors and/or low frequency capacitors.

**Note:** Components with schematic "NI" designation are not normally populated on the Si5344-D-EB and provide locations on the PCB for optional dc/ac terminations by the end user.

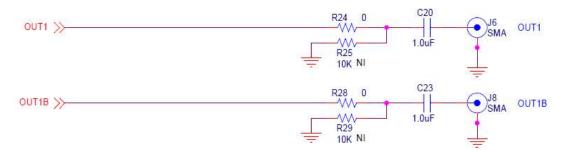


Figure 5. Output Clock Termination Circuit

## 9. Installing ClockBuildPro (CBPro) Desktop Software

To install the CBPro software on any Windows 7 (or later version) PC do the following:

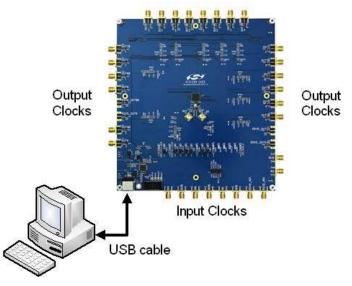
- 1. Go to http://www.silabs.com/CBPro/ and download ClockBuilder Pro software.
- 2. Installation instructions and User's Guide for ClockBuilder Pro can be found at the download link shown above. Please follow the instructions as indicated.



## 10. Using Si5344-D-EVB

#### 10.1. Connecting the EVB to Your Host PC

Once ClockBuilder Pro software in installed, connect to the EVB with a USB cable as shown in Figure 6.





#### 10.2. Overview of ClockBuilder Pro Applications

The ClockBuilder Pro installer installs two main applications: the ClockBuilder Pro Wizard and the EVB GUI. Note: The following instructions and screen captures may vary slightly depending on your version of ClockBuilder Pro. The ClockBuilder Pro installer will install two main applications:



Figure 7. Application #1: ClockBuilder Pro Wizard



# Si5344-D-EVB

Use the CBPro Wizard to do the following:

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

	Help		12					1	
nfo	DUT SPI	I2C	DUT Regist	er Editor	Regulators	All Voltages	GPIO	Status Regi	isters
					Voltage	Curre	nt	Power	
	VD	D 1.	80V 🔹 🔽	On	V		A	W	Read
	VDD	A		On	V		A	W	Read
	VDDO	0 1.	80V 🔽	0	ff V		A	W	Read
	VDDO	1	80V 🔽	0	ff V		A	W	Read
	VDDO	2 1.	80V 🔽	0	ff V		A	W	Read
	VDDO	3 1.	80V 🔽	0	ff V		A	W	Read
A1	l Output	IT Se	elect Voltage	e	Total	100	A	W	Read A

#### Figure 8. Application #2: EVB GUI

Use the EVB GUI to do the following:

- Download configuration to EVB's DUT (Si5344)
- 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 Si5344-D-EVB. These workflow scenarios are as follows:

- 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.

#### 10.3.1. 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.

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



#### Figure 9. ClockBuilder Pro Desktop Icon

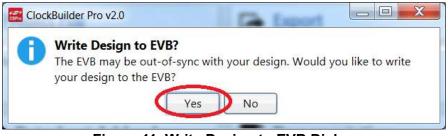


2. When the EVB is detected, click on the **Open Default Plan** button on the Wizard's main menu. CBPro automatically detects the EVB and device type.

ClockBuilder Pro Wizard           ClockBuilder Pro Wizard           SILICON LABS         We Make Timing Simple					
Work With a Design	Quick Links				
Create New Design	Jitter Attenuator Clock Products Knowledge Base Custom Part Number Lookup ClockBuilder Go iOS App				
ex Open Sample Design	Applications Documentation				
SIS344 EVB Open Default Plan EVB GUT	10/40/100G Line Card White Paper Clock Generators for Cloud Data Centers White Paper Optimizing, SiS34x Jitter Performance App. Note SyncE and IEEE 1588 App. Note				
Export Configuration	ClockBuilder Pro Documentation				
	CBPro Overview Command Line Interface: <u>Overview</u> • <u>User's Guide</u> CBPro Knowledge Base				
•	Version 2.0 Built on 6/13/2015				

#### Figure 10. Open Default Plan

3. Once you open the default plan (based on your EVB model number), a popup window opens.



#### Figure 11. Write Design to EVB Dialog

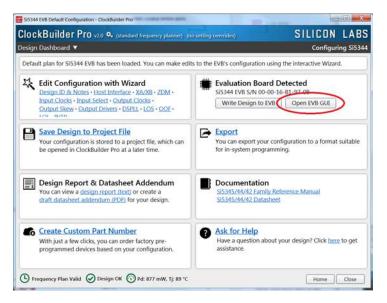
4. Select **Yes** to write the default plan to the Si5344 device mounted on your EVB. This ensures the device is completely reconfigured per the Silicon Labs default plan for the DUT type mounted on the EVB.



Figure 12. Writing Design Status



5. After CBPro writes the default plan to the EVB, click on Open EVB GUI.



#### Figure 13. Open EVB GUI

6. The EVB GUI opens. All power supplies are set to the values defined in the device's default CBPro project file created by Silicon Labs, as shown in Figure 14.

e Help									
nfo DL	IT SPI	I2C	DUT Regis	ter Editor	Regulators	All Voltages	GPIO	Status Regis	sters
					Voltage	Curre	nt	Power	
	VDD	1.8	0V 🔽	On	\	/	A	W	Read
	VDDA			On	\		A	W	Read
	VDD00	1.8	0V 🔽	Of	ff \		A	W	Read
	VDD01	1.8	0V 🔽	O	ff \		A	W	Read
	VDDO2	1.8	0V 🔽	Of	ff \	/	A	W	Read
	VDDO3	1.8	0V 🔽	Of	ff \		A	W	Read
All Ou		Sal	ect Voltag		Total		A	W	Read Al

Figure 14. EVB GUI Window



#### 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 (bottom right-hand corner of Figure 14) and then reviewing the voltage, current, and power readings for each VDDx supply.

**Note:** Shutting the VDD and VDDA power supplies "Off" and then "On" 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**.

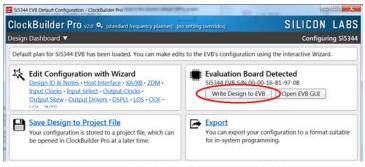


Figure 15. Write Design to EVB

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 in 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 in Figure 16.

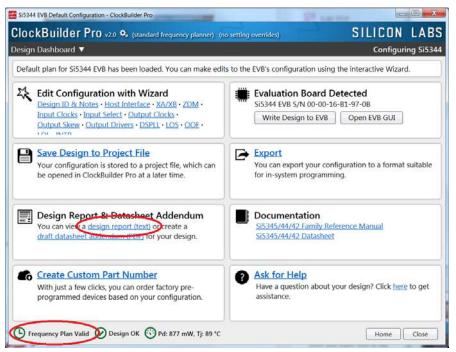


Figure 16. View Design Report



# Si5344-D-EVB

Your configuration's design report opens in a new window, as shown in Figure 17. Compare the observed output clocks to the frequencies and formats noted in your default project's Design Report.

```
🚟 Si5344 Design Report
                                                                      _ 🗆 🗙
 Design Report
 Created By:
               ClockBuilder Pro v2.0 [2015-06-13]
                                                                               .
               2015-06-15 15:12:54 GMT-05:00
 Timestamp:
 Design Rule Check
 Errors:
  - No errors
 Warnings:
 - No warnings
 Device Grade
 ______
 Maximum output frequency: 672.1640625 MHz
 Frequency synthesis mode: Fractional
 Frequency plan grade:
                          A
                          si5344A*
 Minimum Base OPN:
            Output Clock
                                Supported Frequency Synthesis Modes
 Base
 OPN Grade Frequency Range
                                (Typical Jitter)
  _____
                       Si5344A* 100 Hz to 712.5 MHz Integer (< 100 fs) and fractional (< 150 fs)
 S15344B
           100 Hz to 350 MHz
 Si5344C
            100 Hz to 712.5 MHz Integer only (< 100 fs)
 si5344D 100 Hz to 350 MHz
 * Based on your calculated frequency plan, a Si5344A grade device is
 required for your design. See the datasheet Ordering Guide for more
 information.
 Design
 Host Interface:
    I/O Power Supply: VDD (Core)
    SPI Mode: 4-Wire
    I2C Address Range: 104d to 107d / 0x68 to 0x6B (selected via A0/A1 pins)
 XA/XB:
    48 MHz (XTAL - Crystal)
 Inputs:
       : 25 MHz
         Standard
     IN1: 25 MHz
          Standard
     IN2: 19.44 MHz [ 19 + 11/25 MHz ]
          Standard
     IN3: 19.44 MHz [ 19 + 11/25 MHz ]
          Standard
Outputs:
          156.25 MHz [ 156 + 1/4 MHz ]
          Enabled, LVDS 2.5 V
    OUT1: 672.1640625 MHz [ 672 + 21/128 MHz ]
          Enabled, LVDS 2.5 V
    OUT2: 625 MHz
          Enabled, LVDS 2.5 V
  Copy to Clipboard
                      Save Report
                                                                          Close
```

Figure 17. Design Report Window

#### 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.



10.3.2. 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.

SI5344 EVB Default Configuration - ClockBuilder Pro	
ClockBuilder Pro v2.0 % (standard frequency planner) (no	setting overrides) SILICON LABS
Design Dashboard	Configuring Si5344
Default plan for Si5344 EVB has been loaded. You can make edits	s to the EVB's configuration using the interactive Wizard.
Edit Configuration with Wizard Design ID & Notes - Host Interface - XAXB - ZDM - Input Clocks - Input Select - Output Clocks - Output Skew - Output Drivers - DSPLI - LOS - OOF -	Evaluation Board Detected Si5344 EV8 S/N 00-00-16-81-97-08 Write Design to EVB Open EVB GUI
Save Design to Project File Your configuration is stored to a project file, which can be opened in ClockBuilder Pro at a later time.	You can export your configuration to a format suitable for in-system programming.
Design Report & Datasheet Addendum You can view a design report (text) or create a draft datasheet addendum (PDF) for your design.	SIS245/44/42 family Reference Manual SIS245/44/42 Datasheet
Create Custom Part Number With just a few clicks, you can order factory pre- programmed devices based on your configuration.	Ask for Help Have a question about your design? Click here to get assistance.
C Frequency Plan Valid O Design OK O Pd: 877 mW, Tj: 89 °C	Home Close

#### Figure 18. 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.

ep 1 of 14 - De	esign ID & Notes 💙	Configuring Si5							
Design ID									
The device has 8	egisters. DESIGN_ID0 through DESIGN_ID7, that can be used to store a design/configu	aration/revision identifier.							
Design ID:	5344EVB2 (optional: max 8 characters)								
	The string you enter here is stored as ASCII bytes in registers DESIGN_ID0 through DESIGN_ID7.								
Padding Mode:	NULL Padded								
	If you do not enter the full 8 characters, the remaining bytes of DESIGN_IDx will be padded with 0x00 bytes (aka NULL character).								
	Space Padded     If you do not enter the full 8 characters, the remaining bytes of DESIGN_IDx will be padded with 0x20 bytes (space character).								
Design Notes									
	u want here. The text is stored in your project file and included in design reports and c word wrapped in reports, you can use newlines to start a new paragraph.	ustom part number datasheet addendum							

#### Figure 19. Design Wizard

**Note:** You can click on the icon on the lower left hand of the menu to confirm that 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 in real-time. The Design Write status window opens each time you make a change.



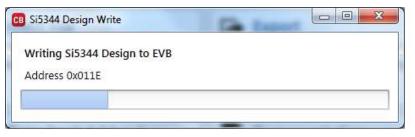


Figure 20. Writing Design Status

- 10.3.3. Workflow Scenario #3: Testing a User Created Device Configuration
  - 1. To test a previously-created user configuration, open the CBPro Wizard by clicking the icon on your desktop and then selecting **Open Design Project File**.

ClockBuilder Pro Wizard - Silicon Labs					
SILICON LABS ClockBuilder Pro	0				
Work With a Design	Quick Links				
Create New Design	Jitter Attenuator Clock Products Knowledge Base Custom Part Number Lookup				
ex Open Sample Design	ClockBuilder Go iOS App Applications Documentation				
Evaluation Board Detected Si5344 EVB Open Default Plan EVB GUI Tools	10/40/1005 Line Card White Paper Clock Generators for Cloud Data Centers White Paper Optimizing SIS34x Jitter Performance App Note Syncf, and JEEE 1588 App Note				
Export Configuration	ClockBuilder Pro Documentation				
	CBPro Overview Command Line Interface: Overview • User's Guide CBPro Knowledge Base				
o.	Version 2.0 Built on 6/13/2015				

Figure 21. Open Design Project File

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

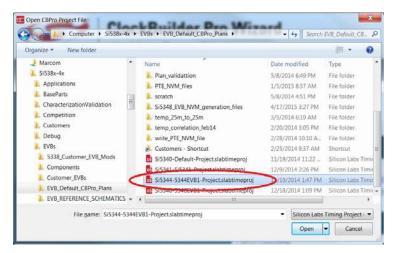


Figure 22. Browse to Project File



3. Select Yes when the WRITE DESIGN to EVB popup appears:



Figure 23. Write Design to EVB Dialog

4. The progress bar is 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.

#### **10.4.** 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 in Figure 24.

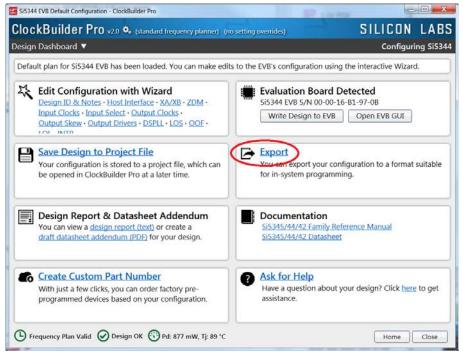


Figure 24. Export Register Map File

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



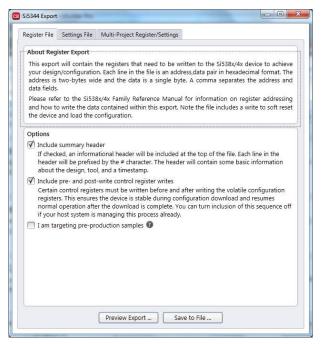


Figure 25. Export Settings



# 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 Si5344 using Clock-Builder Pro on the Si5344-D-EB. Writing a configuration into the EVB from ClockBuilder Pro is done using Si5344 RAM space and can be done virtually unlimited number of times. Writing to OTP is limited as described below.

Refer to the Si534x/8x Family Reference Manuals and device datasheets 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 (Si5344 <--> MCU)

#### 12.1. On-Board SPI Support

The MCU on-board the Si5344-D-EB communicates with the Si5344 device through a 4-wire SPI (Serial Peripheral Interface) link. The MCU is the SPI master and the Si5344 device is the SPI slave. The Si5344 device can also support a 2-wire I2C serial interface, although the Si5344-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<sup>2</sup>C Support

 $I^2C$  can be supported if driven from an external  $I^2C$  controller. The serial interface signals between the MCU and Si5344 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 Si5344 device. The shunt at JP1 (I2C\_SEL) must also be removed to select  $I^2C$  as Si5344 interface type. An external I2C controller connected to the Si5344 side of J17 can then communicate to the Si5344 device. (For more information on  $I^2C$  signal protocol, please refer to the Si5344 data sheet.)

Figure 26 below illustrates the J17 header schematic. J17 even numbered pins (2, 4, 6, etc.) connect to the Si5344 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  $I^2C$  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.

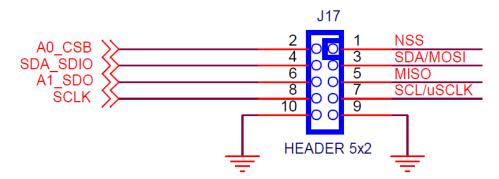


Figure 26. Serial Communications Header J17



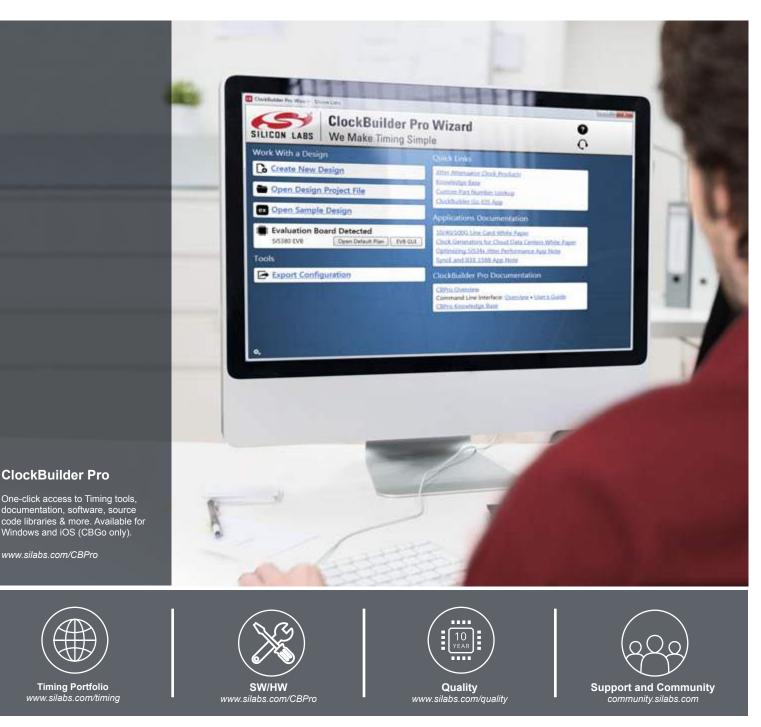
## 13. Si5344-D-EB Schematic and Bill of Materials (BOM)

The Si5344-D-EB Schematic and Bill of Materials (BOM) can be found online at:

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

Please be aware the Si5344-D-VB schematic is in OrCad Capture hierarchical format and not in a typical "flat" schematic format.





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