

### Si5345-D EVALUATION BOARD USER'S GUIDE

#### **Description**

The Si5345-D-EVB is used for evaluating the Si5345 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 "SI5345-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 power supply.
- Onboard 48 MHz XTAL or Reference SMA Inputs allow holdover mode of operation on the Si5345.
- ClockBuilder<sup>®</sup> Pro (CBPro) GUI programmable V<sub>DD</sub> supply allows device to operate from 3.3, 2.5, or 1.8 V.
- CBPro GUI programmable V<sub>DDO</sub> supplies allow each of the 10 outputs to have its own power supply voltage selectable from 3.3, 2.5, or 1.8 V.
- CBPro GUI-controlled voltage, current, and power measurements of V<sub>DD</sub> and all V<sub>DDO</sub> supplies.
- Status LEDs for power supplies and control/status signals of Si5345.
- SMA connectors for input clocks, output clocks, and optional external timing reference clock.



Figure 1. Si5345-D Evaluation Board

#### 1. Functional Block Diagram

Below is a functional block diagram of the Si5345-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" or section "10.3. Overview of ClockBuilder Pro Applications" for more information.

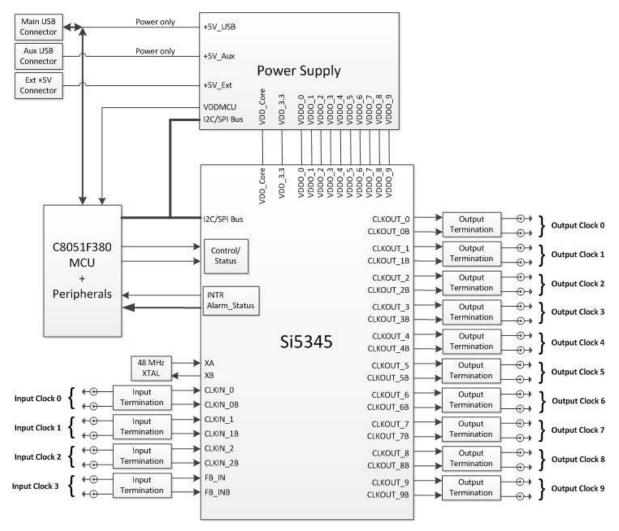


Figure 2. Si5345-D-EB Functional Block Diagram

#### 2. Si5345-D-EVB Support Documentation and ClockBuilder Pro Software

All Si5345-D-EVB schematics, BOMs, User's Guides, and software can be found online at the following link: www.skyworksinc.com/support-ia

#### 3. Quick Start

1. Install ClockBuilder Pro desktop software from

www.skyworksinc.com/en/application-pages/clockbuilder-pro-software.

- 2. Connect a USB cable from Si5345-D-EB to the PC where the software was 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 Si5345-D-EB.
- 6. For the Si5345 data sheet, go to www.skyworksinc.com/en/Products/Timing.

#### 4. Jumper Defaults

		Table 1. 515545	<b>U</b> -		ciduits	
Location	Туре	I = Installed 0 = Open		Location	Туре	l = Installed 0 = Open
JP1	2 pin	0		JP23	2 pin	0
JP2	2 pin	I		JP24	2 pin	0
JP3	2 pin	0		JP25	2 pin	0
JP4	2 pin	I		JP26	2 pin	0
JP5	2 pin	I		JP27	2 pin	0
JP6	2 pin	I		JP28	2 pin	0
JP7	2 pin	I		JP29	2 pin	0
JP8	2 pin	0		JP30	2 pin	0
JP9	2 pin	0		JP31	2 pin	0
JP10	2 pin	I		JP32	2 pin	0
JP13	2 pin	0		JP33	2 pin	0
JP14	2 pin	I		JP34	2 pin	0
JP15	3 pin	1 to 2		JP35	2 pin	0
JP16	3 pin	1 to 2		JP36	2 pin	0
JP17	2 pin	0		JP38	3 pin	All Open
JP18	2 pin	0		JP39	2 pin	0
JP19	2 pin	0		JP40	2 pin	0
JP20	2 pin	0		JP41	2 pin	0
JP21	2 pin	0		J36	5 x 2 Hdr	All 5 installed
JP22	2 pin	0				
*Note: Refer t	o the Si534	15-D-EB schematic	s fo	r the functional	ity associated	I with each jumper.

Table 1. Si5345-D-EB Jumper Defaults\*

#### 5. 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 voltage present
D25	INTR	Red	MCU INTR (Interrupt) active
D21	READY	Green	MCU Ready
D24	BUSY	Green	MCU Busy

Table 2. Si5345-D-EB Status LEDs

D27, D22, and D26 are illuminated when USB +5 V, Si5345 +3.3 V, and Si5345 V<sub>DD</sub> supply voltages, respectively, are present. D25, D21, and D24 are status LEDs showing on-board MCU activity.

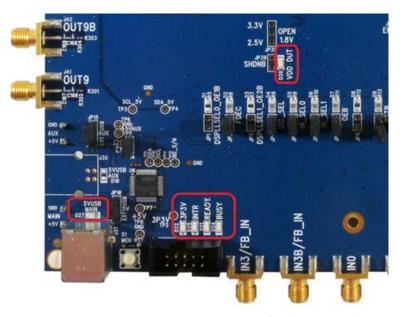


Figure 3. Status LEDs

#### 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 Si5345-D-EVB can also accommodate an external reference clock instead of a crystal. To evaluate the device with a REFCLK, C111 and C113 must be populated and the XTAL removed (see Figure 4 below). The REFCLK can then be supplied to J39 and J40.

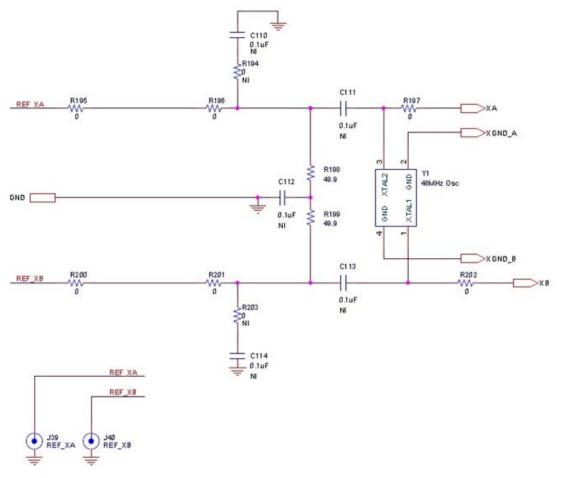
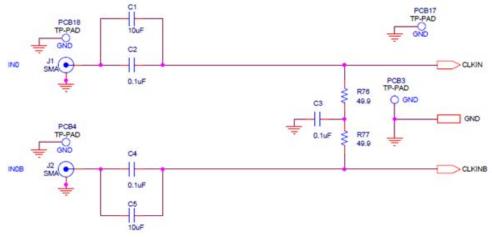


Figure 4. External Reference Input Circuit

#### 7. Clock Input Circuits (INx/INxB)

The Si5345-D-EB has eight SMA connectors (IN0, IN0B–IN3, IN3B) for receiving external clock signals. All input clocks are terminated as shown in Figure 5 below. Note 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 Si5345 data sheet.





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

Each of the twenty output drivers (10 differential pairs) 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 Si5345-D-EVB 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 Si5345-D-EB and provide locations on the PCB for optional dc/ac terminations by the end user.

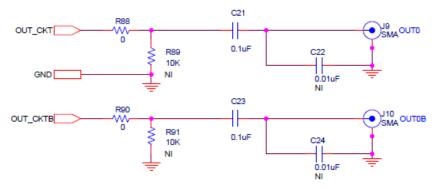


Figure 6. Output Clock Termination Circuit

#### 9. Installing ClockBuilder Pro Desktop Software

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

Go to www.skyworksinc.com/en/application-pages/clockbuilder-pro-software 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 Si5345-D-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.

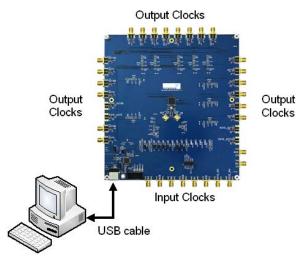


Figure 7. EVB Connection Diagram

#### 10.2. Additional Power Supplies

Although additional power (besides the power supplied by the host PC's USB port) is not needed for most configurations, two additional +5 VDC power supplies (MAIN and AUX) can be connected to J33 and J34 (located on the bottom of the board, near the USB connector). Refer to the Si5345-D-EB schematic for details.

The Si5345-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.

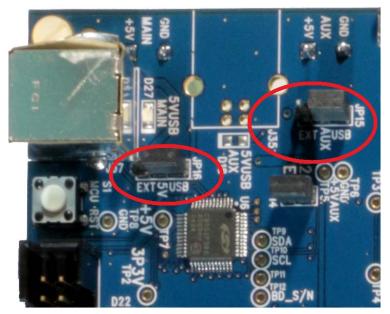


Figure 8. JP15-JP16 Standard Jumper Shunt Installation

Errata Note:Some early versions of the 64-pin Si534x-EVBs 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, reconfigure 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 ClockBuilder Pro Applications

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:

d skyworks
Quick Links
Skyworks Timing Solutions Knowledge Base
Custom Part Number Lookup
Applications Documentation 10/40/100G Line Card Whitepaper
Clock Generators for Cloud Data Centers Optimizing Si534x Jitter Performance
Selecting the Right Clocks for Timing Synchronization Applications PCIe Gen 4.0 Jitter Requirements Selecting a PCIe Reference Clock Source Making Accurate Clock Jitter Measurements
ClockBuilder Pro Documentation
CBPro Dorenview CBPro Tools & Support for In-System Programming CLI User's Guide Release Notes

Figure 9. 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

e Help							
nfo DUT SP	DUT Settin	gs Editor DUT	Register Editor P	egulators All	Voltages GPIC	Status Registers	Control Registers
			Voltage	Current	Power		Soft Reset and Calib
,	/DD 1.80V	On	v	A	W	Read	SOFT_RST_ALL
	DA 3.30V	On	v	A	W	Read	SOFT_RST
	000 1.80V	On On	1.798 V	0 mA	0 mW	Read	Hard Reset, Sync, & Pov
VDI		Con Con	1.777 V	0 mA	0 mW	Read	HARD_RST
		_					SYNC
	002 1.80V			A	W	Read	PDN: 0
VDI	003 1.80V		ff V	A	W	Read	PDN: 0
VDI	004 1.80V	•	a A	A	W	Read	Frequency Adju
VDI	005 1.80V	•	ff 0 V	0 mA	0 mW	Read	FINC
VDI	006 1.80V	On	1.789 V	0 mA	0 mW	Read	FDEC
VDI	007 1.80V	On	1.795 V	0 mA	0 mW	Read	
VDI	008 1.80V		и v	A	W	Read	
	009 1.80V			A	W	Read	
101	1.000			A			
All Output	- Select	/oltage	Total	0 mA	0 W	Read All	
Supplies	Power	On Power O	ff Com	nare Design Est	imates to Meas	irements	
	Power	Fontero					
9							
iltered	Auto Scroll	On 🔽 Inse	rt Marker C	ear Copy	to Clipboard	Pause	
		Message					
_				bold.			
imestamp	E1/0						
imestamp 2:01:11.913		Pausing 70 msec					
imestamp 2:01:11.913 2:01:11.992	EVB	Starting Read_Al	DC(num_samples=				
imestamp 2:01:11.913 2:01:11.992 2:01:12.002	EVB EVB	Starting Read_Al Finished Read_A	DC(num_samples= DC(num_samples=	=10) => 377.6			
imestamp 2:01:11.913 2:01:11.992 2:01:12.002 2:01:12.002	EVB EVB EVB	Starting Read_Al Finished Read_A Finished Measur	DC(num_samples= DC(num_samples= re_Voltage(channe	=10) => 377.6 =VDD_1_PIN) =	=> 1.786		
imestamp 2:01:11.913 2:01:11.992 2:01:12.002 2:01:12.002 2:01:12.002	EVB EVB EVB EVB	Starting Read_Al Finished Read_A Finished Measur Starting Read_D	DC(num_samples= DC(num_samples= e_Voltage(channe UT_Byte(address=	=10) => 377.6 =VDD_1_PIN) = 0x090E)			
imestamp 2:01:11.913 2:01:11.992 2:01:12.002 2:01:12.002	EVB EVB EVB EVB	Starting Read_Al Finished Read_A Finished Measur Starting Read_D	DC(num_samples= DC(num_samples= re_Voltage(channe	=10) => 377.6 =VDD_1_PIN) = 0x090E)			

Figure 10. Application #2: EVB GUI

#### Use the EVB GUI to:

- Download configuration to EVB's DUT (Si5345)
- Control the EVB's regulators
- Monitor voltage, current, power on the EVB

#### 10.4. Common ClockBuilder Pro Work Flow Scenarios

There are three common workflow scenarios when using CBPro and the Si5345-D-EVB. These workflow scenarios are:

- Workflow Scenario #1: Testing a Skyworks-Created Default Configuration
- Workflow Scenario #2: Modifying the Default Skyworks-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 Skyworks-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. 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.

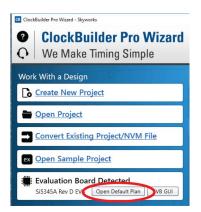


Figure 12. Open Default Plan

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



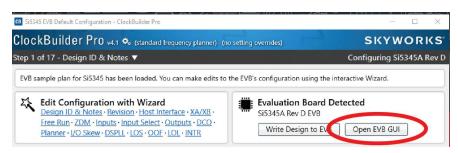
Figure 13. Write Design to EVB Dialog

Select "Yes" to write the default plan to the Si5345 device mounted on your EVB. This ensures the device is completely reconfigured per the Skyworks default plan for the DUT type mounted on the EVB.

Writing Si5345 Design t	o EVB	
Address 0x029C		

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 Skyworks, as shown below.

Info	DUT SPI	DUT Settings Editor	DUT Register Editor	Regulators	All Voltages	GPIO	Status Register
			Voltage	Curren	t Power		
	VDE	D 1.80V	on V	4	· v	/	Read
	VDDA	A 3.30V	on V	4	v	/	Read
	VDDO	0 1.80V 🔽 🖸	n 1.798 V	0 n	nA 0 m	nW [	Read
	VDDO1	1 1.80V 🔽 🖸	n 1.777 V	0 n	nA On	nW [	Read
	VDDO2	2 <b>1.80V</b>	Off V	4	v	v [	Read
	VDDO	3 1.80V 🔽	Off V	4	· v	v [	Read
	VDDO4	4 1.80V 🔽	Off V	4	V	v [	Read
	VDDOS	5 1.80V 🔽	Off 0 V	0 n	nA 0 m	nW [	Read
	VDDO	5 1.80V 🔽 🖸	n 1.789 V	0 n	nA 0 m	nW [	Read
	VDDO	7 1.80V 🔽 🖸	n 1.795 V	0 n	nA 0 m	w [	Read
	VDDO8	8 1.80V 🔽	Off V	A	· v	/	Read
	VDDO	9 1.80V 🔽	Off V	4	· v	/	Read
		- Select Voltage	Total	0 r	nA OV	v	Read All

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 Skyworks-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":

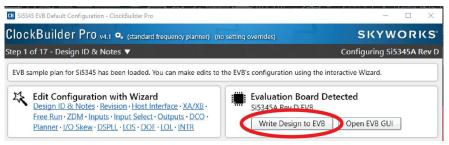
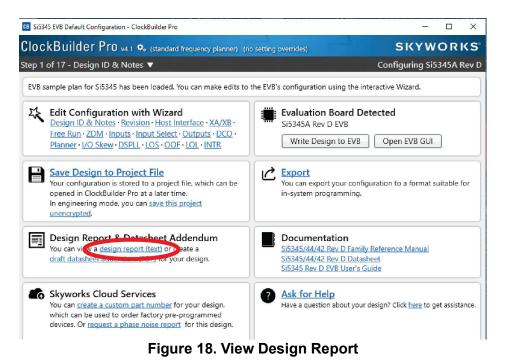


Figure 17. Write Design to EVB

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 Skyworks 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.



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.

Si5345 Design Report				
esign Report				
** Engineering Mon	de Design Repo	rt **		
Overview				
Part:	Si5345A Rev	D		
esign ID:	5345EVB2			
reated By:	ClockBuilde	r Pro v4.1 [2021-09-22]		
imestamp:		12:04:13 GMT-05:00		
esign Rule Check				
innons:				
No errors				
Warnings:				
No warnings				
Device Grade				
laximum Output Fre				
requency Synthes: requency Plan Gra		10041		
linimum Base OPN:	si534	5A*		
Base Output	Clock	Supported Frequency Synthesis Modes		
IPN Grade Freque	ncy Range	(Typical Jitter)		
15345A* 100 Hz		Integer (< 100 fs) and fractional (< 150 fs)		
15345B 100 Hz		"		
		Integer only (< 100 fs)		
i5345D 100 Hz	to 350 MHz	"		
* Based on your c	alculated free	uency plan, a Si5345A grade device is		
equired for your	design. See t	he datasheet Ordering Guide for more		
nformation.				
esign				
lost Interface:				
I/O Power Supp	Ly: VDD (Core)			
SPI Mode: 4-Wi				
I2C Address Ra	nge: 104d to 1	07d / 0x68 to 0x6B (selected via A0/A1 pins)		
A/XB:				
48 MHz (XTAL -	Crystal)			
inputs:				
TNO 5 MHz				
Standard				
IN1: 25 MHz				
Standard				
IN2: 10 MHz				
Standard				
IN3: 10 MHz Standard				
Stanuaru				
Jutputs: 🔵				
0072 .61.1328				
[ 25*(82)	5/128)M ] LVDS 2.5 V			
Enabled,	LVU5 2.5 V			

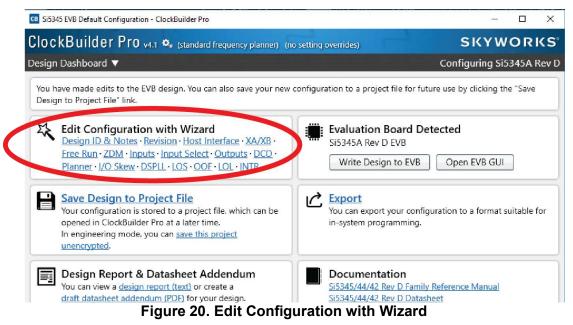
Figure 19. Design Report Window

#### 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 Skyworks-Created Device Configuration

To modify the "default" configuration using the CBPro Wizard, click on 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.

lockBuild				
ep 1 of 17 - De	isign ID & Notes ▼	Configuring S	5345A	Re
Design ID The device has 8 r	egisters, DESIGN_ID0 through DESIGN_ID7, that can be used to store a design/configuration/revisi	on identifier.		
Design ID:	5345EVB2 (optional; max 8 characters) The string you enter here is stored as ASCII bytes in registers DESIGN_ID0 through DESIGN_ID7.			
adding Mode:	NULL Padded If you do not enter the full 8 characters, the remaining bytes of DESIGN_IDx will be padded character).	with 0x00 bytes (	aka NULL	
	🔿 Space Padded			
esign Notes	If you do not enter the full 8 characters, the remaining bytes of DESIGN_IDx will be padded character).			
nter anything yo				ıms
nter anything yo	character).			ıms
inter anything yo	character).			ıms
inter anything yo	character).			ums
nter anything yo	character).			ums

Figure 21. 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.

writing SI534:	5 Design to EVB		
Address 0x029	С		

#### 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.

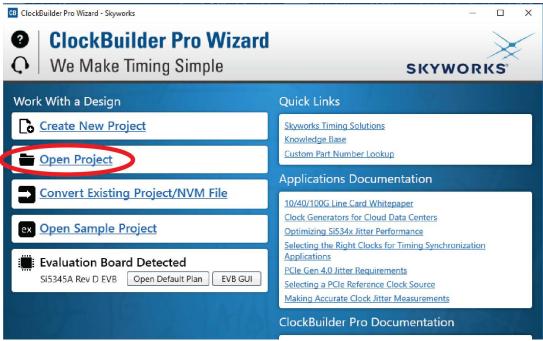


Figure 23. Open Design Project File

## Si5345-D-EVB

Locate your CBPro design file in the Windows file browser.

rganize 🔻 New fol	der Name a Si5345-RevD-5345EVB2-Project	Date modified	Туре	Size	
	Name			Size	
	Si5345-RevD-5345EVB2-Project	11/12/2021 12:07			
-			Skyworks Timing		12 KB
🗄 Documents 🛛 🖈					
🕹 Downloads 🛛 🤘	P				
Pictures 💉	P				
📑 F:\ 🛛 🛪	t				
Si5340					
Si5341					

Figure 24. Browse to Project File

Select Yes when the WRITE DESIGN to EVB popup appears:

CB Clo	ckBuilder Pro v4.1	_		×
A	Write Design to EVB?			
U	The EVB may be out-of-sync with your design. Woul your design to the EVB?	d you li	ke to wr	ite
	Yes No			
	Figure 25. Write Design to EV	B Di	alog	

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:

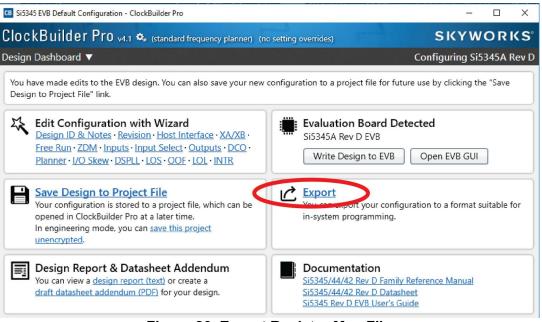


Figure 26. Export Register Map File

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

ntroduction	Register File	Settings File	Multi-Project Register/Setting	is Regmap			
About Regi	ster Export						
This export configuration		e registers that	need to be written to the Si	5345 to achie	eve your	design,	/
	d line version o prompt to learr		ailable. Type CBProProjectR	egistersExpo	rthelp	from a	
Options							
Export Type	2:						
C Coo The r used	directly in firm summary heac ed, an informa	ware code. ler tional header v	ressed in C code via an array vill be included at the top of der will contain some basic ir	the file. Each	line in t	he head	der will
prefixed	amp.					2	
prefixed a timest							
a timest Include Certain This ens the dow	control registe sures the devic	e is stable duri	egister writes tten before and after writing ng configuration download a arn inclusion of this sequenc	ind resumes	normal c	peratio	on after
a timest Include Certain This ens the dow this pro	control registe sures the devic nload is comp cess already.	rs must be writ e is stable duri	tten before and after writing ng configuration download a urn inclusion of this sequenc	ind resumes	normal c	peratio	on after
a timest Include Certain This ens the dow this pro	control registe sures the devic nload is comp cess already.	rs must be writ e is stable duri lete. You can ti	tten before and after writing ng configuration download a urn inclusion of this sequenc	ind resumes	normal c	peratio	on after

# 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 Si5345 using ClockBuilder Pro on the Si5345-D-EB. Writing a configuration into the EVB from ClockBuilder Pro is done using Si5345 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. Si5345-D-EVB Schematic, Layout, and Bill of Materials (BOM)

The Si5345-D-EVB Schematic, Layout, and Bill of Materials (BOM) can be found online at:

www.skyworksinc.com/support-ia

**Note:** Please be aware that the Si5345-D-EB schematic is in **OrCad Capture** *hierarchical format* and not in a typical "flat" schematic format.

## SKYWORKS

#### **ClockBuilder Pro**

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