

# UG397: Si5332-6A-EVB Users' Guide (Using Si5332-AM1-QFN32-EVB)

The Si5332-6A-EVB is used for evaluating the six-output Automotive Grade Si5332 Low Jitter Any-Frequency Clock Generator. The Si5332-AM1 device uses the patented Multisynth™ technology to generate up to six independent clock frequencies each with 0 ppm synthesis error. The Si5332-6A-EVB has two independent input reference clocks or can use the on-board 25 MHz crystal as reference. The Si5332-6A-EVB can be controlled and configured using the Skyworks Clock Builder Pro™ (CBPro™) software tool.



#### KEY FEATURES

- Powered from either USB port or external +5V power supply.
- 25 MHz crystal reference or external input clock reference.
- Programmable device VDD supply for operation at 3.3 V, 2.5 V, or 1.8 V, controlled by CBPro<sup>™</sup> Software.
- Programmable VDDO supplies allow each of the 6 outputs to have its own power supply voltage selectable from 3.3 V, 2.5 V, 1.8 V, or 1.5 V (1.5 V LVCMOS only).
- CBPro<sup>™</sup> GUI-controlled voltage, current, and power measurements of VDD and all VDDO supplies.
- SMA connectors for all input and output clocks.
- External digital input functions emulated via onboard switches.

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### 1. Functional Block Diagram

Below is a functional block diagram of the Si5332-6A-EVB. This EVB can be connected to a PC via the main USB connector for configuration, control, and monitoring using Skyworks' CBPro software. The EVB's power can be supplied from the USB connection or external +5 V power source.

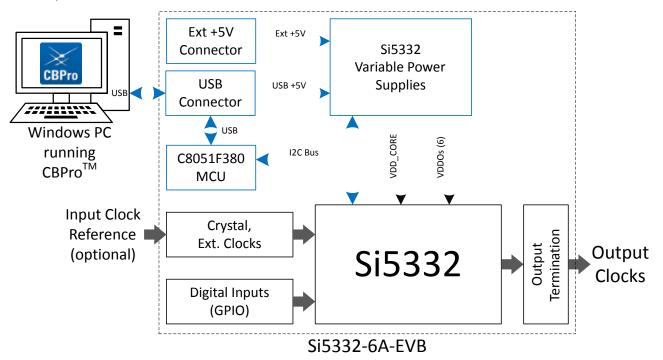


Figure 1.1. Si5332-6A-EVB Functional Block Diagram

UG397: Si5332-6A-EVB Users' Guide (Using Si5332-AM1-QFN32-EVB) • Si5332 CBPro™ Overview

### 2. Si5332 CBPro<sup>™</sup> Overview

All Si5332 devices, and corresponding EVBs, are fully supported in Skyworks' ClockBuilder Pro (CBPro) software. Note that **CBPro** software is required to configure and use the Si5332-6A-EVB. Please download and install CBPro from the link shown below:

https://www.skyworksinc.com/en/Application-Pages/Clockbuilder-Pro-Software

With CBPro, users can perform the following:

- · Create full device configurations (frequency plans) including multi-profile configurations.
- · Get estimated power consumption and estimated operating junction temperature of the configuration.
- · Evaluate/Test configurations using a supported EVB.
- Create downloadable configuration files designed to be I<sup>2</sup>C, downloaded into target Si5332 device.
- Submit a configuration for creation of a custom, factory-programmed device with a unique orderable part number (no added cost).
- · Submit a request for a phase noise report of the specific configuration.

| CB ClockBuilder Pro Wizard - Skyworks                                      | – 🗆 X   |
|--|---|
| <ul> <li>ClockBuilder Pro Wizard</li> <li>We Make Timing Simple</li> </ul> | SKYWORKS  |
| Work With a Design   | Quick Links   |
| Create New Project   | Skyworks Timing Solutions<br>Knowledge Base   |
| E Open Project   | Custom Part Number Lookup   |
| Convert Existing Project/NVM File  | Applications Documentation           10/40/100G Line Card Whitepaper  |
| ex Open Sample Project   | Clock Generators for Cloud Data Centers<br>Optimizing Si534x Jitter Performance   |
| Evaluation Board Detected<br>Si5332-AM1 EVB Open Default Plan EVB GUI      | Selecting the Right Clocks for Timing Synchronization<br>Applications<br>PCIe Gen 4.0 Jitter Requirements<br>Selecting a PCIe Reference Clock Source<br>Making Accurate Clock Jitter Measurements |
|  | ClockBuilder Pro Documentation<br><u>CBPro Overview</u><br><u>CBPro Tools &amp; Support for In-System Programming</u><br><u>CLI User's Guide</u>  |
| ¢.,  | Release Notes<br>Version 4.1<br>Built on 9/22/2021  |

Figure 2.1. CBPro Start-up Window

### 3. Si5332-6A-EVB Operation

### 3.1 Initial Default Configuration

The Si5332-6A-EVB has power supply configuration DIP switches (SW1 – SW7) which are set at the factory to the OFF position. The EVB also has a programmable digital I/O (GPIO) configuration DIP switch (SW8) also with all switches set to OFF position. The required EVB **default** DIP switch settings are all switches OFF (as shown below) and these settings are required to allow the CBPro software to control and configure the EVB. In addition, JP1 jumper should be installed on the "USB" side (pins 1 & 2).

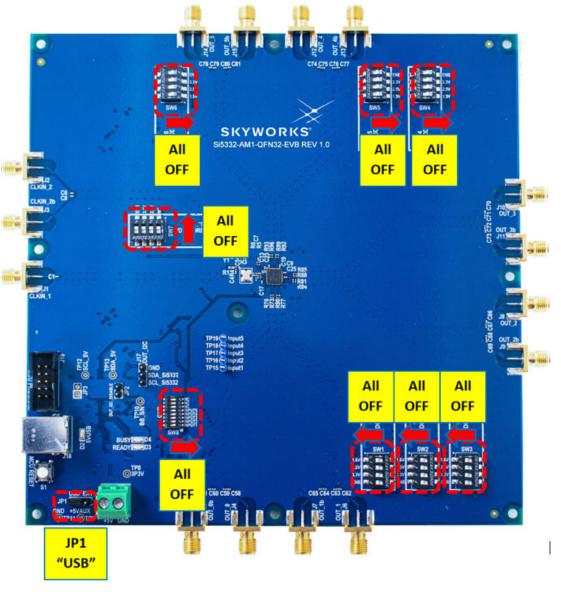


Figure 3.1. Si5332-6A-EVB Initial Default Configuration

### 3.2 DIP Switch Functions

The power supply DIP switches (SW1 – SW7) are intended to provide flexibility in cases when a pre-programmed Si5332-AM1 device is installed on the board and CBPro will not be used to configure the Si5332-AM1 device or to control the on-board power supply settings. Typically, the power supply DIP switches (SW1- SW7) will only be used if a configuration is burned into the Si5332-AM1's NVM by using the CBPro Field Programming Dongle or a pre-configured Si5332-AM1 (custom OPN) is installed on the EVB.

The programmable digital input (GPIO) signal configuration switch (SW8) will only be used to turn specific features on/off based on the CBPro configuration loaded into the Si5332-AM1 device. For example, a programmable digital input, such as an Output Enable (OE), can be assigned to Input 1. Once the Si5332-AM1 configuration with Input 1 assigned as OE is loaded, Input 1 on SW8 can be used to control this OE input signal by setting high/low. Input 1 switch OFF = 1, Input 1 switch ON = 0.

### 3.3 LEDs

The Si5332-6A-EVB has 3 indicator LEDs (D2, D3, D4) near the USB connector as shown and defined below.



Figure 3.2. Si5332-6A-EVB LED Locations

- D2: This Blue LED (+5VUSB) lights to indicate USB +5V is present.
- D3: This Green LED (Ready) lights to indicate the EVB's USB has enumerated with the host PC.
- D4: This Green LED (Busy) lights to indicate CBPro has successfully connected to the EVB.

### 3.4 Input Clocks

The Si5332-AM1 device can support 2 sources of input reference clock. One source is the crystal input on XA/XB pins. (XA can also be used as a single-ended external input if the crystal is removed, see Si5332-AM1 Data Sheet for more details.). The other input clock source is an external differential or single-ended clock on CLKIN\_2/CLKIN\_2b pins.

As shown in the schematic below, the Si5332-6A-EVB is pre-populated with a 25 MHz crystal on the XA/XB crystal input. The CLKIN\_2/ CLKIN\_2b external clock inputs have 50-ohm terminations installed by default. The CLKIN1 input has "not-installed" ("NI") components to isolate the CLKIN1 input from the crystal circuit when the crystal is installed.

### Input Clocks & Crystal

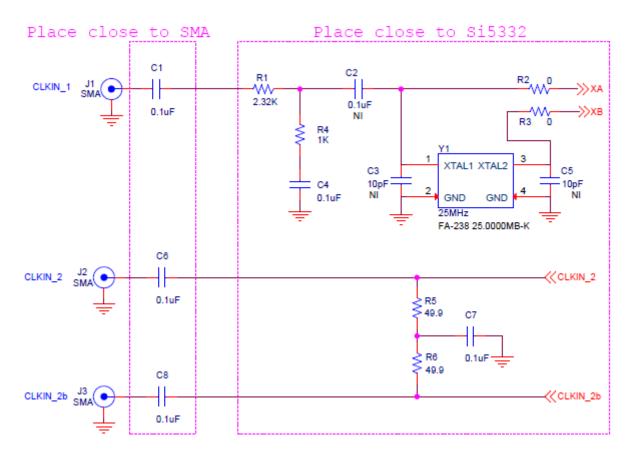


Figure 3.3. Si5332-6A-EVB Input Clock Circuit

### 3.5 Output Clocks

The Si5332-AM1 device can support up to 6 differential pair outputs, or 6 pairs of LVCMOS outputs (12 total LVCMOS outputs). Each output pair has an output termination circuit as shown in figure below. The default output termination is AC coupled outputs from Si5332-AM1 device with no other termination.

The default output termination components (0  $\Omega$  & 0.1  $\mu$ F) combined with the "NI" (not installed) component sites on the EVB can be used as locations to create the desired output termination configuration. For example, if DC output termination is required, the 0.1  $\mu$ F caps can be replaced with 0  $\Omega$  resistors. Note that not all possible termination schemes can be supported by the circuit below and in some cases external components may be required.

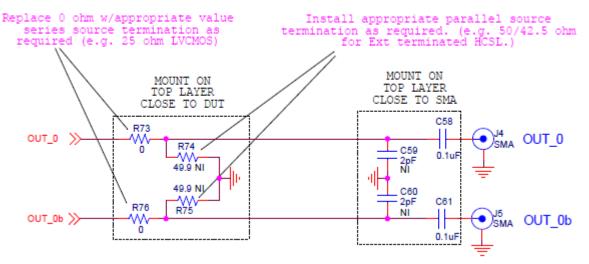


Figure 3.4. Si5332-6A-EVB Single Pair Output Clock Termination Circuit

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### 4. Using CBPro<sup>™</sup> with Si5332-6A-EVB

Skyworks' CBPro software is required for using the Si5332-6A-EVB. It can be downloaded from Skyworks' download link: https://www.skyworksinc.com/en/Application-Pages/Clockbuilder-Pro-Software.

Once downloaded and installed, running CBPro should present the following window:

| CB ClockBuilder Pro Wizard - Skyworks                                      | – 🗆 X  |  |  |  |  |
|--|--|--|--|--|--|
| <ul> <li>ClockBuilder Pro Wizard</li> <li>We Make Timing Simple</li> </ul> | SKYWORKS   |  |  |  |  |
| Work With a Design   | Quick Links  |  |  |  |  |
| Create New Project   | Skyworks Timing Solutions<br>Knowledge Base  |  |  |  |  |
| Dpen Project   | Custom Part Number Lookup  |  |  |  |  |
| <b>Convert Existing Project/NVM File</b>                                   | Applications Documentation <u>10/40/100G Line Card Whitepaper</u>  |  |  |  |  |
| ex <u>Open Sample Project</u>  | Clock Generators for Cloud Data Centers<br>Optimizing Si534x Jitter Performance<br>Selecting the Right Clocks for Timing Synchronization                                 |  |  |  |  |
| Evaluation Board Detected<br>Si5332-AM1 EVB Open Default Plan EVB GUI      | Applications<br>PCIe Gen 4.0 Jitter Requirements<br>Selecting a PCIe Reference Clock Source<br>Making Accurate Clock Jitter Measurements                                 |  |  |  |  |
|  | ClockBuilder Pro Documentation<br><u>CBPro Overview</u><br><u>CBPro Tools &amp; Support for In-System Programming</u><br><u>CLI User's Guide</u><br><u>Release Notes</u> |  |  |  |  |
| 0.   | Version 4.1<br>Built on 9/22/2021  |  |  |  |  |

Figure 4.1. CBPro Start-up Window

If an evaluation board is connected via USB, the EVB should be detected and will be indicated as shown at the arrow in the above image. Multiple EVBs can be connected and individually selected in CBPro.

The EVB GUI is a useful tool as it will allow monitoring and control of EVB functions like the digital inputs and power supply voltage and current measurements. The EVB GUI can also be used to read and write on-chip registers and report other useful status information.

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### 4.1 CBPro™ EVB GUI

The EVB GUI is invoked by pressing the "EVB GUI" button from CBPro's main window. Across the top of the EVB GUI window, as shown below, are several tabs for selection of various useful informational pages, and pages for configuration, control, or monitoring of the EVB.

|   |   |                |            | ~         |
|---|---|----------------|------------|-----------|
| CB Si5332-AM1 EVB - ClockBuilder Pro  |   | -              |            | ×         |
| File Help   |   |                |            |           |
| Info DUT Settings Editor DUT Register Editor Regulators GPIO Status Registers | - | Control Reg    | isters     |           |
| Board Identification:   |   | Reset          | and Mod    | es        |
| Board ID Code: [1] (Si5332GM1-QFN-32 AM)                                      |   |                | ive Mode   |           |
| Board SN: 00-00-1F-52-55-6A   |   | Rea            | ady Mode   |           |
| DUT ID Registers:   |   |                | Reset      |           |
| DEVICE_PN_BASE Si5332   |   |                |            |           |
| DEVICE_REV:   |   |                |            |           |
| DEVICE_PACKAGE QFN_32_Automotive  |   |                |            |           |
| DEVICE_GRADE A  |   |                |            |           |
| OPN_ID 00000  |   |                |            |           |
| OPN_REVISION 0  |   |                |            |           |
| DESIGN_ID EX_BL   |   |                |            |           |
| TOOL_VERSION ClockBuilderPro v2.31.2.0  |   |                |            |           |
|   |   |                |            |           |
| Log   |   |                |            |           |
| Filtered 🔽 Auto Scroll: On 🔽 Insert Marker Clear Copy to Clipboard Pause      |   |                |            |           |
| Timestamp Source Message  |   |                |            |           |
| 13:53:15.225 EVB Starting Read_Voltage_Level(regulator=VDDO_5)                |   |                |            |           |
| 13:53:15.231 EVB Finished Read_Voltage_Level(regulator=VDDO_5) => V3P30       | • |                |            |           |
| Si5332QFN-32 AM   | С | lockBuilder Pr | o v4.1 [20 | 21-09-22] |

Figure 4.2. EVB GUI - Info Page

The "Info" tab shows information regarding EVB board and DUT device identification. Both the "Control Registers" and "Log" windows are shown in all EVB GUI tabs. The "Control Registers" are useful buttons to place Si5332 device in Active or Ready mode and well as Reset the device. (*Refer to follow-on description of "Status Registers" tab for important information on device mode and its effect on register accesses.*) The "Log" window is a log of all CBPro – EVB communications.

The "DUT Settings Editor" and "DUT Register Editor" tabs allow registers to be read/written by either the setting name or by direct hex byte access.

| SI3332-AM1 EVB - ClockBuilder Pro   | - 🗆 X  | SIS332-AM1 EVB - ClockBuilder Pro  | - 🗆 ×  |
|---|--|--|--|
| File Help Info DUT Settings Editor DUT Register Editor Regulators GPIO Status Registers *   | Control Registers                                | File Help Info DUT Settings Editor DUT Register Editor Regulators GPIO Status Registers  | Control Registers                                    |
| Setting Name     Value Read     Value to Write     Location     Type       X I2C_ADDR     Ox0     0x21(sc)     R/W     Read     Write         | Reset and Modes<br>Active Mode<br>Reset<br>Reset | Register Peed/Pole           Her.         Decimal           Address:         0-21           # Bytes:         1           Read         Write           Her:         India           Unsigned inte         7           # Binary:         7           # Binary:         1           Binary:         1 | Reset and Mode<br>Active Mode<br>Ready Mode<br>Reset |
| Log<br>Filtered Auto Scrolt: On Cinsert Marker Clear Copy to Clipboard Pause  |  | Log<br>Filtered 📱 Auto Scroll: On 📱 Insert Marker Clear Copy to Clipboard Pause  |  |
| Timestamp         Source         Message           135521531         EV8         Starting Read OUT_Bytestaddress=0x21; num_bytes=1)         * |  | Timestamp         Source         Message           135521551         EVB         Starting Read_DUT_Bytestaddress=0x21, num_bytes=1)         ************************************   |  |
| 13:55:21:885 EVB Finished Read_DUT_Bytes(address=0x21, num_bytes=1) => 0x6A   |  | 13:55:21:585 EVB Finished Read_DUT_Bytes(address=0x21, num_bytes=1) => 0x6A  | 1  |
| SI5332QFN-32 AM CK  | ockBuilder Pro v4.1 (2021-09-22)                 | \$I5332QFN-32 AM   | ClockBuilder Pro v4.1 [2021-09-22]                   |

Figure 4.3. EVB GUI - DUT Settings / DUT Register Editors

The "Regulators" tab allows reading the voltages and currents for each on-board power supply. Each regulator may be switched on/off or voltage changed as necessary. Similarly, the "GPIO" tab allows for monitoring and control of the programmable digital inputs of the Si5332. Controlling regulators and GPIO functions within CBPro requires DIP switches on the EVB to be set to default positions (Off). See Section 3.1 Initial Default Configuration for more information.

| CB 5i5332-AM1 EVB - ClockBuilder Pro  | - 0 X   | 5/3332-AM1 EVB - ClockBuilder Pro  | - 🗆 X  |
|---|---|--|--|
| File Help   |   | File Help  |  |
| Info DUT Settings Editor DUT Register Editor Regulators GPIO Status Registers   | <ul> <li>Control Registers</li> </ul>                 | Info DUT Settings Editor DUT Register Editor Regulators GPIO Status Registers  | Control Registers                                    |
| Voltage         Current         Power           V00 CORE         3.30V         0         3.30V         44 mA         14.5 mW         Read           V000 0         3.30V         0         3.283 V         1 mA         3 mW         Read           V000 1         3.30V         0         3.237 V         2 mA         7 mW         Read           V000 2         3.30V         0         3.277 V         2 mA         10 mW         Read           V000 3         3.30V         0         3.267 V         3 mA         10 mW         Read           V000 4         3.30V         0         3.267 V         1 mA         3 mW         Read           V000 5         3.30V         0         3.267 V         1 mA         3 mW         Read           V000 5         3.30V         0         3.267 V         1 mA         3 mW         Read           V000 5         3.30V         0         3.267 V         1 mA         3 mW         Read           L02         1.02 mW         1.02 mW         Read         1.02 mW         1.02 mW         Read   | Reset and Modes<br>Active Mode<br>Resdy Mode<br>Reset | Name         McUPin         Ribbon Fin         Type ①         State           input1         36         0         Output         1         Read           input3         32         0         Output         1         Read           input4         31         0         Output         1         Read           input5         30         0         Output         1         Read  | Reset and Modes<br>Active Mode<br>Redy Mode<br>Reset |
| Filtered         Auto Scroit On         Intert Marker         Clear         Copy to Clipboard         Pause           Timestump         Source         Mosspace         Mosspace | A   | Pittered         Auto Scoti: On         Insert Marker         Clear         Copy to Cipboard         Pause           Timestamp         Source         Mesope         Insert Marker         Insert Mesope         Insert Mesope |  |
| [13:58:16.680 EVB Finished Read_DUT_Signal(signal=Input5) => Logic1     [553320FN-32 AM   | ClockBuilder Pro v4.1 [2021-09-22]                    | 13:58:16:680   EV8   Finished Read_DUT_Signal(signal=input5) => Logic1   | ClockBuilder Pro v4.1 [2021-09-22]                   |

Figure 4.4. EVB GUI - Regulators and GPIO Monitoring/Control

### 4.2 Device Register Changes Using the CBPro™ EVB GUI

The last EVB GUI tab is the "Status Registers" tab which shows the present state of the device, in either "Active" or "Ready" mode.

**Important Note:** The Si5332 device must be in "Active" mode to output any clocks. While in "Active" mode *most* register write accesses will not be allowed and will be blocked by the device. The device must be in "Ready" mode to allow write access to many registers. While the device is in "Ready" mode the outputs are stopped. Once device is placed back in "Active" mode, the outputs will resume based on any register changes done while in "Ready" mode.

The only registers not requiring this process are Spread Spectrum enable/disable, Output Enable controls, Input Clock Selection, and the register placing the device into and out of Active or Ready mode. Do not rely on a Si5332 device being in "Active" mode to prevent inadvertent I<sup>2</sup>C write cycles from corrupting device registers.

The general process required to change register values (i.e., register writes) is shown below.

- 1. Place the device into "Ready" mode, at which time the outputs will stop and register changes can be made.
  - Press "Ready Mode" button, then "Refresh All" button to update Status.

| Si5332-AM1 EV                     | /B - ClockB | uilder Pro          |            |      |                  |                    | -              |      | × |
|-----------------------------------|-------------|---------------------|------------|------|------------------|--------------------|----------------|------|---|
| ile Help                          |             |                     |            |      |                  |                    |                |      |   |
| Info DUT Settin                   | ngs Editor  | DUT Register Editor | Regulators | GPIO | Status Registers | Ŧ                  | Control Regist | ers  |   |
| Refresh All Auto Poll Registers 🕢 |             |                     |            |      |                  | Reset an<br>Active | d Mode<br>Mode | s    |   |
| Status                            | Active      | Ready               |            |      |                  |                    | Ready          | Mode |   |

- Confirm device is in "Ready" mode.
- 2. Perform any register updates as desired.
- 3. Place device back into "Active" mode for the register changes to take effect and outputs enabled.
  - Press "Active Mode" button, then "Refresh All" button to update Status.

| File H  | lelp                |                     |            |      |                  |   |                   |
|---------|---------------------|---------------------|------------|------|------------------|---|-------------------|
| Info    | DUT Settings Editor | DUT Register Editor | Regulators | GPIO | Status Registers | Ŧ | Control Registers |
| 1 1 1 1 | efresh All Auto     | Poll Registers 🔞    |            |      |                  |   | Reset and Modes   |

· Confirm device is now in "Active" mode.

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### 4.3 Creating a New Si5332-AM1 CBPro™ Configuration

- 1. To start a new Si5332-AM1 project, click on "Create New Project" from CBPro opening window.
- 2. From selection window click on "Clock Generators".

| CB ClockBuilder Pro Wizard - Skyworks                                      | C Create New Project - ClockBuilder Pro   | - 🗆 X                     |
|--|---|---------------------------|
| <ul> <li>ClockBuilder Pro Wizard</li> <li>We Make Timing Simple</li> </ul> | ClockBuilder Pro Wizard     We Make Timing Simple     Filter Devices by Application | SKYWORKS                  |
| Work With a Design   | Clock Generators  |                           |
| Create New Project   | Jitter Attenuators  | ATATA                     |
| Concer Brainst   | Network Synchronizers   |                           |
| Den Project  | SmartClock <sup>™</sup> Monitors  | Show All Devices          |
| Convert Existing Project/NVM File  | Buffers Broadcast Video   |                           |
| ex Open Sample Project   | Oscillators<br>(XO/VCXO)  | N/53852                   |
| ex open sample risjeet   | PCIe Gen1/2/3/4/5<br>Clocks and Buffers   |                           |
| Evaluation Board Detected<br>Si5332-AM1 EVB Open Default Plan EVB GUI      | 🕑 IEEE 1588 Modules 🖨 Automotive  | Back Next > Fereth Cancel |
|  |   | Cancel                    |

3. Then Select Si5332-GM1 from list of devices.

CB Create New Project - ClockBuilder Pro

| ereate riter ri  | oject       | erectour      | act to         |  |                       |   |  |
|--|-------------|---------------|----------------|--|-----------------------|---|--|
| ClockBuilder Pro 🗤 🗫   |             |               |                |  |                       |   |  |
| Clock Generator Parts  |             |               |                |  |                       |   |  |
| Filter using part number (Si5395, 5332, m88, etc.) or application (serdes, |             |               |                |  |                       |   |  |
| Part   | Num<br>PLLs | Num<br>Inputs | Num<br>Outputs | Input<br>Frequency                           | Output<br>Frequency   | , |  |
| Si5332-GM1/<br>AM1   | 1           | 2             | 6              | 16 MHz to<br>50 MHz, 10<br>MHz to 250<br>MHz | 5 MHz to<br>312.5 MHz | • |  |

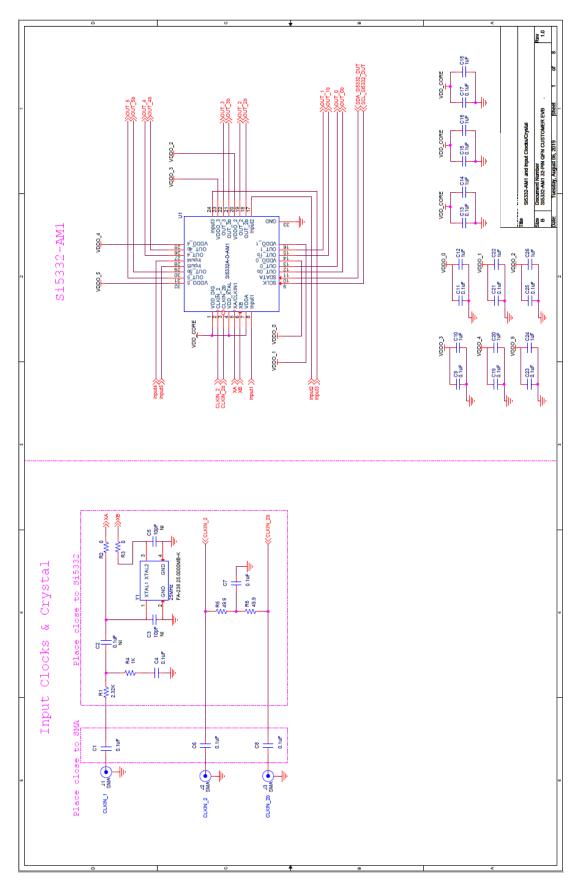
4. Complete the guided step-by-step configuration process being sure to select Automotive grade in Step 3.

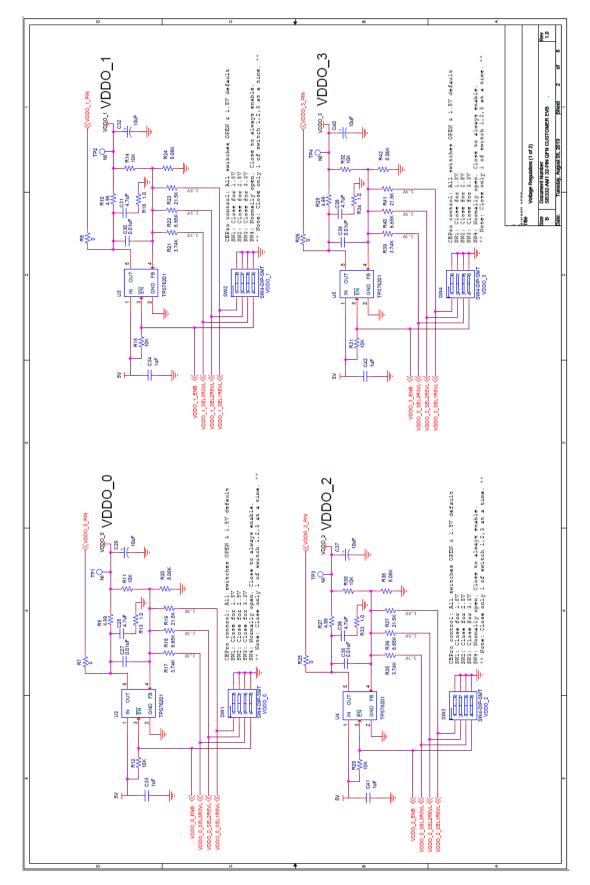
|   | CB New Si5332_GM1 Project - ClockBuilder Pro   |
|---|--|
| ( | ClockBuilder Pro 🗤 🐝   |
| : | Step 3 of 12 - Package Selection ▼   |
|   | Si5332-GM Any Reference (A, B, C, or D)<br>An external crystal (XTAL) or oscillator (OSC) is supplied to XAXB.                   |
|   | Si5332-AM Any Reference Automotive (Grades A, B, C, or D)<br>An external crystal (XTAL) or oscillator (OSC) is supplied to XAXB. |
|   | Si5332-GM Embedded Crystal (Grades E, F, G, H, or L)<br>A 50 MHz crystal is included in the package.                             |

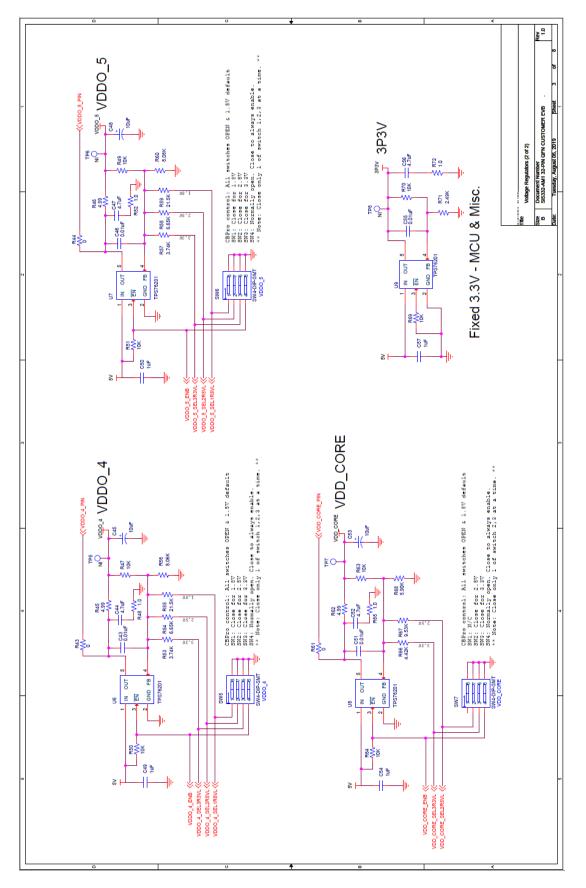
5. When complete with all steps, simply press the "Write to EVB" button to download the configuration to the connected EVB.

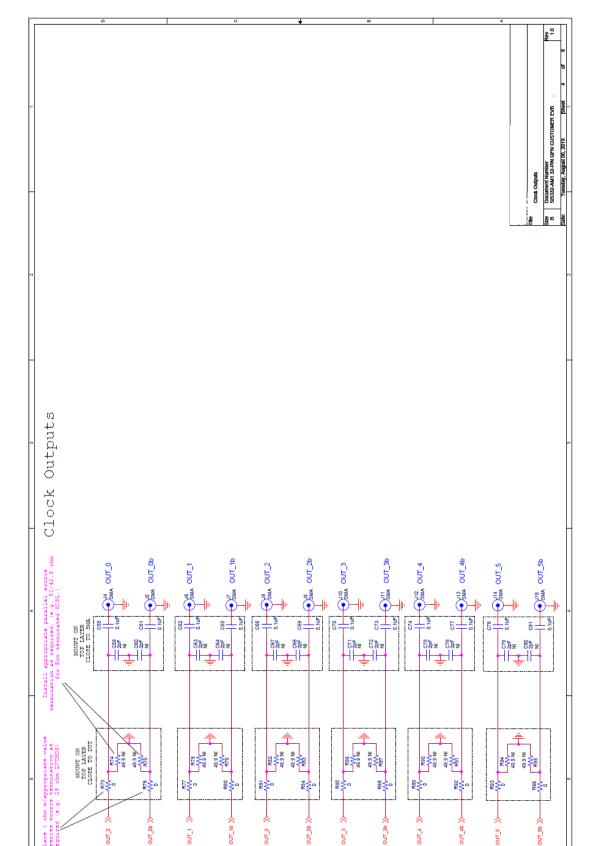
The configuration should now be actively running in the Si5332-6A-EVB.

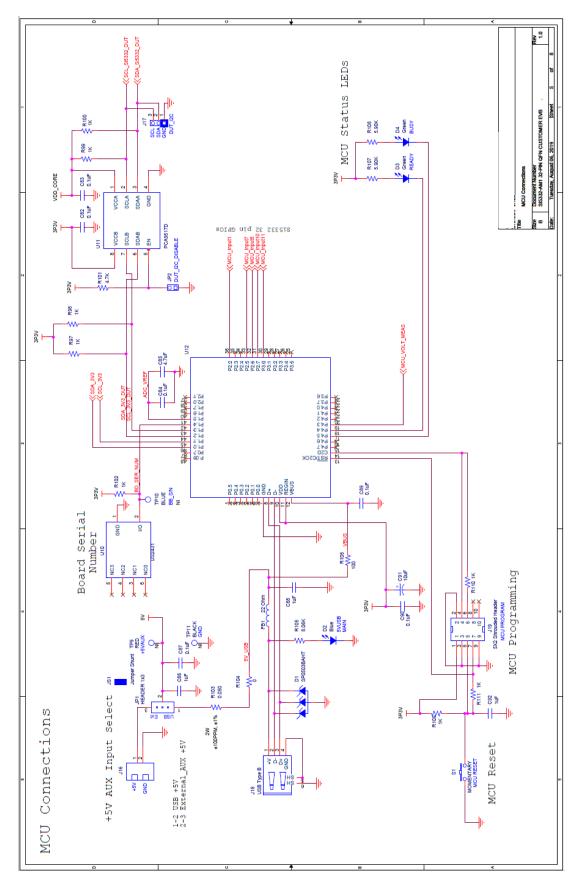
### 5. Si5332-6A-EVB Rev 1.0 Schematics

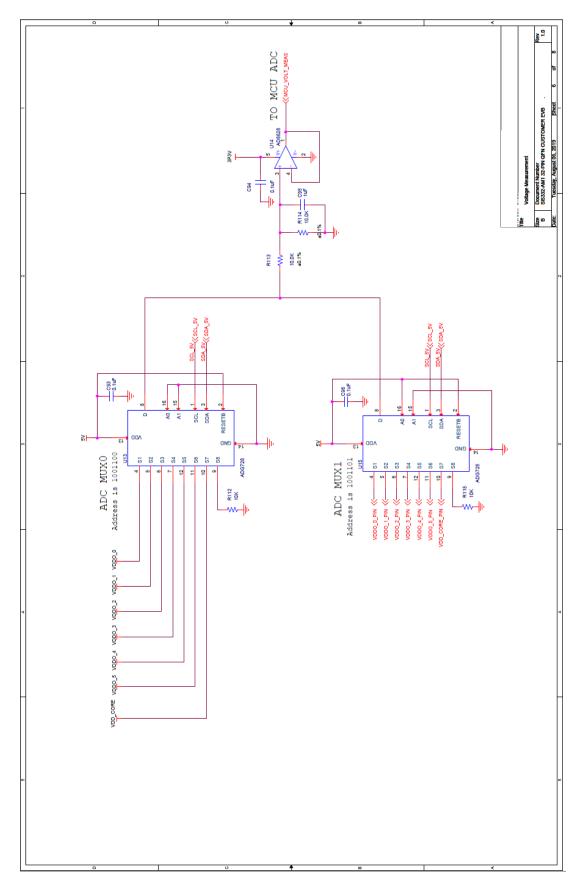


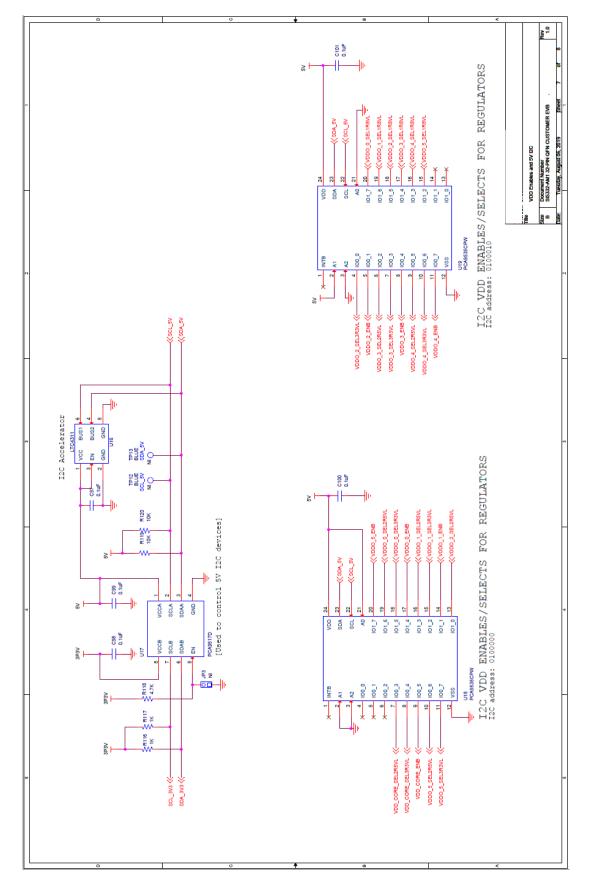


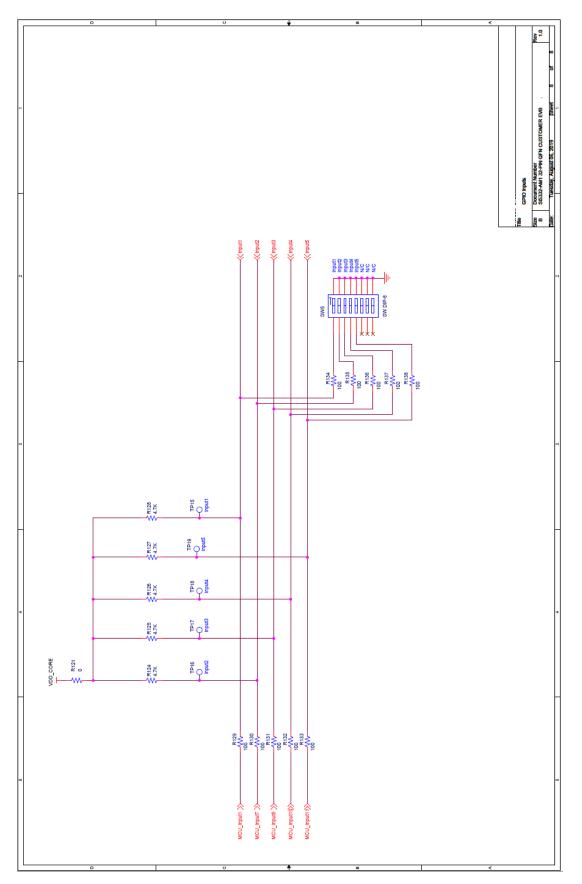












# **SKYWORKS**<sup>®</sup>

### **ClockBuilder Pro**

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

skyworksinc.com/CBPro



**Portfolio** skyworksinc.com SW/HW skyworksinc.com/CBPro





Support & Resources skyworksinc.com/support

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