RC32508A

Evaluation Board

The RC32508A evaluation board (EVB) is designed to help users evaluate the RC32508A Clock Generator, also known as FemtoClock 2x2. The RC32508A supports jitter attenuator and synthesizer functionality.

When the evaluation board (EVB) is connected via USB to a computer running the Renesas RICBox™ Software, FemtoClock 2x2 can be configured and programmed to generate frequencies with best-in-class performance. FemtoClock 2x2 has eight output pairs that can be programmed to CMOS, LVDS, or HCSL style outputs.

Features

- Develop configurations with Renesas RICBox software and upload to the EVB through USB
- Can be powered from the USB connection
- EVB is a combination evaluation with Renesas Low Noise power supply regulators
- Clock input and output pairs are DC coupled

Board Contents

- Renesas RC32508A ultra-low noise synthesizer and jitter attenuator
- Renesas RAA214020 low-noise power supply regulators
- FTDI FT232HQ USB-to-I2C bridge

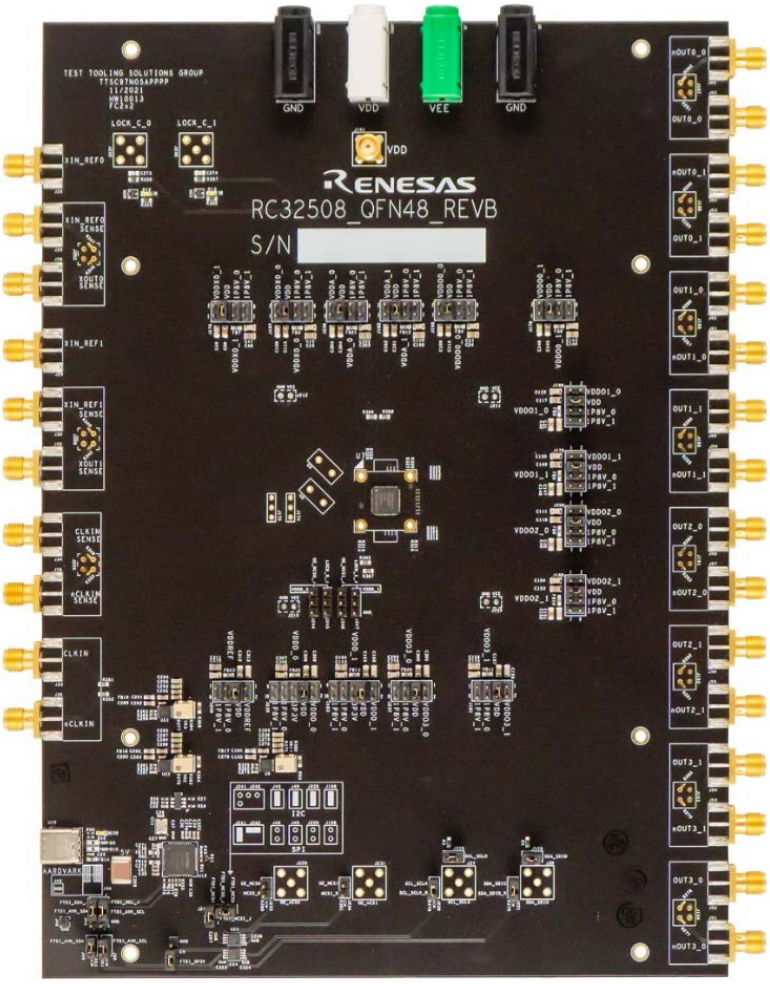

Figure 1. RC32508A Board

Contents

Figures

1. Functional Description

1.1 Connecting the Board to a Computer

The evaluation board can be connected to a computer via the USB connector (see Figure 2). This board has a USB-C type connector. The on-board USB-to-I2C bridge (FTDI chip) handles the data communication, and the +5V in the USB bus powers the on-board regulators. Using a bench power supply with the V_{DD} jacks is optional. The board can fully function with just the USB cable to a computer.

Renesas' *RICBox Software* is used to control the RC32508A on the board. RICBox is compatible with both the on-board USB-to-I2C bridge and the Aardvark adapter. RICBox uses a software wizard for entering the overall configuration and has several tools to fine tune the configuration (for example, block diagram GUI).

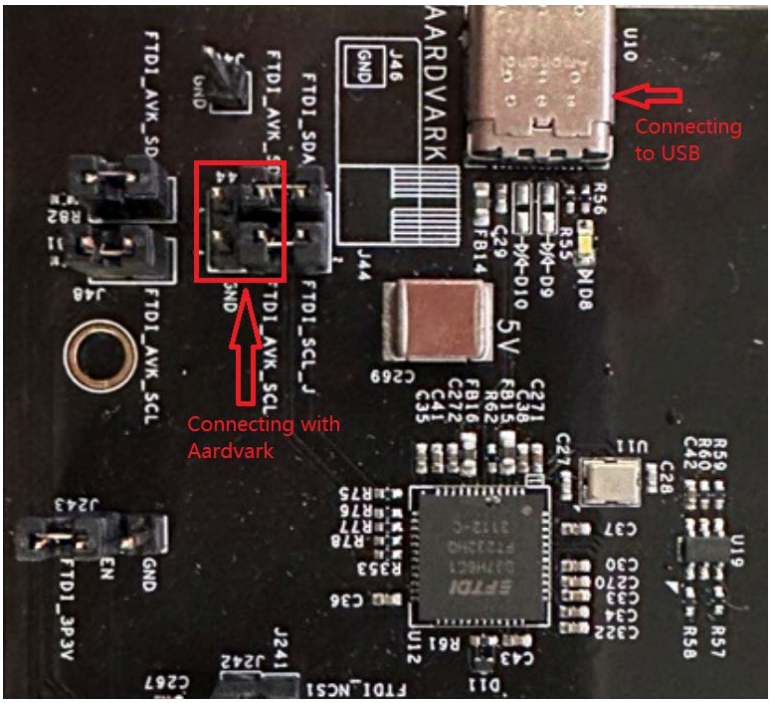

Figure 2. Connecting to USB and Aardvark

When the board is shipped, jumpers are assembled for using the on-board FTDI chip.

Both the FTDI chip and the Aardvark adapter require 3.3V levels for the I^2C bus. For I^2C control, it is recommended to set VDDD-0 and VDDD-1 to 3.3V.

A FemtoClock 2x2 plugin for the RICBox software is available. Complete the following steps to set up the RC32508A EVB using I^2C.

1. Connect the user computer to the board through USB cable.
2. Download and set up the Renesas RICBox Software according to the instructions in the Renesas IC Toolbox (RICBox) Software Manual.
3. An I^2C connection is established between the GUI software and the RC32508A.
4. Start a new configuration. Click *Create New Project* (see Figure 3)

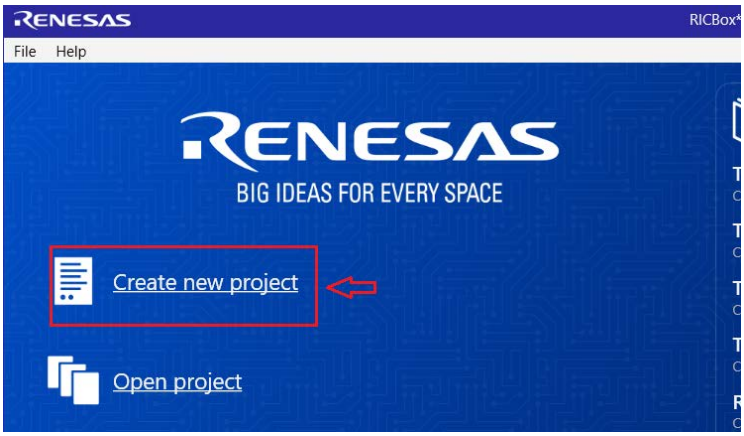

Figure 3. Create New Project Window

5. From the **Select Product Family** section, select the device family that is being used. From the **Select a Product Variant** section, select the working device. Click the *OK* button to open the new configuration.

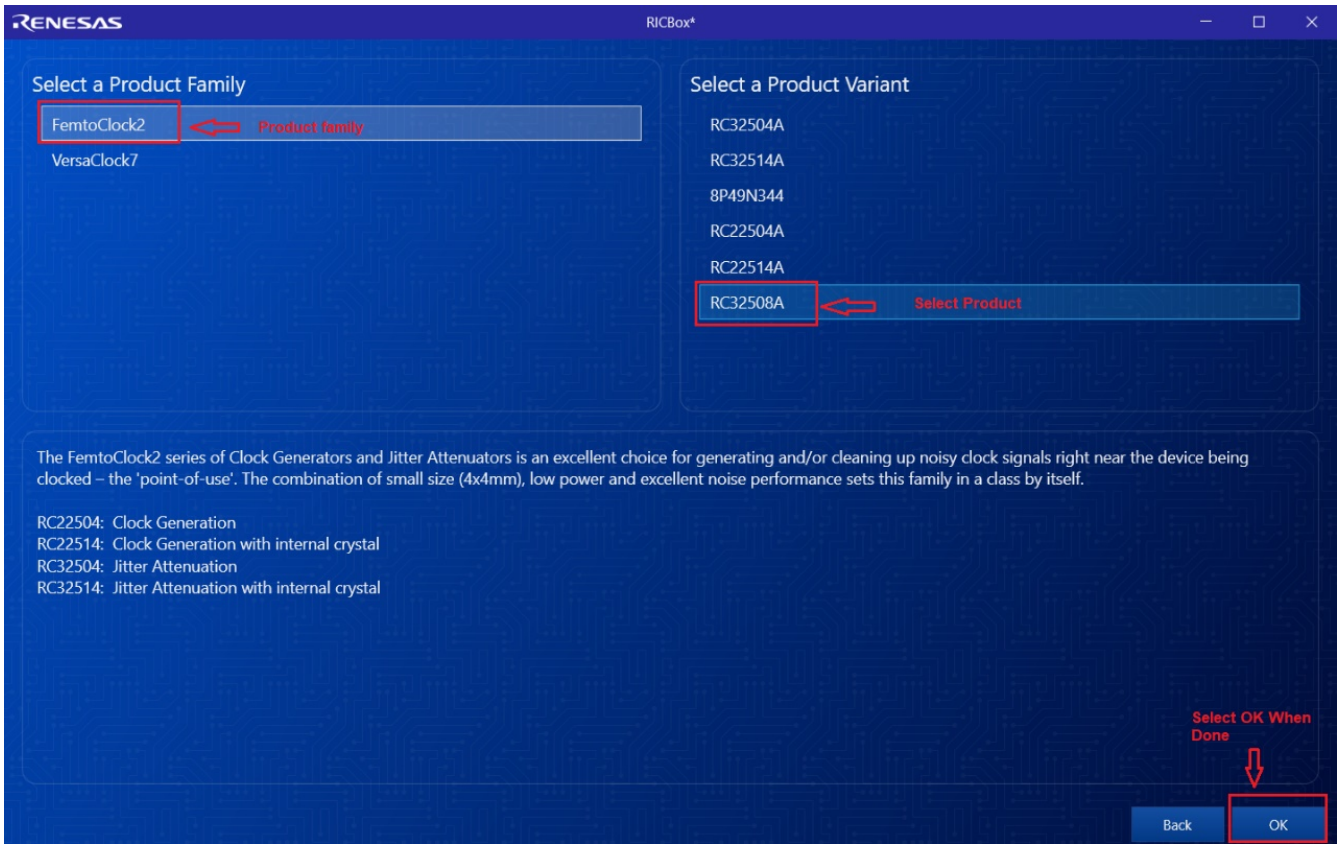

Figure 4. Select Product Plugin

1.2 Board Power Supply

The power source for each V_{DD} pin can be selected with jumpers. The voltage for each pin, except two pins, is 1.8V. The exception is VDDD-0 and VDDD-1, which can be powered with 1.8V or 3.3V.

The power source can be either an on-board voltage regulator or the white V_{DD} jack. Most power source selectors have only two choices, 1.8V from an on-board 1.8V regulator or connect to the white V_{DD} jack. The VDDD selectors have an extra 3.3V choice. The jack can connect to a bench supply. This connection can be useful, for example, to measure supply current into pins. The jack can also be useful to prevent overloading the USB power supply. Total supply current of the board can be up to 800mA. The recommended typical configuration is to use the V_{DD} jack for each V_{DD} pin, except the VDDD pins. Connect the VDDD pins to the on-board 3.3V regulator that is powered by the USB bus.

In Figure 5, the source for the pin VDDO0-1 is chosen to be the on-board 1.8V regulator #1. Because of the total expected supply current, there are two 1.8V regulators on the board. It is good practice to use regulator "_0" for V_{DD} pins "_0" and regulator "_1" for V_{DD} pins "_1". This practice ensures the load on the two regulators is similar.

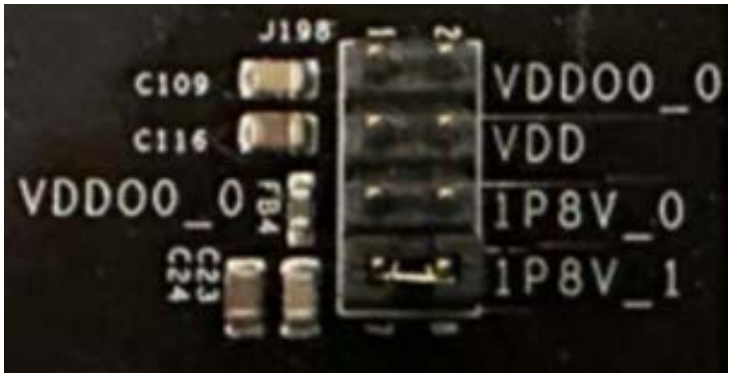

Figure 5. Power Source Selector Example

In Figure 6, the source for the pin VDDD_1 is chosen to be the on-board 3.3V regulator. J183 allows three choices for VDDD_1: 1.8V, 3.3V, or the V_{DD} jack. The jumper position at pins 1–2 is a special test setting that has no use for normal device evaluation.

Figure 6. Power Source Selector for VDDD_1

1.3 Differential Outputs

The right side of the board has eight SMA pairs for the eight differential outputs. See Figure 7 for an SMA pair example.

Figure 7. Differential Output Pair Example

The board is shipped with the SMA connectors DC coupled to the RC32508 output pins. Output pairs can be programmed to LVDS, HCSL or CMOS logic. In the case of an LVDS output, it is recommended to AC couple before test equipment with a DC coupled 50Ω termination, like an oscilloscope. A “DC Block” can be inserted at the SMA connector to facilitate the AC coupling.

In the case of an HCSL output, the DC coupling can be beneficial. When the on-chip termination at the driver is disabled, the DC coupling allows for the oscilloscope input to provide the DC coupled termination. When the on-chip termination is enabled, external AC coupling with a “DC Block” can be used, but DC coupling will work as well. Please note that this situation will be double-terminated with a termination both at the source and the destination, resulting in half the specified signal amplitude.

In the case of a CMOS output, the probe point J187 can be used to connect a high impedance probe. The short traces to the SMA connectors will be open stubs and can create a small reflection. When this interferes with measurements, R291 and R292 can be opened to disconnect the stub. Nothing will be assembled on the R291 and R292 footprints but the footprints are shorted with a thin trace. To be able to use the footprint or to open the footprint, cut the thin trace that shorts the footprint.

After opening the R291 and R292 footprints, 0.1μF capacitors can be placed to create AC coupling on the board. This avoids having to insert “DC Block” devices.

Note: This will not work with HCSL where the on-chip termination is disabled. The HCSL driver needs to see a DC path to ground. When adding AC coupling capacitors on the board, HCSL can only be used with the on-chip termination enabled.

1.4 Differential Inputs

The SMA connectors for the differential input CLKIN are DC coupled to the CLKIN and nCLKIN pins on the RC32508A device (see Figure 8). There is no termination assembled on the board. When needed, on-chip termination can be enabled. On-chip termination can be used with HCSL and LVDS style clocks. In the case of LVDS, it is recommended to AC couple the differential clock and use the DC Bias option of the RC32508A device to set the desired common mode voltage for the CLKIN input. This way, the CLKIN input can handle almost any differential swing from 300mVppdiff to 2400mVppdiff (0.15 ~ 1.2Vpp single ended).

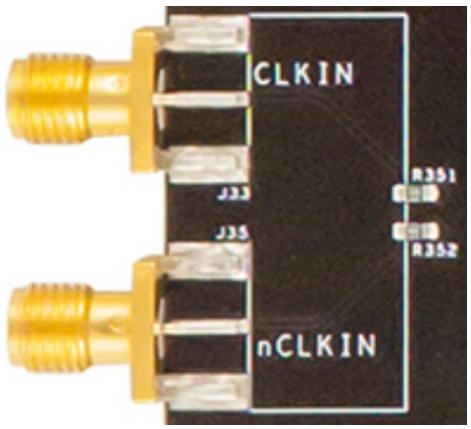

Figure 8. CLKIN/nCLKIN Differential Input

In the case of LVCMOS, use a 1.8V amplitude single-ended clock at CLKIN. For LVCMOS, the on-chip termination at the CLKIN input can be disabled. It is actually possible to have an LVCMOS clock at CLKIN and another LVCMOS clock at nCLKIN where CLKIN is the primary clock and nCLKIN is the secondary (backup) clock, in case of a Jitter Attenuator configuration.

1.5 On-Board Crystal

The evaluation board does not come with crystals pre-assembled. However, there are footprints for crystals on the bottom side of the board.

Figure 9. XIN Inputs

The SMA connector XIN_REF0 AC couples to the pin XIN/REF-0 and the SMA connector XIN_REF1 AC couples to the pin XIN/REF-1 of the RC32508A device. A clock can be used to overdrive XIN. When deciding to use an actual crystal for XIN/REF-0 / XOUT-0, ensure to remove the AC coupling capacitor assembled at R10 to disconnect the PCB trace to J25.

XIN_REF1 can be used for loop back of a clock from APLL0 to APLL1. This is mostly used with jitter attenuator configurations where APLL0 is doing the jitter attenuation and APLL1 acts as a fanout synthesizer to create more clock outputs.

1.6 Setup and Configuration

Complete the following steps to start the configuration of the board.

1. When creating a new configuration, the wizard page is the first screen to appear (see Figure 10). The wizard contains a pull-down list of configuration pages (located in the upper right-hand corner of the window) pertaining to different sections of the device that require overall configuring.

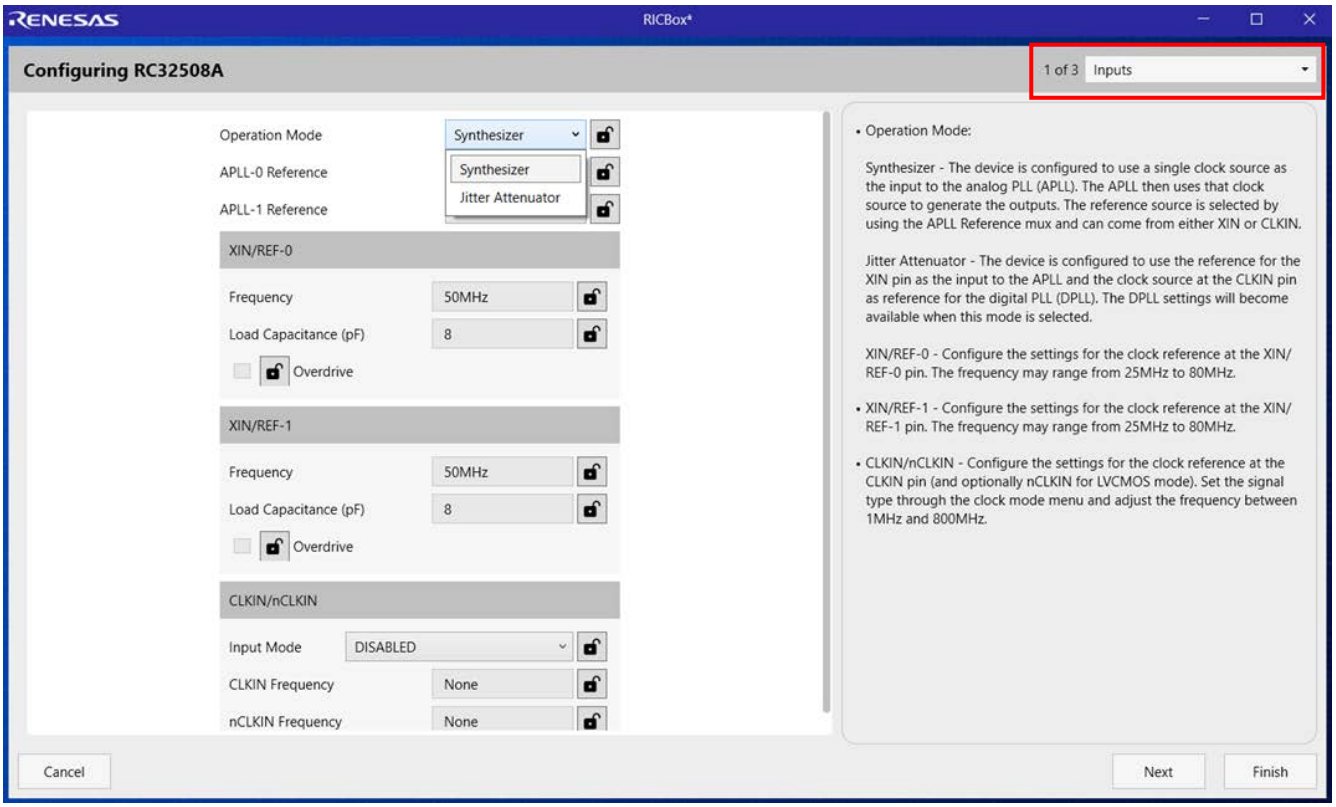

Figure 10. Wizard Page Navigation Window

2. If **Jitter Attenuator** mode is selected, the jitter attenuator configuration window (screen 2 of 3) appears with a list of settings (see Figure 11). If *Synthesizer* mode is selected, the jitter attenuator window is skipped and the user is then directed to the **Output Clocks** window (screen 3 of 3) See Figure 12.

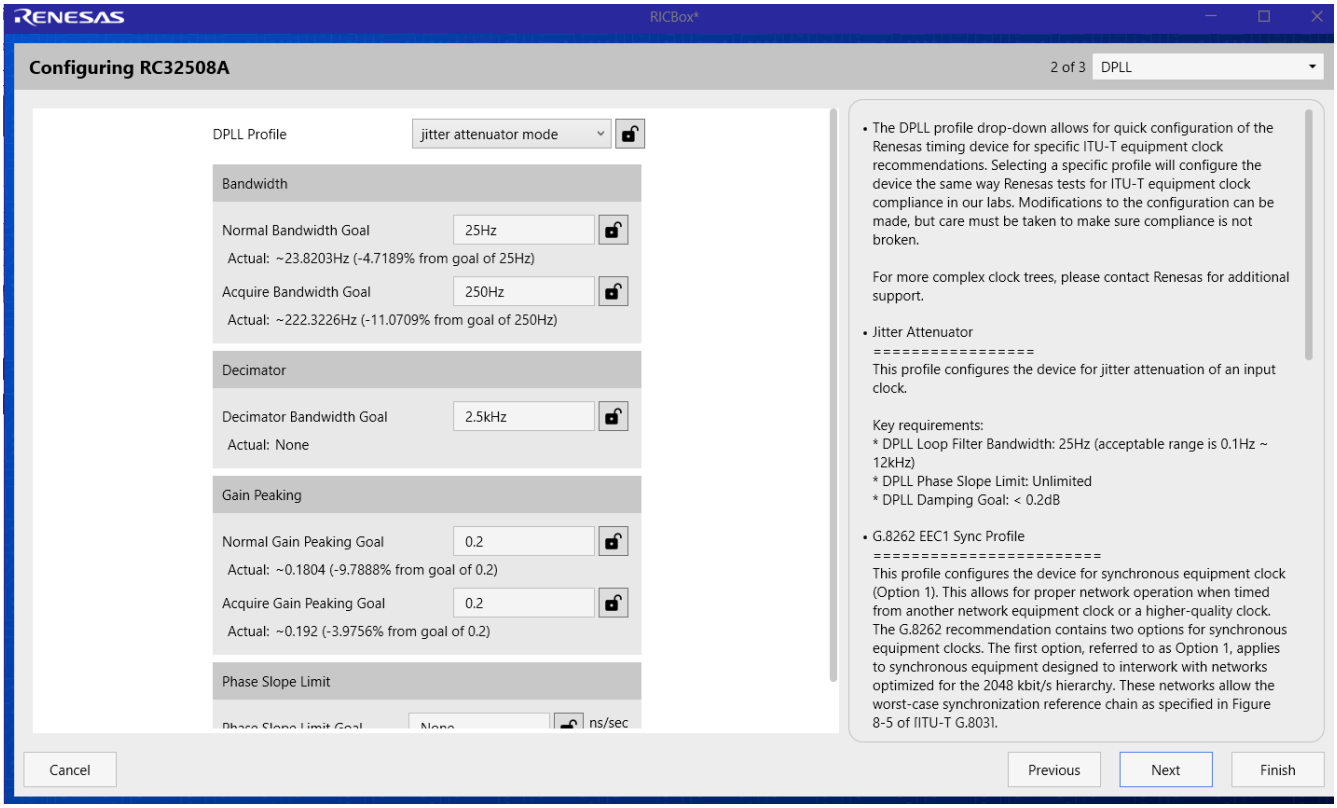

Figure 11. Jitter Attenuator Mode Settings Window

3. The **Output Clocks** window (screen 3 of 3) sets up the outputs (see Figure 12).
   a. Fill in the desired output frequencies. Leave blank unused outputs.
   b. Click on *Advanced Settings* at the red arrow to select **Logic Type** and **Signal Amplitude**.
   c. Click *Finish* to end the Wizard and enter the main configuration utility.

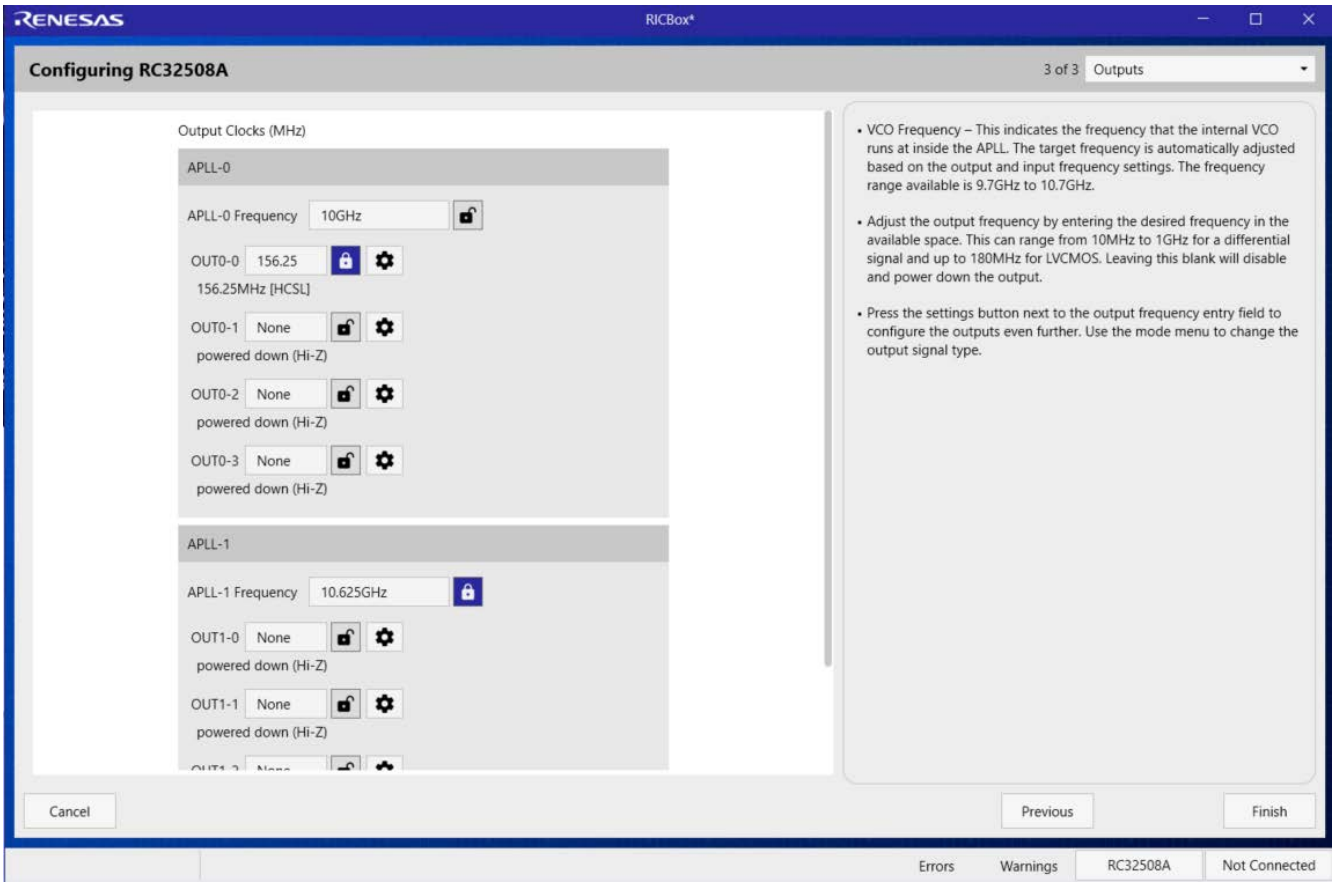

Figure 12. Output Settings Window

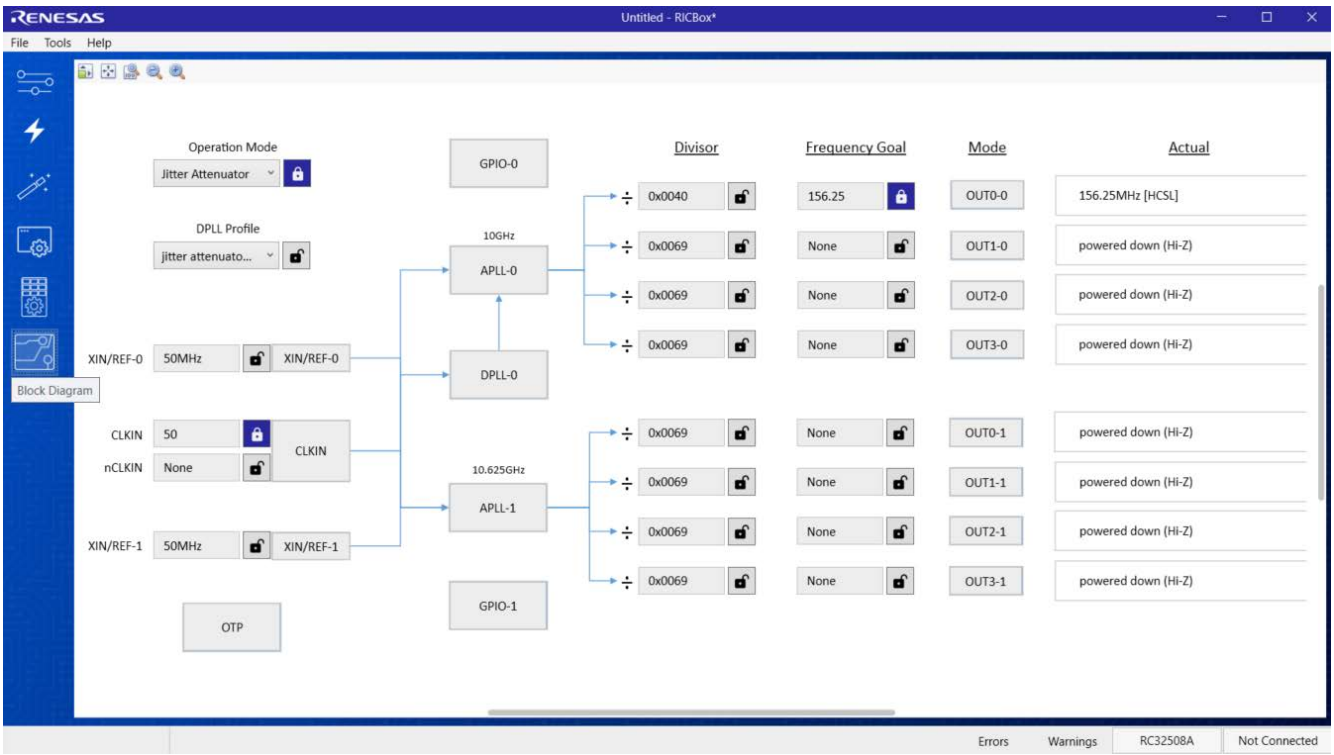

Figure 13. Block Diagram

4. The side panel consists of five separate buttons. The buttons on the top left are Control Panel (the above screen), Wizard, Configuration, Registers, and Block Diagram. For more information, see the Renesas IC Toolbox (RICBox) Software Manual.

Figure 14. Side Panel Buttons

5. Transfer the Configuration from RICBox into the FemtoClock 2x2 device:

   The bottom right of the screen has buttons to control the I^2C connection with the device.

   a. Click the *Not Connected* button to connect. Click the *Connect* button to the right of **Program** to connect.

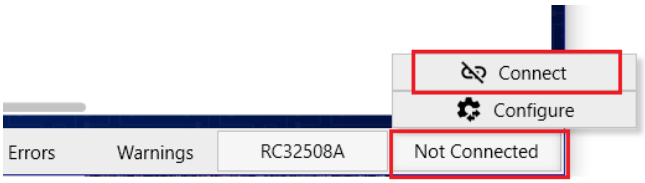

Figure 15. Device Connection

   b. Once fully connected to a device, the connection button will be illuminated green.

Figure 16. Connected Button Illuminated

   c. The **Connection Settings** screen allows you to select a specific device and connect. After attempting to connect, the small *Connected* button turns green to indicate that the connection was successful. Now click *Program* to transfer all settings to the device.

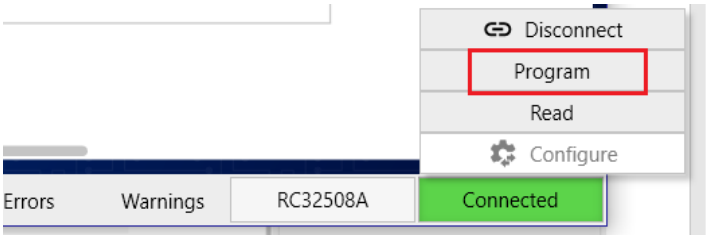

Figure 17. Program Button

2. Board Design

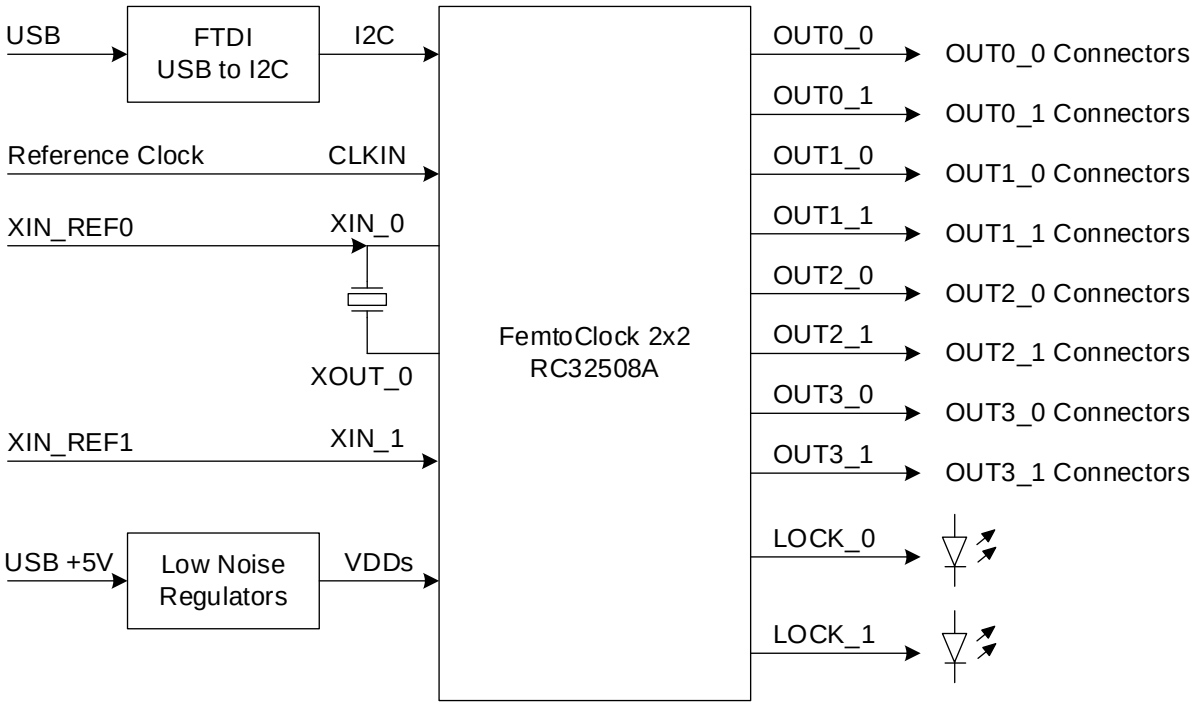

Figure 18. RC32508A EVB – Block Diagram

Each differential output clock is available on a pair of SMA connectors. Each pair of SMA connectors is DC coupled to the output pair pins.

Power is provided through the USB connection and regulated with RAA214020 low noise LDOs. Each power pin can also be switched to a banana plug jack for supply current measurements or relieve the USB port from most of the supply current.

The board has an FTDI USB-to-I2C bridge for programming FemtoClock 2x2 from a computer. Renesas RICBox software is available for easy development of configurations.

The LOCK pins drive LEDs and the LEDs light up when the pin is high. Default function assigned to a LOCK pin is “APLL Lock” so the LED shows if the APLL is locked or not. Several other status items can be assigned to the LOCK pin.

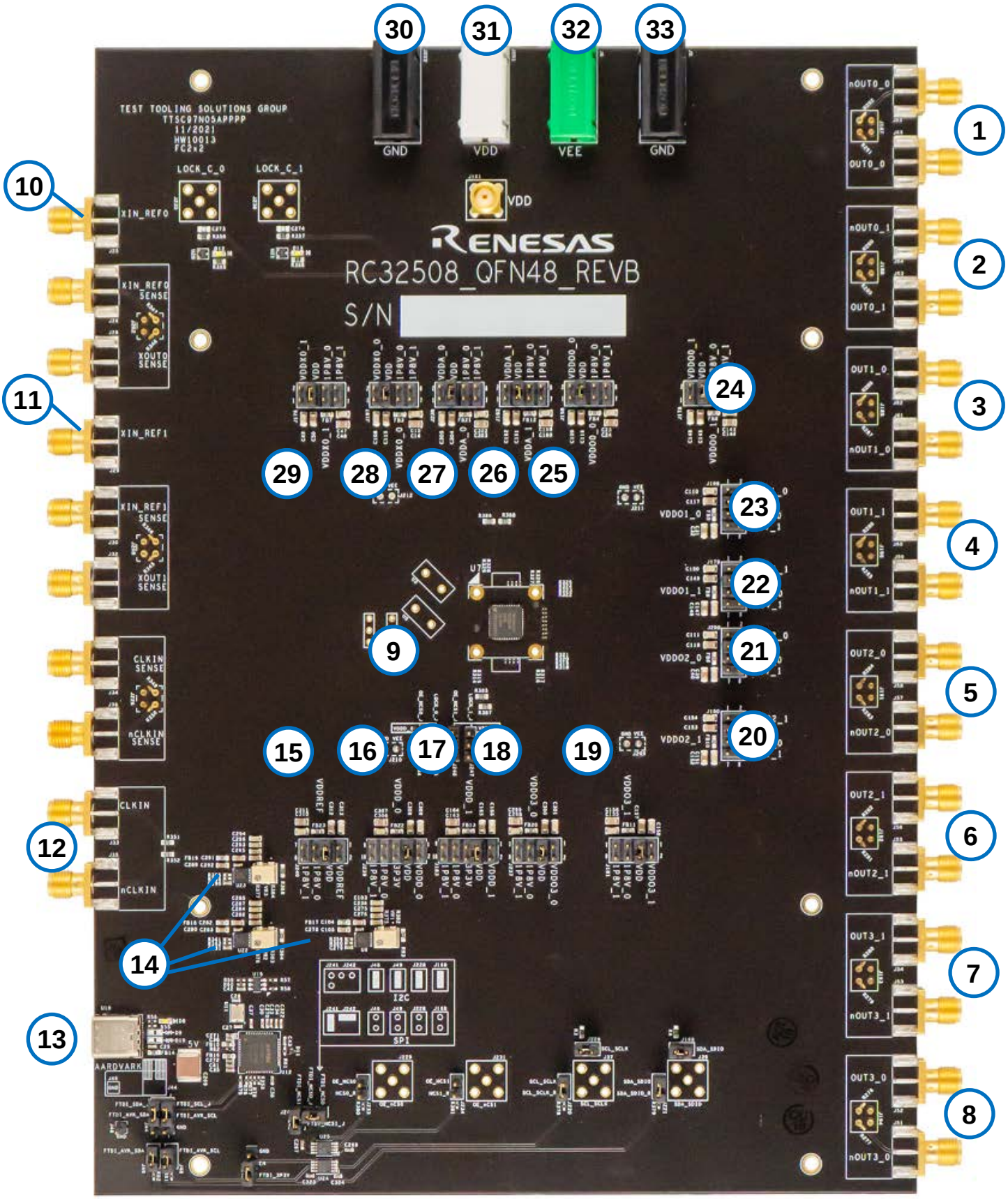

Figure 19. RC32508A Board – Top View

Table 1. RC32508A – EVB Pins and Functions

Note: See Figure 19 for reference numbers in the following table.

Ref.	Name	On-Board Connector Label	Function
1	Output0_0	J65, J66	Differential Clock Output 0-0
2	Output0_1	J63, J64	Differential Clock Output 0-1
3	Output1_0	J61, J62	Differential Clock Output 1-0
4	Output1_1	J59, J60	Differential Clock Output 1-1
5	Output2_0	J57, J58	Differential Clock Output 2-0
6	Output2_1	J55, J56	Differential Clock Output 2-1
7	Output3_1	J53, J54	Differential Clock Output 3-1
8	Output3_0	J51, J52	Differential Clock Output 3-0
9	RC32508A	U7	FemtoClock 2x2 DUT
10	XIN_REF0	J25	Clock Input to overdrive XIN/REF-0
11	XIN_REF1	J29	Clock Input to overdrive XIN/REF-1
12	CLKIN	J33, J35	Differential Reference Clock Input
13	USB Interface	U10	USB-C Type Jack for connection with the computer and interaction with Renesas RICBox Software.
14	RAA214020	U6, U22, U23	Low Noise Voltage Regulators
15	VDDREF	J240	Power Source Selector for pin VDDREF
16	VDDD_0	J239	Power Source Selector for pin VDDD-0 (Digital VDD)
17	VDDD_1	J183	Power Source Selector for pin VDDD-1 (Digital VDD)
18	VDDO3_1	J237	Power Source Selector for pin VDDO3-1
19	VDDO3_0	J181	Power Source Selector for pin VDDO3-0
20	VDDO2_1	J180	Power Source Selector for pin VDDO2-1
21	VDDO2_0	J200	Power Source Selector for pin VDDO2-0
22	VDDO1_1	J179	Power Source Selector for pin VDDO1-1
23	VDDO1_0	J199	Power Source Selector for pin VDDO1-0
24	VDDO0_1	J178	Power Source Selector for pin VDDO0-1
25	VDDO0_0	J198	Power Source Selector for pin VDDO0-0
26	VDDA_1	J182	Power Source Selector for pin VDDA-1
27	VDDA_0	J238	Power Source Selector for pin VDDA-0
28	VDDXO_0	J197	Power Source Selector for pin VDDXO-0
29	VDDXO_1	J176	Power Source Selector for pin VDDXO-1
30	GND Jack	J222	Jack for external Power Supply Ground

Ref.	Name	On-Board Connector Label	Function
31	VDD Jack	J201	Jack for external Power Supply VDD
32	VEE Jack	J6	Jack for external VEE connection For factory testing only. Is connected to GND by default.
33	GND Jack	J5	Jack for external Power Supply Ground

2.1 Schematic Diagrams

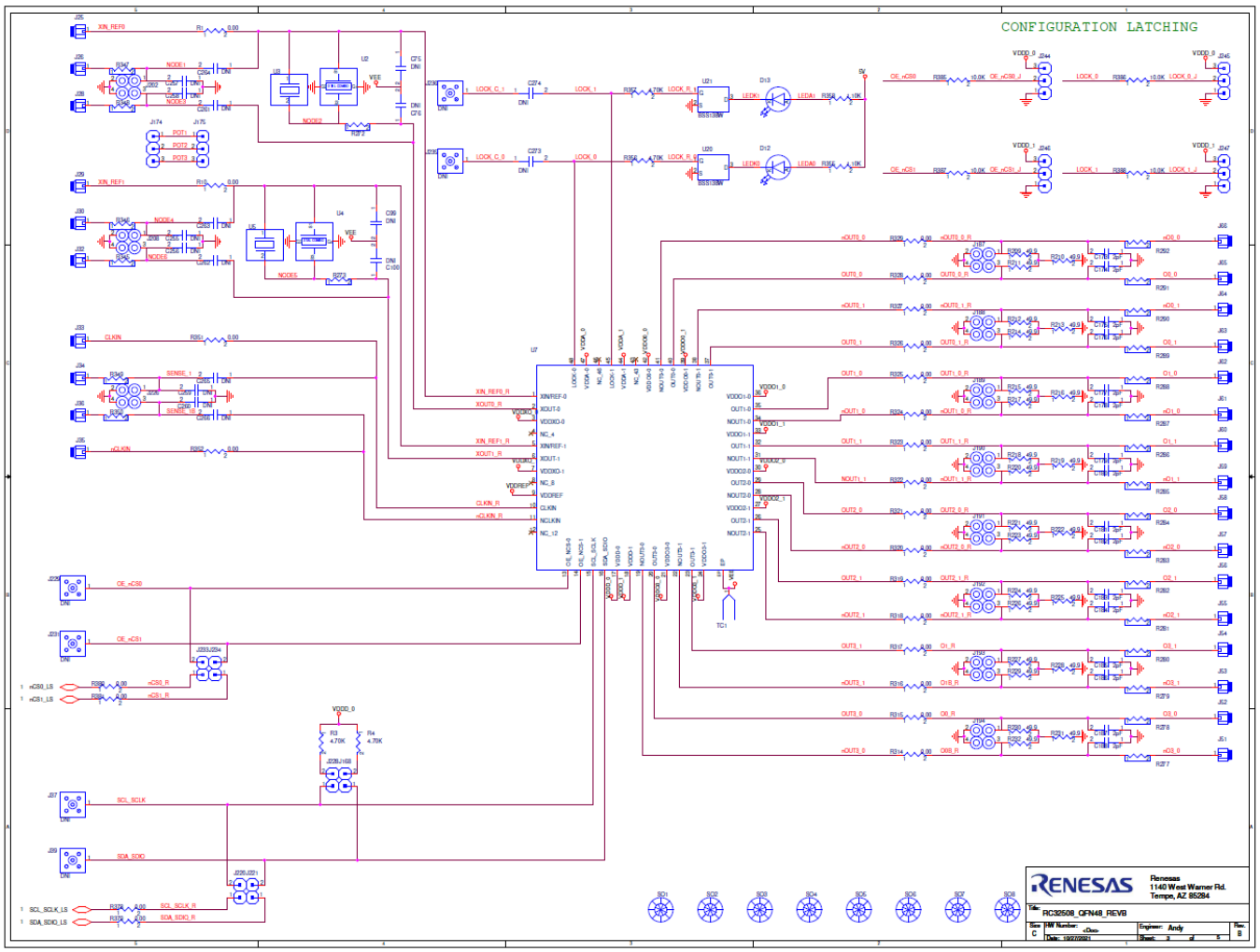

Figure 20. RC32508A Evaluation Board Schematics – Page 1

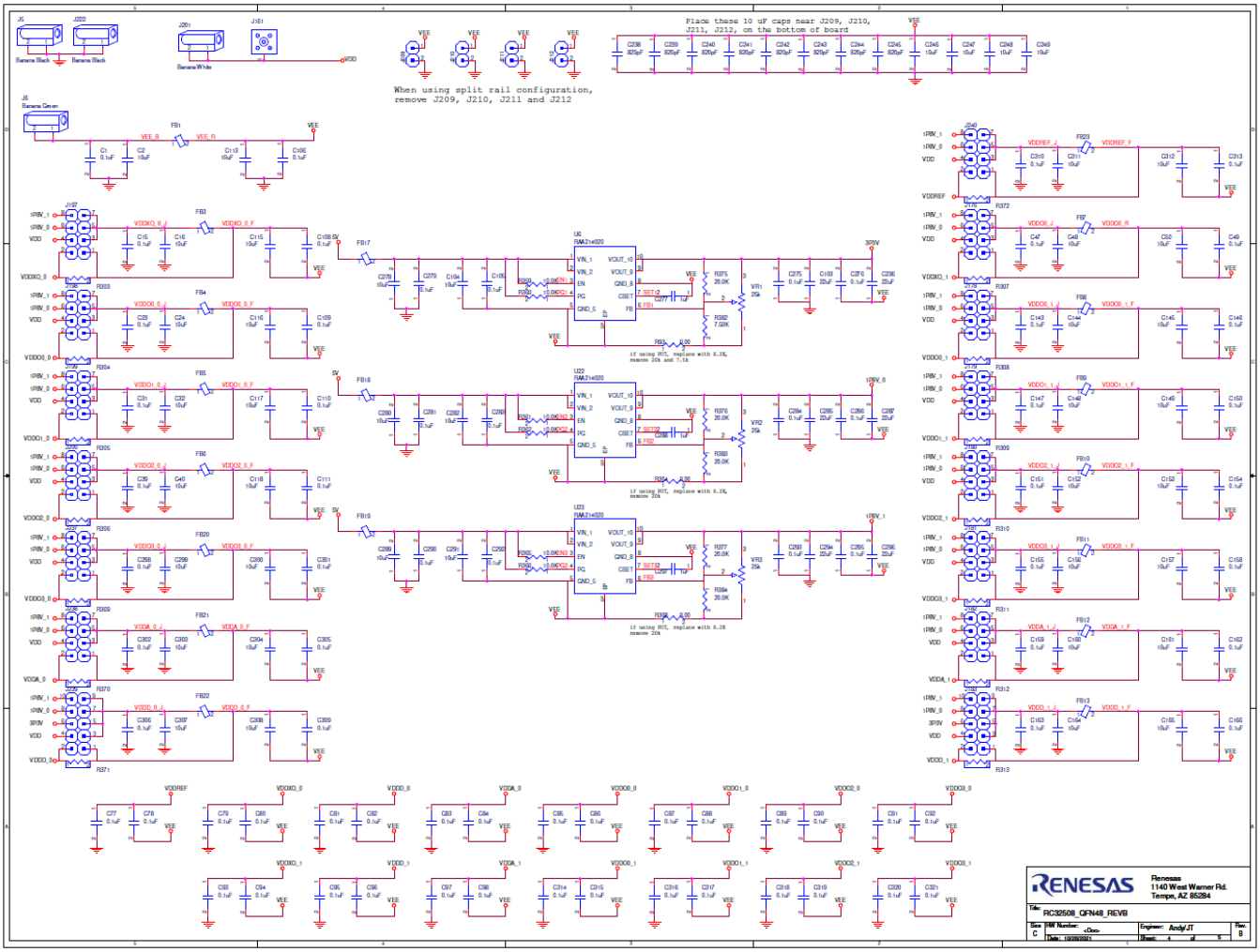

Figure 21. RC32508A Evaluation Board Schematics – Page 2

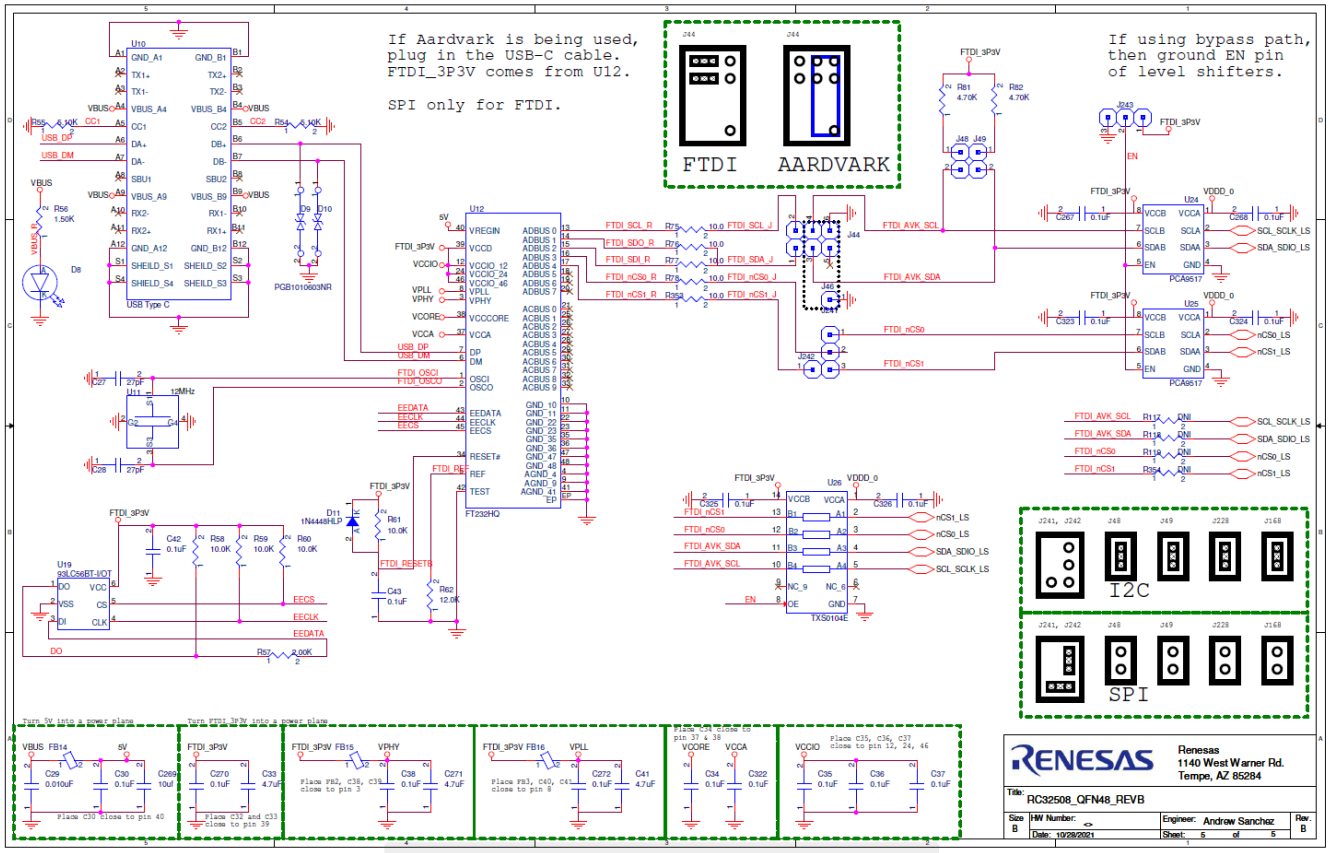

Figure 22. RC32508A Evaluation Board Schematics – Page 3

3. Ordering Information

Part Number	Description
RC32508A-EVK	RC32508A Evaluation Board; A-male to USB-C cable.

4. Revision History

Revision	Date	Description
1.00	Aug 11, 2023	Initial release.

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Corporate Headquarters

TOYOSU FORESIA, 3-2-24 Toyosu,
Koto-ku, Tokyo 135-0061, Japan
www.renesas.com

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