Application Note

RAA2S425x KIT Quick Start Guide

This document provides a short description on how to start using the RAA2S425x KIT, all examples are using the RAA2S4251B IC. The following parts are described in detail:

- RICBox GUI and RAA2S425x plug-in
- RAA2S425x evaluation board
- Demonstration of calibration and reading back data

Contents

1. Evaluation Software

The evaluation software consists of the following parts:

- Renesas IC Toolbox (RICBox): a generic evaluation software framework that supports various Renesas products. It uses a product/family specific plug-in for operation, new supported products and families can be added by specific plug-ins.
- RAA2S425x plug-in: a separate file that adds support for the RAA2S425x products to the RICBox.

1.1 Installation

Detailed description of the computer requirements, installation process, and explanation of various RICBox functionality are presented in the *Renesas IC Toolbox User Guide* document that can be requested from the local Renesas representative.

Notes:

- The RAA2S425x plugin is 32-bit only. Install and use the 32-bit version of the RICBox.
- Install the FTDI USB drivers (including virtual com port VCP drivers) before connecting the evaluation kit and installing the evaluation software as the drivers are needed for communication with the evaluation board. Check the FTDI web page for the FTDI drivers.

In addition to the *Renesas IC Toolbox User Guide* document, below is listed some additional information.

- The user must have local installation rights on the computer to install the Evaluation Software for the kit.
- The RICBox installer automatically installs a Python environment framework, required to execute the product specific plug-ins.
- Installation of product plug-in for RAA2S4251:
  - Run the installation file for the plug-in: *R_RAA2S425x-a.b.c.ddddd.exe*
  - Follow the installation instructions, read the “License Terms and Conditions” and check “I accept the agreement” in order to proceed. The plug-in will be automatically installed in the RICBox plugins folder.

Once both the RICBox and the plugin are successfully installed, the RICBox software can be started from the shortcut in the Windows Start Menu.

After the selected plugin is loaded, the main screen of the RICBox GUI appears. It can be divided into four sections:

- Menu bar
- Page selector: contains buttons to switch between different pages.
- Bottom controls: contains the memory access buttons, the status indicators and the communication section.
- Main work area: all DUT settings, parameters and controls are in this section.

More information on how to use the RICBox can be found in the *Renesas IC Toolbox User Guide* document.

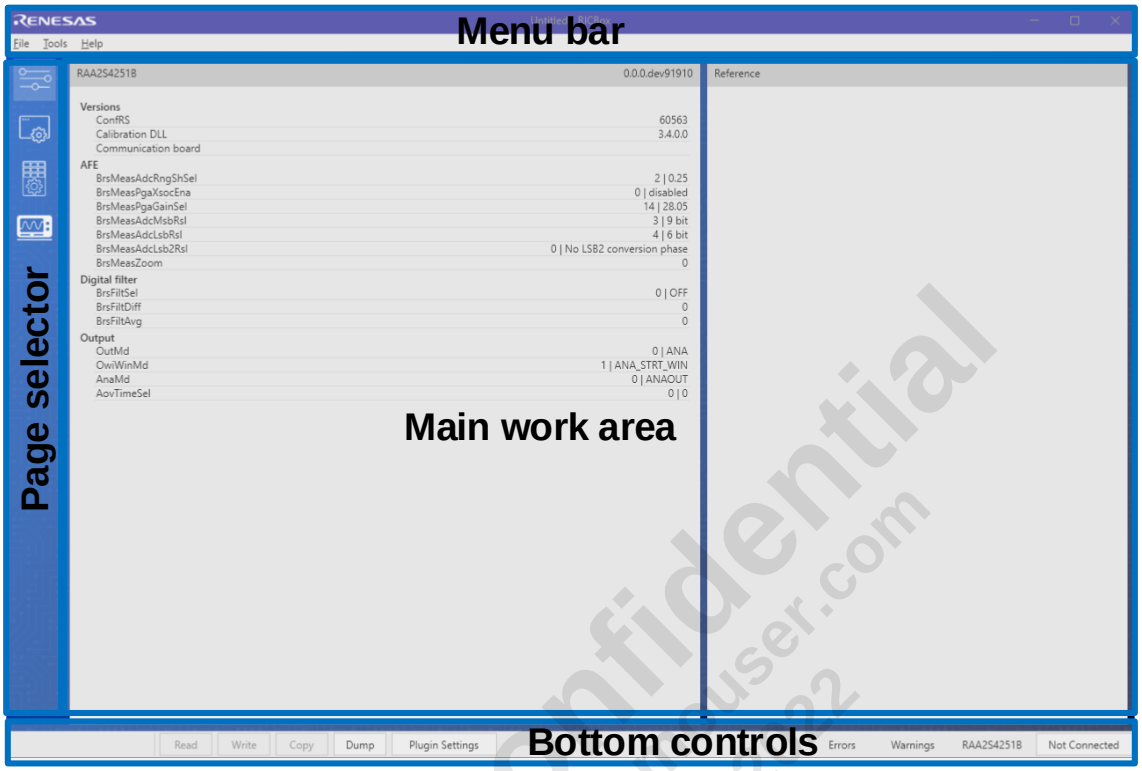


Figure 1. Main Sections of the RICBox GUI

2. RAA2S425x Evaluation Board Description

The RAA2S42xy evaluation board can be connected to a computer via the USB type-B connector. The on-board FTDI chip handles the data communication. A galvanically isolated power supply and dual channel digital isolator powers the rest of the board and provides a safe communication channel.

The evaluation board (see Figure 2) has the following main blocks:

- Galvanically isolated power supply and USB communication: the USB interface is used for both communications and power supply for the evaluation board. Onboard circuitry provides galvanic isolation with the rest of the board.
- Microcontroller and Device under Test (DUT) communication: a Renesas RX651 series microcontroller handles the OWI and I2C communication with the DUT and UART communication with the FTDI device.
- Zero Input Force (ZIF) DUT socket: a QFN socket for the DUT.
- Sensor Replacement Circuit: it allows using the RAA2S425x devices without real sensor by providing means for changing bridge resistance and using an onboard diode for temperature sensor.
  It can be completely disconnected with the jumpers J2.
- External sensor connector and External power supply: the DUT can be connected to external sensor and/or power supply.
  The Sensor Replacement Circuit must be completely disconnected with the jumpers J2 before using the external sensor.
  Note: Never supply more than 5.50V on the External Power Supply Connector!

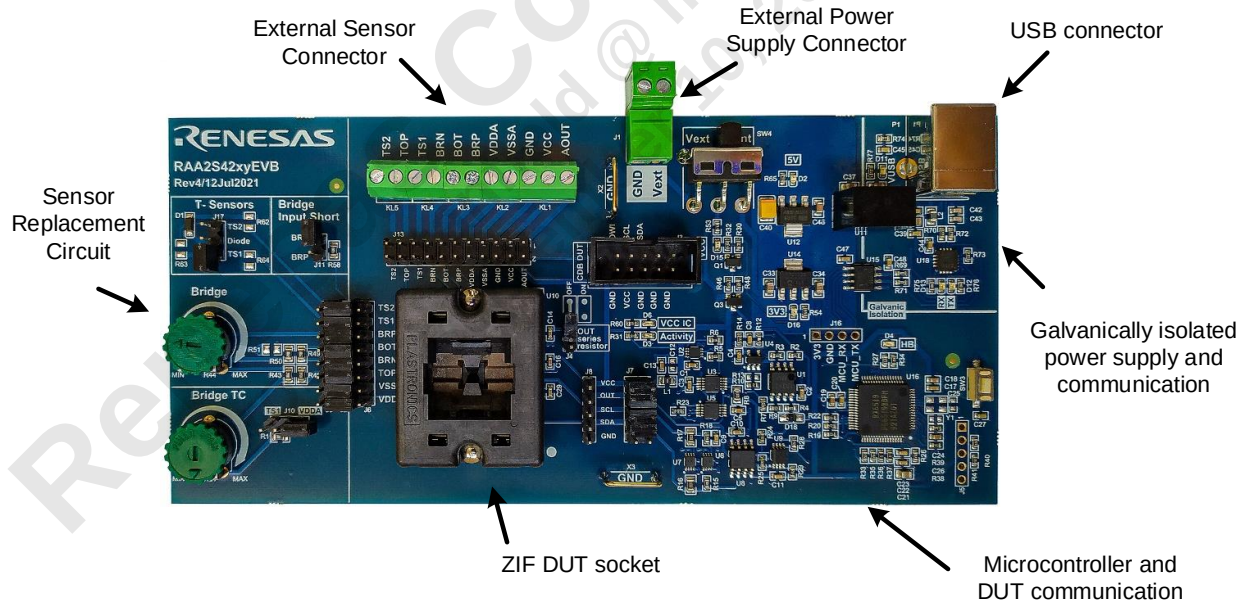


Figure 2. Main Blocks of the Evaluation Board

3. Example Usage

The RAA2S425x devices are delivered with a default NVM configuration to simplify the usage of the part. Sections 3.1and 3.2 describe configuration of the board, the GUI and the DUT in order to start working with the kit.

This section describes a model usage of the RAA2S425x Evaluation Kit for better understanding of the setup. All required items are included in the kit for this demonstration, the conditions used are the following:

- DUT: RAA2S4251
  - Using new settings file
- Sensor: onboard Sensor Replacement Circuit (no real sensor).
- Calibration: 2 points linearization without temperature compensation
  - Low value of sensor replacement potentiometer corresponds to 10% of output
  - High value of sensor replacement potentiometer corresponds to 90% of output
- Power supply: onboard internal galvanically isolated power supply from the USB port.

3.1 Hardware Setup

Follow these steps to setup the evaluation board:

1. Place the DUT in the socket.
   Press down the top side of the socket, and then place the DUT inside so that the pin 1 markings on the DUT and the socket matches (see Figure 2).
2. Set the jumpers as shown on Figure 3 and Table 1

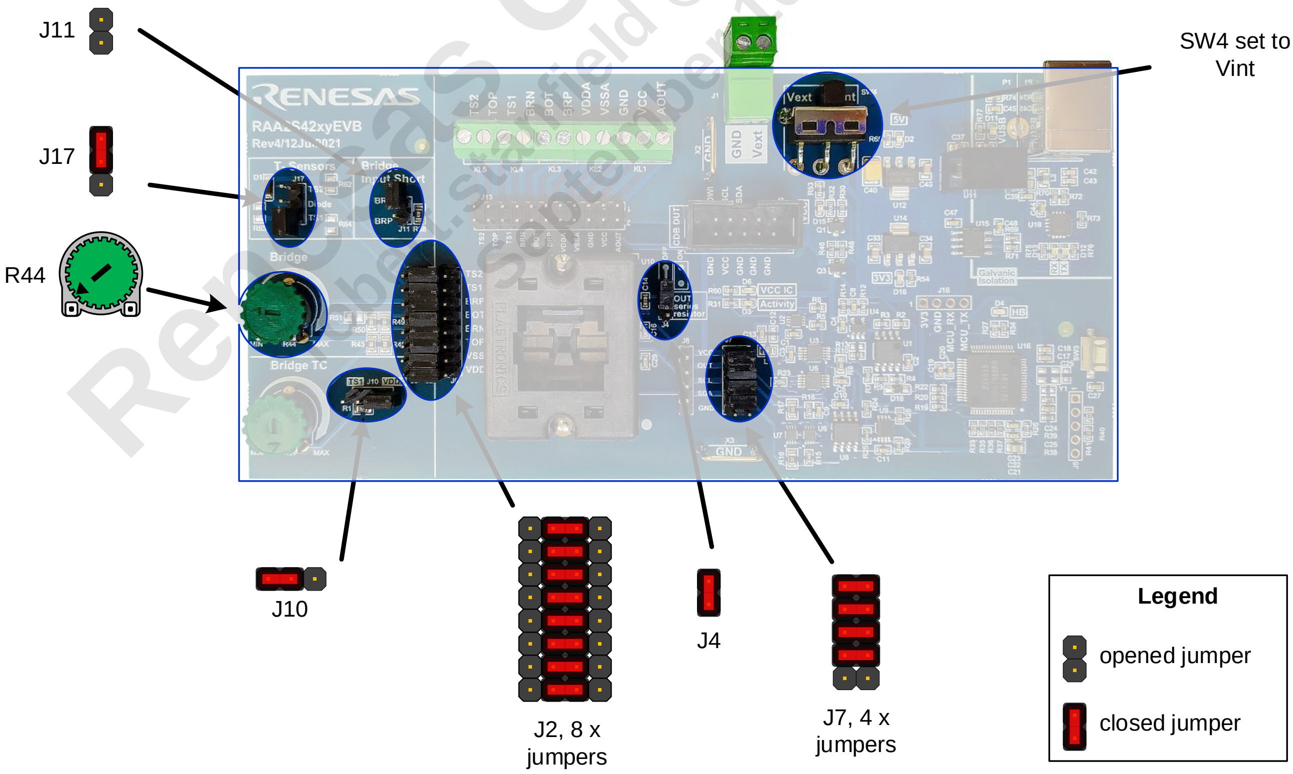


Figure 3. Block Diagram or Labeled Board Image

Table 1. Jumper Position

Jumper Designator	Function	Position
J2	Sensor Replacement Circuit Connect	Closed
J3	SSCCDB connector	Open
J4	OUT series resistor	Closed (OFF)
J7	DUT Communication and Power	Closed
J10	Bridge TC connection	TS1
J11	Bridge Input Short	Open
J13	External Sensor Connector	Open
J16	FTDI-MCU communication	Open
J17	Temperature Sensor Selector	TS2

3. Set the power supply source selector switch (SW4) to Vint position.
4. Rotate the potentiometer R44 in the Sensor Replacement Circuit to leftmost position (lowest value).
5. Connect the provided USB cable to the USB connector P1 and then to the computer USB port.
6. Check that the status of the LEDs is as shown on Figure 4.
   The Heartbeat (HB) LED (D4) should be blinking with approximate frequency 0.5Hz

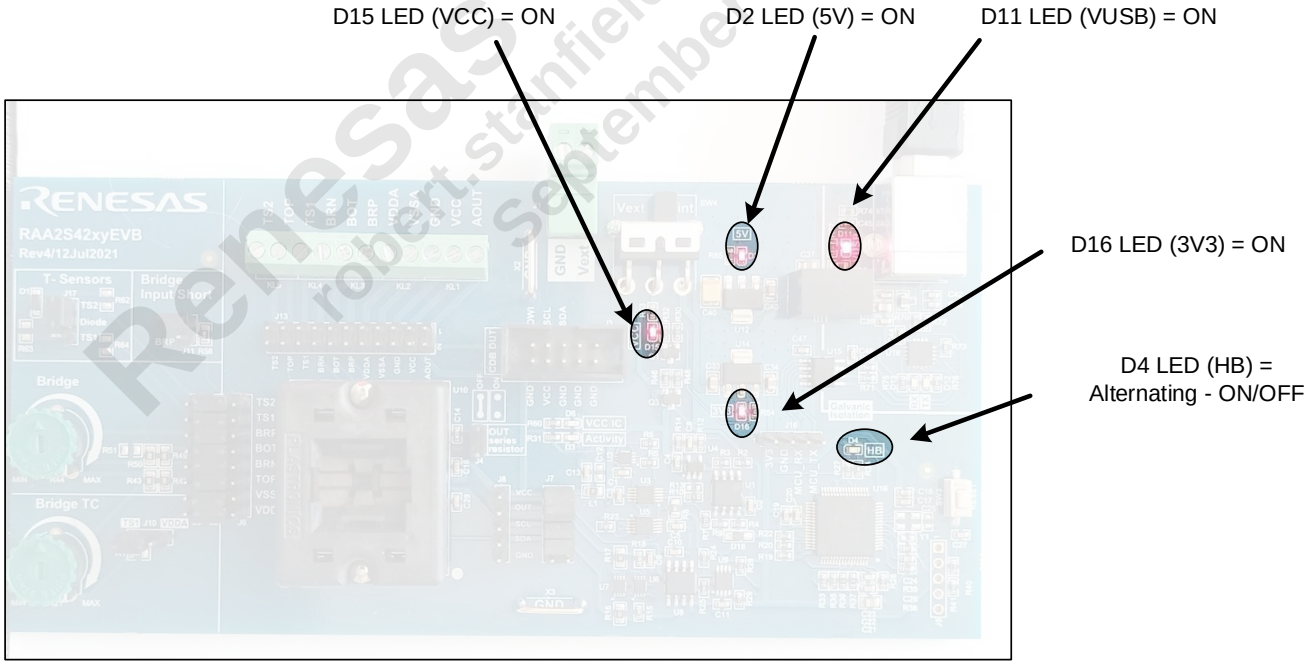


Figure 4. Evaluation Boards LEDs

3.2 Software Setup

To configure the software and the DUT follow these steps:

1. Start the RICBox Evaluation Software and load the RAA2S425x plug-in with the selected RAA2S4251B product, see section 3.2.1 for details.
2. Establish connection to the Evaluation board, see section 3.2.2 for details.
3. Configure the DUT, see section 3.2.3 for details.
4. Calibrate the RAA2S4251B, see section 3.2.4 for details.
5. Read data from the Sensor Replacement Circuit (SRC), see section 3.2.5 for details.
6. Save the DUT settings (optional), see section 3.2.6 for details.

3.2.1. Starting RICBox, Plug-In, and Selected Product

After the software is started, the RICBox start-up window is shown in which the user can select a new settings file or load an existing one (see Figure 5). Additionally, there are useful web links at the bottom section of the window.

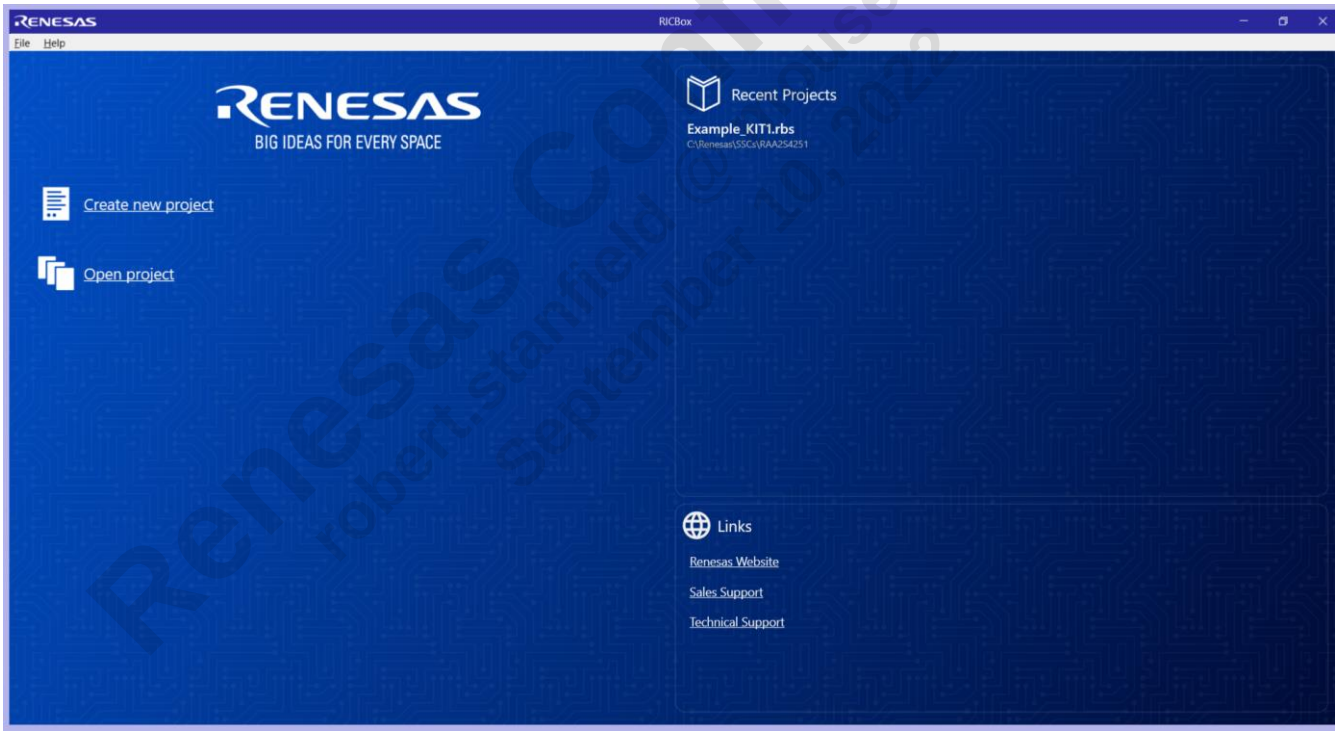


Figure 5. RICBox Start Window

To start a plug-in and select a product, follow these steps:

1. Select a settings file by either clicking on “New” or “Browse”.
   For the demonstration example, a new settings file is used.
2. Select the product family (RAA2S425x in this example) and the corresponding product (RAA2S4251B in this example), see Figure 6.

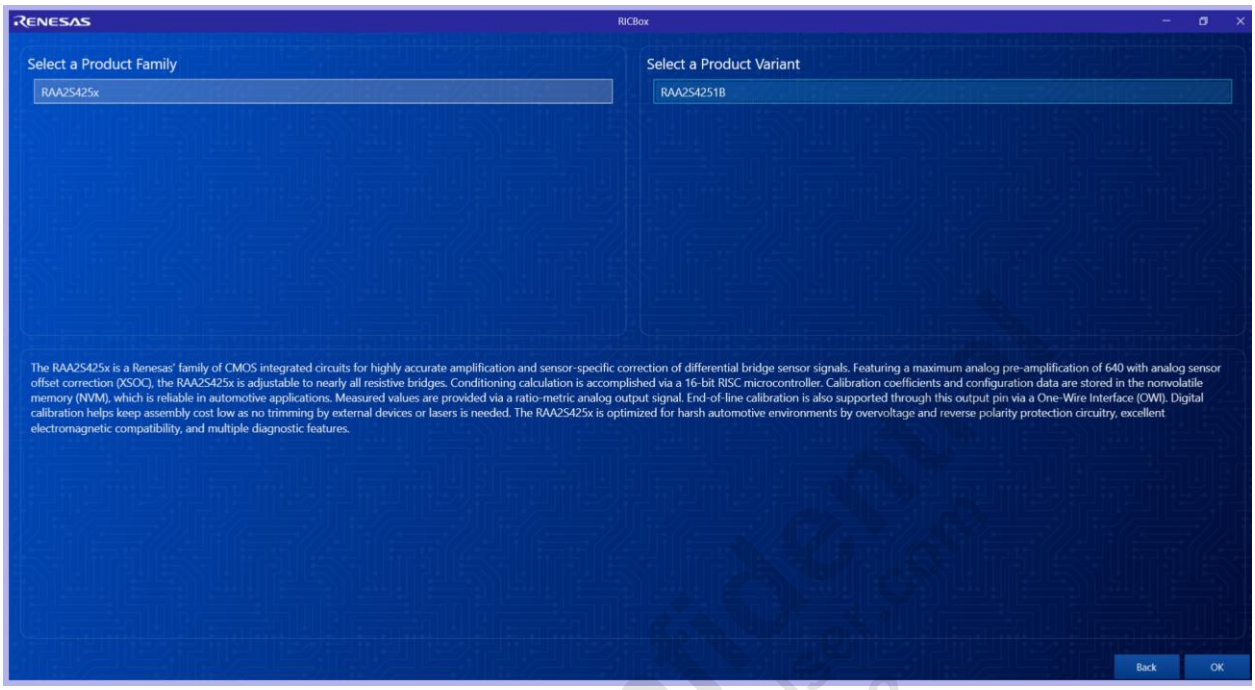


Figure 6. Family and Product Selection

Click “OK“ to initialize the RICBox environment and start the plug-in for the selected product/family.
For a faster start-up, the virtual environment is initialized only on the first run of the plug-in.
After the start of the plug-in, the Control Panel Tab is shown (see Figure 7).

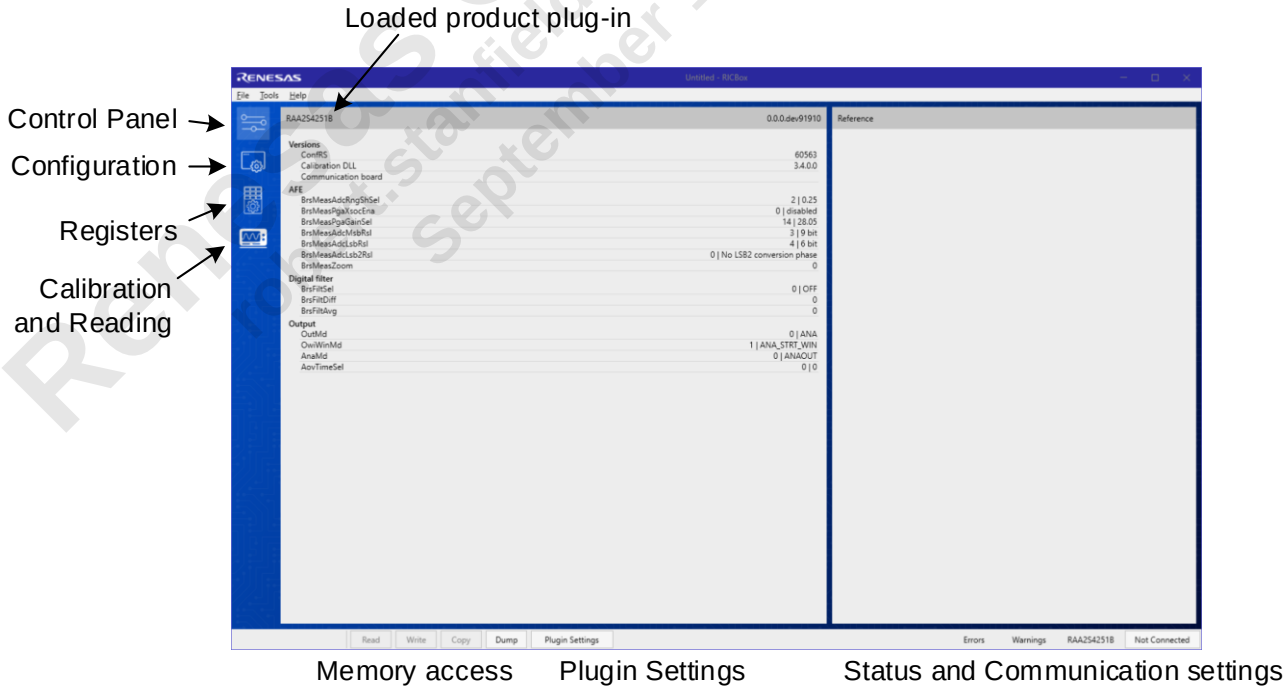


Figure 7. Control Panel Tab

3.2.2. Establishing Connection to the Evaluation Board.

To connect with the Evaluation Board follow these steps:

1. Click the “Not Connected” button.
2. Click the “Connect to device” button (see Figure 8).

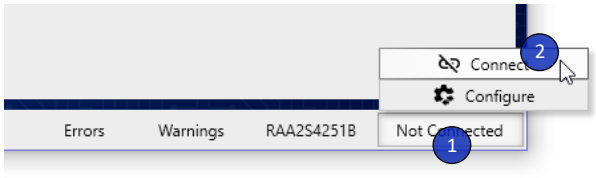


Figure 8. Connection to the Evaluation Board

Upon successful connection the “Not Connected” button now shows “Connected” and the Connection status symbol ( ) appears in the status bar (see Figure 9).

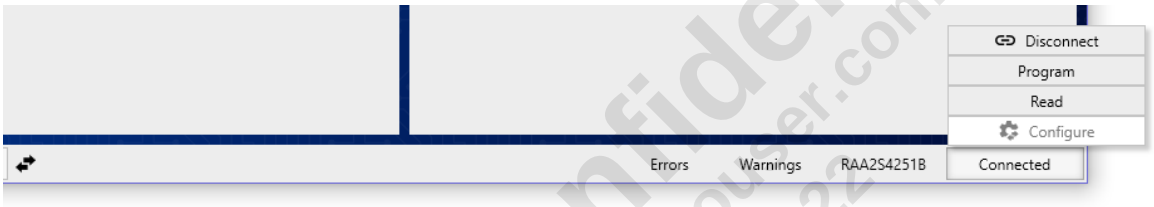


Figure 9. Successful Connection to the Evaluation Board

The GUI automatically reads and compares the memory of the DUT with the memory values in the GUI. If there is a difference the pop-up window on appears asking for confirmation to replace the GUI values with the DUT values. For the demonstration in this document, click No to use the default values of the GUI.

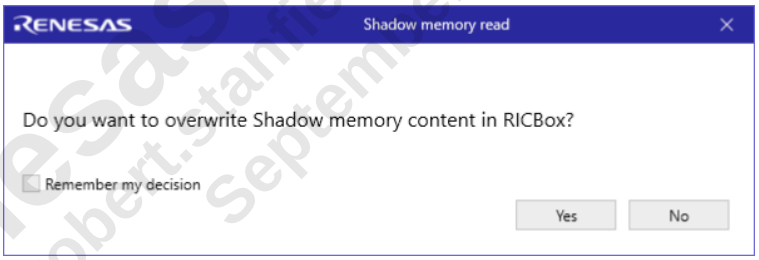


Figure 10. Pop-up Window when There is a Difference in the Values Between GUI and DUT

3.2.3. Configuring the DUT

The new RAA2S4251 parts have default configuration written to the NVM. For this demo minimal changes are required to allow demonstration of raw measurement, conditioning of data, and then reading back the analog output.

The changes must be written to the Shadow or NVM memory of the IC. The Shadow is the preferred option, but its content is lost when the device is powered down, or when the device is started in Normal mode. If memory retention is required, then first write the data to the Shadow (by the “Write” button) and then copy the configuration to the NVM (by the “Copy” button).

Follow these steps to configure the DUT for proper operation with the evaluation board (Figure 11):

1. Open the Calibration and Reading Page
2. Go to Analog Front End
3. Set the BrsMeasAdcRngShSel to 0.5
4. Open the Write Menu
5. Select Shadow Memory

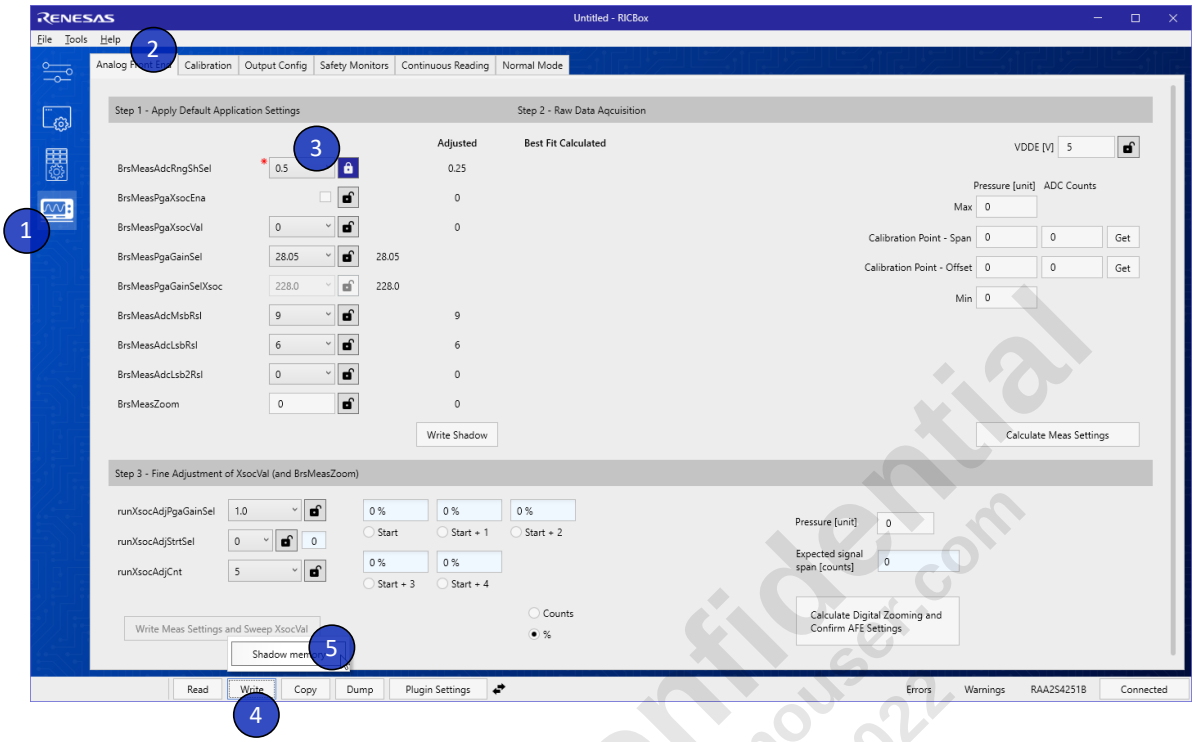


Figure 11. AFE settings

To restore the default configuration of the RAA2S4251, create a new (default) project and write the GUI values to the Shadow/NVM.

3.2.4. Calibrating the RAA2S4251B

To perform two-point calibration without temperature compensation (default settings of RAA2S4251B), follow these steps below. The calibration targets are shown in Table 2.

Table 2. Calibration Targets

Sensor signal	Output, %	Output, V
Min	10	0.50
Max	90	4.50

1. Click on “Calibration and Reading” page and then on “Calibration” to open required tab as shown on Figure 12.

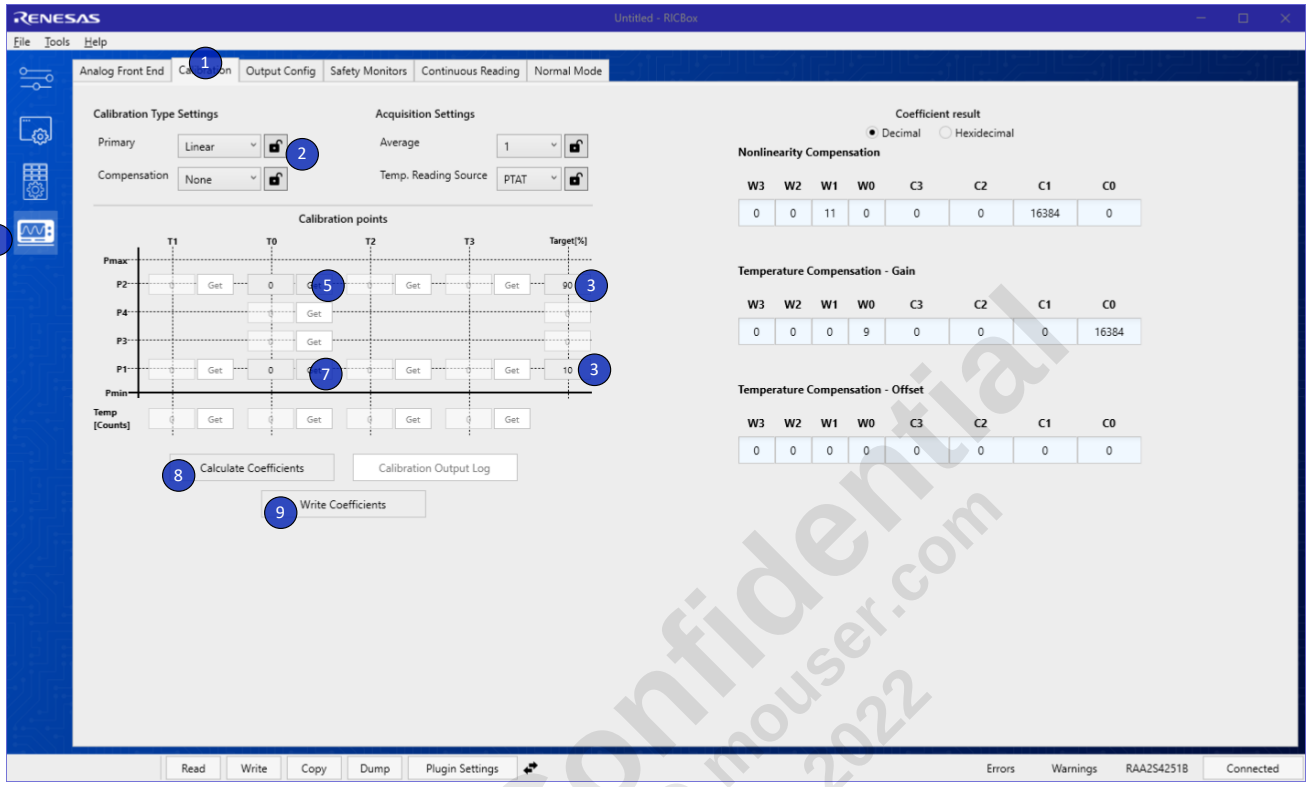


Figure 12. Calibration Tab

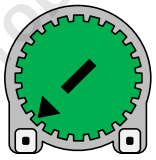
2. Set the Calibration Type settings:

- Primary – Linear
- Compensation – None

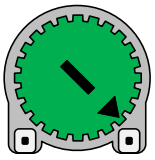
3. Set the Targets

- Target for P1 = 10%
- Target for P2 = 90%

4. Rotate the Bridge potentiometer R44 to LOW value (see Figure 13).



Potentiometer set to MIN value



Potentiometer set to MAX value

Figure 13. Sensor Replacement Circuit Potentiometers Positions

5. Click the corresponding “Get” button to acquire the raw data for P1/T0 point.
6. Rotate the Bridge potentiometer R44 to HIGH value (see Figure 13).
7. Click the corresponding “Get” button to acquire the raw data for P2/T0 point.
8. Click the “Calculate the coefficients” button.
9. Click the “Write Coefficients” to enter data to the Shadow memory of RAA2S4251.

3.2.5. Reading Data from the Sensor Replacement Circuit

3.2.5.1. Reading Data in Command Mode

After all required settings of the DUT are copied to the Shadow memory (see section 3.2.4 for details), check if the DUT operates as expected. Follow these steps to start reading measured data from the DUT:

1. Open the Calibration and Reading page.
2. Open Continuous Reading tab.
3. Click the “Start Reading Output” button.
4. Select what data to be displayed (optional).
   The display of data shown on Figure 14 depends on the selected register and the effect of the potentiometer’s rotation, the default is CondRsltBrsOut.
   In the example on Figure 14, the cursor is located on sample 755 where the bridge potentiometer is rotated to the HIGH position and the digital output value of 29488 corresponds to 89.99% of the output (29488/32768). This matches the P2/T0 calibration target of 90% specified during the calibration. The last measured value, when the potentiometer is rotated to LOW, is shown next to the selected registers and in this case is 3272 which corresponds to 10.00%.

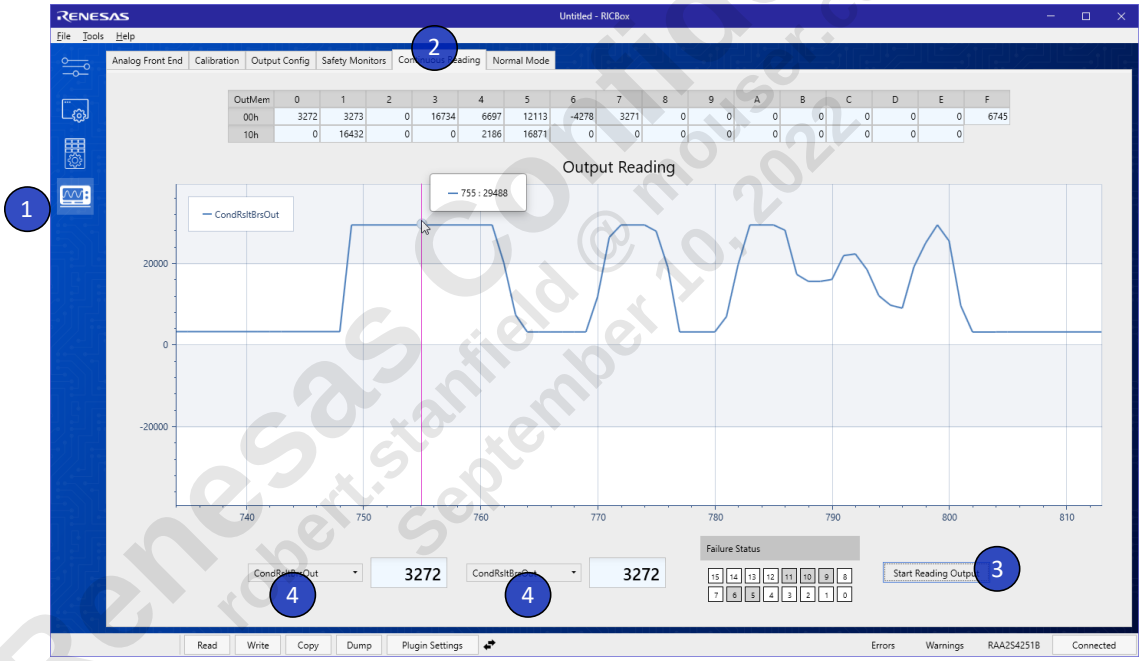


Figure 14. Continuous Reading in Command Mode

3.2.5.2. Reading Data in Normal Mode

In Normal Mode the DUT loads the settings from the NVM.
Follow these steps to start reading measured data from the DUT:

1. Copy the Shadow memory to the NVM using the “Copy” and “OK” buttons for confirmation (see Figure 15 and Figure 16).

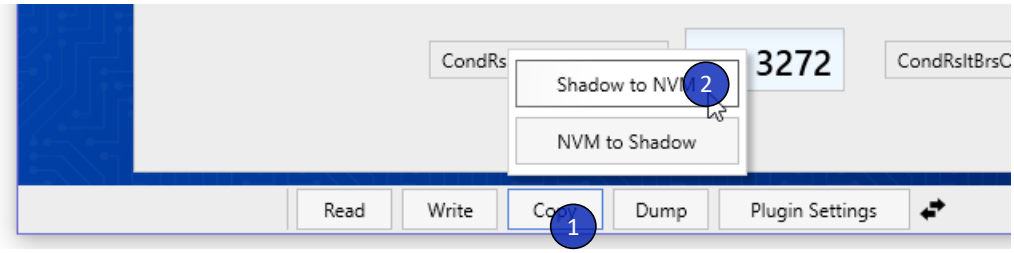


Figure 15. Copy Shadow to NVM

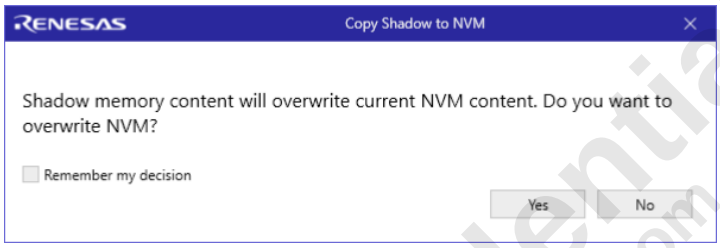


Figure 16. NVM Overwriting Confirmation

2. Open the Normal Mode Tab and click the “Start Reading” button.
   The microcontroller on the Evaluation board is re-configured to start analog to digital conversion on the SSC’s output signal.
   Example graph after rotating the R44 Bridge potentiometer is shown on Figure 17.

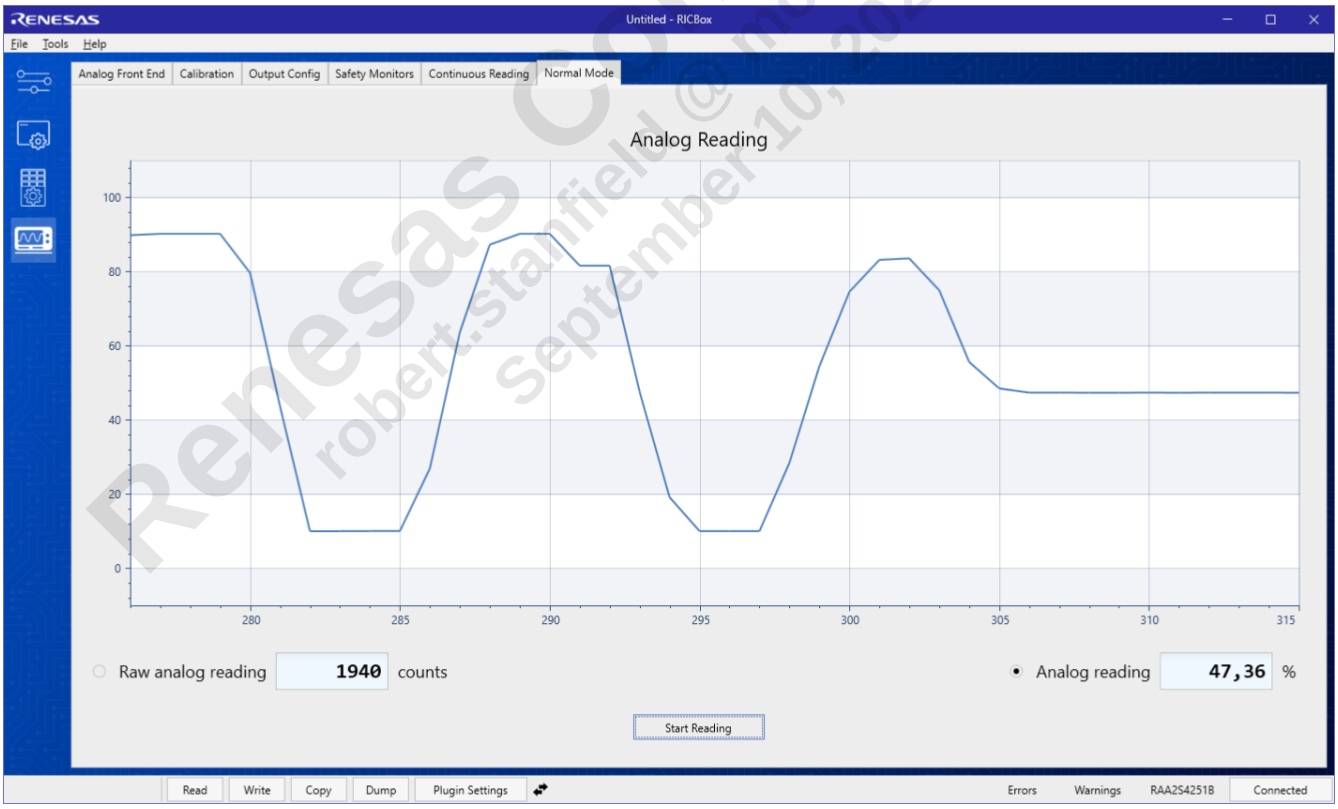


Figure 17. Reading Data in Normal Mode

3.2.6. Saving the DUT Settings

A snapshot of current memory and GUI settings can be saved as an .rbs file by clicking „Save“ or „Save As“ buttons in the File menu. The saved files can be loaded from RICBox main window (see section 3.2.1 for details) can be used as the “Dump” Shadow memory to save only the IC memory settings.

4. Troubleshooting

4.1 Connection Issues

If the Evaluation board and the SSC cannot be connected, check for the following items:

- Heartbeat LED D4 is blinking with frequency of approximately 0.5Hz.
- All Jumpers, LEDs and the switch are properly set, see section 3.1 for details.
- The IC is properly placed inside the socket.
- If there is bad contact between the IC and the socket, see section 4.3 for details.

4.2 Calibration Failed

If the GUI cannot calculate the calibration coefficients, the Calibration Result pop-up window appears (see Figure 18).

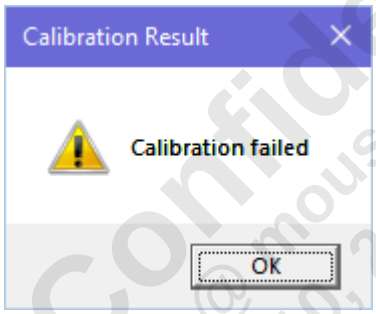


Figure 18. Calibration Failed Pop-up Window

The most probable reason for calibration failing is using wrong input data, very often the same raw values are used for several calibration points. In case of calibration fail, verify the correctness of the input data and/or reacquire it. Check the calibration log file for additional details.

4.3 Bad Contact between the Socket and the IC

If the GUI shows unstable output signal (see Figure 19), there is most probably a bad contact between the QFN socket and the IC, especially when the IC is used for a long time. The oxidation on the QFN pads and on the socket pins are the most probable problem which can be mitigated by either cleaning the contacts of the socket, using a different IC, or removing and installing the IC again.

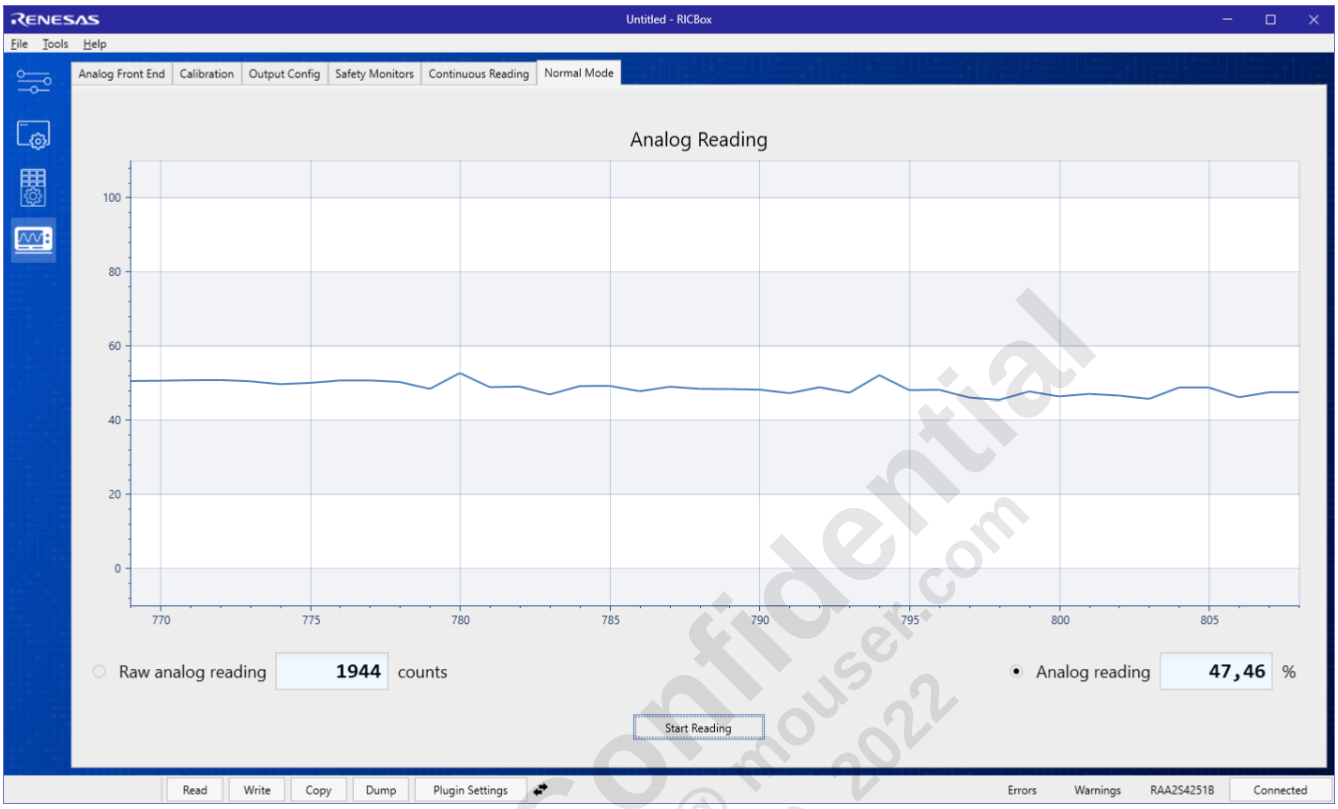


Figure 19. Unstable Reading Due to Bad Contact

5. Schematics

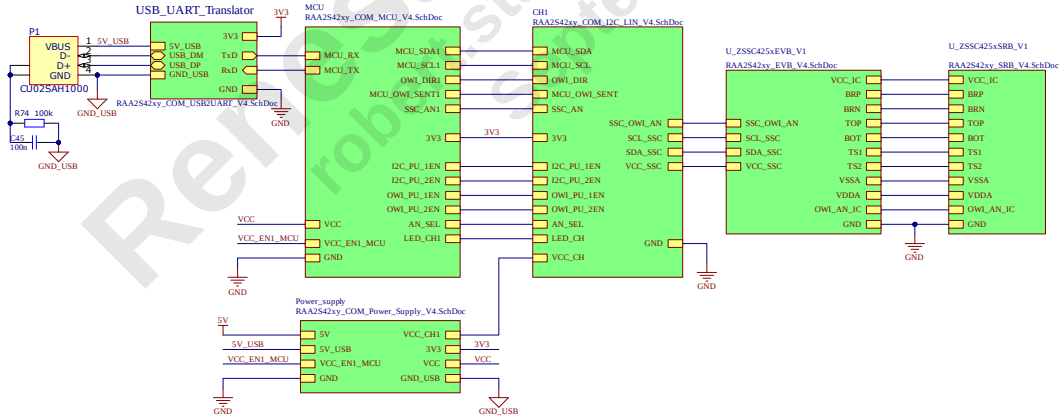


Figure 20. Main diagram

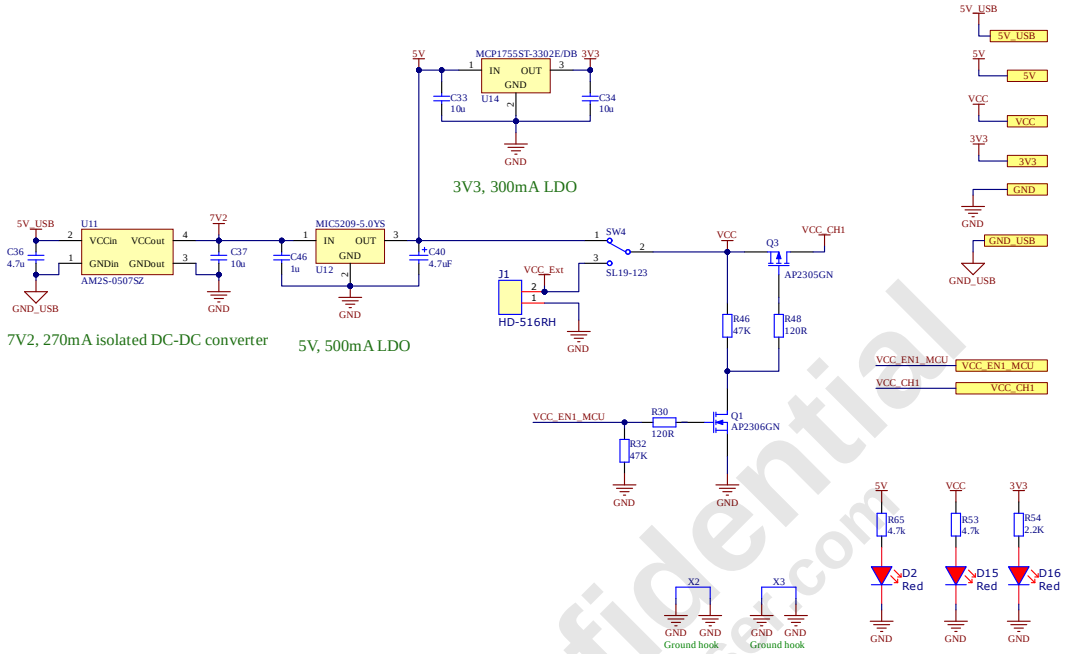


Figure 21. Power supply

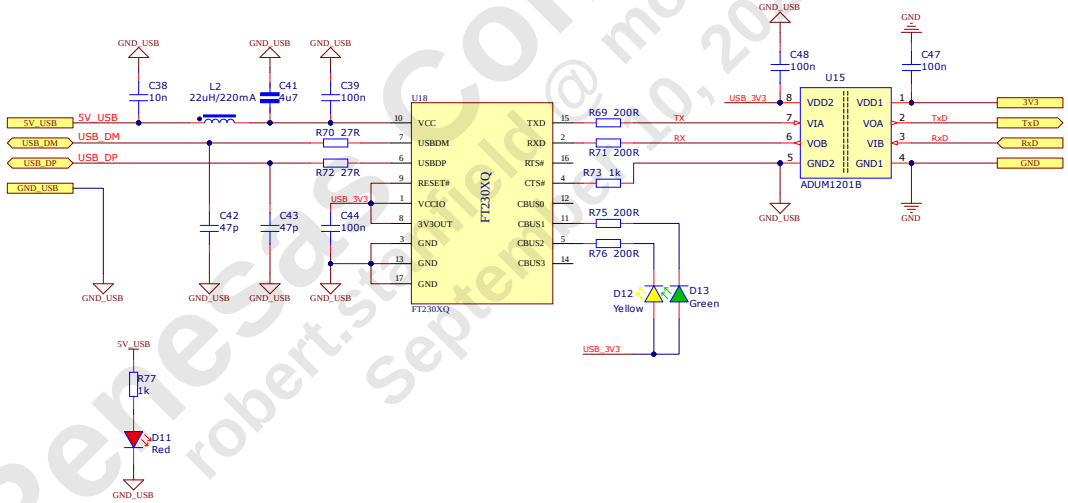


Figure 22. USB communication

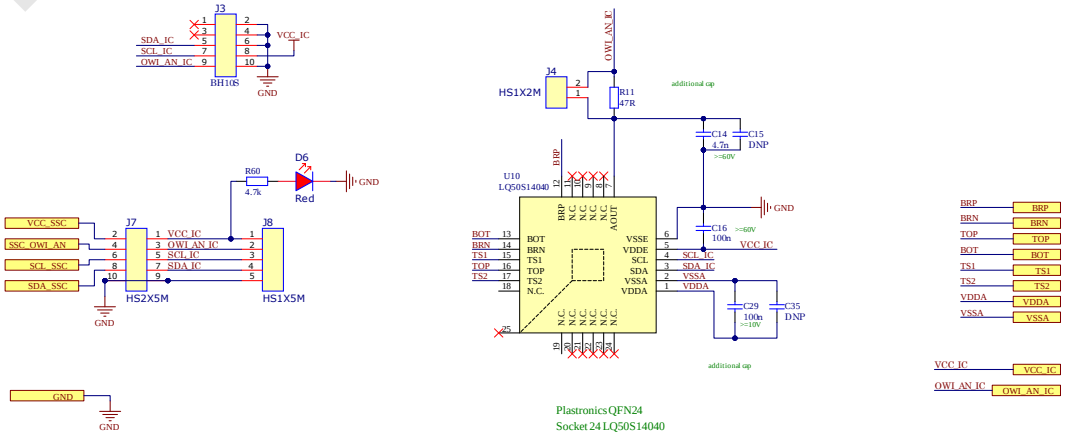


Figure 23. Device Under Test

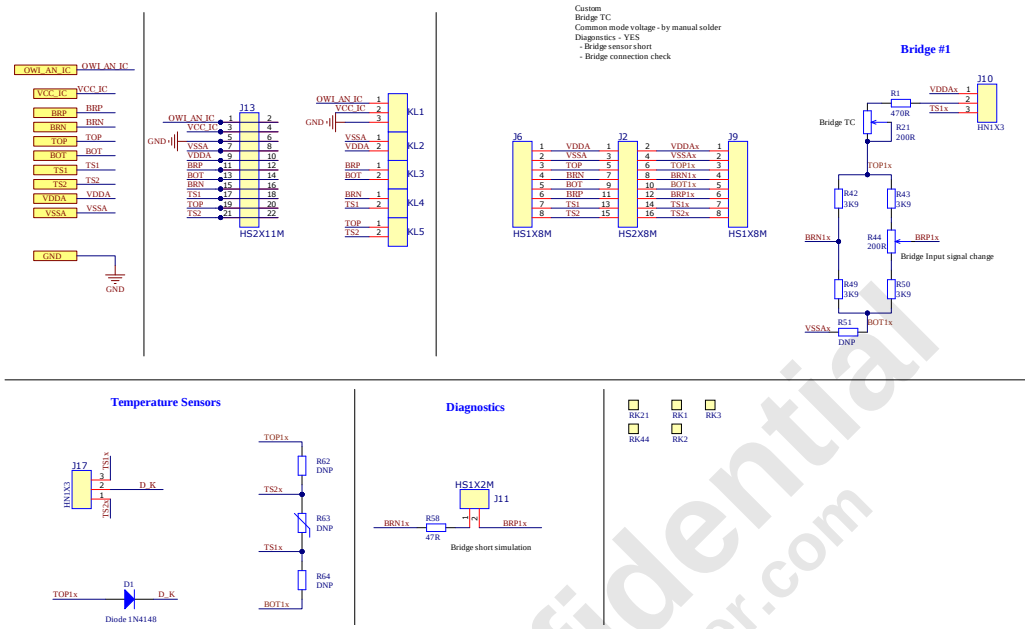


Figure 24. Sensor Replacement Circuit

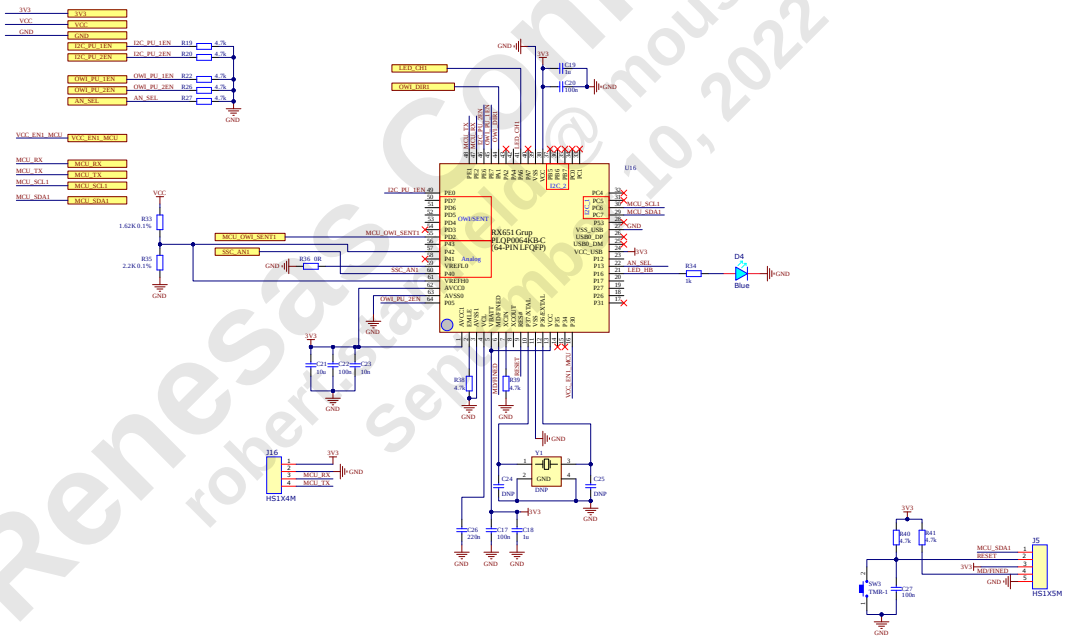


Figure 25. Microcontroller

6. PCB

The RAA2S42mx kit has a two-layer PCB with dimensions of 162mm x 76mm.

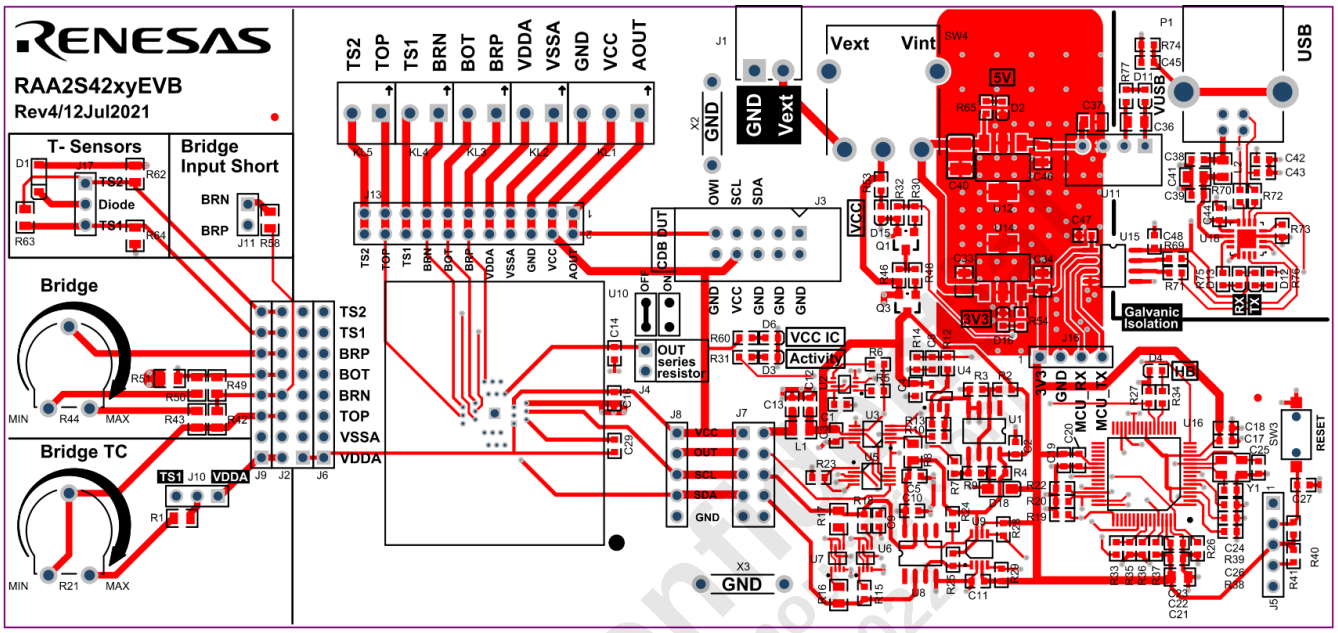


Figure 26. Top Layer

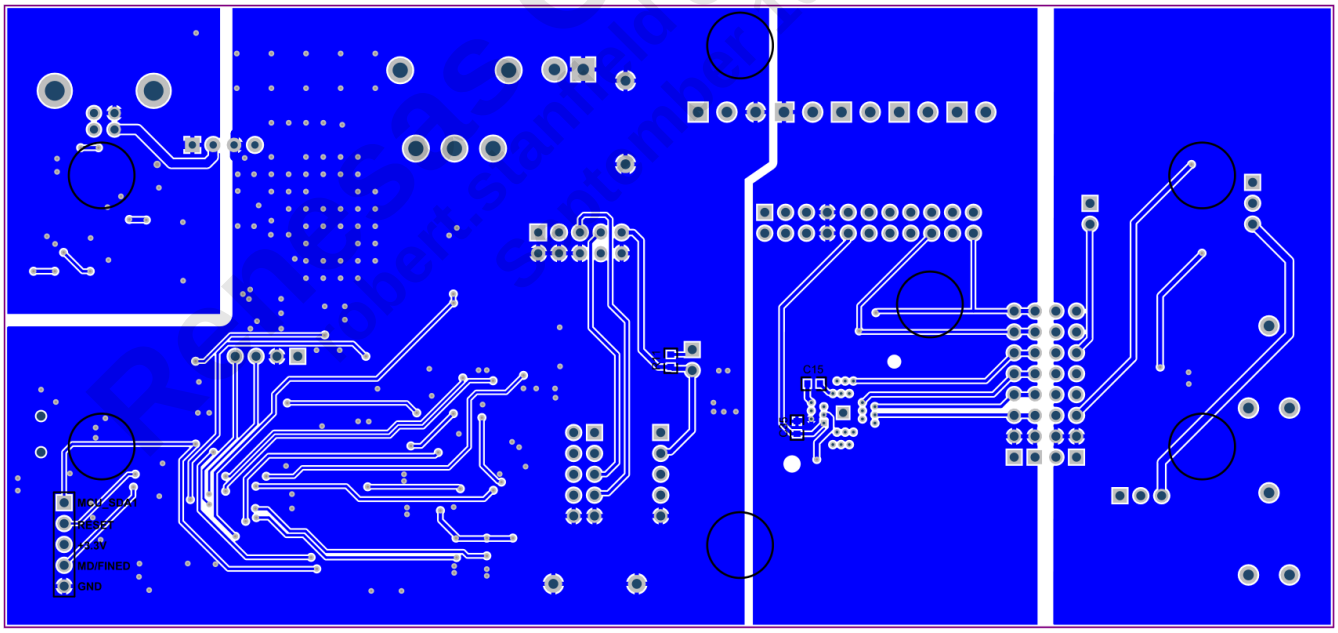


Figure 27. Bottom Layer

7. Glossary

Term	Description
ADC	Analog-to-Digital Converter
BRS	Bridge Sensor
DUT	Device Under Test
GUI	Graphical User Interface – refers to the software application used for communication with the kit
I2C	Inter-Integrated Circuit; serial two-wire data bus; trademark of NXP
IC	Integrated Circuit
LED	Light Emitting Diode
MCU	Microcontroller Unit
NVM	Non-Volatile Memory
PC	Personal Computer
(P)QFN	(Power) Quad Flat No-lead (device package)
SRC	Sensor Replacement Circuit
SSC	Sensor Signal Conditioner
TC	Temperature Coefficient
USB	Universal Serial Bus
ZIF	Zero Input Force (socket)

8. Revision History

Revision	Date	Description
1.0	Mar 11, 2022	Initial release.