iRADAnalyzer

GUI Software

The radiation hardened precision SAR ADC evaluation platform consists of custom designed hardware (RHADC-FMCEV1Z) and software (iRADAnalyzer). The function of the hardware is to excite and/or measure the appropriate analog and digital inputs and outputs of the Renesas portfolio of low-power, high-performance radiation hardened Successive Approximate Register (SAR) Analog-to-Digital Converters (ADC). The iRADAnalyzer software is required to configure the device for initial operation, to modify the device functionality or parameters where applicable, and to process and display the output data (see Figure 1)

Key Features

- Complete radiation hardened precision SAR ADC measurement solution
- Calculation of critical ADC parameters (SNR, SFDR, SINAD, ENOB, Harmonics)
- Multiple display modes: frequency (FFT), time domain
- Works with the RHADC-FMCEV1Z evaluation board to support datasheet-style, live-updated display with calculation of critical ADC parameters (SNR, SFDR, SINAD, ENOB, Harmonics, Power)

Specifications

- Data rates between 1ksps and 1000ksps
- 32k - 1M word capture depth
- USB 2.0 interface for rapid data transfer

Related Literature

For a full list of related documents, visit our website:

- RH ADCs page

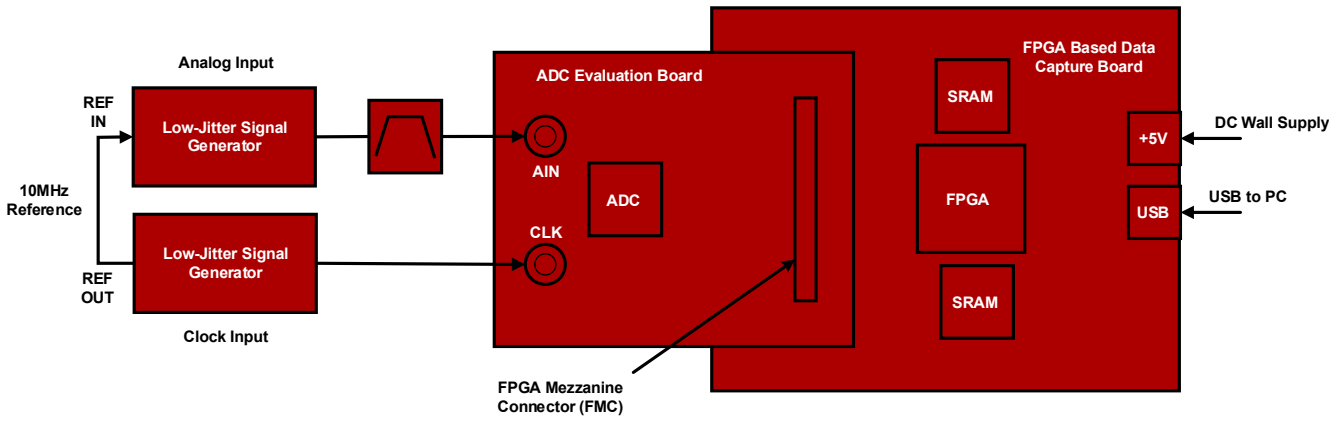

Figure 1. Evaluation Platform Block Diagram

1. Functional Description

The RHADC-FMCEV1Z motherboard is intended to operate with the iRADAnalyzer software along with a radiation hardened precision SAR ADC evaluation board (daughterboard). The motherboard collects digitized data from the daughter board ADC and relays that data to a PC running iRADAnalyzer so the data can be analyzed for performance.

1.1 Hardware

There are two components in the hardware portion of the evaluation platform: the RHADC-FMCEV1Z motherboard and the ADC daughter card (Figure 1). The ADC is contained on the daughter card that contains the analog input and clock circuitry. The daughter card interfaces with the motherboard through a High Pin Count (HPC) FPGA Mezzanine Connector (FMC). The daughter card was designed to be compatible with the Vita 57.1 standard. The motherboard contains a USB interface, an FPGA, and four banks of SDRAM. The motherboard serves as the interface between the host PC and the ADC daughter card. The daughter cards have jumpers that set the operating voltages. The FPGA accepts output data from the ADC and buffers it in the SDRAMs before passing it to the PC at a lower speed for post-processing. The maximum buffer depth is 32 Megawords (225), however, the evaluation software is capable of processing data records only up to 1 Megaword (220) deep. If usage of the full 32 Megaword depth is required.

You must supply the low-jitter analog signal generators for the clock and analog inputs to operate the daughter card. Recommendations of suitable generators can be found in Appendix: Analog Signal Generators. Many low-jitter analog signal generators exhibit high harmonic spectral content relative to the ADC performance. A band-pass filter is recommended to attenuate the harmonics.

1.2 Daughter Card

The daughter card is designed to produce optimal ADC performance and simplify the evaluation process. Some boards have multiple connections for the analog input and clock.

1.2.1 Daughter Card Compatibility with FMC Host Cards

The daughter card connects to the motherboard through a High Pin Count (HPC) FPGA Mezzanine Connector (FMC). The daughter card was designed to be compatible with the Vita 57.1 standard. This is intended to facilitate the use of the daughter card with commercially available FMC host cards. These generators provide low jitter to optimize the SNR performance of the ADC under test. Other generators with similar phase noise performance can also be used. Contact Renesas Technical Support for recommendations. Signals described as being sourced by the Host must be provided by the FMC host card to the daughter card. These signals are necessary for the daughter card to be fully functional. Signals described as being sourced by the daughter card are provided by the daughter card to the host card. These signals can be optionally ignored by the host card if the functionality they provide is deemed unnecessary.

1.3 Motherboard

The only connections required for the motherboard are a +5V power supply and a USB connection to the PC running iRADAnalyzer. No additional configuration of the motherboard is required.

1.4 Software

The software component is iRADAnalyzer, a Graphical User Interface (GUI) created with Java. The GUI reads data from the motherboard, optionally post-processes the data (FFT analysis), and displays the results. Data can be viewed in the time or frequency domain and can be saved for processing later. Critical performance parameters such as SNR, SFDR, and harmonic distortion are calculated and displayed on-screen when viewing in the frequency domain.

1.5 Installation Requirements

To operate the RHADC-FMCEV1Z motherboard, the iRADAnalyzer software must be installed. Before installing the iRADAnalyzer, confirm the following:

- PC operating system is Windows 7 or greater.
- The account that the software is installed from has administrator privileges.
- Java is required for operation of the iRADAnalyzer software.
  - If the Java runtime environment is not installed on the PC, Java is installed during the installation of the iRADAnalyzer software.
  - Windows has associated files with the *.jar extension with the java runtime environment. This is done by default during the java runtime environment install. File extension associations can be modified by opening an explorer window, clicking on the **Tools** drop-down menu, selecting **Folder Options**, and interacting with the pop-up window.

2. Installing the iRADAnalyzer Software

1. Double click the installer executable (that is, iRADAnalyzer_VX.XX.X.exe). This launches the installer, resulting in the following window for language selection. Click **Next >**.

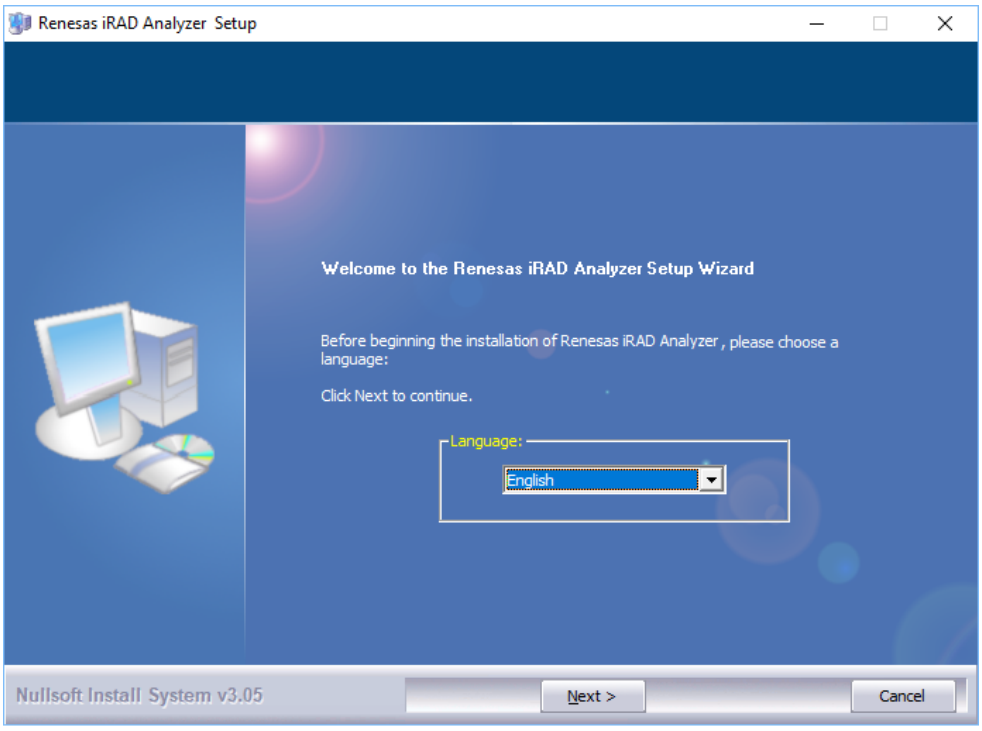

Figure 2. Language Selection Window

2. The install introduction page opens up showing the current version of the software, click **Next >** to continue.

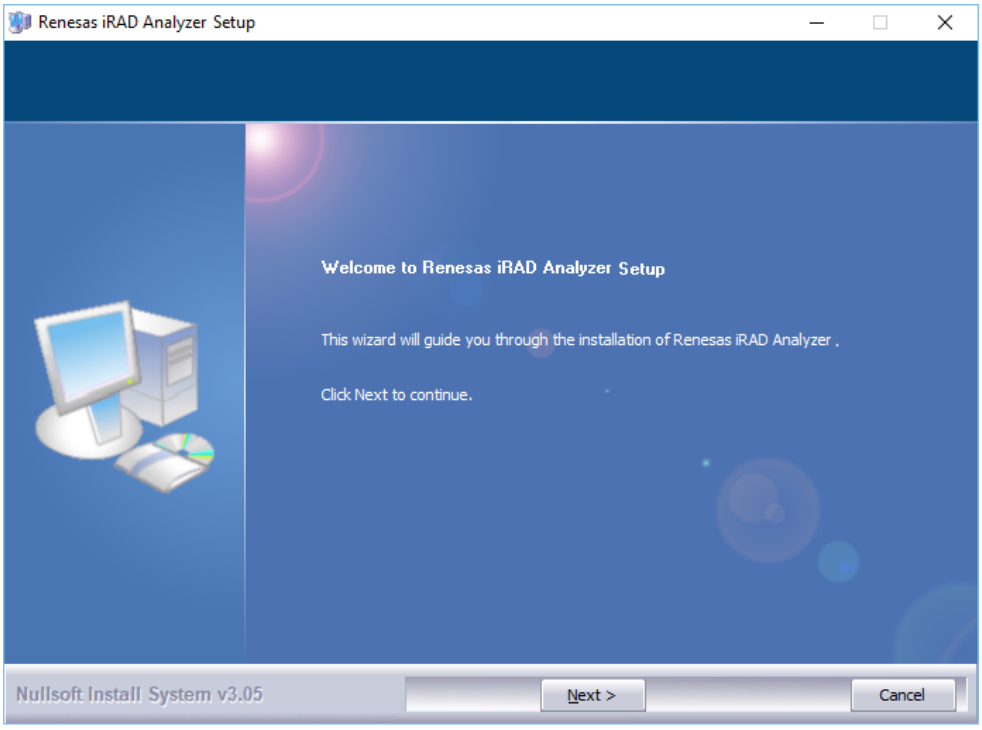

Figure 3. Install Introduction Window

3. In the License Agreement window, confirm the Software Evaluation License Agreement by clicking the **I Agree** radio button, then click **Next >**.

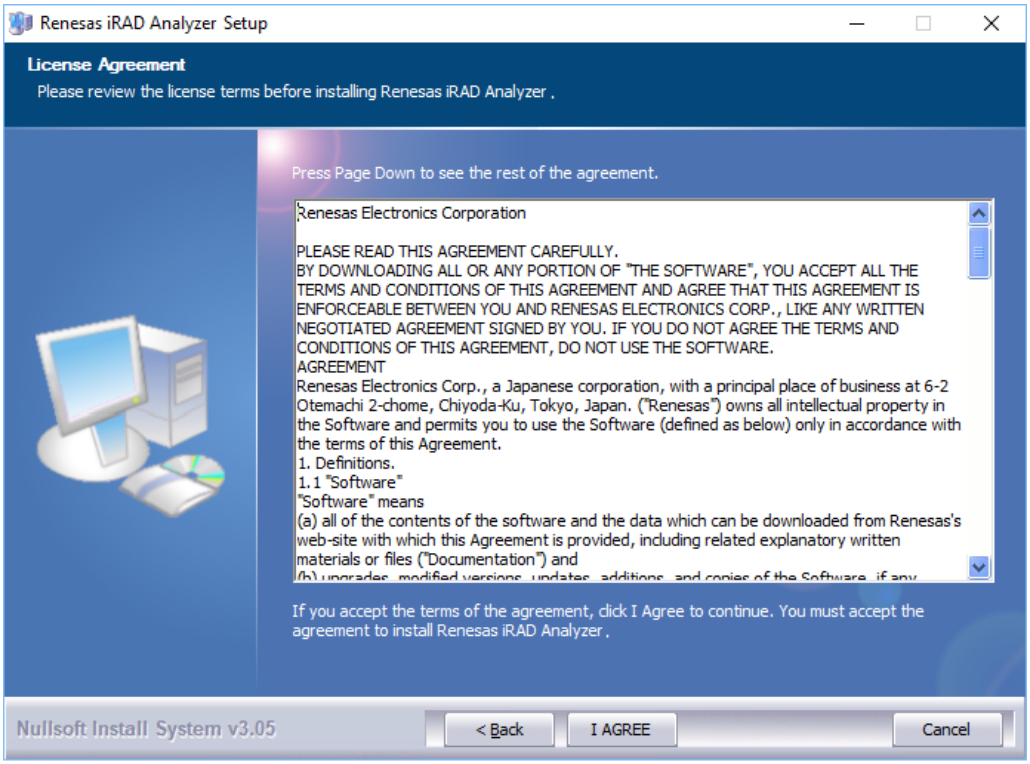

Figure 4. License Agreement Window

4. The Choose Install Location window opens. Click **Next >**.

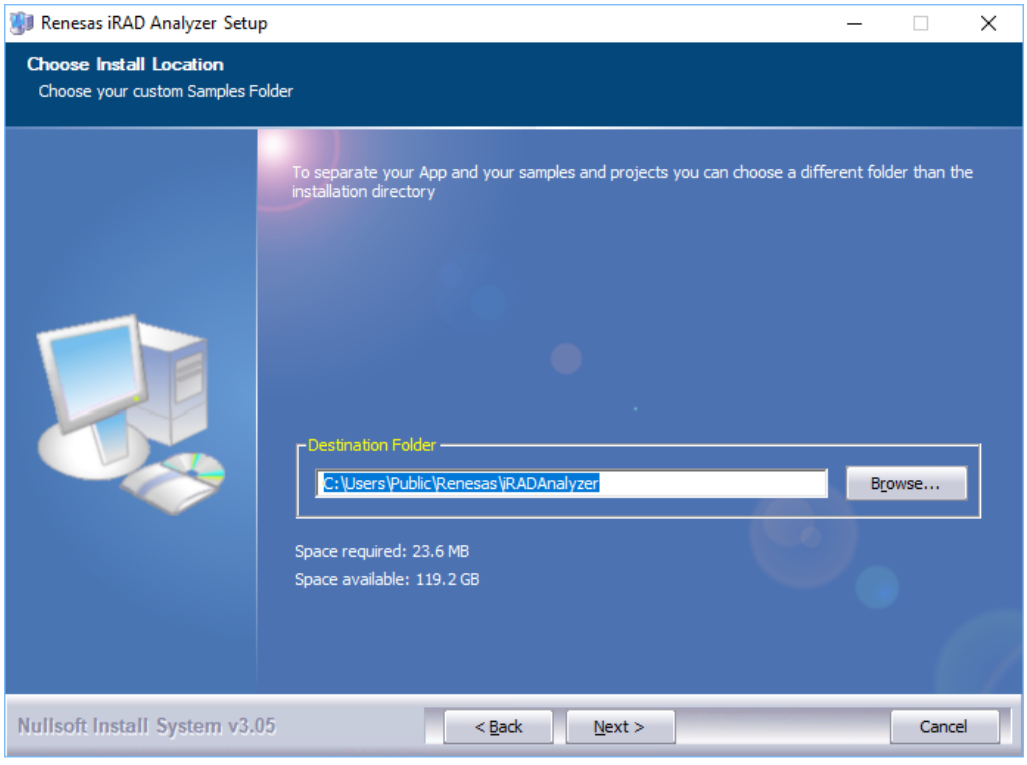

Figure 5. Choose Install Location Window

5. The Choose Start Menu Folder window opens. If installing with administrative privileges, the **For all users** or **Only for the current user** options can be selected to indicate which users the shortcuts are created for. Click **Next >**.

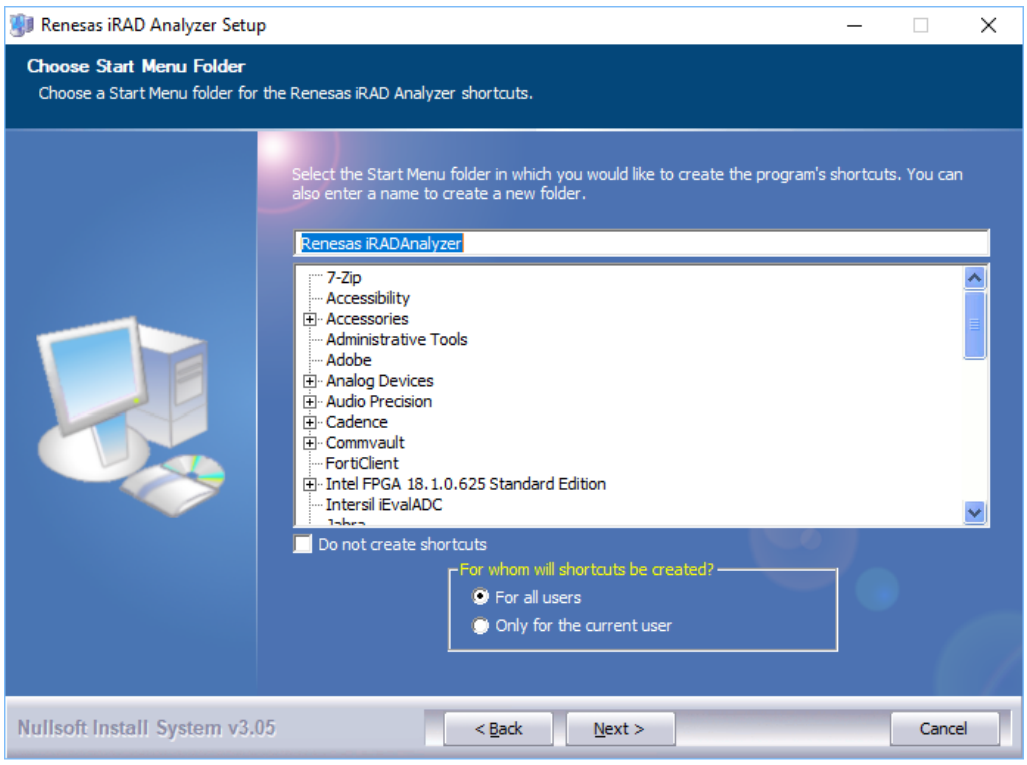

Figure 6. Choose Start Menu Folder Window

6. The Additional Tasks window opens. Select the desired options for creating a desktop icon and for installing the driver for the RHADC-FMCEV1Z. **Note:** If the USB driver has previously been installed, the **Install Driver** check box can be left unchecked. Click **Next >**.

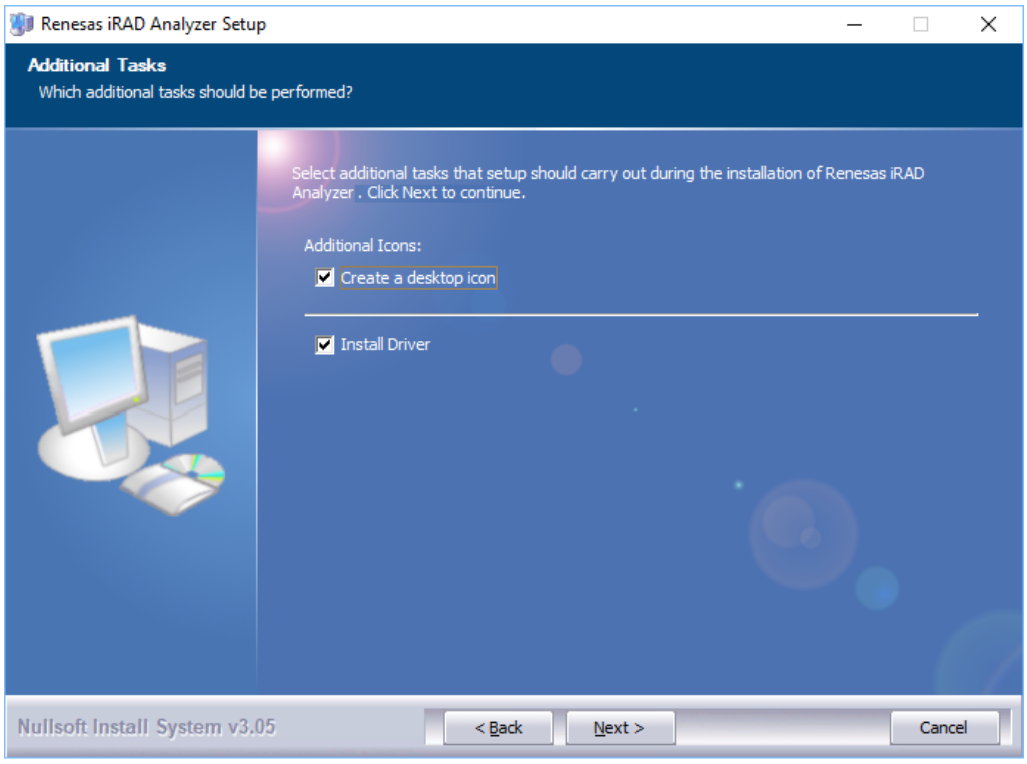

Figure 7. Additional Tasks Window

7. The Complete Installation window opens. Click **Install**.

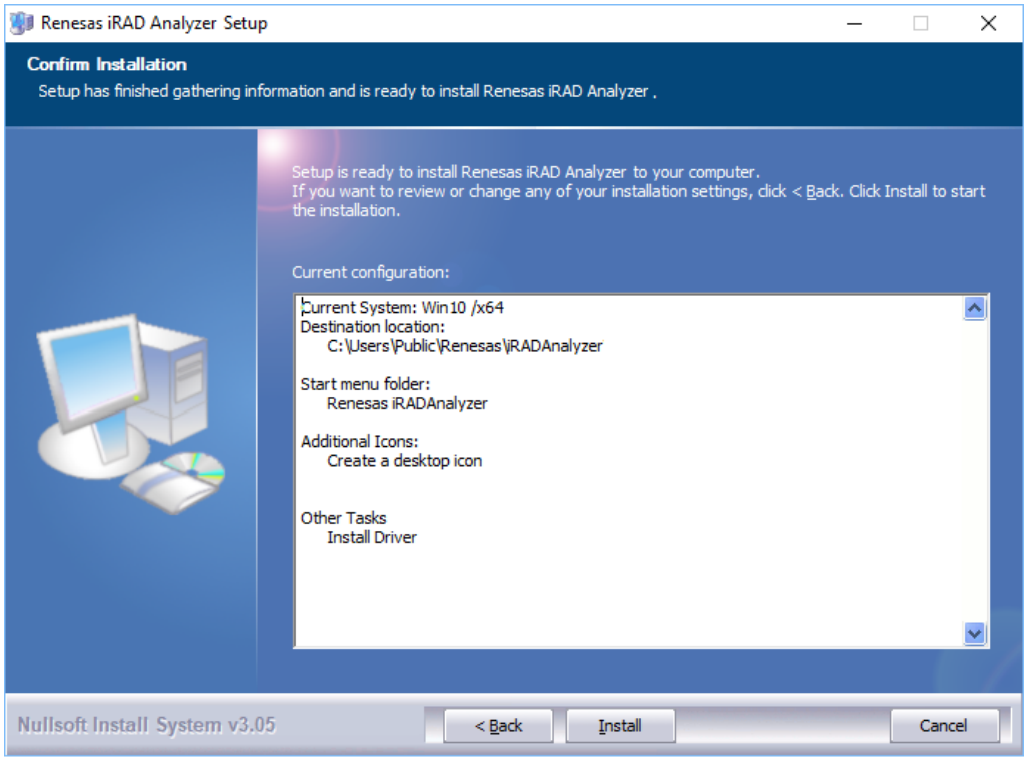

Figure 8. Complete Installation Window

8. If the driver has not previously been installed, follow the prompts to install the driver. Select the check box to **always trust drivers from Renesas Electronics America Inc**. and click **Install**.

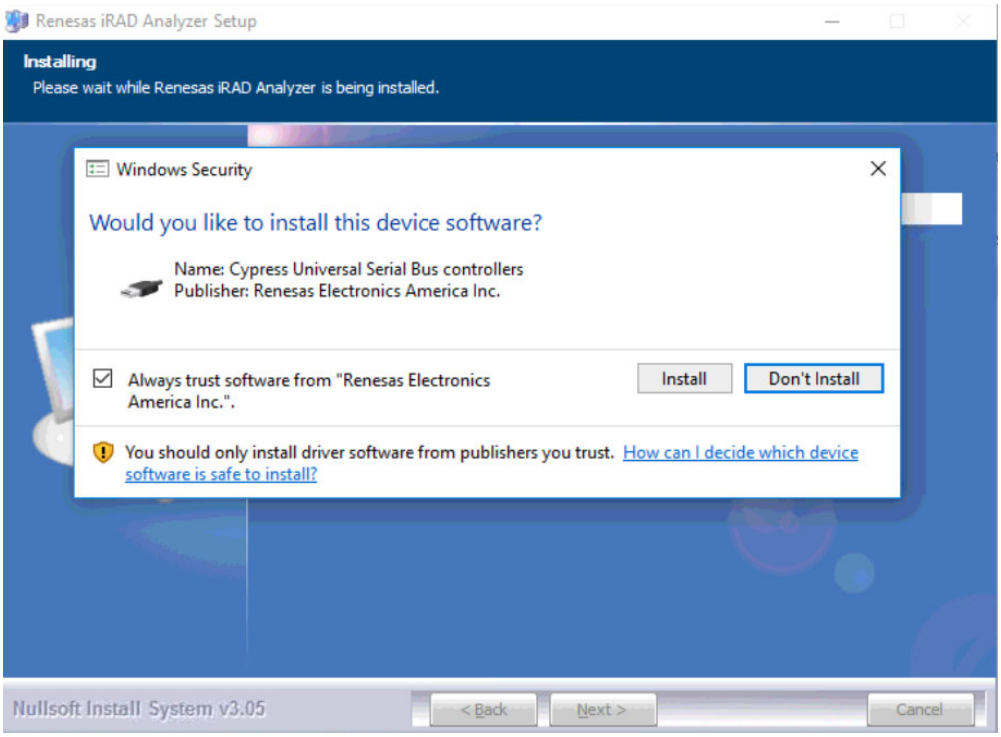

Figure 9. Install the USB Driver

9. The Completing Renesas iRADAnalyzer Setup window opens. Click **Finish**.

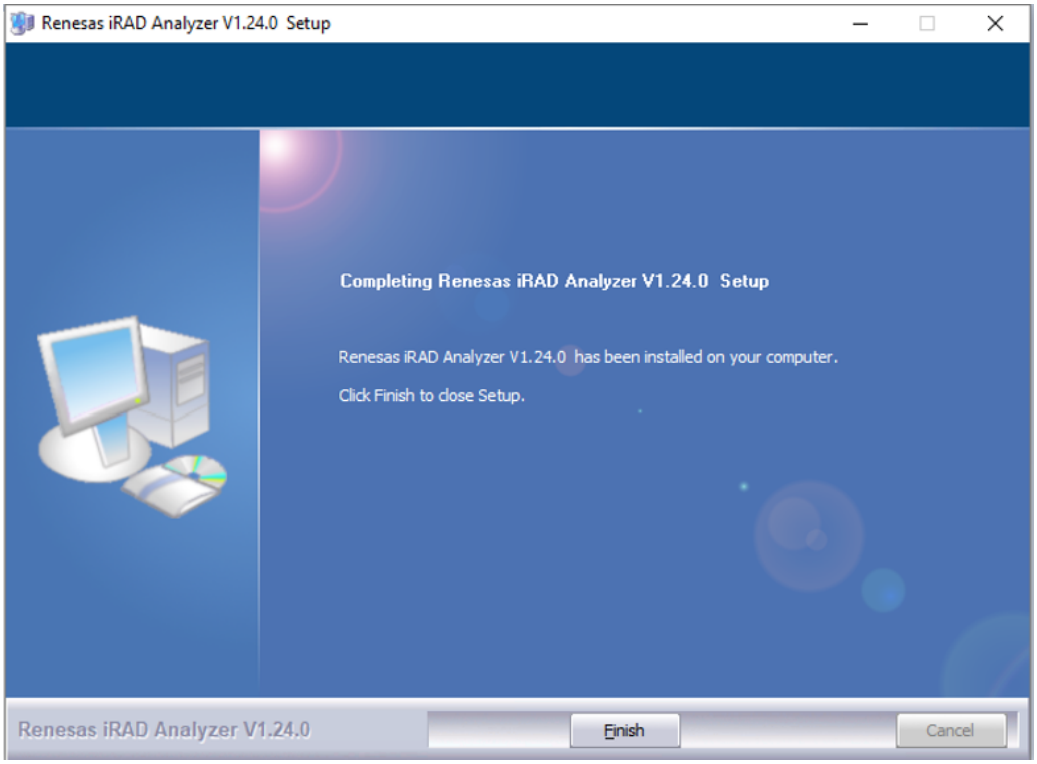

Figure 10. Complete the iRADAnalyzer Installation

3. Evaluation Kit Setup

1. Referencing to Figure 1, connect the daughter card to the motherboard by aligning the two mating FMC connectors. Four screws on the motherboard (not shown) align with mounting holes in the daughter card.
2. Connect the analog signal generators to the Clock and Analog input SMA connectors.
3. Set the clock frequency as required with a power level of at least +0dBm (approximately $1.2V_{PP}$). Similarly, set the analog input frequency with an appropriate power level depending on the connected ADC evaluation board (the full-scale value varies depending on the loss of the input path, the gain of the ADC, and the reference voltage of the ADC).
4. Apply +5V power (minimum 18W supply) to the motherboard. Unless otherwise stated in the ADC evaluation board user guide, the motherboard can supply power to the daughter card. The daughter card contains power conditioning circuitry to filter and convert the power provided by the motherboard (or external power supply) to the voltages required by the daughter card circuitry. When the motherboard and the daughter card are powered up, the analog signal generators can be turned on to supply the input signals to the ADC clock and analog inputs.
5. The iRADAnalyzer software can be launched by double-clicking the iRADAnalyzer icon that should have been copied to the desktop during the installation process (see the RHADC-FMCEV1Z User Manual for detailed installation instructions). iRADAnalyzer can also be launched by selecting **Start→All Programs→Renesas iRADAnalyzer→iRADAnalyzer**. The main iRADAnalyzer window opens.
6. If the hardware has been set up as previously described, data collection can proceed by pressing the **Data Capture** button. If the hardware has not been configured or is not functioning properly, the **Data Capture** button is inactive and an **Init Eval Kit** button is displayed. In this case, the **Init Eval Kit** button should be pressed when the hardware has been connected.

4. Overview of Software Features

iRADAnalyzer is the evaluation kit control software for the evaluation of Rensas' newest radiation hardened precision SAR ADC products. The remainder of this guide assumes the iRADAnalyzer software has been installed by following the iRADAnalyzer installation guide.

Double-clicking on the desktop shortcut iRADAnalyzer brings up a window similar to the one shown in Figure 11. With a daughterboard attached, iRADAnalyzer should indicate that the board is initialized.

Note: iRADAnalyzer can be run without the hardware attached to analyze previous data captures.

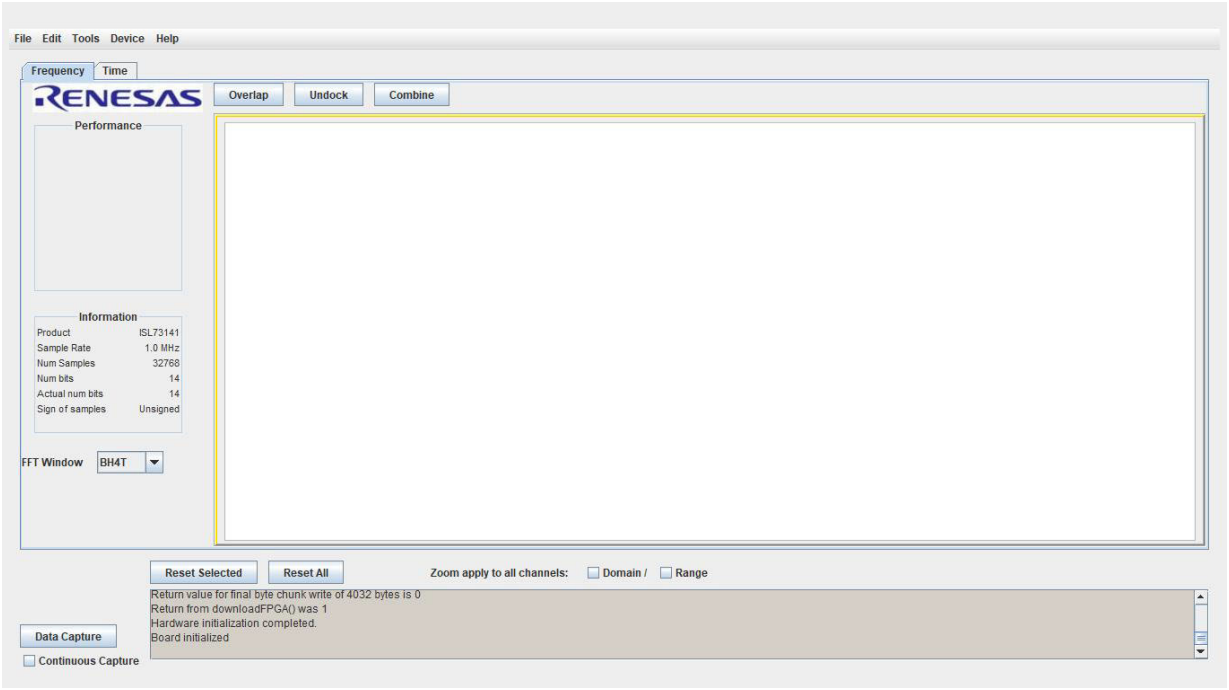

Figure 11. Board Initialization

After clicking on the **Data Capture** button with a powered-up evaluation kit attached, a window similar to the following is displayed. Figure 12 shows the major portions of the iRADAnalyzer GUI.

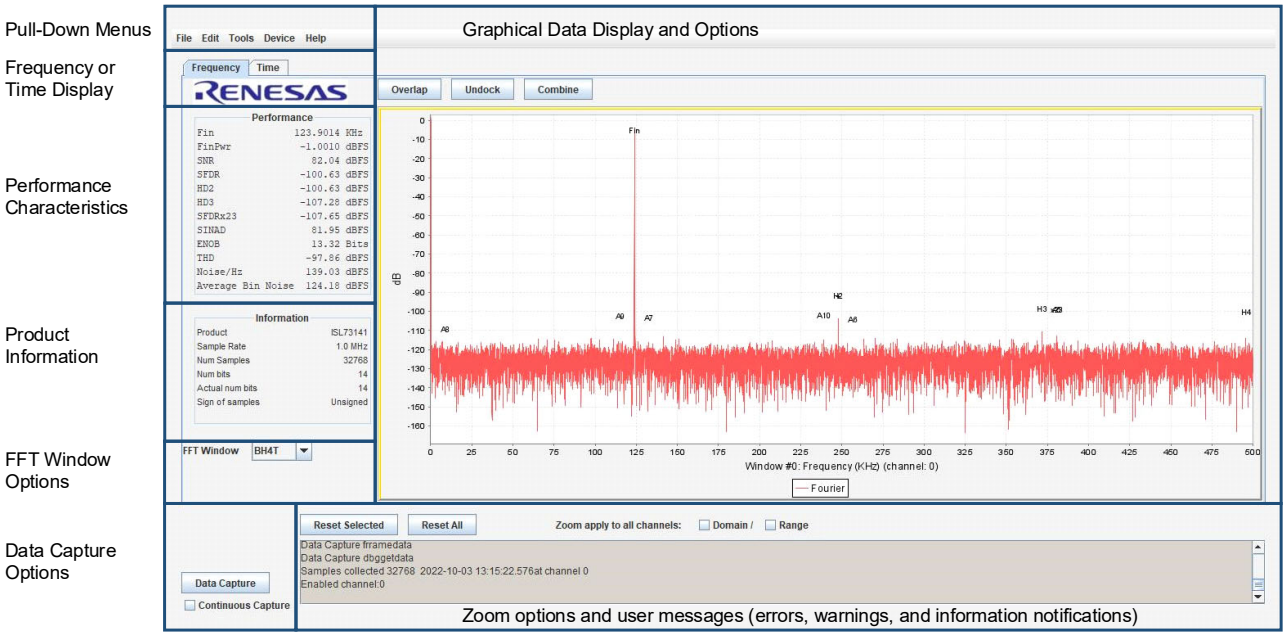

Figure 12. iRADAnalyzer GUI

Clicking on the **Time** or **Frequency** display panel changes the display of the current capture between time and frequency domain. The typical ADC performance characteristics, as calculated from the current data capture, are shown in the upper-left area of the GUI (such as SNR, SFDR, H2, H3, and ENOB). The product information is shown in the lower-left area of the GUI. The product information includes the ADC product name, the number of samples captured, and analog and digital power consumption of the ADC, as measured during the last data capture.

4.1 File Menu

The File pull-down menu contains the following selections:

- Open Data File
- Save Data File
- Open Configuration File
- Save Configuration File
- Print
- Exit

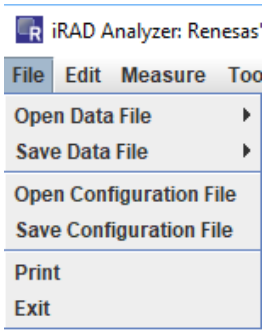

Figure 13. File Menu

4.1.1 Open Data File

By clicking on **Open Data File**, the GUI opens a previously saved Comma Separated Format (CSV) file and analyzes the data as if it was received from the evaluation kit. CSV is an industry-standard text format. The CSV files saved and loaded by iRADAnalyzer have one ADC sample per line, with each sample represented by a decimal number. The decimal number is generated by taking the raw ADC data in unsigned magnitude format and left shifting as needed until the MSB of the ADC sample is in bit position 16, with the resulting binary number being represented as a decimal. This default format has the advantage that a program can load this CSV file without having prior knowledge of the resolution of the ADC. As an option, iRADAnalyzer can also load and save more traditional LSB-justified CSV files from the **Tools→Option** drop-down selection.

4.1.2 Save Data File

By clicking on **Save Data File**, the GUI saves the currently displayed data as a CSV file. The saved data is always in the time domain, irrespective of the graphical time or frequency domain display selection.

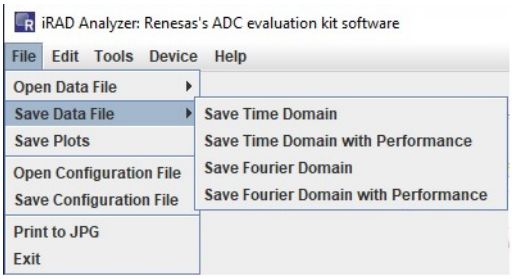

Figure 14. Save Data Options

4.1.3 Open Configuration File

By clicking on **Open Configuration File**, the GUI opens the configuration file previously saved by iRADAnalyzer. Configuration files are a convenient way to save settings for the iRADAnalyzer, including FFT windowing, continuous capture, FFT bin width settings, data capture setting such as number of samples.

4.1.4 Save Configuration File

By clicking on **Save Configuration File**, the GUI saves the configuration state of iRADAnalyzer into a configuration file.

4.1.5 Print

By clicking on **Print**, the GUI brings up the printing window.

4.1.6 Exit

By clicking on **Exit**, the GUI exits iRADAnalyzer.

4.2 Edit Menu

The Edit pull-down menu contains the following selections:

- Data Capture
- Connect to Eval Hardware

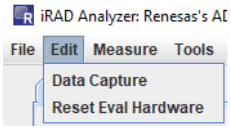

Figure 15. Edit Menu

4.2.1 Data Capture

By clicking on **Data Capture**, the GUI brings up a window that allows you to configure the data capture operation. Each of these settings affects data captures from the hardware and from CSV files read in. Available parameters that can be set are shown in Figure 16.

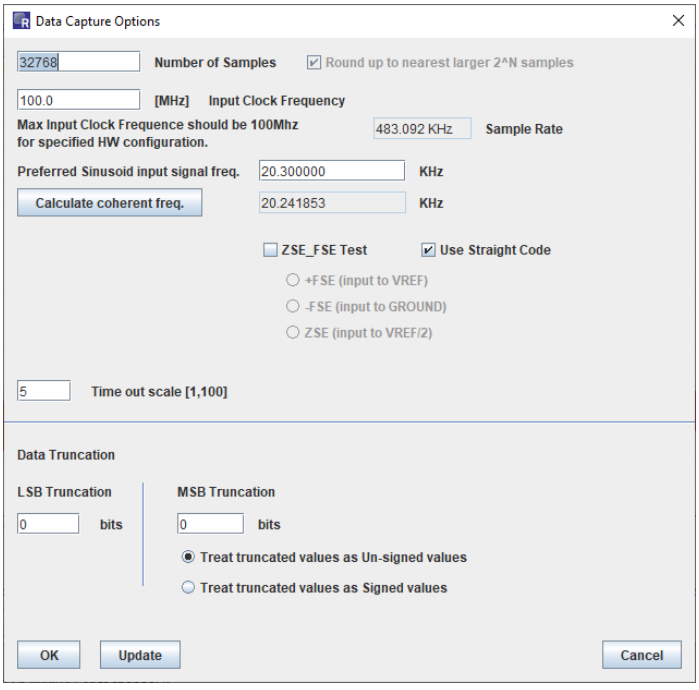

Figure 16. Data Capture Parameters

4.2.1.1 Number of Samples

The number of contiguous samples in each capture can be selected each time the **Data Capture** button is pressed. This number is automatically rounded up to the next largest power of 2 as required by the FFT routine of the iRADAnalyzer. The hardware supports up to 32Meg (2^{25}) continuous data samples captured.
IMPORTANT: Downloading in excess of 4Meg (2^{22}) samples can result in long capture times and can cause the program to run out of memory.

4.2.1.2 Input Clock Frequency

The **Input Clock Frequency** field allows you to set the input clock frequency for subsequent data analysis, which calculates the sample rate based on the product type and device settings. When reading in data from a CSV file, the sample rate is read into iRADAnalyzer from the file and updated accordingly.

4.2.1.3 Calculate Coherent Frequency

The **Calculate Coherent Frequency** field allows you to calculate the coherent frequency for sampling with no windowing. Input the required frequency into the box labeled **Preferred Sinusoid input signal freq.** after the required mode of the product is selected. This calculation can be updated to provide the appropriate frequency for the input frequency, number of samples selected, and the sample rate.

4.2.1.4 Reset Eval Hardware

When the **Reset Eval Hardware** button is selected, the entire evaluation kit hardware is re-initialized. This process takes several seconds to complete.

4.3 Tools Menu

The Tools pull-down menu contains the following selection:

- Options

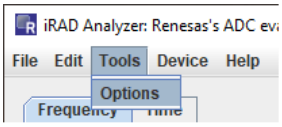

Figure 17. Tools Menu

4.3.1 Options

The Options selection allows you to set the iRADAnalyzer options to adjust the behavior of the software, as required.

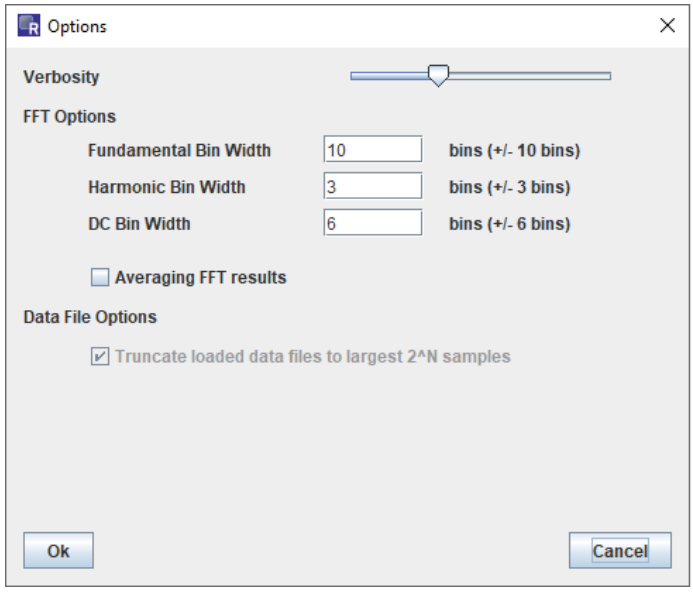

Figure 18. Options Window

4.4 Device Menu

The device menu allows you to see the information for the connected product, configure the connected product, and reset the data capture board.

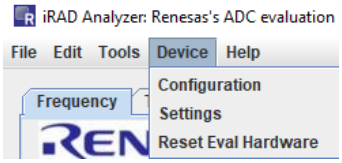

Figure 19. Device Menu

4.4.1 Configuration

The information about the connected product and data capture board status are provided in this menu (ISL73148SEH shown as an example).

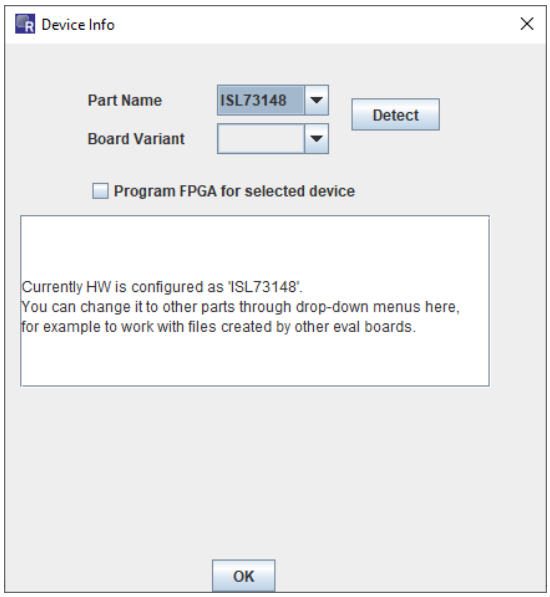

Figure 20. Device Configuration Menu

4.4.2 Settings

The settings for the connected product are configured using this menu. Depending on the connected product, different options are populated for you to select the required mode of operation.

4.4.3 Reset Eval Hardware

When **Reset Eval Hardware** is selected, the entire evaluation kit hardware is re-initialized. Press the **reset** button on the RHADC-FMCEV1Z board before clicking the **Done** button on this menu. This process takes several seconds to complete.

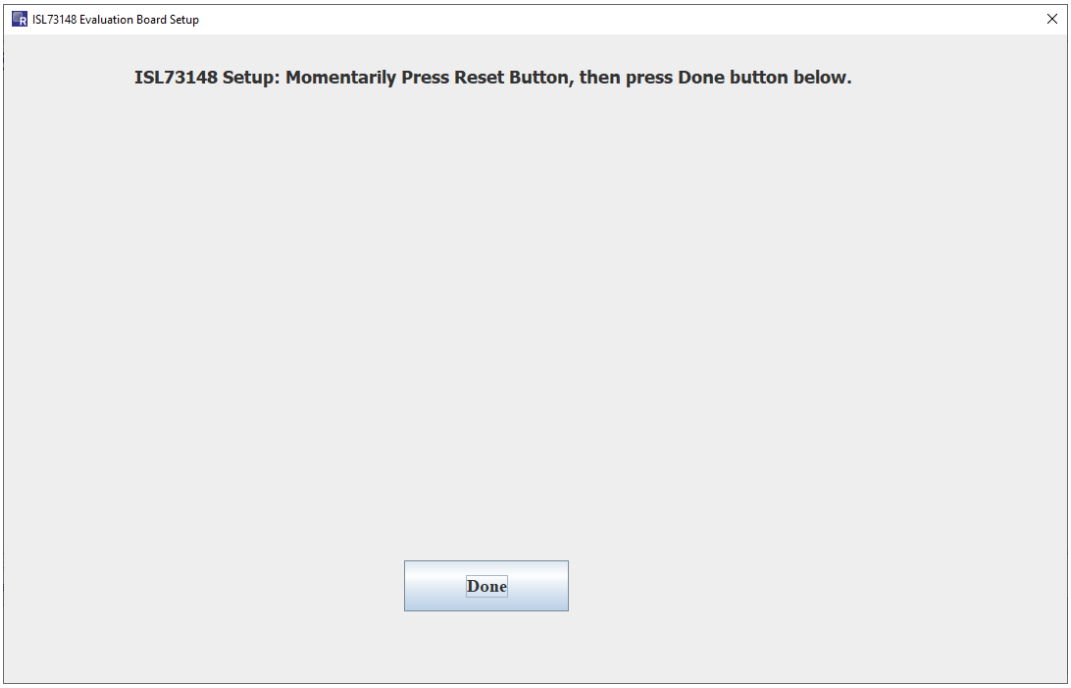

Figure 21. Reset Eval Hardware Menu

4.5 Help Menu

The Help pull-down menu contains the following selections:

- Device Link
- Online Feedback
- About

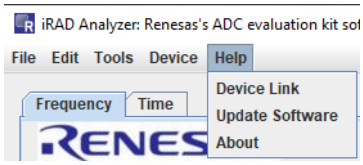

Figure 22. Help Menu

The Help drop-down menu contains links to various on-line resources for acquiring device information, updating the iRADAnalyzer software, obtaining information on the software version, and obtaining the serial number of the connected evaluation board.

4.5.1 About Menu

The about menu provides information about the version of software and the serial number for the evaluation board that is attached to the RHADC-FMCEV1Z board.

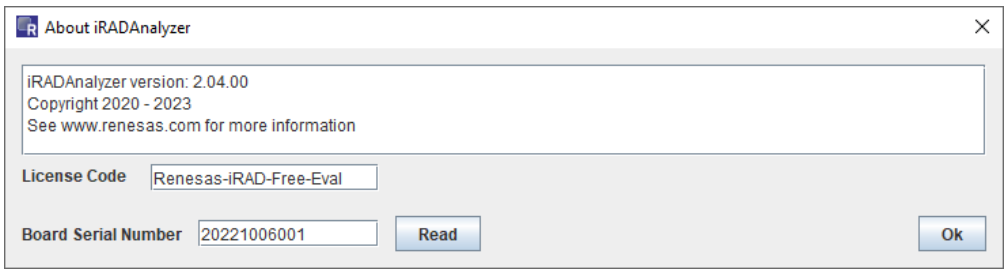

Figure 23. Help - About Menu

5. Appendix: Analog Signal Generators

Renesas uses the following analog signal generators as clock and signal sources when characterizing low-power, high-performance radiation hardened precision SAR ADCs:

- Rohde & Schwarz: SMA100A or SMA100B (with low phase noise and clock synthesis options)
- Audio Precision SYS-2722 Audio Analyzer/Generator

These generators provide very low jitter to optimize the SNR performance of the ADC under test. Other generators with similar phase noise performance can also be used. Contact Renesas Technical Support for recommendations.

6. Revision History

Rev.	Date	Description
2.00	Oct 18, 2022	Changed tolerant to hardened throughout document. Updated Specifications section. Updated PC operating system requirements. Updated Evaluation Kit Setup section. Updated Figures 11, 12, 14, 16, 19, and 20 Changed Sample Rate section to Input Clock Frequency section. Changed Number of Bits in Each Sample section to Calculate Coherent Frequency section. Removed Measure menu section and subsections. Removed the Options subsections. Added Device Menu section and subsections. Updated Help Menu section. Added About Menu section. Updated Appendix section.
1.01	Jun 15, 2021	Updated the Installation Requirements section.
1.00	Aug 26, 2020	Initial release

IMPORTANT NOTICE AND DISCLAIMER

RENESAS ELECTRONICS CORPORATION AND ITS SUBSIDIARIES (“RENESAS”) PROVIDES TECHNICAL SPECIFICATIONS AND RELIABILITY DATA (INCLUDING DATASHEETS), DESIGN RESOURCES (INCLUDING REFERENCE DESIGNS), APPLICATION OR OTHER DESIGN ADVICE, WEB TOOLS, SAFETY INFORMATION, AND OTHER RESOURCES “AS IS” AND WITH ALL FAULTS, AND DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, OR NON-INFRINGEMENT OF THIRD PARTY INTELLECTUAL PROPERTY RIGHTS.

These resources are intended for developers skilled in the art designing with Renesas products. You are solely responsible for (1) selecting the appropriate products for your application, (2) designing, validating, and testing your application, and (3) ensuring your application meets applicable standards, and any other safety, security, or other requirements. These resources are subject to change without notice. Renesas grants you permission to use these resources only for development of an application that uses Renesas products. Other reproduction or use of these resources is strictly prohibited. No license is granted to any other Renesas intellectual property or to any third party intellectual property. Renesas disclaims responsibility for, and you will fully indemnify Renesas and its representatives against, any claims, damages, costs, losses, or liabilities arising out of your use of these resources. Renesas' products are provided only subject to Renesas' Terms and Conditions of Sale or other applicable terms agreed to in writing. No use of any Renesas resources expands or otherwise alters any applicable warranties or warranty disclaimers for these products.

(Rev.1.0 Mar 2020)

Corporate Headquarters

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

Contact Information

For further information on a product, technology, the most up-to-date version of a document, or your nearest sales office, please visit:
www.renesas.com/contact/