

ISL73141VMREFEVKIT1Z

Voltage Monitor Reference Design

The [ISL73141VMREFEVKIT1Z](#) evaluation kit and iRADNavigator software GUI are used to demonstrate the [ISL73141SEH](#) 14-bit SAR ADC in a voltage monitoring application.

The ISL73141VMREFEV1Z voltage monitor reference design board uses the Renesas ISL73141SEH radiation hardened 14-bit 1000ksps SAR ADC paired with the [ISL71091SEH40](#) voltage reference, the [ISL71030M](#) 16-channel multiplexer, and the [ISL70062SEH](#) load switch to monitor up to 17 voltages. The primary use of this reference design is to pair with the [ISLVERSALDEMO2Z](#) reference design board. The ISL73141VMREFEV1Z board is intended to be used with the Vorago VA41620 MCU board and iRADNavigator software.

The ISLVERSALDEMO2Z produces all 17 power supply voltages required to power the AMD Versal device. The ISL71030M and the ISL70062SEH on the ISL73141VMREFEV1Z board allow the selection of these 17 power supply voltages. The voltages are digitized by the ISL73141SEH and read by the iRADNavigator software. Two [HS-117RHs](#) provide the AVCC and DVCC supply rails to the ISL73141SEH. The ISL71091SEH40 precision voltage reference provides the VREF (4.096V) for the ISL73141SEH to set the analog input range. All of the Versal power supply voltages, with the exception of the 5.0V system rail, fall within the analog input range of the ADC. The 5.0V system rail voltage is divided by two in hardware on the ISLVERSALDEMO2Z board before being output to the ISL73141VMREFEV1Z board. The subsequent value read in by the iRADNavigator software GUI is multiplied by two to display the correct value. For a block diagram of the reference design circuit, see [Figure 1](#).

This evaluation system supports a text or graphical display of the selected power supply voltage of the ISLVERSALDEMO2Z board in the iRADNavigator software. Any number of voltages from 1 to 17 can be displayed in the software in a text-based format. Up to 8 voltages can be displayed in a graphical format simultaneously.

The included Vorago VA41620 MCU evaluation board must be mated to the ISL73141VMREFEV1Z evaluation board to acquire data and observe the power supply voltages.

Key Features

This evaluation kit demonstrates an example signal chain used to monitor a large number of power supply voltages in an application while highlighting the accuracy and reconfigurability of all four of the main system components: the 16-channel multiplexer, the load switch, the precision reference, and the SAR ADC.

- Accurate voltage measurement
- Multiple power supply rail observation configurations
- User-friendly software GUI

Specifications

- +12V power supply input (from a bench top power supply)
- Main system components support -55°C to +125°C operation
- Supporting components support -40°C to +85°C operation

Kit Contents

- ISL73141VMREFEV1Z ADC evaluation board
- Vorago VA41620 MCU Board
- 40-Pin ribbon cable
- USB 2.0 cable Type A to Micro USB
- USB 2.0 cable with UART adapter - DTech DT-6554 or similar

Required Equipment

To properly operate the ISL73141VMREFEV1Z board the following equipment is required:

- Renesas [iRADNavigator software](#)
- 12V power supply
- PC running Windows 10 or greater

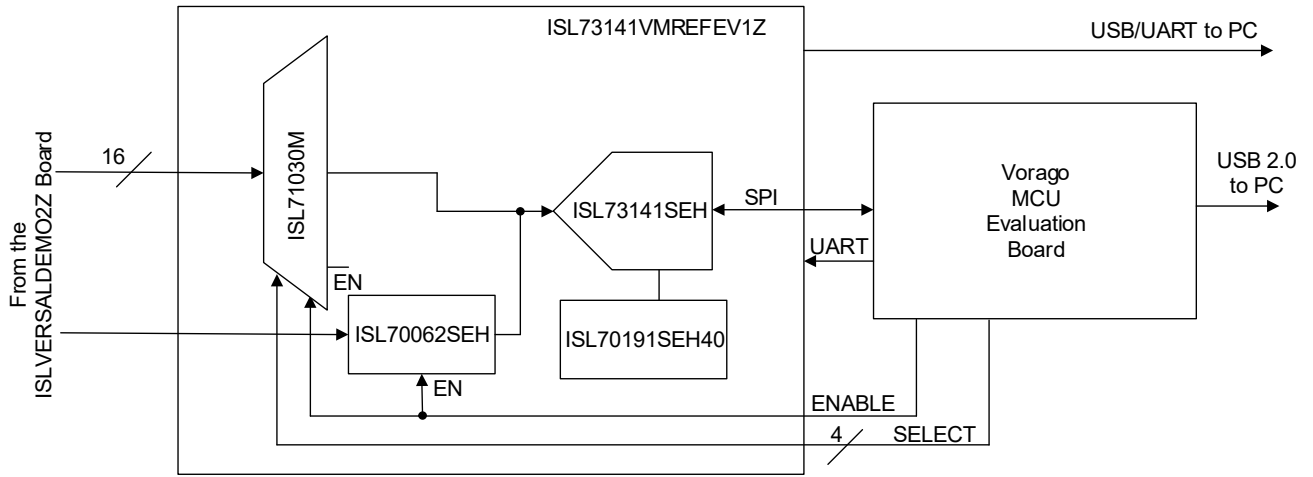


Figure 1. ISL73141VMREFEV1Z Block Diagram

1. Functional Description

The ISL73141VMREF1Z voltage monitor reference design board operates with the ISLVERSALDEMO2Z reference design board. However, it can be mated to other boards with compatible connectors and topologies with voltages to monitor or measure. This user guide discusses the operation of the reference design platform and power supply voltages that are monitored. [Table 1](#) shows the 17 voltages that are monitored.

Table 1. ISL73141VMREFEV1Z Power Supply Rails and Voltages^[1]

| Voltage Value (V) | Power Supply Rail Name |
|-------------------|------------------------|
| 5.0 | 5V0_SYS |
| 3.3 | 3V3_SYS |
| 2.5 | VCCO_50X |
| 1.2 | VCCO_XPIO |
| 0.8 | VCC_PSFP |
| 0.8 | VCC_SOC_IO |
| 0.8 | VCC_PMC |
| 0.8 | VCC_PLSP |
| 0.8 | VCCINT |
| 1.5 | VCCAUX |
| 1.5 | VCCAUX_PMC |
| 0.8 | GTY_AVCC |
| 1.5 | GTY_AVCCAUX |
| 1.2 | GTY_AVTT |
| 1.2 | DDR_VDD |
| 0.6 | DDR_VTT |
| 2.5 | DDR_VPP |

1. The ISL71030MNZ is a 16 channel multiplexer and in order to read 17 total voltages the ISL70062 load switch is incorporated to allow for the 17th channel measurement.

[Figure 2](#) shows the top side of the ISL73141VMREFEV1Z board. Note the orientation of the attached ribbon cable. It is imperative to connect the ribbon cable properly between the ISLVERSALDEMO2Z and the ISL73141VMREFEV1Z reference design boards. On both reference design boards, the ribbon cable should lead away from the connector off of the adjacent edge of the circuit board. A +12V input must be applied to the VIN and GND banana jacks on both reference design boards to supply power to each board. The Vorago VA41620 board connects to the ISL73141VMREFEV1Z reference design board using connectors J1A and J2A.

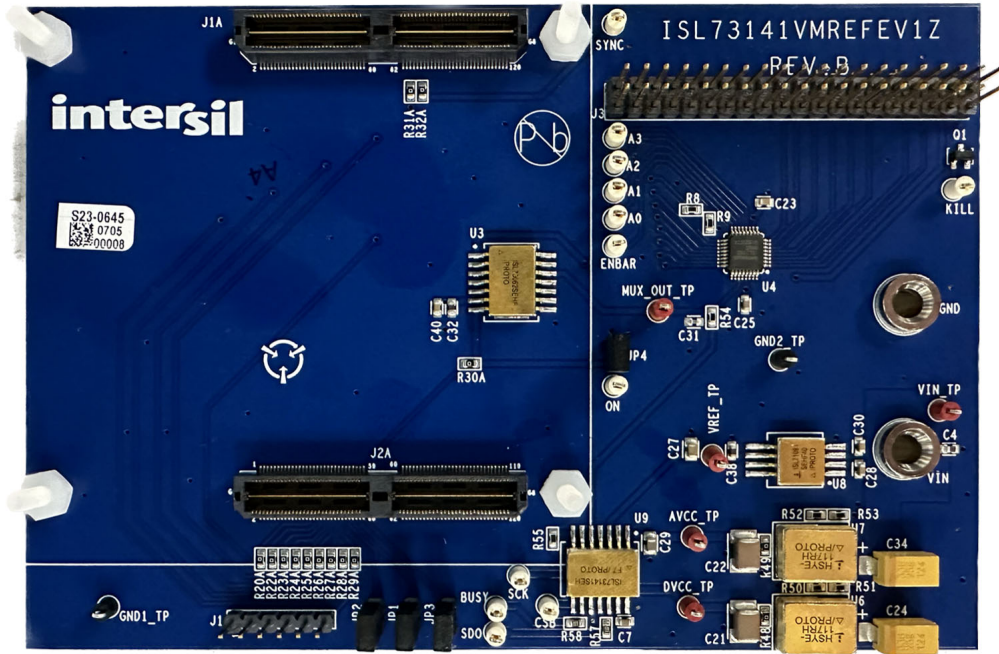


Figure 2. ISL73141VMREFEV1Z Evaluation Board Top

Figure 3 shows the Vorago VA41620 evaluation board connected to the ISL73141VMREFEV1Z voltage monitor reference design board. All of the main system components of the signal chain are radiation hardened products. The Vorago VA41620 MCU is also radiation hardened by design. The remaining components, the surface mount passives, are commercial products that are not radiation hardened and may or may not support extended temperatures used in a typical space application.

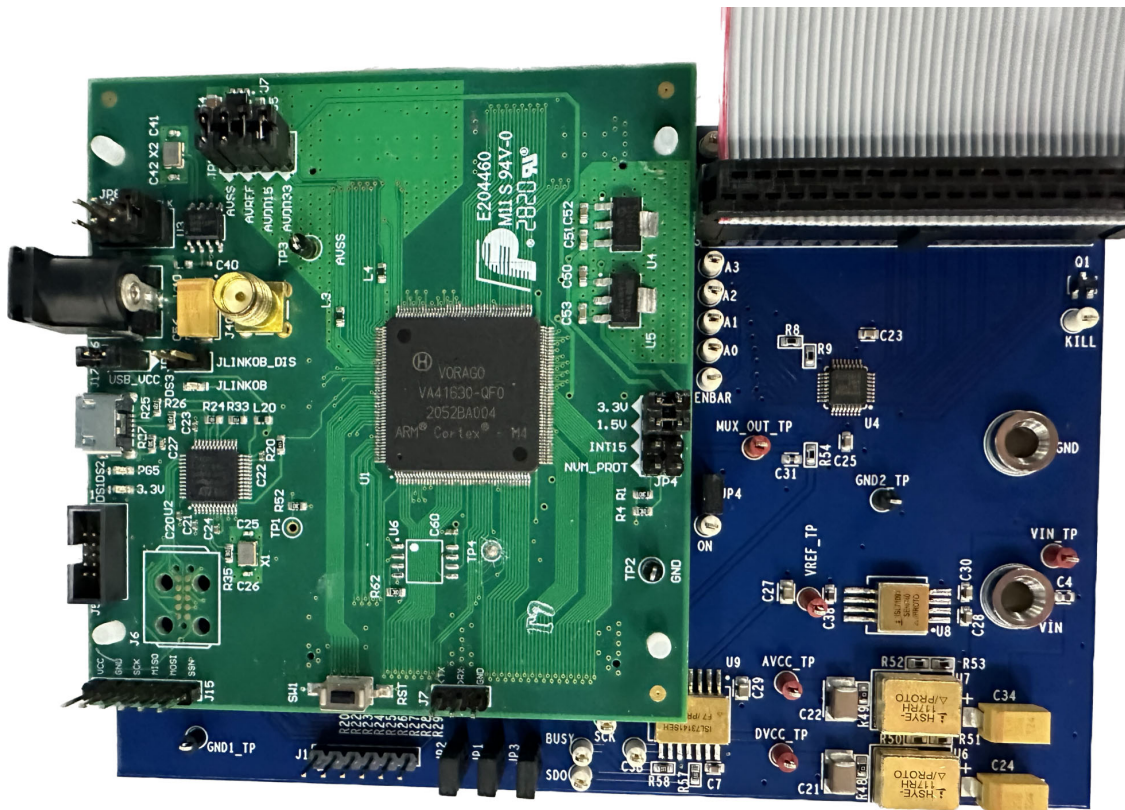


Figure 3. ISL73141VMREFEV1Z Evaluation Board with Vorago VA41620 MCU Evaluation Board

Figure 4 shows the ribbon cable connection to the ISLVERSALDEMO2Z board that connects to the ISL73141VMREFEV1Z board. Similar to the connection on the ISL73141VMREFEV1Z board, the ribbon cable must connect so that the ribbon cable leads away from the connector off the adjacent edge of the circuit board.

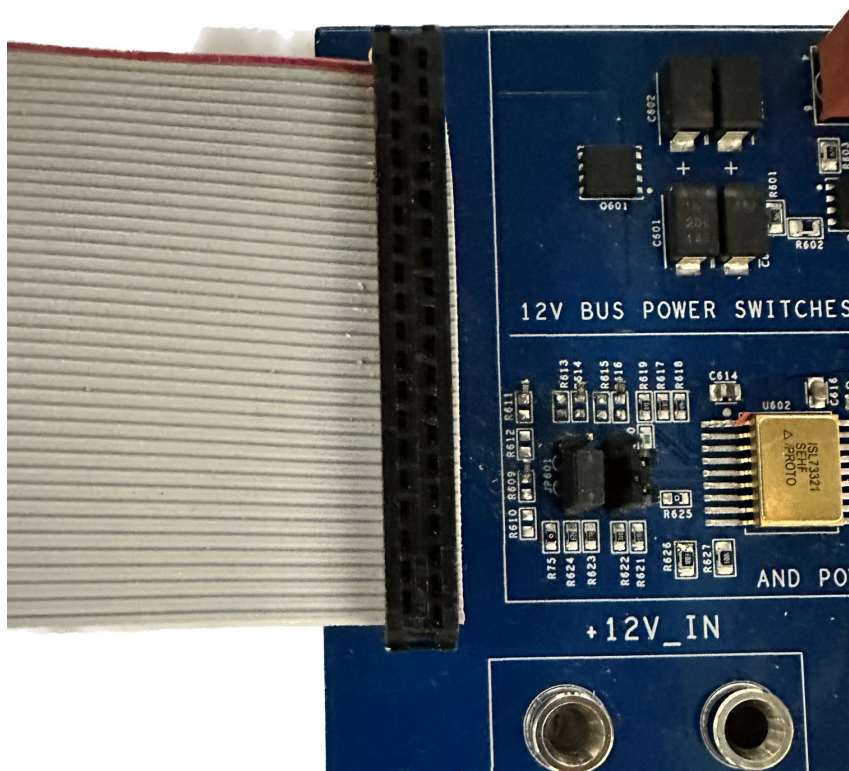


Figure 4. ISLVERSALDEMO2Z Ribbon Cable Connection with the ISL73141VMREFEV1Z Evaluation Board

Power for the ISL73141VMREFEV1Z and the ISLVERSALDEMO2Z reference design boards should be provided by a 12V power supply, which is connected to the VIN and GND connections on the ISL73141VMREFEV1Z board and to the +12V_IN and GND connections on the ISLVERSALDEMO2Z board. A USB 2.0 to UART cable is connected to J1 with the GND pin of the cable connected to the side of the header, with J1 showing in the silkscreen. This cable collects the ADC data from the MCU, which is subsequently processed in the iRADNavigator software GUI. Power is provided to the Vorago MCU through the USB 2.0 cable that connects to J17 on the Vorago VA41620 evaluation board.

1.1 Evaluation Board Operation

The ISL73141VMREFEV1Z reference design board operates with the ISLVERSALDEMO2Z to show the 17 power supply rails provided. The two boards are connected using a ribbon cable, which supplies the power supply voltages from the ISLVERSALDEMO2Z board to the ISL73141VMREFEV1Z board. These voltages are input to the ISL71030M and the ISL70062SEH on the ISL73141VMREFEV1Z board. The iRADNavigator software GUI drives the voltage selection to provide to the ISL73141SEH at a given time to perform a measurement. The ISL71091SEH40 provides the reference voltage (4.096V) to the ISL73141SEH, which in turn sets the analog input range of the ISL73141SEH. The 5V main supply voltage is outside of this range, so the voltage is divided by 2 in hardware on the ISLVERSALDEMO2Z board, and then the iRADNavigator software scales this voltage back up by a factor of 2 to report the correct voltage.

The ISL71030M, ISL70062SEH, ISL71091SEH40, and ISL73141SEH devices on the evaluation board support operation from -55°C to +125°C. However, many components (namely the surface mount passive components used on the evaluation board) support a commercial temperature range of -40°C to +85°C. This evaluation board operates under ambient temperature conditions at or near 25°C.

1.2 Connecting the Voltage Monitor, Versal, and MCU Evaluation Boards

Complete the following steps to connect the boards successfully.

1. Connect the supplied Vorago VA41620 MCU evaluation board to the ISL73141VMREFEV1Z board.
2. Connect the ribbon cable from the ISL73141VMREFEV1Z board to the ISLVERSALDEMO2Z board.
3. Connect the supplied USB Type A to Micro USB cable from the PC to the Vorago VA41620 MCU evaluation board.
4. Connect +12V to the ISL73141VMREFEV1Z and the ISLVERSALDEMO2Z boards.
5. Observe LED DS2 on the Vorago VA41620 board to make sure it starts blinking. When the LED blinks, connect the supplied DTech FTDI USB to the UART cable from the PC to the ISL73141VMREFEV1Z board.
6. Press the reset button (SW1) on the Vorago VA41620 MCU evaluation board to load the firmware from the MRAM into the VA41620 MCU.

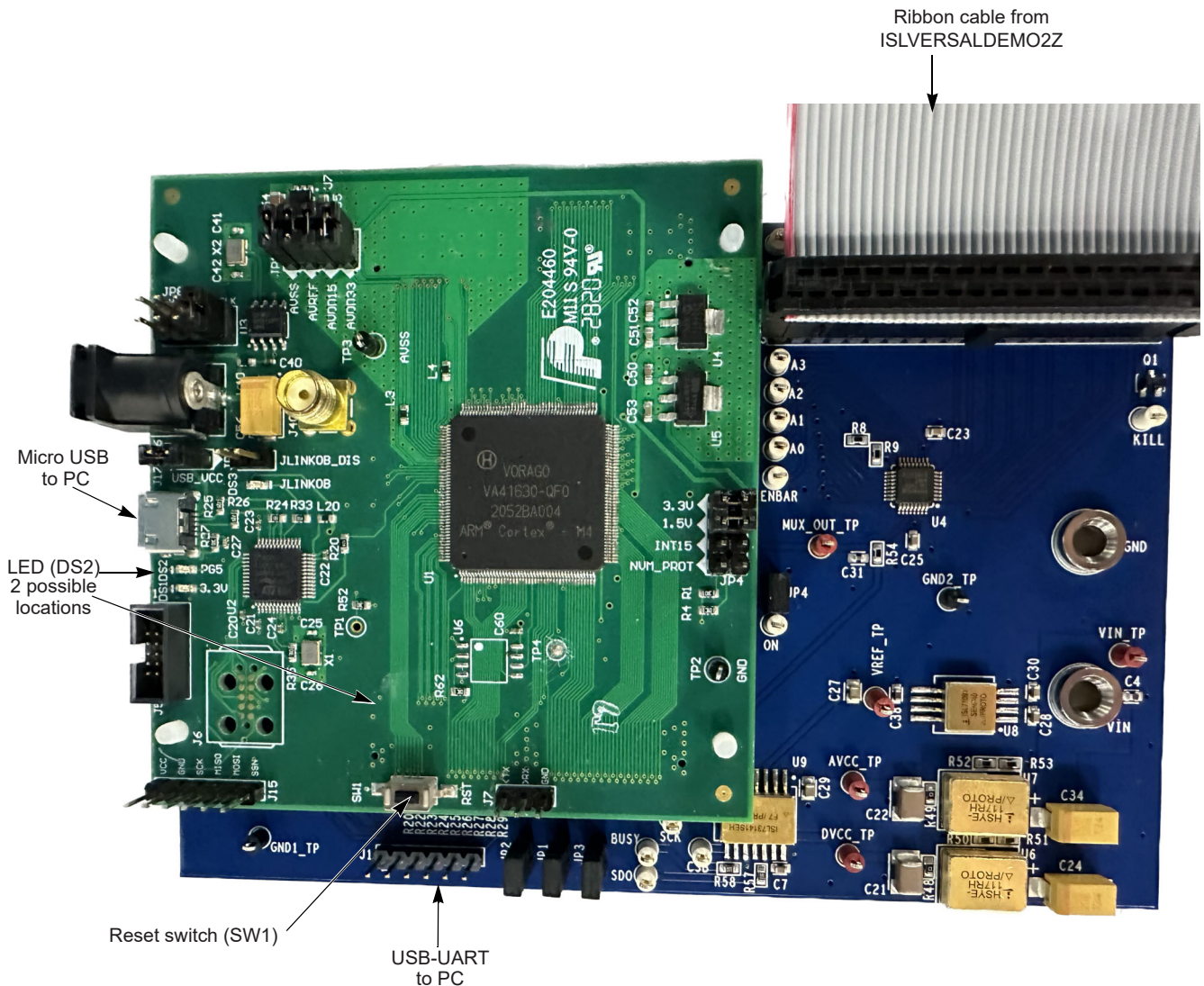


Figure 5. ISL73141VMREFEV1Z/VA41620/ISLVERSALDEMO2Z Connection Diagram

1.2.1 iRADNavigator Board Selection

Double-click on the **iRADNavigator** icon from the desktop on the PC to open the **iRADNavigator** software. In the Available Hardware box, click to expand the list of ADC Reference designs. Select ISL73141_Voltage_Monitor from the list and then click the **Select** button.

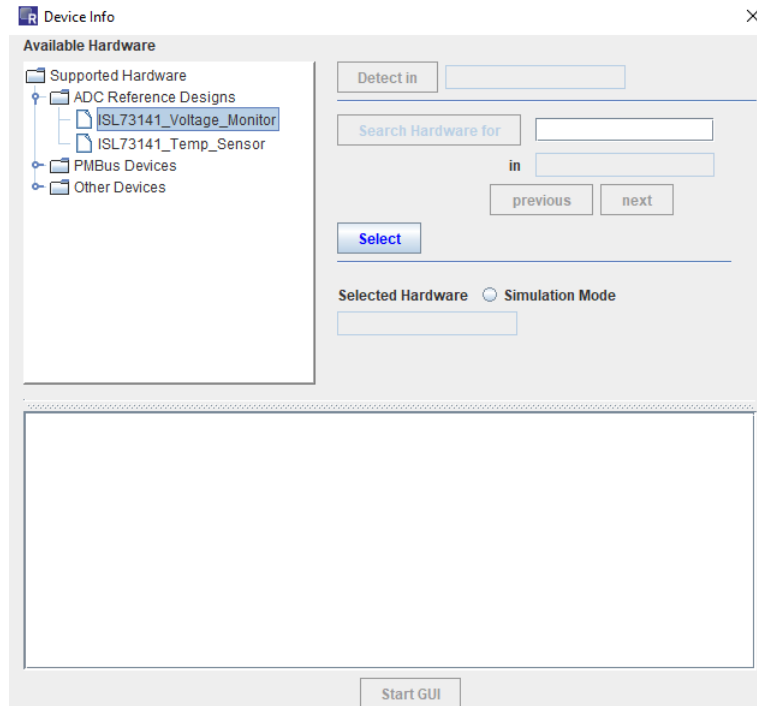


Figure 6. iRADNavigator Board Selection

After clicking **Select**, the GUI loads the screen shown in [Figure 7](#), which shows the ISL73141 Voltage Monitor board is selected and the available board communication options. Click **Connect** to connect the GUI to the board.

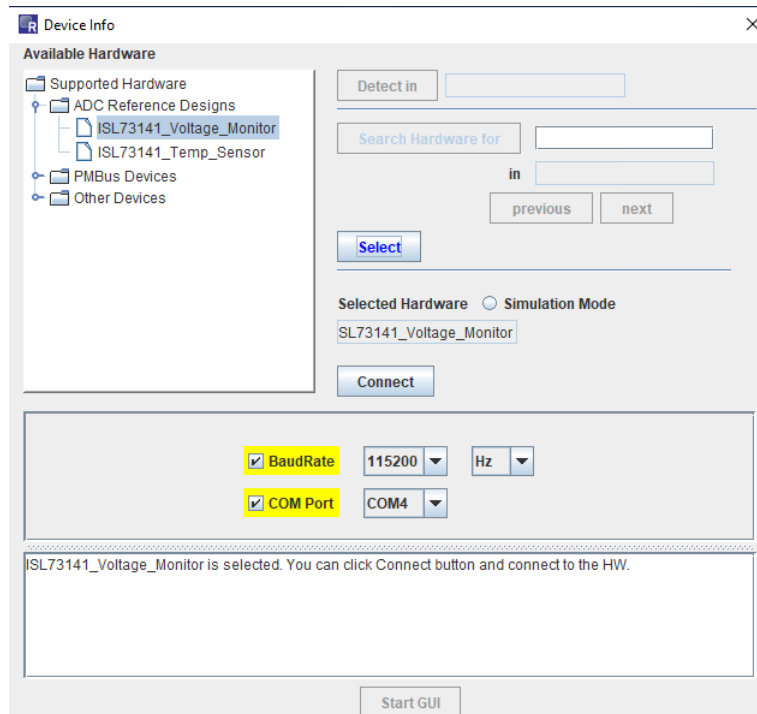


Figure 7. iRADNavigator Board Selection and Communication Options

After clicking the **Connect** button, iRADNavigator communicates with the Vorago MCU board to ensure the latest firmware is loaded into the Vorago MCU. If not, a pop-up window opens prompting the update of the firmware. If the Vorago MCU firmware is up to date, this pop-up window does not open.

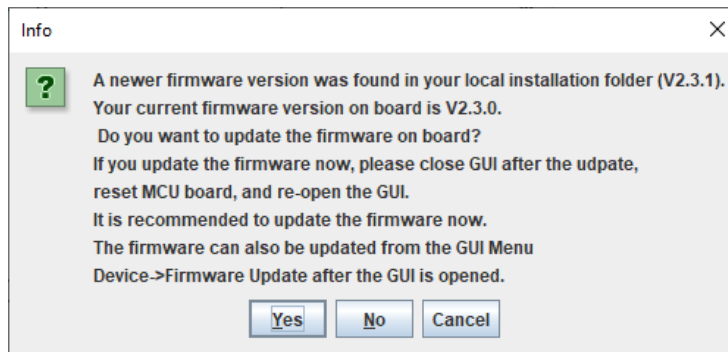


Figure 8. iRADNavigator Firmware Update Prompt

When the firmware update is complete, another pop-up window opens to state that the Vorago MCU firmware has been updated. Click **OK** to acknowledge the firmware update.



Figure 9. iRADNavigator Firmware Update Complete

After clicking **OK**, close iRADNavigator, press the reset button on the Vorago MCU board, and reopen the GUI. Select the ISL73141_Temp_Sensor from the selection tree and click **Connect**.

The **Start GUI** button is enabled when communication is established to the ISL73141 Voltage Monitor board. Click the **Start GUI** button to proceed.

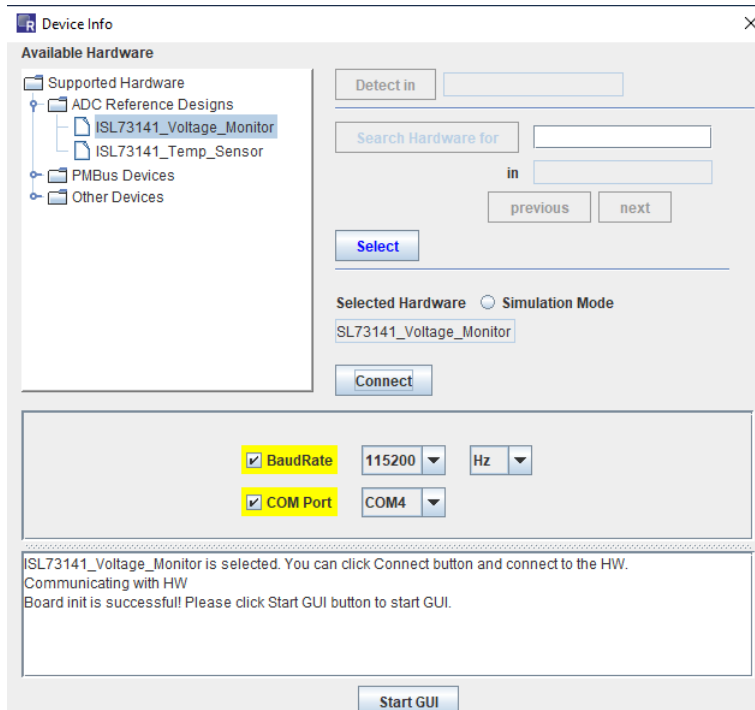


Figure 10. iRADNavigator Start GUI

1.2.2 iRADNavigator Voltage Monitor Selection and Measurements

After selecting the **Start GUI** button, the GUI window changes to allow selecting the voltages to monitor with the ISL73141VMREFEV1Z board from the ISLVERSALDEMO2Z board. All of the available voltages display on this main screen. The block diagram on the left side of this screen shows the power rail system configuration on the ISLVERSALDEMO2Z board and the expected voltages. All the voltage selections on the right side of this screen can be read from the ISLVERSALDEMO2Z board.

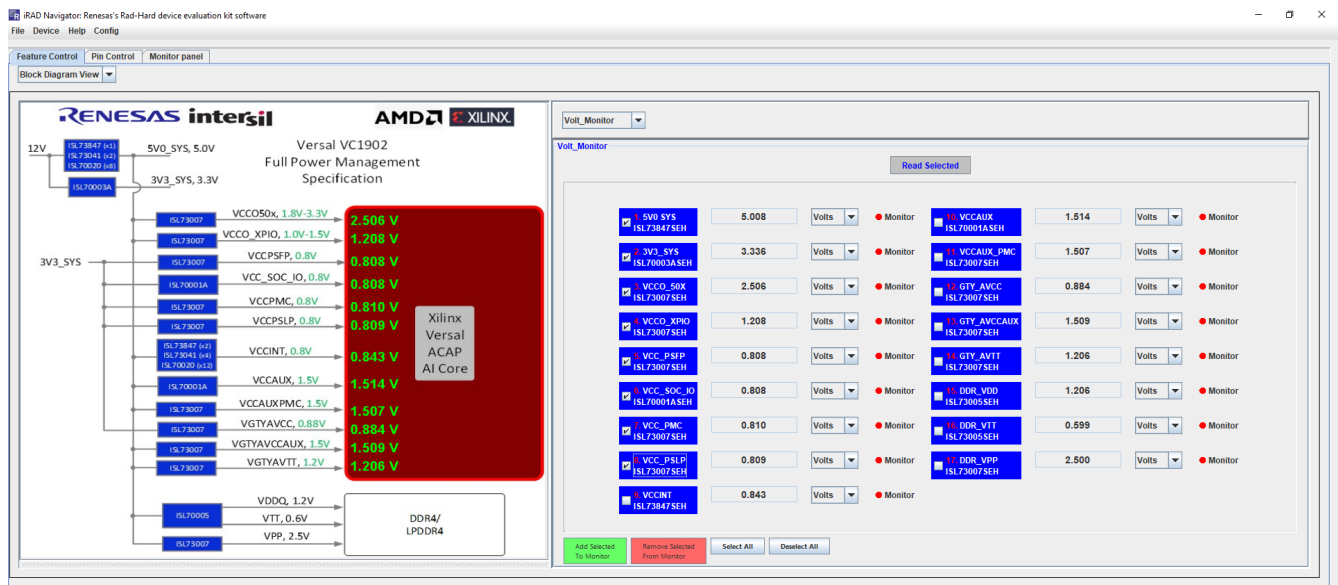


Figure 11. iRADNavigator Voltage Selection Main Screen

From this screen, check the box beside any required voltage and click the **Read Selected** button to obtain a single measurement. Each time the **Read Selected** button is pressed, it updates the values in the boxes on the right side of the screen while also updating the values in green on the left side of the screen in the block diagram. The values should update and look similar to those shown in [Figure 12](#).

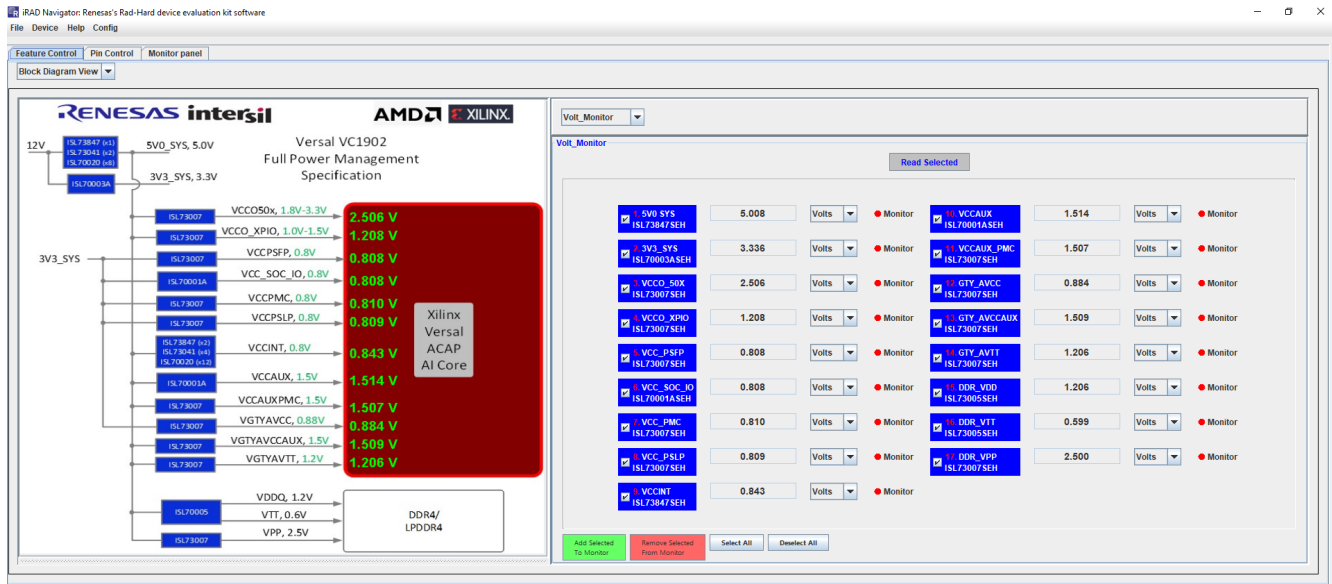


Figure 12. iRADNavigator Updated Voltage Values

When the required voltages are selected, the measurements can be added to the Monitor so they can be plotted in the Monitor Panel. The plotting in the Monitor Panel can only support plotting up to eight channels at a time, which keeps the plots in the display legible. Displaying more than eight plots simultaneously makes the plots and text sizes too small to read clearly on most monitors.

A couple of features make selecting voltages to monitor quick and simple. This screen has a **Select All** button and a **Deselect All** button. All voltages are selected by default. Therefore, if only eight are needed, either manually deselect the check boxes for the voltages that are not needed or click **Deselect All** and then select the check boxes for the voltages required. For this example, in [Figure 13](#), the first eight power supply voltages are selected. After making selections, click the green box that says **Add Selected to Monitor**.

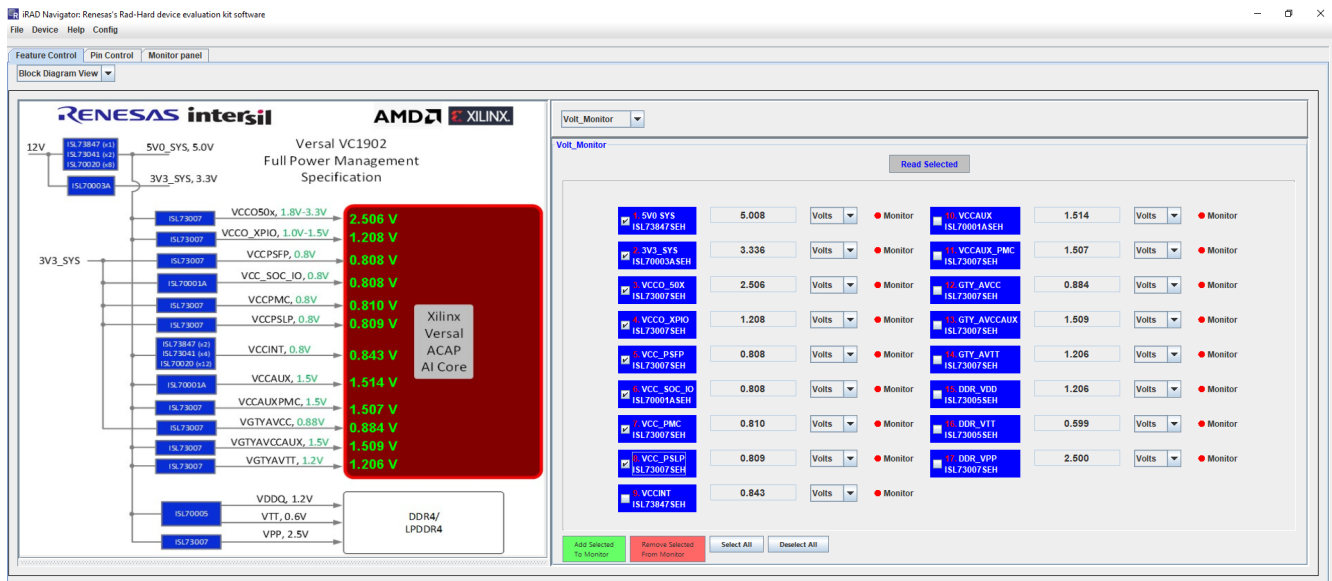


Figure 13. iRADNavigator Eight Voltages Selected for Monitor

1.2.3 iRADNavigator Monitor Panel

After the voltage selections have been added to the monitor, the red dots beside the selected voltage change to green dots to indicate the selected voltages are ready for plotting in the **Monitor Panel**, see [Figure 14](#). Select the Monitor Panel tab to begin plotting the selected voltages.

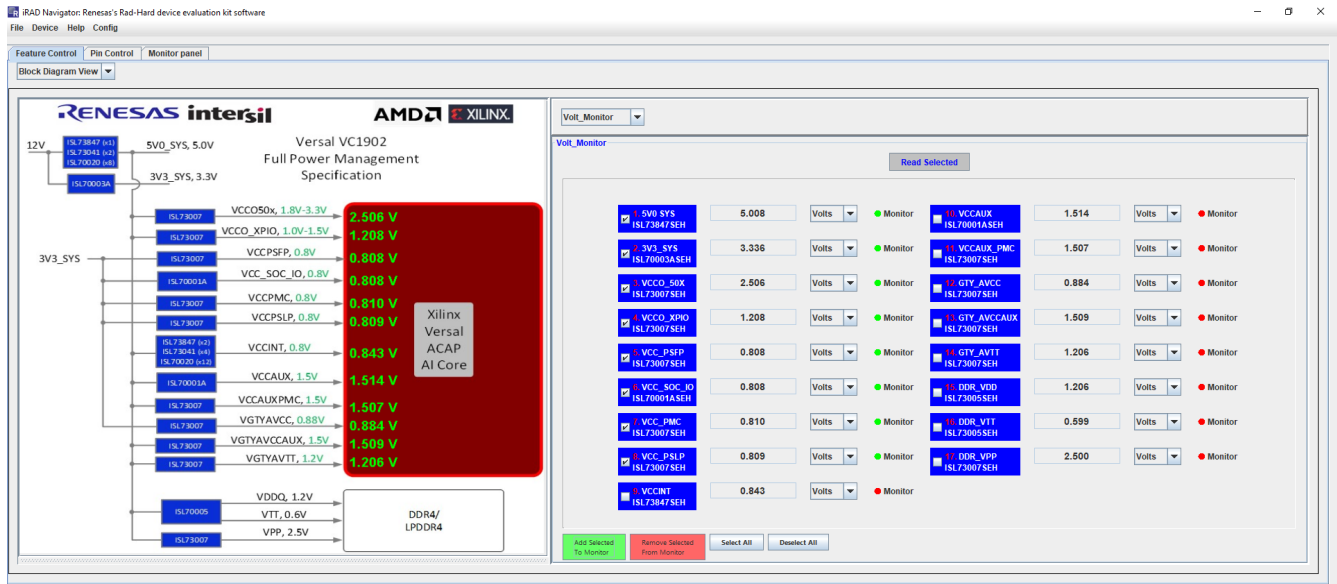


Figure 14. iRADNavigator Voltages Ready for Display in Monitor Panel

Click **Start Monitor** to begin plotting the temperature measurement. This action opens a separate window that begins plotting the selected temperature measurement. Press the **Start Monitor** from the **Monitor Panel** button to begin reading and displaying the voltages on this tab of iRADNavigator. The voltages begin to periodically update in this display.

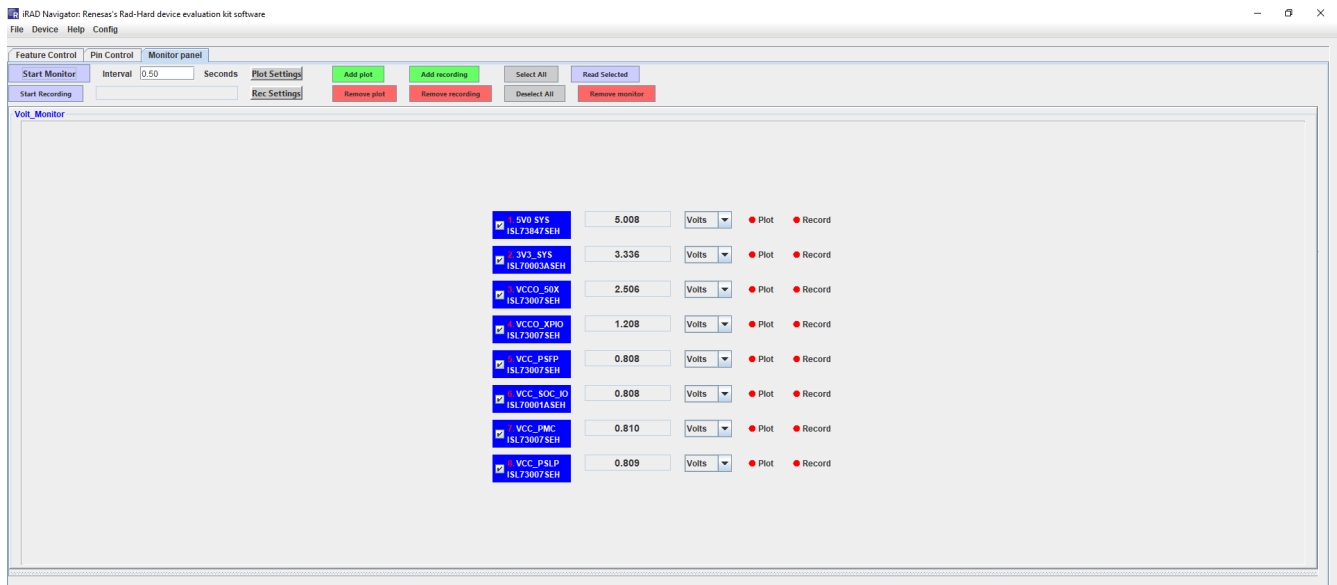


Figure 15. iRADNavigator Temperature Measurement Plot

Note: The dots beside the Plot in this panel are red. Similarly to adding the voltages to the monitor, the voltages from the **Monitor Panel** must be added to the plot if a plot is required. To add these voltages to a plot, check the required voltages and click the green button labeled **Add Plot**. The red dots turn green when completed, as shown in [Figure 16](#).

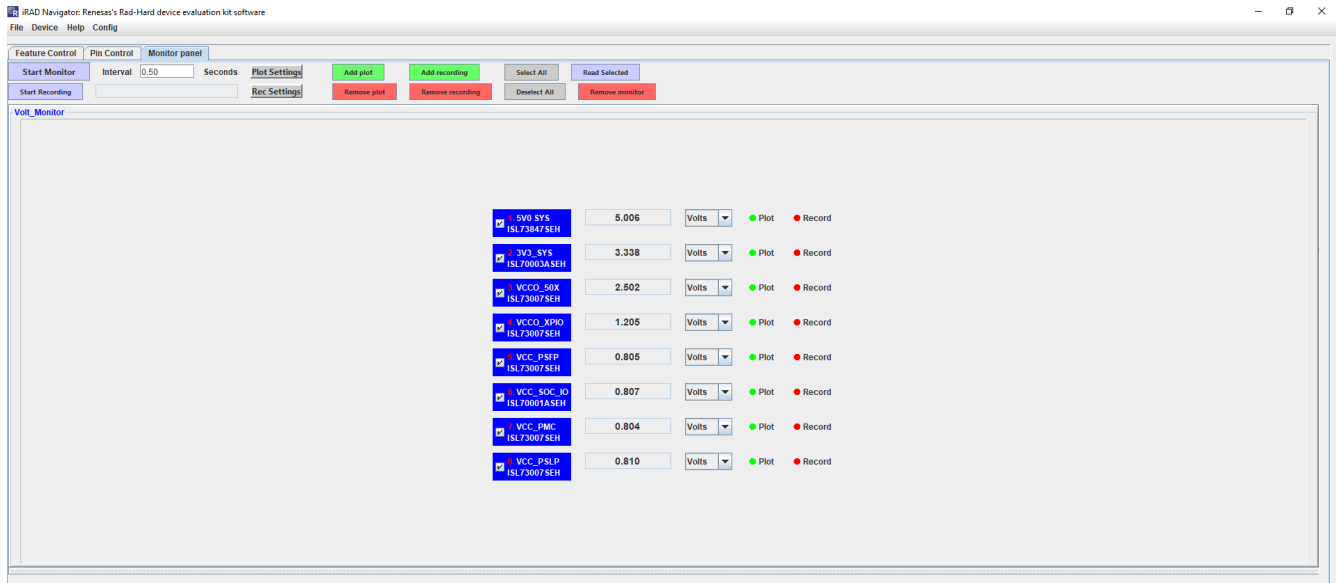


Figure 16. iRADNavigator Temperature Measurement Add to Plot

After the required voltages have been added to the plot, they can be plotted graphically in a new window by clicking the **Start Monitor** button on the **Monitor Panel**. The iRADNavigator software initially opens a new window with only one voltage plot as shown in [Figure 17](#).

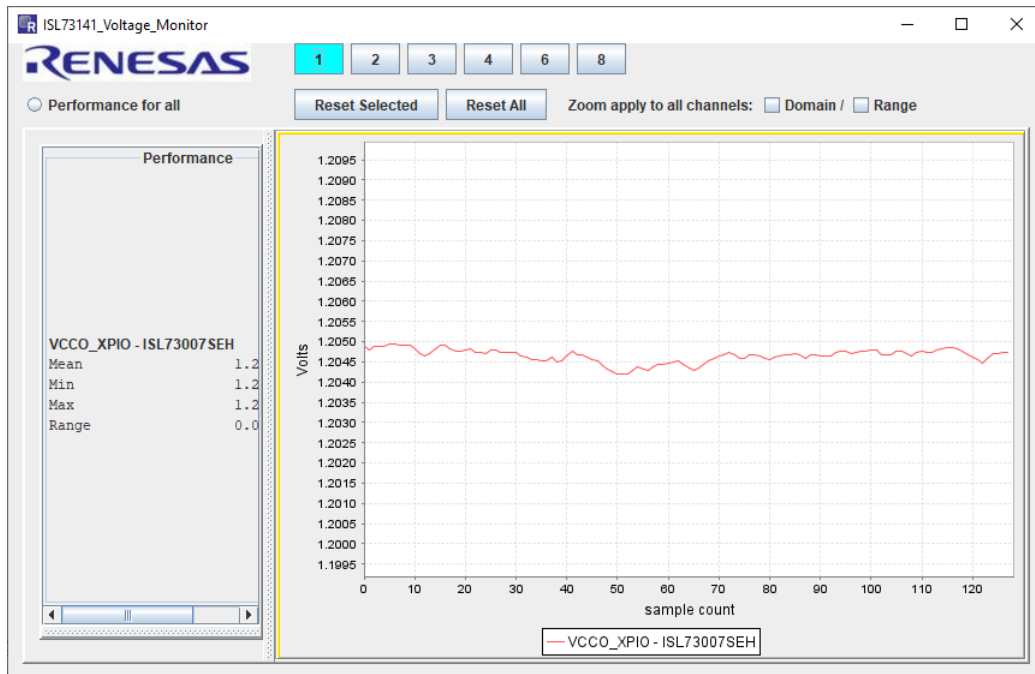


Figure 17. iRADNavigator Voltage Measurement Plot

Click one of the buttons at the top of the new window labeled 1, 2, 3, 4, 6, and 8 to enable additional voltage plots, allowing plotting up to the eight voltages selected. This action also opens a new window, allowing the voltage selection to add to the plot, as shown in Figure 19. When this window opens, all eight voltages are selected by default. Select the required voltages from this window, and when complete, select **OK**.

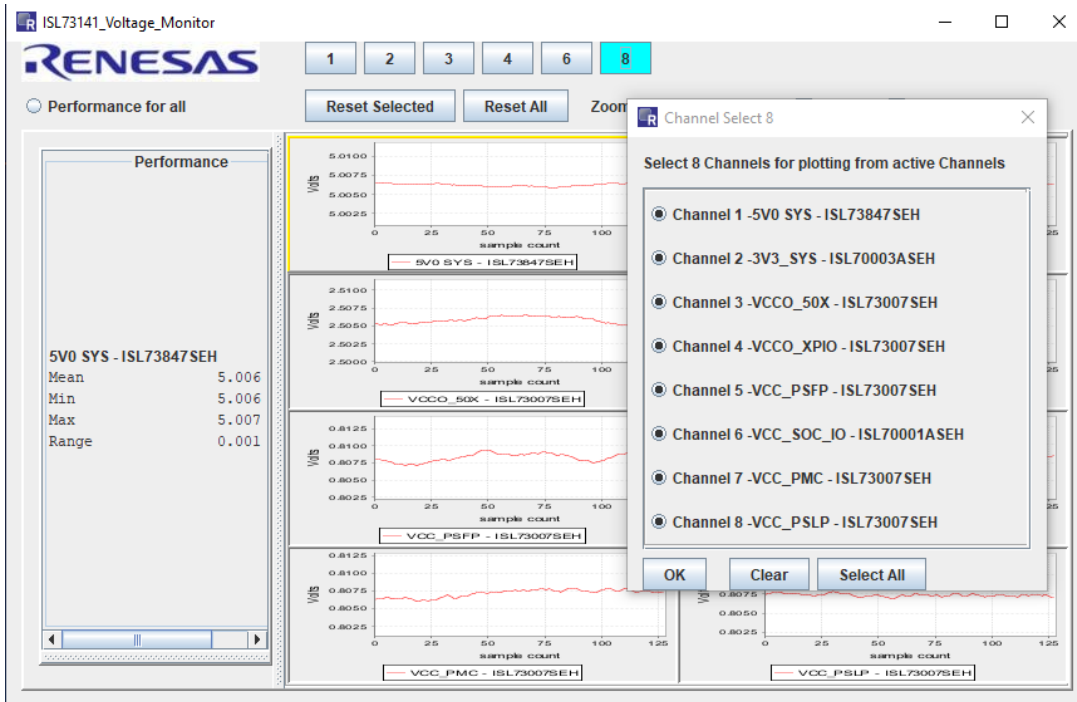


Figure 18. iRADNavigator Voltage Measurement Select Plots

After selecting **OK**, the plot shown has the eight voltages displayed that were selected.

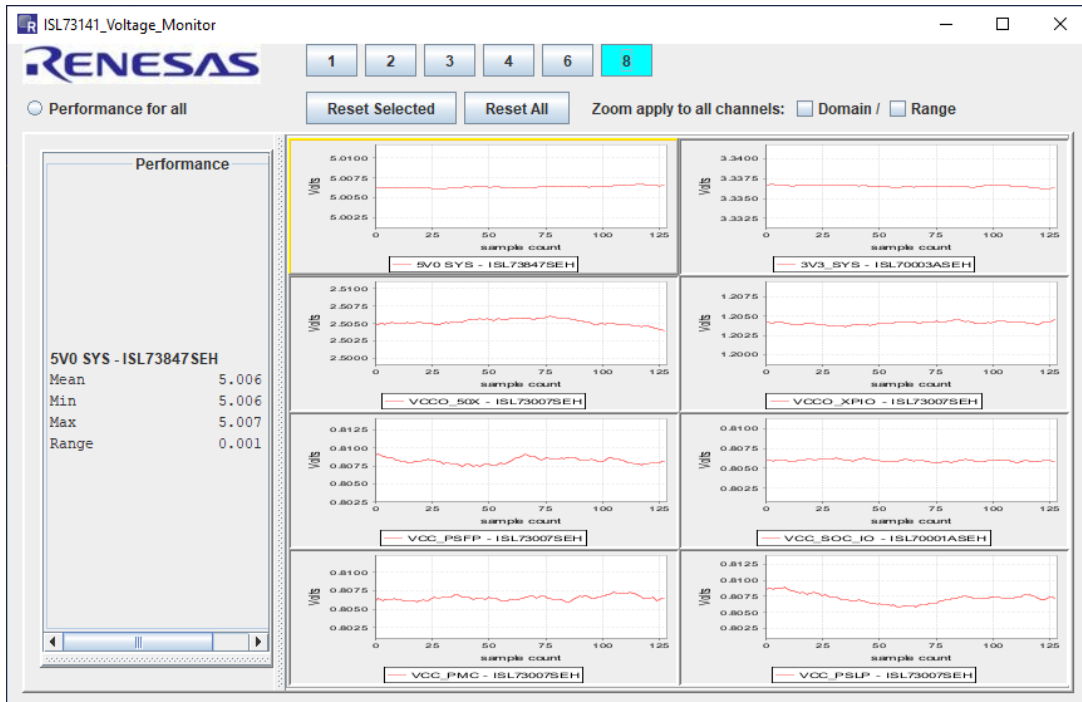


Figure 19. iRADNavigator 8 Voltage Measurement Plots

The voltage data from the plot window highlighted in yellow is displayed on the left side of the window. Click the required plot window to change the selected voltage measurement to view the data on the left side of the window. When all the required data has been observed to stop the plotting of the data, go back to the main iRADNavigator window and select the **Stop Monitor** button. This button stops the plotting of the voltage data in the plot window. After the monitor has stopped, close the plot window and the iRADNavigator window, if required.

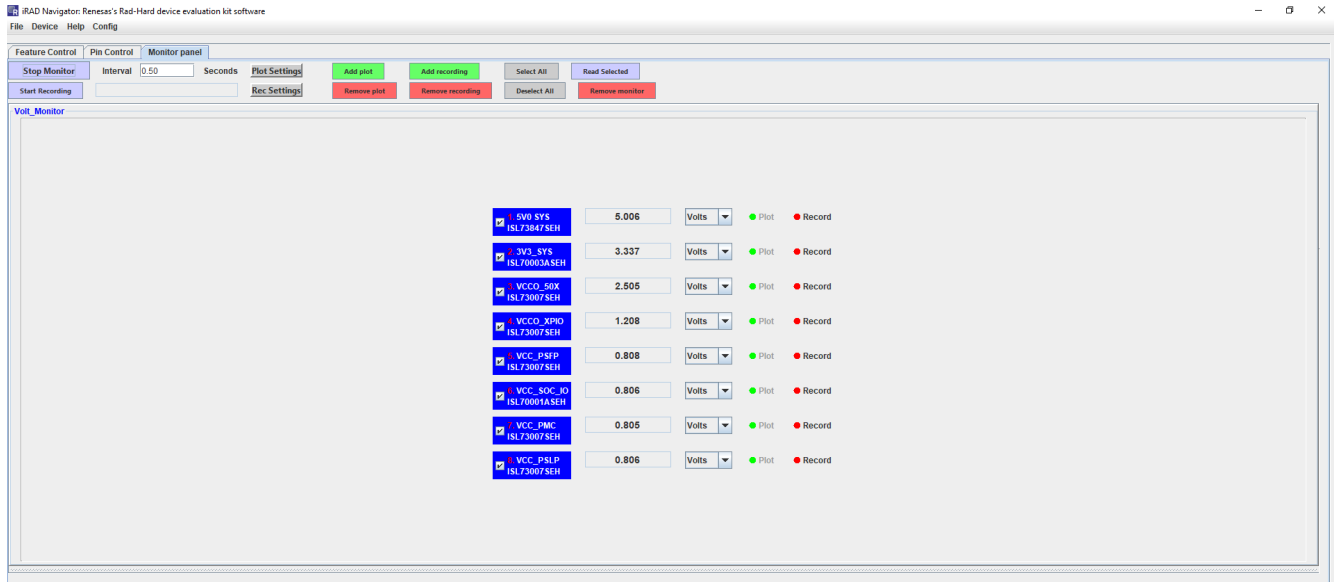


Figure 20. iRADNavigator Monitor Panel - Stop Monitor

1.3 iRADNavigator MCU Firmware Update

The Vorago MCU firmware can be updated from within the iRADNavigator software GUI to ensure that the latest firmware is present in the MCU. To perform an update, select **Device** then **Firmware Update** from the menu bar.

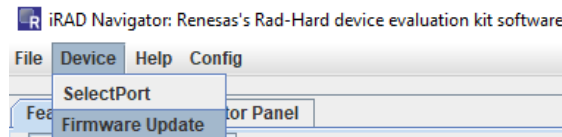


Figure 21. iRADNavigator MCU Firmware Update Selection

A pop-up window opens, which allows reading the current firmware version, performing an online update, or performing a local update. The latest firmware should be installed along with the most recent iRADNavigator installation, but an online update might be required to have the most recent version of MCU firmware.

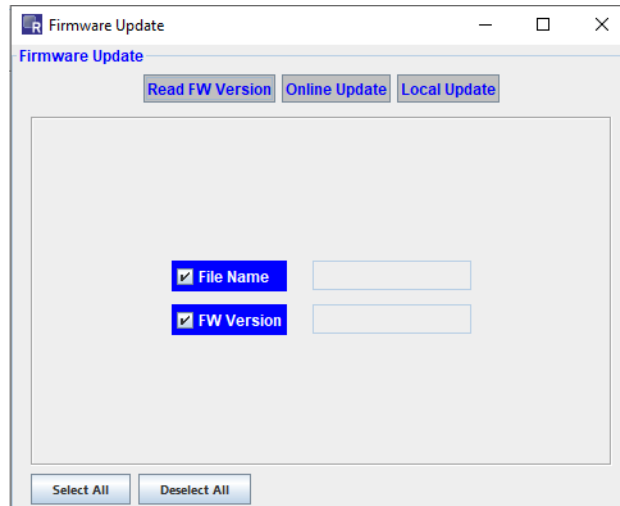


Figure 22. iRADNavigator MCU Firmware Update Action Window

If performing an online update, the GUI looks for the latest MCU firmware on the Renesas website when **Online Update** is selected. Renesas recommends using the online update; however, the firmware can be downloaded from the Renesas website and stored locally and then a local update can be performed. After selecting **Online Update**, the GUI searches for the latest firmware on the Renesas website and reports back the latest version found as shown in Figure 23. Click **Yes** to proceed with updating the firmware.



Figure 23. iRADNavigator MCU Firmware Online Update

Click **Yes** to update the firmware. After the firmware is downloaded, a GUI prompt opens in a pop-up window to confirm programming the new firmware into the board. Click **Yes** again to program the firmware.



Figure 24. iRADNavigator MCU Firmware Online Update - Program Firmware

After the firmware is programmed into the board, the GUI prompts that it is complete. Click **OK** and then close the GUI, reset the MCU board, and then reopen the GUI.

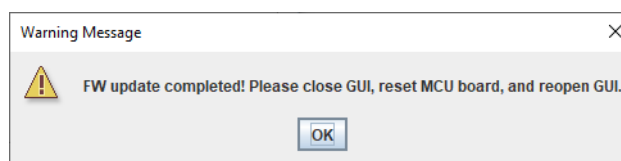


Figure 25. iRADNavigator MCU Firmware Online Update - Program Firmware

When selecting Local Update, point iRADNavigator to the installation folder to find the firmware or to the folder where the firmware is stored if it was downloaded previously from the Renesas website. Figure 26 shows the typical installation path.

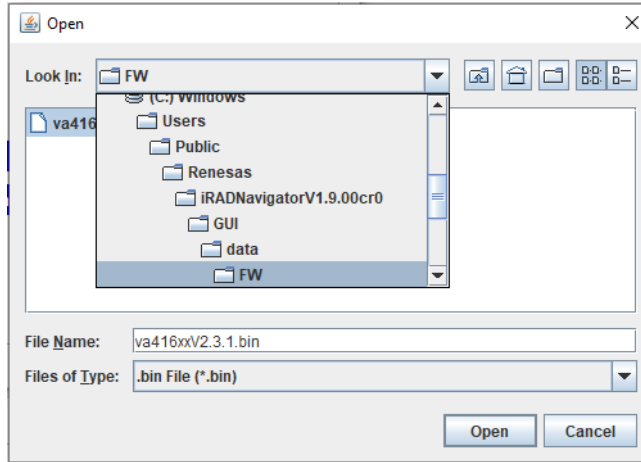


Figure 26. iRADNavigator MCU Firmware Location on Local Computer

Select the latest firmware in this location and click **Open**. Figure 27 shows the next prompt to confirm that programming the selected firmware into the MCU is required.

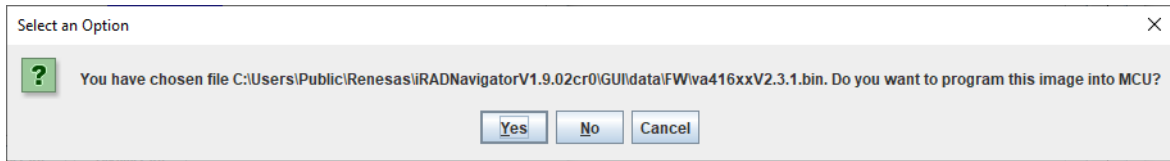


Figure 27. iRADNavigator MCU Firmware Confirmation

When the MCU firmware is installed into the MCU, the window in Figure 28 opens to alert that the installation is complete. Click **OK** and then close iRADNavigator. Press the reset button on the Vorago MCU board and reopen iRADNavigator.

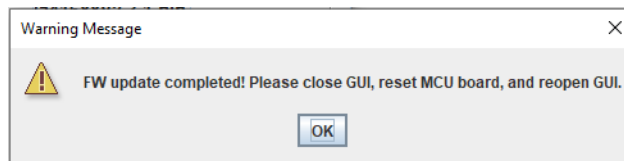


Figure 28. iRADNavigator MCU Firmware Update Complete

2. Board Design

2.1 ISL73141VMREFEV1Z Evaluation Board

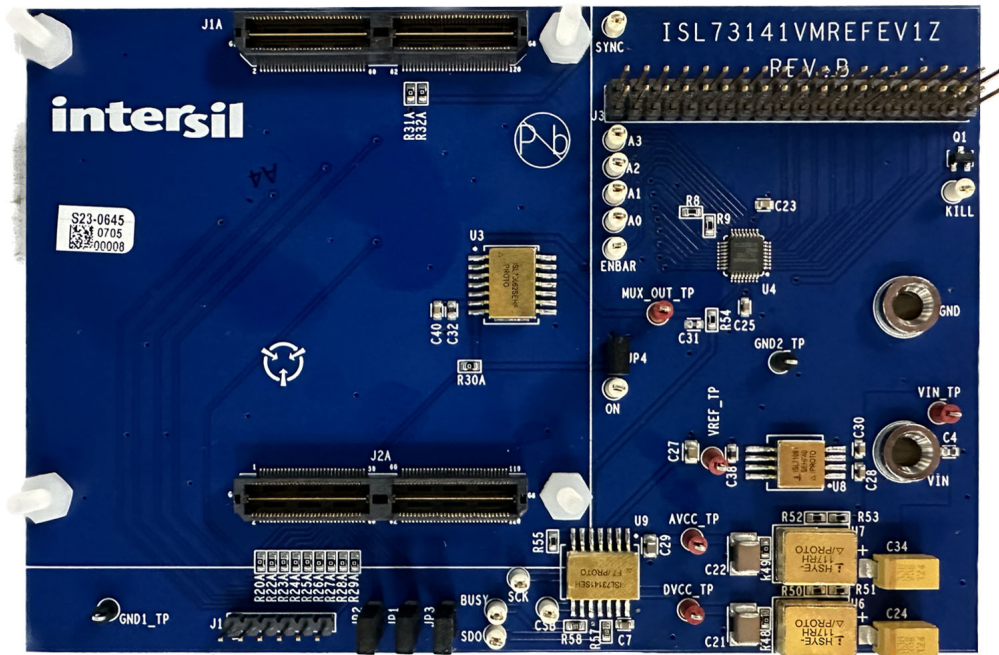


Figure 29. ISL73141VMREFEV1Z Evaluation Board (Top)

2.2 Board Schematics

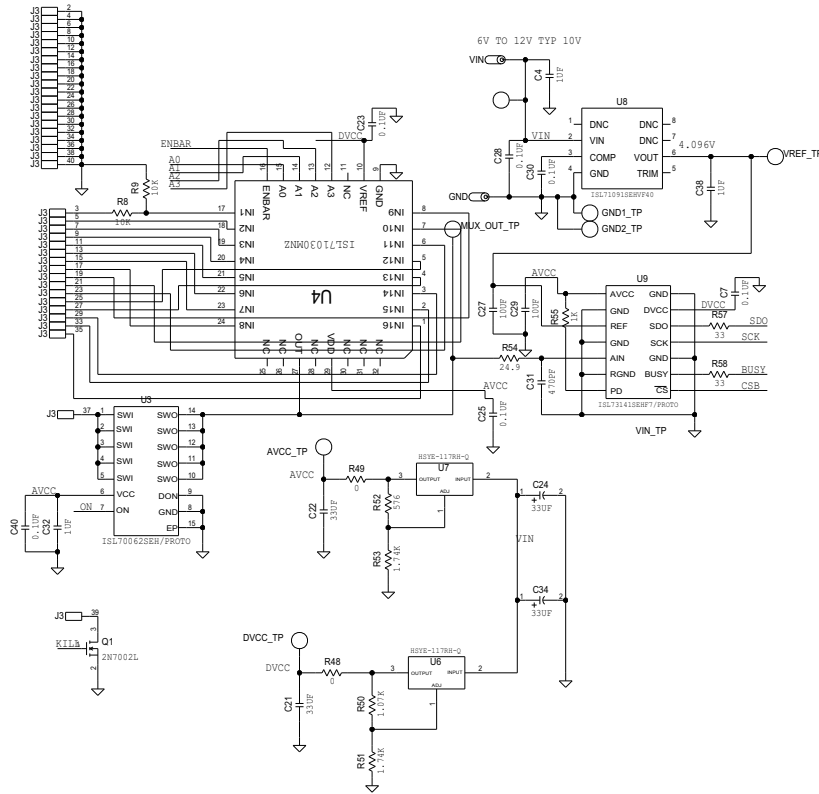


Figure 30. ADC, Multiplexer, Load Switch, Voltage Reference, and Power Supply Circuit

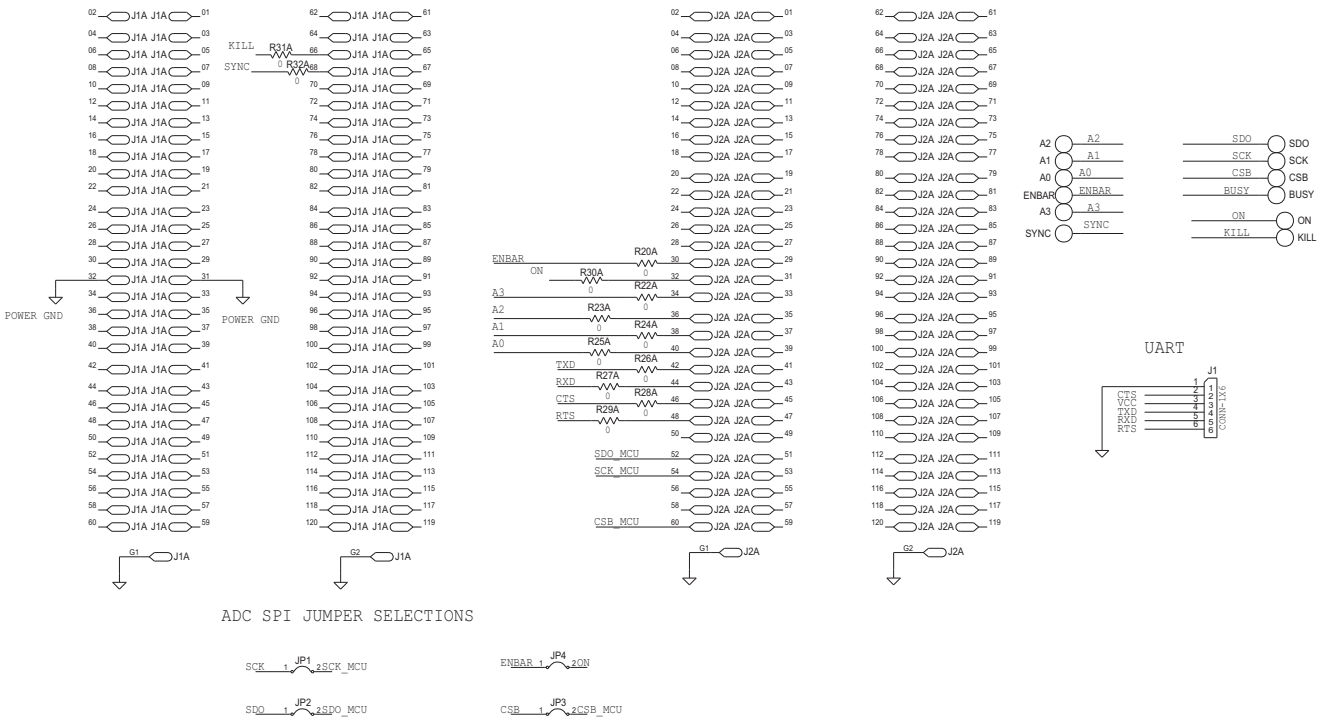


Figure 31. Board Connector Circuitry

2.3 Bill of Materials

| Qty | Reference Designator | Description | Manufacturer | Manufacturer Part |
|-----|--|---|------------------|--------------------------|
| 1 | | PWB-PCB, ISL73141VMREFEV1Z, REVB,ROHS | Imagineering Inc | ISL73141VMREFEV1ZREVBPCB |
| 1 | Q1 | N-Channel 60V 115mA MOSFET | ON Semi | 2N7002L |
| 5 | AVCC_TP, DVCC_TP, MUX_OUT_TP, VIN_TP, VREF_TP | Miniature Red Test Point 0.100 Pad 0.040 Thole | Keystone | 5000 |
| 2 | GND1_TP, GND2_TP | Miniature Black Test Point 0.100 Pad 0.040 Thole | Keystone | 5001 |
| 12 | A0, A1, A2, A3, BUSY, CSB, ENBAR, KILL, ON, SCK, SDO, SYNC | Miniature White Test Point 0.100 Pad 0.040 Thole | Keystone | 5002 |
| 2 | GND, VIN | L = 0.350in Solder Mount Banana Plug | Keystone | 575-8 |
| 1 | J3 | Dual Row Vertical PCB Male Connector | Molex | 70280-0769 |
| 6 | C7, C23, C25, C28, C30, C40 | Multilayer Cap | TDK | C1608X7R1H104K |
| 2 | C21, C22 | Multilayer Cap | TDK | C4532X7R1C336M250KC |
| 1 | J1 | Male Inline 6 pins X 0.1 inch Connector Strip | BERG/FCI | 68000-106HLF |
| 2 | R57, R58 | Moisture Resistant Thick Film Resistor | TE Connectivity | CRGCQ0603F33R |
| 2 | C24, C34 | Solid Elect Tant Cap | Kemet | T491X336M025AT |
| | C4, C32, C38 | Ceramic Chip Cap | Yageo | CC0603KRX7R8BB105 |
| 2 | C27, C29 | Ceramic Cap | Murata | GRM21BR61E106MA73L |
| 1 | C31 | Multilayer Cap | AVX | 04025A471KAT2A |
| 14 | R20A, R22A, R23A, R24A, R25A, R26A, R27A, R28A, R29A, R30A, R31A, R32A, R48, R49 | RES, SMD, 0603, 0Ω, 1/10W, TF, ROHS | Yageo | RC0603FR-070RL |
| 1 | R55 | Thick Film Chip Resistor | Panasonic | ERJ-3EKF1001V |
| 2 | R8, R9 | RES, SMD, 0603, 10K, 1/10W, 1%, TF, ROHS | Panasonic | ERJ-3EKF1002V |
| 1 | R50 | Thick Film Chip Resistor | Panasonic | ERJ-3EKF1071V |

| Qty | Reference Designator | Description | Manufacturer | Manufacturer Part |
|-----|----------------------|---|-----------------------------|-----------------------|
| 2 | R51, R53 | Thick Film Chip Resistor | Panasonic | ERJ-3EKF1741V |
| 1 | R54 | Thick Film Chip Resistor | Panasonic | ERJ-3EKF24R9V |
| 1 | R52 | Thick Film Chip Resistor | Panasonic | ERJ-3EKF5760V |
| 2 | U6, U7 | Radiation Hardened Adjustable Positive Regulator | Renesas Electronics America | HSYE-117RH-Q |
| 1 | U3 | Ron 20mΩ Radiation Harden 10A Protection Switch | Renesas Electronics America | ISL70062SEH/PROTO |
| 1 | U4 | Radiation Tolerant 5V 16-Channel Analog Multiplexer | Renesas Electronics America | ISL71030MNZ |
| 1 | U8 | 4.096V Rad-Hard Ultra Low Noise Precision Voltage Reference | Renesas Electronics America | ISL71091SEHVF40/PROTO |
| 1 | U9 | RAD Hard Single Channel 14-Bit 1MSPS SAR ADC Converter | Renesas Electronics America | ISL73141SEHVF7/PROTO |
| 4 | JP1, JP2, JP3, JP4 | CONN-HEADER, 1×2, RETENTIVE, 2.54mm, 0.230×0.120, ROHS | BERG/FCI | 69190-202HLF |
| 2 | J1A, J2A | 120 pin QTH Series Connector | Samtec | QTH-060-01-F-D-A |
| 1 | | 40-Pin Ribbon Cable, Socket to Socket, 0.100" Pitch | Samtec | IDSD-20-D-24.00 |
| 4 | JP1, JP2, JP3, JP4 | CONN-Jumper, Shunt, 2P, 2.54mm Pitch, BLK, 6mm, OPEN, ROHS | Sullins | SPC02SYAN |

2.4 Evaluation Board Layout

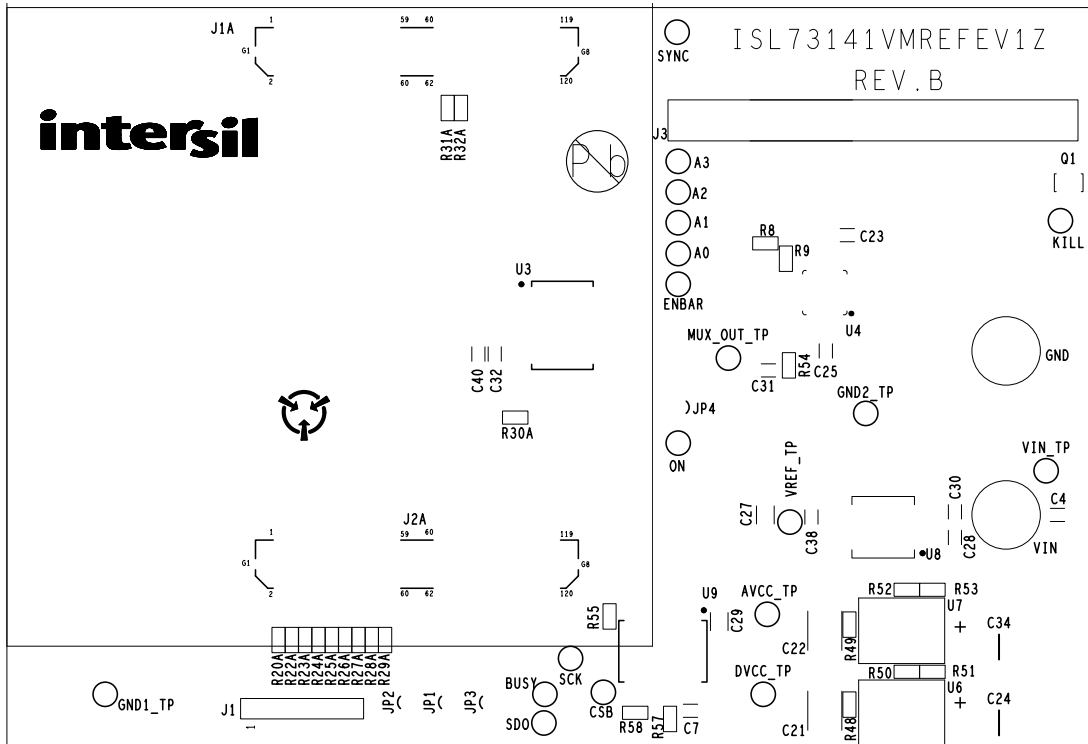


Figure 32. Top Silkscreen

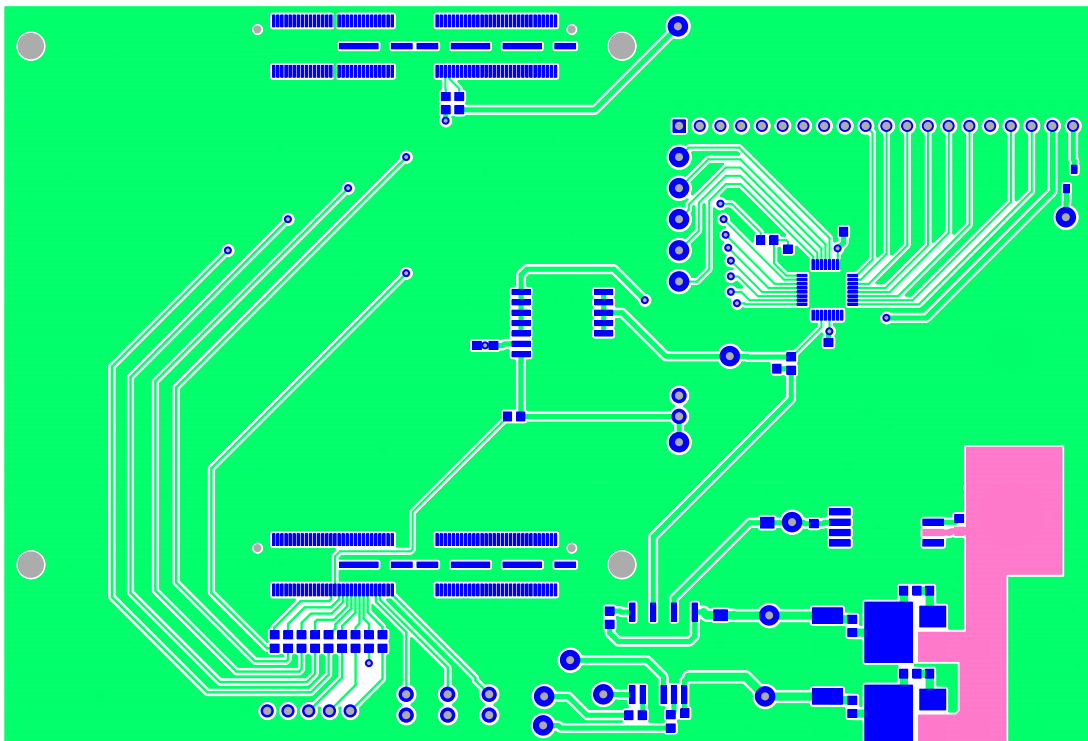


Figure 33. Top Layer

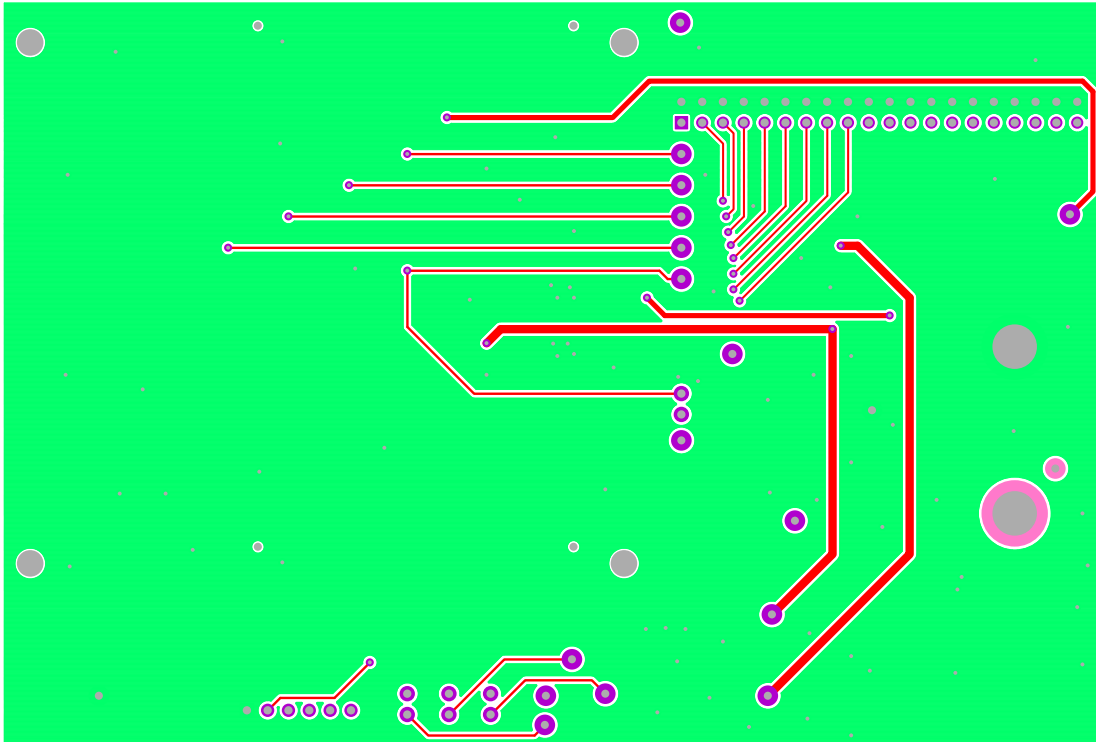


Figure 34. Bottom Layer

3. Ordering Information

| Part Number | Description |
|----------------------|--|
| ISL73141VMREFEVKIT1Z | ISL73141SEH ADC Voltage Monitor Reference Design Kit |
| ISL73141VMREFEV1Z | ISL73141SEH ADC Voltage Monitor Reference Board |

4. Revision History

| Revision | Date | Description |
|----------|--------------|--|
| 1.03 | Nov 8, 2024 | Updated iRADNavigator Board Selection section. Added iRADNavigator MCU Firmware Update section. |
| 1.02 | Jun 12, 2024 | Updated Required Equipment section on page 1. Updated Figure 4 title. |
| 1.01 | Feb 7, 2024 | Updated Page 1 information. Updated Ordering table. |
| 1.00 | Jan 9, 2024 | Initial release |

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