

ISL71148VMREFEV2Z

Voltage Monitor Reference Design

Description

The [ISL71148VMREFEV2Z](#) evaluation board and iRADNavigator software GUI are used to demonstrate the [ISL71148M](#) 14-bit SAR ADC in a voltage monitoring application.

The ISL71148VMREFEV2Z voltage monitor reference design board uses the Renesas ISL71148M high precision, 8-channel 14-bit 900ksps SAR ADC paired with the [ISL71010B25](#) voltage reference and the [ISL75054M](#) low noise LDO. The primary use of this reference design is to pair with the [ISLRTPFDEMO1Z](#) reference design board. The ISL71148VMREFEV2Z board uses the Renesas RA6M3 MCU to interface to the ADC and iRADNavigator software.

The ISLRTPFDEMO1Z produces all 16 power supply voltages required to power the Microchip RT PolarFire® device. The RA6M3 MCU switches between two ISL71148M ADCs by placing the unused ADC in powerdown while reading from the active ADC. This allows the selection of those 16 power supply voltages using the integrated 8-channel MUX in each ISL71148M ADC. The voltages are digitized by the ISL71148M and read by the iRADNavigator software. Two ISL75054Ms provide the AVCC and DVCC supply rails to the ISL71148M. The ISL71010B25 precision voltage reference provides the VREF (2.5V) for the ISL71148M to set the analog input range. Where the voltage level of the RT PolarFire power supply voltages is greater than the ADC reference voltage, a resistive voltage divider circuit is used so the voltages fall within the analog input range of the ADC. The subsequent values read in by the iRADNavigator software GUI are scaled to display the correct value. [Figure 1](#) shows a block diagram of the reference design circuit.

This evaluation system supports a text or graphical display of the selected power supply voltage of the ISLRTPFDEMO1Z board in the iRADNavigator software. Any number of voltages from 1 to 16 can be displayed in the software in a text-based format. Up to 16 voltages can be displayed in a graphical format simultaneously.

Key Features

This evaluation board 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 ADC with integrated 8-channel MUX, the precision reference, and the low dropout voltage regulators.

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

Specifications

- +12V power supply input (from a bench top power supply if not connected to the ISLRTPFDEMO1Z board)
- Main system components support -55°C to +125°C operation
- Supporting components support -40°C to +85°C operation

Contents

- ISL71148VMREFEV2Z ADC evaluation board
- USB 2.0 cable Type A to USB-C

Required Equipment

To properly operate the ISL71148VMREFEV2Z board the following equipment is required:

- Renesas [iRADNavigator software](#)
- 12V power supply (if not connected to the ISLRTPFDEMO1Z board)
- PC running Windows 10 or greater

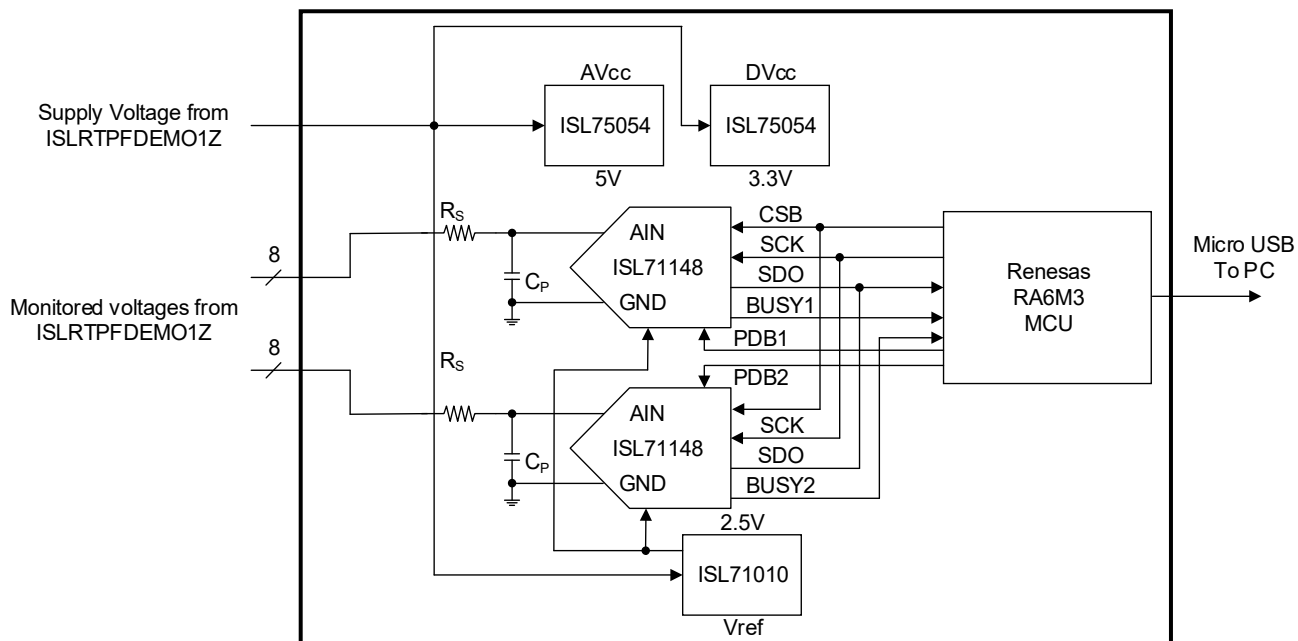


Figure 1. ISL71148VMREFEV2Z Block Diagram

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1. Functional Description

The ISL71148VMREFEV2Z voltage monitor reference design board operates with the ISLRTPFDEMO1Z reference design board. However, it can be mated to other boards with a compatible FMC VITA 57 connector and with similar topology, which has 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 16 voltages that are monitored.

Table 1. ISL71148VMREFEV2Z Power Supply Rails and Voltages

Voltage Value (V)	Power Supply Rail Name
1/1.05	VDD
1/1.05	VDDA
2.5	VDD25/VDDA25
1.8	VDD18
1.2	VDDI (0,1,6,7)
1.5	VDDI (2,4,5)
2.5	VDDI3
N/A	VDD Current
2.5	VDD_XCVR_CLK
1.25	XCVR_VREF
1.2	VDDQ
0.6	VTT
2.5	VDDAUX (2, 4, 5)/VPP
5	5V
3.3	3.3V
N/A	Input Current

[Figure 2](#) shows the top side of the ISL71148VMREFEV2Z board. The alignment holes on the ISL71148VMREFEV2Z board should sit in the standoffs on the ISLRTPFDEMO1Z board. A +12V input must be applied to the ISLRTPFDEMO1Z board to power up all the supply rails. The ISLRTPFDEMO1Z board powers the ISL71148VMREFEV2Z through the FMC VITA 57 connector. Alternatively, VIN and GND5 test points on the ISL71148VMREFEV2Z board can be used to supply +12V to power the board if not connected to the ISLRTPFDEMO1Z board.

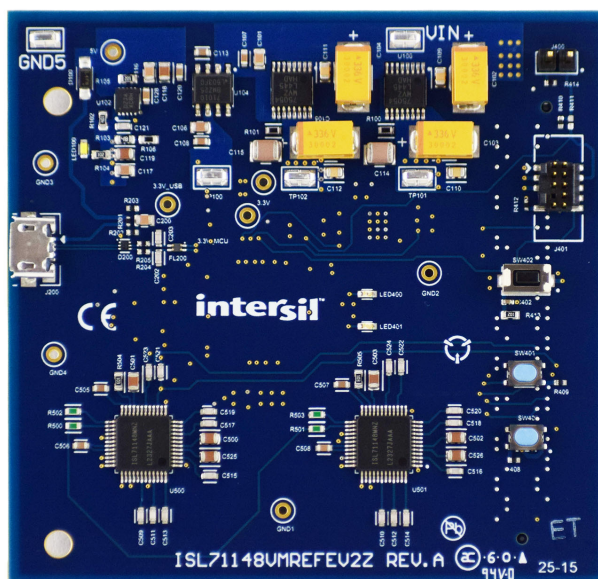


Figure 2. ISL71148VMREFEV2Z Evaluation Board Top

Figure 3 shows the ISL71148VMREFEV2Z evaluation board connected to the ISLRTPFDEMO1Z power reference design board. All of the main system components of the signal chain are radiation hardened products. 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.

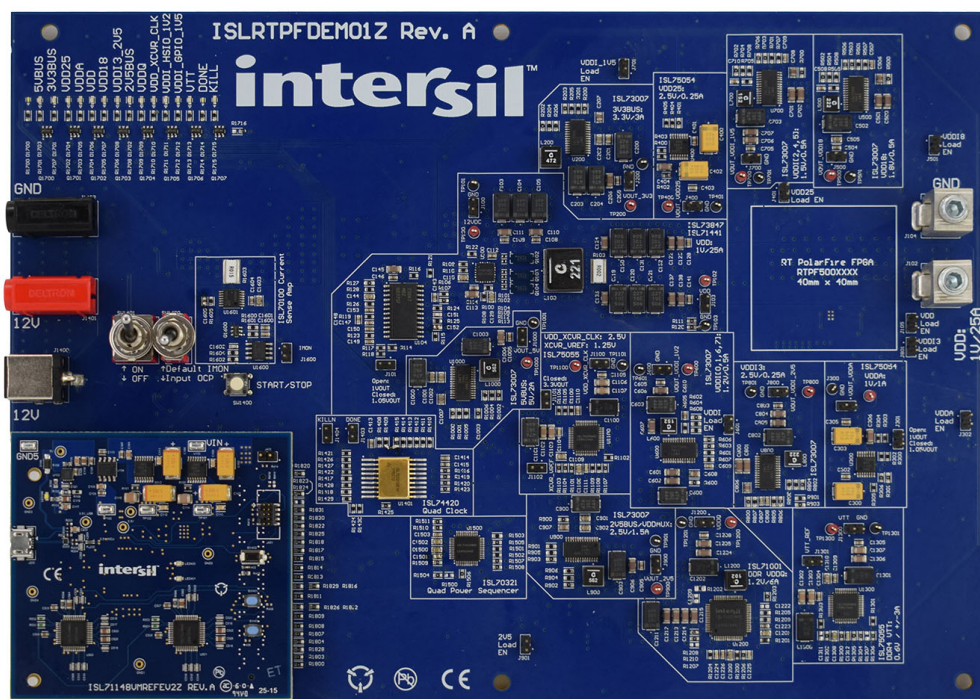


Figure 3. ISL71148VMREFEV2Z Evaluation Board with ISLRTPFDEMO1Z Power Reference Design Board

Provide power for the ISL71148VMREFEV2Z and the ISLRTPFDEMO1Z reference design boards using a 12V power supply connected to the 12V and GND connections on the ISLRTPFDEMO1Z board. A USB 2.0 to USB-C cable is connected to J200. This cable allows for programming of the RA6M3 MCU on the ISL71148VMREFEV2Z board and also facilitates data transfer of the ADC data from the MCU to the PC, which is subsequently processed in the iRADNavigator software GUI. Power is provided to the RA6M3 MCU circuitry through the USB 2.0 cable while the VIN and GND5 connections on the ISL71148VMREFEV2Z can provide power to the ISL71148M and its associated circuitry if not connected to the ISLRTPFDEMO1Z board.

1.1 Evaluation Board Operation

The ISL71148VMREFEV2Z reference design board operates with the ISLRTPFDEMO1Z to show the 16 power supply rails provided. The two boards are connected using an FMC VITA 57 connector, which supplies the power supply voltages from the ISLRTPFDEMO1Z board to the ISL71148VMREFEV2Z board. These voltages are input to two ISL71148M devices on the ISL71148VMREFEV2Z board. The iRADNavigator software GUI drives the voltage selection to provide to one of two ISL71148M devices at a given time to perform a voltage measurement. The ISL71010B25 provides the reference voltage (2.5V) to the ISL71148M, which in turn sets the analog input range of the ISL71148M. Some of the voltages from the ISLRTPFDEMO1Z are outside of this range, so the voltage is divided by a resistive divider in the hardware on the ISLRTPFDEMO1Z board, and then the iRADNavigator software scales this voltage accordingly to report the correct voltage.

The ISL71010B25, ISL75054M, and ISL71148M 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 and Powering the ISL71148VMREFEV2Z and ISLRTPFDEMO1Z Boards

Complete the following steps to connect the boards successfully.

1. Connect the supplied ISL71148VMREFEV2Z evaluation board to the ISLRTPFDEMO1Z board.
2. Connect the supplied USB Type A to USB-C cable from the PC to the ISL71148VMREFEV2Z evaluation board.
3. Connect +12V to the ISLRTPFDEMO1Z board.
4. Observe LEDs LED100, LED400, and LED401 on the ISL71148VMREFEV2Z board to ensure they are on.
Note: LED100 is solid white, while LED400 is blinking red and LED401 is blinking green.

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 **ISL71148_RT PolarFire®** from the list and then click the **Select** button.

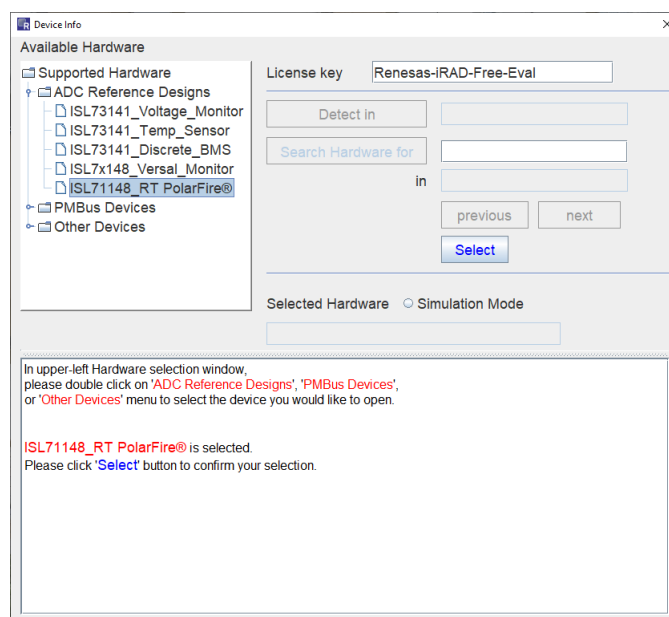


Figure 4. iRADNavigator Board Selection

After clicking **Select**, the GUI loads the screen shown in [Figure 5](#), which shows the ISL71148_RT PolarFire board is selected and the available board communication options. Click **Connect** to connect the GUI to the board.

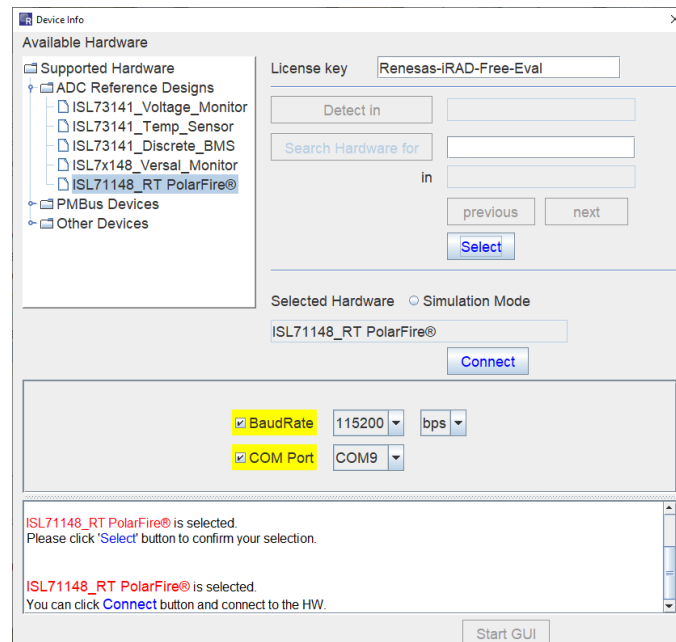


Figure 5. iRADNavigator Board Selection and Communication Options

The **Start GUI** button is enabled when communication is established to the ISL71148VMREFEV2Z board. Click the **Start GUI** button to proceed.

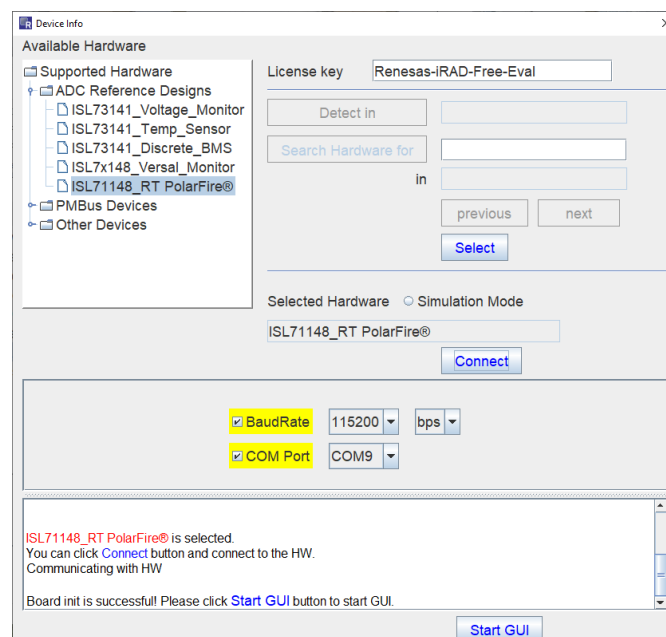


Figure 6. iRADNavigator Start GUI

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 ISL71148VMREFEV2Z board from the ISLRTPFDEMO1Z board. All of the available voltages display on this main screen. This screen shows the power rail system configuration on the ISLRTPFDEMO1Z board and the expected voltages. All the voltage selections on this screen can be read from the ISLRTPFDEMO1Z board.

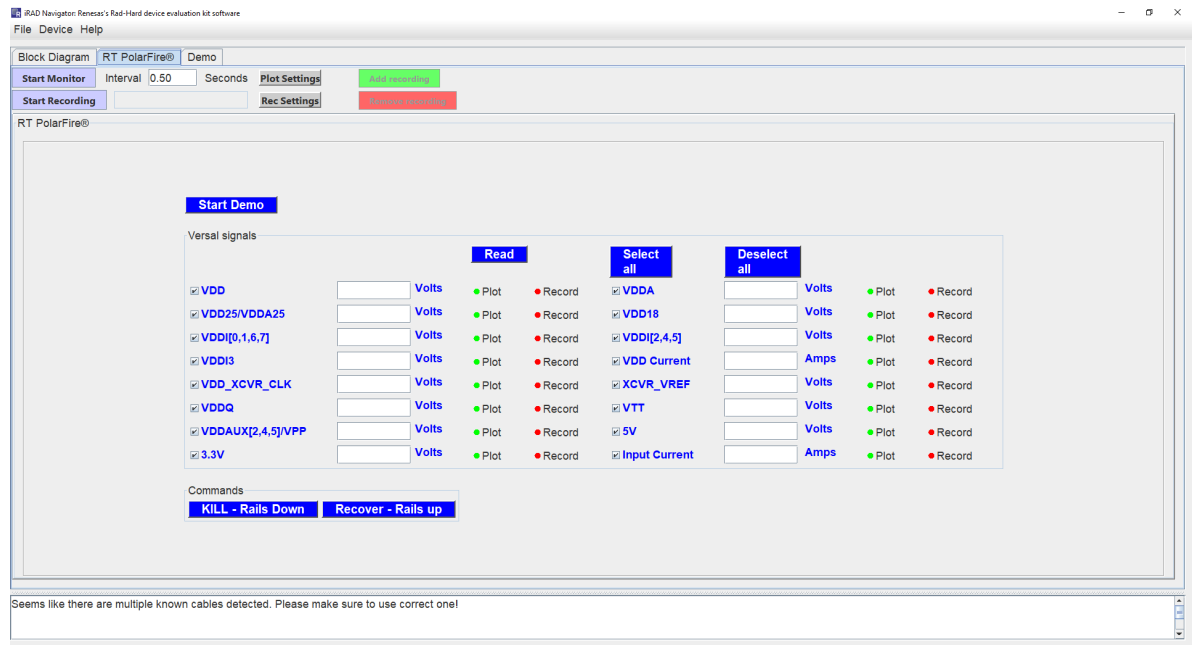


Figure 7. iRADNavigator Voltage Selection Main Screen

From this screen, click the **Start Demo** button and the voltages begin to display and the GUI automatically switches to the Demo panel as shown in Figure 8. In addition, a second window opens displaying plots for all 16 voltages values. From the Demo panel, individual voltages from the ISLRTPFDEMO1Z board can be displayed by clicking on the values on the right side of the display. The currently selected voltage is highlighted in red and all other values are highlighted in blue.

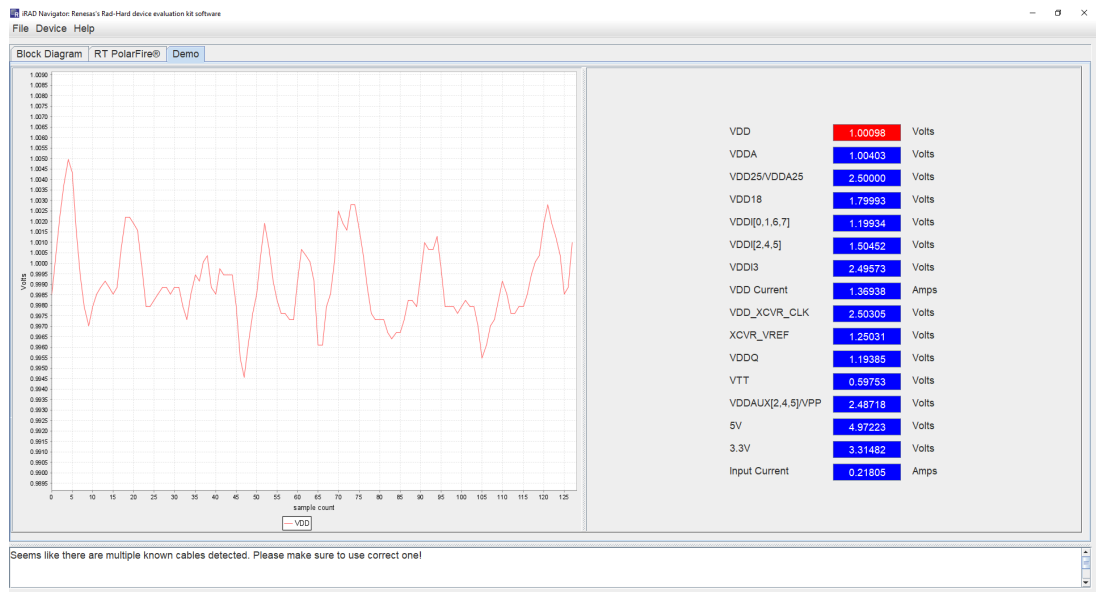


Figure 8. iRADNavigator Updated Voltage Values

Alternatively, checking the box beside any required voltage and clicking the **Read** button to obtain a single measurement is also an option. *Note:* Click on **Stop Demo** before selecting voltages for reading or adding to the monitor. Each time the **Read** 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 9. After clicking the **Start Monitor** button a plot window automatically opens showing all 16 voltages in Figure 10. Similarly, clicking on the button also opens the voltage plotting window.

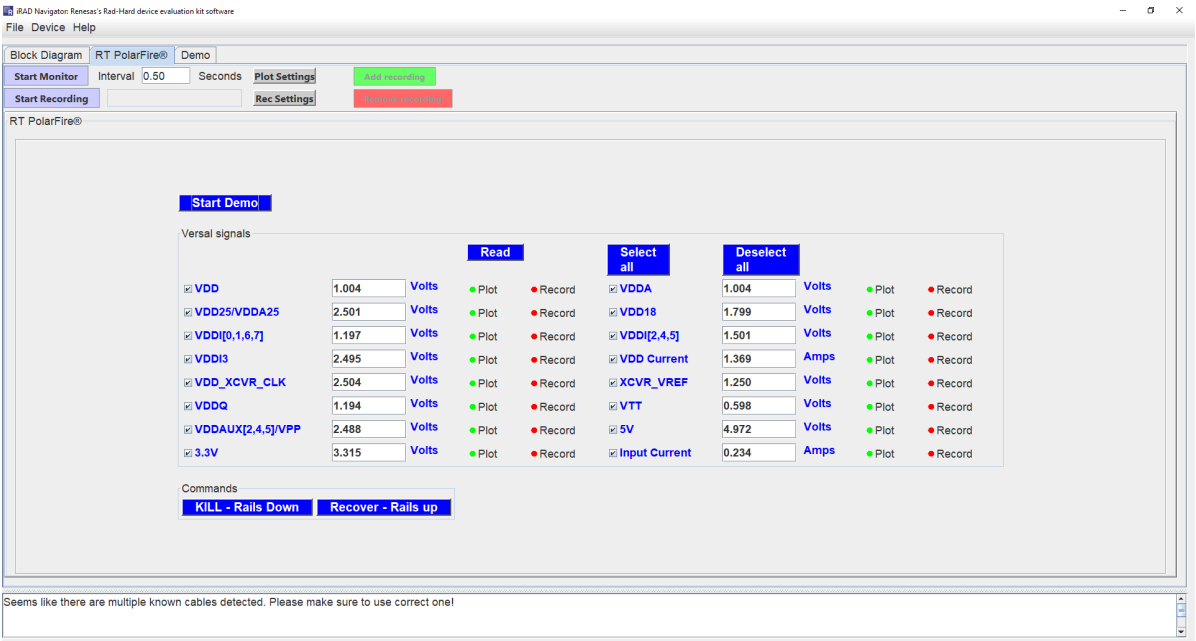


Figure 9. iRADNavigator Voltage Monitor Plots

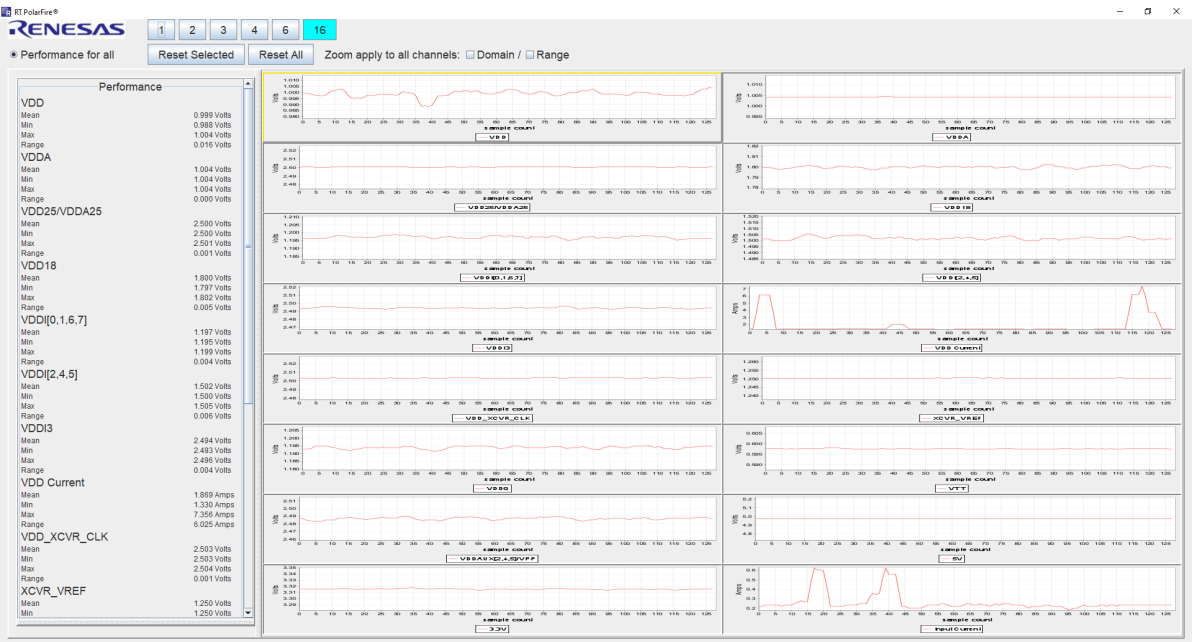


Figure 10. iRADNavigator Voltage Monitor Plots

If performing manual selection, 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 support plotting up to 16 channels at a time.

A couple of features make selecting voltages to monitor quick and simple. This screen has a **Select All** button and a **Clear** button. All voltages are selected by default. Therefore, if only eight are required, either manually deselect the check boxes for the voltages that are not required or click **Clear** and then select the check boxes for the voltages required.

Click **Start Monitor** to begin plotting the voltage measurements. This action opens a separate window that begins plotting the selected voltage measurement. Press the **Start Monitor** from the **RT PolarFire Monitor Panel** button to begin reading and displaying the voltages in the plot window. The voltages begin to periodically update in this display. The iRADNavigator software opens a new window with the selected voltages plotted as shown in [Figure 11](#). The plot window selections are the same regardless if started from the **Start Demo** function or the **Start Monitor** function.

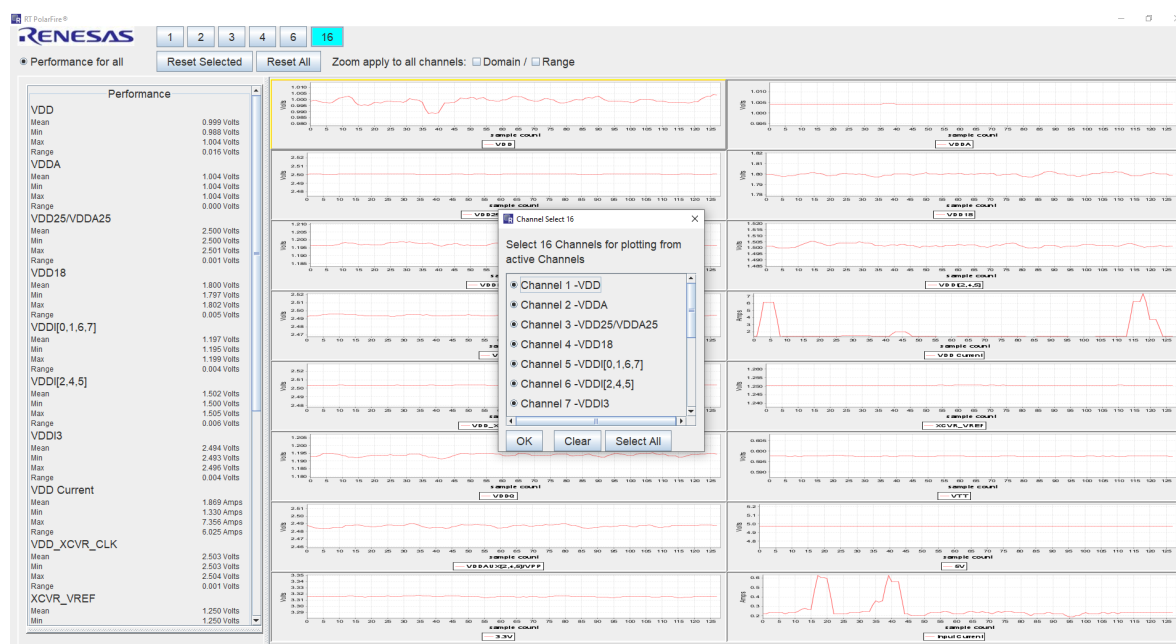


Figure 11. iRADNavigator Voltage Measurement Plot Selection

Click one of the buttons at the top of the new window labeled 1, 2, 3, 4, 6, and 16 to enable the selection of voltage plots, allowing plotting up to the 16 voltages selected. This action also opens a new window, allowing the voltage selection to add to the plot, as shown in [Figure 11](#). In the plot window, all 16 voltages are selected by default. Select the required voltages from this window, and when complete, select **OK**.

In the example shown in [Figure 12](#), six voltages are selected for plotting. To stop plotting data return to the RT PolarFire Monitor tab and select **Stop Monitor**. If plotting was initiated with **Start Demo** then click **Stop Demo** to stop plotting.

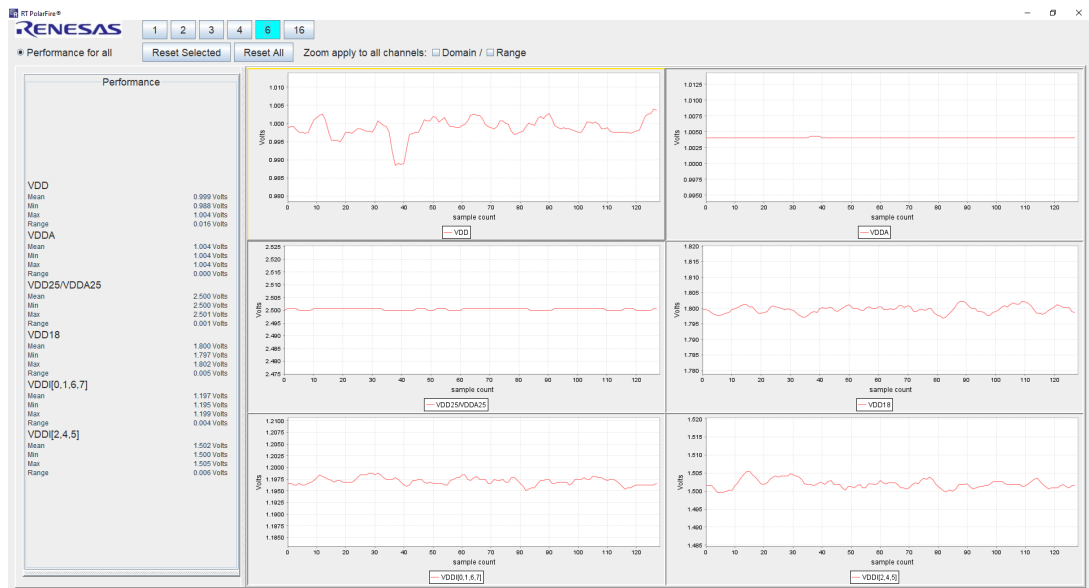


Figure 12. iRADNavigator Voltage Measurement Select Six Voltage Plots

The ISLRTPFDEMO1Z has manual switches on the board that allow for the power supply rails to be taken down. This can also be done through the ISL71148VMREFEV2Z board with selections within iRADNavigator. To take the rails down, click on the **KILL - Rails Down** button in the RT PolarFire panel. When selected, the text turns gray to indicate the button has been activated and the power supply voltages drop to at or near 0V.

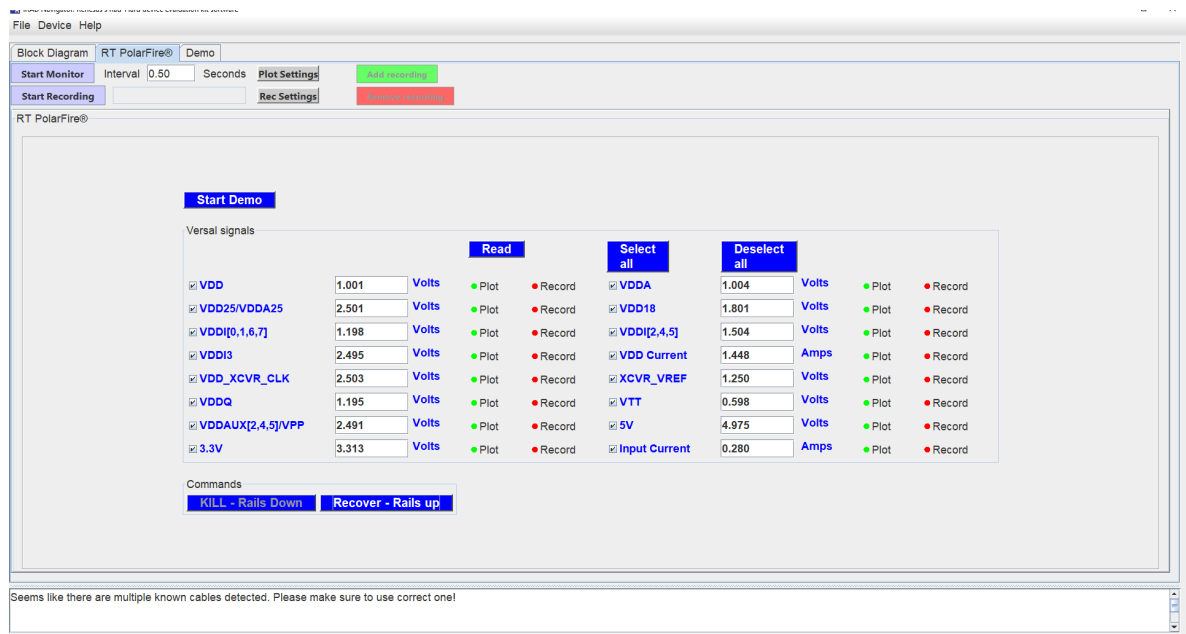


Figure 13. ISL71148VMREFEV2Z Power Supply Rail KILL Function

Similarly, the ISLRTPDEMO1Z has manual switches on the board that allow for the power supply rails to be brought up. In this case, however, this software feature can only be used after the power supply rails have been initially brought up with the manual switches on the ISLRTPDEMO1Z board and the **KILL - Rails Down** button has previously been selected. To bring the rails up, click on the **Recover - Rails Up** button in the RT PolarFire panel. When selected, the text turns gray to indicate the button has been activated and the power supply voltages return to their respective values.

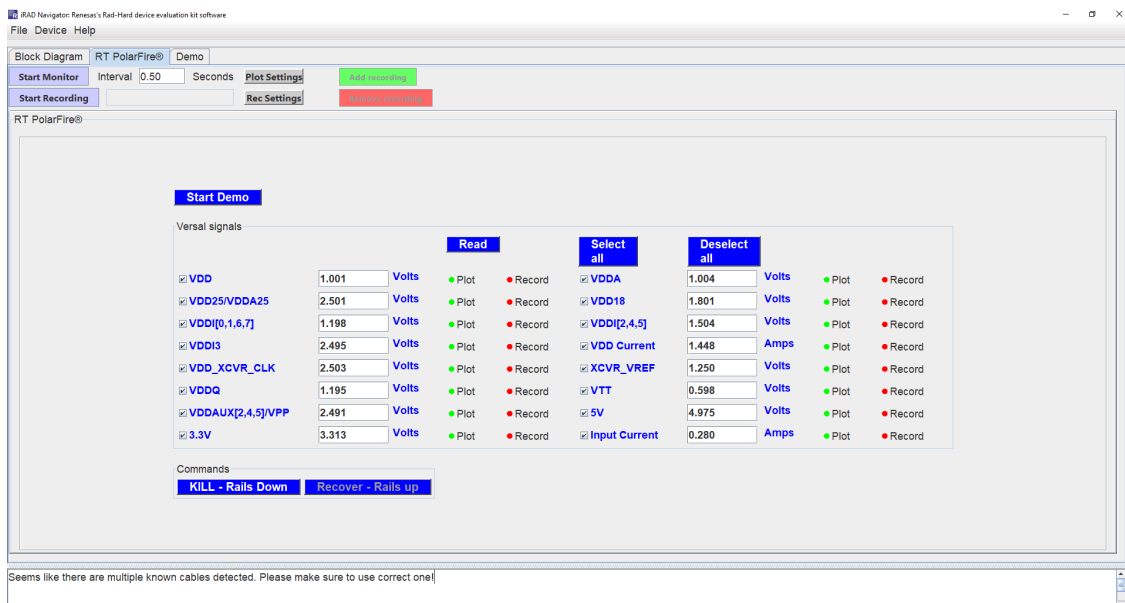


Figure 14. ISL71148VMREFEV2Z Power Supply Recover Function

Within iRADNavigator there is a block diagram view of the power supply design for the ISLRTPFDEMO1Z board. This block diagram provides details on the configuration of the different power supply rails along with the Renesas power products used in the design. To view the details, select the Block Diagram panel within iRADNavigator. From this view, all the power supply rail voltages are updated if iRADNavigator is currently running in the Demo mode or in the Monitor mode where the voltages are actively read. From this view, the KILL and Recover functions can also be activate in the same manner because they are from the RT PolarFire panel.

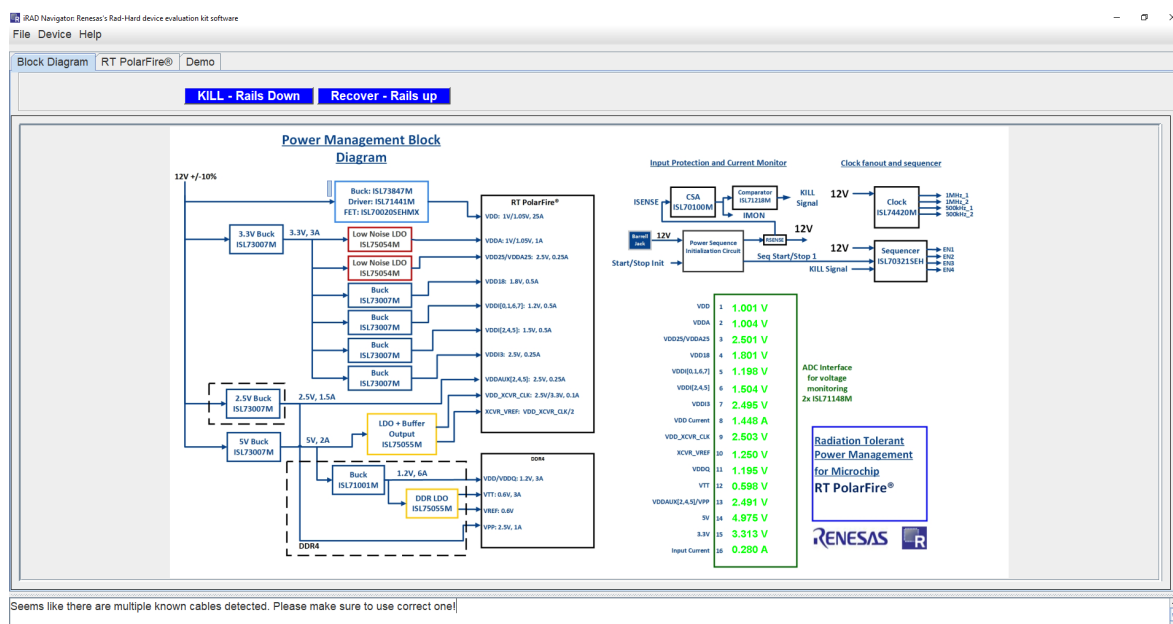


Figure 15. ISLRTPFDEMO1Z Power Supply Block Diagram Panel

2. Board Design

2.1 ISL71148VMREFEV2Z Evaluation Board

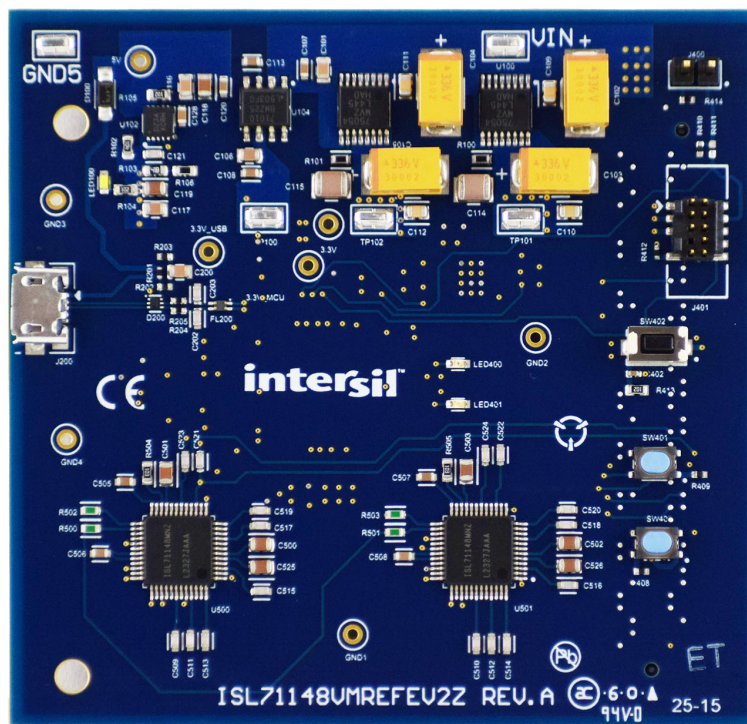


Figure 16. ISL71148VMREFEV2Z Evaluation Board (Top)

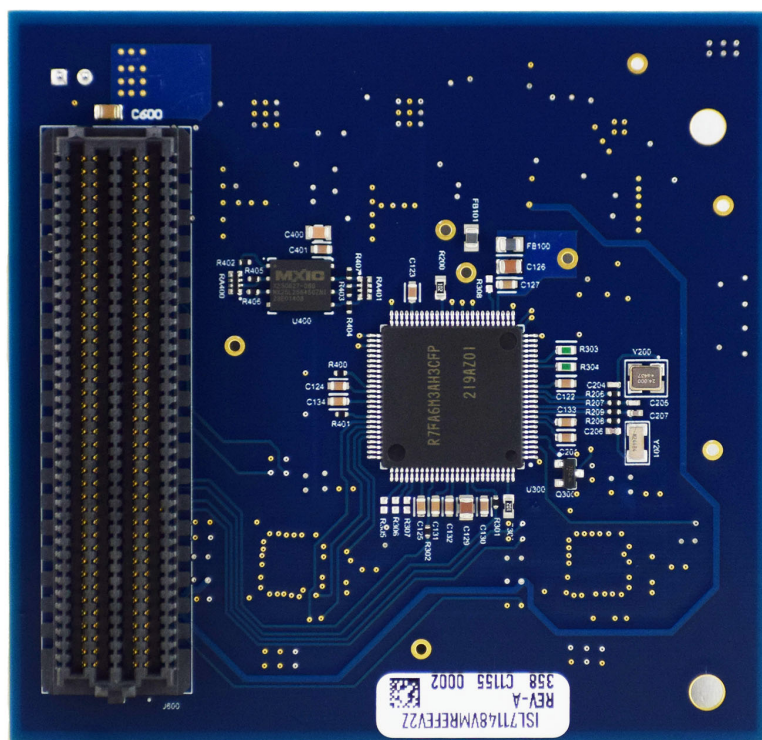


Figure 17. ISL71148VMREFEV2Z Evaluation Board (Bottom)

2.2 Board Schematics

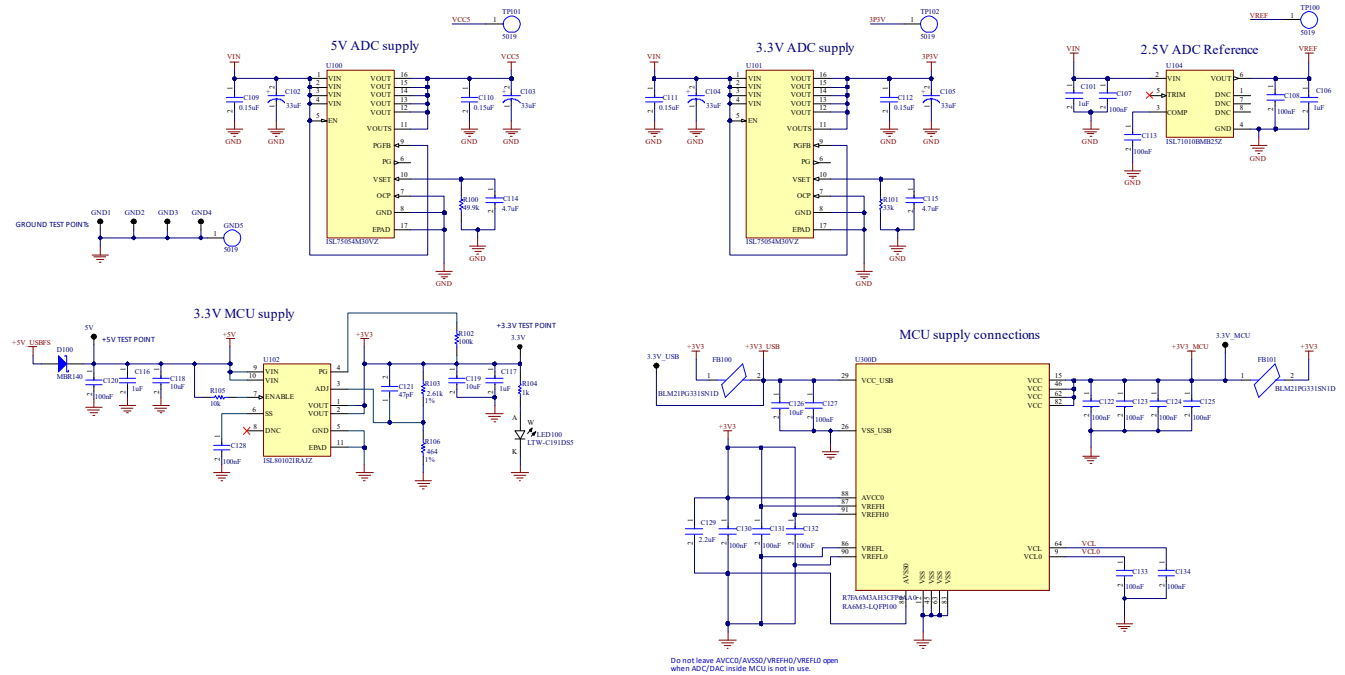


Figure 18. ADC and MCU Power Supply Circuit

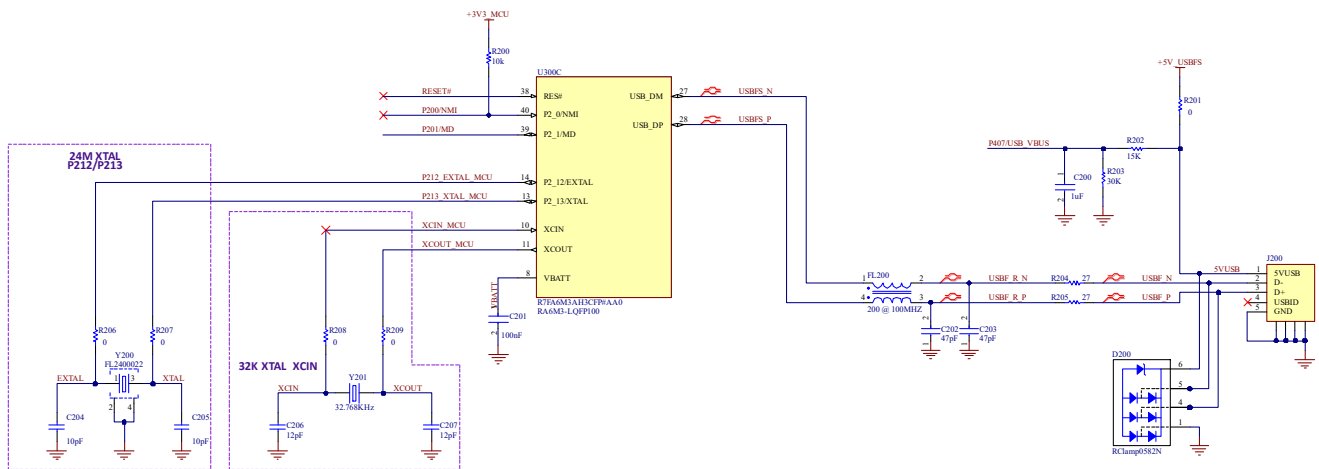


Figure 19. USB Interface and Clock Circuit

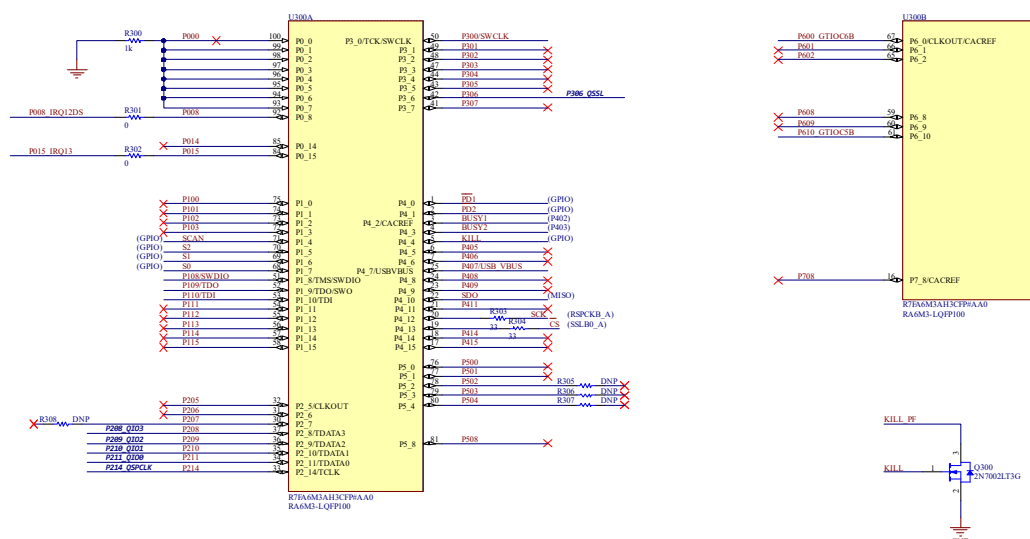


Figure 20. MCU I/O Port Circuit

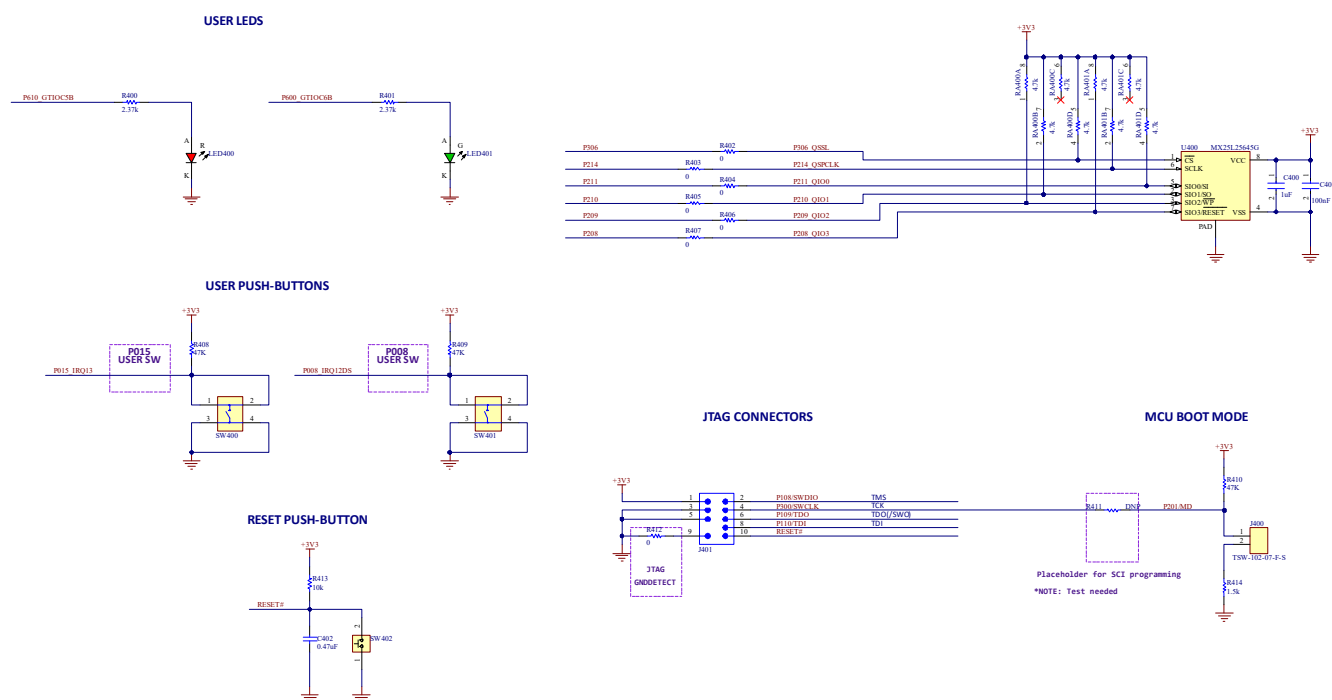


Figure 21. Button, LED, QSPI Flash, and JTAG Circuits

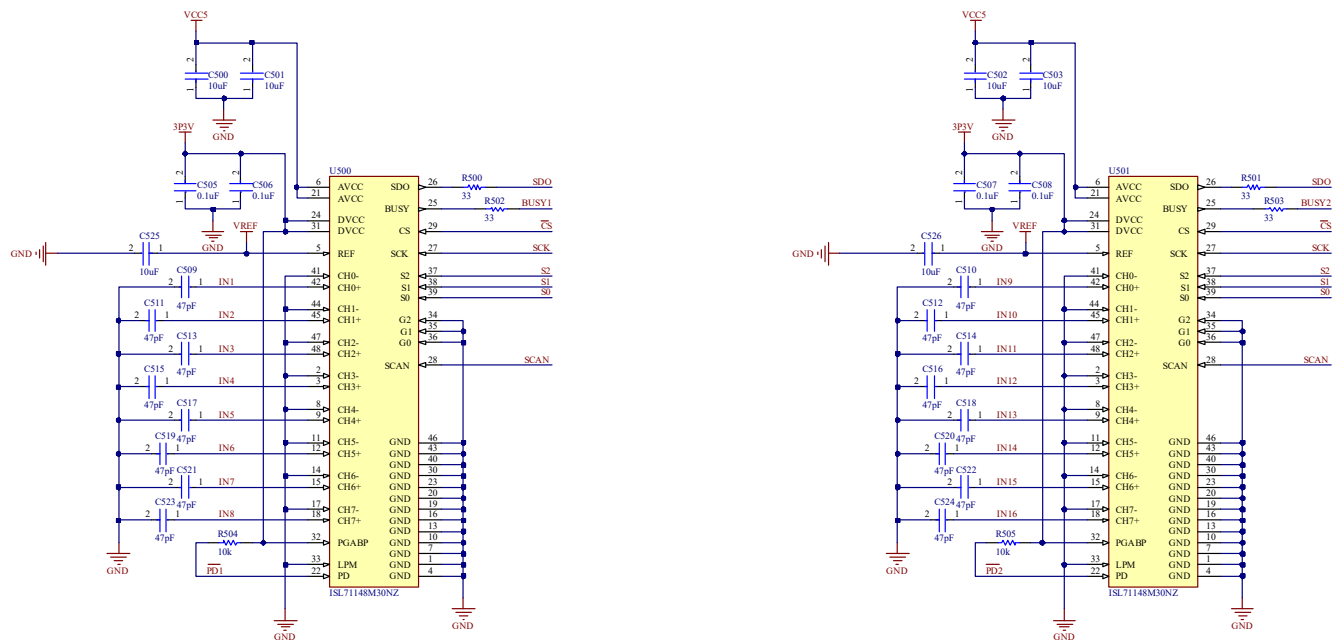
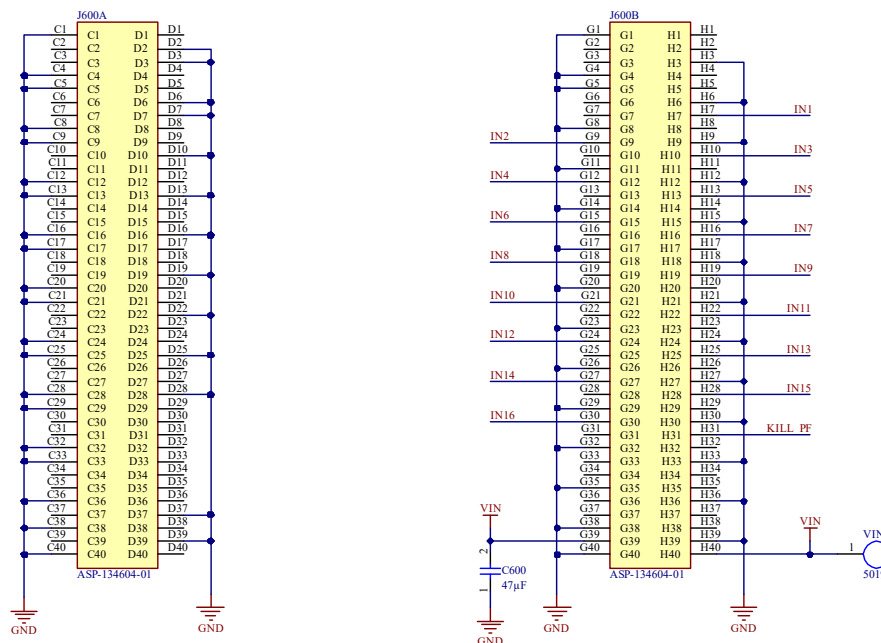


Figure 22. ADC Circuit



*FMC Connector Mounted to Bottom Side of Board

Figure 23. Board Connector Circuitry

2.3 Bill of Materials

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
1	-	PWB-PCB, ISL71148VMREFEV2Z, REV B, ROHS	Imagineering Inc	ISL71148VMREFEV2ZB
6	C100	CAP CER 47µF 10V X5R 0805	Murata	GRM21BR61A476ME15L
4	C101, C106, C116, C117, C200, C400	Cap Ceramic 1µF 25V X7R 10% Pad SMD 0805 +125°C Automotive T/R	TDK	CGA4J1X8R1E105K125AC
17	C102, C103, C104, C105	Tantalum Capacitor, Polarized, Tantalum (dry/solid), 35V, 10% +Tol, 10% -Tol, 33µF, Surface Mount, 2917	Kyocera AVX	TPME336K035R0065
4	C107, C108, C113, C120, C122, C123, C124, C125, C127, C128, C130, C131, C132, C133, C134, C201, C401	Multilayer Ceramic Capacitors 100nF ±10% 75V X7R SMD 0603	TDK	C1608X7R1H104K080AA
2	C109, C110, C111, C112	General Purpose Ceramic Capacitor, 0805, 150nF, 10%, X7R, 15%, 50V	Kyocera AVX	08055C154KAT2A
9	C114, C115	General Purpose Ceramic Capacitor, 1210, 4.7µF, 10%, X7R, 15%, 50V	Kyocera AVX	12105C475KAT2A
20	C118, C119, C126, C500, C501, C502, C503, C525, C526	Multi-Layer Ceramic Capacitor 10µF 25V AEC ±10% 0805	TDK	CGA4J1X7S1E106K125AC
1	C121, C202, C203, C504, C509, C510, C511, C512, C513, C514, C515, C516, C517, C518, C519, C520, C521, C522, C523, C524	Multi-Layer Ceramic Capacitor 47pF 50V NP0 ±5% 0603	Murata	GRM1885C1H470JA01D
2	C129	Cap Ceramic 2.2µF 25V X7R 10% Pad SMD 0805 +125°C Automotive T/R	TDK	CGA4J1X8L1V225K125AC
2	C204, C205	Ceramic Chip Capacitor 0402 10pF 50V	Yageo	CC0402JRNPO9BN100
1	C206, C207	Ceramic Chip Capacitor 0402 12pF 50V	Samsung	CL05C120JB5NNNC
4	C402	Ceramic Chip Capacitor 0402 0.47µF 10V	Samsung	CL05A474KP5NNNC
1	C505, C506, C507, C508	Multi-Layer Ceramic Capacitor 0.1µF 50V NP0 ±10% 0603	TDK	CGA3E2X7R1H104K080AA
1	D100	OnSemi Schottky Power Rectifier 40V 1A	On Semi	MBR140SFT1G
2	D200	Semtech TVS Diode Array for USB	Semtech	RClamp0582N.TCT
1	FB100, FB101	FERRITE BEAD 330Ω 0805 1LN	Murata	BLM21PG331SN1D

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
1	FL200	Common Mode Filter Inductor, 200Ω CM at 100MHz	Murata	DLP11SN201HL2L
1	J100	Test Jack, 4mm Dia Test Plugs, 10A, 1.94mm, 50V, Red, 571 Series	Deltron	571-0500
1	J101	Test Jack, 4mm Dia Test Plugs, 10A, 1.94mm, 50V, Black, 571 Series	Deltron	571-0100
1	J200	USB Micro 2.0 Female 5 Pin Right Angle	FCI	10118192-0001LF
1	J400	CONN HEADER VERT 2POS 2.54MM	Samtec	TSW-102-07-F-S
1	J401	10 Position Shrouded Header 1.27mm Pitch Pin #7 Removed	Samtec	FTSH-105-01-L-DV-007-K
1	J600	CONN HDR 160POS SMD VITA 57.1 MALE	Samtec	ASP-134604-01
1	LED100	Lite-On LED White, Yellow lens 0603 - VERTICAL	Lite-On	LTW-C191DS5
1	LED400	Würth Elektronik LED RED Clear 0603	Würth Elektronik	150060RS75000
1	LED401	Würth Elektronik LED Green Clear 0603	Würth Elektronik	150060GS75000
1	Q300	Small Signal MOSFET, 60 V, 115 mA, N-Channel, 3-Pin SOT-23, Pb-Free, Tape and Reel	On Semiconductor	2N7002LT3G
1	R100	RES SMD 49.9KΩ 1% 1/10W 0603	Panasonic	ERJ-3EKF4992V
1	R101	RES SMD 33KΩ 1% 1/10W 0603	Panasonic	ERJ-3EKF33802V
1	R102	RES SMD 100KΩ 0.1% 1/10W 0603	Panasonic	ERA-3AEB104V
5	R103	Chip Resistor Thick Film 0603 2.61k 1% 1/10W	Yageo	RC0603FR-072K61L
1	R104, R105, R200, R300, R413	RES SMD 1KΩ 0.1% 1/10W 0603	Panasonic	ERA-3AEB102V
14	R106	Chip Resistor Thick Film 0603 464R 1% 1/10W	Panasonic	ERJ-3EKF4640V
1	R201, R206, R207, R208, R209, R301, R302, R402, R403, R404, R405, R406, R407, R412	Chip Resistor, 0Ω, 0.1 W, -55 to 155°C, 0402 (1005 Metric), RoHS, Tape and Reel	Panasonic	ERJ2GE0R00X
1	R202	Chip Resistor Thick Film 0402 15K01% 1/10W	Panasonic	ERJ-2RKF1502X

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
2	R203	Chip Resistor Thick Film 0402 30K 1% 1/10W	Panasonic	ERJ-2RKF3002X
6	R204, R205	Chip Resistor Thick Film 0402 27 1% 1/10W	Panasonic	ERJ-2RKF27R0X
5	R303, R304, R500, R501, R502, R503	RES SMD 33Ω 0.1% 0.21W 0603	Vishay	TNPW060333R0BEEA
2	R305, R306, R307, R308, R411	DNP	-	-
3	R400, R401	Chip Resistor, 2.37kΩ, 0.1 W, -55 to 155°C, 0402 (1005 Metric), RoHS, Tape and Reel	Panasonic	ERA-2AEB2371X
1	R408, R409, R410	Chip Resistor Thick Film 0402 47K 1% 1/10W	Panasonic	ERJ-2RKF4702X
2	R414	Chip Resistor Thick Film 0402 1.5k 0.5% 1/16W	Panasonic	ERA-2AED152X
2	R504, R505	RES SMD 10KΩ 0.1% 1/10W 0603	Panasonic	ERA-3AEB103V
2	RA400, RA401	Chip Resistor Array 0804 4.7k 5% 1/16W 4 x 0402	Panasonic	EXB-28V472JX
1	SW400, SW401	Switch Tactile SPST-NO 0.05A 16V	C&K	PTS810SJG250SMTRLFS
3	SW402	Switch Tactile SPST-NO 0.05A 12V	Alps Alpine	SKQMASE010
2	TP100, TP101, TP102	PC Test Point Miniature	Keystone Electronics	5019
1	U100, U101	Renesas Radiation Tolerant Ultra Low Noise LDO	Renesas	ISL75054M30VZ
1	U102	IC Reg Linear POS ADJ 2A 10DFN	Renesas	ISL80102IRAJZ
1	U104	Renesas Ultra Low Noise, 2.5V Precision Voltage Reference	Renesas	ISL71010BMB25Z
1	U300	Renesas RA6M3 120MHz 32-bit Cortex M4 MCU LQFP-100	Renesas	R7FA6M3AH3CFP#AA0
2	U400	Macronix 256Mbit MX25L QSPI 6x5 WSON 8L	Macronix	MX25L25645GZNI-08G
1	U500, U501	Renesas Radiation Tolerant 8-Channel 14-Bit 900/480ksps SAR ADC	Renesas	ISL71148M30NZ
1	Y200	24MHz SMT Xtal 20ppm 10pF	Diodes Inc.	FL2400022
1	Y201	Crystal 32.769KHz 12.5pF SMT	Abracon	ABS07-32.768KHZ-TXTL-000006-01

2.4 Evaluation Board Layout

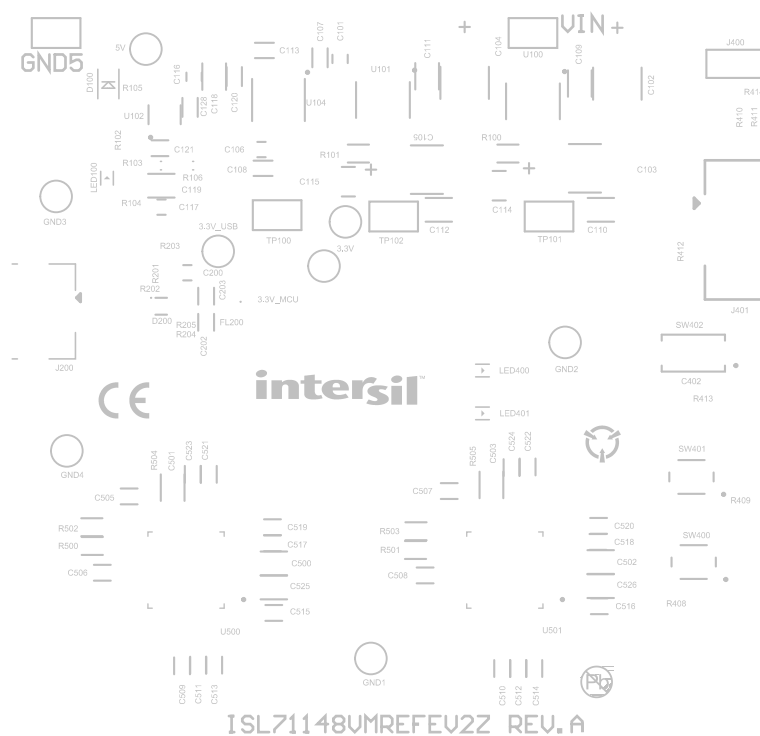


Figure 24. Top Silkscreen

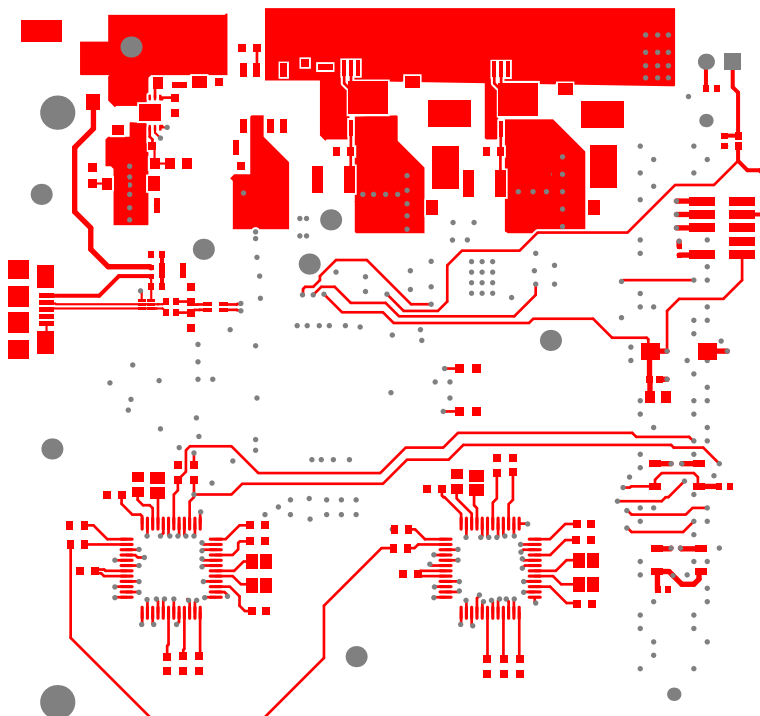


Figure 25. Top Layer

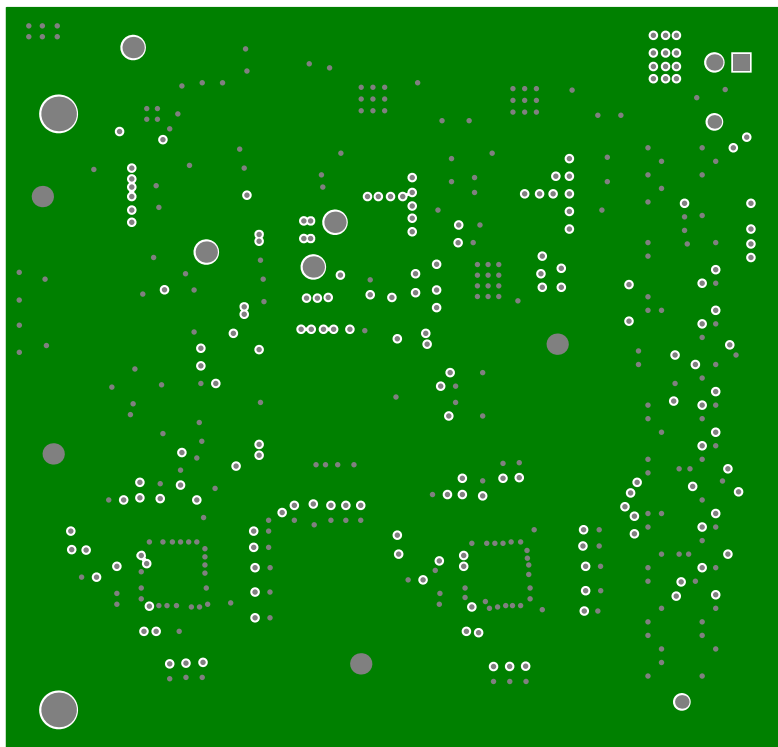


Figure 26. Layer 2

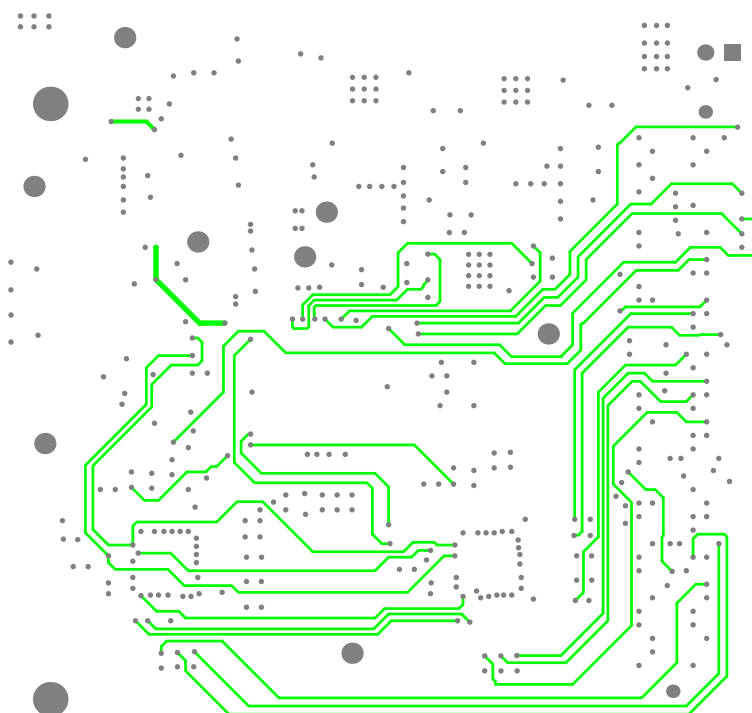


Figure 27. Layer 3

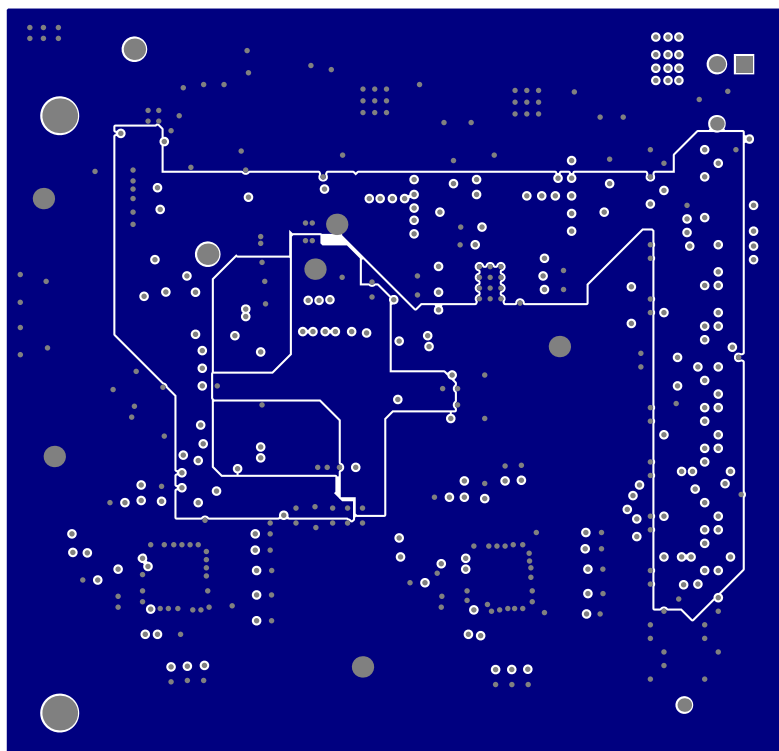


Figure 28. Layer 4

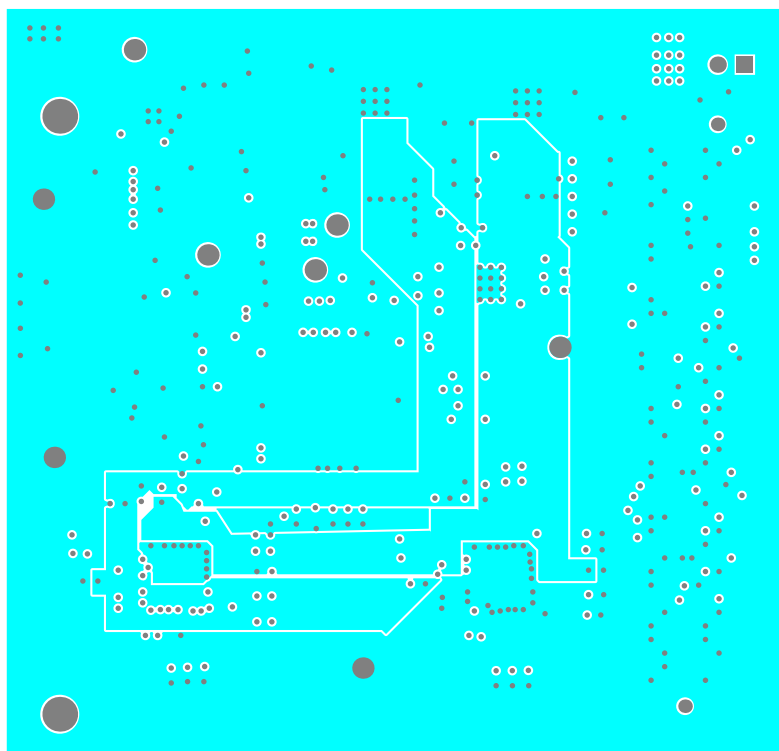


Figure 29. Layer 5

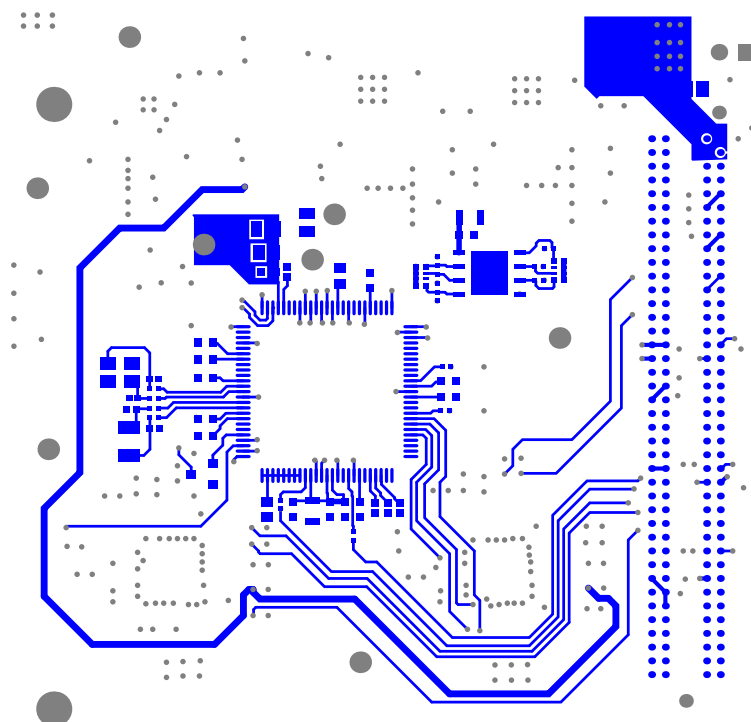


Figure 30. Bottom Layer

Figure 31. Bottom Silkscreen

3. Ordering Information

Part Number	Description
ISL71148VMREFEV2Z	ISL71148M ADC Voltage Monitor Reference Board

4. Revision History

Revision	Date	Description
1.00	July 9, 2025	Initial release

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