ISL94212EVKIT1Z Evaluation Kit User Guide

Description

The ISL94212EVKIT1Z is a kit that facilitates use of the ISL94212 BMS device. The ISL94212 monitors cell voltage and temperature. It converts the cell voltages and temperatures to 14-bit digital values, provides cell balance control, It provides significant fault detection. The ISL94212 can operate in a single device configuration, or multiple kits can be cascaded using a built-in daisy chain connection. The daisy chain hardware provides robust, redundant board-to- board communications.

Specifications

This board has been configured and optimized for the following operating conditions:

- V_{BAT} = 6V to 60V
- V_{BAT} daisy chain = 10V to 60V
- VC_n (for n = 1 to 12) = V(VCn-1) to V(VCn-1) + 5V
- CB_n (for n = 1 to 9) = V(VCn-1) to V(VCn-1) + 9V
- CB_n (for n = 10 to 12) = V(VCn) -9V to V(VCn)
- External inputs Ext_{1-4} = 0V to 2.5V
- SPI communications refer to ISL94212 datasheet
- V_{POR} (V_{BAT}) voltage (rising) typical 5.1V

Key Features

- Supports both stand alone and daisy chained configurations
- Daisy chaining with both connector only or wire jumper options
- GUI provided export option for generation of detailed register and/or SPI communications log files.
- USB dongle runs HID firmware for driver-less enumeration and communications with Windows platforms
- GUI add-in chart generation tool supports real-time graphing, zoom and export of captured data.
- Software provides checksum requirements associated with daisy chain communications.
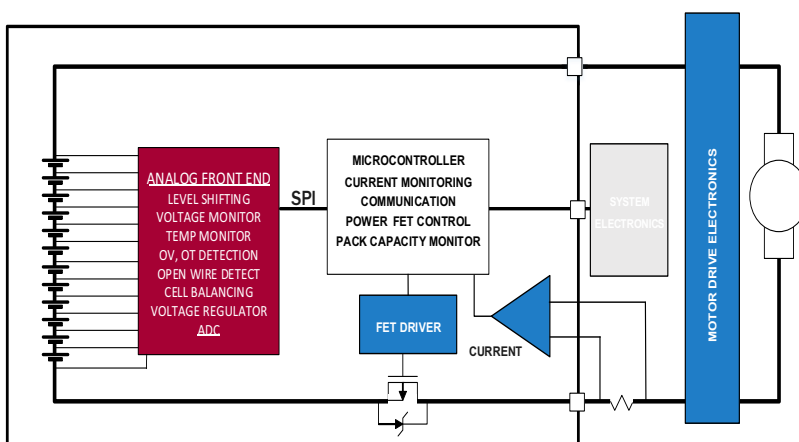- Kit includes "Battery Emulation" board(s) for cell voltages generation.

References

ISL94212 web page

ISL94212 datasheet

Ordering Information

PART NUMBER	DESCRIPTION (Note)
ISL94212EVKIT1Z	ISL94212 master
ISL94212EVZ	ISL94212 slave/daisy chain kit to be used as either "middle" or "top" device(s)

NOTE: See "What is inside" on page 2 for kit details.

Applications requiring 12 cells or less can operate with a single device as shown above.

Also the ISL94212 can also operate in a 2 to 14 device configuration (Daisy Chain). See example to the right.
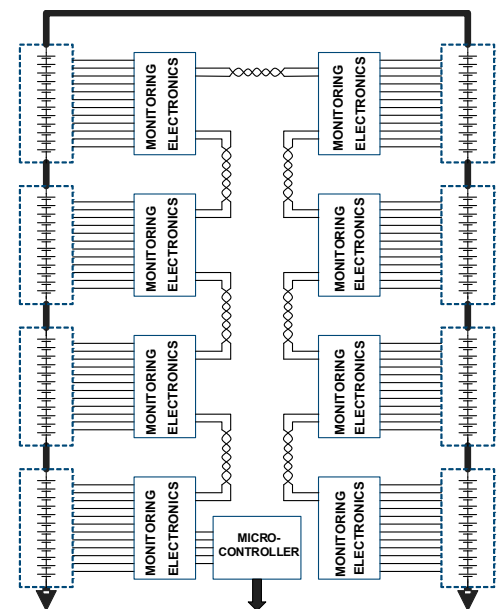
FIGURE 1. SINGLE DEVICE CONFIGURATION

FIGURE 2. DAISY CHAIN CONFIGURATION

Document Overview

The following are three key portions of this document:

Software Installation

The software is necessary to use this evaluation kit. This section guides you through the installation and verification of both the GUI / Windows software and also the USB enumeration of the HID firmware/dongle device for PC to device(s) communication.

Quick Hardware Setup Guide

This section provides information regarding the connection of the various boards and the settings of the configuration options.

Quick GUI Setup Guide (Using the GUI)

The section steps the user through fundamental use of the GUI software. Enough information is provided to establish and verify communications are working properly and enable the user to observe measurements in real time and export data as well.

Functional Description

The ISL94212 evaluation Kit, coupled with the associated GUI provides the means to familiarize oneself with the various instructions capability and operation of the device. A single ISL94212 Li-ion battery manager IC supervises up to 12 series connected cells. The part provides accurate monitoring, cell balancing and extensive system diagnostics functions.

The kit enables the user to activate and data log voltage and temperature measurements. Cell voltages are supplied via a resistor ladder network in the MCB_PS2_Z multi-cell power supply test board.

The ISL94212 has three cell balancing modes incorporated: Manual Balance mode, Timed Balance mode and Auto Balance mode. The auto balance mode terminates balancing functions when a charge transfer value specified by the host microcontroller has been met. Note: Cell balancing will require the removal of the MCB_PS2_Z multicell power supply test board and attachment of Cell devices that are capable of sourcing and sinking current.

The ISL94212 communicates to a host microcontroller via an SPI interface and to other ISL94212 devices using a robust, two-wire daisy chain system. The primary evaluation board provides configuration options that can be set via switches. These are discussed in detail later in this document.

Connecting multiple Intersil boards allows the user to setup communications and measurement capability of many packs and up to 185 battery cells. However, one should review the "Quick Hardware Setup Guide" on page 3. There will be safety concerns as voltage levels increase with multiple packs.

What is inside

The ISL94212EVKIT1Z (Master) evaluation kit contains:

- ISL94212EV1Z evaluation board
- MCB_PS2_Z multicell power supply test board
- MCB_MICRO_EVZ multicell power supply test board
- USB cable, connects PC to evaluation board
- 16 conductor flat cable (connects power supply board to evaluation board)
- One daisy chain cable

The ISL94212EV1Z (Slave(s)) evaluation kit contains:

- ISL94212EV1Z evaluation board
- MCB_PS2_Z multicell power supply test board
- 16 conductor flat cable (connects power supply board to evaluation board)
- One daisy chain cable

What is needed

The following instruments will be needed to perform testing:

- 60V/1A adjustable power supply
- Wires to connect power supply to MCB_PS2_Z board
- Precision multimeter
- Oscilloscope (optional)
- Cables and wires (Optional)
- Windows computer with USB port

Operating Range

Single device setup (non-daisy chain) mode can operate with a battery voltage of 6V to 60V. When using less than 12 cells, the user should consult the datasheet regarding cell connections.

However, caution should be employed during daisy chain operation. In this mode, up to 14 boards can be connected. While each board is operating on a relative voltage of up to 60V, this "floating" is accomplished via the AC coupling of the daisy chain circuits. (see below)
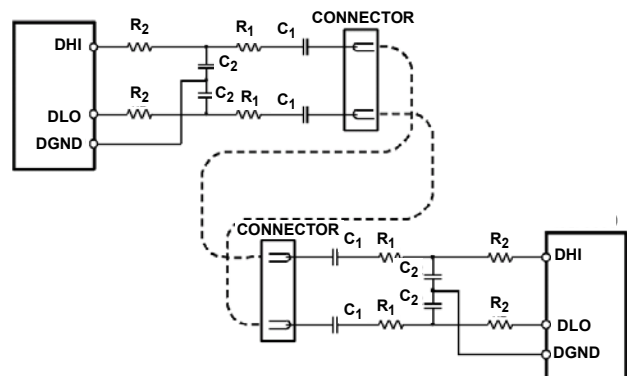
As mentioned in the <u>"Quick Hardware Setup Guide" on page 3</u>, while each board is operation in 60V range, total voltage across multiple packs can be dangerous.

PCB Layout Guidelines

The ISL94212 layout has been optimized for electrical and protection during hot plug conditions.

During layout the designer should consider:

- While the ISL94212 does not dissipate much power itself, the internal temperature sensor might be more functional if a thermal array is incorporated under the QFN thermal slug. The user is invited to review Intersil's Technical Brief <u>TB389</u> regarding the thermal vias and the package pad.
- The user should review closely the artwork, component values and routing of the daisy chain circuitry.
- The standard evaluation board accommodates both connector-to-connector or cabled communication paths. If multiple devices are being used, physical placement/size of the cells should be reviewed in starting you product's layout.
- Finally, the mechanical aspects of the battery pack should be considered. Much as been written regarding damaged BMS PCBs as a result of slight shifting of battery cells. (Cells tend to be heavy and therefore can impart significant force)

Software Installation

This version of software supports both ISL94212 or ISL78600 devices. It has been tested on XP, Win7 and Win8 platforms.

Step 1:   Run the *Intersil_BMS_Vxxx.exe* file. This installs the BMS GUI software to the PC. Depending on your IT department there are a couple of items to address when performing an installation.

Select "Run As Administrator" option when available (Right click in installation program)
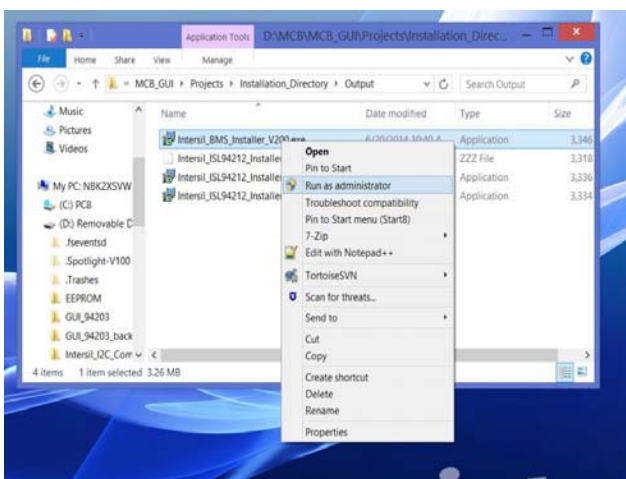
When setting up project installation and shortcut paths, consider using Users\Public instead of program directory.
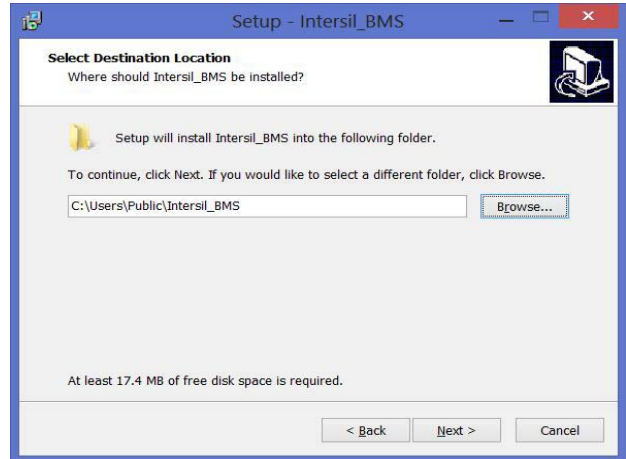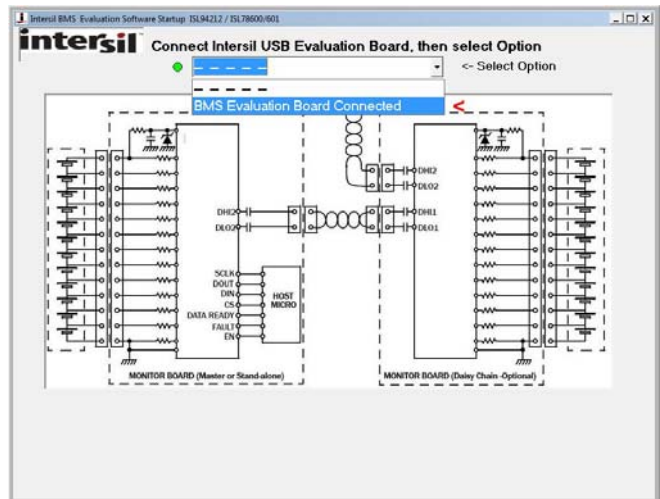

Step 2:   Connecting the evaluation board will result in automatic USB enumeration under the Human Interface section of the Windows device manager.

Quick Hardware Setup Guide

Single Board

Step 1:   A "Startup" screen in the GUI (will wait for you to select the combo box. Compete steps below.)

Step 2:   Connect the MCB_MICRO_EVZ board (J1) to the ISL94212EVZ board (J2). (See <u>Figure 3</u>)

Step 3:   Set the power supply voltage to 39.6V (**3.3V per cell**). If there are fewer cells being tested, reduce the power supply voltage such that it equals 3.3V times the number of cells.)

Step 4:   Connect the power supply to the MCB_PS2_Z board. The positive terminal of the MCB_PS2_Z board is J5/J11 and the negative terminal is J8/J12. Connector J7 can also be used to provide power to the board. The J7 tip is positive and the ring is negative. Check that the voltages on the J3 connector of the board are +3.3V from PIN(n) to Pin(n-1).

Step 5: Turn off the power to the power supply.

Step 6: Connect the flat cable between the MCB_PS2_Z board, connector J1 and the ISL94212EVZ board, connector J1.

Step 7: Check the jumpers and switches on the board. Since this is a single board configuration, the board should be configured as follows:

- SPI/daisy switch set to SPI.

- EN0 and ENR should contain jumpers.

- LEDEN should contain a jumper.

- CMSSel1 (left) and CMSel2 (right) switches both set to "0". This sets single board operation.

- CMRSel1 (left) and CMRSel0 (right) should have jumpers to "1". These set the daisy chain speed and are not used in the single board operation, but it is OK to leave the jumpers in place.

Step 8: Turn on the power to the supply and notice that there is a green LED (VDD), indicating the LDO regulator on the ISL94212 is operating.

The voltages at various points should be:

VDD = 3.3V ±3%
VCC = ~3.3V ±5%(a little lower than VDD)
V2P5 = 2.5V ±2%
VREF = 2.50V ± 0.5%

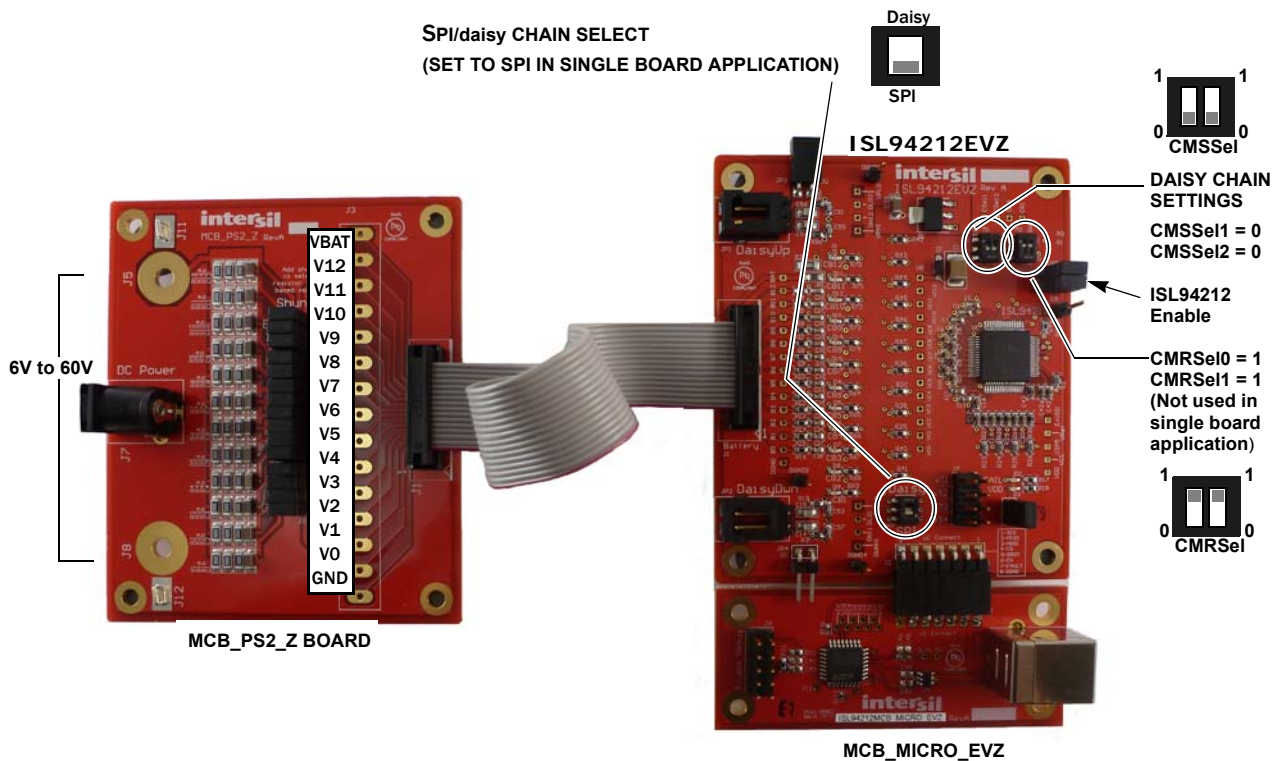Step 9: Connect the USB port of the PC to the USB port of the MCB_MICRO_EVZ board.
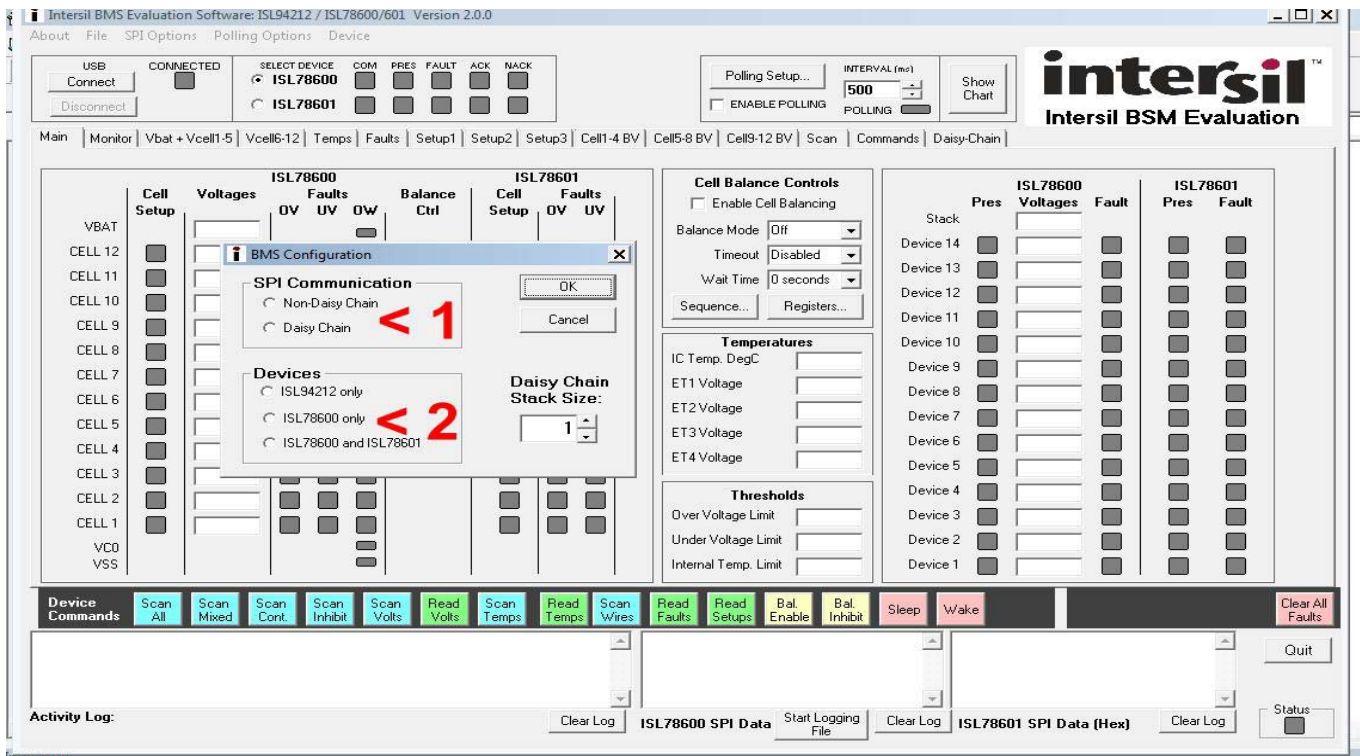
FIGURE 3. ISL94212EVKIT1Z SINGLE BOARD SETUP

FIGURE 4. ISL94212EVZ

Step 10: Open the ISL94212 GUI software, select the "BMS Evaluation Board Connected" in the "Select Option" box as seen in step one. The software will automatically take you to the Configuration Screen. Select "non-daisy chain" and device type, then click "OK." GUI will return to the main screen. Use the software to read the cell voltages and registers

Daisy Chain

Step 1: To Connect all boards, complete steps below. Specify "daisy" chain when configuration screen appears.

Step 2: Connect the MCB_MICRO_EVZ board (J1) to the Master ISL94212EVZ board (J2). (See Figure 5)

Step 3: Set the power supply voltage to 39.6V (**3.3V per cell**). If there are fewer cells being tested, reduce the power supply voltage such that it equals 3.3V times the number of cells.)

Step 4: Connect the power supply to all MCB_PS2_Z boards in parallel. There should be one MCB_PS2_Z board for every evaluation board. This connection is not typical of a battery installation, where the ground of one board is the VBAT of another, but it easily facilitates testing of the communication and allows a safer environment for initial testing.

The positive terminal of the MCB_PS2_Z board is J5/J11 and the negative terminal is J8/J12. Connector J7 can also be used to provide power to the board. The J7 tip is positive and the ring is negative. Check that the voltages on the J3 connector of all boards are +3.3V from PIN(n) to Pin(n-1).

> ⚠️ **USE CAUTION** when connecting the MCB_PS2_Z boards in series, since voltages quickly reach hazardous levels. **BE CAREFUL!**

Step 5: Turn off the power to the power supply.

Step 6: Connect the flat cable between each MCB_PS2_Z board, connector J1 and an ISL94212EVZ board, connector J1.

Step 7: Check the jumpers and switches on the board. Since this is a daisy chain configuration, the boards should be configured as follows:

- SPI/Daisy switch set to SPI on the master. For all other boards, this switch should be set to Daisy.

- EN0 and ENR should contain jumpers.

- LEDEN should contain a jumper.

- CMS1 and CMS2 should have switches set as follows:

TABLE 1. DAISY CHAIN COMMUNICATIONS DATA RATE SELECTION

COMMS RATE 0	COMMS RATE 1	DATA RATE (kHz)
0	0	62
0	1	125
1	0	250
1	1	500

This sets daisy chain operation and locates the boards within the daisy chain.

- CMRSel1 and CMRSel0 should have jumpers set to 1. These set the daisy chain speed at the maximum 500kHz.

Step 8: Connect the daisy chain wires.
The boards can plug together to complete the daisy chain connections, or the enclosed twisted pair cable can connect the boards. Connect as shown in Table 2. See also the 36-cell daisy chain connection Figure 5 on page 7. For a 24-cell connection, drop out the Middle board.

TABLE 2. COMMUNICATIONS MODE CONTROL

COMMS SELECT 1	COMMS SELECT 2	PORT 1 COMM	PORT 2 COMM	COMMUNICATIONS CONFIGURATION
0	0	SPI (Full Duplex)	Disabled	Standalone
0	1	SPI (Half Duplex)	Enabled	Daisy Chain, Master device setting
1	0	Daisy Chain	Disabled	Daisy Chain, Top device setting
1	1	Daisy Chain	Enabled	Daisy Chain Middle device setting

Step 9: Turn on the power to the supply and notice that there is a green LED (VDD) on each board, indicating the LDO regulators on the ISL94212 are operating.

The voltages at various points should be:

VDD = 3.3V ±3%
VCC = ~3.3V ±5% (a little lower than VDD)
V2P5 = 2.5V ± 2%
VREF = 2.50V ±0.5%

> If boards are connected in series, be aware of the voltage potentials between the different boards when measuring and monitoring signals with a meter or a scope.

Step 10: Connect the USB port of the PC to the USB port of the ISL94212EVZ daisy chain master board.

Step 11: Open the ISL94212 GUI software.
Select **Daisy Chain Mode** in the Device Menu at the top left of the screen. **Click Connect.** Use the software to read the cell voltages and other register content.
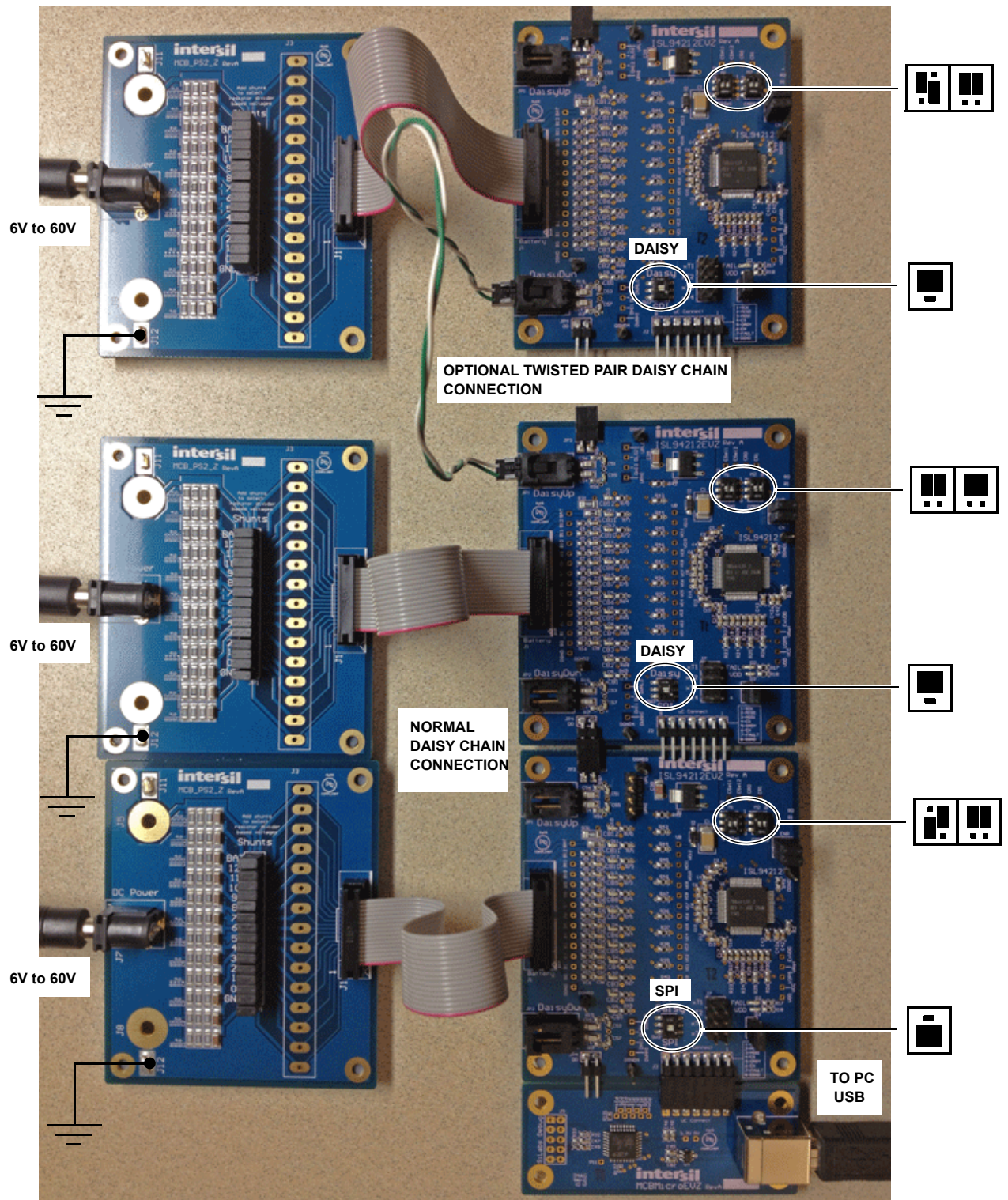
FIGURE 5. ISL94212EVZ IN 36-CELL DAISY CHAIN CONFIGURATION (SHOWN 1 ISL94212EVKIT1Z (MASTER) AND 2 ISL94212EV1Z (SLAVES)

Quick GUI Setup Guide (Using the GUI)

Step 1: Once the board is powered up and connected to the PC through the USB cable, start the GUI program.

Step 2: Choose the communication mode (stand-alone or daisy chain). If the GUI is already running, select the operating mode in the device menu (upper left of the screen.)

Step 3: The GUI program identifies the devices connected, either in a single board, or a daisy chain configuration, (See Figure 6). NOTE: Figure 5 on page 7 shows the daisy chain configuration.

In a daisy chain configuration, the top bar provides an indication of the boards connected and allows selection of any ISL94212EVZ board for monitoring and control. Select the specific device in the daisy chain. Device 15 selects all devices. Device 0 selects devices that are not yet identified. For a single board, these boxes are not shown.

Step 4: Use the various tabs and buttons to monitor and control the operation of the device.

Step 5: The "Device Commands" buttons along the bottom of the main tab are commands sent to all boards in the system. So, selecting "Scan Volts" then "Read Volts" causes all boards to read the cell voltages, temperatures and update the ISL94212 register values and the GUI display boxes. (Note: these buttons send separate commands to each board. It does not send a "Scan All" or "Read All" command.)

Step 6: At the bottom of the screen there are activity logs showing the USB communications and the SPI communications to the master board.

Step 7: To clear fault indications, the fault first needs to be cleared. When the fault is no longer active, do a "Read Faults" command, then read the Faults register and click on each individual bit to change the setting (or write 0 to the register value). Then click on Write to send the value to the device.
Using the "Read Group or Write Group" button sends commands to all registers on the page.

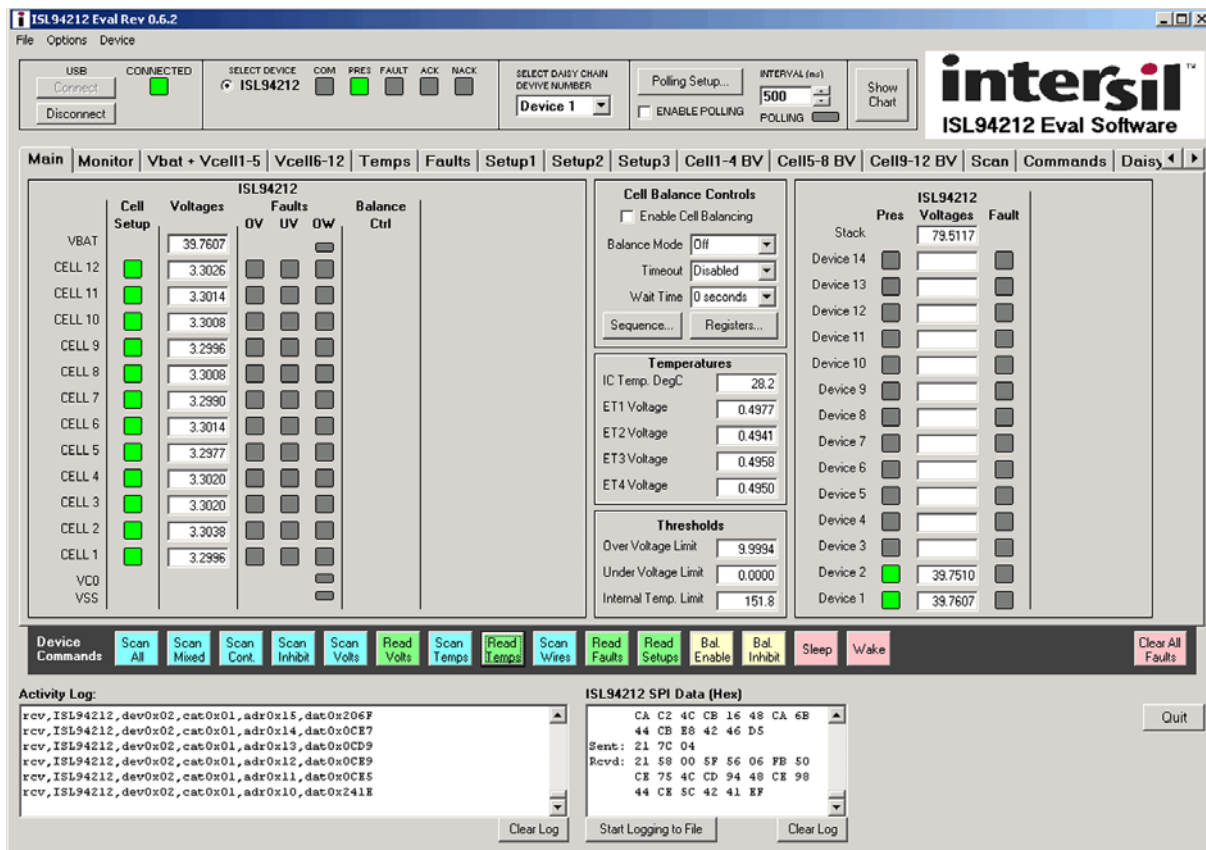**Step 8:** Use the "Show Chart" button to view various voltages and status in real time (See Figure 7).

FIGURE 6. MAIN GUI WINDOW - TWO CASCADED DEVICES

User Guide 048

Chart Window

The charting function of the GUI provides real time viewing of the critical voltages in the battery pack. The chart updates results as long as the GUI is polling. If the GUI stops polling (or there is a communication interruption) the chart maintains the last valid value.

At the end of a sample period, the captured data can be exported to a file that can be loaded into Excel for further analysis by clicking on the "Export" button.

Using the controls at the left of the screen, various charts can be turned off and the specific cells being monitored can be chosen. At this time, the cell voltages of only two packs can be monitored on one screen and only the temperatures of board 1 can be monitored.
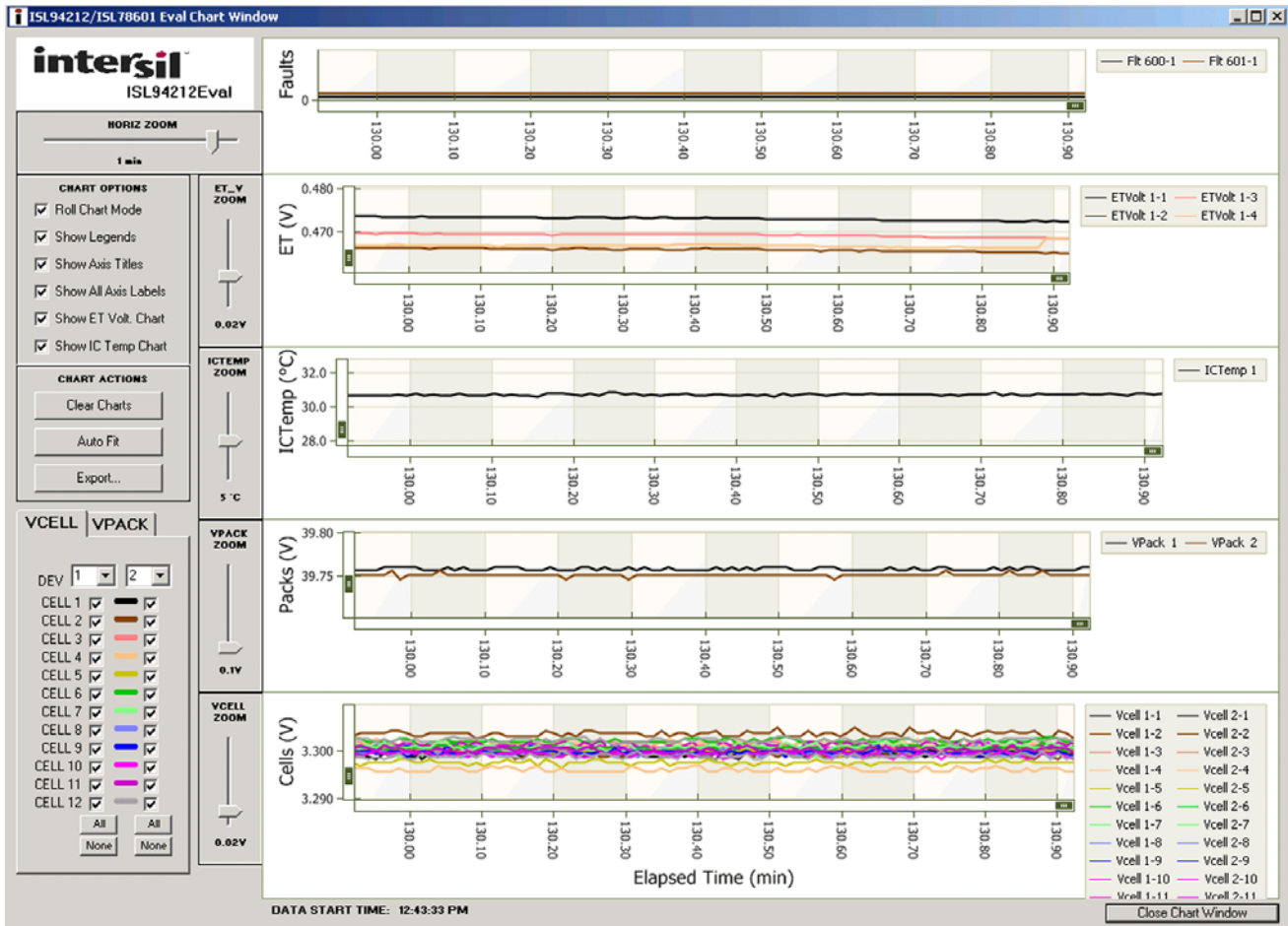
FIGURE 7. CHART WINDOW

Monitor Tab

The monitor tab shows the voltages and status of the first 4 boards in the daisy chain. (See Figure 8)

At this time, it is not possible to select the results for any other boards in the stack. Individual boards can be monitored in the main window, one board at a time.

If there are more than 4 boards, only boards 1 through 4 are shown in this tab.
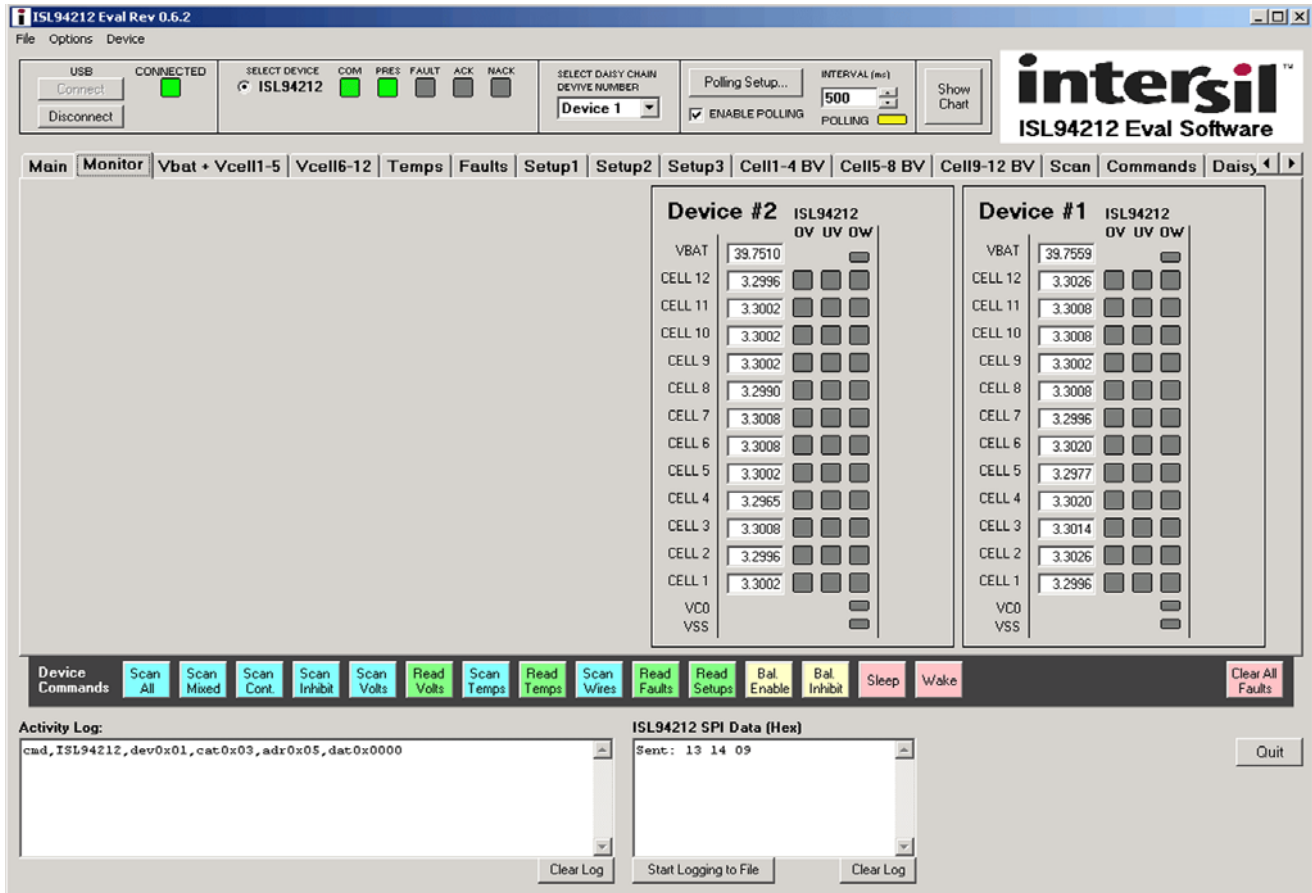
FIGURE 8. MONITOR TAB

Fault Tab

The fault tab shows the status of the fault register of the selected device (See Figure 9). To update the display, click on the individual "Read" buttons at the end of each fault register, or click on the "Read Group" button on the device command line (toward the bottom of the window) to read all registers in the Tab.

To clear a bit, click on the bit that is set (or write a 0 in the box at the right to reset all bits.) Then, click on the "Write" button at the end of each fault register, or click on the "Write Group" button on the device command line to write to all of the registers in the Tab.
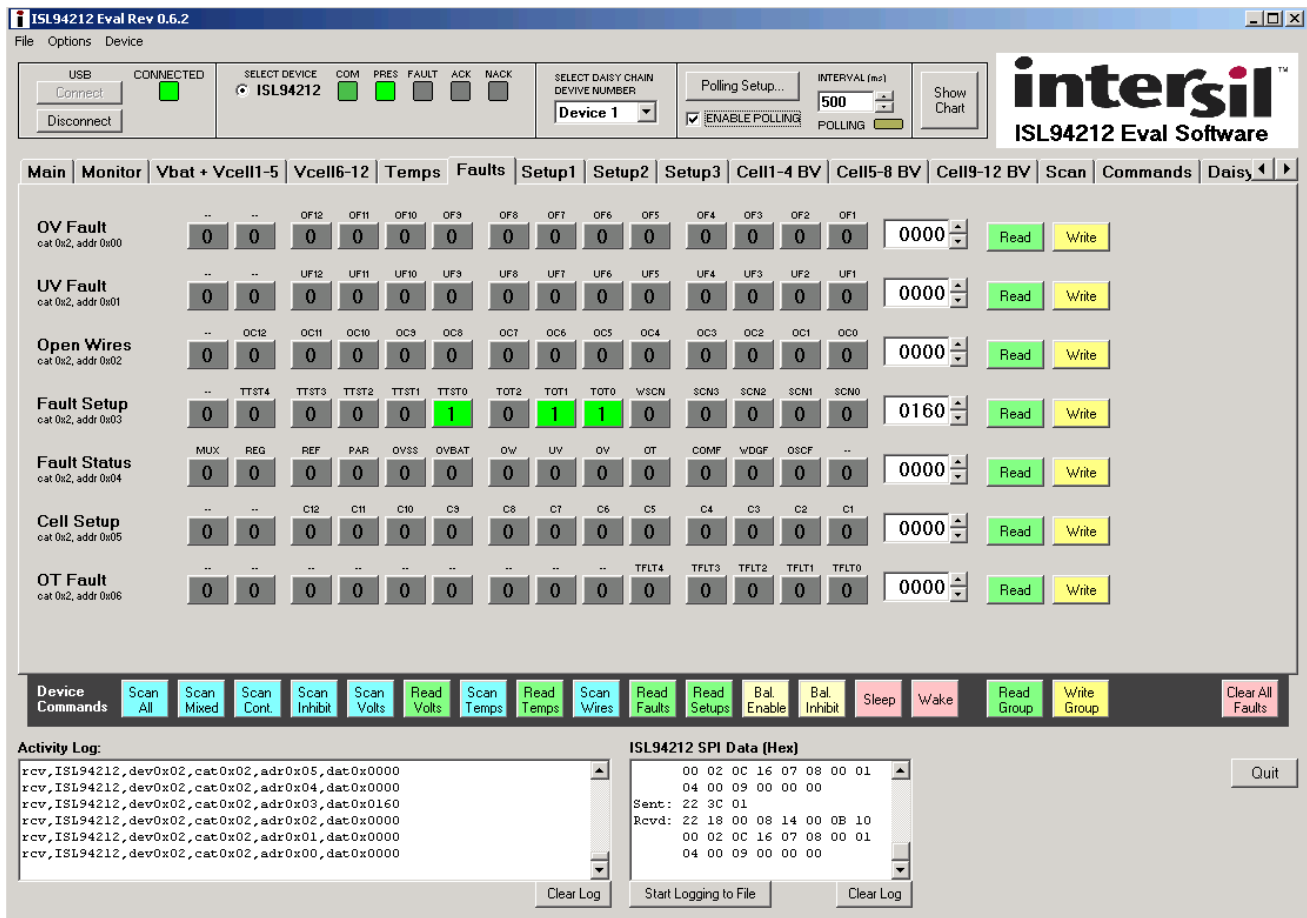
FIGURE 9. FAULT REGISTERS

Command Tab

The command tab allows individual commands to be sent to any device in the stack (or all devices, if device 15 is chosen.) This tab includes a raw message sender and CRC4 calculator. By entering in the device address, data type, data address and data, the GUI calculates the CRC4 value and shows the resulting encoded command. This command can then be sent to the chosen device. The image in Figure 10 shows the command for SLEEP.

NOTE: This screen shows a selection for ISL78600 and ISL78601. This is an error in the 0.6.2 release of the software. For the ISL94212, use the selection for the ISL78600. The selection for ISL78601 has no function.
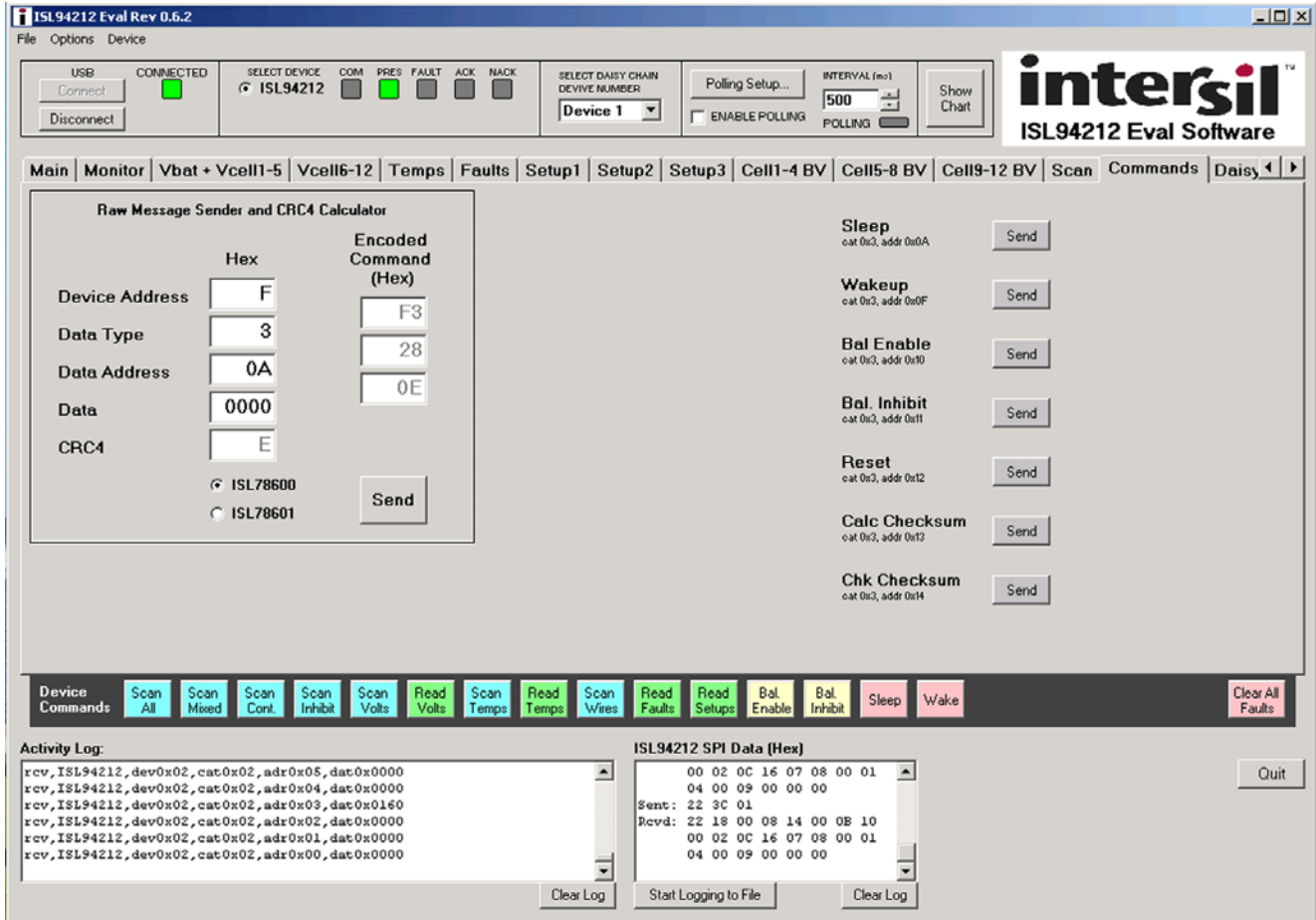
FIGURE 10. COMMANDS

ISL94212 Evaluation Board
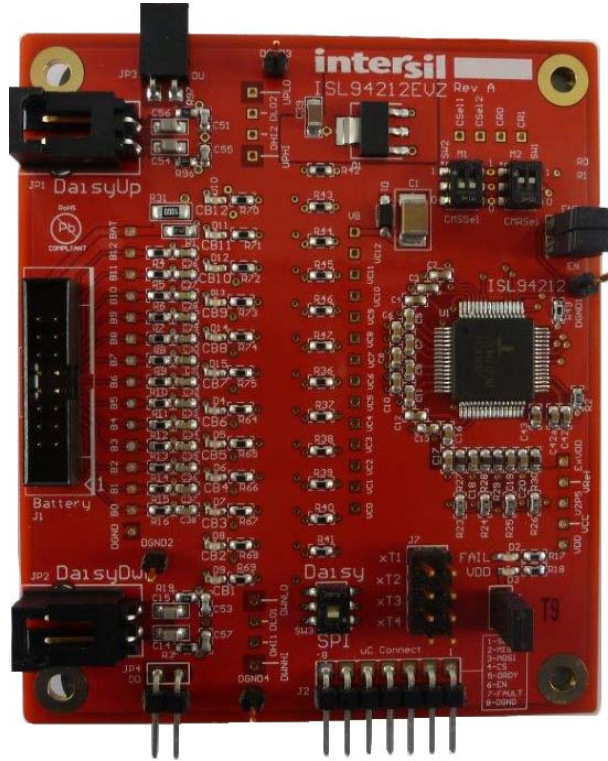
FIGURE 11. TOP SIDE
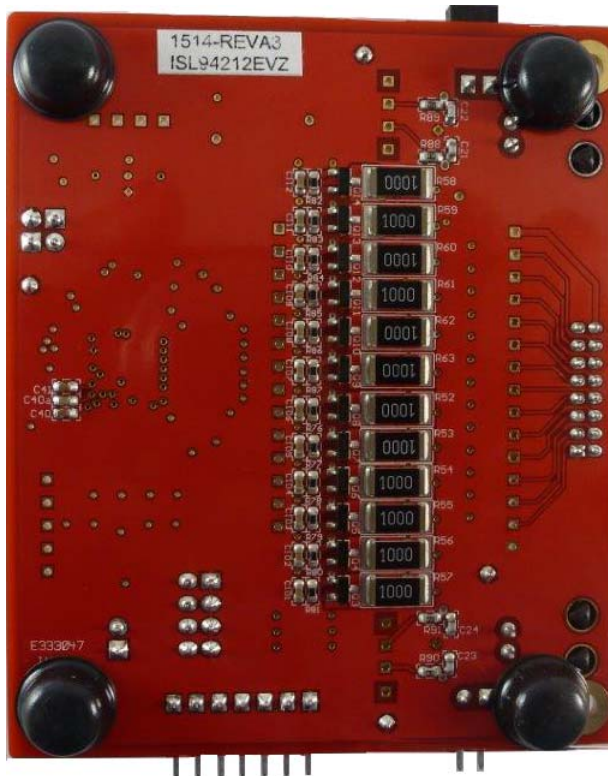
FIGURE 12. BOTTOM SIDE

Schematic
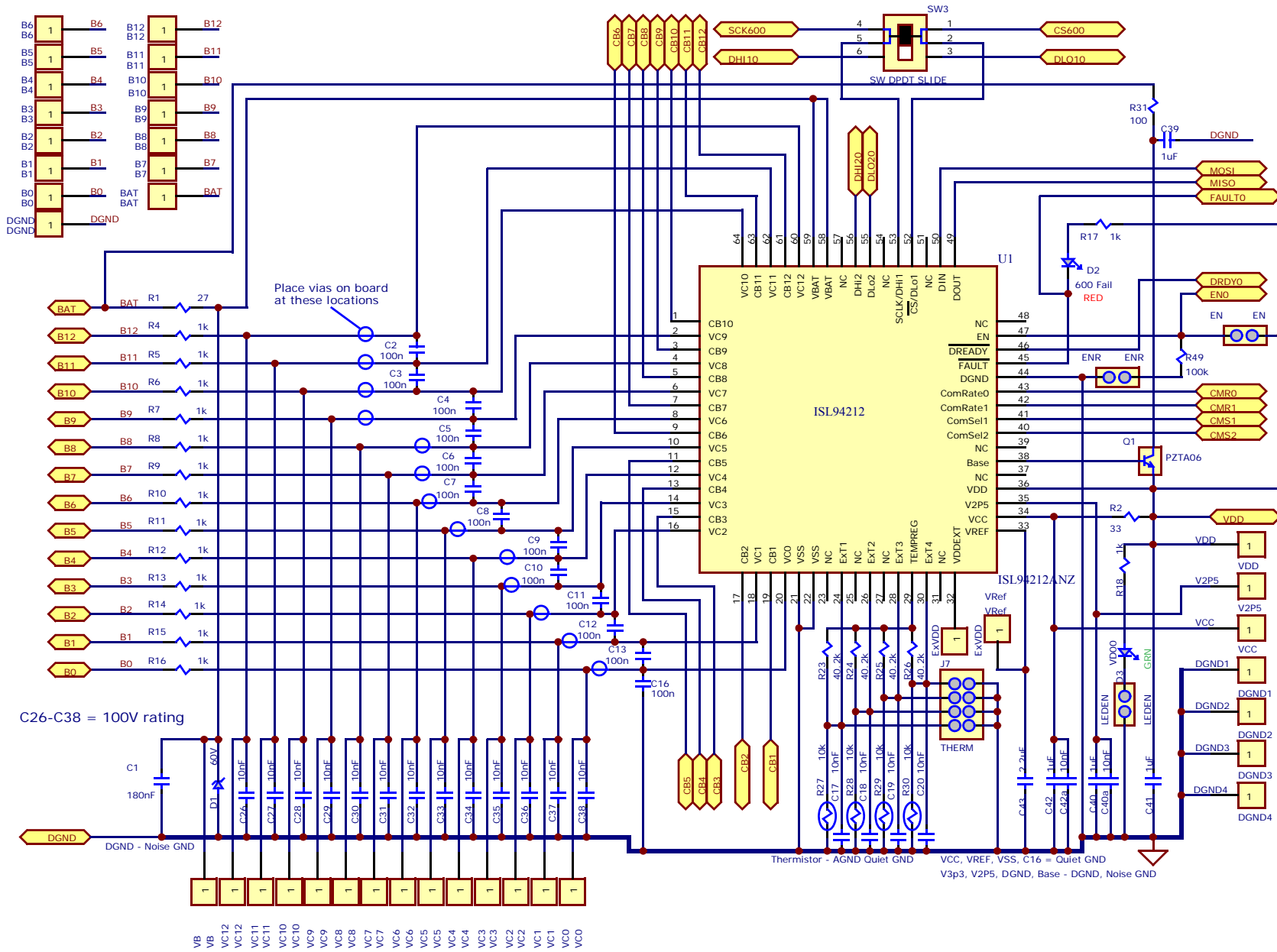
FIGURE 13. ISL94212EVZ EVALUATION BOARD SCHEMATIC

FIGURE 14. ISL94212EVZ EVALUATION BOARD SCHEMATIC
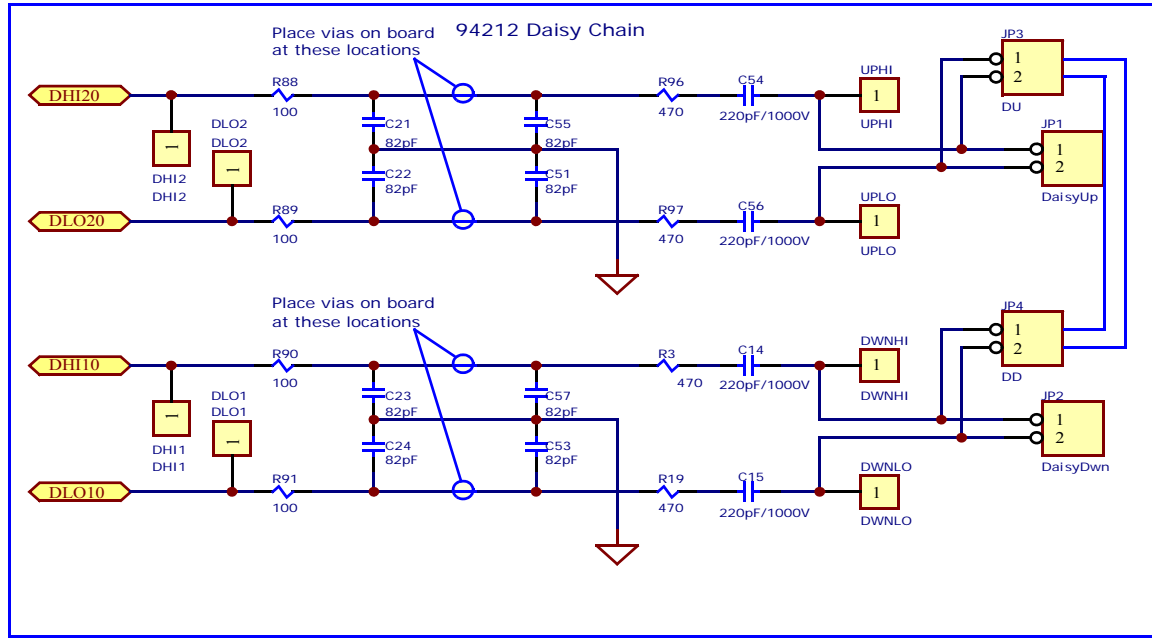
Schematic (Continued)

94212 Daisy Chain

Place vias on board at these locations

Place vias on board at these locations
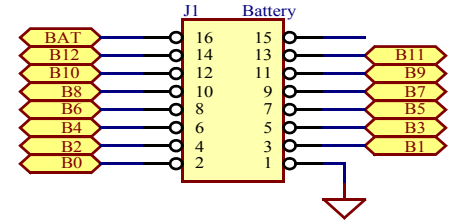
Add jumpers to JP5 to communicate through the USB port and on-board µC. Remove jumpers and use even numbered pins to communicate to ISL78600/601 via external µC.
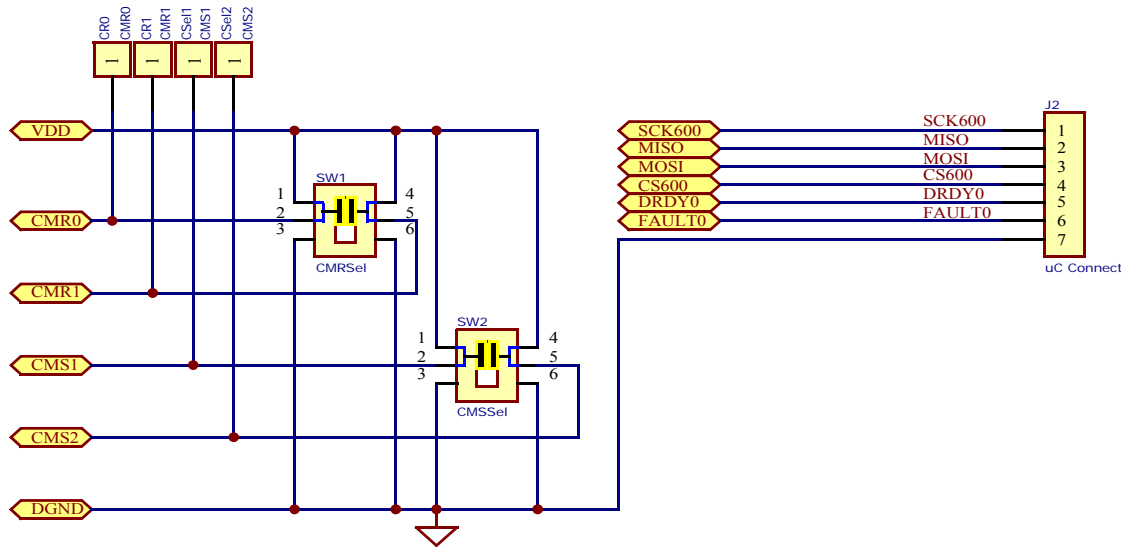
FIGURE 15. ISL94212EVZ EVALUATION BOARD SCHEMATIC

Bill of Materials

QTY	REFERENCE DESIGNATOR	DESCRIPTION	MANUFACTURER	MANUFACTURER PART
1	C1	CAP, SMD, 1812, 0.18µF, 100V, 10%, X7R, ROHS	MURATA	GRM43RR72A184KA01L
4	C14, C15, C54, C56	CAP, SMD, 0805, 220pF, 1kV, 5%, C0G, ROHS	VISHAY/VITRAMON	VJ0805A221JXGAT5Z
18	C17-C20, C40a, C42a, C101-C112	CAP, SMD, 0603, 0.01µF, 16V, 1 0%, X7R, ROHS	VENKEL	C0603X7R160-103KNE
13	C2-C13, C16	CAP, SMD, 0603, 0.1µF, 16V, 10%, X7R, ROHS	MURATA	GRM39X7R104K016AD
8	C21-C24, C51, C53, C55, C57	CAP, SMD, 0603, 82pF, 100V, 5%, C0G, ROHS	MURATA	GRM1885C2A820JA01D
13	C26-C38	CAP, SMD, 0603, 0.01µF, 100V, 5%, X7R, ROHS	KEMET	C0603C103J1RACTU
1	C39	CAP, SMD, 1206, 1µF, 100V, 10%, X7R, ROHS	VENKEL	C1206X7R101-105KNE
3	C40, C41, C42	CAP, SMD, 0603, 1.0µF, 10V, 10%, X7R, ROHS	AVX	0603ZC105KAT2A
1	C43	CAP, SMD, 0603, 2.2µF, 10V, 10%, X7R, ROHS	MURATA	GRM188R71A225KE15D
2	CABLE ASSY	CONN SOCKET IDC 16POS W/KEY GOLD, ROHS	ASSMAN	SFH41-PPPB-D08-ID-BK
6	CABLE ASSY	CABLE-FLAT RIBBON, 16CIRCUIT, 28AWG STRANDED, 300V, ROHS	ASSMANN	AWG28-16/G-1/300-R
1	D1	DIODE-ZENER, SMD, 2P, SOD-123, 60V, 500mW, 2.1mA, ROHS	ON SEMICONDUCTOR	MMSZ5264BT1G
1	D2	LED-SMART, SMD, 0603, 2P, RED, 1.8V, 2mA, 630nm, 4.5mcd, ROHS	OSRAM	LSL29K-G1J2-1-0-2-R18-Z
1	D3	LED-SMART, SMD, 0603, GREEN, 1.7V, 2mA, 570nm, 3.9mcd, ROHS	OSRAM	LGL29K-G2J1-24-Z
12	D4-D15	LED-SMART, SMD, 0603, YELLOW, 1.8V, 2mA, 587nm, 7.9mcd, ROHS	OSRAM	LY L29K-J1K2-26-Z
4	DGND1-DGND4	CONN-HEADER, 1x1, BREAKAWAY 1X36, 2.54mm, ROHS	BERG/FCI	68000-236HLF
3	EN, ENR, LEDEN	CONN-HEADER, 1x2, BREAKAWAY 1X36, 2.54mm, ROHS	BERG/FCI	68000-236HLF
3	EN, ENR, LEDEN	CONN-JUMPER, SHORTING, 2PIN, BLACK, GOLD, ROHS	SULLINS	SPC02SYAN
1	J1	CONN HEADER LO-PRO 2MM 16PS VERT ROHS	ASSMAN	AWHW2-16G-0202-T-R
1	J2	CONN-HEADER, 1X7, BRKAWY-1X36, R/A, 2.54mm, ROHS	FCI/BERG	68015-436HLF
1	J7	CONN-HEADER, 2X4, BRKAWY-2X36, 2.54mm, ROHS	BERG/FCI	67996-272HLF
2	JP1-JP2	CONN-HEADER, SHROUDED, TH, 2POS, 2.54mm, R/A, ROHS	MOLEX	70555-0036
1	JP3	CONN-RECEPTACLE, TH, 1X2, 2.54mm, R/A, TIN, ROHS	SULLINS	PPTC021LGBN-RC
1	JP4	CONN-HEADER, 1X2, BRKAWY-1X36, R/A, 2.54mm, ROHS	FCI/BERG	68015-436HLF
1	Q1	TRANSISTOR, NPN, 4P, SOT-223, 80V, 1A, 1W, ROHS	DIODES, INC.	DCP56-16-13
3	Q12, Q13, Q14	TRANSISTOR, P-CHANNEL, SMD, SOT23, -60V, -180mA, ROHS	FAIRCHILD	NDS0605
9	Q3-Q11	TRANSISTOR-MOS, N-CHANNEL, SMD, SOT23, 60V, 280mA, ROHS	FAIRCHILD	NDS7002A
1	R1	RES, SMD, 0805, 27Ω, 1/8W, 1%,TF, ROHS	PANASONIC	ERJ-6ENF27R0V
1	R2	RES, SMD, 0603, 33Ω, 1/10W, 1%, TF, ROHS	VENKEL	CR0603-10W-33R0FT

| QTY	REFERENCE DESIGNATOR	DESCRIPTION	MANUFACTURER	MANUFACTURER PART
4	R23-R26	RES, SMD, 0603, 40.2k, 1/10W, 1%, TF, ROHS	YAGEO	RC0603FR-0740K2L
4	R27-R30	THERMISTOR-NTC, SMD, 0603, 10k, 1%, - 40 +125°C, ROHS	MURATA	NCP18XH103F03RB
4	R3, R19, R96, R97	RES, SMD, 0603, 470Ω,1/10W, 1%, TF, ROHS	ROHM	MCR03EZPFX4700
1	R31	RES, SMD, 1206, 100Ω, 1/4W, 1%, TF, ROHS	STACKPOLE	RMC1/8 100R 1% T/R
12	R36-R47	RES, SMD, 0603, 10k, 1/10W, 1%, TF, ROHS	KOA	RK73H1JT1002F
27	R4-R18, R64-R75	RES, SMD, 0603, 1k, 1/10W, 1%, TF, ROHS	PANASONIC	ERJ-3EKF1001V
1	R49	RES, SMD, 0603, 100k, 1/10W, 1%, TF, ROHS	VENKEL	CR0603-10W-1003FT
12	R52-R63	RES, SMD, 2512, 100Ω, 1W, 1%, TF, ROHS	VISHAY/DALE	CRCW2512100RFKEG
12	R76-R87	RES, SMD, 0603, 330k, 1/10W, 1%, TF, ROHS	YAGEO	RC0603FR-07330KL
4	R88-R91	RES, SMD, 0603, 100Ω, 1/10W, 1%, TF, ROHS	VENKEL	CR0603-10W-1000FT
2	SW1, SW2	SWITCH-SLIDE, SMD, 5.4X5.2, 2POS, SPDT, ROHS	COPAL ELECTRONICS	CAS-D20TA
1	SW3	SWITCH-SLIDE, SMD, 5.4X5.2, 2POS, SPDT, ROHS	COPAL ELECTRONICS	CAS-220TA
1	U1	IC-MULTI-CELL BATTERY MANAGER, 14P, TQFP, 10X10, ROHS	INTERSIL	ISL94212ANZ
0	DGND, B0-B12, BAT	DO NOT POPULATE		
0	DWNHI-DHI1-DLO1-DWNLO, UPHI-DHI2-DLO2-UPLO	DO NOT POPULATE		
0	ExVDD-VREF-V2P5-VCC-VDD	DO NOT POPULATE		
0	VC0-VC12, VB	DO NOT POPULATE		

Layout
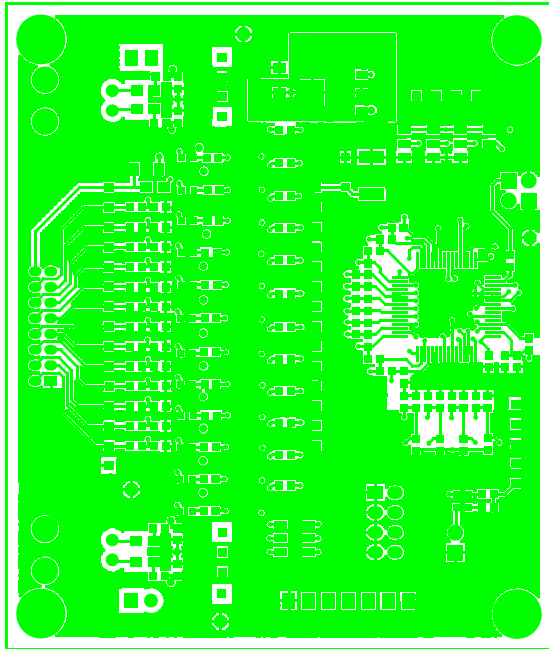
FIGURE 16. TOP LAYER
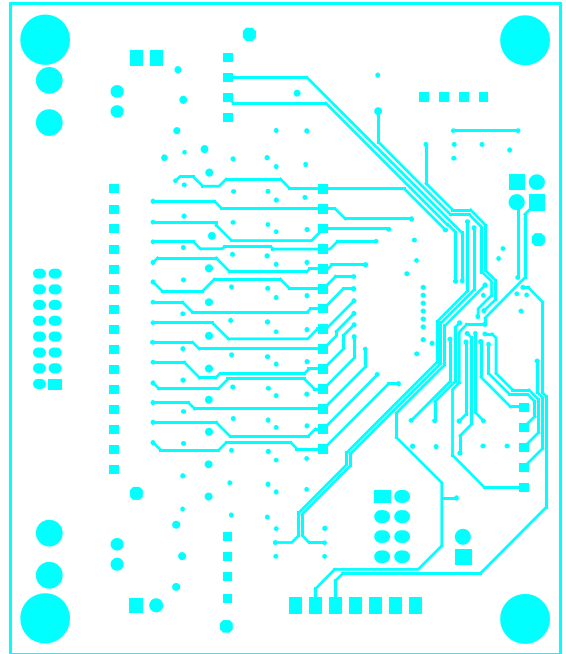
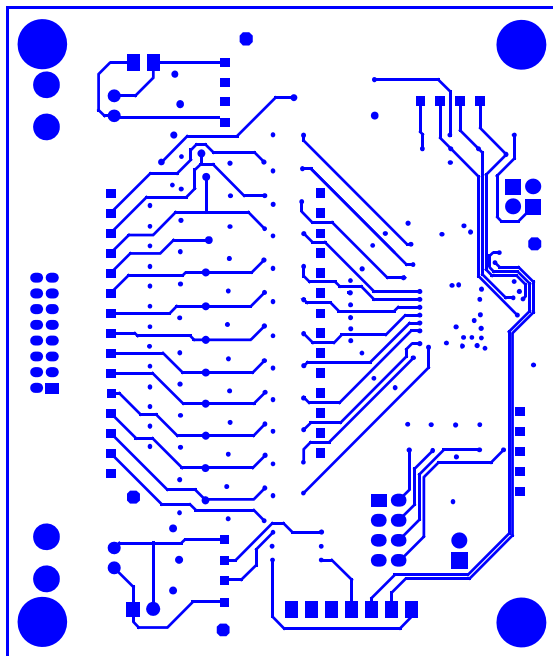**FIGURE 17. MIDDLE LAYER 1**

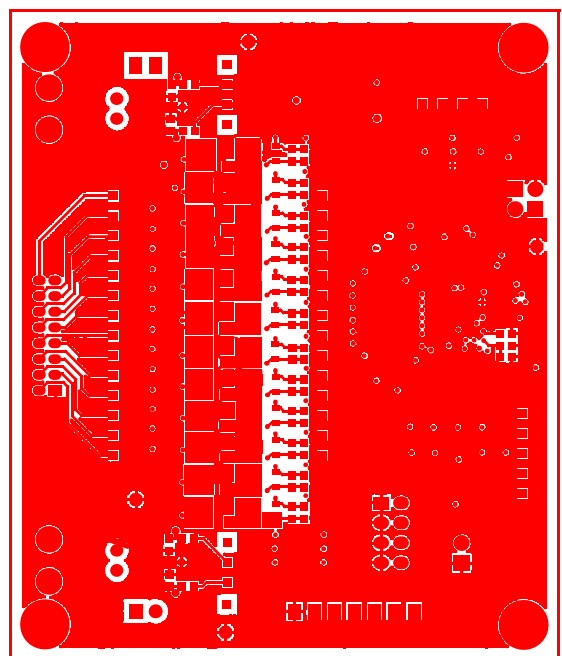**FIGURE 18. MIDDLE LAYER 2**

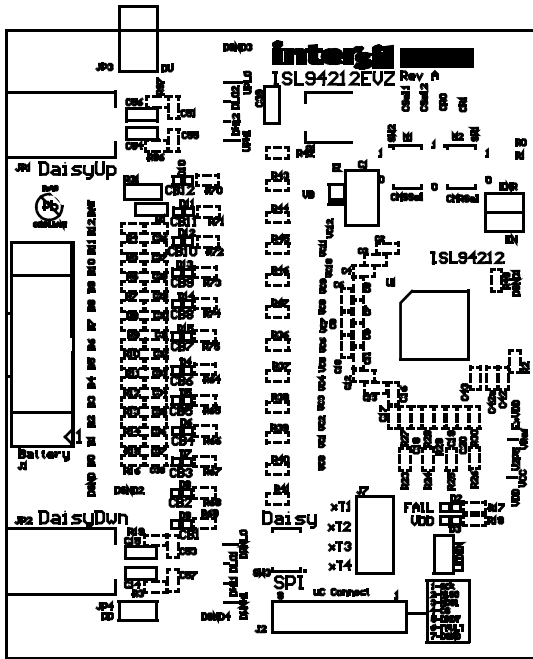**FIGURE 19. BOTTOM LAYER**
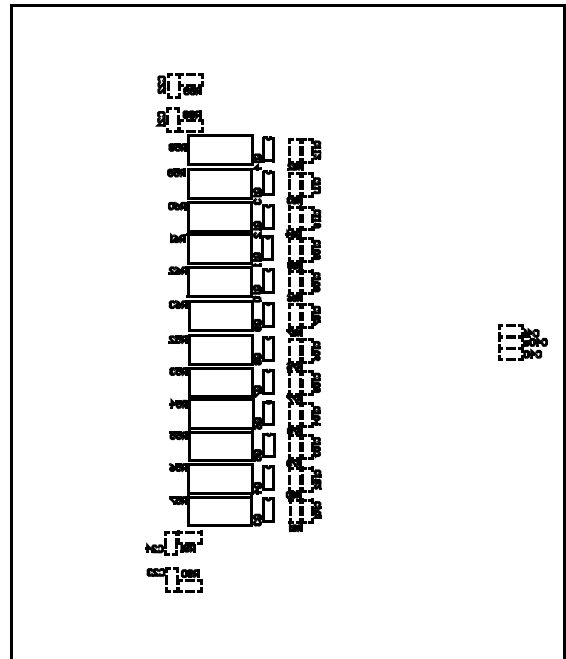
Layout (Continued)

FIGURE 20. SILK TOP LAYER

FIGURE 21. SILK BOTTOM LAYER

Default Configuration Settings

Configuration settings for this design are set by switch settings. See Figures 3 and 5 for switch setting information.

- The primary ISL94212EVKIT1Z kit is set for non-daisy chain operation. It is intended to operate as a stand-alone for single device (Figure 3 on page 4) or as master in a daisy chain configuration (Figure 5 on page 7).

- Add-on kits part# ISL94212EVZ will need to be setup for daisy chain and either middle or top device. (Figure 5 on page 7) This will depend on the extension kits board physical placement in the chain.

- In daisy chain mode, chain circuity component values are specified to operate in 500kHz rate. All devices receive a unique serial number when ATE testing in manufacturing. Consult datasheet regarding serial number register locations.

Errata/Q&A

1. When I click on Connect, nothing happens.

   The most common problem encountered when setting up the boards is a "connection' or switch error. This is seen after clicking on the connect button and Device Present "PRES" indicators do not turn green. The Activity Log at the bottom of the screen also indicates that one or more of the devices cannot be found.

   If this happens, check that all of the cables are connected properly and that the wires are not broken.

   - Make sure that the daisy chain cables or boards connect as shown in Figure 5 on page 7.

   - Check that the USB cable is plugged in and that the ISL94212 driver was installed properly before clicking on Connect.

   - Make sure the switches are set as shown in Figure 5 on page 7.

   - Inspect the LEDs to identify if all boards are powered properly. This is not always a good indication, since a board in sleep mode has an LED on, but at a lower voltage. It would be a good idea, if there is a communication problem not solved by the above, to check the voltage on the VDD and VREF pins. VDD should be 3.3V. If the board is in sleep mode, the voltage on VDD will drop to about 2.8V and VCC should equal VDD. The the VREF should be 2.5V in normal operation and drop to 0V in sleep. If the voltages do not match these values, then there could be a board problem and you should contact your Intersil representative.

   - You could try to shuffle the boards. If this works, then this indicates that one of the daisy channels is not working properly.

- If these suggestions still do not work, then configure the "Master" board as a stand-alone board and try this. If it works, set up a stack of two boards. Then try three boards, and so on, until there is an error in communications. This identifies the point of communication failure. It could be a bad daisy chain cable or some problem with that particular device. Replace the cable or the board and try again.

2. When I enable polling, the voltages do not update.

   When the GUI starts, there are no items selected for polling. Click on the "Polling Setup" button and click on the "Quick Setup" button. This enables the most common measurement operations.

3. The Label for the J2 connector on the ISL94212EVZ board is incorrect. It should read as follows (i.e. there is no EN signal between the two boards.)

1 - SCK
2 - MISO
3 - MOSI
4 - CS
5 - DRDY
6 - FAULT
7 - DGND

4. When contacting the factory with questions click on the "About" menu item and click on read firmware version and send the GUI and firmware version with your question. See example below.

Typical Performance Curves

Unless noted: V_{Batt} 24V or 48V as designated, T_A = +25°C. Curves provided below are based on exported data from the ISL94212 GUI software. Measurements are captured from three ISL94212 devices operating in daisy chain mode. Charts are based on either 24V or 48V battery voltage. Measurements are taken with time being the x-axis. This provides information regarding typical subsystem reading variation. Some graphs provide device to device comparisons as well.
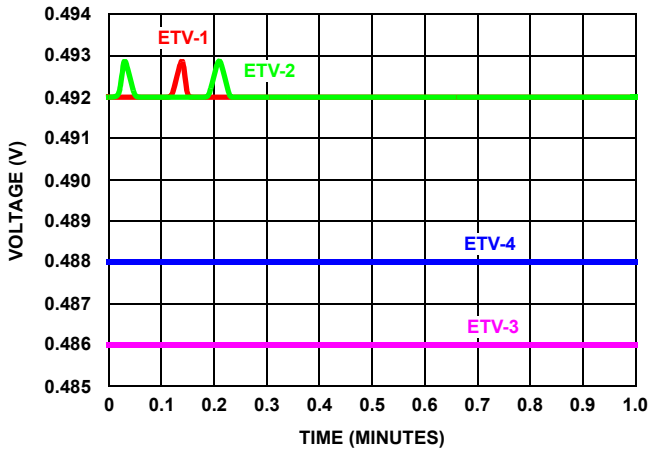

FIGURE 22. ETV1-4 DEVICE 1 48V
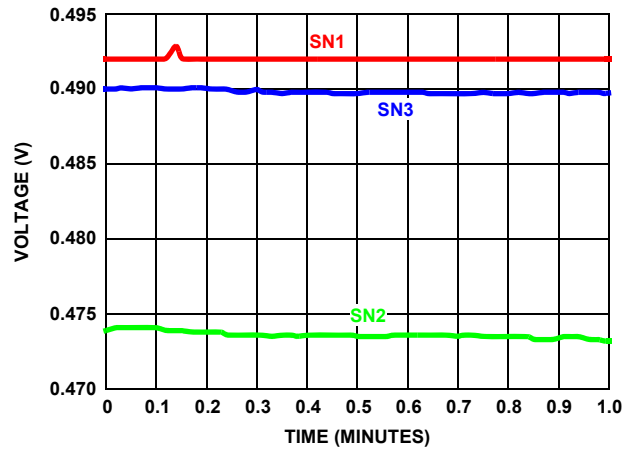
FIGURE 23. ETV1 DEVICE TO DEVICE SPREAD 48V

Internal Temperature
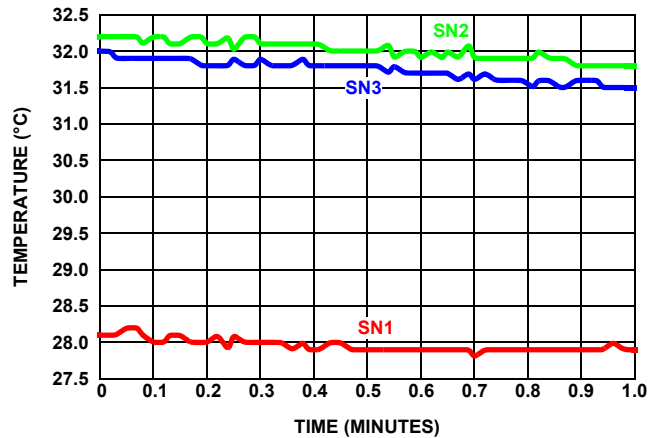
FIGURE 24. INTERNAL TEMPERATURE DEVICE TO DEVICE SPREAD 24V
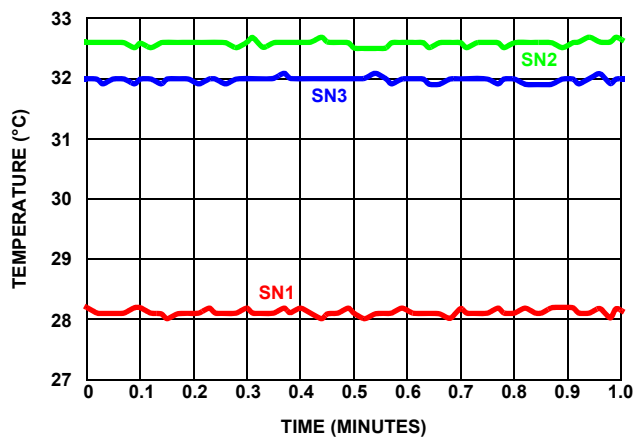
FIGURE 25. INTERNAL TEMPERATURE DEVICE TO DEVICE SPREAD 48V
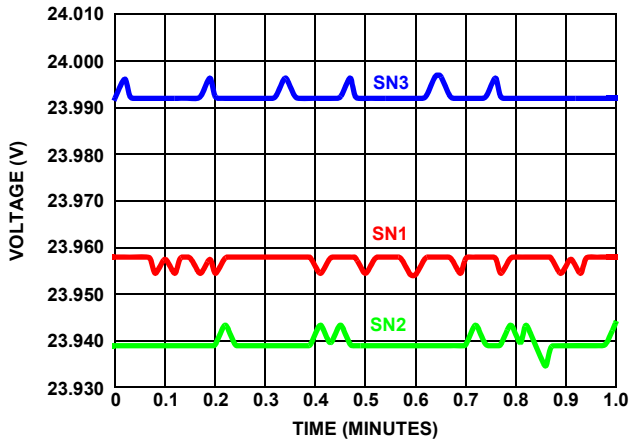
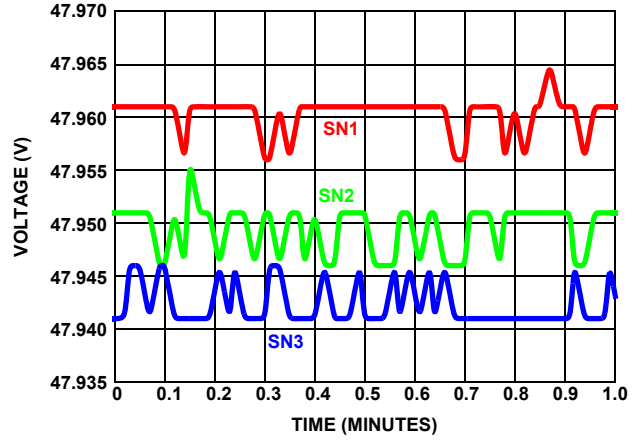## Voltage Inputs

FIGURE 26. V$_{BAT}$ DEVICE TO DEVICE 24V

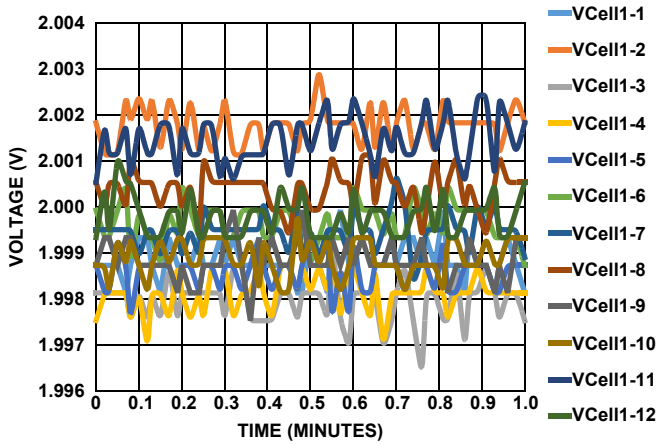FIGURE 27. V$_{BAT}$ DEVICE TO DEVICE 48V

FIGURE 28. SN1 V$_{CELLS}$ V$_{BAT}$ 24V
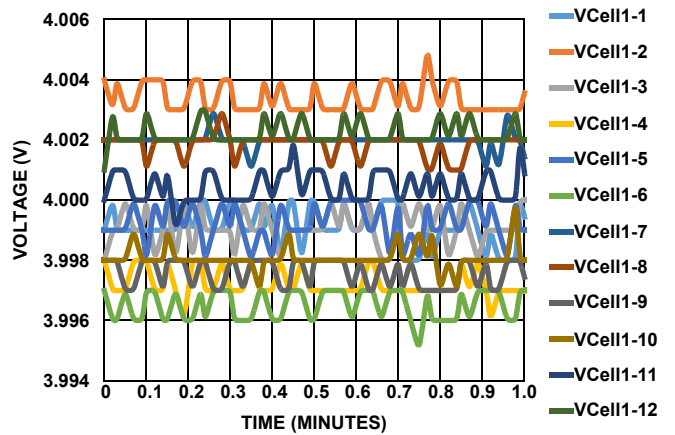
FIGURE 29. SN1 V$_{CELLS}$ V$_{BAT}$ 24V

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