ISL9208EVAL2Z (Rev. A) User Guide

Application Note | December 15, 2008 | AN1444.0

Description

This document is intended for use by individuals engaged in the development of hardware for a 4 to 7 series connected Li-ion battery pack using the ISL9208EVAL2Z board.

The evaluation kit consists of the ISL9208EVAL2Z board. Operation of the ISL9208EVAL2Z board requires the use of a USB to I^2C kit, part number “ISLI2C-KIT”, which is ordered separately. An optional link between the PC and the microcontroller BKGD connector is available from Freescale (used for monitoring and debugging the microcontroller code).

First Steps

- If not already available, acquire the DeVaSys USB to I^2C interface cable and module. This is available from Intersil in the ISLI2C-KIT.
- Download the software from the Intersil website on the ISL9208 page.

http://www.intersil.com/cda/deviceinfo/0,1477,ISL9208,0.html

This is a zip file titled: “ISL92xx Eval Kit Software Release V1.41”.

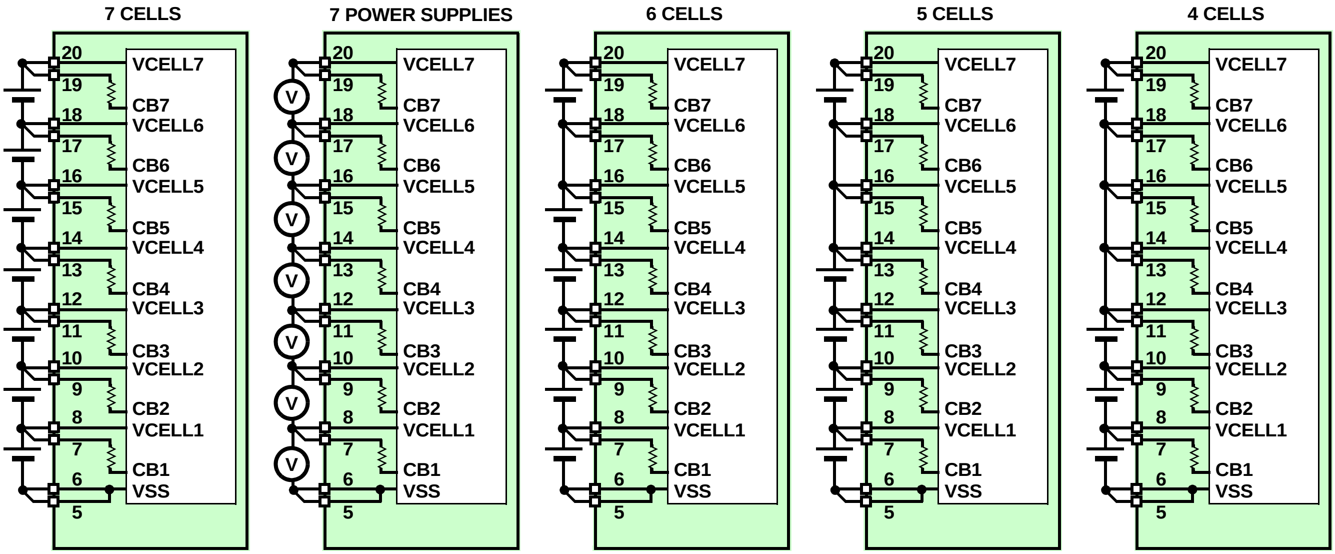
- Unzip the software files to a directory of your choice.
- Prior to powering the ISL9208 board, install the USB to I^2C board software and connect the DeVaSys board to the PC (see “Appendix 1” on page 13). However, don’t connect the DeVaSys board to the ISL9208EVAL2Z board yet. This is just preparation of the test set up. With these pieces in place, the PC interface can then quickly be used to monitor the operation of the board once power is applied.
- If changes to the microcontroller code are desired, then it will be necessary to order a programming/debug module from Freescale, part number, USBMULTILINKBDME. This kit also contains the Code Warrior development tools. To get the source code, contact Intersil and sign the license agreement.
- Set up a power supply for the board. The power supply should consist of a string of 4 to 7 batteries (see Figure 1), or a string of 4 to 7 resistors and a power supply, or 4 to 7 individual power supplies (see Figures 1 or 2).

Battery/Power Supply Connection

When connecting battery packs or power supplies, use the connections of Figures 1 and 2. If individual power supplies are being used to replace battery cells, then connect the power supplies identically to the battery connections (see Figure 1.) Also, make sure that the individual power supply voltages do not exceed the ISL9208 maximum input voltage differential of 5V per cell.

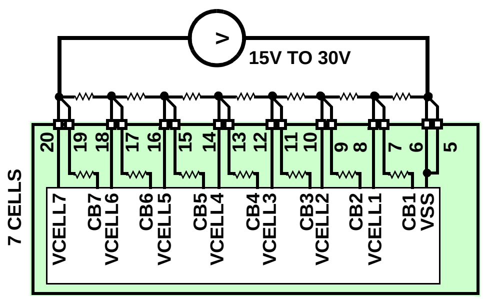
If using a string of resistors to emulate the battery cells, then use the connection in Figure 2. In this case, limit the power supply voltage so that the resistor divider outputs do not exceed the ISL9208 input maximum ratings.

It is recommended that, when using the circuit of Figure 2, the series resistors be 20Ω or less and 2W minimum. Resistors with higher resistance can be used, but when activating the ISL9208 cell balance outputs, the 39Ω cell balance resistor on the board will lower the voltage across that series power supply resistor, while raising the voltage on all of the other series resistors. Turning on multiple cell balance outputs could then result in one or more of the VCELLN input voltages exceeding their maximum specified limit. If using series resistors greater than 20Ω, the cell balance resistors on the ISL9208EVAL2Z board (R14-R20) should be replaced with higher values (1kΩ recommended).



Note: Multiple cells can be connected in parallel

FIGURE 1. BATTERY CONNECTION OPTIONS



NOTES:

1. For the battery simulation resistors, use 20Ω/2W devices (minimum). If the resistors are more than 100Ω, then turning on the cell balance resistors cause fluctuations in the cell input voltages that can violate the ISL9208 max specifications. If the series resistors are larger than 20Ω, we recommend replacing the cell balance resistors on the board with 1kΩ devices.
2. Before connecting the cable to the board, check the voltages at the connector to verify that they are correct.

FIGURE 2. USING RESISTOR/POWER SUPPLY COMBINATION TO EMULATE A STRING OF BATTERIES

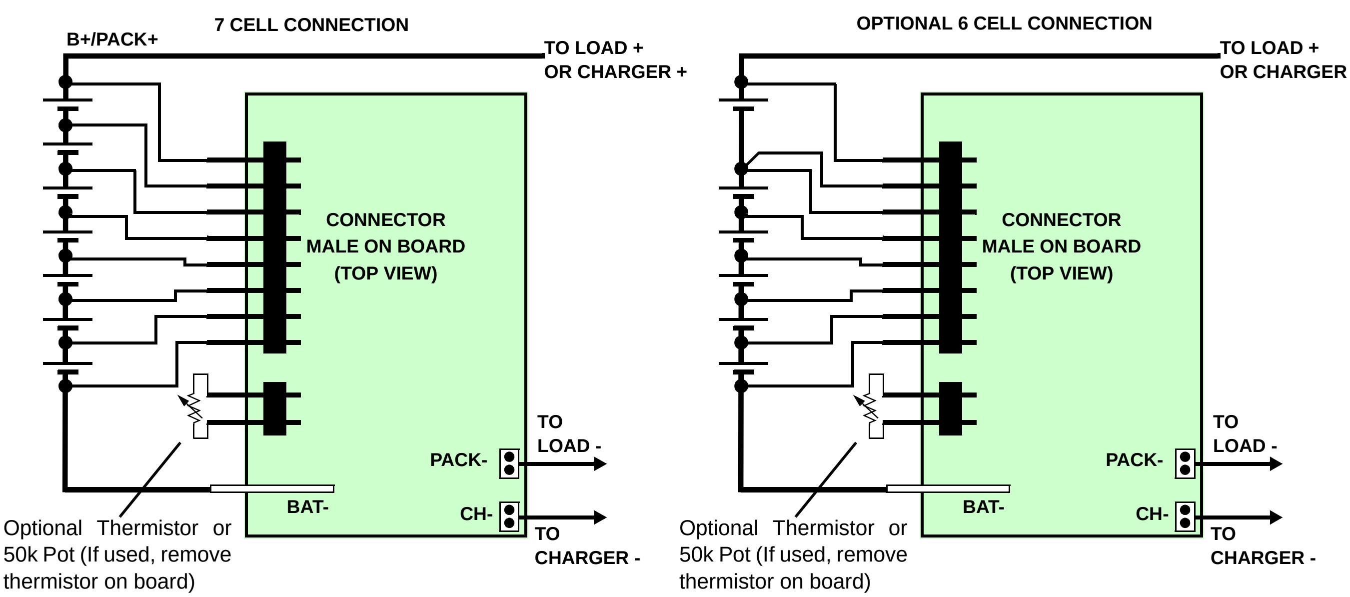


FIGURE 3. BATTERY CELL CONNECTION TO ISL9208 PCB

Initial Testing

Setup (See Figure 4)

- Figure 4 shows a blue board that connects between a power supply and the evaluation board. This board is not provided in the kit, but is an example of an interface connection that supports the connection of both a single power supply (with resistor dividers) or separate power supplies or battery cells. To obtain a blank interface board, please contact your Intersil representative.
- Before connecting the PC to the ISL9208EVAL2Z board (through the USB to I^2C interface) turn off the power supply and then connect the power supply to the ISL9208EVAL2Z board.
- Turn on the power to the board. Once power is turned on (or Li-ion cells are connected to the ISL9208EVAL2Z board,) the RGO LED should light. Use Meter 1 to measure the RGO voltage. It should read about 3.3V.

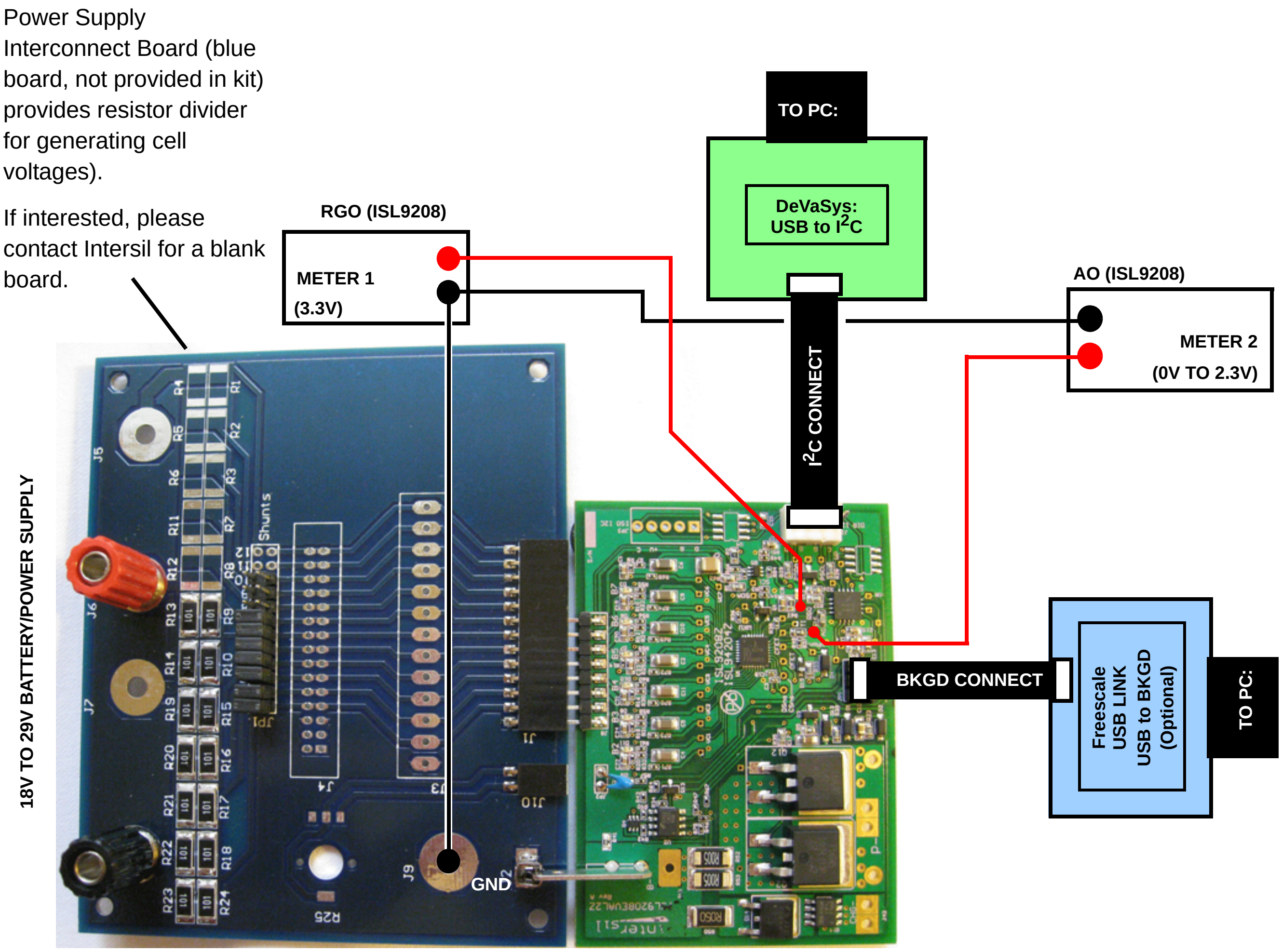


FIGURE 4. ISL9208EVAL2Z EVALUATION BOARD TEST CONNECTION

USB to I2C interface

- Once the power supply connections are verified, power-down the ISL9208EVAL2Z boards and make the PC connection to the board, via the USB port, the DeVaSys board, and the I2C cable. Before making this connection, make sure that the USB to I2C interface software is installed (see software installation guide).
- Connect the I2C cable from the interface board to the ISL9208EVAL2Z as in Figure 5. Use the 5-pin to 4-pin cable provided in the ISLI2C-KIT.

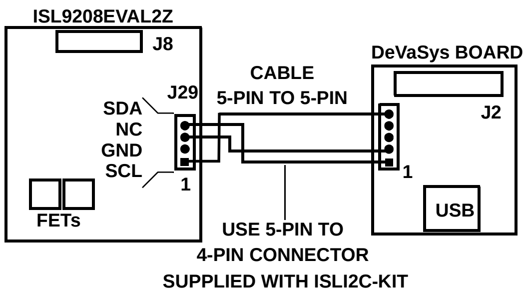


FIGURE 5. I2C CONNECTION TO ISL9208 PCB

- **CAUTION**: The I2C interface ground pin connects with the Battery negative terminal. If a load connected between the Pack + and Pack - pins has the same ground reference as the PC, then both sides of the power FETs will be connected together through the PC and load ground leads, so there will be no interruption in the power path. Also, without proper care, there can be problems with ground loops or excess voltage conditions as a result of this connection. If this may be a concern, see "I2C Isolation" on page 7.

Testing the Board

- Power-up the board and start the GUI. Now, the PC will be communicating with the microcontroller and the microcontroller will be communicating with the ISL9208.
- The GUI should power up with some color. In this case, the FET controls should be GREEN and the indicators should be all be green. If the GUI is all gray, then there is a communication problem. If there is a communication problem, see the troubleshooting guide in the Appendix.
- If the FET indicators remain RED after power up, then it is likely that at least one input voltage or the temperature is out of range.

The microcontroller on the board performs a number of automatic functions. These are:

1. The cell inputs are monitored for too high or too low voltage. If any of the cell voltages go too high, the charge FET is turned off. If any of the cell voltages go too low, the discharge FET turns off. When the voltage recovers from these excursions, back into the normal range, the FETs automatically turn on.
2. After an overcurrent or undervoltage condition, the microcontroller monitors the load and turns the FETs back on when the load is released.
3. The microcontroller monitors the temperature and turns off the cell balance and the power FETs if the temperature is too high or low.
4. The microcontroller performs cell balancing (once it is enabled through the GUI).
5. The microcontroller monitors the cell voltages and reports these voltages to the GUI.

Over/Undervoltage Testing

- Test the overvoltage and undervoltage conditions by:
  - If Li-ion cells are being used, discharge the pack until one or more of the cells reach the undervoltage limit and the discharge FET turns off. Then, charge the pack until the FETs turn on again and continue charging until a cell overvoltage condition is reached.
  - If one power supply is being used, lower the voltage on the power supply until one or more of the cells reach the undervoltage limit and the discharge FET turns off. Then, increase the voltage until the FETs turn on again and continue increasing the voltage until a cell overvoltage condition is reached.
  - If seven power supplies are used, then simply decrease or increase any individual supply until the thresholds are reached and the FET turns off (or on).

Overcurrent Testing

Testing the overcurrent settings with the ISL9208EVAL2Z Rev A is not easy without changing the values of the sense resistors on the board, because it was designed as a possible reference application.

As delivered, the ISL9208EVAL2Z provides a discharge sense resistor of 2.5mΩ and a charge sense resistor of 50mΩ. To get a discharge short circuit condition requires 80A. To get a discharge overcurrent condition requires a load of 40A. To get a charge overcurrent condition requires 2A. Changing both resistors to 0.5Ω provides a mechanism for easily testing the current thresholds.

To test the board in an application most likely requires that battery cells be used and that there is a large load available. While the board was not extensively tested for these high load currents, the traces are short and wide enough to (theoretically) handle the currents up to the 40A threshold.

Cell Balance Testing

- Testing the cell balance operation requires the use of Li-ion cells or a power supply, or requires modifying the board to use 1000Ω cell balancing resistors (with 7 cells, a string of 20Ω voltage divider resistors, and 39Ω cell balancing resistors, turning on one cell balance output drops the voltage on that cell to less than 2.5V. At this voltage, the microcontroller puts the ISL9208 to sleep).
- Start the cell balance test by first observing if the cell with the maximum cell voltage exceeds the cell with the

minimum voltage by more than 30mV. If so, note the cell number of the maximum voltage cell.

- Next, select “CB Max #” to be “1”. This limits the balancing to only one cell - the one with the maximum voltage.
- Monitor the call balance LEDs on the board or the GUI to track the cell balance operation. On the GUI, use the CB refresh button (or start auto update) to update the indicators to show which cell is being balanced, it should be the maximum voltage cell. Be patient, because the microcontroller will balance for 10s, then turn off balancing for 2s[1], then balance again. Also, if the maximum voltage cell is very close to the next highest voltage cell, or if there are many cells within a narrow voltage range, then any of these cells could be balanced, due to the limited accuracy of the microcontroller A/D converter.
- Next, select “CB Max #” to be “2”. This limits the balancing to two cells - the highest two voltage cells. Again refresh the CB screen periodically to see the operation of the cell balance code.
- Open the pack tab in the GUI and change some of the settings for overvoltage, undervoltage, or cell balance and re-test. Remember to click on “Write” to send the new parameters to the microcontroller.

Sleep/Wake Testing

The ISL9208 board can be put to sleep via commands from the PC or by lowering the voltage on any cell below 2.5V (default software setting). This sequence is described in the following paragraphs.

To put the ISL9208 into the sleep mode, use the Register Access window to write an 80H to the ISL9208 register 4. This turns off the ISL9208 RGO output and LED. Or, the ISL9208 can be put to sleep by the microcontroller automatically when it detects that the voltage on any cell is less than 2.5V.

To wake-up the ISL9208 requires that the ISL9208 WKUP pin go below its walk-up threshold.This can happen when a charger connects to the pack charge terminals or when a load is connected to the load terminals. This can be done with real loads or chargers or by using a resistor, as shown in Figure 6.

1. If this is too long to wait, go to the “Pack Tab” in the GUI and change the cell balance on/off times. Setting 1s on and 1s off is the minimum setting for cell balancing, but 2s on, 2s off is the recommended minimum, only because an autoscan of 1s can cause confusion due to the asynchronous nature of cell balance and autoscan.

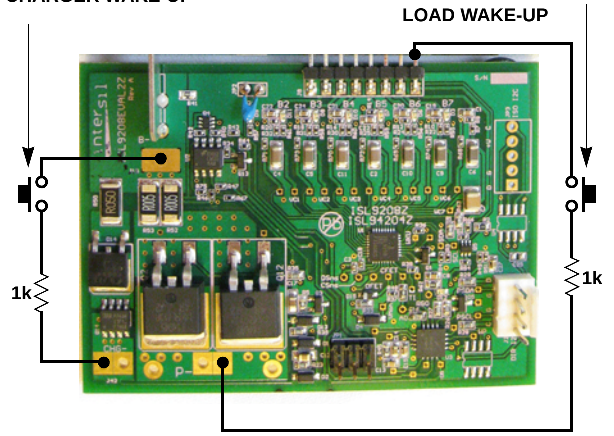


FIGURE 6. ISL9208EVAL2Z CURRENT DETECTION CONNECTIONS

- The charger connection works because it pulls the charger negative terminal to about the ISL9208 VSS voltage, the same as would an unloaded charger.
- The load connection works, because the load terminal is pulled high (in sleep mode, the power FETs are off, so the connection from the ISL9208 VSS pin to the Pack- pin is open). Circuitry on the board inverts this signal to pull the ISL9208 WKUP pin low to wake the device.
- When the WKUP pin is pulled low, the ISL9208 wakes up and turns on the RGO output. This turns on the RGO LED.

Additional Testing

Further tests on the board will likely follow the lines of battery pack testing, so it can become quite involved and be very specific to the application. Therefore, before setting up the tests, see the “GUI user Manual” for information on using the interface and see the “Microcode Reference Guide” for information about how the software works.

Other Board Features/Options

Current Direction Detection

The ISL9208EVAL2Z (Rev A) board has a circuit to detect a charge or discharge condition (see Figure 7). It is designed to detect a small current flowing into or out of the pack. The software revision 1.5 does not yet support this hardware, but the signals can be monitored with a meter or a scope to determine their performance.

There are two main uses for the current direction detection circuit. The first is in power control. If the microcontroller does not see any current for a long period of time, it can put the pack hardware to sleep to extend battery life. Second, the cell balance routine is usually conducted only during a charge condition. To do this requires information that charge current is flowing.

The current direction detectors are comparators only, so when the current is high enough, the indicators go high. For charge current, the threshold is about 60mA, for discharge the threshold is about 800mA. These thresholds can be changed by replacing a resistor, but making the thresholds much lower may cause problems due to the LM358 input offset. To change the discharge current detection threshold, change the value of R_{46}. A lower value lowers the current threshold. To change the charge current detection threshold, change the value of R_{40}. A lower value lowers the current threshold.

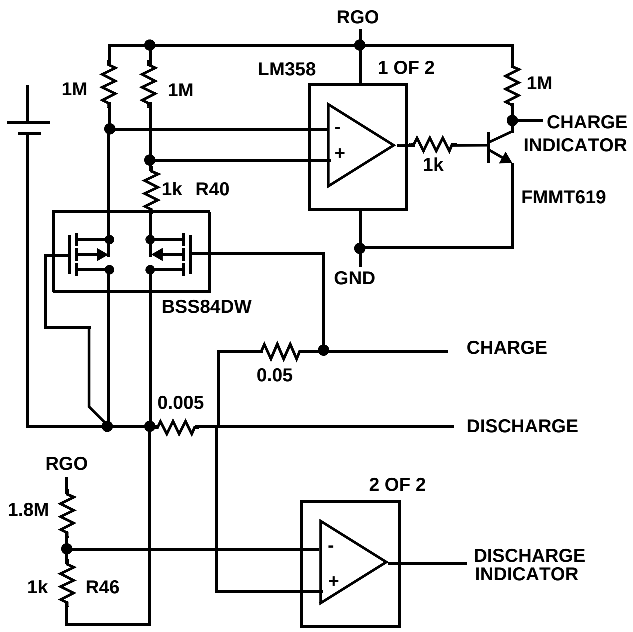


FIGURE 7. USING OP AMP AND FETS TO DETECT CHARGE AND DISCHARGE CURRENT

Future code revisions will have support for this hardware, but if custom code is desired, then the charge indicator connects to the microcontroller pin PTB4 and the discharge indicator connects to pin PTB5. See Figure 8.

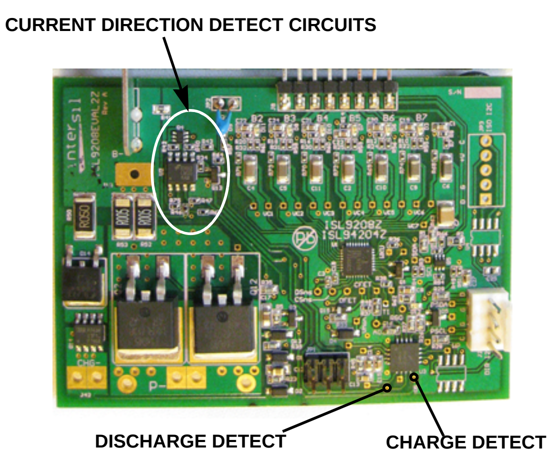


FIGURE 8. ISL9208EVAL2Z CURRENT DETECTION CONNECTIONS

Pack Voltage Monitoring

The ISL9208EVAL2Z has a circuit that is activated by the microcontroller to monitor the pack voltage directly. The input to the microcontroller is the pack voltage divided by 16 (see Figure 9).

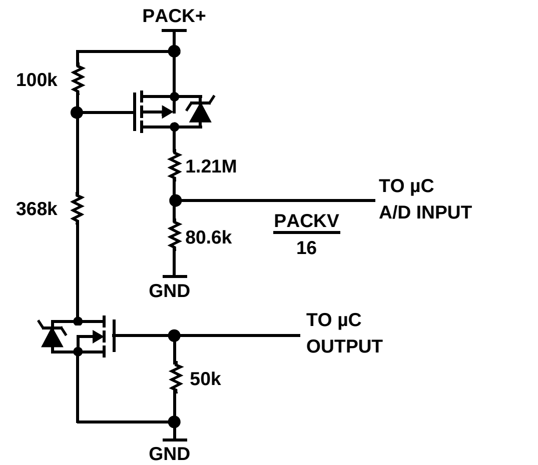


FIGURE 9. DIRECT MONITOR OF THE PACK VOLTAGE

The purpose of this circuit is to get a more accurate reading of the pack voltage. Without this circuit, the pack voltage is determined by adding the individual cell voltages. However, this results in adding the measurement errors of each cell, so the accuracy of the pack voltage is not very useful. With an accurate reading of the pack voltage, the microcontroller can use the value to determine if there is any low level discharge current or can use the value to compare to the summation of the cell voltages to detect any gross cell measurement errors.

The software revision 1.5 does not support the pack voltage monitor hardware, but if support is desired, then the microcontroller needs to turn on the PTB6 output to enable the circuit, then do an analog read of the ADP4 input.

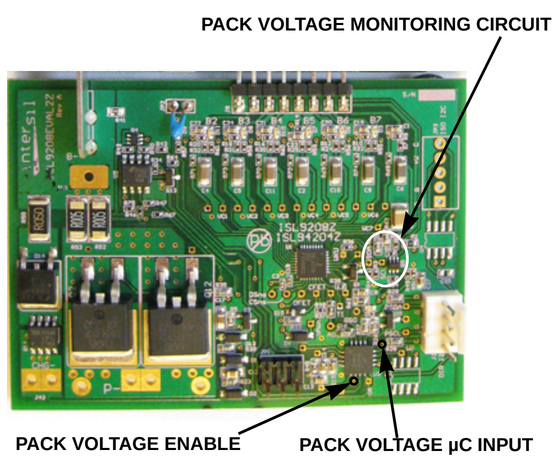


FIGURE 10. ISL9208EVAL2Z PACK VOLTAGE MONITORING CONNECTIONS

I²C Isolation

In some test conditions, ground connections can cause problems. This is because the I²C ground, power supply, load, and perhaps an oscilloscope, may all connect to ground. This can cause problems ranging from grounding both sides of the power FETs (taking them out of the circuit) to creating ground loops or unexpected voltage potentials that can damage components.

The ISL9208EVAL2Z provides an option for the addition of an isolation device for the I²C interface; the Analog Device ADuM1250. This allows the PC to monitor a battery pack that is connected to a load without some of the grounding problems that can arise. To use this option, the device and a header needs to be installed on the board, then the DeVaSys board needs to connect to the JP3 connector (see Figure 11).

The DeVaSys board will need to connect with a 5-pin to 5-pin point-to-point connector (pin 3 is not used, but the ADuM1250 uses the 3.3V supply provided by the DeVaSys board).

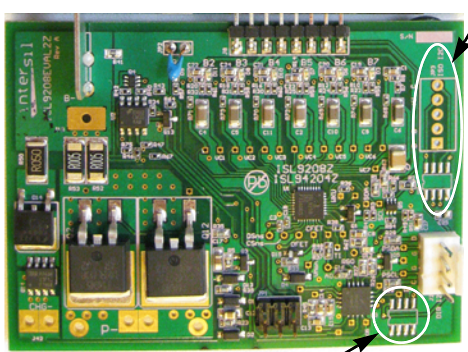


FIGURE 11. ISL9208EVAL2Z ISOLATED INTERFACE CONNECTION AND EEPROM

EEPROM

For applications that require non-volatile storage or require calibration and the microcontroller flash is no longer available, the ISL9208EVAL2Z (Rev A) board provides a serial EEPROM connection to the microcontroller (see Figure 11). An example EEPROM device is the AT24C16 from Atmel. This is not populated as shipped and there is no code in the microcontroller in software release 1.5 to support this device.

Microcontroller Options

The BKGD connection on the ISL9208 board allows development of new or modified code for the Freescale MC9S08QG8 microcontroller, which is supplied on the board.

Related Documentation

From Intersil

ISL9208, ISL9216, ISL9217 Microcode Reference Guide

ISL9208 (FN6446) Data Sheet

ISL9208 Application Note (AN1333)

ISL9208, ISL9216 GUI User Guide (AN1334)

DeVaSys USB-I2C Software Installation

From Texas Instruments

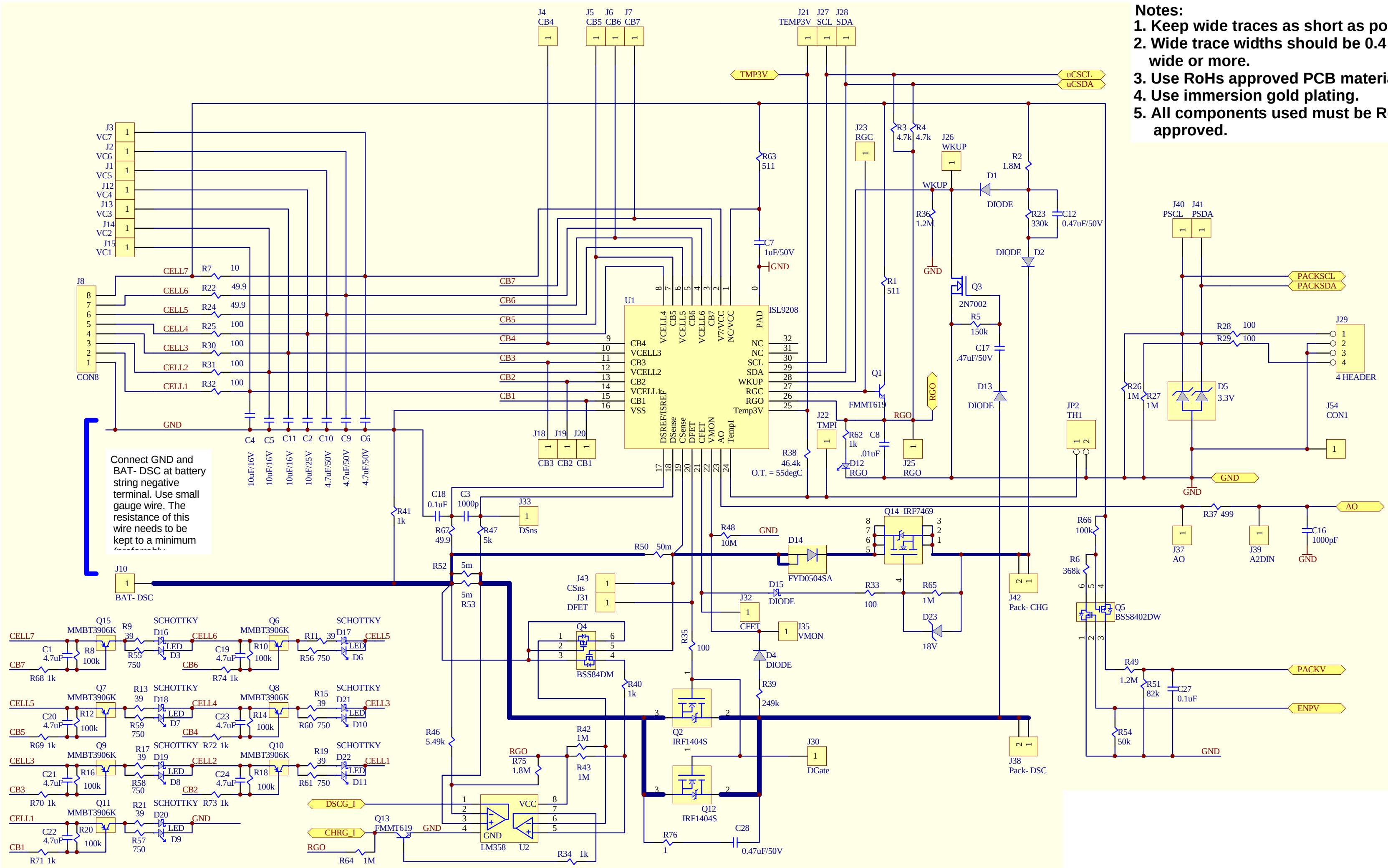
ADS1100 Data Sheet

From Freescale

MC9S08QG8 Microcontroller Data Sheet

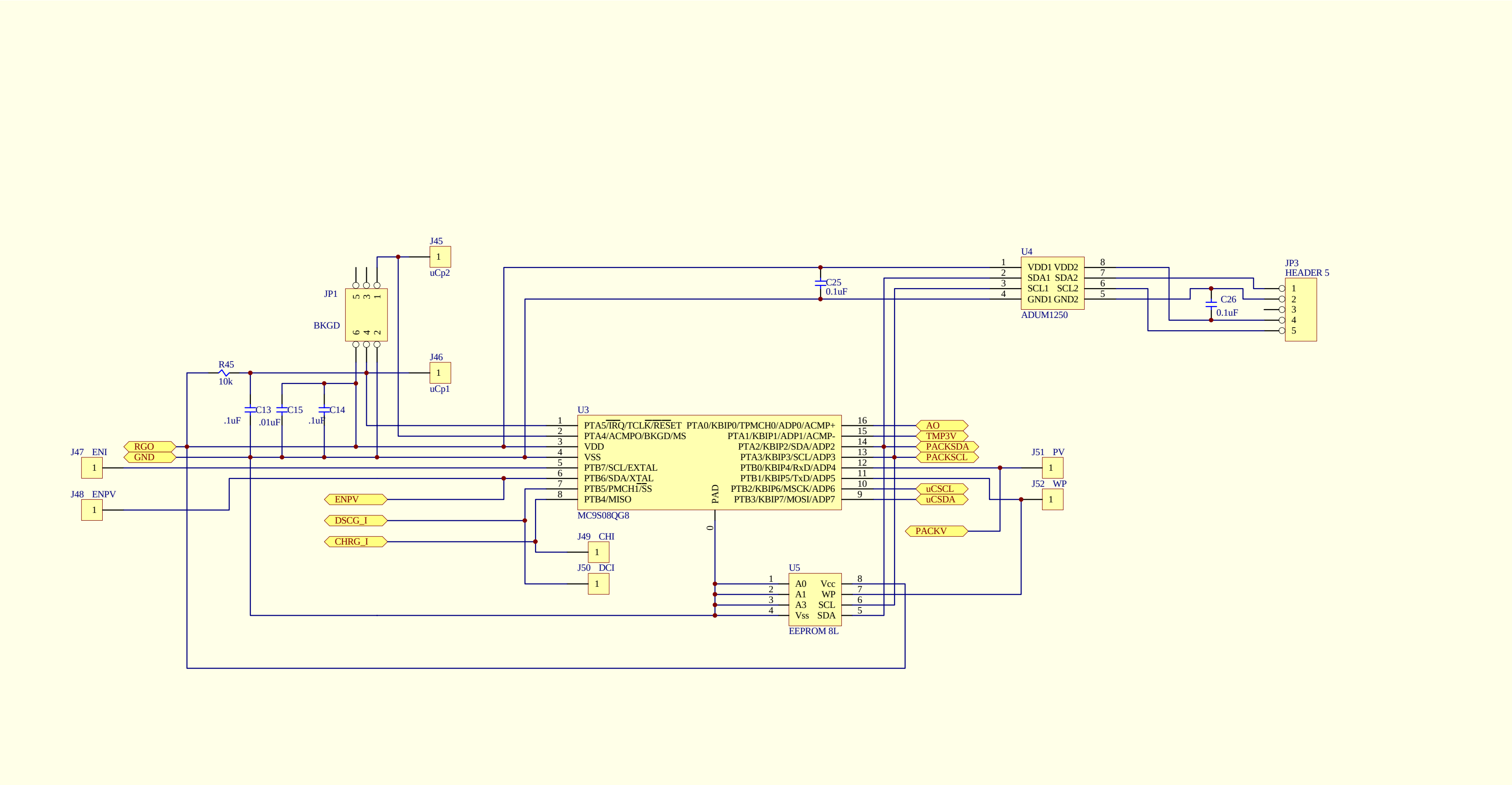
HCS08 Microcontrollers Family Reference Manual

AFE Schematic



Notes:
1. Keep wide traces as short as possible
2. Wide trace widths should be 0.4 inches wide or more.
3. Use RoHs approved PCB materials.
4. Use immersion gold plating.
5. All components used must be RoHs approved.

Microcrontroller Schematic



intersil

ISL9208EVAL2Z Bill of Materials

PART NUMBER	QTY	UNITS	REFERENCE DESIGNATOR	DESCRIPTION	MANUFACT.	MANUFACTURER PART
ISL9208EVAL2ZREVAPCB	1	ea		PWB-PCB, ISL9208EVAL2Z, REVA, QFN, ROHS	TBD	ISL9208EVAL2ZREVAPCB
GMK212BJ474KG-T	3	ea	C12, C17, C28	CAP, SMD, 0805, 0.47µF, 35V, 10%, X5R, ROHS	TAIYO YUDEN	GMK212BJ474KG-T
GRM31CF51H475ZA01L-T	3	ea	C6, C9, C10	CAP, SMD, 1206, 4.7µF, 50V, -20 + 80%, Y5V, ROHS	MURATA	GRM31CF51H475ZA01L
H1044-00102-25V10-T	1	ea	C3	CAP, SMD, 0402, 1000pF, 25V, 10%, X7R, ROHS	MURATA	GRP155R71E102K
H1044-00104-16V10-T	1	ea	C18	CAP, SMD, 0402, 0.1µF, 16V, 10%, X7R, ROHS	MURATA	GRM36X7R104K016AD
H1045-00102-25V10-T	1	ea	C16	CAP, SMD, 0603, 1000PF, 25V, 10%, X7R, ROHS	AVX	08053C102KAT2A
H1045-00103-16V10-T	2	ea	C8, C15	CAP, SMD, 0603, 0.01µF, 16V, 10%, X7R, ROHS	VENKEL	C0603X7R160-103KNE
H1045-00104-16V10-T	3	ea	C13, C14, C27	CAP, SMD, 0603, 0.1µF, 16V, 10%, X7R, ROHS	MURATA	GRM39X7R104K016AD
H1045-00104-16V10-T	0	ea	DNP (C25, C26)	CAP, SMD, 0603, 0.1µF, 16V, 10%, X7R, ROHS	MURATA	GRM39X7R104K016AD
H1045-00475-6R3V10-T	7	ea	C1, C19-C24	CAP, SMD, 0603, 4.7µF, 6.3V, 10%, X5R, ROHS	VENKEL	C0603X5R6R3-475KNE
H1065-00106-25V10-T	4	ea	C2, C4, C5, C11	CAP, SMD, 1206, 10µF, 25V, 10%, X5R, ROHS	VENKEL	C1206X5R250-106KNE
H1082-00105-50V10-T	1	ea	C7	CAP, SMD, 1210, 1µF, 50V, 10%, X7R, ROHS	VENKEL	C1210X7R500-105KNE
1266	1	ea	B- (Located right of J10)	CONN-TERMINAL, TH, QUICK-FIT MALE TAB, 20.1x8.9, ROHS	KEYSTONE	1266
22-23-2041	1	ea	J29	CONN-HEADER, 1x4, SOLID, 2.54mm, FRICTION LOCK, ROHS	MOLEX	22-23-2041
22-23-2051	0	ea	DNP (JP3)	CONN-HEADER, 1x5, SOLID, 2.54mm, VERTICAL, FRICTION LOCK, TIN, PbFREE	MOLEX	22-23-2051
22-28-8361	1	ea	J8 (Break off in 8-pin segments)	CONN-HEADER, 1x36, BREAK-AWAY, 2.54mm, R/A, ROHS	MOLEX	22-28-8361
67996-272HLF-2x3	1	ea	JP1	CONN-HEADER, 2x3, BRKAWY 2X36, 2.54mm, VERTICAL, ROHS	BERG/FCI	67996-272HLF
AZ23C3V3-7-F-T	1	ea	D5	DIODE-ZENER, DUAL, SMD, SOT23, 3.3V, 300mW, ROHS	DIODES INC.	AZ23C3V3-7-F
BAT6203WE6327	1	ea	D15	DIODE-SCHOTTKY, SMD, 2P, SOD323, 40V, 20mA, ROHS	INFINEON TECHNOLOGY	BAT6203WE6327
FYD0504SATM	1	ea	D14	DIODE-SCHOTTKY RECTIFIER, SMD, D-PAK, 40V, 5A, ROHS	FAIRCHILD	FYD0504SATM
MBR0540T1G-T	11	ea	D1, D2, D4, D13, D16-D22	DIODE-RECTIFIER, SMD, SOD-123, 2P, 40V, 0.5A, ROHS	ON SEMICONDUCTOR	MBR0540T1G

ISL9208EVAL2Z Bill of Materials (Continued)

PART NUMBER	QTY	UNITS	REFERENCE DESIGNATOR	DESCRIPTION	MANUFACT.	MANUFACTURER PART
MMSZ4705T1G-T	1	ea	D23	DIODE-ZENER, SMD, 2P, SOD-123, 18V, 500mW, ROHS	ON SEMICONDUCTOR	MMSZ4705T1G
LNJ826W83RA	8	ea	D3, D6-D12	LED, SMD, 0603, ORANGE, 19mcd, 5mA, 1.9V, 620nm, ROHS	PANASONIC	LNJ826W83RA
ADUM1250ARZ	0	ea	DNP (U4)	IC-HOT SWAP DUAL I^2C ISOLATOR, 8P, NSOIC, ROHS	ANALOG DEVICES	ADUM1250ARZ
CAT24C01WI-GT3	0	ea	DNP (U5)	IC-CMOS SERIAL EEPROM, 8P, SOIC, 1.7V to 5.5V, 16BYTE, ROHS	CATALYST SEMICONDUCTOR INC	CAT24C01WI-GT3
ISL9208IRZ	1	ea	U1	IC-MULTI-CELL BATTERY PACK, 32P, QFN, 5x5, ROHS	INTERSIL	ISL9208IRZ
LM358AM	1	ea	U2	IC-DUAL OP AMP, 8P, SOIC, ROHS	FAIRCHILD	LM358AM
MC9S08QG8CFFE	1	ea	U3	IC-MCU, FLASH, 8kx8, 10MHz, 16P, QFN, ROHS	FREESCALE SEMICONDUCTOR	MC9S08QG8CFFE
2N7002-7-F-T	1	ea	Q3	TRANSISTOR, N-CHANNEL, 3 Ld, SOT-23, 60V, 115mA, ROHS	DIODES, INC.	2N7002-7-F
BSS8402DW-7-F-T	1	ea	Q5	TRANSIST-MOS, P-CHANNEL/N-CHANNEL, 6P, SOT-363, 200mW, ROHS	DIODES INC.	BSS8402DW-7-F
BSS84DW-7-F-T	1	ea	Q4	TRANSIST, DUAL P-CHANNEL, 6P, SOT-363, -50V, -130mA, ROHS	DIODES INC.	BSS84DW-7-F
FMMT619TA-T	2	ea	Q1, Q13	TRANSISTOR, NPN, SOT23, 50V, 2A, ROHS	ZETEX, INC.	FMMT619TA
IRF1404SPBF	2	ea	Q2, Q12	TRANSIST-MOS, N-CHANNEL, TH, D2-PAK, 40V, 162A, ROHS	INTERNATIONAL RECTIFIER	IRF1404SPBF
IRF7469PBF	1	ea	Q14	TRANSISTOR-MOS, SMPS, 8P, SOIC, 40V, 9A, ROHS	INTERNATIONAL RECTIFIER	IRF7469PBF
MMBT3906K-T	7	ea	Q6-Q11, Q15	TRANSISTOR, PNP, 3P, SOT-23, -40V, -200mA, ROHS	FAIRCHILD	MMBT3906K
CSNL20.0051%R-T	2	ea	R52, R53	RES-CURR SENSE, SMD, 2512, 0.005Ω, 2W, 1%, MF, ROHS	STACKPOLE	CSNL 2 0.005 1% R
CSRN20.051%I-T	1	ea	R50	RES-CURR SENSE, SMD, 2512, 0.05Ω, 2W, 1%, TF, ROHS	STACKPOLE	CSRN 2 0.05 1% I
H2510-00100-1/16W1-T	1	ea	R7	RES, SMD, 0402, 10Ω, 1/16W, 1%, TF, ROHS	PANASONIC	ERJ-2RKF10R0
H2510-01000-1/16W1-T	4	ea	R25, R30, R31,R32	RES, SMD, 0402, 100Ω, 1/16W, 1%, TF, ROHS	PANASONIC	ERJ-2RKF1000
H2510-01001-1/16W1-T	9	ea	R34, R40, R68-R74	RES, SMD, 0402, 1k, 1/16W, 1%, TF, ROHS	VENKEL	CR0402-16W-102JT
H2510-01003-1/16W1-T	8	ea	R8, R10, R12, R14, R16, R18, R20, R66	RES, SMD, 0402, 100k, 1/16W, 1%, TF, ROHS	PANASONIC	ERJ2RKF1003

ISL9208EVAL2Z Bill of Materials (Continued)

PART NUMBER	QTY	UNITS	REFERENCE DESIGNATOR	DESCRIPTION	MANUFACT.	MANUFACTURER PART
H2510-01004-1/16W1-T	3	ea	R42, R43, R64	RES, SMD, 0402, 1M, 1/16W, 1%, TF, ROHS	PANSONIC	ERJ-2RKF1004X
H2510-01005-1/16W1-T	1	ea	R48	RES, SMD, 0402, 10M, 1/16W, 1%, TF, ROHS	VISHAY/DALE	CRCW040210M0FKED
H2510-01204-1/16W1-T	2	ea	R36, R49	RES, SMD, 0402, 1.2M, 1/16W, 1%, TF, ROHS	VENKEL	CR0603-16W-1204FT
H2510-01804-1/16W1-T	1	ea	R75	RES, SMD, 0402, 1.8M, 1/16W, 1%, TF, ROHS	VENKEL	CR0402-16W-1804FT
H2510-03653-1/16W1-T	1	ea	R6	RES, SMD, 0402, 365k, 1/16W, 1%, TF, ROHS	VENKEL	CR0402-16W-3653FT
H2510-04642-1/16W1-T	1	ea	R38	RES, SMD, 0402, 46.4k, 1/16W, 1%, TF, ROHS	PANASONIC	ERJ2RKF4642
H2510-04701-1/16W1-T	2	ea	R3,R4	RES, SMD, 0402, 4.7k, 1/16W, 1%, TF, ROHS	VENKEL	CR0402-16W-4701FT
H2510-04991-1/16W1-T	1	ea	R47	RES, SMD, 0402, 4.99k, 1/16W, 1%, TF, ROHS	KDA	RK73H1E4991F
H2510-04992-1/16W1-T	1	ea	R54	RES, SMD, 0402, 49.9k, 1/16W, 1%, TF, ROHS	PANASONIC	ERJ-2RKF4992
H2510-049R9-1/16W1-T	3	ea	R22, R24, R67	RES, SMD, 0402, 49.9Ω, 1/16W, 1%, TF, ROHS	PANASONIC	ERJ-2RKF49R9
H2510-05491-1/16W1-T	1	ea	R46	RES, SMD, 0402, 5.49k, 1/16W,1%, TF, ROHS		
H2510-07500-1/16W1-T	7	ea	R55-R61	RES, SMD, 0402, 750Ω, 1/16W, 1%, TF, ROHS	PANASONIC	ERJ-2RKF7500X
H2510-08202-1/16W1-T	1	ea	R51	RES, SMD, 0402, 82k, 1/16W, 1%, TF, ROHS	PANASONIC	ERJ-2RKF8202X
H2511-01000-1/10W1-T	4	ea	R28, R29, R33, R35	RES, SMD, 0603, 100Ω, 1/10W, 1%, TF, ROHS	KOA	RK73H1JT1000F
H2511-01001-1/10W1-T	2	ea	R41, R62	RES, SMD, 0603, 1k, 1/10W, 1%, TF, ROHS	KOA	RK73H1JTTD1001F
H2511-01002-1/10W1-T	1	ea	R45	RES, SMD, 0603, 10k, 1/10W, 1%, TF, ROHS	KOA	RK73H1JT1002F
H2511-01004-1/10W1-T	3	ea	R26, R27, R65	RES, SMD, 0603, 1M, 1/10W, 1%, TF, ROHS	PANASONIC	ERJ-3EKF1004V
H2511-01503-1/10W1-T	1	ea	R5	RES, SMD, 0603, 150k, 1/10W, 1%, TF, ROHS	YAGEO	RC0603FR-07150KL
H2511-01804-1/10W1-T	1	ea	R2	RES, SMD, 0603, 1.8M, 1/10W, 1%, TF, ROHS	VENKEL	CR0603-10W-1804FT
H2511-02493-1/10W1-T	1	ea	R39	RES, SMD, 0603, 249k, 1/10W, 1%, TF, ROHS	YAGEO	9C06031A2493FKHFT
H2511-03303-1/10W1-T	1	ea	R23	RES, SMD, 0603, 330k, 1/10W, 1%, TF, ROHS	YAGEO	RC0603FR-07330KL
H2511-04990-1/10W1-T	1	ea	R37	RES, SMD, 0603, 499Ω, 1/10W, 1%, TF, ROHS	KOA	RK73H1JTTD4990F
H2511-05110-1/10W1-T	2	ea	R1,R63	RES, SMD, 0603, 511Ω, 1/10W, 1%, TF, ROHS	VENKEL	CR0603-10W-5110FT
H2512-00010-1/8W1-T	1	ea	R76	RES, SMD, 0805, 1Ω, 1/8W, 1%, TF, ROHS	VENKEL	CR0805-8W-1R00FT

ISL9208EVAL2Z Bill of Materials (Continued)

PART NUMBER	QTY	UNITS	REFERENCE DESIGNATOR	DESCRIPTION	MANUFACT.	MANUFACTURER PART
H2515-00390-1W1-T	7	ea	R9, R11, R13, R15, R17, R19, R21	RES, SMD, 2512, 39Ω, 1W, 1%, TF, ROHS	VENKEL	CR2512-1W-39R0FT
SJ-5003-BLACK	4	ea	Bottom four corners	BUMPONS, 0.44inWx0.20inH, DOMETOP, BLACK	3M	SJ-5003SPBL
5X8-STATIC-BAG	1	ea	Place assy in bag	BAG, STATIC, 5x8, ZIP LOC	INTERSIL	212403-013
DNP	0	ea	B1-B7	DO NOT POPULATE OR PURCHASE		
DNP	0	ea	J10	DO NOT POPULATE OR PURCHASE		
DNP	0	ea	J42, P-	DO NOT POPULATE OR PURCHASE		
DNP	0	ea	VC1-VC7	DO NOT POPULATE OR PURCHASE		
DNP	0	ea	a) CSns, DSns, CFET, DFET, TI, RGO, AO, SCL,	DO NOT POPULATE OR PURCHASE		
DNP	0	ea	b) SDA, PSCL, PSDA, VMon, WKU, WP	DO NOT POPULATE OR PURCHASE		
LABEL-SERIAL NUMBER	1	ea		LABEL, FOR SERIAL NUMBER AND BOM REV #		
NTSD1XH103FPB50	1	ea	JP2	THERMISTOR-NTC, TH, 10k, 15mW, 1%, 50mm, B VALUE = 3380k, ROHS	MURATA	NTSD1XH103FPB50

Appendix 1

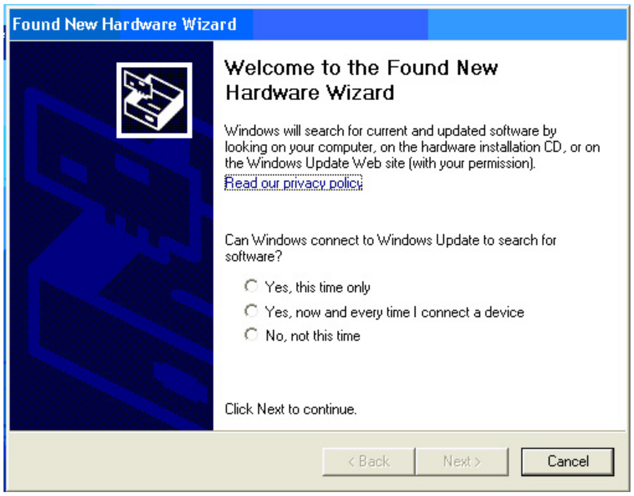
Installing the DeVaSys USB to I²C Board Software

Obtain the DeVaSys software along with the GUI code from the Intersil website on the ISL9208 page. Copy and extract the files from the "ISL92xx Eval Kit Software Release V1.41" zip file to the PC at whichever location is desired.

Disconnect the DeVaSys board from the ISL9208, ISL9216 board.

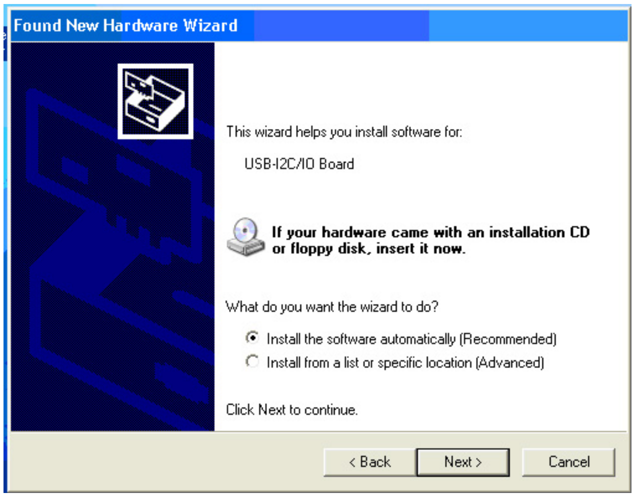
Plug in the DeVaSys board into the USB port.

The following screen should pop up.



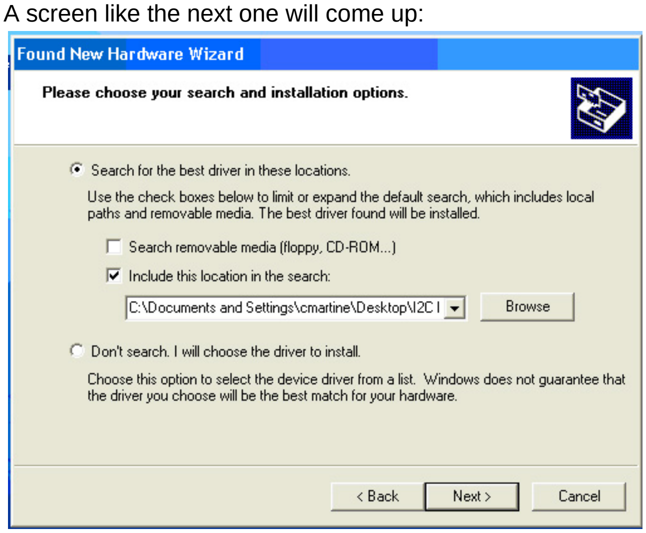
Select "Yes, this time only" and click "Next".

Then, this screen will come up:



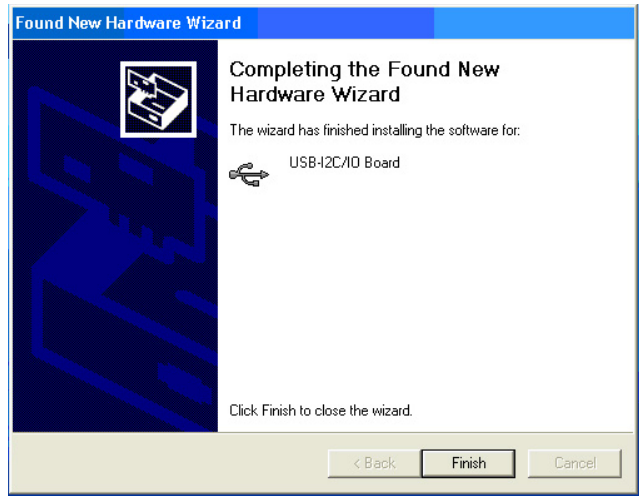
Select “Install from a list or specific location” and click “Next”

A screen like the next one will come up:



Browse for the Software in directory “ISL9208_16 Eval Kit SW and docs” folder then click “Next”.

This should install the software, eventually bringing up the following screen:



Click “Finish” and you’re done.

Appendix 2

Communication Troubleshooting

IF THE GUI STARTS UP WITH ALL ITEMS “GRAYED OUT”

1. Check that the I^2C cable is connected properly.
2. Check that the board is powered and that the RGO voltage is ~3.3V.
3. If the RGO voltage is not powered to the right voltage, move to the power supply troubleshooting section.
4. Make sure that the board drivers are installed correctly. On the DeVaSys USB to I^2C interface board, there should be one red LED and one green LED lit.
5. Use a scope to see that the I^2C communication is correct at the board. Monitor the SCL and the SDA lines while initiating a read of the ISL9208 status register. Set the scope to single trigger on the falling edge of SCL.

Power Supply Troubleshooting

IF RGO DOES NOT HAVE THE CORRECT VOLTAGE

1. Check that the voltage on each of the input terminals are between 2.6V and 4.5V.
2. Check that there is no unexpected load on the RGO output.

ISL9208 Troubleshooting

IF THE AO VOLTAGES ARE READING INCORRECTLY AT THE AO PIN

1. Check that all cell balance outputs are off.
2. Make sure that there is no series resistance between the battery and the input pins of the ISL9208EVAL2Z board and that the input voltage is between 2.6V and 4.3V.

IF THE AO VOLTAGES ARE READING INCORRECTLY ON THE GU

1. Check that the RGO output is 3.3V. GUI and microcontroller calculations assume the RGO voltage is 3.3V. Any variation translates directly into errors in the GUI screen value.
2. Power-down the board and stop the GUI. Power-up the board and restart the GUI. This should clear any communication problems.
3. Turn off the cell balancing. On the ISL9208EVAL2Z board, external PNP transistors are used to provide external balancing elements. When the PNP transistor turns on, current flows into the CBN pin and out the VCELL(N-1) pin. The current flowing out the VCELL(N-1) pin causes the VCELL voltage on one side of the balanced input to go up and the other side to go down. This difference can be up to 200mV to 300mV. This is an inherent design deficiency. An alternative is to replace the PNP transistors with P-Channel FETs or reduce the value of the series resistors on the inputs. However, these changes introduce some reliability concerns during a pack “dead short circuit”. A future revision of the board is planned that will address these issues.

Other Questions

Forward any ISL9208EVAL2Z questions to the Intersil Application Engineer at cmartine@intersil.com