USER'S MANUAL

ISL28022EVKIT1Z

ISL28022 Digital Power Monitor Evaluation Kit

AN1875
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Introduction

The ISL28022 Digital Power Monitor (DPM) evaluation kit is a three evaluation board design that demonstrates the functionality of the ISL28022. By design, the ISL28022 is considered a digital helper for a variety of applications ranging from energy optimization to diagnostics of complex systems. The three board evaluation kit demonstrates the functionality of the DPM for three specific applications while offering a configurable board for users to connect to their systems.

The DPM Evaluation kit is accompanied by a graphical user interface (GUI) that allows the user to configure the ISL28022 for monitoring bus voltage and current in a specific application. The GUI has a data save feature allowing the transfer of measurement data to another software application for analysis.

Dongle Evaluation Board (ISL28022USBEV1Z)

The ISL28022 DPM evaluation kit consists of three boards; a dongle, a generic ISL28022 board, and a R_{LOAD} board. The dongle board mates from a PC to the ISL28022 via a microcontroller. The microcontroller converts USB commands sourced from the PC to an I^2C header. The I^2C pins (SCL and SDA) are connected to the right angle header at the edge of the board. The dongle board has three circuits that convert the USB supply voltage from 5V to 3.3V, 12V and a selectable point of load (POL) voltage. Each voltage translation circuit has a ISL28022 connected to monitor the current sourced by the supply. Each circuit has been optimized to measure 100mA at full scale. The three supply voltages are routed to the right angle connector along with the I^2C pins, SDA and SCL.

R_{LOAD} Board (ISL28022DBEV1Z)

The 2nd DPM evaluation kit board is the R_{LOAD} board. The purpose of the R_{LOAD} board is to exercise the three supplies sourced by the dongle board. The R_{LOAD} board also allows the user to source power to a user defined system via a jumper selection. The R_{LOAD} board has a programmable load resistor. The programmable load resistor is a ISL23345 digitally controlled potentiometer (DCP). The evaluation software allows the user to configure the DCP for monitoring power. The R_{LOAD} board connects to the dongle board to demonstrate the functionality of the ISL28022.

ISL28022 Generic Board (ISL28022MBEV1Z)

The final ISL28022 board is a non-configured ISL28022 that connects the analog inputs to the outside world. The board allows a user to build a system that requires either current or power monitoring around the ISL28022. The analog inputs (VINP, VINM and VBUS) of the ISL28022 accept input voltages ranging from 0V to 60V. The ISL28022 allows the user to uniquely configure the slave address via jumper selections. The ISL28022 can be powered from a user defined source or the 3.3V supply generated from the USB voltage. The acceptable power supply voltage range for the ISL28022 is from 3V to 5.5V. The external clock/interrupt pin is routed to the outside world via a jumper selection. The maximum measurable input differential ±(VINP - VINM) is ±300mV. The differential voltage between the VINP and VINM pins can withstand a magnitude of 60V. The differential supply tolerance allows for the debug of catastrophic circuit events.
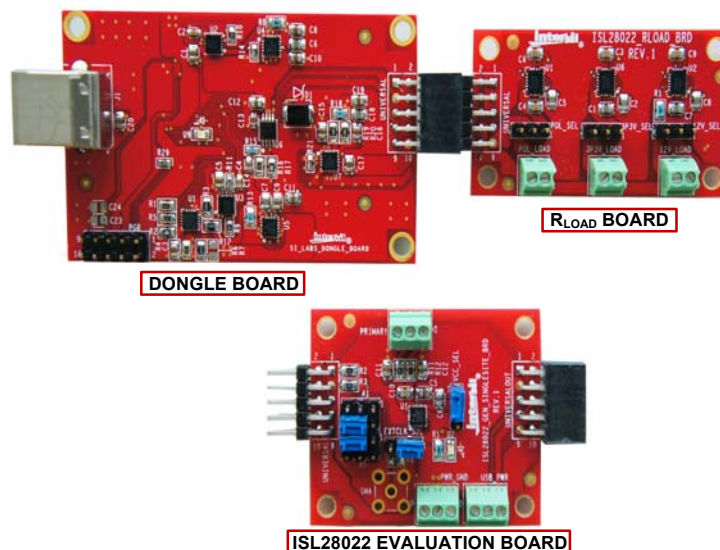

RLOAD BOARD

DONGLE BOARD

ISL28022 EVALUATION BOARD

FIGURE 1. ISL28022 EVALUATION KIT EVALUATION BOARDS

Evaluation Package (Online Order)

The ISL28022 Evaluation Kit (ISL28022EVKIT1Z) contains the following items:

- Dongle Board (SI_Labs_Dongle_Board) - ISL28022USBEV1Z

- Generic ISL28022 Board (ISL28022_GEN_SINGLESITE_BRD) - ISL28022MBEV1Z

- R_{LOAD} Board (ISL28022_RLOAD_BRD) - ISL28022DBEV1Z

- Evaluation Software (Online)

- User Guide

- ISL28022 Data sheet

Documentation for the individual device can be found in the following link:

http://www.intersil.com/products/ISL28022

System Requirements

- Windows 98/NT/2000/XP/VISTA/WIN7
- Available USB Port

Software Installation

Download the latest Evaluation Board GUI (Graphical User Interface) from the following link:

http://www.intersil.com/products/ISL28022

Installing the Software

From the link supplied in the previous section, download and run the *executable file* to start installing the GUI. The user will be greeted by the screen shown in Figure 2. Continue through the installer and read the instructions. The PC and PCB should *not* be connected via the USB port until after the installation has completed.
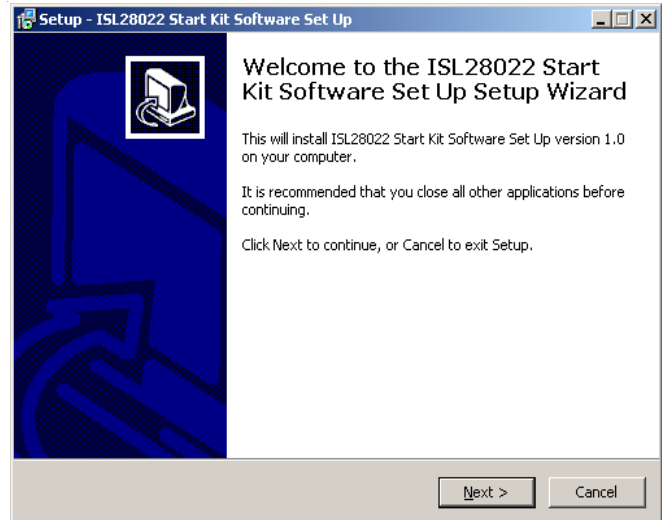

FIGURE 2. INSTALLATION WELCOME SCREEN

Hardware Setup

- Connect the USB 2.0 cable to the PC first, and then to the Evaluation Board
- The computer may ask about installing software for new found hardware; select "Yes, this time only"
- On the following screen, it will ask about how to install hardware. Select the recommended option (Installing from CD) and follow the directions
- The USB is the only connector needed

Running the ISL28022 Evaluation Kit Software

- To run the program, go to the "Start" menu and choose the ISL28022 Evaluation Kit folder, then choose the ISL28022 Evaluation Kit icon. Once clicked, the demo software window should appear as illustrated in Figure 3.
- If a generic ISL28022 board is connected to the dongle board, the front panel of ISL28022 software will be enabled while the Demo drop down menu will be disabled, see Figure 4.
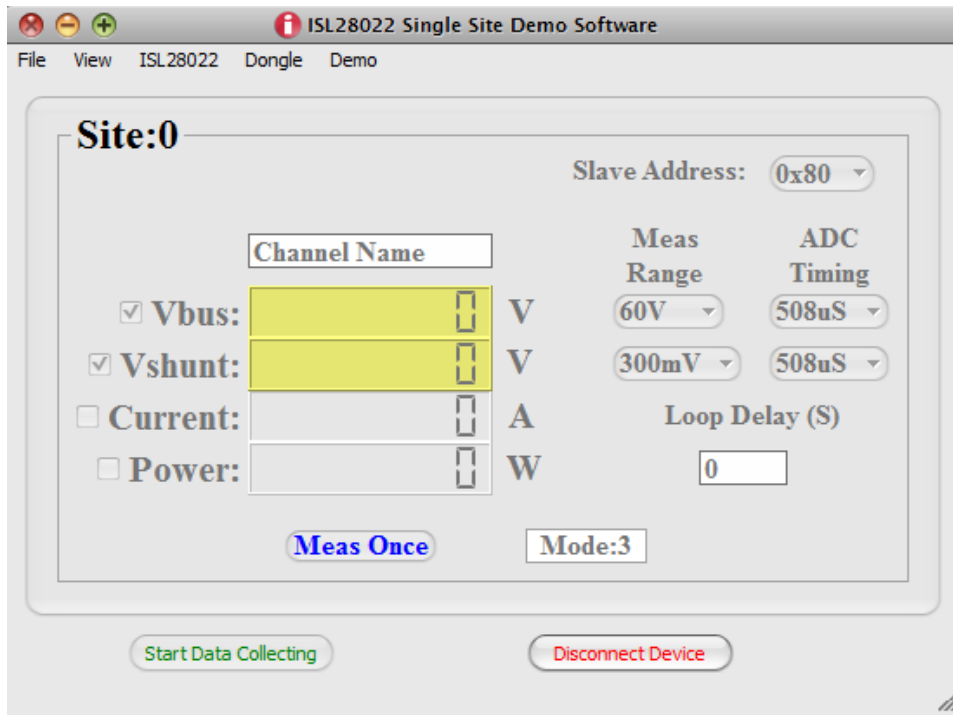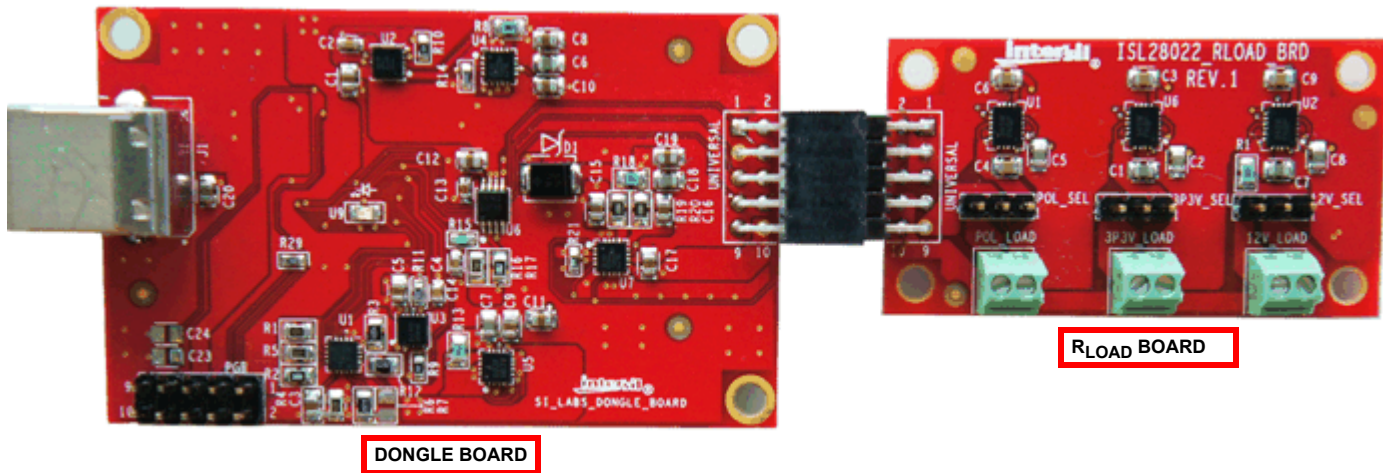
FIGURE 3. ISL28022 EVALUATION KIT SOFTWARE WINDOW

DONGLE BOARD

R$_{LOAD}$ BOARD

FIGURE 4. ISL28022 DEMONSTRATION SOFTWARE CONFIGURATION

Demonstration Software

- Connect the R$_{LOAD}$ board to the dongle as shown in Figure 4. Enable communication between the evaluation board and the computer by pressing the "Connect to Device" button at the bottom right of the software window. If the connection is successful, the text on the button will be changed to "Disconnect Device". Otherwise, the button text will not change. Upon successful connection between the PC and the dongle board, the evaluation software searches specific resistors to determine the type of board that is connected to the dongle. The board that is connected determines the behavior of the software. Connecting the R$_{LOAD}$ board to the dongle disables the front features of the ISL28022 GUI. All menus are disabled except the Demo and Dongle drop down menus.
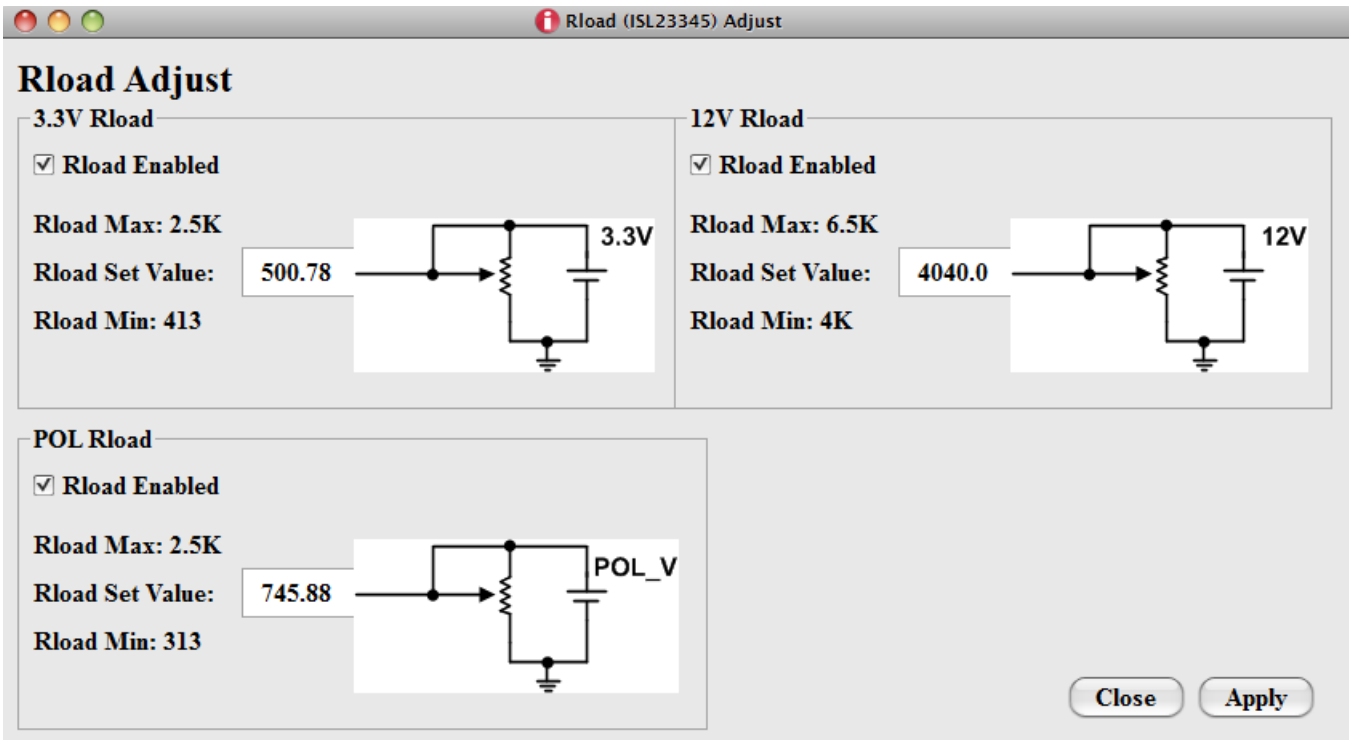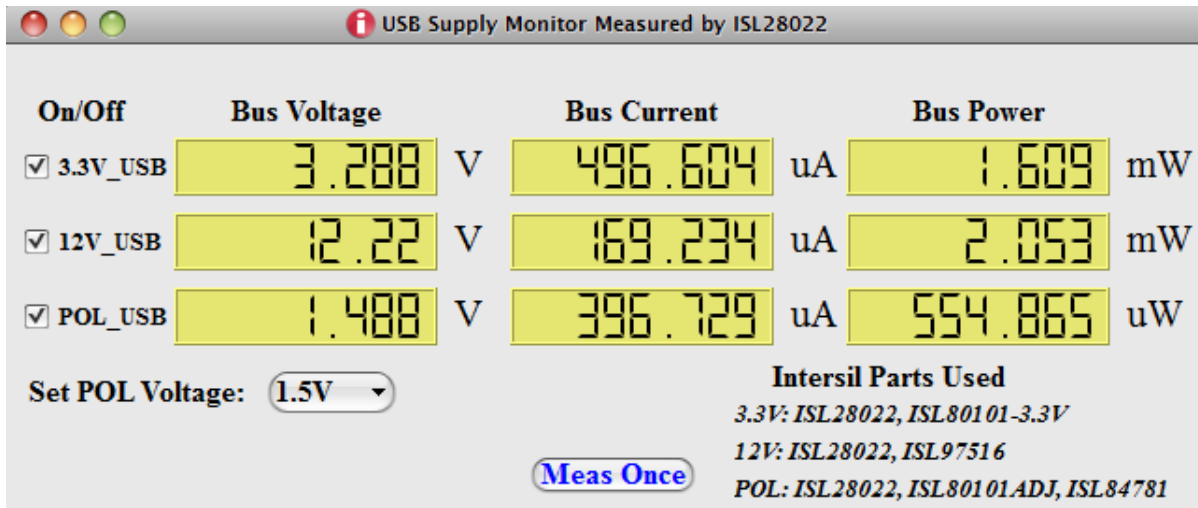

FIGURE 5. (A) TOP: ISL28022 USB SUPPLY MONITORING WINDOW. (B) BOTTOM: R$_{LOAD}$ BOARD SOFTWARE WINDOW. THE WINDOW CONTROLS THE DIGITALLY CONTROLLED RESISTORS

- Mouse to the Demo drop down menu and select the R$_{LOAD}$ selection. Two windows will appear. A USB supply monitor window and a R$_{LOAD}$ window. The two windows are shown in Figure 5. The USB supply monitor reports the current, voltage and power of the supplies sourced from the USB Dongle by pressing the "Meas Once" button. The USB Supply Monitor window allows the user to select the point of load (POL) voltage sourced by the dongle via a combo box. The POL voltage ranges from 2.5V to 0.8V. The AUX POL selection allows a user to generate a unique voltage that is not offered by the pre-configured ranges. The Aux voltage is configured by soldering a resistor to R7 of the Dongle board. Use Equation 1 to configure the Aux voltage.

$$Aux_V = 0.5\left(1 + \frac{26100}{R7}\right) \qquad \text{(EQ. 1)}$$

- The 12V and POL supplies can be disabled by unchecking the supply voltage next to the desired supply. Disabling the supply will shut down the ISL28022 and the regulator. Unchecking the 3.3V supply will only shutdown the ISL28022 for the 3.3V supply. The 3.3V supply remains on to power critical circuitry.

- The R$_{LOAD}$ board connects a load to the USB generated supplies sourced by the dongle board. A jumper selects the source of the load. Shorting pins 1 and 2 of each supply routes the load to the digitally controlled potentiometer (DCP). The DCP is controlled through an I^{2}C interface. R$_{LOAD}$ window controls the DCP's value for each supply. Enter a value within the resistance range (Figure 5(B)), for the respective supply DCP and press the "Apply" button. The value will be set accordingly to the nearest value. In the USB supply monitor window (Figure 5(A)), press the "Meas Once" button and the measured current will change accordingly for the resistance values that were changed.

- The R$_{LOAD}$ board can be configured to route the USB supply voltages to a terminal connector. This allows a user to source voltage from a USB supply to an external circuit while monitoring voltage, current and power levels on the supply. The terminal connection path is enabled by shorting pins 2 and 3 for the desired USB supply.

- Connect the ISL28022 board to the dongle as shown in Figure 6. Enable communication between the evaluation board and the computer by pressing the "Connect to Device" button at the bottom right of the software window. If the connection is successful, the text on the button will be red and read "Disconnect Device" otherwise, the button text will not change. Upon successful connection between the PC and the dongle board, the evaluation software searches specific resistors to determine the board that is connected to dongle.

- Prior to connecting to the device, a slave address should be configured to one of 13 available slave addresses on the Generic ISL28022 Board. Three slave addresses (0x9E, 0x9C and 0x9A) are reserved to monitor the USB supplies of the dongle board. The slave address is configured by jumpering the address pins A0 and A1 to a level. There are four levels (VCC, GND, SDA and SCL) per pin. The translation between the jumpered pin value and slave address is defined in the ISL28022 datasheet.

- Successful connection between the PC and ISL28022 evaluation board will enable the front panel of the Evaluation Kit GUI while disabling the Demo drop down options.

DATA COLLECTING

- To start collecting data, press the "Start Data Collecting" button located to the left of the "Connect to Device" button at the bottom of the screen. Once pressed, the color of the text and verbiage of the button will change to "Stop Data Collecting". The default state of the software reads each DPM for shunt and bus voltages. To change the read settings of the DPM, toggle the check box label next to each numerical readout. The backlight of the display will toggle between yellow and gray. A backlight of yellow means a channel is enabled. A change in the functionality of the DPM will change the mode value for the respective channel. The mode of each DPM is displayed in the lower left hand corner of each channel's display. Figure 6 represents a zoomed in view of a single DPM interface.
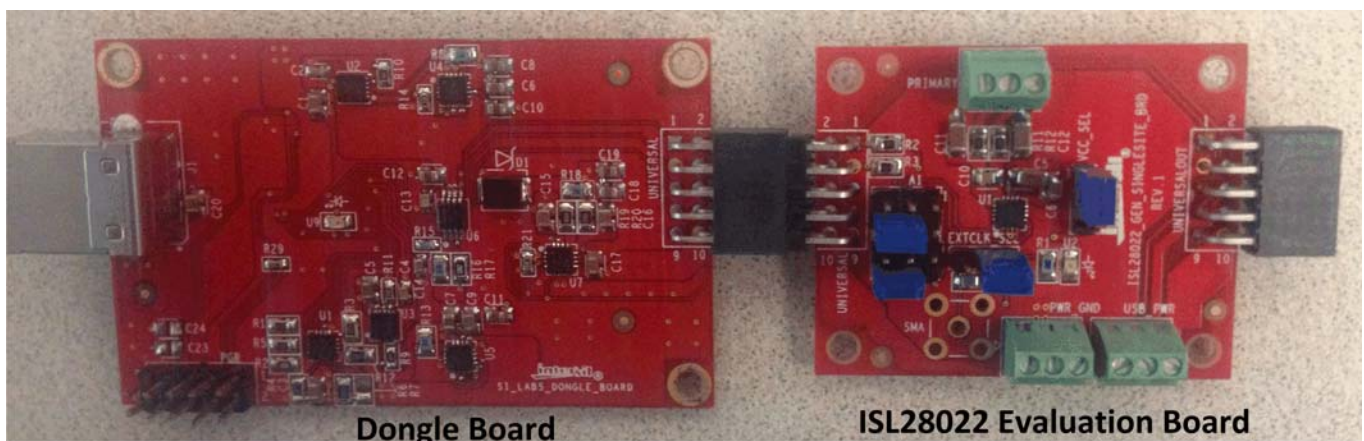

FIGURE 6. DONGLE UNCONNECTED TO THE ISL28022 BOARD

LOOP DELAY (S)

• Timing between successive measurements can be fast causing the LCD readout to be illegible. The Loop Delay (S) input field allows the user to input a delay between measurements.

DPM MEASUREMENT FUNCTIONALITY

• Enabling the current functional block on the DPM interface requires the user to enter a shunt resistor value. The entered value is stored in the DPM calibration register and is used to calculate the current or power depending on the enabled check box. Figure 7 illustrates the dialog box that request the shunt resistor value when current functionality is enabled.
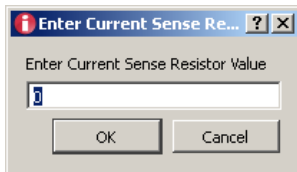

FIGURE 7. CURRENT SENSE DIALOG BOX

ADC RANGE AND TIMING CONTROLS

• The BRNG (Bus Voltage Range) and PGA (Shunt Voltage Range) combo boxes control the full-scale measurement range setting of the DPM. The BRNG range spans from 60V to 16V. The PGA has full-scale ranges from ±300mV to ±40mV.

• The SADC (Shunt acquisition time) and BADC (Bus acquisition time) change the speed at which the DPM measures either the bus or shunt channels. Faster acquisition times reduces the resolution of the measurement. ADC acquisition times equal to 508µs and greater have 15 bits of resolution while 72µs of acquisition time represents 12 bits of resolution.

THRESHOLD AND AUXILIARY CONTROLS

• Choose the Threshold selection under the ISL28022 drop down menu that invokes the Auxiliary Control dialog box. The dialog box allows the user to configure the threshold detectors of the DPM chip as well as route the alert status to the interrupt pin. Figure 8 shows the Auxiliary Controls Dialog Box.
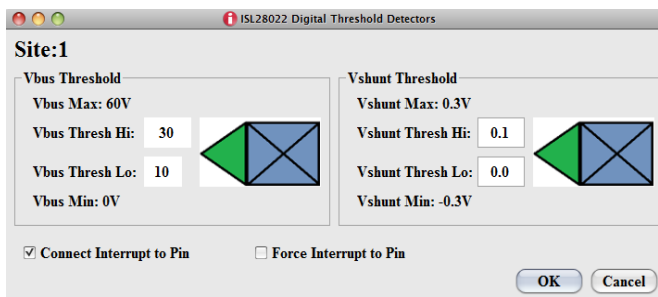

FIGURE 8. AUXILIARY CONTROL DIALOG BOX

• The Vbus thresholds can be set between 0V and 60V. Vshunt thresholds range between ±300mV. The Vbus and Vshunt thresholds do not scale versus BRNG and PGA settings. Once an input is set and the measured signal violates a threshold level, the backlight of the measured signal will turn from yellow to orange for a measured value above the upper threshold. Measured signals below the lower threshold results in a backlight changing from yellow to blue.

RESET THE DEVICE

• Choosing the Reset selection under the ISL28022 drop down menu will soft reset the ISL28022 and restore the device to the default value. A soft reset will perform an auto calibration on the device.

EXTERNAL CLOCK ENABLE

• The ISL28022 can be synchronized to an external clock to reduce measurement noise in a system. To configure and enable the external clock feature choose the EXTCLK/INT selection in the ISL28022 drop down menu. A dialog box, illustrated in Figure 9, will appear allowing the user to enable the external clock feature. The input bandwidth of the external clock pin is roughly 4MHz. The external clock frequency can be divided to match the internal system clock frequency of 500kHz. Choosing a clock division that results in internal clock frequency close to 500kHz will guarantee ADC acquisition times similar to the default times.
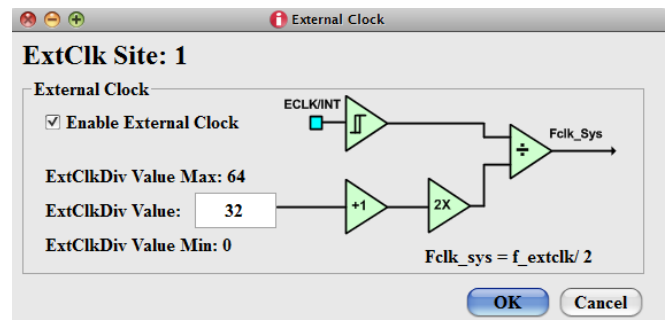

FIGURE 9. EXTERNAL CLOCK DIALOG BOX

SINGLE MEASUREMENT CONTROL

• Pressing the "Meas Once" button on the main panel measures the individual channel once that is associated with the "Meas Once" button.

SAVING DATA

• The DPM software allows the user to store a set number of points of data. Go to the menu bar of the ISL28022 DPM Demo Software window and choose File –> Save Data. Choosing the Save Data option will open a dialog box asking for the filename and directory of the save path. Figure 10 is an illustration of the dialog box.
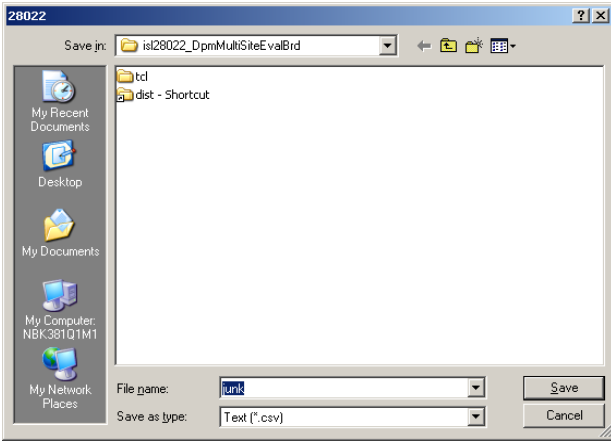
FIGURE 10. FILE NAME AND DIRECTORY SAVE DIALOG BOX

The file name entered in the dialog box is the base name for all files saved. A unique named file is generated for each measured parameter (Vbus, Vshunt, Current, Power) across 8 channels. The software only saves data to a file for each measured parameter selected. If a measured parameter is not selected, then a file with the non selected measured parameter is not generated. For example, power and current files would not be generated for the configuration of the DPM window shown in Figure 3 on page 3.

All saved files are tab delimited. The naming convention of the file is <base name>_<measured parameter>_dataset. The base name is the file name entered in the save dialog box. The measured parameter names are vbus, vshunt, current and power.

- Upon completion of the save dialog box, an input box (Figure 11) asks for the number of points to be saved per channel.
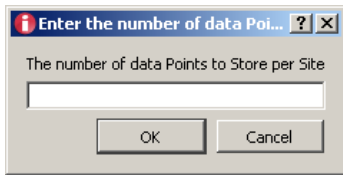

FIGURE 11. NUMBER OF POINTS PER CHANNEL INPUT BOX

Pressing the "OK" button with a valid numerical entry will begin data collection. The numerical values changes on the main window while the data is being recorded. The completion of data collection will commence when all of the active measurement numbers cease to change.

- The settings of all channels should be finalized prior to invoking the Save Data feature. The user has the option of uniquely naming each channel and having the channel name be passed to the column name of each respective data file. Changing the field named "Channel Name" in Figure 4 on page 3 will change the name of the column data.

USB SUPPLIES

- The ISL28022 Demo Software allows a user to build their own board to mate with the Dongle board. The final design of the third party board may use the dongle generated power supplies. The user can monitor the current draw for each of the Dongle supplies by selecting USB Supplies under the Dongle drop down menu. The dialog box in Figure 12 will appear once the USB Supplies are selected.
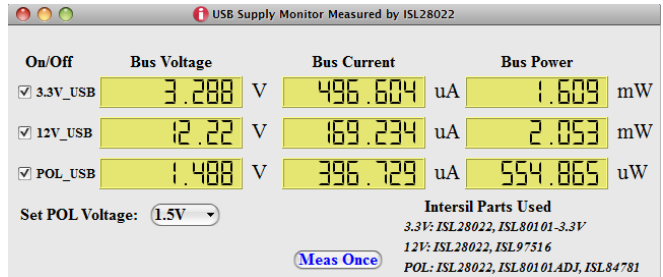

FIGURE 12. USB SUPPLY DIALOG BOX

I²C TRANSACTION

- The ISL28022 Demo Software allows a user to build their own board to mate with the Dongle board. The final design may have an I²C Device incorporated into the design. The I²C Transaction selection in the Dongle drop down menu allows the user to send read and write commands to I²C devices. Figure 13 is the dialog box that appears when the I²C transaction is chosen.
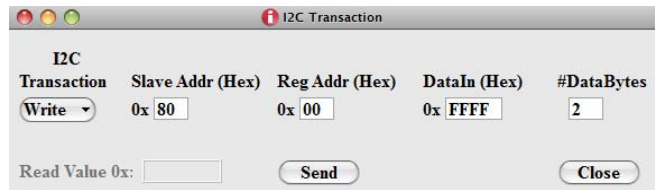

FIGURE 13. I²C TRANSACTION DIALOG BOX

CONNECTING MULTIPLE ISL28022 EVALUATION BOARDS TO A DONGLE

- An ISL28022 design can have 16 devices connected on a single I²C bus. The ISL28022 evaluation kit allows the user to cascade up to 13 ISL28022 Evaluation Boards. The dongle uses three slave addresses (0x9E, 0x9C, and 0x9A) for measuring the current and voltage of the 3.3V, 12V and Pol_V supplies. Figure 14 is a picture of the dongle board connected to two ISL28022 evaluation boards.

- Connect the Dongle board to the computer via a USB cable. Start the ISL28022 evaluation kit demo hardware.

- Connect the software to the Dongle by pressing the "Connect to Device" button at the bottom right of the software window. If the connection is successful, the text on the button will be red and read "Disconnect Device". All buttons on the front panel of the GUI will be enabled. The GUI should look similar to Figure 15. When the software connects to the microcontroller, the software scans for all the acceptable ISL28022 slave addresses to determine if the device is connected to the dongle.

FIGURE 14. PICTURE OF MULTIPLE ISL28022 EVALUATION BOARDS CONNECTED TO THE DONGLE BOARD
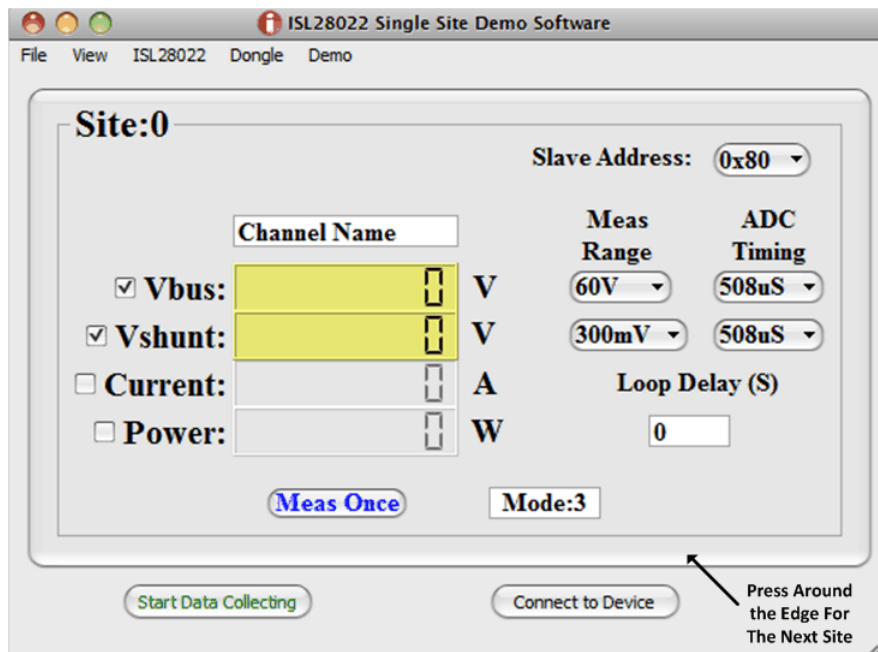

FIGURE 15. PICTURE OF THE MAIN GUI WITH AT LEAST ONE ISL28022 EVALUATION BOARD CONNECTED TO THE DONGLE BOARD

- Configure the site as desired. The slave address in the upper right of the button indicates the device that is being configured. When multiple ISL28022s are connected to dongle, the software arranges the site in ascending order of the ISL28022 slave addresses connected to the dongle.

- To advance to the next site/device, press around the rim of the button. Continuously pressing the rim of the button will loop through all ISL28022 devices connected to the dongle.

- Pressing the "Start Collecting Data" button or saving data from the front panel will only collect data for the site chosen.

SAVING AND LOADING THE CONFIGURATION FILES

- The software allows the user to save and load the configuration of each of the devices. To load or save a configuration, select Load Config or Save Config under the File drop down menu. A window will appear similar to Figure 10 that will ask for directory information of the file to save or load.

SYSTEM VIEW

- When multiple ISL28022 devices are connected to the dongle board a system view screen is available. The system view allows the user to view all the ISL28022 devices as configured.

- To enter the system view, select System under the View drop down menu. The window in Figure 16 will appear while the main GUI window will disappear.

- The window will size to the number of ISL28022 devices connected to the dongle.

- Pressing the "Start Data Collecting" button will loop through all sites and measure the configure parameters for each ISL28022 device.

- Pressing the "Save Data" button will save data for all sites. See "Saving Data" on page 6 for more detail.

- Pressing the "Single Site View" button will restore the main GUI view.

RENESAS

FIGURE 16. PICTURE OF THE SYSTEM VIEW WINDOW FOR MULTIPLE ISL28022 CONNECTED TO THE DONGLE
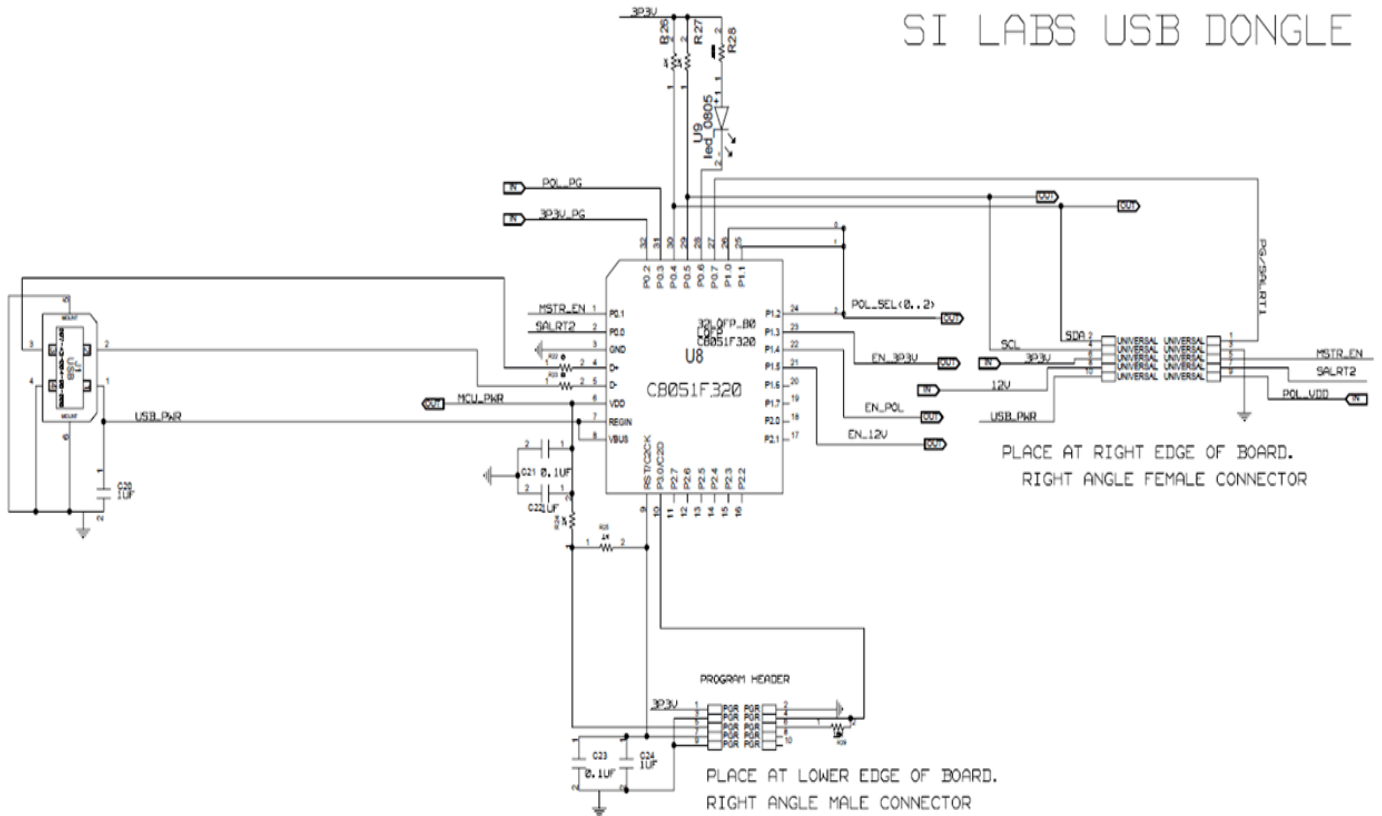
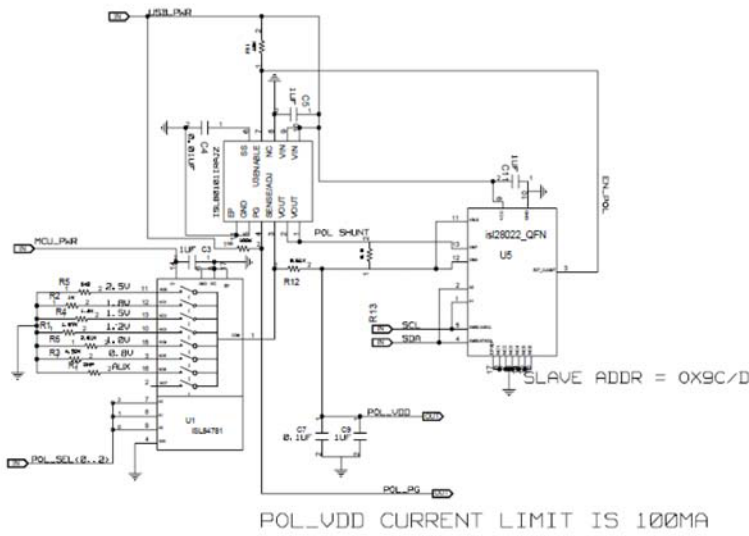FIGURE 17. PAGE 1 SCHEMATIC OF THE ISL28022 DONGLE
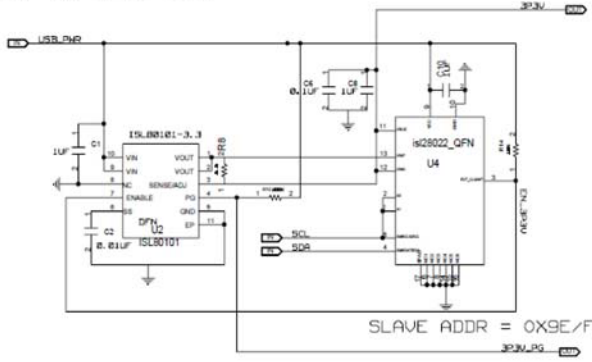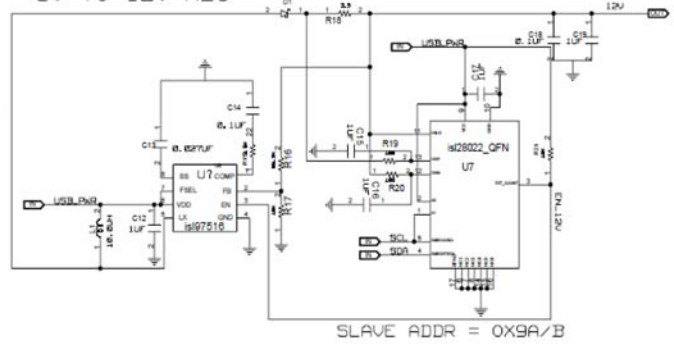
FIGURE 18. PAGE 2 SCHEMATIC OF THE ISL28022 DONGLE

TABLE 1.   ISL28022 DONGLE BOARD BILL OF MATERIAL

ITEM#	QTY	PART NAME	PART VALUE	FOOTPRINT	REFERENCE DESIGNATOR	VENDOR NAME	VENDOR P/N	MANUFACTURER NAME	MANUFACTURER P/N
1	1	USB Micro Controller	C8051F320 - LQFP32	QUAD32	U8	Digi-Key	336-1259-ND	Silicon Labs	C8051F320LQFP32
2	1	Linear Regulator	ISL80101 - 3.3V	DFN10	U2	Digi-Key	ISL80101IR33Z-T-ND	Intersil Corp	ISL80101IR33Z-T
3	1	Linear Regulator	ISL80101RAJZ	DFN10	U3	Digi-Key	ISL80101RAJZ-ND	Intersil Corp	ISL80101IRAJZ
4	1	LED	Red	0805	U9			Dialight	
5	14	Capacitor	1µF	0805	C1, C3, C5, C8-C12, C15-C17, C19, C20, C22	Generic		Generic	
6	2	Capacitor	0.01µF	0603	C2, C4	Generic		Generic	
7	1	Capacitor	0.027µF	0603	C13	Generic		Generic	
8	1	Capacitor	0.1µF	0603	C14	Generic		Generic	
9	4	Capacitor	0.1µF	0805	C6, C7, C18, C21	Generic		Generic	
10	1	Resistor	1.87kΩ	0805	R1	Generic		Generic	
11	2	Resistor	100kΩ	0603	R9, R10	Generic		Generic	
12	4	Resistor	10kΩ	0603	R11, R14, R21, R29	Generic		Generic	
13	2	Resistor	2.61kΩ	0805	R6, R12	Generic		Generic	
14	3	Resistor	3.3Ω	0805	R8, R13, R18	Generic		Generic	
15	1	Resistor	3.9kΩ	0603	R15	Generic		Generic	
16	1	Resistor	86.6kΩ	0805	R16	Generic		Generic	
17	1	Resistor	10.2kΩ	0805	R17	Generic		Generic	
18	2	Resistor	100Ω	0805	R19, R20	Generic		Generic	
19	3	Resistor	1kΩ	0805	R2, R26, R27	Generic		Generic	
20	2	Resistor	1kΩ	0603	R24, R25	Generic		Generic	
21	2	Resistor	0Ω	0603	R22, R23	Generic		Generic	
22	1	Resistor	4.32kΩ	0805	R3	Generic		Generic	
23	1	Resistor	1.3kΩ	0805	R4	Generic		Generic	
24	1	Resistor	649Ω	0805	R5	Generic		Generic	
25	1	Resistor	300Ω	0805	R28	Generic		Generic	
26	1	USB Connector	USB Connector	USB B	J1	Digi-Key	ED90064-ND	Mill-Max	897-43-004-90-000000

TABLE 1.   ISL28022 DONGLE BOARD BILL OF MATERIAL (Continued)

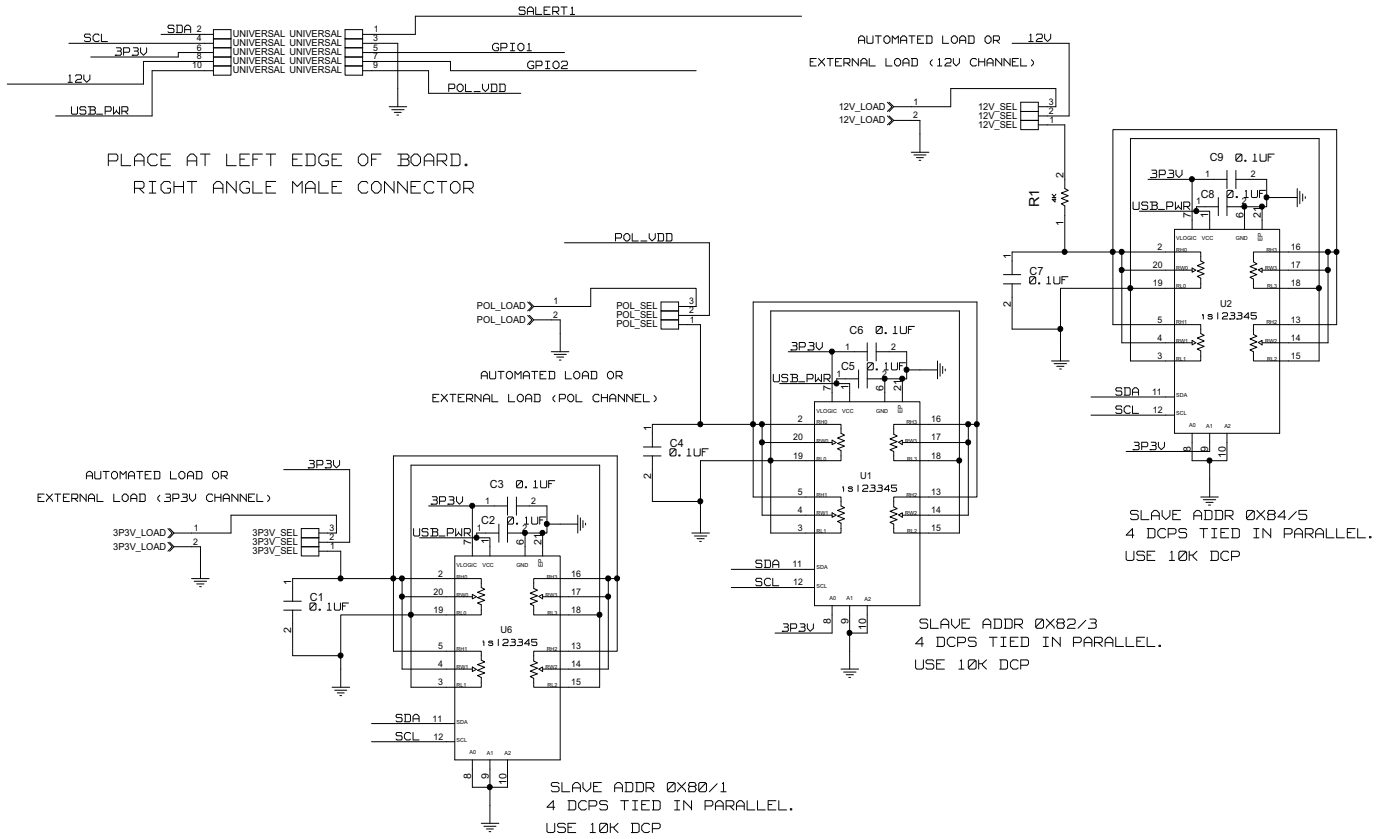| ITEM#	QTY	PART NAME	PART VALUE	FOOTPRINT	REFERENCE DESIGNATOR	VENDOR NAME	VENDOR P/N	MANUFACTURER NAME	MANUFACTURER P/N
27	1	10 pin Jumper	5x2 pin 0.1 spacing Right angle Female Connector	CON10	Universal	Generic		Generic	
28	1	10 pin Jumper	5x2 pin 0.1 spacing jumper	CON10	PGR	Generic		Generic	
29	3	ISL28022FRT	ISL28022	QFN16	U4, U5, U7				
30	1	ISL84781FRT	ISL84781	QFN16	U1			Intersil Corp	
31	1	Inductor	10µH	SMT-30%	L1	Generic		CDRH8D43NP-100N	

FIGURE 19. SCHEMATIC OF THE ISL28022 R_{LOAD} BOARD

TABLE 2. ISL28022 R$_{LOAD}$ BOARD BILL OF MATERIAL

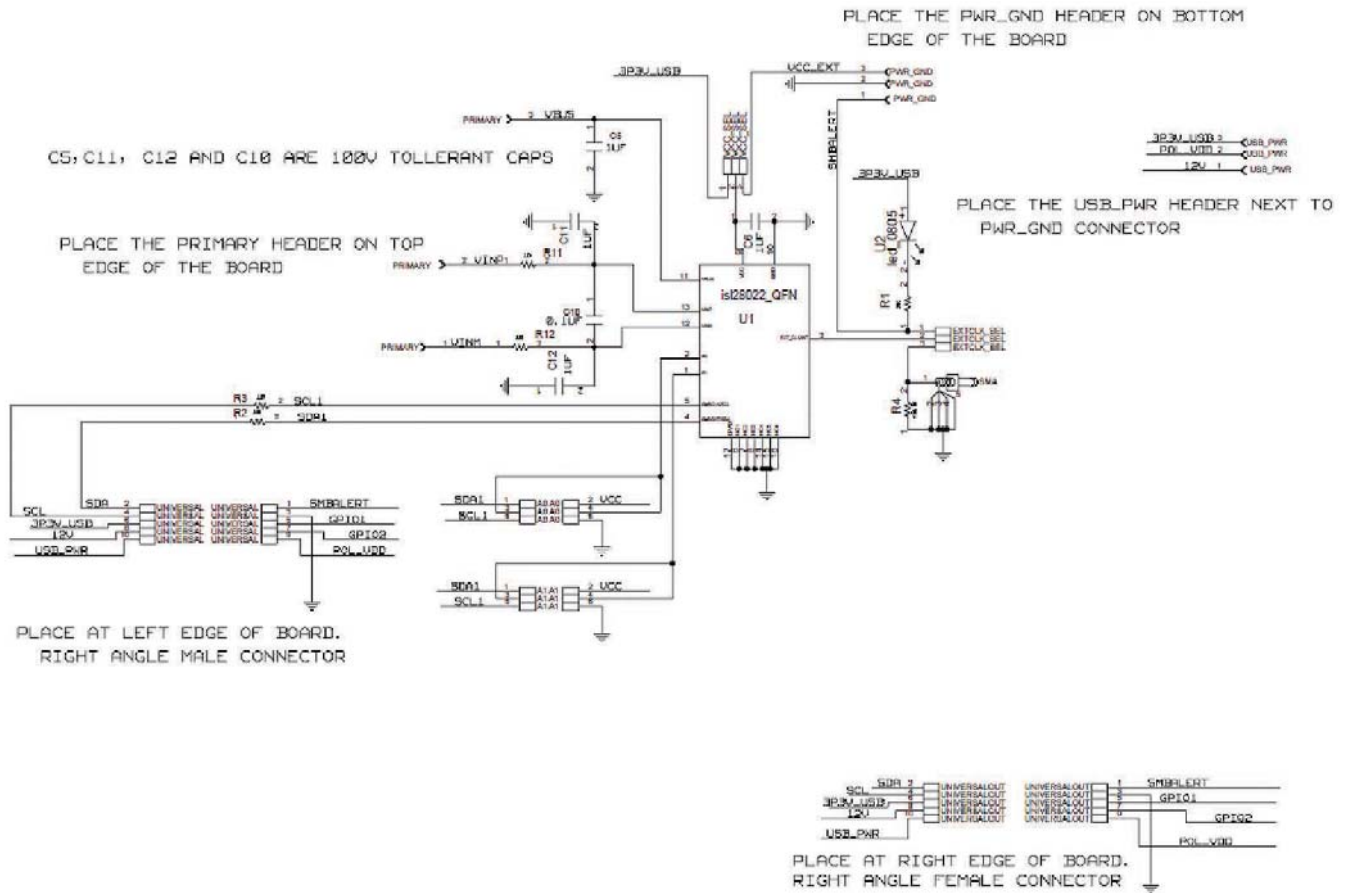| ITEM #	QTY	PART NAME	PART VALUE	FOOTPRINT	REFERENCE DESIGNATOR	VENDOR NAME	VENDOR P/N	MANUFACTURER NAME	MANUFACTURER P/N
1	9	Capacitor	0.1µF	0805	C1-C9	Generic		Generic	
2	1	Resistor	4kΩ	0805	R1	Generic		Generic	
3	1	10 pin Jumper	5X2 pin 0.1 spacing Right angle male Connector	CON10	Universal	Generic		Generic	
4	3	ISL23345WFVZ	ISL23345-10K	QFN20	U1, U2, U6	Avnet	ISL23345WFVZ	Intersil Corp	ISL23345WFVZ
5	3	2 Terminal Terminator	1725656	2MNT	12V_LOAD, 3p3V_LOAD, POL_LOAD	Digikey	277-1273-ND	Molex	1725656
6	3	3 pin Jumper	3 pin 0.1 spacing jumper	THOLE	12V_Sel, 3p3V_Sel, Pol_Sel	Generic		Generic	

FIGURE 20. SCHEMATIC OF THE ISL28022 GENERIC BOARD

TABLE 3.   ISL28022 GENERIC BOARD BILL OF MATERIAL

ITEM #	QTY	PART NAME	PART VALUE	FOOTPRINT	REFERENCE DESIGNATOR	VENDOR NAME	VENDOR P/N	MFR NAME	MFR P/N
1	1	Capacitor	0.1µF	0805	C10	Generic		Generic	
2	4	Capacitor	1µF/100V	0805	C5, C6, C11, C12	Generic		Generic	
3	1	Resistor	2kΩ	0805	R1	Generic		Generic	
4	4	Resistor	10Ω	0805	R2, R3, R11, R12	Generic		Generic	
5	1	Resistor	49.9Ω	0805	R4	Generic		Generic	
6	1	10 pin Jumper	5X2 pin 0.1 spacing right angle male connector	CON10	Universal	Generic		Generic	
7	1	10 pin Jumper	5X2 pin 0.1 spacing right angle female connector	CON10	Universal Out	Generic		Generic	
8	1	ISL28022FRT	ISL28022	QFN16	U1				
9	3	3 Terminal Terminator	1725669	3MNT	Primary, Pwr_Gnd, USB_Pwr	Digikey	277-1274-ND		1725669
10	1	LED	Red	0805	U2			Dialight	
11	2	3 pin Jumper	3 pin 0.1 spacing jumper	THOLE	Vcc_Sel, ExtClk_Sel	Generic		Generic	
12	2	6 pin Jumper	3x2 pin 0.1 spacing jumper	CONN6	A0, A1	Generic		Generic	

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