

## ISL28023EVAL1Z, ISL28023EVAL2Z

ISL28023 Precision Digital Power Monitor Evaluation Kit

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### Introduction

The Precision Digital Power Monitor (DPM) Evaluation Kit is a three evaluation board design that demonstrates the functionality of the ISL28023. The ISL28023 is an IC with a 16-bit Analog-to-Digital Converter (ADC), an 8-bit Digital-to-Analog Converter (DAC), and analog comparators that monitors for undervoltage, overvoltage and overcurrent conditions. The IC is serially controlled through an I<sup>2</sup>C bus. The device abides by the PMBus standards.

The DPM Evaluation Kit is accompanied by a graphical user interface (GUI) that allows the user to configure ISL28023 for monitoring bus voltage and current in a specific application. The GUI has a data save feature allowing the transfer of measurement data to other software application for analysis.

The ISL28023 DPM Evaluation Kit consists of three boards; a USB dongle, a generic ISL28023EVAL1Z board and an ISL28023EVAL2Z demonstration board.

#### Dongle Evaluation Board (ISLUSBPWRDONGLE1Z)

The dongle board mates from a PC to the ISL28023 via a microcontroller. The microcontroller converts USB commands sourced from the PC to an I<sup>2</sup>C header. The I<sup>2</sup>C pins (SCL and SDA) are connected to the right angle header at the edge of the board. The dongle board has a circuit that converts the USB supply voltage to 3.3V. The 3.3V supply circuit has an ISL28022 connected to monitor the current sourced by the supply. Each circuit has been optimized to measure 100mA at full scale. The 3.3V supply output and the SDA and SCL lines of the I<sup>2</sup>C bus are routed to the right angle connector.

#### ISL28023 Generic Board (ISL28023EVAL1Z)

The generic ISL28023 board is a nonconfigured ISL28023 that connects the analog inputs to the outside world. The board allows a user to build a system that requires voltage, current or power monitoring around the ISL28023. The analog inputs (VINP, VINM and VBUS) of the ISL28023 accept input voltages ranging from 0V to 60V. The ISL28023 allows the user to uniquely configure the slave address via jumper selections. The ISL28023 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 ISL28023 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 ±80mV. The differential voltage between the VINP and VINM pins can withstand a magnitude of 60V. The differential supply tolerance allows for the debugging of catastrophic circuit events.

#### ISL28023 Demo Board (ISL28023EVAL2Z)

A peripheral circuit is required to demonstrate the functionality of the ISL28023. The ISL28023 is paired up with a buck regulator (ISL85415) and some sample loads to measure the current and efficiency calculations of the regulator to the load.

The buck circuit allows the user to define a unique load that connects to the regulator. The user can define the switching frequency of the regulator by programming a resistor value into the ISL23345 digital potentiometer. All features of the ISL28023 are available.

### Ordering Information

PART NUMBER	DESCRIPTION
ISL28023EVAL1Z	Evaluation Board
ISL28023EVKIT1Z	Evaluation Kit



FIGURE 1. ISL28023 EVALUATION KIT EVALUATION BOARDS

## Evaluation Package (Online Order)

The Digital Power Monitor Generic Evaluation Kit contains the following items:

- ISL28023 Demo Board (ISL28023EVAL2Z)
- ISL28023 Generic Board (ISL28023EVAL1Z)
- USB to I<sup>2</sup>C Dongle Board (ISLUSBPWRDONGLE1Z)
- Evaluation Software (Online)
- User Guide
- [ISL28023](#) Data sheet

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

<http://www.intersil.com/products/ISL28023>

## System Requirements

- Windows 98/NT/2000/XP/VISTA/WIN7/Win8
- Available USB Port

## Software Installation

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

[ISL28023EVKIT1Z, ISL28025EVKIT1Z Evaluation Kit Software](#)

### 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.

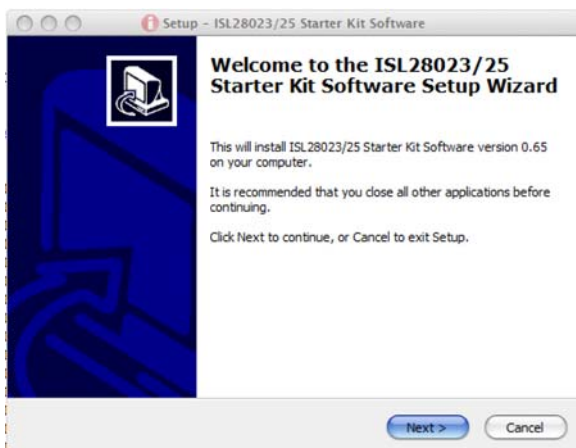


FIGURE 2. INSTALLATION WELCOME SCREEN

### 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 Software with the ISL28023 Generic Board

To run the program, go to the "Start" menu and choose the ISL28023setup folder, and then choose the ISL28023GenEvalSoftwareSetup icon. Once clicked, the demo software window should appear as illustrated in [Figure 3](#).

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 connection is successful, the text on the button will be red and read "Disconnect Device" as shown in [Figure 3](#). Otherwise, the button text will not change.

The evaluation program controls and measures an ISL28023 device on a single I<sup>2</sup>C/SMBus. The main software window displays one site.

### 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 defaults 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 read out. The back light of the display will toggle between yellow and gray. A back light 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.

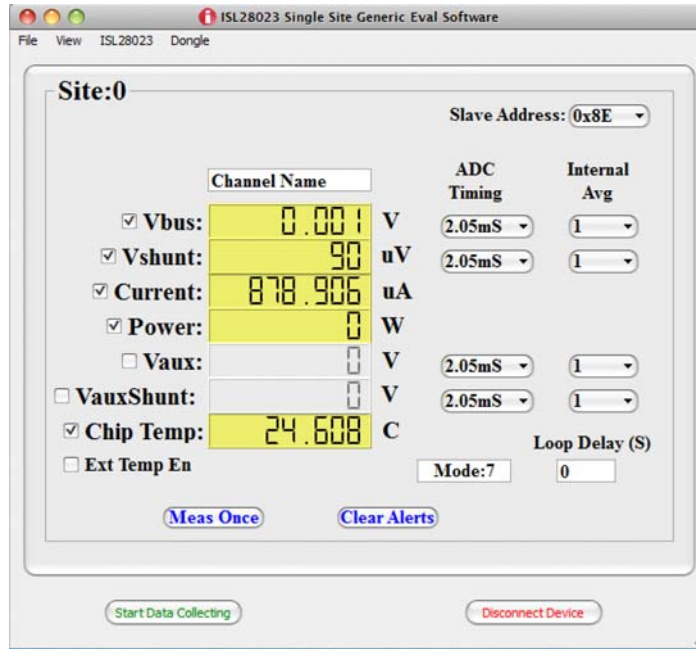


FIGURE 3. MAIN WINDOW OF THE ISL28023 GENERIC USER INTERFACE (GUI) CONNECTED TO THE ISL28023 GENERIC BOARD

**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 4 illustrates the dialog box that requests the shunt resistor value when current functionality is enabled.

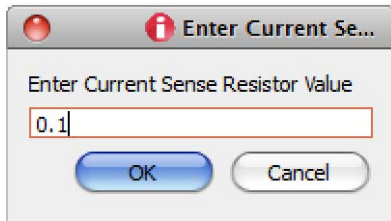


FIGURE 4. DIALOG BOX THAT ALLOWS THE USER TO ENTER THE SENSE RESISTOR VALUE INTO THE ISL28023 DEVICE

**ADC TIMING AND INTERNAL AVERAGE CONTROLS**

The ADC Timing is the acquisition time of the ADC for the channel. The acquisition timing selection of a channel is located to the right of the channel’s measurement display in Figure 3. The user can select ADC acquisition times ranging from 64µs to 2.05ms for each of the four channels shown in Figure 3.

The user adjusts the number of internal averages the ISL28023 makes before reporting out a value. The ISL28023 internal averages can be programmed from a single measurement to 4096 measurements.

**LOOP DELAY**

The loop delay field in the lower right corner of the GUI allows the user to program a delay between measurements. When the ISL28023 is programmed to fast acquisition times, the screen is updating quickly such that the user cannot read the measurements that is taken by the ISL28023. The loop delay field inserts a time delay after each measurement. Allowing for a time delay makes the measurements readable.

**SINGLE MEASUREMENT CONTROL**

Pressing the Meas Once button on the main panel will measure each enabled individual channel once.

**THRESHOLD AND AUXILIARY CONTROLS**

Choose the Threshold selection under the ISL28023 drop down menu that invokes the Auxiliary Control dialog box. The dialog box allows the user to configure the threshold detectors of the ISL28023 chip. Figure 5 shows the Auxiliary Controls Dialog Box.

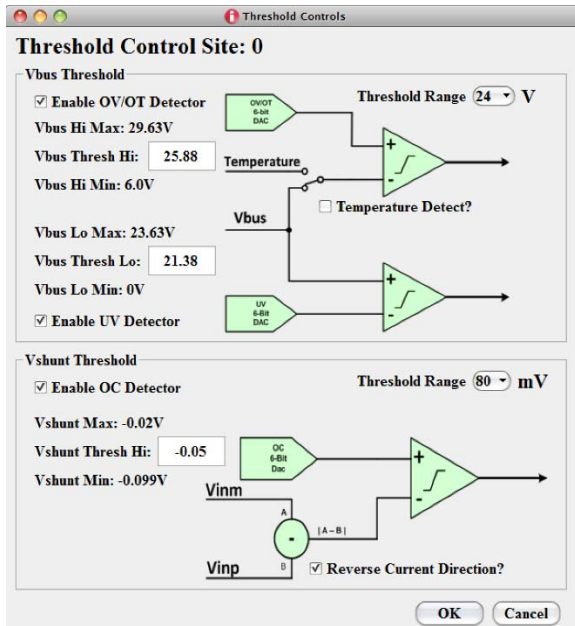


FIGURE 5. THE WINDOW THAT CONTROLS THE ISL28023 COMPARATORS

The threshold levels of the analog comparators for the overvoltage (OV), undervoltage (UV) and overcurrent conditions (OC) are created from three 6-bit DACs. The DACs have voltage ranges. There are two voltage ranges for the OC comparator and six for the OV/UV comparators. The analog comparators can be enabled and disabled by checking the enable check boxes. Depending on the voltage range selected, the voltage range for each threshold is stated above and below each input box.

The OC analog detector detection polarity can be set via checking the "Reverse Current Direction?" check box.

The OV detector can be converted to a temperature threshold detector by checking the "Temperature Detect?" check box.

**SMBALERT**

Choose the SMB Alert selection under the ISL28023 drop down menu. A window similar to the [Figure 6](#) will appear.

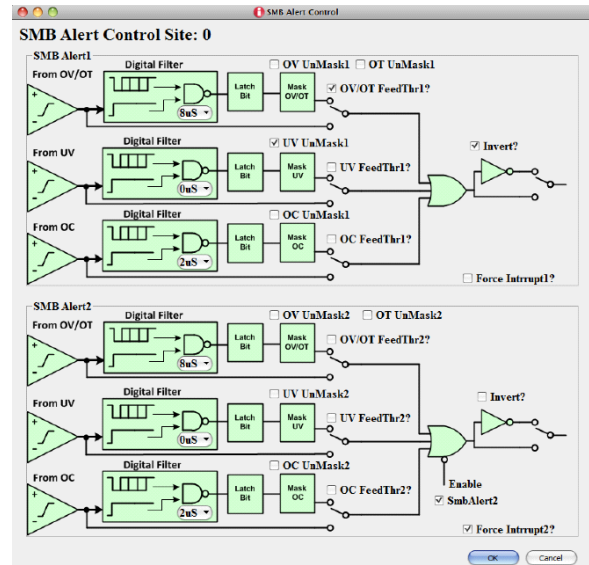


FIGURE 6. THE SMB ALERT CONFIGURATION WINDOW

The outputs of the threshold comparators feed into the SMB Alert control window. The comparator output can be routed to the SMBALERT pins of the device via checking the respective feed-through check box.

The default state of each comparator connects to a digital timing filter and mask circuitry. All three comparators feed into an OR gate to determine the status of the SMBALERT pin.

The active state polarity can be selected by checking the invert check box of the respective SMBALERT pin.

There is one digital filter per threshold comparator. Setting the digital filter changes the behavior for both SMBALERT pins. The digital filter filters out aberrant responses from the analog comparators by way of fault longevity. The device allows the user to choose between four fault timing windows before allowing a fault to pass to the latch bit (D flip-flop).

The mask block allows the user to determine if the fault is passed to the OR gate.

Each SMBALERT pin can be controlled independent of comparator circuitry by checking the force interrupt pin.

The default state of the SMBALERT2 pin is disabled. This puts the pin state to tri-state. The SMBALERT2 pin has push-pull output stage while the SMBALERT1 is an open drain.



## MARGIN DAC

Choose the SMB Alert selection under the ISL28023 drop down menu. A window similar to [Figure 7](#) appears.

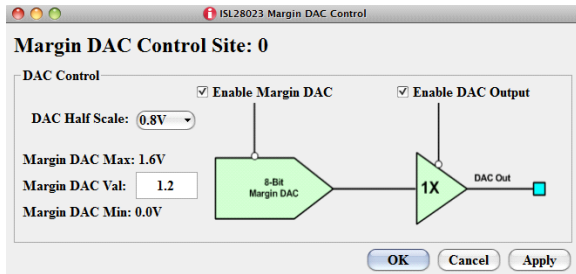


FIGURE 7. MARGIN DAC CONTROL WINDOW

The default state of the margin DAC is off, causing the DAC output pin to be in tri-state. Enabling the margin DAC feature requires the DAC output and DAC check boxes to be checked.

The Margin DAC is an 8-bit DAC with eight voltage ranges that half scale voltage ranges from 0.4V to 1.2V. The user can choose the DAC range next to the DAC Half Scale label. The min and max input for each range is stated above and below the input box.

The Apply button sets the DAC voltage to the input voltage value without closing the window. The OK button does the same as the Apply button but closes the window. The cancel button does not apply the input voltage.

## EXTERNAL CLOCK ENABLE

The ISL28023 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 selection in the ISL28023 drop down menu. A dialog box, illustrated in [Figure 8](#), will appear allowing the user to enable the external clock feature.

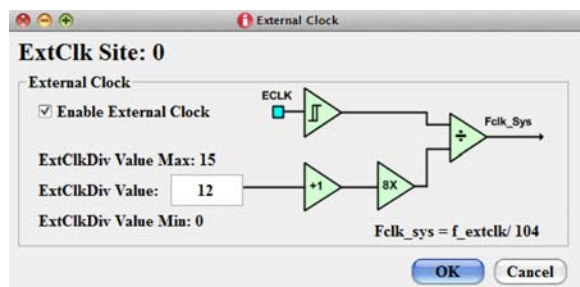


FIGURE 8. THE EXTERNAL CLOCK WINDOW FOR THE ISL28023

The input bandwidth of the external clock pin is roughly 30MHz. The external clock frequency can be divided to match the internal system clock frequency of 500kHz. Choosing a clock division that results in an internal clock frequency close to 500kHz will guarantee ADC acquisition times similar to the default times.

## PEAK CURRENT

Choose the Current Min/Max selection under the ISL28023 drop down menu. A window similar to [Figure 9](#) appears.

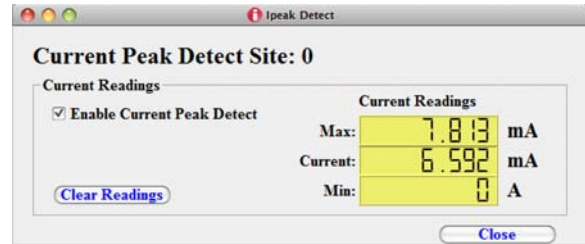


FIGURE 9. THE CURRENT PEAK DETECT WINDOW

The current peak detect feature reports the min and max reading of a single sample. For example, suppose the settings for the Vshunt input has an acquisition time of 64µs and an internal average of 4096. The sense resistor has been digitized, such that it enables current measurements. If the measure once button has been pressed, the device will perform 4096 averages and place the average value in the current register. With the current peak detect enabled, the maximum and the minimum current readings from the 4096 measurements are placed in the current peak register and displayed in the window. If the meas once button is pressed again, the Max/Min readings will reflect the Max/Min readings for 8192 measurements. The Max/Min will reflect the Max/Min current for all readings since the registers have been cleared last.

## EXTERNAL TEMPERATURE SENSOR

The external temperature sensor is a feature that measures the temperature remotely from the DPM by connecting a diode to the Aux shunt inputs. The DPM will squirt two currents to determine the temperature of the diode.

The External Temperature sensor feature can be enabled by checking the Ext Temp En check box in [Figure 3 on page 3](#). Checking the Ext Temp En check box will disable the internal temperature sensor. The value from the external temperature sensor is stored in the internal temperature register.

Upon enabling the external temperature sensor, an input box will appear asking to null the temperature. The dialog box looks similar to [Figure 10](#).



FIGURE 10. INPUT BOX THAT APPEARS WHEN ENABLING THE EXTERNAL TEMPERATURE SENSOR

Diodes are not very good at measuring absolute temperature but a very good at measuring temperature change.

If Yes is selected, the reading that is reported back is the subtraction of the null temperature and the current temperature that was measured.

**CONNECTING MULTIPLE ISL28023 EVALUATION BOARDS TO A DONGLE**

An ISL28023 design can have 55 devices connected on a single I<sup>2</sup>C bus. The ISL28023 Evaluation Kit allows the user to cascade up to 54 ISL28023 Evaluation Boards. The dongle uses a slave address (0x9E) for measuring the current and voltage of the 3.3V. [Figure 11](#) is a picture of the dongle board connected to multiple ISL28023 evaluation boards.

Connect the Dongle board to the computer via a USB cable. Start the ISL28023 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 3 on page 3](#). When the software connects to the microcontroller, the software scans for all the acceptable ISL28023 slave addresses to determine if the device is connected to the dongle.

Once connected, each device can be configured uniquely by pressing the next button that envelops the main features of the GUI. [Figure 12](#) illustrates the button to push.

**SYSTEM VIEW**

When multiple ISL28023 devices are connected to the dongle board, a system view screen is available. The system view allows the user to view all the ISL28023 devices as configured.

To enter the system view, select System under the View drop down menu. The window in [Figure 13](#) will appear while the main GUI window will disappear.

The window will size to the number of ISL2803 devices connected to the dongle.

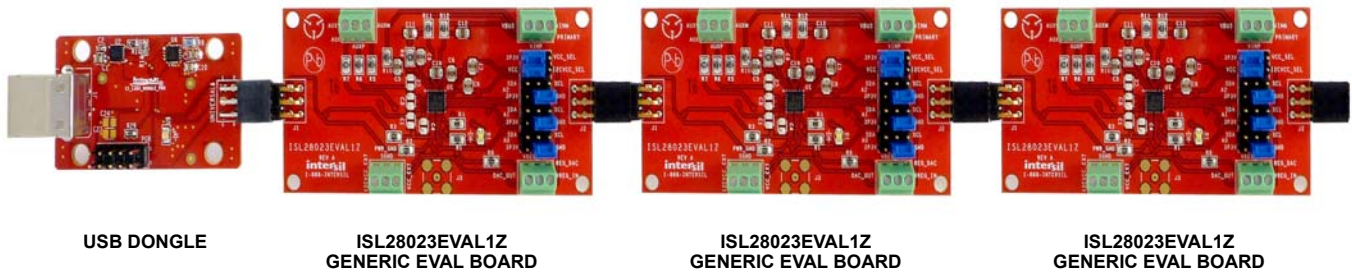
Pressing the "Start Data Collecting" button will loop through all sites and measure the configure parameters for each ISL28023 device.

Pressing the "Save Data" button will save data for all sites. See ["SAVING DATA" on page 8](#) for more detail.

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

**RESET THE DEVICE**

Choosing the Reset selection under the ISL28023 drop down menu will soft reset the ISL28023 and restore the device to the default value. A soft reset will perform an auto calibration of the offset for each of the four channels of the device.



**FIGURE 11. PICTURES OF SEVERAL ISL28023 GENERIC BOARDS CONNECTED TO A DONGLE ENABLING SYSTEM VIEW**

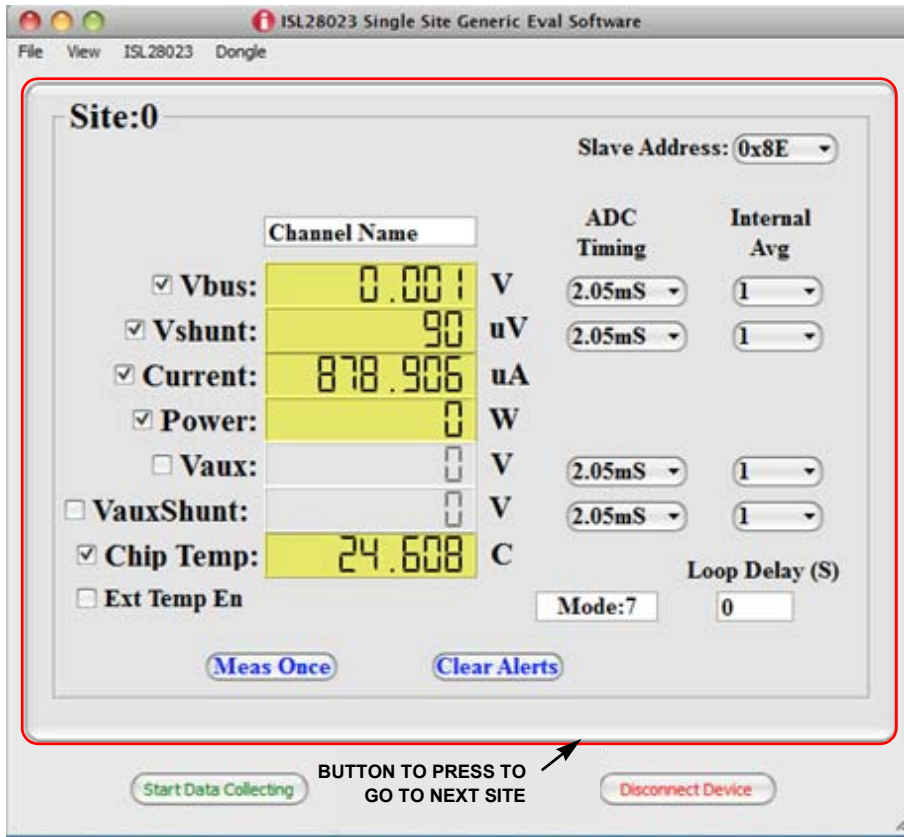


FIGURE 12. ISL28023 SINGLE SITE VIEW ILLUSTRATES THE BUTTON TO GO TO THE NEXT DEVICE/SITE

ISL28023 System View

Channel Name	Slave Addr	Bus Voltage	Shunt Voltage	Current	Power
S0: Vreg5	0x80	0 V	20 uV	65.104 uA	0 W
S1: Ext Vreg3.3	0x82	0 V	70 uV	3.418 mA	219.727 mW
S2: subCircuit1	0x84	0 V	25 uV	0 A	0 W
S3: subcircuit2	0x86	0 V	0 V	0 A	0 W
S4: Current2Load	0x88	0 V	205 uV	4.053 mA	0 W
S5: isBusVThere	0x8a	0.001 V	0 V	0 A	0 W
S6: subCircuit4	0x8c	0 V	0 V	0 A	0 W
S7: OutdoorTemp	0x8e	0 V	0 V	0 A	0 W
S8: externalTemp	0x92	2 mV	220 uV	0 A	0 W
S9: subCircuit6	0x94	0 V	-280 uV	0 A	0 W
S10: subcircuit7	0x96	0 V	-325 uV	-9.55 mA	623.277 mW
S11: subcircuit10	0x98	0 V	-222.5 uV	0 A	0 W
S12: subcircuit11	0x9a	0 V	-7.5 uV	0 A	0 W

Buttons: Stop Data Collecting, Save Data, Single Site View, Page 1/1

FIGURE 13. SYSTEM VIEW FOR THE ISL28023 SOFTWARE

**USB SUPPLIES**

The ISL28023 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 3.3V power supply. The user can monitor the current draw from 3.3V supply by selecting USB Supplies under the dongle drop down menu. The dialog box in [Figure 14](#) will appear once the USB Supplies are selected.

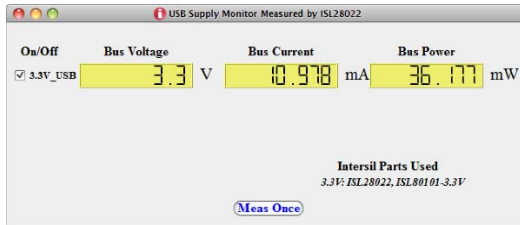


FIGURE 14. USB SUPPLY WINDOW OF THE 3.3V GENERATED SUPPLY

**I<sup>2</sup>C TRANSACTION**

The ISL28023 Demo Software allows a user to build their own board to mate with the dongle board. The final design may have an I<sup>2</sup>C device incorporated into the design. The I<sup>2</sup>C transaction selection in the dongle drop down menu allows the user to send read and write commands to I<sup>2</sup>C devices. [Figure 15](#) is the dialog box that appears when the I<sup>2</sup>C transaction is chosen under the dongle drop down menu.



FIGURE 15. THE I<sup>2</sup>C TRANSACTION WINDOW

**SAVING DATA**

The DPM software allows the user to store a set number of points of data. Go to the menu bar of the ISL28023 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 16](#) is an illustration of the dialog box.

**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 16](#) that will ask for directory information of the file to save or load.

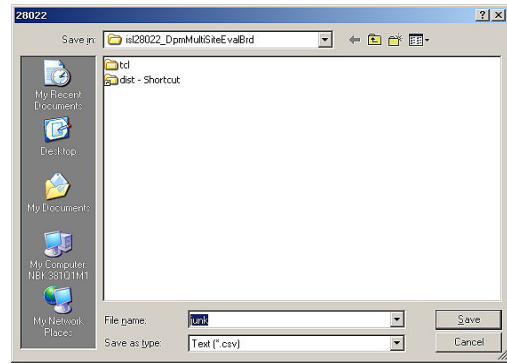


FIGURE 16. THE DIALOG BOX THAT REQUESTS WHERE TO SAVE THE DATA FILES

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, etc...) across all active devices. 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, VAUX and VAUXSHUNT are files that would not be generated for the configuration of the DPM window shown in [Figure 3 on page 3](#).

All saved files are comma 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, etc.

Upon completion of the save dialog box, an input box ([Figure 17](#)) asks for the number of points to be saved per site if the GUI is in the Single Site Mode. Otherwise, the software will save the same number of points for all sites in the System mode.

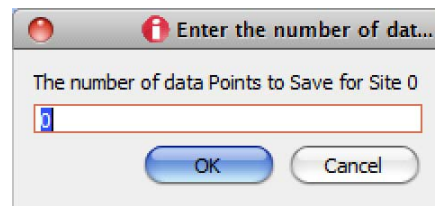


FIGURE 17. THE DIALOG BOX THAT ASKS THE USER TO ENTER THE NUMBER OF DATA POINTS TO SAVE

Pressing the OK button with a valid numerical entry will begin data collection. The numerical values change 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 passed to the column name of each respective data file. Changing the field named "Channel Name" in [Figure 3 on page 3](#) will change the name of the column data.



## Running the Software with the ISL28023 Demo Board

Connect and power the Demo board to the dongle board as shown in [Figure 18](#). Either use a power supply or a battery pack to supply power to the Demo board. The Demo board can accept voltages from 4.5V to 36V.

The board is properly powered by the battery pack with the most negative voltage connected to the left of the VIN connector at the top of the ISL28023 Demo board. This is illustrated in [Figure 18](#).

Once properly powered, launch the ISL28023 software. The same software used to control the ISL28023 generic board. Press the "Connect To Device" button. The software will scan all allowable slave addresses and determine the type of board connected to the dongle. If the demo board is successfully connected to the dongle, the window in [Figure 19](#) appears.

The screen is the same as the ISL28023 generic evaluation software plus the controls for the demo board. The Demo Controls are illustrated as the ISL85415 group box in [Figure 19](#).

All the controls and features discussed in the ISL28023 generic board software are available to the user in the Demo software.

The ISL28023 Demo board connects the ISL28023 to a buck regulator (ISL85415) and some resistive loads.

The current going into the regulator is monitored by the Vshunt inputs (Vinp, Vinm) and a shunt resistor of 0.02Ω (R<sub>20</sub>). The VauxShunt inputs (Aux\_P, Aux\_N) are connected across a 0.02Ω shunt resistor (R<sub>12</sub>). The VauxShunt channel measures the current going to the load. The Vaux input measures the regulated voltage at the load. The Vbus input measures the voltage applied at VIN terminator. The current and power displays represent the current and power being sourced to the regulator and load.

Press the "ON" button in the lower right hand corner to turn on the ISL85415. The Vbus, Vshunt, Current, Power, Vaux channels will turn on if they are not currently active.



FIGURE 18. THE ISL28023 DEMO CONNECTED TO THE DONGLE BOARD AND A BATTERY PACK

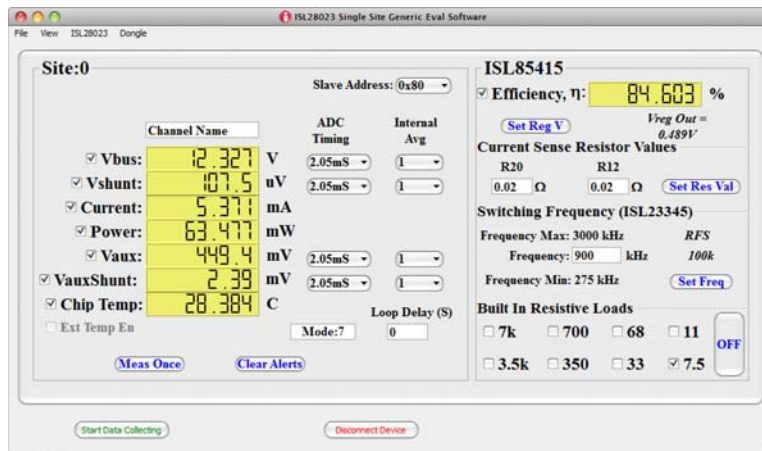


FIGURE 19. THE CONFIGURATION SCREEN FOR THE ISL28023 DEMO SOFTWARE

## Setting the Regulated Output Voltage

Press the "Set Reg V" will launch the margin DAC window. The margin DAC is connected to R<sub>15</sub> or the R<sub>g</sub> resistor of the ISL85415 feedback. [Equation 1](#) determines the regulated output voltage.

$$V_{OUT} = 0.6 + (0.6 - DAC\_OUT) \cdot \frac{R_{16}}{R_{15}} \quad (\text{EQ. 1})$$

Where the reference voltage for the ISL85415 is 0.6V. The value of R<sub>16</sub> is the 120kΩ. The value of R<sub>15</sub> is 20.5kΩ. The ISL85415 is in a gain of 5.8537. The DAC\_OUT is the voltage sourced from the margin DAC. The output voltage will only work properly if the output buffer and the DAC are enabled.

## Setting the Switching Frequency

Press the "Set Freq" button to adjust the ISL23345, digitally controlled potentiometer, which connects to the frequency select, FS, pin of the ISL85415. The switching frequency of the regulator will be altered causing the efficiency rating of the system to change.

## Changing the Shunt Resistor Values

Press the "Set Res Val" button changes the values used to calculate system current and load current as well the efficiency readings of the system.

## Change the Load Values Connected to the Regulator

If the jumper setting for the OUTPUT LOAD header is connected between pins 1 and 2, the output of the regulator is connected to a series of loads that are controlled by a port extender and a series of ISL83699 switches. To connect a load to the regulator, check the check box of the desired load.

## Enabling Efficiency Readings

By measuring the power going into the ISL85415 regulator and calculating the power going to the load, the efficiency can be calculated as shown in [Equation 2](#), the efficiency equation used in the ISL28023 Demo Software.

$$\eta = \frac{P_{LOAD}}{P_{TOTAL}} \cdot 100 \quad (\text{EQ. 2})$$

**Note:** At light loads, the current measurements will have errors due to the temperature coefficient of the resistors. The resistors are calibrated at moderate current levels. The magnitude of current causes the resistors to heat up resulting in a shunt resistor value change. The resistors installed on the demo board are 50ppm/°C TC resistors with a power rating of 0.5W. Improving the temperature coefficient of shunt resistors or increasing the power rating of the resistors will limit the resistor change due to current.

**Note:** The power supply that is connected to the demo board should be able to source 1A of current. If the sourcing capabilities of the power supply are less than 1A, the regulate buck voltage may oscillate or become unstable under certain load conditions.

**Remember:** The current of the primary channel of the ISL28023 only measures the current delivered to the ISL85415 buck regulator. The VIN connector sources current to both the ISL85415 and the 3.3V regulator that is part of the ISL28023. The regulator draws approximately 1mA.

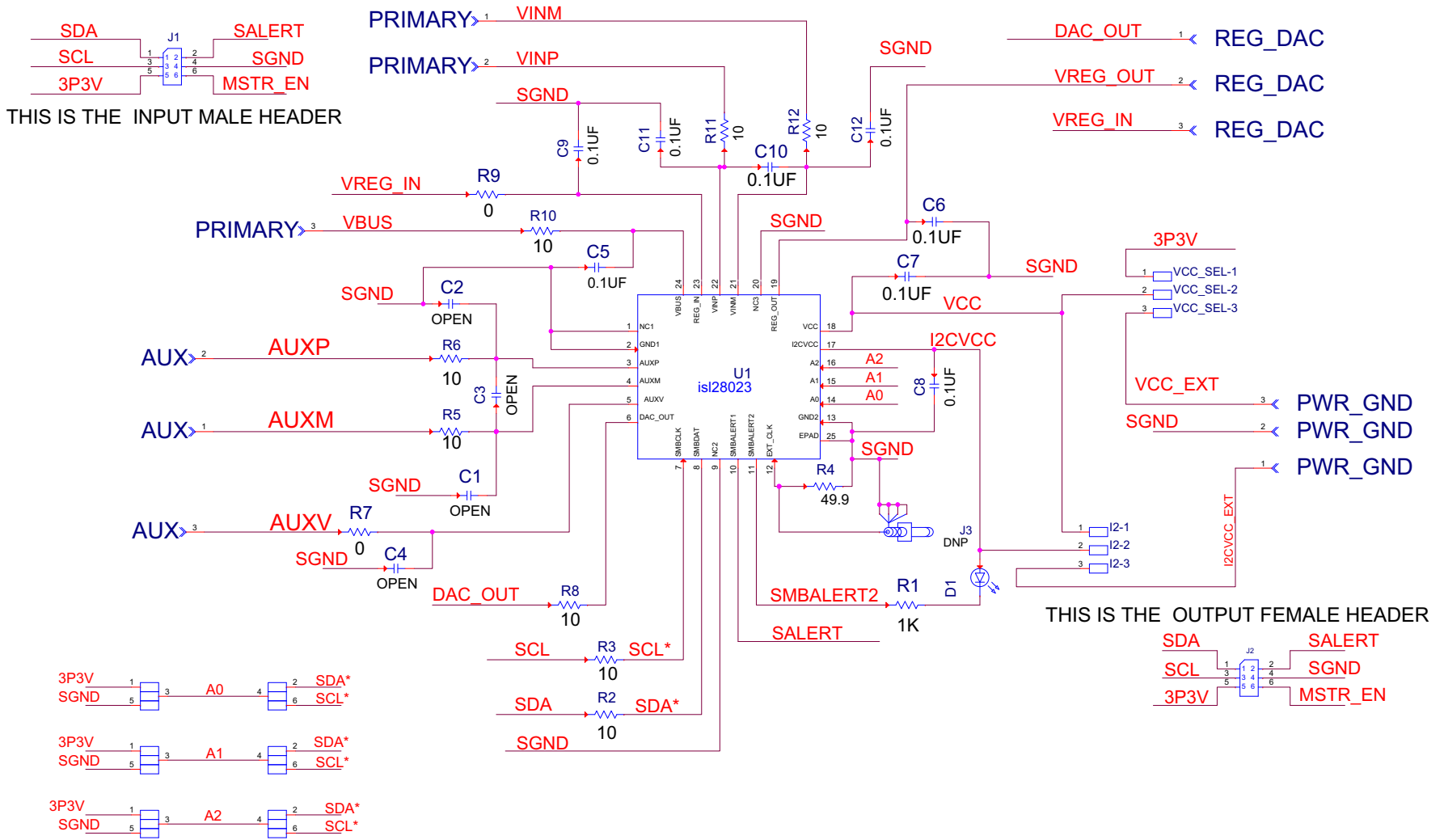
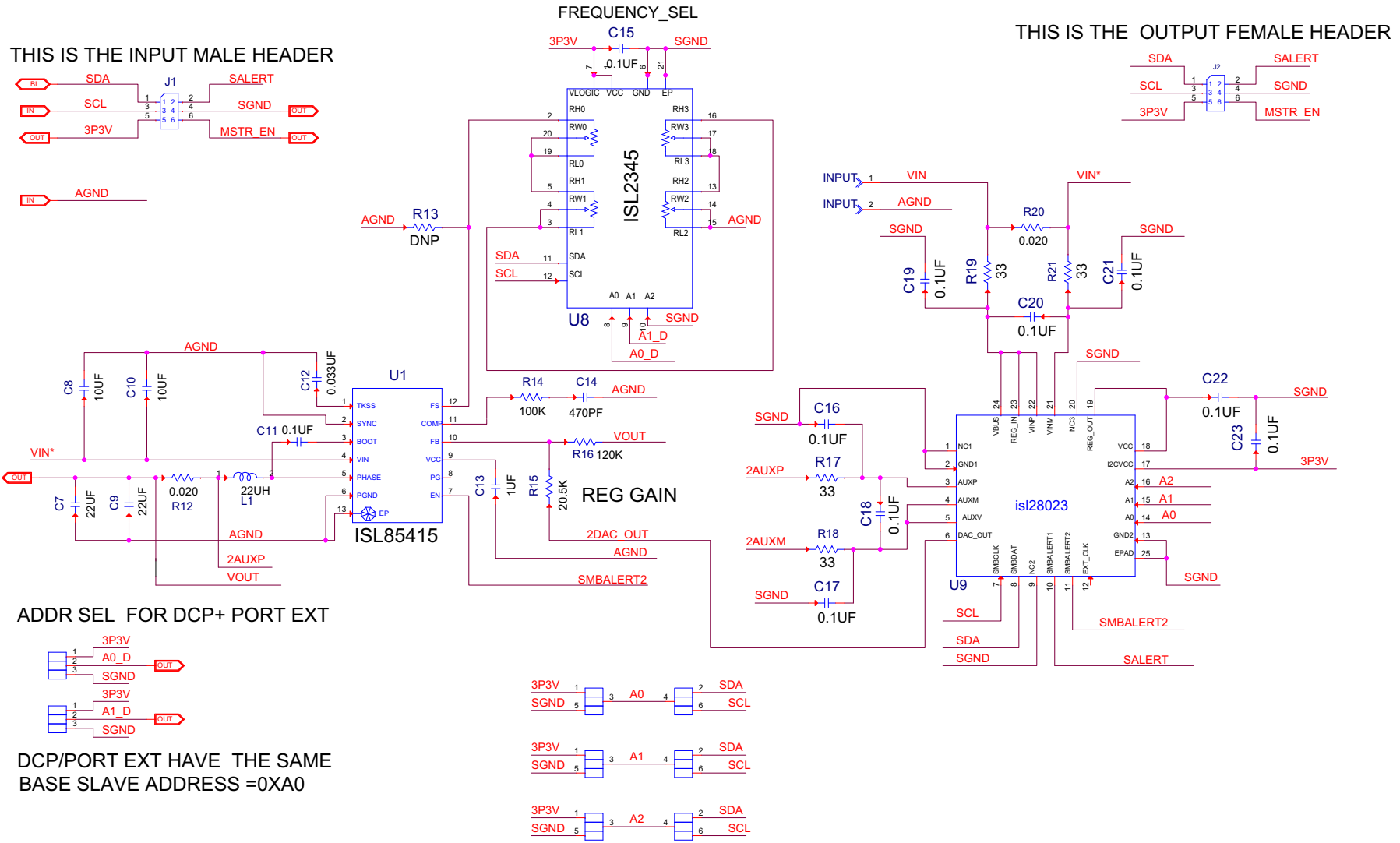


FIGURE 20. SCHEMATIC OF THE ISL28023EVAL1Z BOARD

## ISL28023EVAL1Z Bill of Materials

MANUFACTURER PART	QTY	UNITS	REFERENCE DESIGNATOR	DESCRIPTION	MANUFACTURER
ISL28023EVAL1ZREVAPCB	1	ea.		PWB-PCB, ISL28023EVAL1Z, REVA, ROHS	IMAGINEERING INC
C2012X7R2A104K	6	ea.	C5, C6, C9, C10, C11, C12	CAP, SMD, 0805, 0.1µF, 100V, 10%, X7R, ROHS	TDK
ECJ-2VB1E104K	2	ea.	C7, C8	CAP, SMD, 0805, 0.1µF, 25V,10%,X7R,ROHS	PANASONIC
	0	ea.	C1, C2, C3, C4	CAP, SMD, 0805, DNP-PLACE HOLDER, ROHS	
1725669	4	ea.	AUX, PRIMARY, PWR_GND, REG_DAC	CONN-TERMINAL BLK, TH, 3POS, 2.54mm, 20-30AWG, ROHS	PHOENIX CONTACT
65474-010LF	5	ea.	a) A0-PINS 5-3, A1-PINS 5-3, A2-PINS 5-3;	CONN-MINI JUMPER, SHORTING, 2PIN, BLUE, ROHS	FCI/BERG
65474-010LF	0	ea.	b) VCC_SEL-PINS 1-2, I2CVCC_SEL-PINS 1-2.	CONN-MINI JUMPER, SHORTING, 2PIN, BLUE, ROHS	FCI/BERG
67996-272HLF	3	ea.	A0, A1, A2	CONN-HEADER, 2x3, BRKAWY 2X36, 2.54mm, VERTICAL, ROHS	BERG/FCI
68000-236HLF	2	ea.	VCC_SEL, I2CVCC_SEL	CONN-HEADER, 1x3, BREAKAWY 1x36, 2.54mm, ROHS	BERG/FCI
MTSW-150-22-G-D-215-RA	1	ea.	J1	CONN-HEADER, 2x25, 2.54mmPITCH, R/A, 1.13x1.43in, ROHS	SAMTEC
PPPC032LJBN-RC	1	ea.	J2	CONN-SOCKET, TH, 6P, 2x3, INSULATED, R/A, 2.54mm, ROHS	SULLINS
CMD17-21VYD/TR8	1	ea.	D1	LED,SMD, 0805, YELLOW/DIFF., 2V, 20mA, 4mcd, 585nm, ROHS	CHICAGO MINIATURE
ISL28023FR60Z	1	ea.	U1	IC-PRECISION DIGITAL MONITOR, 24P, QFN, ROHS	INTERSIL
ERA-6AEB102V	1	ea.	R1	RES, SMD, 0805,1k, 1/8W, 0.1%, MF, ROHS	PANASONIC
CR0805-8W-10R0FT	8	ea.	R2, R3, R5, R6, R8, R10, R11, R12	RES, SMD, 0805, 10Ω, 1/8W, 1%, TF, ROHS	VENKEL
RC0805JR-070RL	2	ea.	R7, R9	RES, SMD, 0805, 0Ω, 1/8W, TF, ROHS	YAGEO
MCR10EZHF49R9	1	ea.	R4	RES, SMD, 0805, 49.9Ω, 1/8W, 1%, TF, ROHS	ROHM
S-2261	1	ea.	Place assy in bag	BAG, STATIC, 4X6, ZIPLOC, ROHS	ULINE
LABEL-DATE CODE	1	ea.	AFFIX TO BACK OF PCB	LABEL-DATE CODE_LINE 1: YRWK/REV#, LINE 2: BOM NAME	INTERSIL





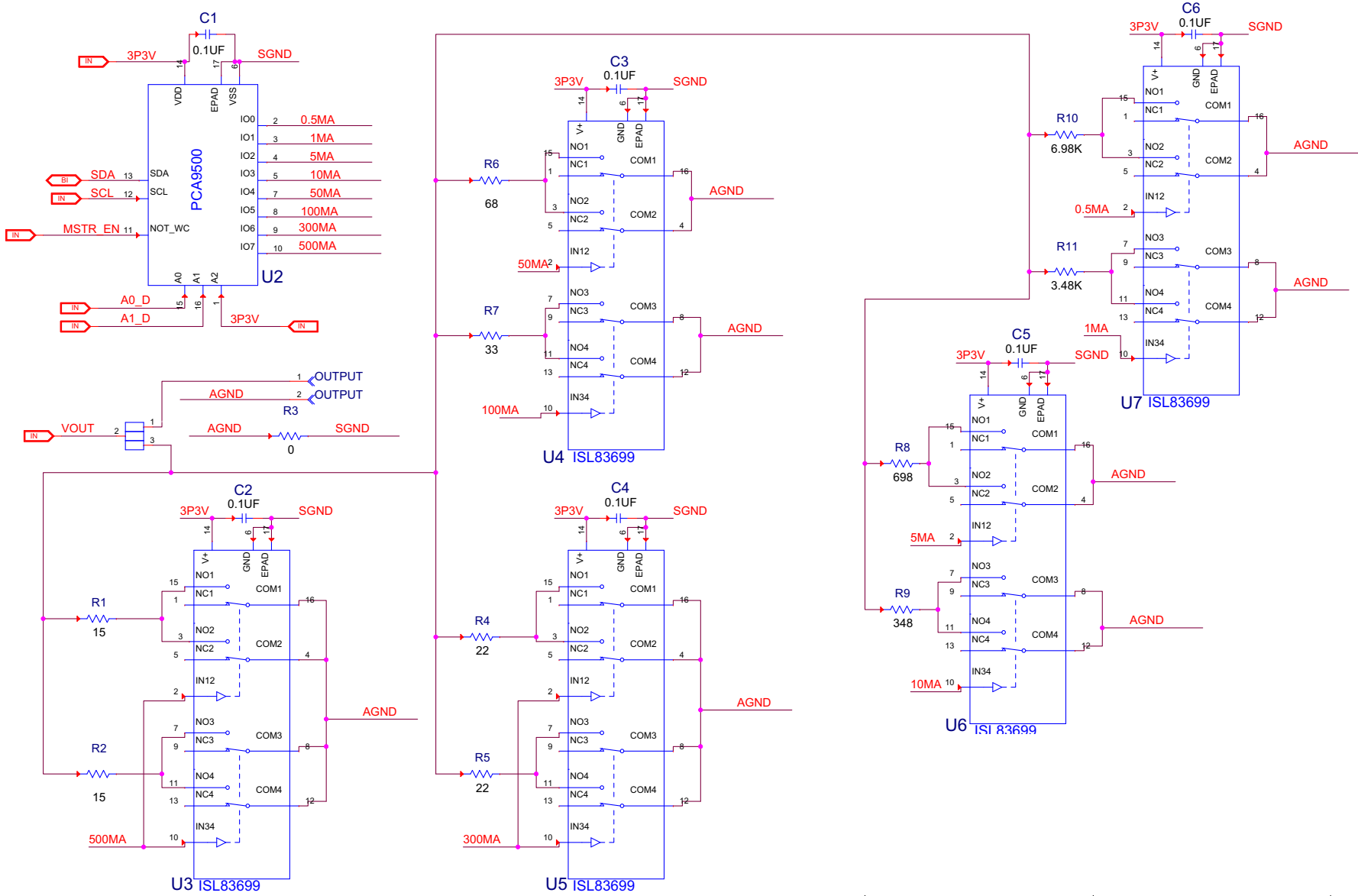


FIGURE 22. SCHEMATIC OF THE ISL28023EVAL2Z BOARD (2 OF 2)

## ISL28023EVAL2Z Bill of Materials

MANUFACTURER PART	QTY	UNITS	REFERENCE DESIGNATOR	DESCRIPTION	MANUFACTURER
ISL28023EVAL2ZREVA PCB	1	ea.		PWB-PCB, ISL28023EVAL2Z, REVA, ROHS	IMAGINEERING INC
GRM36X7R333K016AQ	1	ea.	C12	CAP, SMD, 0402, 33000pF, 16V, 10%, X7R, ROHS	MURATA
ECJ-0EB1H471K	1	ea.	C14	CAP, SMD, 0402, 470pF, 50V, 10%, X7R, ROHS	PANASONIC
06035C104KAT2A	16	ea.	C1-C6, C11, C15-C23	CAP, SMD, 0603, 0.1µF, 50V, 10%, X7R, ROHS	AVX
GRM188R61C105KA12D	1	ea.	C13	CAP, SMD, 0603, 1µF, 16V, 10%, X5R, ROHS	MURATA
C1206C107M9PACTU	2	ea.	C7, C9	CAP, SMD, 1206, 100µF, 6.3V, 20%, X5R, ROHS	KEMET
TMK316B7106KL-TD	2	ea.	C8, C10	CAP, SMD, 1206, 10µF, 25V, 10%, X7R, ROHS	TAIYO YUDEN
74408943220	1	ea.	L1	COIL-PWR INDUCTOR, SMD, 4.8mm, 22µH, 20%, 1.1A, ROHS	Würth Electronics
1725656	2	ea.	INPUT, OUTPUT	CONN-TERMINAL BLK, TH, 2P, 6A, 125V, 20-30AWG, 2.54mm, ROHS	PHOENIX CONTACT
67996-272HLF	3	ea.	A0-A2	CONN-HEADER, 2x3, BRKAWY 2x36, 2.54mm, VERTICAL, ROHS	BERG/FCI
68000-236HLF	3	ea.	VOUT, ADDR0, ADDR1	CONN-HEADER, 1x3, BREAKAWY 1x36, 2.54mm, ROHS	BERG/FCI
MTSW-150-22-G-D-215-RA	1	ea.	J1	CONN-HEADER, 2x25, 2.54mm PITCH, R/A, 1.13x1.43in, ROHS	SAMTEC
PPPC032LJBN-RC	1	ea.	J2	CONN-SOCKET, TH, 6P, 2x3, INSULATED, R/A, 2.54mm, ROHS	SULLINS
ISL23345TFRZ	1	ea.	U8	IC-100k LO VOLT. DIGITAL POTENTIOMETER, 20P, QFN, ROHS	INTERSIL
ISL28023FR60Z	1	ea.	U9	IC-PRECISION DIGITAL MONITOR, 24P, QFN, ROHS	INTERSIL
ISL83699IRZ	5	ea.	U3-U7	IC-QUAD SPDT ANALOG SWITCH, 16P, QFN, ROHS	INTERSIL
ISL85415FRZ	1	ea.	U1	IC-500mA BUCK REGULATOR, 12P, DFN, 3x4, ROHS	INTERSIL
PCA9500BS,118	1	ea.	U2	IC-8-BIT I2C I/O EXPANDER, 16P, HVQFN, 4X4, ROHS	NXP SEMICONDUCTOR
	0	ea.	R13	RESISTOR, SMD, 0603, 0.1%, MF, DNP-PLACE HOLDER	
ERJ2RK1003	1	ea.	R14	RES, SMD, 0402, 100k, 1/16W, 1%, TF, ROHS	PANASONIC
	2	ea.	R19, R21	RES, SMD, 0603, 0Ω, 1/10W, 1%, TF, ROHS	
	2	ea.	R17, R18	RES, SMD, 0603, 33Ω, 1/10W, 1%, TF, ROHS	
CRCW0603120KFKEA	1	ea.	R16	RES, SMD, 0603, 120k, 1/10W, 1%, TF, ROHS	VISHAY/DALE
	1	ea.	R15	RES, SMD, 0603, 20.5k, 1/10W, 1%, TF, ROHS	
	1	ea.	R11	RES, SMD, 0805, 200Ω, 1/8W, 1%, TF, ROHS	PANASONIC
	1	ea.	R8	RES, SMD, 0805, 150Ω, 1/8W, 1%, TF, ROHS	PANASONIC
	1	ea.	R10	RES, SMD, 0805, 301Ω, 1/8W, 1%, TF, ROHS	PANASONIC

**ISL28023EVAL2Z Bill of Materials (Continued)**

MANUFACTURER PART	QTY	UNITS	REFERENCE DESIGNATOR	DESCRIPTION	MANUFACTURER
CRCW1206-000Z	1	ea.	R3	RES, SMD, 1206, 0Ω, 1/4W, TF, ROHS	VISHAY
	1	ea.	R9	RES, SMD, 1206, 49.9Ω, 1/4W, 1%, TF, ROHS	
CRCW251215R0FKEG	2	ea.	R1, R2	RES, SMD, 2512, 15Ω, 1W, 1%, TF, ROHS	VISHAY/DALE
CR2512-1W-220JT	2	ea.	R4, R5	RES, SMD, 2512, 22Ω, 1W, 5%, TF, ROHS	VENKEL
MCR50JZHJ330	1	ea.	R6	RES, SMD, 2010, 33Ω, 1/2W, 5%, TF, ROHS	ROHM
MCR50JZHJ220	1	ea.	R7	RES, SMD, 2010, 22Ω, 1/2W, 5%, TF, ROHS	ROHM
KRL1220E-M-R022-F-T5	2	ea.	R12, R20	RES-CURR.SENSE, SMD, 0805, 0.022Ω, 0.5W, 1%, 55ppm, ROHS	SUSUMU
65474-010LF	6	ea.	a) A0-PINS 1-3, A1-PINS 5-3, A2-PINS 5-3, ADDR0 2-3, ADDR1 2-3	CONN-MINI JUMPER, SHORTING, 2PIN, BLUE, ROHS	FCI/BERG
65474-010LF	0	ea.	b) OUTPUT 2-3	CONN-MINI JUMPER, SHORTING, 2PIN, BLUE, ROHS	FCI/BERG
212403-013	1	ea.	Place assy in bag	BAG, STATIC, 5x8, ZIPLOC, ROHS	INTERSIL
LABEL-DATE CODE	1	ea.	AFFIX TO BACK OF PCB	LABEL-DATE CODE_LINE 1: YRWK/REV#, LINE 2: BOM NAME	INTERSIL



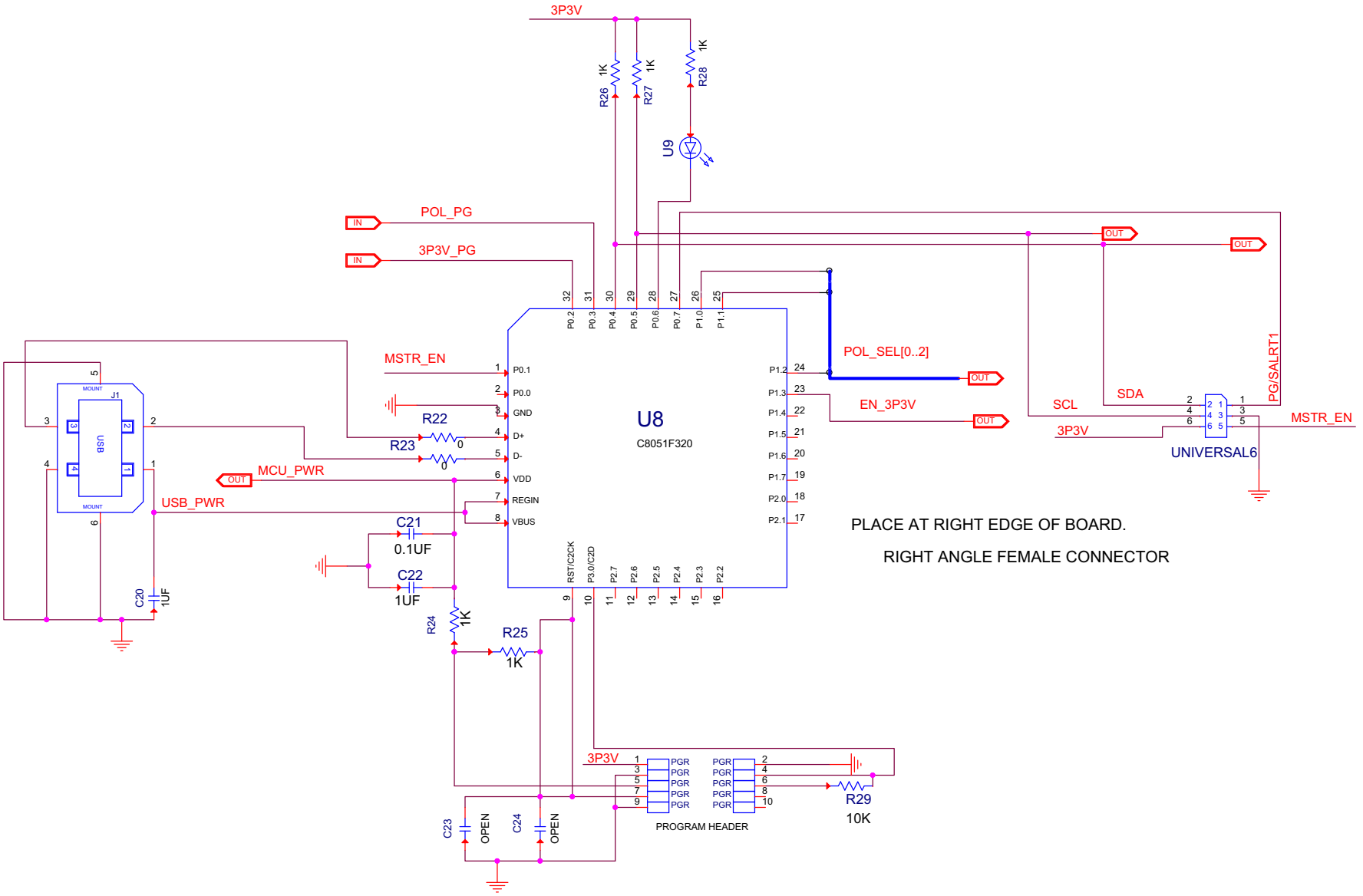


FIGURE 23. ISLUSBPWRDONGLE1Z SCHEMATIC (1 OF 2)

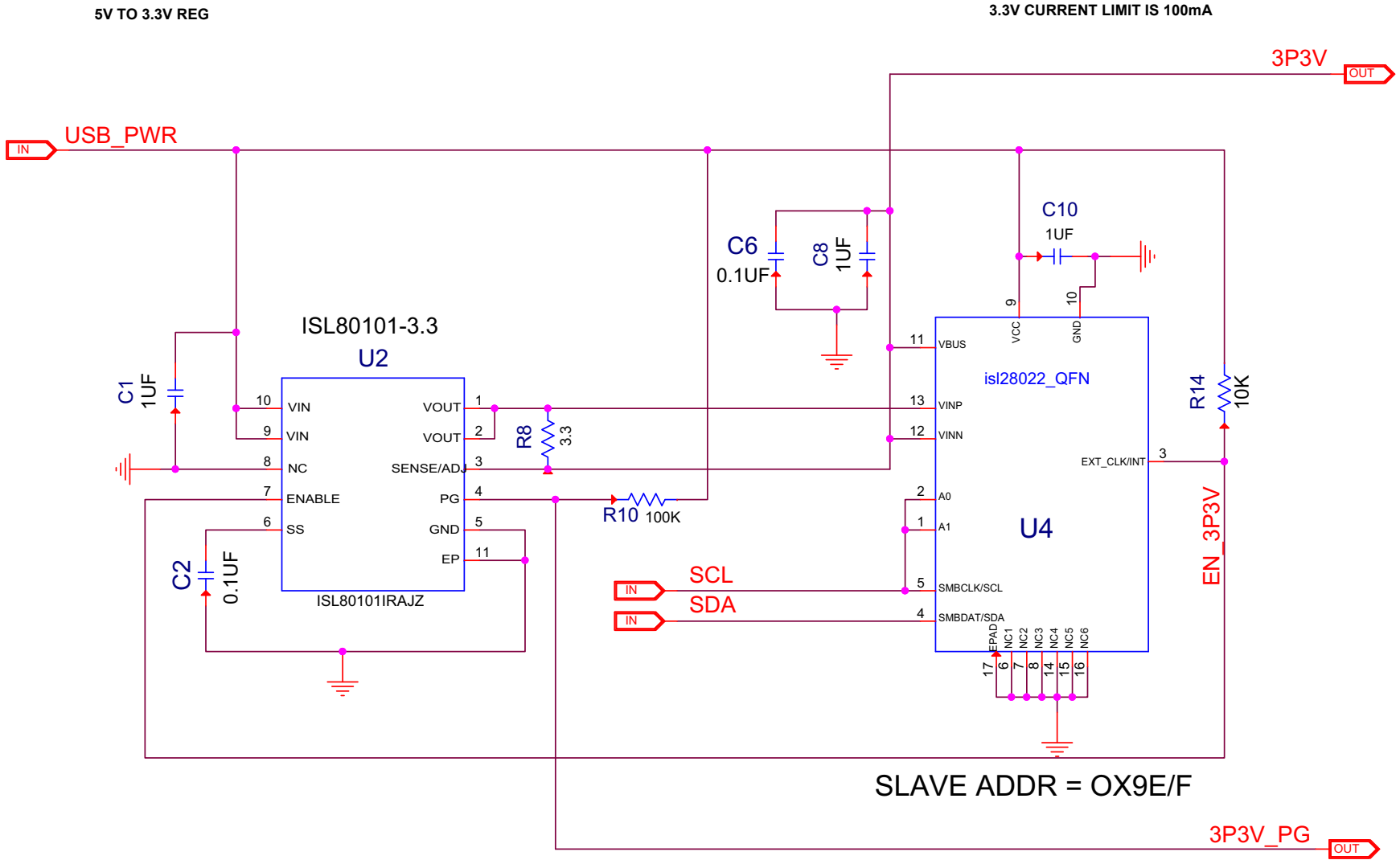


FIGURE 24. ISLUSBWRDONGLE1Z SCHEMATIC (2 OF 2)

## ISLUSBPWRDONGLE1Z Bill of Materials

MANUFACTURER PART NUMBER	QTY	UNITS	REFERENCE DESIGNATOR	DESCRIPTION	MANUFACTURER
C2012X7R1E105K	5	ea	C1, C8, C10, C20, C22	CAP, SMD, 0805, 1.0 $\mu$ F, 25V, 10%, X7R, ROHS	TDK
ECJ-2VB1E104K	3	ea	C2, C6, C21	CAP, SMD, 0805, 0.1 $\mu$ F, 25V, 10%, X7R, ROHS	PANASONIC
67996-272HLF	1	ea	PGR	CONN-HEADER, 2X5, BRKAWY-2X36, 2.54mm, ROHS	BERG/FCI
897-43-004-90-000	1	ea	J1	CONN-USB TYPE B, RECEPTACLE, PCB MOUNT, ROHS	MILL-MAX
SSQ-103-02-T-D-RA	1	ea	UNIVERSAL6	CONN-SOCKET STRIP, TH, 2X3, 2.54mm, TIN, R/A, ROHS	SAMTEC
CMD17-21VGC/TR8	1	ea	U9	LED, SMD, 0805, GREEN, CLEAR, 10mcd, 2.1V, 20mA, 570nm, ROHS	CHICAGO MINIATURE
C8051F320-GQ	1	ea	U8	IC-USB MICROCONTROLLER, 32P, LQFP, 8-BIT, 25MIPS, ROHS	SILICON LABORATORIES
ISL28022FRZ	1	ea	U4	IC-DIGITAL POWER MONITOR, 16P, QFN, ROHS	INTERSIL
ISL80101IR33Z	1	ea	U2	IC-3.3V, 1A LDO REGULATOR, 10P, DFN, 3X3, ROHS	INTERSIL
CR0603-10W-000T	2	ea	R22, R23	RES, SMD, 0603, 0 $\Omega$ , 1/10W, TF, ROHS	VENKEL
ERJ-3EKF1001V	2	ea	R24, R25	RES, SMD, 0603, 1k, 1/10W, 1%, TF, ROHS	PANASONIC
RK73H1JT1002F	2	ea	R14, R29	RES, SMD, 0603, 10k, 1/10W, 1%, TF, ROHS	KOA
CR0603-10W-1003FT	1	ea	R10	RES, SMD, 0603, 100k, 1/10W, 1%, TF, ROHS	VENKEL
ERJ-6RQF3R3V	1	ea	R8	RES, SMD, 0805, 3.3 $\Omega$ , 1/8W, 1%, TF, ROHS	PANASONIC
CR0805-8W-1001FT	3	ea	R26, R27, R28	RES, SMD, 0805, 1k, 1/8W, 1%, TF, ROHS	VENKEL
	0	ea	C23, C24	DO NOT POPULATE OR PURCHASE	

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