ISL76682EVAL1Z

The ISL76682EVAL1Z evaluation board is a RoHS compliant evaluation board designed for exploring the operation of the ISL76682 light-to-digital output sensor. The evaluation board is an easy-to-use platform for testing most of the specifications and functionalities of the ISL76682. The board has a self-contained USB connection that powers the board.

Specifications

- 2.25 to 3.3V light sensor supply input provided by on board regulator

- High sensitivity

Provided with the Board

- Evaluation demo board ISL76682EVAL1Z

- USB daughter board ISL290XXUSBCEVAL1Z

- USB 2.0 cable

Features

- Low power
  - 65µA maximum operating current to IC
  - 0.5µA maximum shutdown current to IC
- Ideal spectral response
  - Close to human eye response
  - Excellent UV rejection
- Easy to use
  - Simple I^{2}C and SMBus compatible output
- Small form factor
  - 2.0mmx2.1mmx0.7mm 6Ld ODFN Package
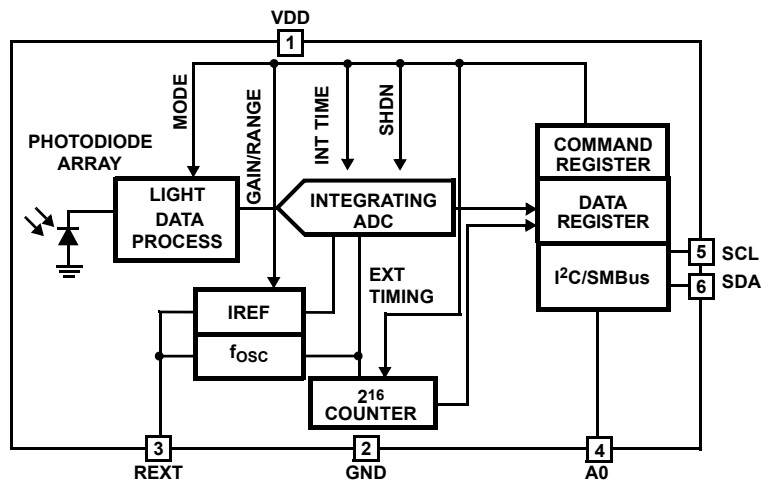- 3.3V regulator located on USB board
- AEC-Q100 Qualified

Figure 1. Block Diagram

Contents

1. Functional Description

The light sensor U1 mounted on the top side of the evaluation board converts light intensity to a USB replica proportional to lux. Both jumpers are installed on the underside of this board to implement the on board regulator and the LED display located on the USB daughter board. See Figure 25.

1.1 Operational Characteristics

An on board linear regulator on the underside of the USB daughter board supplies the input voltage to the light sensor.

1.2 Setup and Configuration

The following sections describe how to setup the hardware and software for this board.

1.2.1 Hardware Setup

• Install the USB daughter board on the evaluation board with the USB connector facing out.

• Connect the USB 2.0 Cable to the PC first, and then to the evaluation board.

▪ The USB cable is the only connection needed, power is supplied using USB.

1.2.2 Software Setup

▪ Use the URL link below and install it.

• To open the program, go to program folder -> Intersil ->Intersil_ISL29XXX_HID

• Double click on ISL29XXX_HID_v139_1.exe. This opens the GUI as shown in Figure 2.

Figure 2. ALS Evaluation Software Main Startup Menu

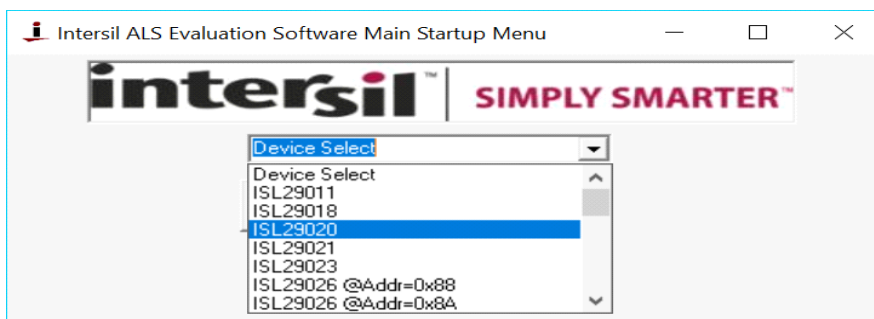▪ Go to the **Device Select** drop-down menu and select **ISL29020**.

Figure 3. Device Select Drop-Down Menu

▪ The window shown in Figure 4 opens. This is the main window where all demonstrations are done.
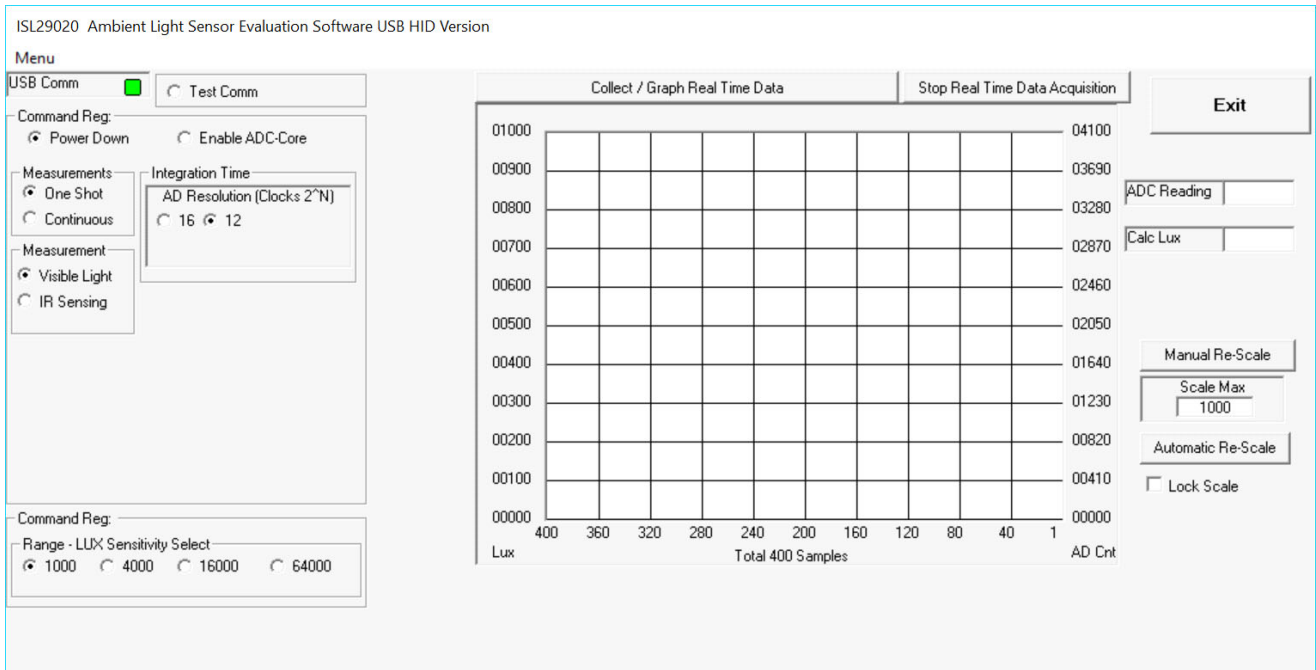

Figure 4. ISL29020 Ambient Light Sensor Evaluation Software USB HID Version

▪ Click on the **Test Comm** radio button. The green square indicates operational I^{2}C communication. If it is not green, check your USB connection.

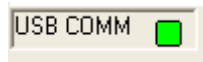**Figure 5. USB Communication Indicator**

▪ The indicator of Figure 6 appears after a click on the **Test Comm** radio button.

Figure 6. Test Comm Radial Button

Test Communication - click the **Test Comm** button; if it shows **Good**, the hardware and software are properly set up; if it says **Fail**, check your USB connections. If the problem still persists, restart the software.

2.   Multi-Function Sensor Evaluation Software Guide

From menu on left, choose the specific **Mode** that you want to operate the IC in. A detailed explanation is described in the data sheet. Table 1 summarizes the different modes.
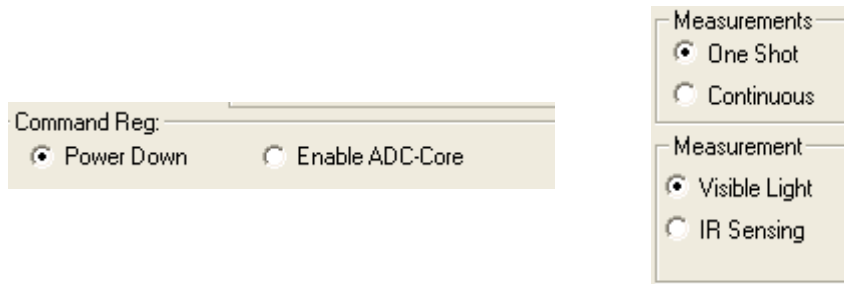

Figure 7. Modes

Table 1. Summary of Modes

Mode	Explanation
Command Reg: Power-Down	Turn off and keep data in registers
Command Reg: Enable ADC-Core	Normal running
Measurements: One Shot	One conversion
Measurements: Continuous	Continuous conversion
Measurement: Visible Light	Sense Visible Light
Measurement: IR Sensing	Sense Infrared Light

▪ **Integration Time -** This corresponds to the resolution of the internal ADC, the number of bits allocated to representing the Count. Higher resolution (more bits) requires a large number of counts and needs a longer acquisition (integration) time, see Figure 8.

Figure 8. Integration Time
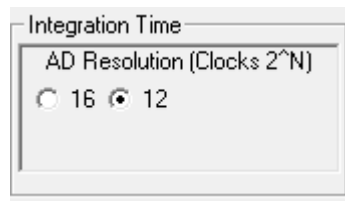
▪ **Sensitivity-Range Select -** Allows you to choose the sensitivity of the sensor based on external conditions/object detection. For example, a really bright object would require a higher range, such as 64000, versus a dark object that requires a lower range, such as 1000. A higher range reduces photo detector sensitivity, see Figure 9.
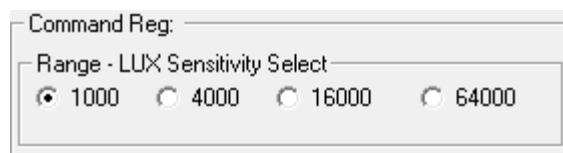

Figure 9. Sensitivity Range Select

- **Collect Data Graphical Real Time Data -** Allows you to sample data (whether ALS, IR, or Prox-IR). Samples are now being taken and are being plotted and appropriate values are displayed on the right in the corresponding box, see Figure 10.
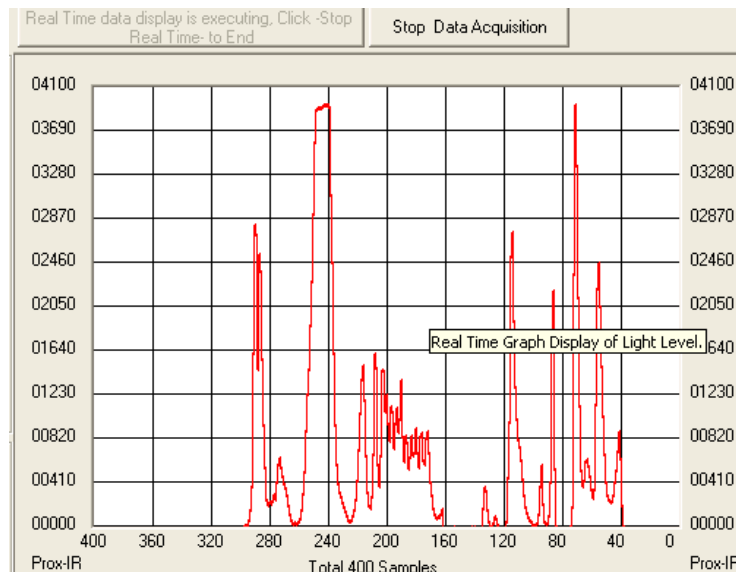- **Stop Data Acquisition -** To stop sampling of data.

Figure 10. Graphical Real Time

Here, the scale can be adjusted to meet your sampling needs. **Manual Re-Scale** allows you to type in the maximum and minimum values for the scale (vertical axis) in the appropriate boxes. The **Automatic Re-Scale** button is useful if the sampled data is out of the range of the displayed graph or need to zoom-in on data. It rescales the vertical axis to an appropriate field of view, see Figure 11.

- **Exit -** This button closes the entire program. It becomes available after **Stop Real Time Acquisition** is clicked.
- The value in the **ADC Reading** and/or **lux Reading** fields are the appropriate output coming out of the sensor according to the Mode that is engaged.
- **Max Count -** Scale Max is the maximum value that can be measured based on the resolution chosen (Integration Time). Maximum count increases with more integration time.

Figure 11. Scale Adjustment Fields

2.1 I²C Operation and Waveforms

▪ **Scale Max -** This is the maximum value that can be measured based on the resolution chosen (Integration Time). Maximum count increases with more integration time, see Figure 12.
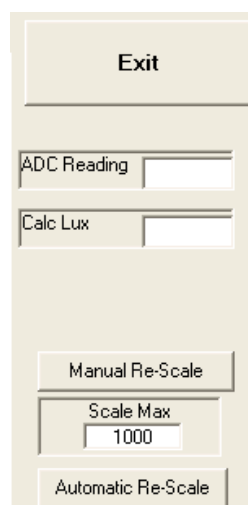

Figure 12. Software GUI

The GUI page in Figure 12 appears after the .exe program executes. Click on the **Collect / Graph Real Time Data** command to see the GUI shown in Figure 13.
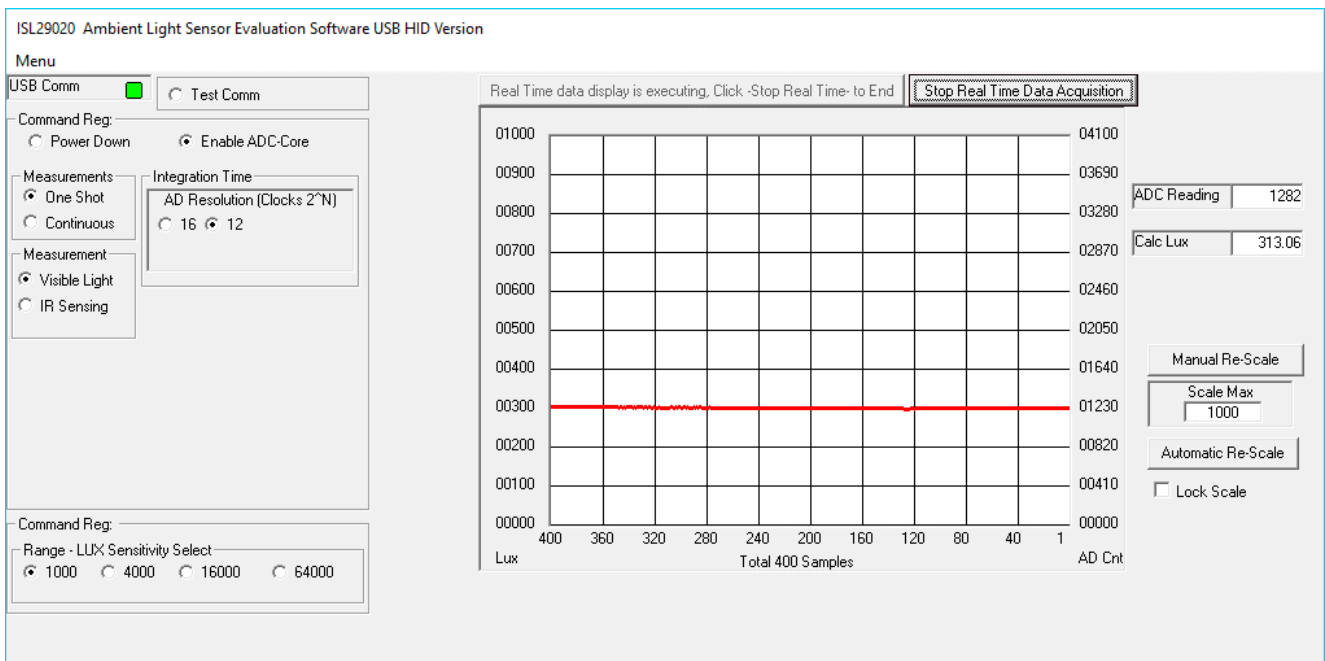
Figure 13. GUI Showing Data Waveform

An ADC reading is displayed, 1282 in the case above, and a red data trace starts to march across the grid from right to left indicating the calculated light intensity in lux. The image in Figure 13 was recorded in a room illuminated with florescent tubes at a typical office space intensity. Click on **Automatic Re-Scale** to rescale the graph and produce the GUI shown in Figure 14.

Figure 14. Rescaled Waveform

The I^{2}C waveform can be observed by attaching oscilloscope probes to the SCL and SDA terminal posts. If an oscilloscope is set to trigger on the falling edge of the SDA waveform, the scope trace shown in Figure 16 can be captured when the **Stop Real Time Data Acquisition** command is clicked.

Figure 15. Static GUI

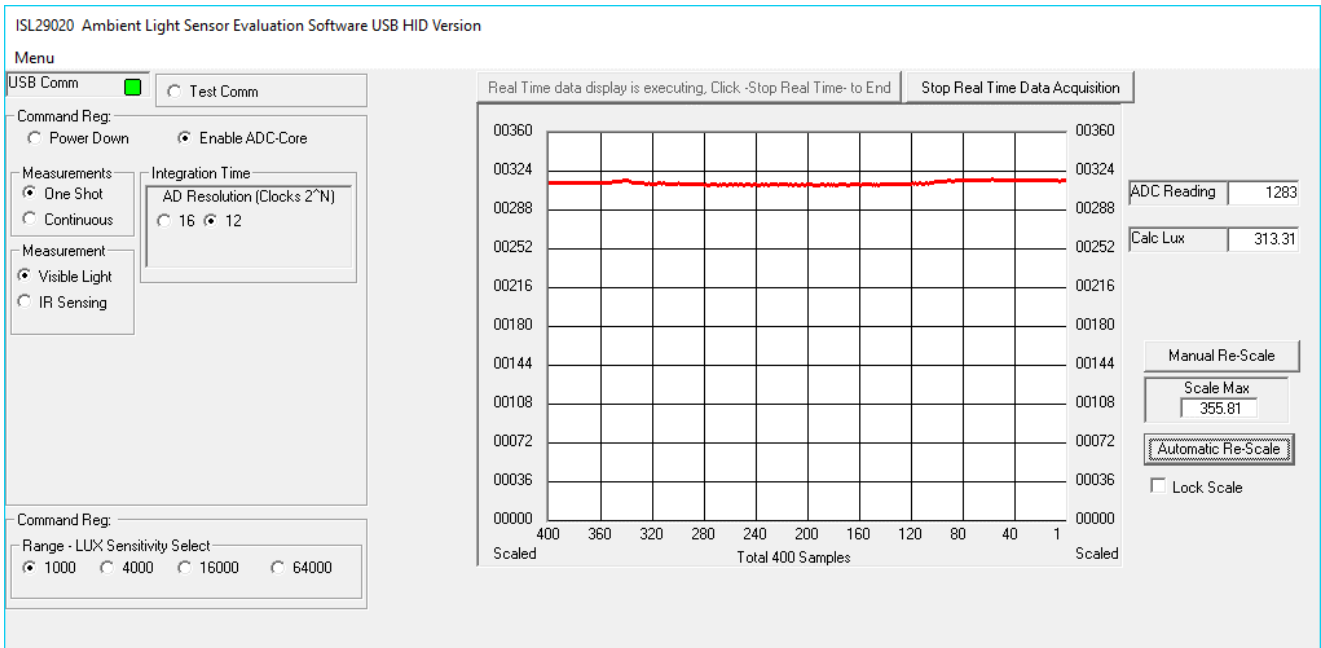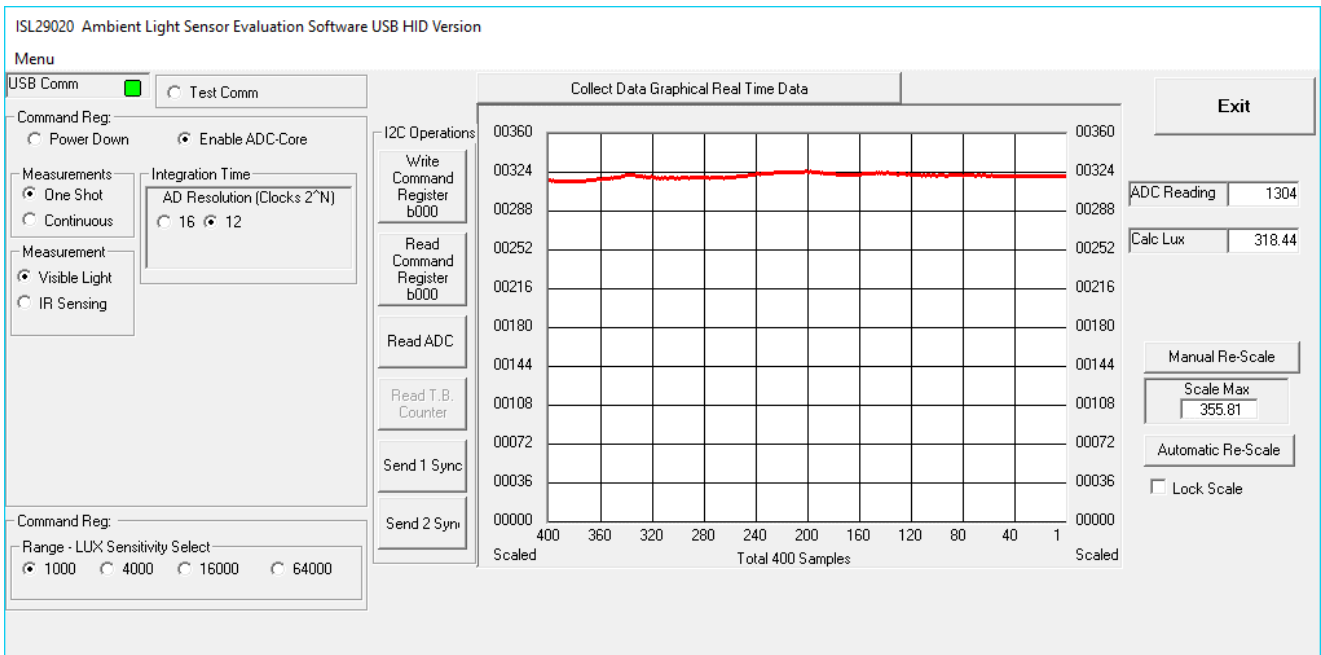The GUI displayed in Figure 15 is now static and in this particular case the decimal number the ADC Reading is 1304. The corresponding oscilloscope traces shown in Figure 16 have been captured. The Channel 1 trace (yellow) is the clock and the Channel 2 trace (red) is the data.
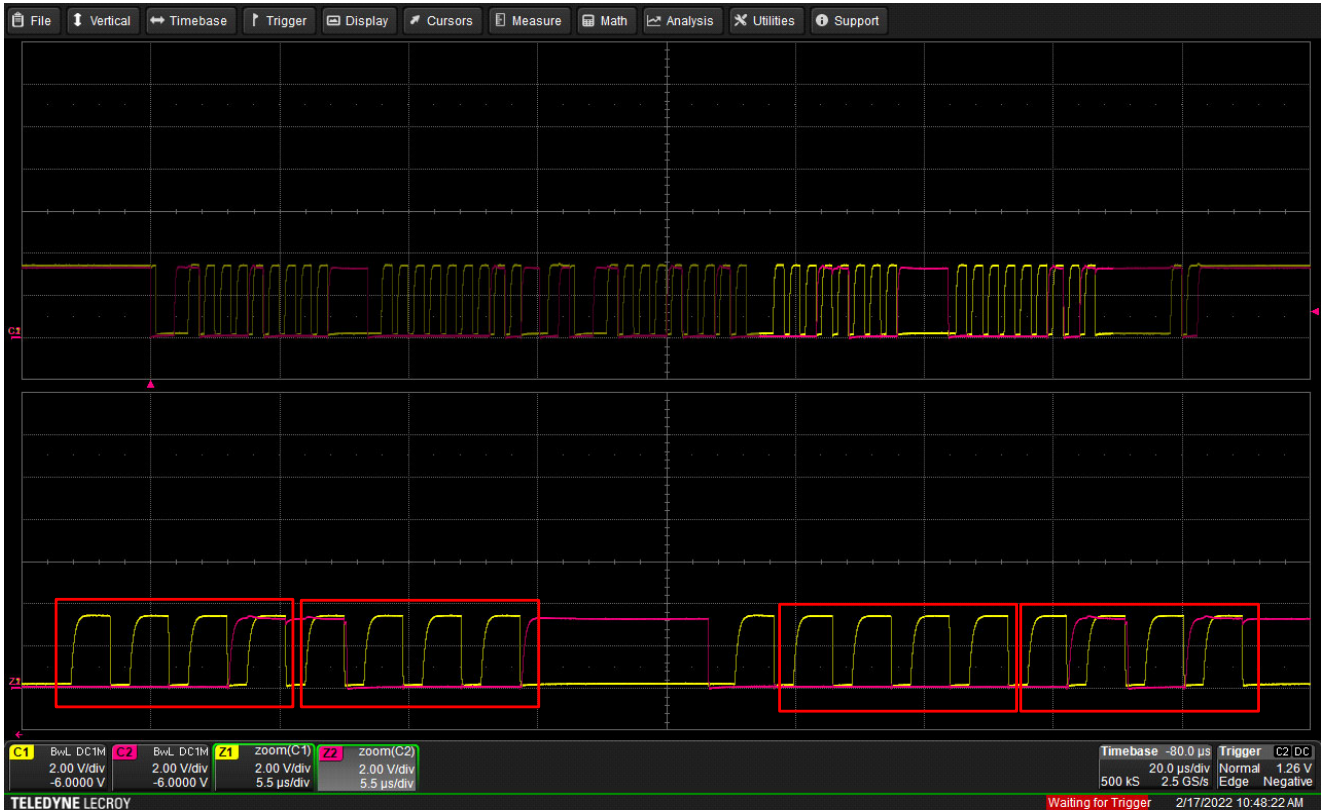

Figure 16. Oscilloscope Traces

The ADC Reading data is parsed out as follows. For now, concentrate on the zoomed portion of the waveform inscribed in the four red rectangular boxes of Figure 16. Read the first box as b0001, the second box as b1000, the third box as b0000, and the forth box as b0101. The MSB is contained in the last two boxes, b0000 0101. The LSB is contained in the first two boxes, b0001 1000. The total binary number is b0000 0101 0001 1000. This is equivalent to d1304, also the number displayed in the ADC Reading box in the GUI display Figure 15.

The GUI shown in Figure 15 shows that the range is 1000 and that the ADC Reading is 1304. Similarly, it shows that n = 12. Use Equation 1 to calculate the lux value as 318 lux as presented in the GUI of Figure 15.

(EQ. 1) $\quad E = \dfrac{Range \bullet ADCReading}{2^n}$

Similarly, the preamble to access the data register above is shown in Figure 17. It is resolved as follows. The first three boxes are the I^{2}C slave address request from the master (computer), b1000, b1000, ACK. (also known as 0100 0100 or 0x44, the trailing 0 indicating a master write and described in the I^{2}C Slave Address section in the datasheet).

The second set of three boxes is the data register address, 0000 0001 ACK. Data register 0x01 contains both the MSB and LSB as described in the previous oscilloscope shot (Figure 16).

The third set of three boxes is the master request to read, 1000 1001 ACK. This is the same as was sent in the first three boxes except that the trailing bit is a 1 instead of a 0 indicating a master read.
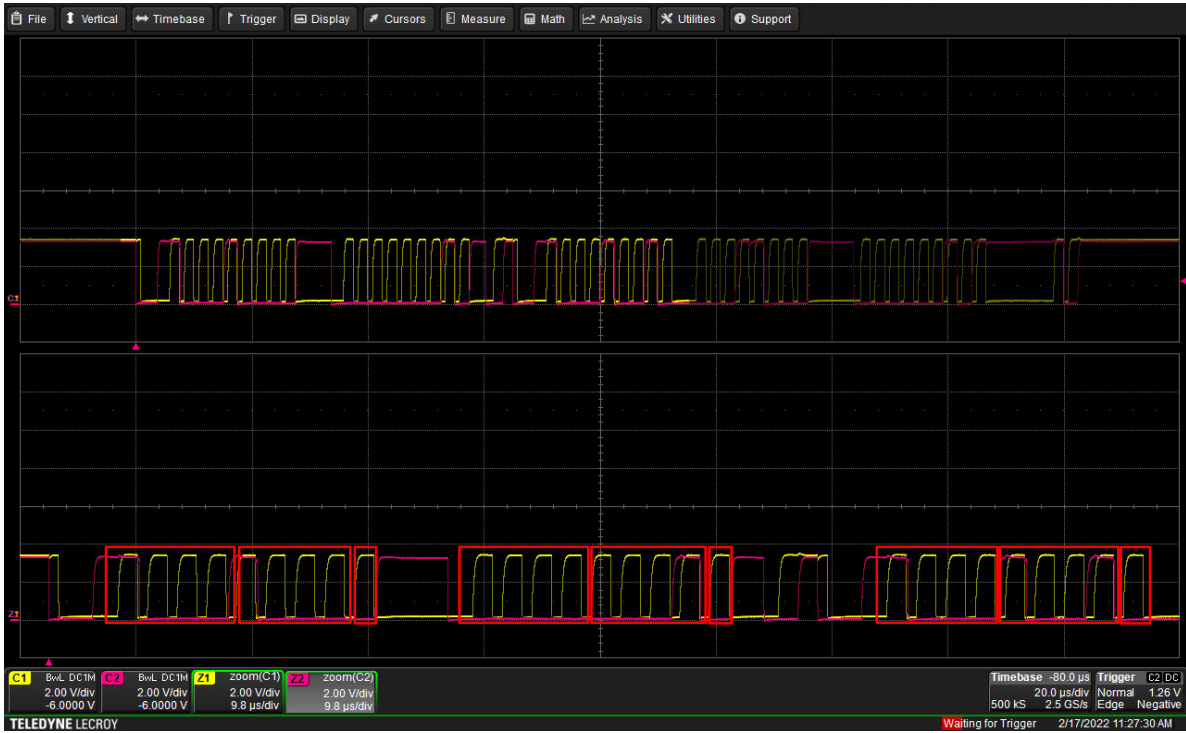

Figure 17. I²C Preamble

The command register is accessed as shown in Figure 18. With the same oscilloscope trigger set up, click on the **4000** radio button as shown in this example and the GUI displayed in Figure 18 and the oscilloscope traces shown in Figure 19 appear.
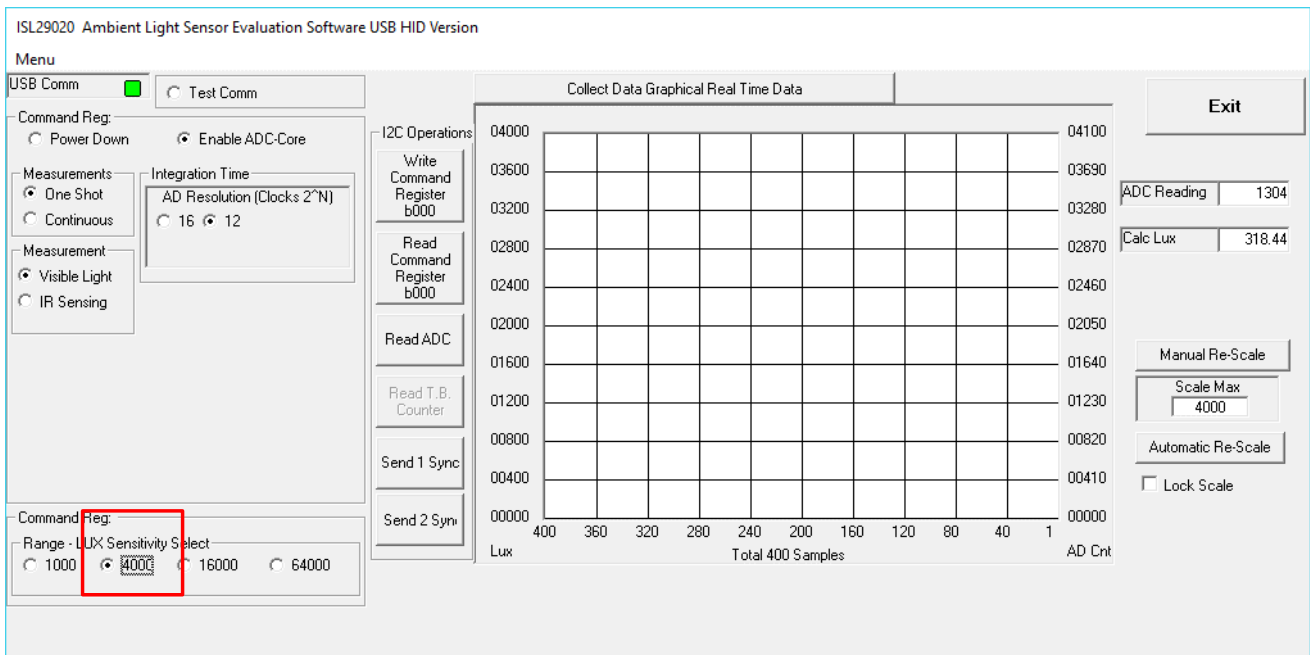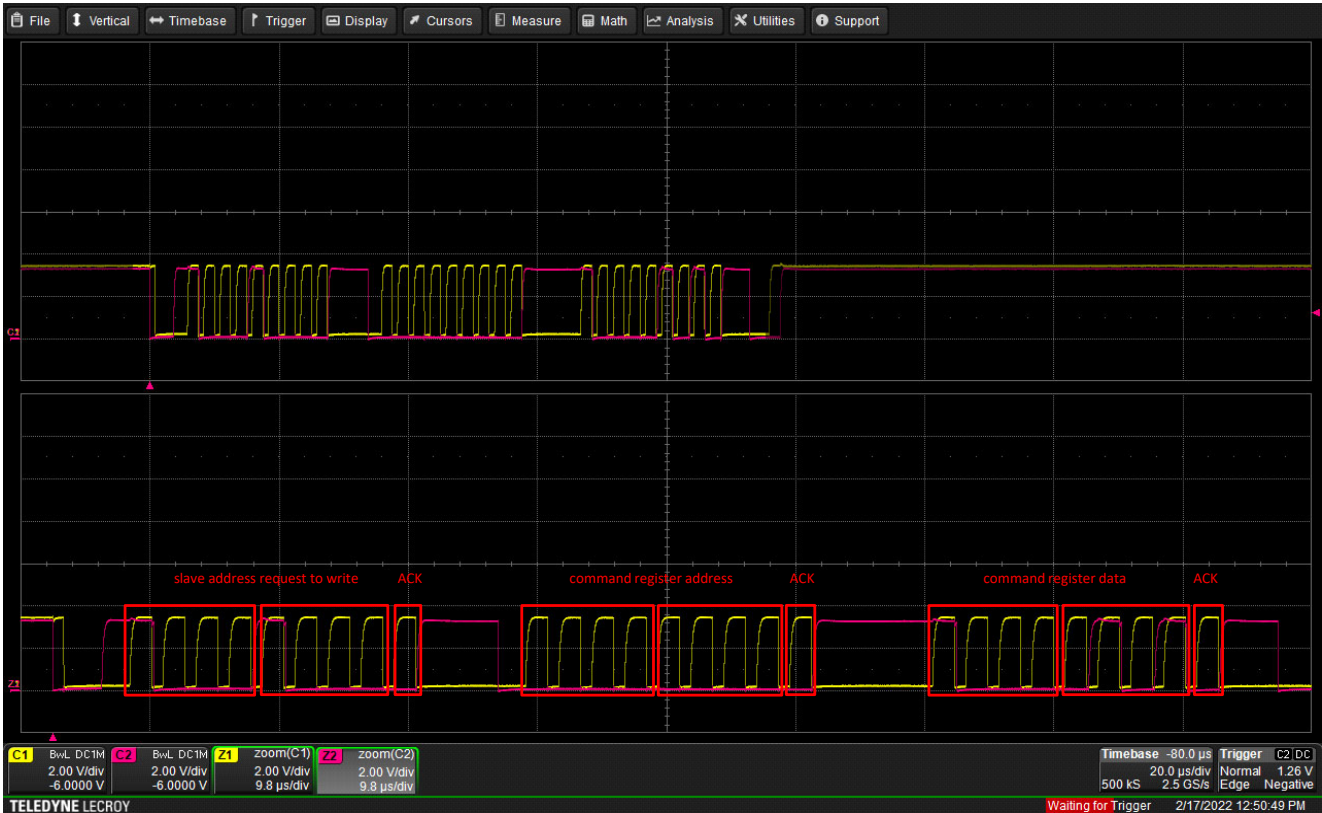

Figure 18. GUI after Range is changed to 4000

Figure 19. I^{2}C after Range is changed to 4000

Consider again the three sets of three boxes. The first is 1000 1000 ACK, just like last time and for the same reason. The second set of three boxes is 0000 0000 ACK. This is the address of the command register, 0x00. The command register is described in the data sheet on page 9.

The command register contents are b1000 0101 ACK. Consider them individually as follows:

- Bit 7 high yields enable the device
- Bit 6 low yields one time measurement
- Bit 5 low yields Ambient light sensing
- Bits 4:3:2 001 yields internal; timing, 12-bit ADC data output
- Bits 1:0 low:hi yields 4000 lux FSR
- All of these settings are indicated on the GUI, Figure 18.

2.2 Troubleshooting

- If suffering from poor USB connection then change the USB port.
- If proximity sensor is unable to measure anything within a certain distance, the sensor has saturated and the selectivity parameter needs to be increased.
- If the program says connection fail and instantly the sensor stops working, simply unplug it from the computer and plug it back in. If the problem still persists, unplug, close program, plug it back in, then reopen program.
- If during a measurement the program crashes or instantly the evaluation board is no longer detected as being connected, unplug and plug back in.
- If too much noise is being picked up, increase the frequency parameter.
- If you require better detection of far distances then increasing the current parameter helps. See the *ISL76682 datasheet* equation 5 for instructions to change the value of the R_{EXT} resistor,

3.   Board Design

3.1   Layout Guidelines

Place R_{EXT} close to the light sensor. Keep the light sensor, R_{EXT}, and its associated traces away from noisy signals. Bypass VDD to GND with a high quality ceramic capacitor located close to the sensor.
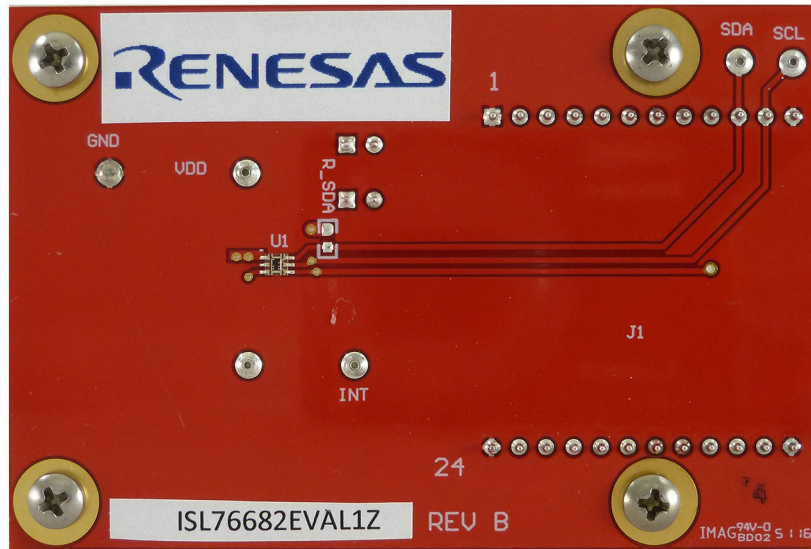
3.2   Mother Board

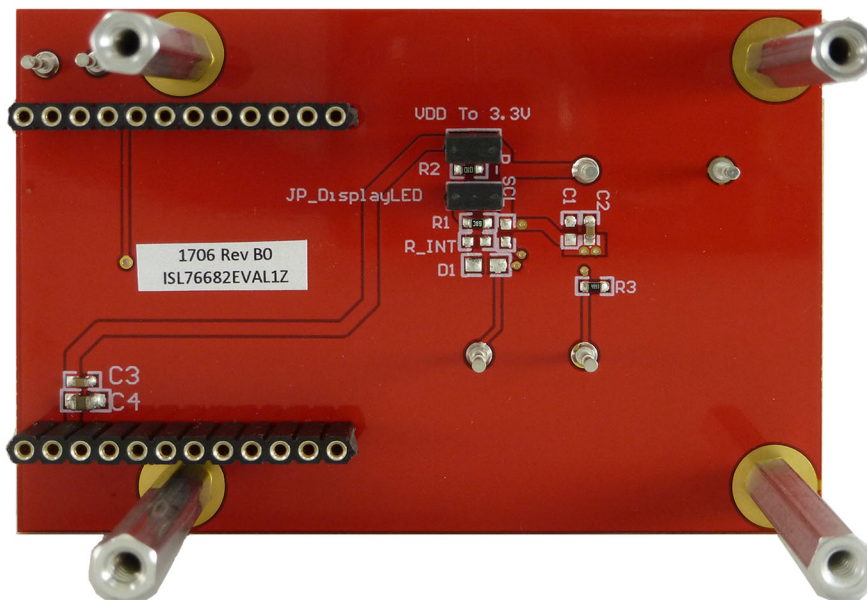**Figure 20. ISL76682EVAL1Z Evaluation Board (Top)**

Figure 21. ISL76682EVAL1Z Evaluation Board (Bottom)

3.2.1 Schematic Diagram

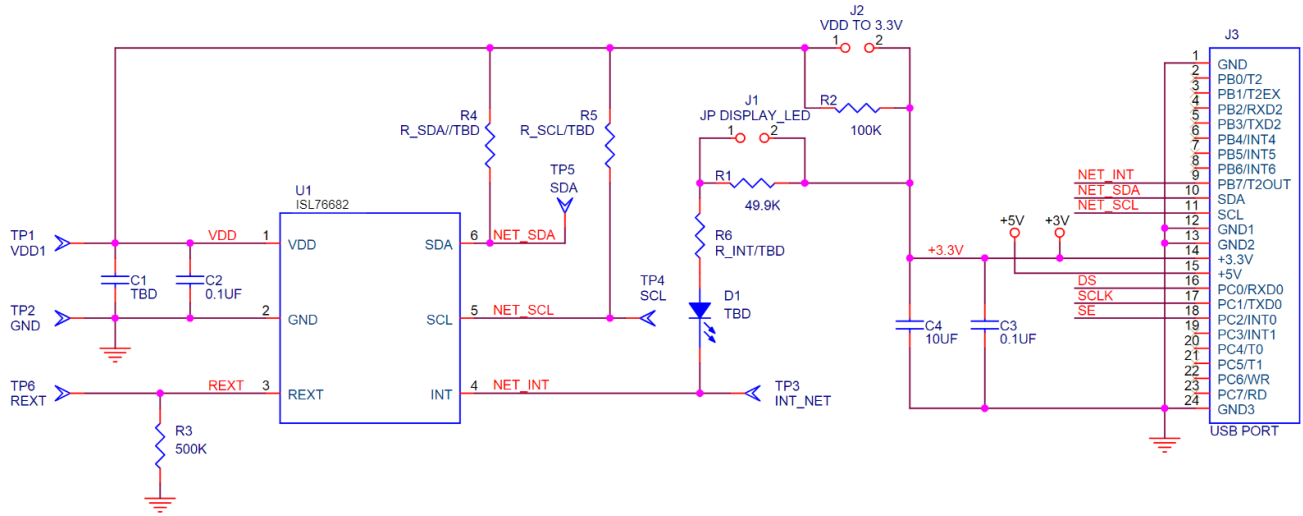The schematic diagram for the evaluation board is shown below.

Figure 22. Mother Board Schematic

3.2.2 Bill of Materials

Table 2. Mother Board BOM

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part Number
1	ISLUSBCEVAL1Z-EVALZRVBPCB	PCB	IMAGINEERING INC	ISL29023IROZ-EVALZRVBPCB
2	C2, C3	CAP, SMD, 0603, 0.1µF, 50V, 5%, X7R, ROHS	AVX	06035C104JAT2A
1	C4	CAP, SMD, 0805, 10µF, 16V, 10%, X5R, ROHS	VENKEL	C0805X5R160-106KNE
6	GND, INT, REXT, SCL, SDA, VDD	CONN-TURRET, TH, SWAGE MNT, 0.230LENGTH, ROHS	MILL-MAX	2110-2-00-80-00-00-07-0
2	JP_DisplayLED, Vdd To 3.3V	CONN-HEADER, 1X2, RETENTIVE, 2.54mm, 0.230X 0.120, ROHS	BERG/FCI	69190-202HLF
1		CONN-RECEPTACLE, SKT STRIP, 50P, 2.54mmPITCH, ROHS	MIL-MAX	801-43-050-10-001000
2	JP_DisplayLED, Vdd To 3.3V	CONN-JUMPER, SHORTING, 2PIN, BLACK, GOLD, ROHS	SULLINS	SPC02SYAN
1	R2	RES, SMD, 0603, 100k, 1/10W, 1%, TF, ROHS	VENKEL	CR0603-10W-1003FT
1	R1	RES, SMD, 0603, 49.9k, 1/10W, 1%, TF, ROHS	VENKEL	CR0603-10W-4992FT
1	R3	RES, SMD, 0603, 499k, 1/10W, 1%, TF, ROHS	PANASONIC	ERJ-3EKF4993V
4	Four corners	STANDOFF, 4-40×1in., F/F, HEX, ALUMINUM, ROHS	KEYSTONE	1897 (.187 OD)
4	Four corners	SCREW, 4-40×1/4in, PHILLIPS, PANHEAD, STAINLESS, ROHS	BUILDING FASTENERS	PMSSS 440 0025 PH
1	U1	IC-DIGITAL OUTPUT LIGHT SENSOR, 6P, ODFN, 6.2×2.1, ROHS	Renesas	ISL29020IROZ
1	Daughter card	PWB-FG, ISL290XXUSBCEVAL1Z, ROHS	Renesas	ISL290XXUSBCEVAL1ZFG

3.2.3   Board Layout
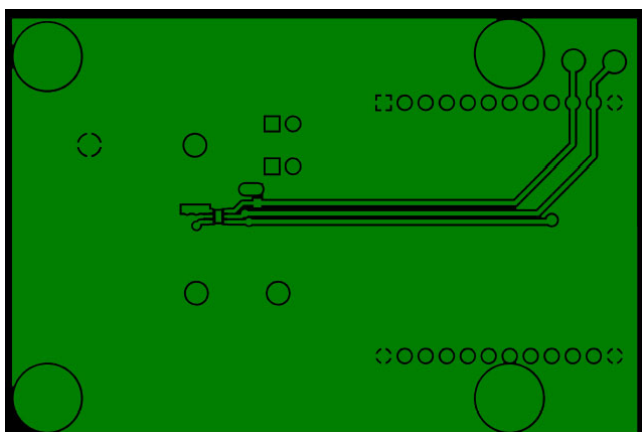
Figure 23. Top Layer, Mother Board
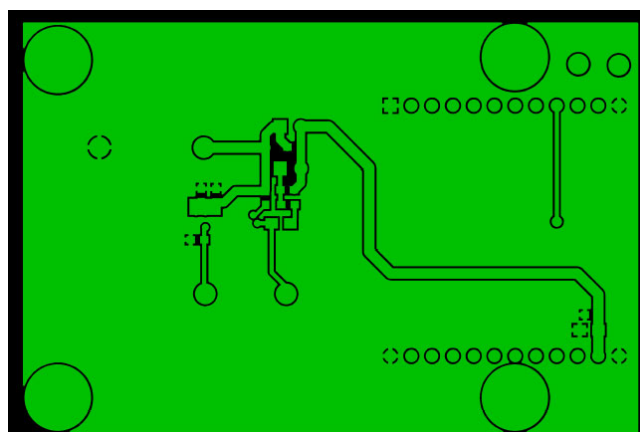
Figure 24. Bottom Layer, Mother Board

3.3   USB Daughter Board
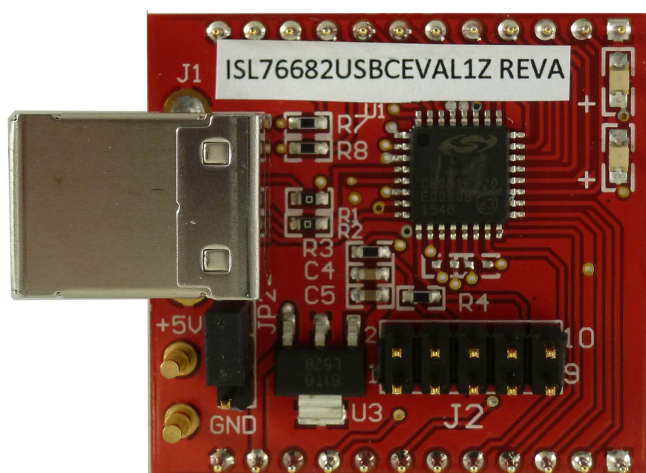
Figure 25. USB Daughter Board (Top)
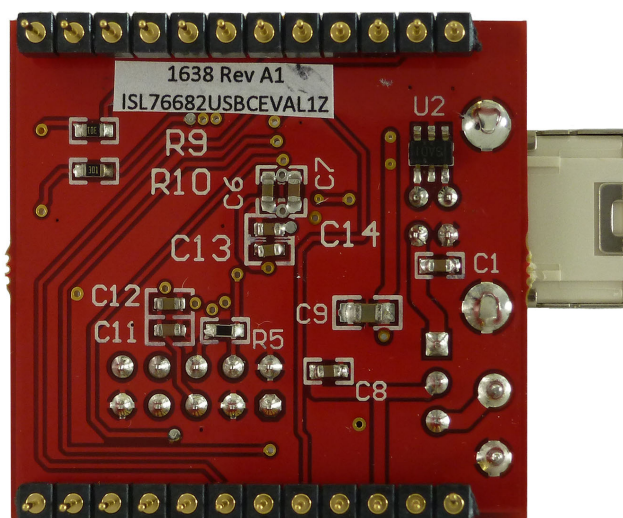
Figure 26. USB Daughter Board (Bottom)

3.3.1 Schematic Diagram
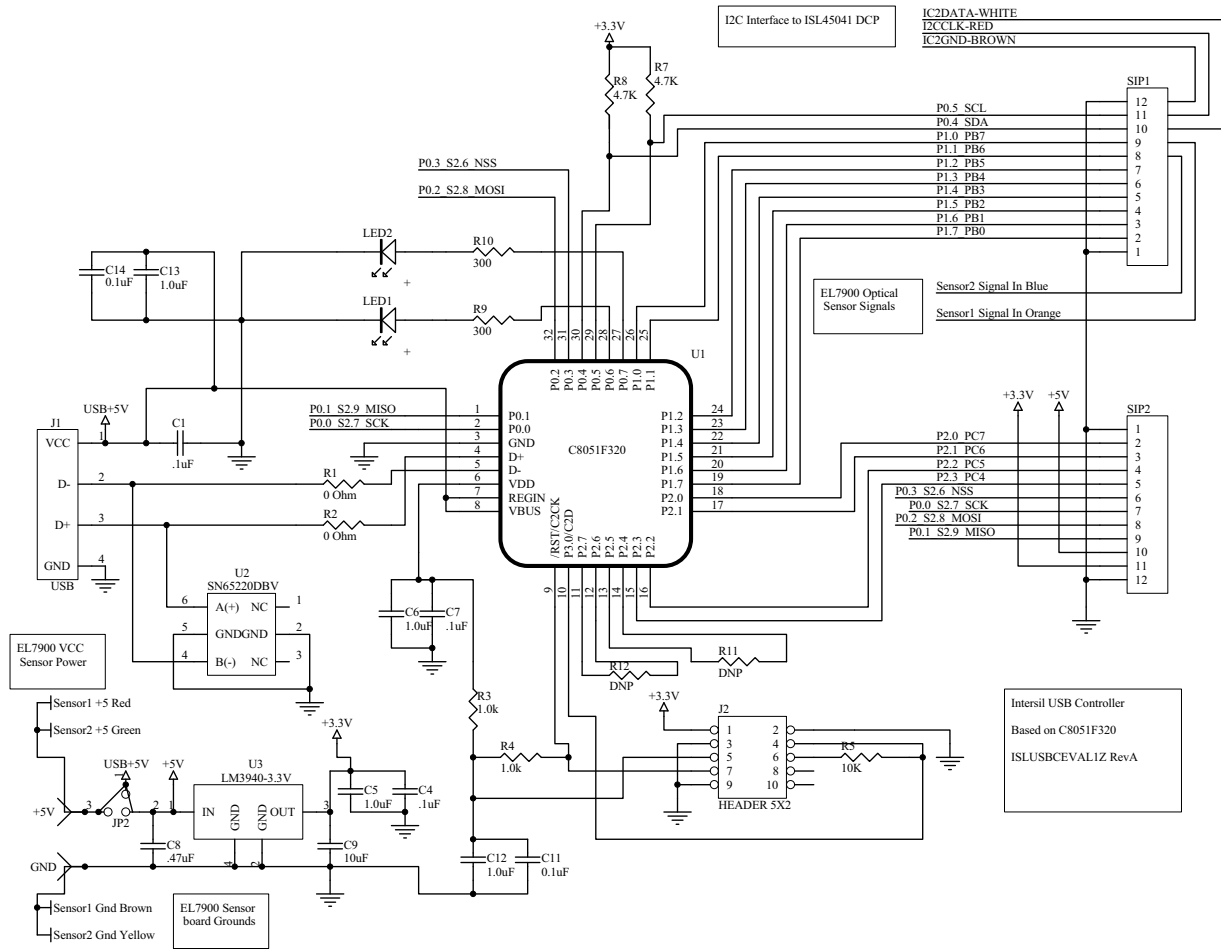
Figure 27. Daughter Board Schematic

3.3.2 Bill of Materials

Table 3. Daughter Board BOM

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
1	SEE LABEL-RENAME BOARD	PWB-PCB, ISLUSBCEVAL1Z, REVA, ROHS		ISLUSBCEVAL1ZREVAPCB
5	C1, C4, C7, C11, C14.	CAP, SMD, 0603, 0.1µF, 16V, 10%, X7R, ROHS	Murata	GCM188R71C104KA37D
4	C5, C6, C12, C13	CAP, SMD, 0603, 1µF, 16V, 10%, X5R, ROHS	Murata	GRM188R61C105KA12D
1	C8	CAP, SMD, 0603, 0.47µF, 10V, 10%, X5R, ROHS	Panasonic	ECJ-1VB1A474K
1	C9	CAP, SMD, 0805, 10µF, 10V, 10%, X5R, ROHS	Murata	GRM21BR61A106KE19L
2	GND, +5V	CONN-SWAGE MNT.TURRET, TH, 0.357LENGTH, 0.062PCB, ROHS	MILL-MAX	3156-2-00-21-00-00-08-0

Table 3. Daughter Board BOM (Cont.)

Qty	Reference Designator	Description	Manufacturer	Manufacturer Part
1	J2	CONN-HEADER, 2x5, BRKAWY-2X36, 2.54mm, ROHS	BERG/FCI	67996-272HLF
1	JP2	CONN-HEADER, 1x3, BREAKAWY 1X36, 2.54mm, ROHS	BERG/FCI	68000-236HLF
1	J1	CONN-USB TYPE B, RECEPTACLE, PCB MOUNT, ROHS	MILL-MAX	897-43-004-90-000
2	12 PIN HEADER (SEE ASSEMBLY INSTRUCTIONS)	CONN-HEADER, 1x12, BRKAWAY 1x36, 2.54mm, STRAIGHT, GOLD	Samtec	HTS-136-G-A-1X12
1	JP2	CONN-JUMPER, SHUNT, 2P, 2.54mmPITCH, BLK, 6mm, OPEN, RoHS	Sullins	SPC02SYAN
1	Lower two pads located to right of U1. Observe cathode marking	LED, SMD, 0805, GREEN, 2V, 20mA, 565nm, 11mcd, RoHS	Lumex	SML-LXT0805GW-TR-T
1	Upper two pads located to right of U1. *Observe cathode marking	LED, SMD, 0805, RED, 2V, 20mA, 635nm, 11mcd, RoHS	Lumex	SML-LXT0805IW-TR
1	U1-PROGRAM FIRMWARE_HID REV1.	IC-USB uCONTROLLER, 32P, LQFP, HID-REV2.4 PROGRAM, ROHS	Silicon Laboratories	C8051F320-GQ
1	U3	IC-1A LDO REGULATOR, SMD, SOT-223, 3.3V, RoHS, Pb-Free	National Semiconductor	LM3940IMP-3.3/NOPB
1	U2	IC-SINGLE USB PORT TVS, SMD, 6P, SOT-23-6, ROHS	Texas Instruments	SN65220DBVR
0	LOCATED BELOW U1 (R11, R12)	RES, SMD, 0402, DNP, DNP, DNP, TF, ROHS		
2	R1, R2	RES, SMD, 0603, 0Ω, 1/10W, TF, ROHS	Venkel	CR0603-10W-000T
2	R3, R4	RES, SMD, 0603, 1k, 1/10W, 1%, TF, ROHS	Panasonic	ERJ-3EKF1001V
1	R5	RES, SMD, 0603, 10k, 1/10W, 1%, TF, ROHS	Venkel	CR0603-10W-1002FT
2	R9, R10	RES, SMD, 0603, 300Ω, 1/10W, 1%, TF, ROHS	Rohm	MCR03EZPFX3000
2	R7, R8	RES, SMD, 0603, 4.7k, 1/10W, 1%, TF, ROHS	Yageo	RC0603FR-074K7L

3.3.3   Board Layout

The USB to/from I2C daughter board top and bottom layers are shown below.
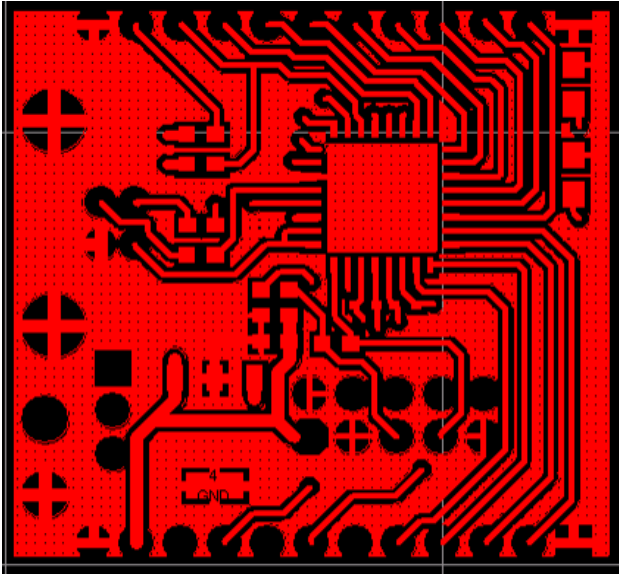
Figure 28. Top Layer, USB Daughter Board
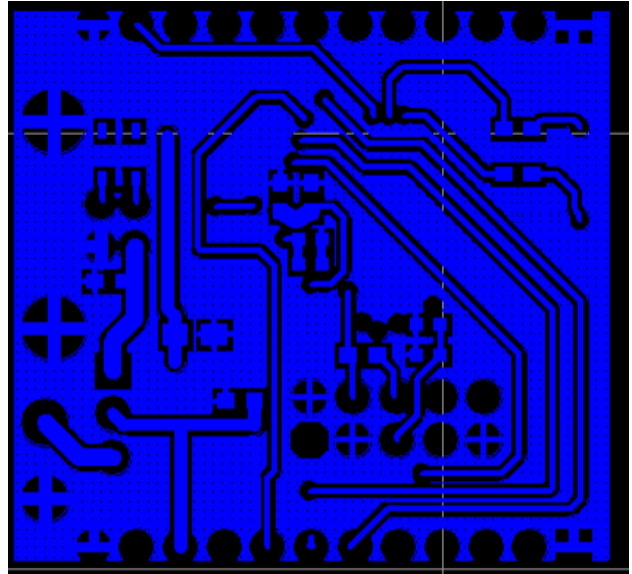
Figure 29. Bottom Layer, USB Daughter Board

4.   Typical Performance Graphs

Figure 30 shows the measured luminosity versus the radiation angle. Figure 31 shows the indicated luminosity versus the actual luminosity with three given light sources.
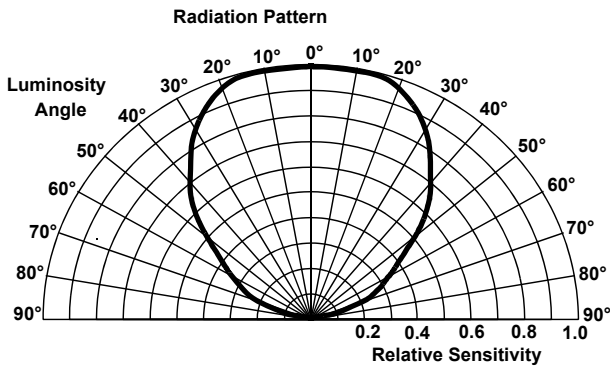
Figure 30. Luminosity vs Angle
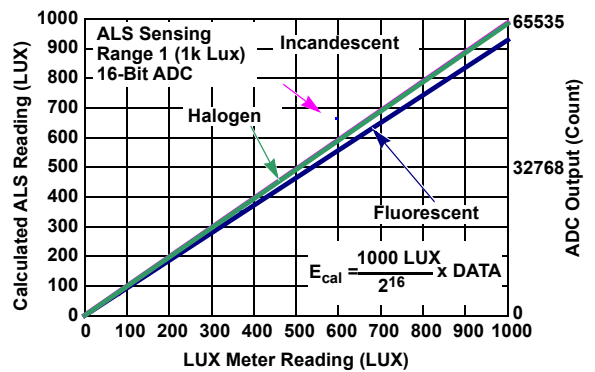
Figure 31. Indicated lux vs Actual

5.   Ordering Information

Part Number	Description
ISL76682EVAL1Z	ISL76682 evaluation board

6.   Revision History

Revision	Date	Description
1.00	Apr 29, 2022	Initial release

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