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ADP1650 Evaluation Board

FEATURES

Input voltage: 2.7 V to 5.0 V
Evaluates single LED flash driver performance
I²C interface
Jumpers for measurement of flash LED current and supply current
Evaluation software CD with measurement report included

GENERAL DESCRIPTION

The evaluation system is composed of a motherboard, daughterboard, and LED subboard. The motherboard provides the I²C signals from the PC USB port and generates the I/O voltages and digital high and low signals for the daughterboard. For overtemperature measurement, the daughterboard can be either plugged directly into the motherboard or connected to the motherboard via a ribbon cable.

The motherboard features a 3.3 V regulator and 2.8 V/1.8 V regulators for VDDIO. The daughterboard contains jumpers and test points for easy evaluation of the flash driver integrated circuit (IC).

Operating details are provided in the ADP1650 data sheet, which should be consulted in conjunction with this evaluation board user guide.

Figure 1 shows the contents of the ADP1650-EVALZ kit, which includes

- Cables: power (red/black), USB, 2× current measurements
- Samples: five ADP1650 devices, two FDSD3012 inductors
- LED boards: OSRAM LUWF65N, LumiLEDs PWF-4

The ADP1650-EVALZ is intended for very detailed evaluation. Contact a local sales office at Analog Devices, Inc., to request it.

ADP1650 EVALUATION BOARD KIT

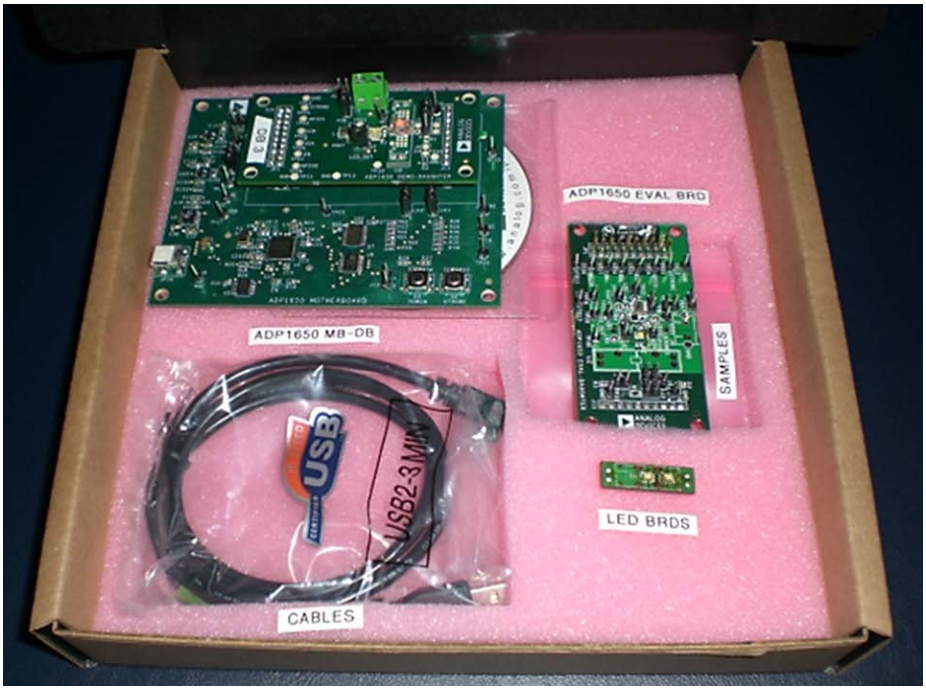

Figure 1.

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REVISION HISTORY

9/10—Rev. 0 to Rev. A

Added Installing the LabVIEW Run-Time Engine Section 3
Changes to Installing ADP1650 Evaluation Software Section ... 3
Changes to Using the Software GUI Section 5
Deleted ADC Mode Section 7
Deleted ADP1650 EVALZ for Detailed Evaluation Section 11
Changes to Evaluation Board Schematics Section 11
Changes to Bill of Materials Section 14

5/10—Revision 0: Initial Version

EVALUATION BOARD SOFTWARE

INSTALLING THE LABVIEW RUN-TIME ENGINE

The LabVIEW™ run-time engine must be installed on the PC first unless LabVIEW 2009 is already installed. Insert the ADP1650-EVALZ setup CD into the CD-ROM and run **LVRTE90STD.exe**.

INSTALLING ADP1650 EVALUATION SOFTWARE

1. Insert the ADP1650-EVALZ setup CD into the CD-ROM and run **Setup.exe**. When the dialog box shown in Figure 2 appears, click **Next**.

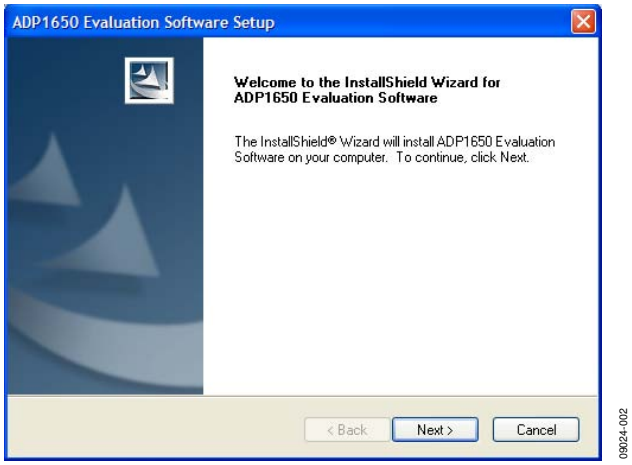

Figure 2. ADP1650 Evaluation Software Setup

2. When the box shown in Figure 3 is displayed, click **Yes** to accept the license agreement.

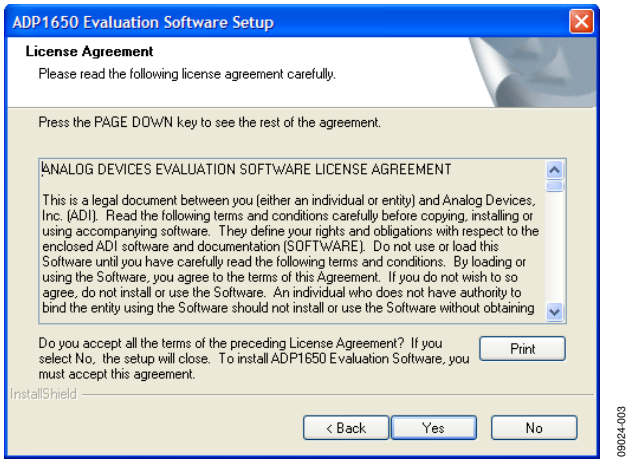

Figure 3. License Agreement

3. In the box shown in Figure 4, click **Next** to install the files to the default destination folder, or click **Browse…** to choose a different location.

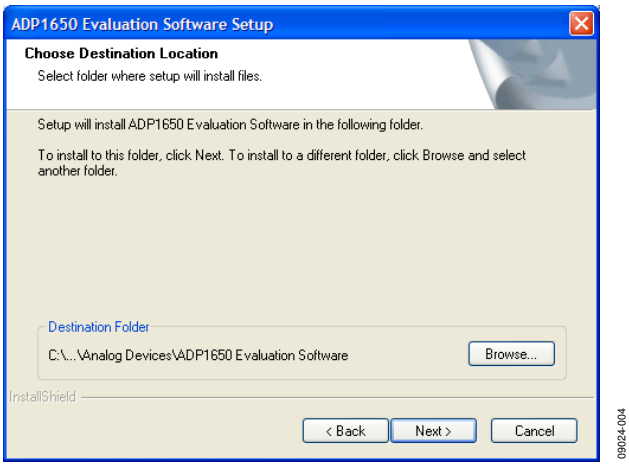

Figure 4. Installation Summary

4. Click **Finish** to complete the installation.

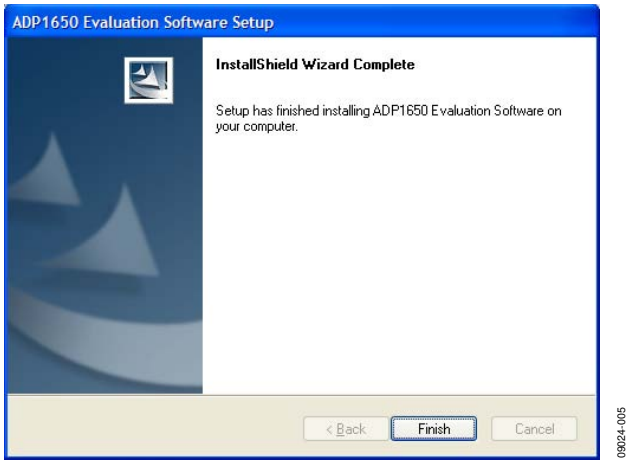

Figure 5. Installation Complete

USB DRIVER INSTALLATION

1. Plug the ADP1650 board into the computer using the USB cable provided with the evaluation kit. When the system recognizes the board, the **Found New Hardware Wizard** dialog box appears.

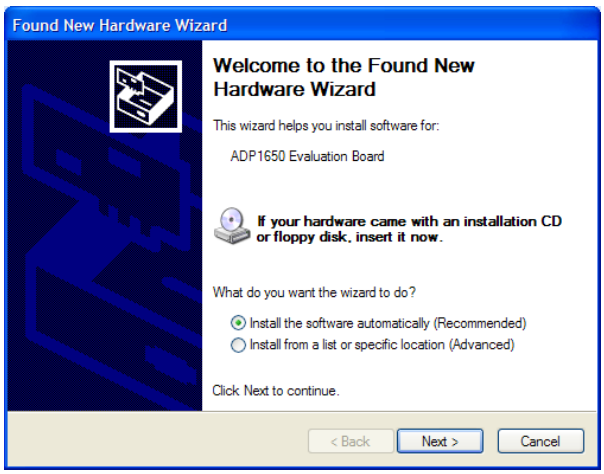

Figure 6. New Hardware Wizard

2. Click **Next** to install the USB driver.
3. Click **Continue Anyway** and then **Finish** to complete the driver installation.

Figure 7. New Hardware Installation

USING THE SOFTWARE GUI

HARDWARE CONFIGURATION AND MONITORS

Complete the following steps to load the ADP1650 evaluation software:

1. Before running the software, ensure that the motherboard is plugged into the computer USB port (the 3.3 V OK LED on the motherboard should light up).
2. Ensure that the daughterboard is supplied with a source that can supply 3 A.
3. Click the **Start** button at the bottom left on your desktop.
4. Select **All Programs**, then the **Analog Devices** folder, and then **ADP1650 Evaluation Software v1.0** to load the software.

The user registers window shown in Figure 8 is displayed.

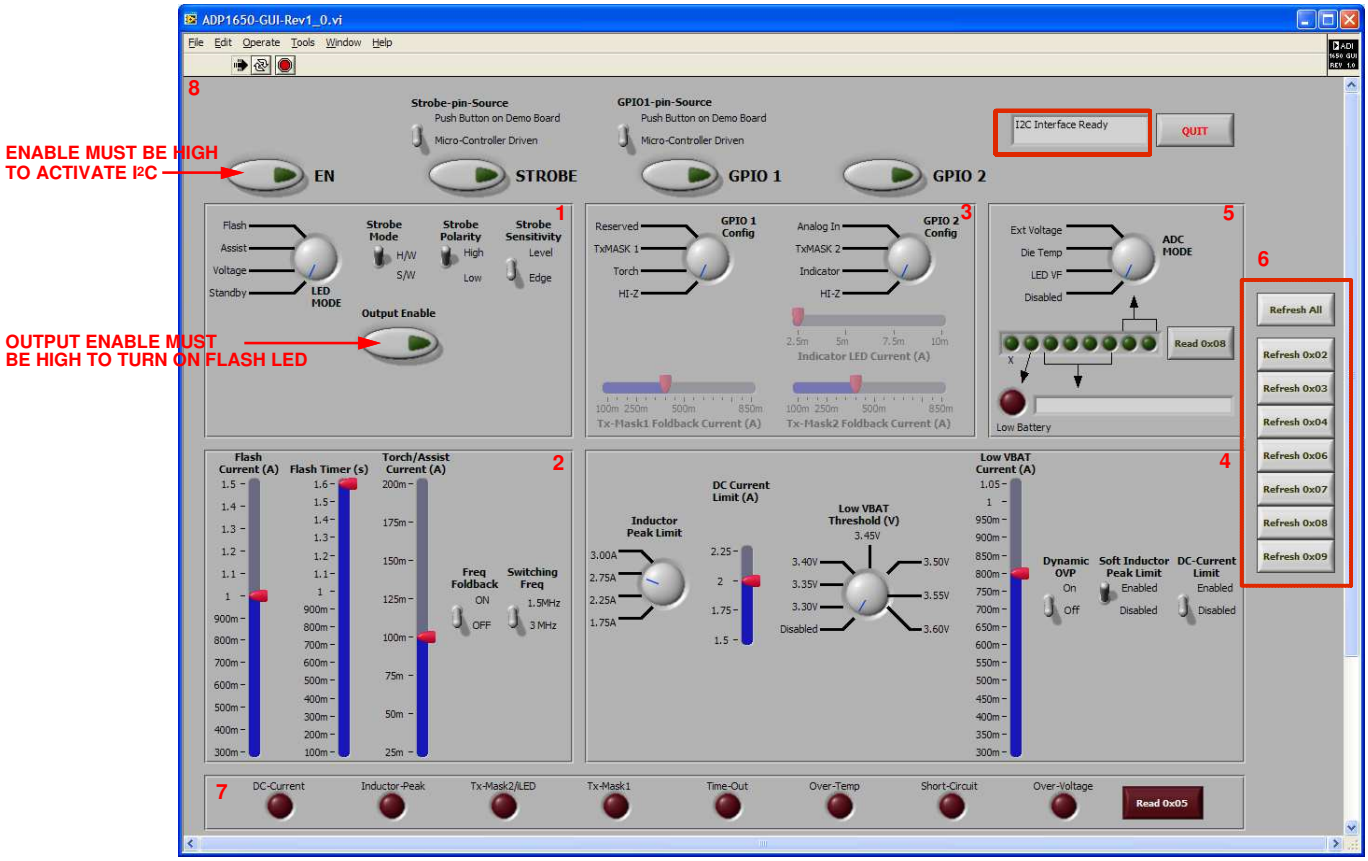

Figure 8. ADP1650 Evaluation Software GUI: User Registers Window

LED CURRENT PROGRAMMING

Before changing settings in the ADP1650 registers, you must enable the I²C interface by clicking the **EN** button in Section 8 of the user registers window (the button turns green and the EN LED on the motherboard lights up). This sets the EN pin of the ADP1650 high.

INDICATOR LED MODE

Using the indicator LED can be a quick way to verify communication between the software and the ADP1650.

1. Set **GPIO2 Config** in Section 3 of the user registers window to **Indicator**. Then update Register 0x02 by pressing **Refresh 0x02**. The red indicator LED on the motherboard should turn on.
2. Ensure that Header J12 on the demo board has Pin 2 and Pin 3 shorted with a jumper to connect the GPIO2 pin to the red LED on the motherboard.
3. To change the indicator LED current, use Section 3 of the user registers window.
4. Ensure a write to the ADP1650 by clicking the appropriate refresh button in Section 6 on the right side of the user registers window. The refresh button turns red to indicate that a setting has changed for a register and must be updated.
5. Turn off the indicator LED by setting **GPIO2 Config** to **Hi-Z** before performing the flash/assist light evaluation.

FLASH LED PROGRAMMING

1. To program the LED current, set **Torch/Assist Current** and **Flash Current** in Section 2 of the user registers window, and click the **Refresh 0x03** button.
2. For USB-only powered demonstrations, use a maximum **Flash Current** setting of 300 mA to avoid exceeding the USB current source capability of 500 mA.

SOFTWARE OR HARDWARE STROBE FOR FLASH

There are three ways to initiate flash.

I²C Enabled Flash

1. Set **EN** in Section 8 of the user registers window.
2. In Section 1 of the window, set **LED Mode** to **Flash,** set **Output Enable** to **ON**, and set **Strobe Mode** to **S/W**. **Refresh 0x04** should turn red to indicate that the front panel settings must be written to the ADP1650.
3. Click the **Refresh 0x04** button to initiate flash.
4. To program the length of the flash event, set the value under **S/W Flash Timer** in Section 2 of the window and click the **Refresh 0x02** button.

Strobe Enabled Flash – Using the STROBE Button on the Motherboard (Most Common)

1. Set **EN** in Section 8 of the user registers window.
2. In Section 1 of the window, set **LED Mode** to **Flash**, set **Strobe Mode** to **H/W**, and set **Output Enable** to **ON**.
3. Click the **Refresh 0x04** button.
4. In Section 8 at the top left of the window, set **Strobe pin Source** to **Push Button on Demo Board**.
5. Press the STROBE button on the motherboard to initiate flash.

Strobe Enabled Flash – Using the User Registers Window

1. Set **EN** in Section 8 of the user registers window.
2. In Section 1 of the window, set **Output Mode** to **Flash**, set **Strobe Mode** to **H/W,** and set **Output Enable** to **ON**.
3. Click the **Refresh 0x04** button.
4. In Section 8 of the window, set **Strobe pin Source** to **Micro-controller Driven**.
5. Click the **STROBE** button in Section 8 of the window to initiate flash.
6. Program the length of the flash event by setting the value under **S/W Flash Timer** in Section 2 and clicking the **Refresh 0x02** button.
7. To initiate flash again, click **Refresh 0x04** and click **STROBE** again. STROBE can be enabled either from the user registers window by clicking **STROBE** in Section 8 or from the hardware by pressing the STROBE button on the motherboard.

SOFTWARE OR HARDWARE TORCH

The torch can be activated in two ways: by pressing the TORCH button on the motherboard or by completing the following steps in the user registers window:

1. Set **EN** high (green) in Section 8 of the user registers window.
2. In Section 1 of the window, set **LED Mode** to **Assist**.
3. Set **Output Enable** = 1 by clicking the **Output Enable** button (green = 1).
4. Click the **Refresh 0x04** button.

TIMEOUT DURATION PROGRAMMING

Timeout is hardware limited to a maximum of 1600 ms.

1. To set the desired flash timeouts, change the setting under the **Flash Timer** box in Section 2, and click the **Refresh 0x02** button. The timeout doubling bit is set by default by the software.
2. To get 50 ms resolution, contact your Analog Devices field applications engineer (FAE).

FAULT DETECTION STATUS

Section 7 of the user registers window is used to read back the fault detection status from the ADP1650. Click **Read 0x05** to view information about the fault. **EN** in Section 8 of the window must be high (green) to be in read mode. An overvoltage fault occurs when the output voltage is greater than 5.3 V (typical). A timeout fault occurs when the STROBE button on the evaluation board is pressed longer than the programmed timeout duration in strobe level-sensitive mode. A thermal fault occurs when the device junction temperature is greater than 150°C. A short-circuit fault occurs when the LED_OUT pin remains grounded during startup. If the **DC Current Limit** feature is enabled in Section 4 of the user registers window, and the dc current programmed is exceeded, the input dc current limit bit [IL_DC] is set and the **DC-Current** indicator in Section 7 of the user registers window lights up.

The TxMask2/ILED bit is set depending on the mode of GPIO2 set in Section 3 of the window. If GPIO2 is set to **Indicator** (ILED mode) and there is a fault with the ILED, the TxMask2/ILED bit is set. If GPIO2 is set to **TxMASK2** and a TxMaSK2 event occurs during a flash, the TxMask2/ILED bit is set high.

Faults that are indicated by lighted LEDs in Section 7 of the user registers window are cleared after you click the **Read 0x05** button.

LOW VBAT

Set the low VBAT threshold and the desired current setting in Section 4 of the user registers window. The battery voltage can be reduced during a flash event, which causes the flash current to be reduced to the programmed level and the low battery status bit to be set to indicate that the part has entered low battery mode and the current is reduced.

DC CURRENT LIMIT

The dc current limit feature prevents the battery current from exceeding the programmed level set in Section 4 of the user registers window. Set **DC-Current Limit** to **Enabled** in Section 4, and set the maximum current level using **DC Current Limit**. During a flash event, if the DC current limit is reached, the DC current limit status bit is set in the fault register. Click the **Read 0x05** button at the bottom right of the user registers window to check the status after a flash event. The flash current shown in Section 2 of the window is updated with the actual current into the LED during the flash event. For example, the user may program 1.5 A for the flash current but the **Flash Current** bar shows 1.3 A at the end of the Flash event. 1.3 A is the actual current delivered to the LED. Bits I_FL in Register 0x03 are automatically read back during a flash event to update the user registers window.

EVALUATION BOARD OVERVIEW

MOTHERBOARD

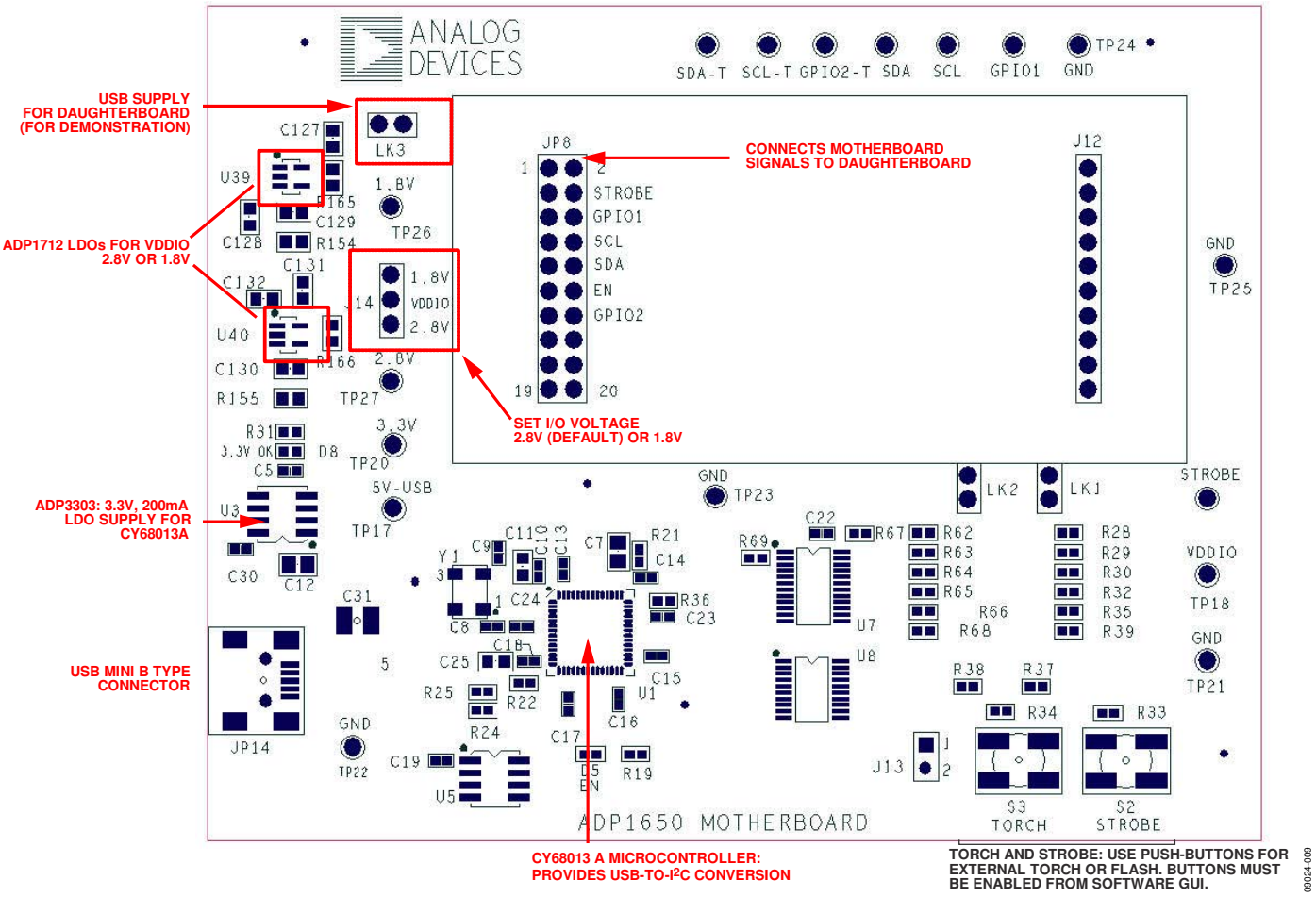

Figure 9. Motherboard

The ADP1650 motherboard provides the interface signals to the ADP1650 flash driver IC. These signals are controlled via the evaluation software GUI.

The Cypress Semiconductor Corporation CY68013A provides the USB interface and I²C signals. The selected I²C frequency is 400 kHz. The EEPROM U5 M24C64 provides the USB address of the board.

Typically, the daughterboard is inserted directly into the 20-pin header of the motherboard. For temperature measurements, however, the ribbon cable provided with the evaluation kit must be used to connect the motherboard and the daughterboard because the Cypress CY68013A is not rated at −40°C.

DEMO DAUGHTERBOARD

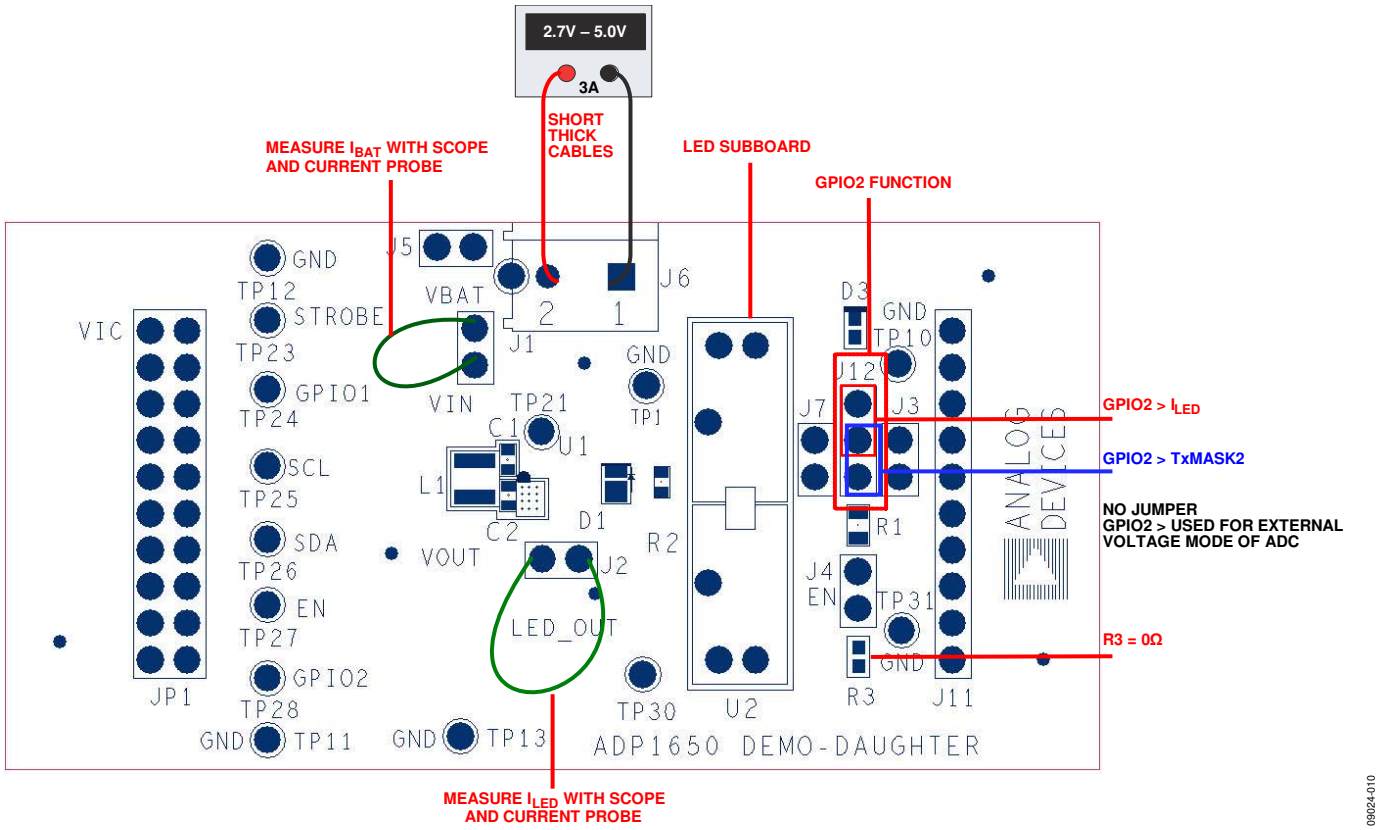

Figure 10. Demonstration Daughterboard

The ADP1650 evaluation daughterboard is designed to quickly evaluate key parameters of the ADP1650 IC. Headers are available to measure currents using a current probe (preferred) or ammeter.

Connect a power supply or Li-Ion battery with >3 A capability to J5. Up to 2.5 A can be drawn from the battery; therefore, short thick cables (provided) are recommended to minimize the IR drops. A high current can cause a big IR drop, and V_{IN} of ADP1650 can be low enough to put the part into UVLO.

I_{BAT}

I_{BAT} is the battery current and can be measured by using an ammeter or current loop across J1.

I_{LED}

I_{LED} is the LED current and can be measured by using an ammeter or current loop across J2.

VIN

A VIN sense point is provided at TP21. This should be used to sense the true voltage at the ADP1650 supply for measuring LED power efficiency.

High V_F LEDs

The LED subboard (at U2 in Figure 10) can be replaced with a different subboard containing various LEDs with higher V_F to test the performance over the full range of LEDs used in a production environment.

POWER BOARD FROM USB PORT ONLY

To power the motherboard via the USB for demonstration purposes without using an external supply, short Pin 1 and Pin 2 on both of the LK3 jumpers on the motherboard. Short Pin 1 and Pin 2 of J5 on the daughterboard. Figure 11 illustrates jumper settings for USB powered operation. Ensure that the LED current is less than 200 mA to avoid exceeding the 500 mA current limit of the USB.

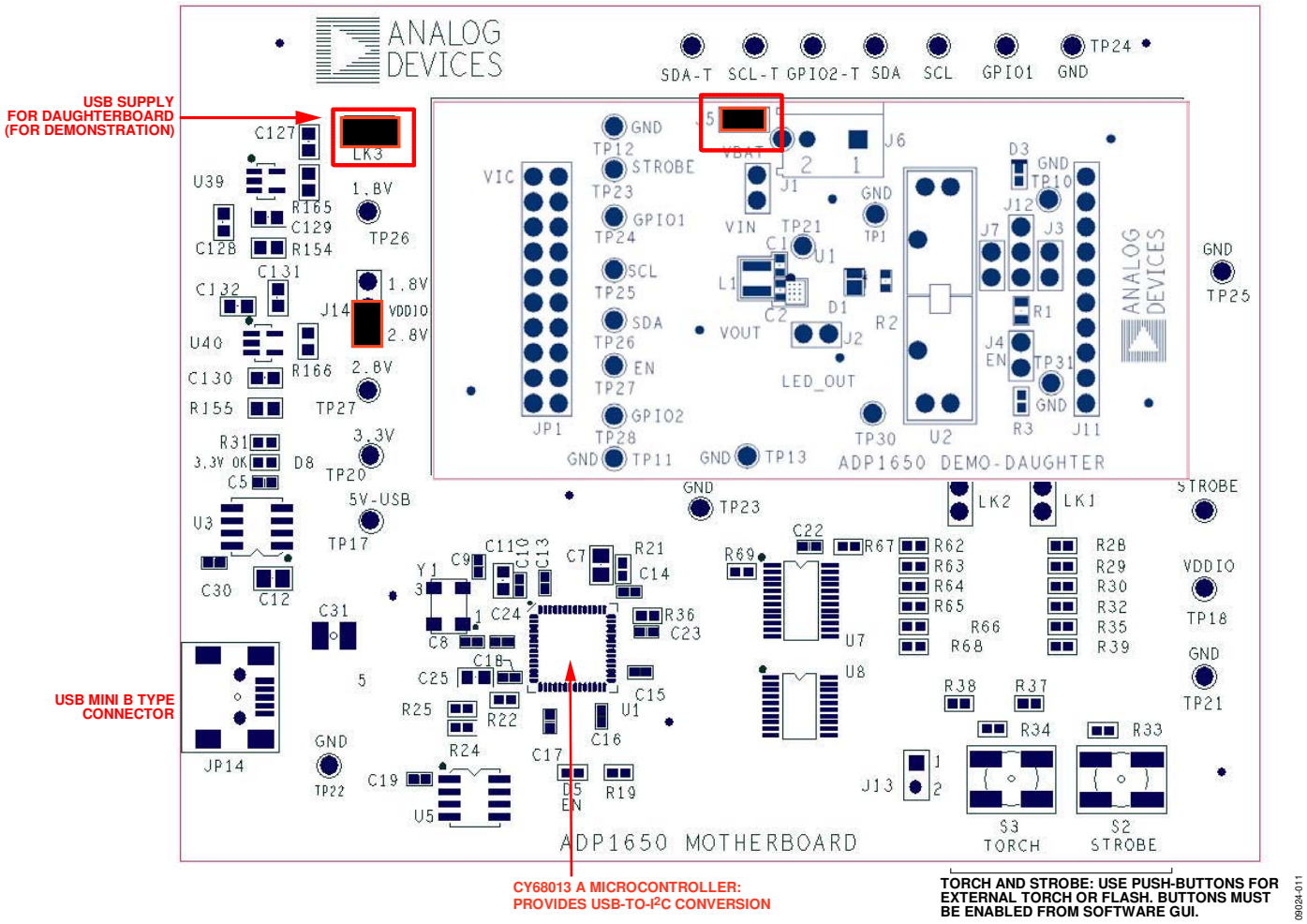

Figure 11. Powering the ADP1650 from a USB Port

EVALUATION BOARD SCHEMATICS

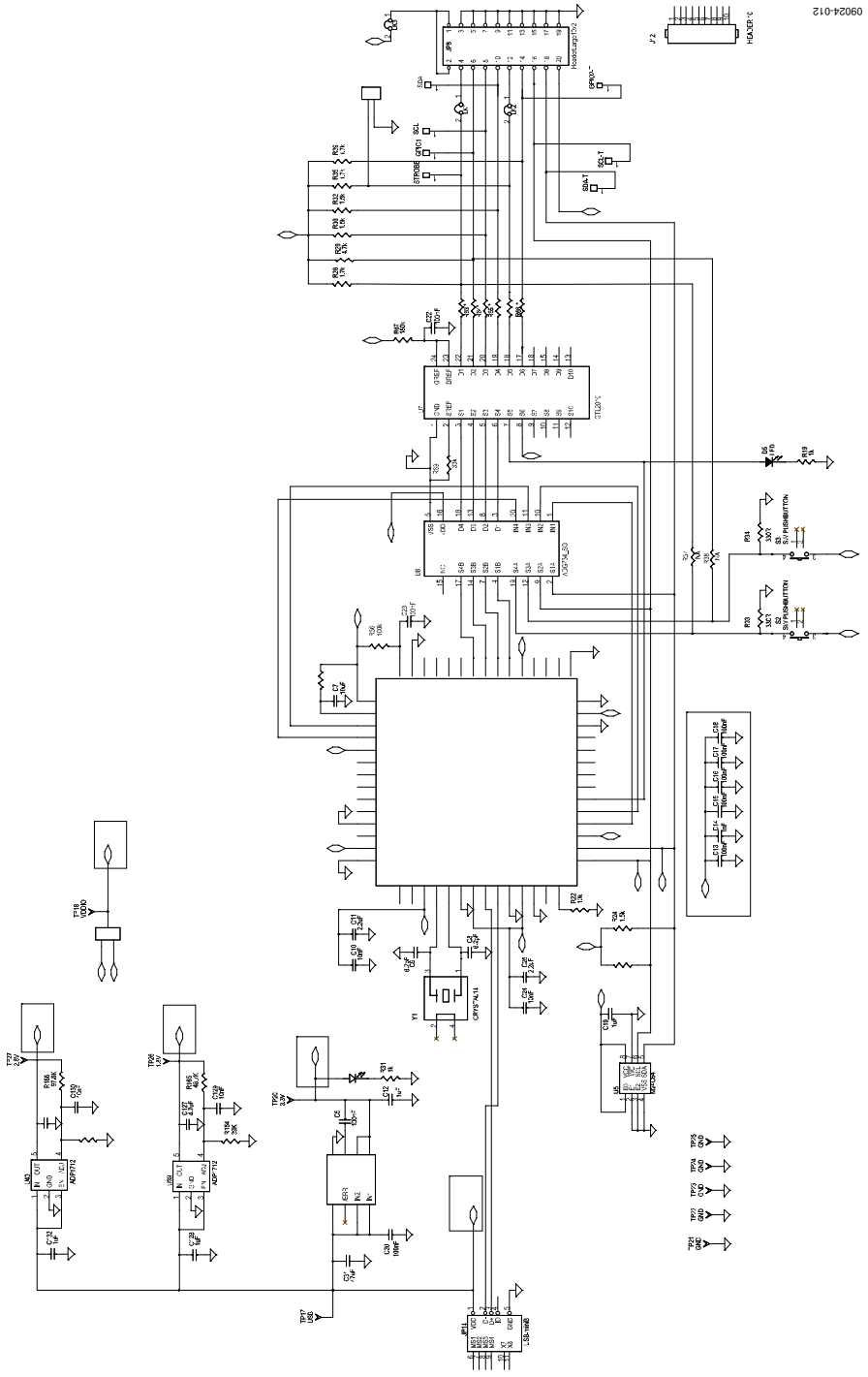

Figure 12. ADP1650 Evaluation Motherboard Schematic

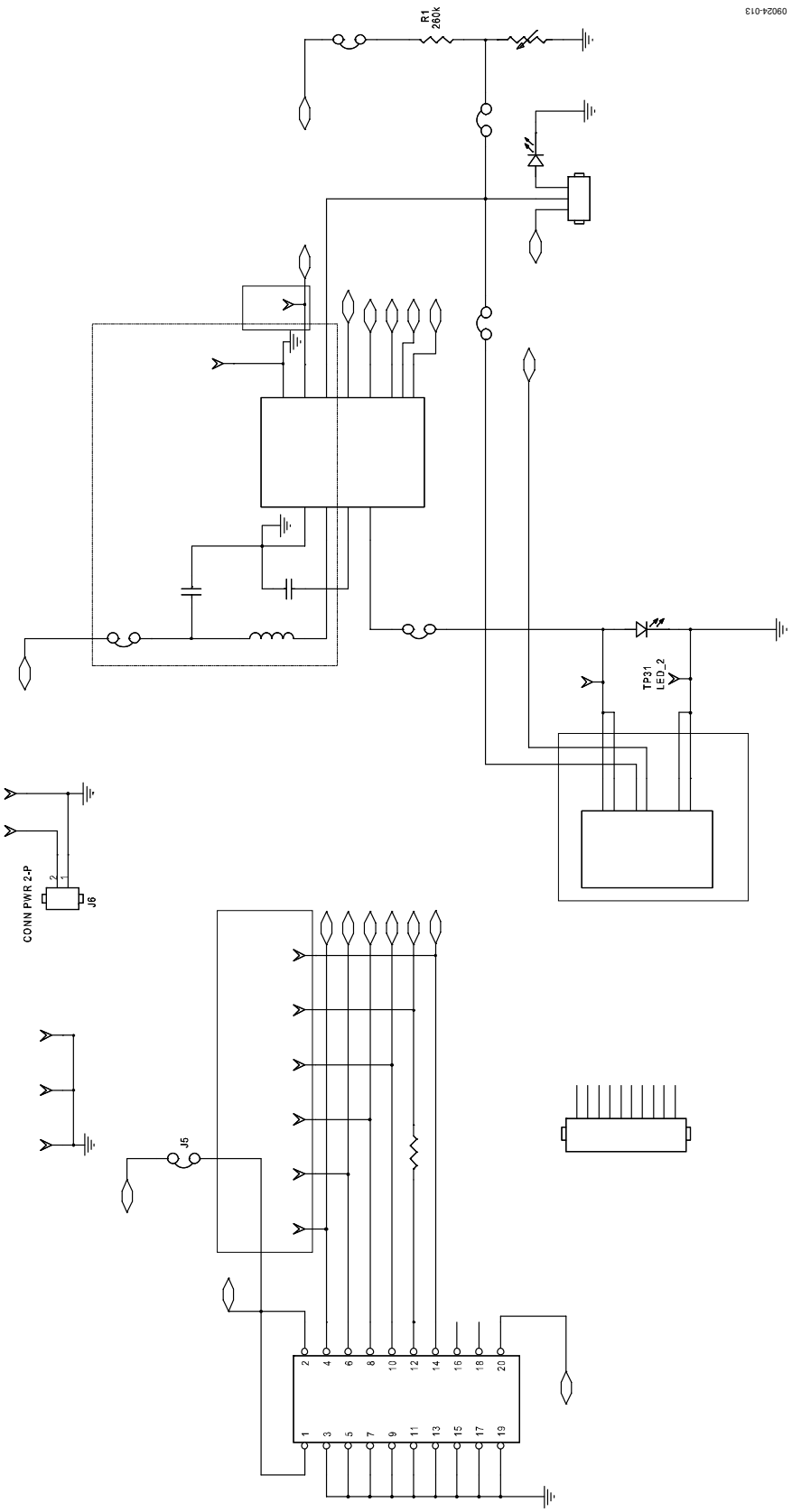

Figure 13. ADP1650 Evaluation Daughterboard Schematic

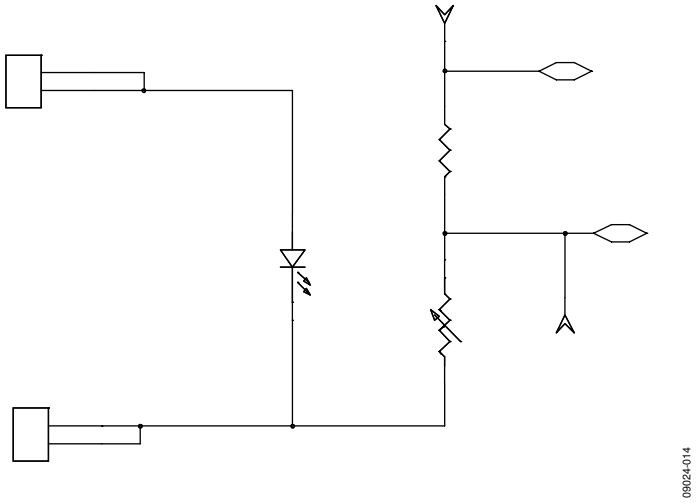

Figure 14. LED Subboard

ORDERING INFORMATION

BILL OF MATERIALS

Table 1. Demo Daughterboard Bill of Materials

Qty	Reference Designator	Description	Manufacturer/Vendor	Part Number
2	C1, C2	Capacitor, MLCC, 10 µF, 6.3 V/4.0 V, 0603, X5R	Murata, TDK	GRM188R60J106ME, C1608X5R0G106MT
1	R1	Resistor, open, 1%, 0805, 270 kΩ, SMD	Vishay or equivalent	CRCW0805270KFKEA
1	R2	Resistor, open, 1%, 0603, 0 Ω, SMD	Vishay or equivalent	CRCW06030000Z0TA
1	R3	Resistor, 0 Ω, 1%, 0402, 0.125 W, SMD	Vishay or equivalent	CRCW04020000Z0EDHP
1	D1	White LED, open when you plug LED subboard	OSRAM/LumiLEDs	LUWC9SP or PWF4
1	D3	Indicator LED, red, 0402	Lumex	SML-LX0402SIC-TR
6	J1 to J5, J7	Connector header, two pins × 1	Samtec	TSW-150-07-T-S
1	J6	Terminal block, two pins × 1	Sullins	PEC36SAAN
1	J11	Connector header, 10 pins × 1	Samtec	SSQ-110-01-G-S
1	JP1	Connector header, 10 pins × 2	Samtec	SSW-110-03-G-D
1	L1	Inductor, 1.0 µH, 3 mm × 3 mm	TOKO	FDSD0312-1R0M, FDSE0312-1R0M
15	TP1, TP10 to TP14, TP21, TP23 to TP28, TP30, TP31	Connector header, 1 pin × 1	Samtec	TSW-150-07-T-S
1	U1	ADP1650, 12-ball WLCSP	Analog Devices	ADP1650
1	U2	ADP1650 plug-in LED boards, six pcs gold sockets	Kensington	YSK0076-011AH

Table 2. LED Subboard Bill of Materials

Qty	Reference Designator	Description	Manufacturer/Vendor	Part Number
1	D1	White LED	OSRAM/LumiLEDs	LUWC9SP or PWF4
1	R1	Resistor, 267 kΩ, 1%, 0805, SMD	Vishay or Equivalent	CRCW0805267KFKEA
1	R2	Thermistor, PTC, 470 Ω, 0603, SMD	Murata	PRF18BE471QB1RB
6	J1, J2, J3, J4	Gold pin (plug into demo/evaluation board)	Kensington	HSP030M2H

Table 3. Motherboard Bill of Materials

Qty	Reference Designator	Description	Manufacturer/Vendor	Part Number
1	C7	Capacitor, MLCC, 10 µF, 10 V, 0805, X5R	Murata	GRM219R61A106K
9	C5, C13, C15 to C18, C22, C23, C30	Capacitor, MLCC,100 nF,16 V, 0402, X5R	Murata	GRM155R71C104K
2	C11, C25	Capacitor, MLCC, 2.2 µF,10 V, 0603, X5R	Murata	GRM188R61A225K
1	C31	Capacitor, MLCC, 47 µF, 10 V, 1210, X5R	Murata	GRM32ER61A476K
2	C8, C9	Capacitor, MLCC, 6.2 pF, 50 V, 0402, COG	Murata	GRM1555C1H6R2B
1	C19	Capacitor, MLCC, 1 µF, 10 V, 0402, X5R	Murata	GRM155R61A105K
2	C128, C132	Capacitor, MLCC, 1 µF, 10 V, 0603, X5R	Murata	GRM188R61A105K
1	C12	Capacitor, MLCC, 1 µF, 25 V, 0805, X7R	Murata	GRM21BR71E105K
2	C10, C24	Capacitor, MLCC, 10 nF, 50 V, 0402, X7R	Murata	GRM155R71H103K
2	C129, C130	Capacitor, MLCC, 10 nF, 50 V, 0603, X7R	Murata	GRM188R71H103K
1	C14	Capacitor, MLCC, 1 nF, 50 V, 0402, X7R	Murata	GRM155R71H102K
2	C127, C131	Capacitor, MLCC, 4.7 µF, 6.3 V, 0603, X5R	Murata	GRM188R60J475K
2	R19, R31	Resistor, 1 kΩ, 1%, 0402, SMD	Vishay or equivalent	CRCW04021K00FKED
2	R21, R36	Resistor, 100 kΩ, 1%, 0402, SMD	Vishay or equivalent	CRCW0402100KFKED
2	R33, R34	Resistor, 330 Ω, 1%, 0402, SMD	Vishay or equivalent	CRCW0402330RFKED
N/A	R37, R38	Open	No assembly	No assembly
1	R22	Resistor, 10 kΩ, 1%, 0402, SMD	Vishay or equivalent	CRCW040210K0FKED
4	R24, R25, R30, R32	Resistor, 1.5 kΩ, 1%, 0402, SMD	Vishay or equivalent	CRCW04021K50FKED
4	R28, R29, R35, R39	Resistor, 4.7 kΩ, 1%, 0402, SMD	Vishay or equivalent	CRCW04024K70FKED
6	R62 to R66, R68	Resistor, 0 Ω, 1%, 0402, SMD	Vishay or equivalent	CRCW04020000Z0EDHP

Qty	Reference Designator	Description	Manufacturer/Vendor	Part Number
1	R67	Resistor, 180 kΩ, 1%, 0402, SMD	Vishay or equivalent	CRCW0402180KFKED
1	R69	Resistor, 33 kΩ, 1%, 0402, SMD	Vishay or equivalent	CRCW040233K0FKED
2	R154, R155	Resistor, 39 kΩ, 1%, 0603, SMD	Vishay or equivalent	CRCW060339K0FKEA
1	R165	Resistor, 48.7 kΩ, 1%, 0603, SMD	Vishay or equivalent	CRCW060348K7FKEA
1	R166	Resistor, 97.6 kΩ, 1%, 0603, SMD	Vishay or equivalent	CRCW060397K6FKEA
2	D5, D8	LED, 0402, green	Lumex	SML-LX0402SUGC-TR
7	GPIO1, GPIO2-T, SCL, SCL-T, SDA, SDA-T, STROBE	Connector header	Sullins Electronics	PEC36SAAN
1	J13	Connector header, two pins × 1	Sullins Electronics	PEC36SAAN
1	J12	Connector header, 10 pins × 1	Sullins Electronics	PEC36SAAN
1	JP8	Connector header, 10 pins × 2	Sullins Electronics	PEC36DAAN
3	LK1, LK2, LK3	Connector header, two pins × 1	Sullins Electronics	PEC36SAAN
1	JP14	Connector receptacle, mini USB2.0, five-position	Hirose Electronics	UX60-MB-5ST
1	J14	Connector header, three pins × 1	Sullins Electronics	PEC36SAAN
2	S2, S3	Switch pushbutton	C & K components	KSC321JLFS or KT11P3JM34LFS
10	TP17, TP18, TP20 to TP27	Connector header	Sullins Electronics	PEC36SAAN
1	U1	IC MCU USB peripheral high speed 56-QFN	Cypress Semiconductor	CY7C68013A-56LFXC
1	U3	ADP3303, 3.3 V	Analog Devices	ADP3303-3.3
1	U5	IC SRL EEPROM I2C, 64 kB, SO-8	STMicroelectronics	M24C64
1	U7	IC 10-bit voltage clamp, 24-TSSOP	NXP Semiconductors	GTL2010PW
1	U8	ADG734BRUZ, 20-lead TSSOP	Analog Devices	ADG734BRUZ
2	U39, U40	ADP1712, five-lead TSOT	Analog Devices	ADP712AUJZ-R7
1	Y1	Crystal, 24 MHz	CTS Electronic Components	CTX651CT

NOTES

I²C refers to a communications protocol originally developed by Philips Semiconductors (now NXP Semiconductors).

ESD Caution

ESD (electrostatic discharge) sensitive device. Charged devices and circuit boards can discharge without detection. Although this product features patented or proprietary protection circuitry, damage may occur on devices subjected to high energy ESD. Therefore, proper ESD precautions should be taken to avoid performance degradation or loss of functionality.

ANALOG DEVICES

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