Click here to ask an associate for production status of specific part numbers.

Evaluates: MAX86174A

MAX86174 Evaluation System

General Description

The MAX86174 evaluation system (EV Sys) provides a platform to evaluate the functionality and features of the MAX86174A with photoplethysmogram (PPG) measurement capabilities. The EV Sys allows for flexible hardware and software configurations to help the user quickly learn how to configure and optimize the MAX86174A for their own applications.

The MAX86174A is an ultra-low power PPG analog front-end solution that has dual optical-readout channels and supports up to 4 LEDs and 2 photodiode inputs. For more information, refer to the MAX86174A data sheet.

The MAX86174 EV Sys consists of two boards. MAXSENSORBLE_EVKIT_B is the microcontroller (MCU) board while MAX86174A_OSB_EVKIT_B is the sensor board containing the MAX86174A. To enable PPG measurement capabilities, the sensor board contains 3 LEDs (red, green, and IR in a single package: OSRAM SFH7016), three discrete photodiodes (Vishay VEMD8080), and an accelerometer. The EV Sys is powered through the included LiPo Battery. The EV Sys communicates with MAX86174GUI (should be installed in user's system) using Bluetooth built into Windows (Win BLE). The EV Sys contains the latest firmware but comes with the programming circuit board MAXDAP-TYPE-C in case a firmware change is needed.

Features

- Convenient Platform to Evaluate the MAX86174A
- Many Easy-to-Reach Test Points
- Real-Time Monitoring and Plotting
- Data Logging Capabilities
- Bluetooth LE
- Windows®-10-Compatible GUI software

EV Sys Contents

- MAXSENSORBLE_EVKIT_B microcontroller board
- MAX86174A_OSB_EVKIT_B sensor board
- 105 mAh Li-Po battery LP-401230
- USB-C to USB-A cable
- MAXDAP-TYPE-C programmer board
- Micro USB-B to USB-A cable

MAX86174 EV Sys Files

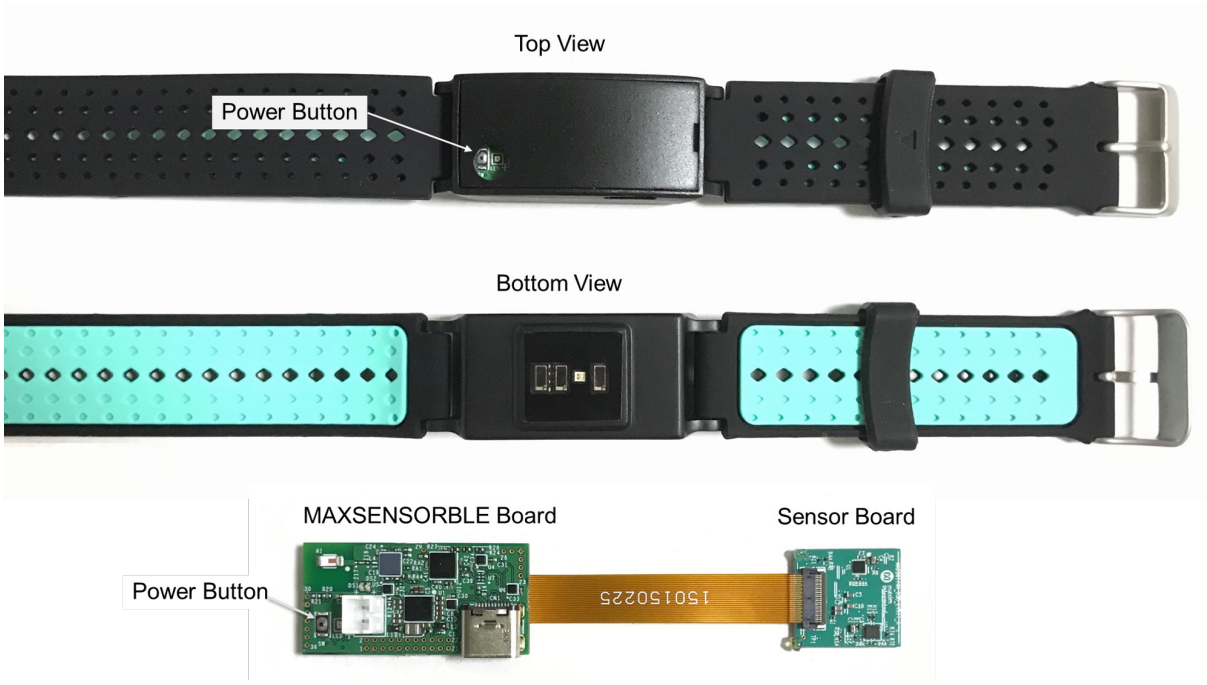
FILE	DESCRIPTION
MAX86174GUISetupV1.0.0_Web.zip	Setup file to install the PC GUI program
MAXSENSORBLE_EVKIT_B.zip	Schematic, BOM, layout
MAX86174A_OSB_EVKIT_B.zip	Schematic, BOM, layout

***Ordering Information* appears at end of data sheet.**

Windows is a registered trademark of Microsoft Corporation.

319-100756; Rev 1; 3/22

MAX86174 EV System Photo



Quick Start

Required Equipment

- MAX86174 EV Sys
- USB-C to USB-A cable
- Windows System with a USB port and Bluetooth 4 with BLE supported on its Hardware (Win BLE)
- 105mAh Li-Po battery LP-401230
- Microsoft .NET framework 4.7.2 or above

Procedure

The EV Sys is fully assembled and tested. Follow the steps below to verify board operation.

Note: In the following sections, text in **bold** refers to items and buttons in the MAX86174EVSYSGui.exe GUI program.

1) Enable Bluetooth on the user's Windows System/PC.
2) Visit **www.maximintegrated.com/MAX86174** to download the most recent version of the EV Sys software, MAX86174GUISetupV1.0.0_Web.zip. Save the EV Sys software to a temporary folder and unzip the zip file.
3) Open MAX86174GUISetupV1.0.0.exe and follow the instructions from the pop-up windows. This will install the MAX86174EVSYSGUI.exe GUI program to the user's system successfully.
4) Press the power button to turn on/off the EV Sys. When powered on, the green status LED indicator flashes at 1Hz. Note: USB-C to USB-A cable is for charging the battery only. System performance during charging might decrease.
5) Launch the MAX86174EVSYSGUI.exe GUI program. A **Connect to Device** window should appear. **Win BLE** appears on the Port, if multiple connections appear then select **Win BLE**. The EV Sys device should appear under the **Select a device below**. Choose the device and click **Connect**. The GUI is then launched.
6) Configure GUI settings as needed. The default GUI settings are configured to record one PPG measurement.
7) Click the **Start** button on the bottom right to start data acquisition. When running, the plots on the GUI should stream with data. Figure 1 shows an example of a plot with PPG measurements enabled.

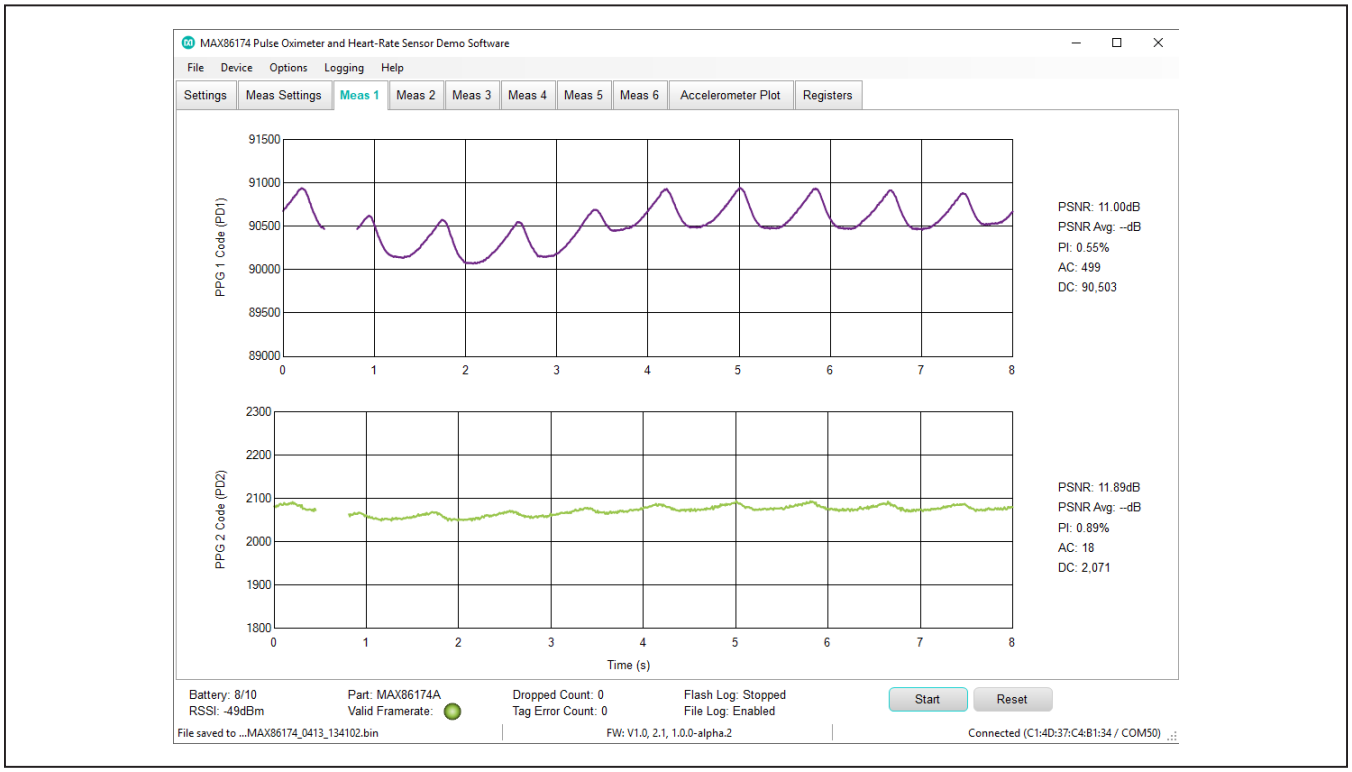


Figure 1. Plot of PPG

Detailed Description of Software

The EV Sys allows PPG data to be sampled and transferred to the GUI for both dynamic viewing and logging for later analysis. The EV Sys MCU board performs SPI-to-Bluetooth LE (BLE) communication, transporting the data to the PC through BLE. Most functionality of the MAX86174A has been mapped to the EV Sys GUI, so that the user can explore a wide variety of applications supported by the MAX86174A. The following sections describe these functionalities.

Software Startup

To begin Bluetooth connection of the EV Sys to the PC, first ensure that Bluetooth is enabled on the PC so that it can detect the EV Sys for pairing. Now turn on the EV Sys. Start up the MAX86174EVSYSGui.exe GUI program, which prompts a **Connect To Device** window, as shown in Figure 2. In this window, click on the COM port that corresponds with the **Win BLE** and the EV Sys device should appear under the **Select a device below**. Choose the EV Sys and click **Connect**.

When launched, the software first initializes the EV Sys to communicate. The software then reads the EV Sys registers and updates all the associated control fields displayed on the GUI. The status strip at the bottom of the GUI displays the firmware version, GUI version, and the hardware's associated COM port.

Toolstrip Menu Bar

The Toolstrip Menu bar is located at the top of the GUI window. This bar comprises of **File**, **Device**, **Options**, **Logging**, and **Help** menus, whose functions are detailed in the following sections.

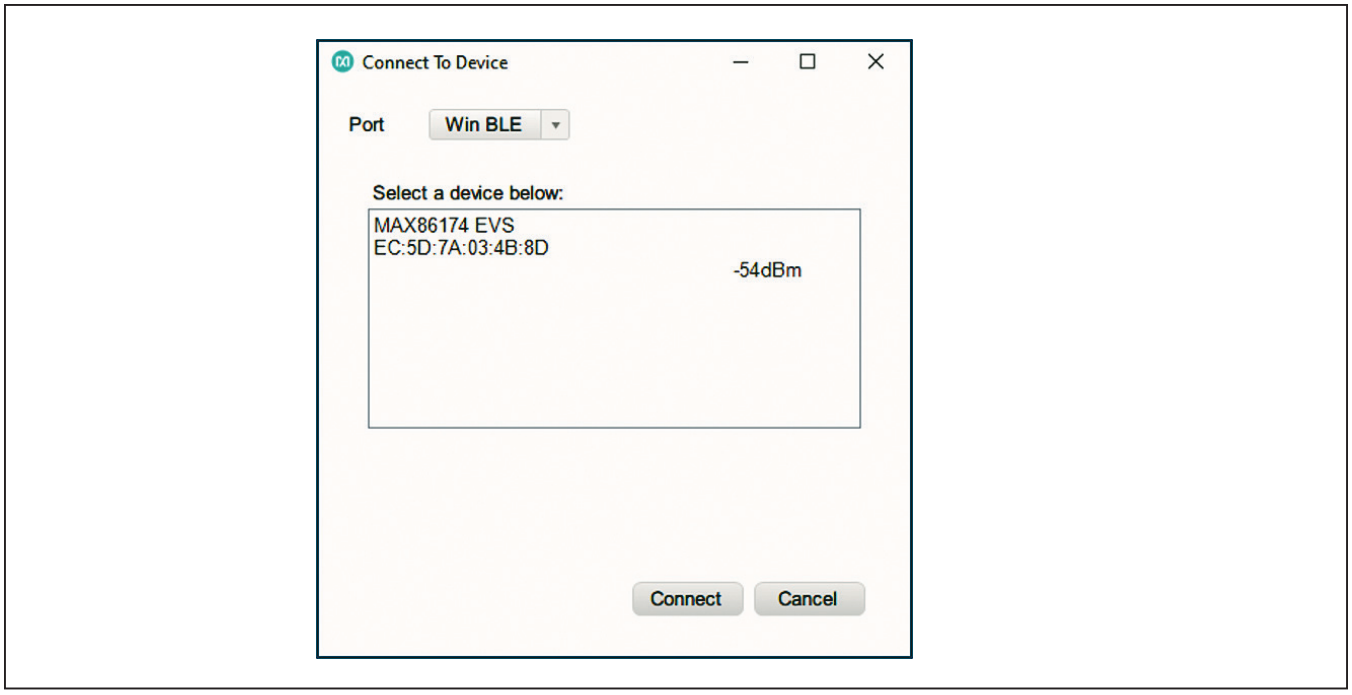


Figure 2. Connect to Device Window

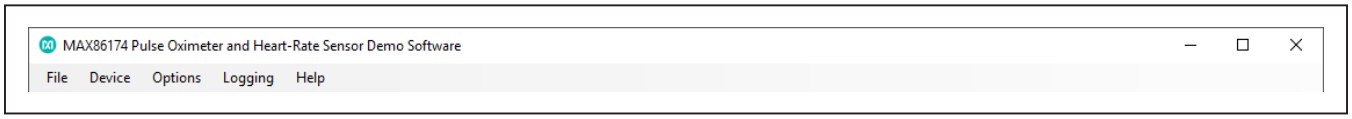


Figure 3. Toolstrip Menu Bar

File Menu

The **File** menu contains the option to exit out of the GUI program.

Device Menu

The **Device** menu provides the ability to connect or disconnect the EV Sys to or from the GUI. If the EV Sys is disconnected while the GUI is open, the GUI displays **Disconnected** in the lower-right corner. To connect, turn on the EV Sys, navigate to the **Device** menu, and select **Connect**. This opens the **Connect To Device** window, allowing the user to connect. Once connection is successful, the bottom-right corner of the GUI reads **Connected** and displays the COM port to which the EV Sys is connected.

Options Menu

The **Options** menu provides several settings to access more features offered by the GUI. **Register Export/Import** allows the user to quickly set up the GUI based on previously saved register settings. **Export** saves the current register settings and **Import** loads in register settings from a file. **Plot Time Scale** allows the user to select the number of seconds of data they want to see on the plot at once. **Register Access** under **Advanced** provides access to more register and system settings in the **Registers** tab for the user to customize.

Logging Menu

The **Logging** menu provides a way to export exact data measured by the EV Sys. There are two options available: **File** to save data to a ".csv" file, or **Flash** to save data in the flash memory of the EV Sys. When the MAX86174 EV Sys is plugged in to the PC through the USB-C to USB-A cable, the option **Parse Bin File** parses the binary file saved in the flash memory into a ".csv" file. See the *Data Logging* section of this data sheet for more details.

Help Menu

The **Help** menu contains GUI information and links that can help with GUI issues.

Data Acquisition Bar

The Data Acquisition bar is located at the bottom of the GUI window. This bar is comprised of EV Sys and GUI statuses, a **Start/Stop** button, and a **Reset** button.

EV Sys and GUI Statuses

The statuses on the left of the **Data Acquisition** bar indicate the status of the EV Sys, EV Sys information, and whether flash and file logging are enabled. The bottom right of the bar indicates whether the EV Sys is connected. The bottom middle of the bar displays the GUI version.

Start/Stop Button

Pressing **Start** begins data acquisition and visualizes the data in the **Plots** tab. During data acquisition, the **Start** button turns into a **Stop** button. Press this **Stop** button to stop data acquisition and data visualization.

Reset Button

Pressing **Reset** resets all registers and GUI settings to predefined default values.

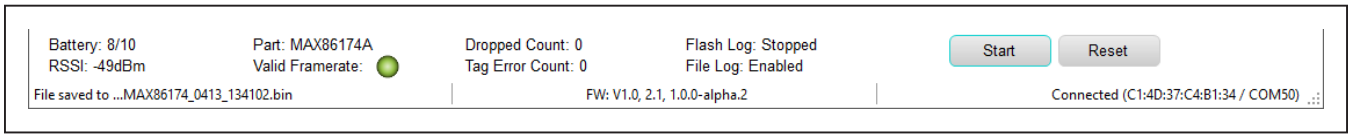


Figure 4. Data Acquisition Bar

Settings Tab

Frame Rate

A frame is a collection of measurements that has a minimum of 1 measurement and a maximum of 6 measurements. The frame rate defines how frequently a frame is repeated. The frame rate can take on any value from 1fps to 2.9kfps. The **Valid Framerate** indicator at the bottom of the GUI displays green if the frame rate is valid, yellow if the frame rate might cause unexpected behavior, and red if the frame rate does not work.

PPG Filter Configuration

The MAX86174A contains a second order decimation filter that can be used instead of the default third order COI3 decimation filter. This second order decimation filter has narrower bandwidth and can improve PPG SNR by about 1dB to 2dB. This filter can be enabled in the **Second Order Filter** of the EV Sys GUI. Note that this second order decimation filter can only be enabled when the **SINC3 Filter** option is disabled and **Integration Time** is set to 117.1µs or 118.2µs for all enabled measurements in the **Measurement Settings** tab.

The MAX86174A contains a digital low-pass filter that significantly improves SNR. This digital low-pass filter can be enabled in the **Digital LPF Enable** of the EV Sys GUI and selected between an on-chip IIR filter with selectable corner frequencies as defined in **IIR Cut Off Frequency** of the GUI or sample averaging, aka decimation averaging, with selectable number of samples to be averaged as defined in **Averaging** of the GUI. Note that, when using the IIR filter, the PPG frame rates supported are 50Hz, 100Hz, and 200Hz. Note that, when using sample averaging, averaging a larger number of samples reduces the data rate. Refer to the *MAX86174A data sheet On-Chip Filtering and On-Chip Averaging* sections for details.

System Control

The MAX86174A contains three modes of frame rate control. Selecting **Internal Frame** in the EV Sys GUI allows the MAX86174A to use the internal 32768Hz oscillator and internal frequency divider to control the frame rate. Selecting **External Frame** enables the MAX86174A to use the TRIG input pin to trigger a frame to start. Selecting **External Clock** enables the MAX86174A to use the TRIG input pin to be an external frame clock input. Refer to the *MAX86174A data sheet Synchronization Modes* section for details.

The MAX86174A contains the option to power down one of the PPG readout channels or to use dual PPG channels simultaneously, which can be configured by **PPG1 Power Down** and **PPG2 Power Down** in the EV Sys GUI. Powering down a channel disables the channel from outputting data for all measurements.

Photodiode Bias

The MAX86174A provides multiple photodiode biasing options to allow the MAX86174A to operate with a large range of photodiode capacitances. The **PD1** and **PD2** bias settings in the EV Sys GUI adjust the photodiode bias point impedance on the dual optical readout channels of the MAX86174A chip to ensure that the photodiode settles rapidly enough to support the sample timing. Configure **PD1** and **PD2** biasing settings depending on the capacitance of the photodiode used. It is recommended to set the **PD1** and **PD2** biasing settings to 0pF to 125pF if using the provided photodiodes in the EV Sys. Note that, when PD1 and PD2 go to the same PPG channel, the greater of the two PD bias settings is used.

Accelerometer Configuration

The MAX86174 EV Sys comes with an accelerometer. The **Free-Run** in the EV Sys GUI is enabled by default and runs the accelerometer asynchronously at the sample rate defined in **Output Data Rate**. This data rate should be set higher than the optical PPG frame rate. The default full-scale range of the accelerometer is ±8g. If the accelerometer is enabled, the accelerometer data is plotted in the **Accelerometer Plot** tab.

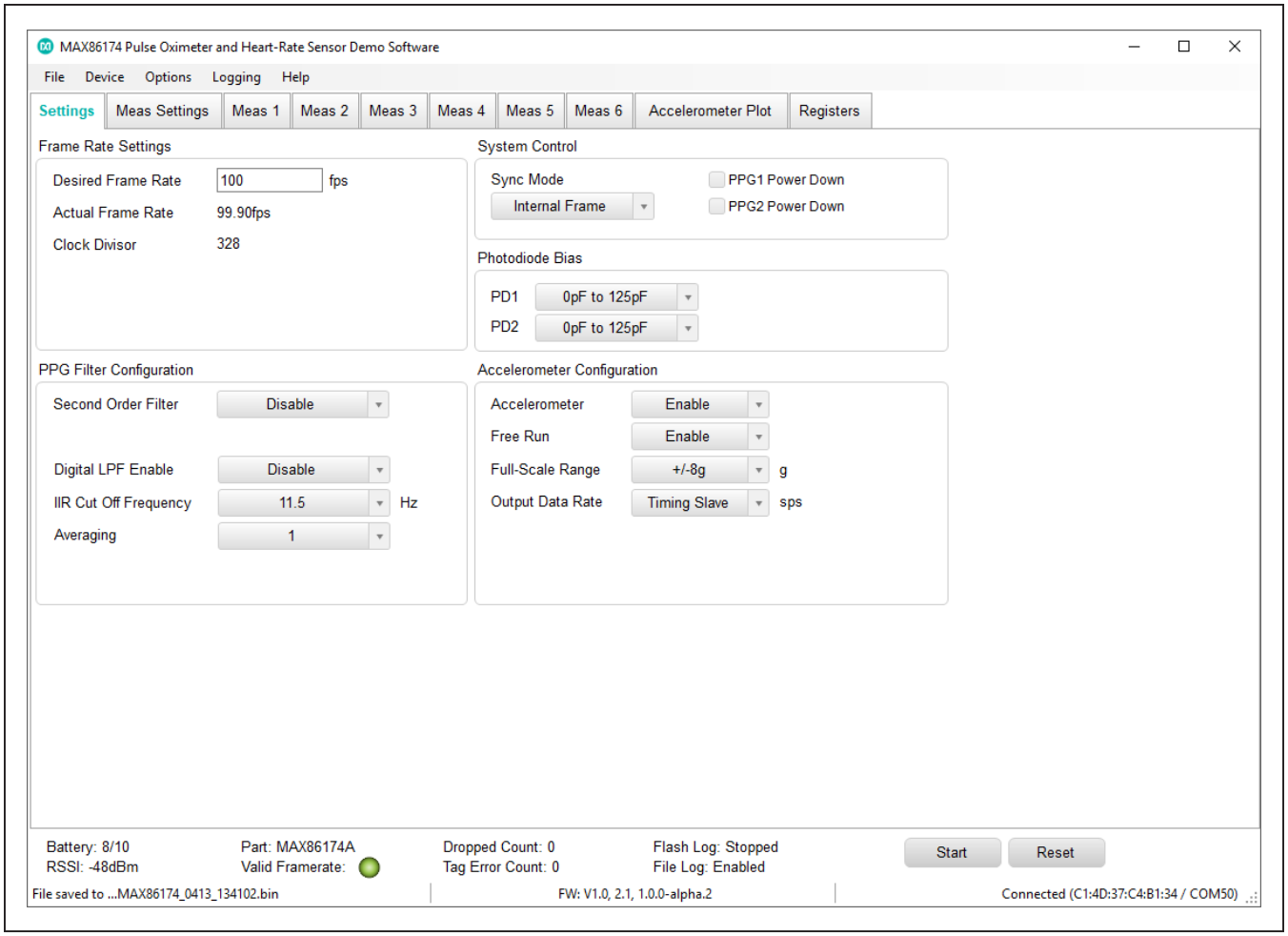


Figure 5. Settings Tab

Measurement Settings Tab

Measurements

The MAX86174A supports up to six measurements per frame. Any measurement can be enabled, and the measurements do not need to be contiguous. If a measurement is disabled, then data acquisition is skipped for that measurement. If ambient light needs to be measured, it should always be the last enabled measurement in the frame. Select **Enable** in **Meas Enable** of the EV Sys GUI to enable the corresponding measurements. The sequence of enabled measurements repeats for each frame and is plotted in the corresponding **Meas 1** to **Meas 6** tabs.

Click **Apply to All Meas** to apply the corresponding setting of the first enabled measurement to the rest of the enabled measurements.

Integration Time

The MAX86174A supports exposure integration times of 14.6µs, 29.2µs, 58.6µs, and 117.1µs or 118.2µs (with COI2 filter integration time is 118.2µs), which is selected in **Integration Time** of the EV Sys GUI. Longer exposures allow more photons to be captured and integrated, but also increase system power and reduce ambient rejection capability.

Average

The MAX86174A supports burst averaging of 1 sample to 128 samples, which is selected in **Average** of the EV Sys GUI. This feature is useful if more optical energy is needed to make a low perfusion measurement but the data rate across the interface or the processing power in a host microcontroller might not be desirable.

PPG Range

The MAX86174A optical receive channel has 4 ADC full-scale range settings, which is selected in **PPG1 Range** and **PPG2 Range** of the EV Sys GUI. These ranges are 4µA, 8µA, 16µA, and 32µA. Larger ADC range prevents saturation thereby allowing a larger exposure range to be captured.

PPG PD Select

The MAX86174A contains four custom configurations to route PD1 and PD2 inputs to the two optical ADC read-out channels PPG1 and PPG2. These configurations are truncated in the GUI and are decoded as follows:

- "PD1+PD2/-" means that PPG1 is connected to both PD1 and PD2 inputs.
- "PD2/PD1" means that PPG1 is connected to PD2 input, and PPG2 is connected to PD1 input.
- "PD1/PD2" means that PPG1 is connected to PD1 input, and PPG2 is connected to PD2 input.
- "-/PD1+PD2" means that PPG2 is connected to both PD1 and PD2 inputs.

PD Settling Time

The MAX86174A requires a photodiode settling time in-between samples to allow the photodiode to settle before integrating the next sample's exposure photocurrent. This setting is defined in the **PD Settling** of the EV Sys GUI and ranges from 8.1µs to 80.1µs. The **PD Settling** time must be more than the **LED Settling** time.

LED Driver Configurations

In each measurement, there are two LED drivers that have a DAC output current range defined by **LED Range**. There are 4 full-scale range settings 32mA, 64mA, 96mA, and 128mA.

Each measurement can drive none, both, or one of these LED drivers. This configuration of LED driver and LED mux is highly flexible, allowing for any of the four LED driver pins to sink current from one or both LED drivers. The **Driver x PA** box defines the LED pulse amplitude and allows for a desired current value to be entered. The nearest available DAC current is then selected and used to drive the corresponding LED selected in **LED Driver x**.

LED Settling Time

The MAX86174A requires an LED settling time for each sample to allow brightness to settle after the LED turns on before integrating the sample's exposure photocurrent. This setting is defined in the **LED Settling** time of the EV Sys GUI and contains four settings, 8µs, 12µs, 16µs, and 24µs.

Ambient Only

Enabling **Ambient Only** for a measurement results in only ambient light to be acquired and plotted in that measurement.

SINC3 Filter

The MAX86174A contains a SINC3 decimation filter that offers better high-frequency ambient-light cancellation than the default COI3 decimation filter. Selecting **Enable** in **SINC3 Filter** of the EV Sys GUI enables the SINC3 Filter. The SINC3 filter is only available when using an **Integration Time** of 117.1µs.

Ambient Light Cancellation Method

The MAX86174A contains a digital ambient light cancellation scheme, which can be configured as either central-difference method or forward-difference method. These methods cancel photodiode current generated by ambient light, allowing the sensor to work in high ambient light conditions. The ambient-light cancellation method is selected in the **ALC Method** of the EV Sys GUI. Refer to the *MAX86174A data sheet Ambient-Light Cancellation* section for details.

PPG Offset

Each of the dual optical readout channels of the MAX86174A incorporates a 3-bit offset DAC for extending the optical dynamic range. The offset values can be set in the **PPG Offset** setting of the EV Sys GUI and ranges from 0µA to 28µA. This setting allows for a larger convertible exposure range by sourcing some of the exposure current from the offset DAC.

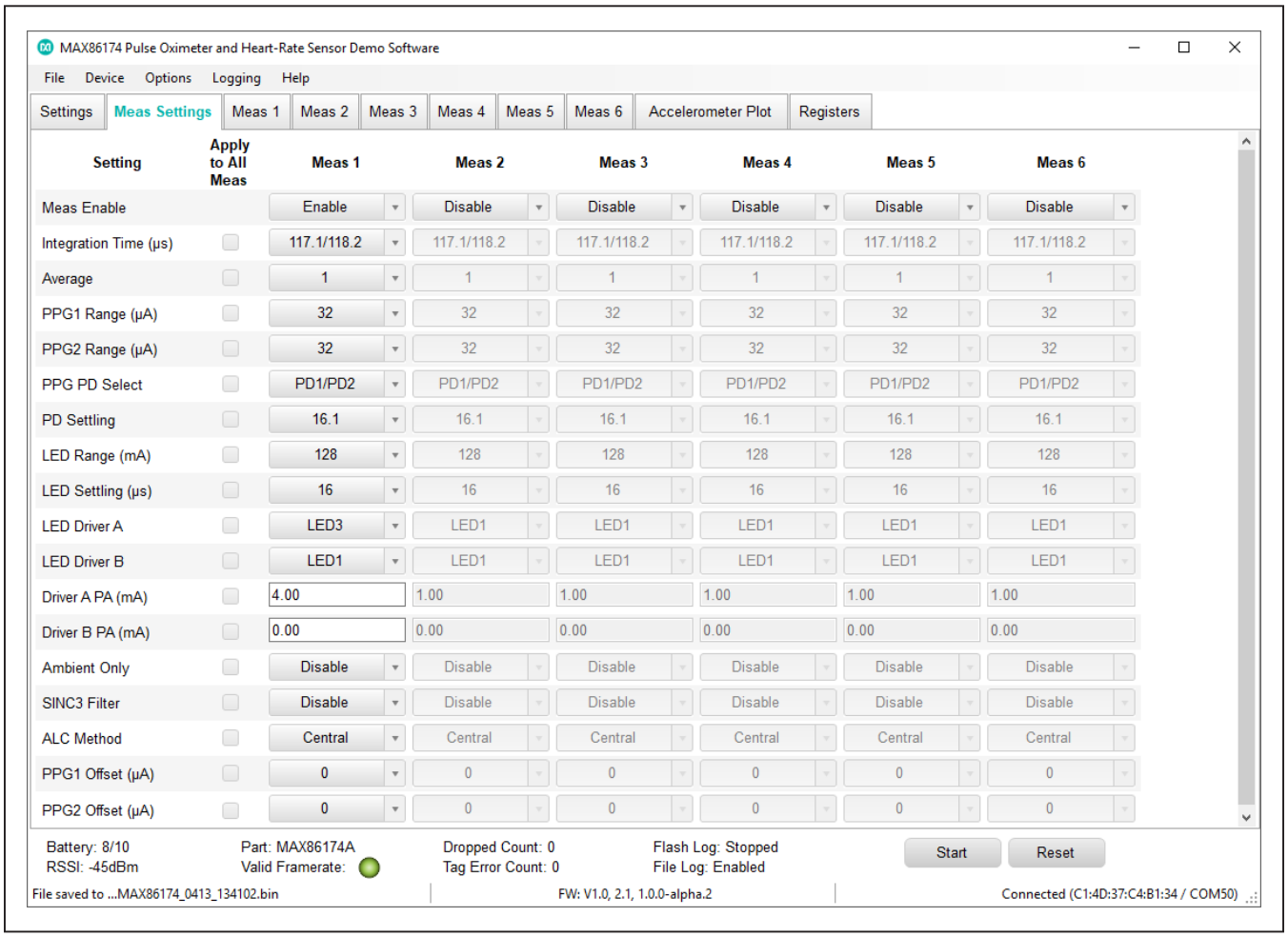


Figure 6. Measurement Settings tab

Measurement Tabs

The **Meas 1** to **Meas 6** tabs display the plot for the corresponding PPG measurements, if enabled. In each tab, the PSNR, PSNR Average, and perfusion index are calculated and displayed to the right of the plots. Select **Plot Time Scale** under **Options** in the Toolstrip Menu Bar to change the time scale.

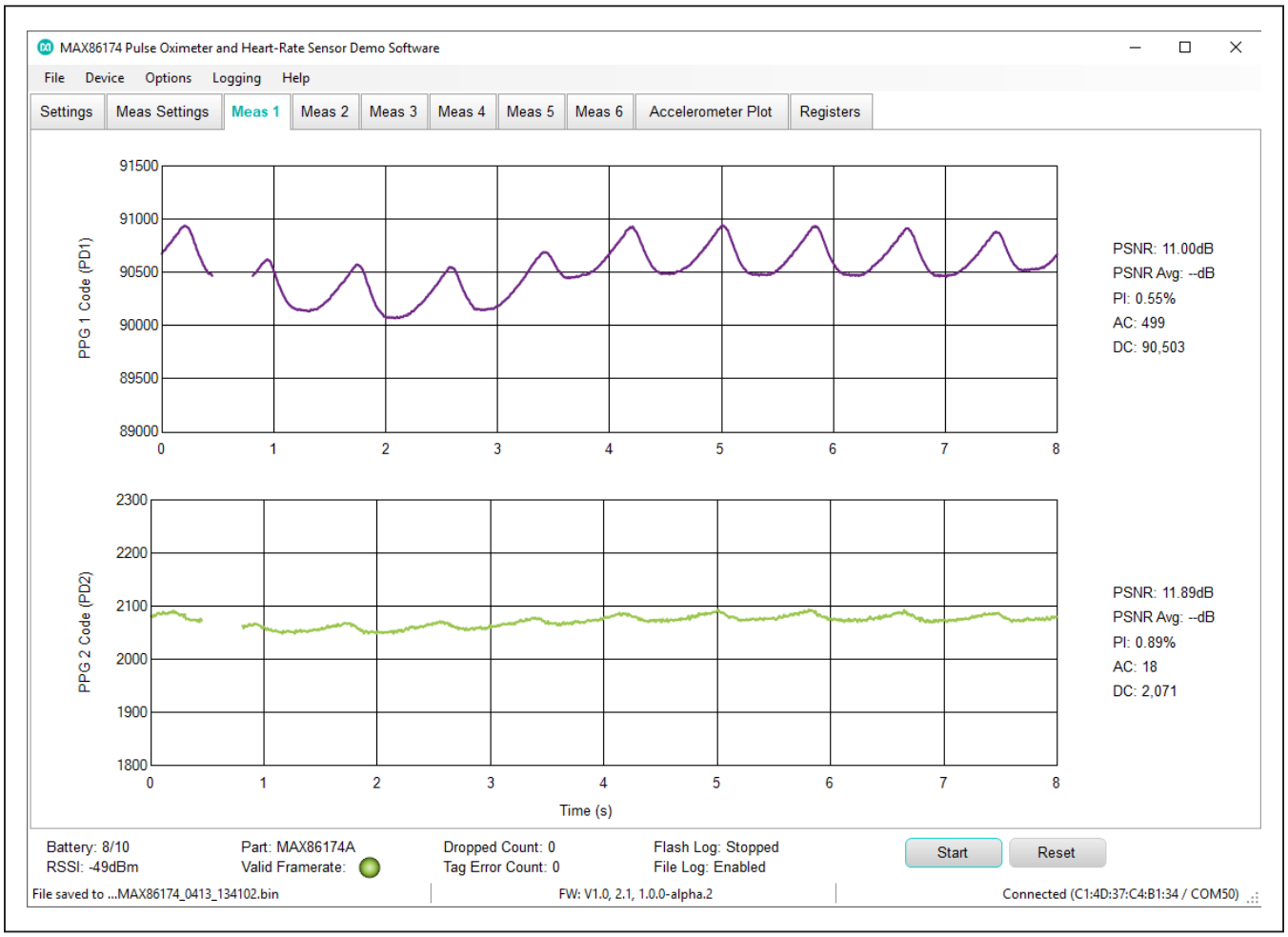


Figure 7. Meas 1 Tab

Accelerometer Plot Tab

The **Accelerometer Plot** tab plots the accelerometer data if the accelerometer is enabled. Select **Plot Time Scale** under **Options** in the Toolstrip Menu Bar to change the time scale. Select **Range** to change the y-axis scale.

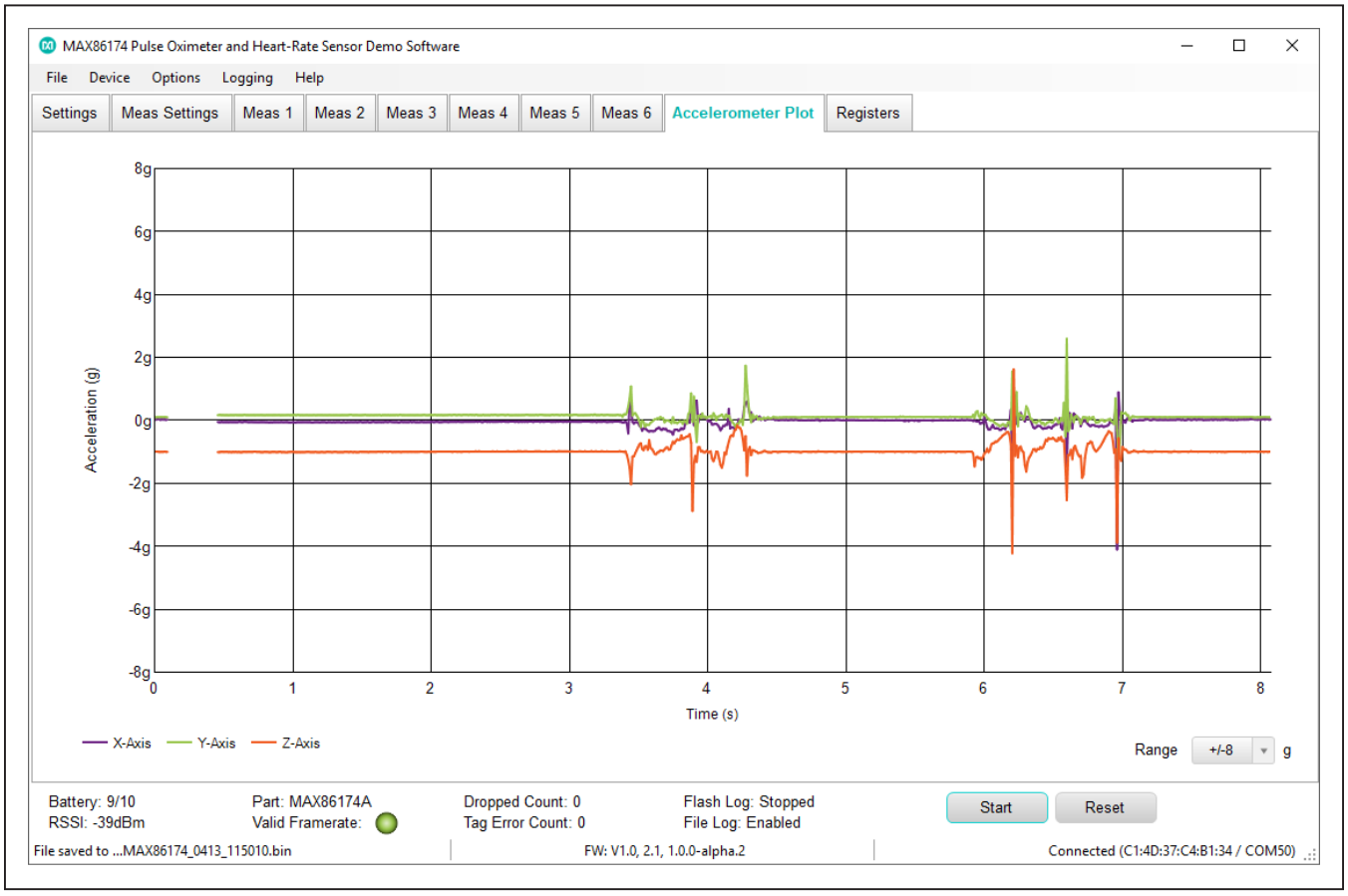


Figure 8. Accelerometer Plot Tab

Registers Tab

The Registers tab allows you to read and write registers. Click a register to set or clear bit and **W** to commit to the EV Sys. Click **R** to read register or **Read All** at the top right to read all registers. Bold text is logic 1 and regular text is logic 0.

Note that the GUI interface, besides the **Register** tab, reflects commonly used register values and does not reflect all possible register values. Take caution when customizing register values in the **Registers** tab, as they might not be reflected or supported in the GUI interface.

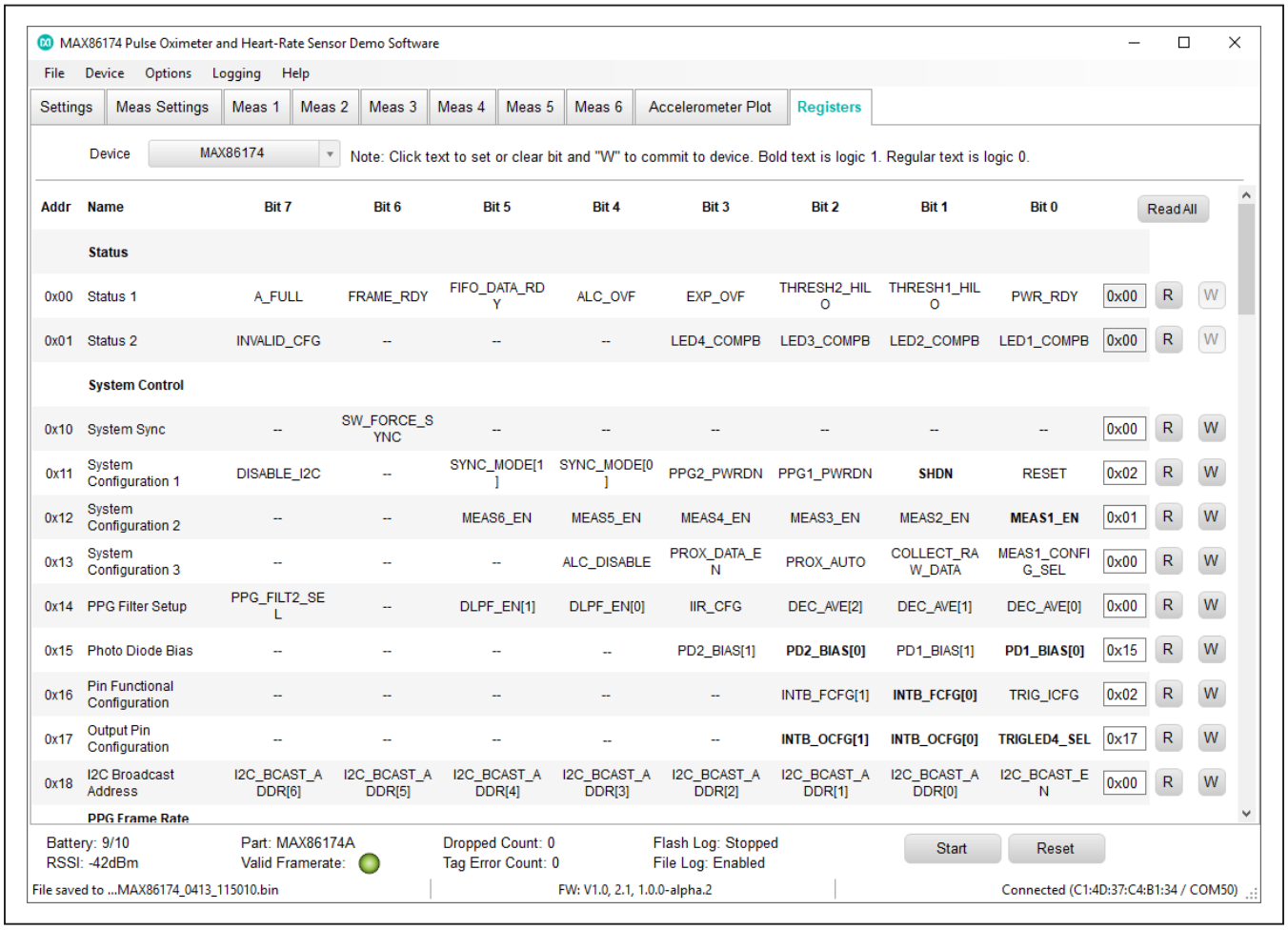


Figure 9. Registers Tab

Data Logging

This section explains how to save data. Data can be saved directly to the PC in a ".csv" file or in the MAX86174 EV Sys flash memory.

Setup

To directly save data to the PC, select **File** data logging in the **Logging Menu**. The GUI then asks for a folder location where the ".csv" file is saved. Logging begins when **Start** is pressed and ends when **Stop** is pressed. This creates a ".csv" file in the defined folder location and saves data to the file.

To save data in the flash memory, select **Flash** logging in the **Logging Menu**. The EV Sys first clears existing flash memory and then logs raw sensor data to the integrated 32MB flash memory chip in a binary file format. The EV Sys can be disconnected and powered by the Li-Po battery during flash logging, allowing for remote operation.

Note that clearing the existing flash memory can be as long as 1 minute after **Flash** is selected depending on how full the flash memory is. A flashing yellow status LED indicates that flash logging has begun. If flash memory fills or battery power drops too low, flash logging is automatically stopped and the file closes.

The file must be downloaded since it is erased from flash memory on the next log request. If a log has completed, a binary file will be found on the EV Sys. To download the binary file, connect the EV Sys to the PC using the USB-C to USB-A cable, and copy the binary file from the EV Sys onto the PC. Select **Parse Bin File** in the **Logging Menu** to open the **Parser Configuration Window** and parse the binary file into a ".csv" file, as in Figure 10. Once completed, the **Parser Completed Messaged Window** appears, as in Figure 11.

Note that the max duration for flash logging is dependent on frame rate and number of optical channels.

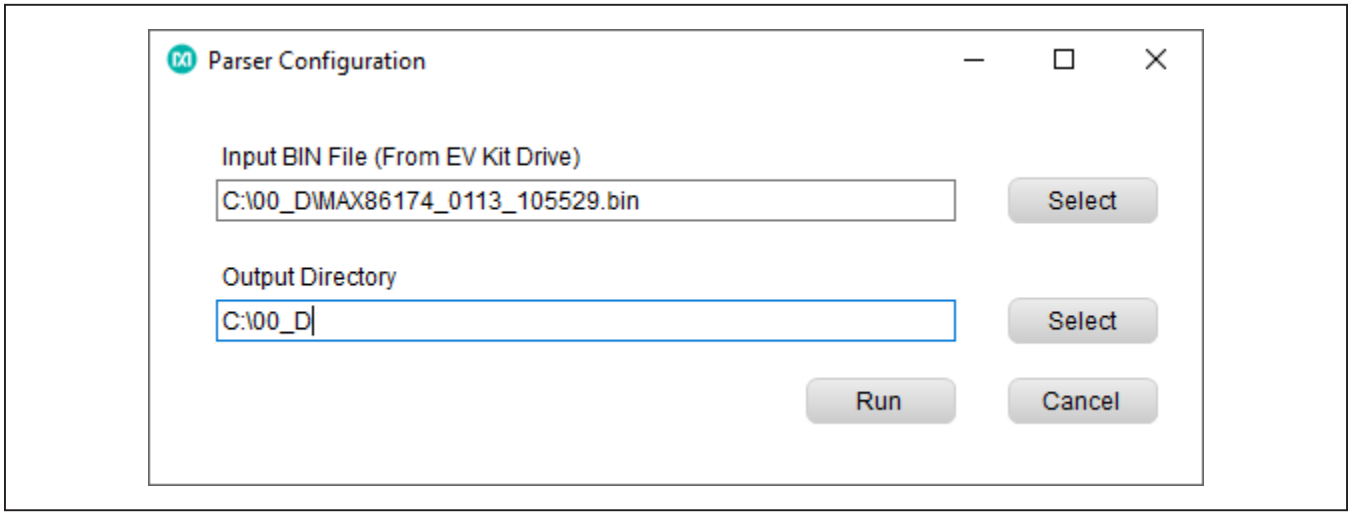


Figure 10. Parser Configuration Window

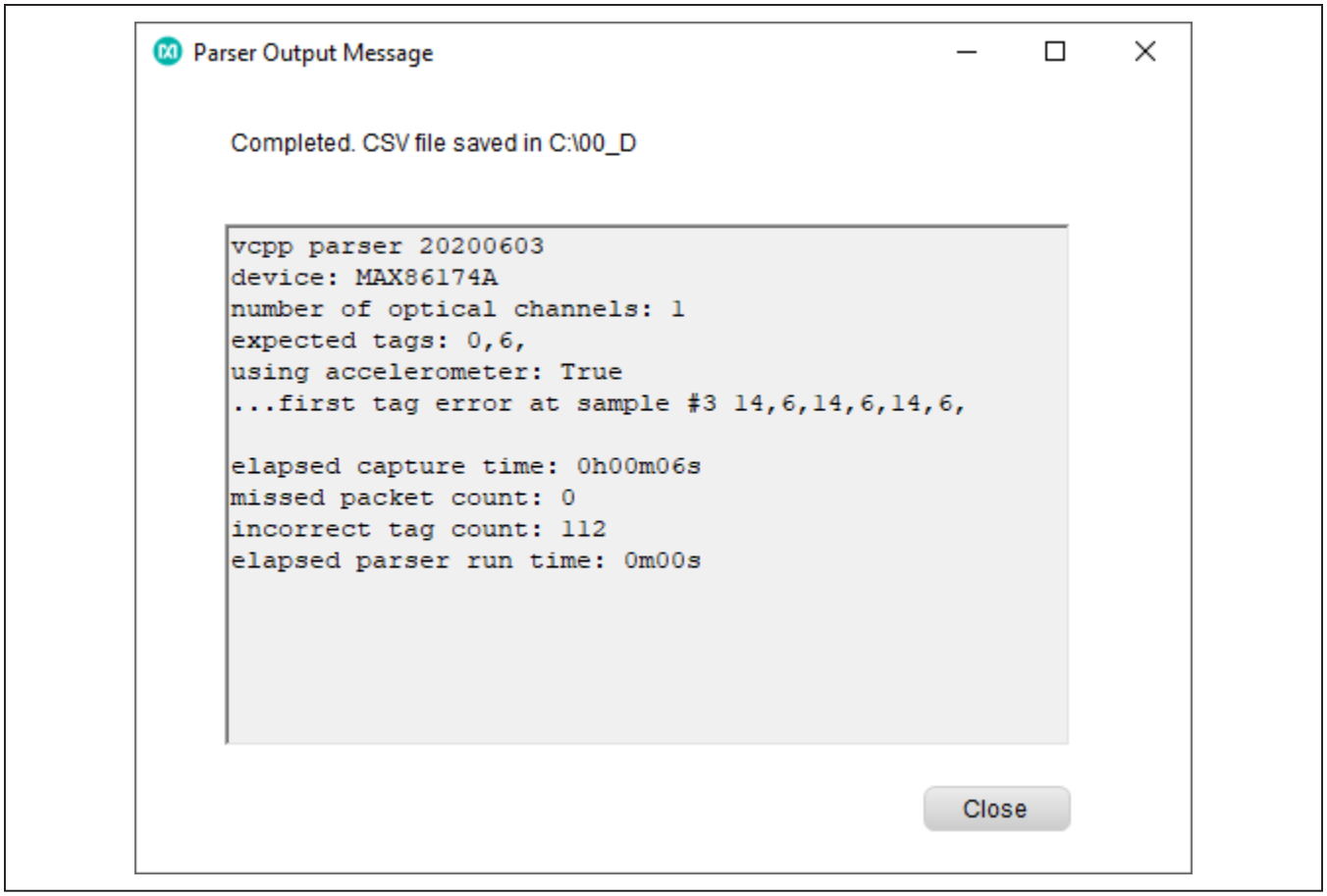


Figure 11. Parser Completed Message Window

Output File Format

PPG data is saved in a ".csv" file. The following describes the format of this file. Rows 1–10 contain register values. Row 11 contains the start time in milliseconds. Row 12 contains expected tag values. Row 13 is a column header denoting the timestamp in milliseconds, sample number, tags for LED, PPG channels for each measurement, accelerator x, y, z data, temperature, total RTC ticks, regAddr, val, and I2Caddr. The rows below contain rows of data corresponding to the column headers. Finally, the rows below the rows of data show stop time, elapsed capture time, missed packet count, incorrect tag count, and parser data.

Refer to Figure 12 for an example where one PPG measurement is enabled with only LED driver A running at 5.0mA and with both PPG channel 1 and PPG channel 2 enabled, and all else set to their default settings. The column header for PPG measurements are denoted in the format "LEDCn_PDm," where n corresponds to the nth enabled measurement and m corresponds to the PPG channel 1 or 2. In this example, "LEDC1_PD2" represents the 1st enabled measurement and PPG channel 2 of that measurement. Note that this header format does not describe which LED, LED driver, or photodiode is used. When multiple measurements are enabled, the corresponding columns are added in the ".csv" file following this header format.

	A	B	C	D	E	F	G	H	I	J	K	
1	MAX86174Areg0x10	Areg0x11	Areg0x12	Areg0x13	174Areg0x14	174Areg0x15	74Areg0x1A	74Areg0x1B	74Areg0x1B	6174Areg0x20	Areg0x21	Are
2	0	0	Areg0xFE	Areg0xFF	A280reg0x0F	A280reg0x10	accelID	fileParseID	0	0	CpreScale	ICl
3	MAX86174Areg0x28	Areg0x29	Areg0x2a	Areg0x2b	174Areg0x2c	74Areg0x2d	74Areg0x2e	0	0	6174Areg0x30	Areg0x31	Are
4	MAX86174Areg0x38	Areg0x39	Areg0x3a	Areg0x3b	174Areg0x3c	74Areg0x3d	74Areg0x3e	0	0	6174Areg0x40	Areg0x41	Are
5	MAX86174Areg0x48	Areg0x49	Areg0x4a	Areg0x4b	174Areg0x4c	74Areg0x4d	74Areg0x4e	0	0	0	0	
6	0x00	0x02	0x01	0x00	0x00	0x15	0x1a	0x01	0x48	0x02	0x98	0x3f
7	0x00	0x00	0x00	0x40	0xfb	0x20	0x01	0x00	0x00	0x00	0x1f	0xc9
8	0x00	0x98	0x3f	0x50	0x00	0x02	0x00	0x00	0x00	0x00	0x98	0x3f
9	0x00	0x98	0x3f	0x50	0x00	0x02	0x00	0x00	0x00	0x00	0x98	0x3f
10	0x00	0x98	0x3f	0x50	0x00	0x02	0x00	0x00	0x00	0x00	0x00	0x00
11	start time	1.62E+12										
12	expected tags	0	6									
13	timestamp	sampleNu	tagLEDC1_	tagLEDC1	LEDC1_PD1	LEDC1_PD2	ACCX	ACCY	ACCZ	temperature	RTC	sens
14	1.61828E+12	1	0	6	101841	1453	-5	-257	-4225			
15	1.61828E+12	2	0	6	101821	1452	-5	-257	-4225			
16	1.61828E+12	3	0	6	101806	1456	-5	-257	-4225			
17	1.61828E+12	4	0	6	101790	1451	-5	-257	-4225			

Figure 12. Output CSV File Example for PPG Measurements (First Few Rows)

Detailed Description of Hardware

Status LED Indicators

The following onboard tri-color LEDs are used as status indicators.

LED Green

Toggling (1Hz 50% duty cycle) = BLE is advertising
Toggling (1Hz 10% duty cycle) = BLE is connected

LED Red

USB-C cable is connected to the charger.
On = Charging
Off = Charge complete

Flash Logging

On = Busy preparing the flash memory or flash memory is full
Toggling (synchronously with the green LED) = Logging
Off = Not logging

Note that flash logging indication takes precedence over the charging indication (i.e., if the EV Sys is plugged into a charger, the red LED indicates charge status). If flash logging is enabled while plugged into the charger, the red LED indicates flash log status.

Powering the EV Sys

Press the power switch (SW) to turn on/off the EV Sys. When powered on, the green status indicator LED toggles as described in the *Status LED Indicators* section of this data sheet. When powered off, the green status indicator LED goes out. The red status indicator LED might light temporarily, indicating that the flash log is closing. Plugging in the USB-C to USB-A cable also powers up the EV Sys.

Use the USB-C to USB-A cable to charge the integrated single-cell LiPo battery. The integrated PMIC initiates and stops charging automatically. Charge status is indicated through the red status indicator LED and GUI.

Upgrading Firmware

In case the MAXSENSORBLE board firmware needs to be upgraded, follow the procedure below to properly flash the firmware:

1) Connect the MAXSENSORBLE board to the MAXDAP-TYPE-C programmer board as shown in Figure 13. Whether the MAXSENSORBLE board is connected to the sensor board or not does not matter. The orientation of Type-C connection between the MAXDAP-TYPE-C programming board to the MAXSENSORBLE board does matter during flashing, which can be checked by making the Maxim logo on the programmer board stay on the same side with the Power Button of MAXSENSORBLE. Connect the USB Micro to USB-A cable to your PC and then the MAXSENSORBLE board has red and yellow status indicator LEDs on.
2) Unzip the MAX86174_mcu_flashtools.7z. In the unzipped folder, double click the file “erase+flash_nrf52.bat.” Note: Do not simply copy the .bat file to any other folder, as the .bat file requires support from the files in this folder.
3) A command prompt should pop up when the “.bat” file is opened. Follow instructions provided in the command prompt to finish flashing the firmware. If the command prompt shows “Verified Okay,” the firmware has been successfully flashed on the MAXSENSORBLE board, as shown in Figure 15. If you get any error, check all USB orientations and redo step 2 and step 3.
4) Once finished, unplug the MAXDAP-TYPE-C from the MAXSENSORBLE board.
5) Power off the MAXSENSORBLE board by holding down the Power Button for 12+ seconds and all the LEDs will be off. If sensor board is not connected to the MAXSENSORBLE, connect those two boards as shown in Figure 16.
6) Now the MAXSENSORBLE is ready. Power on the system by holding the Power Button for less than 1 second. Note: Holding longer for 1 second brings MAXSENSORBLE into bootloader mode.

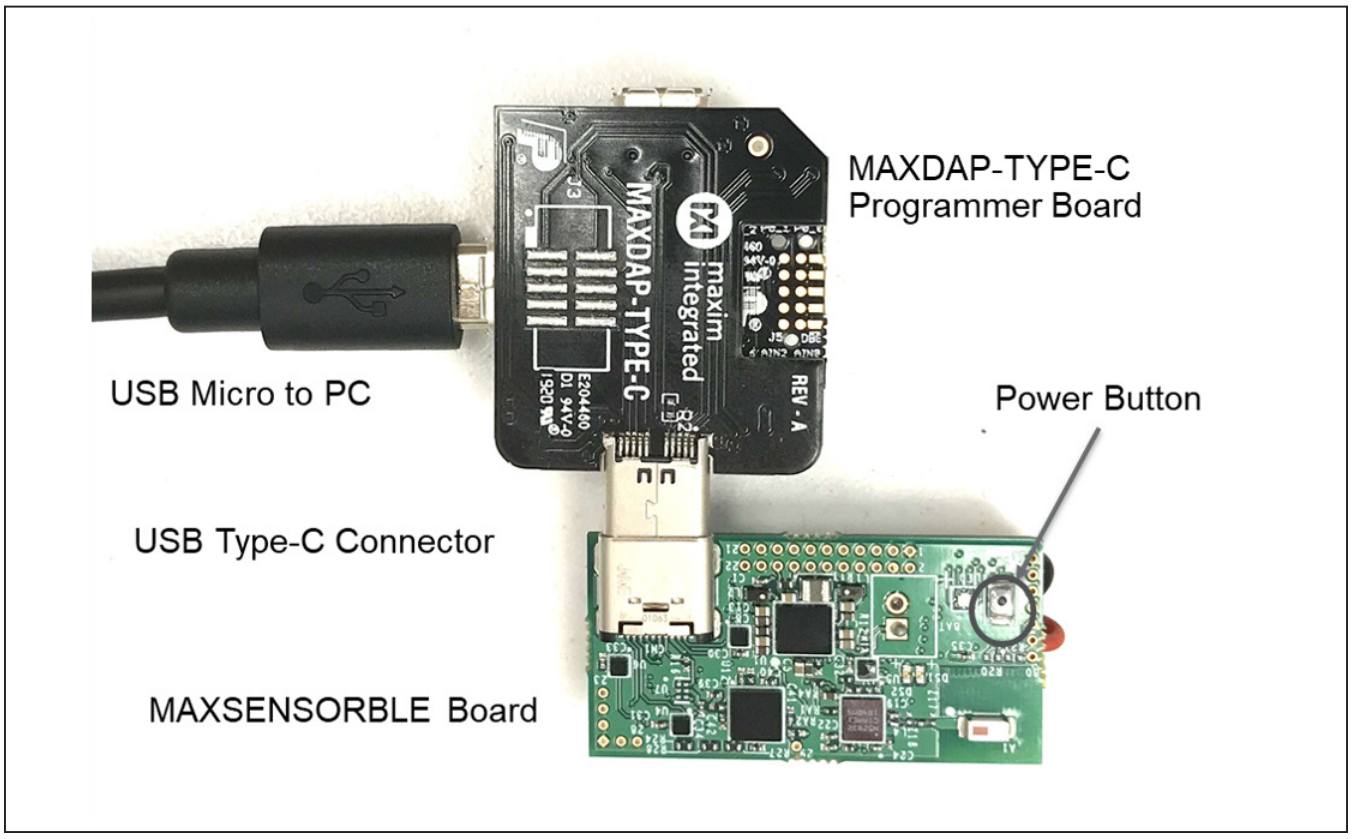


Figure 13. Connections to Flash Firmware on MAXSENSORBLE_EVKIT_B Board

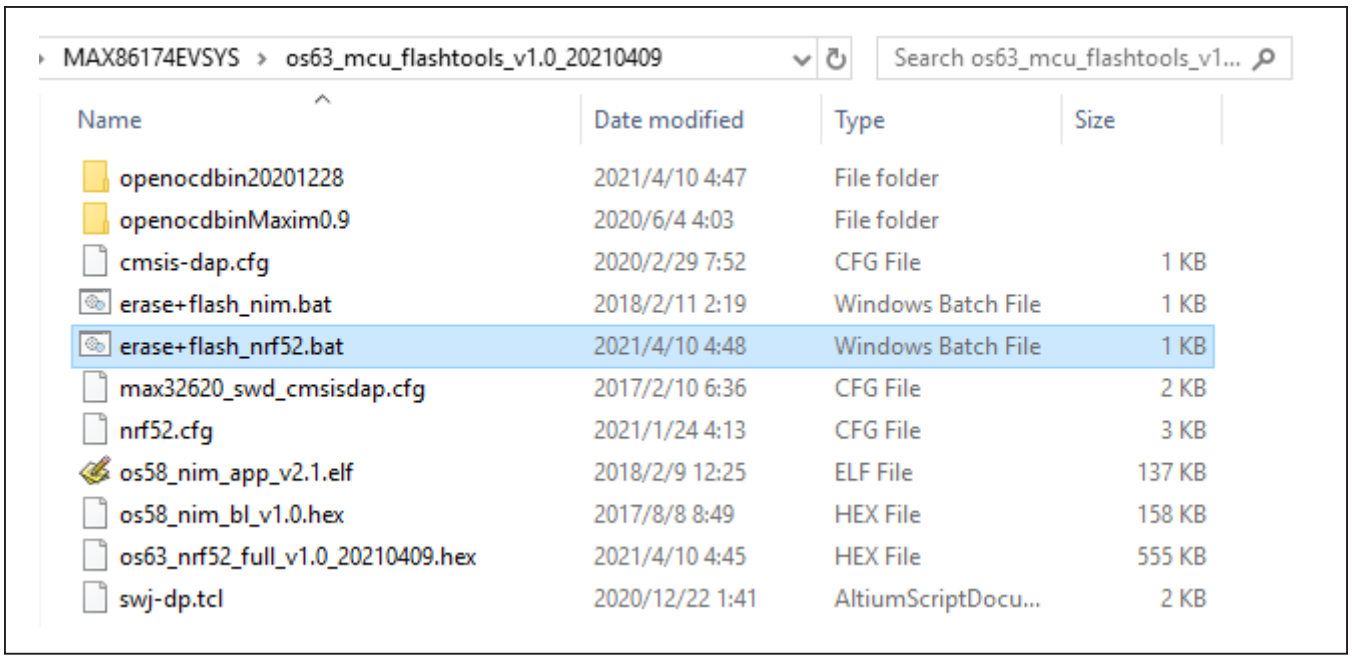


Figure 14. Flash nRF by Double-Clicking "erase+flash_nrf52.bat"

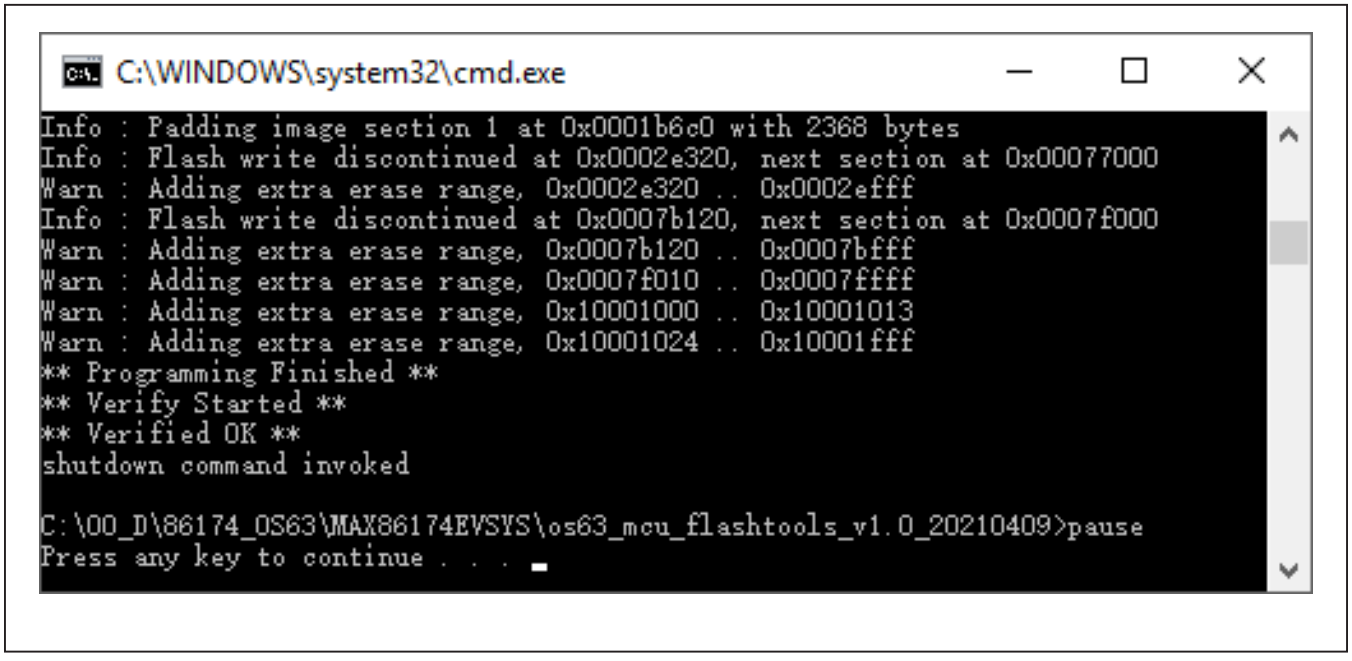


Figure 15. Command Prompt Display when Firmware Has Successfully Been Flashed

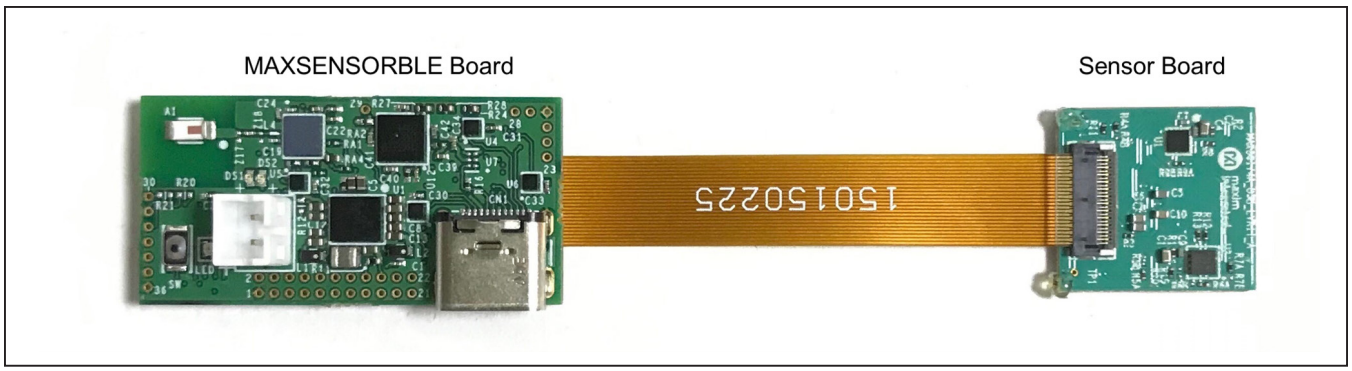


Figure 16. Connect Sensor Board to MAXSENSORBLE

Component List

MAX86174 EV System

PART	QTY	DESCRIPTION
MAXSENSORBLE_EVKIT_B	1	MAX86174 EV Sys Data Acquisition Board
MAX86174A_OSB_EVKIT_B	1	MAX86174 EV Sys Sensor Board
101181XX-000XXX	1	USB-C to USB-A Cable, 3 Ft.
LP-401320	1	105mAh Li-Po battery
MAXDAP-Type-C	1	Programmer board
AK67421-1-r 2 USB 2.0	1	USB-A to micro-USB cable

Ordering Information

PART	TYPE
MAX86174EVSYS#	EV System

#Denotes RoHS compliant.

MAX86174 EV System Bill of Materials

MAXSENSORBLE_EVKIT_B

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	A1	-	1	2450AT18A100	JOHANSON TECHNOLOGY	2450AT18A100	ANTENNA; 2450AT SERIES; BOARDMOUNT; MINI 2.45 GHZ ANTENNA; 2450MHZ
2	BAT	-	1	B2B-PH-K-S(LF)(SN)	JST MANUFACTURING	B2B-PH-K-S(LF)(SN)	CONNECTOR; MALE; THROUGH HOLE; PH CONNECTOR; 2MM PITCH; SHROUDED HEADER; STRAIGHT; 2PINS
3	C1, C22, C26, C30-C37	-	11	GRM033R61A104KE15; LMK063BJ104KP	MURATA;TAIYO YUDEN	0.1UF	CAPACITOR; SMT (0201); CERAMIC CHIP; 0.1UF; 10V; TOL=10%; MODEL=; TG=-55 DEGC TO +125 DEGC; TC=X5R
4	C2, C15, C25, C38-C43	-	9	GRM033R61A105ME15	MURATA	1UF	CAPACITOR; SMT (0201); CERAMIC CHIP; 1UF; 10V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R
5	C3, C4, C8, C9, C12, C16, C27	-	7	ZRB15XR61A475ME01; CL05A475MP5NRN; GRM155R61A475MEAA; C1005X5R1A475M050BC	MURATA;SAMSUNG;MURATA;TDK	4.7UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 4.7UF; 10V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R
6	C5-C7, C10, C13, C14, C47	-	7	GRM155R60J226ME11	MURATA	22UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 22UF; 6.3V; TOL=20%; TC=X5R ;
7	C19	-	1	GJM0335C1E1R0WB01	MURATA	1PF	CAPACITOR; SMT (0201); CERAMIC CHIP; 1PF; 25V; TOL=0.05PF; TG=-55 DEGC TO +125 DEGC; TC=C0G
8	C20, C21, C28, C29, C45, C46, Z44	-	7	GRM0335C1H120GA01	MURATA	12PF	CAPACITOR; SMT (0201); CERAMIC CHIP; 12PF; 50V; TOL=2%; TG=-55 DEGC TO +125 DEGC; TC=C0G
9	C23, C24	-	2	GRM0335C1H101JA01	MURATA	100PF	CAPACITOR; SMT (0201); CERAMIC CHIP; 100PF; 50V; TOL=5%; TG=-55 DEGC TO +125 DEGC; TC=C0G
10	CN1	-	1	DX07S024JJ3R1300	JAE ELECTRONIC INDUSTRY	DX07S024JJ3	CONNECTOR; FEMALE; SMT; USB TYPE-C CONNECTOR; DX07 SERIES RECEPTACLE; RIGHT ANGLE; 24PINS
11	DS1, DS2	-	2	SML-P11UTT86	ROHM	SML-P11UTT86	DIODE; LED; SMT; PIV=1.8V; IF=0.02A
12	J3	-	1	5035662500	MOLEX	5035662500	CONNECTOR; FEMALE; SMT; EASY-ON TYPE HOUSING ASSEMBLY; RIGHT ANGLE; 25PINS
13	L1, L2	-	2	DFE18SBN2R2MELL	MURATA	2.2UH	EVKIT PART - INDUCTOR; SMT (0603); SHIELDED; 2.2UH; 20%; 1.2A
14	L3	-	1	DFE201610E-4R7M=P2	MURATA	4.7UH	INDUCTOR; SMT (2016); METAL ALLOY CHIP; 4.7UH; TOL=+/-20%; 1.3A
15	L4	-	1	LQP03HQ3N3B02	MURATA	3.3NH	INDUCTOR; SMT (0201); FILM TYPE; 3.3NH; TOL=+/-0.1nH; 0.5A
16	LED	-	1	SML-LX0404SIUPGUSB	LUMEX OPTOCOMPONENTS INC	SML-LX0404SIUPGUSB	DIODE; LED; SML; FULL COLOR; WATER CLEAR LENS; RED-GREEN-BLUE; SMT; VF=2.95V; IF=0.1A
17	R2, R3, R11, R15, R24, R27-R31, R34	-	11	ERJ-2GE0R00	PANASONIC	0	RESISTOR; 0402; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM
18	R5, R9	-	2	ERJ-1GEF1002	PANASONIC	10K	RESISTOR; 0201; 10K OHM; 1%; 200PPM; 0.05W; THICK FILM
19	R6, R7, R16, R17, R23, R25, R26	-	7	ERJ-1GEF4701C	PANASONIC	4.7K	RESISTOR; 0201; 4.7K OHM; 1%; 100PPM; 0.05W; THICK FILM 3-LAYER ELECTRODE
20	R8	-	1	ERJ-1GEF3902	PANASONIC	39K	RESISTOR; 0201; 39K OHM; 1%; 100PPM; 0.05W; THICK FILM 3-LAYER ELECTRODE
21	R10	-	1	NCP15XH103F03	MURATA	10K	THERMISTOR; SMT (0402); THICK FILM (NICKEL PLATED); 10K; TOL=+/-1%
22	R13	-	1	ERJ-1GEF2613C	PANASONIC	261K	RESISTOR; 0201; 261K OHM; 1%; 200PPM; 0.05W; THICK FILM
23	R14	-	1	CRCW0201100KFK	VISHAY DALE	100K	RESISTOR; 0201; 100K OHM; 1%; 100PPM; 0.05W; THICK FILM
24	R18, R19	-	2	ERJ-1GEF2000C	PANASONIC	200	RESISTOR; 0201; 200 OHM; 1%; 200PPM; 0.05W; THICK FILM
25	RA1-RA4	-	4	ERJ-1GEF33R0C	PANASONIC	33	RESISTOR; 0201; 33 OHM; 1%; 100PPM; 0.05W; THICK FILM 3-LAYER ELECTRODE
26	SW	-	1	EVP-AWCD2A	PANASONIC	EVP-AWCD2A	SWITCH; SPST; SMT; STRAIGHT; 15V; 0.02A; EVP-AW SERIES
27	U1	-	1	MAX20303KEWN+	MAXIM	MAX20303KEWN+	EVKIT PART- IC; WEARABLE POWER NAMAGEMENT SOLUTION; PACKAGE OUTLINE; WLP 56 PINS; 0.5MM PITCH; PKG. CODE: W563A4+1; PKG. OUTLINE: 21-100104
28	U2	-	1	NRF52832-CIAA	NORDIC SEMICONDUCTOR	NRF52832-CIAA	IC; SOC; MULTIPROTOCOL BLUETOOTH LOW ENERGY; ANT; 2.4GHZ RF SOC; WLCSP50

MAX86174 EV System Bill of Materials (continued)

MAXSENSORBLE_EVKIT_B (continued)

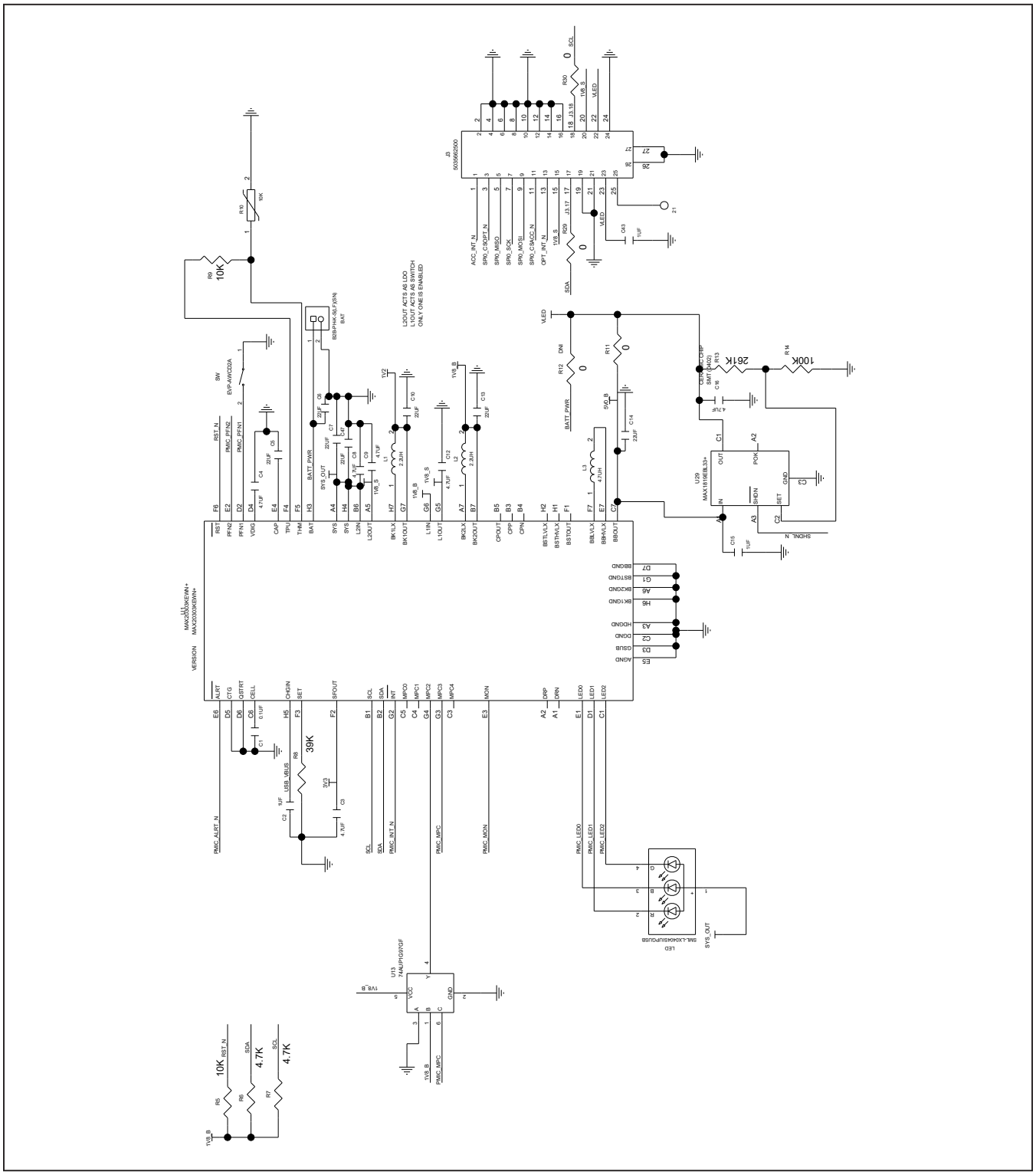
ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
29	U3-U6, U9	-	5	MAX14689EWL+	MAXIM	MAX14689EWL+	IC; ASW; 0.125A; FREQUENCY-SELECTSBLE; SWITCHED-CAPACITOR VOLTAGE CONVERTER; WLP9 1.2X1.2
30	U7	-	1	IP4221CZ6-S	NXP	IP4221CZ6-S	IC; PROT; ESD PROTECTION FOR HIGH-SPEED INTERFACE; XSON6
31	U8	-	1	S25FS256SAGNFI001	SPANSION	S25FS256SAGNFI001	IC; MMRY; MIRRORBIT FLASH; NON-VOLATILE MEMORY; 1.8V SINGLE SUPPLY WITH CMOS I/O; SERIAL PERIPHERAL INTERFACE WITH MULTI-I/O; WSON8-EP
32	U10, U11	-	2	MAX9062EBS+G45	MAXIM	MAX9062EBS+G45	IC; COMP; ULTRA-SMALL; LOW-POWER SINGLE COMPARATOR; UCSP4
33	U12	-	1	MAX32620IWG+	MAXIM	MAX32620IWG+	IC; UCON; HIGH-PERFORMANCE; ULTRA-LOW POWER CORTEX-M4F MICROCONTROLLER FOR RECHARGEABLE DEVICES; WLP81
34	U13	-	1	74AUP1G97GF	NXP	74AUP1G97GF	IC; LOGC; LOW-POWER CONFIGURABLE MULTIPLE FUNCTION GATE; XSON6
35	U29	-	1	MAX1819EBL33+	MAXIM	MAX1819EBL33+	IC; VREG; 500MA LOW-DROPOUT LINEAR REGULATOR IN UCSP; UCSP6
36	X2, Y2	-	2	ECS-.327-6-12	ECS INC	32.768KHZ	CRYSTAL; SMT 2.0 MM X 1.2 MM; 6PF; 32.768KHZ; +/-20PPM; -0.03PPM/DEGC2
37	Y1	-	1	US3200005Z	PERICOM SEMICONDUCTOR	32MHZ	CRYSTAL; SMT 1.6 MM X 1.2MM; 8PF; 32MHZ; +/-10PPM; +/-10PPM
38	PCB	-	1	MAXSENSORBLE	MAXIM	PCB	PCB:MAXSENSORBLE
39	MISC1	DNI	1	101181XX-000XXX	N/A	101181XX-000XXX	CONNECTOR; MALE; PALETTE SERIES 3.0 USB-C TO USB-A; 3FT BLACK
40	R1, R4, R12, R20-R22, R32, R33	DNP	0	ERJ-2GE0R00	PANASONIC	0	RESISTOR; 0402; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM
41	Z17	DNP	0	GJM0335C1E1R0WB01	MURATA	1PF	CAPACITOR; SMT (0201); CERAMIC CHIP; 1PF; 25V; TOL=0.05PF; TG=-55 DEGC TO +125 DEGC; TC=C0G
42	Z18	DNP	0	250R05L1R8AV4	JOHANSON TECHNOLOGY	1.8PF	CAPACITOR; SMT (0201); MICROWAVE; 1.8PF; 25V; TOL=0.05PF; TG=-55 DEGC TO +125 DEGC; TC=C0G
43	1-36	DNP	0	N/A	N/A	N/A	TEST POINT; PAD DIA=0.762MM; BOARD HOLE=0.381MM
TOTAL			105				

MAX86174A_OSB_EVKIT_B

ITEM	REF_DES	DNI/DNP	QTY	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION	COMMENTS
1	C1-C3, C5, C6, C10	-	6	GRM155R60J226ME11	MURATA	22UF	CAP; SMT (0402); 22UF; 20%; 6.3V; X5R; CERAMIC;	
2	C4, C7, C9	-	3	GRM033R61A105ME15	MURATA	1UF	CAP; SMT (0201); 1UF; 20%; 10V; X5R; CERAMIC	
3	D1	-	1	SFH 7016	OSRAM	SFH 7016	DIODE; LED; RED-GREEN-IR; SMT; VF=RED=2.1V; GREEN=2.5V; IR=1.3V; IF=RED=0.04A; GREEN=0.03A; IR=0.06A ;	
4	J1	-	1	5016162575	MOLEX	5016162575	CONNECTOR; FEMALE; SMT; EASY-ON TYPE FPC CONNECTOR; RIGHT ANGLE; 25PINS ;	
5	PD1-PD3	-	3	VEMD8080	VISHAY	VEMD8080	DIODE; PIN; SMT; VRM=20V; IF=0.05A ;	
6	R1-R3, R4A-R7A, R8, R9A, R10-R13	-	13	CRCW02010000ZS; ERJ-1GN0R00	VISHAY DALE;PANASONIC	0	RES; SMT (0201); 0; 1%; JUMPER; 0.0500W	
7	U1	-	1	MAX86174A	MAXIM	MAX86174A	EVKIT PART - IC; MAX86174A; BEST-IN-CLASS OPTICAL PULSE OXIMETER AND HEARTRATE SENSOR AFE FOR WEARABLE HEALTH; PACKAGE OUTLINE DRAWING: 21-100454; PACKAGE CODE: N161B1+1; WLP16	
8	U2	-	1	KX122-1037	KIONIX	KX122-1037	IC; SNSR; +/-2G/4G/8G TRI-AXIS DIGITAL ACCELEROMETER; LGA12	
9	PCB	-	1	MAX86174AOSB	MAXIM	PCB	PCB:MAX86174AOSB	-
10	R4B-R7B, R9B, R15	DNP	0	CRCW02010000ZS; ERJ-1GN0R00	VISHAY DALE;PANASONIC	0	RES; SMT (0201); 0; 1%; JUMPER; 0.0500W	
11	R16, R18	DNP	0	N/A	N/A	SHORT	PACKAGE OUTLINE 0201 RESISTOR	
12	R17	DNP	0	N/A	N/A	OPEN	PACKAGE OUTLINE 0201 RESISTOR	
TOTAL			30					

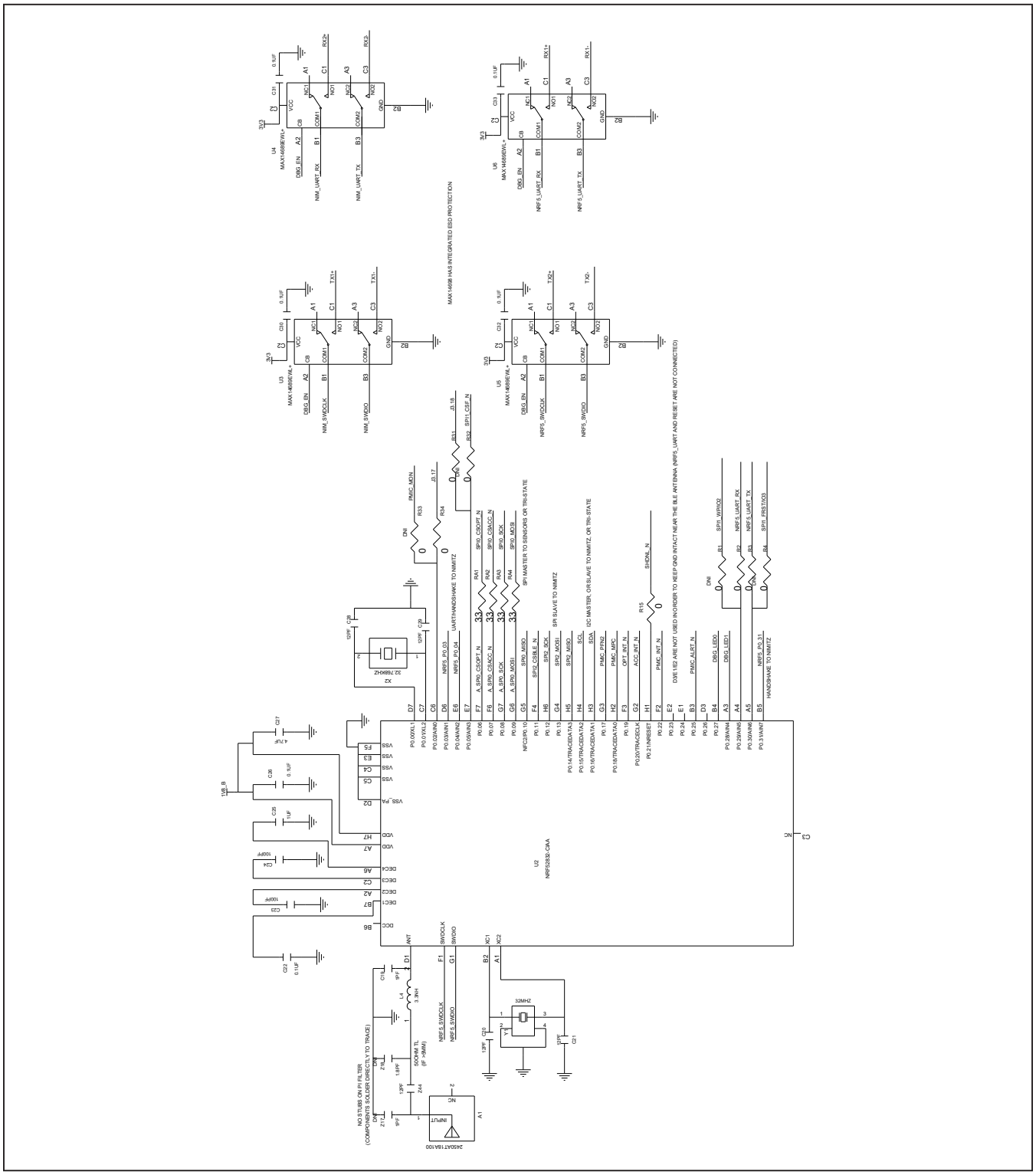
MAX86174 EV System Schematics

MAXSENSORBLE_EVKIT_B



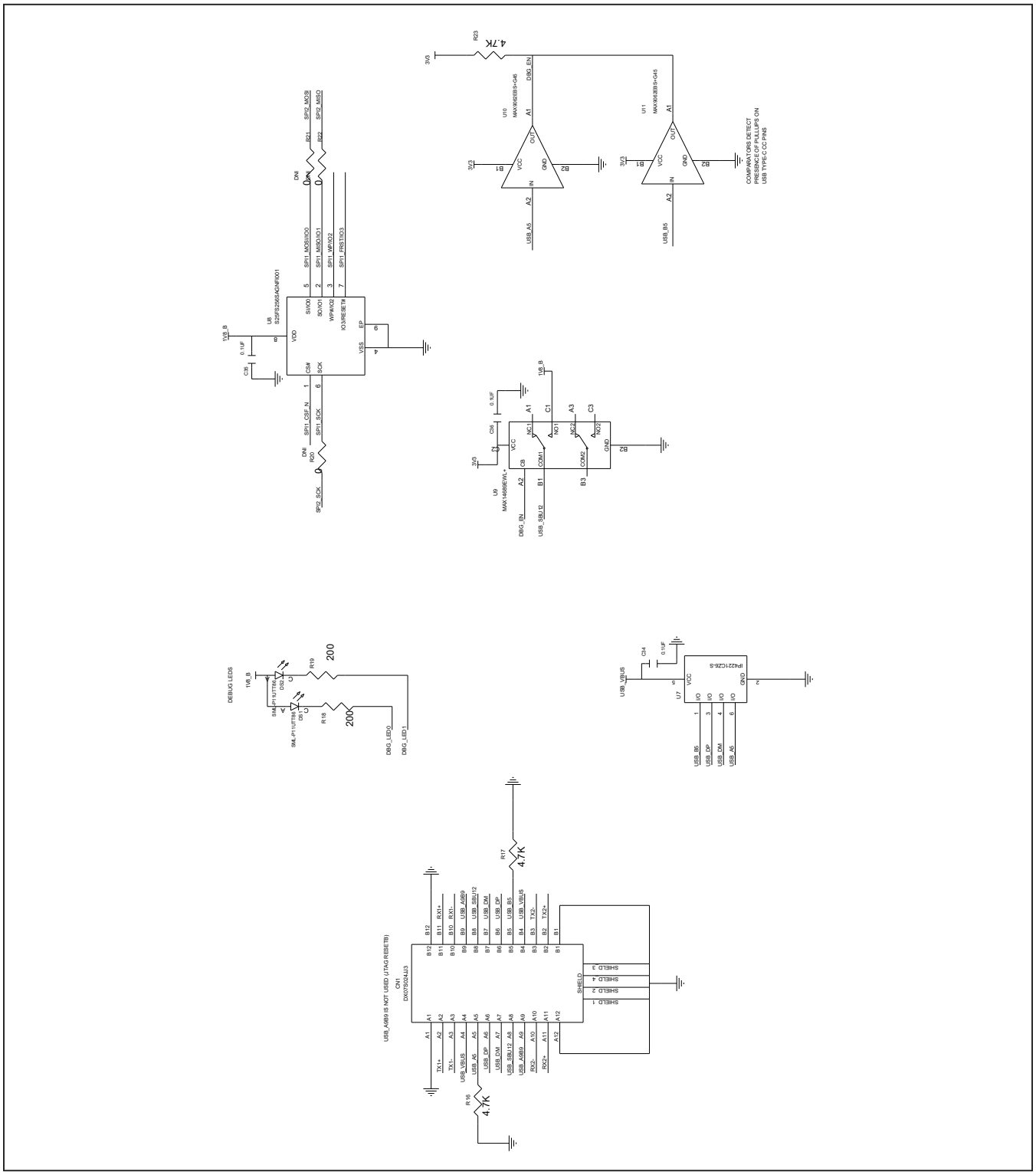
MAX86174 EV System Schematics (continued)

MAXSENSORBLE_EVKIT_B (continued)



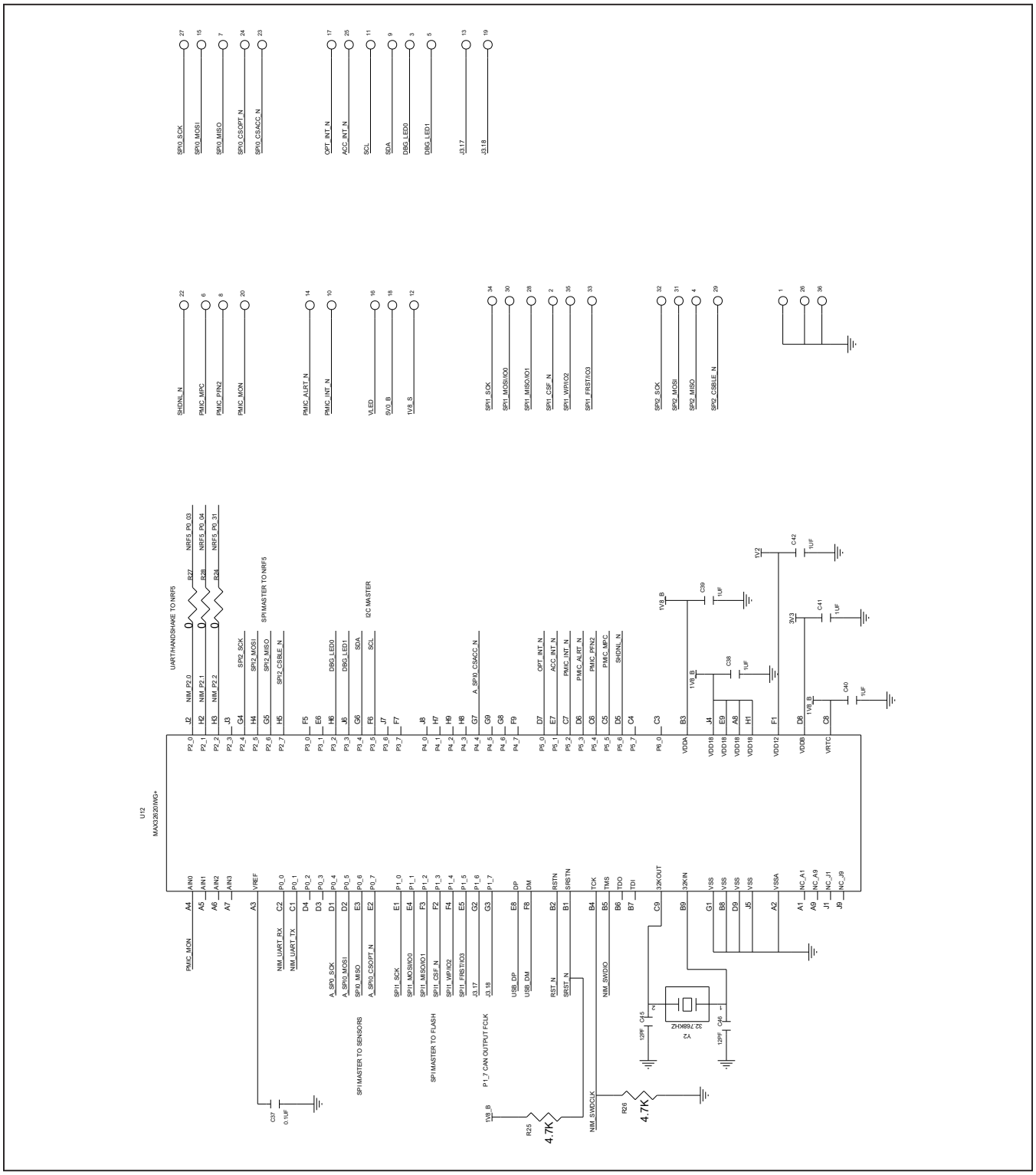
MAX86174 EV System Schematics (continued)

MAXSENSORBLE_EVKIT_B (continued)



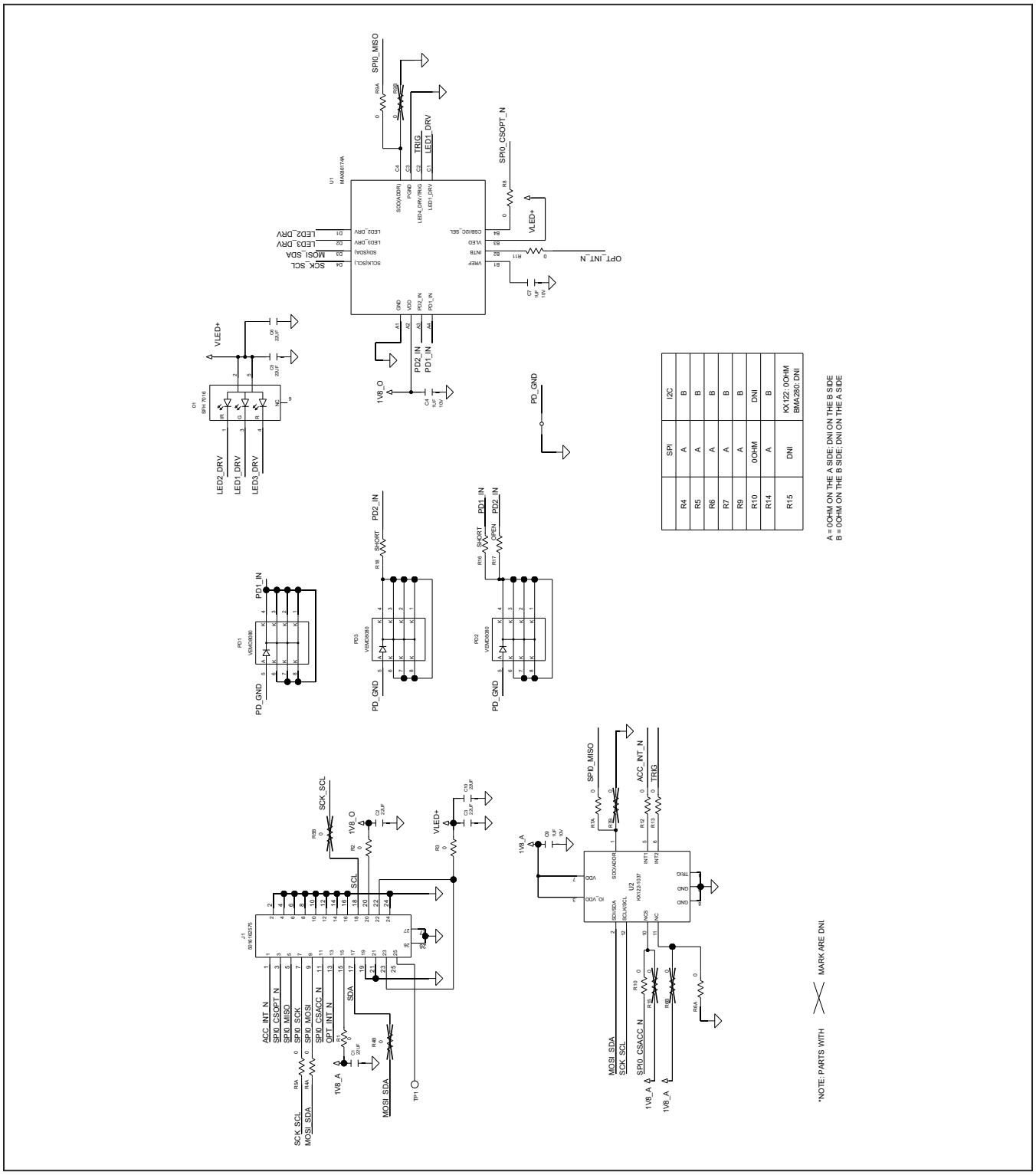
MAX86174 EV System Schematics (continued)

MAXSENSORBLE_EVKIT_B (continued)



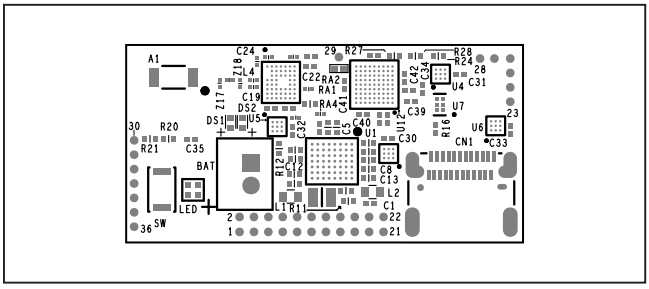
MAX86174 EV System Schematics (continued)

MAX86174A_OSB_EVKIT_B

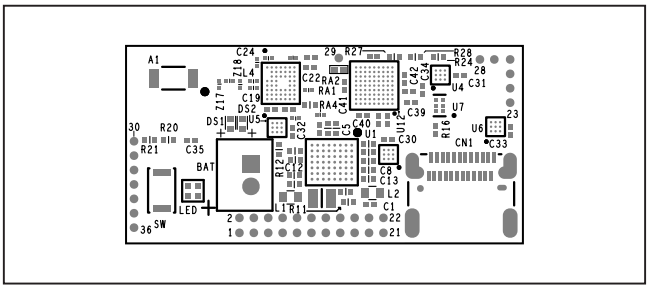


MAX86174 EV System PCB Layout Diagrams

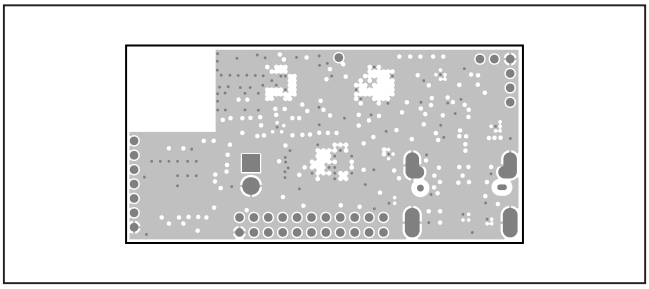
MAXSENSORBLE_EVKIT_B



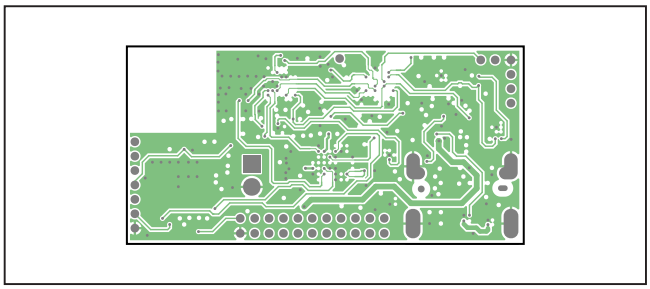
MAXSENSORBLE_EVKIT_B—Silkscreen Top



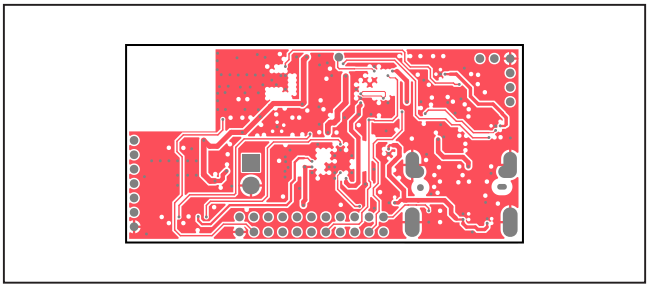
MAXSENSORBLE_EVKIT_B—Top Layer



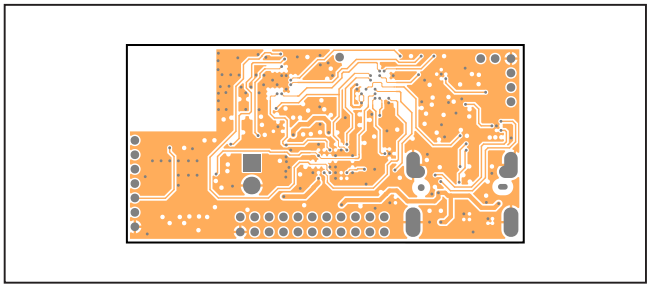
MAXSENSORBLE_EVKIT_B—Layer 2



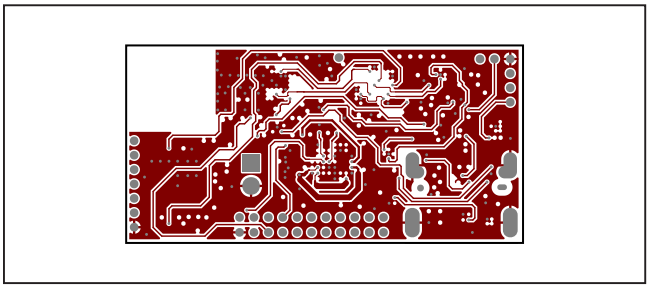
MAXSENSORBLE_EVKIT_B—Layer 3



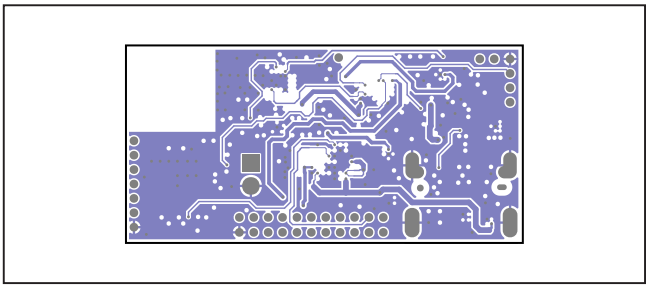
MAXSENSORBLE_EVKIT_B—Layer 4



MAXSENSORBLE_EVKIT_B—Layer 5



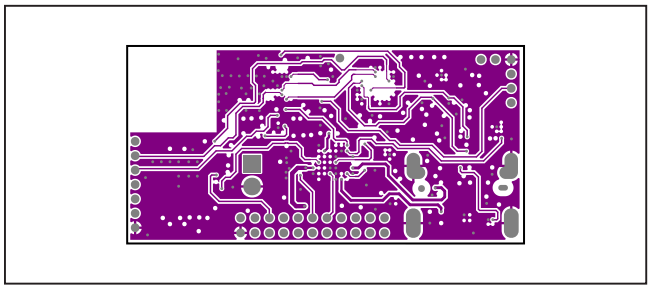
MAXSENSORBLE_EVKIT_B—Layer 6



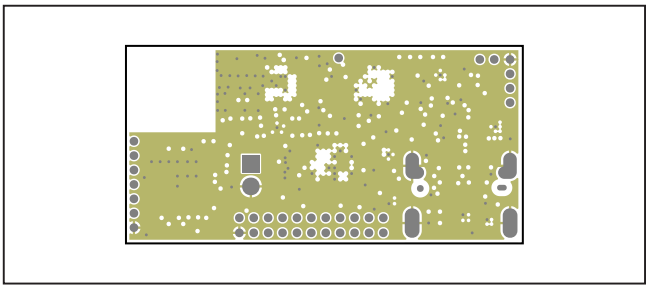
MAXSENSORBLE_EVKIT_B—Layer 7

MAX86174 EV System PCB Layout Diagrams (continued)

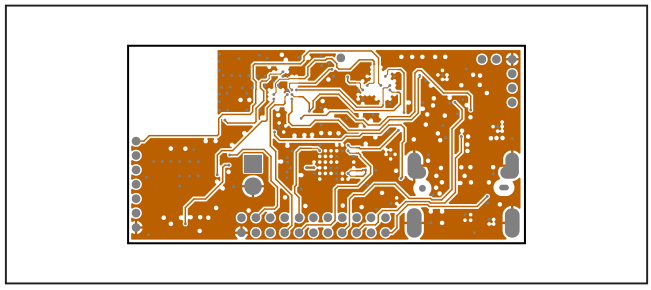
MAXSENSORBLE_EVKIT_B



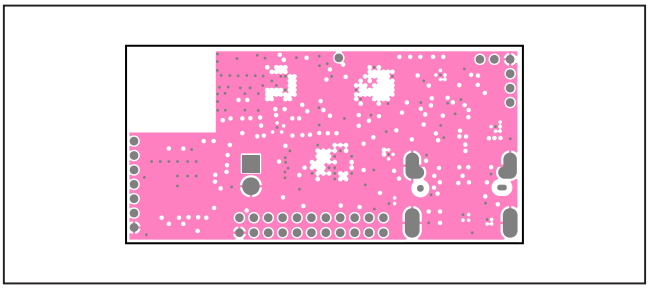
MAXSENSORBLE_EVKIT_B—Layer 8



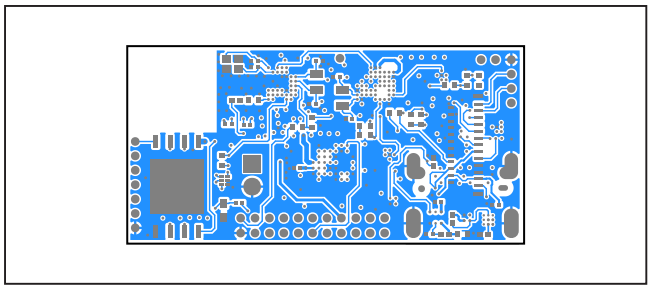
MAXSENSORBLE_EVKIT_B—Layer 9



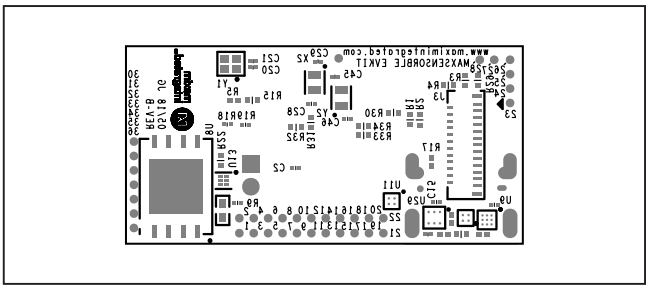
MAXSENSORBLE_EVKIT_B—Layer 10



MAXSENSORBLE_EVKIT_B—Layer 11



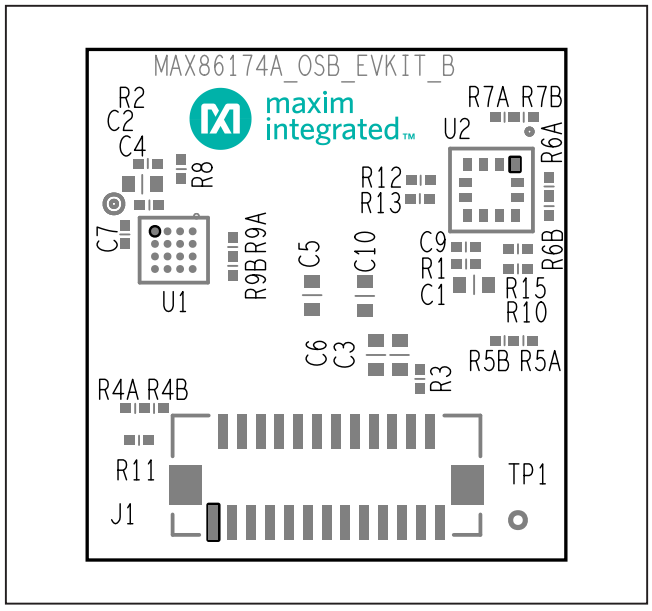
MAXSENSORBLE_EVKIT_B—Bottom Layer



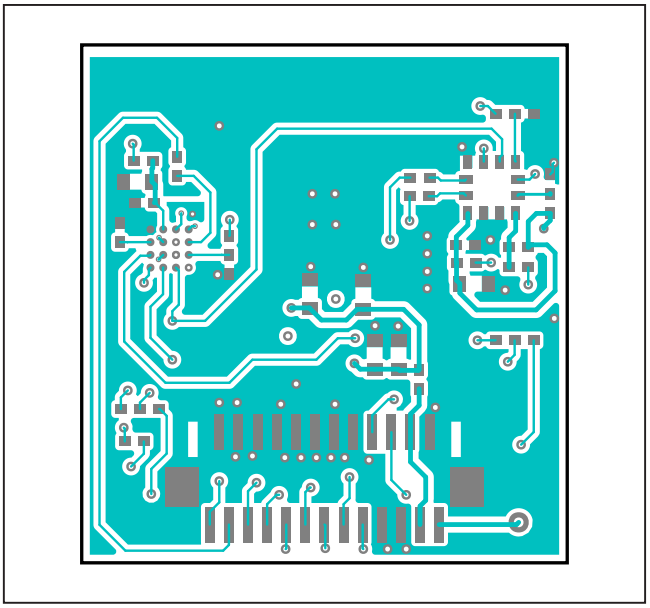
MAXSENSORBLE_EVKIT_B—Silkscreen Bottom

MAX86174 EV System PCB Layout Diagrams (continued)

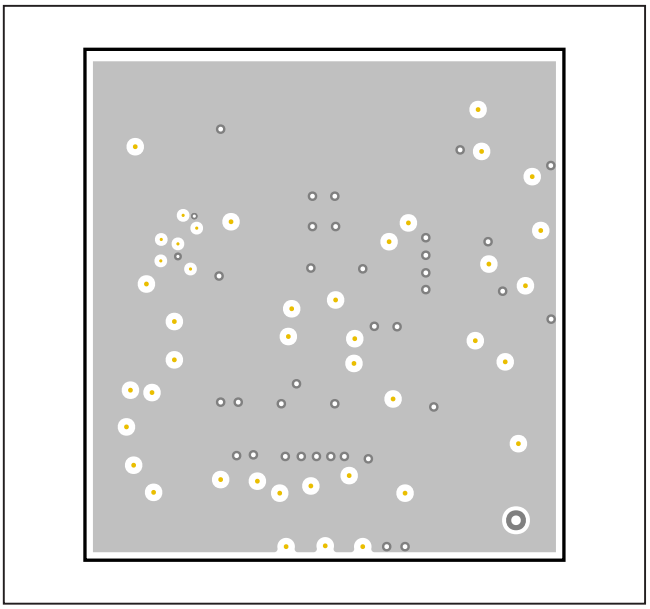
MAX86174A_OSB_EVKIT_B



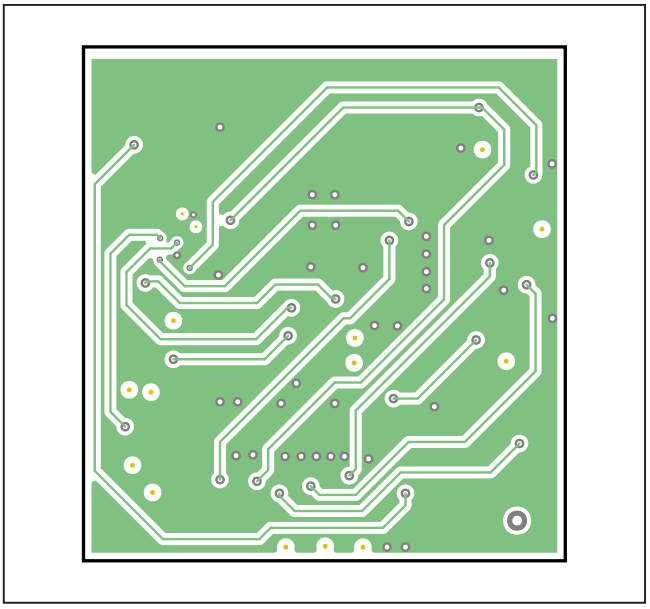
MAX86174A_OSB_EVKIT_B—Silkscreen Top



MAX86174A_OSB_EVKIT_B—Top Layer



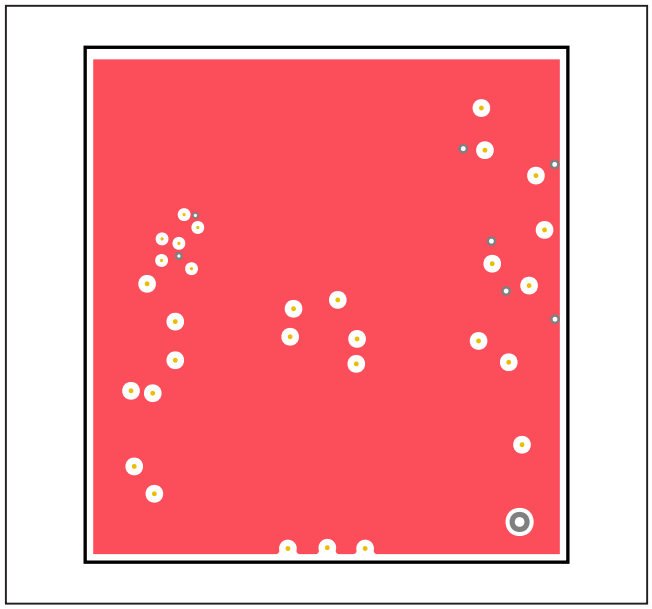
MAX86174A_OSB_EVKIT_B—Layer 2



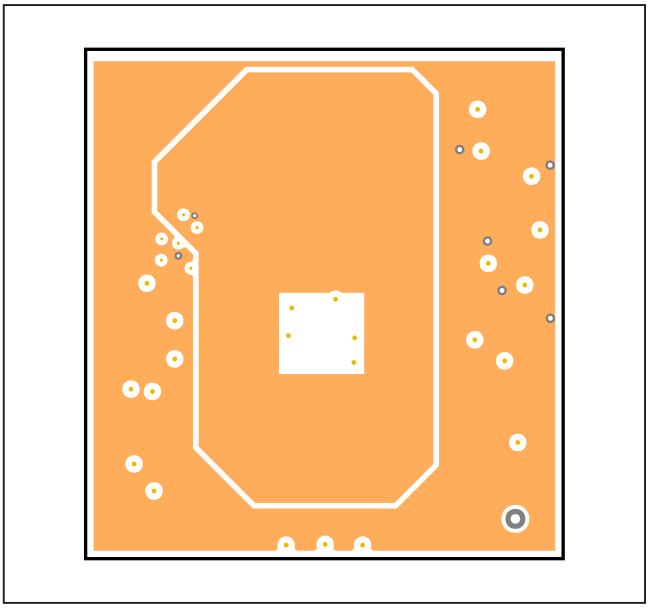
MAX86174A_OSB_EVKIT_B—Layer 3

MAX86174 EV System PCB Layout Diagrams (continued)

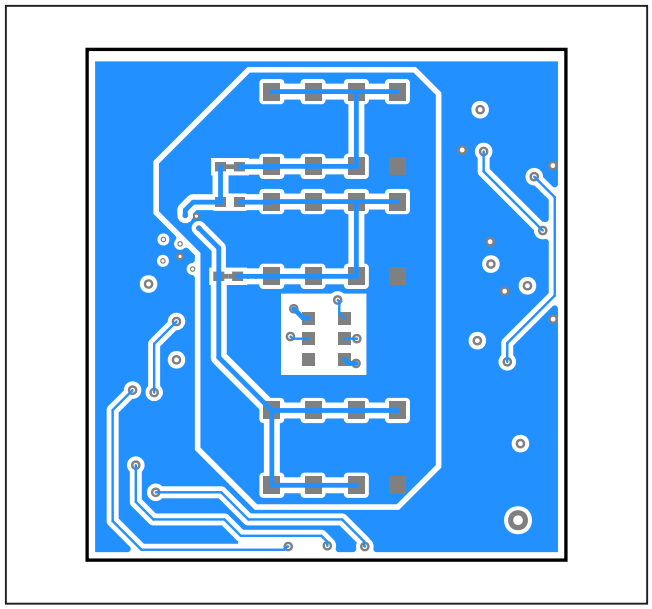
MAX86174A_OSB_EVKIT_B (continued)



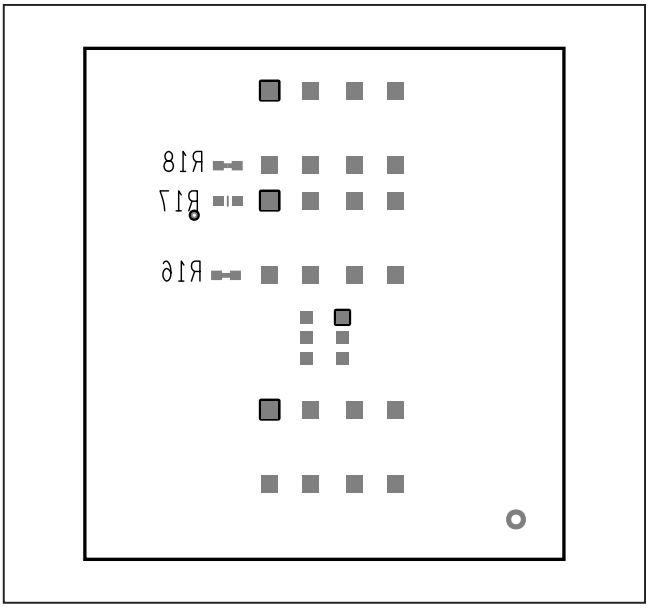
MAX86174A_OSB_EVKIT_B—Layer 4



MAX86174A_OSB_EVKIT_B—Layer 5



MAX86174A_OSB_EVKIT_B—Bottom Layer



MAX86174A_OSB_EVKIT_B—Silkscreen Bottom

Revision History

REVISION NUMBER	REVISION DATE	DESCRIPTION	PAGES CHANGED
0	4/21	Initial Release	—
1	3/22	Removing Cypress Dongle references in the EV kit. Updated *General Description*, *EV Sys Contents*, *Quick Start*, *Detailed Description of Software*, *Figure 2*, and *Component List*.	1, 3, 4, and 18