Chipsmall

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General Description

The MAX86140/MAX86141 Evaluation System (EVSYS) allows for the quick evaluation of the MAX86140 and MAX86141 optical AFE for applications at various sites on the body, particularly the wrist. Both MAX86140 and MAX86141 supports standard SPI compatible interface. MAX86140 consists of a single optical readout channels, while MAX86141 has two optical readout channels that operate simultaneously. The EVSYS allows flexible configurations to optimize measurement signal quality at minimal power consumption. The EVSYS helps the user quickly learn about how to configure and use the MAX86140 and MAX86141.

The EVSYS consists of three boards. MAX32620UC-BLEEK# is the main data acquisition board while MAX86140OSBEK# and MAX86141OSBEK# are the sensor daughter boards for MAX86140 and MAX86141 respectively. The EVSYS can be powered using the USB-C supply or LiPo Battery.

The EVSYS comes with a MAX86140ENP+/MAX86141-ENP+ in a 24-bump wafer-level package (WLP).

Features

- Quick Evaluation of the MAX86140/MAX86141
- Supports Optimization of Configurations
- Facilitates Understanding MAX86140/MAX86141 Architecture and Solution Strategy
- Real-time Monitoring
- Data Logging Capabilities
- On-Board Accelerometer
- Bluetooth LE

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

Quick Start

Required Equipment

- MAX86140 EVSYS
- Data Acquisition EVSYS Micro-PCB (MAX32620UCBLEEK#)
- MAX86140 EVSYS Sensor PCB (MAX86140OSBEK#)
- MAX86141 EVSYS Sensor PCB (MAX86141OSBEK#)
- Flex cable
- USB-C cable
- MAX86140 EVSYS GUI Software
- MAX86140 Parser and User guide (included in MAX86140GUISetupVxxx.ZIP)
- Windows PC
- Required Bluetooth LE Dongle **CY5677** or **CY5670** (not shipped with EVSYS)
- Optional LiPo Battery (**LP-401230** suggested, not shipped with EVSYS)

Note: If you do not already have one of the listed BLE dongles above, purchasing one is recommended.

Procedure

1) The EVSYS is fully assembled and tested. Follow the steps below to verify board operation: Visit **www.maximintegrated.com/evkit-software** to download the most recent version of the EVSYS software, MAX86140GUISetupVxxx_Web.ZIP. Save the EVSYS software to a temporary folder and decompress the ZIP file.
2) Plugged in the BLE dongle to one of the USB port on the PC.
3) Open up MAX86140GUISetupVxxx.exe and follow the instructions from the pop-up windows, as shown in Figure 1 to Figure 7.
4) The BLE Dongle driver installation will also be completed after the GUI installation, as shown in Figure 8.
5) If the MAX86140 EVSYS flex cable is not already connecting the Data Acquisition EVSYS Micro PCB to the MAX86140 or MAX86141 Sensor PCB, then please connect the two PCBs with the cable as shown in Figure 9 and Figure 10 or Figure 11 and Figure 12.

6) Connect USB-C cable or LiPo Battery to the Data Acquisition Board to power up the EVSYS. If LiPo battery is used, press the power switch (SW) to turn on/off the device. When powered on, the green LED will toggle.

7) After that, start the MAX86140 EVSYS GUI program. "Connect Device" will appears, choose your device and press "Connect" as shown in Figure 11.

8) The GUI will then be launched as shown in Figure 12.

9) Configure the EVSYS on the GUI and Click on the <Start> button on the bottom left side to start the data acquisition.

10) When running, the LEDs on the Micro PCB should illuminate and the plots on the GUI should stream with data as shown in Figure 13 and Figure 14.

Figure 1. Setup MAX86140 EVSYS GUI Software Step 1

Figure 2. Setup MAX86140 EVSYS GUI Software Step 2

Figure 3. Setup MAX86140 EVSYS GUI Software Step 3
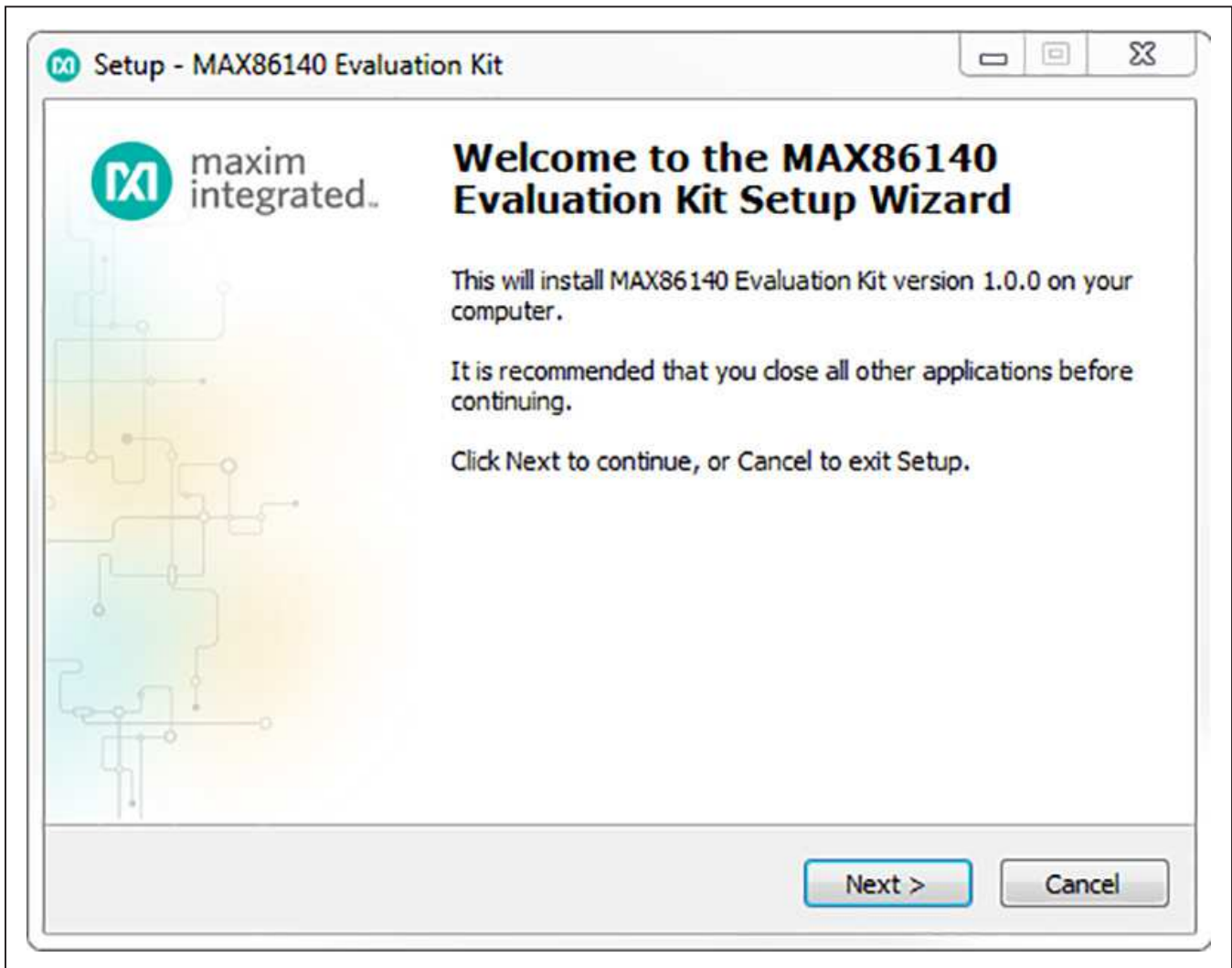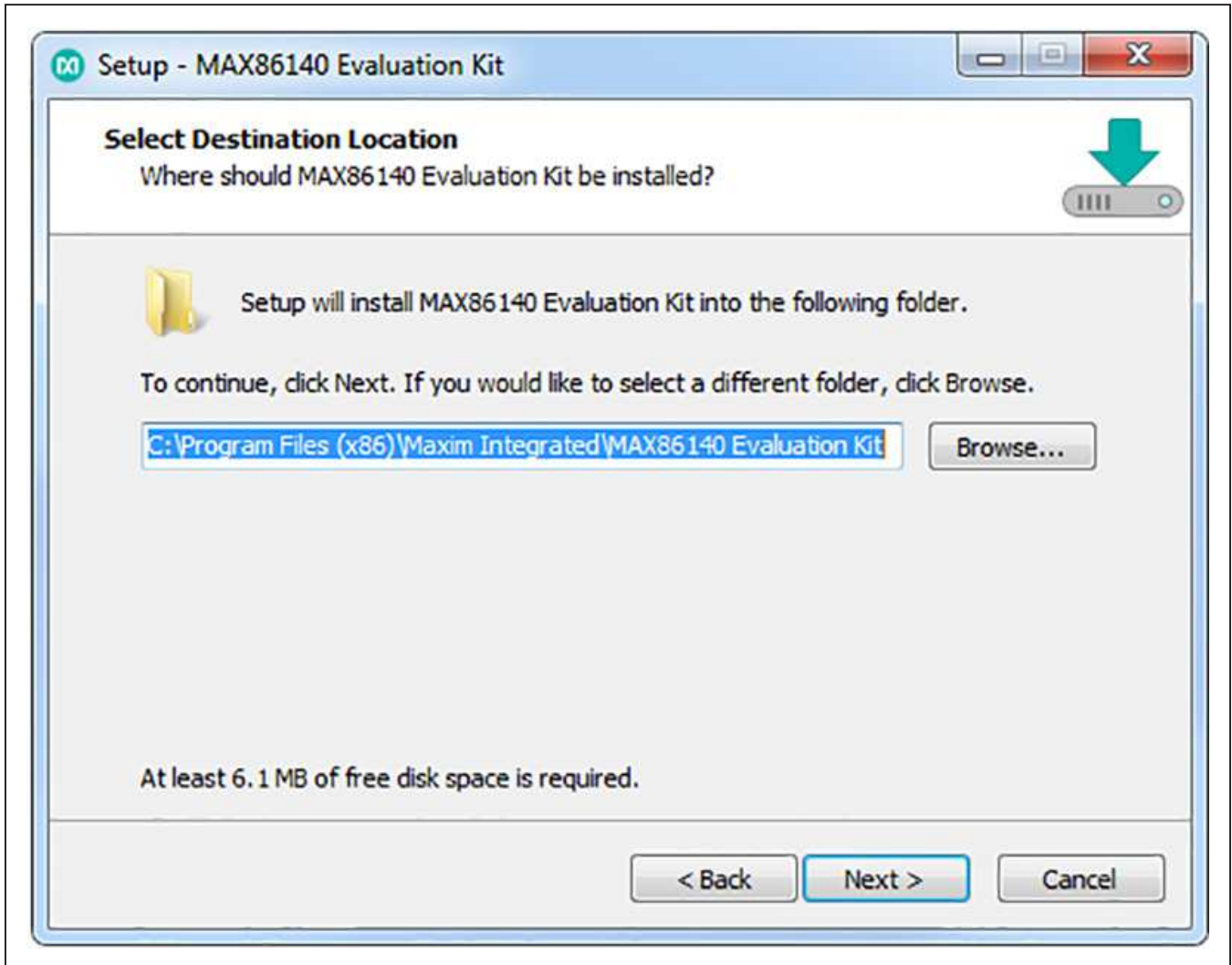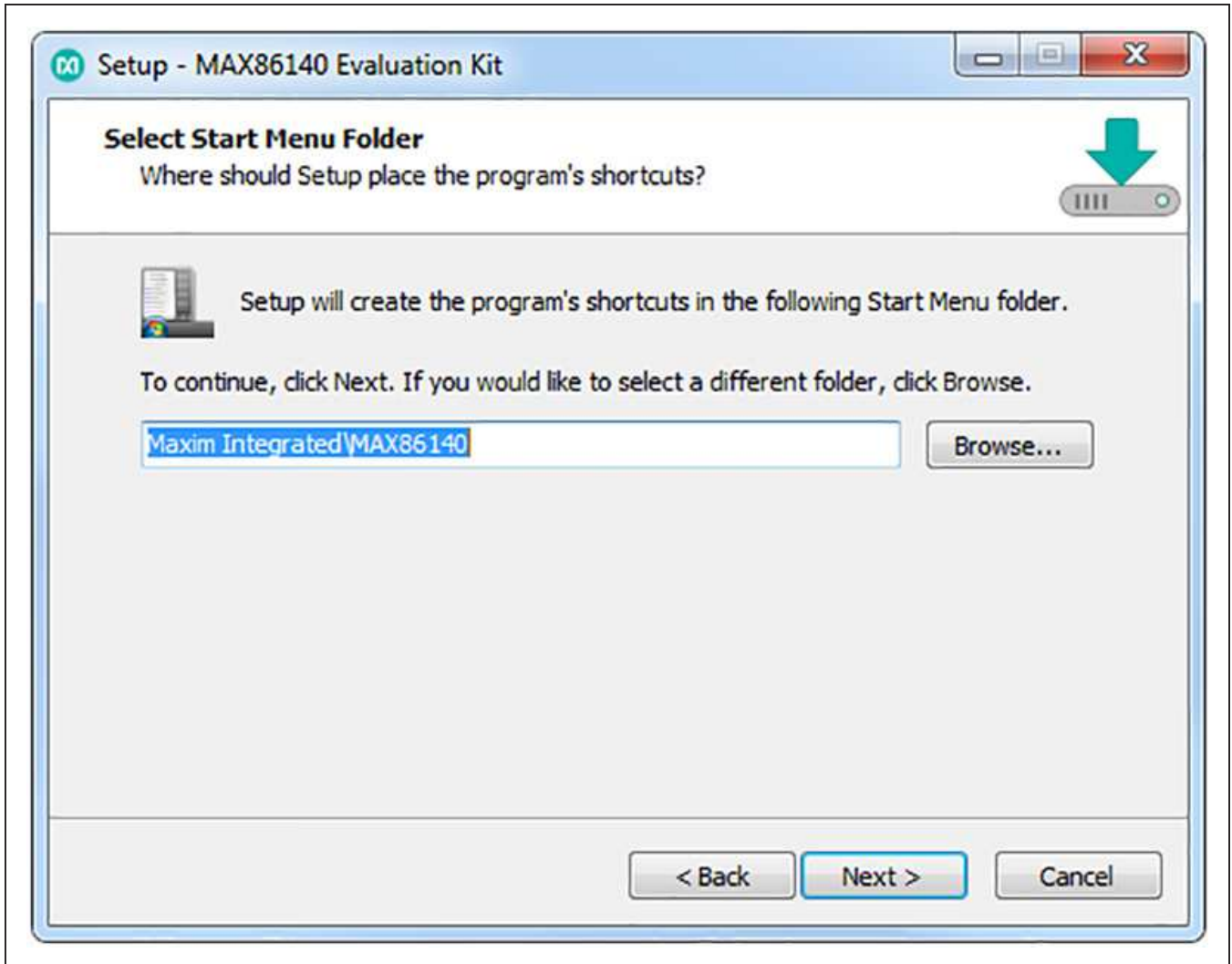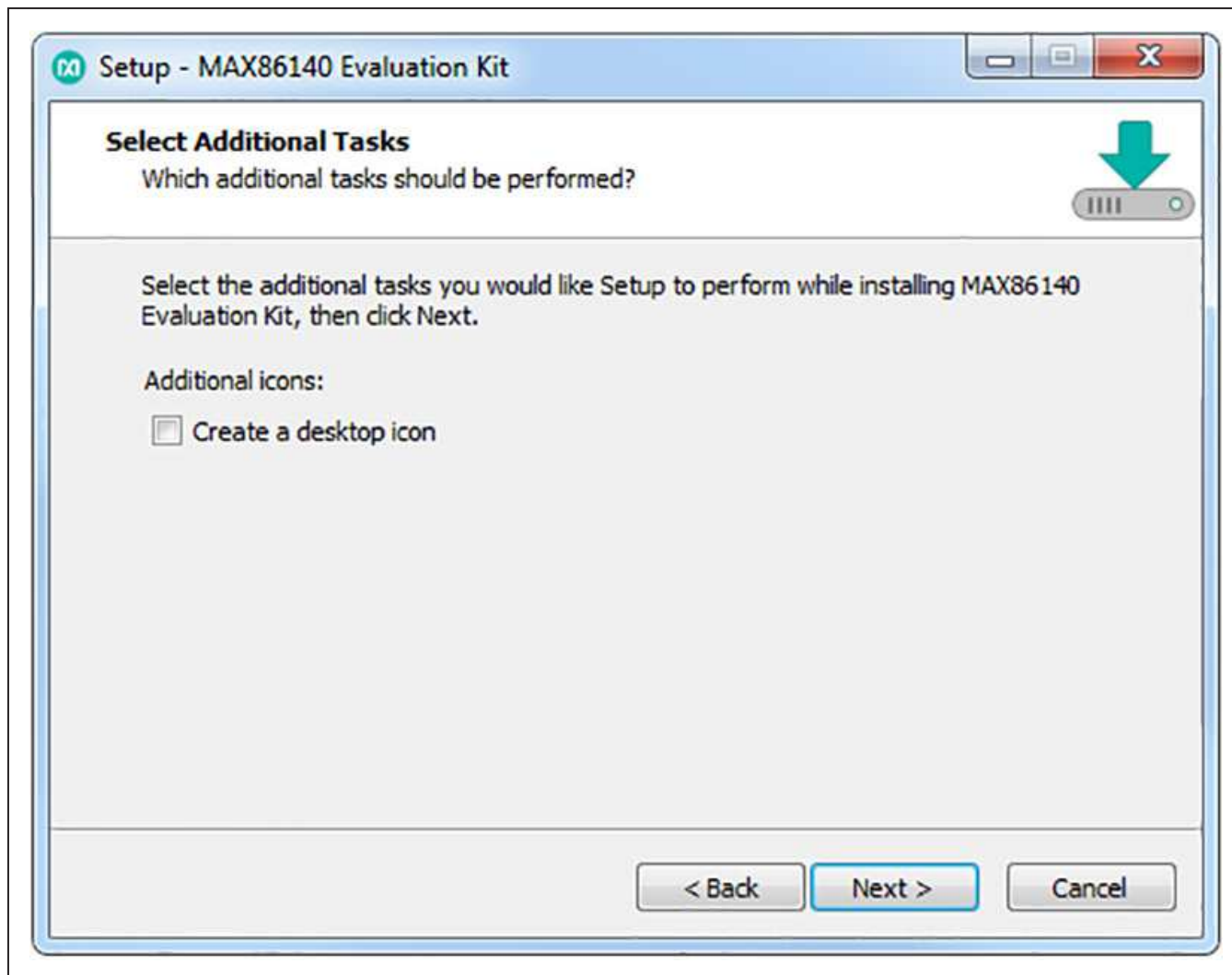
Figure 4. Setup MAX86140 EVSYS GUI Software Step 4
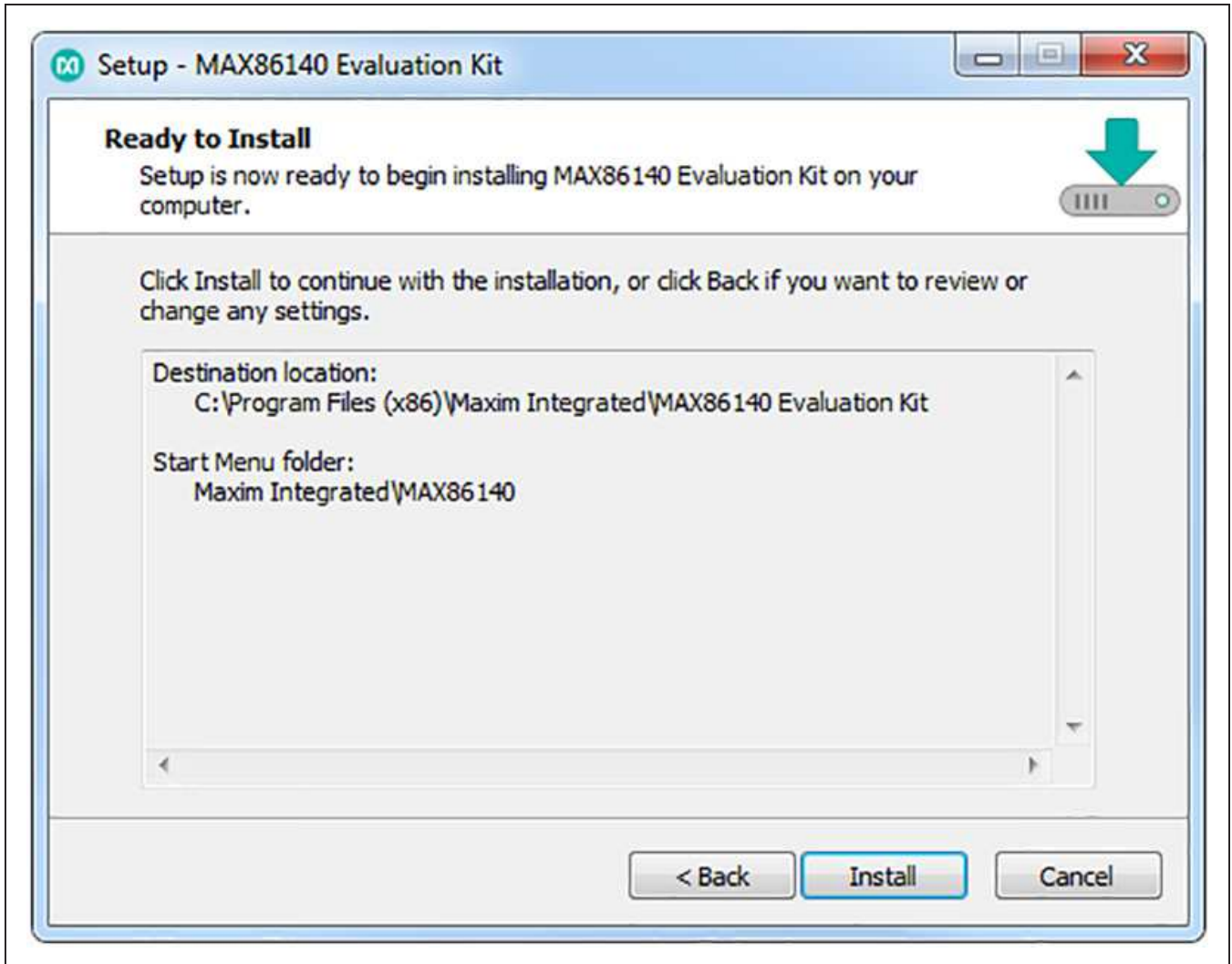
Figure 5. Setup MAX86140 EVSYS GUI Software Step 5
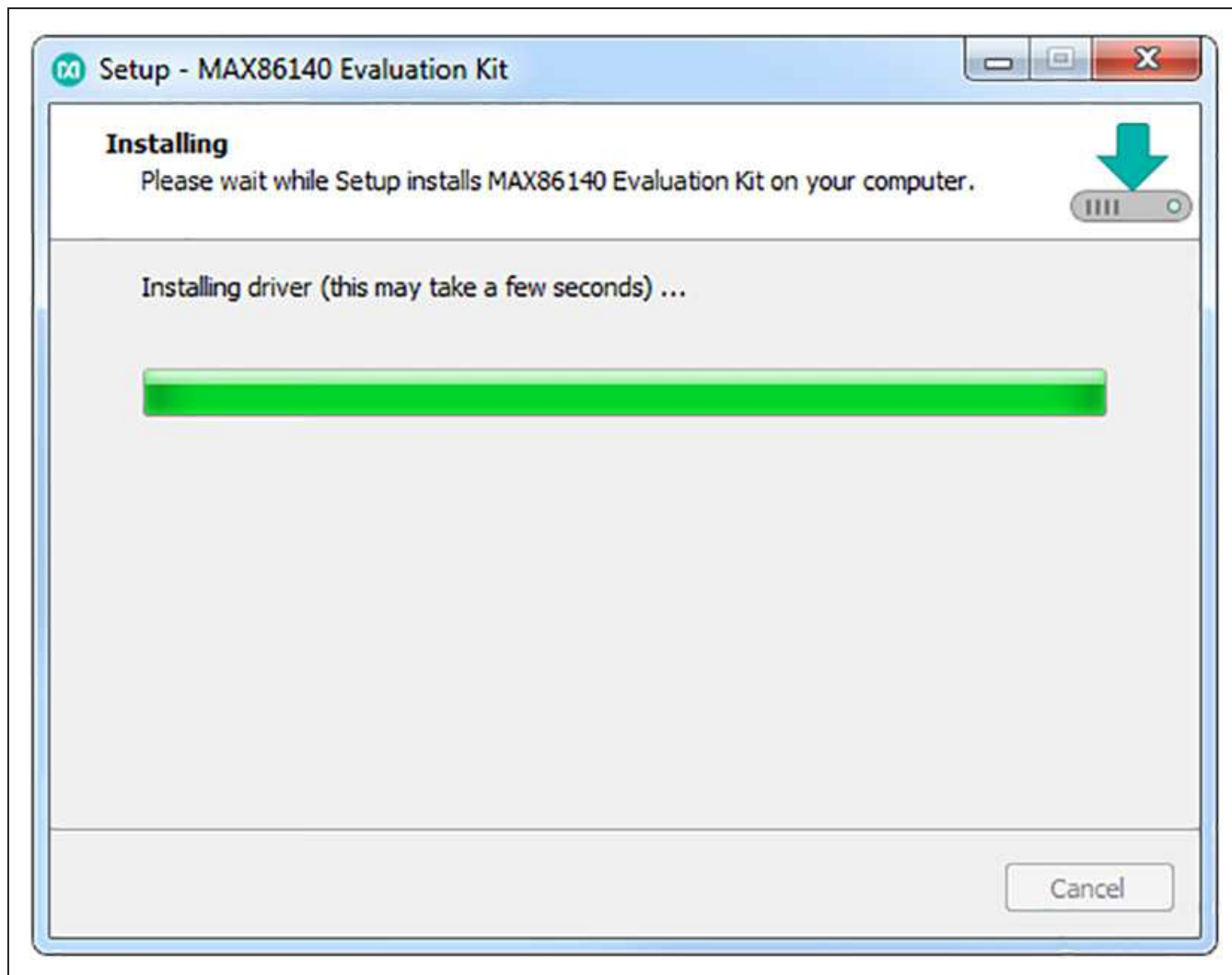
Figure 6. Setup MAX86140 EVSYS GUI Software Step 6
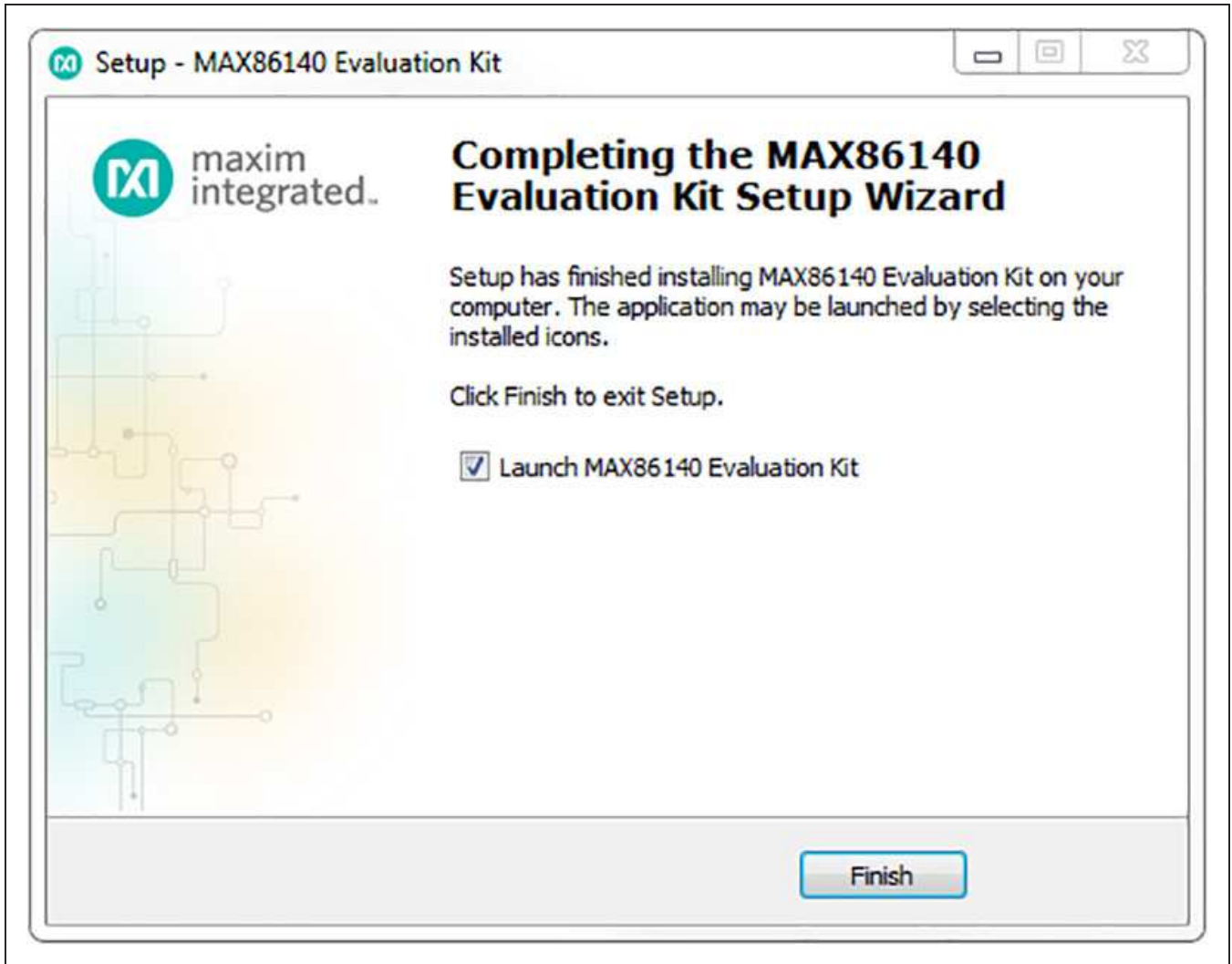
Figure 7. Setup MAX86140 EVSYS GUI Software Step 7
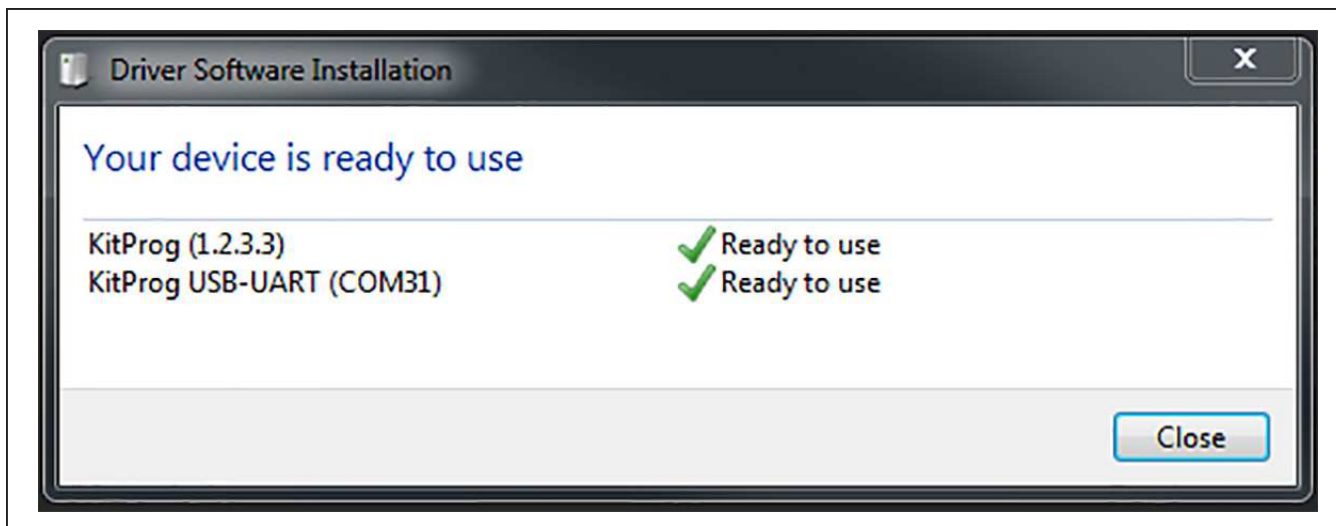
Figure 8. BLE Dongle Driver Installation

Figure 9. Hardware Setup (MAX86140 EVSYS Micro-PCB)
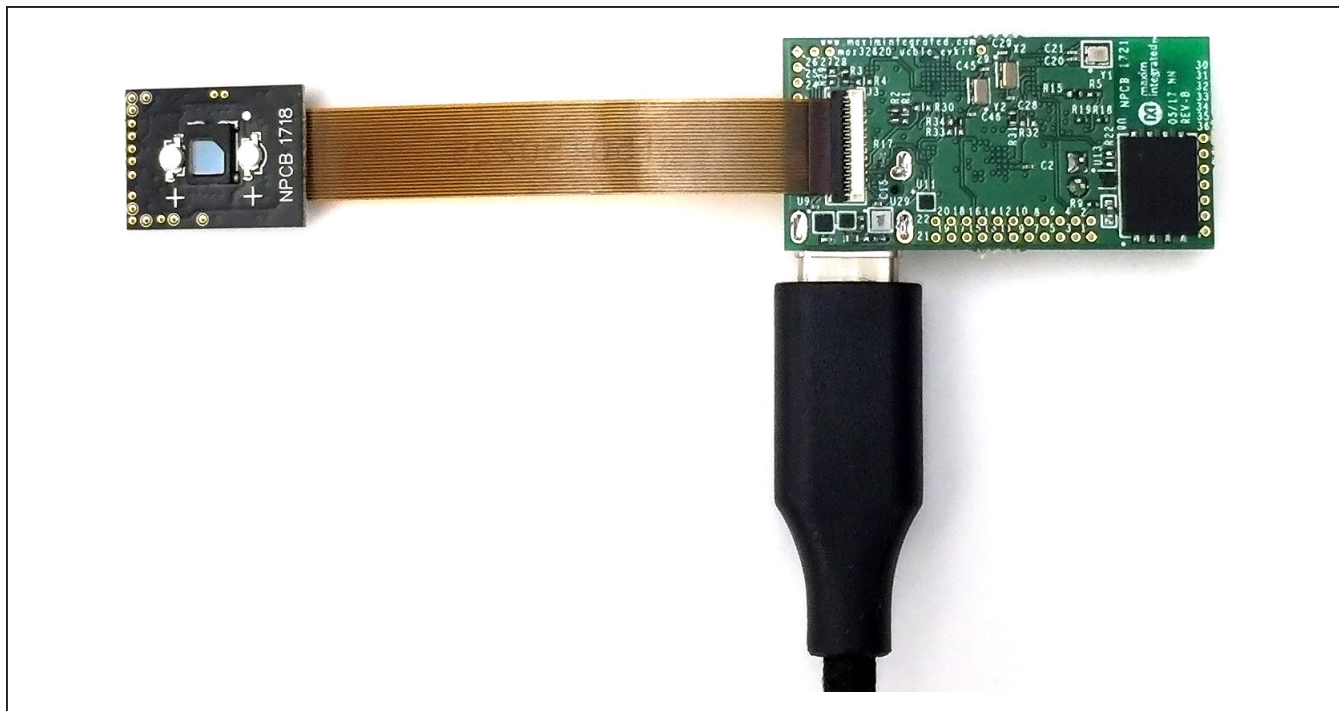
Figure 10. Hardware Setup (MAX86140 EVSYS Sensor PCB)

Figure 11. Hardware Setup (MAX86141 EVSYS Micro PCB)
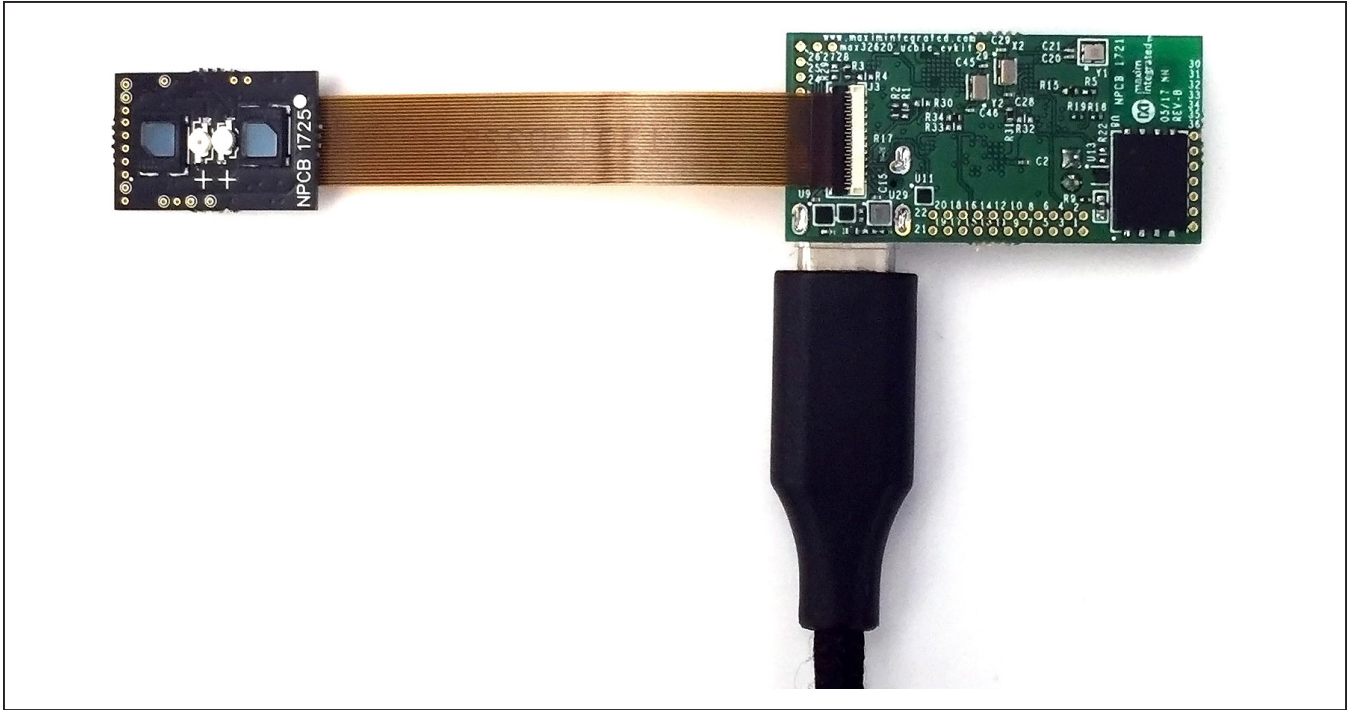
Figure 12. Hardware Setup (MAX86141 EVSYS Sensor PCB)
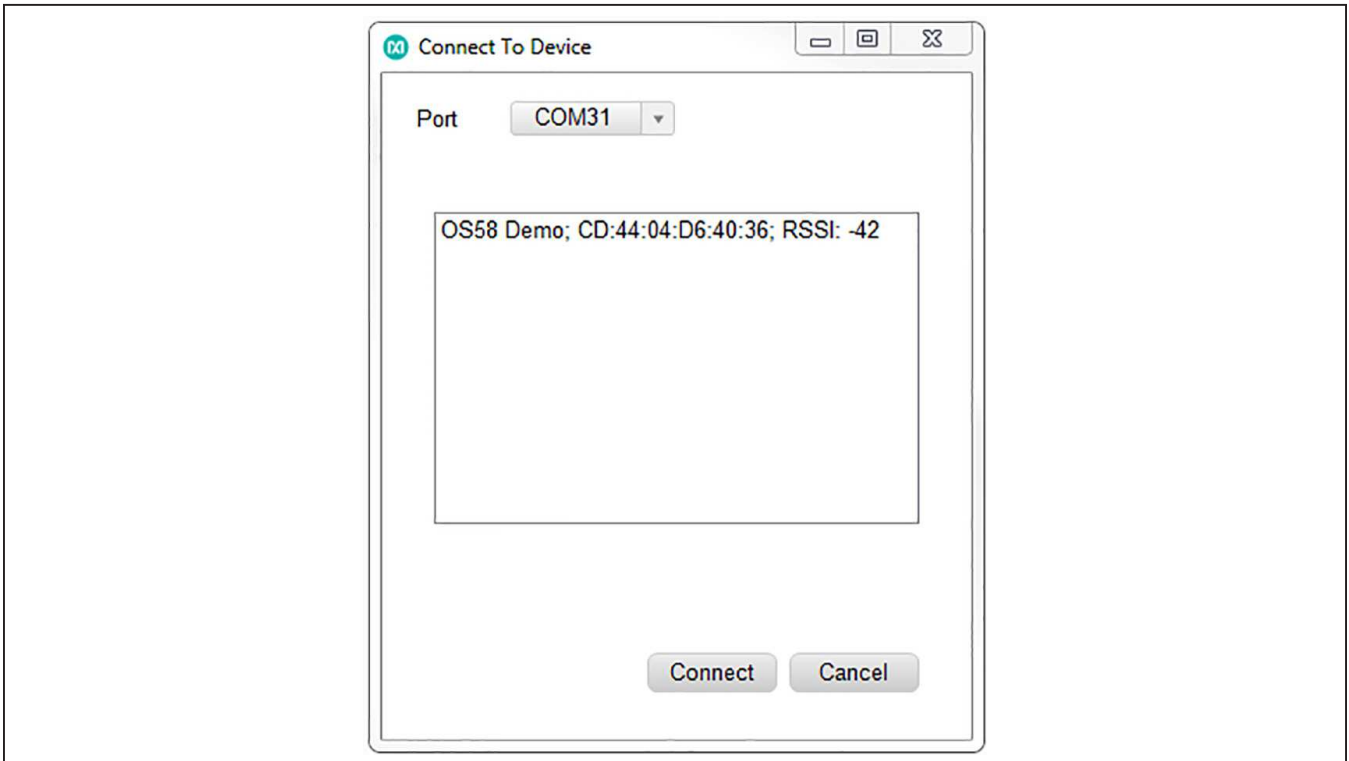
Figure 13. Connect to BLE Device

Figure 14. MAX86140 EVSYS GUI

Figure 15. MAX86140 EVSYS GUI (PPG Plots)

Figure 16. MAX86140 EVSYS GUI (Accelerometer Plots)

Detailed Description of Software

The EVSYS includes two sensor PCB. Each contains MAX86140/MAX86141 optical AFE, a 3-axis accelerometer together with two different photodiodes and LEDs. MAX86140_OSB_EVSYS comes with a discreet photodiode (VEMD5010X01) and two green LEDs (LT PWSG-AABB-36-46-F), while MAX86140_OSB_EVSYS comes with two discreet photodiodes (VEMD5010X01), a gre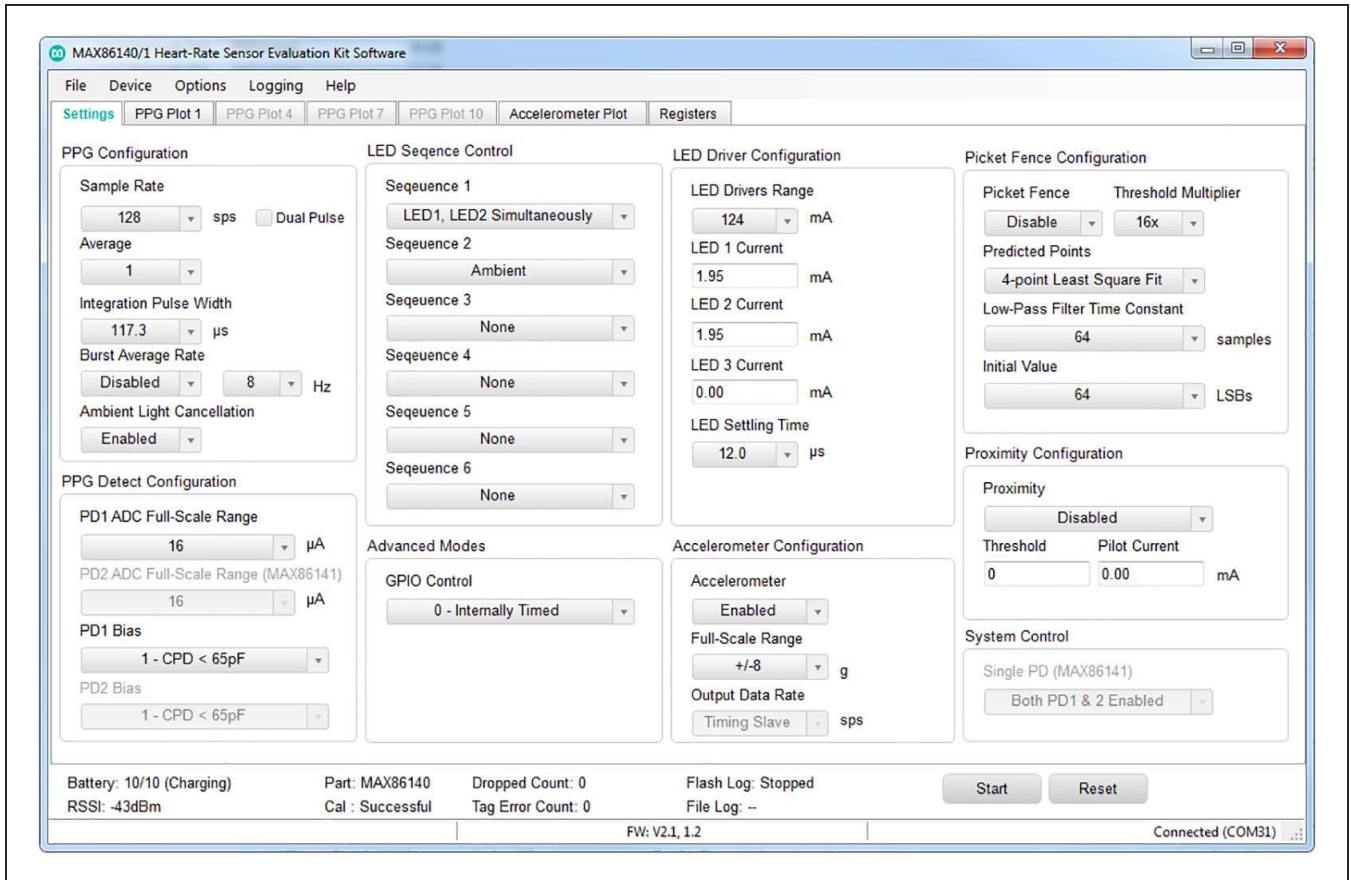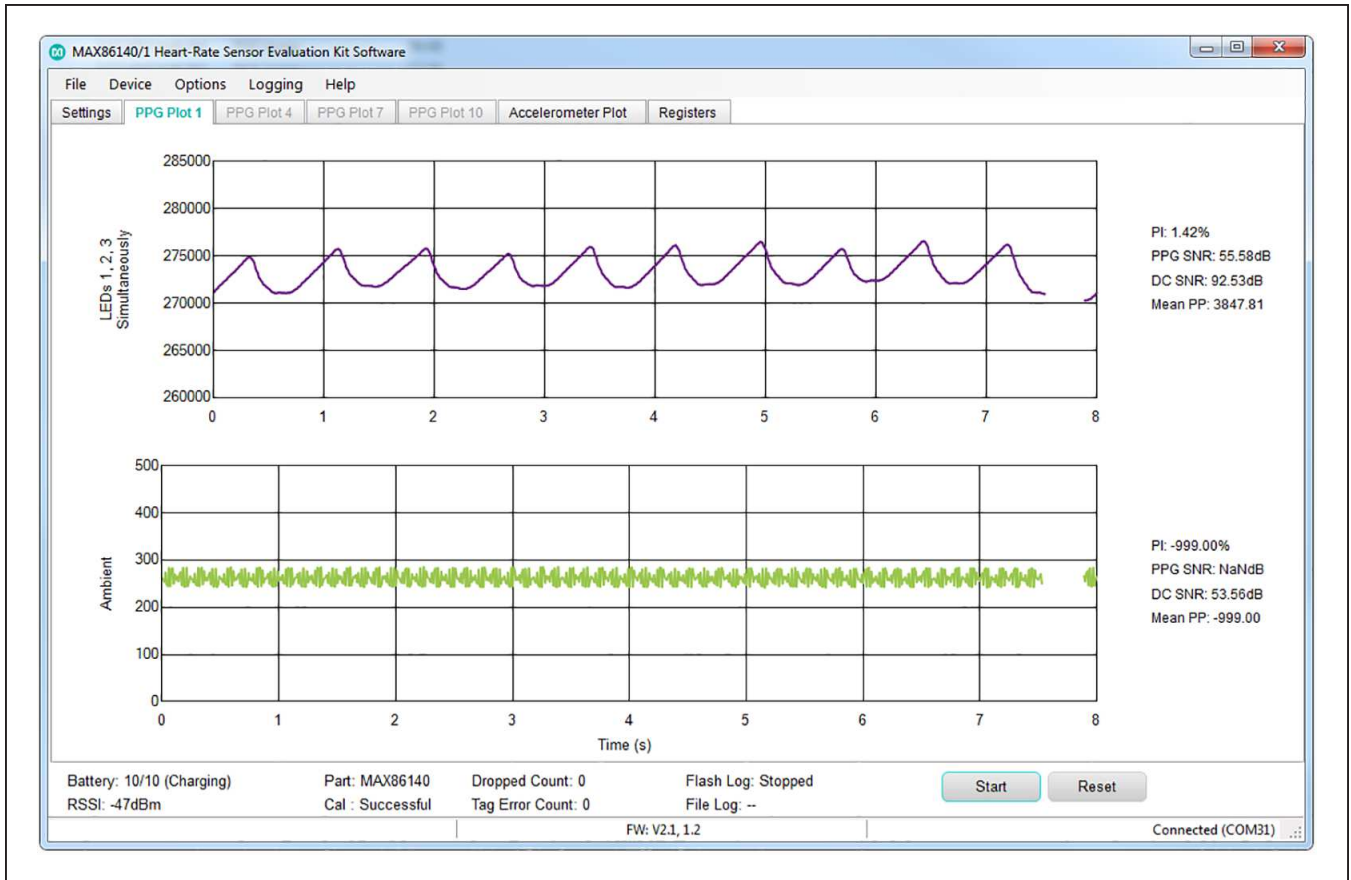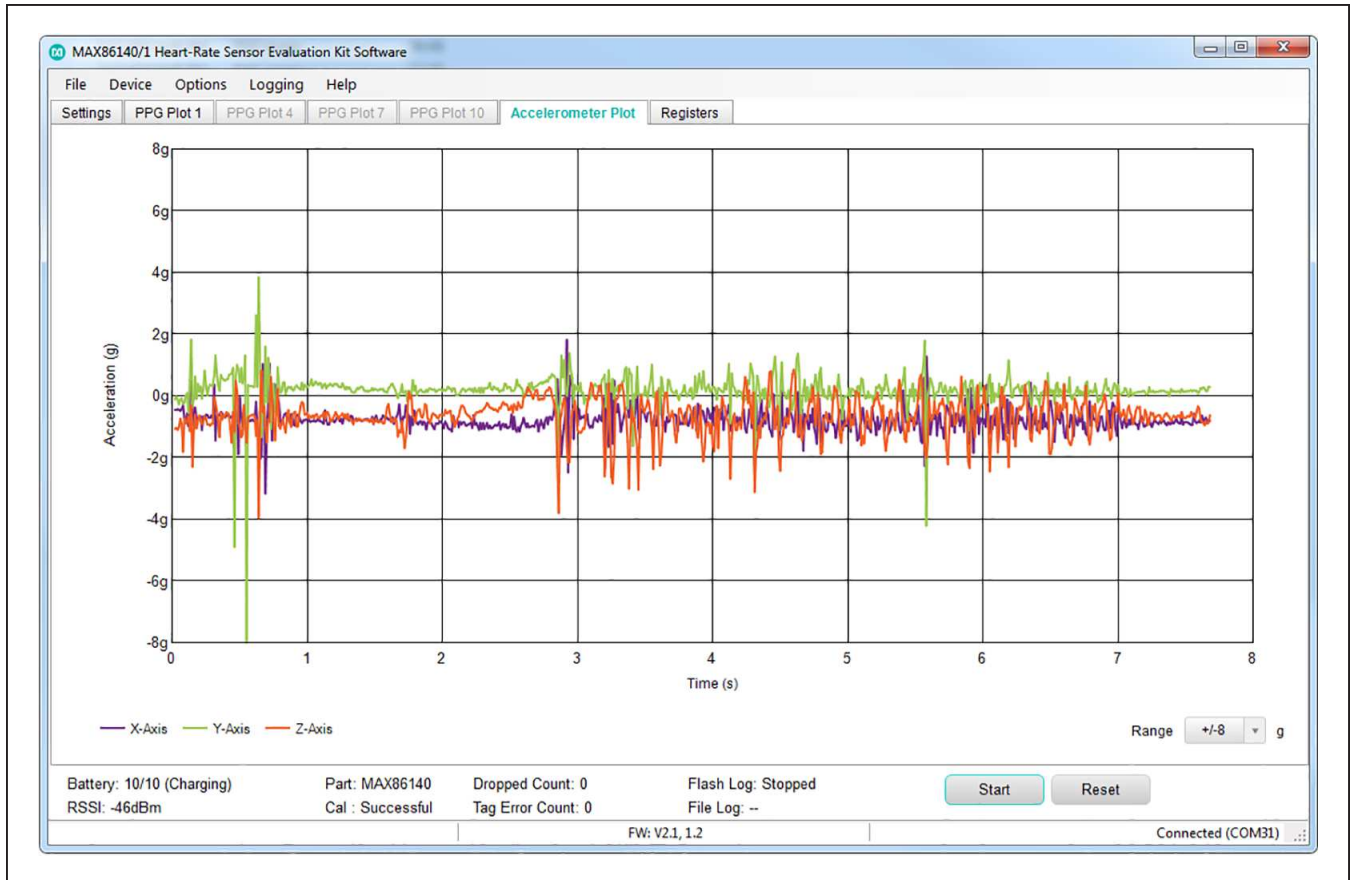en LED (LT PWSG-AABB-36-46-F) and an amber LED(Q65111A5283). The EVSYS allows raw optical and accelerometer data to be sampled and transferred to the GUI for both dynamic viewing and logging for later analysis. The EVSYS micro controller PCB is used to do SPI to BLE communication, transporting the raw optical and accelerometer data to the PC via BLE.

Most functionality of the MAX86140/MAX86141 has been mapped to the GUI so the wide variety of applications supported by the MAX86140/MAX86141 can be rapidly explored. The following is a brief description of this functionality options.

Sample Rate

The sample rate can take on values between 8 to 4096sps. The dual pulse mode option are modes where the samples are unevenly spaced and averaged to improve the ambient rejection of mains line rate ambient signals.

Table 1 and Table 2 shows the maximum supported sampling rates (in Sps) for the MAX86140 and MAX86141 respectively for the given number of exposure sequences and use of accelerometer. The maximum sample rate is limited by the BLE protocol, not the AFE itself.

For a given sample rate, the number listed can be increased to the next available MAX86140/MAX86141 sample rate (i.e., 500Sps → 512Sps).

Integration Pulse Width

The pulse width setting adjusts the integration time of an exposure. The MAX86140\MAX86141 supports exposure integration times of 14.8µs, 29.4µs, 58.7µs, and 117.3µs. The exposure pulse width is a critical parameter in any optical measurement. Longer exposures allow for more optical photons to be integrated but also increase system power and reduce ambient rejection capability.

Burst Rate

When Burst Mode is disabled, PPG data conversions are continuous at the sample rate defined by PPG_SR register, When Burst mode is enabled, a burst of PPG data conversions occurs at the sample rate defined by Sample Rate

(PPG_SR) register. Number of conversion in the burst is defined by the SMP_AVE register. Average data from the burst of data conversions is pushed to the FIFO at the rate of burst average rate. The burst repeats at the rate of 8, 32, 84, or 256Hz can be configured in burst average field. The burst average rate field defines the rate at which data is pushed into the FIFO. If the number of conversions cannot be accommodated, the device will use the next highest number of conversions. If the effective sample rate is too slow to accommodate the burst rate programmed, BURST_EN is automatically set to 0, and the device runs in continuous mode.

Ambient Light Cancellation

The on-chip Ambient Light Cancellation incorporates a proprietary scheme to cancel ambient light generated photo diode current, allowing the sensor to work in high ambient light conditions.

ADC Full-Scale Range

The MAX86140\MAX86141 optical channel has 4 full-scale ranges. These ranges are 4µA, 8µA, 16µA, and 32µA.

Table 1. MAX86140 Max Sample Rates (Sps)

ACCELEROMETER # OF SEQUENCES	WITH	WITHOUT
1	500	1000
2	500	1000
3	250	500
4	250	500
5	125	250
6	125	250

Table 2. MAX86141 Max Sample Rates (Sps)

ACCELEROMETER # OF SEQUENCES	WITH	WITHOUT
1	500	1000
2	250	500
3	125	250
4	125	125
5	125	125
6	62.5	125

Sample Average

The MAX86140\MAX86141 has the capability to do sample averaging of 2 ~ 128 samples internally. 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 micro is not desirable. This mode is also useful to further suppress the mains line noises in indoor lighting conditions.

PD Bias

The MAX86140\MAX86141 provides multiple photo diode biasing options. These options allow the MAX86140\MAX86141 to operate with a large range of photo diode capacitance. The PDBIAS values adjust the PD_IN bias point impedance to ensure that the photo diode settles rapidly enough to support the sample timing. PDBIAS is configured depending on the Capacitance (CPD) of the photodiode used.

Note: PD2 configuration is only available for MAX86141.

LED Sequence Control (FIFO Time Slots)

The LED Sequence Control specifies the data acquisition sequence that the internal state machine controller will follow and where the converted data will be mapped into the FIFO.

Each FIFO field can be applied to one measurement. Acquired data can be from LED1, LED2, or LED3 (optical exposure from LED1~3) illuminated independently. The LED1&LED2, LED1&LED3, LED2&LED3, and LED1&LED2&LED3 are optical exposures from LEDs illuminated simultaneously. The other options are Ambient (optical data with no exposure, just ambient illumination) or None (skip this acquisition). The LED4-6 (Mux Control) are not supported with the sensor PCB. If a custom sensor board with MUX is used, LED4, LED5 and LED6 can also be configured. Only LED1 and LED2 are available in this EVSYS.

The exposure sequence will be the entry in Sequence 1 (LEDC1) slot, Sequence 2 (LEDC 2) slot, Sequence 3 (LEDC3), Sequence 4 (LEDC4), Sequence 5 (LEDC5) slot then Sequence 6 (LEDC6) slot. This sequence will repeat for each sample instance. Each Sequence if programmed, will be plot in the PPG Plot x tabs respectively as shown in Figure 15.

Please refer to the MAX86140/MAX86141 datasheet under FIFO Configuration Section for details.

LED Driver Configurations

Each of the three LED drivers has a Range and Peak LED Current setting. There are 4 full-scale range settings 31mA, 62mA, 93mA and 124mA. Each range has an 8-bit current source DAC. The Peak LED Current box allows for an actual current to be entered. The nearest available DAC current is selected and displayed in the field.

LED Settling Time

The LED Settling Time is the time prior to the start of integration (pulse-width setting) that the LED is turned on. There are four settlings, 12µs, 8µs, 6µs and 4µs. This time is necessary to allow the LED driver to settle before integrating the exposure photo current.

GPIO Control

Various options of GPIO controls are available on MAX86140. For the EVSYS, when set to GPIO options 2, the sample rate will be triggered by the on-board accelerometer.

Please refer to the MAX86140/MAX86141 datasheet under GPIO Configuration Section for details.

Accelerometer Configuration

The on-board accelerometer can be enabled or disabled by using the GUI. Supported accelerometer Full-Scale Range are ±2g, ±4g, ±8g and ±16g. The output data of the accelerometer can also be configured from 15.63Hz to 2000Hz when used with GPIO Control Option 2.

Picket Fence Configuration

Under typical situations, the rate of change of ambient light is such that the ambient signal level during exposure can be accurately predicted and high levels of ambient rejection are obtained. However, it is possible to have situations where the ambient light level changes extremely rapidly, for example when in a car with direct sunlight exposure passes under a bridge and into a dark shadow. In these situations, it is possible for the on-chip ambient light correction (ALC) circuit to fail and produce and erroneous estimation of the ambient light during the exposure interval. The optical controller has a built-in algorithm, call the picket fence function, that can correct for these extreme conditions resultant failure of the ALC circuit.

Please refer to the MAX86140/MAX86141 datasheet under Picket Fence Detect-and-Replace Function Section for details.

Proximity Configuration

The optical controller also includes an optical proximity function which could significantly reduce energy consumption and extend battery life when the sensor is not in contact with the skin.

Please refer to the MAX86140/MAX86141 datasheet under Proximity Mode Section for details.

System Control

When MAX86141 is used, there is option to use single PD (PD1) or Dual PD simultaneously (PD1 and PD2). When Dual PD mode is used, the data log will shows data from both PD for each configured sequence.

<Start >/<Stop > Button

The <Start Monitor> button is used to start data acquisition from the demo. The <Start Monitor> button will only be effective when the EVSYS is connected and detected. Once the <Start > has been pushed the <Stop> button appears, which can be used to stop the acquisition. Once the acquisition has started, all settings are locked. Terminate the acquisition to change any settling.

<Reset> Button

The <Reset> button will clear out all register settlings back to the programs start up.

Data Logging

Raw optical and accelerometer data can be logged from the <Logging> pull-down menu item. There are two options available: Data saved to file or in the flash. When "file" data logging is selected, the GUI asks for a folder location where the logging file will be saved. Create a new folder or accept the default. Data logging will start on the next <Start> button and will continue until the <Stop > button is pressed. The final file write is only done when the <File> pull-down menu item is accessed and the data-logging button is pressed.

Flash logging allows raw sensor data to be stored to the integrated 32MB flash memory chip in a binary file format. The max duration for flash logging is dependent on: sample rate, number of optical channels, and use of accelerometer.

The GUI enables/disables flash logging. The GUI can be disconnected while flash logging, allowing for remote operation (PPG Plots not available). Preparing the flash memory can take up to 30s after enabling. If the flash memory fills or battery power drops too low, flash logging will automatically stop and the file will close. Only one file can be saved at a time. The file must be downloaded since it will be erased on the next log request.

If a log has completed, a binary file will be found on the device. The binary log file must be downloaded via the USB-C cable; it cannot be downloaded through BLE. When the device is plugged into the PC, it enumerates as a USB mass storage device. However, the file can only be copied from this device. No other operations (such as deleting or saving other files) will work on this device. Copy the file to a local PC volume. Then run the parser to generate a CSV file.

Please refer to the Evaluation Kit Parser User Guide (max8614x demo + eval kit parser user guide 20170719.pdf) for details operation.

Register Map Access

Under the <Register> Tab the user can access to sensor register map as shown in Figure 15. Press <Read All>, to read all the register value currently in configured in the Optical AFE. Bolded font bits are logic one. Normal font bits are logic zero. Click on the bits to toggle their value and click on <W> to write the value to the device. The register value does not change until <W> is clicked. Click <R> to read the register value to verify the write.
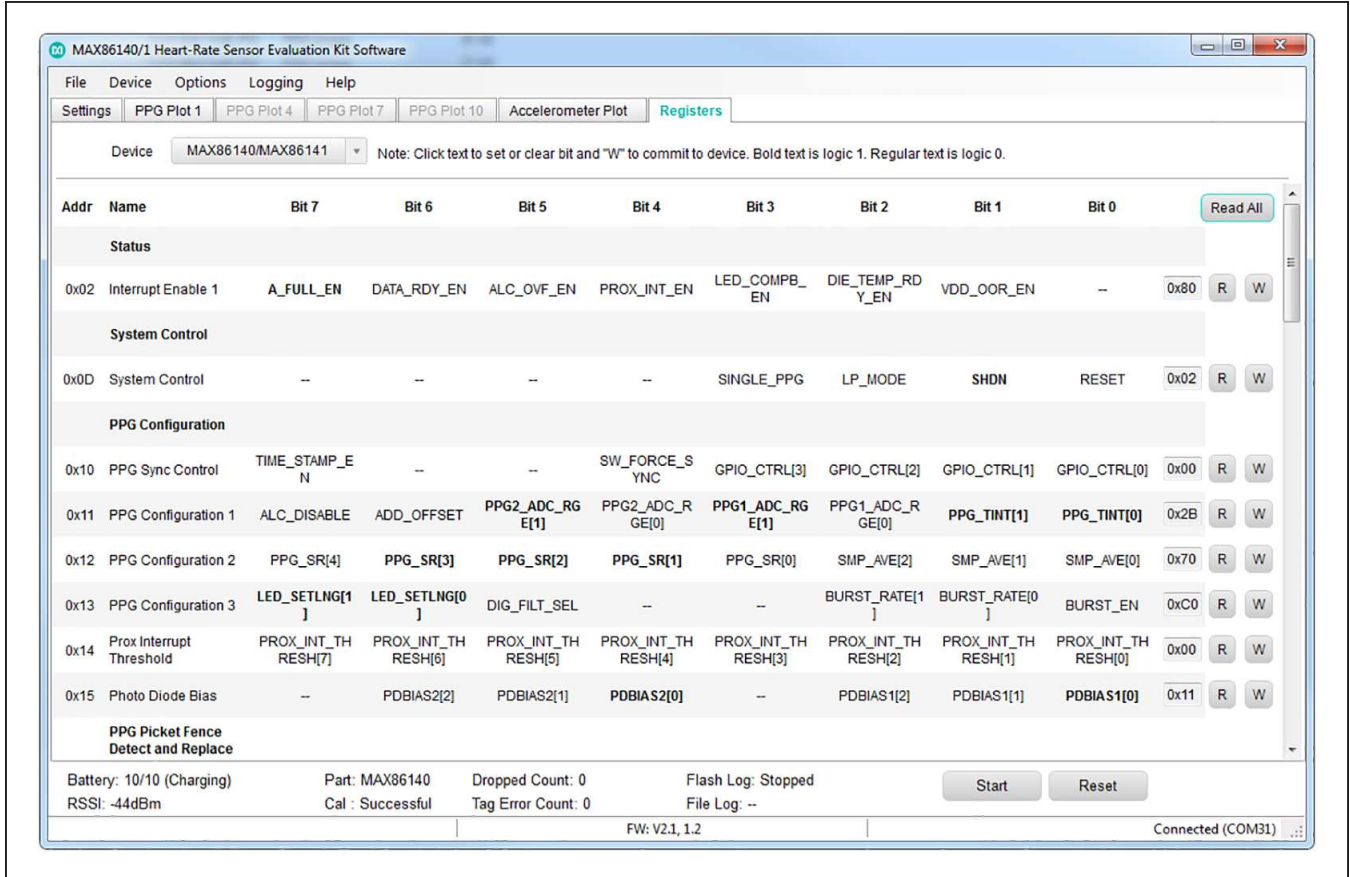
Figure 17. Register Map Access

Detailed Description of Hardware

Status LED Indicators

The onboard tri-color LEDs are use as status indicator.

LED Green

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

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

LED Red

USB-C cable connected to 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 device 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.

Power Switch

Press the power switch (SW) to turn on/off the device. When powered on, the green LED will toggle per the LED indicator section. When powered off, the green LED will go out. The red LED may light temporarily, indicating that the flash log is closing. Plugging in the USB-C cable will also power up the device.

Battery/Charging

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

Ordering Information

PART	TYPE
MAX86140EVSYS#	EVSYS

#Denotes RoHS compliant.

Component List

MAX86140 EVSYS

PART	QTY	DESCRIPTION
MAX32620UCBLEEK#	1	MAX86140 EVSYS Micro-PCB
MAX86140OSBEK#	1	MAX86140 EVSYS Sensor PCB
MAX86141OSBEK#	1	MAX86141 EVSYS Sensor PCB

MAX86140/MAX86141 EV Kit Bill of Materials

MAX32620UCBLEEK#

QTY	REF DES	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	A1	2450AT18A100	JOHANSON TECHNOLOGY	2450AT18A100	ANTENNA; 2450AT SERIES; BOARDMOUNT; MINI 2.45 GHZ ANTENNA; 2450MHZ
1	BAT	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
11	C1, C22, C26, C30-C37	GRM033R61A104KE15D; 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
9	C2, C15, C25, C38-C43	GRM033R61A105ME15	MURATA	1UF	CAPACITOR; SMT (0201); CERAMIC CHIP; 1UF; 10V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R
7	C3, C4, C8, C9, C12, C16, C27	C1005X5R1A475M050BC	TDK	4.7UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 4.7UF; 10V; TOL=20%; MODEL=C SERIES; TG=-55 DEGC TO +85 DEGC; TC=X5R
7	C5-C7, C10, C13, C14, C47	GRM155R60J226ME11	MURATA	22UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 22UF; 6.3V; TOL=20%; TC=X5R
1	C19	GJM0335C1E1R0WB01	MURATA	1PF	CAPACITOR; SMT (0201); CERAMIC CHIP; 1PF; 25V; TOL=0.05PF; TG=-55 DEGC TO +125 DEGC; TC=C0G
7	C20, C21, C28, C29, C45, C46, Z44	GRM0335C1H120GA01	MURATA	12PF	CAPACITOR; SMT (0201); CERAMIC CHIP; 12PF; 50V; TOL=2%; TG=-55 DEGC TO +125 DEGC; TC=C0G
2	C23, C24	GRM0335C1H101JA01	MURATA	100PF	CAPACITOR; SMT (0201); CERAMIC CHIP; 100PF; 50V; TOL=5%; TG=-55 DEGC TO +125 DEGC; TC=C0G
1	CN1	DX07S024JJ3	JAE ELECTRONIC INDUSTRY	DX07S024JJ3	CONNECTOR; FEMALE; SMT; USB TYPE-C CONNECTOR; DX07 SERIES RECEPTACLE; RIGHT ANGLE; 24PINS
2	DS1, DS2	SML-P11UTT86	ROHM	SML-P11UTT86	DIODE; LED; SMT; PIV=1.8V; IF=0.02A
1	J3	5035662500	MOLEX	5035662500	CONNECTOR; FEMALE; SMT; EASY-ON TYPE HOUSING ASSEMBLY; RIGHT ANGLE; 25PINS
2	L1, L2	DFM18PAN2R2MG0L	MURATA	2.2UH	INDUCTOR; SMT (0603); CERAMIC CHIP; 2.2UH; TOL=+/-20%; 1.1A; NOTE: ORDERED DIRECT FROM MANUFACTURER
1	L3	DFE201610E-4R7M=P2	MURATA	4.7UH	INDUCTOR; SMT (2016); METAL ALLOY CHIP; 4.7UH; TOL=+/-20%; 1.3A
1	L4	LQP03HQ3N3B02	MURATA	3.3NH	INDUCTOR; SMT (0201); FILM TYPE; 3.3NH; TOL=+/-0.1nH; 0.5A
1	LED	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
9	R2, R3, R11, R15, R24, R27, R28, R31, R34	ERJ-2GE0R00X	PANASONIC	0	RESISTOR; 0402; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM
2	R5, R9	ERJ-1GEF1002C	PANASONIC	10K	RESISTOR; 0201; 10K OHM; 1%; 200PPM; 0.05W; THICK FILM
7	R6, R7, R16, R17, R23, R25, R26	ERJ-1GEF4701C	PANASONIC	4.7K	RESISTOR; 0201; 4.7K OHM; 1%; 100PPM; 0.05W; THICK FILM 3-LAYER ELECTRODE
1	R8	ERJ-1GEF3902C	PANASONIC	39K	RESISTOR; 0201; 39K OHM; 1%; 100PPM; 0.05W; THICK FILM 3-LAYER ELECTRODE
1	R10	NCP15XH103F03RC	MURATA	10K	THERMISTOR; SMT (0402); THICK FILM (NICKEL PLATED); 10K; TOL=+/-1%
1	R13	ERJ-1GEF2613C	PANASONIC	261K	RESISTOR; 0201; 261K OHM; 1%; 200PPM; 0.05W; THICK FILM
1	R14	CRCW0201100KFKF	VISHAY DALE	100K	RESISTOR; 0201; 100K OHM; 1%; 100PPM; 0.05W; THICK FILM
2	R18, R19	ERJ-1GEF2000C	PANASONIC	200	RESISTOR; 0201; 200 OHM; 1%; 200PPM; 0.05W; THICK FILM
4	RA1-RA4	ERJ-1GEF33R0C	PANASONIC	33	RESISTOR; 0201; 33 OHM; 1%; 100PPM; 0.05W; THICK FILM 3-LAYER ELECTRODE
1	SW	EVP-AWCD2A	PANASONIC	EVP-AWCD2A	SWITCH; SPST; SMT; STRAIGHT; 15V; 0.02A; EVP-AW SERIES
1	U1	MAX20303	MAXIM	MAX20303	EVKIT PART- IC; WEARABLE POWER NAMAGEMENT SOLUTION; PACKAGE OUTLINE; WLP 56 PINS; 0.5MM PITCH; PKG. CODE: W563A4+1; PKG. OUTLINE: 21-100104
1	U2	NRF52832-CIAA	NORDIC SEMICONDUCTOR	NRF52832-CIAA	IC; SOC; MULTIPROTOCOL BLUETOOTH LOW ENERGY; ANT; 2.4GHZ RF SOC; WLCSP50
5	U3-U6, U9	MAX14689EWL+	MAXIM	MAX14689EWL+	IC; ASW; 0.125A; FREQUENCY-SELECTSBLE; SWITCHED-CAPACITOR VOLTAGE CONVERTER; WLP9 1.2X1.2
1	U7	IP4221CZ6-S	NXP	IP4221CZ6-S	IC; PROT; ESD PROTECTION FOR HIGH-SPEED INTERFACE; XSON6
1	U8	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
2	U10, U11	MAX9062EBS+G45	MAXIM	MAX9062EBS+G45	IC; COMP; ULTRA-SMALL; LOW-POWER SINGLE COMPARATOR; UCSP4
1	U12	MAX32620IWG+	MAXIM	MAX32620IWG+	IC; UCON; HIGH-PERFORMANCE; ULTRA-LOW POWER CORTEX-M4F MICROCONTROLLER FOR RECHARGEABLE DEVICES; WLP81
1	U13	74AUP1G97GF	NXP	74AUP1G97GF	IC; LOGC; LOW-POWER CONFIGURABLE MULTIPLE FUNCTION GATE; XSON6
1	U29	MAX1819EBL50+	MAXIM	MAX1819EBL50+	IC; VREG; 500MA LOW-DROPOUT LINEAR REGULATOR IN UCSP; UCSP6
2	X2, Y2	ECS-.327-6-12	ECS INC	32.768KHZ	CRYSTAL; SMT 2.0 MM X 1.2 MM; 6PF; 32.768KHZ; +/-20PPM; -0.03PPM/DEGC2
1	Y1	US3200005Z	PERICOM SEMICONDUCTOR	32MHZ	CRYSTAL; SMT 1.6 MM X 1.2MM; 8PF; 32MHZ; +/-10PPM; +/-10PPM
1	PCB	MAX	MAXIM	PCB	PCB:MAX
9	R1, R4, R20-R22, R29, R30, R32, R33	ERJ-2GE0R00X	PANASONIC	0	RESISTOR; 0402; 0 OHM; 0%; JUMPER; 0.10W; THICK FILM
1	Z17	GJM0335C1E1R0WB01	MURATA	1PF	CAPACITOR; SMT (0201); CERAMIC CHIP; 1PF; 25V; TOL=0.05PF; TG=-55 DEGC TO +125 DEGC; TC=C0G
1	Z18	250R05L1R8AV4	JOHANSON TECHNOLOGY	1.8PF	CAPACITOR; SMT (0201); MICROWAVE; 1.8PF; 25V; TOL=0.05PF; TG=-55 DEGC TO +125 DEGC; TC=C0G

MAX86140/MAX86141 EV Kit Bill of Materials (continued)

MAX86140OSBEK#

ITEM	QTY	REF DES	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
1	6	C1-C3, C5, C6, C9	04026D226MAT2A	AVX	22UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 22UF; 6.3V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R
2	2	C4, C8	GRM033R61A105ME15	MURATA	1UF	CAPACITOR; SMT (0201); CERAMIC CHIP; 1UF; 10V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R
3	1	C7	GRM155R61A106ME44; GRM155R61A106ME11; 0402ZD106MAT2A	MURATA; AVX	10UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 10UF; 10V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R
4	1	D1	VEMD5010X01	VISHAY SEMICONDUCTORS	VEMD5010X01	DIODE; PIN; SMT; PIV=1V; IF=0.05
5	2	DS1, DS2	LT PWSG-AABB-36-46-F	OSRAM	LT PWSG-AABB-36-46-F	DIODE; LED; POINTLED; GREEN; SMT; VF=3.2V; IF=0.02A
6	1	J1	5016162575	MOLEX	5016162575	CONNECTOR; FEMALE; SMT; EASY-ON TYPE FPC CONNECTOR; RIGHT ANGLE; 25PINS
7	7	R1-R3, R5, R6, R4, R13	CRCW02010000ZS; ERJ-1GN0R00C	VISHAY DALE/PANASONIC	0	RESISTOR; 0201; 0 OHM; 0%; JUMPER; 0.05W; THICK FILM
8	6	R9-R12, R14, R15	CRCW0201100RFK; ERJ-1GEF1000C	VISHAY DALE/PANASONIC	100	RESISTOR; 0201; 100 OHM; 1%; 100PPM; 0.05W; THICK FILM
9	1	U1	MAX86140	MAXIM	MAX86140	EVKIT PART-IC; OPTICAL AFE OPTIMIZE FOR HR ON WRIST APPLICATION; WLP20
10	1	U2	BMA280	BOSCH	BMA280	IC; SNSR; 14 BIT DIGITAL TRIAXIAL ACCELERATION SENSOR WITH INTELLIGENT ON-CHIP MOTION-TRIGGRED INTERRUPT CONTROLLER; LGA12

MAX86141OSBEK#

QTY	REF DES	MFG PART #	MANUFACTURER	VALUE	DESCRIPTION
6	C1-C5, C10	04026D226MAT2A	AVX	22UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 22UF; 6.3V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R
1	C7	GRM155R61A106ME44; GRM155R61A106ME11; 0402ZD106MAT2A	MURATA; AVX	10UF	CAPACITOR; SMT (0402); CERAMIC CHIP; 10UF; 10V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R
2	C8, C9	GRM033R61A105ME15	MURATA	1UF	CAPACITOR; SMT (0201); CERAMIC CHIP; 1UF; 10V; TOL=20%; TG=-55 DEGC TO +85 DEGC; TC=X5R
2	D1, D2	VEMD5010X01	VISHAY SEMICONDUCTORS	VEMD5010X01	DIODE; PIN; SMT; PIV=1V; IF=0.05A
1	DS1	LT PWSG-AABB-36-46-F	OSRAM	LT PWSG-AABB-36-46-F	DIODE; LED; POINTLED; GREEN; SMT; VF=3.2V; IF=0.02A
1	DS2	Q65111A5283	OSRAM	Q65111A5283	DIODE; LED; LY P47F SERIES; POINTLED; YELLOW; SMT; VF=2.35V; IF=0.03A
1	J1	5016162575	MOLEX	5016162575	CONNECTOR; FEMALE; SMT; EASY-ON TYPE FPC CONNECTOR; RIGHT ANGLE; 25PINS
7	R1-R3, R5, R6, R4, R13	CRCW02010000ZS; ERJ-1GN0R00C	VISHAY DALE/PANASONIC	0	RESISTOR; 0201; 0 OHM; 0%; JUMPER; 0.05W; THICK FILM
6	R9-R12, R14, R15	CRCW0201100RFK; ERJ-1GEF1000C	VISHAY DALE/PANASONIC	100	RESISTOR; 0201; 100 OHM; 1%; 100PPM; 0.05W; THICK FILM
1	U1	MAX86141	MAXIM	MAX86141	EVKIT PART-IC; OPTICAL ANALOG FRONT-END (AFE) OPTIMIZE FOR HR ON WRIST APPLICATION; WLP20
1	U2	BMA280	BOSCH	BMA280	IC; SNSR; 14 BIT DIGITAL TRIAXIAL ACCELERATION SENSOR WITH INTELLIGENT ON-CHIP MOTION-TRIGGRED INTERRUPT CONTROLLER; LGA12

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MAX86140/MAX86141
Evaluation System

MAX86140/MAX86141 EV Kit Schematics

MAX32620UCBLEEK#

Evaluates: MAX86140 and MAX86141

U1
MAX20303

Pin	Signal		Pin	Signal
E6	ALRT	PMIC_ALRT_N	F6	RST	RST_N
D5	CTG		E2	PFN2	PMIC_PFN2
D6	QSTRT		D2	PFN1	PMIC_PFN1
C6	CELL		VDIG	D4
H5	CHGIN	USB_VBUS	E4	CAP
F3	SET		F4	TPU
F2	SFOUT		F5	THM
			H3	BAT	BATT_PWR
B1	SCL	SCL	A4	SYS	SYS_OUT
B2	SDA	SDA	H4	SYS
G2	INT	PMIC_INT_N	B6	L2IN
C5	MPC0		A5	L2OUT
C4	MPC1		H7	BK1LX
G4	MPC2		G7	BK1OUT
G3	MPC3	PMIC_MPC	G6	L1IN
C3	MPC4		G5	L1OUT
E3	MON	PMIC_MON	A7	BK2LX
A2	DRP		B7	BK2OUT
A1	DRN		B5	CPOUT
E1	LED0	PMIC_LED0	B3	CPP
D1	LED1	PMIC_LED1	B4	CPN
C1	LED2	PMIC_LED2	H2	BSTLVLX
			H1	BSTHVLX
			F1	BSTOUT
			F7	BBLVLX
			E7	BBHVLX
			C7	BBOUT

AGND E5, GSUB D3, DGND C2, HDGND A3, BK1GND H6, BK2GND A6, BSTGND G1, BBGND D7

U13
74AUP1G97GF
VCC 5, A 3, B 1, C 6, Y 4, GND 2
PMIC_MPC

1V8_B
R5 10K RST_N
R6 4.7K SDA
R7 4.7K SCL

C1 0.1UF
C2 1UF
R8 39K
3V3
C3 4.7UF

SW
EVP-AWCD2A
R9 10K
R10 10K

C4 4.7UF
C5 22UF

BATT_PWR
C6 22UF C7 22UF
B2B-PH-K-S(LF)(SN) BAT
C47 22UF
C8 4.7UF
C9 1V8_S 4.7UF

1V2
L1 2.2UH
C10 22UF

1V8_B
L1 C12 4.7UF
1V8_S

L2 2.2UH
C13 22UF
1V8_B

L2OUT ACTS AS LDO
L1OUT ACTS AS SWITCH
ONLY ONE IS ENABLED

L3 4.7UH
5V0_B
C14 22UF
R11 0

U29
MAX1819EBL50+
IN OUT
SHDN POK
SET GND
C15 1UF
C16 4.7UF
R13 261K
R14 100K
SHDN_N
C3

LED
SM_LX0404SIUPGUSB
R, B, G
SYS_OUT

J3
5035662500

Signal	Pin		Pin
ACC_INT_N	1		2
SPI0_CSOPT_N	3		4
SPI0_MISO	5		6
SPI0_SCK	7		8
SPI0_MOSI	9		10
SPI0_CSACC	11		12
OPT_INT_N	13		14
1V8_S	15		16
	17	J3.17	18	J3.18
	19		20
	21		22
VLED	23		24
	25		26
	27		

SDA R29 DNI J3.17
SCL R30 DNI J3.18
VLED
C43 1UF

MAX86140/MAX86141 EV Kit Schematics (continued)

MAX32620UCBLEEK#

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MAX86140/MAX86141
Evaluation System

Evaluates: MAX86140 and MAX86141

MAX86140/MAX86141 EV Kit Schematics (continued)

MAX32620UCBLEEK#

DEBUG LEDS

1V8_B

C

SML-P11UTT86   DS2
SML-P11UTT86   DS1

R19
200

R18
200

DBG_LED0
DBG_LED1

1V8_B

C35   0.1UF

U8   S25FS256SAGNFI001

VDD   8

SPI2_SCK   R20   SPI1_CSF_N   1   CS#   SI/IO0   5   SPI1_MOSI/IO0   0   DNI   R21   SPI2_MOSI
DNI   SO/IO1   2   SPI1_MISO/IO1   0   DNI   R22   SPI2_MISO
SPI1_SCK   6   SCK   WP#/IO2   3   SPI1_WP/IO2
IO3/RESET#   7   SPI1_FRST/IO3

VSS   EP
4   9

USB_A9B9 IS NOT USED (JTAG RESETB)
CN1
DX07S024JJ3

A1   A1   B12   B12
TX1+   A2   A2   B11   B11   RX1+
TX1-   A3   A3   B10   B10   RX1-
USB_VBUS   A4   A4   B9   B9   USB_A9B9
USB_A5   A5   A5   B8   B8   USB_SBU12
USB_DP   A6   A6   B7   B7   USB_DM
USB_DM   A7   A7   B6   B6   USB_DP
USB_SBU12   A8   A8   B5   B5   USB_B5
USB_A9B9   A9   A9   B4   B4   USB_VBUS
RX2-   A10   A10   B3   B3   TX2+
RX2+   A11   A11   B2   B2   TX2+
A12   A12   B1   B1

R16
4.7K

R17
4.7K

SHIELD
SHIELD_1   SHIELD_2   SHIELD_4   SHIELD_3

3V3

U9
MAX14689EWL+

C36   0.1UF

VCC
DBG_EN   A2   CB
USB_SBU12   B1   COM1   NC1   A1
NO1   C1   1V8_B
B3   COM2   NC2   A3
NO2   C3
GND

USB_VBUS

C34
0.1UF

U7
IP4221CZ6-S

USB_B5   1   I/O   VCC   5
USB_DP   3   I/O
USB_DM   4   I/O
USB_A5   6   I/O   GND   2

3V3

3V3

U10
MAX9062EBS+G45

R23
4.7K

USB_A5   A2   IN   VCC   B1
OUT   A1   DBG_E
GND   B2

3V3

U11
MAX9062EBS+G45

USB_B5   A2   IN   VCC   B1
OUT   A1
GND   B2

COMPARATORS DETECT
PRESENCE OF PULLUPS ON
USB TYPE-C CC PINS

MAX86140/MAX86141 EV Kit Schematics (continued)

MAX32620UCBLEEK#

U12
MAX32620IWG+

PMIC_MON	A4	AIN0	
	A5	AIN1	
	A6	AIN2	
	A7	AIN3	
	A3	VREF	

C37
0.1UF

NIM_UART_RX	C2	P0_0	
NIM_UART_TX	C1	P0_1	
	D4	P0_2	
	D3	P0_3	
A_SP0_SCK	D1	P0_4	
A_SPI0_MOSI	D2	P0_5	
SPI0_MISO	E3	P0_6	
A_SPI0_CSOPT_N	E2	P0_7	

SPI MASTER TO SENSORS

SPI1_SCK	E1	P1_0	
SPI1_MOSI/IO0	E4	P1_1	
SPI1_MISO/IO1	F3	P1_2	
SPI1_CSF_N	F2	P1_3	
SPI1_WP/IO2	F4	P1_4	
SPI1_FRST/IO3	E5	P1_5	
J3.17	G2	P1_6	
J3.18	G3	P1_7	

SPI MASTER TO FLASH

P1_7 CAN OUTPUT FCLK

1V8_B

R25
4.7K

	E8	DP	
	F8	DM	
RST_N	B2	RSTN	
SRST_N	B1	SRSTN	
NIM_SWDCLK	B4	TCK	
NIM_SWDIO	B5	TMS	
	B6	TDO	
	B7	TDI	

USB_DP
USB_DM

R26
4.7K

12PF C45

Y2
32.768KHZ

12PF C46

	C9	32KOUT	
	B9	32KIN	
	G1	VSS	
	B8	VSS	
	D9	VSS	
	J5	VSS	
	A2	VSSA	
	A1	NC_A1	
	A9	NC_A9	
	J1	NC_J1	
	J9	NC_J9	

UART/HANDSHAKE TO NRF5

P2_0	J2	NIM_P2.0	
P2_1	H2	NIM_P2.1	
P2_2	H3	NIM_P2.2	
P2_3	J3		
P2_4	G4	SPI2_SCK	
P2_5	H4	SPI2_MOSI	
P2_6	G5	SPI2_MISO	
P2_7	H5	SPI2_CSBLE_N	

0 R27 NRF5_P0_03
0 R28 NRF5_P0_04
0 R24 NRF5_P0_31

SPI MASTER TO NRF5

P3_0	F5		
P3_1	E6		
P3_2	H6	DBG_LED0	
P3_3	J6	DBG_LED1	
P3_4	G6	SDA	
P3_5	F6	SCL	
P3_6	J7		
P3_7	F7		

I2C MASTER

P4_0	J8		
P4_1	H7		
P4_2	H9		
P4_3	H8		
P4_4	G7	A_SPI0_CSACC_N	
P4_5	G9		
P4_6	G8		
P4_7	F9		

P5_0	D7	OPT_INT_N	
P5_1	E7	ACC_INT_N	
P5_2	C7	PMIC_INT_N	
P5_3	D6	PMIC_ALRT_N	
P5_4	C6	PMIC_PFN2	
P5_5	C5	PMIC_MPC	
P5_6	D5	SHDNL_N	
P5_7	C4		

P6_0 C3

VDDA	B3	1V8_B
VDD18	J4	1V8_B
VDD18	E9	
VDD18	A8	
VDD18	H1	
VDD12	F1	1V2
VDDB	D8	3V3
VRTC	C8	1V8_B

C39 1UF
C38 1UF
C42 1UF
C41 1UF
C40 1UF

SHDNL_N	◯	22
PMIC_MPC	◯	6
PMIC_PFN2	◯	8
PMIC_MON	◯	20
PMIC_ALRT_N	◯	14
PMIC_INT_N	◯	10
VLED	◯	16
5V0_B	◯	18
1V8_S	◯	12
SPI1_SCK	◯	34
SPI1_MOSI/IO0	◯	30
SPI1_MISO/IO1	◯	28
SPI1_CSF_N	◯	2
SPI1_WP/IO2	◯	35
SPI1_FRST/IO3	◯	33
SPI2_SCK	◯	32
SPI2_MOSI	◯	31
SPI2_MISO	◯	4
SPI2_CSBLE_N	◯	29

SPI0_SCK	◯	27
SPI0_MOSI	◯	15
SPI0_MISO	◯	7
SPI0_CSOPT_N	◯	24
SPI0_CSACC_N	◯	23
OPT_INT_N	◯	17
ACC_INT_N	◯	25
SCL	◯	11
SDA	◯	9
DBG_LED0	◯	3
DBG_LED1	◯	5
J3.17	◯	13
J3.18	◯	19

◯ 1
◯ 26
◯ 36