Datasheet

SaBLE-x-R2™ Bluetooth® Smart (Bluetooth LE) Module

Version 1.10

Revision History

Version	Date	Notes	Contributors	Approver
1.0	20 June 2017	Initial Release		Josh Bablitch
1.1	22 June 2017	Updated Device Markings Section		Josh Bablitch
1.2	6 July 2017	Added Industry Canada Statement		Josh Bablitch
1.3	21 Aug 2017	Added mFlexPIFA antenna information		Bill Steinike
1.4	9 Nov 2017	Updated Certification Section		Robert Gosewehr
1.5	22 Oct 2018	Updated legal statement, label info, & added new part numbers		Robert Gosewehr
1.6	13 Nov 2019	Fixed antenna type error in Ordering Information table (450-0185)	Derek Wong	Jonathan Kaye
1.7	21 May 2020	Updated Bluetooth SIG info		Jonathan Kaye
1.8	30 Nov 2021	Updated regulatory information	Ryan Urness	Jonathan Kaye
1.9	14 Jan 2021	Move regulatory information to separate document	Sue White	Jonathan Kaye
1.10	15 Oct 2021	Added Korea and UKCA certifications	Sue White	Jonathan Kaye

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1 Description

Laird Connectivity is announcing a low-cost and low-power consumption module with all Bluetooth 5 Low Energy functionalities.

The SaBLE-x-R2 module fully supports the single mode Bluetooth Low Energy operation and the output power can support class 2. The module provides the ability to either put your entire application into the integrated ARM Cortex M3 microcontroller.

Need to get to market quickly? Not an expert in Bluetooth Low Energy? Need a custom antenna? Do you need help with your host board? Laird Connectivity Design Services will be happy to develop custom hardware or software or help integrate the design. Contact us at sales@lairdconnect.com or call us at 262-375-4400.

2 Features

- Built-in CC2640R2F Bluetooth 5 Low Energy System-On-Chip (SOC) 5x5 mm RHB package with 15 GPIOs
- 128 kB Flash/20 kB SRAM
- RF Output Power: +5 dBm
- RF Receive Sensitivity: -96 dBm
- Size: 11.6 mm x 17.9 mm x 2.4 mm
- Operating Voltage: 1.8V to 3.8V
- Operating Temperature: -40 to +85C
- 8.4 mA Transmit Mode (+5 dBm)
- 7.4 mA Receive Mode
- 1µA Standby (SRAM/CPU retention and RTC running) with quick 100 µs start up
- 200 nA Shutdown
- 61µA/MHz Active CPU Current
- Drivers, Bluetooth Low Energy Controller, and bootloader in ROM
- Flexible peripheral set
- On board 32 KHz and 24 MHz Crystals
- Worldwide Acceptance:
  - FCC (USA)
  - IC (Canada)
  - ETSI (Europe)
  - Giteki (Japan)
  - RCM (AU/NZ)
- BT SIG QD ID: 96853
- REACH and RoHS-compliant

3 Applications

- Consumer electronics
- Mobile phone accessories
- Sports and fitness equipment
- HID applications
- Home and building automation, lighting control, alarm and security
- Electronic shelf labeling and proximity tags

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4 Ordering Information

Table 1: Orderable model numbers

Order Number	Description
450-0177C	SaBLE-x-R2 Module, PCB Trace Antenna (Cut Tape)
450-0177R	SaBLE-x-R2 Module, PCB Trace Antenna (Tape & Reel)
450-0178C	SaBLE-x-R2 Module, External Antenna Port (Cut Tape)
450-0178R	SaBLE-x-R2 Module, External Antenna Port (Tape & Reel)
450-0184	SaBLE-x-R2 Evaluation Kit, PCB Trace Antenna
450-0185	SaBLE-x-R2 Development Kit, External Antenna Port
450-0194C	SaBLE-x-R2 Module, Non-Ferrous Shield, PCB Trace Antenna (Cut Tape)
450-0194R	SaBLE-x-R2 Module, Non-Ferrous Shield, PCB Trace Antenna (Tape & Reel)
450-0195C	SaBLE-x-R2 Module, Non-Ferrous Shield, External Antenna Port (Cut Tape)
450-0195R	SaBLE-x-R2 Module, Non-Ferrous Shield, External Antenna Port (Tape & Reel)

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5 Module Accessories

Table 2: Module accessories

	Order Number	Description
	001-0001	2.4 GHz Dipole Antenna with Reverse Polarity SMA Connector
	080-0001	U.FL to Reverse Polarity SMA Bulkhead Cable 105 mm
	001-0014	2.4 GHz FlexPIFA antenna
	001-0015	2.4 GHz FlexNotch Antenna
	001-0030	2.4 GHz Metal FlexPIFA Antenna w/U.FL Cable, 100mm

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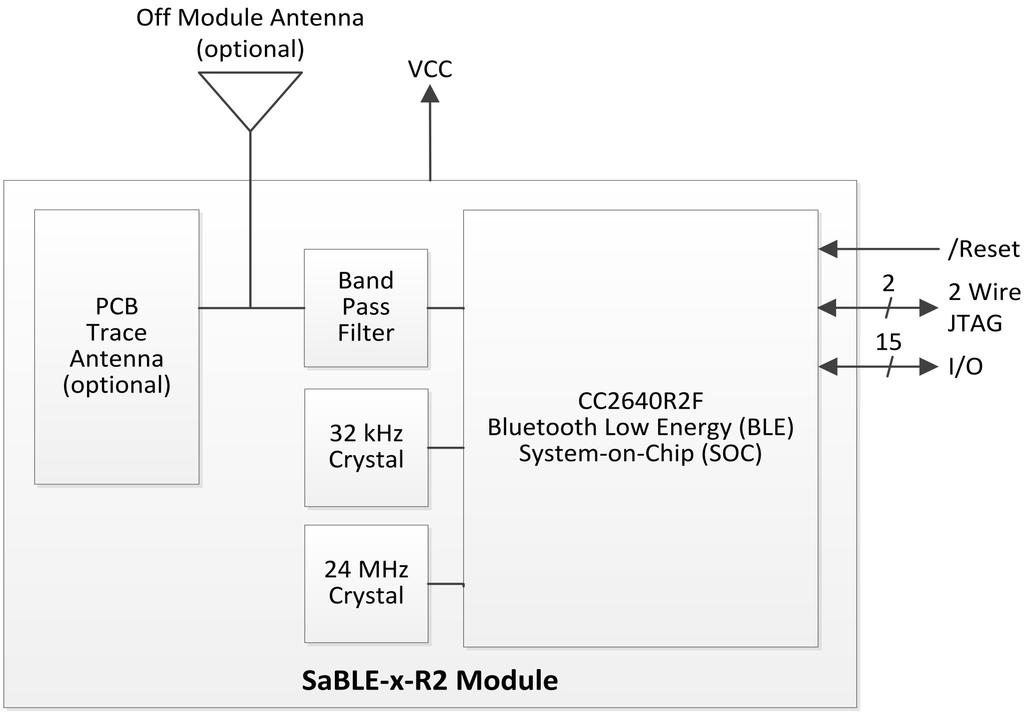

Figure 1: SaBLE-x-R2 module block diagram

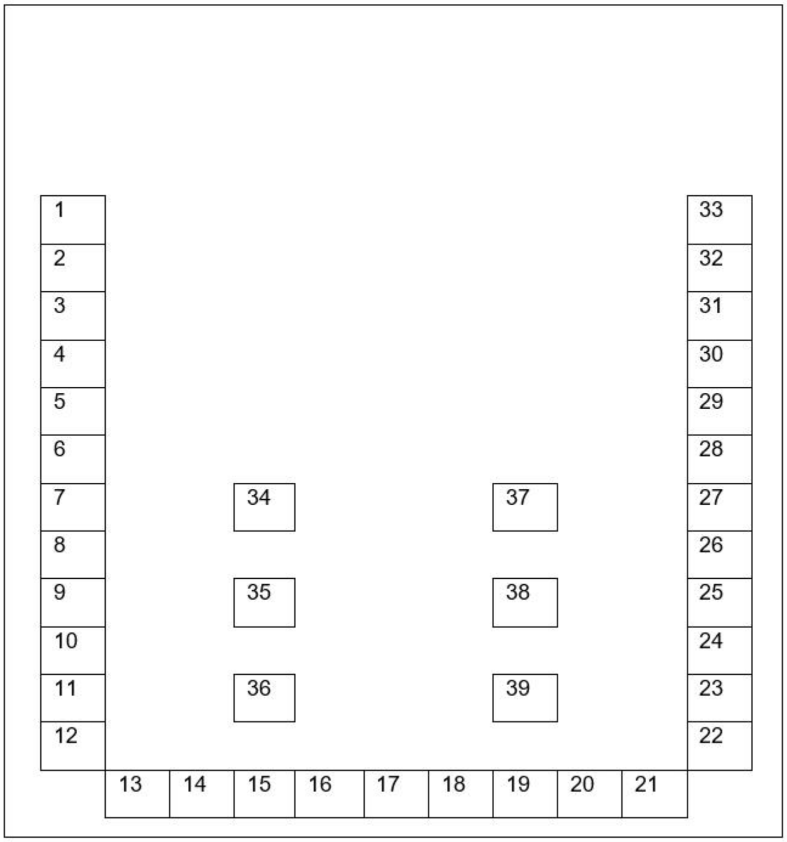

Figure 2: SaBLE-x-R2 module footprint (viewed from top)

6 Pin Descriptions

Table 3: SaBLE-x-R2 Pin Descriptions

Module Pin	Name	I/O Type	Description
1	RF OUT	RF	Antenna, 50 OHMS
2	GND	GND	Ground
3	GND	GND	Ground
4	NC	-	No Connect (Do Not Connect)
5	NC	-	No Connect (Do Not Connect)
6	/RESET	DI	Active Low Reset. 100 kΩ Pull-up
7	JTAG_TCKC	DI/DIO	JTAG TCKC
8	JTAG_TMSC	DIO	JTAG TMSC
9	NC	-	No Connect (Do Not Connect)
10	NC	-	No Connect (Do Not Connect)
11	VCC	PI	Power Supply to Module
12	VCC	PI	Power Supply to Module
13	DIO_5/JTAG_TDO	DIO	GPIO, JTAG_TDO, LED Driving Capability
14	DIO_6/JTAG_TDI	DIO	GPIO, JTAG_TDI, LED Driving Capability
15	DIO_4	DIO	GPIO, ULP Sensor Interface, LED Driving Capability
16	DIO_3	DIO	GPIO, ULP Sensor Interface, LED Driving Capability
17	DIO_2	DIO	GPIO, ULP Sensor Interface, LED Driving Capability
18	DIO_1/BOOT_RX	DIO	GPIO, ULP Sensor Interface, Bootloader RX (UART0)
19	DIO_0/BOOT_TX	DIO	GPIO, ULP Sensor Interface, Bootloader TX (UART0)
20	DIO_7	DIO	GPIO, Analog Input, ULP Sensor Interface
21	DIO_8	DIO	GPIO, Analog Input, ULP Sensor Interface
22	GND	GND	Ground
23	DIO_10	DIO	GPIO, Analog Input, ULP Sensor Interface
24	DIO_9	DIO	GPIO, Analog Input, ULP Sensor Interface
25	NC	-	No Connect (Do Not Connect)
26	NC	-	No Connect (Do Not Connect)
27	NC	-	No Connect (Do Not Connect)
28	NC	-	No Connect (Do Not Connect)
29	DIO_11	DIO	GPIO, Analog Input, ULP Sensor Interface
30	DIO_12	DIO	GPIO, Analog Input, ULP Sensor Interface
31	DIO_13	DIO	GPIO, Analog Input, ULP Sensor Interface
32	DIO_14	DIO	GPIO, Analog Input, ULP Sensor Interface
33	GND	GND	Ground
34-39	GND	GND	Ground and Thermal Relief Pads

PI = Power Input
GND = Ground
DI = Digital Input
DO = Digital Output
DIO = Digital Input/Output
AI = Analog Input
RF = Bi-directional RF Port

Note: See the Texas Instruments CC2640 datasheet and user guide for further details on the I/O.

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7 Electrical Specifications

7.1 Absolute Maximum Ratings

Table 4: Absolute maximum ratings

Symbol	Description	Min	Max	Unit
VCC	Digital Input Supply Voltage	-0.3	4.1	V
Voltage on any digital pin		-0.3	VCC+0.3, max 4.1	V
Input RF level			+5	dBm

Important!
Do not exceed the absolute maximum ratings specified in Table 4 under any circumstances. Stressing the module beyond these limits may result in permanent damage to the module; this damage is not covered by the warranty.

7.2 Recommended Operating Conditions

Test Conditions: Ambient Temp = 25°C

Table 5: Recommended operating conditions

Symbol	Min	Typ	Max	Unit
VCC	1.8	3.3	3.8	V

7.3 General Characteristics

Table 6: General Characteristics

Characteristic	Description
Model Name	SaBLE-x-R2
Product Description	Bluetooth Low Energy Wireless Module
Dimension	11.63 mm x 17.86 mm x 2.4 mm (W*L*T)
Operating temperature	-40°C to 85°C
Storage temperature	-40°C to 85°C
Humidity	Operating Humidity: 10% to 95% Non-Condensing Storage Humidity: 5% to 95% Non-Condensing
Weight	0.75 g ± 0.05 g

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7.4 DC Characteristics

Table 7: SaBLE-x-R2 module Bluetooth general DC characteristics

Parameter	Test Conditions	Min	Typ	Max	Unit
Input low-to-high transition with hysteresis	Transition from 0 to 1, T_A= 25°C, VCC=1.8V		1.07		V
Input high-to-low transition with hysteresis	Transition from 1 to 0, T_A= 25°C, VCC=1.8V		0.74		V
Input hysteresis	Difference between 0 to 1 and 1 to 0.		0.33		V
Input low-to-high transition with hysteresis	Transition from 0 to 1, T_A= 25°C, VCC=3.8V		1.94		V
Input high-to-low transition with hysteresis	Transition from 1 to 0, T_A= 25°C, VCC=3.8V		1.54		V
Input hysteresis	Difference between 0 to 1 and 1 to 0.		0.40		V
Logic-0 output voltage, 4 mA pins	Output load 4 mA, T_A= 25°C, VCC=1.8V		0.26		V
Logic-1 output voltage, 4 mA pins	Output load 4 mA, T_A= 25°C, VCC=1.8V		1.54		V
Logic-0 output voltage, 8 mA pins	Output load 8 mA, T_A= 25°C, VCC=1.8V		0.21		V
Logic-1 output voltage, 8 mA pins	Output load 8 mA, T_A= 25°C, VCC=1.8V		1.58		V
Logic-0 output voltage, 4 mA pins	Output load 4 mA, T_A= 25°C, VCC=3.0V		0.33		V
Logic-1 output voltage, 4 mA pins	Output load 4 mA, T_A= 25°C, VCC=3.0V		2.72		V
Logic-0 output voltage, 8 mA pins	Output load 8 mA, T_A= 25°C, VCC=3.0V		0.28		V
Logic-1 output voltage, 8 mA pins	Output load 8 mA, T_A= 25°C, VCC=3.0V		2.68		V
Input pullup current	Vpad=0V, T_A= 25°C, VCC=1.8V		72		uA
Input pulldown current	Vpad=1.8V, T_A= 25°C, VCC=1.8V		22		uA
Input pullup current	Vpad=0V, T_A= 25°C, VCC=3.8V		277		uA
Input pulldown current	Vpad=3.8V, T_A= 25°C, VCC=3.8V		113		uA

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7.5 General Power Consumption

T_A = 25°C

Table 8: SaBLE-x-R2 module Bluetooth TX and RX current consumption specifications

Parameter	Test Conditions	Min	Typical Average Current				Max	Unit
			1.8V	3.0V	3.3V	3.8V		
Shutdown	No clocks running, no data retention				200			nA
Standby 1	With RTC, CPU, RAM, and partial register retention. XOSC_LF				1.2			uA
Standby 2	With Cache, RTC, CPU, RAM, and partial register retention. XOSC_LF				2.7			uA
Idle	Supply Systems and RAM powered.				550			uA
Active	Core running CoreMark				1.45 mA + 31 uA/MHz			
Radio RX	DC-DC Turned OFF		12.7	12.8	12.9	13.0		mA
Radio TX	+5 dBm output power		13.6	9.0	8.4	7.9		

7.6 RF Characteristics - TX

The following results are typical performance for the following data rates:

1 Mbps (BLE), 2 Mbps (BLE5), 125 kbps, and 500 kbps Coded (BLE5)

Results measured on Laird Connectivity SaBLE-x-R2 external antenna development board reference design with T_A = 25°C, LEDs disabled, DC-to-DC converter enabled**,** and measured at RF connector.

Table 9: BLE TX RF characteristics

Parameter	Test Conditions	Min	Typical				Max	Unit
			1.8V	3.0V	3.3V	3.8V		
Output Power	CH 0 (2402 MHZ)		4.8	4.8	4.8	4.8		dBm
	CH 19 (2440 MHZ)		4.6	4.7	4.7	4.7		
	CH 39 (2480 MHZ)		4.3	4.3	4.3	4.4		
Spurious Emission Conducted Measurement	f < 1 GHz		-43					dBm
	f > 1 GHz		-46					dBm
RF Frequency Range	Programmable in one-MHz steps	2402					2480	MHz

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7.7 RF Characteristics – RX 1 Mbps (Bluetooth LE)

Table 10: Bluetooth LE TX RF characteristics

Parameter	Test Conditions	Min	Typical				Max	Unit
			1.8V	3.0V	3.3V	3.8V		
Receiver Sensitivity DC to DC Disabled	CH 0 (2402 MHZ)		-95	-95	-95	-95		dBm
	CH 19 (2440 MHZ)		-95	-95	-95	-95		
	CH 39 (2480 MHZ)		-95	-95	-95	-95		
Receiver Sensitivity DC to DC Enabled	CH 0 (2402 MHZ)		-95	-94	-93	-92		dBm
	CH 19 (2440 MHZ)		-95	-94	-93	-92		
	CH 39 (2480 MHZ)		-95	-94	-93	-92		
Saturation	BER < 0.1%				4			dBm
Co-channel Rejection	Wanted signal –67 dBm				-6			dB
Frequency Error Tolerance	Difference between the incoming carrier frequency and the internally-generated carrier frequency	-350					350	kHz
Intermodulation	Minimum interferer level				-34			dBm

7.8 RF Characteristics – RX 2 Mbps (Bluetooth LE5)

Table 11: Bluetooth LE TX RF characteristics

Parameter	Test Conditions	Min	Typical				Max	Unit
			1.8V	3.0V	3.3V	3.8V		
Receiver Sensitivity DC to DC Disabled	CH 0 (2402 MHZ)		-91.5	-91.5	-91.5	-91.5		dBm
	CH 19 (2440 MHZ)		-91.5	-91.5	-91.5	-91.5		
	CH 39 (2480 MHZ)		-91.5	-91.5	-91.5	-91.5		
Receiver Sensitivity DC to DC Enabled	CH 0 (2402 MHZ)		-91.5	-90	-89.5	-89		dBm
	CH 19 (2440 MHZ)		-91.5	-90	-89.5	-89		
	CH 39 (2480 MHZ)		-91.5	-90	-89.5	-89		
Saturation	BER < 0.1%				4			dBm
Co-channel Rejection	Wanted signal –67 dBm				-7			dB
Frequency Error Tolerance	Difference between the incoming carrier frequency and the internally generated carrier frequency	-300					500	kHz
Intermodulation	Minimum interferer level				-45			dBm

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7.9 RF Characteristics – RX 125-kbps Coded (Bluetooth LE5)

Table 12: Bluetooth LE TX RF characteristics

Parameter	Test Conditions	Min	Typical				Max	Unit
			1.8V	3.0V	3.3V	3.8V		
Receiver Sensitivity DC to DC Disabled	CH 0 (2402 MHZ)		-102	-102	-102	-102		dBm
	CH 19 (2440 MHZ)		-102	-102	-102	-102		
	CH 39 (2480 MHZ)		-102	-102	-102	-102		
Receiver Sensitivity DC to DC Enabled	CH 0 (2402 MHZ)		-102	-100	-98	-97		dBm
	CH 19 (2440 MHZ)		-102	-100	-98	-97		
	CH 39 (2480 MHZ)		-102	-100	-98	-97		
Saturation	BER < 0.1%				5			dBm
Co-channel Rejection	Wanted signal –79 dBm				-3			dB
Frequency Error Tolerance	Difference between the incoming carrier frequency and the internally generated carrier frequency	-260					310	kHz
Intermodulation	Minimum interferer level				-42			dBm

7.10 RF Characteristics – RX 500-kbps Coded (Bluetooth LE5)

Table 13: Bluetooth LE TX RF characteristics

Parameter	Test Conditions	Min	Typical				Max	Unit
			1.8V	3.0V	3.3V	3.8V		
Receiver Sensitivity DC to DC Disabled	CH 0 (2402 MHZ)		-99.5	-99.5	-99.5	-99.5		dBm
	CH 19 (2440 MHZ)		-99.5	-99.5	-99.5	-99.5		
	CH 39 (2480 MHZ)		-99.5	-99.5	-99.5	-99.5		
Receiver Sensitivity DC to DC Enabled	CH 0 (2402 MHZ)		-99.5	-98	-96	-95		dBm
	CH 19 (2440 MHZ)		-99.5	-98	-96	-95		
	CH 39 (2480 MHZ)		-99.5	-98	-96	-95		
Saturation	BER < 0.1%				5			dBm
Co-channel Rejection	Wanted signal –79 dBm				-5			dB
Frequency Error Tolerance	Difference between the incoming carrier frequency and the internally generated carrier frequency	-240					240	kHz
Intermodulation	Minimum interferer level				-37			dBm

7.11 Wakeup Timing

7.11.1 Shutdown

Shutdown is similar to holding the device in reset with two exceptions:

- It latches the state of IO prior to shutting down.
- It consumes 0.1 uA, versus approximately 37 uA.

Figure 3 shows the response time to wake up from shutdown by using a wake-up pin. The pin is configured to wake the device up on a negative edge. Once the device wakes, it drives an awake pin low:

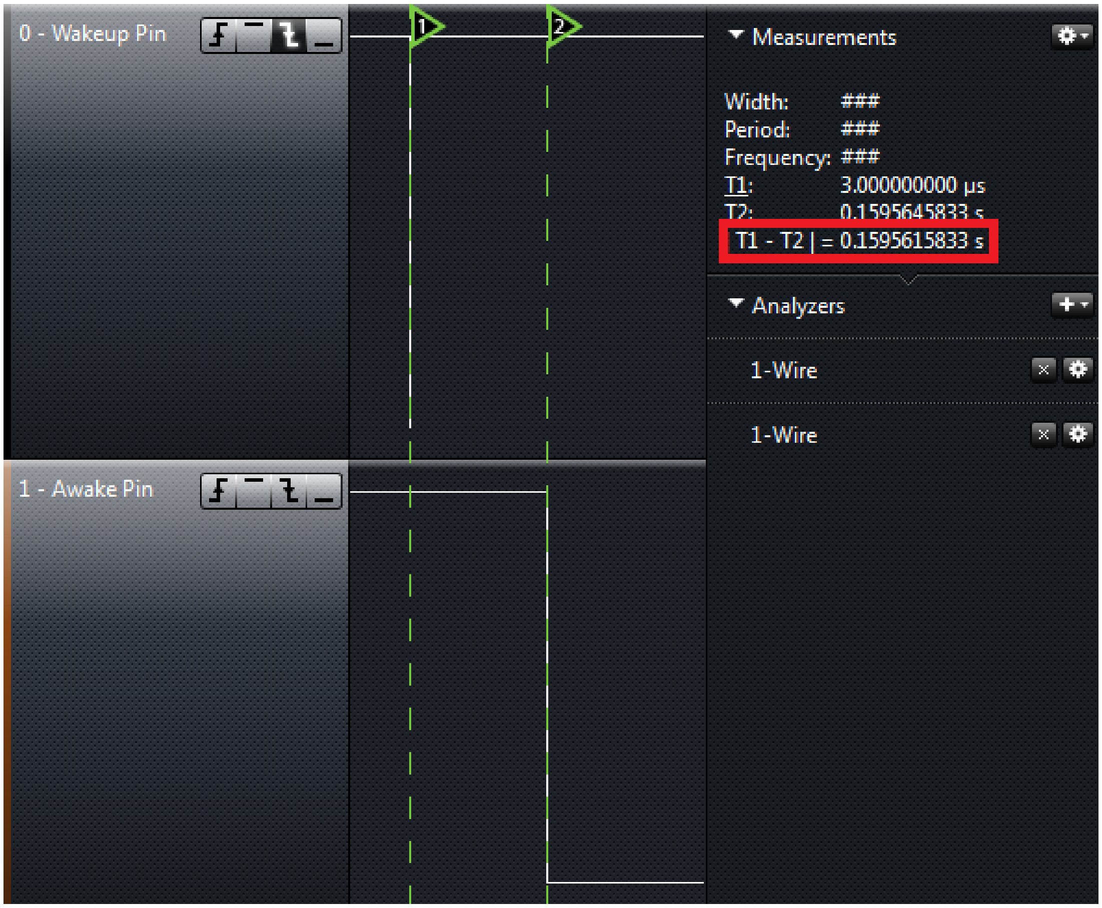

Figure 3: SaBLE-x-R2 module waking from shutdown timing diagram

Figure 3 shows the module taking approximately 160 milliseconds to wake.

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7.11.2 Standby

Standby is a low power mode policy. When configured correctly in code the software goes into standby.

Figure 4 shows the response time to wake up from standby using a wake up pin. The method is the same as described in the shutdown section:

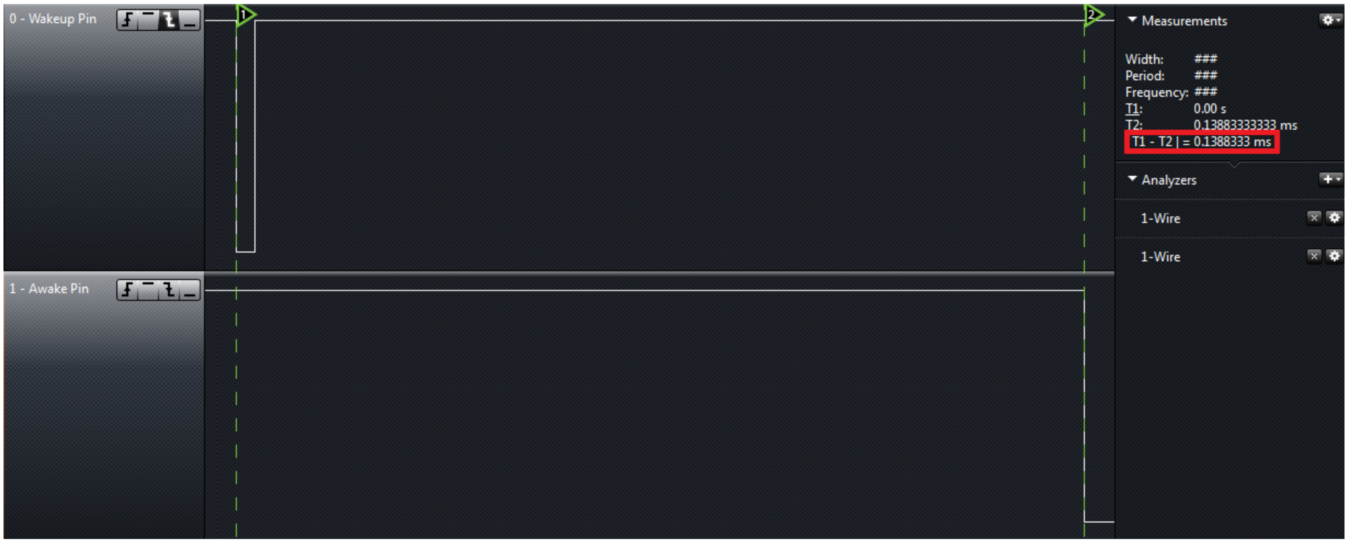

Figure 4: SaBLE-x-R2 module waking from standby timing diagram

Figure 4 shows the module taking approximately 139 µs to wake.

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8 Soldering Recommendations

8.1 Recommended Reflow Profile for Lead Free Solder

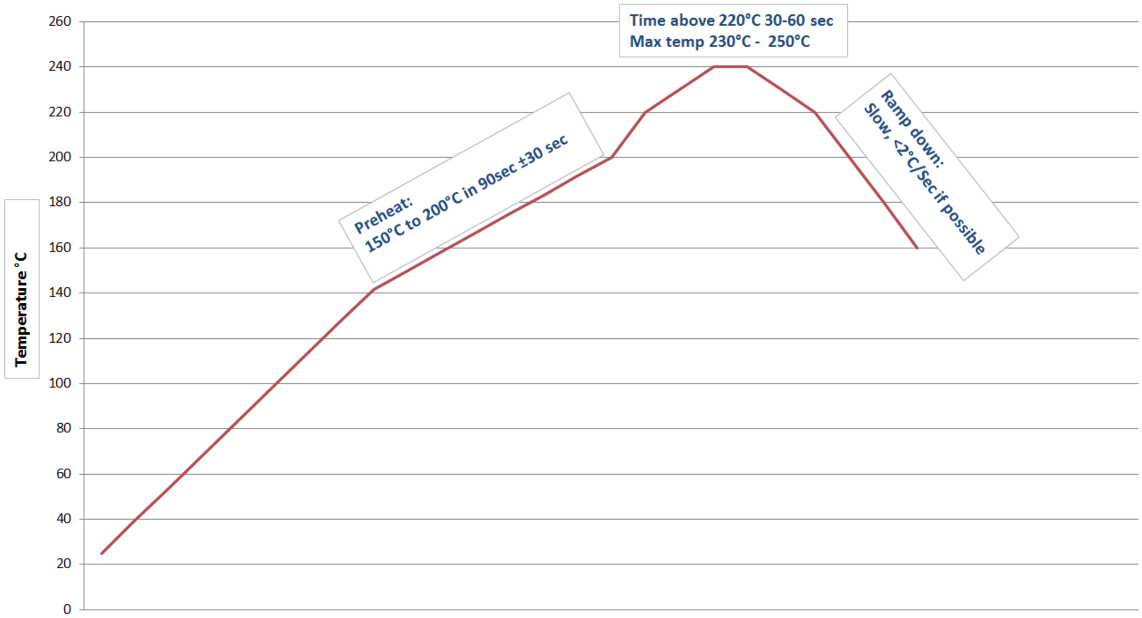

Figure 5: Recommended soldering profile

Note: The quality of solder joints on the surface mount pads where they contact the host board should meet the appropriate IPC Specification. See IPC-A-610-D Acceptability of Electronic Assemblies, section 8.2.1 *Bottom Only Terminations*.

9 Cleaning

In general, cleaning the populated modules is strongly discouraged. Residuals under the module cannot be easily removed with any cleaning process.

- Cleaning with water can lead to capillary effects where water is absorbed into the gap between the host board and the module. The combination of soldering flux residuals and encapsulated water could lead to short circuits between neighboring pads. Water could also damage any stickers or labels.
- Cleaning with alcohol or a similar organic solvent will likely flood soldering flux residuals into the RF shield, which is not accessible for post-washing inspection. The solvent could also damage any stickers or labels.
- Ultrasonic cleaning could damage the module permanently.

10 Optical Inspection

After soldering the module to the host board, consider optical inspection to check the following:

- Proper alignment and centering of the module over the pads.
- Proper solder joints on all pads.
- Excessive solder or contacts to neighboring pads, or vias.

11 Rework

The module can be unsoldered from the host board if the Moisture Sensitivity Level (MSL) requirements are met as described in this datasheet.

Note: Never attempt a rework on the module itself, e.g. replacing individual components. Such actions will terminate warranty coverage.

12 Shipping, Handling, and Storage

12.1 Shipping

Bulk orders of the SaBLE-x-R2 modules are delivered in reels of 1,000.

12.2 Handling

The SaBLE-x-R2 modules contain a highly sensitive electronic circuitry. Handling without proper ESD protection may damage the module permanently.

12.3 Moisture Sensitivity Level (MSL)

Per J-STD-020, devices rated as MSL 4 and not stored in a sealed bag with desiccant pack should be baked prior to use.

Devices are packaged in a Moisture Barrier Bag with a desiccant pack and Humidity Indicator Card (HIC). Devices that will be subjected to reflow should reference the HIC and J-STD-033 to determine if baking is required.

If baking is required, refer to J-STD-033 for bake procedure.

12.4 Storage

Per J-STD-033, the shelf life of devices in a Moisture Barrier Bag is 12 months at <40ºC and <90% room humidity (RH).

Do not store in salty air or in an environment with a high concentration of corrosive gas, such as Cl2, H2S, NH3, SO2, or NOX.

Do not store in direct sunlight.

The product should not be subject to excessive mechanical shock.

12.5 Repeating Reflow Soldering

Note: Only a single reflow soldering process is encouraged for host boards.

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13 Regulatory

Note: For complete regulatory information, refer to the SaBLE-x-R2 Regulatory Information document which is also available from the SaBLE-x-R2 product page.

The SaBLE-x-R2 holds current certifications in the following countries:

Country/Region	Regulatory ID
USA (FCC)	TFB-1005
EU	N/A
UKCA	N/A
Canada (ISED)	5969A-1005
Japan (MIC)	201-170613 (PCB trace antenna) 201-170614 (External antenna)
Korea (KC)	R-C-L7C-SaBLE-x-R2

14 Bluetooth SIG Qualification

The SaBLE-x-R2 module is listed on the Bluetooth SIG website as a *Component Tested* design. It is intended use is integration into a new End Product design by a third-party SIG member.

Design Name	Owner	Declaration ID	QD ID	Link to listing on the SIG website
SaBLE-x-R2	Laird Connectivity	D035147	96853	https://www.bluetooth.org/tpg/QLI_viewQDL.cfm?qid=35147

It is a mandatory requirement of the Bluetooth Special Interest Group (SIG) that every product implementing Bluetooth technology has a Declaration ID. Every Bluetooth design is required to go through the qualification process, even when referencing a Bluetooth design that already has its own Declaration ID. The qualification process requires each company to registered as a member of the Bluetooth SIG – www.bluetooth.org

The following link provides a link to the Bluetooth Registration page: https://www.bluetooth.org/login/register/

For each Bluetooth design it is necessary to purchase a Declaration ID. This can be done before starting the new qualification, either through invoicing or credit card payment. The fees for the Declaration ID depend on your membership status. Please refer to the following webpage:

https://www.bluetooth.org/en-us/test-qualification/qualification-overview/fees

For a detailed procedure of how to obtain a new Declaration ID for your design, please refer to the following SIG document:

https://www.bluetooth.org/DocMan/handlers/DownloadDoc.ashx?doc_id=283698&vId=317486

14.1 Qualification Steps When Combining with a Laird Connectivity Component

If you wish to use a Laird Connectivity component in your end product, the qualification process follows the *Traditional Project* route, creating a completely new design. When creating a new design, it is necessary to complete the full qualification listing process and maintain a compliance folder for the new design.

The SaBLE-x-R2 design under D035147 incorporates the following Texas Instrument component;

Listing reference	Design Name	Core Spec Version

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D035408 (RF-PHY)	CC2640R2F SimpleLink™ Bluetooth® 5.0 low energy Wireless MCU	5.0

If your design is based on un-modified SaBLE-x-R2 hardware, it is possible to use the following process;

1. Reference the existing RF-PHY test report from the SaBLE-x-R2 listing.
2. Combine the relevant Texas Instruments component(s) – covering as a minimum LL, L2CAP, GAP, ATT, GATT, SM). Check relevant QDID with Texas Instruments\Laird Connectivity.

   Example component is Texas Instruments D041507)
3. Test on PTS any standard SIG profiles that are supported in the design. Customs profiles are exempt.

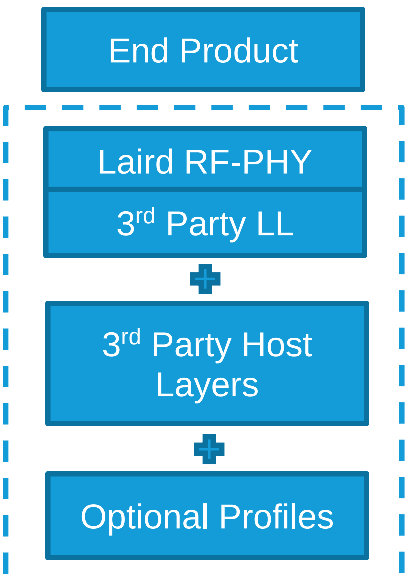

Figure 6: End Product design qualification scope

Figure 6 shows the scope of the qualification for an End Product Design.

The first step is to generate a project on the TPG (Test Plan Generator) system. This determines which test cases apply to demonstrate compliance with the Bluetooth Test Specifications. When combining qualified components in your design, and they are within their 3-year listing period, you are not required to re-test those layers covered by those components.

If the design incorporates any standard SIG LE profiles (such as the Heart Rate Profile), it is necessary to test these profiles using PTS or other tools where permitted; the results are added to the compliance folder.

You must upload your test declaration and test reports (where applicable) and then complete the final listing steps on the SIG website.

Note: Remember to purchase your Declaration ID before you start the qualification process, as it is not possible to complete the listing without it.

For further information please refer to the following training material:

https://www.bluetooth.org/en-us/test-qualification/qualification-overview/listing-process-updates

If you require assistance with the qualification process, please contact our recommended Bluetooth Qualification Expert (BQE), Steve Flooks, steve.flook@eurexuk.com.

15 Antenna Information

15.1 Laird Connectivity Dipole Antenna

See antenna datasheet.

15.2 Laird Connectivity FlexPIFA

See antenna datasheet.

15.3 Laird Connectivity FlexNotch

See antenna datasheet.

15.4 Laird Connectivity mFlexPIFA

See antenna datasheet.

15.5 PCB Trace Antenna

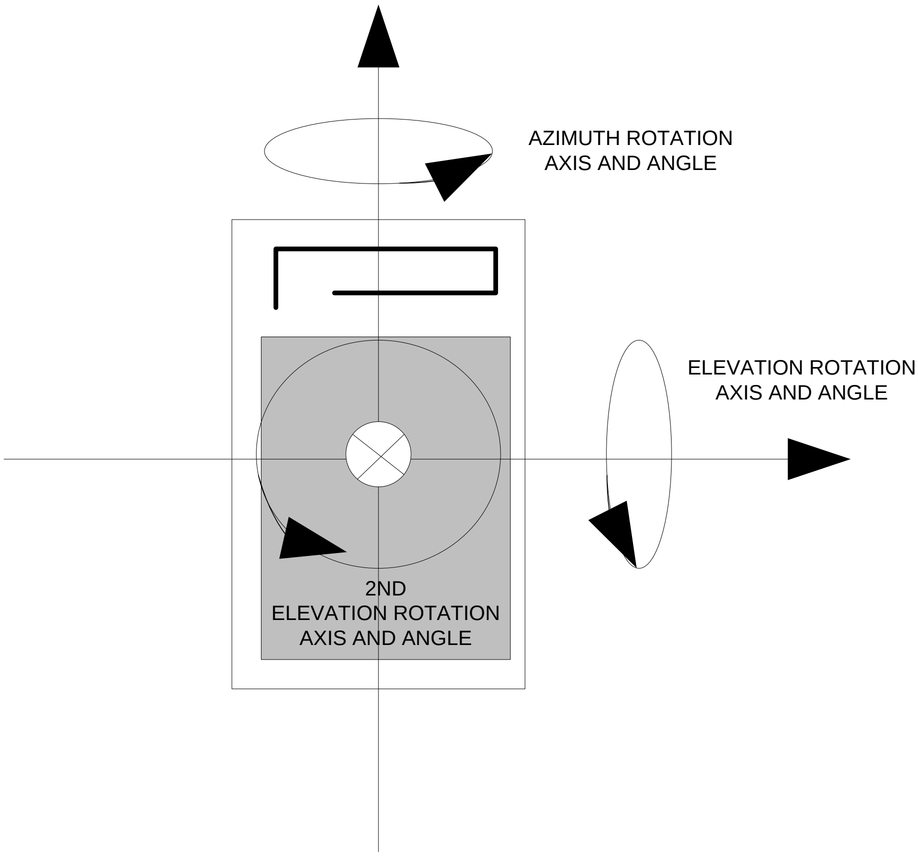

Figure 7: PCB trace antenna pattern measurement planes

Table 14: PCB trace antenna gain summary

Orientation	Frequency (MHz)	Polarization	Peak Gain (dBi)	Average Gain (dBi)	Average Total Gain (P) (dBi)	Average Total Gain (F, P) (dBi)	Average Total Gain (O, F, P) (dBi)
Azimuth	2402	Vertical	0.0	-3.6	-3.0	-4.6	-5.9
Azimuth	2402	Horizontal	-6.6	-12.4			
Azimuth	2440	Vertical	-1.7	-5.1	-4.5		
Azimuth	2440	Horizontal	-1.7	-13.4			
Azimuth	2480	Vertical	-4.3	-7.9	-7.3		
Azimuth	2480	Horizontal	-11.5	-15.9			
Elevation	2402	Vertical	-7.3	-11.4	-4.7	-6.0	
Elevation	2402	Horizontal	-1.2	-5.7			
Elevation	2440	Vertical	-7.9	-12.6	-5.6		
Elevation	2440	Horizontal	-7.9	-6.6			
Elevation	2480	Vertical	-11.0	-15.9	-8.3		
Elevation	2480	Horizontal	-4.2	-9.1			
2nd Elevation	2402	Vertical	-9.4	-14.8	-6.6	-7.7	
2nd Elevation	2402	Horizontal	-2.8	-7.3			
2nd Elevation	2440	Vertical	-10.3	-16.6	-7.3		
2nd Elevation	2440	Horizontal	-3.4	-7.9			
2nd Elevation	2480	Vertical	-12.8	-18.9	-9.8		
2nd Elevation	2480	Horizontal	-6.0	-10.4			

Vertical, Horizontal Antenna Patterns at 2402 MHz (dB) – Azimuth Cut

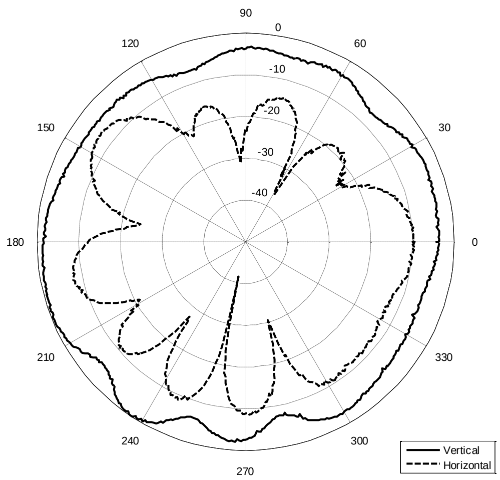

Figure 8: PCB Trace Antenna Pattern (Azimuth @ 2402 MHz)

Vertical, Horizontal Antenna Patterns at 2402 MHz (dB) – Elevation Cut

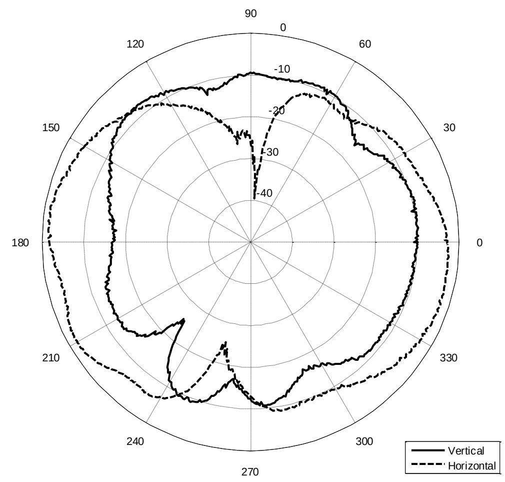

Figure 9: PCB Trace Antenna Pattern (Elevation @ 2402 MHz)

Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852-2762-4823

Vertical, Horizontal Antenna Patterns at 2402 MHz (dB) – Second Elevation Cut

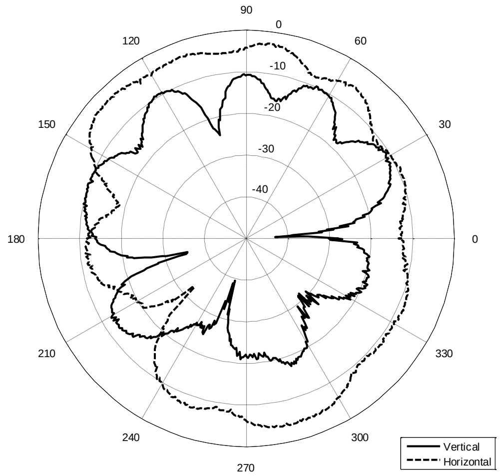

Figure 10: PCB Trace Antenna Pattern (2nd Elevation @ 2402 MHz)

Vertical, Horizontal Antenna Patterns at 2440 MHz (dB) – Azimuth Cut

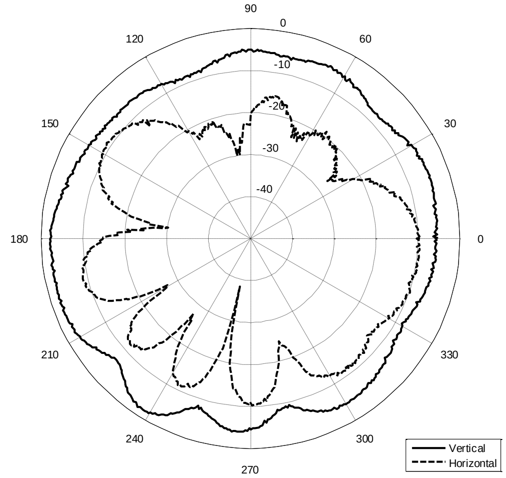

Figure 11: PCB Trace Antenna Pattern (Azimuth @ 2440 MHz)

Vertical, Horizontal Antenna Patterns at 2440 MHz (dB) – Elevation Cut

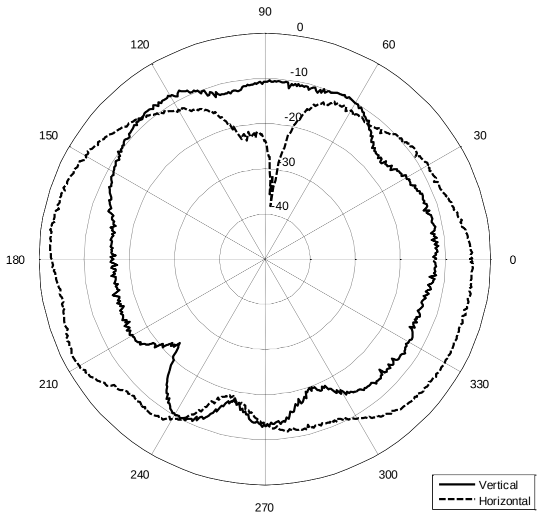

Figure 12: PCB Trace Antenna Pattern (Elevation @ 2440 MHz)

Vertical, Horizontal Antenna Patterns at 2440 MHz (dB) – Second Elevation Cut

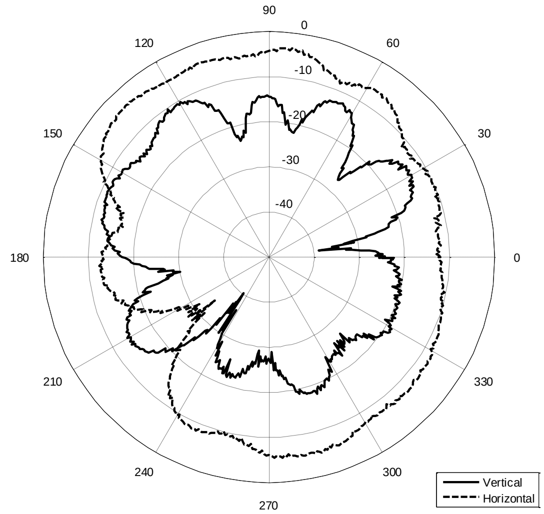

Figure 13: PCB Trace Antenna Pattern (2nd Elevation @ 2440 MHz)

Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852-2762-4823

Vertical, Horizontal Antenna Patterns at 2480 MHz (dB) – Azimuth Cut

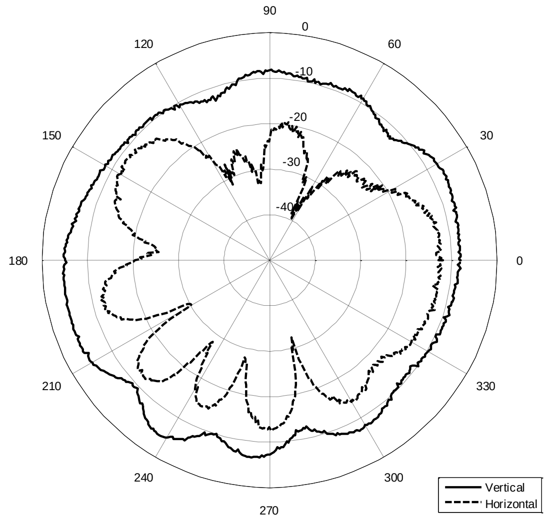

Figure 14: PCB Trace Antenna Pattern (Azimuth @ 2480 MHz)

Vertical, Horizontal Antenna Patterns at 2480 MHz (dB) – Elevation Cut

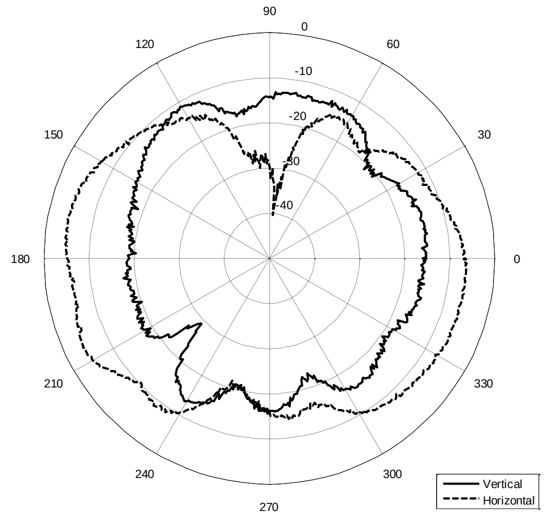

Figure 15: PCB Trace Antenna Pattern (Elevation @ 2480 MHz)

Vertical, Horizontal Antenna Patterns at 2480 MHz (dB) – Second Elevation Cut

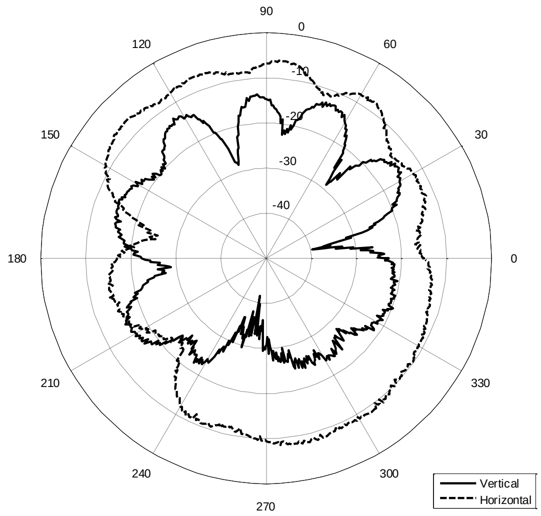

Figure 16: PCB Trace Antenna Pattern (2nd Elevation @ 2480 MHz)

Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852-2762-4823

16 Mechanical Data

The following are the mechanical dimensions of the SaBLE-x-R2 module.

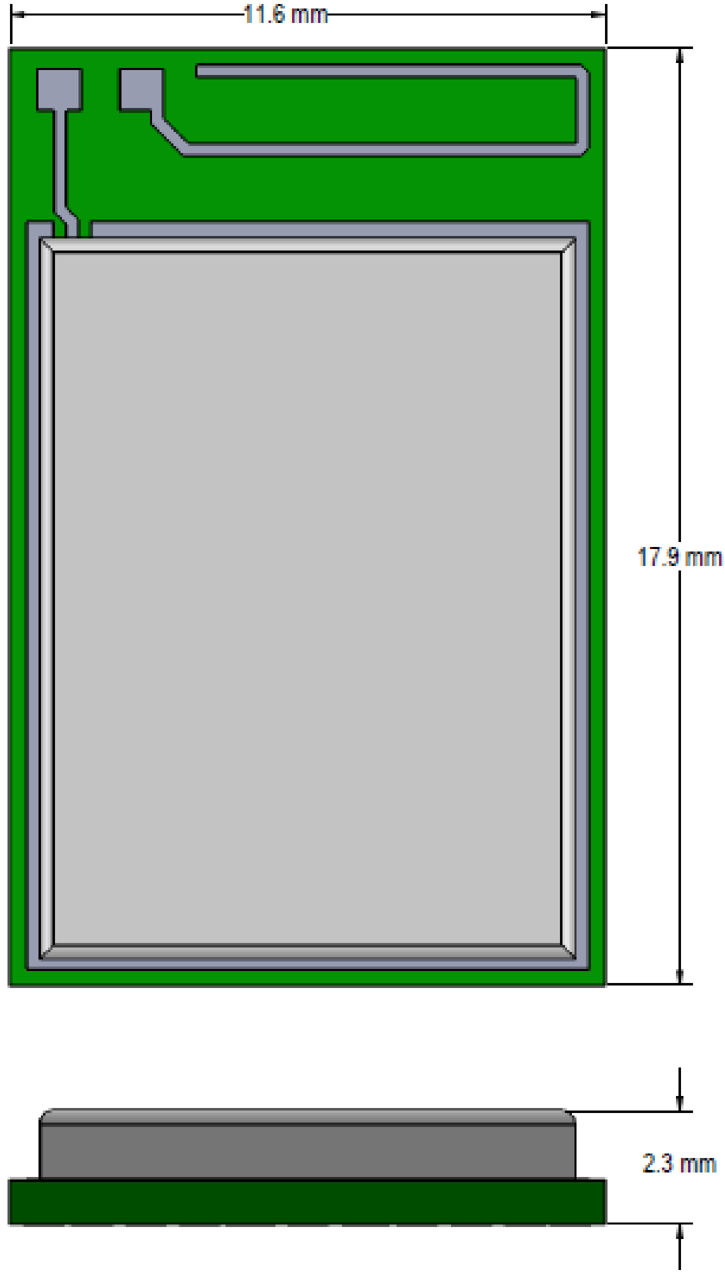

Figure 17: Module Mechanical Dimensions (Maximum Module Height = 2.4mm)

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17 PCB Footprint

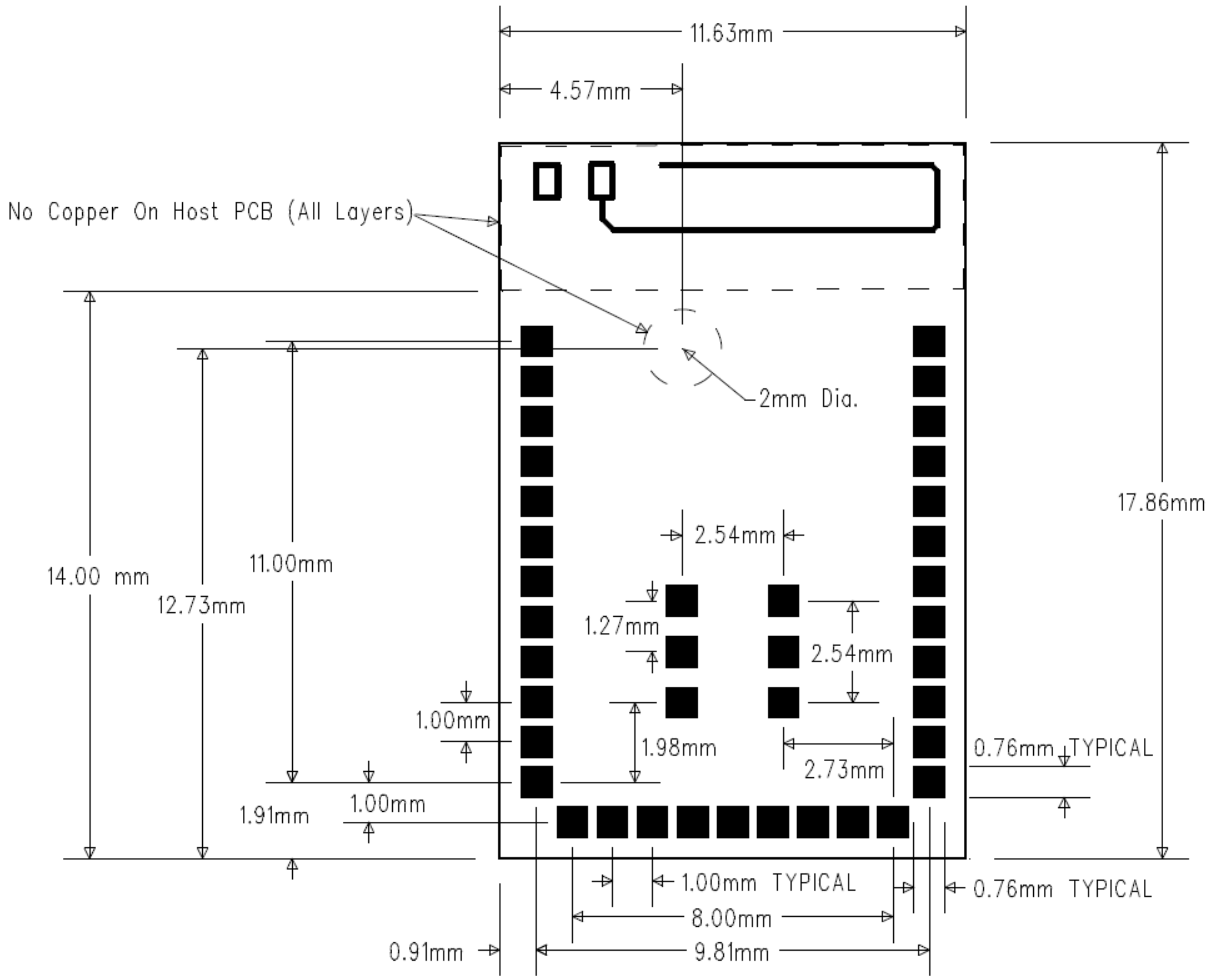
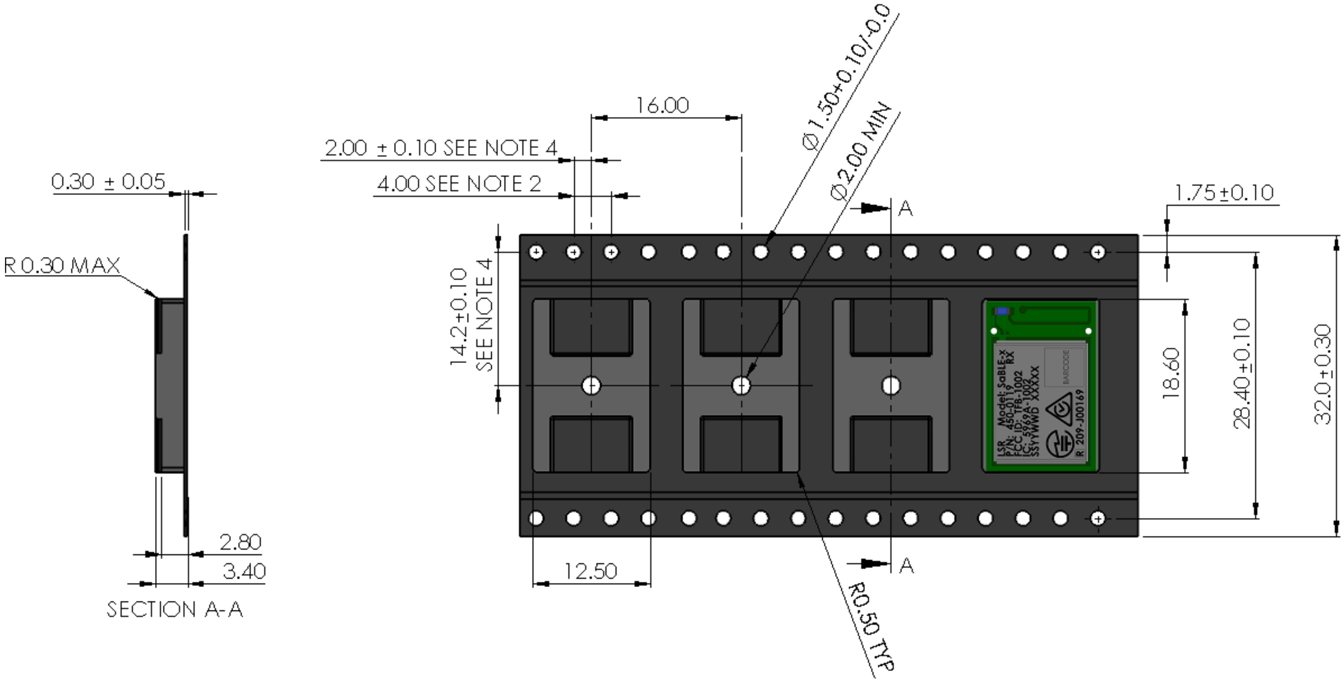


Figure 18: SaBLE-x-R2 Recommended PCB Footprint (Viewed from Top)

17.1 Tape and Reel Dimensions

Tape Dimensions



NOTES:
1. DIM in mm.
2. 10 Sprocket Hole Pitch Cumulative Tolerance ± 0.2mm.
3. Camber in Compliance with EIA 481.
4. Pocket Position Relative to Sprocket Hole Measured as True Position of Pocket, not Pocket Hole
5. A Full Reel contains 1000 Modules

Note: Module must be in this orientation when feeding tape.

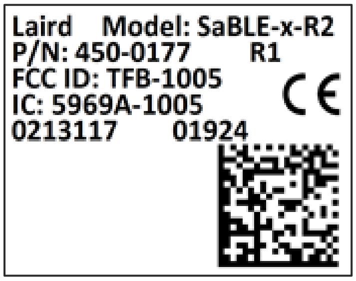
Figure 19: Tape and reel specification

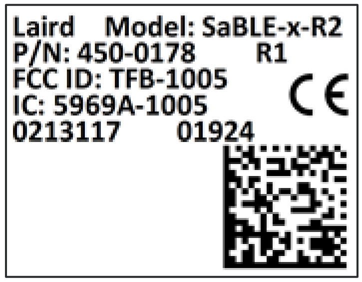
Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852-2762-4823

18 DEVICE MARKINGS

18.1 450-0177 and 450-0178

18.1.1 Rev 1 Devices



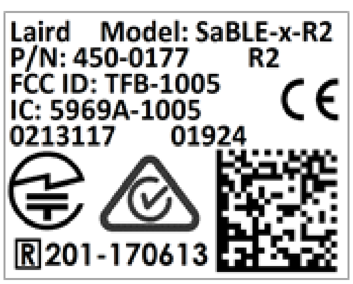


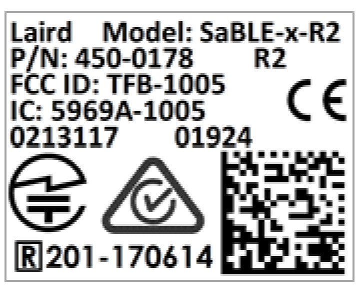
The shield on the 450-0177/450-0178 modules contains the following information:

- Laird Connectivity Model: SaBLE-x-R2
- Part Number and Revision:
  - Part Number: 450-0177 or 450-0178
  - Revision: -RX (where X is the latest revision)
- FCC ID: TFB-1005
- IC: 5969A-1005
- SSYYWWD = Date Code (YY=Year, WW=Week)
- XXXXX = Incremental Serial Number
- 2D Barcode Format is Data Matrix Standard

18.1.2 Rev 2 Devices

Added Giteki and C-Tick Certification





The shield on the 450-0177/450-0178 modules contains the following additional information:

- C-Tick Logo (Australia and New Zealand Certification)
- Giteki Logo (Japan Certification)
  - Symbol of Radio Certification
  - **201** CAB ID assigned by Minister of MIC
  - **170613** (450-0177) or **170614** (450-0178) Certification number assigned by the CAB.

18.2 450-0194 and 450-0195

18.2.1 Rev 1 Devices

The shield on the 450-0194/450-0195 modules contains the following information:

- Laird Connectivity Model: SaBLE-x-R2
- Part Number and Revision:
  - Part Number: 450-0194 or 450-0195
  - Revision: -RX (where X is the latest revision)
- FCC ID: TFB-1005
- IC: 5969A-1005
- SSYYWWD = Date Code (YY=Year, WW=Week)
- XXXXX = Incremental Serial Number
- 2D Barcode Format is Data Matrix Standard

- C-Tick Logo (Australia and New Zealand Certification)
- Giteki Logo (Japan Certification)
  - Symbol of Radio Certification
  - **201** CAB ID assigned by Minister of MIC
  - **170613** (450-0177) or **170614** (450-0178) Certification number assigned by the CAB.

Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852-2762-4823

19 Contacting Laird Connectivity

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Technical Support	https://www.lairdconnect.com/resources/support support@lairdconnect.com
Sales Contact	sales@lairdconnect.com

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