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Datasheet

Sterling™ LWB5+ 1x1 802.11 a/b/g/n/ac + Bluetooth 5.2 USB Adaptor

Version 1.0

REVISION HISTORY

Version	Date	Notes	Contributors	Approver
1.0	20 Aug 2021	Initial version	Andrew Chen	Andy Ross

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1 SCOPE

This document describes key hardware aspects of the Laird Connectivity Sterling™ LWB5+ wireless USB adaptor providing USB2.0 interface for WLAN and Bluetooth connection. This document is intended to assist user and related parties with the integration of this radio into their host devices. Data in this document is drawn from several sources and includes information found in the Infineon CYW4373EUBGT data sheet issued in July 2020 along with other documents provided from Infineon.

Note: **The information in this document is subject to change.** Please contact Laird Connectivity to obtain the most recent version of this document.

2 INTRODUCTION

2.1 General Description

The LWB5+ wireless USB adapter is an integrated, small form factor 1x1 SISO 802.11 a/b/g/n/ac WLAN plus Bluetooth® 5.2 dual mode USB adaptor that is optimized for low-power mobile devices. The integration of all WLAN and Bluetooth functionality in a single package supports low cost and easy use.

The adaptor is pre-calibrated and contains the complete transmit/receive RF paths including diplexer, switches, ceramic chip antenna, reference crystal oscillator, slow clock oscillator and power management unit (PMU).

The LWB5+ wireless adaptor supports IEEE 802.11ac 1x1 SISO with data rates up to MCS9 (433.3 Mbps). An internal Wi-Fi and Bluetooth coexistence scheme provides optimized connectivity while Wi-Fi and Bluetooth are operating simultaneously. The device's low power consumption radio architecture and power management unit (PMU) proprietary power save technologies allow for extended battery life.

In addition, its dual 802.11ac and Bluetooth radio includes full digital MAC and baseband engines that handle all 802.11 CCK/OFDM® 2.4/5 GHz and Bluetooth 5.2 (Basic Rate, Enhanced Data Rate, and Bluetooth Low Energy) baseband and protocol processing.

LWB5+ product ordering information is listed in Table 1. Please contact Laird Connectivity Sales/FAE for further information.

Table 1: Product ordering information

Part Number	Description
450-00137B	Sterling LWB5+, USB Adapter, Bulk

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3 LWB5+ WIRELESS USB ADAPTOR FEATURES SUMMARY

The Laird Connectivity LWB5+ wireless USB adaptor features are described in Table 2.

Table 2: LWB5+ wireless USB adaptor features

Feature	Description
Radio Front End	▪ Integrates the complete transmit/receive RF paths including diplexer, switches, reference crystal oscillator, ceramic chip antenna and power manage unit (PMU) ▪ Supports 20/40/80 MHz channel bandwidth ▪ WLAN/Bluetooth share one antenna
The *Bluetooth*® word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. Any use of such marks by Laird Connectivity is under license. Other trademarks and trade names are those of their respective owners.	
Power Management	High efficiency buck regulator converts USB VBUS 5.0V to 3.3V for the CYW4373E chip. One buck regulator, multiple LDO regulators, and a power management unit (PMU) are integrated into the CYW4373E. All regulators are programmable via the PMU. These blocks simplify power supply design for Bluetooth and WLAN functions in embedded designs.
Pre-Calibration	RF system tested and calibrated in production
Sleep Clock	Built in 32.768 kHz oscillator
Host Interface	An on-chip USB 2.0 hub provides a single shared USB connection to both WLAN and Bluetooth target devices.
Advanced WLAN	▪ IEEE 802.11ac compliant ▪ Support for MCS8 VHT20 in 20 MHz channels for up to 86.7 Mbps data ▪ Single-stream spatial multiplexing up to 433.3 Mbps data rate ▪ Supports 20, 40, and 80 MHz channels with optional SGI (256 QAM modulation) ▪ Full IEEE 802.11a/b/g/n legacy compatibility with enhanced performance ▪ TX and RX low-density parity check (LDPC) support for improved range and power efficiency ▪ On-chip power amplifiers and low-noise amplifiers for both bands ▪ Support wide variety of WLAN encryption: WEP/WPA/TKIP/WPA2/WPA3 AES-CCMP
Advanced Bluetooth	▪ Qualified for Bluetooth Core Specification 5.2 with all Bluetooth 4.2 optional features – QDID: 158628 – Declaration ID: D050382 ▪ Bluetooth Class 1 or Class 2 transmitter operation ▪ Support data rate: 1 Mbps (GFSK), 2 Mbps (π/4-DQPSK), 3 Mbps (8-DPSK) ▪ Supports extended synchronous connections (eSCO) for enhanced voice quality by allowing for retransmission of dropped packets ▪ Adaptive frequency hopping (AFH) for reducing radio frequency interference ▪ Low power consumption improves battery life of IoT and embedded devices ▪ Supports multiple simultaneous Advanced Audio Distribution Profiles (A2DP) for stereo sound

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4 SPECIFICATIONS

Table 3: Specifications

Feature	Description
Physical Interface	USB 2.0 Type-A connector
Wi-Fi Interface	USB 2.0
Bluetooth/BLE Interface	USB 2.0
Main Chip	Infineon CYW4373E
Input Voltage Requirements	Operational: USB Vbus 5.0V+/-10%
Operating Temperature	-40° to +85°C (-40° to +185°F) [1]
Operating Humidity	10 to 90% (non-condensing)
Storage Temperature	-40° to +85°C (-40° to +185°F)
Storage Humidity	10 to 90% (non-condensing)
MSL (Moisture Sensitivity Level)	3
Maximum Electrostatic Discharge	Conductive 4KV; Air coupled 8KV (follow EN61000-4-2)
Size – mm (in.)	Length: 47 (1.85) Width: 17.5 (0.89) Thickness: 11.7 (0.46)
Weight – g (oz.)	~7g (0.25)
Wi-Fi Media	Direct Sequence-Spread Spectrum (DSSS) Complementary Code Keying (CCK) Orthogonal Frequency Divisional Multiplexing (OFDM)
Bluetooth Media	Frequency Hopping Spread Spectrum (FHSS)
Wi-Fi Multimedia	WMM Wi-Fi Multimedia - PowerSave (WMM-PS with U-APSD) WMM-Sequential Access (WMM-SA with PCF)
Network Architecture Types	Infrastructure (client operation), Access Point
Wi-Fi Standards	IEEE 802.11a, 802.11b, 802.11e, 802.11g, 802.11h, 802.11i, 802.11k*, 802.11n, 802.11r, 802.11v*, 802.11ac
Bluetooth Standards	Bluetooth 5.2 Core Spec
Wi-Fi Data Rates Supported	Support 802.11 ac/a/b/g/n 1x1 SISO. 802.11b (DSSS, CCK) 1, 2, 5.5, 11 Mbps 802.11a/g (OFDM) 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11n (OFDM, HT20/HT40, MCS0-7) 802.11ac (OFDM, VHT20, MCS0-8; OFDM, VHT40/HT80, MCS0-9)
Modulation Table	BPSK, QPSK, CCK, 16-QAM, 64-QAM, and 256-QAM

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Feature				Description							
802.11ac 802.11n	HT MCS Index	VHT MCS Index	Spatial Streams	Modulation	Coding	20 MHz		40 MHz		80 MHz	
						No SGI	SGI	No SGI	SGI	No SGI	SGI
	0	0	1	BPSK	1/2	6.5	7.2	13.5	15	29.3	32.5
	1	1	1	QPSK	1/2	13	14.4	27	30	58.5	65
	2	2	1	QPSK	3/4	19.5	21.7	40.5	45	87.8	97.5
	3	3	1	16-QAM	1/2	26	28.9	54	60	117	130
	4	4	1	16-QAM	3/4	39	43.3	81	90	175.5	195
	5	5	1	64-QAM	2/3	52	57.8	108	120	234	260
	6	6	1	64-QAM	3/4	58.5	65	121.5	135	263.3	292.5
	7	7	1	64-QAM	5/6	65	72.2	135	150	292.5	325
		8	1	256-QAM	3/4	78	86.7	162	180	351	390
		9	1	256-QAM	5/6	N/A	N/A	180	200	390	**433.3**

802.11ac/n Spatial Streams	1 (1x1 SISO)
Bluetooth Data Rates Supported	1, 2, 3 Mbps
Bluetooth Modulation	GFSK@ 1 Mbps Pi/4-DQPSK@ 2 Mbps 8-DPSK@ 3 Mbps
Regulatory Certifications	United States (FCC) EU - Member countries of European Union (ETSI) ISED (Canada) Australia Japan
2.4 GHz Frequency Bands	**EU:** 2.4 GHz to 2.483 GHz **FCC/ISED:** 2.4 GHz to 2.473 GHz **MIC:** 2.4 GHz to 2.495 GHz **RCM**: 2.4 GHz to 2.483 GHz
2.4 GHz Operating Channels (Wi-Fi)	**EU:** 13 (3 non-overlapping) **FCC/ISED:** 11 (3 non-overlapping) **MIC:** 14 (4 non-overlapping) **RCM**: 13 (3 non-overlapping)

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Feature	Description	
5 GHz Frequency Bands	**EU** 5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64) 5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/120/124/128/132/136/140) 5.725 GHz to 5.85 GHz (Ch 149/153/157/161/165) **FCC** 5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64) 5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/120/124/128/132/136/140/144 5.725 GHz to 5.85 GHz (Ch 149/153/157/161/165) **ISED** 5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64) 5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/132/136/140/144 5.725 GHz to 5.85 GHz (Ch 149/153/157/161/165) **MIC** 5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64) 5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/120/124/128/132/136/140) **RCM** 5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64) 5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/132/136/140 5.725 GHz to 5.85 GHz (Ch 149/153/157/161/165)	
5 GHz Operating Channels (Wi-Fi)	EU: 24 non-overlapping; FCC: 25 non-overlapping ISED: 22 non-overlapping; MIC: 19 non-overlapping RCM: 21 non-overlapping	
Transmit Power (conducted, measured at output of embedded module) ***Note:*** *Transmit power on each channel varies per individual country regulations. All values are nominal with +/-2 dBm tolerance at room temperature.* *Tolerance could be up to +/-2.5 dBm across operating temperature.* ***Note:*** *HT20 – 20 MHz-wide channels* *HT40 – 40 MHz-wide channels* *HT80 – 80 MHz-wide channels*	**802.11a** 6 Mbps 54 Mbps **802.11b** 1 Mbps 11 Mbps **802.11g** 6 Mbps 54 Mbps **802.11n (2.4 GHz)** HT20; MCS0-7 HT40; MCS0-7 **802.11n (5 GHz)** HT20; MCS0-5 HT20; MCS6-7 HT40; MCS0-7 **802.11ac (5 GHz)** VHT20; MCS0-5 VHT20; MCS6-7 VHT20; MCS8 VHT40; MCS0-7 VHT40; MCS8-9 VHT80; MCS0-7 VHT80; MCS8-9 **Bluetooth** 1 Mbps (1DH5) 2 Mbps 3 Mbps BLE (1 Mbps)	 16 dBm (40 mW) 15 dBm (31.6 mW) 16.5 dBm (44.7 mW) 16.5 dBm (44.7 mW) 16 dBm (40 mW) 15.5 dBm (35.5 mW) 13.5 dBm (22.4 mW) 13.5 dBm (22.4 mW) 16 dBm (40 mW) 15 dBm (31.6 mW) 13 dBm (20 mW) 16 dBm (40 mW) 15 dBm (31.6 mW) 13 dBm (20 mW) 13 dBm (20 mW) 11 dBm (12.6 mW) 12 dBm (15.8 mW) 11 dBm (12.6 mW) 7 dBm (5 mW) 3 dBm (1.99 mW) 3 dBm (1.99 mW) 7 dBm (5 mW)

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Feature	Description	
Typical Receiver Sensitivity (conductive) (PER <= 10%) ***1)*** ***Note:*** *All values nominal, +/-3 dBm.*	**802.11a:**	
	6 Mbps	-92 dBm
	54 Mbps	-74 dBm
	802.11b:	
	1 Mbps	-96 dBm (PER < 8%)
	11 Mbps	-90 dBm (PER < 8%)
	802.11g:	
	6 Mbps	-93 dBm
	54 Mbps	-76 dBm
	802.11n (2.4 GHz)	
	6.5 Mbps (MCS0; HT20)	-93 dBm
	65 Mbps (MCS7; HT20)	-74 dBm
	13.5 Mbps (MCS0; HT40)	-91 dBm
	135 Mbps (MCS7; HT40)	-71 dBm
	802.11n (5 GHz)	
	6.5 Mbps (MCS0; HT20)	-91 dBm
	65 Mbps (MCS7; HT20)	-73 dBm
	13.5Mbps (MCS0; HT40)	-89 dBm
	135Mbps (MCS7; HT40)	-69 dBm
	802.11ac (5 GHz)	
	6.5 Mbps (MCS0; VHT20)	-90 dBm
	78 Mbps (MCS8; VHT20)	-67 dBm
	13.5 Mbps (MCS0; VHT40)	-89 dBm
	180 Mbps (MCS9; VHT40)	-63 dBm
	29.3 Mbps (MCS0; VHT80)	-85 dBm
	390 Mbps (MCS9; VHT80)	-60 dBm
	Bluetooth:	
	1 Mbps (1DH5)	-91 dBm
	2Mbps (2DH5)	-93 dBm
	3 Mbps (3DH5)	-87 dBm
	Bluetooth LE	-94 dBm
Operating Systems Supported	Linux Android	
Security	▪ WEP ▪ WPA, WPA2 (Personal and Enterprise) and WPA3[2] support for powerful encryption and authentication ▪ AES and TKIP in hardware for faster data encryption and IEEE 802.11i compatibility ▪ Reference WLAN subsystem provides Wi-Fi Protected Setup (WPS). ▪ CKIP	

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Feature	Description	
Compliance	**EU**	
	EN 300 328	EN 62368-1:2014
	EN 301 489-1	EN 300 440
	EN 301 489-17	2011/65/EU (RoHS)
	EN 301 893	
	FCC	**ISED Canada**
	47 CFR FCC Part 15.247	RSS-247
	47 CFR FCC Part 15.407	
	47 CFR FCC Part 2.1091	
	AS/NZS	**MIC**
	AS/NZS 4268:2017	ARIB STD-T66/RCR STD-33 (2.4 GHz)
		ARIB STD-T71 (5 GHz)
Certifications (Pending)	***Bluetooth*® SIG Qualification**	
Warranty	One Year Warranty	
Notes	1. When ambient temperatures are >65°C, under heavy data throughput loads the device will enable thermal throttling to protect from thermal damage. Throughput will be reduced. 2. WPA3 is currently in development. Please contact Laird sales/support for availability.	
All specifications are subject to change without notice		

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5 WLAN Functional Description

5.1 Overview

The LWB5+ wireless USB adaptor is designed based on the Cypress CYW4373EUBGT 802.11ac/a/b/g/n chipset. It is optimized for high speed, reliability, and low-power embedded applications. It is integrated with dual-band WLAN (2.4/5 GHz) and Bluetooth 5.2. Its functionality includes the following:

- Improved throughput on the link due to frame aggregation, RIFS (reduced inter-frame spacing), and half guard intervals.
- Support for LDPC (Low Density Parity Check) codes.
- Improved 11n performance due to features such as 11n frame aggregation (TX A-MPDU) and low-overhead host-assisted buffering (RX A-MPDU). These techniques can improve performance and efficiency of applications involving large bulk data transfers such as file transfers or high-resolution video streaming.
- IEEE 802.11ac, 1x1 SISO with data rate up to MCS9 (433.3 Mbps).

Additional functionality is listed in Table 4.

Table 4: WLAN functions

Feature	Description
WLAN MAC	▪ Enhanced MAC for supporting IEEE 802.11ac features ▪ Transmission and reception of aggregated MPDUs (A-MPDUs) for very high throughput (VHT) ▪ Support for power management schemes, including WMM power-save, power-save multi-poll (PSMP) and multiphase PSMP operation ▪ Support for immediate ACK and Block-ACK policies ▪ Interframe space timing support, including RIFS ▪ Support for RTS/CTS and CTS-to-self frame sequences for protecting frame exchanges ▪ Back-off counters in hardware for supporting multiple priorities as specified in the WMM specification ▪ Timing synchronization function (TSF), network allocation vector (NAV) maintenance, and target beacon transmission time (TBTT) ▪ generation in hardware and capturing the TSF timer on an external time synchronization pulse ▪ Hardware offload for AES-CCMP, legacy WPA TKIP, legacy WEP ciphers, WAPI, and support for key management ▪ Support for coexistence with Bluetooth and other external radios ▪ Programmable independent basic service set (IBSS) or infrastructure basic service set functionality ▪ Statistics counters for MIB support
WLAN Security	▪ WLAN Encryption features supported include: – Temporal Key Integrity Protocol (TKIP)/Wired Equivalent Privacy (WEP) – Advanced Encryption Standard (AES)/Counter-Mode/CBC-MAC Protocol (CCMP) – WLAN Authentication and Private Infrastructure (WPAI)

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Feature	Description
WLAN Channel	Channel frequency supported.

20 MHz				40 MHz		80 MHz	
Channel	**Freq. (MHz)**	**Channel**	**Freq. (MHz)**	**Channel**	**Freq. (MHz)**	**Channel**	**Freq. (MHz)**
1	2412	36	5180	1-5	2422	42	5210
2	2417	40	5200	2-6	2427	58	5290
3	2422	44	5220	3-7	2432	74	5370
4	2427	48	5240	4-8	2437	90	5410
5	2432	52	5260	5-9	2422	106	5530
6	2437	56	5280	6-10	2447	122	5610
7	2422	60	5300	7-11	2452	138	5690
8	2447	64	5320	36-40	5190	155	5775
9	2452	100	5500	44-48	5230		
10	2457	104	5520	52-56	5270		
11	2462	108	5540	60-64	5310		
12	2467	112	5560	68-72	5350		
13	2472	116	5580	76-80	5390		
		120	5600	84-88	5430		
		124	5620	92-96	5470		
		128	5640	100-104	5510		
		132	5660	108-112	5550		
		136	5680	116-120	5590		
		140	5700	124-128	5630		
		144	5720	132-136	5670		
		149	5745	140-144	5710		
		153	5765	149-153	5755		
		157	5785	157-161	5795		
		161	5805				
▪		165	5825				

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6 BLUETOOTH FUNCTIONAL DESCRIPTION

The LWB5+ wireless USB adaptor includes a fully integrated Bluetooth baseband/radio. Several features and functions are listed in Table 5.

Table 5: Bluetooth functions

Feature	Description
Bluetooth Interface	▪ USB 2.0
Bluetooth Core functionality	▪ Bluetooth 5.2 ▪ Bluetooth Class 2/Bluetooth class 1 ▪ WLAN and Bluetooth share same LNA and antenna ▪ Baseband and radio BDR and EDR package type: 1 Mbps, 2 Mbps, 3 Mbps ▪ Fully functional Bluetooth baseband: AFH, forward error correction, header error control, access code correction, CRC, encryption bit stream generation, and whitening. ▪ Adaptive Frequency Hopping (AFH) using Packet Error Rate (PER) ▪ Interlaced scan for faster connection setup ▪ Simultaneous active ACL connection setup ▪ Automatic ACL package type selection ▪ Full master and slave piconet support ▪ Scatter net support ▪ SCO/eSCO links with hardware accelerated audio signal processing and hardware supported PPEC algorithm for speech quality improvement ▪ All standard SCO/eSCO voice coding ▪ All standard pairing, authentication, link key, and encryption operations ▪ Encryption (AES) support
Bluetooth Low Energy (BLE) Core functionality	▪ Bluetooth 5.2 Core Spec ▪ Bluetooth 4.2 features: ○ LE privacy 1.2 ○ LE Secure Connection ○ LE Data Length Extension ▪ Bluetooth 4.0 features: ○ Advertiser, scanner, initiator, master, and slave roles support (connects to 16 links) ○ WLAN/Bluetooth coexistence (BCA) protocol support. ○ Shared RF with BDR/EDR ○ Encryption (AES) support ○ Intelligent Adaptive Frequency Hopping (AFH)

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7 BLOCK DIAGRAM

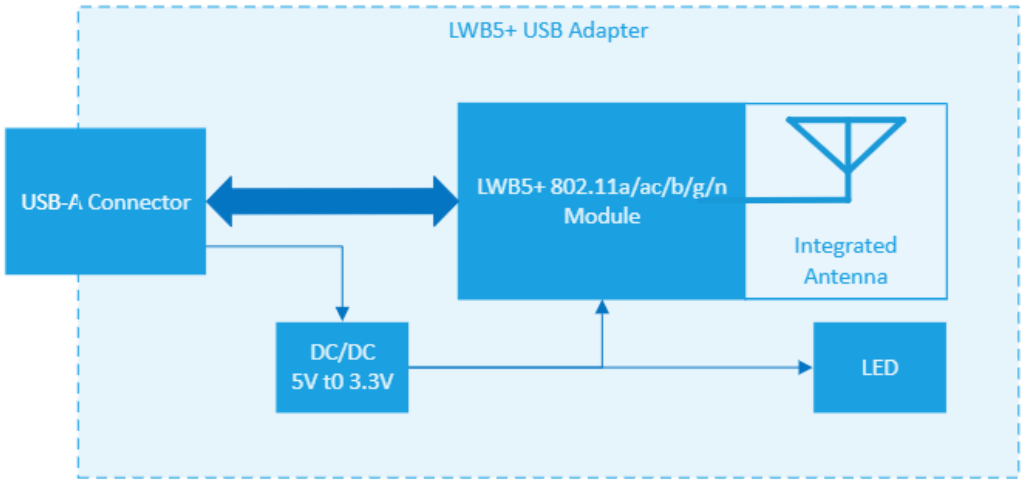

Figure 1: Block diagram

8 ELECTRICAL CHARACTERISTICS

8.1 Absolute Maximum Ratings

Table 6 summarizes the absolute maximum ratings and Table 7 lists the recommended operating conditions for the LWB5+ series wireless module. Absolute maximum ratings are those values beyond which damage to the device can occur. Functional operation under these conditions, or at any other condition beyond those indicated in the operational sections of this document, is not recommended.

Note: Maximum rating for signals follows the supply domain of the signals.

Table 6: Absolute maximum ratings

Symbol (Domain)	Parameter	Max Rating	Unit
USB_VBUS	External DC power supply from USB VBUS	5.5	V
Storage	Storage temperature	-40 to +85	°C
ESD	Electrostatic discharge tolerance	2000	V

8.2 Recommended Operating Conditions

Table 7: Recommended operating conditions

Symbol (Domain)	Parameter	Min	Typ	Max	Unit
USB_VBUS	External DC power supply from USB VBUS	4.5	5.0	5.5	V
T-ambient	Ambient temperature Note 1	-40	25	85	°C

Note 1: When ambient temperature is higher than +65 degree C, the thermal throttling algorithm may be enabled and reduce the transmit duty cycle to lower the heat generated by the chip. Throughput will drop accordingly.

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8.3 WLAN Radio Receiver Characteristics

Table 8 and Table 9 summarize the LWB5+ wireless USB adaptor receiver characteristics.

Table 8: WLAN receiver conductive characteristics for 2.4 GHz single chain operation

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Frx	Receive input frequency range	—	2.412	—	2.484	GHz
Srf	Sensitivity					
	CCK, 1 Mbps	See Note[1]	—	-95	—	dBm
	CCK, 11 Mbps		—	-90	—	
	OFDM, 6 Mbps		—	-92	—	
	OFDM, 54 Mbps		—	-75	—	
	HT20, MCS0		—	-91	—	
	HT20, MCS7		—	-73	—	
	HT40, MCS0		—	-90	—	
	HT40, MCS7		—	-71	—	
Radj	Adjacent channel rejection					
	OFDM, 6 Mbps	See Note[1]	16	38	—	dB
	OFDM, 54 Mbps		-1	20.4	—	
	HT20, MCS0		16	33.3	—	
	HT20, MCS7		-2	13.7	—	

Table 9: WLAN receiver conductive characteristics for 5 GHz single chain operation

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Frx	Receive input frequency range	—	5.15	—	5.825	GHz
Srf	Sensitivity					
	OFDM, 6 Mbps	See Note[1]	—	-92	—	dBm
	OFDM, 54 Mbps		—	-74	—	
	HT20, MCS0		—	-91	—	
	HT20, MCS7		—	-73	—	
	HT40, MCS0		—	-89	—	
	HT40, MCS7		—	-69	—	
	VHT20, MCS0		—	-90	—	
	VHT20, MCS8		—	-67	—	
	VHT40, MCS0		—	-89	—	
	VHT40, MCS9		—	-63	—	
	VHT80, MCS0		—	-85	—	
	VHT80, MCS9		—	-60	—	
Radj [Difference between interfering and desired signal (20 MHz apart)]	Adjacent channel rejection					
	OFDM, 6 Mbps	See Note[1]	16	31.7	—	dB
	OFDM, 54 Mbps		-1	13.8	—	
	OFDM, 65 Mbps		-2	8.4	—	
Radj.	OFDM, 6 Mbps		32	44.7	—	dB

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[Difference between interfering and desired signal (40 MHz apart)]	OFDM, 54 Mbps	See Note[1]	15	26.6	—
	OFDM, 65 Mbps		14	26.8	—

Note[1]: Performance data are measured under signal chain operation.

Note: All the conductive measurements are carried out by installing a MHF4 connector on the module reference to the LWB5+ (453-00046R)

8.4 WLAN Transmitter Characteristics

Table 10: WLAN transmitter conductive characteristics for 2.4 GHz operation

Symbol	Parameter	Conditions	Min	Typ		Max	Unit
Ftx	Transmit output frequency range	—	2.402	—		2.484	GHz
Pout	Output power	See Note[2]	—	—		—	—
	11b mask compliant	1-11Mbps	—	18		—	dBm
	11g mask compliant	6-36Mbps	—	18		—	
	11g EVM compliant	48-54Mbps	—	18		—	
	11n HT20 mask compliant	MCS0-6	—	18		—	
	11n HT20 EVM compliant	MCS7	—	17.5		—	
	11n HT40 mask compliant	MCS0-5	—	18		—	
	11n HT40 EVM compliant	MCS6-7	—	16.5		—	
ATx	Transmit power accuracy at 25 ℃	—	-2.0	—		+2.0	dB

Table 11: WLAN current consumption on 2.4 GHz operation@25 degree C

Freq.	Mode/Rate (Mbps)	Output Power (dBm)	Maximum Current Consumption @ USB VBUS (mA)
2412 MHz	1 Mbps	18 dBm	288
	54 Mbps	18 dBm	280
2422 MHz	HT20 MCS7	17.5 dBm	290
	HT40 MCS7	16.5 dBm	295
2442 MHz	1 Mbps	18 dBm	290
	54 Mbps	17 dBm	278
	HT20 MCS7	17 dBm	290
	HT40 MCS7	16 dBm	300
2472 MHz	1 Mbps	18 dBm	290
	54 Mbps	17 dBm	280
2462 MHz	HT20 MCS7	17 dBm	287
	HT40 MCS7	16 dBm	298

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Table 12: WLAN transmitter conductive characteristics for 5 GHz operation

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Ftx	Transmit output frequency range	—	5.15	—	5.925	GHz
Pout	Output power	See Note[2]	—	—	—	—
	11a mask compliant	6-36Mbps	—	17.5	—	dBm
	11a EVM compliant	48-54Mbps	—	17.5	—	
	11n HT20 mask compliant	MCS0-5	—	17.5	—	
	11n HT20 EVM compliant	MCS6-7	—	16.5	—	
	11n HT40 mask compliant	MCS0-5	—	17.5	—	
	11n HT40 EVM compliant	MCS6-7	—	16	—	
	11ac VHT20 mask compliant	MCS0-5	—	17.5	—	
	11ac VHT20 EVM compliant	MCS6-8	—	15	—	
	11ac VHT40 mask compliant	MCS0-5	—	17.5	—	
	11ac VHT40 EVM compliant	MCS6-7	—	16	—	
	11ac VHT40 EVM compliant	MCS8-9	—	13.5	—	
	11ac VHT80 mask compliant	MCS0-5	—	17.5	—	
	11ac VHT80 EVM compliant	MCS6-7	—	16	—	
	11ac VHT80 EVM compliant	MCS8-9	—	13.5	—	
ATx	Transmit power accuracy at 25 ℃	—	-2.0	—	+2.0	dB

Table 13: WLAN current consumption on 5 GHz operation@ 25 degree C

Frequency (MHz)	Mode/Rate (Mbps)	Output Power (dBm)	Maximum Current Consumption @ USB VBUS(mA)
5180	6 Mbps	17.5	295
	54 Mbps	17.5	280
	HT20 MCS0	17.5	288
	HT20 MCS7	16.5	275
5190	HT40 MCS0	17.5	335
	HT40 MCS7	16	315
5210	VHT80 MCS0	17.5	345
	VHT80 MCS9	13.5	290
5500	6 Mbps	17.5	298
	54 Mbps	17.5	282
	HT20 MCS0	17.5	287
	HT20 MCS7	16.5	277
5510	HT40 MCS0	17.5	340
	HT40 MCS7	16	318
5530	VHT80 MCS0	17.5	350
	VHT80 MCS9	13.5	295
5825	6 Mbps	17.5	293
	54 Mbps	17.5	284

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Frequency (MHz)	Mode/Rate (Mbps)	Output Power (dBm)	Maximum Current Consumption @ USB VBUS(mA)
	HT20 MCS0	17.5	287
	HT20 MCS7	16.5	279
5795	HT40 MCS0	17.5	344
	HT40 MCS7	16	320
5775	VHT80 MCS0	17.5	355
	VHT80 MCS9	13.5	300

Note[2]: Final TX power values on each channel are limited by regulatory requirements

Note: All the conductive measurements are carried out by installing a MHF4 connector on the module reference to the LWB5+ (453-00046R)

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9 Bluetooth Radio Characteristics

Table 14 through Table 16 describe the basic rate transmitter performance, basic rate receiver performance, enhanced rate receiver performance, and current consumption conditions at 25°C.

Table 14: Basic rate transmitter performance temperature at 25°C

Test Parameter		Min	Typ	Max	BT Spec.	Unit
Maximum RF Output Power	GFSK	—	—	7	0 ~ +20	dBm
	π/4-DQPSK	—	3	—		
	8-DPSK	—	3	—		
Frequency Range		2.4	—	2.4835	2.4 ≤ f ≤ 2.4835	GHz
20 dB Bandwidth		—	919.5	—	≤ 1000	KHz
Δf1avg Maximum Modulation		140	155	175	140 < Δf1avg < 175	KHz
Δf2max Minimum Modulation		115	135	—	≥ 115	KHz
Δf2avg/Δf1avg		—	0.9	—	≥ 0.80	—
Initial Carrier Frequency		—	± 25	± 75	≤ ± 75	KHz
Frequency Drift (DH1 packet)		—	± 10	± 25	± 25	KHz
Frequency Drift (DH3 packet)		—	± 10	± 40	± 40	KHz
Frequency Drift (DH5 packet)		—	± 10	± 40	± 40	KHz
Drift rate		—	8	20	20	KHz/50us
Adjacent Channel Power	F ≥ ± 3 MHz	—	-50	—	< -40	dBm
	F = ± 2 MHz	—	-46	—	≤ -20	dBm
	F = ± 1 MHz	—	-15	—	N/A	dBm

Table 15: Basic rate receiver performance temperature at 25°C

Test Parameter		Min	Typ	Max	Bluetooth Spec.	Unit
Sensitivity (1DH5)	BER ≤ 0.1%	—	-91	—	≤ -70	dBm
Maximum Input	BER ≤ 0.1%	—	—	-20	≥ -20	dBm
Interference Performance	Co-Channel	—	9	11	11	dB
	C/I 1 MHz adjacent channel	—	-5.5	0	0	dB
	C/I 2 MHz adjacent channel	—	-38	-30	-30	dB
	C/I ≥ 3 MHz adjacent channel	—	-46	-40	-40	dB
	C/I image channel	—	-25.5	-9	-9	dB
	C/I 1-MHz adjacent to image channel	—	-39	-20	-20	dB

Table 16: Enhanced data rate receiver performance

Test Parameter		Min	Typ	Max	Bluetooth Spec.	Unit
Sensitivity (BER ≤ 0.01%)	π/4-DQPSK	—	-93	—	≤ -70	dBm
	8-DPSK	—	-87	—	≤ -70	dBm
Maximum Input (BER ≤ 0.1%)	π/4-DQPSK	—	—	-20	≥ -20	dBm
	8-DPSK	—	—	-20	≥ -20	dBm
C/I Co-Channel (BER ≤ 0.1%)	π/4-DQPSK	—	10.5	13	≤ ±13	dB
	8-DPSK	—	17.5	21	≤ ±21	dB

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Test Parameter		Min	Typ	Max	Bluetooth Spec.	Unit
C/I 1 MHz adjacent Channel	π/4-DQPSK	—	-6	0	≤ 0	dB
	8-DPSK	—	-3	5	≤5	dB
C/I 2 MHz adjacent Channel	π/4-DQPSK	—	-38.5	-30	≤ -30	dB
	8-DPSK	—	-37.5	-25	≤ -25	dB
C/I ≥ 3 MHz adjacent Channel	π/4-DQPSK	—	-47	-40	≤ -40	dB
	8-DPSK	—	-39.5	-33	≤ -33	dB
C/I image channel	π/4-DQPSK	—	-24.5	-7	≤ -7	dB
	8-DPSK	—	-17	0	≤ 0	dB
C/I 1 MHz adjacent to image channel	π/4-DQPSK	—	-43	-20	≤ -20	dB
	8-DPSK	—	-37	-13	≤ -13	dB
Out-of-Band Blocking Performance (CW) BER ≤ 0.1%	30-2000MHz	—	-10	—	—	dBm
	2-2.399GHz	—	-27	—	—	dBm
	2.484-3GHz	—	-27	—	—	dBm
	3-12.75GHz	—	-10	—	—	dBm

Table 17: BLE RF Specifications

Parameter	Conditions	Min	Typ	Max	Unit
Frequency range	—	2402	—	2480	MHz
Rx sensitivity[3]	GFSK, 30.8% PER, 1Mbps	—	-94	—	dBm
Tx power	—	—	—	7	dBm
Δf1 average	—	225	255	275	KHz
Δf2 maximum[4]	—	185	220	—	KHz
$\frac{\Delta f2\ avg}{\Delta f1\ avg}$ ratio	—	0.8	0.95	—	—

Notes

[3] Dirty Tx is Off.

[4] At least 99.9% of all Δf2 maximum frequency values recorded over 10 packets must be greater than 185 KHz.

Table 18: Bluetooth current consumption @ USB VBUS

Mode	Current(mA)					
	Tx			Rx		
	Min	Avg	Max	Min	Avg	Max
1DH1	51.85	57.22	61.9	52.64	57.2	62.18
1DH3	51.29	57.27	62.28	55.52	57.28	60.81
2DH1	46.13	50.53	54.93	46.51	50.58	55.54
2DH3	49.29	50.79	54.09	45.8	50.76	54.78
3DH1	49.26	50.65	54.42	46.06	50.56	54.37
3DH3	49.13	50.75	54.65	49.16	50.76	54.52
LE(1M)	63.35	66.02	70.85	44.45	45.63	48.83

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10 USB Host Interface Specifications

10.1 USB LS Driver and Receiver Parameters

Notes: Over full range of values specified in the Recommended Operating Conditions unless otherwise specified.

The load is 100Ω differential for these parameters, unless other specified.

Table 19: USB LS driver and receiver specifications

Symbol	Parameter	Min.	Typ.	Max.	Unit
BR	Baud rate	-	1.5	-	Mbps
BRPPM	Baud rate tolerance	-15000	-	15000	ppm
Driver Specifications					
VOH	Output signal ended high Defined with 1.425KΩ pull-up resistor to 3.6V	2.8	-	3.6	V
VOL	Output signal ended low Defined with 1.425KΩ pull-up resistor to ground	0.0	-	0.3	V
VCRS	Output signal crossover voltage	1.3		2.0	V
TLR	Data fall time Defined from 10% to 90% for raise time and 90% to 10% for fall time	75.0	-	300.0	ns
TLF	Data rise time Defined from 10% to 90% for raise time and 90% to 10% for fall time	75.0	-	300.0	ns
TLRFM	Rise and fall time matching	80.0	-	125.0	%
TUDJ1	Source jitter total: to next transition *Including frequency tolerance. Timing difference between the differential data signals. *Defined at crossover point of differential signals	-95	-	95	ns
TUDJ2	Source jitter total: for paired transitions *Including frequency tolerance. Timing difference between the differential data signals. *Defined at crossover point of differential signals	-150	-	150	ns
Receiver Specifications					
VIH	Input signal ended high	2.0	-	-	V
VIL	Input signal ended low	-	-	0.8	V
VDI	Differential input sensitivity	0.2	-	-	V

10.2 USB FS Driver and Receiver Parameters

Notes: Over full range of values specified in the Recommended Operating Conditions unless otherwise specified.
The load is 100Ω differential for these parameters, unless other specified.

Table 20: USB FS driver and receiver specifications

Symbol	Parameter	Min.	Typ.	Max.	Unit
BR	Baud rate	-	12.0	-	Mbps

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Symbol	Parameter	Min.	Typ.	Max.	Unit
BRPPM	Baud rate tolerance	-2500	-	2500	ppm
Driver Specifications					
VOH	Output signal ended high Defined with 1.425KΩ pull-up resistor to 3.6V	2.8	-	3.6	V
VOL	Output signal ended low Defined with 1.425KΩ pull-up resistor to ground	0.0	-	0.3	V
VCRS	Output signal crossover voltage	1.3		2.0	V
TFR	Output raise time Defined from 10% to 90% for raise time and 90% to 10% for fall time	-4.0	-	20.0	ns
TFL	Output fall time Defined from 10% to 90% for raise time and 90% to 10% for fall time	-4.0	-	20.0	ns
TDJ1	Source jitter total: to next transition *Including frequency tolerance. Timing difference between the differential data signals. *Defined at crossover point of differential signals	-3.5	-	3.5	ns
TDJ2	Source jitter total: for paired transitions *Including frequency tolerance. Timing difference between the differential data signals. *Defined at crossover point of differential signals	-4.0	-	4.0	ns
TFDEOP	Source jitter for differential transition to SE0 transition. Defined at crossover point of differential signals	-2.0	-	5.0	ns
Receiver Specifications					
VIH	Input signal ended high	2.0	-	-	V
VIL	Input signal ended low	-	-	0.8	V
VDI	Differential input sensitivity	0.2	-	-	V
TJR1	Receiver jitter: to next transition Defined at crossover point of differential data signals	-18.5	-	18.5	ns
TJR2	Receiver jitter: for paired transitions Defined at crossover point of differential data signals	-9.0	-	9.0	ns

10.3 USB HS Driver and Receiver Parameters

Notes: Over full range of values specified in the Recommended Operating Conditions unless otherwise specified.
The load is 100Ω differential for these parameters, unless other specified.

Table 21: USB HS driver and receiver specifications

Symbol	Parameter	Min.	Typ.	Max.	Unit
BR	Baud rate	-	480	-	Mbps
BRPPM	Baud rate tolerance	-500	-	500	ppm

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Symbol	Parameter	Min.	Typ.	Max.	Unit
Driver Specifications					
VHSOH	Data signal high	360	-	440	mV
VHSOL	Data signal low	-10	-	10	mV
THSR	Data rise time Defined from 10% to 90% for raise time and 90% to 10% for fall time	500	-	-	ns
THSF	Data fall time Defined from 10% to 90% for raise time and 90% to 10% for fall time	-500	-	-	ns
Receiver Specifications					
VHSCM	Input signal ended low	-50	-	500	mV

11 Mechanical Specifications

LWB5+ USB Adapter dimensions is 47 x 17.5 x 11.7 mm. Detail drawings are shown in Figure 2.

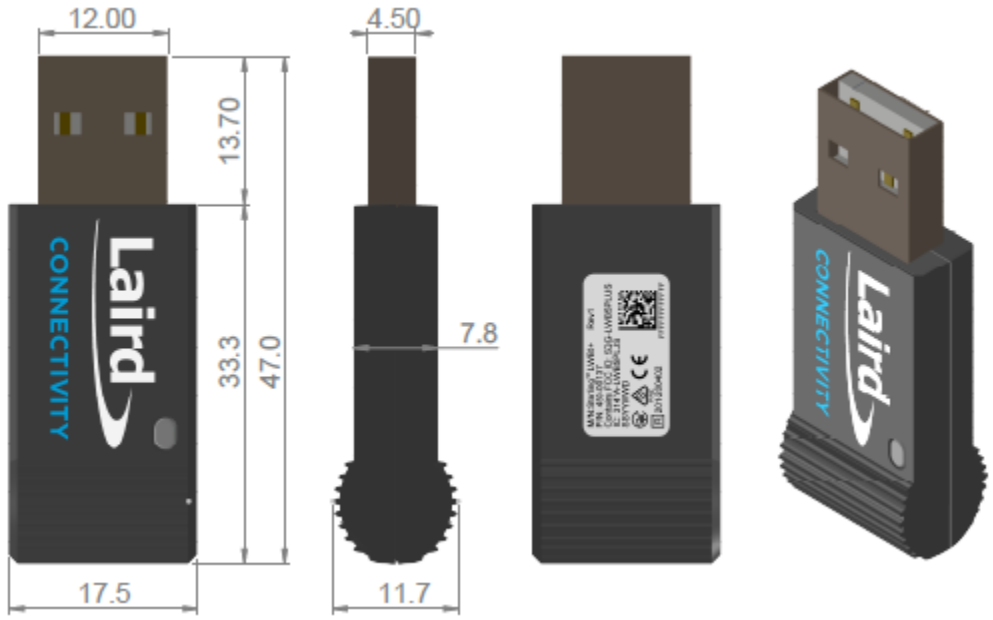

Figure 2: Mechanical drawing - LWB5+ USB Adapter

Note: The Wi-Fi MAC address is located on the product label.
The last digit of Wi-Fi MAC address is assigned to either *0, 2, 4, 6, 8, A, C, E.*
The Bluetooth MAC address is the Wi-Fi MAC address plus 1.

11.1 Required Storage Conditions

TBD

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12 Packaging Information

12.1 450-00137 Single Unit

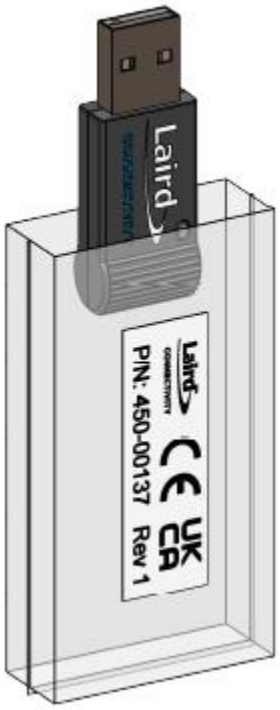

Figure 3: 450-00137 Single Unit

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12.2 450-00137B Bulk

Figure 4: 450-00137B Bulk (100 units)

13 Regulatory

Note: For complete regulatory information, refer to the Sterling LWB5+ Regulatory Information document which is also available from the Sterling LWB5+ product page.

The Sterling LWB5+ holds current certifications in the following countries:

Country/Region	Regulatory ID
USA (FCC)	SQG-LWB5PLUS
EU	N/A
Canada (ISED)	3147A-LWB5PLUS
Japan (MIC)	201-200402
Australia	N/A
New Zealand	N/A

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13.1 Federal Communication Commission Interference Statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

IMPORTANT NOTE:

Radiation Exposure Statement:

The product complies with the US portable RF exposure limit set forth for an uncontrolled environment and are safe for intended operation as described in this manual. The further RF exposure reduction can be achieved if the product can be kept as far as possible from the user body or set the device to lower output power if such function is available.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

13.2 Industry Canada Statement

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

(1) This device may not cause interference
(2) This device must accept any interference, including interference that may cause undesired operation of the device

L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :

(1) L'*appareil ne doit pas produire de brouillage;*
(2) L'*appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

Radiation Exposure Statement:

The product complies with the Canada portable RF exposure limit set forth for an uncontrolled environment and are safe for intended operation as described in this manual. The further RF exposure reduction can be achieved if the product can be kept as far as possible from the user body or set the device to lower output power if such function is available.

Déclaration d'exposition aux radiations:
Le produit est conforme aux limites d'exposition pour les appareils portables RF pour les Etats-Unis et le Canada établies pour un environnement non contrôlé. Le produit est sûr pour un fonctionnement tel que décrit dans ce manuel. La réduction aux expositions RF peut être augmentée si l'appareil peut être conservé aussi loin que possible du corps de l'utilisateur ou que le dispositif est réglé sur la puissance de sortie la plus faible si une telle fonction est disponible.

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14 Ordering Information

Part Number	Description
450-00137	1x1 802.11 a/b/g/n/ac + Bluetooth 5.2 USB Adapter (Single Unit)
450-00137B	1x1 802.11 a/b/g/n/ac + Bluetooth 5.2 USB Adapter (Bulk)

14.1 General Comments

This is a preliminary datasheet. Please check with Laird Connectivity for the latest information before commencing a design. If in doubt, ask.

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15 BLUETOOTH SIG QUALIFICATION

15.1 Overview

The LWB5+ Series module is listed on the Bluetooth SIG website as a qualified Controller Subsystem.

Design Name	Owner	Declaration ID	Link to listing on the SIG website
Sterling LWB5+	Laird Connectivity	D050382	https://launchstudio.bluetooth.com/ListingDetails/119009

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 register as a member of the Bluetooth SIG – www.bluetooth.org

The following is 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 will 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, (login is required to views this document):

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

15.2 Qualification Steps When Referencing a Laird Connectivity Controller Subsystem Design

To qualify your product when referencing a Laird Connectivity Controller Subsystem design, follow these steps:

1. To start a listing, go to: https://www.bluetooth.org/tpg/QLI_SDoc.cfm

   Note: A username and password are required to access this site.

2. In step 1, select the option, New Listing and Reference a Qualified Design.
3. Enter D050382 in the Controller Subsystem table entry.
4. Enter your complimentary Host Subsystem and optional Profile Subsystem QDID in the table entry.
5. Select your pre-paid Declaration ID from the drop-down menu or go to the Purchase Declaration ID page.

   Note: Unless the Declaration ID is pre-paid or purchased with a credit card, you cannot proceed until the SIG invoice is paid.

6. Once all the relevant sections of step 1 are finished, complete steps 2, 3, and 4 as described in the help document accessible from the site.

   Your new design will be listed on the SIG website and you can print your Certificate and DoC.

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.flooks@eurexuk.com.

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16 Additional Assistance

Please contact your local sales representative or our support team for further assistance:

Laird Connectivity
Support Centre: https://www.lairdconnect.com/resources/support
Email: wireless.support@lairdconnectivity.com
Phone: Americas: +1-800-492-2320
Europe: +44-1628-858-940
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Web: https://www.lairdconnect.com/products

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