Datasheet
M2SD50NBT

M2SD50NBT
Datasheet

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Contents

1 SCOPE

This document describes key hardware aspects of the Laird M2SD50NBT module. This document is intended to assist device manufacturers and related parties with the integration of this radio into their host devices. Data in this document is drawn from a number of sources and includes information found in the Laird SSD50NBT which including Qualcomm Atheros (QCA) QCA6004 and Cambridge Silicon Radio Ltd. (CSR) CSR8811 A08 data sheet issued in July 2011, along with other documents provided from QCA and CSR

Note that the information in this document is subject to change. Please contact Laird to obtain the most recent version of this document.

2 SPECIFICATIONS

Table 1: Specifications

Feature	Description
Wi-Fi Interface	1-bit or 4-bit Secure Digital I/O
Bluetooth Interface	Host Controller Interface (HCI) using High Speed UART
Main Chip	Wi-Fi – Qualcomm Atheros QCA6004 BT – Cambridge Silicon Radio Ltd. (CSR) CSR8811 A08
Input Voltage Requirements	3.3 VDC (3.20V min to 3.46V max)
I/O Signalling Voltage	3.3 VDC ± 5% or 1.8 VDC ± 5%
Operating Temperature	-30° to 85°C (-22° to 185°F)
Operating Humidity	10 to 90% (non-condensing)
Storage Temperature	-40° to 85°C (-40° to 185°F)
Storage Humidity	10 to 90% (non-condensing)
Size	22 mm X 30 mm X 3.3 mm (.87" x 1.18" x .13")
Weight	< 3.0 grams (< 0.105822 ounces)
Wi-Fi Standards	IEEE 802.11a, 802.11b, 802.11d, 802.11e, 802.11g, 802.11h, 802.11i, 802.11n, 802.11r
Bluetooth Standards	Bluetooth version 2.1 with Enhanced Data Rate Bluetooth 4.0 (Bluetooth Low Energy or BLE)
Wi-Fi Data Rates Supported	11a (OFDM) 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11b (DSSS, CCK) 1, 2, 5.5, 11 Mbps 802.11g (OFDM) 6, 9, 12, 18, 24, 36, 48, 54 Mbps 802.11n (OFDM, MCS 0-15) Full Guard Interval: 6.5,13.0, 19.5, 26.0,39.0,52.0,58.5,65.0, 13.0,26.0,39.0, 52.0, 78.0,104.0,117.0 Mbps Short Guard Interval: 1.2,14.4,21.7,29.9,43.3,57.8,65.0,72.2, 14.4,28.9,43.3,57.8, 86.7,115.6,130.0,144.4 Mbps

Feature	Description
Modulation	BPSK @ 1, 6,9, 6.5, 7.2,13 and 14.4 Mbps QPSK @ 2, 12, 18, 13, 14.4,19.5, 21.7, 26, 28.9, 39,43.3 Mbps CCK @ 5.5 and 11 Mbps 16-QAM @ 24, 36,26, 29.9,39,43.3,52,57.8,78,86.7 Mbps 64-QAM @ 48,54,52, 57.8, 58.5, 65,72.2,104.0,115.6,117.0,130.0,144.4 Mbps
802.11n Spatial Streams	2 (2x2 MIMO)
Bluetooth Data Rates Supported	1, 2, 3 Mbps
Bluetooth Modulation	GFSK@ 1 Mbps Pi/4-DQPSK@ 2 Mbps 8-DPSK@ 3 Mbps
Regulatory Domain Support	FCC (Americas, Parts of Asia, and Middle East) ETSI (Europe, Middle East, Africa, and Parts of Asia) IC (Industry Canada) MIC (Japan) (formerly TELEC) – Option KC (Korea) (formerly KCC) – Option
2.4 GHz Frequency Bands	ETSI: 2.4 GHz to 2.483 GHz FCC: 2.4 GHz to 2.473 GHz MIC: 2.4 GHz to 2.495 GHz KC: 2.4 GHz to 2.483 GHz
2.4 GHz Operating Channels (Wi-Fi)	ETSI: 13 (3 non-overlapping) FCC: 11 (3 non-overlapping) MIC: 14 (4 non-overlapping) KC: 13 (3 non-overlapping)
5 GHz Frequency Bands	**ETSI** 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) **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 5.725 GHz to 5.825 GHz(Ch 149/153/157/161/165) **MIC (Japan)** 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) **KC** 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) 5.725 GHz to 5.825 GHz (Ch 149/153/157/161)

Feature	Description
5 GHz Operating Channels (Wi-Fi)	ETSI: 19 non-overlapping FCC: 24 non-overlapping MIC: (Japan): 19 non-overlapping KC: 19 non-overlapping
Certifications	**Wi-Fi Alliance** 802.11a, 802.11b, 802.11g , 802.11n WPA Enterprise WPA2 Enterprise **Cisco Compatible Extensions (Version 4)** **Bluetooth SIG Qualification**
Warranty	**Three Year Warranty**

All specifications are subject to change without notice

3   WLAN FUNCTIONAL DESCRIPTION

3.1   Overview

The M2SD50NBT WLAN block is based on the Laird SSD50NBT SIP (System in Package). It is optimized for low-power embedded applications and is configured to operate in dual-band, two-stream (2x2 MIMO) mode. Its functionality includes:

- Improved throughput on the link due to frame aggregation, RIFS (reduced inter-frame spacing), and half-guard intervals.
- Support for STBC (space-time block coding) and LDPC (Low Density Parity Check) codes.
- Improved 11n performance due to features such as 11n frame aggregation (A-MPDU and A-MSDU) and low-overhead host-assisted buffering (RX A-MSDU and 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.

Other functionality includes the following:

Feature	Description
System Clocking (RTC Block)	An RTC block controls the clocks and power going to other internal modules. Its inputs contain sleep requests from these modules and its outputs contain clock enable and power signals which are used to gate the clocks going to these modules. The RTC block also manages resets going to other modules with the device. The M2SD50NBT's clocking is grouped into two types: high-speed and low-speed. 3.1.1.1 *High Speed Clocking* The reference 26 MHz clock source drives the PLL and RF synthesizer of Wi-Fi and Bluetooth. To minimize power consumption, the reference clock source is powered off in SLEEP, HOST_OFF, and OFF states. 3.1.1.2 *Low Speed Clocking* This module requires an external sleep clock (32.768 KHz) source from host platform through pin-50 on the NFGG golden finger. It is used to place BT into deep sleep mode. For Wi-Fi only application, it is not needed. 3.1.1.3 *Interface Clock* The host interface clock represents another clock domain for the M2SD50NBT. This clock comes from the SDIO and is independent from the other internal clocks. It drives the host interface logic as well as certain registers which can be accessed by the host in HOST_OFF and SLEEP states.
MAC/BB/RF Block	The M2SD50NBT Wireless MAC consists of five major blocks: ▪ Host interface unit (HIU) for bridging to the AHB for bulk data accesses and APB for register accesses ▪ Ten queue control units (QCU) for transferring TX data ▪ Ten DCF control units (DCU) for managing channel access ▪ Protocol control unit (PCU) for interfacing to baseband ▪ DMA receive unit (DRU) for transferring RX data
Baseband Block	The M2SD50NBT baseband block (BB) is the physical layer controller for the 802.11b/g/n air interface. ▪ It modulates data packets in the transmit direction ▪ Detects and demodulates data packets in the receive direction. ▪ It has a direct control interface to the radio to enable hardware to adjust analog gains and modes dynamically.
Clock Sharing	▪ Clock sharing is implemented on the M2SD50NBT. The Bluetooth chip (CSR8811) receives a reference clock from the Wi-Fi chip (QCA6004). When Wi-Fi is in power off/reset state, Bluetooth is also off. ▪ External 32.768 KHz signal present on pin 50 allows the BT chip to go into deep sleep mode and consume lowest amount of power

4 BLUETOOTH FUNCTIONAL DESCRIPTION

The M2SD50NBT Bluetooth (BT) block is based on the CSR8811A08 and described in the Table 2.

Table 2: Bluetooth functions

Feature	Description
HCI-UART Interface	The UART Interface is a standard high-speed UART interface. It operates up to 4 Mbps, supporting Bluetooth HCI UART interface.
PCM or I2S Interface	- Continuous PCM encoded audio data transmission and reception over Bluetooth - Processor overhead reduction through hardware support for continual transmission and reception of PCM data - A bi-directional digital audio interface that routes directly into the baseband layer of the firmware. It does not pass through the HCI protocol layer - Hardware on CSR8811 for sending data to and from a SCO connection - Up to three SCO connections on the PCM interface at any one time - PCM interface master, generating PCM_SYNC and PCM_CLK - PCM interface slave, accepting externally generated PCM_SYNC and PCM_CLK. - Various clock formats including: – *Long Frame Sync – *Short Frame Sync - GCI timing environments 13-bit or 16-bit linear, 8-bit μ-law or A-law companded sample formats - Receives and transmits on any selection of three of the first four slots following PCM_SYNC - The PCM configuration options are enabled by setting SKEY_PCM_CONFIG32
CPU and Memory	- Uses a 16-bit RISC MCU for low power consumption and efficient use of memory. The MCU, interrupt controller, and event timer run the Bluetooth software stack and control the Bluetooth radio and host interfaces. 56 KB of on-chip RAM is provided to support the RISC MCU and is shared between the ring buffers used to hold voice/data for each active connection and the general-purpose memory required by the Bluetooth stack. 5 Mb of Internal ROM memory is available on the CSR8811. This memory is provided for system firmware, storing CSR8811 settings and program code.
Build-in Standard WLAN Coexistence	The M2SD50NBT internally supports the standard WLAN coexistence interface through the WLAN_ACTIVE, BT_PRIORITY, and BT_ACTIVE pins.
Reference Clock	The BT block is configured for 26 MHz reference clock frequency. The clock source is provided to BT internally from the WLAN block on demand from BT_CLK_REQ. *Note:* *The WLAN block must be initialized prior before BT clock sharing is enabled.*
BT Low Energy	Supports Low Energy specification which allows for connections to devices with single mode LE function (such as a watch, sensor, and HID). The implementation is optimized for coexistence with WLAN.
BT_RFKILL	The NGFF pin-54 is connected to (BT_PWD_L) resets and powers down the BT block. Holding the pin-54 at Low state turns off the entire BT block; all state information is lost. To ensure a full reset, the reset signal should be asserted for a period greater than five milliseconds.

Feature	Description
Radio	The BT radio shares the single antenna port with the WLAN through an internal three-way RF switch. The M2SD50NBT implements WLAN/BT coexistence internally. VDDIO is to set the I/O voltage internally with either 1.8 V or 3.3 V to ensure same voltage level for the internal Wi-Fi and BT coexistence signal. Refer to the reference design specifications for details.

5 ELECTRICAL CHARACTERISTICS

5.1 Absolute Maximum Ratings

Table 3 summarizes the absolute maximum ratings and Table 4 lists the recommended operating conditions for the M2SD50NBT. 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 3: Absolute Maximum Ratings

Symbol (Domain)	Parameter	Max Rating	Unit
VDDIO	WLAN host SDIO interface and BT I/O supply	-0.3 to 3.6	V
VCC3_3	External 3.3V power supply	-0.3 to 3.6	V
Storage	Storage Temperature	-40 to +85	°C
ANT1; ANT2	Maximum RF input (reference to 50-Ω input)	+10	dBm
ESD	Electrostatic discharge tolerance	2000	V

5.2 Recommended Operating Conditions

Table 4: Recommended Operating Conditions

Symbol (Domain)	Parameter	Min	Typ	Max	Unit
VDDIO	WLAN host interface and BT I/O supply	1.71/3.2	1.8/3.3	1.89/3.46	V
VCC3_3	External 3.3V power supply	3.2	3.30	3.46	V
T-ambient	Ambient temperature	-30	25	85	°C

5.3 DC Electrical Characteristics

Table 5 and Table 6 list the general DC electrical characteristics over recommended operating conditions (unless otherwise specified).

Table 5: General DC Electrical Characteristics (For 3.3V I/O Operation)

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VIH	High Level Input Voltage		0.7 x VDD			V
VIL	Low Level Input Voltage				0.3 x VDD	V
IIL	Input Leakage Current	Without Pull-up or Pull-down 0V < VIN < VDD 0V < VOUT< VDD	0		-3	nA
		With Pull-up 0 V < VIN < VDD 0V < VOUT < VDD	16		48	µA

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
	With Pull-down	0V < VIN < VDD 0V < VOUT < VDD	-14		-47	µA
VOH	High Level Output Voltage	IOH = -4mA	0.9 x VDD			V
		IOH = -12mA	0.9 x VDD			V
VOL	Low Level Output Voltage	IOH = 4mA			0.1 x VDD	V
		IOH = 12mA			0.1 x VDD	V

Table 6: General DC Electrical Characteristics (For 1.8V I/O Operation)

Symbol	Parameter		Conditions	Min	Typ	Max	Unit
VIH	High Level Input Voltage			0.7 x VDD			V
VIL	Low Level Input Voltage					0.3 x VDD	V
IIL	Input Leakage Current	Without Pull-up or Pull-down	0V < VIN < VDD 0V < VOUT < VDD	0		-3	nA
		With Pull-up	0V < VIN < VDD 0V < VOUT < VDD	3.5		13	µA
		With Pull-down	0V < VIN < VDD 0V < VOUT < VDD	-6.2		-23	µA
VOH	High Level Output Voltage		IOH = -4mA	0.9 x VDD			V
			IOH = -12mA	0.9 x VDD			V
VOL	Low Level Output Voltage		IOH = 4mA			0.1 x VDD	V
			IOH = 12mA			0.1 x VDD	V
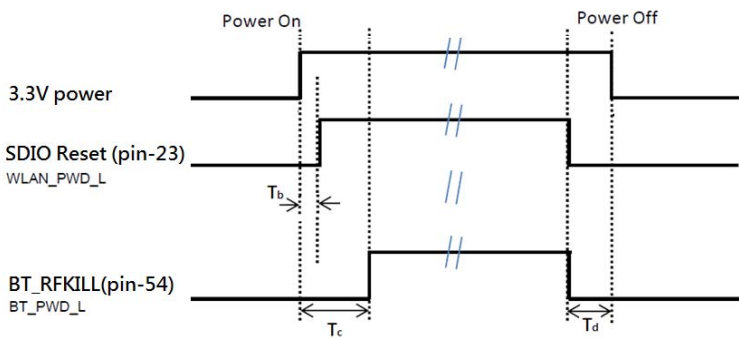
Figure 1: Power On/Off Timing
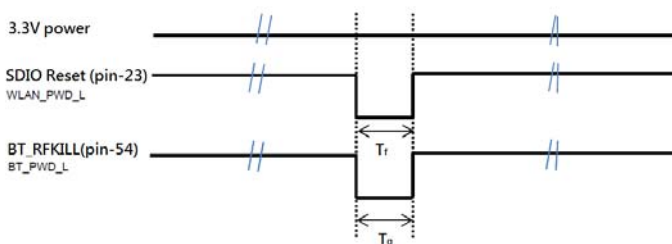
Figure 2: Reset Timing

Table 7: Timing Diagram Definitions

Timing	Description	Min	Unit
Tb	Time between VDD33 (3.3V)supplies valid, to SDIO reset (pin-56;WLAN_PWD_L) negation. **Note:** have suitable 10K ohm Pull-up on SDIO bus, already. No extra pull-up resistor is required.	5	µsec
Tc	Time between VDD33 (3.3V) supplies valid and BT_RFKILL (pin-54; BT_PWD_L) negation	5	msec
Td	Time between SDIO reset (pin-56;WLAN_PWD_L) negation and VDD33 (3.3V) invalid, or time between BT_RFKILL (pin-54; BT_PWD_L) negation and VDD33(3.3V) invalid.	0	µsec
Tf	Time of SDIO reset (pin-56;WLAN_PWD_L) assertion during reset or power down period. 3.3V should keep ON.	5	µsec
Tg	Time of BT_RFKILL (pin-54; BT_PWD_L)assertion during reset or power down period. 3.3V should keep ON.	5	msec

Important: There is 10K ohm pull high resistor already implemented on SD_D0, SD_D1, and SD_D3. No external pull-up is required for those three lines.

5.4   WLAN Radio Receiver Characteristics

Table 8 and Table 9 summarize the WLAN M2SD50NBT receiver characteristics.

Table 8: WLAN Receiver Characteristics for 2.4 GHz Signal Chain Operation

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Frx	Receive input frequency range		2.412		2.484	GHz
Srf	Sensitivity					
	CCK, 1 Mbps			-94		
	CCK, 11 Mbps			-87		
	OFDM, 6 Mbps	See Note[3]		-91		dBm
	OFDM, 54 Mbps			-74		
	HT20, MCS0			-91		
	HT20, MCS7			-71		
Radj	Adjacent channel rejection					
	OFDM, 6 Mbps			32		
	OFDM, 54 Mbps	See Note[4]		16		dB
	HT20, MCS0			31		
	HT20, MCS7			14		

[3]Performance data are measured under signal chain operation.

[4]Performance data are measured under signal chain operation.

Table 9: WLAN Receiver Characteristics for 5 GHz Dual Chain Operation

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
Frx	Receive input frequency		5.15		5.825	GHz

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
	range					
Srf	Sensitivity					
	OFDM, 6 Mbps			-92		
	OFDM, 54 Mbps			-74		
	HT20, MCS0	See Note[5]		-92		dBm
	HT20, MCS7			-71		
	HT40, MCS0			-86		
	HT40, MCS7			-66		
Radj	Adjacent channel rejection					
	OFDM, 6 Mbps			22		
	OFDM, 54 Mbps	See Note[6]		9		dB
	HT20, MCS0			20		
	HT20, MCS7			19		

[5]Performance data are measured under signal chain operation.

[6]Performance data are measured under signal chain operation.

6 BLUETOOTH RADIO CHARACTERISTICS

Table 10 through Table 11 describe the basic rate transmitter performance, enhanced data transmitter performance, basic rate receiver performance, enhanced rate receiver performance, and current consumption conditions at 25°C.

Table 10: Basic Rate Transmitter Performance Temperature at 25°C (3.3V)

Test Parameter	Min	Typ	Max	BT Spec.	Unit
Maximum RF Output Power	0.5	6	—	−6 to +10	dBm
Frequency Range	2.4	—	2.4835	$2.4 \leq f \leq 2.4835$	GHz
20 dB Bandwidth	—	925	—	≤ 1000	KHz
Adjacent Channel TX Power F = F0 + 2 MHz	—	−36	—	≤ −20	dBm
Adjacent Channel TX Power F = F0 +3 MHz	—	−42	—	≤ −40	dBm
Δf1avg Maximum Modulation	140	165	175	$140 < \Delta f1avg < 175$	KHz
Δf2max Minimum Modulation	—	135	—	≥ 115	KHz
Δf2avg/Δf1avg	—	0.9	—	≥ 0.80	—
Initial Carrier Frequency	—	5	—	≤±75	KHz
Drift Rate	—	5	—	≤ 20	KHz/50 μs
Drift (DH1 packet)	—	6	—	≤25	KHz
Drift (DH5 packet)	—	7	—	≤ 40	KHz

Table 11: Enhanced Data Rate Transmitter Performance 25°C (3.3V)

Test Parameter		Min	Typ	Max	BT Spec.	Unit
Relative Transmit Power		−1	3	6	−4 to +1	dBm
Max Carrier Frequency	π/4 DQPSK	—	1	—	≤ ±10	KHz

Test Parameter		Min	Typ	Max	BT Spec.	Unit
Stability |wo|	8 DPSK	—	1	—		
Max Carrier Frequency Stability |wi|	π/4 DQPSK	—	1	—	≤ ±75	KHz
	8 DPSK	—	1	—		
Max Carrier Frequency Stability |w0+wi|	π/4 DQPSK	—	2	—	≤ ±75	KHz
	8 DPSK	—	1.5	—		
RMS DEVM	π/4 DQPSK	—	6	—	≤ 20	%
	8 DPSK	—	6	—	≤13	%
Peak DEVM	π/4 DQPSK	—	16	—	≤ 35	%
	8 DPSK	—	15	—	≤ 25	%
99% DEVM	π/4 DQPSK	—	12	—	≤ 30	%
	8 DPSK	—	12	—	≤ 20	%
EDR Differential Phase Encoding		—	99	—	≥ 99	%
Adjacent Channel Power	F≥ ± 3MHz	—	−60	—	< −40	dBm
	F = ± 2MHz	—	−28	—	≤ −20	dBm
	F = ±1MHz	—	−32	—	≤ −26	dB

Table 12: Basic Rate Receiver Performance at 3.3V

Test Parameter		Min	Typ	Max	BT Spec.	Unit
Sensitivity	BER ≤ 0.1%	—	−84	-78	≤ −70	dBm
Maximum Input	BER ≤ 0.1%	−20	-10	—	≥ −20	dBm
Carrier-to-Interferer Ratio (C/I)	Co-Channel	—	—	11	11	
	Adjacent Channel (± 1 MHz)	—	-4/-2	0	0	dB
	Second Adjacent Channel (± 2 MHz)	—	-35/-28	−30	−30	dB
	Third Adjacent Channel (± 3 MHz)	—	-42	−40	−40	dB
Maximum Level of Intermodulation Interferers		−39	-30	-	≥ −39	dBm

Table 13: Enhanced Data Rate Receiver Performance 3.3V

Test Parameter		Min	Typ	Max	Bluetooth Specification	Unit
Sensitivity (BER ≤0.01%)	8 DPSK	—	−76	-71	≤ −70	dBm

Test Parameter		Min	Typ	Max	Bluetooth Specification	Unit
Maximum Input (BER ≤0.1%)	π/4 DQPSK	−20	—	—	≥ −20	dBm
	8 DPSK	−20	—	—	≥ −20	dBm
Co-Channel C/I (BER ≤0.1%)	π/4 DQPSK	—	10	13	≤ ±13	dB
	8 DPSK	—	18	20	≤ ±20	dB
Adjacent Channel C/I (BER≤ 0.1%)	π/4 DQPSK	—	-9/-6	0	≤ 0	dB
	8 DPSK	—	-3/0	5	≤5	dB
Second Adjacent Channel C/I (BER ≤ 0.1%)	π/4 DQPSK	—	-42/-28	−30	≤ −30	dB
	8 DPSK	—	-28/-22	−25	≤ −25	dB
Third Adjacent Channel C/I (BER ≤ 0.1%)	π/4 DQPSK	—	-45	−40	≤ −40	dB
	8 DPSK	—	-39	−33	≤ −33	dB

7 SDIO Timing Requirements

The following figure (Figure 3) and table display SDIO default mode timing.
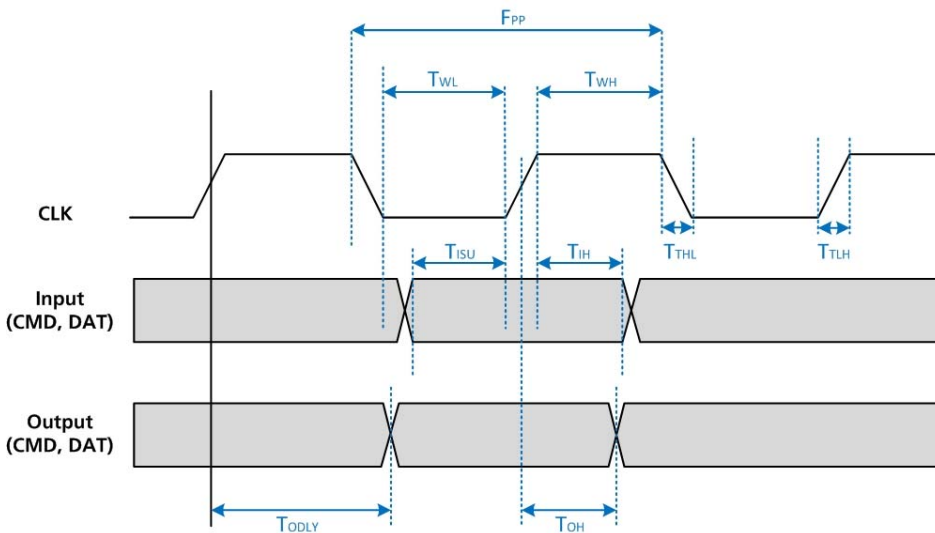

Figure 3: SDIO Default Mode Timing

Note: Timing is based on CL ≤ 40 pF load on CMD and Data.

Table 14: SDIO Timing Requirements

Symbol	Parameter	Min.	Typ.	Max.	Unit
fPP	Frequency – Data Transfer mode	0	-	50	MHz
tWL	Clock low time	7	-	-	ns
tWH	Clock high time	7	-	-	ns
tTLH	Clock rise time	-	-	10	ns
tTHL	Clock low time	-	-	10	ns
Inputs: CMD, DAT (referenced to CLK)					
tISU	Input setup time	6	-	-	ns

Symbol	Parameter	Min.	Typ.	Max.	Unit
tIH	Input hold time	2	-	-	ns
Outputs: CMD, DAT (referenced to CLK)					
tODLY	Output delay time – Data Transfer mode	0	-	14	ns

8 PIN DEFINITIONS

Pin #	Name	Type	Voltage Reference	Description	If Not Used
1	GND	-	-	Ground	GND
2	3.3Vaux	-	-	3.3V power supply	3.3V
3	Reserved	I/O	-	Reserved pin. Please leave open.	N/C
4	3.3Vaux	-	-	3.3V power supply	3.3V
5	Reserved	I/O	-	Reserved pin. Please leave open.	N/C
6	LED#1	-	-	Reserved for Wi-Fi LED indicator, Active High. **Note:** Not supported by current software.	N/C
7	GND	-	-	Ground	GND
8	BT_PCM_CLK	I/O	1.8V	BT PCM clock	N/C
9	SDIO_CLK	I	1.8V	WLAN SDIO clock Only used for M2SD50NBT.	N/C
10	BT_PCM_SYNC	I/O	1.8V	BT PCM Synchronous data	N/C
11	SDIO_CMD	I	1.8V	WLAN SDIO command data Only used on M2SD50NBT.	N/C
12	BT_PCM_OUT	O	1.8V	BT PCM synchronous data output	N/C
13	SDIO_DATA0	I/O	1.8V	WLAN SDIO Data0 Only used on M2SD50NBT.	N/C
14	BT_PCM_IN	I	1.8V	BT PCM synchronous data input	N/C
15	SDIO_DATA1	I/O	1.8V	WLAN SDIO Data1 Only used on M2SD50NBT.	N/C
16	LED#2	-	-	N/C	N/C
17	SDIO_DATA2	I/O	1.8V	WLAN SDIO Data2 (used on M2SD50NBT)	N/C
18	GND	-	-	Ground	Ground
19	SDIO_DATA3	I/O	1.8V	WLAN SDIO Data3 (used on M2SD50NBT)	N/C
20	BT_UART_WAKE	O	3.3V	Reserved for BT to wakeup Host. When BT wakes up from its deep sleep state, it sends an H pulse signal out to Host. Normally, it is Low state.	N/C
21	Wake on WLAN	O	1.8V	Reserved for Wake-ON-Wireless (WOW) LAN, WLAN output signal to wake up host, active Low and already has internal 10K pull up. **Note:** Not supported by current software.	N/C

Pin #	Name	Type	Voltage Reference	Description	If Not Used
22	BT_UART_TXD	O	1.8V	BT UART transmission data.	N/C
23	WLAN reset	I	1.8V	WLAN reset or power down; Active **L** Already has internal 10K pull-up. Hold this to **L** to power down the Wi-Fi chip.	N/C
24	Mechanical Key-E	-	-	-	-
25	Mechanical Key-E	-	-	-	-
26	Mechanical Key-E	-	-	-	-
27	Mechanical Key-E	-	-	-	-
28	Mechanical Key-E	-	-	-	-
29	Mechanical Key-E	-	-	-	-
30	Mechanical Key-E	-	-	-	-
31	Mechanical Key-E	-	-	-	-
32	BT_UART_RXD	I	1.8V	BT UART receives data.	N/C
33	GND	-	-	Ground	GND
34	BT_UART_RTS	O	1.8V	BT UART Ready to Send.	N/C
35	N/C	-	-	N/C	N/C
36	BT_UART_CTS	O	1.8V	BT UART Clear to Send.	N/C
37	N/C	-	-	N/C	NC/
38	N/C	-	-	N/C	N/C
39	GND	-	-	Ground	GND
40	N/C	-	-	N/C	N/C
41	N/C	-	-	N/C	N/C
42	N/C	-	-	N/C	N/C
43	N/C	-	-	N/C	N/C
44	LTE_COEX3	I	1.8V	Reserved for LTE coexistence **Note:** Not currently supported.	N/C
45	GND	-	-	Ground	GND
46	LTE_ACTIVE	I	1.8V	Reserved for LTE coexistence **Note:** Not currently supported.	N/C
47	N/C	-	-	N/C	N/C
48	LTE_FRAME_SYNC	I	1.8V	Reserved for LTE coexistence **Note:** Not currently supported.	N/C
49	N/C	-	-	N/C	N/C
50	CLK_32K	I	3.3V	32.768KHz slow clock input. Necessary to put BT into deep sleep mode.	N/C
51	GND	-	-	Ground	GND
52	N/C	-	-	N/C	N/C
53	N/C	-	-	N/C	N/C
54	BT_RFKILL	I	3.3V	Reset BT or to disable BT; Active **L**	N/C

Pin #	Name	Type	Voltage Reference	Description	If Not Used
55	N/C	-	-	N/C	N/C
56	WIFI_RFKILL	I	3.3V	Reserved for RF disable (RF Kill) feature. Active Low. **Note:** Not supported by current software.	N/C
57	GND	-	-	Ground	GND
58	N/C	-	-	N/C	N/C
59	N/C	-	-	N/C	N/C
60	N/C	-	-	N/C	N/C
61	N/C	-	-	N/C	N/C
62	N/C	-	-	N/C	N/C
63	GND	-	-	Ground	GND
64	N/C	-	-	N/C	N/C
65	N/C	-	-	N/C	N/C
66	N/C	-	-	N/C	N/C
67	N/C	-	-	N/C	N/C
78	N/C	-	-	N/C	N/C
69	GND	-	-	Ground	GND
70	N/C	-	-	N/C	N/C
71	N/C	-	-	N/C	N/C
72	3.3Vaux	-	-	3.3V power supply	3.3V
73	N/C	-	-	N/C	N/C
74	3.3Vaux	-	-	3.3V power supply	3.3V
75	GND	-	-	Ground	GND

9 MECHANICAL SPECIFICATIONS
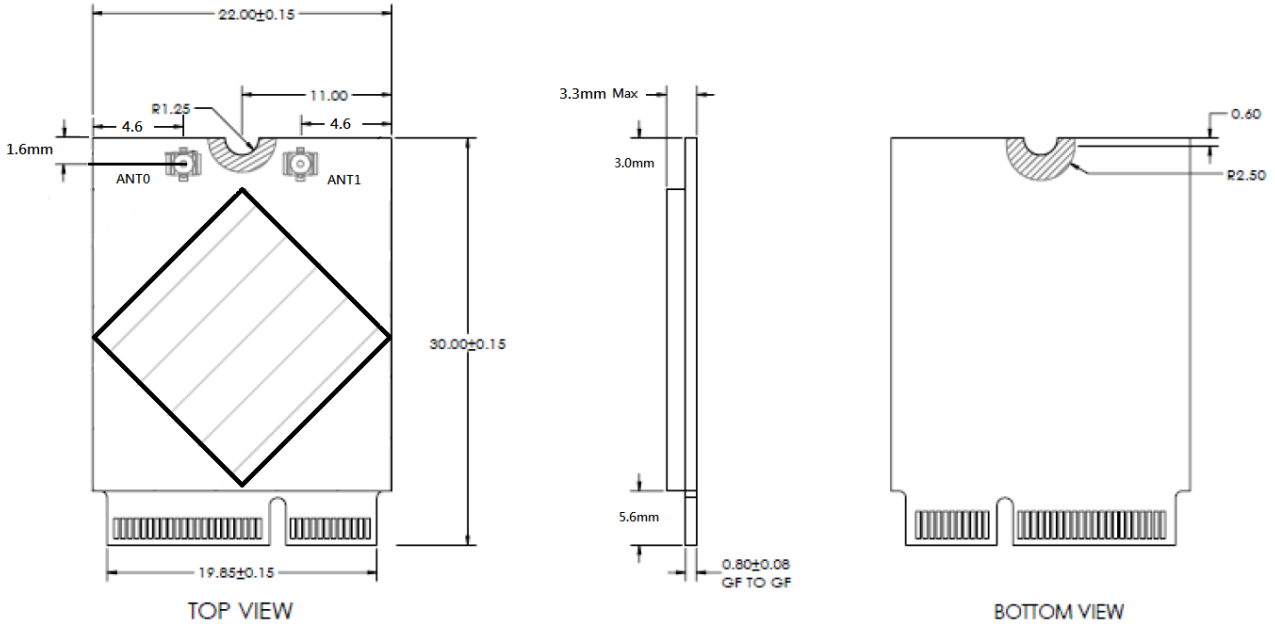
Figure 4: M.2 mechanical drawings

Note: The Wi-Fi MAC address is located on the product label. The BT MAC address is always be numerically subsequent to the Wi-Fi MAC address. Therefore, the BT MAC address is Wi-Fi MAC address plus one.

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10 MOUNTING

The M2SD50NBT connects to the host via a standard PCI EXPRESS M2 connector.

Kyocera's (www.Kyocera-connector.com) 6411 series provide 1.8 mm, 2.3 mm and 3.2 mm connector heights.

M2SD50NBT is a signal-side component module; Laird recommends part number 24-6411-067-101-897E which has 2.3 mm connector height.

The stand-off mating to the recommend 2.3 mm connector from EMI STOP (www.EMISTOP.com) is part number F50M16-041525P1D4M. Detail layout and stencil opening are show in Figure 5.
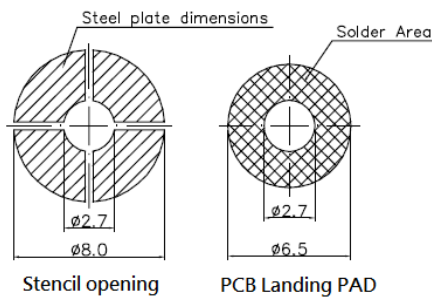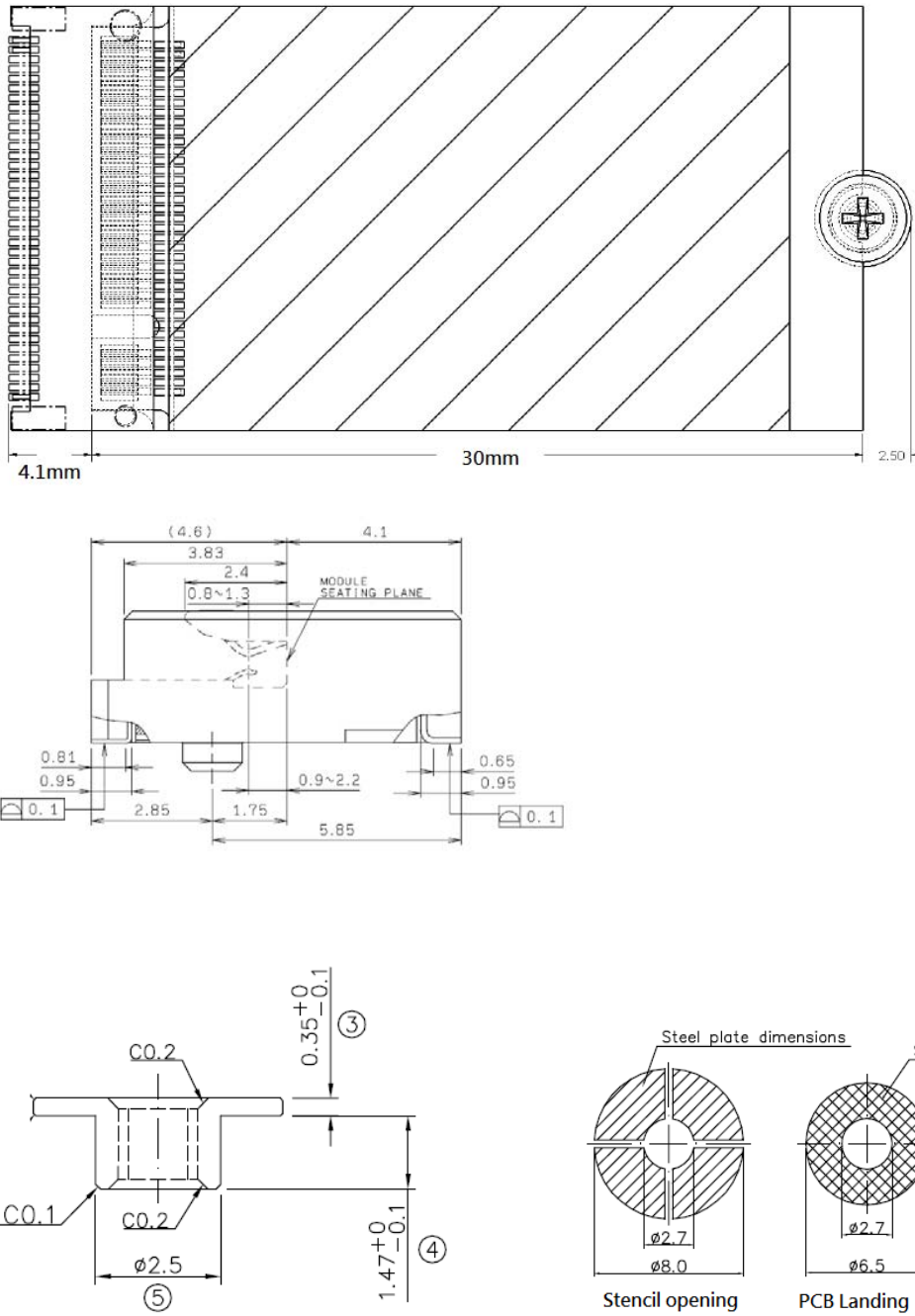
Figure 5: Mounting information for M2SD50NBT and recommended land pad for stand-off

11 RF Layout Design Guidelines/Precautions

The following is a list of RF layout design guidelines and recommendation when installing a Laird radio into your device.

- Do not run antenna cables directly above or directly below the radio.
- Do not place any parts or run any high speed digital lines below the radio.
- If there are other radios or transmitters located on the device (such as a Bluetooth radio), place the devices as far apart from each other as possible. Also, make sure there are at least 25dB isolation between Bluetooth antenna and Wi-Fi antenna.
- Laird recommends the use of a double shielded cable for the connection between the radio and the antenna elements.
- Be sure to put the capacitor on the power pin as close as possible to reduce the radiation issue.
- Use proper electro-static-discharge (ESD) procedures when installing the Laird radio module.
- In order to get maximum throughput when operate at MIMO 2x2, two antennas with at least 25dB isolation is recommended.
- To avoid negatively impacting TX power and receiver sensitivity, do no cover the antennas with metallic objects or components.
- Opening/handing/removing must be done on an anti-ESD treated workbench.
  All workers must also have undergone anti-ESD treatment.
- The devices should be mounted within one year of the date of delivery.

12 REGULATORY

12.1 Certified Antennas

NOTE: The module is professionally installed device and installed in industry computer that is generally for industrial use. The device cannot be sold retail, to the general public or by mail order. It must be sold to dealers or have strict marketing control (such as Datalogic S.r.l. and SOREDI touch system GmbH).

The module must be installed by a specified installers that require approval installation by Datalogic S.r.l. and SOREDI touch system GmbH.

Due to this module is a professional installation device, only the antennas listed below are allowed to use.

Model	Type	Connector	2400~2500MHz 5150~5875MHz
HUBER+SUHNER 1399.99.0124	**PCB**	Antenna includes cable pigtail, terminated by connector U.FL	1 dBi (2.4-2.5GHz), 1dBi (5.15-5.875GHz)

Model	Type	Connector	2400~2500MHz 2500~2700MHz 3400~3700MHz 4900~5470MHz 5470~5935MHz
HUBER+SUHNER 1399.17.0106	Sencity® Omni-S Antenna	N, 50 jack (female)	6 dBi (2.4-2.5GHz), 6dBi (2.5-2.7GHz) 7 dBi (3.4-3.7GHz), 8dBi (4.9-5.47GHz) 8dBi (5.47-5.935)

13 FCC AND IC REGULATORY

Model	US/FCC	CANADA/IC
M2SD50NBT	U4G-RHINOIIWEC7	3862E-RHINOIIWEC7

The M2SD50NBT is designed to pass certification with the antenna listed below. The required antenna impedance is 50 ohms.

Model	Type	Connector	Peak gain (dBi)	
			2400~2500 MHz	5150~5875MHz
HUBER+SUHNER 1399.99.0124	**PCB**	Antenna includes cable pigtail terminated by connector U.FL	1 dBi	1dBi

Model	Type	Connector	Peak gain (dBi)				
			2400~2500 MHz	2500~2700 MHz	3400~3700 MHz	4900~5470 MHz	5470~5935 MHz
HUBER+SUHNER 1399.17.0106	Sencity® Omni-S Antenna	N, 50 jack (female)	6 dBi	6 dBi	7 dBi	8 dBi	8 dBi

13.1 FCC

13.1.1 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.

13.1.1.1 *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.

13.1.1.2 *Important Note:*

Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

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

Country Code selection feature to be disabled for products marketed to the US/Canada.

This device is intended only for OEM integrators under the following conditions:

1. The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2. The transmitter module may not be co-located with any other transmitter or antenna,
3. For all products market in US, OEM has to limit the operation channels in CH1 to CH11 for 2.4G band by supplied firmware programming tool. OEM shall not supply any tool or info to the end-user regarding to Regulatory Domain change.

As long as the three conditions above are met, further **transmitter** testing will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

13.1.1.3 *Important Note:*

In the event that these conditions **cannot be met** (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID **cannot** be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

13.1.2 **End Product Labeling**

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: **Contains FCC ID: U4G-RHINOIIWEC7.**

13.1.3 **Manual Information to the End User**

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

13.2 **Industry Canada**

13.2.1 **Industry Canada Statement**

This device complies with Industry Canada's license-exempt RSSs. Operation is subject to the following two conditions:

- This device may not cause interference; and
- This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- l'appareil ne doit pas produire de brouillage;
- l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

This radio transmitter (M2SD50NBT – *IC: 3862E-RHINOIIWEC7*) has been approved by *Industry Canada* to operate with the antenna types listed below with the maximum permissible gain indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Le présent émetteur radio (M2SD50NBT –*IC: 3862E-RHINOIIWEC7*)) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal. Les types d'antenne non inclus dans cette liste, et dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

13.2.2 Antenna Information

NOTE: The module is professionally installed device and installed in industry computer that is generally for industrial use. The device cannot be sold retail, to the general public or by mail order. It must be sold to dealers or have strict marketing control (such as Datalogic S.r.l. and SOREDI touch system GmbH).

The module must be installed by a specified installers that require approval installation by Datalogic S.r.l. and SOREDI touch system GmbH.

Due to this module is a professional installation device, only the antennas listed below are allowed to use.

Model	Type	Connector	Peak gain (dBi)	
			2400~2500 MHz	5150~5875MHz
HUBER+SUHNER 1399.99.0124	**PCB**	Antenna includes cable pigtail terminated by connector U.FL	1 dBi	1dBi

Model	Type	Connector	Peak gain (dBi)				
			2400~2500 MHz	2500~2700 MHz	3400~3700 MHz	4900~5470 MHz	5470~5935 MHz
HUBER+SUHNER 1399.17.0106	Sencity® Omni-S Antenna	N, 50 jack (female)	6 dBi	6 dBi	7 dBi	8 dBi	8 dBi

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13.2.2.1 *Caution:*

(i) The device for operation in the band 5150–5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems;

(ii) For devices with detachable antenna(s), the maximum antenna gain permitted for devices in the bands 5250-5350 MHz and 5470-5725 MHz shall be such that the equipment still complies with the EIRP limit;

(iii) For devices with detachable antenna(s), the maximum antenna gain permitted for devices in the band 5725-5850 MHz shall be such that the equipment still complies with the EIRP limits specified for point-to-point and non-point-to-point operation as appropriate; and

Operations in the 5.25-5.35GHz band are restricted to indoor usage only.

13.2.2.2 *Avertissement:*

(i) les dispositifs fonctionnant dans la bande de 5150 à 5250MHz sont réservés uniquement pour une utilisation à l'intérieur afin de réduire les risques de brouillage préjudiciable aux systèmes de satellites mobiles utilisant les mêmes canaux;

(ii) pour les dispositifs munis d'antennes amovibles, le gain maximal d'antenne permis pour les dispositifs utilisant les bandes de 5250 à 5350MHz et de 5470 à 5725 MHz doit être conforme à la limite de la p.i.r.e;

(iii) pour les dispositifs munis d'antennes amovibles, le gain maximal d'antenne permis (pour les dispositifs utilisant la bande de 5725 à 5850 MHz) doit être conforme à la limite de la p.i.r.e. spécifiée pour l'exploitation point à point et l'exploitation non point à point, selon le cas;

Les opérations dans la bande de 5.25-5.35GHz sont limités à un usage intérieur seulement.

13.2.3 **Radiation Exposure Statement**

This equipment complies with Canada radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

13.2.4 **Déclaration d'exposition aux radiations**

Cet équipement est conforme Canada limites d'exposition aux radiations dans un environnement non contrôlé. Cet équipement doit être installé et utilisé à distance minimum de 20cm entre le radiateur et votre corps.

This device is intended only for OEM integrators under the following condition:

- The transmitter module may not be co-located with any other transmitter or antenna.

As long as the condition above is met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes:

- Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 1 condition ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

13.2.4.1 *Important Note:*

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the Canada authorization is no longer considered valid and the IC ID cannot be used

on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

13.2.4.2 *Note Importante:*

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

13.2.5 End Product Labeling

The final end product must be labeled in a visible area with the following: *Contains IC: IC: 3862E-RHINOIIWEC7.*

13.2.6 Plaque signalétique du produit final

Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: *IC: 3862E-RHINOIIWEC7.*

13.2.7 Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

13.2.8 Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.