Laird™
CONNECTIVITY

# Datasheet

## MSD50NBT

*Version 2.0*

# REVISION HISTORY

| Version | Date | Notes | Approver |
|---|---|---|---|
| 1.0 | 27 Mar 2016 | Initial Version | Andrew Chen |
| 1.1 | 09 Aug 2016 | Changed from HIG to Datasheet | Sue White |
| 1.2 | 07 Sept 2016 | Updated EU Declaration of Conformity | Sue White |
| 1.3 | 03 Nov 2016 | Updated Tx power numbers to the following:<br>**802.11a (UNII-1, UNII-2A, UNII-2C) or CH 36 – CH140**<br>6 Mbps 17 dBm (50.1 mW)<br>54 Mbps 14 dBm (25.1 mW)<br>**802.11a (UNII-3) or CH 148 – CH 165**<br>6 Mbps 15 dBm (31.6 mW)<br>54 Mbps 14 dBm (25.1 mW)<br>**802.11n (5 GHz) (UNII-1, UNII-2A, UNII-2C) or CH 36 – CH140**<br>6.5 Mbps (MCS0; HT20) 17 dBm (50.1 mW)<br>65 Mbps (MCS7;HT20) 13 dBm (20 mW)<br>(MCS0; HT40) 14 dBm (25.1 mW)<br>(MCS7; HT40) 11 dBm (12.5 mW)<br>**802.11n (5 GHz) (UNII-3) or CH 148 – CH 165**<br>6.5 Mbps (MCS0; HT20) 15 dBm (31.6 mW)<br>65 Mbps (MCS7;HT20) 12 dBm (15.8 mW)<br>(MCS0; HT40) 14 dBm (25.1 mW)<br>(MCS7; HT40) 11 dBm (12.5 mW) | Andrew Chen |
| 1.4 | 08 Nov 2016 | Added section numbering. | Sue White |
| 1.5 | 09 Dec 2016 | Removed *Preliminary* references | Jay White |
| 1.6 | 10 Mar 2017 | Updated 5 GHz frequency bands and operating channels information | Kris Sidle |
| 1.7 | 19 Apr 2017 | Fixed FCC frequency ranges | Miles Chung |
| 1.8 | 1 May 2017 | OS Support | Jay White |
| 1.9 | 24 May 2017 | Updated EU DoC for new RED standards | Maggie Teng |
| 1.10 | 15 June 2017 | Updated EU DoC with new DoC style | Tom Smith |
| 1.11 | 18 Aug 2017 | Removed 802.11r references | Jay White |
| 1.12 | 01 May 2018 | Updated product photo<br>Updated Industry Canada statement<br>Updated to new Laird template | Maggie Teng |
| 1.13 | 06 Mar 2019 | Updated logos and URLs | Sue White |
| 1.14 | 04 Sept 2020 | Updated Regulatory section | Ryan Urness |
| 2.0 | 15 Feb 2021 | Moved detailed regulatory information to separate document | Jonathan Kaye |



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# CONTENTS





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# 1 SCOPE

This document describes key hardware aspects of the Laird Connectivity MSD50NBT 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 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

**The information in this document is subject to change.** Please refer to the MSD50NBT product page for the most recent documentation.

# 2 INTRODUCTION

## 2.1 General Description

The MSD50NBT module (which uses an SDIO interface) is a 2x2 MIMO 802.11 a/b/g/n WLAN plus Bluetooth 4.0 dual mode device that is optimized for low-power mobile devices. The integration of all WLAN and Bluetooth functionality in a single package supports low cost and simple implementation along with flexibility for platform-specific customization.

This device is pre-calibrated and integrates the complete transmit/receive RF paths including baluns, mobile phone coexistence band pass filter, diplexer, switches, power amplifier, low noise amplifier, and reference crystal oscillator.

The MSD50NBTdevice supports Bluetooth 2.1 + EDR and Bluetooth 4.0 (Bluetooth Low Energy or BLE). The device's low power consumption radio architecture and proprietary power save technologies allow for extended battery life.

When operating on channels in the UNII-2 and UNII-2 Extended bands that are in the 5GHz portion of the frequency spectrum and are subject to Dynamic Frequency Selection requirements, the MSD50NBT fully conforms to applicable regulatory requirements. In the event that specified types of radar are detected by the network infrastructure, the MSD50NBT fully conforms to commands from the infrastructure for radar avoidance.

The MSD50NBT interfaces to host devices via a 60-pin connector (Molex 60-pin connector). The I/O voltage level configuration (either 3.3 V or 1.8 V) is required from the host platform to configure the SDIO bus signal to run at a 3.3 V or 1.8 V signal level.

In addition, its dual 802.11 and Bluetooth radio includes full digital MAC and baseband engines that handle all 802.11 CCK/OFDM® 2.4/5GHz, and Bluetooth basic rate and EDR baseband and protocol processing.

MSD50NBT has its own RF shielding and does not require shielding provided by the host device into which it is installed in order to maintain compliance with applicable regulatory standards. As such, the device may be tested in a standalone configuration via an extender card.



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# 3 MSD50NBT Features Summary

The Laird Connectivity MSD50NBT device features are described in Table 1.

***Table 1: MSD50NBT features***

| Feature | Description |
|---|---|
| **Radio Front End** | Integrates the complete transmit/receive RF paths including baluns, coexistence band pass filter, diplexer, switches, power amplifier, low noise amplifier, and reference crystal oscillator. |
| **Enhanced WLAN/BT Coexistence Algorithms** | Enhanced important use cases including:<br>▪ PCM/I2S digital audio interface<br>▪ BT stereo audio (A2DP)<br>▪ BT data transfer profiles (such as OPP and FTP)<br>▪ BT2.1+EDR<br>▪ BT-LE<br>Flexible radio architecture ensures simple customization for future use cases. |
| **Power Management** | Uses power-saving techniques including:<br>▪ Gating clocks to idle or inactive blocks<br>▪ Fast start and settling circuits to reduce Tx power<br>▪ Active duty cycles<br>▪ CPU frequency scaling |
| **Pre-Calibration** | RF system tested and calibrated in production. |
| **Internal Sleep Clock** | Integrated on-chip low power sleep clock to regulate internal timing. |
| **Multiple Interface Support** | ▪ SDIO 2.0 (50 MHz, 4-bit and 1-bit)<br>▪ HS-UART for Bluetooth HCI (compatible with any upper layer Bluetooth stack) |
| **Advanced 802.11n** | ▪ Half Guard Interval and Frame Aggregation for high throughput<br>▪ Space Time Block Coding (STBC) Rx for improved downlink robustness over range<br>▪ Low Density Parity Check (LDPC) for improved uplink and downlink robustness over range |
| **Reference Frequency** | ▪ Incorporates a 26 MHz reference frequency source in package<br>▪ Sleep regulated and gated to enable the internal crystal to be powered down when the device is in sleep mode<br>▪ BT shares the clock from the Wi-Fi chip.<br>▪ Wi-Fi cannot be turned off or in reset statue when running BT. |
| **Advanced WLAN** | Includes the following advanced WLAN features:<br>▪ IEEE 802.11e QoS, Wi-Fi Alliance WMM Power Save, and 802.11n power saving compliance<br>▪ AES, AES-CCMP, TKIP engines for faster data encryption<br>▪ Cisco CCXv4 ASD, WPS support<br>▪ Standard WEP/WPA/WPA2 for personal and enterprise environments support<br>▪ WWR, 802.11d, 802.11h support<br>▪ Wi-Fi Direct (Peer-to-Peer)<br>▪ RTT for indoor positioning<br>▪ Statistics and events for monitoring<br>▪ Self-managed power state handling<br>▪ Self-contained beacon processing<br>▪ Shared authentication<br>▪ Ad-hoc power save<br>▪ Multiple PMK ID support<br>▪ Simulated UAPSD<br>▪ T-Spec support<br>▪ Production flow diagnostics<br>▪ 3-wire scheme for Wi-Fi and BT coexistence. |
| **Host Offloading (WLAN)** | Integrates extensive hardware signal processing and an embedded on-chip CPU to offload complete 11n MAC/BB/PHY processing to minimize host processor loading and support application specific customization. |
| **Advanced Bluetooth** | ▪ High-speed UART port (up to 4 Mbps)<br>▪ HFP v1.6 wide-band speech supported on-chip<br>▪ On-chip encoding of SBC and aptX® codecs for A2DP music streaming<br>▪ PCM/I2S digital audio interface<br>▪ Support for IEEE 802.11 coexistence<br>▪ The flexible RAM/ROM based architecture enables custom or future profiles to be easily added. |



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# 4 SPECIFICATIONS

***Table 2: Specifications***

| Feature | Description | |
|---|---|---|
| **Physical Interface** | 60-pin board to board connector (Molex 54722-0607) | |
| **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.<br>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% | |
| **Average Current Consumption, VDDIO = 3.3 volts (At maximum transmit power setting)**<br><br>***Note:*** *Reset refers to the radio in reset mode. Both Wi-Fi and BT reset pin are asserted.*<br><br>***Note:*** *MIMO measurements are generally higher than Single Stream.* | **Single Stream**<br>**802.11a (with BT in standby) @ 18 dBm 6 Mbps**<br>Transmit: 600 mA<br>Receive: 120 mA<br>Reset: 0.5 mA<br>**802.11b (with BT in standby) @ 18 dBm 1 Mbps**<br>Transmit: 460 mA<br>Receive: 120 mA<br>Reset: 0.5 mA<br>**802.11g (with BT in standby) @ 18 dBm 6 Mbps**<br>Transmit: 450 mA<br>Receive: 250 mA<br>Reset: 0.5 mA<br>**802.11n (2.4 GHz) (with BT in standby) @ 14 dBm MCS7**<br>Transmit: 340 mA<br>Receive: 120mA<br>Reset: 0.5 mA<br>**802.11n (5 GHz) (with BT in standby) @ 14 dBm MCS7**<br>Transmit: 490 mA<br>Receive: 120 mA<br>Reset: 0.5 mA<br>**Bluetooth (with Wi-Fi in standby)**<br>Transmit: 85 mA<br>Receive: 70 mA<br>Reset: 0.5 mA | **MIMO**<br>**802.11a (with BT in standby) @ 18 dBm 6 Mbps**<br>Transmit: 900 mA<br>Receive: 140 mA<br>Reset: 0.5 mA<br>**802.11b (with BT in standby) @ 18 dBm 1 Mbps**<br>Transmit: 680 mA<br>Receive: 140 mA<br>Reset: 0.5 mA<br>**802.11g (with BT in standby) @ 18 dBm 6 Mbps**<br>Transmit: 710 mA<br>Receive: 140 mA<br>Reset: 0.5 mA<br>**802.11n (2.4 GHz) (with BT in standby) @ 14 dBm MCS7**<br>Transmit: 460 mA<br>Receive: 140 mA<br>Reset: 0.5 mA<br>**802.11n (5 GHz) (with BT in standby) @ 14 dBm MCS7**<br>Transmit: 720 mA<br>Receive: 140 mA<br>Reset: 0.5 mA<br>**Bluetooth (with Wi-Fi in standby)**<br>Transmit: 85 mA<br>Receive: 70 mA<br>Reset: 0.5 mA |
| **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) | |
| **Maximum Electrostatic** | Conductive 4KV; Air coupled 8KV EN61000-4-2 | |



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| Feature | Description |
|---|---|
| **Discharge** | |
| **Size** | 32 mm (length) x 22 mm (width) x 4.7 mm (thickness) |
| **Weight** | TBD |
| **Mounting** | Please see the mounting and handling guide. |
| **Wi-Fi Media** | Direct Sequence-Spread Spectrum (DSSS)<br>Complementary Code Keying (CCK)<br>Orthogonal Frequency Divisional Multiplexing (OFDM) |
| **Bluetooth Media** | Frequency Hopping Spread Spectrum (FHSS) |
| **Wi-Fi Media Access Protocol** | Carrier sense multiple access with collision avoidance (CSMA/CA) |
| **Network Architecture Types** | Infrastructure and ad-hoc |
| **Wi-Fi Standards** | IEEE 802.11a, 802.11b, 802.11d, 802.11e, 802.11g, 802.11h, 802.11i, 802.11n |
| **Bluetooth Standards** | Bluetooth version 2.1 with Enhanced Data Rate<br>Bluetooth 4.0 (Bluetooth Low Energy or BLE) |
| **Wi-Fi Data Rates Supported** | 11a (OFDM) 6, 9, 12, 18, 24, 36, 48, 54 Mbps<br>802.11b (DSSS, CCK) 1, 2, 5.5, 11 Mbps<br>802.11g (OFDM) 6, 9, 12, 18, 24, 36, 48, 54 Mbps<br>802.11n (OFDM, MCS 0-15)<br>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<br>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 |
| **Modulation** | BPSK @ 1, 6,9, 6.5, 7.2,13 and 14.4 Mbps<br>QPSK @ 2, 12, 18, 13, 14.4,19.5, 21.7, 26, 28.9, 39,43.3 Mbps<br>CCK @ 5.5 and 11 Mbps<br>16-QAM @ 24, 36,26, 29.9,39,43.3,52,57.8,78,86.7 Mbps<br>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<br>Pi/4-DQPSK@ 2 Mbps<br>8-DPSK@ 3 Mbps |
| **Regulatory Domain Support** | FCC<br>EU<br>ISED Canada<br>MIC (Japan)<br>KC (Korea) |
| **2.4 GHz Frequency Bands** | **EU:** 2.4 GHz to 2.483 GHz<br>**FCC:** 2.4 GHz to 2.473 GHz<br>**MIC:** 2.4 GHz to 2.495 GHz<br>**KC:** 2.4 GHz to 2.483 GHz |



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| Feature | Description |
|---|---|
| **2.4 GHz Operating Channels (Wi-Fi)** | **EU:** 13 (3 non-overlapping)<br>**FCC:** 11 (3 non-overlapping)<br>**MIC:** 14 (4 non-overlapping)<br>**KC:** 13 (3 non-overlapping) |
| **5 GHz Frequency Bands** | **EU**<br>5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64)<br>5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/120/124/128/132/136/140)<br>**FCC**<br>5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64)<br>5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/120/124/128/ 132/136/140)<br>5.725 GHz to 5.85 GHz (Ch 149/153/157/161/165)<br>**MIC (Japan)**<br>5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64)<br>5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/120/124/128/ 132/136/140)<br>**KC**<br>5.15 GHz to 5.35 GHz (Ch 36/40/44/48/52/56/60/64)<br>5.47 GHz to 5.725 GHz (Ch 100/104/108/112/116/120/124)<br>5.725 GHz to 5.825 GHz (Ch 149/153/157/161) |
| **5 GHz Operating Channels** | EU:19 non-overlapping) MIC: 19 non-overlapping<br>FCC: 24 non-overlapping KC: 19 non-overlapping |
| **Transmit Power**<br><br>***Note:*** *Transmit power on each channels varies according to individual country regulations. All values for lowest data rate is nominal, +/-2 dBm.*<br>*Others are +/-2.5dBm.*<br><br>***Note:***<br>*HT40 – 40 Mhz-wide channels*<br>*HT20 – 20 MHz-wide channels* | **802.11a (UNII-1, UNII-2A, UNII-2C) or CH 36 – CH140**<br>6 Mbps 17 dBm (50.1 mW)<br>54 Mbps 14 dBm (25.1 mW)<br>**802.11a (UNII-3) or CH 148 – CH 165**<br>6 Mbps 15 dBm (31.6 mW)<br>54 Mbps 14 dBm (25.1 mW)<br>**802.11b**<br>1 Mbps 17 dBm<br>11 Mbps 17 dBm<br>**802.11g**<br>6 Mbps 17 dBm<br>54 Mbps 14 dBm<br>**802.11n (2.4 GHz)**<br>6.5 Mbps (MCS0) 17 dBm<br>65 Mbps (MCS7) 13 dBm<br>**802.11n (5 GHz) (UNII-1, UNII-2A, UNII-2C) or CH 36 – CH140**<br>6.5 Mbps (MCS0; HT20) 17 dBm (50.1 mW)<br>65 Mbps (MCS7; HT20) 13 dBm (20 mW)<br>(MCS0; HT40) 14 dBm (25.1 mW)<br>(MCS7; HT40) 11 dBm (12.5 mW)<br>**802.11n (5 GHz) (UNII-3) or CH 148 – CH 165**<br>6.5 Mbps (MCS0; HT20) 15 dBm (31.6 mW)<br>65 Mbps (MCS7; HT20) 12 dBm (15.8 mW)<br>(MCS0; HT40) 14 dBm (25.1 mW)<br>(MCS7; HT40) 11 dBm (12.5 mW)<br>**Bluetooth**<br>1 Mbps 6 dBm<br>2 Mbps 6 dBm<br>3 Mbps 3 dBm |



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| Feature | Description |
|---|---|
| **Typical Receiver Sensitivity**<br><br>***Note:*** *All values nominal, +/-3 dBm.* | **802.11a:**<br>6 Mbps -92 dBm<br>54 Mbps -74 dBm (PER <= 10%)<br>**802.11b:**<br>1 Mbps -94 dBm<br>11 Mbps -87 dBm (PER <= 10%)<br>**802.11g:**<br>6 Mbps -91 dBm<br>54 Mbps -74 dBm (PER <= 10%)<br>**802.11n (2.4 GHz)**<br>MCS0 Mbps -91 dBm<br>MCS7 Mbps -71 dBm<br>**802.11n (5 GHz)**<br>MCS0 Mbps -92 dBm<br>MCS7 Mbps -71 dBm<br>**Bluetooth:**<br>1 Mbps -83 dBm (1DH1)<br>3 Mbps -75 dBm (3DH5)<br>BLE -86 dBm |
| **Operating Systems Supported** | Linux 2.6.x, 3.x.x, 4.0.x kernel<br>Android 4.1.2 (Jellybean) and forward |
| **Security** | **Standards**<br>Wireless Equivalent Privacy (WEP)<br>Wi-Fi Protected Access (WPA)<br>IEEE 802.11i (WPA2)<br>**Encryption**<br>Wireless Equivalent Privacy (WEP, RC4 Algorithm)<br>Temporal Key Integrity Protocol (TKIP, RC4 Algorithm)<br>Advanced Encryption Standard (AES, Rijndael Algorithm)<br>**Encryption Key Provisioning**<br>Static (40-bit and 128-bit lengths)<br>Pre-Shared (PSK)<br>**Dynamic**<br>802.1X Extensible Authentication Protocol Types<br>EAP-FAST PEAP-MSCHAPv2<br>EAP-TLS PEAP-TLS<br>EAP-TTLS LEAP<br>PEAP-GTC |



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| Feature | Description | |
|---|---|---|
| **Compliance** | **EU Regulatory** | |
| | EN 300 328 | 62311:2008 |
| | EN 301 489-1 | EN 50665:2017 |
| | EN 301 489-17 | EN 50385:2017 |
| | EN 301 893 | EU 2015/863 (RoHS 3) |
| | **FCC Regulatory** | **ISED Canada** |
| | 47 CFR FCC Part 15.247 | ICES-003 |
| | 47 CFR FCC Part 15.407 | ANSI C63.4:2014 |
| | 47 CFR FCC Part 2.1091 | RSS-102 |
| | FCC Part 15 Subpart B Class B | RSS-247 |
| **Certifications** | **Wi-Fi Alliance**<br>802.11a, 802.11b, 802.11g , 802.11n<br>WPA Enterprise<br>WPA2 Enterprise<br>**Cisco Compatible Extensions (Version 4)**<br>**Bluetooth SIG Qualification** | |
| **Warranty** | **Three Year Warranty** | |
| | ***All specifications are subject to change without notice*** | |

# 5 WLAN Functional Description

## 5.1 Overview

The MSD50NBT WLAN block is based on the Qualcomm-Atheros AR6004 802.11a/b/g/n chipset. 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 codes) 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 included functionality is show in the following table (Table 3).

***Table 3: MSD50NBT WLAN functionality***

| Feature | Description |
|---|---|
| **Reset Control** | CHIP_PWD_L and BT_RST_L pins must be asserted low to reset Wi-Fi and Bluetooth. After these signals are de-asserted, the radio waits for host communication. Until then, all modules except the host interface are held in reset.<br>Once the host has initiated communication, the radio turns on its crystal and then the PLL. After all clocks are stable and running, the block resets are automatically de-asserted.<br><br>**Note**: Because BT chip derives clock from WLAN, the Bluetooth function should be powered down/reset whenever WLAN is reset. |



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| Feature | Description |
|---|---|
| **System Clocking** (RTC Block) | The MSD50NBT has an RTC block which controls the clocks and power going to other internal modules. Its inputs consist of sleep requests from these modules and its outputs consists of 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 MSD50NBT's clocking is grouped into two types: high-speed and low-speed.<br>**High Speed Clocking**<br>The reference 26 MHz clock source inside the MSD50NBT 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.<br>**Low Speed Clocking**<br>The MSD50NBT has an 32.768 KHz oscillator that provide slow clock for BT to get deep sleep mode.<br>**Interface Clock**<br>The host interface clock represents another clock domain for the MSD50NBT. 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 MSD50NBT Wireless MAC consists of five major blocks:<br>▪ Host interface unit (HIU) for bridging to the AHB for bulk data accesses and APB for register accesses<br>▪ Ten queue control units (QCU) for transferring TX data<br>▪ Ten DCF control units (DCU) for managing channel access<br>▪ Protocol control unit (PCU) for interfacing to baseband<br>DMA receive unit (DRU) for transferring RX data |
| **Baseband Block** | The MSD50NBT baseband module (BB) is the physical layer controller for the 802.11b/g/n air interface. It is responsible for modulating data packets in the transmit direction and detecting and demodulating 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 MSD50NBT. The Bluetooth chip (CSR8811) receives a reference clock from Wi-Fi chip (QCA6004). When Wi-Fi is in power off/reset state, no 26MHz reference clock is available; therefore, bluetooth is also off. |

# 6 Bluetooth Functional Description

The MSD50NBT Bluetooth (BT) block is based on CSR8811A08 and described in the following table (Table 4).

***Table 4: 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.<br>▪ Processor overhead reduction through hardware support for continual transmission and reception of PCM data.<br>▪ A bidirectional digital audio interface that routes directly into the baseband layer of the firmware. It does not pass through the HCI protocol layer.<br>▪ Hardware on CSR8811 for sending data to and from a SCO connection.<br>▪ Up to three SCO connections on the PCM interface at any one time.<br>▪ PCM interface master, generating PCM_SYNC and PCM_CLK.<br>▪ PCM interface slave, accepting externally generated PCM_SYNC and PCM_CLK.<br>▪ Various clock formats including:<br>▪ *Long Frame Sync<br>▪ *Short Frame Sync<br>▪ GCI timing environments<br>▪ 13-bit or 16-bit linear, 8-bit μ-law or A-law companded sample formats. |



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| Feature | Description |
|---|---|
| | ▪ Receives and transmits on any selection of three of the first four slots following PCM_SYNC.<br>▪ The PCM configuration options are enabled by setting SKEY_PCM_CONFIG32. |
| **CPU and Memory** | The CSR8811 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.<br>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.<br>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 MSD50NBT supports internally 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.<br>***Note:*** *The WLAN block must be initialized prior before BT clock sharing is enabled.* |
| **BT Low Energy** | The MSD50NBT supports Low Energy specification which allows for connection to devices with single mode LE function (such as a watch, sensor, and HID). The implementation is optimized for coexistence with WLAN. |
| **Reset** | The pin BT_RST_L resets and powers down the BT block.<br>Holding the BT_RST_L pin at GND 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<br>5 ms. |
| **Radio** | The BT radio shares the single antenna port with the WLAN through an internal 3-way RF switch. The MSD50NBT implements WLAN/BT coexistence internally.<br>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. |
| **BT_WAKEUP_HOST** | Pin-12 on MSD50NBT is reserved for BT to wake host from deep sleep mode. Current s/w may not support it. Contact Laird Connectivity for more information. |
| **VDDIO** | Pin-21 on MSD50NBT is WLAN Host IO (SDIO) power supply input. Can be either 1.8V or 3.3V. |



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# 7 BLOCK DIAGRAM

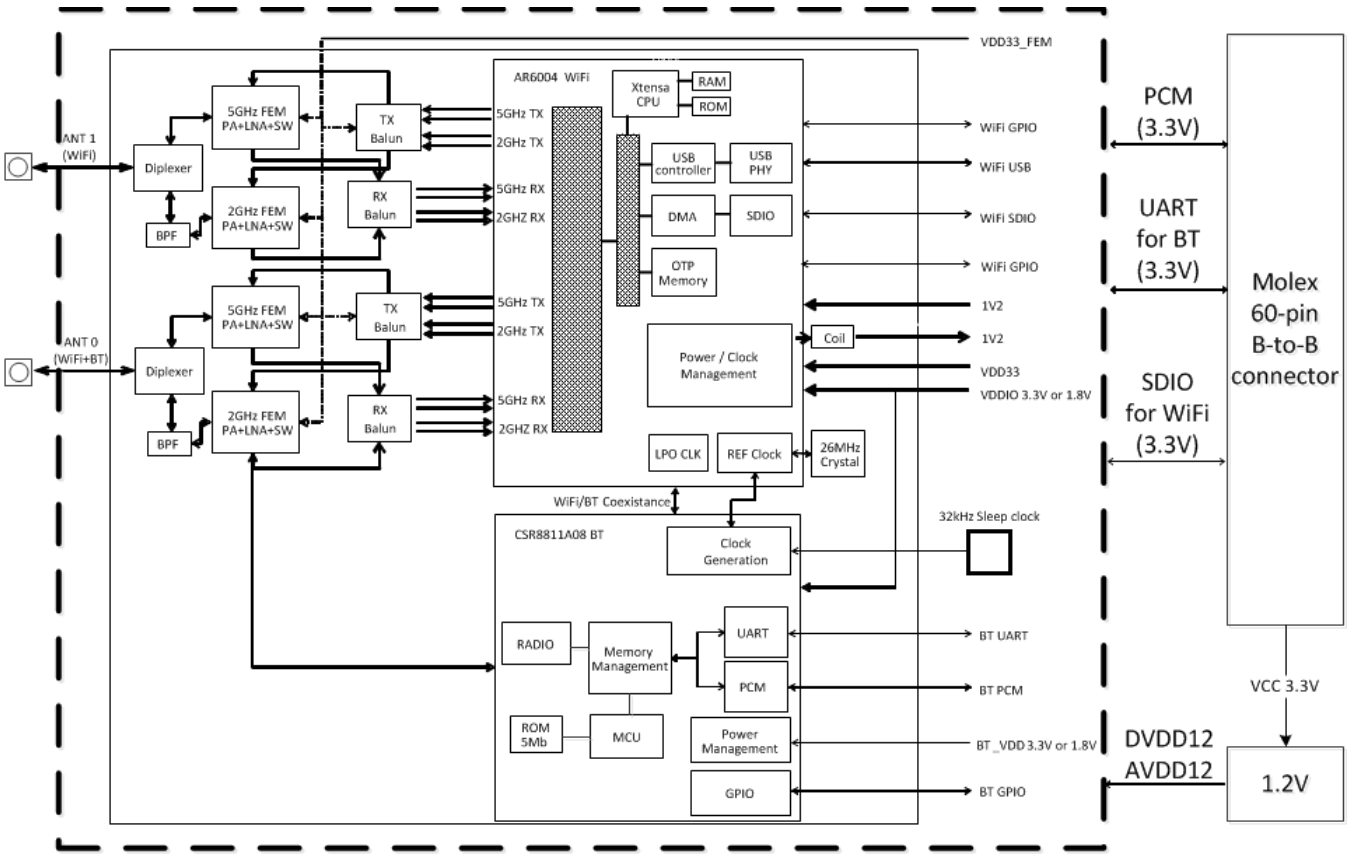


***Figure 1: MSD50NBT block diagram***

**Note:** Refer to the Specifications table for the Wi-Fi transmitter frequencies. BT signal only present on ANT0.



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# 8 ELECTRICAL CHARACTERISTICS

## 8.1 Absolute Maximum Ratings

Table 5 summarizes the absolute maximum ratings and Table 6 lists the recommended operating conditions for the **MSD50NBT**. 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 5: Absolute Maximum Ratings***

| Symbol (Domain) | Parameter | Max Rating | Unit |
|---|---|---|---|
| VDDIO | WLAN host SDIO interface and BT I/O supply | -0.3 to 4.0 | 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 |

## 8.2 Recommended Operating Conditions

***Table 6: 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 |

## 8.3 DC Electrical Characteristics

Table 7 and Table 8 list the general DC electrical characteristics over recommended operating conditions (unless otherwise specified).

***Table 7: 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<br>0V < VOUT< VDD | 0 | | -3 | nA |
| | | With Pull-up | 0 V < VIN < VDD<br>0V < VOUT < VDD | 16 | | 48 | µA |
| | | With Pull-down | 0V < VIN < VDD<br>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 |



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| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| VOL | Low Level Output Voltage | IOH = 4mA | | | 0.1 x VDD | V |
| | | IOH = 12mA | | | 0.1 x VDD | V |

***Table 8: 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<br>0V < VOUT < VDD | 0 | | -3 | nA |
| | | With Pull-up | 0V < VIN < VDD<br>0V < VOUT < VDD | 3.5 | | 13 | µA |
| | | With Pull-down | 0V < VIN < VDD<br>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 |

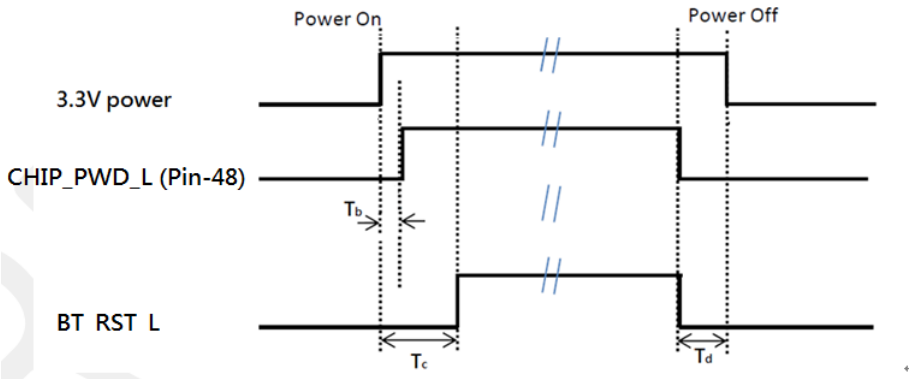


***Figure 2: Power On/Off Timing***

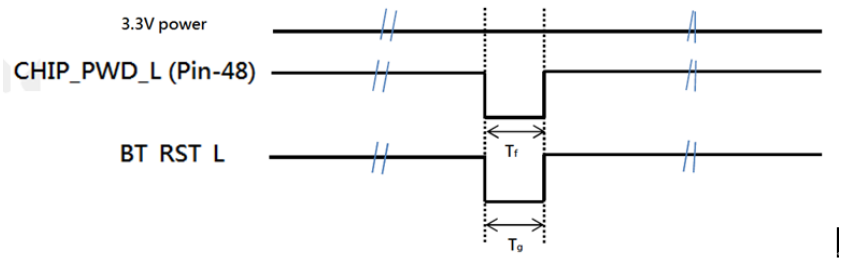


***Figure 3: Power On/Off Timing***



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***Table 9: Timing Diagram Definitions***

| Timing | Description | Min | Unit |
|---|---|---|---|
| Tb | Time between VDD33 (3.3V )supplies valid, to WiFi reset (pin-48;CHIP_PWD_L ) negation.<br><br>**Note:** have suitable 10K ohm Pull-up on pin-48, already. No extra pull-up resistor is required. | 5 | µsec |
| Tc | Time between VDD33 (3.3V) supplies valid and BT_RST_L (pin-32) negation | 5 | msec |
| Td | Time between WiFi reset (pin-48;CHIP_PWD_L ) negation and VDD33 (3.3V) invalid, or time between BT_RST_L (pin-32) negation and VDD33(3.3V) invalid. | 0 | µsec |
| Tf | Time of WiFi reset (pin-48; CHIP_PWD_L ) assertion during reset or power down period. 3.3V should keep ON. | 5 | µsec |
| Tg | Time of BT_RST_L (pin-32) assertion during reset or power down period. 3.3V should keep ON. | 5 | |

**Note:** We suggest that Tb and Tf timing is greater than 5µsec but no longer than 100 msec.

## 8.4 WLAN Radio Receiver Characteristics

Table 10 and Table 11 summarize the WLAN MSD50NBT receiver characteristics.

***Table 10: 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 | See Note[3] | | -94 | | dBm |
| | CCK, 11 Mbps | | | -87 | | |
| | OFDM, 6 Mbps | | | -91 | | |
| | OFDM, 54 Mbps | | | -74 | | |
| | HT20, MCS0 | | | -91 | | |
| | HT20, MCS7 | | | -71 | | |
| Radj | Adjacent channel rejection | | | | | |
| | OFDM, 6 Mbps | See Note[4] | | 32 | | dB |
| | OFDM, 54 Mbps | | | 16 | | |
| | HT20, MCS0 | | | 31 | | |
| | HT20, MCS7 | | | 14 | | |

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

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



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***Table 11: WLAN Receiver Characteristics for 5 GHz Dual 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[5] | | -92 | | dBm |
| | OFDM, 54 Mbps | | | -74 | | |
| | HT20, MCS0 | | | -92 | | |
| | HT20, MCS7 | | | -71 | | |
| | HT40, MCS0 | | | -86 | | |
| | HT40, MCS7 | | | -66 | | |
| Radj | Adjacent channel rejection | | | | | |
| | OFDM, 6 Mbps | See Note[6] | | 22 | | dB |
| | OFDM, 54 Mbps | | | 9 | | |
| | HT20, MCS0 | | | 20 | | |
| | HT20, MCS7 | | | 19 | | |

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

## 8.5 WLAN Transmitter Characteristics

***Table 12: WLAN Transmitter Characteristics for 2.4 GHz Per Chain Operation***

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Ftx | Transmit output frequency range | | 2.412 | | 2.484 | GHz |
| Pout | Output power | See Note[7] | | | | |
| | 11b mask compliant | 1Mbps | | 17 | | dBm |
| | 11g mask compliant | 6Mbps | | 17 | | |
| | 11g EVM compliant | 54Mbps | | 14 | | |
| | 11n HT20 mask compliant | MCS0 | | 17 | | |
| | 11n HT20 EVM compliant | MCS7 | | 13 | | |
| | 11n HT20 EVM compliant | MCS15 | | 13 | | |
| ATx | Transmit power accuracy at 17 dBm | - | - | + 2.0 | | dB |

| Freq. | Mode/Rate (Mbps) | Output Power Per Chain (dBm) | Typical Current Consumption Single Chain (mA)[8] | Max. Current Consumption Single Chain (mA)[8] |
|---|---|---|---|---|
| 2412MHz | 1 Mbps | 18dBm | 420 | 560 |
| | 54 Mbps | 15dBm | 350 | 450 |
| | HT20 MCS7 | 14dBm | 340 | 420 |
| 2442MHz | 1 Mbps | 18dBm | 420 | 560 |
| | 54 Mbps | 15dBm | 350 | 450 |
| | HT20 MCS7 | 14dBm | 340 | 420 |



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| Freq. | Mode/Rate (Mbps) | Output Power Per Chain (dBm) | Typical Current Consumption Single Chain (mA)[8] | Max. Current Consumption Single Chain (mA)[8] |
|---|---|---|---|---|
| 2472MHz | 1 Mbps | 18dBm | 420 | 560 |
| | 54 Mbps | 15dBm | 350 | 450 |
| | HT20 MCS7 | 14dBm | 340 | 420 |

***Table 13: WLAN Transmitter Characteristics for 5 GHz Per Chain Operation***

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| Ftx | Transmit output frequency range | | 5.15 | | 5.925 | GHz |
| Pout | Output power | See Note[3] | | | | |
| | 11a mask compliant | 6Mbps | | 17 | | dBm |
| | 11a EVM compliant | 54Mbps | | 14 | | |
| | 11n HT20 mask compliant | MCS0 | | 17 | | |
| | 11n HT20 EVM compliant | MCS7 | | 13 | | |
| | 11n HT20 EVM compliant | MCS15 | | 13 | | |
| | 11n HT40 mask compliant | MCS0 | | 14 | | |
| | 11n HT40 EVM compliant | MCS7 | | 11 | | |
| | 11n HT40 EVM compliant | MCS15 | | 11 | | |
| ATx | Transmit power accuracy at 17dBm | - | - | + 2.0 | | dB |

| Freq. | Mode/Rate [Mbps] | Output Power Per Chain [dBm] | Typical Current Consumption Single Chain (mA)[8] | Max. Current Consumption Single Chain (mA)[8] |
|---|---|---|---|---|
| 5180MHz | 54 Mbps | 15dBm | 490 | 590 |
| | HT20 MCS7 | 14dBm | 450 | 560 |
| | HT40 MCS7 | 12dBm | 470 | 540 |
| 5500MHz | 54 Mbps | 15dBm | 490 | 590 |
| | HT20 MCS7 | 14dBm | 450 | 560 |
| | HT40 MCS7 | 12dBm | 470 | 540 |
| 5825MHz | 54 Mbps | 15dBm | 490 | 590 |
| | HT20 MCS7 | 14dBm | 450 | 560 |
| | HT40 MCS7 | 12dBm | 470 | 540 |

[7]Performance data are measured under single chain operation.

**Note:** Final TX power values on each channels are limited by the regulatory certification test limit.

**Note: 2.4GHz does not support HT40 operation, only 5GHz support HT40 operation.**



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# 9 BLUETOOTH RADIO CHARACTERISTICS

Table 14 through Table 15 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 14: Basic Rate Transmitter Performance Temperature at 25°C (3.3V)***

| Test Parameter | Min | Typ | Max | BT Spec. | Unit |
|---|---|---|---|---|---|
| Maximum RF Output Power | 2 | 6 | — | –6 to +10 | dBm |
| Frequency Range | 2.4 | — | 2.4835 | 2.4 ≤ f ≤ 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 < Δf1avg < 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 15: 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 Stability \|wo\| | π/4 DQPSK | — | 1 | — | ≤ ±10 | KHz |
| | 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 | % |



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| Test Parameter | | Min | Typ | Max | BT Spec. | Unit |
|---|---|---|---|---|---|---|
| Adjacent Channel Power | F≥ ± 3MHz | — | –60 | — | < –40 | dBm |
| | F = ± 2MHz | — | –28 | — | ≤ –20 | dBm |
| | F = ±1MHz | — | –32 | — | ≤ –26 | dB |

***Table 16: 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 17: 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 |
| 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 |



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# 10 SDIO Timing Requirements

The following figure (Figure 4) and table display SDIO default mode timing.

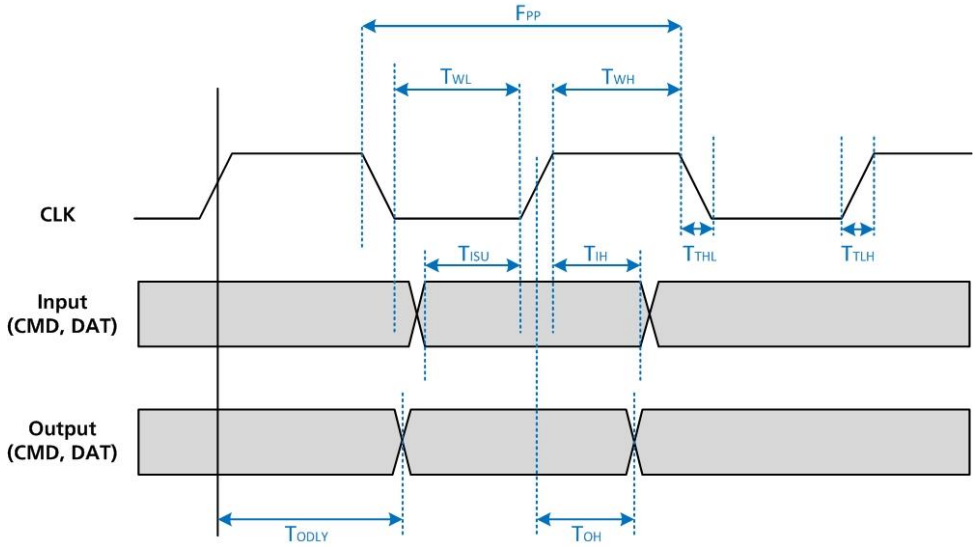


***Figure 4: SDIO Default Mode Timing***

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

***Table 18: 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 |
| tIH | Input hold time | 2 | - | - | ns |
| | Outputs: CMD, DAT (referenced to CLK) | | | | |
| tODLY | Output delay time – Data Transfer mode | 0 | - | 14 | ns |



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# 11 Pin Definitions

| Pin # | Name | Type | Voltage Reference | Description | If Not Used |
|---|---|---|---|---|---|
| 1 | GND | - | - | Ground | GND |
| 2 | BT_UART_TXD | O | VDD_IO | Bluetooth UART Serial output | N/C |
| 3 | No Connect | - | - | No Connect | N/C |
| 4 | No Connect | - | - | No Connect | N/C |
| 5 | BT_UART_RTS_N | O | VDD_IO | "Request-to-send signal for the Bluetooth UART interface, active low" | N/C |
| 6 | BT_UART_RXD | I | VDD_IO | Bluetooth UART Serial input | N/C |
| 7 | No Connect | - | - | No Connect | N/C |
| 8 | Wake On Wireless | O | VDD_IO | Reserved as Wake-ON-Wireless (WOW) LAN, WLAN output signal to wake up host, active Low and need external 10K pull up. **Note:** The current software does not support it. | N/C |
| 9 | No Connect | - | - | No Connect | N/C |
| 10 | BT_PCM_OUT | O | VDD_IO | BT PCM synchronous data output | N/C |
| 11 | BT_UART_CTS_N | I | VDD_IO | "Clear-to-send signal for the Bluetooth UART interface, active low" | N/C |
| 12 | BT_WAKEUP_HOST | O | VDD_IO | When BT wakes up from its deep sleep state, it sends an H pulse signal out to Host. Normally, it is Low state. **Note:** The current software does not support it. | N/C |
| 13 | VCC3_3 | - | - | 3.3V Power Supply for the Module. (3.2V Min; 3.46V Max) | 3.3V |
| 14 | No Connect | - | - | No Connect | N/C |
| 15 | No Connect | - | - | No Connect | N/C |
| 16 | No Connect | - | - | No Connect | N/C |
| 17 | No Connect | - | - | No Connect | N/C |
| 18 | No Connect | - | - | No Connect | N/C |
| 19 | No Connect | - | - | No Connect | N/C |
| 20 | BT_PCM_SYNC | I/O | VDD_IO | BT PCM Synchronous data | N/C |
| 21 | VDD_IO | - | - | Bus and IO voltage level configuration. Either 3.3V or 1.8V | 1.8V or 3.3V |
| 22 | BT_PCM_IN | I | VDD_IO | BT PCM synchronous data input | N/C |
| 23 | No Connect | - | - | No Connect | N/C |
| 24 | BT_PCM_CLK | I/O | VDD_IO | BT PCM clock | N/C |
| 25 | No Connect | - | - | No Connect | N/C |
| 26 | No Connect | - | - | No Connect | N/C |
| 27 | SDIO_DATA_2 | I/O | VDD_IO | SDIO Data 2 – Internal pull-up. No external pull-up required | N/C |



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| Pin # | Name | Type | Voltage Reference | Description | If Not Used |
|---|---|---|---|---|---|
| 28 | No Connect | - | - | No Connect | N/C |
| 29 | VCC3_3 | - | - | 3.3V Power Supply for the Module. (3.2V Min; 3.46V Max) | 3.3V |
| 30 | GND | - | - | Ground | GND |
| 31 | GND | - | - | Ground | GND |
| 32 | BT_RST_L | I | VDD_IO | BT chip power-down control. Driving this pin active low powers down or resets the BT signal. Has internal weak pull-up. Should be active low for at least 5ms to reset the BT.<br>**Note:10K ohm internal pull-up**. | N/C |
| 33 | No Connect | - | - | No Connect | N/C |
| 34 | No Connect | - | - | No Connect | N/C |
| 35 | No Connect | - | - | No Connect | N/C |
| 36 | No Connect | - | - | No Connect | N/C |
| 37 | No Connect | - | - | No Connect | N/C |
| 38 | No Connect | - | - | No Connect | N/C |
| 39 | No Connect | - | - | No Connect | N/C |
| 40 | No Connect | - | - | No Connect | N/C |
| 41 | No Connect | - | - | No Connect | N/C |
| 42 | No Connect | - | - | No Connect | N/C |
| 43 | No Connect | - | - | No Connect | N/C |
| 44 | No Connect | - | - | No Connect | N/C |
| 45 | No Connect | - | - | No Connect | N/C |
| 46 | No Connect | - | - | No Connect | N/C |
| 47 | No Connect | - | - | No Connect | N/C |
| 48 | CHIP_PWD_L | I | VDD_IO | "WLAN Power Down (0=power down, 1= WLAN awake)<br>**Note:10K ohm internal pull-up**. | N/C |
| 49 | No Connect | - | - | No Connect | N/C |
| 50 | No Connect | - | - | No Connect | N/C |
| 51 | No Connect | - | - | No Connect | N/C |
| 52 | No Connect | - | - | No Connect | N/C |
| 53 | No Connect | - | - | No Connect | N/C |
| 54 | No Connect | - | - | No Connect | N/C |
| 55 | SDIO_CMD | I/O | VDD_IO | SDIO Command – Internal pull-up. | N/C |
| 56 | SDIO_CLK | I | VDD_IO | SDIO Clock (25MHz max) | N/C |
| 57 | SDIO_DATA_0 | I/O | VDD_IO | SDIO Data 0 – Internal pull-up. No external pull-up required | N/C |
| 58 | SDIO_DATA_3 | I/O | VDD_IO | SDIO Data 3 – Internal pull-up. No external pull-up | N/C |



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| Pin # | Name | Type | Voltage Reference | Description | If Not Used |
|---|---|---|---|---|---|
| | | | | required | |
| 59 | SDIO_DATA_1 | I/O | VDD_IO | SDIO Data 1 – Internal pull-up. No external pull-up required | N/C |
| 60 | GND | - | - | Ground | GND |

## 11.1 MSD40NBT, MSD45N, and MSD50NBT Pin Comparison Table

| Pin # | Pin Name – MSD40NBT | Pin Name – MSD45N | Pin Name – MSD50NBT |
|---|---|---|---|
| 1 | GND | GND | GND |
| 2 | BT_UART_TXD | No Connect | BT_UART_TXD |
| 3 | BT_PRIORITY | BT_PRIORITY | No Connect |
| 4 | BT_GPIO_6 | No Connect | No Connect |
| 5 | BT_UART_RTS_N | No Connect | BT_UART_RTS_N |
| 6 | BT_UART_RXD | No Connect | BT_UART_RXD |
| 7 | BT_HOST_WAKE_B | No Connect | No Connect |
| 8 | RSVD | No Connect | Wake On Wireless |
| 9 | RSVD | No Connect | No Connect |
| 10 | BT_PCM_OUT | No Connect | BT_PCM_OUT |
| 11 | BT_UART_CTS_N | No Connect | BT_UART_CTS_N |
| 12 | BT_WAKE_B | No Connect | BT_WAKEUP_HOST |
| 13 | VCC3_3 | VCC3_3 | VCC3_3 |
| 14 | No Connect | No Connect | No Connect |
| 15 | No Connect | No Connect | No Connect |
| 16 | No Connect | No Connect | No Connect |
| 17 | No Connect | No Connect | No Connect |
| 18 | No Connect | No Connect | No Connect |
| 19 | No Connect | No Connect | No Connect |
| 20 | BT_PCM_SYNC | No Connect | BT_PCM_SYNC |
| 21 | No Connect | VDD_IO | VDD_IO |
| 22 | BT_PCM_IN | No Connect | BT_PCM_IN |
| 23 | No Connect | No Connect | No Connect |
| 24 | BT_PCM_CLK | No Connect | BT_PCM_CLK |
| 25 | No Connect | No Connect | No Connect |
| 26 | SYS_RST_L | No Connect | No Connect |
| 27 | SDIO_DATA_2 | SDIO_D2 | SDIO_DATA_2 |
| 28 | RSVD | WL_ACTIVE | RSVD |
| 29 | VCC3_3 | VCC3_3 | VCC3_3 |
| 30 | GND | GND | GND |



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| Pin # | Pin Name – MSD40NBT | Pin Name – MSD45N | Pin Name – MSD50NBT |
|---|---|---|---|
| 31 | GND | GND | GND |
| 32 | BT_RST_L | No Connect | BT_RST_L |
| 33 | No Connect | No Connect | No Connect |
| 34 | No Connect | No Connect | No Connect |
| 35 | No Connect | No Connect | No Connect |
| 36 | RSVD | BT_ACTIVE | No Connect |
| 37 | No Connect | No Connect | No Connect |
| 38 | No Connect | No Connect | No Connect |
| 39 | No Connect | No Connect | No Connect |
| 40 | No Connect | No Connect | No Connect |
| 41 | No Connect | No Connect | No Connect |
| 42 | RSVD | WL_LED_ACT/ANTE | No Connect |
| 43 | No Connect | No Connect | No Connect |
| 44 | No Connect | No Connect | No Connect |
| 45 | No Connect | No Connect | No Connect |
| 46 | No Connect | No Connect | No Connect |
| 47 | No Connect | No Connect | No Connect |
| 48 | CHIP_PWD_L | CHIP_PWD_L | CHIP_PWD_L |
| 49 | No Connect | No Connect | No Connect |
| 50 | RSVD | No Connect | No Connect |
| 51 | No Connect | No Connect | No Connect |
| 52 | RSVD | No Connect | No Connect |
| 53 | RSVD | No Connect | No Connect |
| 54 | RSVD | No Connect | No Connect |
| 55 | SDIO_CMD | SDIO_CMD | SDIO_CMD |
| 56 | SDIO_CLK | SDIO_CLK | SDIO_CLK |
| 57 | SDIO_DATA_0 | SDIO_D0 | SDIO_DATA_0 |
| 58 | SDIO_DATA_3 | SDIO_D3 | SDIO_DATA_3 |
| 59 | SDIO_DATA_1 | SDIO_D1 | SDIO_DATA_1 |
| 60 | GND | GND | GND |

# 12 MECHANICAL SPECIFICATIONS

Module dimensions of MSD50NBT are 16x16x2.5mm. Detail drawings are shown in Figure 5.



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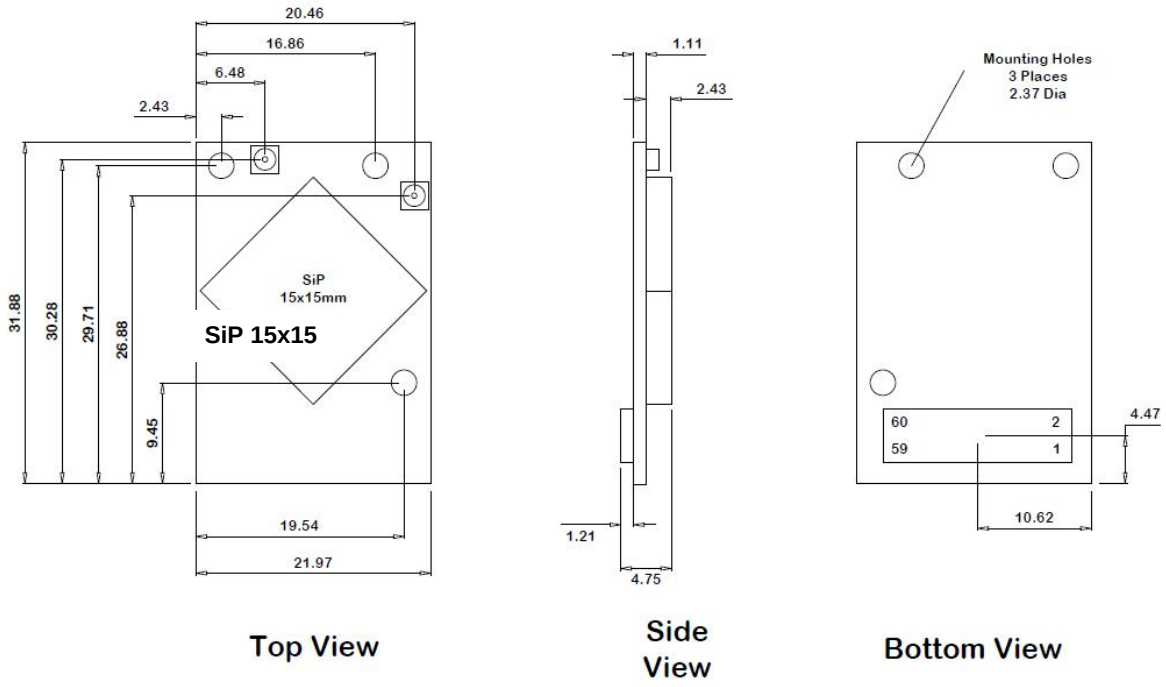


***Figure 5: Module dimension of MSD50NBT (version 1.1)***

**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.

# 13 MOUNTING

The MSD50NBT connects to the host via a 60-pin connector. In addition, there are three mounting holes used to secure the device to the host using 2 mm mounting screws.

Laird Connectivity recommends a 1.5 mm metal spacer (bushing) with a conductive mounting screw to connect the exposed ground pads of the radio circuit board to the host ground plane. A 1.5 mm conductive metal spacer with a maximum OD of 4 mm maximizes grounding of the radio and helps to reduce emissions from the radio circuit board. The spacer may also prevent the MSD board from slanting and breaking the connection to the host device when the board is attached to the host.

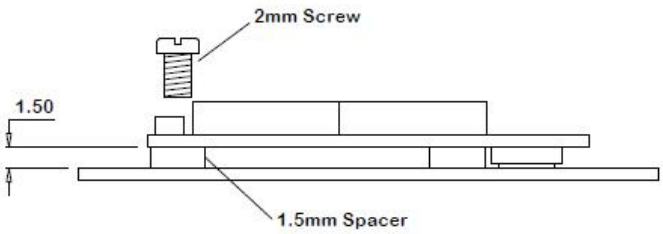


***Figure 7: Mounting information for MSD50NBT (version 1.1)***



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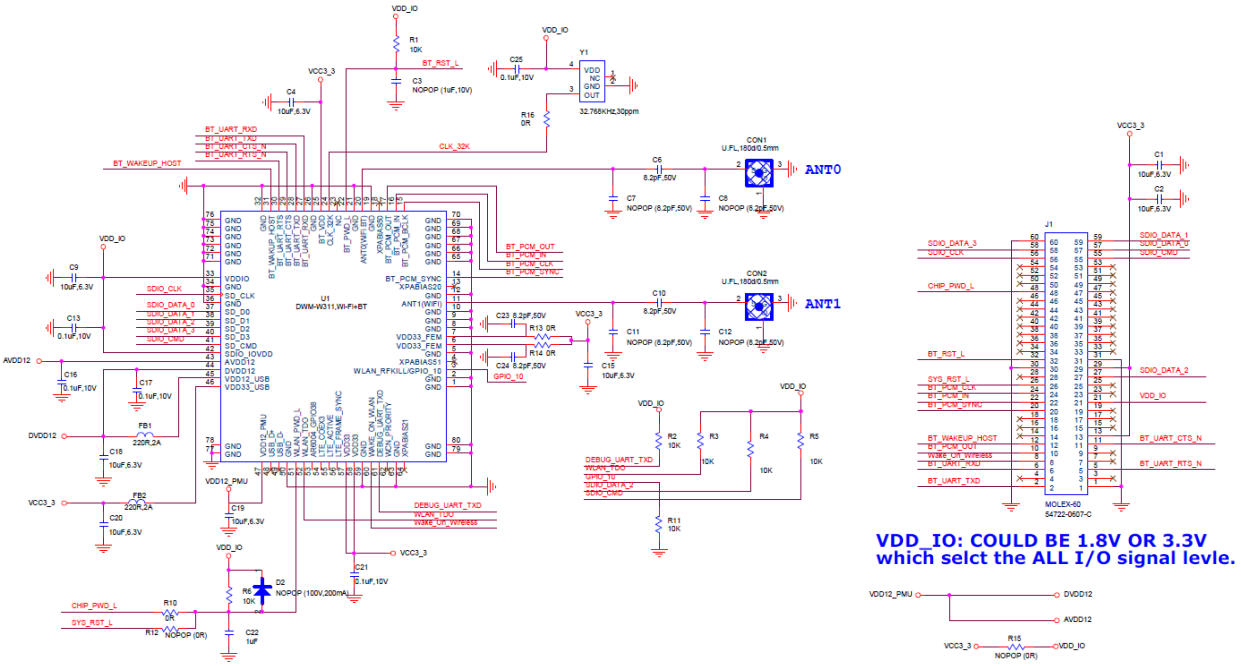
# 14 Reference Schematic of MSD50NBT




# 15 RF Layout Design Guidelines/Precautions

The following is a list of RF layout design guidelines and recommendation when installing a Laird Connectivity 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 Connectivity 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 Connectivity 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.



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# 16 Regulatory

: For complete regulatory information, refer to the MSD50NBT Regulatory Information document which is also available from the MSD50NBT product page.

The M2SD50NBT holds current certifications in the following countries:

| Country/Region | Regulatory ID |
|---|---|
| USA (FCC) | SQG-MSD50NBT |
| EU | N/A |
| Canada (ISED) | 3147A-MSD50NBT |

# 17 Ordering Information

| Part Number | Description |
|---|---|
| MSD50NBT | 2X2 802.11 a/b/g/n with BT4.0 dual mode module. |

# 18 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
Hong Kong: +852 2923 0610
Web: https://www.lairdconnect.com/products

**Note:** Information contained in this document is subject to change.





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