

# Datasheet

## M2SD50NBT

*Version 1.11*

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## REVISION HISTORY

| Version | Date         | Notes  | Approver    |
|---------|--------------|--|-------------|
| 1.0     | 27 Mar 2016  | Initial Version  | Andrew Chen |
| 1.1     | 09 Aug 2016  | Changed document name to Datasheet   | Sue White   |
| 1.2     | 07 Sept 2016 | Updated EU Declaration of Conformity   | Sue White   |
|         |              | Updated Tx power numbers to the following:<br><b>802.11a (UNII-1, UNII-2A, UNII-2C) or CH 36 – CH140</b><br>6 Mbps 17 dBm (50.1 mW)<br>54 Mbps 14 dBm (25.1 mW)<br><b>802.11a (UNII-3) or CH 148 – CH 165</b><br>6 Mbps 15 dBm (31.6 mW)<br>54 Mbps 14 dBm (25.1 mW)<br><b>802.11n (5 GHz) (UNII-1, UNII-2A, UNII-2C) or CH 36 – CH140</b>                 |             |
| 1.3     | 03 Nov 2016  | 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><b>802.11n (5 GHz) (UNII-3) or CH 148 – CH 165</b><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     | 7 Nov 2016   | Updated to add section numbers   | Sue White   |
| 1.5     | 09 Dec 2016  | Removed <i>Preliminary</i> references  | Jay White   |
| 1.6     | 07 Mar 2017  | Removed M2US50NBT references   | Andrew Chen |
| 1.7     | 19 Apr 2017  | Fixed FCC frequency ranges   | Miles Chung |
| 1.8     | 1 May 2017   | OS Support   | Jay White   |
| 1.9     | 15 June 2017 | Updated EU DoC with new RED standards  | Tom Smith   |
| 1.10    | 18 Aug 2017  | Removed references to 802.11r  | Jay White   |
| 1.11    | 01 May 2018  | Updated product photo<br>Updated Industry Canada statement<br>Updated to new Laird template  | Maggie Teng |

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# 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 INTRODUCTION

## 2.1 General Description

Powered by Laird’s 50-series modules, the M2SD50NBT introduces smaller, more versatile form factors. Child modules of the SSD50NBT leverage the best of Laird’s resources into reliable connectivity in any environment. Performance enhancements (2x2 MIMO, Bluetooth Low Energy or BLE, TX/RX diversity, fast roaming, and more) bring performance wireless to handheld devices.

The M2SD50NBT is a PCI Express M.2 (NGFF or Next Generation Form Factor) card (Type 2230) that supports various standard bus interfaces defined by PCI Express. This module adopts the SDIO bus for Wi-Fi connections and high speed UART; a PCM bus is used for Bluetooth functionality.

The M2SD50NBT integrates all WLAN and Bluetooth functionality into a single package which supports low cost and simple implementation along with flexibility for platform-specific customization.

This device is pre-calibrated and integrate 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 M2SD50NBT device 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.

In addition, their 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.

Dual embedded low-power CPU cores minimize host loading and maximize flexibility to support customer-specific use cases.



# 3 M2SD50NBT FEATURES SUMMARY

The Laird M2SD50NBT device features are described in [Table 1](#).

**Table 1: M2SD50NBT features**

| Feature  | Description   |
|--|---|
| <b>Radio Front End</b>                         | Integrates the complete transmit/receive RF paths including baluns, coexistence band pass filter, diplexer, switches, power amplifier, low noise amplifier, and reference crystal oscillator.   |
| <b>Enhanced WLAN/BT Coexistence Algorithms</b> | Enhanced important use cases including: <ul style="list-style-type: none"> <li>▪ PCM/I2S digital audio interface</li> <li>▪ BT stereo audio (A2DP)</li> <li>▪ BT data transfer profiles (such as OPP and FTP)</li> <li>▪ BT2.1+EDR</li> </ul> |

| Feature  | Description   |  |   |
|--|---|--|---|
|  | <ul style="list-style-type: none"> <li>▪ BT-LE</li> </ul> Flexible radio architecture ensures simple customization for future use cases.  |  |   |
| <b>Power Management</b>  | Uses power-saving techniques including: <ul style="list-style-type: none"> <li>▪ Gating clocks to idle or inactive blocks</li> <li>▪ Fast start and settling circuits to reduce Tx power</li> <li>▪ Active duty cycles</li> <li>▪ CPU frequency scaling</li> </ul>  |  |   |
| <b>Pre-Calibration</b>   | RF system tested and calibrated in production.  |  |   |
| <b>Internal Sleep Clock</b>  | Integrated on-chip low power sleep clock to regulate internal timing.   |  |   |
| <b>Multiple Interface Support</b>  | <ul style="list-style-type: none"> <li>▪ M2SD50NBT – SDIO 2.0 (50 MHz, 4-bit and 1-bit) for WLAN</li> <li>▪ HS-UART and PCM for Bluetooth HCI (compatible with any upper layer Bluetooth stack)</li> </ul>  |  |   |
| <b>Advanced 802.11n</b>  | <ul style="list-style-type: none"> <li>▪ Half Guard Interval and Frame Aggregation for high throughput</li> <li>▪ Space Time Block Coding (STBC) Rx for improved downlink robustness over range</li> <li>▪ Low Density Parity Check (LDPC) for improved uplink and downlink robustness over range</li> </ul>  |  |   |
| <b>Reference Frequency</b>   | <ul style="list-style-type: none"> <li>▪ Incorporates a 26 MHz reference frequency source in package</li> <li>▪ Sleep regulated and gated to enable the internal crystal to be powered down when the device is in sleep mode</li> <li>▪ BT shares the clock from the Wi-Fi chip.</li> <li>▪ Wi-Fi cannot be turned off or put in reset state when running BT.</li> <li>▪ 32.768 KHz slow clock is needed for BT to get into deep sleep mode.</li> </ul>   |  |   |
| <b>Advanced WLAN</b>   | Includes the following advanced WLAN features: <table border="0" style="width: 100%;"> <tr> <td style="vertical-align: top;"> <ul style="list-style-type: none"> <li>▪ IEEE 802.11e QoS, Wi-Fi Alliance WMM Power Save, and 802.11n power saving compliance</li> <li>▪ AES, AES-CCMP, TKIP engines for faster data encryption</li> <li>▪ Cisco CCXv4 ASD, WPS support</li> <li>▪ Standard WEP/WPA/WPA2 for personal and enterprise environments support</li> <li>▪ WWR, 802.11d, 802.11h support</li> <li>▪ Wi-Fi Direct (Peer-to-Peer)</li> <li>▪ RTT for indoor positioning</li> <li>▪ Statistics and events for monitoring</li> </ul> </td> <td style="vertical-align: top;"> <ul style="list-style-type: none"> <li>▪ Self-managed power state handling</li> <li>▪ Self-contained beacon processing</li> <li>▪ Shared authentication</li> <li>▪ Ad-hoc power save</li> <li>▪ Multiple PMK ID support</li> <li>▪ Simulated UAPSD</li> <li>▪ T-Spec support</li> <li>▪ Production flow diagnostics</li> <li>▪ 3-wire scheme for Wi-Fi and BT coexistence.</li> </ul> </td> </tr> </table> | <ul style="list-style-type: none"> <li>▪ IEEE 802.11e QoS, Wi-Fi Alliance WMM Power Save, and 802.11n power saving compliance</li> <li>▪ AES, AES-CCMP, TKIP engines for faster data encryption</li> <li>▪ Cisco CCXv4 ASD, WPS support</li> <li>▪ Standard WEP/WPA/WPA2 for personal and enterprise environments support</li> <li>▪ WWR, 802.11d, 802.11h support</li> <li>▪ Wi-Fi Direct (Peer-to-Peer)</li> <li>▪ RTT for indoor positioning</li> <li>▪ Statistics and events for monitoring</li> </ul> | <ul style="list-style-type: none"> <li>▪ Self-managed power state handling</li> <li>▪ Self-contained beacon processing</li> <li>▪ Shared authentication</li> <li>▪ Ad-hoc power save</li> <li>▪ Multiple PMK ID support</li> <li>▪ Simulated UAPSD</li> <li>▪ T-Spec support</li> <li>▪ Production flow diagnostics</li> <li>▪ 3-wire scheme for Wi-Fi and BT coexistence.</li> </ul> |
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| <b>Advanced Bluetooth</b>  | <ul style="list-style-type: none"> <li>▪ High-speed UART port (up to 4 Mbps)</li> <li>▪ HFP v1.6 wide-band speech supported on-chip</li> <li>▪ On-chip encoding of SBC and aptX® codecs for A2DP music streaming</li> <li>▪ PCM/I2S digital audio interface</li> <li>▪ Support for IEEE 802.11 coexistence</li> <li>▪ The flexible RAM/ROM based architecture enables custom or future profiles to be easily added</li> </ul>   |  |   |

## 4 SPECIFICATIONS

Table 2: Specifications

| Feature  | Description   |  |   |
|--|---|--|---|
|  | PCI Express NGFF card type 2230-S3-E (2230 = 22mm x 30 mm, S3 = single side, E = key ID)  |  |   |
| <b>Physical Interface</b>  | <p><b>Note:</b> The M2SD50NBT is type 2230-S3-E, but the top side component height is 2.5 mm max. The standard top side height for S3 is 1.5 mm max.</p> <p><b>Mating connector</b> – (Kyocera) part number: 24-6411-067-101-897E</p> <p><b>Stand-off</b> – (EMI STOP) part number: F50M16-041525P1D4M</p>  |  |   |
| <b>Wi-Fi Interface</b>   | 1-bit or 4-bit Secure Digital I/O   |  |   |
| <b>Bluetooth Interface</b>   | Host Controller Interface (HCI) using High Speed UART   |  |   |
| <b>Main Chip</b>   | <p>Wi-Fi – Qualcomm Atheros QCA6004</p> <p>BT – Cambridge Silicon Radio Ltd. (CSR) CSR8811 A08</p>  |  |   |
| <b>Input Voltage Requirements</b>  | 3.3 VDC (3.20V min to 3.46V max)  |  |   |
| <b>I/O Signalling Voltage</b>  | 3.3 VDC ± 5% or 1.8 VDC ± 5%  |  |   |
| <p><b>Average Current Consumption, VDDIO = 3.3 volts</b><br/>(At maximum transmit power setting)</p> <p><b>Note:</b> Reset refers to the radio are in reset, both Wifi and BT reset are asserted.</p> <p><b>Note:</b> MIMO measurements are generally higher than Single Stream.</p>   | <table border="0"> <tr> <td> <p><b>Single Stream</b></p> <p><b>802.11a (with BT in standby) @ 18 dBm 6 Mbps</b><br/>Transmit: 600 mA<br/>Receive: 260 mA<br/>Reset: 0.13mA</p> <p><b>802.11b (with BT in standby) @ 18 dBm 1 Mbps</b><br/>Transmit: 460 mA<br/>Receive: 250 mA<br/>Reset: 0.13mA</p> <p><b>802.11g (with BT in standby) @ 18 dBm 6 Mbps</b><br/>Transmit: 450 mA<br/>Receive: 250 mA<br/>Reset: 0.13mA</p> <p><b>802.11n (2.4 GHz) (with BT in standby) @ 14 dBm MCS7</b><br/>Transmit: 340 mA<br/>Receive: 250 mA<br/>Reset: 0.13mA</p> <p><b>802.11n (5 GHz) (with BT in standby) @ 14 dBm MCS7</b><br/>Transmit: 490 mA<br/>Receive: 260 mA<br/>Reset: 0.13mA</p> <p><b>Bluetooth (with Wi-Fi in standby)</b><br/>Transmit: 85 mA<br/>Receive: 70 mA<br/>Reset: 0.13mA</p> </td> <td> <p><b>MIMO</b></p> <p><b>802.11a (with BT in standby) @ 18 dBm 6 Mbps</b><br/>Transmit: 900 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>802.11b (with BT in standby) @ 18 dBm 1 Mbps</b><br/>Transmit: 680 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>802.11g (with BT in standby) @ 18 dBm 6 Mbps</b><br/>Transmit: 710 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>802.11n (2.4 GHz) (with BT in standby) @ 14 dBm MCS7</b><br/>Transmit: 710 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>802.11n (5 GHz) (with BT in standby) @ 14 dBm MCS7</b><br/>Transmit: 720 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>Bluetooth (with Wi-Fi in standby)</b><br/>Transmit: 720 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> </td> </tr> </table> | <p><b>Single Stream</b></p> <p><b>802.11a (with BT in standby) @ 18 dBm 6 Mbps</b><br/>Transmit: 600 mA<br/>Receive: 260 mA<br/>Reset: 0.13mA</p> <p><b>802.11b (with BT in standby) @ 18 dBm 1 Mbps</b><br/>Transmit: 460 mA<br/>Receive: 250 mA<br/>Reset: 0.13mA</p> <p><b>802.11g (with BT in standby) @ 18 dBm 6 Mbps</b><br/>Transmit: 450 mA<br/>Receive: 250 mA<br/>Reset: 0.13mA</p> <p><b>802.11n (2.4 GHz) (with BT in standby) @ 14 dBm MCS7</b><br/>Transmit: 340 mA<br/>Receive: 250 mA<br/>Reset: 0.13mA</p> <p><b>802.11n (5 GHz) (with BT in standby) @ 14 dBm MCS7</b><br/>Transmit: 490 mA<br/>Receive: 260 mA<br/>Reset: 0.13mA</p> <p><b>Bluetooth (with Wi-Fi in standby)</b><br/>Transmit: 85 mA<br/>Receive: 70 mA<br/>Reset: 0.13mA</p> | <p><b>MIMO</b></p> <p><b>802.11a (with BT in standby) @ 18 dBm 6 Mbps</b><br/>Transmit: 900 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>802.11b (with BT in standby) @ 18 dBm 1 Mbps</b><br/>Transmit: 680 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>802.11g (with BT in standby) @ 18 dBm 6 Mbps</b><br/>Transmit: 710 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>802.11n (2.4 GHz) (with BT in standby) @ 14 dBm MCS7</b><br/>Transmit: 710 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>802.11n (5 GHz) (with BT in standby) @ 14 dBm MCS7</b><br/>Transmit: 720 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>Bluetooth (with Wi-Fi in standby)</b><br/>Transmit: 720 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> |
| <p><b>Single Stream</b></p> <p><b>802.11a (with BT in standby) @ 18 dBm 6 Mbps</b><br/>Transmit: 600 mA<br/>Receive: 260 mA<br/>Reset: 0.13mA</p> <p><b>802.11b (with BT in standby) @ 18 dBm 1 Mbps</b><br/>Transmit: 460 mA<br/>Receive: 250 mA<br/>Reset: 0.13mA</p> <p><b>802.11g (with BT in standby) @ 18 dBm 6 Mbps</b><br/>Transmit: 450 mA<br/>Receive: 250 mA<br/>Reset: 0.13mA</p> <p><b>802.11n (2.4 GHz) (with BT in standby) @ 14 dBm MCS7</b><br/>Transmit: 340 mA<br/>Receive: 250 mA<br/>Reset: 0.13mA</p> <p><b>802.11n (5 GHz) (with BT in standby) @ 14 dBm MCS7</b><br/>Transmit: 490 mA<br/>Receive: 260 mA<br/>Reset: 0.13mA</p> <p><b>Bluetooth (with Wi-Fi in standby)</b><br/>Transmit: 85 mA<br/>Receive: 70 mA<br/>Reset: 0.13mA</p> | <p><b>MIMO</b></p> <p><b>802.11a (with BT in standby) @ 18 dBm 6 Mbps</b><br/>Transmit: 900 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>802.11b (with BT in standby) @ 18 dBm 1 Mbps</b><br/>Transmit: 680 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>802.11g (with BT in standby) @ 18 dBm 6 Mbps</b><br/>Transmit: 710 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>802.11n (2.4 GHz) (with BT in standby) @ 14 dBm MCS7</b><br/>Transmit: 710 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>802.11n (5 GHz) (with BT in standby) @ 14 dBm MCS7</b><br/>Transmit: 720 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p> <p><b>Bluetooth (with Wi-Fi in standby)</b><br/>Transmit: 720 mA<br/>Receive: 140 mA<br/>Reset: 0.13mA</p>   |  |   |
| <b>Operating Temperature</b>   | -30° to 85°C (-22° to 185°F)  |  |   |

| Feature                                | Description  |
|--|--|
| <b>Operating Humidity</b>              | 10 to 90% (non-condensing)   |
| <b>Storage Temperature</b>             | -40° to 85°C (-40° to 185°F)   |
| <b>Storage Humidity</b>                | 10 to 90% (non-condensing)   |
| <b>Maximum Electrostatic Discharge</b> | Conductive 4KV; Air coupled 8KV EN61000-4-2  |
| <b>Size</b>                            | 22 mm X 30 mm X 3.3 mm (.87" x 1.18" x .13")   |
| <b>Weight</b>                          | < 3.0 grams (< 0.105822 ounces)  |
| <b>Mounting</b>                        | See the mounting and handling guide  |
| <b>Wi-Fi Media</b>                     | Direct Sequence-Spread Spectrum (DSSS)<br>Complementary Code Keying (CCK)<br>Orthogonal Frequency Divisional Multiplexing (OFDM)   |
| <b>Bluetooth Media</b>                 | Frequency Hopping Spread Spectrum (FHSS)   |
| <b>Wi-Fi Media Access Protocol</b>     | Carrier sense multiple access with collision avoidance (CSMA/CA)   |
| <b>Network Architecture Types</b>      | Infrastructure and ad-hoc  |
| <b>Wi-Fi Standards</b>                 | IEEE 802.11a, 802.11b, 802.11d, 802.11e, 802.11g, 802.11h, 802.11i, 802.11n  |
| <b>Bluetooth Standards</b>             | Bluetooth version 2.1 with Enhanced Data Rate<br>Bluetooth 4.0 (Bluetooth Low Energy or BLE)   |
| <b>Wi-Fi Data Rates Supported</b>      | 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 |
| <b>Modulation</b>                      | 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   |
| <b>802.11n Spatial Streams</b>         | 2 (2x2 MIMO)   |
| <b>Bluetooth Data Rates Supported</b>  | 1, 2, 3 Mbps   |
| <b>Bluetooth Modulation</b>            | GFSK@ 1 Mbps<br>Pi/4-DQPSK@ 2 Mbps<br>8-DPSK@ 3 Mbps   |
| <b>Regulatory Domain Support</b>       | FCC (Americas, Parts of Asia, and Middle East)<br>ETSI (Europe, Middle East, Africa, and Parts of Asia)<br>IC (Industry Canada )<br>MIC (Japan) (formerly TELEC) – Option<br>KC (Korea) (formerly KCC) – Option  |




| Feature                                   | Description  |
|---|--|
| <b>2.4 GHz Frequency Bands</b>            | ETSI: 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   |
| <b>2.4 GHz Operating Channels (Wi-Fi)</b> | ETSI: 13 (3 non-overlapping)<br>FCC: 11 (3 non-overlapping)<br>MIC: 14 (4 non-overlapping)<br>KC: 13 (3 non-overlapping)   |
| <b>5 GHz Frequency Bands</b>              | <b>ETSI</b><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><b>FCC</b><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 5.825 GHz (Ch 149/153/157/161/165)<br><b>MIC (Japan)</b><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><b>KC</b><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) |
| <b>5 GHz Operating Channels (Wi-Fi)</b>   | ETSI: 19 non-overlapping<br>FCC: 24 non-overlapping<br>MIC: (Japan): 19 non-overlapping<br>KC: 19 non-overlapping  |
| <b>Transmit Power</b>                     | <b>802.11a (UNII-1, UNII-2A, UNII-2C) or CH 36 – CH140</b><br>6 Mbps 17 dBm (50.1 mW)<br>54 Mbps 14 dBm (25.1 mW)<br><b>802.11a (UNII-3) or CH 148 – CH 165</b><br>6 Mbps 15 dBm (31.6 mW)<br>54 Mbps 14 dBm (25.1 mW)<br><b>802.11b</b><br>1 Mbps 17 dBm<br>11 Mbps 17 dBm<br><b>802.11g</b><br>6 Mbps 17 dBm<br>54 Mbps 14 dBm<br><b>802.11n (2.4 GHz)</b><br>6.5 Mbps (MCS0) 17 dBm<br>65 Mbps (MCS7) 13 dBm  |

*Note: Transmit power on each channels varies according to individual country regulations. All values for lowest data rate is nominal, +/-2 dBm. Others are +/-2.5dBm.*

**Note:**  
*HT40 – 40 Mhz-wide channels*  
*HT20 – 20 MHz-wide channels*



| Feature                             | Description   |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
|-------------------------------------|---|-----------------------|------------------|----------------------|----------------------|--------------|------------------|--------------|----------------------|-----------------------|------------------|----------------------|----------------------|--------------|------------------|--------------|------------------|-----------|---------|-----------|---------|--------|---------|--------|--------|---------|--------|-----|---------|--|
|                                     | <p><b>802.11n (5 GHz) (UNII-1, UNII-2A, UNII-2C) or CH 36 – CH140</b></p> <table> <tr> <td>6.5 Mbps (MCS0; HT20)</td> <td>17 dBm (50.1 mW)</td> </tr> <tr> <td>65 Mbps (MCS7; HT20)</td> <td>13 dBm (20 mW)</td> </tr> <tr> <td>(MCS0; HT40)</td> <td>14 dBm (25.1 mW)</td> </tr> <tr> <td>(MCS7; HT40)</td> <td>11 dBm (12.5 mW)</td> </tr> </table> <p><b>802.11n (5 GHz) (UNII-3) or CH 148 – CH 165</b></p> <table> <tr> <td>6.5 Mbps (MCS0; HT20)</td> <td>15 dBm (31.6 mW)</td> </tr> <tr> <td>65 Mbps (MCS7; HT20)</td> <td>12 dBm (15.8 mW)</td> </tr> <tr> <td>(MCS0; HT40)</td> <td>14 dBm (25.1 mW)</td> </tr> <tr> <td>(MCS7; HT40)</td> <td>11 dBm (12.5 mW)</td> </tr> </table> <p><b>Bluetooth</b></p> <table> <tr> <td>1 Mbps</td> <td>6 dBm</td> </tr> <tr> <td>2 Mbps</td> <td>6 dBm</td> </tr> <tr> <td>3 Mbps</td> <td>3 dBm</td> </tr> </table>  | 6.5 Mbps (MCS0; HT20) | 17 dBm (50.1 mW) | 65 Mbps (MCS7; HT20) | 13 dBm (20 mW)       | (MCS0; HT40) | 14 dBm (25.1 mW) | (MCS7; HT40) | 11 dBm (12.5 mW)     | 6.5 Mbps (MCS0; HT20) | 15 dBm (31.6 mW) | 65 Mbps (MCS7; HT20) | 12 dBm (15.8 mW)     | (MCS0; HT40) | 14 dBm (25.1 mW) | (MCS7; HT40) | 11 dBm (12.5 mW) | 1 Mbps    | 6 dBm   | 2 Mbps    | 6 dBm   | 3 Mbps | 3 dBm   |        |        |         |        |     |         |  |
| 6.5 Mbps (MCS0; HT20)               | 17 dBm (50.1 mW)  |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| 65 Mbps (MCS7; HT20)                | 13 dBm (20 mW)  |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| (MCS0; HT40)                        | 14 dBm (25.1 mW)  |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| (MCS7; HT40)                        | 11 dBm (12.5 mW)  |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| 6.5 Mbps (MCS0; HT20)               | 15 dBm (31.6 mW)  |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| 65 Mbps (MCS7; HT20)                | 12 dBm (15.8 mW)  |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| (MCS0; HT40)                        | 14 dBm (25.1 mW)  |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| (MCS7; HT40)                        | 11 dBm (12.5 mW)  |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| 1 Mbps                              | 6 dBm   |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| 2 Mbps                              | 6 dBm   |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| 3 Mbps                              | 3 dBm   |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| <b>Typical Receiver Sensitivity</b> | <p><b>802.11a:</b></p> <table> <tr> <td>6 Mbps</td> <td>-92 dBm</td> </tr> <tr> <td>54 Mbps</td> <td>-74 dBm (PER &lt;= 10%)</td> </tr> </table> <p><b>802.11b:</b></p> <table> <tr> <td>1 Mbps</td> <td>-94 dBm</td> </tr> <tr> <td>11 Mbps</td> <td>-87 dBm (PER &lt;= 10%)</td> </tr> </table> <p><b>802.11g:</b></p> <table> <tr> <td>6 Mbps</td> <td>-91 dBm</td> </tr> <tr> <td>54 Mbps</td> <td>-74 dBm (PER &lt;= 10%)</td> </tr> </table> <p><b>802.11n (2.4 GHz)</b></p> <table> <tr> <td>MCS0 Mbps</td> <td>-91 dBm</td> </tr> <tr> <td>MCS7 Mbps</td> <td>-71 dBm</td> </tr> </table> <p><b>802.11n (5 GHz)</b></p> <table> <tr> <td>MCS0 Mbps</td> <td>-92 dBm</td> </tr> <tr> <td>MCS7 Mbps</td> <td>-71 dBm</td> </tr> </table> <p><b>Bluetooth:</b></p> <table> <tr> <td>1 Mbps</td> <td>-83 dBm</td> <td>(1DH1)</td> </tr> <tr> <td>3 Mbps</td> <td>-75 dBm</td> <td>(3DH5)</td> </tr> <tr> <td>BLE</td> <td>-86 dBm</td> <td></td> </tr> </table> | 6 Mbps                | -92 dBm          | 54 Mbps              | -74 dBm (PER <= 10%) | 1 Mbps       | -94 dBm          | 11 Mbps      | -87 dBm (PER <= 10%) | 6 Mbps                | -91 dBm          | 54 Mbps              | -74 dBm (PER <= 10%) | MCS0 Mbps    | -91 dBm          | MCS7 Mbps    | -71 dBm          | MCS0 Mbps | -92 dBm | MCS7 Mbps | -71 dBm | 1 Mbps | -83 dBm | (1DH1) | 3 Mbps | -75 dBm | (3DH5) | BLE | -86 dBm |  |
| 6 Mbps                              | -92 dBm   |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| 54 Mbps                             | -74 dBm (PER <= 10%)  |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| 1 Mbps                              | -94 dBm   |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| 11 Mbps                             | -87 dBm (PER <= 10%)  |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| 6 Mbps                              | -91 dBm   |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| 54 Mbps                             | -74 dBm (PER <= 10%)  |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| MCS0 Mbps                           | -91 dBm   |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| MCS7 Mbps                           | -71 dBm   |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| MCS0 Mbps                           | -92 dBm   |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| MCS7 Mbps                           | -71 dBm   |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| 1 Mbps                              | -83 dBm   | (1DH1)                |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| 3 Mbps                              | -75 dBm   | (3DH5)                |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| BLE                                 | -86 dBm   |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |
| <b>Operating Systems Supported</b>  | <p>Linux 2.6.x, 3.x.x, 4.0.x kernel<br/>Android 4.1.2 (Jellybean) and forward</p>   |                       |                  |                      |                      |              |                  |              |                      |                       |                  |                      |                      |              |                  |              |                  |           |         |           |         |        |         |        |        |         |        |     |         |  |

| Feature  | Description   |          |               |         |          |          |      |          |  |
|--|---|----------|---------------|---------|----------|----------|------|----------|--|
| <b>Security</b>  | <p><b>Standards</b></p> <p>Wireless Equivalent Privacy (WEP)<br/>Wi-Fi Protected Access (WPA)<br/>IEEE 802.11i (WPA2)</p> <p><b>Encryption</b></p> <p>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)</p> <p><b>Dynamic</b></p> <p>802.1X Extensible Authentication Protocol Types</p> <table border="1" style="width: 100%; background-color: #0070C0; color: white;"> <tr> <td>EAP-FAST</td> <td>PEAP-MSCHAPv2</td> </tr> <tr> <td>EAP-TLS</td> <td>PEAP-TLS</td> </tr> <tr> <td>EAP-TTLS</td> <td>LEAP</td> </tr> <tr> <td>PEAP-GTC</td> <td></td> </tr> </table> | EAP-FAST | PEAP-MSCHAPv2 | EAP-TLS | PEAP-TLS | EAP-TTLS | LEAP | PEAP-GTC |  |
| EAP-FAST   | PEAP-MSCHAPv2   |          |               |         |          |          |      |          |  |
| EAP-TLS  | PEAP-TLS  |          |               |         |          |          |      |          |  |
| EAP-TTLS   | LEAP  |          |               |         |          |          |      |          |  |
| PEAP-GTC   |   |          |               |         |          |          |      |          |  |
| <b>Compliance</b>  | <p><b>ETSI Regulatory Domain</b></p> <p>EN 300 328 (Wi-Fi®)<br/>EN 300 328 v1.8.1 (BT 2.1)<br/>EN 301 489-1<br/>EN 301 489-17<br/>EN 301 893<br/>EN 60950-1<br/>EU 2002/95/EC (RoHS)</p> <p><b>FCC Regulatory Domain</b></p> <p>FCC 15.247 DTS – 802.11b/g (Wi-Fi) – 2.4 GHz<br/>FCC 15.407 UNII – 802.11a (Wi-Fi) – 5 GHz<br/>FCC 15.247 DSS – BT 2.1</p> <p><b>Industry Canada</b></p> <p>RSS-247 – 802.11a/b/g/n (Wi-Fi) – 2.4 GHz, 5.8 GHz, 5.2 GHz, and 5.4 GHz<br/>RSS-247 – BT 2.1</p>   |          |               |         |          |          |      |          |  |
| <b>Certifications</b>  | <p><b>Wi-Fi Alliance</b></p> <p>802.11a, 802.11b, 802.11g , 802.11n<br/>WPA Enterprise<br/>WPA2 Enterprise</p> <p><b>Cisco Compatible Extensions (Version 4)</b></p> <p><b>Bluetooth SIG Qualification</b></p> <div style="text-align: right;">    </div>  |          |               |         |          |          |      |          |  |
| <b>Warranty</b>  | <b>Three Year Warranty</b>  |          |               |         |          |          |      |          |  |
| <b>All specifications are subject to change without notice</b> |   |          |               |         |          |          |      |          |  |

## 5 WLAN FUNCTIONAL DESCRIPTION

### 5.1 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  |
|------------------------------------|--|
| <b>System Clocking (RTC Block)</b> | <p>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.</p> <p><i>5.1.1.1 High Speed Clocking</i></p> <p>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.</p> <p><i>5.1.1.2 Low Speed Clocking</i></p> <p>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.</p> <p><i>5.1.1.3 Interface Clock</i></p> <p>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.</p> |
| <b>MAC/BB/RF Block</b>             | <p>The M2SD50NBT Wireless MAC consists of five major blocks:</p> <ul style="list-style-type: none"> <li>▪ Host interface unit (HIU) for bridging to the AHB for bulk data accesses and APB for register accesses</li> <li>▪ Ten queue control units (QCU) for transferring TX data</li> <li>▪ Ten DCF control units (DCU) for managing channel access</li> <li>▪ Protocol control unit (PCU) for interfacing to baseband</li> <li>▪ DMA receive unit (DRU) for transferring RX data</li> </ul>   |
| <b>Baseband Block</b>              | <p>The M2SD50NBT baseband block (BB) is the physical layer controller for the 802.11b/g/n air interface.</p> <ul style="list-style-type: none"> <li>▪ It modulates data packets in the transmit direction</li> <li>▪ Detects and demodulates data packets in the receive direction.</li> <li>▪ It has a direct control interface to the radio to enable hardware to adjust analog gains and modes dynamically.</li> </ul>  |

| Feature       | Description   |
|---------------|---|
| Clock Sharing | <ul style="list-style-type: none"> <li>▪ 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.</li> <li>▪ 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</li> </ul> |

## 6 BLUETOOTH FUNCTIONAL DESCRIPTION

The M2SD50NBT Bluetooth (BT) block is based on the CSR8811A08 and described in the [Table 3](#).

**Table 3: 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               | <ul style="list-style-type: none"> <li>▪ Continuous PCM encoded audio data transmission and reception over Bluetooth</li> <li>▪ Processor overhead reduction through hardware support for continual transmission and reception of PCM data</li> <li>▪ 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</li> <li>▪ Hardware on CSR8811 for sending data to and from a SCO connection</li> <li>▪ Up to three SCO connections on the PCM interface at any one time</li> <li>▪ PCM interface master, generating PCM_SYNC and PCM_CLK</li> <li>▪ PCM interface slave, accepting externally generated PCM_SYNC and PCM_CLK.</li> <li>▪ Various clock formats including: <ul style="list-style-type: none"> <li>– *Long Frame Sync</li> <li>– *Short Frame Sync</li> </ul> </li> <li>▪ GCI timing environments</li> <li>▪ 13-bit or 16-bit linear, 8-bit <math>\mu</math>-law or A-law companded sample formats</li> <li>▪ Receives and transmits on any selection of three of the first four slots following PCM_SYNC</li> <li>▪ The PCM configuration options are enabled by setting SKEY_PCM_CONFIG32</li> </ul> |
| CPU and Memory                     | <ul style="list-style-type: none"> <li>▪ 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.</li> <li>▪ 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.</li> <li>▪ 5 Mb of Internal ROM memory is available on the CSR8811. This memory is provided for system firmware, storing CSR8811 settings and program code.</li> </ul>   |
| 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                    | <p>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.</p> <p><b>Note:</b> <i>The WLAN block must be initialized prior before BT clock sharing is enabled.</i></p>   |
| 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.  |

| Feature          | Description   |
|------------------|---|
| <b>BT_RFKILL</b> | The NGFF pin-54 is connected to (BT_PWD_L) resets and powers down the BT block.<br>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.   |
| <b>Radio</b>     | 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.<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. |

## 7 BLOCK DIAGRAM

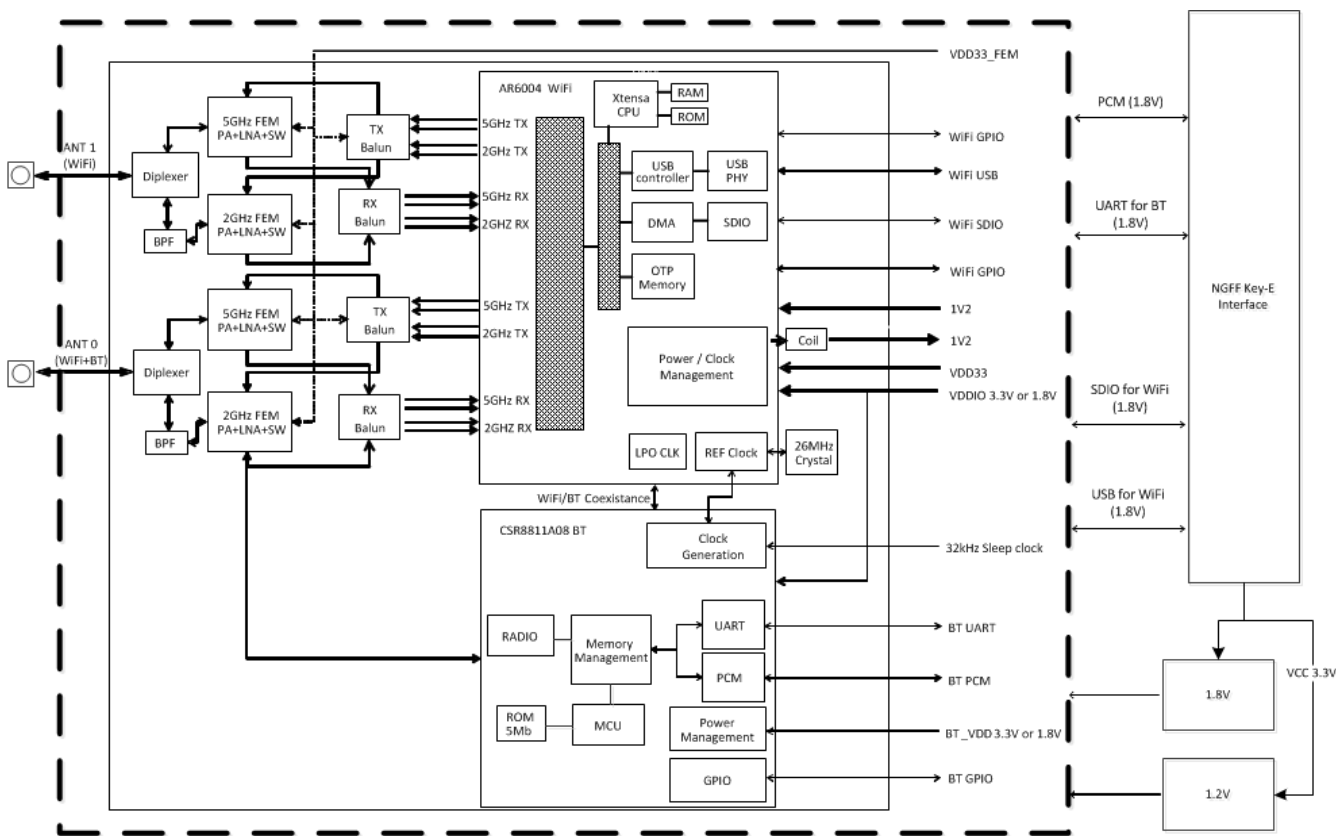


Figure 1: Block Diagram

**Note:** BT signal only present at ANT0. Only 5 GHz support HT40 mode.

## 8 ELECTRICAL CHARACTERISTICS

### 8.1 Absolute Maximum Ratings

Table 4 summarizes the absolute maximum ratings and Table 5 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 4: 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    |

### 8.2 Recommended Operating Conditions

**Table 5: 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

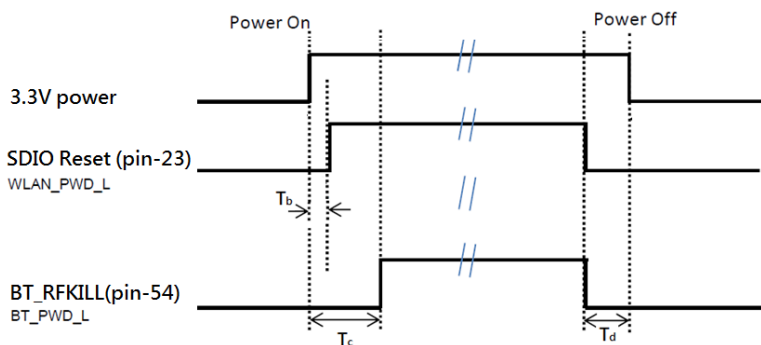
Table 6 and Table 7 list the general DC electrical characteristics over recommended operating conditions (unless otherwise specified).

**Table 6: General DC Electrical Characteristics (For 3.3V I/O Operation)**

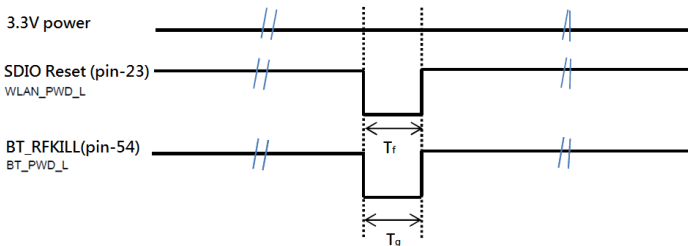
| Symbol          | Parameter                 | Conditions                   | Min  | Typ | Max       | Unit |
|-----------------|---------------------------|------------------------------|--|-----|-----------|------|
| V <sub>IH</sub> | High Level Input Voltage  |                              | 0.7 x VDD  |     |           | V    |
| V <sub>IL</sub> | Low Level Input Voltage   |                              |  |     | 0.3 x VDD | V    |
| I <sub>IL</sub> | Input Leakage Current     | Without Pull-up or Pull-down | 0V < V <sub>IN</sub> < VDD<br>0V < V <sub>OUT</sub> < VDD  | 0   | -3        | nA   |
|                 |                           | With Pull-up                 | 0 V < V <sub>IN</sub> < VDD<br>0V < V <sub>OUT</sub> < VDD | 16  | 48        | μA   |
|                 |                           | With Pull-down               | 0V < V <sub>IN</sub> < VDD<br>0V < V <sub>OUT</sub> < VDD  | -14 | -47       | μA   |
| V <sub>OH</sub> | High Level Output Voltage | I <sub>OH</sub> = -4mA       | 0.9 x VDD  |     |           | V    |
|                 |                           | I <sub>OH</sub> = -12mA      | 0.9 x VDD  |     |           | V    |
| V <sub>OL</sub> | Low Level Output Voltage  | I <sub>OH</sub> = 4mA        |  |     | 0.1 x VDD | V    |
|                 |                           | I <sub>OH</sub> = 12mA       |  |     | 0.1 x VDD | V    |

**Table 7: General DC Electrical Characteristics (For 1.8V I/O Operation)**

| Symbol          | Parameter                 | Conditions                   | Min   | Typ  | Max       | Unit |
|-----------------|---------------------------|------------------------------|---|------|-----------|------|
| V <sub>IH</sub> | High Level Input Voltage  |                              | 0.7 x VDD   |      |           | V    |
| V <sub>IL</sub> | Low Level Input Voltage   |                              |   |      | 0.3 x VDD | V    |
| I <sub>IL</sub> | Input Leakage Current     | Without Pull-up or Pull-down | 0V < V <sub>IN</sub> < VDD<br>0V < V <sub>OUT</sub> < VDD | 0    | -3        | nA   |
|                 |                           | With Pull-up                 | 0V < V <sub>IN</sub> < VDD<br>0V < V <sub>OUT</sub> < VDD | 3.5  | 13        | μA   |
|                 |                           | With Pull-down               | 0V < V <sub>IN</sub> < VDD<br>0V < V <sub>OUT</sub> < VDD | -6.2 | -23       | μA   |
|                 |                           |                              |   |      |           |      |
| V <sub>OH</sub> | High Level Output Voltage | I <sub>OH</sub> = -4mA       | 0.9 x VDD   |      |           | V    |
|                 |                           | I <sub>OH</sub> = -12mA      | 0.9 x VDD   |      |           | V    |
| V <sub>OL</sub> | Low Level Output Voltage  | I <sub>OH</sub> = 4mA        |   |      | 0.1 x VDD | V    |
|                 |                           | I <sub>OH</sub> = 12mA       |   |      | 0.1 x VDD | V    |



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



**Figure 3: Reset Timing**

**Table 8: Timing Diagram Definitions**

| Timing  | Description  | Min | Unit |
|---|--|-----|------|
| T <sub>b</sub>  | Time between VDD33 (3.3V) supplies valid, to SDIO reset (pin-56; WLAN_PWD_L) negation. | 5   | μsec |
| <b>Note:</b> have suitable 10K ohm Pull-up on SDIO bus, already. No extra pull-up resistor is required. |  |     |      |

| Timing | Description   | Min | Unit |
|--------|---|-----|------|
| 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.

## 8.4 WLAN Radio Receiver Characteristics

Table 9 and Table 10 summarize the WLAN M2SD50NBT receiver characteristics.

**Table 9: WLAN Receiver Characteristics for 2.4 GHz Signal Chain Operation**

| Symbol          | Parameter                     | Conditions            | Min   | Typ | Max   | Unit |
|-----------------|-------------------------------|-----------------------|-------|-----|-------|------|
| Fr <sub>x</sub> | Receive input frequency range |                       | 2.412 |     | 2.484 | GHz  |
| Srf             | Sensitivity                   |                       |       |     |       |      |
|                 | CCK, 1 Mbps                   | See Note <sup>3</sup> |       | -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 <sup>4</sup> |       | 32  |       | dB   |
|                 | OFDM, 54 Mbps                 |                       |       | 16  |       |      |
|                 | HT20, MCS0                    |                       |       | 31  |       |      |
|                 | HT20, MCS7                    |                       |       | 14  |       |      |

<sup>3</sup>Performance data are measured under signal chain operation.

<sup>4</sup>Performance data are measured under signal chain operation.

**Table 10: WLAN Receiver Characteristics for 5 GHz Dual Chain Operation**

| Symbol          | Parameter                     | Conditions            | Min  | Typ | Max   | Unit |
|-----------------|-------------------------------|-----------------------|------|-----|-------|------|
| Fr <sub>x</sub> | Receive input frequency range |                       | 5.15 |     | 5.825 | GHz  |
| Srf             | Sensitivity                   |                       |      |     |       |      |
|                 | OFDM, 6 Mbps                  | See Note <sup>5</sup> |      | -92 |       | dBm  |
|                 | OFDM, 54 Mbps                 |                       |      | -74 |       |      |
|                 | HT20, MCS0                    |                       |      | -92 |       |      |
|                 | HT20, MCS7                    |                       |      | -71 |       |      |



| Symbol | Parameter                  | Conditions            | Min | Typ | Max | Unit |
|--------|----------------------------|-----------------------|-----|-----|-----|------|
| Radj   | HT40, MCS0                 |                       |     | -86 |     |      |
|        | HT40, MCS7                 |                       |     | -66 |     |      |
|        | Adjacent channel rejection |                       |     |     |     |      |
|        | OFDM, 6 Mbps               |                       |     | 22  |     |      |
|        | OFDM, 54 Mbps              | See Note <sup>6</sup> |     | 9   |     | dB   |
|        | HT20, MCS0                 |                       |     | 20  |     |      |
|        | HT20, MCS7                 |                       |     | 19  |     |      |

<sup>5</sup>Performance data are measured under signal chain operation.

<sup>6</sup>Performance data are measured under signal chain operation.

## 8.5 WLAN Transmitter Characteristics

**Table 11: 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 <sup>7</sup> |       |       |       |      |
|        | 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 |       |      |

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

**Table 12: 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  |

| Symbol | Parameter                        | Conditions            | Min | Typ   | Max | Unit |    |
|--------|----------------------------------|-----------------------|-----|-------|-----|------|----|
| Pout   | Output power                     | See Note <sup>3</sup> |     |       |     |      |    |
|        | 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) <sup>8</sup> | Max. Current Consumption Single Chain (mA) <sup>8</sup> |
|---------|------------------|------------------------------|--|---|
| 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   |

<sup>7</sup>Performance data are measured under single chain operation.

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

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

## 9 BLUETOOTH RADIO CHARACTERISTICS

Table 13 through Table 14 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 13: 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 | $2.4 \leq f \leq 2.4835$ | GHz  |
| 20 dB Bandwidth                             | —   | 925 | —      | $\leq 1000$              | KHz  |
| Adjacent Channel TX Power $F = F_0 + 2$ MHz | —   | -36 | —      | $\leq -20$               | dBm  |
| Adjacent Channel TX Power $F = F_0 + 3$ MHz | —   | -42 | —      | $\leq -40$               | dBm  |

| Test Parameter                       | Min | Typ | Max | BT Spec.                      | Unit           |
|--------------------------------------|-----|-----|-----|-------------------------------|----------------|
| $\Delta f_{1avg}$ Maximum Modulation | 140 | 165 | 175 | $140 < \Delta f_{1avg} < 175$ | KHz            |
| $\Delta f_{2max}$ Minimum Modulation | —   | 135 | —   | $\geq 115$                    | KHz            |
| $\Delta f_{2avg}/\Delta f_{1avg}$    | —   | 0.9 | —   | $\geq 0.80$                   | —              |
| Initial Carrier Frequency            | —   | 5   | —   | $\leq \pm 75$                 | KHz            |
| Drift Rate                           | —   | 5   | —   | $\leq 20$                     | KHz/50 $\mu$ s |
| Drift (DH1 packet)                   | —   | 6   | —   | $\leq 25$                     | KHz            |
| Drift (DH5 packet)                   | —   | 7   | —   | $\leq 40$                     | KHz            |

**Table 14: 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    | $\pi/4$ DQPSK      | —   | 1   | $\leq \pm 10$ | KHz  |
|  | 8 DPSK             | —   | 1   |               |      |
| Max Carrier Frequency Stability  wi    | $\pi/4$ DQPSK      | —   | 1   | $\leq \pm 75$ | KHz  |
|  | 8 DPSK             | —   | 1   |               |      |
| Max Carrier Frequency Stability  w0+wi | $\pi/4$ DQPSK      | —   | 2   | $\leq \pm 75$ | KHz  |
|  | 8 DPSK             | —   | 1.5 |               |      |
| RMS DEVM                               | $\pi/4$ DQPSK      | —   | 6   | $\leq 20$     | %    |
|  | 8 DPSK             | —   | 6   | $\leq 13$     | %    |
| Peak DEVM                              | $\pi/4$ DQPSK      | —   | 16  | $\leq 35$     | %    |
|  | 8 DPSK             | —   | 15  | $\leq 25$     | %    |
| 99% DEVM                               | $\pi/4$ DQPSK      | —   | 12  | $\leq 30$     | %    |
|  | 8 DPSK             | —   | 12  | $\leq 20$     | %    |
| EDR Differential Phase Encoding        | —                  | 99  | —   | $\geq 99$     | %    |
| Adjacent Channel Power                 | $F \geq \pm 3$ MHz | —   | -60 | $< -40$       | dBm  |
|  | $F = \pm 2$ MHz    | —   | -28 | $\leq -20$    | dBm  |
|  | $F = \pm 1$ MHz    | —   | -32 | $\leq -26$    | dB   |

**Table 15: Basic Rate Receiver Performance at 3.3V**

| Test Parameter | Min              | Typ | Max | BT Spec. | Unit       |     |
|----------------|------------------|-----|-----|----------|------------|-----|
| Sensitivity    | BER $\leq 0.1\%$ | —   | -84 | -78      | $\leq -70$ | dBm |
| Maximum Input  | BER $\leq 0.1\%$ | -20 | -10 | —        | $\geq -20$ | dBm |
|                | Co-Channel       | —   | —   | 11       | 11         |     |

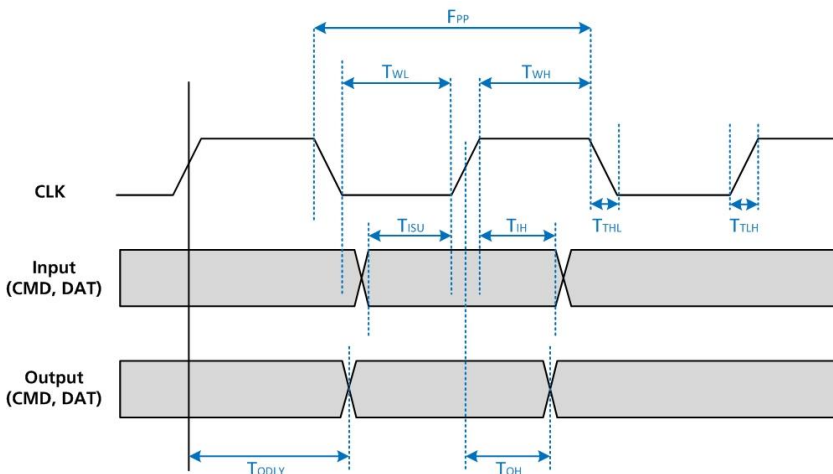
| Test Parameter                               | Min                                    | Typ | Max     | BT Spec.   | Unit |    |
|--|--|-----|---------|------------|------|----|
| Carrier-to-Interferer Ratio (C/I)            | Adjacent Channel ( $\pm 1$ MHz)        | —   | -4/-2   | 0          | 0    | dB |
|  | Second Adjacent Channel ( $\pm 2$ MHz) | —   | -35/-28 | -30        | -30  | dB |
|  | Third Adjacent Channel ( $\pm 3$ MHz)  | —   | -42     | -40        | -40  | dB |
| Maximum Level of Intermodulation Interferers | -39                                    | -30 | -       | $\geq -39$ | dBm  |    |

**Table 16: Enhanced Data Rate Receiver Performance 3.3V**

| Test Parameter                                  | Min           | Typ | Max     | Bluetooth Specification | Unit          |     |
|---|---------------|-----|---------|-------------------------|---------------|-----|
| Sensitivity (BER $\leq 0.01\%$ )                | 8 DPSK        | —   | -76     | -71                     | $\leq -70$    | dBm |
| Maximum Input (BER $\leq 0.1\%$ )               | $\pi/4$ DQPSK | -20 | —       | —                       | $\geq -20$    | dBm |
|   | 8 DPSK        | -20 | —       | —                       | $\geq -20$    | dBm |
| Co-Channel C/I (BER $\leq 0.1\%$ )              | $\pi/4$ DQPSK | —   | 10      | 13                      | $\leq \pm 13$ | dB  |
|   | 8 DPSK        | —   | 18      | 20                      | $\leq \pm 20$ | dB  |
| Adjacent Channel C/I (BER $\leq 0.1\%$ )        | $\pi/4$ DQPSK | —   | -9/-6   | 0                       | $\leq 0$      | dB  |
|   | 8 DPSK        | —   | -3/0    | 5                       | $\leq 5$      | dB  |
| Second Adjacent Channel C/I (BER $\leq 0.1\%$ ) | $\pi/4$ DQPSK | —   | -42/-28 | -30                     | $\leq -30$    | dB  |
|   | 8 DPSK        | —   | -28/-22 | -25                     | $\leq -25$    | dB  |
| Third Adjacent Channel C/I (BER $\leq 0.1\%$ )  | $\pi/4$ DQPSK | —   | -45     | -40                     | $\leq -40$    | dB  |
|   | 8 DPSK        | —   | -39     | -33                     | $\leq -33$    | dB  |

## 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  $CL \leq 40$  pF load on CMD and Data.

**Table 17: 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   |

## 11 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.<br><b>Note:</b> 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<br>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<br>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<br>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<br>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      |

| Pin # | Name             | Type | Voltage Reference | Description  | If Not Used |
|-------|------------------|------|-------------------|--|-------------|
| 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.<br>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.<br><b>Note:</b> Not supported by current software. | N/C         |
| 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<br>Already has internal 10K pull-up.<br>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  | N/C         |
| 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<br><b>Note:</b> Not currently supported.  | N/C         |
| 45    | GND              | -    | -                 | Ground   | GND         |
| 46    | LTE_ACTIVE       | I    | 1.8V              | Reserved for LTE coexistence<br><b>Note:</b> Not currently supported.  | N/C         |
| 47    | N/C              | -    | -                 | N/C  | N/C         |

| Pin # | Name           | Type | Voltage Reference | Description   | If Not Used |
|-------|----------------|------|-------------------|---|-------------|
| 48    | LTE_FRAME_SYNC | I    | 1.8V              | Reserved for LTE coexistence<br><b>Note:</b> Not currently supported.                                     | N/C         |
| 49    | N/C            | -    | -                 | N/C   | N/C         |
| 50    | CLK_32K        | I    | 3.3V              | 32.768KHz slow clock input.<br>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         |
| 55    | N/C            | -    | -                 | N/C   | N/C         |
| 56    | WIFI_RFKILL    | I    | 3.3V              | Reserved for RF disable (RF Kill) feature. Active Low.<br><b>Note:</b> 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         |

## 12 MECHANICAL SPECIFICATIONS

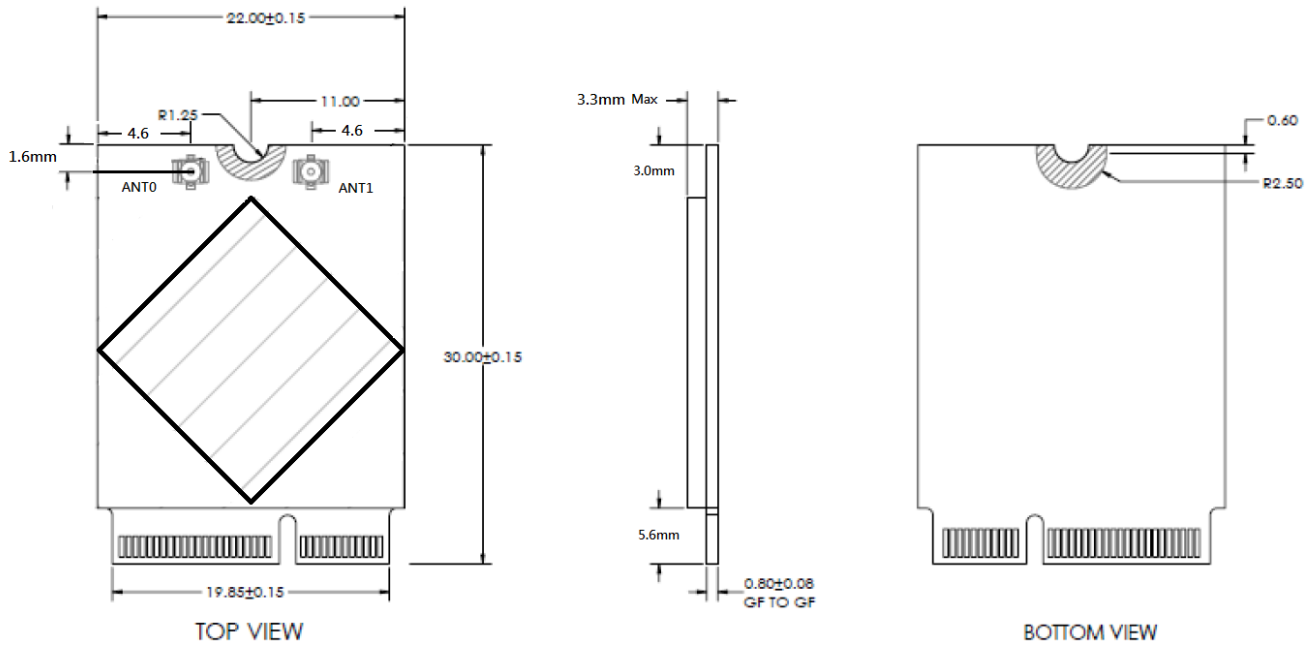


Figure 5: M.2 mechanical drawings

**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.



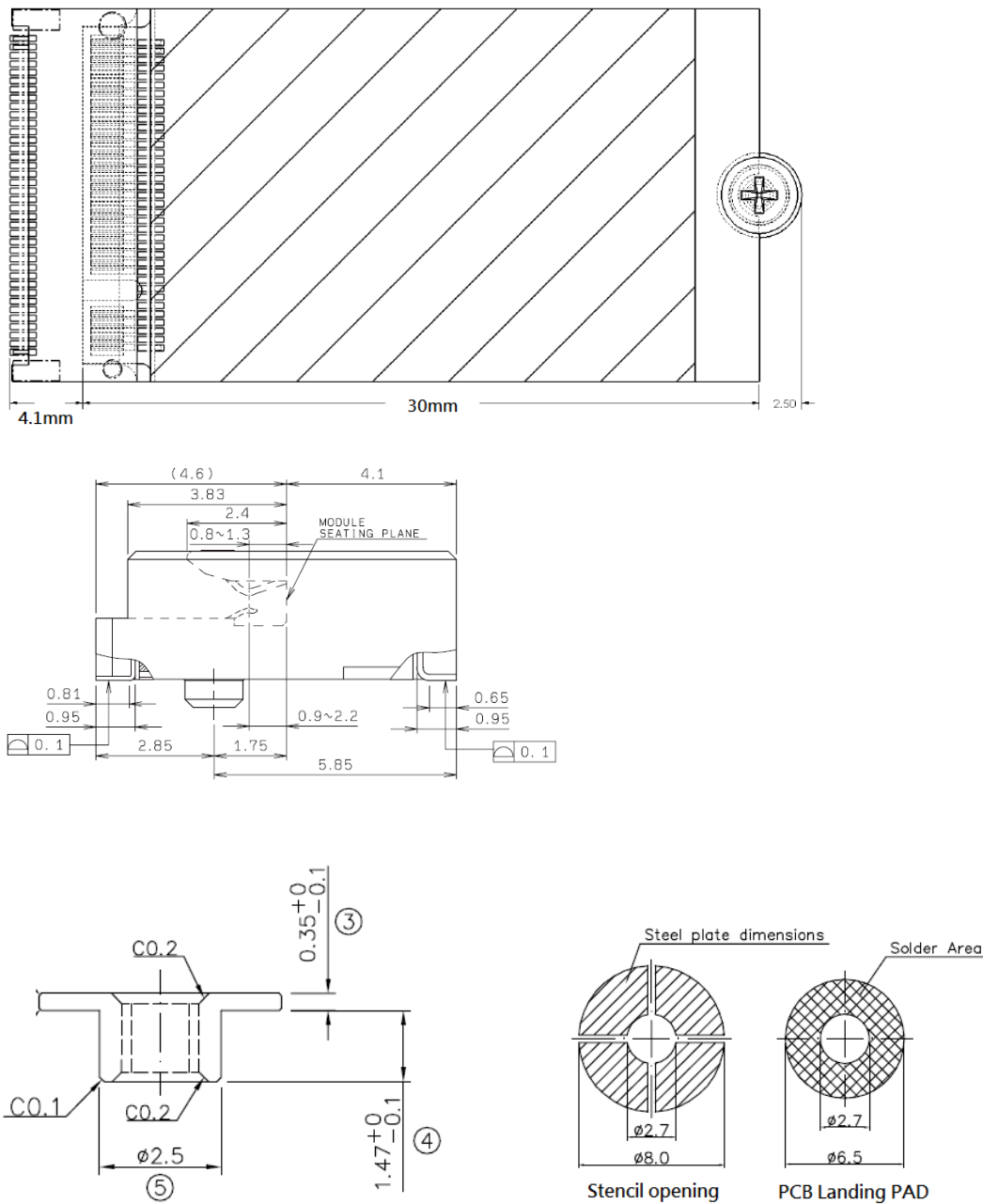
## 13 MOUNTING

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

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

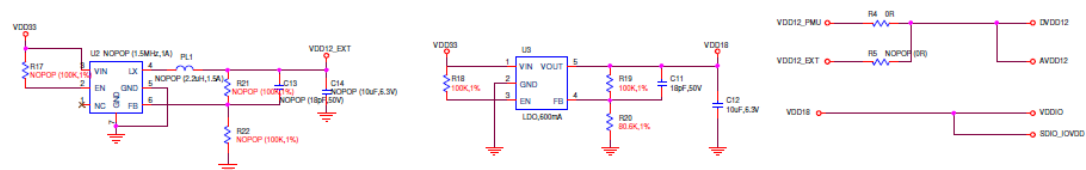
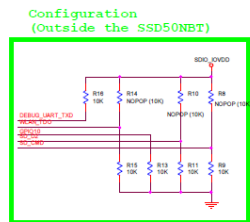
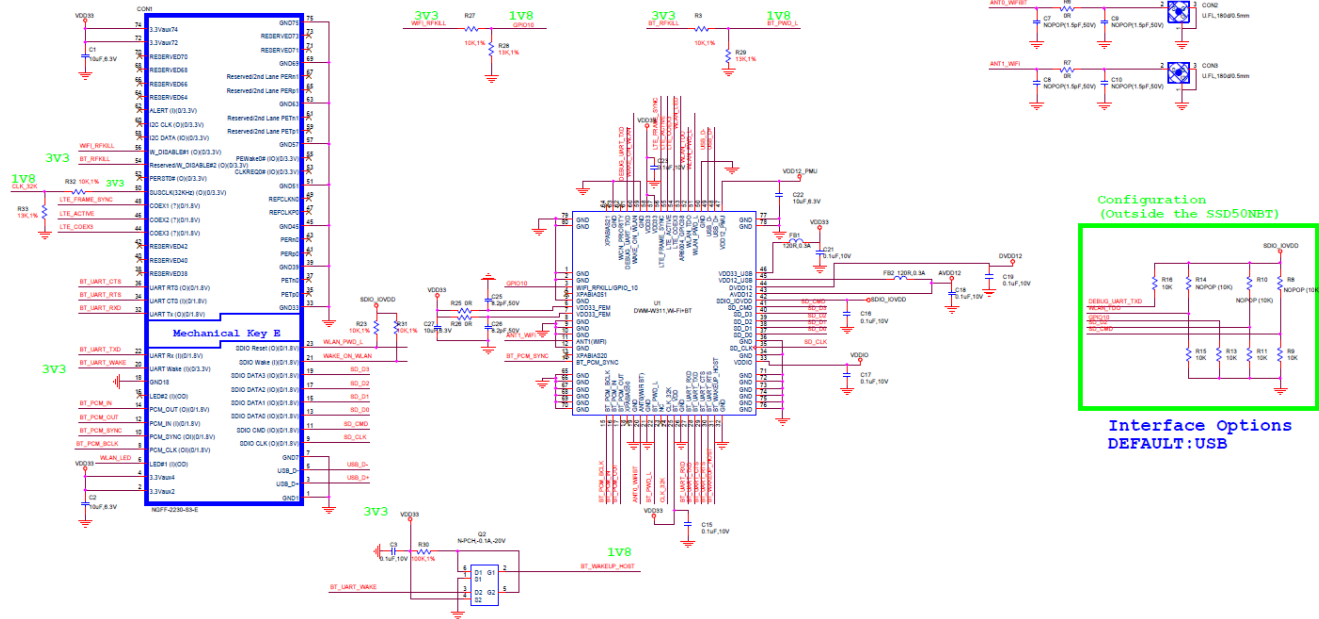
M2SD50NBT is a signal-side component module; Laird recommends part number 24-6411-067-101-897E which has 2.3 mm connector height.

The stand-off mating to the recommend 2.3 mm connector from EMI STOP ([www.EMISTOP.com](http://www.EMISTOP.com)) is part number F50M16-041525P1D4M. Detail layout and stencil opening are show in Figure 6.

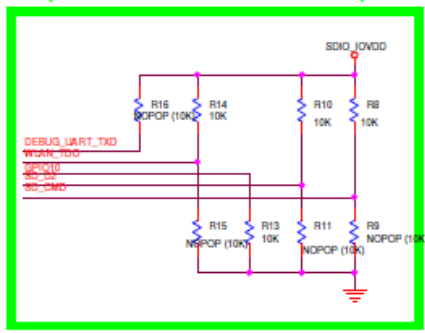


**Figure 6: Mounting information for M2SD50NBT and recommended land pad for stand-off**

# 14 REFERENCE SCHEMATIC OF M2SD50NBT



Configuration (Outside the SSD50NBT)



| PinName             | SDIO2.0 | USB2.0 | HSIC | Notes                                      |
|---------------------|---------|--------|------|--|
| SD_CMD              | 1       | 0      | 0    |  |
| SD_D2               | 1       | 0      | 0    |  |
| SD_D1<br>Inside SIP | 1       | 1      | 1    | Pull High to Avoid Booting into test modes |
| GPIO10              | 0       | 0      | 1    | Pull low to Avoid leakage (SDIO only)      |
| DEBUG_UART_TXD      | X       | 1      | 1    | No Connect at SDIO                         |
| WLAN_TDO            | 1       | 0      | 0    | Pull high to Avoid leakage Only SDIO       |

| M2SD50NBT | SD_CMD | SD_D2 | GPIO-10 | WLAN_TDO | DEBUG_UART_TXD | R4/R5 |
|-----------|--------|-------|---------|----------|----------------|-------|
| M2SD50NBT | H      | H     | L       | H        | X              | NP/0Ω |

## 15 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/handling/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.

## 16 REGULATORY

### 16.1 Certified Antennas

| Model                               | Type                           | Connector | 2400~2483.5MHz  |
|-------------------------------------|--------------------------------|-----------|---|
|                                     |                                |           | 5150~5250MHz 5250~5350MHz<br>5470~5725MHz 5725~5850MHz                              |
| Laird MAF94051                      | Dipole                         | RP-SMA    | 2.1 dBi (2.4-2.5 GHz), 2.4 dBi (4.9 GHz)<br>2.6 dBi (5.25 GHz), 3.4 dBi (5.875 GHz) |
| Laird/NanoBlade-IP04                | PCB Dipole                     | IPEX MHF  | 2 dBi (2.4-2.5 GHz),<br>3.9 dBi (5.15-5.35 GHz), 4 dBi (5.6 GHz)                    |
| Laird/MAF95310 Mini Nano Blade Flex | PCB Dipole                     | IPEX MHF  | 2.79 dBi (2.4 GHz), 3.38 dBi (5 GHz)  |
| Laird/NanoBlue-IP04                 | PCB Dipole                     | IPEX MHF  | 2 dBi (2.4 GHz only)  |
| Ethertronics/WLAN_1000146           | Isolated<br>Magnetic<br>Dipole | IPEX MHF  | 2.5 dBi (2.390-2.490 GHz),<br>3.5 dBi (4.900-5.100, 5.150-5.350,<br>5.70-5.900 GHz) |

## 17 FCC AND IC REGULATORY

| Model     | US/FCC        | CANADA/IC       |
|-----------|---------------|-----------------|
| M2SD50NBT | SQG-M2SD50NBT | 3147A-M2SD50NBT |

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 ) |               |               |               |               |
|------------------------------------|--------------------------|-----------|-------------------|---------------|---------------|---------------|---------------|
|                                    |                          |           | 2400~2483.5 MHz   | 5150~5250 MHz | 5250~5350 MHz | 5470~5725 MHz | 5725~5850 MHz |
| Laird MAF94051                     | Dipole                   | RP-SMA    | 2.1 dBi           | 2.4 dBi       | 2.6 dBi       | 3.4 dBi       |               |
| Laird NanoBlade-IP04               | PCB Dipole               | IPEX MHF  | 2 dBi             | 3.9 dBi       |               | 4 dBi         |               |
| Laird MAF95310 Mini NanoBlade Flex | PCB Dipole               | IPEX MHF  | 2.79 dBi          | 3.38 dBi      |               |               |               |
| Laird NanoBlue-IP04                | PCB Dipole               | IPEX MHF  | 2dBi              | -             |               |               |               |
| Ethertronics WLAN_1000146          | Isolated Magnetic Dipole | IPEX MHF  | 2.5dBi            | 3.5 dBi       |               |               |               |

### 17.1 FCC

#### 17.1.1 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.

#### *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**

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.

### *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.

## 17.1.2 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: SQG-M2SD50NBT.**

## 17.1.3 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.

## 17.2 Industry Canada

### 17.2.1 Industry Canada Statement

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

1. This device may not cause interference; and
2. 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:

1. l'appareil ne doit pas produire de brouillage;
2. 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 (IC: 3147A-M2SD50NBT) 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 (IC: 3147A-M2SD50NBT) 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.

## 17.2.2 Antenna Information

| Model                              | Type                     | Connector | Peak gain ( dBi ) |               |               |               |               |
|------------------------------------|--------------------------|-----------|-------------------|---------------|---------------|---------------|---------------|
|                                    |                          |           | 2400~2483.5 MHz   | 5150~5250 MHz | 5250~5350 MHz | 5470~5725 MHz | 5725~5850 MHz |
| Laird MAF94051                     | Dipole                   | RP-SMA    | 2.1 dBi           | 2.4 dBi       | 2.6 dBi       | 3.4 dBi       |               |
| Laird NanoBlade-IP04               | PCB Dipole               | IPEX MHF  | 2 dBi             | 3.9 dBi       |               | 4 dBi         |               |
| Laird MAF95310 Mini NanoBlade Flex | PCB Dipole               | IPEX MHF  | 2.79 dBi          | 3.38 dBi      |               |               |               |
| Laird NanoBlue-IP04                | PCB Dipole               | IPEX MHF  | 2dBi              | -             |               |               |               |
| Ethertronics WLAN_1000146          | Isolated Magnetic Dipole | IPEX MHF  | 2.5dBi            | 3.5 dBi       |               |               |               |

### 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 e.i.r.p. 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 e.i.r.p. 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.

### 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.

### *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.

### *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 conditions:

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

As long as 1 condition above are 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:*

- 1) Le module émetteur peut ne pas être coimplanté 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.

---

#### **IMPORTANT NOTE:**

In the event that these conditions can not 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 can not 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.

---

#### **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.

---

### *End Product Labeling*

The final end product must be labeled in a visible area with the following: "Contains IC: 3147A-M2SD50NBT".

### *Plaque signalétique du produit final*

Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 3147A-M2SD50NBT".

### *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.

### *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.

## 18 EUROPEAN UNION REGULATORY

The M2SD50NBT was tested for compliance with relevant standards for the EU market. It was tested with antennas listed below.

| Model                               | Type                           | Connector | 2400~2483.5MHz                           |   |
|-------------------------------------|--------------------------------|-----------|--|---|
|                                     |                                |           | 5150~5250MHz                             | 5250~5350MHz  |
| Laird MAF94051                      | Dipole                         | RP-SMA    | 2.1 dBi (2.4-2.5 GHz), 2.4 dBi (4.9 GHz) | 2.6 dBi (5.25 GHz), 3.4 dBi (5.875 GHz)               |
| Laird/NanoBlade-IP04                | PCB Dipole                     | IPEX MHF  | 2 dBi (2.4-2.5 GHz),                     | 3.9 dBi (5.15-5.35 GHz), 4 dBi (5.6 GHz)              |
| Laird/MAF95310 Mini Nano Blade Flex | PCB Dipole                     | IPEX MHF  | 2.79 dBi (2.4 GHz),                      | 3.38 dBi (5 GHz)                                      |
| Laird/NanoBlue-IP04                 | PCB Dipole                     | IPEX MHF  | 2 dBi (2.4 GHz only)                     |   |
| Ethertronics/WLAN_1000146           | Isolated<br>Magnetic<br>Dipole | IPEX MHF  | 2.5 dBi (2.390-2.490 GHz),               | 3.5 dBi (4.900-5.100, 5.150-5.350,<br>5.70-5.900 GHz) |

The OEM should consult with a qualified test house before entering their device into an EU member country to make sure all regulatory requirements have been met for their complete device.

Reference the Declaration of Conformities listed below for a full list of the standards to which the module was tested. Test reports are available upon request.

### 18.1 EU Declarations of Conformity

|                            |  |
|----------------------------|--|
| <b>Manufacturer</b>        | Laird  |
| <b>Products</b>            | M2SD50NBT  |
| <b>Product Description</b> | 802.11 a/b/g/n Enterprise Wi-Fi + Bluetooth module |
| <b>EU Directives</b>       | 2014/53/EU – Radio Equipment Directive (RED)       |



#### Reference standards used for presumption of conformity:

| Article Number | Requirement   | Reference standard(s)   |
|----------------|---|---|
| 3.1a           | Low voltage equipment safety  | EN 60950-1:2006 +A11:2009 +A1:2010<br>+A12:2011 +A2:2013        |
|                | RF Exposure   | EN 62311:2008   |
| 3.1b           | Protection requirements with respect to electromagnetic compatibility | EN 301 489-1 v2.2.0 (2017-03)<br>EN 301 489-17 v3.2.0 (2017-03) |
| 3.2            | Protection requirements – Electromagnetic compatibility               | EN 300 328 v2.1.1 (2016-11)<br>EN 301 893 v2.1.1 (2017-05)      |



**Declaration:**

We, Laird, declare under our sole responsibility that the essential radio test suites have been carried out and that the above product to which this declaration relates is in conformity with all the applicable essential requirements of Article 3 of the EU Directive 2014/53/EU, when used for its intended purpose.

|                                 |   |
|---------------------------------|---|
| Place of Issue:                 | Laird<br>W66N220 Commerce Court, Cedarburg, WI 53012 USA<br>tel: +1-262-375-4400 fax: +1-262-364-2649 |
| Date of Issue:                  | June 2017   |
| Name of Authorized Person:      | Thomas T Smith, Director of EMC Compliance  |
| Signature of Authorized Person: |   |

**Maximum Output Power for Each Frequency**

|                                      |                          |
|--------------------------------------|--------------------------|
| 20.00 dBm, 2.4G: 2.412 GHz~2.472 GHz | 22.80 dBm, 5.15-5.25GHz  |
| 10.00 dBm, for BT                    | 22.60 dBm, 5.25-5.35GHz  |
| 10.00 dBm, for BT LE                 | 22.60 dBm, 5.47-5.725GHz |

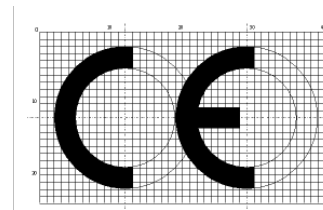
**Software Version for Testing**

SW version: 3.5.2.15

The minimum distance between the user and/or any bystander and the radiating structure of the transmitter is 20 cm.

5150 ~ 5350 MHz is limited to indoor used in the following countries:

|  |    |    |    |    |    |    |    |    |    |    |    |
|--|----|----|----|----|----|----|----|----|----|----|----|
|  | BE | DK | IE | FR | CY | LU | NL | PT | SK | UK | NO |
|  | BG | DE | EL | HR | LV | HU | AT | RO | FI | LI | TR |
|  | CZ | EE | ES | IT | LT | MT | PL | SI | SE | IS | CH |



## 19 ORDERING INFORMATION

| Part Number | Description   |
|-------------|---|
| M2SD50NBT   | 2X2 802.11 a/b/g/n with BT4.0 dual mode module.<br>WLAN run at SDIO bus. BT run at UART/PCM |

### 19.1 General Comments

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

|                         |  |
|-------------------------|--|
| <b>Česky [Czech]</b>    | [ <i>Jméno výrobce</i> ] tímto prohlašuje, že tento [ <i>typ zařízení</i> ] je ve shodě se základními požadavky a dalšími příslušnými ustanoveními směrnice 1999/5/ES.   |
| <b>Dansk [Danish]</b>   | Undertegnede [ <i>fabrikantens navn</i> ] erklærer herved, at følgende udstyr [ <i>udstyrets typebetegnelse</i> ] overholder de væsentlige krav og øvrige relevante krav i direktiv 1999/5/EF.   |
| <b>Deutsch [German]</b> | Hiermit erkläre [ <i>Name des Herstellers</i> ], dass sich das Gerät [ <i>Gerätetyp</i> ] in Übereinstimmung mit den grundlegenden Anforderungen und den übrigen einschlägigen Bestimmungen der Richtlinie 1999/5/EG befindet.           |
| <b>Eesti [Estonian]</b> | Käesolevaga kinnitab [ <i>tootja nimi = name of manufacturer</i> ] seadme [ <i>seadme tüüp = type of equipment</i> ] vastavust direktiivi 1999/5/EÜ põhinõuetele ja nimetatud direktiivist tulenevatele teistele asjakohastele sätetele. |