

Integrated 802.11 b/g/n WLAN, Bluetooth & BLE Module

FEATURES

- IEEE 802.11 b/g/n (single stream n)
- Typical WLAN Transmit Power:
 - +17.5 dBm, 11 Mbps, CCK (b)
 - +14.0 dBm, 54 Mbps, OFDM (g)
 - +12.5 dBm, HT20 MCS7 (n)
- Typical WLAN Sensitivity:
 - -88 dBm, 8% PER, 11 Mbps (b)
 - -75 dBm, 10% PER, 54 Mbps (g)
 - -72 dBm, 10% PER, MCS7 (n)
- Bluetooth 2.1+EDR, Bluetooth 3.0, Bluetooth 4.1 (Bluetooth Low Energy)
- WLAN and Bluetooth coexistence
- Available in two footprint styles:
 - Easy to Integrate: 15.5 mm x 21 mm
 - Miniature footprint: 10 mm x 10 mm
- Available with integrated chip antenna or U.FL connector for external antenna
- Operating voltage: 3.0V to 3.6V
- Operating temperature: -40° to +85° C
- Storage temperature: -40° to +125° C
- Compact design based on Broadcom BCM4343W SoC
- Worldwide acceptance: FCC (USA), IC (Canada), ETSI (Europe), Giteki (Japan), and RCM (AU/NZ)
BT SIG QDID: 85005
- REACH and RoHS compliant

APPLICATIONS

- Security & Building Automation
- Internet of Things / M2M Connectivity
- Smart Gateways

DESCRIPTION

The Sterling-LWB is a high performance 2.4 GHz WLAN and Bluetooth Smart Ready combo module based on latest-generation silicon (Broadcom's BCM4343W). With an industrial temperature rating, broad country certifications, and the availability of three different package styles, the Sterling-LWB provides significant flexibility to meet various end user application needs.

The on-module chip antenna package style for the Sterling-LWB eliminates complexity for design integration, simplifies manufacturing assembly with larger pin outs, and features an advanced chip antenna that offers greater resistance to de-tuning than typical trace or chip antennas.



The module includes the MAC, Baseband and Radio to support WLAN applications and an independent, high-speed UART is provided for the Bluetooth host interface. In addition, the latest Linux and Android drivers are supported directly by LSR and Broadcom.

Need to get to market quickly? Not an expert in 802.11. Need a custom antenna? Would you like to own the design? Would you like a custom design? Not quite sure what you need? Do you need help with your host board? LSR Design Services will be happy to develop custom hardware or software, or assist with integrating the design. Contact us at sales@lsr.com or call us at **262-375-4400**.

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MODULE VARIANTS

The LSR Sterling-LWB Module is available in three different versions. Depending on the user's antenna and footprint needs, there is a variant to suite most application requirements. LSR recommends that for simplicity of both the host PCB design, as well as the manufacturing process, that either the Chip Antenna or RF Connector version of the modules be used in your design.

- **450-0159 - Base SiP Module**

This module variant is supplied in a compact, 151 pin, 0.5 mm pitch LGA footprint. Unlike the other module variants, it requires the addition of either an off module antenna or RF connector, as well as the associated matching components. In order to benefit from the EMC certifications on the module, strictly following the layout in the module application guide is required. This requires adherence to the PCB stack-up and layout around the antenna. The footprint of this module may require additional care during reflow and PCB assembly.

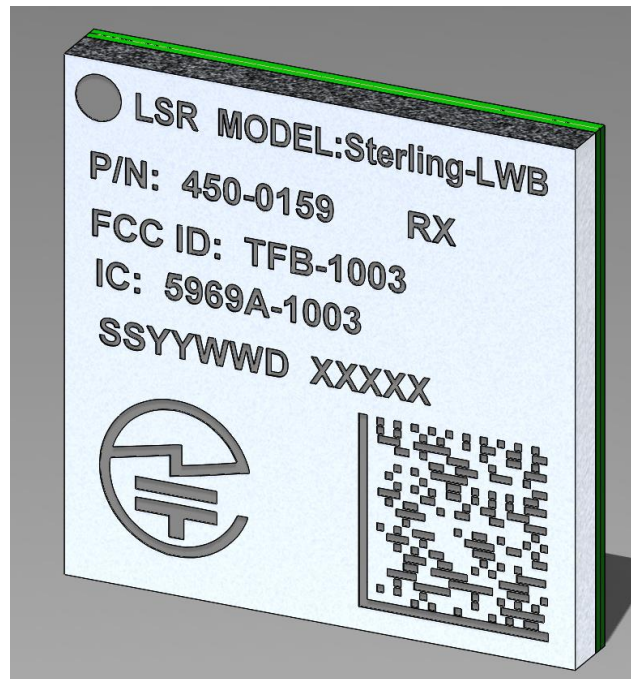


Figure 1 Sterling-LWB Base SiP Module (450-0159)

- **450-0148 – U.FL Module**

This module variant integrates the 450-0159 Base SiP Module, a U.FL RF connector, and all associated RF matching components on a PCB. This integrated approach not only provides a U.FL connector for connections to external antennas, but also simplifies and reduces the cost of the end users host board by simplifying the module PCB footprint.

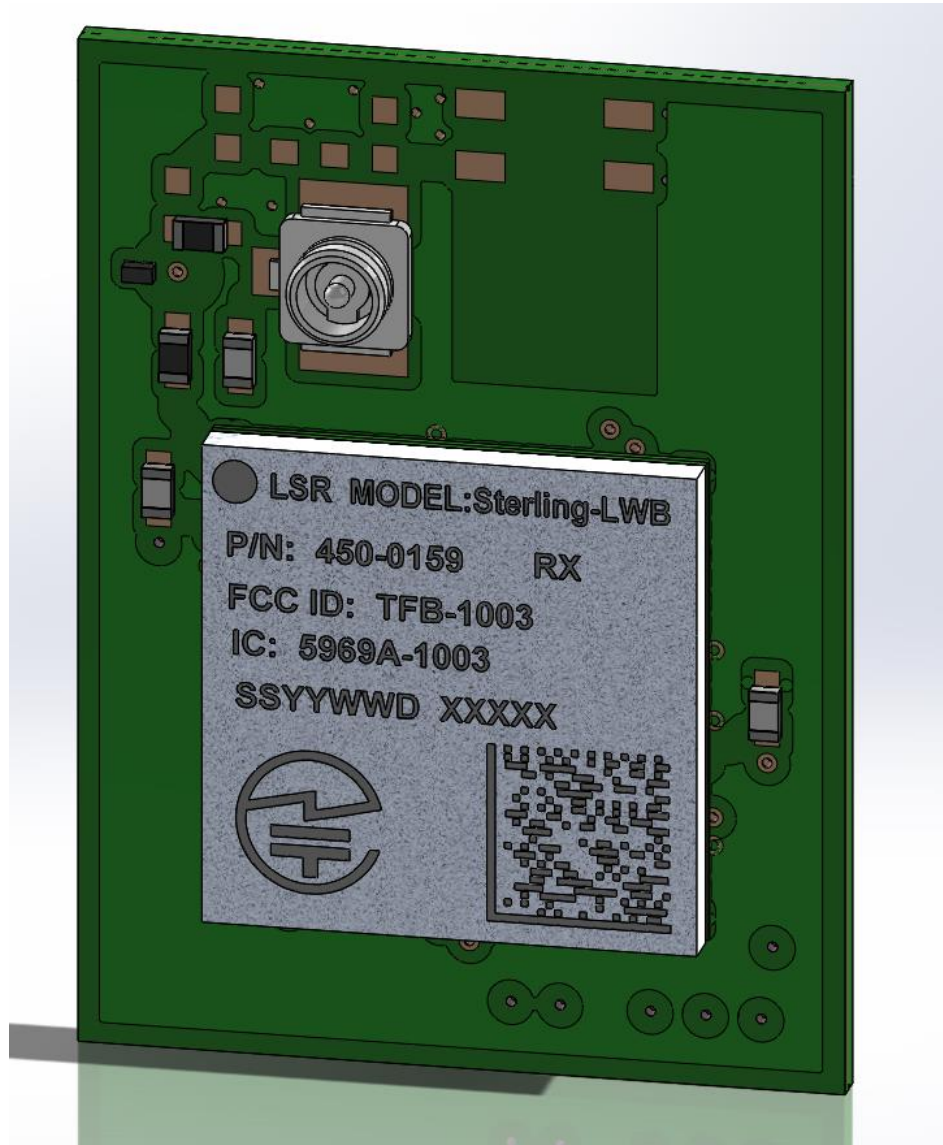


Figure 2 Sterling-LWB U.FL Module (450-0148)

- **450-0152 - Chip Antenna Module**

This module variant integrates the 450-0159 Base SiP Module, a chip antenna, and all associated RF matching components on a PCB. This integrated approach not only provides an external antenna solution, but also simplifies and reduces the cost of the end users host board by simplifying the module PCB footprint.



Figure 3 Sterling-LWB Chip Antenna Module (450-0152)

FUNCTIONAL FEATURES

WLAN Features

- IEEE802.11b/g/n 1x1 2.4 GHz Radio
 - Internal Power Amplifier (PA)
 - Internal Low Noise Amplifier(LNA)
 - Internal T/R Switch
 - Simultaneous BT/WLAN reception with a single antenna.
- Media Access Controller (MAC)
- Physical Layer (PHY)
- Baseband Processor
- **Standards**
 - IEEE 802.11b, 802.11g, 802.11n (single stream)

Bluetooth Features

- Class 2 power amplifier with Class 2 capability
- HCI Interface using High Speed UART
- PCM for Audio Data
- Bluetooth 2.1+EDR, Bluetooth 3.0, Bluetooth 4.1 (Bluetooth Low Energy)

Wireless Security System Features



- **Supported modes:**
 - Open (no security)
 - WEP
 - WPA Personal
 - WPA2 Personal
 - WMM
 - WMM-PS (U-APSD)
 - WMM-SA
 - WAPI
 - AES (Hardware Accelerator)
 - TKIP (host-computed)
 - CKIP (SW Support)

ORDERING INFORMATION

| Order Number | Description |
|--------------|--|
| 450-0148C | Sterling-LWB U.FL Module (Cut Tape) |
| 450-0148R | Sterling-LWB U.FL Module (Tape and Reel, SPQ = 1000) |
| 450-0152C | Sterling-LWB Chip Antenna Module (Cut Tape) |
| 450-0152R | Sterling-LWB Chip Antenna Module (Tape and Reel, SPQ = 1000) |
| 450-0159C | Sterling-LWB Base SiP Module (Cut Tape) |
| 450-0159R | Sterling-LWB Base SiP Module (Tape and Reel, SPQ = 1000) |
| 450-0155 | Sterling-LWB SD Development Board, U.FL |
| 450-0156 | Sterling-LWB SD Development Board, Chip Antenna |
| 450-0173 | Sterling-LWB Development Board, WICED |

Table 1 Orderable Sterling-LWB Part Numbers

MODULE ACCESSORIES

| | Order Number | Description |
|---|-----------------|--|
|  | 001-0001 | 2.4 GHz Dipole Antenna with Reverse Polarity SMA Connector |
|  | 080-0001 | U.FL to Reverse Polarity SMA Bulkhead Cable 105mm |

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| | | |
|--|------------------------|----------------------------------|
|  <p>The image shows a small, rectangular antenna module with a black top half and an orange bottom half. The orange part has a white label with the LSR logo and text: "LS RESEARCH", "001-0014 Rev 1", and "2.4GHz FlexPIFA". A thin black cable is attached to the bottom of the module, ending in a gold-colored SMA connector.</p> | <p>001-0014</p> | <p>2.4 GHz FlexPIFA Antenna</p> |
|  <p>The image shows a rectangular antenna module with an orange top half and a black bottom half. The orange part has a white label with the LSR logo and text: "LS RESEARCH", "001-0015 Rev 2", "2.4GHz FlexNotch Antenna", and "LSR". A thin black cable is attached to the top of the module, ending in a gold-colored SMA connector.</p> | <p>001-0015</p> | <p>2.4 GHz FlexNotch Antenna</p> |

Table 2 Module Accessories

APPLICABLE DOCUMENTS

- Sterling-LWB Module User Guide (330-0192)
- Sterling-LWB SD Card User Guide (330-0201)
- Sterling-LWB WICED Board User Guide (330-0234)

BLOCK DIAGRAMS

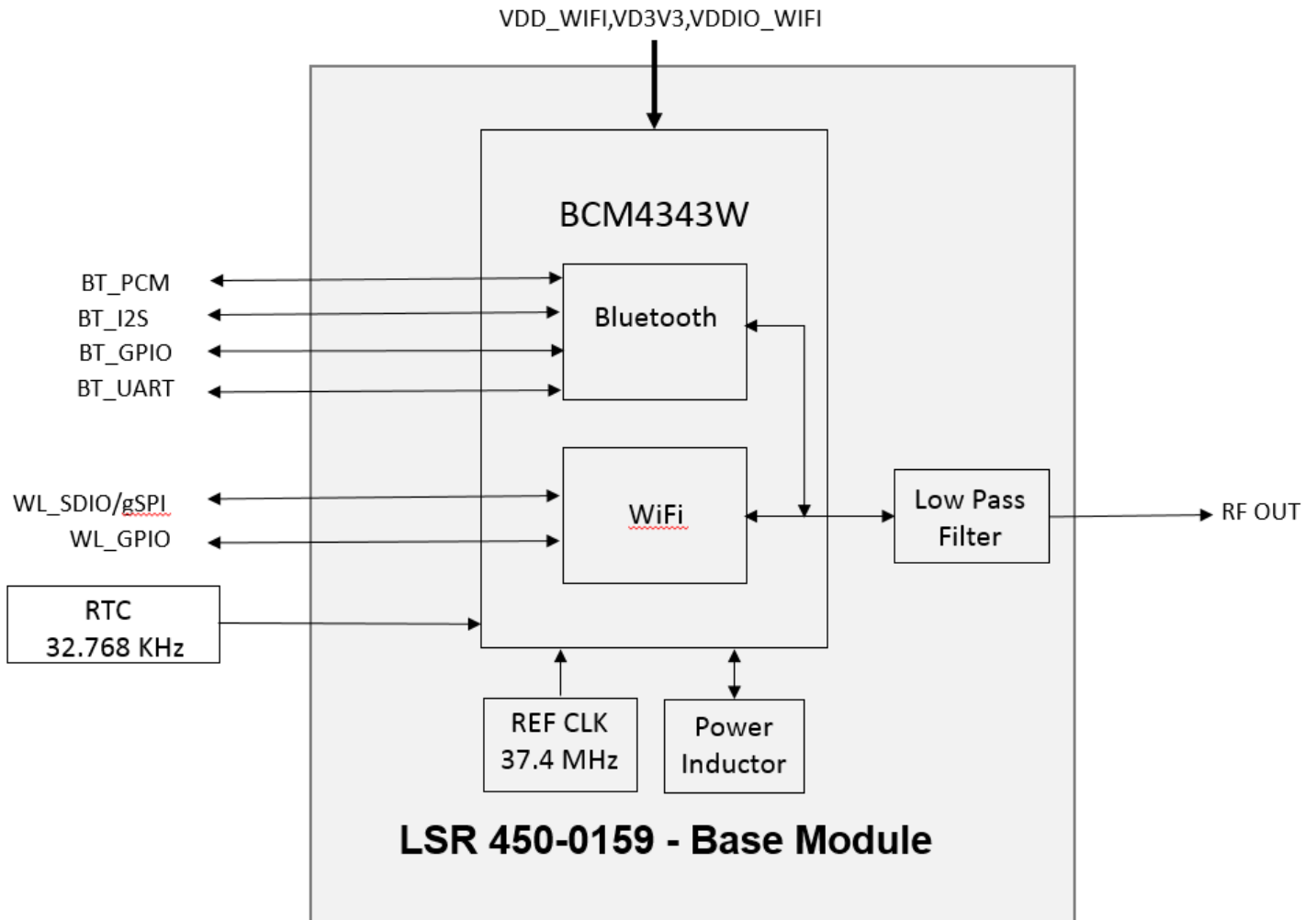


Figure 4 Sterling-LWB Base SiP Module Block Diagram

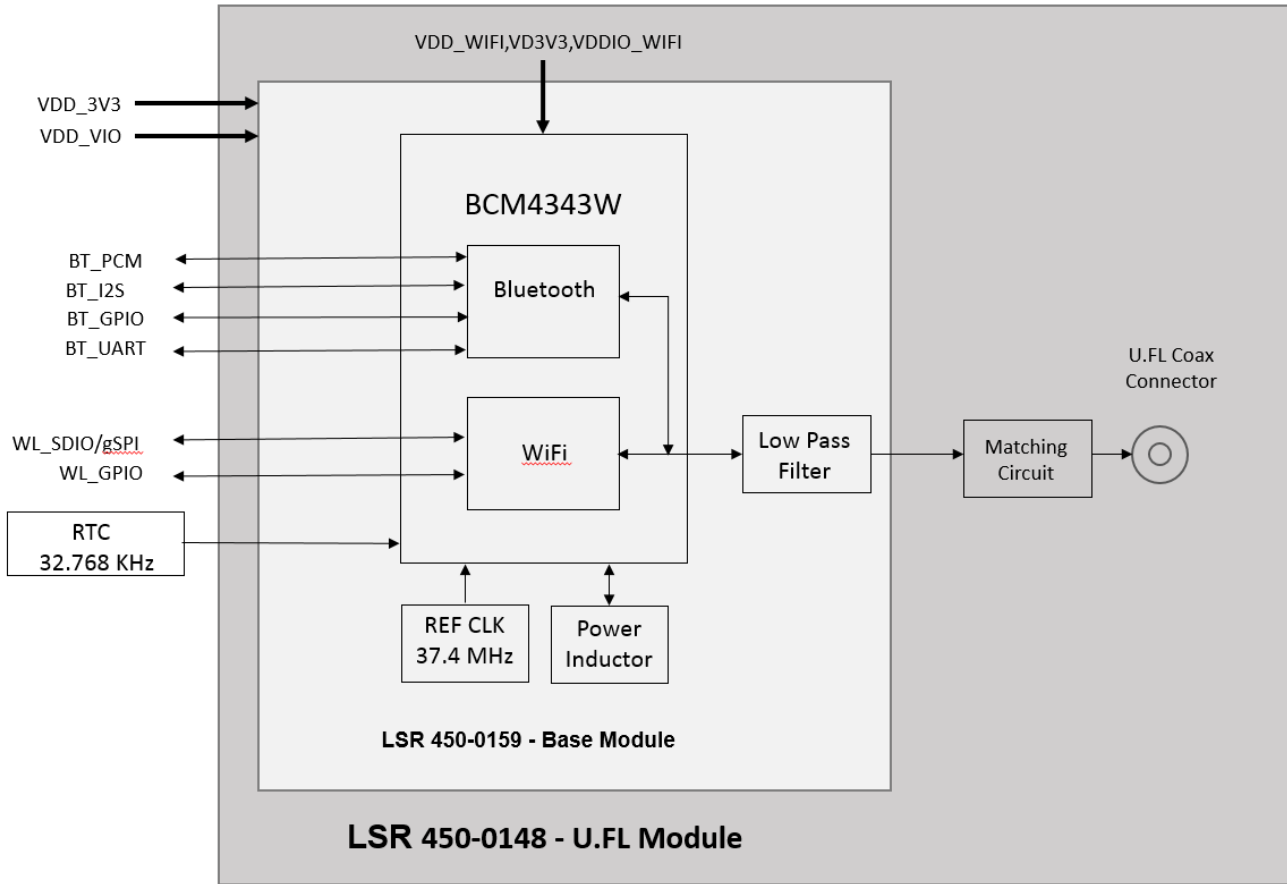


Figure 5 Sterling-LWB U.FL Module Block Diagram

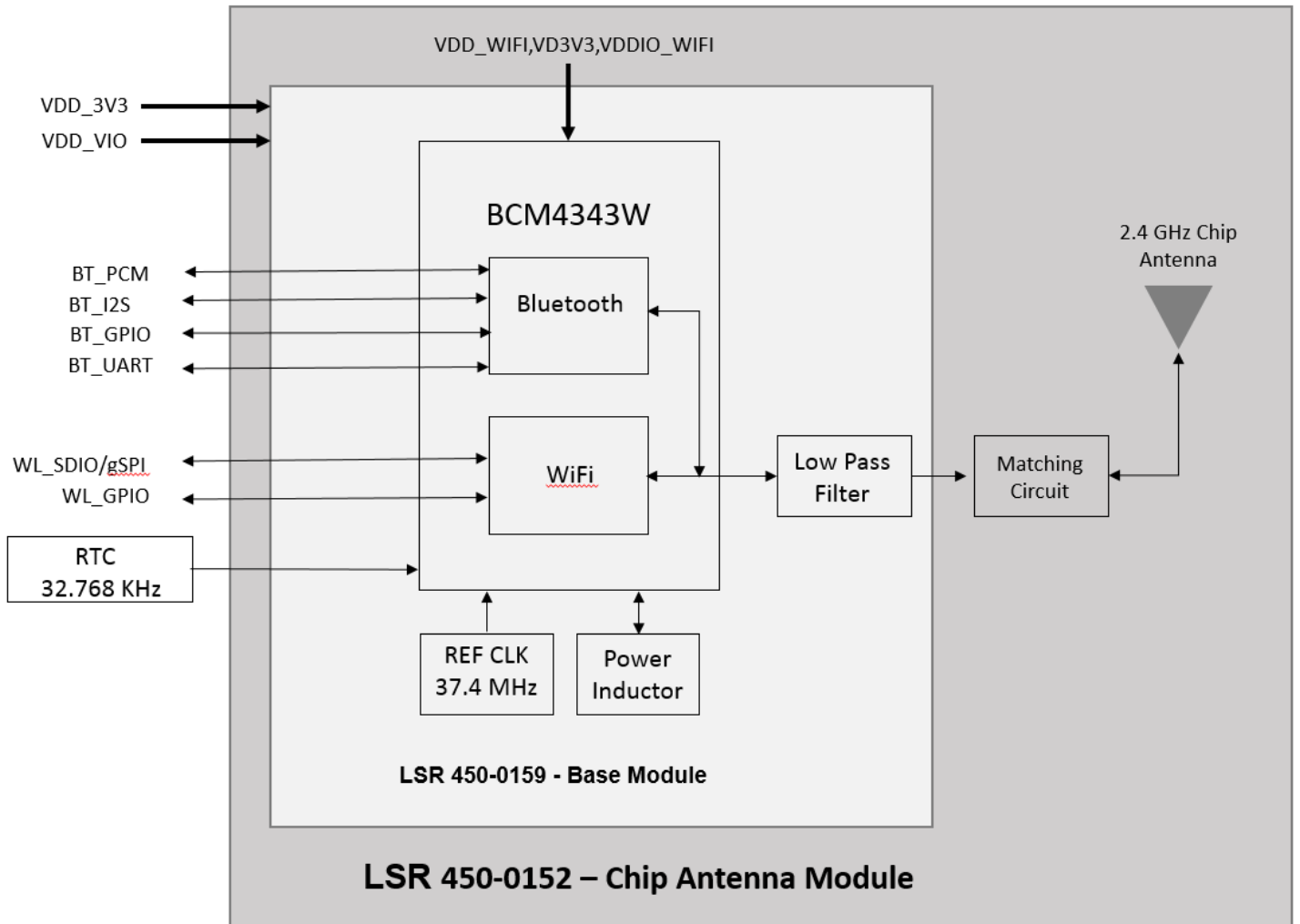


Figure 6 Sterling-LWB Chip Antenna Module Block Diagram

BASE SIP MODULE FOOTPRINT AND PIN DEFINITIONS

Note that the following footprint and pin definition applies to the Sterling-LWB Base SiP Module (450-0159). There are two module footprints depending on which variant of the module is being used, so it is important to make certain you are using the correct version on your design.

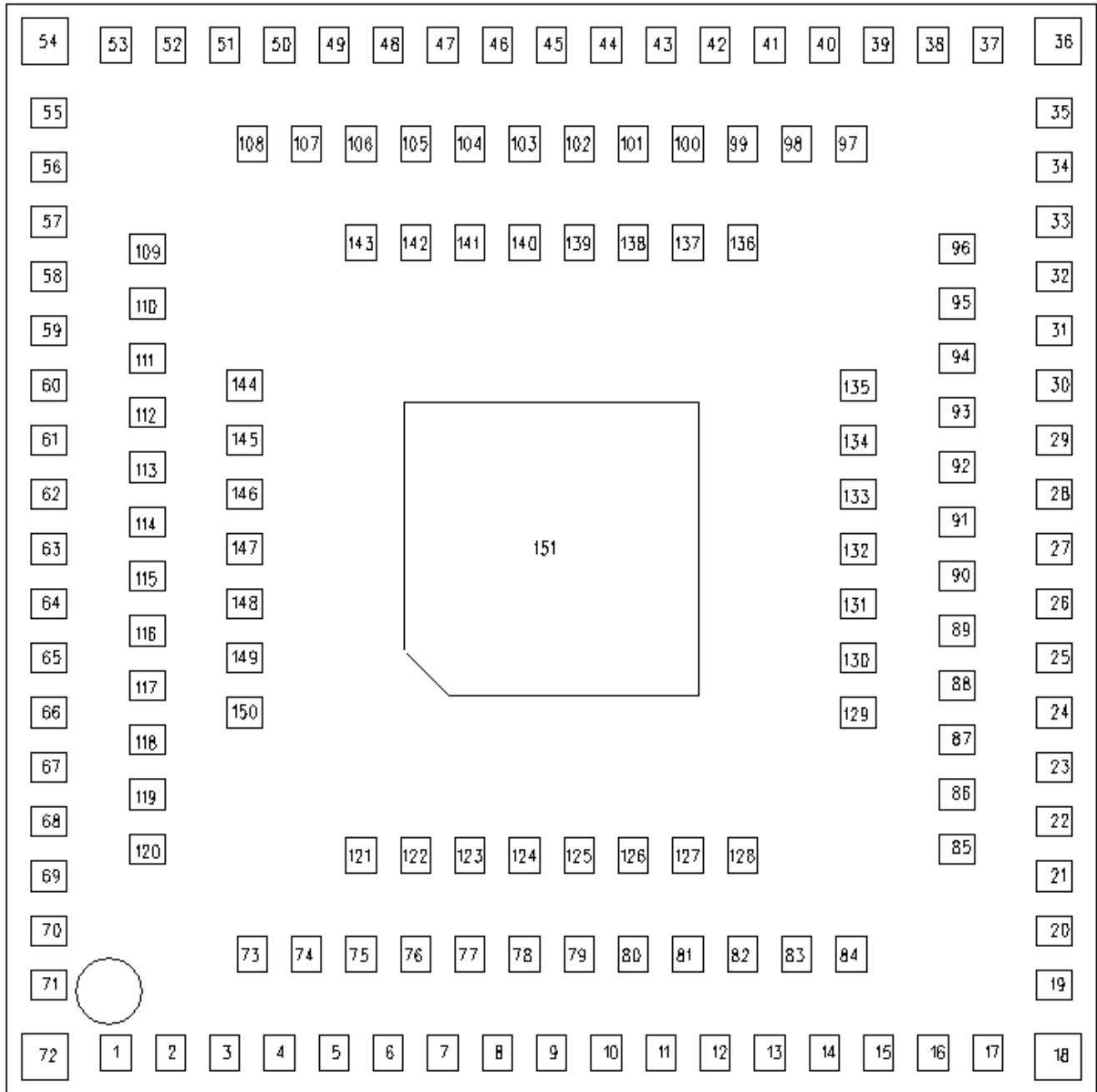


Figure 7 Sterling-LWB Base SiP Module Pinout (Top View)

BASE SIP MODULE PIN DESCRIPTIONS

| Module Pin | Name | I/O Type | Description |
|------------|-----------------|----------|---|
| 1 | ANT | RF | RF TRANSMITTER OUTPUT AND RECEIVE INPUT |
| 2 | GND | GND | GROUND |
| 3 | VDD_3V3_WIFI_PA | PI | WIFI PA POWER SUPPLY |
| 4 | VDD_3V3_WIFI_PA | PI | WIFI PA POWER SUPPLY |
| 5 | GND | GND | GROUND |
| 6 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 7 | GND | GND | GROUND |
| 8 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 9 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 10 | GND | GND | GROUND |
| 11 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 12 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 13 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 14 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 15 | GND | GND | GROUND |
| 16 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 17 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 18 | GND | GND | GROUND |
| 19 | CLK_REQ | DO | EXTERNAL SYSTEM CLOCK REQUEST – USED WHEN THE SYSTEM CLOCK IS NOT PROVIDED BY A DEDICATED CRYSTAL |
| 20 | BT_GPIO_3 | DIO | WPT_INTb TO WIRELESS CHARGING PMU |
| 21 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 22 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 23 | GND | GND | GROUND |
| 24 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 25 | GND | GND | GROUND |
| 26 | 32K_PWM_IN | DI | EXTERNAL SLEEP CLOCK INPUT |
| 27 | GND | GND | GROUND |
| 28 | VDD3V3_WiFi_IO | PI | DC SUPPLY FOR WIFI AND I/O |
| 29 | GND | GND | GROUND |
| 30 | NC | - | NO CONNECT (DO NOT CONNECT) |

The information in this document is subject to change without notice.

| Module Pin | Name | I/O Type | Description |
|------------|--------------|----------|--|
| 31 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 32 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 33 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 34 | GND | GND | GROUND |
| 35 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 36 | GND | GND | GROUND |
| 37 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 38 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 39 | GND | GND | GROUND |
| 40 | SDIO_D3 | DIO | SDIO DATA LINE 3 |
| 41 | GND | GND | GROUND |
| 42 | VDD3V3_WIFI | PI | WIFI POWER SUPPLY |
| 43 | VDD3V3_WIFI | PI | WIFI POWER SUPPLY |
| 44 | GND | GND | GROUND |
| 45 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 46 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 47 | GND | GND | GROUND |
| 48 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 49 | GND | GND | GROUND |
| 50 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 51 | GND | GND | GROUND |
| 52 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 53 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 54 | GND | GND | GROUND |
| 55 | BT_PCM_CLK | DIO | PCM CLOCK; CAN BE MASTER (OUTPUT) OR SLAVE (INPUT) |
| 56 | BT_DEV_WAKE | DIO | DEV_WAKE OR GENERAL-PURPOSE I/O SIGNAL |
| 57 | BT_HOST_WAKE | DO | HOST_WAKE OR GENERAL-PURPOSE I/O SIGNAL |
| 58 | GND | GND | GROUND |
| 59 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 60 | GND | GND | GROUND |
| 61 | GND | GND | GROUND |
| 62 | NC | - | NO CONNECT (DO NOT CONNECT) |

The information in this document is subject to change without notice.

| Module Pin | Name | I/O Type | Description |
|------------|-------------|----------|--|
| 63 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 64 | GND | GND | GROUND |
| 65 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 66 | GND | GND | GROUND |
| 67 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 68 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 69 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 70 | GND | GND | GROUND |
| 71 | GND | GND | GROUND |
| 72 | GND | GND | GROUND |
| 73 | GND | GND | GROUND |
| 74 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 75 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 76 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 77 | GND | GND | GROUND |
| 78 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 79 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 80 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 81 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 82 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 83 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 84 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 85 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 86 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 87 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 88 | WL_REG_ON | DI | USED BY PMU TO POWER UP OR POWER DOWN THE INTERNAL REGULATORS USED BY THE WLAN SECTION |
| 89 | WIFI_GPIO_1 | DIO | PROGRAMMABLE GPIO PIN |
| 90 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 91 | GND | GND | GROUND |
| 92 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 93 | NC | - | NO CONNECT (DO NOT CONNECT) |

The information in this document is subject to change without notice.

| Module Pin | Name | I/O Type | Description |
|------------|-------------|----------|--|
| 94 | GND | GND | GROUND |
| 95 | SDIO_D0 | DIO | SDIO DATA LINE 0 |
| 96 | SDIO_D1 | DIO | SDIO DATA LINE 1 |
| 97 | SDIO_D2 | DIO | SDIO DATA LINE 2 |
| 98 | SDIO_CMD | DIO | SDIO COMMAND LINE |
| 99 | GND | GND | GROUND |
| 100 | SDIO_CK | DI | SDIO CLOCK INPUT |
| 101 | GND | GND | GROUND |
| 102 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 103 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 104 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 105 | BT_I2S_CLK | DIO | I2S CLOCK; CAN BE MASTER (OUTPUT) OR SLAVE (INPUT) |
| 106 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 107 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 108 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 109 | BT_I2S_WS | DIO | I2S_WS; CAN BE MASTER (OUTPUT) OR SLAVE (INPUT) |
| 110 | BT_I2S_D0 | DIO | I2S DATA OUTPUT |
| 111 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 112 | GND | GND | GROUND |
| 113 | GND | GND | GROUND |
| 114 | GND | GND | GROUND |
| 115 | GND | GND | GROUND |
| 116 | GND | GND | GROUND |
| 117 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 118 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 119 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 120 | GND | GND | GROUND |
| 121 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 122 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 123 | GND | GND | GROUND |
| 124 | WIFI_GPIO_4 | DIO | PROGRAMMABLE GPIO PIN |
| 125 | NC | - | NO CONNECT (DO NOT CONNECT) |

The information in this document is subject to change without notice.

| Module Pin | Name | I/O Type | Description |
|------------|---------------|----------|--|
| 126 | WIFI_GPIO_2 | DIO | PROGRAMMABLE GPIO PIN |
| 127 | WIFI_GPIO_3 | DIO | PROGRAMMABLE GPIO PIN |
| 128 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 129 | BT_GPIO_4 | DIO | BSC_SDA TO/FROM WIRELESS CHARGING PMU. |
| 130 | BT_GPIO_5 | DIO | BSC_SCL FROM WIRELESS CHARGING PMU. |
| 131 | WIFI_GPIO_0 | DIO | PROGRAMMABLE GPIO PIN. THIS PIN BECOMES AN OUTPUT PIN WHEN IT IS USED AS WLAN_HOST_WAKE/ OUT-OF-BAND SIGNAL. |
| 132 | GND | GND | GROUND |
| 133 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 134 | GND | GND | GROUND |
| 135 | GND | GND | GROUND |
| 136 | BT_REG_ON | DI | USED BY PMU TO POWER UP OR POWER DOWN THE INTERNAL REGULATORS USED BY THE BLUETOOTH SECTION |
| 137 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 138 | BT_UART_RTS_L | DO | UART REQUEST-TO-SEND |
| 139 | BT_UART_CTS_L | DI | UART CLEAR-TO-SEND |
| 140 | BT_UART_TXD | DO | UART TRANSMIT OUTPUT |
| 141 | BT_UART_RXD | DI | UART RECEIVE INPUT |
| 142 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 143 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 144 | BT_PCM_SYNC | DIO | PCM SYNC; CAN BE MASTER (OUTPUT) OR SLAVE (INPUT) |
| 145 | BT_PCM_OUT | DO | PCM DATA OUTPUT |
| 146 | BT_PCM_IN | DI | PCM DATA INPUT SENSING |
| 147 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 148 | GND | GND | GROUND |
| 149 | GND | GND | GROUND |
| 150 | NC | - | NO CONNECT (DO NOT CONNECT) |
| 151 | GND | GND | GROUND |

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

Table 3 Sterling-LWB Module Pin Descriptions

The information in this document is subject to change without notice.

U.FL AND CHIP ANTENNA MODULE FOOTPRINT AND PIN DEFINITIONS

Note that the following footprint and pin definitions apply to the Sterling-LWB U.FL and Chip Antenna variants of the module (450-0148 and 450-0152). There are two module footprints depending on which variant of the module is being used, so it is important to make certain you are using the correct version on your design.

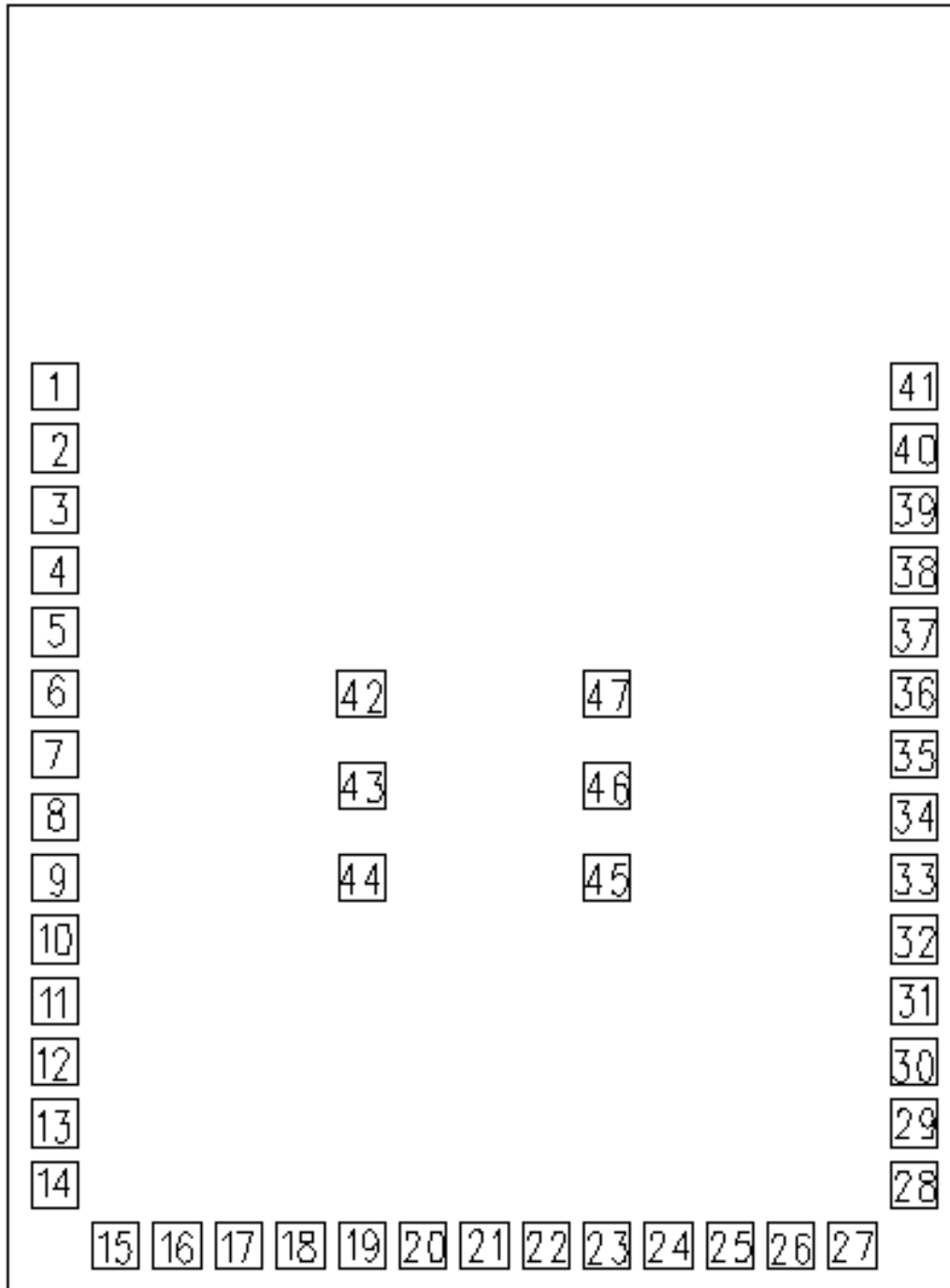


Figure 8 Sterling-LWB U.FL and Chip Antenna Module Pinout (Top View)

The information in this document is subject to change without notice.

U.FL AND CHIP ANTENNA MODULE PIN DESCRIPTIONS

| Module Pin | Name | I/O Type | Description |
|------------|--------------|----------|--|
| 1 | GND | GND | GROUND |
| 2 | BT_PCM_SYNC | DIO | PCM SYNC; CAN BE MASTER (OUTPUT) OR SLAVE (INPUT) |
| 3 | BT_PCM_IN | DI | PCM DATA INPUT SENSING |
| 4 | BT_PCM_OUT | DO | PCM DATA OUTPUT |
| 5 | VDD_3V3 | PI | WIFI AND BLUETOOTH POWER SUPPLY |
| 6 | GND | GND | GROUND |
| 7 | WIFI_GPIO_4 | DIO | PROGRAMMABLE GPIO PIN |
| 8 | WIFI_GPIO_3 | DIO | PROGRAMMABLE GPIO PIN |
| 9 | WIFI_GPIO_2 | DIO | PROGRAMMABLE GPIO PIN |
| 10 | WIFI_GPIO_1 | DIO | PROGRAMMABLE GPIO PIN |
| 11 | WIFI_GPIO_0 | DIO | PROGRAMMABLE GPIO PIN. THIS PIN BECOMES AN OUTPUT WHEN IT IS USED AS WLAN_HOST_WAKE/ OUT-OF-BAND SIGNAL. |
| 12 | WLREG_ON | DI | USED BY PMU TO POWER UP OR POWER DOWN THE INTERNAL REGULATORS USED BY THE WLAN SECTION. |
| 13 | CLK_REQ | DO | EXTERNAL SYSTEM CLOCK REQUEST – USED WHEN THE SYSTEM CLOCK IS NOT PROVIDED BY A DEDICATED CRYSTAL |
| 14 | GND | GND | GROUND |
| 15 | BT_GPIO_3 | DIO | PROGRAMMABLE GPIO PIN |
| 16 | BT_GPIO_4 | DIO | PROGRAMMABLE GPIO PIN |
| 17 | BT_GPIO_5 | DIO | PROGRAMMABLE GPIO PIN |
| 18 | GND | GND | GROUND |
| 19 | 32KHZ_OSC_IN | DI | EXTERNAL SLEEP CLOCK INPUT |
| 20 | VDD_VIO | PI | DC SUPPLY FOR I/O |
| 21 | BT_REG_ON | DI | USED BY PMU TO POWER UP OR POWER DOWN THE INTERNAL REGULATORS USED BY THE BLUETOOTH SECTION. |
| 22 | SDIO_D0 | DIO | SDIO DATA LINE 0 |
| 23 | SDIO_D1 | DIO | SDIO DATA LINE 1 |
| 24 | GND | GND | GROUND |
| 25 | SDIO_D2 | DIO | SDIO DATA LINE 2 |
| 26 | SDIO_CMD | DIO | SDIO COMMAND LINE |
| 27 | SDIO_D3 | DIO | SDIO DATA LINE 3 |

The information in this document is subject to change without notice.

| Module Pin | Name | I/O Type | Description |
|------------|---------------|----------|--|
| 28 | GND | GND | GROUND |
| 29 | SDIO_CK | DIO | SDIO CLOCK LINE |
| 30 | GND | GND | GROUND |
| 31 | BT_UART_RTS_L | DO | BT UART REQUEST-TO-SEND |
| 32 | BT_UART_CTS_L | DI | BT UART CLEAR-TO-SEND |
| 33 | BT_UART_TXD | DO | BT UART TRANSMIT OUTPUT |
| 34 | BT_UART_RXD | DI | BT UART RECEIVE INPUT |
| 35 | BT_I2S_CLK | DIO | I2S CLOCK; CAN BE MASTER (OUTPUT) OR SLAVE (INPUT) |
| 36 | BT_I2S_D0 | DO | I2S DATA OUTPUT |
| 37 | BT_I2S_WS | DIO | I2S_WS; CAN BE MASTER (OUTPUT) OR SLAVE (INPUT) |
| 38 | BT_PCM_CLK | DIO | PCM CLOCK; CAN BE MASTER (OUTPUT) OR SLAVE (INPUT) |
| 39 | BT_DEV_WAKE | DIO | DEV_WAKE OR GENERAL-PURPOSE I/O SIGNAL |
| 40 | BT_HOST_WAKE | DO | HOST_WAKE OR GENERAL-PURPOSE I/O SIGNAL |
| 41 | GND | GND | GROUND |
| 42 | GND | GND | GROUND |
| 43 | GND | GND | GROUND |
| 44 | GND | GND | GROUND |
| 45 | GND | GND | GROUND |
| 46 | GND | GND | GROUND |
| 47 | GND | GND | GROUND |

PI = Power Input, DI = Digital Input, DO = Digital Output, DIO = Bi-directional Digital Port, GND = Ground

Table 4 Sterling-LWB U.FL and Chip Antenna Module Pin Descriptions

MODULE POWER STATES

The Sterling-LWB WLAN power states are described as follows:

- **Active mode-** All WLAN blocks in the Sterling-LWB are powered up and fully functional with active carrier sensing and frame transmission and receiving. All required regulators are enabled and put in the most efficient mode based on the load current. Clock speeds are dynamically adjusted by the PMU sequencer.
- **Doze mode-** The radio, analog domains, and most of the linear regulators are powered down. The rest of the BCM4343W remains powered up in an IDLE state. All main clocks (PLL, crystal oscillator) are shut down to reduce active power to the minimum. The 32.768 kHz LPO clock is available only for the PMU sequencer. This condition is necessary to allow the PMU sequencer to wake up the chip and transition to Active mode. In Doze mode, the primary power consumed is due to leakage current.
- **Deep-sleep mode-** Most of the chip, including analog and digital domains, and most of the regulators are powered off. Logic states in the digital core are saved and preserved to retention memory in the always-on domain before the digital core is powered off. To avoid lengthy hardware re-initialization, the logic states in the digital core are restored to their pre-deep-sleep settings when a wake-up event is triggered by an external interrupt, a host resume through the SDIO bus, or by the PMU timers.
- **Power-down mode—**The BCM4343W is effectively powered off by shutting down all internal regulators. The chip is brought out of this mode by external logic re-enabling the internal regulators.

U.FL AND CHIP ANTENNA MODULE PIN I/O STATES

| Pin # | Name | Keeper (b) | Active Mode | Low Power State/Sleep (All Power Present) | Power Down(c) WL_REG_ON = 0 BT_REG_ON = 0 | Out Of Reset: (VDD_VIO is present) | | |
|-------|-------------|------------|---------------------------------------|---|---|------------------------------------|--------------------------------|--------------------------------|
| | | | | | | WL_REG_ON = 1 BT_REG_ON = any | WL_REG_ON = 1 BT_REG_ON = 0 | WL_REG_ON = 0 BT_REG_ON = 1 |
| 2 | BT_PCM_SYNC | Y | Input No Pull(d) | Input No Pull(d) | High -Z No Pull(d) | - | Input,PD | Input,PD |
| 3 | BT_PCM_IN | Y | Input No Pull(d) | Input No Pull(d) | High -Z No Pull(d) | - | Input,PD | Input,PD |
| 4 | BT_PCM_OUT | Y | Input No Pull(d) | Input No Pull(d) | High -Z No Pull(d) | - | Input,PD | Input,PD |
| 7 | WIFI_GPIO_4 | Y | TBD | Active Mode | High -Z No Pull(f) | Input,GCI GPIO[1] PU | Active Mode | Input,PU |
| 8 | WIFI_GPIO_3 | Y | TBD | Active Mode | High -Z No Pull(f) | Input,GCI GPIO[0] PU | Active Mode | Input,PU |
| 9 | WIFI_GPIO_2 | Y | TBD | Active Mode | High -Z No Pull(f) | Input,GCI GPIO[7] NoPull | Active Mode | Input,NoPull |
| 10 | WIFI_GPIO_1 | Y | TBD | Active Mode | High -Z No Pull(f) | Input,PD | Active Mode | Input,PD |
| 11 | WIFI_GPIO_0 | Y | TBD | Active Mode | High -Z No Pull(f) | Input,SDIO OOB Int. NoPull | Active Mode | Input,NoPull |
| 12 | WLREG_ON | N | Input; PD (pull-down can be disabled) | Input; PD (pull-down can be disabled) | Input; PD (of 200K) | Input; PD (of 200K) | Input; PD (of 200K) | - |
| 13 | CLK_REQ | Y | Open drain or push-pull(Active high) | Open drain or push-pull (Active high) | PD | Open drain, (Active high) | Open drain, (Active high) | Open drain, (Active high) |
| 21 | BT_REG_ON | N | Input; PD (pull-down can be disabled) | Input; PD (pull-down can be disabled) | Input; PD (of 200K) | Input; PD (of 200K) | Input; PD (of 200K) | Input; PD (of 200K) |
| 22 | SDIO_D0 | N | SDIO MODE -> NoPull | SDIO MODE -> NoPull | SDIO MODE -> NoPull | SDIO MODE ->PullUP | SDIO MODE -> NoPull | Input,PU |
| 23 | SDIO_D1 | N | SDIO MODE -> NoPull | SDIO MODE -> NoPull | SDIO MODE -> NoPull | SDIO MODE ->PullUP | SDIO MODE -> NoPull | Input,PU |
| 25 | SDIO_D2 | N | SDIO MODE -> NoPull | SDIO MODE -> NoPull | SDIO MODE -> NoPull | SDIO MODE ->PullUP | SDIO MODE -> NoPull | Input,PU |

The information in this document is subject to change without notice.

| Pin # | Name | Keeper (b) | Active Mode | Low Power State/Sleep (All Power Present) | Power Down(c) WL_REG_ON=0 BT_REG_ON=0 | Out Of Reset: (VDD_VIO is present) | | |
|-------|---------------|------------|----------------------------------|---|---|------------------------------------|----------------------------|----------------------------|
| | | | | | | WL_REG_ON=1 BT_REG_ON=any | WL_REG_ON=1 BT_REG_ON=0 | WL_REG_ON=0 BT_REG_ON=1 |
| 26 | SDIO_CMD | N | SDIO MODE -> NoPull | SDIO MODE -> NoPull | SDIO MODE -> NoPull | SDIO MODE ->PullUP | SDIO MODE -> NoPull | Input,PU |
| 27 | SDIO_D3 | N | SDIO MODE -> NoPull | SDIO MODE -> NoPull | SDIO MODE -> NoPull | SDIO MODE ->PullUP | SDIO MODE -> NoPull | Input,PU |
| 29 | SDIO_CK | N | SDIO MODE -> NoPull | SDIO MODE -> NoPull | SDIO MODE -> NoPull | SDIO MODE ->NoPull | SDIO MODE -> NoPull | Input |
| 31 | BT_UART_RTS_L | Y | Output:NoPull | Output:NoPull | High-Z,NoPull | - | Input:PU | Output:NoPull |
| 32 | BT_UART_CTS_L | Y | Input:NoPull | Input:NoPull | High-Z,NoPull | - | Input:PU | Input:NoPull |
| 33 | BT_UART_TXD | Y | Output:NoPull | Output:NoPull | High-Z,NoPull | - | Input:PU | Output:NoPull |
| 34 | BT_UART_RXD | Y | Input:PU | Input:NoPull | High-Z,NoPull | - | Input:PU | Input:NoPull |
| 35 | BT_I2S_CLK | Y | Input:NoPull(e) | Input:NoPull(e) | High-Z,NoPull | - | Input,PD | Output: DrivenLow |
| 36 | BT_I2S_D0 | Y | Input:NoPull(e) | Input:NoPull(e) | High-Z,NoPull | - | Input,PD | Input,PD |
| 37 | BT_I2S_WS | Y | Input:NoPull(e) | Input:NoPull(e) | High-Z,NoPull | - | Input,PD | Input,PD |
| 38 | BT_PCM_CLK | Y | Input No Pull(d) | Input No Pull(d) | High-Z,NoPull | - | Input,PD | Input,PD |
| 39 | BT_DEV_WAKE | Y | I/O: PU,PD,NoPull (Programmable) | I/O: PU,PD,NoPull (Programmable) | High-Z,NoPull | - | Input,PD | Output: DrivenLow |
| 40 | BT_HOST_WAKE | Y | I/O: PU,PD,NoPull (Programmable) | I/O: PU,PD,NoPull (Programmable) | High-Z,NoPull | - | Input,PD | Input,PD |

Table 5 I/O States

The information in this document is subject to change without notice.

The following notations are used:

Input signal

- O: Output signal
- I/O: Input/Output signal
- PU = Pulled up
- PD = Pulled down
- NoPull = Neither pulled up nor pulled down

Notes:

- PU = pulled up, PD = pulled down.
- N = pad has no keeper. Y = pad has a keeper. Keeper is always active except in the power-down state. If there is no keeper, and it is an input and there is NoPull, then the pad should be driven to prevent leakage due to floating pad, for example, SDIO_CLK.
- In the Power-down state ($xx_REG_ON = 0$): High-Z; NoPull => The pad is disabled because power is not supplied.
- Depending on whether the PCM interface is enabled and the configuration is master or slave mode, it can be either an output or input.
- Depending on whether the I2S interface is enabled and configuration is master or slave mode, it can be either an input or output.
- The GPIO pull states for the active and low-power states are hardware defaults. They can all be subsequently programmed as a pull-up or pull-down.

GENERAL CHARACTERISTICS

General

| Characteristic | Description |
|-----------------------------------|--|
| Model Name | Sterling-LWB |
| Product Description | WiFi and Bluetooth Smart Ready Wireless Module |
| Dimension (SiP Module) | 10 mm x 10 mm x 1.2 mm (W*L*T) |
| Dimension (Antenna Option Module) | 15.5 mm x 21 mm x 2 mm (W*L*T) |
| Operating temperature | -40°C to 85°C |
| Storage temperature | -40°C to 125°C |
| Weight | 0.9 g +/- 0.1g |

Table 6 General Characteristics

DC Characteristics – General Purpose I/O

| Parameter | Test Conditions | Min | Typical | Max | Unit |
|-----------------------------|--------------------------|---------------------|---------|---------------------|------|
| Logic input low, V_{IL} | $V_{DD_VIO} = 1.8V$ | - | - | $0.35x V_{DD_VIO}$ | V |
| Logic input high, V_{IH} | $V_{DD_VIO} = 1.8V$ | $0.65x V_{DD_VIO}$ | - | - | V |
| Logic output low, V_{OL} | $V_{DD_VIO} = 1.8V$ 2mA | - | - | 0.45 | V |
| Logic output high, V_{OH} | $V_{DD_VIO} = 1.8V$ 2mA | $V_{DD_VIO}-0.45$ | - | - | V |
| Logic input low, V_{IL} | $V_{DD_VIO} = 3.3V$ | -- | - | 0.80 | V |
| Logic input high, V_{IH} | $V_{DD_VIO} = 3.3V$ | 2.00 | - | - | V |
| Logic output low, V_{OL} | $V_{DD_VIO} = 3.3$ 2mA | - | - | 0.40 | V |
| Logic output high, V_{OH} | $V_{DD_VIO} = 3.3$ 2mA | $V_{DD_VIO}-0.40$ | - | - | V |

Table 7 DC Characteristics General Purpose I/O

DC Characteristics – SDO Interface Pins

| Parameter | Test Conditions | Min | Typical | Max | Unit |
|-----------------------------|------------------------|-------------------------|---------|-------------------------|------|
| Logic input low, V_{IL} | $VDD_VIO = 1.8V$ | - | - | 0.58 | V |
| Logic input high, V_{IH} | $VDD_VIO = 1.8V$ | 1.27 | - | - | V |
| Logic output low, V_{OL} | $VDD_VIO = 1.8V$ 2mA | - | - | 0.45 | V |
| Logic output high, V_{OH} | $VDD_VIO = 1.8V$ 2mA | 1.4 | - | - | V |
| Logic input low, V_{IL} | $VDD_VIO = 3.3V$ | $0.625 \times VDD_VIO$ | - | - | V |
| Logic input high, V_{IH} | $VDD_VIO = 3.3V$ | - | - | $0.25 \times VDD_VIO$ | V |
| Logic output low, V_{OL} | $VDD_VIO = 3.3 @ 2mA$ | - | - | $0.125 \times VDD_VIO$ | V |
| Logic output high, V_{OH} | $VDD_VIO = 3.3 @ 2mA$ | $0.75 \times VDD_VIO$ | - | - | V |

Figure 9 DC Characteristics SDIO I/O

RF Characteristics

| Parameter | Min | Typical | Max | Unit |
|--------------------|------|------------------------------|------|------|
| RF frequency range | 2400 | | 2500 | MHz |
| RF data rate | 1 | 802.11 b/g/n rates supported | 65 | Mbps |

Table 8 RF Characteristics

WLAN Power Consumption

| Parameter | Test Conditions | Min | Typical | Max | Unit |
|----------------------------|---|-----|---------|-----|------|
| Power Down Mode | T _{amb} = +25°C, VDD3V3 = VDD_VIO = 3.3V | - | 4 | - | uA |
| Sleep (idle, unassociated) | T _{amb} = +25°C, VDD3V3 = VDD_VIO = 3.3V | - | 80 | - | uA |
| IEEE Power Save DTIM 1 | T _{amb} = +25°C, VDD3V3 = VDD_VIO = 3.3V | - | 2 | - | mA |
| 11b TX Current | 11 Mbps, T _{amb} = +25°C, 3.3V | - | 290 | - | mA |
| 11g TX Current | 6 Mbps, T _{amb} = +25°C, 3.3V | - | 245 | - | mA |
| 11g TX Current | 54 Mbps, T _{amb} = +25°C, 3.3V | - | 215 | - | mA |
| 11n TX Current | MCS0, T _{amb} = +25°C, 3.3V | - | 230 | - | mA |
| 11n TX Current | MCS7, T _{amb} = +25°C, 3.3V | - | 200 | - | mA |
| 11b RX Current | 11 Mbps, T _{amb} = +25°C, 3.3V | - | 35 | - | mA |
| 11g RX Current | 54 Mbps, T _{amb} = +25°C, 3.3V | - | 35 | - | mA |
| 11n RX Current | MCS7, T _{amb} = +25°C, 3.3V | - | 35 | - | mA |

Table 9 WLAN Power Consumption

Bluetooth Power Consumption

| Parameter | Test Conditions | Min | Typical | Max | Unit |
|-----------------|--|-----|---------|-----|------|
| Power Down Mode | T _{amb} = +25°C, VDD3V3 = VDD_VIO = 3.3V | - | 4 | - | uA |
| GFSK TX Current | Constant Transmit, DH5, PRBS9 T _{amb} = +25°C, 3.3V | - | 50 | - | mA |
| EDR TX Current | Constant Transmit, 2DH5,3DH5, PRBS9 T _{amb} = +25°C, 3.3V | - | 43 | - | mA |
| GFSK RX Current | Constant Receive, DH5 T _{amb} = +25°C, 3.3V | - | 25 | - | mA |
| EDR RX Current | Constant Receive, 2DH5, 3DH5 T _{amb} = +25°C, 3.3V | - | 25 | - | mA |
| BLE TX Current | T _{amb} = +25°C, 3.3V | - | 44 | - | mA |
| BLE RX Current | T _{amb} = +25°C, 3.3V | - | 25 | - | mA |

Table 10 WLAN Power Consumption

The information in this document is subject to change without notice.

Power Supply Requirements

| Power Supply Requirements | Min | Typical | Max | Unit |
|---------------------------|-----|-----------|-----|------|
| VDD_VIO | 1.8 | 3.3 | 3.6 | V |
| VDD_VIO Current | - | 300 | - | uA |
| VDD_3V3 | 3.0 | 3.3 | 3.6 | V |
| VDD_3V3 Current | - | See Note* | - | mA |

Table 11 Power Supply Requirements

* Note: See WLAN and Bluetooth Power Consumption Table for various steady-state operating values. This value is the typical peak current required for the Radio Transmitter Calibration Mode. See Current Waveform in Calibration Current Profile shown below.

Calibration Current Profile

Although the Max continuous supply current to the module is <300 mA, when providing power to the module, a power source capable of supplying 600 mA peak current for a duration of ~20 mSec is required by the module transmitter during calibration.

Module calibration occurs:

- (1) When the Module is initially powered up.
- (2) The module is reset.
- (3) When the radio is initialized.
- (4) Every 2 minutes after the radio is initialized.

Note: Radio calibration will not occur while the module is in modes Doze, Deep Sleep, Power Down or if the radio is not initialized.

Figure 10 shows the current profile of the Sterling-LWB module during calibration. If current is limited to <600mA during this process, the module will fail to calibrate.

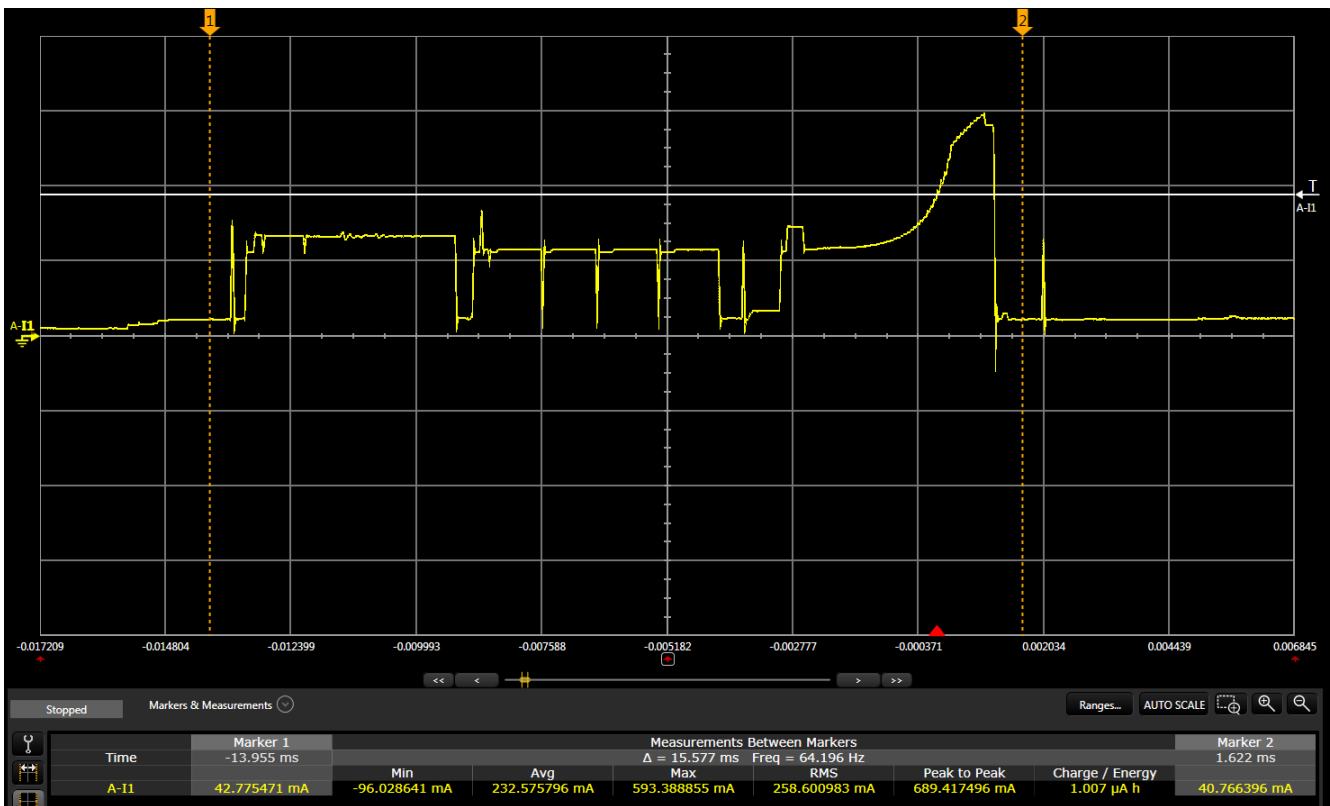


Figure 10 Module RF Calibration Current Profile

CRYSTAL OSCILLATOR REQUIREMENTS

| 32.768 KHz Oscillator | |
|-------------------------------|---------------------|
| Frequency Accuracy | ± 200 ppm |
| Duty Cycle | 30% - 70% |
| Input Signal Amplitude | 200 – 3300 mV, p-p |
| Signal Type | Square or Sine Wave |
| Clock Jitter | <10,000 ppm |

Table 12 Oscillator Requirements

Note: A 32.768 KHz crystal is required in order for the module to be fully functional. The module will not boot without it.

CONTROL SIGNAL TIMING DIAGRAMS

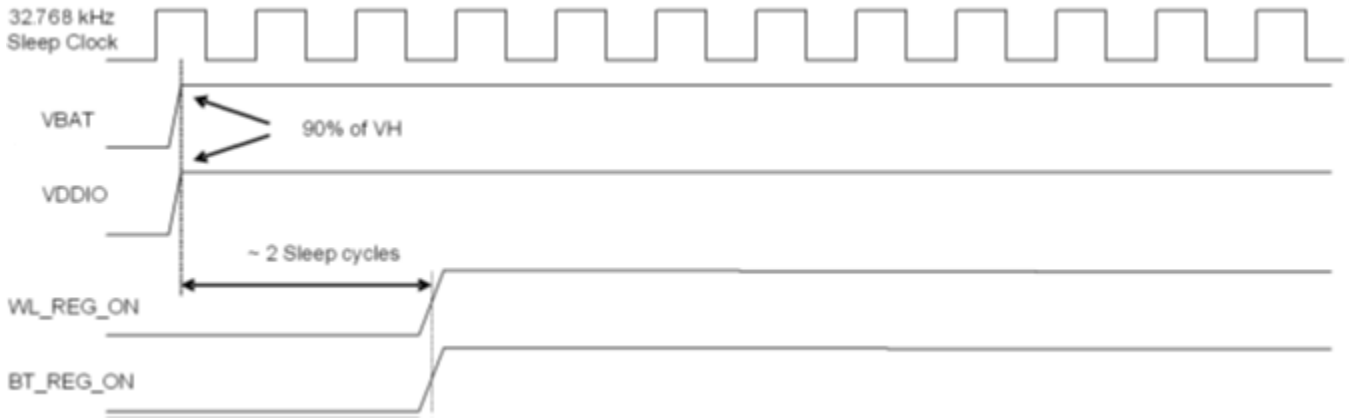


Figure 11 WLAN = ON, Bluetooth = ON

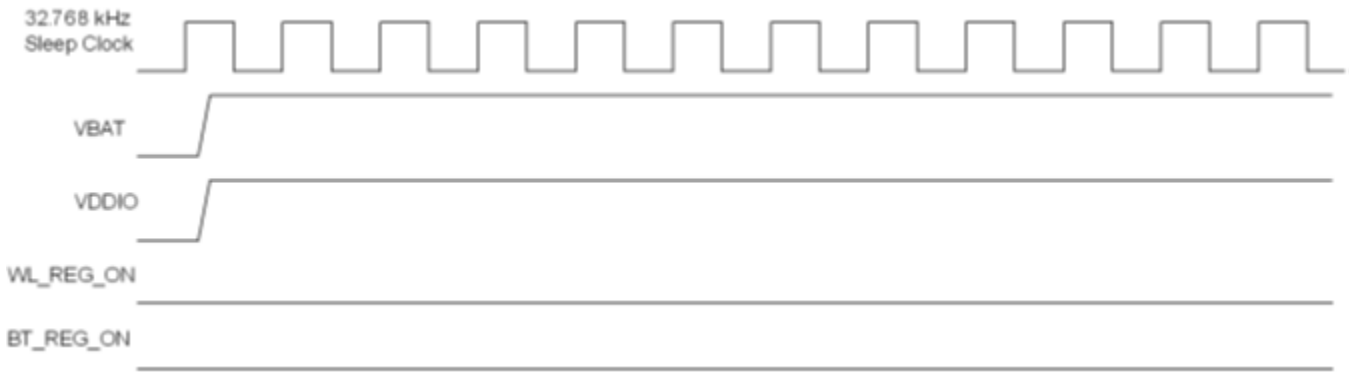


Figure 12 WLAN = OFF, Bluetooth = OFF

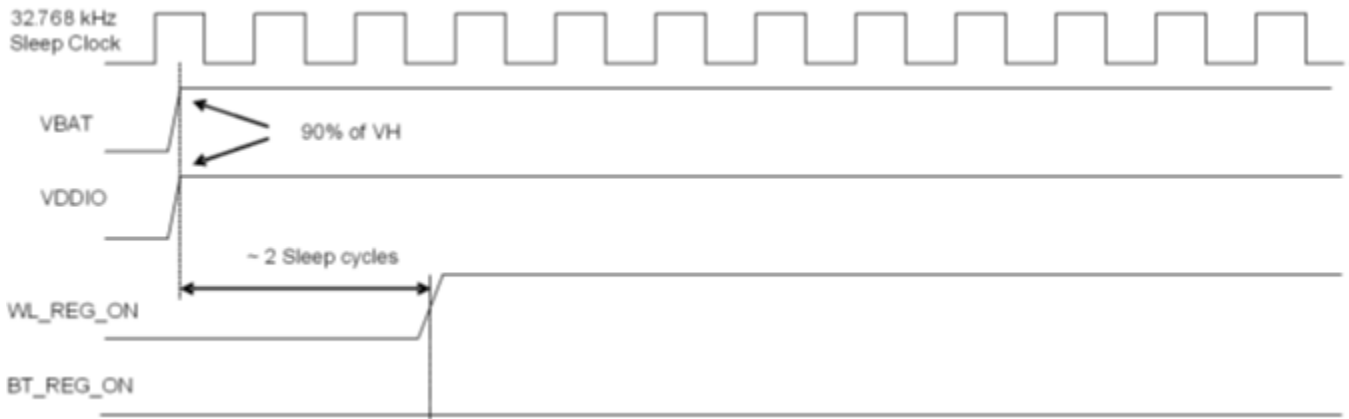


Figure 13 WLAN = ON, Bluetooth = OFF

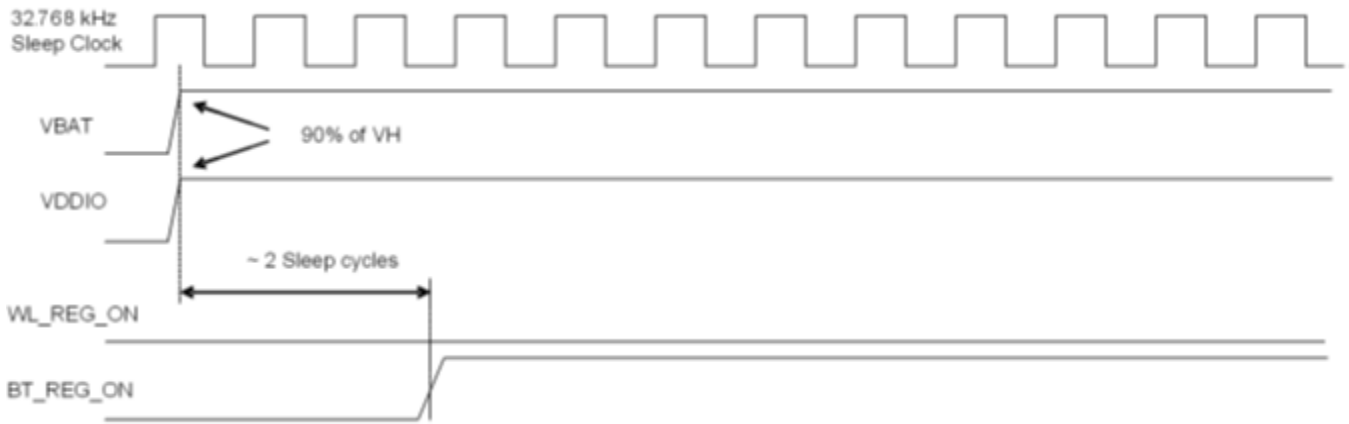


Figure 14 WLAN = OFF, Bluetooth = ON

Note: For both the WL_REG_ON and BT_REG_ON pins, there should be at least a 10 ms time delay between consecutive toggles (where both signals have been driven low). This is to allow time for the CBUCK regulator to discharge. If this delay is not followed, then there may be a VDDIO in-rush current on the order of 36 mA during the next PMU cold start.

WLAN RF Characteristics

WLAN Transmitter Characteristics (TA = +25°C, VCC = 3.3 V)

| Parameter | Test Conditions | Min | Typ | Max | Unit |
|-----------------------------------|---|-----|------|-----|------|
| 1 Mbps DSSS (b) TX Output Power | 1 Mbps BPSK 802.11(b) Mask Compliance 35% EVM RMS power over TX packet | - | 17.5 | - | dBm |
| 2 Mbps DSSS (b) TX Output Power | 2 Mbps QPSK 802.11(b) Mask Compliance 35% EVM RMS power over TX packet | - | 17.5 | - | dBm |
| 5.5 Mbps DSSS (b) TX Output Power | 5.5 Mbps QPSK 802.11(b) Mask Compliance 35% EVM RMS power over TX packet | - | 17.5 | - | dBm |
| 11 Mbps DSSS (b) TX Output Power | 11 Mbps CCK 802.11(b) Mask Compliance 35% EVM RMS power over TX packet | - | 17.5 | - | dBm |
| 6 Mbps OFDM (g) TX Output Power | 6 Mbps BPSK 802.11(g) Mask Compliance -5 dB EVM RMS power over TX packet | - | 14.0 | - | dBm |
| 9 Mbps OFDM (g) TX Output Power | 9 Mbps BPSK 802.11(g) Mask Compliance -8 dB EVM RMS power over TX packet | - | 14.0 | - | dBm |
| 12 Mbps OFDM (g) TX Output Power | 12 Mbps QPSK 802.11(g) Mask Compliance -10 dB EVM RMS power over TX packet | - | 14.0 | - | dBm |
| 18 Mbps OFDM (g) TX Output Power | 18 Mbps QPSK 802.11(g) Mask Compliance -13 dB EVM RMS power over TX packet | - | 14.0 | - | dBm |
| 24 Mbps OFDM (g) TX Output Power | 24 Mbps 16-QAM 802.11(g) Mask Compliance -16 dB EVM RMS power over TX packet | - | 14.0 | - | dBm |
| 36 Mbps OFDM (g) TX Output Power | 36 Mbps 16-QAM 802.11(g) Mask Compliance -19 dB EVM RMS power over TX packet | - | 14.0 | - | dBm |
| 48 Mbps OFDM (g) TX Output Power | 48 Mbps 64-QAM 802.11(g) Mask Compliance -22 dB EVM RMS power over TX packet | - | 14.0 | - | dBm |
| 54 Mbps OFDM (g) TX Output Power | 54 Mbps 64-QAM 802.11(g) Mask Compliance -25 dB EVM RMS power over TX packet | - | 14.0 | - | dBm |
| MCS0 OFDM (n) TX Output Power | 6.5 Mbps BPSK 802.11(n) Mask Compliance -5 dB EVM RMS power over TX packet | - | 12.5 | - | dBm |
| MCS1 OFDM (n) TX Output Power | 13 Mbps QPSK 802.11(n) Mask Compliance -10 dB EVM RMS power over TX packet | - | 12.5 | - | dBm |
| MCS2 OFDM (n) TX Output Power | 19.5 Mbps QPSK 802.11(n) Mask Compliance -13 dB EVM RMS power over TX packet | - | 12.5 | - | dBm |
| MCS3 OFDM (n) TX Output Power | 26 Mbps 16-QAM 802.11(n) Mask Compliance -16 dB EVM RMS power over TX packet | - | 12.5 | - | dBm |
| MCS4 OFDM (n) TX Output Power | 39 Mbps 16-QAM 802.11(n) Mask Compliance -19 dB EVM RMS power over TX packet | - | 12.5 | - | dBm |
| MCS5 OFDM (n) TX Output Power | 52 Mbps 64-QAM 802.11(n) Mask Compliance -22 dB EVM RMS power over TX packet | - | 12.5 | - | dBm |
| MCS6 OFDM (n) TX Output Power | 58.5 Mbps 64-QAM 802.11(n) Mask Compliance -25 dB EVM RMS power over TX packet | - | 12.5 | - | dBm |
| MCS7 OFDM (n) TX Output Power | 65 Mbps 64-QAM 802.11(n) Mask Compliance -27 dB EVM RMS power over TX packet | - | 12.5 | - | dBm |

Table 13 WLAN Transmitter RF Characteristics

The information in this document is subject to change without notice.

WLAN Receiver Characteristics
(TA = +25°C, VCC = 3.3 V)

| Parameter | Test Conditions | Min | Typ | Max | Unit |
|--|------------------|-----|-----|-----|------|
| 1 Mbps DSSS (b) RX Sensitivity | 8% PER | - | -94 | - | dBm |
| 2 Mbps DSSS (b) RX Sensitivity | 8% PER | - | -93 | - | dBm |
| 5.5 Mbps DSSS (b) RX Sensitivity | 8% PER | - | -91 | - | dBm |
| 11 Mbps DSSS (b) RX Sensitivity | 8% PER | - | -88 | - | dBm |
| | | | | | |
| 6 Mbps OFDM (g) RX Sensitivity | 10% PER | - | -90 | - | dBm |
| 9 Mbps OFDM (g) RX Sensitivity | 10% PER | - | -89 | - | dBm |
| 12 Mbps OFDM (g) RX Sensitivity | 10% PER | - | -87 | - | dBm |
| 18 Mbps OFDM (g) RX Sensitivity | 10% PER | - | -85 | - | dBm |
| 24 Mbps OFDM (g) RX Sensitivity | 10% PER | - | -83 | - | dBm |
| 36 Mbps OFDM (g) RX Sensitivity | 10% PER | - | -80 | - | dBm |
| 48 Mbps OFDM (g) RX Sensitivity | 10% PER | - | -76 | - | dBm |
| 54 Mbps OFDM (g) RX Sensitivity | 10% PER | - | -75 | - | dBm |
| | | | | | |
| MCS0 (6.5 Mbps) OFDM (n) RX Sensitivity | 10% PER | - | -89 | - | dBm |
| MCS1 (13 Mbps) OFDM (n) RX Sensitivity | 10% PER | - | -86 | - | dBm |
| MCS2 (19.5 Mbps) OFDM (n) RX Sensitivity | 10% PER | - | -84 | - | dBm |
| MCS3 26 Mbps OFDM (n) RX Sensitivity | 10% PER | - | -82 | - | dBm |
| MCS4 39 Mbps OFDM (n) RX Sensitivity | 10% PER | - | -79 | - | dBm |
| MCS5 52 Mbps OFDM (n) RX Sensitivity | 10% PER | - | -75 | - | dBm |
| MCS6 58.5 Mbps OFDM (n) RX Sensitivity | 10% PER | - | -73 | - | dBm |
| MCS7 65 Mbps OFDM (n) RX Sensitivity | 10% PER | - | -72 | - | dBm |
| | | | | | |
| 11b RX Overload Level | 8% PER, 11 Mbps | -10 | - | - | dBm |
| 11g RX Overload Level | 10% PER, 54 Mbps | -20 | - | - | dBm |
| 11n RX Overload Level | 10% PER, MCS7 | -20 | - | - | dBm |

Table 14 WLAN Receiver RF Characteristics

The information in this document is subject to change without notice.

Bluetooth RF Characteristics

Bluetooth Transmitter GFSK & EDR Characteristics (TA=25°C, VBAT=3.3 V)

| Parameter | Test Conditions | Min | Typical | Max | Bluetooth Spec | Unit |
|-------------------------|-----------------|-----|---------|-----|----------------|------|
| GFSK RF Output Power | | - | 8.5 | - | | dBm |
| EDR RF Output Power | | - | 4.0 | - | | dBm |
| Power Control Step Size | | 2 | 4 | 8 | 2-8 | dB |
| EDR Relative Power | | -4 | | 1 | -4/+1 | dB |

Table 15 Bluetooth

Bluetooth Receiver GFSK & EDR Characteristics (TA=25°C, VBAT=3.3 V)

| Parameter | Test Conditions | Min | Typical | Max | Bluetooth Spec | Unit |
|---------------------------|-----------------|-----|---------|-----|----------------|------|
| GFSK Sensitivity | BER=0.1% | - | -90 | - | -70 | dBm |
| EDR 2 Mbps Sensitivity | BER=0.01% | - | -92 | - | -70 | dBm |
| EDR 3 Mbps Sensitivity | BER=0.01% | - | -87 | - | -70 | dBm |
| GFSK Maximum Input Level | BER=0.1% | - | -20 | - | -20 | dBm |
| EDR 2 Maximum Input Level | BER=0.01% | - | -20 | - | - | dBm |
| EDR 3 Maximum Input Level | BER=0.01% | - | -20 | - | - | dBm |

Table 16 Bluetooth

BLE Transmitter Characteristics (TA=25°C, VBAT=3.3 V)

| Parameter | Test Conditions | Min | Typical | Max | Bluetooth Spec | Unit |
|-------------------------|-----------------|-----|---------|-----|----------------|------|
| GFSK RF Output Power | | - | 7.5 | - | | dBm |
| Power Control Step Size | | 2 | 4 | 8 | 2-8 | dB |

Table 17 Bluetooth

BLE Receiver Characteristics (TA=25°C, VBAT=3.3 V)

| Parameter | Test Conditions | Min | Typical | Max | Bluetooth Spec | Unit |
|--------------------------|-----------------|-----|---------|-----|----------------|------|
| GFSK Sensitivity | PER = 30.8% | - | -94 | - | -70 | dBm |
| GMSK Maximum Input Level | PER = 30.8% | - | -20 | - | -20 | dBm |

Table 18 Bluetooth

WLAN HOST INTERFACE

SDIO Interface

Overview

The Sterling-LWB Module WLAN section supports SDIO version 2.0. for both 1-bit (25 Mbps) and 4-bit modes (100 Mbps), as well as high speed 4-bit mode (50 MHz clocks—200 Mbps).

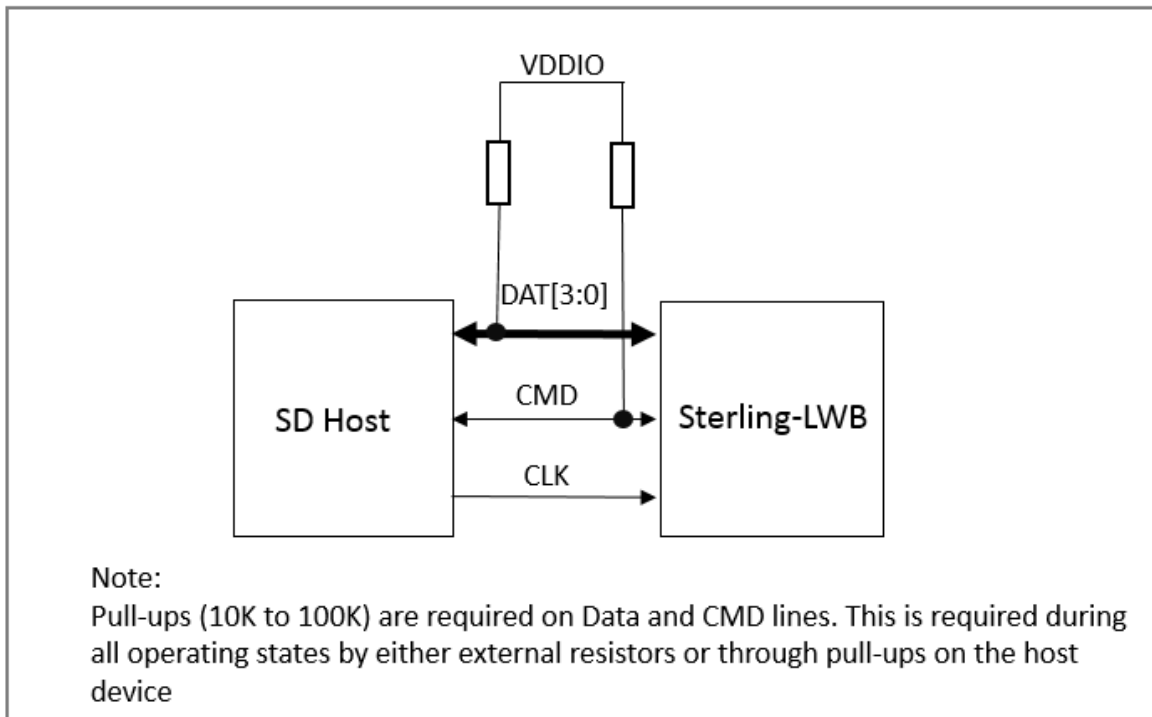


Figure 15 Signal Connections to SDIO Host (SD 4-Bit Mode)

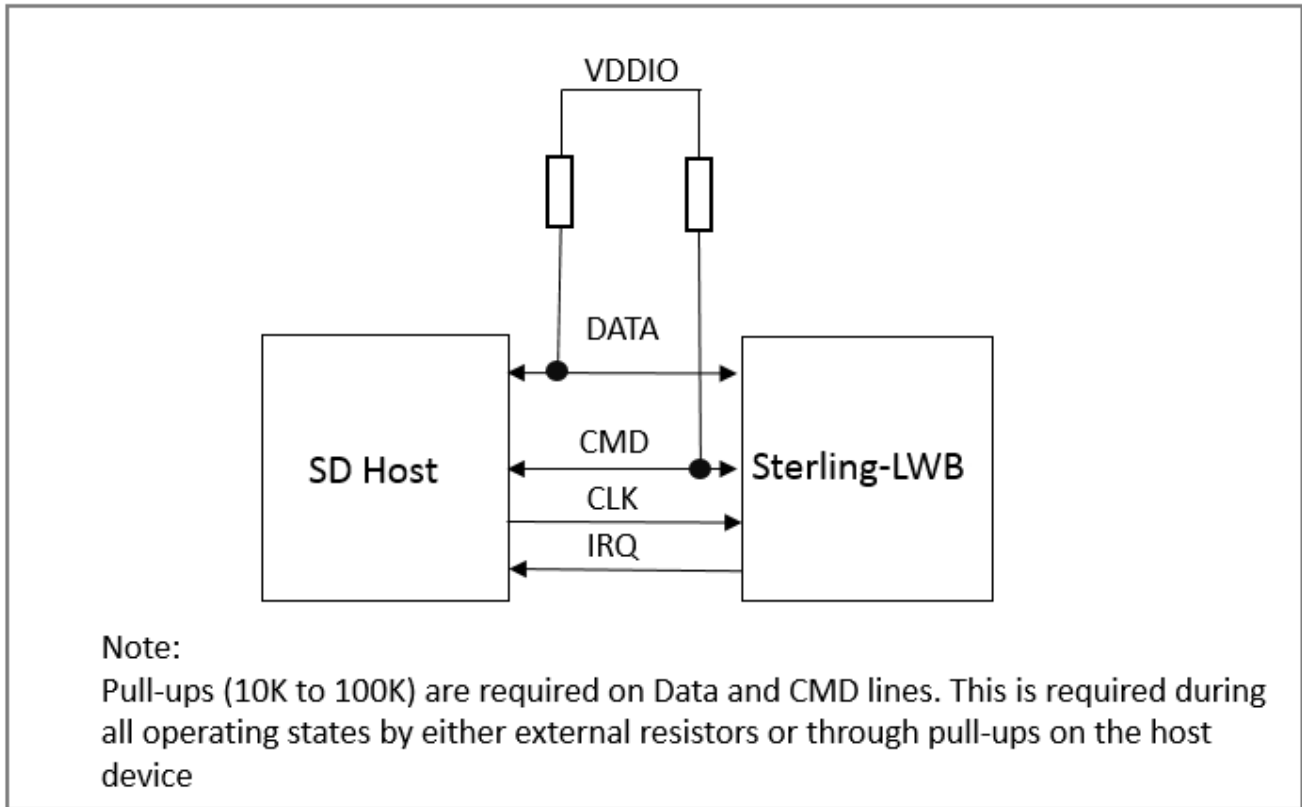


Figure 16 Signal Connections to SDIO Host (SD 1-Bit Mode)

WLAN SPI Interface

Overview

In addition to the full SDIO mode, the BCM4343W includes the option of using the simplified generic SPI (gSPI)

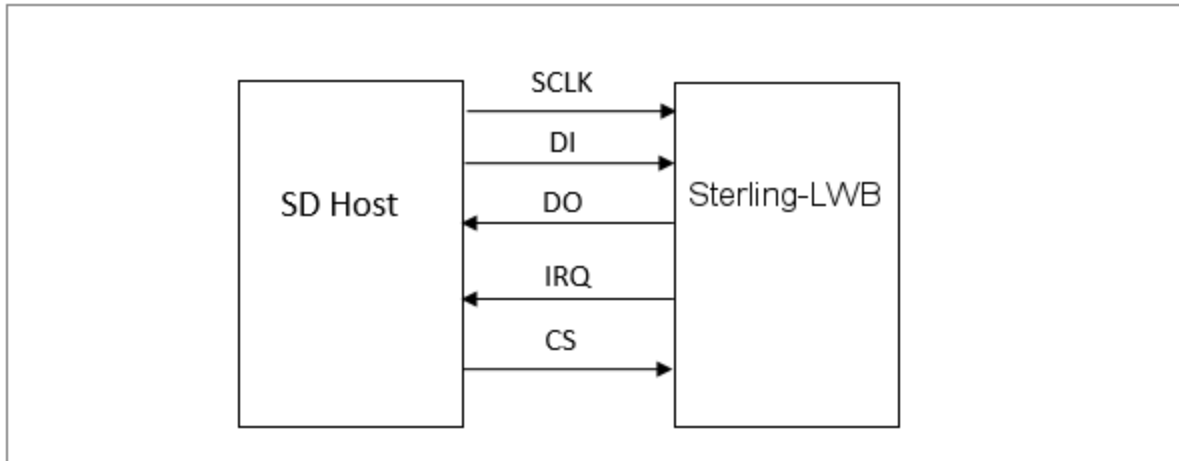


Figure 17 Signal Connections to SDIO Host (gSPI Mode)

NOTE: For gSPI, pull SDIO_DATA_2 pin low. The default is SDIO.

BLUETOOTH UART HOST INTERFACE

Overview

The Sterling-LWB uses a single UART for Bluetooth. The UART is a standard 4-wire interface (RX, TX, RTS, and CTS) with adjustable baud rates from 9600 bps to 4.0 Mbps. The interface features an automatic baud rate detection capability that returns a baud rate selection. The baud rate may be selected through a vendor-specific UART HCI command to a value other than the default rate of 115.2 kbps.

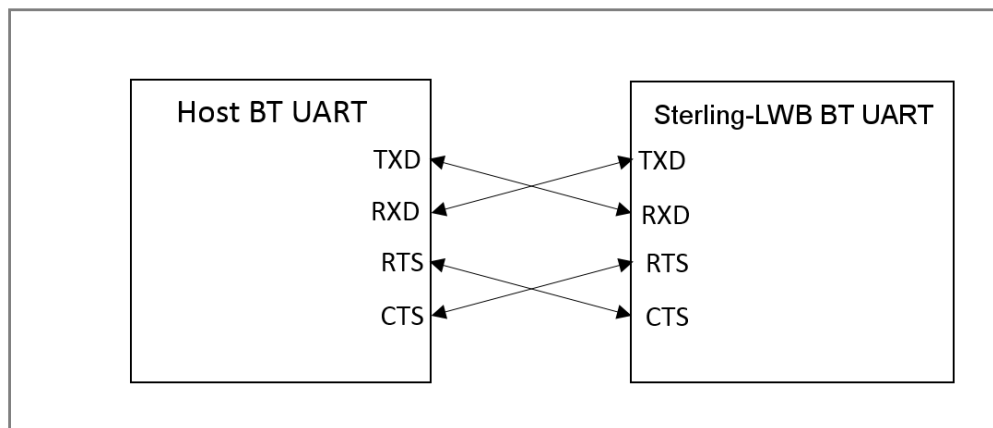


Figure 18 UART Connection from Sterling-LWB to Host

The information in this document is subject to change without notice.

Soldering Recommendations

Reflow for Lead Free Solder Paste

- Optimal solder reflow profile depends on solder paste properties and should be optimized as part of an overall process development.
- It is important to provide a solder reflow profile that matches the solder paste supplier's recommendations.
- Temperature ranges beyond that of the solder paste supplier's recommendation could result in poor solderability.
- All solder paste suppliers recommend an ideal reflow profile to give the best solderability.

Recommended Reflow Profile for Lead Free Solder

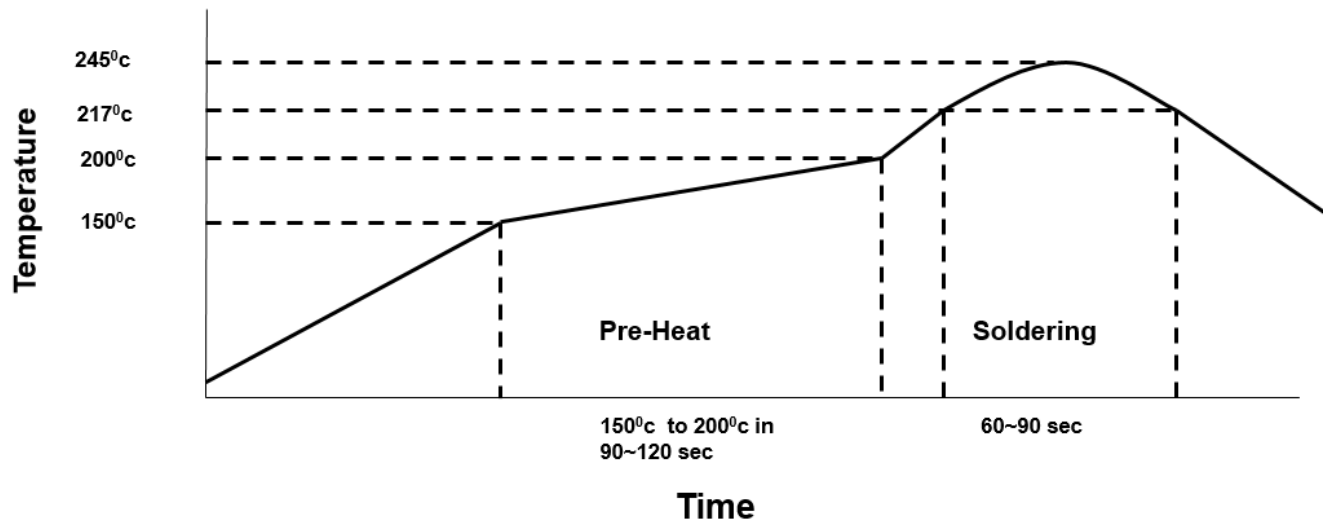


Figure 19 Recommended Soldering Profile

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

WiFi MAC IDS/BLUETOOTH MAC IDS

LSR has procured a block of IEEE MAC Address from the IEEE association. The MAC addresses are six (6) bytes in length and the three (3) Most Significant Bytes (MSBs) are the OUI, which is used to identify the company to which the block of IEEE addresses was assigned. LSR’s OUI is **00:25:CA**.

For the Sterling-LWB, the WiFi MAC ID and Bluetooth MAC ID is preprogrammed during production for each module. The Bluetooth MAC ID is the WiFi MAC ID plus one.

Example:

| | WiFi MAC ID | Bluetooth MAC ID |
|-----------------|--------------------|-------------------------|
| Module 1 | 00:25:CA:07:00:01 | 00:25:CA:07:00:02 |
| Module 2 | 00:25:CA:07:00:03 | 00:25:CA:07:00:04 |
| Module 3 | 00:25:CA:07:00:05 | 00:25:CA:07:00:06 |
| Module 4 | 00:25:CA:07:00:07 | 00:25:CA:07:00:08 |

Table 19 Example MAC ID Assignments

The information in this document is subject to change without notice.

CLEANING

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

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

OPTICAL INSPECTION

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

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

REWORK

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

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

SHIPPING, HANDLING, AND STORAGE

Shipping

Bulk orders of the Sterling-LWB base module are delivered in reels of 2000. Bulk orders for the antenna option PCBAs are delivered in reels of 1000.

Handling

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

Moisture Sensitivity Level (MSL)

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

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

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

Storage

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

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

Do not store in direct sunlight.

The product should not be subject to excessive mechanical shock.

Repeated Reflow Soldering

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

AGENCY CERTIFICATIONS

FCC ID: TFB-1003, 15.247

IC ID: 5969A-1003, RSS 247

CE: Compliant to standards EN 60950-1, EN 300 328, and EN 301 489

Giteki: 209-J00212

RCM: Compliant to standards EN 300 328 V1.9.1, AS/NZS 4268: 2012-A1:2013, and EN 55022:2010/AC:2011

AGENCY STATEMENTS

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.

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.

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.

Industry Canada Statements

This Device complies with Industry Canada License-exempt RSS standard(s). 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.

To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that permitted for successful communication.

This device has been designed to operate with the antenna(s) listed below, and having a maximum gain of 2.0 dBi (LSR Dipole), 2.0 dBi (LSR FlexPIFA), 2.0 dBi (LSR FlexNotch), and 1.5 dBi (Johanson Chip). Antennas not included in this list or having a gain greater than 2.0 dBi, 2.0 dBi, 2.0 dBi, and 1.5 dBi are strictly prohibited for use with this device. The required antenna impedance is 50 ohms.

List of all Antennas Acceptable for use with the Transmitter

- 1) LSR 001-0001 center-fed 2.4 GHz dipole antenna and LSR 080-0001 U.FL to Reverse Polarity SMA connector cable.
- 2) LSR 001-0014 2.4 GHz FlexPIFA antenna.
- 3) LSR 001-0015 2.4 GHz FlexNotch antenna.
- 4) Johanson Technology 2450AT18D0100 chip antenna.

Cet appareil est conforme avec Industrie Canada, exempts de licence standard RSS (s). L'opération est soumise aux deux conditions suivantes: (1) cet appareil ne peut pas provoquer d'interférences et (2) cet appareil doit accepter toute interférence, y compris les interférences qui peuvent causer un mauvais fonctionnement de l'appareil.

Pour réduire le risque d'interférence aux autres utilisateurs, le type d'antenne et son gain doivent être choisis de manière que la puissance isotrope rayonnée équivalente (PIRE) ne dépasse pas celle permise pour une communication réussie.

Cet appareil a été conçu pour fonctionner avec l'antenne (s) ci-dessous, et ayant un gain maximum de 2,0 dBi (LSR Dipole), 2,0 dBi (LSR FlexPIFA), 2,0 dBi (LSR FlexNotch), et 1,5 dBi (Johanson Chip). Antennes pas inclus dans cette liste ou présentant un gain supérieure à 2,0 dBi, 2,0 dBi, 2,0 dBi, et 1,5 dBi sont strictement interdits pour une utilisation avec cet appareil. L'impédance d'antenne requise est de 50 ohms.

Liste de toutes les antennes acceptables pour une utilisation avec l'émetteur

- 1) Antenne LSR 001-0001 2.4 GHz de centre-dipôle alimenté et LSR 080-0001 U.FL inverser câble connecteur SMA à polarité.
- 2) LSR 001-0014 antenne FlexPIFA 2,4 GHz w/U.FL câble.
- 3) LSR 001-0015 antenne FlexNotch 2,4 GHz w/U.FL câble.
- 4) Antenne de puce Johanson Technology 2450AT18D0100.

OEM RESPONSIBILITIES TO COMPLY WITH FCC AND INDUSTRY CANADA REGULATIONS

The Sterling-LWB Module has been certified for integration into products only by OEM integrators under the following conditions:

To comply with FCC and Industry Canada RF exposure limits for general population / uncontrolled exposure, the antenna must be installed to provide a separation distance of at least 29mm from all persons and operating in conjunction with any other antenna or transmitter, except in accordance with FCC multi-transmitter product procedures.

As long as the two 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 (for example, digital device emissions, PC peripheral requirements, etc.).

IMPORTANT NOTE: In the event that these conditions cannot be met (for certain configurations or co-location with another transmitter), then the FCC and Industry Canada authorizations are no longer considered valid and the FCC ID and IC Certification Number 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 and Industry Canada authorization.

Le module de Sterling-LWB a été certifié pour l'intégration dans des produits uniquement par des intégrateurs OEM dans les conditions suivantes:

Pour se conformer aux limites d'exposition aux RF de la FCC et d'Industrie Canada pour la population générale / exposition non contrôlée, l'antenne doit être installée pour fournir une distance de séparation d'au moins 29mm de toutes les personnes et fonctionnant conjointement avec une autre antenne ou émetteur, sauf en conformité avec la FCC procédures de produits multi-émetteurs.

Tant que les deux conditions précitées sont réunies, les tests de transmetteurs supplémentaires ne seront pas tenus. Toutefois, l'intégrateur OEM est toujours responsable de tester leur produit final pour toutes les exigences de conformité supplémentaires requis avec ce module installé (par exemple, les émissions appareil numérique, les exigences de périphériques PC, etc.)

NOTE IMPORTANTE: Dans le cas où ces conditions ne peuvent être satisfaites (pour certaines configurations ou de co-implantation avec un autre émetteur), puis la FCC et Industrie autorisations Canada ne sont plus considérés comme valides et l'ID de la FCC et IC numéro de certification ne peut pas être utilisé sur la produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'un distincte de la FCC et Industrie Canada l'autorisation.

OEM LABELING REQUIREMENTS FOR END-PRODUCT

The Sterling-LWB module is labeled with its own FCC ID and IC Certification Number. The FCC ID and IC certification numbers are not visible when the module is installed inside another device, as such the end device into which the module is installed must display a label referring to the enclosed module. The final end product must be labeled in a visible area with the following:

“Contains Transmitter Module FCC ID: TFB-1003”

“Contains Transmitter Module IC: 5969A-1003”

or

“Contains FCC ID: TFB-1003”

“Contains IC: 5969A-1003”

The OEM of the Sterling-LWB Module must only use the approved antenna(s) listed above, which have been certified with this module.

Le module de Sterling-LWB est étiqueté avec son propre ID de la FCC et IC numéro de certification. L'ID de la FCC et IC numéros de certification ne sont pas visibles lorsque le module est installé à l'intérieur d'un autre appareil, comme par exemple le terminal dans lequel le module est installé doit afficher une étiquette faisant référence au module ci-joint. Le produit final doit être étiqueté dans un endroit visible par le suivant:

“Contient Module émetteur FCC ID: TFB-1003”

“Contient Module émetteur IC: 5969A-1003”

ou

“Contient FCC ID: TFB-1003”

“Contient IC: 5969A-1003”

Les OEM du module Sterling-LWB ne doit utiliser l'antenne approuvée (s) ci-dessus, qui ont été certifiés avec ce module.

OEM END PRODUCT USER MANUAL STATEMENTS

The OEM integrator should not to provide information to the end user regarding how to install or remove this RF module or change RF related parameters in the user manual of the end product.

The user manual for the end product must include the following information in a prominent location:

To comply with FCC and Industry Canada RF exposure limits for general population / uncontrolled exposure, the antenna(s) used for this transmitter must be installed to provide a separation distance of at least 29mm from all persons and operating in conjunction with any other antenna or transmitter, except in accordance with FCC multi-transmitter product procedures.

Other user manual statements may apply.

L'intégrateur OEM ne devraient pas fournir des informations à l'utilisateur final sur la façon d'installer ou de supprimer ce module RF ou modifier les paramètres liés RF dans le manuel utilisateur du produit final.

Le manuel d'utilisation pour le produit final doit comporter les informations suivantes dans un endroit bien en vue:

Pour se conformer aux limites d'exposition aux RF de la FCC et d'Industrie Canada pour la population générale / exposition non contrôlée, l'antenne(s) utilisée pour ce transmetteur doit être installé pour fournir une distance de séparation d'au moins 29mm de toutes les personnes et fonctionnant conjointement avec une autre antenne ou émetteur, sauf en conformité avec les procédures de produits multi-émetteur FCC.

Autres déclarations manuel de l'utilisateur peuvent s'appliquer.

EUROPE

CE Notice

This device has been tested and certified for use in the European Union. See the Declaration of Conformity (DOC) for specifics.

If this device is used in a product, the OEM has responsibility to verify compliance of the final product to the EU standards. A Declaration of Conformity must be issued and kept on file as described in the Radio and Telecommunications Terminal Equipment (R&TTE) Directive.

The 'CE' mark must be placed on the OEM product per the labeling requirements of the Directive.

Declaration of Conformity (DOC)

This DOC can be downloaded from the LSR Website.

AUSTRALIA

RCM

| |
|---|
| <p>Radiocommunications (Short Range Devices) Standard 2014 (Amnt 1:2015) Radiocommunications (Low Interference Potential Device) Class License 2015</p> |
| <p>AS/NZS 4268: 2012-A1:2013 EN 300328 V1.9.1 Report No.: 316052 (316051), Dated: 21 July 2016, LS Research</p> |
| <p>Radiocommunications (Electromagnetic Compatibility) Standard 2008</p> |
| <p>EN 55022 : 2010/AC :2011 Information Technology Equipment – Radio disturbance characteristics – Limits and methods measurement Report No. : TR 316051 B, dated : 6 July 2016, LS Research</p> |
| <p>Radiocommunications (Electromagnetic Radiation – Human Exposure) Standard 2014</p> |
| <p>Maximum Exposure Levels to Radio Frequency Fields – 3 KHz to 300 GHz (2002) RPS 3, ARPANSA Category B Exemption – Fixed Station Exemption, ARPANSA Schedule 5, General Public Exposure, <20mW Mean Power, Or no antenna near the body (>20cm from unaware user) and mean output power does not exceed Table 2 threshold for testing.</p> |

Table 20 AU/NZS Certification

If this device is used in a product, the OEM has responsibility to verify compliance of the final end product to the Australia/New Zealand (RCM) Standards. All end-products require their own certification (SDoc). You will not be able to leverage the module certification and ship product into the country.

BLUETOOTH SIG QUALIFICATION

Overview

The Sterling-LWB module is listed on the Bluetooth SIG website as a qualified Controller Subsystem.

| Design Name | Owner | Declaration ID | Link to listing on the SIG website |
|-------------|-------|----------------|---------------------------------------|
| 450-0159 | Laird | D031500 | Sterling-LWB 450-0159 |
| 450-0148 | Laird | D031500 | Sterling-LWB 450-0148 |
| 450-0152 | Laird | D031500 | Sterling-LWB 450-0152 |

Table 21 Sterling-LWB Declaration ID

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

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

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

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

For a detailed procedure of how to obtain a new Declaration ID for your design, please refer to the following SIG document, (login is required to view this document):

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

Qualification Steps When Referencing a Laird Controller Subsystem Design

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

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

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

2. In step 1, select the option, New Listing and Reference a Qualified Design.
3. Enter 85005 in the Controller Subsystem table entry.
4. Enter your complimentary Host Subsystem and optional Profile Subsystem in the table entry.
5. Select your pre-paid Declaration ID from the drop down menu or go to the Purchase Declaration ID page.

The information in this document is subject to change without notice.

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

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

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

For further information please refer to the following training material:

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

Additional Assistance

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

Laird Technologies Connectivity Products Business Unit
Support Centre: <http://ews-support.lairdtech.com>

Email: wireless.support@lairdtech.com

Phone: Americas: +1-800-492-2320
Europe: +44-1628-858-940
Hong Kong: +852 2923 0610

Web: <http://www.lairdtech.com/bluetooth>

BASE SIP MODULE MECHANICAL DATA

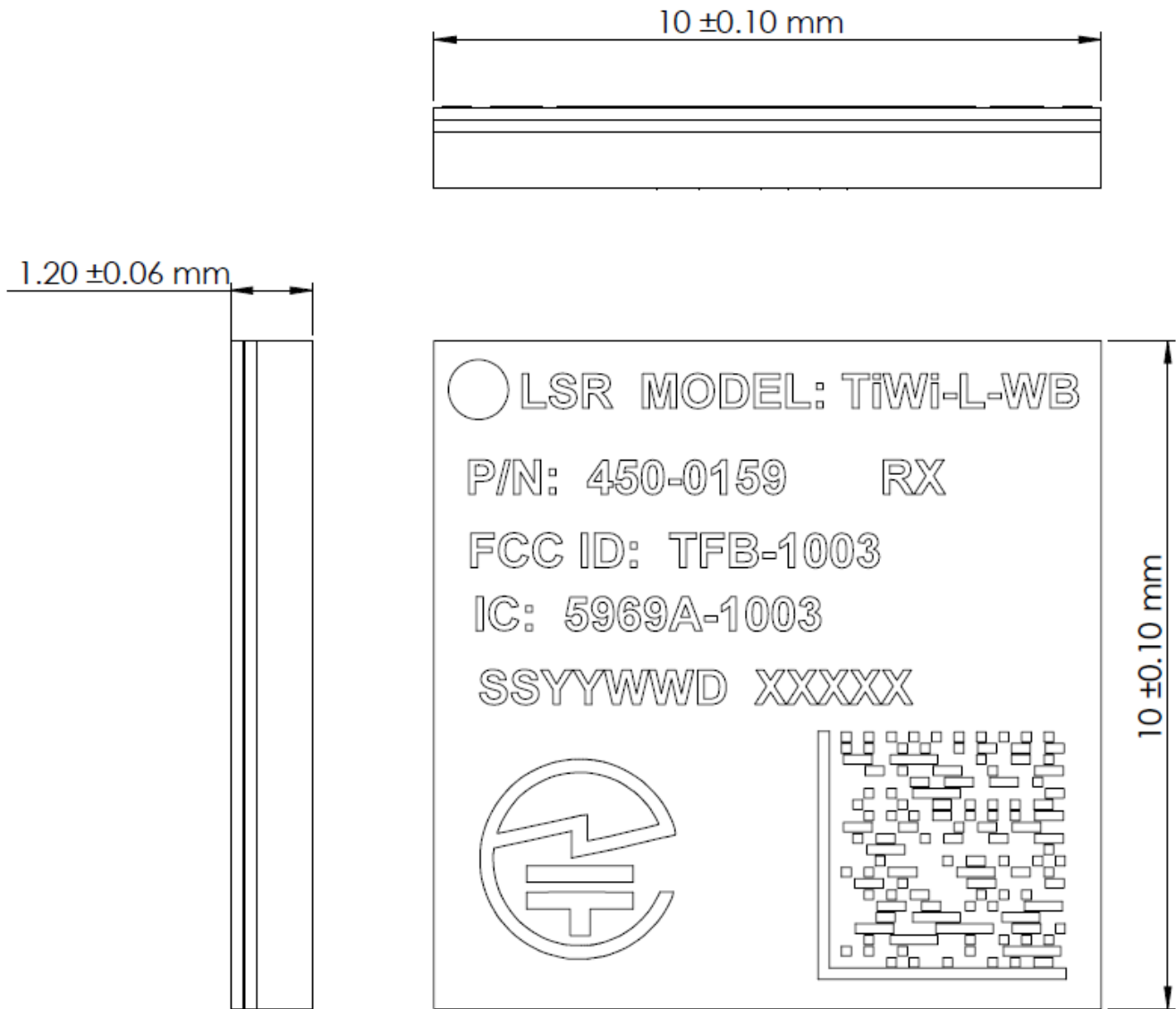
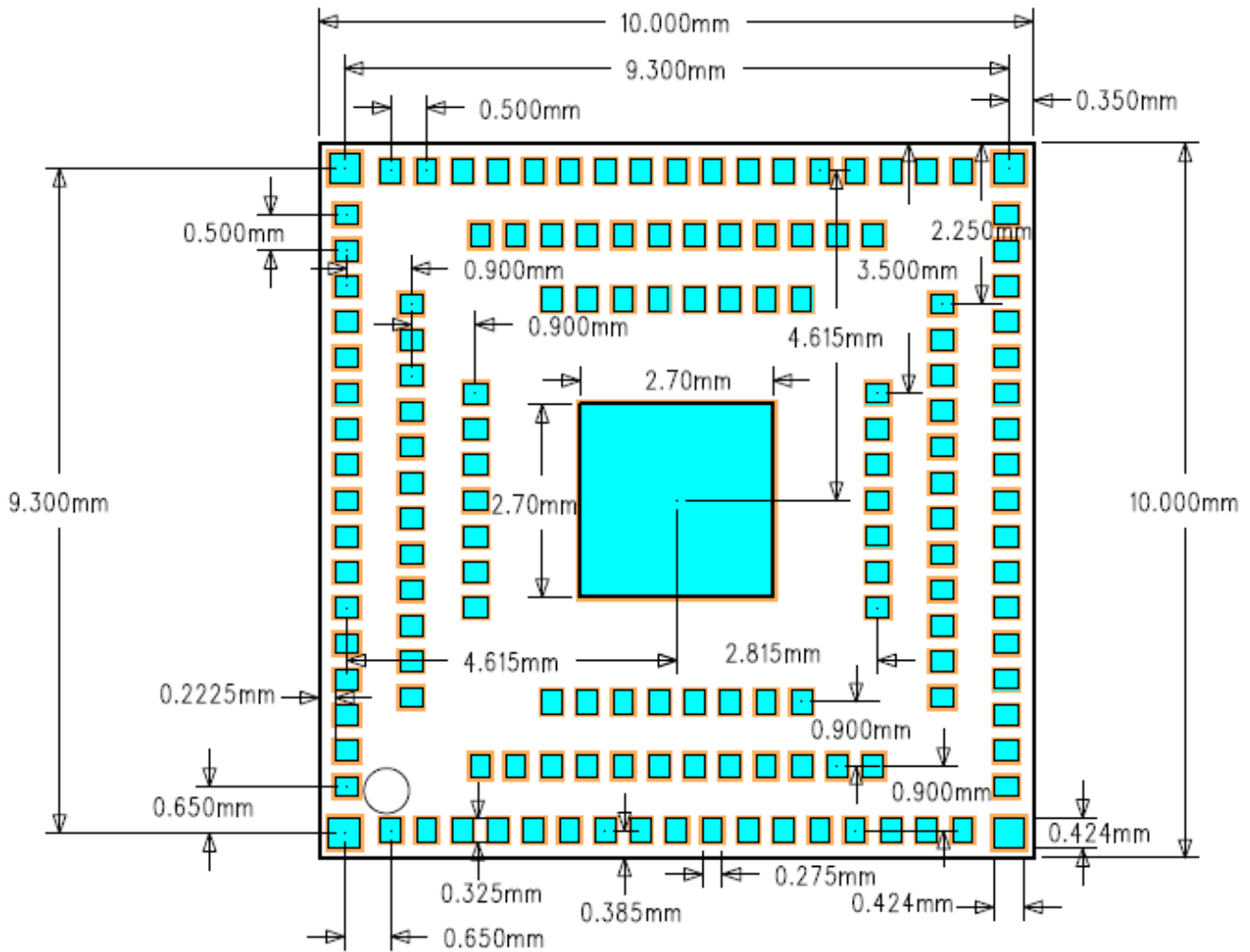


Figure 20 Base SIP Module Mechanical Dimensions

BASE SIP MODULE PCB FOOTPRINT



©

Figure 21 Base SIP Module Footprint (Top View)

Note:

| Three Pad Sizes | Solder Mask |
|---------------------------|------------------|
| Type A - 0.424 x 0.424 mm | 0.524 x 0.524 mm |
| Type B - 0.275 x 0.325 mm | 0.35 x 0.40mm |
| Type C - 2.7 x 2.7 mm | 2.8 x 2.8 mm |

BASE SIP MODULE RECOMMENDED SOLDER STENCIL

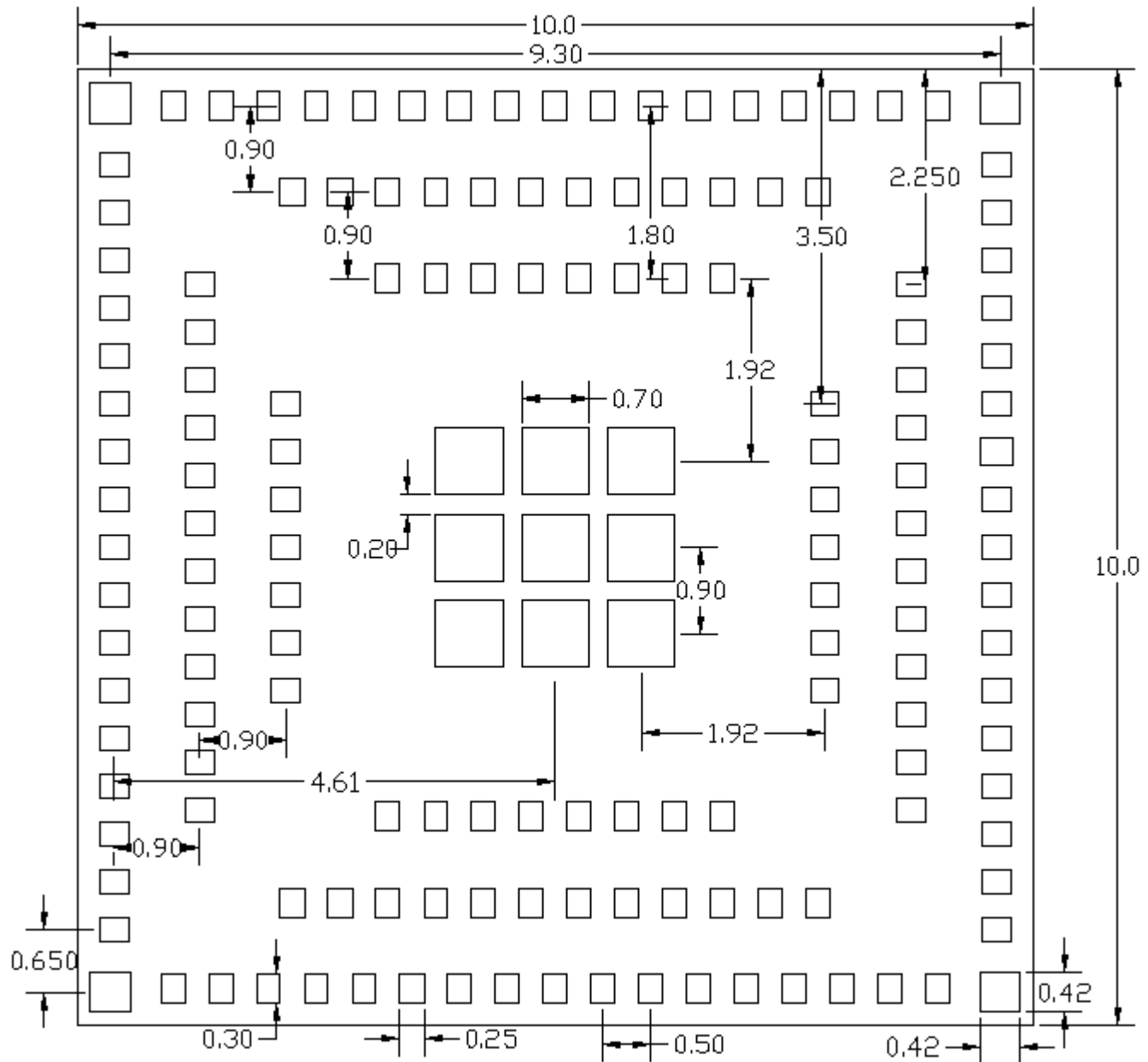
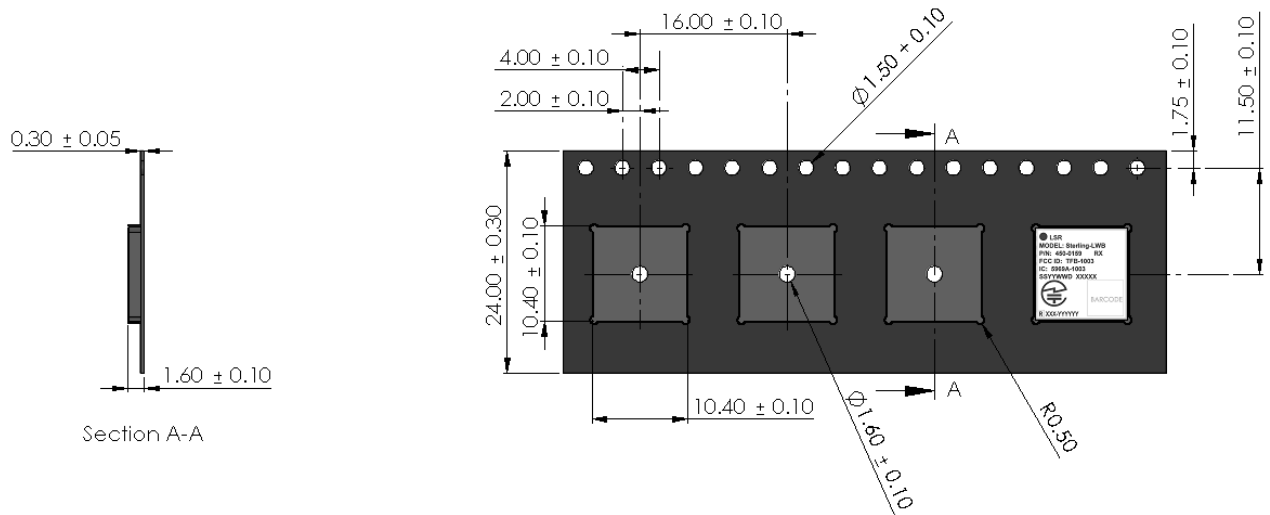


Figure 22 – Base SiP Module Recommended Solder Stencil (Top View)

Note: Solder Mask and Paste Mask to be adjusted according to end users assembly process

BASE SiP MODULE TAPE AND REEL PACKAGING

Tape Dimensions



- NOTES:
1. DIM in mm.
 2. 10 Sprocket Hole Pitch Cumulative Tolerance ± 0.20 mm.
 3. Pocket Position Relative to Sprocket Hole Measured as True Position of Pocket, not Pocket Hole
 4. A Full Reel contains 2000 modules.

(Module must be in this Orientation when Feeding Tape)

Figure 23 Base SiP Module Tape and Reel Specification

U.FL AND CHIP ANTENNA MECHANICAL DATA

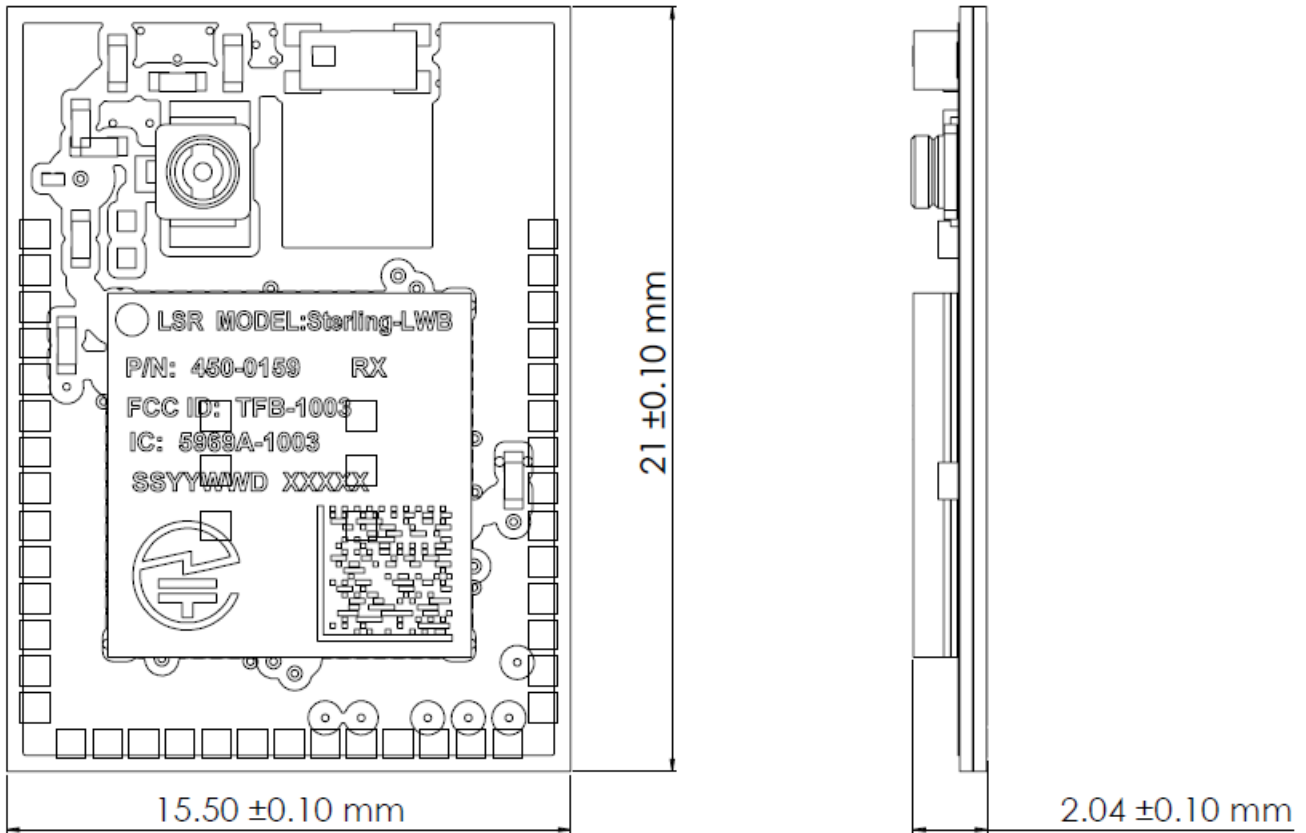


Figure 24 U.FL and Chip Antenna Mechanical Dimensions

U.FL AND CHIP ANTENNA PCB FOOTPRINT

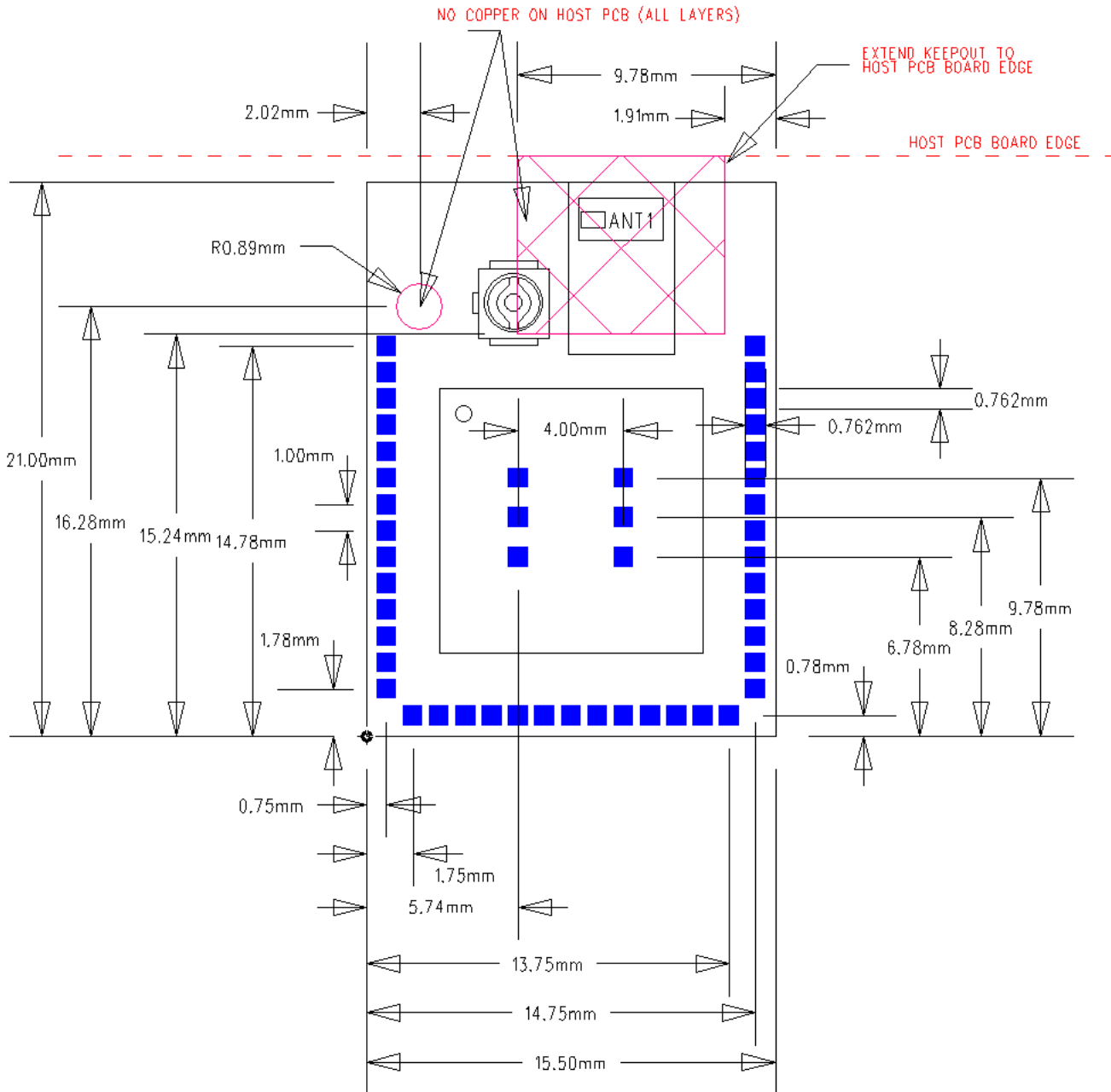
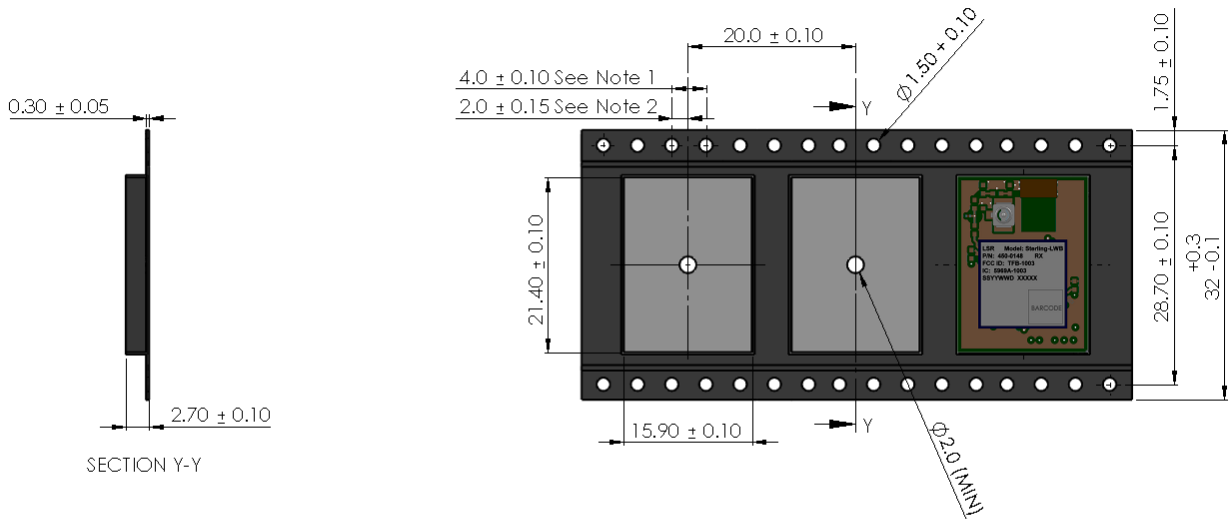


Figure 25 U.FL and Chip Antenna Host PCB Footprint

Note: All Pads .762mm x .762mm Square. Solder Mask and Paste Mask to be adjusted according to end users assembly process

U.FL AND CHIP ANTENNA TAPE AND REEL PACKAGING

Tape Dimensions



NOTES:

1. DIM in mm.
2. 10 Sprocket Hole Pitch Cumulative Tolerance ± 0.1 mm.
3. Pocket Position Relative to Sprocket Hole Measured as True Position of Pocket, not Pocket Hole
4. A Full Reel contains 1000 modules.

(Module must be in this Orientation when Feeding Tape)

Figure 26 U.FL and Chip Antenna Modules Tape and Reel Specification

DEVICE MARKINGS

Rev 1 Devices

- Initial Release



The shield on the 450-0148 / 450-0152 /450-0159 modules contains the following information:

- LSR Model: Sterling-LWB
- Part Number and Revision:
 - Part Number: 450-0148 or 450-0152 or 450-0159
 - R1 = Revision 1
- FCC ID: TFB-1003
- IC: 5969A-1003
- SSYYWWD = Date Code (SS=Manufacturer, YY=Year, WW=Week, D=Day)
- XXXXX = Incremental Serial Number
- 2D Barcode Format is Data Matrix Standard

Rev 2 Devices

- Updated the label to include Giteki marking information.



The shield on the 450-0148 / 450-0152 /450-0159 modules contains the following information:

- LSR Model: Sterling-LWB
- Part Number and Revision:
 - Part Number: 450-0148 or 450-0152 or 450-0159
 - R2 = Revision 2
- FCC ID: TFB-1003
- IC: 5969A-1003
- SSYYWWD = Date Code (SS=Manufacturer, YY=Year, WW=Week, D=Day)
- XXXXX = Incremental Serial Number
- 2D Barcode Format is Data Matrix Standard



- Giteki Logo
- Giteki Symbol of Radio Certification: R in the Square Box
- Giteki Certification Type Number: 209-J00212. 209 is the CAB ID assigned by the Minister of MIC. J00212 is the Certification Number assigned by the CAB.

Rev 3 Devices

- Updated the label to include RCM marking information.



The shield on the 450-0148 / 450-0152 /450-0159 modules contains the following information:

- LSR Model: Sterling-LWB
- Part Number and Revision:
 - Part Number: 450-0148 or 450-0152 or 450-0159
 - R3 = Revision 3
- FCC ID: TFB-1003
- IC: 5969A-1003
- SSYYWWD = Date Code (SS=Manufacturer, YY=Year, WW=Week, D=Day)
- XXXXX = Incremental Serial Number
- 2D Barcode Format is Data Matrix Standard



- Giteki Logo
- Giteki Symbol of Radio Certification: R in the Square Box
- Giteki Certification Type Number: 209-J00212. 209 is the CAB ID assigned by the Minister of MIC. J00212 is the Certification Number assigned by the CAB.



- RCM Logo (Australia/New Zealand Certification)

CONTACTING LSR

| | |
|--------------------------|--|
| Headquarters | LS Research, LLC W66 N220 Commerce Court Cedarburg, WI 53012-2636 USA Tel: (262) 375-4400 Fax: (262) 375-4248 |
| Website | www.lsr.com |
| Technical Support | forum.lsr.com |
| Sales Contact | sales@lsr.com |

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