



# **Bluetooth v4.0 Dual-Mode USB HCI Module**

## **Hardware Integration Guide (HIG)**

*Version 1.10*

BT800

**global solutions: local support™**

Americas: +1-800-492-2320

Europe: +44-1628-858-940

Hong Kong: +852-2923-0610

**Embedded Wireless Solutions Support Center:** <http://ews-support.lairdtech.com>

[www.lairdtech.com/bluetooth](http://www.lairdtech.com/bluetooth)

## REVISION HISTORY

| Revision | Date          | Changes                                                                                                                                                                                                                                                                                                                                                                                        | Approved By   |
|----------|---------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| 1.0      | 04 Sept 2013  | Initial Release                                                                                                                                                                                                                                                                                                                                                                                | Jonathan Kaye |
| 1.1      | 23 Sept 2013  | Updated Regulatory/Certification section                                                                                                                                                                                                                                                                                                                                                       | Jonathan Kaye |
| 1.2      | 07 Oct 2013   | Update BT SIG Approvals section<br>Edited text in <i>Low-voltage VDD_RADIO Linear Regulator</i> section                                                                                                                                                                                                                                                                                        | Jonathan Kaye |
| 1.3      | 04 Feb 2014   | Added following SPI note where applicable:<br><br><b>Note:</b> The purpose of the SPI interface is to access the module's inner settings such as selecting different WLAN CO-EXIST scheme and enabling HID proxy mode. The SPI interface can also be used to put the module in RF test mode. You cannot use the module over the SPI interface for normal operation as the main host interface. | Jonathan Kaye |
| 1.4      | 05 Feb 2014   | Updated the Bluetooth SIG Approvals section.                                                                                                                                                                                                                                                                                                                                                   | Jonathan Kaye |
| 1.5      | 16 July 2014  | Updated Pin Definitions with "If Unconnected" information.                                                                                                                                                                                                                                                                                                                                     | Jonathan Kaye |
| 1.6      | 03 Dec 2014   | Updated the Power Control and Regulation section.                                                                                                                                                                                                                                                                                                                                              | Jonathan Kaye |
| 1.7      | 25 March 2015 | Updated document links                                                                                                                                                                                                                                                                                                                                                                         | Sue White     |
| 1.8      | 28 April 2015 | Removed MIC certification references                                                                                                                                                                                                                                                                                                                                                           | Sue White     |
| 1.9      | 10 Aug 2015   | Added Tape/Reel packaging information                                                                                                                                                                                                                                                                                                                                                          | Jonathan Kaye |
| 1.10     | 08 Sept 2015  | Added MIC certification references                                                                                                                                                                                                                                                                                                                                                             | Sue White     |

## CONTENTS

|                                                       |    |
|-------------------------------------------------------|----|
| Revision History .....                                | 2  |
| Contents .....                                        | 3  |
| 1 Scope .....                                         | 5  |
| 2 Operational Description .....                       | 5  |
| Features and Benefits .....                           | 5  |
| Application Areas .....                               | 5  |
| 3 Block Diagram and Descriptions .....                | 6  |
| 4 Specifications .....                                | 7  |
| 5 Pin Definitions .....                               | 8  |
| 6 DC Electrical Characteristic .....                  | 9  |
| 7 RF Characteristics .....                            | 11 |
| 8 Interface .....                                     | 12 |
| 8.1 PIO .....                                         | 12 |
| 8.2 WLAN Coexistence Interface .....                  | 12 |
| 8.3 USB Interface .....                               | 12 |
| 8.4 PCM Interface .....                               | 13 |
| 8.5 GCI Interface .....                               | 15 |
| 8.6 Slots and Sample Formats .....                    | 15 |
| 8.7 PCM Timing Information .....                      | 16 |
| 8.8 PCM Slave Timing .....                            | 18 |
| 8.9 PCM Slave Mode Timing Parameters .....            | 18 |
| 8.10 PCM_CLK and PCM_SYNC Generation .....            | 19 |
| 8.11 PCM Configuration .....                          | 20 |
| 8.12 Digital Audio Interface (I <sup>2</sup> S) ..... | 20 |
| 9 Power Control and Regulation .....                  | 23 |
| 9.1 USB Linear Regulator .....                        | 23 |
| 9.2 High-voltage Linear Regulator .....               | 23 |
| 9.3 Voltage Regulator Enable and Reset .....          | 24 |
| 9.4 Power Sequencing .....                            | 24 |
| 10 Antenna Performance .....                          | 25 |
| 11 Mechanical Dimensions and Land Pattern .....       | 27 |
| 12 Implementation Note .....                          | 28 |
| 12.1 PCB Layout on Host PCB .....                     | 28 |
| 13 Application Note for Surface Mount Modules .....   | 30 |
| 13.1 Introduction .....                               | 30 |
| 13.2 Shipping .....                                   | 30 |
| 13.3 Reflow Parameters .....                          | 33 |
| 14 Japan (MIC) Regulatory .....                       | 34 |
| 15 FCC and IC Regulatory .....                        | 35 |
| 16 European Union Regulatory .....                    | 37 |
| 17 Ordering Information .....                         | 38 |
| 17.1 General Comments .....                           | 38 |
| 18 Bluetooth SIG Approvals .....                      | 38 |
| 18.1 Application Note: Subsystem Combinations .....   | 38 |
| 18.2 Additional Assistance .....                      | 40 |

# BT800 Hardware Integration Guide

Version 1.10

## 1 SCOPE

This document describes key hardware aspects of the Laird BT800 Bluetooth HCI/HID module. This document is intended to assist device manufacturers and related parties with the integration of this module into their host devices. Data in this document are drawn from a number of sources including data sheets for the CSR8510.

Because the BT800 is currently in development stage, this document is preliminary and the information in this document is subject to change. Please contact Laird Technologies or visit the Laird website at [www.Lairdtech.com](http://www.Lairdtech.com) to obtain the most recent version of this document.

## 2 OPERATIONAL DESCRIPTION

The BT800 series of USB HCI devices are designed to meet the needs of OEMs adding robust Bluetooth connectivity and using embedded Bluetooth stacks within these products.

Leveraging the market-leading CSR8510 chipset, the BT800 series provides exceptionally low power consumption with outstanding range. Supporting the latest Bluetooth v4.0 Specification with EDR (Enhanced Data Rate), the Laird BT800 series enables OEMs to accelerate their development time for leveraging either Classic Bluetooth or Bluetooth Low Energy (BLE) into their operating system based devices.

With a tiny footprint as small as 8.5 x 13 mm, yet output power at 8 dBm, these modules are ideal for applications where designers need high performance in minimal size. For maximum flexibility in systems integration, the modules are designed to support a full speed USB interface plus GPIO and additionally I2S and PCM audio interfaces.

These modules present an HCI interface and have native support for Windows and Linux Bluetooth software stacks. All BT800 series devices are fully qualified as Bluetooth Controller Subsystem products. This also allows designers to integrate their existing pre-approved Bluetooth Host and Profile subsystem stacks to gain a Bluetooth END product approval for their products.

The BT800 series is engineered to provide excellent RF performance with integrated antenna and additional band pass filters. It further reduces regulatory and testing requirements for OEMs and ensures a hassle free development cycle. As an additional benefit of the BT800 series, Laird has implemented CSR's HID (Human Interface Device) Proxy Mode enabling out of the box HID connectivity for pointing devices and / or keyboard functionality, requiring zero host device software or configuration.

A fully featured, low-cost developer's kit is available for prototyping, debug, and integration testing of the BT800 series modules and further reduces risk and time in development cycles.



*BT800 module*



*BT820 USB dongle*

### Features and Benefits



- Bluetooth v4.0 - Dual mode (Classic Bluetooth and BLE)
- Compact footprint
- 2-wire and 3-wire Wi-Fi coexistence scheme
- High antenna radiation gain and efficiency
- Good interference rejection for multi-com system (GSM/WCDMA)
- Class 1 output – 8 dBm
- USB, GPIO, I2S, and PCM
- Industrial Temperature Range
- 64 k EEPROM support for HID Proxy mode
- Bluetooth Controller subsystem
- FCC, IC, MIC, and CE approvals

### Application Areas

- Medical devices
- ePOS terminals
- Barcode scanners
- Industrial Cable Replacement
- M2M Connectivity
- Automotive Diagnostic Equipment
- Personal Digital Assistants (PDA)
- Bluetooth HID device (keyboard, mouse, joystick)

### 3 BLOCK DIAGRAM AND DESCRIPTIONS

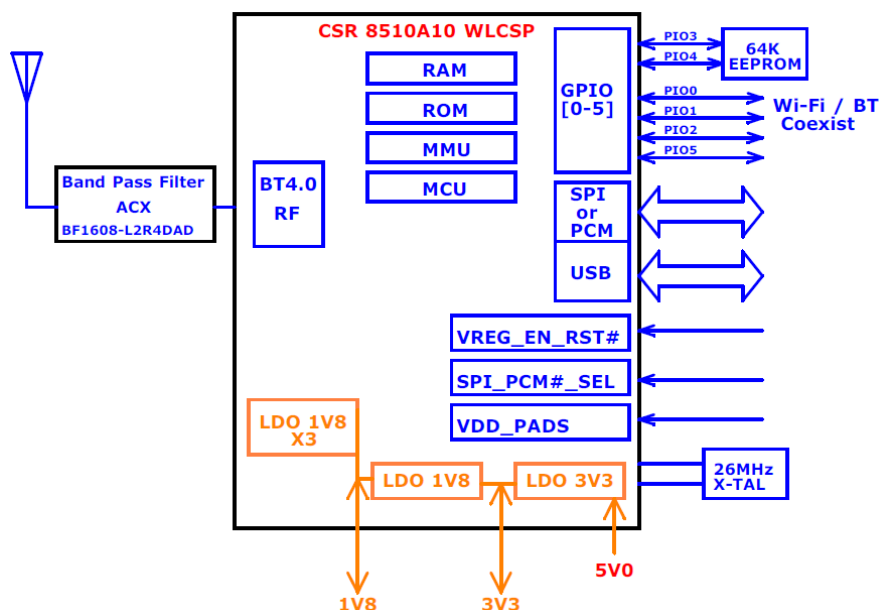


Figure 1: BT800 module block diagram

**CS8510A10 (Main chip)** The BT800 is based on CSR8510A10 dual mode chip. The chip is a single-chip radio with on-chip LDO regulators and baseband IC for Bluetooth 2.4 GHz systems including EDR to 3 Mbps. Dedicated signal and baseband processing is included for full Bluetooth operation. The chip provides SPI/PCM and USB interfaces. Up to four general purpose I/Os are available for general use such as Wi-Fi coexistence or general indicators.

**Note:** The purpose of the SPI interface is to access the module's inner settings such as selecting different WLAN CO-EXIST scheme and enabling HID proxy mode. The SPI interface can also be used to put the module in RF test mode. You cannot use the module over the SPI interface for normal operation as the main host interface.

|                         |                                                                                                                                                                                                                                                                                  |
|-------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Antenna</b>          | BT800- The antenna is a ceramic monopole chip antenna.                                                                                                                                                                                                                           |
| <b>Band Pass Filter</b> | The band pass filter filters the out-of-band emissions from the transmitter to meet the specific regulations for type approvals of various countries.                                                                                                                            |
| <b>EEPROM</b>           | There are 64 k bits EEPROM embedded on the BT800 module which can be used to store customizable parameters, such as maximum TX power, PCM configuration, USB product ID, USB vendor ID, and USB product description. With that, the BT800 module can support HID/HCI Proxy mode. |
| <b>Crystal</b>          | The embedded 26 MHz crystal is used for generating the clock for the entire module.                                                                                                                                                                                              |

## 4 SPECIFICATIONS

Table 1: BT800 specifications

| CATEGORIES             | FEATURE                | IMPLEMENTATION                                                                                                               |
|------------------------|------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Wireless Specification | Bluetooth®             | V4.0 Dual Mode                                                                                                               |
|                        | Frequency              | 2.402 - 2.480 GHz                                                                                                            |
|                        | Maximum Transmit Power | Class 1<br>+8 dBm from antenna                                                                                               |
|                        | Receive Sensitivity    | -89 dBm                                                                                                                      |
|                        | Range                  | Circa 100 meters                                                                                                             |
|                        | Data Rates             | Up to 3 Mbps (over the air)                                                                                                  |
| Host Interface         | USB                    | Full Speed USB 2.0                                                                                                           |
|                        | GPIO                   | Four configurable lines<br>(1.8V/3.3V configurable by VDD_PADS)                                                              |
| Operational Modes      | HCI                    | Host Controller Interface over USB                                                                                           |
|                        | HID Proxy Mode         | Human Interface Device                                                                                                       |
| EEPROM                 | 2-wire                 | 64 K bits                                                                                                                    |
| Coexistence            | 802.11 (Wi-Fi)         | 3 wire CSR schemes supported<br>(Unity-3;Unity-3e, and Unity+)                                                               |
| Supply Voltage         | Supply                 | 5V +/-10%<br><b>Note:</b> See <a href="#">Implementation Note</a> for details on different DC power selections on the BT800. |
|                        | Current                | Idle Mode ~5 mA<br>File Transfer ~58 mA                                                                                      |
| Antenna Option         | Internal               | Multilayer ceramic antenna with up to 41% efficiency.                                                                        |
| Physical               | Dimensions             | 8.5 x 13 x 1.6 mm (BT800 - Module)                                                                                           |
|                        |                        | 16 x 43 x 11 (BT820 – USB Dongle)                                                                                            |
| Environmental          | Operating              | -30C to +85C                                                                                                                 |
|                        | Storage                | -40C to +85C                                                                                                                 |
| Miscellaneous          | Lead Free              | Lead-free and RoHS compliant                                                                                                 |
|                        | Warranty               | 5-Year Limited Lifetime                                                                                                      |
| Approvals              | Bluetooth®             | Controller Subsystem Approved                                                                                                |
|                        | FCC / IC / CE          | All BT800 series                                                                                                             |

## 5 PIN DEFINITIONS

Table 2: BT800 pin definitions

| #  | Pin Name                       | I/O                                                    | Supply Domain            | Description                                                                                                                                                                                 | If Unused |
|----|--------------------------------|--------------------------------------------------------|--------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 1  | SPI_PCM#_SEL                   | Input with weak internal pull-down                     | VDD_PADS                 | High switches SPI/PCM lines to SPI,<br>Low switches SPI/PCM lines to PCM/PIO<br><b>*See Note 1.</b>                                                                                         | NC        |
| 2  | VDD_HOST                       | Power supply                                           | (3.1V-3.6V)              | USB system positive supply                                                                                                                                                                  | N/A       |
| 3  | GND                            | GND                                                    | -                        | Ground                                                                                                                                                                                      | GND       |
| 4  | USB+                           | Bidirectional                                          | VDD_HOST                 | USB data plus with selectable internal 1.5k $\Omega$ pull-up resistor                                                                                                                       | NC        |
| 5  | USB-                           | Bidirectional                                          | VDD_HOST                 |                                                                                                                                                                                             | NC        |
| 6  | GND                            | GND                                                    | -                        | Ground                                                                                                                                                                                      | GND       |
| 7  | VREG_IN_USB                    | Power supply                                           | Analogue regulator input | Input to USB regulator. Connect to external USB bus supply (USB_VBUS)                                                                                                                       | N/A       |
| 8  | VREG_EN_RST#                   | Input with strong internal pull-down                   | VDD_PADS                 | Take high to enable internal regulators. Also acts as active low reset. Maximum voltage is VDD_PADS.<br><b>Note:</b> <i>USB regulator is always enabled and not controlled by this pin.</i> | NC        |
| 9  | VREG_IN_HV                     | Analogue regulator input / output                      | 3.3V                     | Input to internal high-voltage regulator to 1.8V regulator, 3.3V output from USB regulator.                                                                                                 | N/A       |
| 10 | VREG_OUT_HV                    | Analogue regulator input / output                      | 1.8V                     | Output from internal high-voltage to 1.8V regulator. Input to second stage internal regulators.                                                                                             | N/A       |
| 11 | GND                            | GND                                                    | -                        | Ground                                                                                                                                                                                      | GND       |
| 12 | GND                            | GND                                                    | -                        | Ground                                                                                                                                                                                      | GND       |
| 13 | GND                            | GND                                                    | -                        | Ground                                                                                                                                                                                      | GND       |
| 14 | GND                            | GND                                                    | -                        | Ground                                                                                                                                                                                      | GND       |
| 15 | GND                            | GND                                                    | -                        | Ground                                                                                                                                                                                      | GND       |
| 16 | GND                            | GND                                                    | -                        | Ground                                                                                                                                                                                      | GND       |
| 17 | NC                             | -                                                      | -                        | This pin is reserved for future use. No connection.                                                                                                                                         | -         |
| 18 | GND                            | GND                                                    | -                        | Ground                                                                                                                                                                                      | GND       |
| 19 | PCM_SYNC/<br>SPI_CS#/<br>PIO23 | Bidirectional, tri-state, with weak internal pull-down | VDD_PADS                 | PCM synchronous data sync SPI chip select, active low<br>Programmable input/output line<br><b>*See Note 1.</b>                                                                              | NC        |

| #  | Pin Name                       | I/O                                                    | Supply Domain | Description                                                                                             | If Unused |
|----|--------------------------------|--------------------------------------------------------|---------------|---------------------------------------------------------------------------------------------------------|-----------|
| 20 | PCM_CLK/<br>SPI_CLK/<br>PIO24  | Bidirectional, tri-state, with weak internal pull-down | VDD_PADS      | PCM synchronous data clock<br>SPI clock<br>Programmable input/output line<br><b>*See Note 1.</b>        | NC        |
| 21 | PCM_IN/<br>SPI_MOSI/<br>PIO21  | Input, tri-state, with weak internal pull-down         | VDD_PADS      | PCM synchronous data input<br>SPI data input<br>Programmable input/output line<br><b>*See Note 1.</b>   | NC        |
| 22 | PCM_OUT/<br>SPI_MISO/<br>PIO22 | Output, tri-state, with weak internal pull-down        | VDD_PADS      | PCM synchronous data output<br>SPI data output<br>Programmable input/output line<br><b>*See Note 1.</b> | NC        |
| 23 | PIO0/<br>WLAN_ACTIVE           | Bidirectional, tri-state, with weak internal pull-down | VDD_PADS      | Programmable input/output line                                                                          | NC        |
| 24 | GND                            | GND                                                    | -             | Ground                                                                                                  | GND       |
| 25 | PIO1/<br>BT_PIRORITY           | Bidirectional, tri-state, with weak internal pull-down | VDD_PADS      | Programmable input/output line                                                                          | NC        |
| 26 | PIO2/<br>BT_ACTIVE             | Bidirectional, tri-state, with weak internal pull-down | VDD_PADS      | Programmable input/output line                                                                          | NC        |
| 27 | VDD_PADS                       | Power supply                                           | (1.7V-3.6V)   | Positive supply for digital I/O pads                                                                    | N/A       |
| 28 | PIO5                           | Bidirectional, tri-state, with weak internal pull-down | VDD_PADS      | Programmable input/output line                                                                          | NC        |

**Note 1:** The purpose of the SPI interface is to access the module's inner settings such as selecting different WLAN CO-EXIST scheme and enabling HID proxy mode. The SPI interface can also be used to put the module in RF test mode. You cannot use the module over the SPI interface for normal operation as the main host interface.

## 6 DC ELECTRICAL CHARACTERISTIC

**Table 3: Absolute maximum ratings**

| Rating              | Min  | Max  | Unit |
|---------------------|------|------|------|
| Storage temperature | -40  | +85  | °C   |
| VREG_IN_USB         | -0.2 | 5.75 | V    |
| VREG_IN_HV          | -0.2 | 4.9  | V    |

## BT800 Hardware Integration Guide

Version 1.10

|                         |            |             |   |
|-------------------------|------------|-------------|---|
| VDD_HOST                | -0.2       | 3.7         | V |
| VDD_PADS                | -0.2       | 3.7         | V |
| Other terminal voltages | VSS - 0.4V | VDD + 0.4 V | V |

**Table 4: Recommended operating conditions**

| Rating                | Min | Max | Unit |
|-----------------------|-----|-----|------|
| Operating temperature | -30 | +85 | °C   |
| VREG_IN_USB           | 4.5 | 5.5 | V    |
| VREG_IN_HV            | 3.1 | 3.6 | V    |
| VDD_HOST              | 3.1 | 3.6 | V    |
| VDD_PADS              | 1.7 | 3.6 | V    |

**Table 5: USB Linear Regulator**

| Rating                      | Min | Typ | Max | Unit |
|-----------------------------|-----|-----|-----|------|
| Input voltage (VREG_IN_USB) | 4.5 | 5.0 | 5.5 | V    |
| Output voltage (VREG_IN_HV) | 3.2 | 3.3 | 3.4 | V    |
| Output current              | -   | -   | 150 | mA   |

**Table 6: High-voltage Linear Regulator**

| Normal Operation                                           | Min  | Typ  | Max  | Unit   |
|------------------------------------------------------------|------|------|------|--------|
| Input voltage (VREG_IN_HV)                                 | 3.1  | 3.3  | 3.6  | V      |
| Output voltage (VREG_OUT_HV)                               | 1.75 | 1.85 | 1.95 | V      |
| Temperature coefficient                                    | -200 | -    | 200  | ppm/°C |
| Output noise<br>(frequency range 100Hz to 100kHz)          | -    | -    | 0.4  | mV rms |
| Settling time (settling time<br>within 10% of final value) | -    | -    | 5    | µs     |
| Output current                                             | -    | -    | 100  | mA     |
| Quiescent current<br>(excluding load, load <1mA)           | 30   | 40   | 60   | µA     |
| <b>Low-power Mode</b>                                      |      |      |      |        |
| Quiescent current<br>(excluding load, load <100µA)         | 14   | 18   | 23   | µA     |

**Table 7: Digital I/O Characteristics**

| Normal Operation           | Min          | Typ | Max          | Unit |
|----------------------------|--------------|-----|--------------|------|
| <b>Input Voltage</b>       |              |     |              |      |
| VIL input logic level low  | -0.4         | -   | 0.4          | V    |
| VIH input logic level high | 0.7 x<br>VDD | -   | VDD +<br>0.4 | V    |
| <b>Output Voltage</b>      |              |     |              |      |

| Normal Operation                             | Min           | Typ  | Max   | Unit |
|----------------------------------------------|---------------|------|-------|------|
| VOL output logic level low,<br>IOL = 4.0 mA  | -             | -    | 0.4   | V    |
| VOH output logic level high,<br>IOL = 4.0 mA | 0.75 x<br>VDD | -    | -     | V    |
| Input and Tristate Currents                  |               |      |       |      |
| Strong pull-up                               | -150          | -40  | -10   | μA   |
| Strong pull-down                             | 10            | 40   | 150   | μA   |
| Weak pull-up                                 | -5            | -1.0 | -0.33 | μA   |
| Weak pull-down                               | 0.33          | 1.0  | 5.0   | μA   |
| CI input capacitance                         | 1.0           | -    | 5.0   | pF   |

**Table 8: Current Consumption**

| Normal Operation      | Peak (8 dBm) | AVG | Unit |
|-----------------------|--------------|-----|------|
| Idle                  |              | 5   | mA   |
| USB Suspend           |              | 200 | μA   |
| Inquiry               | 73           | 51  | mA   |
| File Transfer         | 73           | 58  | mA   |
| LE Connected (Master) | 74           |     | mA   |
| LE Scan (Master)      | 48           |     | mA   |

## 7 RF CHARACTERISTICS

**Table 9: Receiver Characteristics**

| RF Characteristics, VDD = 3.3V @ room temperature unless otherwise specified |                           | Min | Typ. | Max | BT. Spec. | Unit |
|------------------------------------------------------------------------------|---------------------------|-----|------|-----|-----------|------|
| Maximum RF Transmit Power                                                    |                           |     | 8    | 10  | 20        | dBm  |
| RF power variation over temperature range                                    |                           |     | 1.5  |     | -         | dB   |
| RF power variation over supply voltage range                                 |                           |     |      | 0.2 | -         | dB   |
| RF power variation over BT band                                              |                           |     | 2    |     | -         | dB   |
| RF power control range                                                       |                           | -21 |      | 8   | -         | dBm  |
| 20 dB band width for modulated carrier                                       |                           |     |      |     | 1000      | kHz  |
| ACP                                                                          | F = F <sub>0</sub> ± 2MHz |     |      |     | -20       |      |
|                                                                              | F = F <sub>0</sub> ± 3MHz |     |      |     | -40       |      |
|                                                                              | F = F <sub>0</sub> > 3MHz |     |      |     | -40       |      |
| Drift rate                                                                   |                           |     | 10   |     | +/-25     | kHz  |
| ΔF <sub>1avg</sub>                                                           |                           |     | 165  |     | 140<175   | kHz  |
| ΔF <sub>1max</sub>                                                           |                           |     | 168  |     | 140<175   | kHz  |
| ΔF <sub>2avg</sub> / ΔF <sub>1avg</sub>                                      |                           |     | 0.9  |     | >=0.8     |      |

**Table 10: BDR and EDR receiver sensitivity**

| RF Characteristics, VDD = 3.3V @ room temp. | Packet Type | Min | Typ | Max | BT. Spec. | Unit |
|---------------------------------------------|-------------|-----|-----|-----|-----------|------|
|---------------------------------------------|-------------|-----|-----|-----|-----------|------|

|                                              |       |     |     |     |
|----------------------------------------------|-------|-----|-----|-----|
| Sensitivity for 0.1% BER                     | DH1   | -89 | -70 | dBm |
|                                              | DH3   | -89 |     | dBm |
|                                              | DH5   | -89 |     | dBm |
|                                              | 2-DH5 | -92 |     | dBm |
|                                              | 3-DH5 | -85 |     | dBm |
| Sensitivity variation over BT band           | All   | 2   |     | dB  |
| Sensitivity variation over temperature range | All   | TBD |     | dB  |

## 8 INTERFACE

### 8.1 PIO

See the Device Terminal Functions section for the list of supplies to the PIOs (Programmable I/O ports).

PIO lines are configured through software to have either weak or strong pull-ups or pull-downs. All PIO lines are configured as inputs with weak pull-downs at reset and have additional individual bus-keeper configuration.

### 8.2 WLAN Coexistence Interface

Dedicated hardware is provided to implement a variety of WLAN coexistence schemes. There is support for:

- Channel skipping AFH
- Priority signaling
- Channel signaling
- Host passing of channel instructions

The BT800 supports the WLAN coexistence schemes:

- Unity-3
- Unity-3e
- Unity+

For more information see [BT800 WLAN Coexistence Schemes and LED Indication](#).

### 8.3 USB Interface

BT800 has a full-speed (12 Mbps) USB interface for communicating with other compatible digital devices. The USB interface on the BT800 acts as a USB peripheral, responding to requests from a master host controller.

BT800 supports the Universal Serial Bus Specification (USB v2.0 Specification) and USB Battery Charging Specification, available from <http://www.usb.org>. For more information on how to integrate the USB interface on BT800, see [Figure 19](#) located in the following section: [USB Dongle Design Example Using BT800](#).

As well as describing USB basics and architecture, the application note describes:

- Power distribution for high and low bus-powered configurations
- Power distribution for self-powered configuration, which includes USB VBUS monitoring
- USB enumeration
- Electrical design guidelines for power supply and data lines, as well as PCB tracks and effects of ferrite beads
- USB suspend modes and Bluetooth low-power modes
- Global suspend

- Selective suspend, includes remote wake
- Wake on Bluetooth, includes permitted devices and set-up prior to selective suspend
- Suspend mode current draw
- PIO status in suspend mode
- Resume, detach, and wake PIOs
- Battery charging from USB: dead battery provision, charge currents, charging in suspend modes and USB
- VBUS voltage consideration
- USB termination when interface is not in use
- Internal modules, certification and non-specification compliant operation

## 8.4 PCM Interface

The audio PCM interface on the BT800 supports:

- Continuous transmission and reception of PCM encoded audio data over Bluetooth.
- Processor overhead reduction through hardware support for continual transmission and reception of PCM data.
- A bidirectional digital audio interface that routes directly into the baseband layer of the firmware. It does not pass through the HCI protocol layer.
- Hardware on the BT800 for sending data to and from a SCO connection.
- Up to three SCO connections on the PCM interface at any one time.
- PCM interface master, generating PCM\_SYNC and PCM\_CLK.
- PCM interface slave, accepting externally generated PCM\_SYNC and PCM\_CLK.
- Various clock formats including:
  - Long Frame Sync
  - Short Frame Sync
- GCI timing environments.
- 13-bit or 16-bit linear, 8-bit  $\mu$ -law, or A-law companded sample formats.
- Receives and transmits on any selection of three of the first four slots following PCM\_SYNC.

The PCM configuration options are enabled by setting PSKEY\_PCM\_CONFIG32.

### 8.4.1 PCM Interface Master/Slave

When configured as the master of the PCM interface, the BT800 generates PCM\_CLK and PCM\_SYNC.

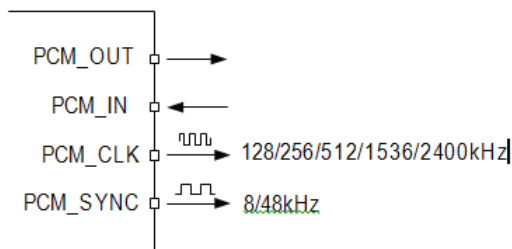


Figure 2: PCM Interface Master

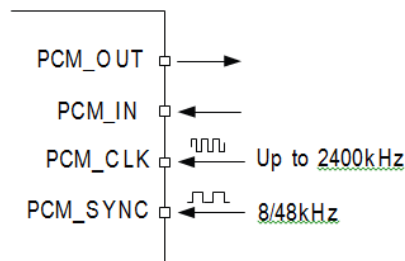


Figure 3: PCM Interface Slave

## 8.4.2 Long Frame Sync

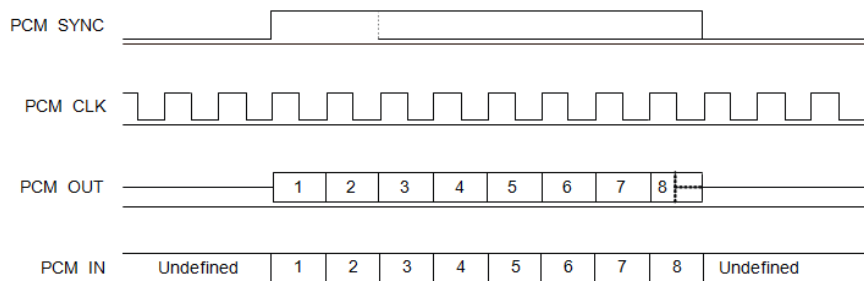


Figure 4: Long Frame Sync (shown with 8-bit Companded Sample)

Long Frame Sync is the name given to a clocking format that controls the transfer of PCM data words or samples. In Long Frame Sync, the rising edge of PCM\_SYNC indicates the start of the PCM word. When the BT800 is configured as PCM master, generating PCM\_SYNC and PCM\_CLK, then PCM\_SYNC is eight bits long. When the BT800 is configured as PCM Slave, PCM\_SYNC is from one cycle PCM\_CLK to half the PCM\_SYNC rate.

BT800 samples PCM\_IN on the falling edge of PCM\_CLK and transmits PCM\_OUT on the rising edge. PCM\_OUT is configurable as high impedance on the falling edge of PCM\_CLK in the LSB position or on the rising edge.

## 8.4.3 Short Frame Sync

In Short Frame Sync, the falling edge of PCM\_SYNC indicates the start of the PCM word. PCM\_SYNC is always one clock cycle long.

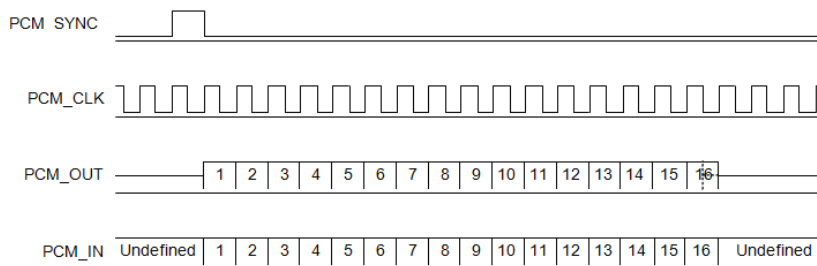


Figure 5: Short Frame Sync (Shown with 16-bit Sample)

As with Long Frame Sync, BT800 samples PCM\_IN on the falling edge of PCM\_CLK and transmits PCM\_OUT on the rising edge. PCM\_OUT is configurable as high impedance on the falling edge of PCM\_CLK in the LSB position or on the rising edge.

## 8.4.4 Multi-Slot Operation

More than 1 SCO connection over the PCM interface is supported using multiple slots. Up to 3 SCO connections are carried over any of the first 4 slots.

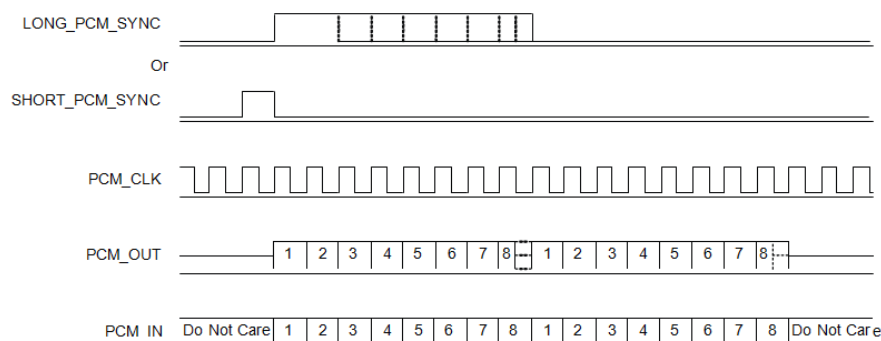


Figure 6: Multi-slot Operation with 2 Slots and 8-bit Companded Samples

## 8.5 GCI Interface

BT800 is compatible with the GCI, a standard synchronous 2B+D ISDN timing interface. The two 64 kbps B channels are accessed when this mode is configured.

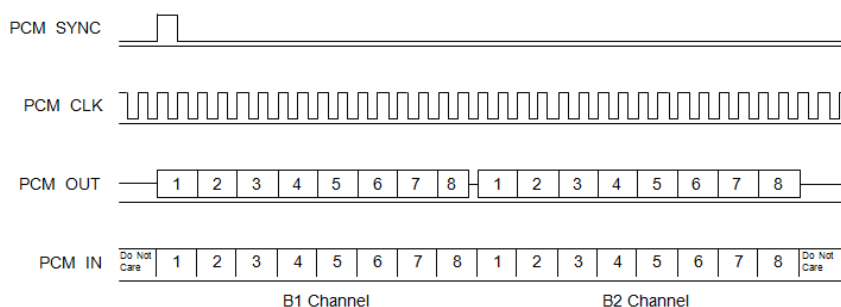


Figure 7: Multi-slot Operation

The start of frame is indicated by the rising edge of PCM\_SYNC and runs at 8 kHz.

## 8.6 Slots and Sample Formats

BT800 receives and transmits on any selection of the first four slots following each sync pulse. Slot durations are either 8 or 16 clock cycles:

- 8 clock cycles for 8-bit sample formats.
- 16 clock cycles for 8-bit, 13-bit, or 16-bit sample formats.

BT800 supports:

- 13-bit linear, 16-bit linear and 8-bit  $\mu$ -law or A-law sample formats
- A sample rate of 8 kbps
- Little or big endian bit order
- For 16-bit slots, the three or eight unused bits in each slot are filled with sign extension, padded with zeros or a programmable 3-bit audio attenuation compatible with some codecs.

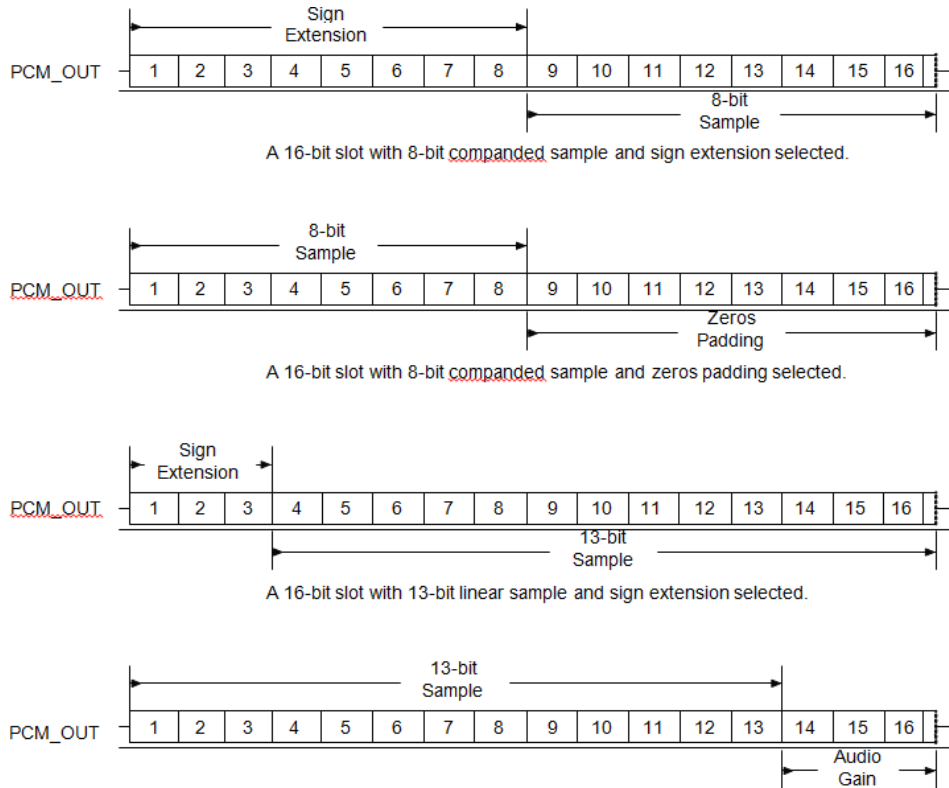


Figure 8: 16-bit Slot Length and Sample Formats

## 8.7 PCM Timing Information

Table 11: PCM Timing information

| Symbol           | Parameter                                                 | Min | Typ               | Max   | Unit        |
|------------------|-----------------------------------------------------------|-----|-------------------|-------|-------------|
| $f_{mclk}$       | PCM_CLK frequency                                         | -   | 128<br>256<br>512 | -     | kHz         |
|                  | 4MHz DDS generation. Frequency selection is programmable. | -   | -                 | -     | -           |
| -                | PCM_SYNC frequency for SCO connection                     | -   | 8                 | -     | kHz         |
| $t_{mclkh}$ (a)  | PCM_CLK high                                              | 980 | -                 | -     | ns          |
| $t_{mclkl}$ (a)  | PCM_CLK low                                               | 730 | -                 | -     | ns          |
| -                | PCM_CLK jitter                                            | -   | -                 | 21    | ns<br>pk-pk |
| $t_{dmclksynch}$ | Delay time from PCM_CLK high to PCM_SYNC high             | -   | -                 | 20    | ns          |
|                  | 4MHz DDS generation                                       | -   | -                 | 40.83 | ns          |
| $t_{dmclkpout}$  | Delay time from PCM_CLK high to valid PCM_OUT             | -   | -                 | 20    | ns          |
|                  | 4MHz DDS generation                                       | -   | -                 | 20    | ns          |

| Symbol            | Parameter                                                          | Min | Typ | Max   | Unit |
|-------------------|--------------------------------------------------------------------|-----|-----|-------|------|
| $t_{dmclklsyncl}$ | Delay time from PCM_CLK low to PCM_SYNC low (long frame sync only) | -   | -   | 40.83 | ns   |

(a) Assumes normal system clock operation. Figures vary during low-power modes, when system clock speeds are reduced.

**Table 12: PCM Master Mode Timing Parameters**

| Symbol            | Parameter                                              | Min | Typ | Max   | Unit |
|-------------------|--------------------------------------------------------|-----|-----|-------|------|
| $t_{dmclkhsyncl}$ | Delay time from PCM_CLK high to PCM_SYNC low           | -   | -   | 20    | ns   |
|                   | 48MHz DDS generation                                   | -   | -   | 40.83 | ns   |
| $t_{dmclkhpoutz}$ | Delay time from PCM_CLK low to PCM_OUT high impedance  | -   | -   | 20    | ns   |
| $t_{dmclkhoutz}$  | Delay time from PCM_CLK high to PCM_OUT high impedance | -   | -   | 20    | ns   |
| $t_{supinckl}$    | Set-up time for PCM_IN valid to PCM_CLK low            | 20  | -   | -     | ns   |
| $t_{hpinckl}$     | Hold time for PCM_CLK low to PCM_IN invalid            | 0   | -   | -     | ns   |

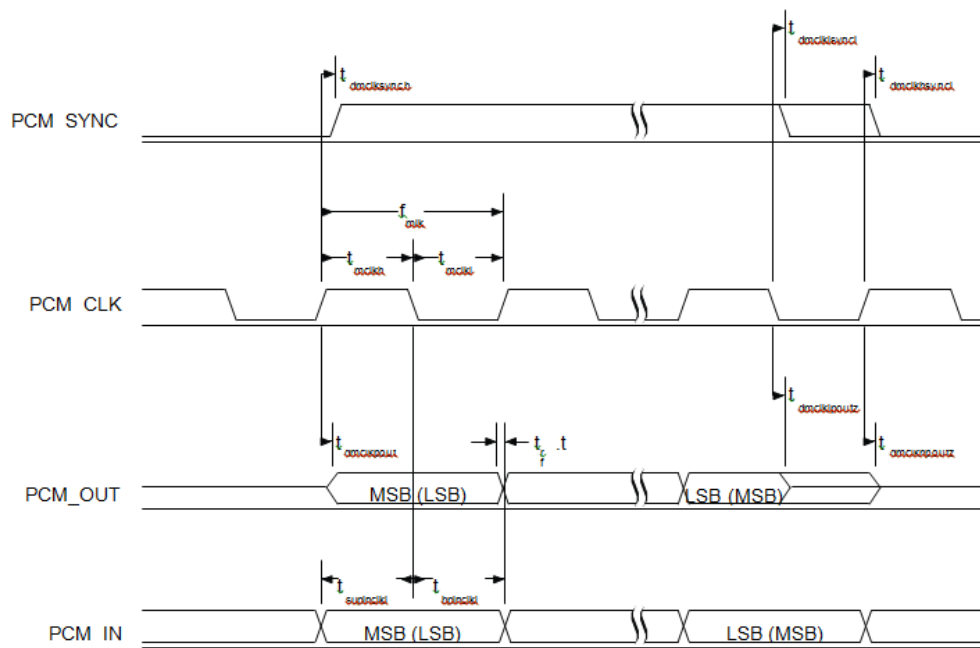


**Figure 9: PCM Master Timing Long Frame Sync**

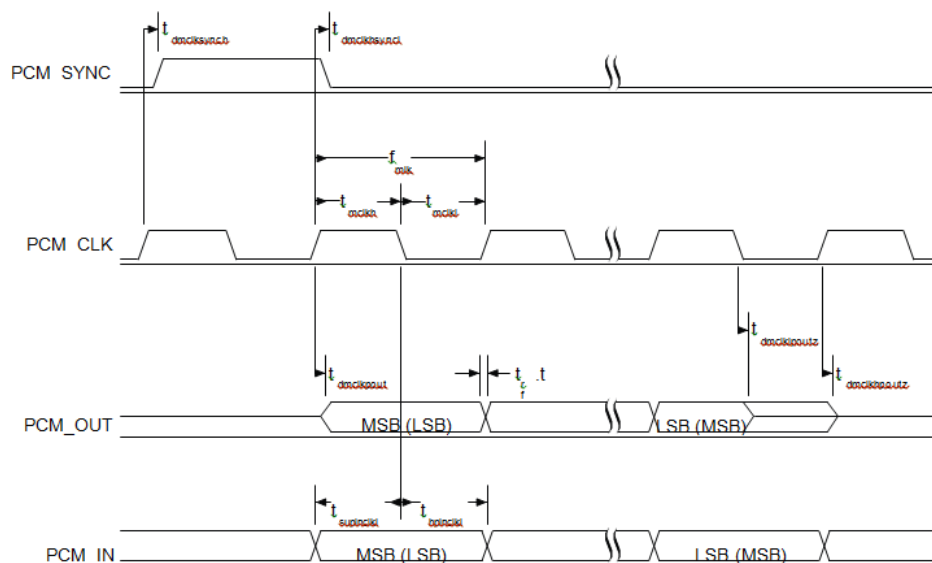


Figure 10: PCM Master Timing Short Frame Sync

## 8.8 PCM Slave Timing

| Symbol     | Parameter                               | Min | Typ | Max  | Unit |
|------------|-----------------------------------------|-----|-----|------|------|
| $f_{sclk}$ | PCM clock frequency (Slave mode: input) | 64  | -   | 2048 | kHz  |
| $f_{sclk}$ | PCM clock frequency (GCI mode)          | 128 | -   | 4096 | kHz  |
| $t_{sckl}$ | PCM_CLK low time                        | 200 | -   | -    | ns   |
| $t_{sckh}$ | PCM_CLK high time                       | 200 | -   | -    | ns   |

## 8.9 PCM Slave Mode Timing Parameters

| Symbol           | Parameter                                                                                             | Min | Typ | Max | Unit |
|------------------|-------------------------------------------------------------------------------------------------------|-----|-----|-----|------|
| $t_{hscklsynch}$ | Hold time from PCM_CLK low to PCM_SYNC high                                                           | 2   | -   | -   | ns   |
| $t_{uscklsynch}$ | Set-up time for PCM_SYNC high to PCM_CLK low                                                          | 20  | -   | -   | ns   |
| $t_{dpout}$      | Delay time from PCM_SYNC or PCM_CLK, whichever is later, to valid PCM_OUT data (long frame sync only) | -   | -   | 15  | ns   |
| $t_{dsckhpout}$  | Delay time from CLK high to PCM_OUT valid data                                                        | -   | -   | 15  | ns   |
| $t_{dpoutz}$     | Delay time from PCM_SYNC or PCM_CLK low, whichever is later, to PCM_OUT data line high impedance      | -   | -   | 20  | ns   |
| $t_{supinsckl}$  | Set-up time for PCM_IN valid to CLK low                                                               | 20  | -   | -   | ns   |
| $t_{hpinsckl}$   | Hold time for PCM_CLK low to PCM_IN invalid                                                           | 2   | -   | -   | ns   |

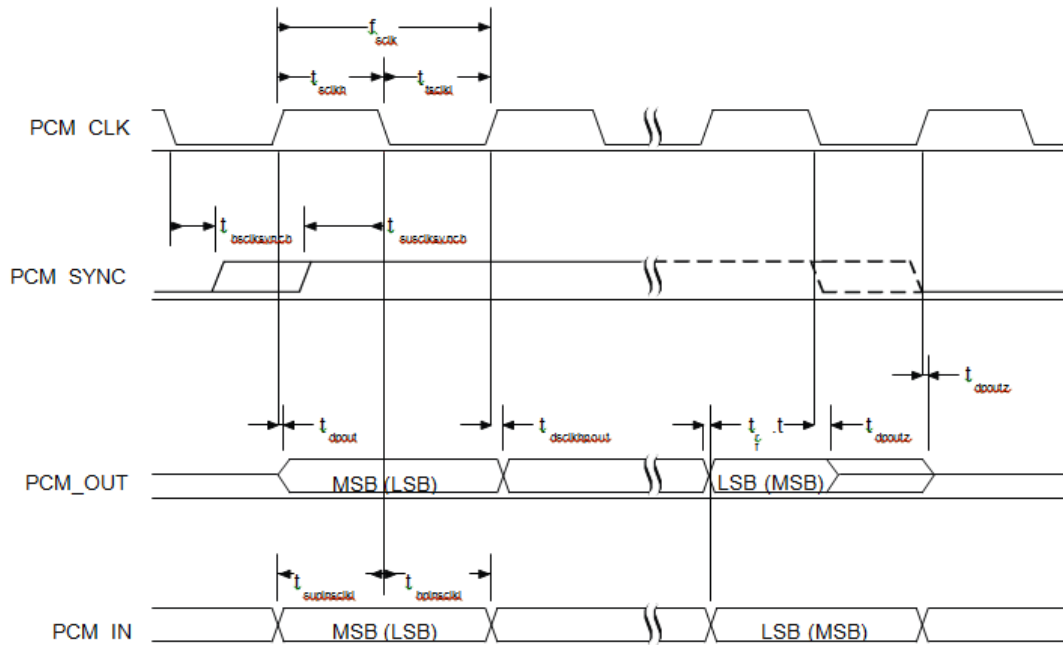


Figure 11: PCM Slave Timing Long Frame Sync

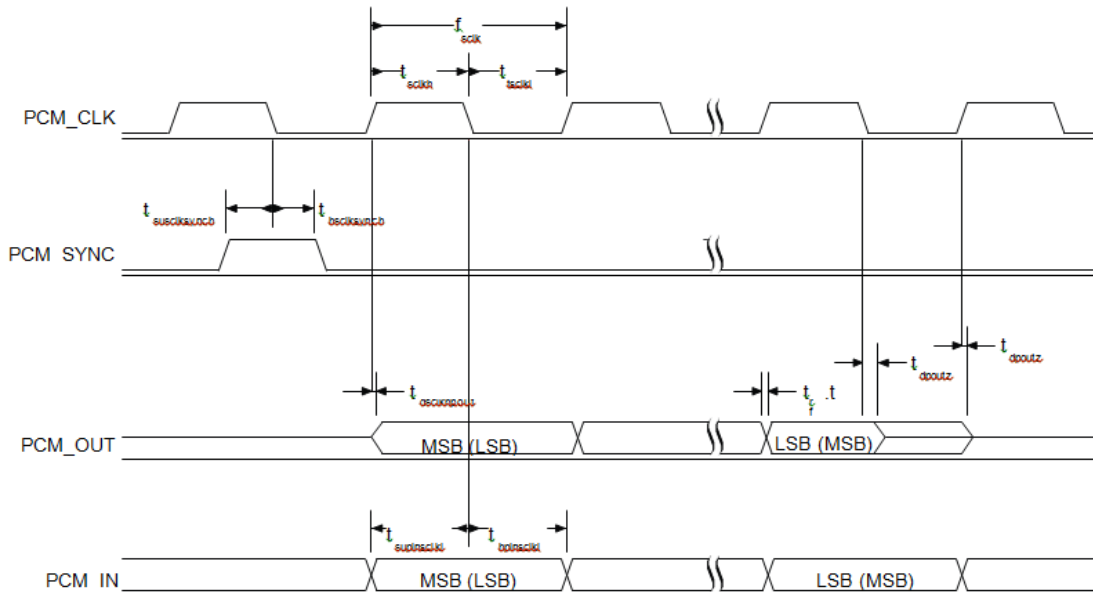


Figure 12: PCM Slave Timing Short Frame Sync

## 8.10 PCM\_CLK and PCM\_SYNC Generation

BT800 has two methods of generating PCM\_CLK and PCM\_SYNC in master mode:

- Generating these signals by DDS from BT800 internal 4MHz clock. Using this mode limits PCM\_CLK to 128, 256 or 512 kHz and PCM\_SYNC to 8 kHz.

- Generating these signals by DDS from an internal 48MHz clock, which enables a greater range of frequencies to be generated with low jitter but consumes more power. To select this second method set bit 48M\_PCM\_CLK\_GEN\_EN in PSKEY\_PCM\_CONFIG32. When in this mode and with long frame sync, the length of PCM\_SYNC is either 8 or 16 cycles of PCM\_CLK, determined by LONG\_LENGTH\_SYNC\_EN in PSKEY\_PCM\_CONFIG32.

Equation 8.1 describes PCM\_CLK frequency when generated from the internal 48MHz clock:

$$f = \frac{\text{CNT\_RATE}}{\text{CNT\_LIMIT}} \times 24\text{MHz}$$

**Equation 8.1:** *PCM\_CLK Frequency Generated Using the Internal 48MHz Clock*

Set the frequency of PCM\_SYNC relative to PCM\_CLK using Equation 8.2:

$$f = \frac{\text{PCM\_CLK}}{\text{SYNC\_LIMIT} \times 8}$$

**Equation 8.2:** *PCM\_SYNC Frequency Relative to PCM\_CLK*

CNT\_RATE, CNT\_LIMIT and SYNC\_LIMIT are set using PSKEY\_PCM\_LOW\_JITTER\_CONFIG. As an example, to generate PCM\_CLK at 512kHz with PCM\_SYNC at 8kHz, set SKEY\_PCM\_LOW\_JITTER\_CONFIG to 0x08080177.

## 8.11 PCM Configuration

Configure the PCM by using PSKEY\_PCM\_CONFIG32 and PSKEY\_PCM\_LOW\_JITTER\_CONFIG (See your PSKey file). The default for PSKEY\_PCM\_CONFIG32 is 0x00800000 (for example: first slot following sync is active, 13-bit linear voice format, long frame sync and interface master generating 256kHz PCM\_CLK from 4MHz internal clock with no tri-state of PCM\_OUT).

## 8.12 Digital Audio Interface (I<sup>2</sup>S)

The digital audio interface supports the industry standard formats for I<sup>2</sup>S, left-justified or right-justified. The interface shares the same pins as the PCM interface, which means each audio bus is mutually exclusive in its usage. Table 13 lists these alternative functions. Figure 11 shows the timing diagram.

**Table 13:** *Alternative Functions of the Digital Audio Bus Interface on the PCM Interface.*

| PCM Interface | I <sup>2</sup> S Interface |
|---------------|----------------------------|
| PCM_OUT       | SD_OUT                     |
| PCM_IN        | SD_IN                      |
| PCM_SYNC      | WS                         |
| PCM_CLK       | SCK                        |

Configure the digital audio interface using PSKEY\_DIGITAL\_AUDIO\_CONFIG, see BlueCore Audio API Specification and the PS Key file.

## BT800 Hardware Integration Guide

Version 1.10

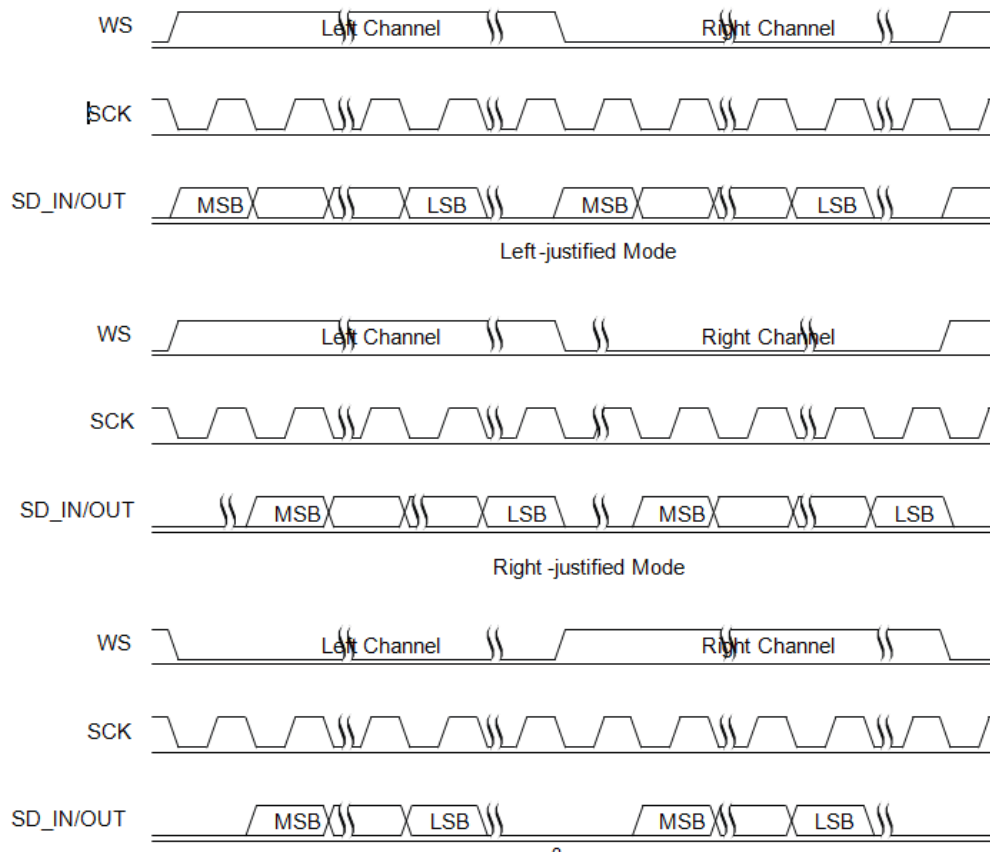


Figure 13: PCM Configuration

The internal representation of audio samples within BT800 is 16-bit and data on SD\_OUT is limited to 16-bit per channel.

Table 14: Digital Audio Interface Slave Timing

| Symbol          | Parameter     | Min | Typ | Max | Unit |
|-----------------|---------------|-----|-----|-----|------|
| -               | SCK Frequency | -   | -   | 6.2 | MHz  |
| -               | WS Frequency  | -   | -   | 96  | kHz  |
| t <sub>ch</sub> | SCK high time | 80  | -   | -   | ns   |
| t <sub>cl</sub> | SCK low time  | 80  | -   | -   | ns   |

Table 15: I<sup>2</sup>S Slave Mode Timing

| Symbol    | Parameter                           | Min | Typ | Max | Unit |
|-----------|-------------------------------------|-----|-----|-----|------|
| $t_{ssu}$ | WS valid to SCK high set-up time    | 20  | -   | -   | ns   |
| $t_{sh}$  | SCK high to WS invalid hold time    | 2.5 | -   | -   | ns   |
| $t_{opd}$ | SCK low to SD_OUT valid delay time  | -   | -   | 20  | ns   |
| $t_{isu}$ | SD_IN valid to SCK high set-up time | 20  | -   | -   | ns   |
| $t_{ih}$  | SCK high to SD_IN invalid hold time | 2.5 | -   | -   | ns   |

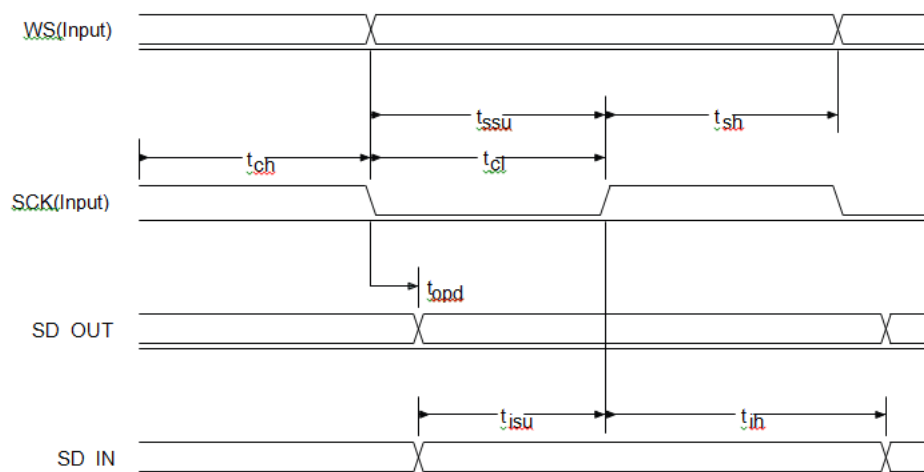


Figure 14: Digital Audio Interface Slave Timing

Table 16: Digital Audio Interface Master Timing

| Symbol | Parameter     | Min | Typ | Max | Unit |
|--------|---------------|-----|-----|-----|------|
| -      | SCK Frequency | -   | -   | 6.2 | MHz  |
| -      | WS Frequency  | -   | -   | 96  | kHz  |

Table 17: I<sup>2</sup>S Master Mode Timing Parameters, WS and SCK as Outputs

| Symbol    | Parameter                           | Min   | Typ | Max   | Unit |
|-----------|-------------------------------------|-------|-----|-------|------|
| $t_{spd}$ | SCK low to WS valid delay time      | -     | -   | 39.27 | ns   |
| $t_{opd}$ | SCK low to SD_OUT valid delay time  | -     | -   | 18.44 | ns   |
| $t_{isu}$ | SD_IN valid to SCK high set-up time | 18.44 | -   | -     | ns   |
| $t_{ih}$  | SCK high to SD_IN invalid hold time | 0     | -   | -     | ns   |

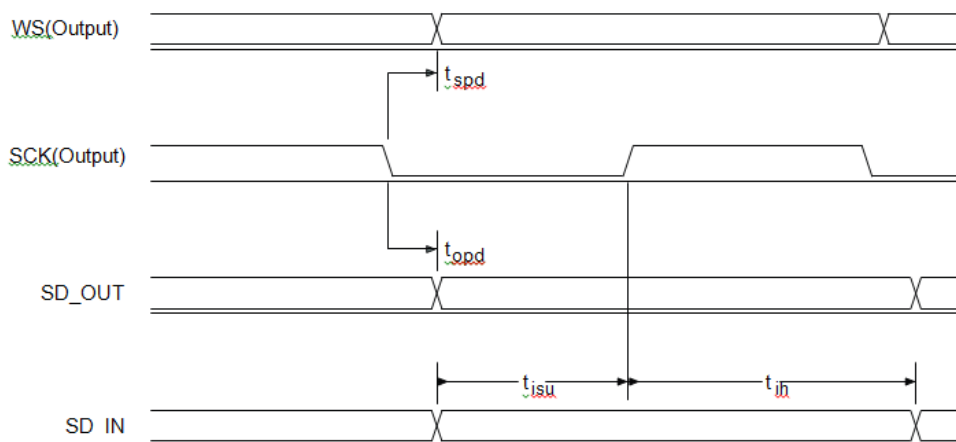


Figure 15: Digital Audio Interface Master Timing

## 9 POWER CONTROL AND REGULATION

See the Example Application Schematic (Figure 19) for the regulator configuration. BT800 contains three regulators:

- USB linear regulator, to generate the 3.3 V from the USB bus power and the input to the high-voltage linear regulator.
- High-voltage linear regulator, to generate the main 1.8 V from the USB linear regulator or an external 3.3 V. This regulator then feeds the three low-voltage regulators:
  - Low-voltage VDD\_DIG linear regulator, a programmable low-voltage regulator to supply a 0.90 V to 1.25 V digital supply, VDD\_DIG.
  - Low-voltage VDD\_ANA linear regulator, to supply the radio supply, VDD\_RADIO.
  - Low-voltage VDD\_AUX linear regulator, to supply the auxiliary supply, VDD\_AUX.

### 9.1 USB Linear Regulator

The integrated USB LDO linear regulator is available as a 3.3 V supply rail and is intended to supply the USB interface and the high-voltage linear regulator. The input voltage range is between 4.25 V and 5.75 V. The maximum current from this regulator is 150 mA, of which 50 mA is available for external use (for example EEPROM/LED). Internally decouple the output of this regulator using a low ESR MLC capacitor to the VREG\_IN\_HV pin. No externally decouple capacitor is required. For hassle environment, an output capacitor of 1  $\mu$ F to 4.7  $\mu$ F ( $\pm 20\%$ ) is preferred.

This regulator is enabled by default. If the USB linear regulator is not required, leave its input (VREG\_IN\_USB) unconnected.

### 9.2 High-voltage Linear Regulator

The integrated high-voltage linear regulator is available to power the main 1.8 V supply rail. The input voltage range is between 2.3 V and 4.8 V. The maximum current from this regulator is 100 mA. Internally decouple the output of this regulator using a low ESR MLC capacitor of a 2.2  $\mu$ F to the VREG\_OUT\_HV pin. No externally decouple capacitor is required. For hassle environment, an output capacitor of 1  $\mu$ F to 4.7  $\mu$ F ( $\pm 20\%$ ) is preferred. Take VREG\_EN\_RST# high to enable this regulator. If this regulator is not required, then leave VREG\_IN\_HV unconnected or tied to VREG\_OUT\_HV.

## 9.3 Voltage Regulator Enable and Reset

A single pin, VREG\_EN\_RST#, controls both the regulator enables and the digital reset function. All the regulators are enabled, except the USB linear regulator, by taking the VREG\_EN\_RST# pin above 1 volt. Software also controls the regulators. The VREG\_EN\_RST# pin is connected internally to the reset function and is powered from VDD\_HOST, so do not apply voltages above VDD\_HOST to the VREG\_EN\_RST# pin. The REG\_EN\_RST# pin is pulled down internally before the software starts. The VREG\_EN\_RST# pin is an active low reset. Assert the reset signal for a period >5 ms to ensure a full reset.

---

**Note:** The regulator enables are released as soon as VREG\_EN\_RST# is low, so the regulators shut down. Therefore do not take VREG\_EN\_RST# low for less than 5 ms, as a full reset is not guaranteed.

Other reset sources are:

**Power-on reset**

**Via a software-configured watchdog timer**

A warm reset function is also available under software control. After a warm reset the RAM data remains available.

---

## 9.4 Power Sequencing

CSR recommends that all power supplies are powered at the same time. The order of powering the supplies relative to the I/O supply, VDD\_PADS to VDD\_HOST, is not important. If the I/O supply is powered before VDD\_DIG, all digital I/Os are weak pull-downs regardless of the reset state.

## 10 ANTENNA PERFORMANCE

Figure 16 illustrates antenna performance.

| Gain Table           |          |      |          |      |          |      |            |
|----------------------|----------|------|----------|------|----------|------|------------|
| Unit in dBi @2.44GHz | XY-plane |      | XZ-plane |      | YZ-plane |      | Efficiency |
|                      | Peak     | Avg. | Peak     | Avg. | Peak     | Avg. |            |
| A1                   | -3.5     | -4.2 | 3.8      | -5.3 | 3.2      | -4.7 | 41.0%      |

Figure 16: BT800 Gain Table

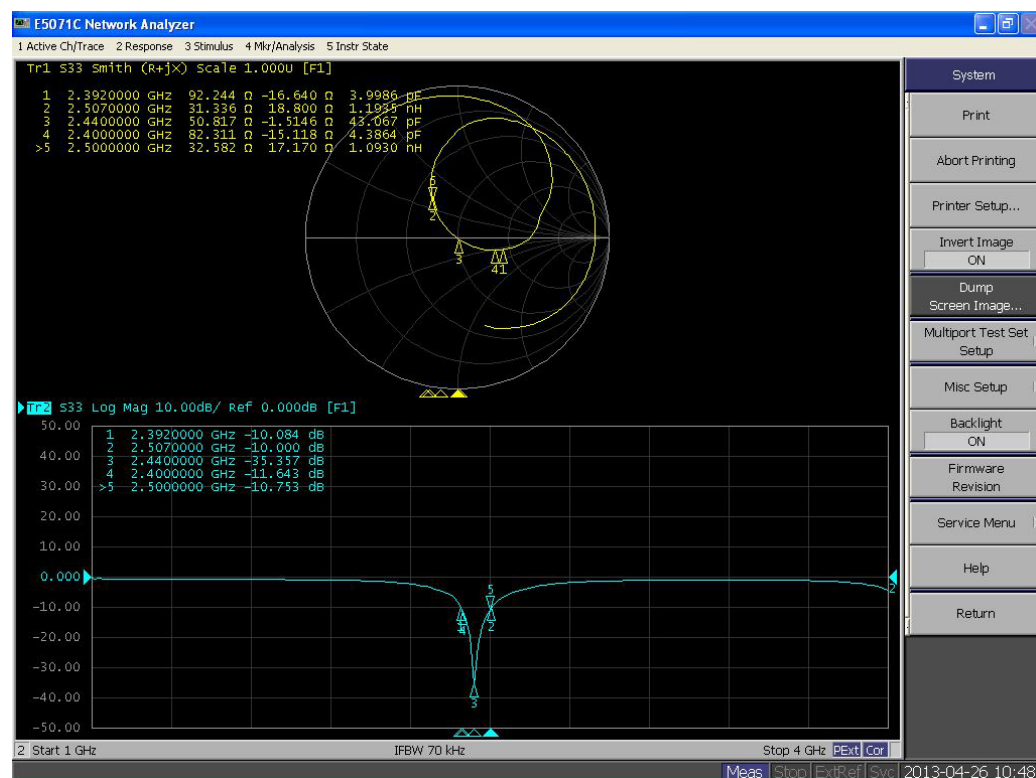
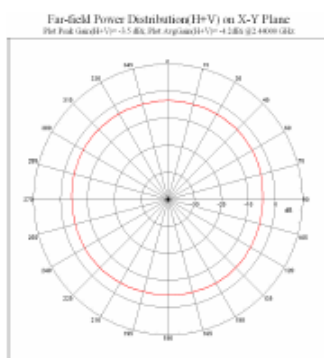


Figure 17: Network Analyzer output

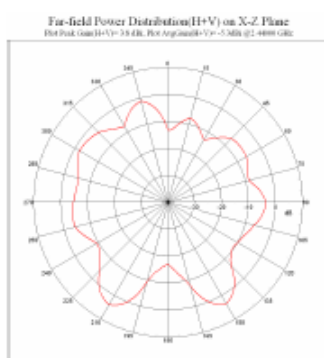
## ◆XY-plane



Unit : dBi

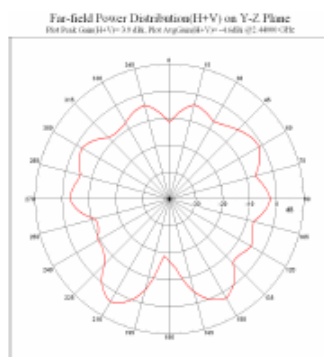
|          | Peak gain | Avg. gain |
|----------|-----------|-----------|
| XY-plane | -3.5      | -4.2      |

## ◆XZ-plane



|          | Peak gain | Avg. gain |
|----------|-----------|-----------|
| XZ-plane | 3.8       | -5.3      |

## ◆YZ-plane

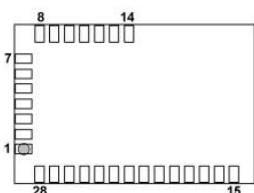


|          | Peak gain | Avg. gain |
|----------|-----------|-----------|
| YZ-plane | 3.2       | -4.7      |

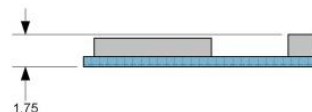
## 11 MECHANICAL DIMENSIONS AND LAND PATTERN

### 11.1 BT800 Mechanical Drawing

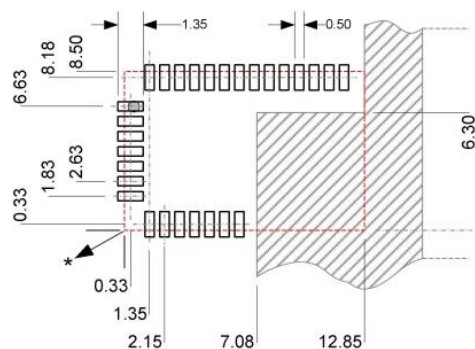
Bottom View Device Pads



Side View



Top View  
Recommended PCB Layout



\* Dimensions from corner of BT800 edge

● Pin1

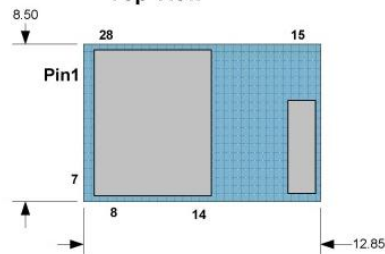


No Copper in this area!



BT800 PCB Edge

Top View



**Note:** Dimensions are in mm.  
Tolerances: .xx  $\pm 0.03$  mm  
.x  $\pm 1.3$  mm

## 12 IMPLEMENTATION NOTE

### 12.1 PCB Layout on Host PCB

Checklist (for PCB):

- **MUST** locate the BT800 module close to the edge of PCB.
- Use solid GND plane on inner layer (for best EMC and RF performance).
- Place GND vias close to module GND pads as possible
- Route traces to avoid noise being picked up on VCC supply.
- Antenna Keep-out area:
  - Ensure there is no copper in the antenna keep-out area on any layers of the host PCB.
  - Keep all mounting hardware and metal clear of the area to allow proper antenna radiation.
  - For best antenna performance, place the BT800 module on the edge of the host PCB, preferably in the corner with the antenna facing the corner.
  - A different host PCB thickness dielectric will have small effect on antenna.

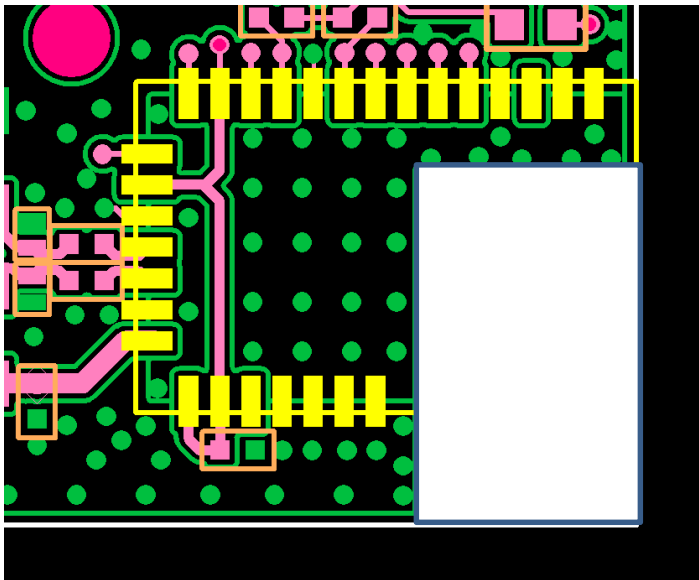


*Figure 18: Recommend Antenna keep-out area (in White) used on the BT800*

#### 12.1.1 Antenna Keep-out and Proximity to Metal or Plastic

Checklist (for metal /plastic enclosure):

- Minimum safe distance for metals without seriously compromising the antenna (tuning) is 40 mm top/bottom and 30 mm left or right.
- Metal close to the BT800 chip monopole antenna (bottom, top, left, right, any direction) will have degradation on the antenna performance. The amount of degradation is entirely system dependent which means some testing by customers is required (in their host application).
- Any metal closer than 20 mm starts to significantly degrade performance (S11, gain, radiation efficiency).
- It is best that the customer tests the range with mock-up (or actual prototype) of the product to assess effects of enclosure height (and material whether metal or plastic).

## 12.1.2 USB Dongle Design Example Using BT800

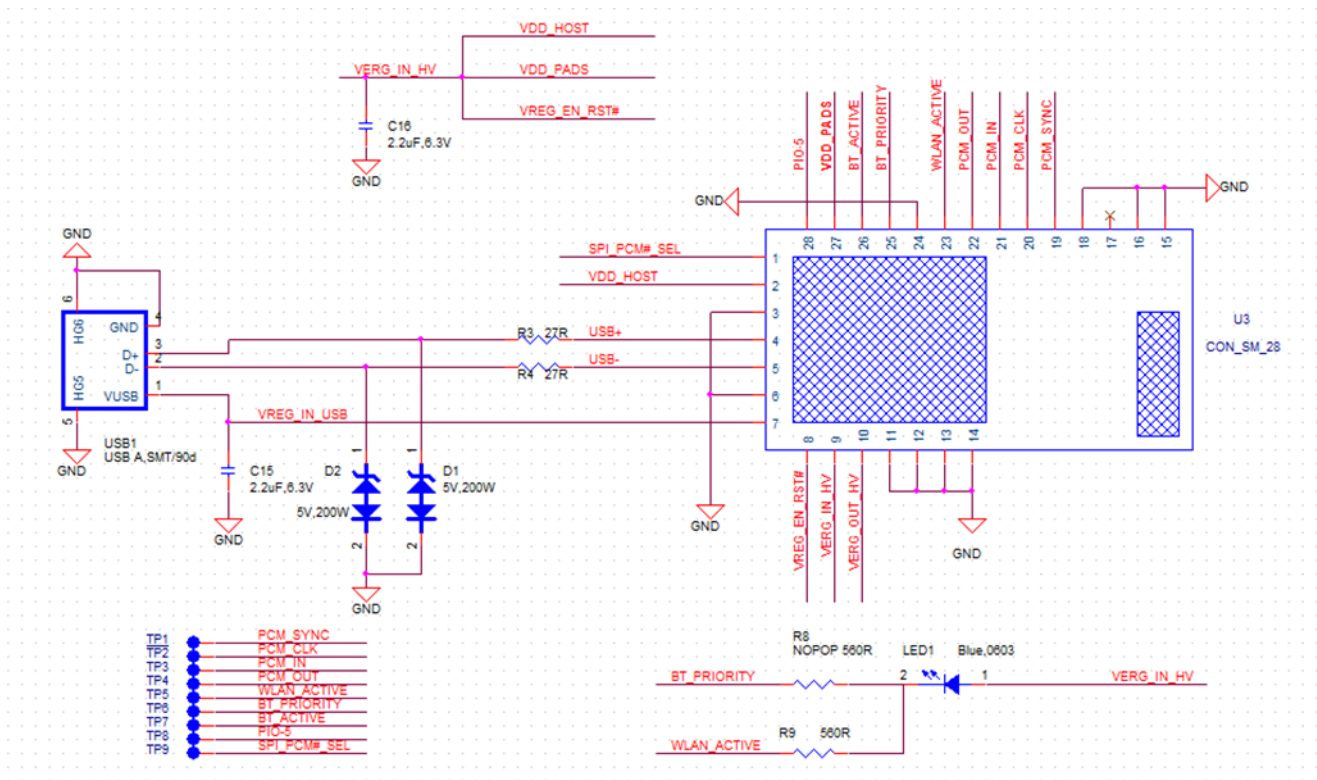


Figure 19: USB Dongle Design Schematic

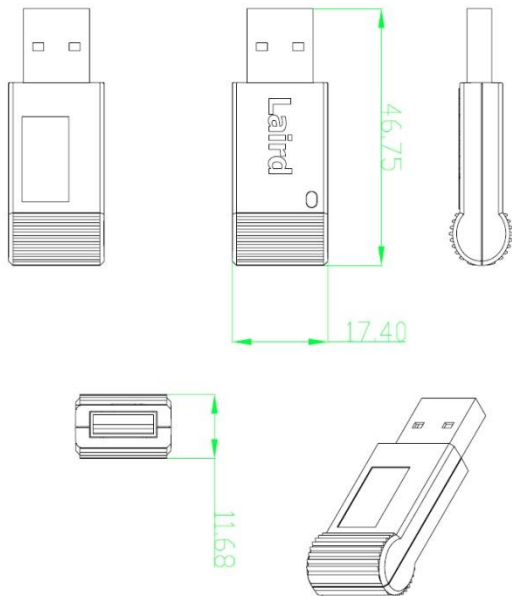


Figure 20: BT820 USB Dongle, containing embedded BT800

### 12.1.3 DC power supply options for using BT800 module

- **Using USB bus power (5V±10%)**  
Apply USB bus power (5V ±10%) directly to the Pin-7 (VREG\_IN\_USB) and pull-high on Pin-8 (VREG\_EN\_RST#) to turn on the internal regulator. The BT800 module generates 3.3 V/1.8 V output on Pin-9 (VREG\_IN\_HV)/Pin-10 (VREG\_OUT\_HV) that can supply to the other DC pin of the board.
- **Using DC power 3.3 V**  
Leave the Pin-7 (VREG\_IN\_USB) no connection, power the on Pin-9 (VREG\_IN\_HV) with 3.3 V and pull-high on Pin-8 (VREG\_EN\_RST#) to turn on the internal regulator. The BT800 module generates 1.8 V output on Pin-10 (VREG\_OUT\_HV) which can supply to the other DC pin of the board.

## 13 APPLICATION NOTE FOR SURFACE MOUNT MODULES

### 13.1 Introduction

Laird surface mount modules are designed to conform to all major manufacturing guidelines. This application note is intended to provide additional guidance beyond the information that is presented in the user manual. This application note is considered a living document and is updated as new information is presented.

The modules are designed to meet the needs of a number of commercial and industrial applications. They are easy to manufacture and they conform to current automated manufacturing processes.

### 13.2 Shipping

#### 13.2.1 Tray Package

Modules are shipped in ESD (Electrostatic Discharge) safe trays that can be loaded into most manufacturers pick and place machines. Layouts of the trays are provided in [Figure 21](#).

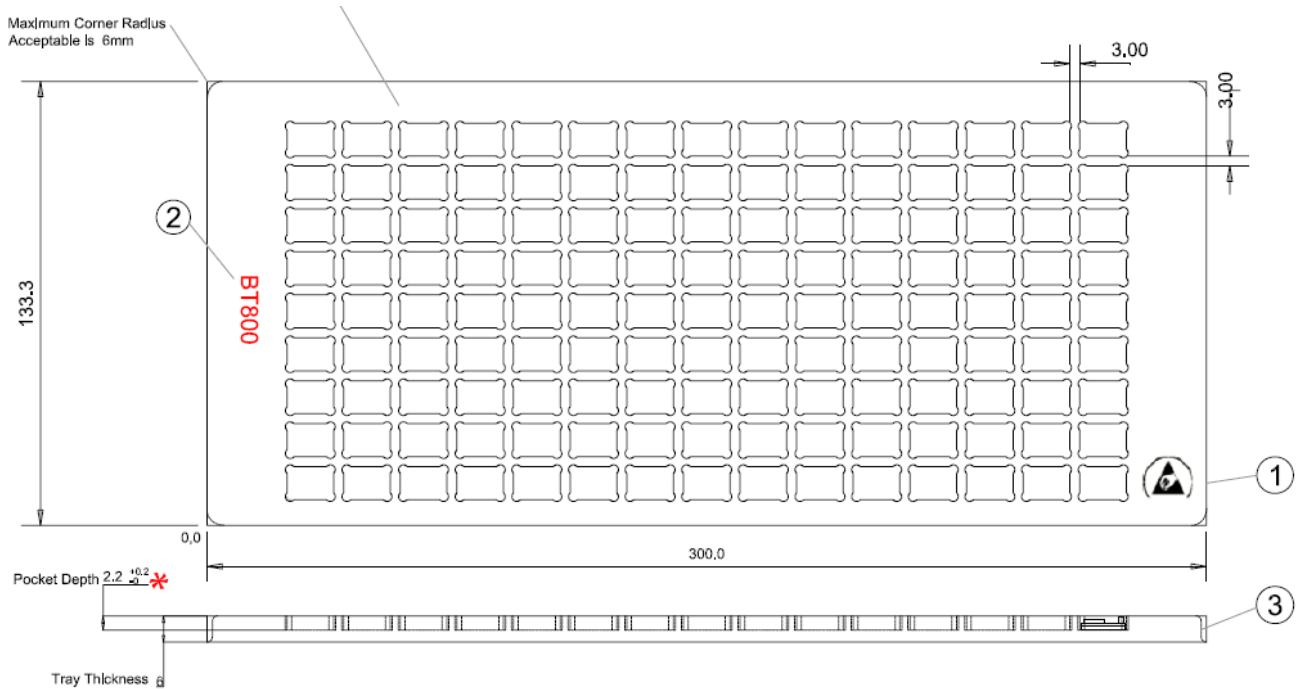


Figure 21: Shipping tray layout

## 13.2.2 Tape and Reel Package Information

**Note:** Ordering information for Tape and Reel packaging is an addition of T/R to the end of the full module part number. For example, BT800 becomes BT800-xx-T/R.

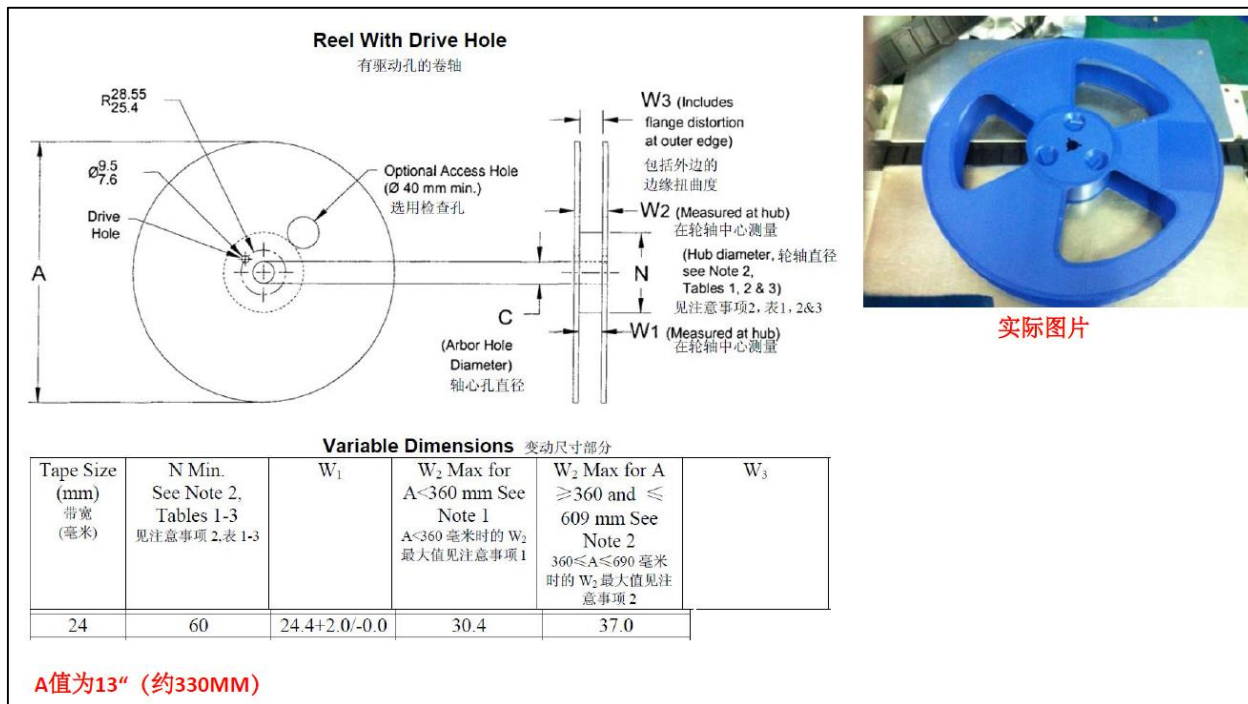


Figure 22: Reel specifications

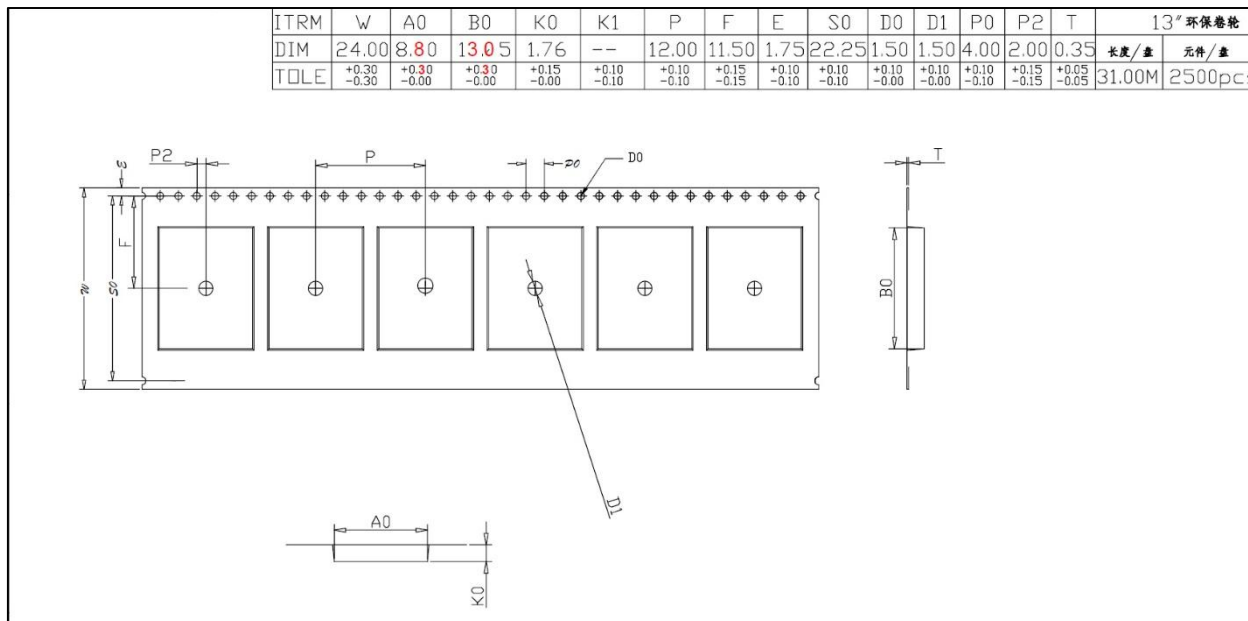


Figure 23: Tape specifications

There are 2500 BT800 modules taped in a reel (and packaged in a pizza box) and five boxes per carton (12,500 modules per carton). Reel, boxes, and carton are labeled with the appropriate labels. See following images (Figures 24-32).

### 13.2.2.1 Packaging Process

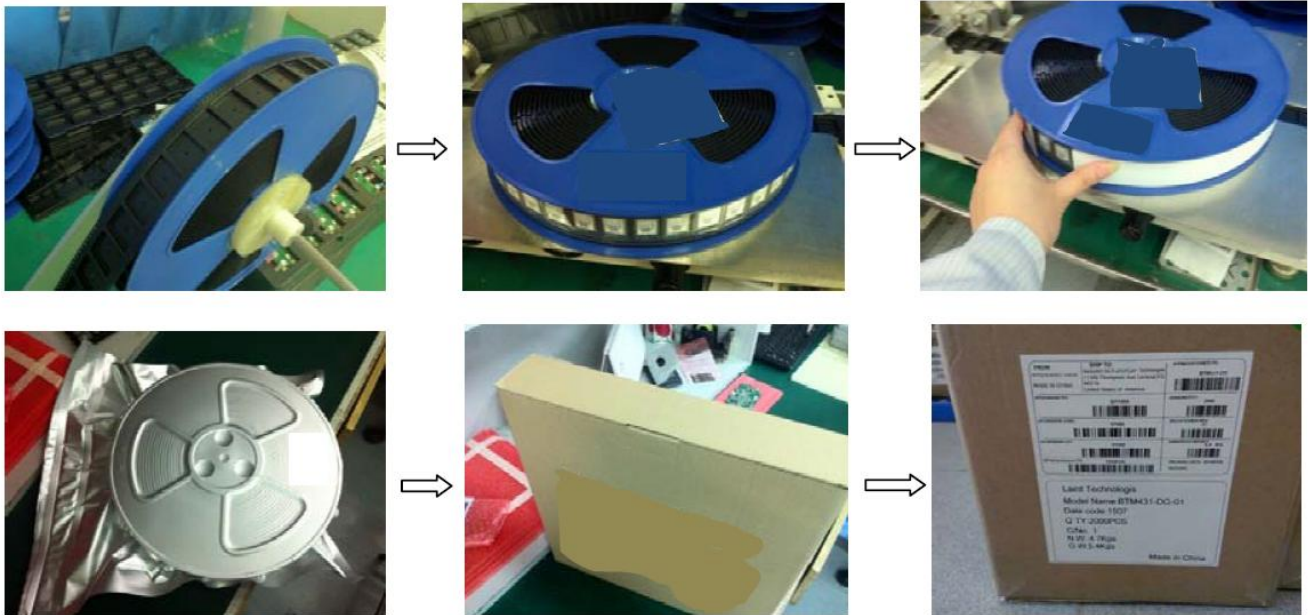


Figure 24: BT800 packaging process

## 13.3 Reflow Parameters

Laird surface mount modules are designed to be easily manufactured, including reflow soldering to a PCB. Ultimately it is the responsibility of the customer to choose the appropriate solder paste and to ensure oven temperatures during reflow meet the requirements of the solder paste. Laird's surface mount modules conform to J-STD-020D1 standards for reflow temperatures.

---

**Important:** During reflow, modules should not be above 260° and not for more than 30 seconds.

---

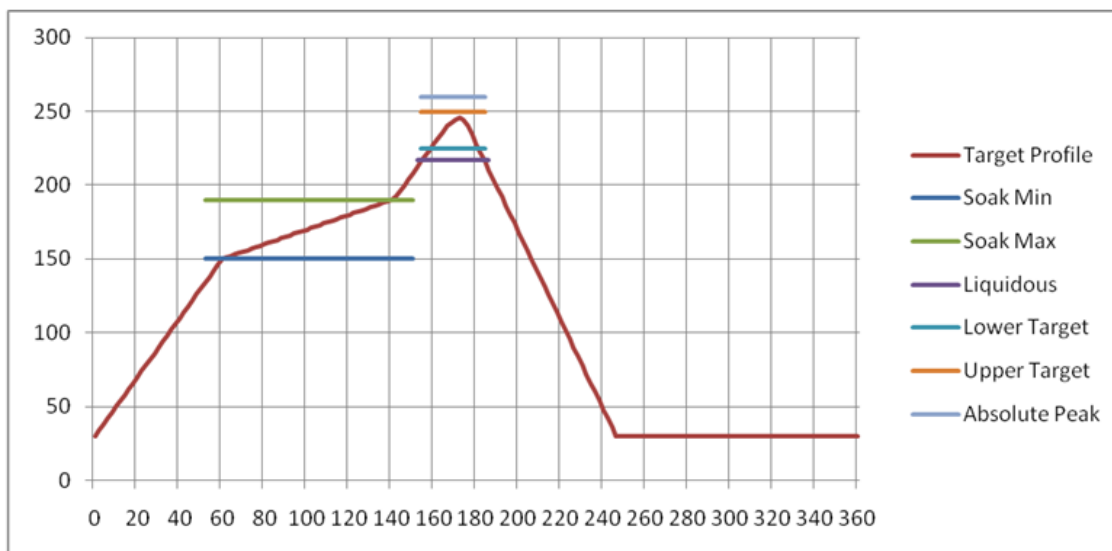


Figure 13-25: Recommended Reflow Temperature

Temperatures should not exceed the minimums or maximums presented in Table 18.

Table 18: Recommended Maximum and minimum temperatures

| Specification                      | Value  | Unit     |
|------------------------------------|--------|----------|
| Temperature Inc./Dec. Rate (max)   | 1~3    | °C / Sec |
| Temperature Decrease rate (goal)   | 2-4    | °C / Sec |
| Soak Temp Increase rate (goal)     | .5 - 1 | °C / Sec |
| Flux Soak Period (Min)             | 70     | Sec      |
| Flux Soak Period (Max)             | 120    | Sec      |
| Flux Soak Temp (Min)               | 150    | °C       |
| Flux Soak Temp (max)               | 190    | °C       |
| Time Above Liquidous (max)         | 70     | Sec      |
| Time Above Liquidous (min)         | 50     | Sec      |
| Time In Target Reflow Range (goal) | 30     | Sec      |
| Time At Absolute Peak (max)        | 5      | Sec      |
| Liquidous Temperature (SAC305)     | 218    | °C       |
| Lower Target Reflow Temperature    | 240    | °C       |
| Upper Target Reflow Temperature    | 250    | °C       |
| Absolute Peak Temperature          | 260    | °C       |

## 14 JAPAN (MIC) REGULATORY

The BT800 is approved for use in the Japanese market. The part numbers listed below hold WW type certification. Refer to **ARIB-STD-T66** for further guidance on OEM's responsibilities.

| Model | Product Name                     | Description                  | Certificate Number |
|-------|----------------------------------|------------------------------|--------------------|
| BT800 | BT v4.0 Dual Mode USB HCI Module | Mounted with chipset antenna | 003-150186         |

## 14.1 Antenna Information

The BT800 was tested with antennas listed below. The OEM can choose a different manufacturer's antenna but must make sure it is of the same type and that the gain is less than or equal to the antenna that is approved for use.

| Item | Part Number         | Mfg. | Type | Gain (dBi) |
|------|---------------------|------|------|------------|
| 1    | AT3216-B2R7HAA_3216 | ACX  | Chip | 0.5        |

## 15 FCC AND IC REGULATORY

| Model     | US/FCC   | CANADA/IC   |
|-----------|----------|-------------|
| BT800     | SQGBT800 | 3147A-BT800 |
| BT820     | SQGBT800 | 3147A-BT800 |
| DVK-BT800 | SQGBT800 | 3147A-BT800 |

The BT800 family has been designed to operate with the antenna listed below having a maximum gain of 0.5 dBi. The required antenna impedance is 50 ohms.

| Item | Part Number    | Mfg. | Type    | Gain (dBi) |
|------|----------------|------|---------|------------|
| 1    | AT3216-B2R7HAA | ACX  | Ceramic | 0.5        |

### 15.1 Documentation Requirements

In order to ensure regulatory compliance, when integrating the BT800 into a host device, it is necessary to meet the documentation requirements set forth by the applicable regulatory agencies. The following sections (FCC, Industry Canada, and European Union) outline the information that may be included in the user's guide and external labels for the host devices into which the BT800 is integrated.

#### FCC

**Note:** You must place "Contains FCC ID: SQG-BT800" on the host product in such a location that it can be seen by an operator at the time of purchase.

#### User's Guide Requirements

The BT800 complies with FCC Part 15 Rules for a Modular Approval. To leverage Laird's grant, the conditions below must be met for the host device into which the BT800 is integrated:

- The transmitter module is not co-located with any other transmitter or antenna that is capable of simultaneous operation.

As long as the conditions above are met, further transmitter testing is typically not required. However, the OEM integrator is still responsible for testing its end-product for any additional compliance requirements required with this module installed, such as (but not limited to) digital device emissions and PC peripheral requirements.

#### IMPORTANT:

In the event that the conditions above cannot be met (for example certain device 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

## BT800 Hardware Integration Guide

### Version 1.10

responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

When using Laird's FCC grant for the BT800, the integrator must include specific information in the user's guide for the device into which the BT800 is integrated. The integrator must not provide information to the end user regarding how to install or remove this RF module in the user's manual of the device into which the BT800 is integrated. The following FCC statements must be added in their entirety and without modification into a prominent place in the user's guide for the device into which the BT800 is integrated:

---

**IMPORTANT NOTE:** To comply with FCC requirements, the BT800 must not be co-located or operating in conjunction with any other antenna or transmitter.

---

#### ***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:

1. Reorient or relocate the receiving antenna.
2. Increase the separation between the equipment and receiver.
3. Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
4. 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:** FCC Radiation Exposure Statement:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.

#### **Industry Canada**

---

**Note:** You must place "Contains IC ID: 3147A-BT800" on the host product in such a location that it can be seen by an operator at the time of purchase.

---

#### ***RF Radiation Hazard Warning***

Using higher gain antennas and types of antennas not certified for use with this product is not allowed. The device shall not be co-located with another transmitter.

Cet avertissement de sécurité est conforme aux limites d'exposition définies par la norme CNR-102 at relative aux fréquences radio.

## BT800 Hardware Integration Guide

### Version 1.10

This radio transmitter (Contains IC ID: 3147A-BT800) has been approved by Industry Canada to operate with the antenna types listed in table above with the maximum permissible gain and required antenna impedance for each antenna type 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 (Contains IC ID: 3147A-BT800) a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés ci-dessous et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur.

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. 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 necessary for successful communication.

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante.

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.

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, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

## 16 EUROPEAN UNION REGULATORY

The BT800 has been tested for compliance with relevant standards for the EU market. BT800 module was tested with a 0.5 dBi chip antenna.

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 that the modules were tested to. Test reports are available upon request.

### 16.1 EU Declarations of Conformity

#### 16.2 BT800 / BT820

|                        |                |
|------------------------|----------------|
| Manufacturer:          | Laird          |
| Product:               | BT800 / BT820  |
| EU Directive:          | RTTE 1995/5/EC |
| Conformity Assessment: | Annex IV       |

Reference standards used for presumption of conformity:

| Article Number | Requirement | Reference standard(s) |
|----------------|-------------|-----------------------|
|----------------|-------------|-----------------------|

## BT800 Hardware Integration Guide

Version 1.10

|      |                                                                       |                                                                                                                   |
|------|-----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| 3.1a | Health and Safety                                                     | EN60950-1:2006+A11:2009+A1:2010+A12:2011                                                                          |
|      | Protection requirements with respect to electromagnetic compatibility | EN 301 489-1 V1.9.2 (2011-09)<br>EN 301 489-17 V2.2.1 (2012-09)                                                   |
| 3.1b |                                                                       | Emissions:<br>EN55022:2006/A1:2007 (Class B)<br>Immunity:<br>EN61000-4-2:2009<br>EN61000-4-3:2006/A1:2008/A2:2010 |
| 3.2  | Means of the efficient use of the radio frequency spectrum            | EN 300 328 V1.8.1 (2012-06)                                                                                       |

### 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 1999/5/EC, when used for its intended purpose.

|                            |                                                                                                                                            |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------|
| Place of Issue:            | Laird<br>Saturn House, Mercury Park<br>Wooburn Green<br>HP100HH,<br>United Kingdom<br>tel: +44 (0)1628 858 940<br>fax: +44 (0)1628 528 382 |
| Date of Issue:             | July 2013                                                                                                                                  |
| Name of Authorized Person: | Andrew Dobbing, Engineering Manager                                                                                                        |
| Signature:                 |                                                          |

## 17 ORDERING INFORMATION

| Part Number | Description                      |
|-------------|----------------------------------|
| BT800       | BTv4.0 Dual Mode USB HCI Module  |
| BT820       | BTv4.0 Dual Mode USB Dongle      |
| DVK-BT800   | Development Kit for BT800 Module |

### 17.1 General Comments

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

## 18 BLUETOOTH SIG APPROVALS

### 18.1 Application Note: Subsystem Combinations

This application note covers the procedure for generating a new Declaration ID for a Subsystem combination on the Bluetooth SIG website. In the instance of subsystems, a member can combine two or more subsystems to create a complete Bluetooth End Product solution.

Subsystem listings referenced as an example:

| Design Name                      | Owner                    | Declaration ID | Link to listing on the SIG website                                                                                            |
|----------------------------------|--------------------------|----------------|-------------------------------------------------------------------------------------------------------------------------------|
| BT800-SA                         | Laird                    | B021369        | <a href="https://www.bluetooth.org/tpg/QLI_viewQDL.cfm?qid=21369">https://www.bluetooth.org/tpg/QLI_viewQDL.cfm?qid=21369</a> |
| Windows 8<br>(Host<br>Subsystem) | Microsoft<br>Corporation | B012854        | <a href="https://www.bluetooth.org/tpg/QLI_viewQDL.cfm?qid=12854">https://www.bluetooth.org/tpg/QLI_viewQDL.cfm?qid=12854</a> |

## Laird Customer Declaration ID Procedure

This procedure assumes that the member is simply combining two subsystems to create a new design, without any modification to the existing, qualified subsystems. This is achieved by using the Listing interface on the Bluetooth SIG website. [Figure 26](#) shows the basic subsystem combination of a controller and host subsystem. The Controller provides the RF/BB/LM and HCI layers, with the Host providing L2CAP, SDP, GAP, RFCOMM/SPP and any other specific protocols and profiles existing in the Host subsystem listing. The design may also include a Profile Subsystem.

The controller provides the RF/BB/LM and HCI layers, with the Host providing L2CAP, SDP, GAP, RFCOMM/SPP and any other specific protocols and profiles existing in the Host subsystem listing. The design may also include a Profile Subsystem.

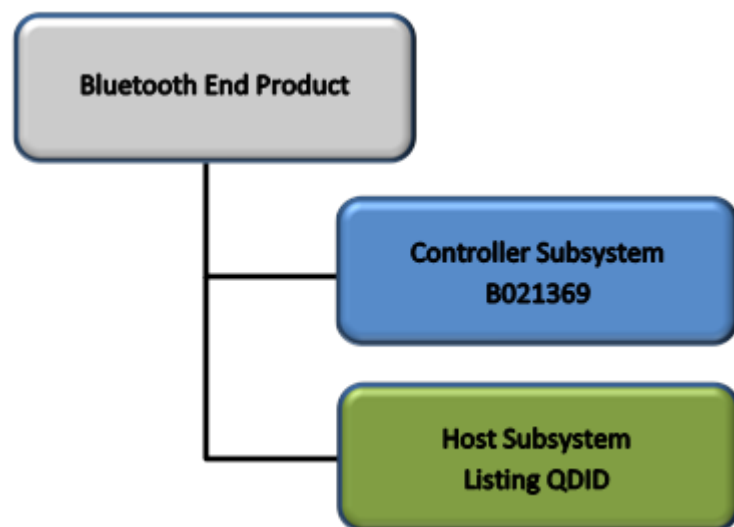


*Figure 26: Basic subsystem combination of a controller and host subsystem*

The Qualification Process requires each company to registered as a member of the Bluetooth SIG – <http://www.bluetooth.org>

The following link provides 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:

[https://www.bluetooth.org/DocMan/handlers/DownloadDoc.ashx?doc\\_id=283698&vld=317486](https://www.bluetooth.org/DocMan/handlers/DownloadDoc.ashx?doc_id=283698&vld=317486)

To start the listing, go to: [https://www.bluetooth.org/tpg/QLI\\_SDoc.cfm](https://www.bluetooth.org/tpg/QLI_SDoc.cfm).

In step 1, select the option, **Reference a Qualified Design** and enter the Declaration IDs of each subsystem used in the End Product design. You can then select your pre-paid Declaration ID from the drop down menu or go to the Purchase Declaration ID page, (please note that unless the Declaration ID is pre-paid or purchased with a credit card, it will not be possible to proceed until the SIG invoice is paid).

Once all the relevant sections of step 1 are finished, complete steps 2, 3, and 4 as described in the help document. Your new Design will be listed on the SIG website and you can print your Certificate and DoC.

For further information please refer to the following training material:

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

## 18.2 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](mailto:wireless.support@lairdtech.com)

Phone: Americas: +1-800-492-2320 Option 2

Europe: +44-1628-858-940

Hong Kong: +852 2923 0610

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

Copyright © 2015 Laird Technologies, Inc. All rights reserved.

The information contained in this manual and the accompanying software programs are copyrighted and all rights are reserved by Laird Technologies, Inc. Laird Technologies, Inc. reserves the right to make periodic modifications of this product without obligation to notify any person or entity of such revision. Copying, duplicating, selling, or otherwise distributing any part of this product or accompanying documentation/software without the prior consent of an authorized representative of Laird Technologies, Inc. is strictly prohibited. All brands and product names in this publication are registered trademarks or trademarks of their respective holders.

This material is preliminary Information furnished by Laird Technologies in this specification is believed to be accurate. Devices sold by Laird Technologies are covered by the warranty and patent indemnification provisions appearing in its Terms of Sale only. Laird Technologies makes no warranty, express, statutory, and implied or by description, regarding the information set forth herein. Laird Technologies reserves the right to change specifications at any time and without notice. Laird Technologies' products are intended for use in normal commercial and industrial applications. Applications requiring unusual environmental requirements such as military, medical life-support or life-sustaining equipment are specifically not recommended without additional testing for such application.

Limited Warranty, Disclaimer, Limitation of Liability