Intelligent BTv4.0 Dual-Mode Module

Part # BT900-SA-0x, BT900-SC-0x

Hardware Integration Guide

Version 0.2

global solutions: local support

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REVISION HISTORY

Version	Revision Date	Change History
0.1	TBD	Initial Preliminary Version
0.2	19May14	Draft version

CONTENTS

1 Overview and Key Features

BT900 Series modules from Laird Technologies make it easy to add Classic BT and Bluetooth Low Energy (BLE) functionality to small, portable, power-conscious devices, including those powered by batteries. The fully approved, programmable module feature Laird's innovative, event-driven *smart*BASIC programming language, which significantly reduces OEM development risk and speeds time to market.

Based on the Cambridge Silicon Radio (CSR) 8811 silicon and a low power Cortex M3 microcontroller, the BT900 modules provide exceptionally low power consumption with outstanding wireless range, all within a compact footprint of 19 mm x 12.5 mm. The modules incorporate all the hardware and firmware required to support development of Dual Mode applications, including:

- Complete radio hardware
- UART, I2C, SPI, ADC, PCM and GPIO interfaces
- Embedded BTv4.0 software stack
    - Classic BT profile - SPP
    - GATT Client & Peripheral Modes

What makes the modules truly innovative is *smart*BASIC, an event-driven programming language that enables standalone operation of the module. Laird has extended the implementation of *smart*BASIC from the popular BL6xx series of single mode BLE modules into the BT900 series. This allows developers the flexibility of utilising the Core and BLE specific *smart*BASIC functions from the BL6xx series to create fully interchangeable BLE applications between these product ranges.

Without the need for any external processor, a simple *smart*BASIC application encapsulates the complete end-to-end process of reading, writing, and processing of sensor data and then using Classic Bluetooth or BLE to transfer it to / from any Bluetooth device. Ultimately *smart*BASIC accelerates initial development, creation of prototypes, and mass production by providing you with your own Bluetooth expert within the module.

In addition to carrying FCC modular, IC, CE and MIC approvals, BT900 modules are fully qualified as a Bluetooth product, enabling designers to integrate the modules in devices without the need for further Bluetooth testing. A low-cost developer's kit including simple software tools simplifies module integration and guarantees the fastest route to market.

1.1 Features & Benefits

- Bluetooth v4.0 - Dual Mode (Classic Bluetooth and BLE)
- External or Internal Antennas
- smartBASIC programming language
- Full Bluetooth EPL
- Compact Footprint
- Programmable TX power 8dBm to -20dBm
- RX sensitivity: -90dBm
- Ultra low power consumption
- TX: 85 mA peak (at +8dBm)
- Standby Doze: 227 uA (refer to Note4 in Power Consumption section)
- Deep Sleep: 7uA
- UART, GPIO, ADC, PWM, FREQ output, TIMERS, I2C, and SPI interfaces

1.2 Application Areas

- Medical devices
- Wellness devices
- Automotive Diagnostic Equipment
- Bar Code Scanners
- Industrial Cable Replacement
- Home automation

- Fast Time to Market
- FCC, CE, IC, and Japan certified; other regulatory certifications on request
- No external components required

2 SPECIFICATION

2.1 Specification Summary

Table 1: Specifications

CATEGORIES	FEATURE	IMPLEMENTATION
Wireless Specification	Bluetooth®	V4.0 – Dual-Mode
	Frequency	2.402 - 2.480 GHz
	Transmit Power	+ 8dBm (maximum) Configurable down to -20dBm
	Receive Sensitivity	-90 dBm (typical)
	Link Budget	98 dB
	Raw Data Rates (Air)	3 Mbps (Classic BT – BR/EDR)
Host Interface and Peripherals	UART Interface	TX, RX, CTS, RTS DTR, DSR, DCD, RI can be implemented in *smart*BASIC-using General Purpose I/O Default 9600, N, ,8, 1 From 1,200 to 4 Mbps RX buffer size (TBD)
	GPIO	18 (maximum – configurable) lines. O/P drive strength (4mA) Pull-up resistor (33KOhms) control (via *smart*BASIC) Read pin-level
	I2C Interface	1 (configurable from GPIO total). Upto 400kbps.
	SPI	1 (configurable from GPIO total) Upto 4Mbps.
	ADC Interface	2 channels (configured from GPIO total). Up to 12-bit resolution Conversion time 2.0uS (at 2.7V to 3.6V) x.xV internal reference 1/1, 2/3, 1/3 pre-scaling
	PWM or FREQ output	Output a PWM or FREQ on upto 2 GPIO output pins. PWM output duty cycle: 0%-100% PWM output frequency: TBD FREQ output frequency: 0MHz to xMHz (50% duty cycle)
	PCM Interface	1
	Wi-Fi-BT coexistence	3 dedicated pins
Profiles	Classic Bluetooth	SPP (Serial Port Profile)
	Bluetooth Low Energy	GATT Client & Peripheral – Any Custom Services
Programmability	*smart*BASIC	On-board programming language similar to BASIC
	*smart*BASIC application	Via UART or Over the Air
Control Protocols		Any that can be implemented using *smart*BASIC vSP – Virtual Serial Port for BLE
FW upgrade	*smart*BASIC runtime engine FW upgrade	Via UART
Coexistence	802.11 (Wi-Fi)	2 and 3 wire CSR schemes supported (Unity-3;Unity-3e, Unity 3e+, Unity 3+ and Unity+)
Operating Modes	Self-contained Run Mode	Selected by nAutoRUN pin status: LOW(0V). Then runs $autorun$ (*smart*BASIC application) if it exists.

	Interactive Development Mode	HIGH(VCC). Then runs via at+run (and "file name" of *smart*BASIC application script).
Supply Voltage	Supply	1.8V – 3.6V
Power Consumption	Current	Max Peak Current (TX Power @ +8dBm TX): 85mA
		Standby Doze (waitevent) – 227uA (internal 32.768kHz) Standby Doze (waitevent) – 113uA (external 32.768kHz, Note5)
		Deep Sleep – 7uA
Physical	Dimensions	19 mm x 12.5 mm x 2.5 mm; Pad Pitch 0.8 mm
Environmental	Operating	-40°C to +85°C
	Storage	-40°C to +85°C
Miscellaneous	Lead Free	Lead-free and RoHS compliant
	Warranty	1 Year
Development Tools	Development Kit	Development board and free Software Tools
Software Tools	Utilities	Windows, Android and iOS applications UART Firmware Upgrade
Approvals	Bluetooth®	Complete Declaration ID
	FCC / IC / CE / MIC	All BT900 Series

Note 1: DSR, DTR, RI, and DCD can be implemented in the *smart*BASIC application.

Note 2: With I2C interface selected, pull-up resistors on I2C SDA and I2C SCL MUST be connected externally as per I2C standard.

Note 3: SPI interface consists of SPI MOSI, SPI MISO and SPI CLK. SPI CS is created by customer using any spare SIO pin within their *smart*BASIC application script allowing multi-dropping.

Note 4: BT900 module comes loaded with *smart* BASIC runtime engine FW, but does not come loaded with any *smart*BASIC application script (as that is dependent on customer end application or use). Laird provides many sample *smart* BASIC application scripts covering the services listed. Additional BLE services being added every quarter.

Note 5: 227uA is when the internal radio chip 32.768kHz is used. 113uA is when external 32.768kHz oscillator is connected to BT900 (radio chip) pin34(BT_Ext_DS_CLK).

3 HARDWARE SPECIFICATIONS

3.1 Block Diagram and Pin-out

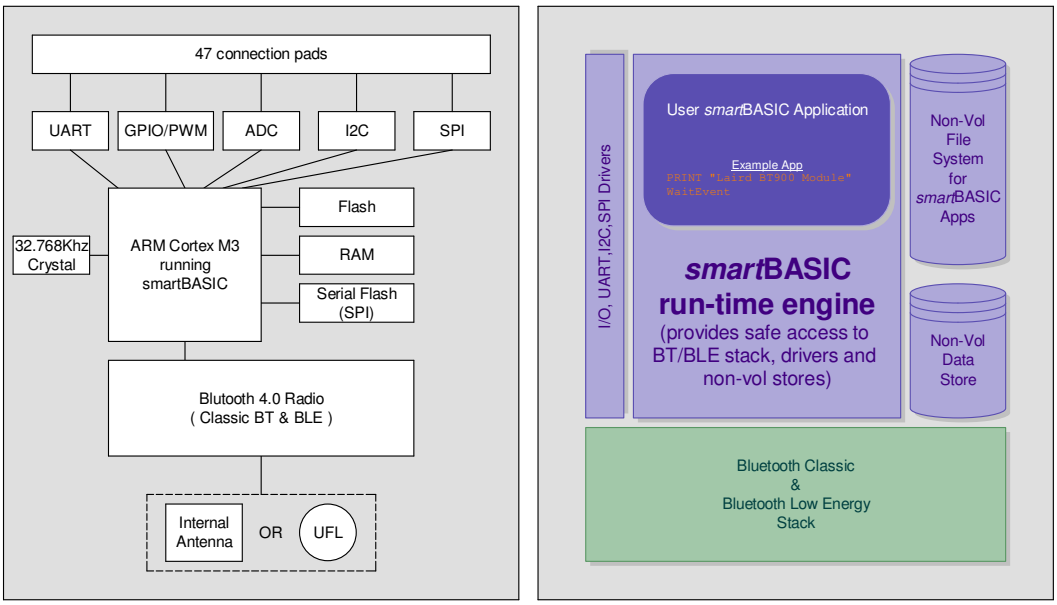


Figure 1: Functional HW and SW block Diagram for BT900 series Dual-Mode BT/ BLE smartBASIC module

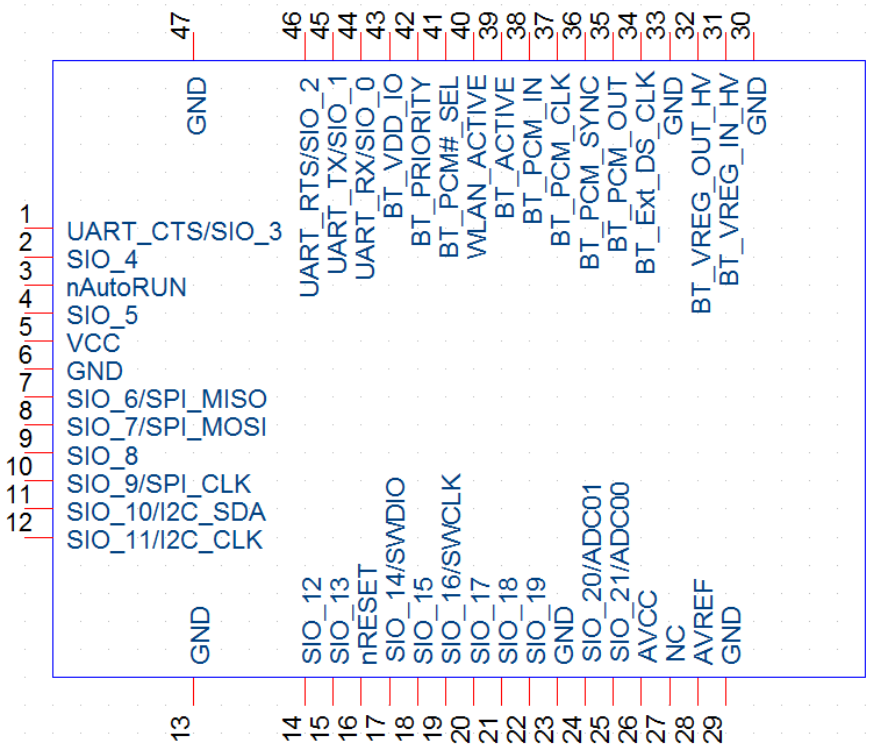


Figure 2: BT900-Sx module pin-out (top view).

3.2 Pin Definitions

Table 2: Pin definitions

Pin #	Pin Designation	Default Function	Alternate Function	Default Direction	Supply Domain	Pull-up or pull down	Notes	Comment
1	UART_CTS	UART	SIO_3	IN	VCC	TBD		
2	SIO_4	DIO	?	IN	VCC	TBD	1,2,3,4,5	Laird Devkit : UART_DTR via CON12
3	nAutoRUN			IN	VCC		In ONLY	Laird Devkit: UART_DSR via CON12???
4	SIO_5	DIO	?	IN	VCC	TBD	1,2,3,4,5	Laird Devkit : UART_DCD vi CON12
5	VCC				1.75V-3.3V			
6	GND							
7	SIO_6	DIO	SPI MISO	IN	VCC	TBD	1,2,3,4,5	SPIOPEN() in *smart*BASIC selects SPI function, MOS and CLK will b outputs when SPI master mo See Note 11?.
8	SIO_7	DIO	SPI MOSI	IN	VCC	TBD	1,2,4,5,6	
9	SIO_8	DIO		IN	VCC	TBD	1,2, 12	Laird Devkit : UART_RI via CON12
10	SIO_9	DIO	SPI CLK	IN	VCC	TBD	1,2,4,5,6	
11	SIO_10	DIO	I2C SDA	IN	VCC	TBD	1,2,4,5,6	I2COPEN() in *smart*BASIC selects I2C function
12	SIO_11	DIO	I2C SCL	IN	VCC	TBD	1,2,4,5,6	
13	GND							
14	SIO_12	DIO		IN	VCC	TBD	1,2,4,5,6	Laird Devkit : Buzzer output
15	SIO_13	DIO		IN	VCC	TBD	1,2,4,5,6	Laird Devkit : Button1 input
16	nRESET			IN	VCC	TBD	9,10	System Reset (Active low)
17	SIO_14	DIO	SWDIO	IN	VCC	TBD		
18	SIO_15	DIO		IN	VCC	TBD	1,2	
19	SIO_16	DIO	SWCLK	IN	VCC	TBD	1,2	
20	SIO_17	DIO		IN	VCC	TBD	1,2	Laird Devkit :
21	SIO_18	DIO		IN	VCC	TBD	1,2	Laird Devkit :
22	SIO_19	DIO		IN	VCC	TBD		

Pin #	Pin Designation	Default Function	Alternate Function	Default Direction	Supply Domain	Pull-up or pull down	Notes	Comment
23	GND							
24	SIO_20	DIO	AIN(ADC 01)	IN	VCC	TBD	1,2	Laird Devkit : Button2 input
25	SIO_21	DIO	AIN(ADC 00)	IN	VCC	TBD	1,2	
26	AVCC			IN	1.7V-3.6V		1,2	
27	NC	NC						Reserved for future use. Do NOT connect.
28	AVREF							
29	GND							
30	GND						8	
31	BT_VREG_IN_HV				3.3V	TBD		
32	BT_VREG_OUT_HV	DIO			1.8V	TBD	1,2,4,6,7	
33	GND	DIO					1,2,4,6,7	
34	BT_Ext_DS_CLK	DIO		IN	BT_VDD_IO	TBD	1,2,4,6,7	
35	BT_PCM_OUT	DIO		OUT	BT_VDD_IO	TBD	1,2,4,6,7	
36	BT_PCM_SYNC	DIO		?	BT_VDD_IO	TBD	1,2	
37	BT_PCM_CLK			OUT	BT_VDD_IO	TBD		
38	BT_PCM_IN	NC		IN	BT_VDD_IO	TBD		
39	BT_ACTIVE	NC		?	BT_VDD_IO	TBD		
40	WLAN_ACTIVE			?	BT_VDD_IO	TBD		
41	BT_PCM#SEL	DIO		IN	BT_VDD_IO	TBD	1,2	
42	BT_PRIORITY	DIO		?	BT_VDD_IO	TBD	1,2	
43	BT_VDD_IO					3.3V or 1.8V		
44	UART_RX	DIO	SIO_0	IN	VCC	TBD	1,2,4,6,7	UARTCLOSE() selects DIO functionality a UARTOPEN() selects uart comms beha
45	UART_TX	DIO	SIO_1	OUT	VCC	TBD	1,2,4,6,7	
46	UART_RTS	DIO	SIO_2	OUT	VCC	TBD	1,2,4,6,7	
47	GND							

Note 1: Secondary function is selectable in *smart*BASIC application.
Note 2: DIO = Digital Input or Output. I/O voltage level tracks VCC.
Note 3: AIN = Analog Input
Note 4: DIO or AIN functionality is selected using the GpioSetFunc() function in *smart*BASIC.
Note 5: AIN configuration selected using GpioSetFunc() function.
Note 6: I2C, UART, SPI controlled by xxxOPEN() functions in *smart*BASIC.
Note 7: SIO_0 to SIO_3 are DIO by default when $autorun$ app runs on power up.
Note 9: Pull the nRESET pin low for minimum 100 mS (TBD) in order for the BT900 to reset.

Note10:	SPI CS is created by customer using any spare SIO pin within their *smart*BASIC application script allowing multi-dropping.
Note11:	SIO_TBD pin has to be pulled high externally to enable OTA (over the Air) *smart*BASIC application download. Refer to the latest FW release documentation for details.

The BT900 module is delivered with the integrated *smart* BASIC runtime engine FW loaded (but no onboard *smart*BASIC application script). Because of this, it starts up in AT command mode by default.

At reset, all SIO lines are configured as the defaults shown above.

SIO lines can be configured through the *smart* BASIC application script to be either inputs or outputs with pull-ups or none. When an alternative SIO function is selected (such as I2C or SPI), the firmware does not allow the setup of internal pull-up. Therefore, when I2C interface is selected, pull-up resistors on I2C SDA and I2C SCL **MUST** be connected externally as per I2C standard.

All the SIO pins (with a default function of **DIO** are inputs – with no internal pull-up apart from SIO_1 and SIO_3, which are outputs):

- SIO_1 (alternative function UART_TX) is an output, set high (in FW).
- SIO_2 (alternative function UART_RTS) is an output, set low (in FW).
- SIO_0 (alternative function UART_RX) is an input, set with internal weak pull-up (in FW).
- SIO_3 (alternative function UART_CTS) is an input, set with internal weak pull-down (in FW).
- SIO_7 is an input, set with internal pull-down (in FW). It is used for over the air downloading of *smart* BASIC applications. Refer to the latest FW release documentation for details.

UART_RX, UART_TX, UART_CTS are 3.3 V level logic (if VCC is 3.3 V, i.e. SIO pin I/O levels track VCC). For example, when RX and TX are idle, they sit at 3.3 V (if VCC is 3.3 V). Conversely, handshaking pins CTS and RTS at 0 V are treated as assertions.

Pin 3 (nAutoRUN) is an input, with active low logic. In the development kit (DVK-BT900-sx) it is connected so that the state is driven by the host's DTR output line. The nAutoRUN pin must be externally held high or low to select between the following two BT900 operating modes:

- Self-contained Run mode (nAutoRUN pin held at 0 V).
- Interactive / development mode (nAutoRUN pin held at VCC).

*smart*BASIC runtime engine firmware checks for the status of nAutoRUN during power-up or reset. If it is low and if there is a *smart*BASIC application script named **$autorun$**, then the *smart*BASIC runtime engine FW executes the application script automatically; hence the name *Self-contained Run Mode*.

3.3 Electrical Specifications

3.3.1 Absolute Maximum ratings

Absolute maximum ratings for supply voltage and voltages on digital and analogue pins of the module are listed below; exceeding these values causes permanent damage.

Table 3: Maximum Current Ratings

Parameter	Min	Max	Unit
Voltage at VCC pin	-0.3	+3.6	V
AVCC	VSS-0.5	VSS+4.6	V
AVREF	VSS-0.5	VSS+4.6	V
BT_VREG_IN_HV	2.3	4.8	V

BT_VREG_OUT_HV	1.7	2.0	V
BT_VDD_IO	-0.4	3.6	V
Voltage at GND pin		0	V
Voltage at SIO pin	-0.3	VCC+0.3	V
Storage temperature	-40	+85	°C

3.3.2 Recommended Operating Parameters

Table 4: Power Supply Operating Parameters

Parameter	Min	Typ	Max	Unit
VCC[1] (Note1)	1.75	3.3	3.6	V
AVCC[1] (AVCC=VCC) Note1	1.75	3.3	3.6	V
AVREF[1] (when AVCC>=2.7V AVREF[1] (when AVCC<2.7V)	2.7V AVCC		AVCC AVCC	V
VCC Maximum ripple or noise[2]			<10%of VCC	%
VCC rise time (0 to 1.8V)[2]			0.1	mS
VCC shut down time (1.8V to 0V)[2]			1	mS
Operating Temperature Range	-40	-	+85	°C
BT_VREG_IN_HV[4]	2.3		3.6	V
BT_VREG_OUT_HV[4]	1.75		1.95	V
BT_VDD_IO	1.2		3.6	V

Note 1: Notes on power on. Turn on/off in the following order or at same time. Turning on: VCC→AVCC→AVRH. Turning off: AVRH→AVCC→VCC. If not using the ADC convertor, connect AVCC=VCC.

Note 2: The maximum VCC ripple or noise (at any frequency) should not exceed 10% of VCC. Ensure transient fluctuation rate does not exceed 0.1V/uS.

Note 3: nRESET input time is minimum 500nS. The on-board power-on reset circuitry may not work for rise times outside the noted interval.
Time reset is active from VCC reaches 1.75 V with x mS rise time is v mS typical.
Time reset is active from VCC reaches 1.75 V with y uS rise time is z mS typical.

Note4: BT radio chip in the BT900 has two internal regulators, a high voltage (input pin BT_VREG_IN_HV) and low voltage (input pin BT_VREG_OUT_HV) regulator. ONLY one regulator can be used to power radio chip.

Method1: If BT900 is required to operate from 3.3V, connect external 3.3V supply to pin31 BT_VREG_IN_HV and MUST leave pin32 BT_VREG_OUT_HV unconnected. Pin5(VCC) and pin43(BT_VDD_IO) should be connected to pin31 BT_VREG_IN_HV.

Method2: If BT900 is required to operate from 1.8V, connect external 1.8V supply to pin32 BT_VREG_OUT_HV and MUST leave pin31 BT_VREG_IN_HV unconnected. Pin5(VCC) and pin43(BT_VDD_IO) should be connected to pin32 BT_VREG_OUT_HV.

Table 5: Signal Levels for Interface, SIO

Parameter	Condition	Min	Typ	Max	Unit
VIH Input high voltage	VCC<2.7V VCC>=2.7V	0.7VxCC 0.8VxCC		VCC+0.3 VCC+0.3	V

VIL Input low voltage	VCC<2.7V VCC>=2.7V	VSS-0.3		0.3xVCC 0.2xVCC	V V
VOH Output high voltage (std. drive, 4mA)	VCC<2.7V VCC>=2.7V	VCC-0.45 VCC-0.5		VCC VCC	V V
VOL Output low voltage (std. drive, 4mA)	VCC<2.7V VCC>=2.7V	VSS VSS		0.4 0.4	V V
Pull up resistance	VCC<2.7V VCC>=2.7V	- 21	- 33	134 66	kΩ kΩ
Input capacitance			5	15	pF

Note 1: Maximum number of pins with 4 mA drive is TBD.

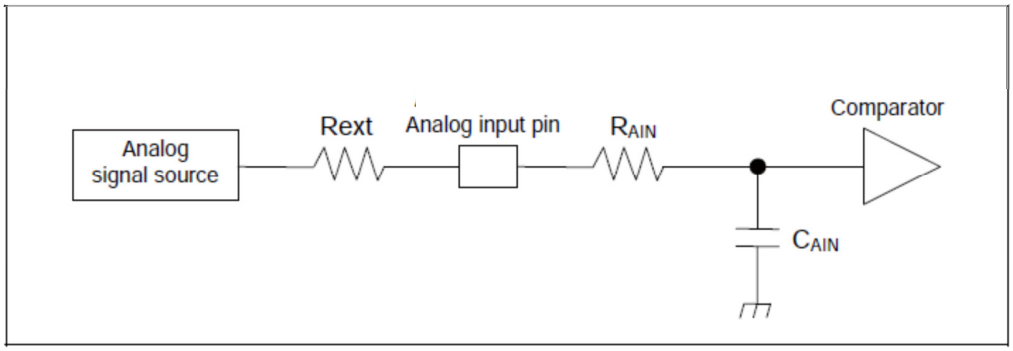
Table 6: SIO pin alternative function AIN (ADC) specification

Parameter	Min	Typ	Max	Unit
AVCC[1] (AVCC=VCC)	1.75	3.3	3.6	V
AVCC current draw(ADC 1 unit operation) [1]		0.27	0.42	mA
AVCC current draw (ADC stop)		0.03	10	uA
AVREF[1] (when AVCC>=2.7V	2.7V		AVCC	V
AVREF[1] (when AVCC<2.7V)	AVCC		AVCC	
AVREF current draw (ADC 1 unit operation)		0.72	1.29	mA
AVREF current draw (ADC stop)		0.02	2.6	uA
ADC input pin (AIN) voltage maximum	VSS		AVREF	V
ADC input port (AIN) current draw			5	uA
Time required to convert single sample 12bit mode	2		10	uS
ADC input resistor impedance (during operation)[3]				
AVCC≥2.7V			2.2	kOhm
1.8V≤AVCC<2.7V			5.5-10.5	kOhm
ADC input capacitance impedance (during operation)[3]				
			9.4	pF

Note 1: TBD

Note 2: Currently, the *smart*BASIC runtime engine firmware allows 12-bit mode.

Note 3: ADC input impedance is estimated mean impedance of the ADC (AIN) pins. The ADC is highly sensitive to the impedance of the source. The ADC (AIN) input impedance is 2.2-10.5k. Normally, when not sampling, the ADC (AIN) impedance will have very high value and can consider it to be an open circuit. The moment ADC is sampling, ADC(AIN) impedance is 2.2-10.5k.



R_{ext}: Output impedance of external circuit (kOhms)

R_{ext}: Sampling time (nS)

$T_s \geq (R_{AIN} + R_{ext}) \times C_{AIN} \times 9$

R_{AIN}: Input resistor of ADC(kOhms)=2.2kOhms at 2.7V≤AVCC≤3.6V

Input resistor of ADC(kOhms)=5.5kOhms at 1.8V≤AVCC≤2.7V

C_{AIN}: Input capacity of ADC(pF)=9.4pF at 1.8V≤AVCC≤3.6V

3.3.3 nAutoRUN pin and Operating Modes

Operating modes (refer to the *smart*BASIC manual for details):

- Self-contained mode
- Interactive / Development mode

Table 7: nAutoRUN pin

Signal Name	Pin No	I/O	Comments
nAutoRUN	3	I	Input with active low logic. Operating mode selected by nAutoRun pin status: If Low (0V), runs $autorun$ if it exists; If High (VCC), runs via at+run (and "file name" of application).

Pin 3 (nAutoRUN) is an input, with active low logic. In the development board (DVK-BT900-sx) it is connected so that the state is driven by the host's DTR output line. nAutoRUN pin needs to be externally held high or low to select between the two BT900 operating modes:

- Self-contained Run mode (nAutoRUN pin held at 0V).
- Interactive / Development mode (nAutoRUN pin held at VCC).

*smart*BASIC runtime engine firmware checks for the status of nAutoRUN during power-up or reset. If it is low and if there is a *smart*BASIC application named $autorun$ then the *smart*BASIC runtime engine executes the application automatically; hence the name *self-contained run mode*.

3.3.4 OTA (Over the Air) *smart*BASIC application download

In future release this feature will be available.

Refer to latest FW release (TBD) documentation (FW release notes and *smart* BASIC user manual) for initial details.

Table 8: OTA mode

Signal Name	Pin No	I/O	Comments
(SIO_TBD)	9	I	Internal pull down (default). OTA mode selected by externally pulling SIO_7 pin: **High (VCC),** then OTA *smart*BASIC application download is possible.

The OTA *smart*BASIC application download feature can be useful for a customer's production because it allows the module to be soldered into an end product without preconfiguration; the application can then be downloaded over the air once the product has been pre-tested.

Note: It is the *smart* BASIC application that is downloaded over the air and NOT the firmware. Due to this principle reason for use in production, to facilitate multiple programming stations in a locality the transmit power is limited (to lower Tx power), refer to *smart* BASIC user manual for more details.

4 POWER CONSUMPTION

Data taken at VCC 3.3V and 25°C.

4.1 Power Consumption

Table 9: Power consumption

Parameter	Min	Typ	Max	Unit
Active Peak current –Note1				
TX only run peak current @TXpwr= +8 dBm		85		mA
TX only run peak current @T pwr= +4 dBm		71		mA
TX only run peak current @TXpwr= 0 dBm		61		mA
TX only run peak current @TXpwr= -4 dBm		55		mA
TX only run peak current @TXpwr= -8 dBm		52		mA
TX only run peak current @TXpwr= -12 dBm		49		mA
TX only run peak current @TXpwr= -16 dBm		48		mA
T X only run peak current @TXpwr= -20 dBm				
Active Mode				
RX only 'peak' current (Note2)		TBD		mA
Ultra Low Power Mode1(Note3)				
Standby Doze (waitevent)		227		uA
Standby Doze (waitevent)-Note3		113		uA
Ultra Low Power Mode2(Note4)				
Deep Sleep (no RAM retention)		7 (Note 4)		uA
BLE Mode				
Active Mode Average current (Note5)				
Advertising Average Current draw		TBD		uA

Parameter		Min	Typ	Max	Unit
Max, with advertising interval (min)	20 mS		TBD		uA
Min, with advertising interval (max)	10240 mS				
Connection Average Current draw					uA
Max, with connection interval (min)	7.5 mS		TBD		uA
with connection interval	67.5 mS		TBD		uA
Min, with connection interval (max)	4000 mS				

Note 1:

Note 2: Firmware version

Note 3: Standby Doze is entered automatically (when *waitevent* statement is encountered within a *smart*BASIC application script). In Standby Doze, all peripherals that are enabled stay on and may re-awaken the chip. Depending on active peripherals, current consumption ranges from ~xx µA to > 1 mA. See individual peripherals current consumption in tables in section *Peripheral block current consumption 4.3*.
External supplied Sleep Clock oscillator for BT Radio chip sleep modes **(BT900 pin34, BT_Ext_DS_CLK).** There is current consumption saving of 114uA when using external 32.768kHz.
227uA is when the internal radio chip 32.768kHz is used.
113uA is when external 32.768kHz oscillator is connected to BT900 (radio chip) pin34(BT_Ext_DS_CLK). PSKey needs to be changed via *smart*BASIC command.

Note 4: In Deep Sleep, everything is disabled and the only wake-up sources are reset and changed on pins on which sense is enabled. The current consumption seen is ~7uA typical. Current *smart* BASIC runtime engine firmware (v9.x.y.z) requires a hardware reset to come out of deep sleep. Future firmware releases allow coming out from Deep Sleep to Standby Doze through GPIO signal through the reset vector. Deep Sleep mode is entered (with a command in *smart* BASIC application script).

Note 5: BLE radio taken with TX power 8 dBm and all peripherals off (UART OFF after radio event), slave latency of 0 (in a connection). Average current consumption depends on a number of factors [including TX power, VCC accuracy of 26 MHz and 32.768 kHz). With these factors fixed, the largest variable is the advertising or connection interval set.

Advertising Interval range:
20 ms to 10240 ms in multiples of 0.625 ms for Advert type=ADV_IND and ADV_DIRECT_IND.
100 ms to 10240 ms in multiples of 0.625 ms for Advert type=ADV_SCAN_IND and ADV_NONCONN_IND.
For advertising timeout, if the advert type is ADV_DIRECT_IND, then the timeout is limited to 1.28 seconds (1280 ms).

For an advertising event,
- the minimum average current consumption is when the advertising interval is large 10240 mS (although this may cause long discover times (for the advertising event) by scanners

- the maximum average current consumption is when the advertising interval is small 20 mS

Other factors that are also related to average current consumption include the advertising payload bytes in each advertising packet and whether continuously advertising or periodically advertising.

Connection Interval range -
7.5 ms to 4000 ms in multiples of 1.25 ms.

For a connection event,
- the minimum average current consumption is when the connection interval is large 4000 mS

– the maximum average current consumption is with the shortest connection interval of 7.5 ms; no slave latency.
Other factors that are also related to average current consumption include whether transmitting 6 packets per connection interval & each packet contains 20 bytes (which is the maximum for each packet) and an inaccurate 32 kHz master clock accuracy would increase the average current consumption.

4.2 Measured Peak Current Waveforms During BLE Advertising and Connection

Error! Reference source not found. illustrates current waveforms observed as the BT900 module performs advertising and connection functionality.

Figure 3: Typical peak current consumption profile during advertising in slave mode @ TX PWR +8dBm. UART is OFF. 8

Figure 4: Typical peak current consumption profile during data connection event in slave mode @ TX PWR +8dBm. UART is ON.

4 dBm	0 dBm	-4 dBm	-8 dBm
-12 dBm	-16 dBm	-20 dBm	

Figure 5: Typical peak current consumption profile during advertising in slave mode versus TX PWR

Note: In the above pictures, UART is ON. X-axis time (1 mS per square), Y-axis current (2 mA per square).

4dBm 0dBm -4dBm -8dBm

-12dBm -16dBm -20dBm

Figure 6: Typical peak current consumption profile during connection event in slave mode versus TX PWR.

Figure 7:

Note: In the above pictures, UART is ON. X-axis time (1 mS per square), Y-axis current (2 mA per square).

4.3 Peripheral block current consumption

The values below are calculated for a typical operating voltage of 3 V.

Table 10: UART Power Consumption

Parameter	Min	Typ	Max	Unit
UART Run current @ 115200 bps		xxx		uA
UART Run current @ 1200 bps		xxx		uA
UART Baud rate	1.2		115.2	kbps

Table 11: SPI Power Consumption

Parameter	Min	Typ	Max	Unit
SPI Master Run current @ 125 kbps		xxx		uA
SPI Master Run current @ 4 Mbps		xxx		uA
SPI bit rate	0.125		8	Mbps

Table 12: I2C Power Consumption

Parameter	Min	Typ	Max	Unit
I2C Run current @ 100 kbps		xxx		uA
I2C Run current @ 400 bps		xxx		uA
I2C Bit rate	100		400	kbps

Table 13: ADC

Parameter	Min	Typ	Max	Unit
ADC current during conversion		xxx		uA

The above current consumption is for the particular peripheral only and to operate that peripheral requires some other internal blocks which consume fixed amount of base current (~xxxuA).

This base current of ~xxxx uA is consumed when the UART, SPI, I2C, or ADC is opened (operated).

For asynchronous interface like the UART (asynchronous as the other end can communicate at any time), the UART (on BT900) must kept open (by a command in *smart* BASIC application script) resulting in the base current consumption penalty.

For synchronous interface like the I2C or SPI (since BT900 side is the master), the interface can be closed and opened only (by a command in *smart* BASIC application script) when needed, resulting in current saving (no base current consumption penalty). Similar argument for ADC (open ADC when needed).

5 FUNCTIONAL DESCRIPTION

The BT900 Dual Mode (BT/BLE) module is a self-contained Bluetooth Low Energy product and requires only power and a user's *smart*BASIC application to implement full BLE functionality. The integrated, high performance antenna combined with the RF and Base-band circuitry provides the Bluetooth Low Energy wireless link, and any of the SIO lines provide the OEM's chosen interface connection to the sensors. The user's *smart*BASIC application binds the sensors to the BLE wireless functionality.

The variety of hardware interfaces and the *smart*BASIC programming language allow the BT900 module to serve a wide range of wireless applications, whilst reducing overall time to market and the learning curve for developing Dual mode BT/ BLE products.

To provide the widest scope for integration a variety of physical host interfaces / sensors are provided. The major BT900 series module functional blocks described below.

5.1 Power management (includes brown-out and power on reset)

Power management features:

- System Standby Doze / Deep Sleep modes.
- Brownout Reset.
- Open /Close Peripherals (UART, SPI, I2C, SIO's and ADC). Peripherals consume current when open; each peripheral can be individually closed to save power consumption (with a command in *a smart*BASIC application script).
- 2-region RAM retention (No RAM retention in Deep Sleep mode).
- *smart*BASIC command allows the VCC voltage to be read (through the internal ADC).
- Power fail comparator.
- Pin wake-up system from Deep sleep.

Power supply features:

- Supervisor HW to manage power on reset, brownout (and power fail).
- 1.8V to 3.6V supply range using internal LDO regulator.

5.2 Clocks and TIMERS

5.2.1 Clocks

The integrated high accuracy (+/-20ppm) 32.768kHz crystal oscillator provides protocol timing and helps with Radio power consumption in the system Standby Doze /Deep sleep modes by reducing the time that the RX window needs to be open. Standard accuracy clocks tend to have lower accuracy +/-250 ppm.

The integrated high accuracy 26 MHz (+/-10ppm) crystal oscillator helps with Radio operation and also helps reduce power consumption in the Active modes.

5.2.2 TIMERS

In keeping with the event driven paradigm of *smart* BASIC, the timer subsystem enables *smart* BASIC applications to be written which allow future events to be generated based on timeouts.

Regular Timer: There are x built-in timers (regular timer) derived from a single RTC clock which are controlled solely by *smart*BASIC functions. The resolution of the regular timer is xyz microseconds.

Tick Timer is a xx bit free running counter that increments every x millisecond. The resolution of this counter is xxx microseconds. This counter can be accessed using the functions GetTickCount() and GetTickSince().

Refer to the *smart*BASIC user manual.

5.3 Memory for *smart*BASIC Application Code

User has up to 4Kbytes (TBD) of data memory available for *smart*BASIC application script.

5.4 RF

- 2402–2480 MHz Bluetooth4.0 Dual Mode (BT and BLE) (1Mbps to 3Mbps over the air data rate).
- TX output power of +8 dBm programmable (via *smart*BASIC command) to -20 dBm in steps of 4 dB.
- Receiver (with integrated channel filters) to achieve maximum sensitivity -90dBm @ 1 Mbps BLE or Classic BT 2Mbps, 3Mbps).
- RF conducted interface available in 3-ways:
  - BT900-SA -RF connected to on-board antenna on BT900-SA
  - BT900-SC -RF connected to on-board uFL RF connector on BT900-SC
- Antenna options:
  - Integrated monopole chip antenna on BT900-SA
  - External dipole antenna connected with to uFL RF connector on BT900-SC.

5.5 UART Interface

The Universal Asynchronous Receiver/Transmitter offers fast, full-duplex, asynchronous serial communication with built-in flow control support (UART_CTS, UART_RTS) in HW up to 1 Mbps baud. Parity checking and generation for the 9th data bit are supported.

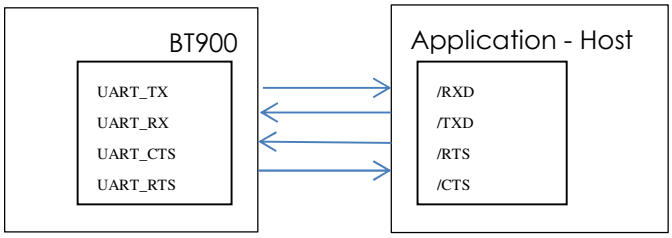
UART_TX, UART_RX, UART_RTS, and UART_CTS form a conventional asynchronous serial data port with handshaking. The interface is designed to operate correctly when connected to other UART devices such as the 16550A. The signalling levels are nominal 0 V and 3.3 V (tracks VCC) and are inverted with respect to the signalling on an RS232 cable.

Two-way hardware flow control is implemented by UART_RTS and UART_CTS. UART_RTS is an output and UART_CTS is an input. Both are active low.

These signals operate according to normal industry convention. UART_RX, UART_TX, UART_CTS, UART_RTS are all 3.3 V level logic (tracks VCC). For example, when RX and TX are idle they sit at 3.3 V. Conversely for handshaking pins CTS, RTS at 0 V is treated as an assertion.

The module communicates with the customer application using the following signals:

- Port /TXD of the application sends data to the module's UART_RX signal line
- Port /RXD of the application receives data from the module's UART_TX signal line



Note: The BT900 serial module output is at 3.3V CMOS logic levels (tracks VCC). Level conversion must be added to interface with an RS-232 level compliant interface.

Some serial implementations link CTS and RTS to remove the need for handshaking. Laird does not recommend linking CTS and RTS other than for testing and prototyping. If these pins are linked and the host sends data at the point that the BT900 deasserts its RTS signal, then there is significant risk that internal receive buffers will overflow, which could lead to an internal processor crash. This will drop the connection and may require a power cycle to reset the module. Laird recommends that the correct CTS/RTS handshaking protocol be adhered to for proper operation.

Table 14: UART Interface

Signal Name	Pin No	I/O	Comments
SIO_1 / UART_TX	45	O	SIO_1 (alternative function UART_TX) is an output, set high (in FW).
SIO_0 / UART_RX	44	I	SIO_0 (alternative function UART_RX) is an input, set with internal pull-up (in FW).
SIO_2 / UART_RTS	46	O	SIO_2 (alternative function UART_RTS) is an output, set low (in FW).
SIO_3 / UART_CTS	35	I	SIO_3 (alternative function UART_CTS) is an input, set with internal pull-down (in FW).

The UART interface is also used to load customer developed *smart* BASIC application script.

5.6 SPI Bus

The SPI interface is an alternate function on SIO pins, configurable by *smart* BASIC.

The Module is a master device that uses terminals SPI_MOSI, SPI_MISO, and SPI_CLK. SPI_CSB is implemented using any spare SIO digital output pins to allow for multi-dropping.

The SPI interface enables full duplex synchronous communication between devices. It supports a 3-wire (SPI_MOSI, SPI_MISO, SPI_SCK,) bidirectional bus with fast data transfers to and from multiple slaves. Individual chip select signals will be necessary for each of the slave devices attached to a bus, but control of these is left to the application through use of SIO signals. I/O data is double buffered.

The SPI peripheral supports SPI mode 0, 1, 2, and 3.

Table 15: Peripheral supports

Signal Name	Pin No	I/O	Comments
SPI_MOSI	8	O	This interface is an alternate function configurable by *smart* BASIC. Default in the FW pin 8 and 10 are inputs. SPIOPEN() in *smart* BASIC selects SPI function and changes pin8and 10 to outputs (when in SPI master mode).
SPI_MISO	7	I	
SPI_CLK	10	O	

5.7 I2C Interface

The I2C interface is an alternate function on SIO pins, configurable by *smart* BASIC command.

The Two-wire interface can interface a bi-directional wired-OR bus with two lines (SCL, SDA) and has master /slave topology. The interface is capable of clock stretching. Data rates of 100 kbps and 400 kbps are supported.

An I2C interface allows multiple masters and slaves to communicate over a shared wired-OR type bus consisting two lines which normally sit at VCC. The BT900 module can only be configured as an I2C master with additional constraint that it be the only master on the bus. The SCL is the clock line which is always sourced by the master and SDA is a bi-directional data line which can be driven by any device on the bus.

IMPORTANT: It is essential to remember that pull-up resistors on both SCL and SDA lines are not provided in the module and MUST be provided external to the module.

Table 16: I2C Interface

Signal Name	Pin No	I/O	Comments
I2C_SDA	11	I/O	This interface is an alternate function on each pin, configurable by *smart*BASIC. I2COPEN() in *smart*BASIC selects I2C function.
I2C_SCL	12	I/O	

5.8 General Purpose I/O, ADC and Quadrature Decoder

5.8.1 GPIO

The 18 SIO pins are configurable by *smart*BASIC. They can be accessed individually. Each has the following user configured features:

- Input/output direction
- Output drive strength (4mA)
- Internal pull up resistors (33K typical) or no pull-up.
- Wake-up from high or low level triggers on all pins.
- GPIO pins (pinswhose names begin with "BT"

5.8.2 Quadrature Decoder

The following feature exists in hardware but cannot be configured in the firmware currently:

- The quadrature decoder provides buffered decoding of quadrature-encoded sensor signals. It is suitable for mechanical and optical sensors with an optional LED output signal and input debounce filters. The sample period and accumulation are configurable to match application requirements. All pins individually can be configured to carry quadrature demodulator signals.

5.8.3 ADC

The ADC is an alternate function on SIO pins, configurable by *smart*BASIC.

The BT900 provides access to six-channel 12-bit incremental ADC. This enables sampling multiple external signals through a front end MUX. The ADC has configurable input and TBD.

Note: Current *smart*BASIC runtime engine firmware (v9.x.y.z) provides access to 12-bit mode resolution only.

5.8.3.1 Analog Interface (ADC)

Table 17: Analog interface

Signal Name	Pin No	I/O	Comments
AIN – Analog Input	24	I	This interface is an alternate function on each pin, configurable by *smart*BASIC. AIN configuration selected using GpioSetFunc() function. Up to 12bit resolution.
AIN – Analog Input	45	I	

5.8.4 APWM and FREQ signal output on upto xSIO pins

The PWM and FREQ output is an alternate function on SIO pins, configurable by *smart*BASIC.

The ability to output a PWM (Pulse Width Modulated) signal or FREQ output signal on up to x GPIO (SIO) output pins has been added since *smart*BASIC runtime engine firmware v9.x.y.z and can be selected using GpioSetFunc() function.

PWM output signal has a frequency and duty cycle property. PWM output is generated using xx-bit hardware timers. The timers are clocked by a xMHz clock source. Frequency is adjustable

(upto xMHz)and the Duty cycle can be set over range from 0% to 100% (both configurable by *smart*BASIC command). Note, the frequency driving each of the x SIO pins is the same but the duty cycle can be independently set for each pin.

FREQ output signal frequency can be set over a range of 0Hz to xMHz (with 50% mark-space ratio).

5.9 nRESET pin

Table 18: nRESET pin

Signal Name	Pin No	I/O	Comments
nRESET	16	I	BT900 HW reset (active low). Pull the nRESET pin low for minimum 100mS in order for the BT900 to reset.

5.10 nAutoRUN pin

Refer to section *nAutoRUN pin and Operating Modes* regarding operating modes and the nAutoRUN pin.

- Self-contained Run mode
- Interactive / Development mode

5.11 *smart*BASIC runtime engine firmware upgrade

The BT900 SW consists of:

- BT900 *smart*BASIC runtime engine FW (loaded at production, may be upgraded customer).
- BT900 *smart*BASIC application script developed by customer (loaded through UART by customer).

To allow customer the capability to upgrade the BT900 *smart*BASIC runtime engine FW, to the latest version released from Laird), the current *smart*BASIC runtime engine firmware (v9.x.y.z) only allows this upgrade via the UART.

Figure 8:

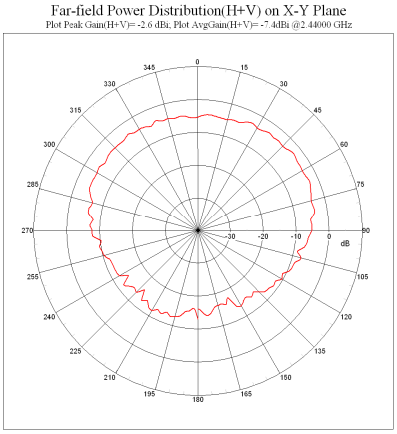
5.12 BT900-SA on-board chip antenna characteristics

The BT900-SA on-board chip monopole antenna radiated performance depends on the host PCB layout.

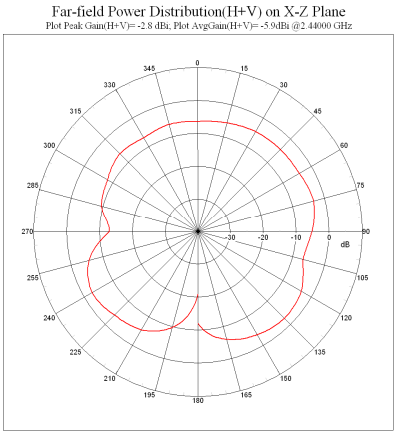
BT900 development board was used for BT900 development and antenna performance evaluation. To obtain similar performance follow guidelines in section *PCB Layout on Host PCB for BT900-SA* to allow the on-board antenna to radiate and reduce proximity effects due to nearby host PCB GND copper or metal covers.

BT900-SA on-board antenna datasheet:
http://www.acxc.com.tw/product/at/at3216/AT3216-B2R7HAA_S-R00-N198_2.pdf

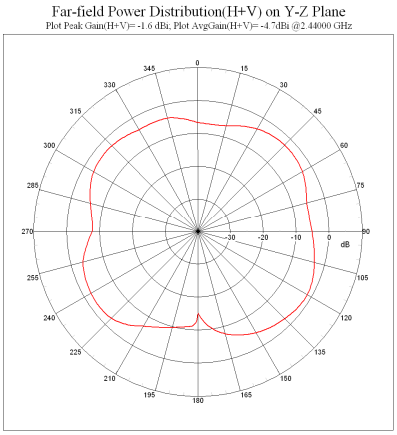
Antenna performance on DVK-BT900-V01 devboard shown below.



	Peak gain	Avg. gain
XY-plane	-2.6	-7.4



	Peak gain	Avg. gain
XZ-plane	-2.8	-5.9



	Peak gain	Avg. gain
YZ-plane	-1.6	-4.7

6 HARDWARE INTEGRATION SUGGESTIONS

6.1 Circuit

The BT900-series module is easy to integrate requiring no external components on the customer's board apart from those required by customer for development and in customers end application.

Checklist (for Schematic):

- **VCC**
  External power source within the operating range, rise time and noise/ripple specification of BT900. Add decoupling capacitors for filtering the external source. Power-on reset circuitry within BT900 series module incorporates brown-out detector, thus simplifying power supply design. Upon application of power, the internal power-on reset ensures module starts correctly.
- **Decide if BT900 is to be powered by 3.3V or 1.8V external Power Supply**
  BT radio chip in the BT900 has two internal regulators, a high voltage (input pin BT_VREG_IN_HV) and low voltage (input pin BT_VREG_OUT_HV) regulator. ONLY one regulator can be used to power radio chip.
  Method1: If BT900 is required to operate from 3.3V, connect external 3.3V supply to pin31 BT_VREG_IN_HV and MUST leave pin32 BT_VREG_OUT_HV unconnected.
  Pin5(VCC) and pin43(BT_VDD_IO) should be connected to pin31 BT_VREG_IN_HV.
  Method2: If BT900 is required to operate from 1.8V, connect external 1.8V supply to pin32 BT_VREG_OUT_HV and MUST leave pin31 BT_VREG_IN_HV unconnected.
  Pin5(VCC) and pin43(BT_VDD_IO) should be connected to pin32 BT_VREG_OUT_HV.
- **Place decoupling capacitor on pin41 BT_VDD_IO.** Value 0.1uF or value suitable to filter the noise present.
- **AIN (ADC) and SIO pin IO voltage levels**
  BT900 SIO voltage levels are at VCC. Ensure input voltage levels into SIO pins are at VCC also (if VCC source is a battery whose voltage will drop). Ensure ADC pin maximum input voltage for damage is not violated.
- **External supplied Sleep Clock oscillator for BT Radio chip sleep modes** (BT900 pin34, BT_Ext_DS_CLK).
  There is current consumption saving of 114uA when using external 32.768kHz.
  227uA is when the internal radio chip 32.768kHz is used.
  113uA is when external 32.768kHz oscillator is connected to BT900 (radio chip) pin34(BT_Ext_DS_CLK). PSKey needs to be changed via *smart*BASIC command.
  Refer to DK-BT900-V01 for schematic and recommended part, Siward OSC863100-SCO-B660 (description: OSC,32.768KHz,+/-25ppm,3.2*2.5*1.2mm,SMD,-40~+85dC).
- **UART**
  Is required for loading customer *smart*BASIC application script during development (or for subsequent upgrade). Add connector to allow UART to be interfaced to PC (via UART – RS232 or UART- USB).
- **UART_RX and UART_CTS**
  SIO_0 (alternative function UART_RX) is an input, set with internal pull-up (in FW). The pull-up prevents the module from going into deep sleep when UART_RX line is idling.
  SIO_3 (alternative function UART_CTS) is an input, set with external pull-down. This pull-down ensures the default state of the UART_CTS will be asserted which means can send data out of the UART_TX line. In the case when UART_CTS is not connected (which we do not recommend).

- **nAutoRUN pin and operating mode selection**
  nAutoRUN pin needs to be externally held high or low to select between the two BT900 operating modes at power-up:
  - Self-contained Run mode (nAutoRUN pin held at 0V).
  - Interactive / development mode (nAutoRUN pin held at VCC).
  Make provision to allow operation in the required mode. Add jumper to allow nAutoRUN pin to be held high or low (via 10K resistor) OR driven by host GPIO.
- **I2C**
  It is essential to remember that pull-up resistors on both I2C_SCL and I2C_SDA lines are not provided in the BT900 module and MUST be provided external to the module as per I2C standard.
- **SPI**
  Implement SPI chip select using any unused SIO pin within your *smart*BASIC application script then SPI_CS is controlled from *smart*BASIC application allowing multi-dropping.
- **SIO pin direction**
  BT900 modules shipped from production with *smart* BASIC runtime engine FW, all SIO pins (with "default function" of "DIO") are mostly digital inputs (see Pin Definitions Table2). Remember to change the direction SIO pin (in your *smart* BASIC application script) if that particular pin is wired to a device that expects to be driven by the BT900 SIO pin configured as an output. Also these SIO pins that are inputs have by default (in FW) no internal pull-up (TBD) resistor-enabled, and therefore are floating (TBD). You are free to configure in your *smart*BASIC application script.

  Note: Internal pull-up, pull down will take current from VCC.

- **SIO_TBD pin** and Over the Air *smart*BASIC application download feature
  SIO_TBD is an input, set with internal pull-down (in FW). Refer to latest FW release documentation on how SIO_TBD is used for Over the Air *smart*BASIC application download feature. SIO_TBD pin has to be pulled high externally to enable the feature. Decide if this feature is required in production.
- **nRESET pin (active low)**
  Hardware reset. Wire out to push button or drive by host.
  By default module is out of reset when power applied to VCC pin.

6.2 PCB Layout on Host PCB - General

Checklist (for PCB):

- MUST locate BT900-Sx module close to the edge of PCB (mandatory for BT900-SA for on-board chips antenna to radiate properly).
- Use solid GND plane on inner layer (for best EMC and RF performance).
- All module GND pins MUST be connected to host PCB GND.
- Place GND vias close to module GND pads as possible
- Unused PCB area on surface layer can flooded with copper but place GND vias regularly to connect copper flood to inner GND plane. If GND flood copper underside the module then connect with GND vias to inner GND plane.
- Route traces to avoid noise being picked up on VCC supply and AIN(analogue) and SIO (digital) traces.
- Do NOT run any track near pin34 of BT900-Sx. Pin34 is BT_Ext_DS_CLK which the external supplied 32.768kHz oscillator is connected to. MUST ensure the 32.768kHz is shield by GND on either side, see devboard PCB layout DVK-BT900-V01.
- Ensure no exposed copper underside of the module (refer to land pattern of BT900 development board).

6.3 PCB Layout on Host PCB for BT900-SA

6.3.1 Antenna keep-out on host PCB

The BT900-SA has an integrated chip antenna and its performance is sensitive to host PCB. It is critical to locate the BT900-SA on the edge of the host PCB (or corner) to allow the antenna to radiate properly. Refer to guidelines in section ***PCB land pattern and antenna keep-out area for BT900-SA***. Some of those guidelines repeated below.

- 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 BT900-SA module on the edge of the host PCB, preferably in the corner with the antenna facing the corner.
- The BT900 development board has the BT900-SA module on the edge of the board (not in the corner). The antenna keep-out area is defined by the BT900 development board which was used for module development and antenna performance evaluation is shown in Figure 9, where the antenna keep-out area is ~4.2 mm wide, 34.2 mm long; with PCB dielectric (no copper) height 1.0 mm sitting under the BT900-SA antenna.
- A different host PCB thickness dielectric will have small effect on antenna.
- The antenna-keep-out defined in Host PCB Land Pattern and Antenna Keep-out for BT900-SA applies when the BT900-SA is placed in the corner of the host PCB. When BT900-SA cannot be placed as such, it must be placed on the edge of the host PCB and the antenna keep out must be observed. An example is shown in Figure 9.

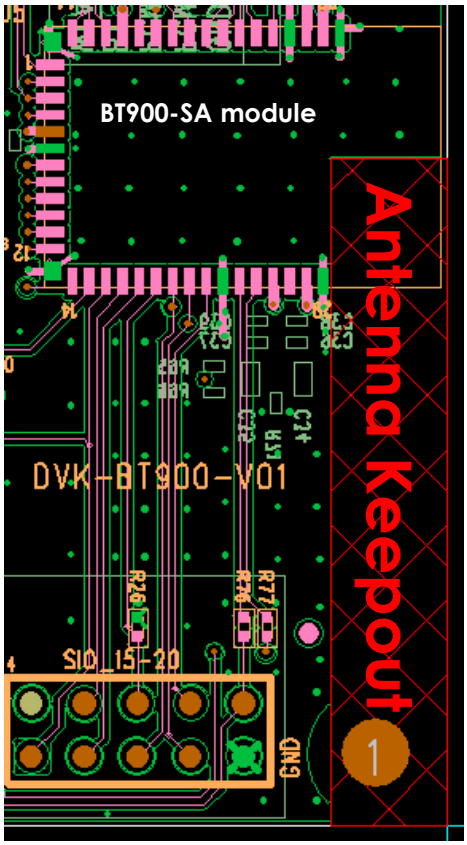


Figure 9: Antenna keep-out area (shown in red), corner of the BT900 development board for BT900-SA module.

Note: 1. BT900 module placed on edge of host PCB.
2. Copper cut-away on all layers in "antenna Keep-out" area under BT900 on host PCB.

6.3.2 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 40mm top/bottom and 30mm left or right.
- Metal close to the BT900-SA chip monopole antenna (bottom, top, left, right, any direction) will have degradation on the antenna performance. How much; that is entirely system dependent which means some testing by customer required (in their host application).
- Anything metal closer than 20mm will start 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).

6.4 External Antenna Integration with BT900-SC

Please refer to the regulatory sections for FCC, IC, CE, and Japan for details of use of BT900-Sx with external antennas in each regulatory region.

The BT900 family has been designed to operate with the below external antennas (with a maximum gain of 2.0 dBi). The required antenna impedance is 50 ohms. See Table 19.

External antennas improve radiation efficiency.

Table 19: External antennas for the BT900

External Antenna Part Number	Mfg.	Type	Gain (dBi)	Connector Type	BT900 Part number
S181FL-L-RMM-2450S	Nearson	Dipole	2.0	uFL Note1	BT900-SC
EBL2449A1-15UFL	Laird	PCB Dipole	2.0	uFL Note1	BT900-SC
MAF94190	Laird	Dipole	2.0	uFL	BT900-SC
MAF94019	Laird	Dipole	1.5	uFL	BT900-SC

Note 1:
Antenna manufacturer Laird contact information:
Sales:
Tel:
Email:

7 MECHANICAL DETAILS

7.1 BT900 Mechanical Details

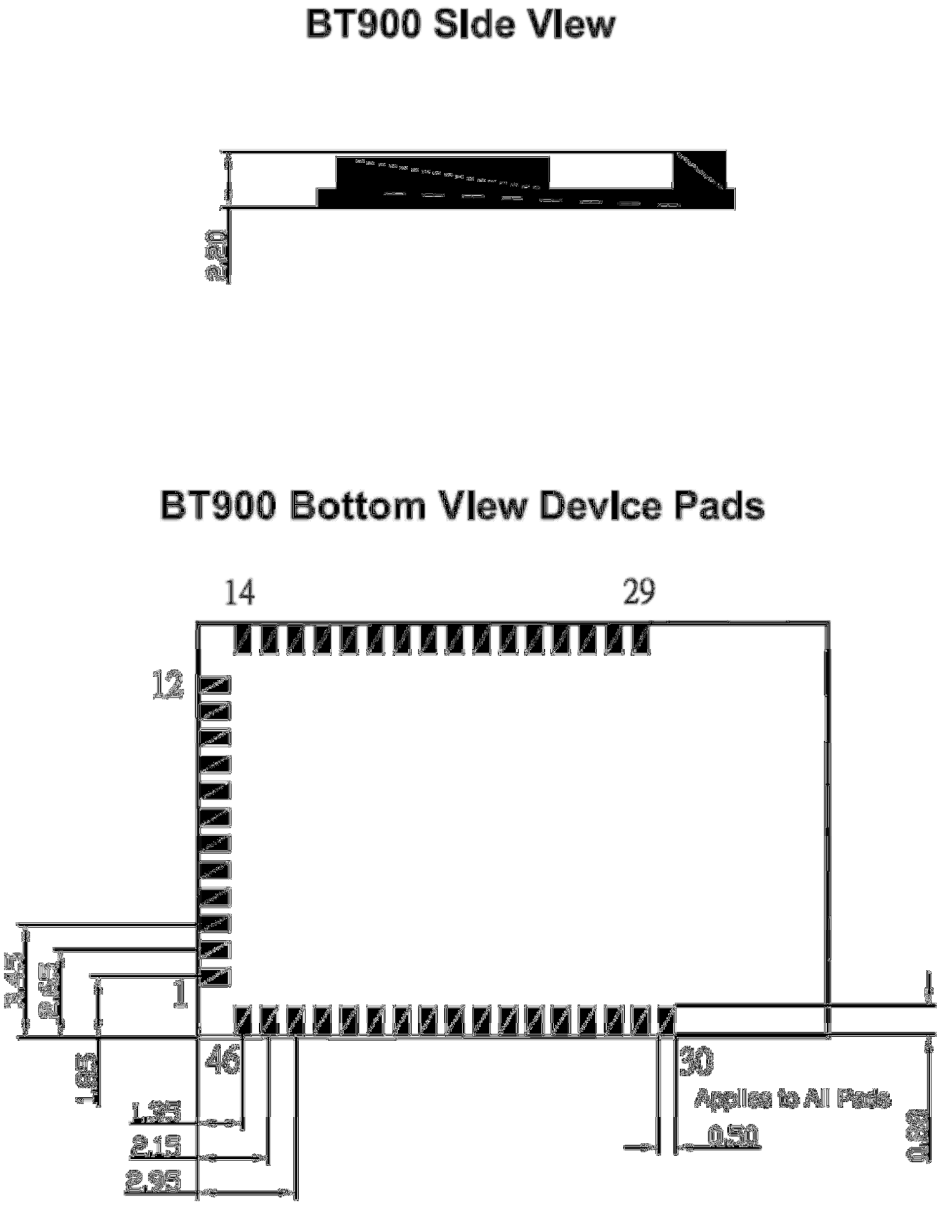
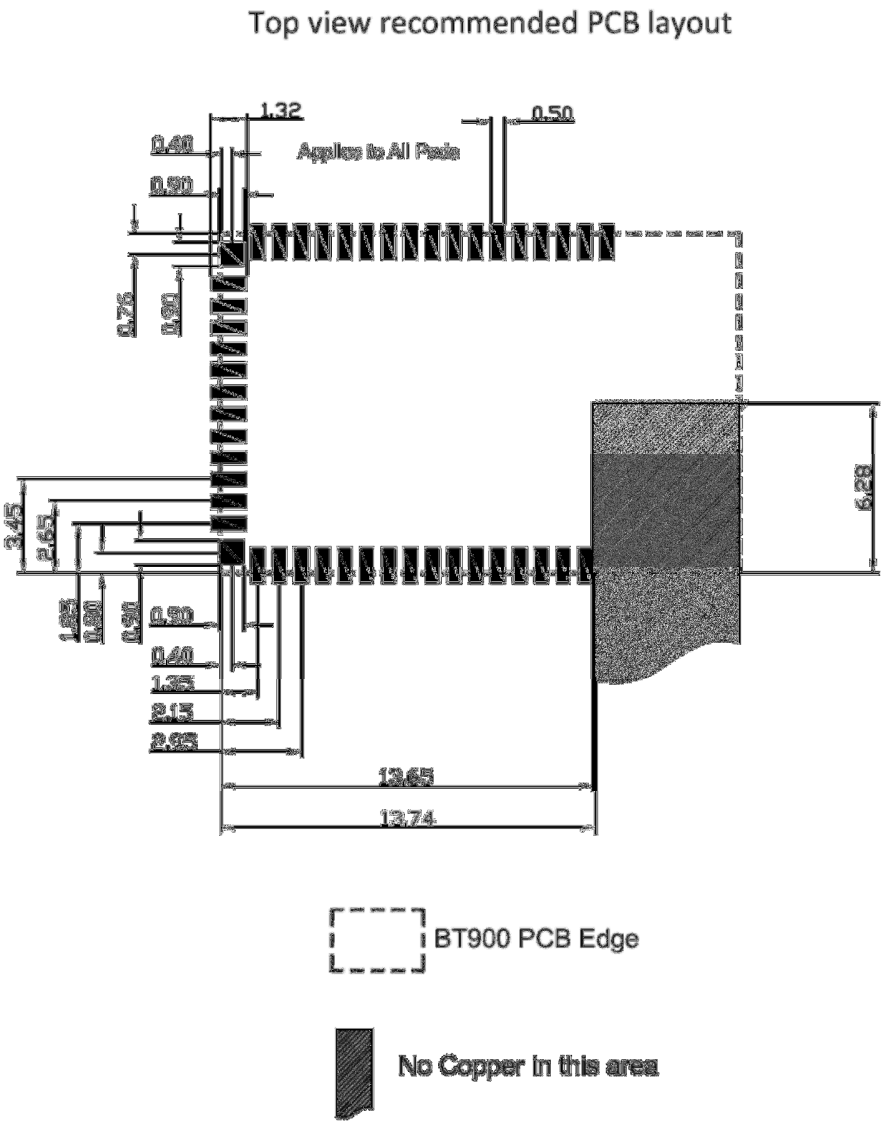


Figure 10: BT900 Mechanical drawings

Development Kit Schematics can be found at:
http://lairdtech.com/Products/Embedded-Wireless-Solutions/Bluetooth-Radio-Modules/BL900-Series/#productGroupTabs-2147488080

7.2 Host PCB Land Pattern and Antenna Keep-out for BT900-SA



Dimensions in mm.

APPLICATION NOTES

1. Ensure there is no copper in the antenna 'keep out area' on any layers of the host PCB. Also keep all mounting hardware or any metal clear (Refer to 6.3.2) on of the area to reduce effects of proximity detuning the antenna and to help antenna radiate properly.
3. For BT900-SA (has on-board chip antenna) best antenna performance, the module BT900-SA MUST be placed on the edge of the host PCB and preferably in the **corner** with the antenna facing the corner. Above "Keep Out Area" is the module placed in corner of

PCB. If BT900-SA is not placed in corner but on edge of host PCB, the antenna "Keep Out Area" is extended (see Note4).

4. BT900 development board has BT900-SA placed on the edge of the PCB board (and not in corner) for that the Antenna keep out area is extended down to the corner of the development board, see section *PCB Layout on Host PCB for BL900-SA,* Figure10. This was used for module development and antenna performance evaluation.
5. Ensure no exposed copper under module on host PCB.
6. The user may modify the PCB land pattern dimensions based on their experience and / or process capability.

---

8 APPLICATION NOTE FOR SURFACE MOUNT MODULES

8.1 Introduction

Laird Technologies 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 will be 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 conform to current automated manufacturing processes.

8.2 Shipping

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 8-1.

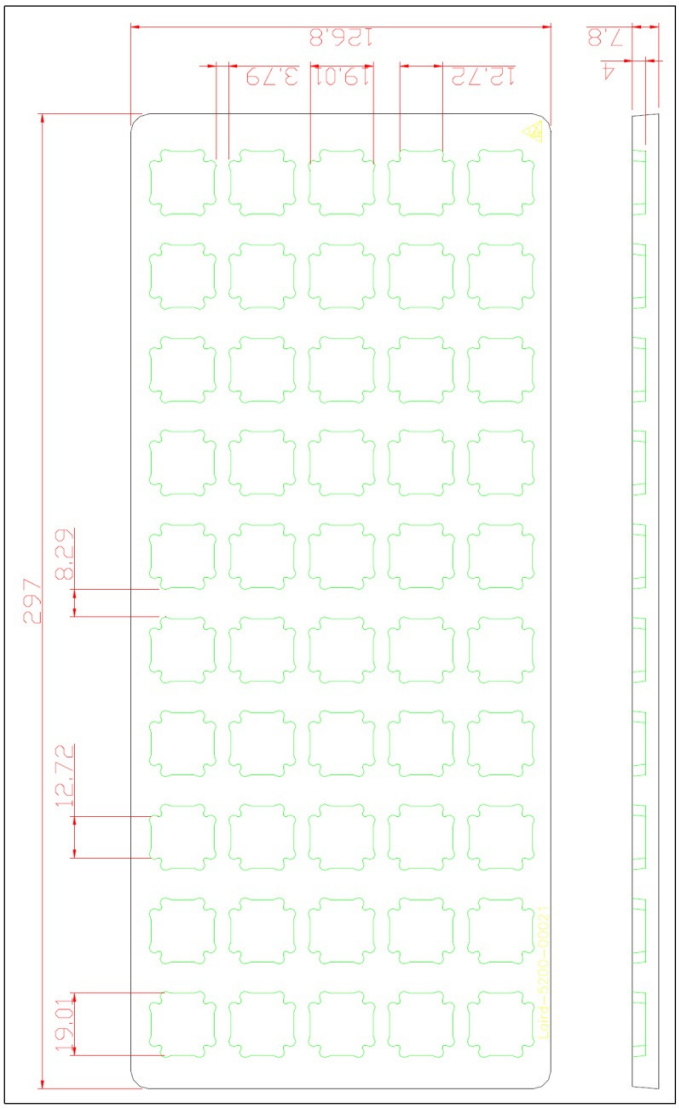


Figure 8-1: BT900 Shipping Tray Details

8.3 Reflow Parameters

Prior to any reflow, it is important to ensure the modules were packaged to prevent moisture absorption. New packages contain desiccate (to absorb moisture) and a humidity indicator card to display the level maintained during storage and shipment. If directed to *bake units* on the card, see Table 20 and follow instructions specified by IPC/JEDEC J-STD-033. A copy of this standard is available from the JEDEC website:
http://www.jedec.org/sites/default/files/docs/jstd033b01.pdf

Note: The shipping tray cannot be heated above 65°C. If baking is required at the higher temperatures displayed in in Table 20, the modules must be removed from the shipping tray.

Any modules not manufactured before exceeding their floor life should be re-packaged with fresh desiccate and a new humidity indicator card. Floor life for MSL (Moisture Sensitivity Level) 3 devices is 168 hours in ambient environment ≤30°C/60%RH.

Table 20: Recommended baking times and temperatures

MSL	125°C Baking Temp.		90°C/≤ 5%RH Baking Temp.		40°C/ ≤ 5%RH Baking Temp.	
	Saturated @ 30°C/85%	Floor Life Limit + 72 hours @ 30°C/60%	Saturated @ 30°C/85%	Floor Life Limit + 72 hours @ 30°C/60%	Saturated @ 30°C/85%	Floor Life Limit + 72 hours @ 30°C/60%
3	9 hours	7 hours	33 hours	23 hours	13 days	9 days

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 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.

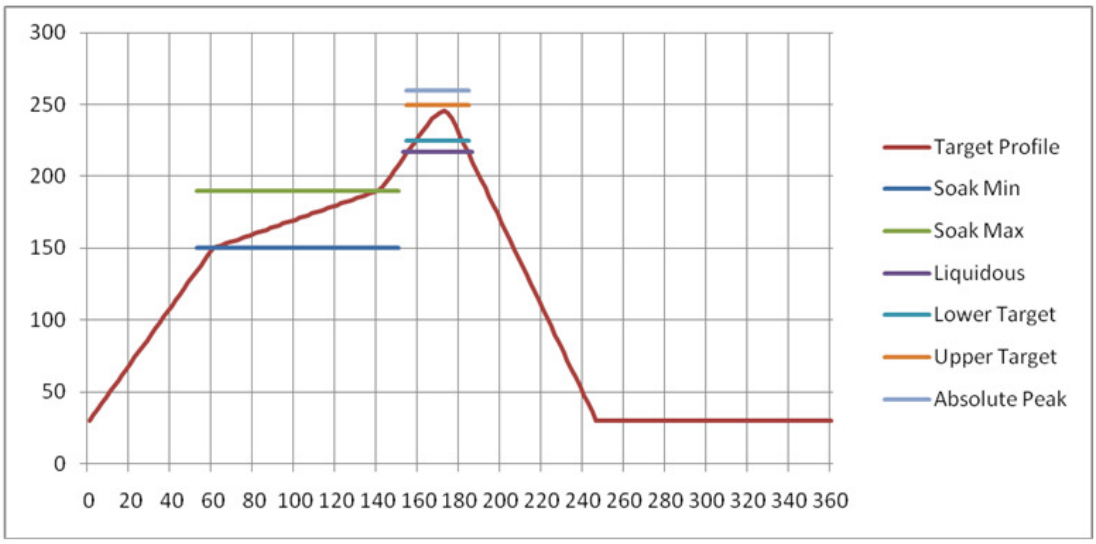


Figure 8-2: Recommended Reflow Temperature

Temperatures should not exceed the minimums or maximums presented in Table 21.

Table 21: 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

Specification	Value	Unit
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

9 FCC AND IC REGULATORY STATEMENTS

Model	US/FCC	CANADA/IC
BT900-SA	TBC	TBC
BT900-SC	TBC	TBC

The BT900-SA and BT900-SC hold full modular approvals. The OEM must follow the regulatory guidelines and warnings listed below to inherit the modular approval.

PART #	FORM FACTOR	TX OUTPUT	ANTENNA
BT900-SA-0X	Surface Mount	8dBm	Ceramic
BT900-SC-0X	Surface Mount	8dBm	u.FL
*Last two slots "0X" in Part # are used for production firmware release changes. Can be values 01-99, aa-zz			

The BT900 family has been designed to operate with the antennas listed below with a maximum gain of 2.0 dBi. The required antenna impedance is 50 ohms.

Item	Part Number	Mfg.	Type	Gain (dBi)	Model
1	AT3216-B2R7HAA	ACX	Ceramic	0.5	BT900-SA
2	S181FL-L-RMM-2450S	Nearson	Dipole	2.0	BT900-SC
3	MAF94045	Laird	PCB Dipole	2.0	BT900-SC
4	MAF94017	Laird	Dipole	2.0	BT900-SC
5	MAF94019	Laird	Dipole	1.5	BT900-SC

Note: The OEM is free to choose another vendor's antenna of like type and equal or lesser gain as an antenna appearing in the table and still maintain compliance. Reference FCC Part 15.204(c)(4) for further information on this topic.

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

9.1 Power Exposure Information

Federal Communication Commission (FCC) Radiation Exposure Statement:
This EUT is in compliance with SAR for general population/uncontrolled exposure limits in ANSI/IEEE C95.1-1999 and had been tested in accordance with the measurement methods and procedures specified in OET Bulletin 65 Supplement C.

This transceiver must not be co-located or operating in conjunction with any other antenna, transmitter, or external amplifiers. Further testing / evaluation of the end product will be required if the OEM's device violates any of these requirements.

The BT900 is fully approved for mobile and portable applications.

9.2 OEM Responsibilities

WARNING: The OEM must ensure that FCC labelling requirements are met. This includes a clearly visible label on the outside of the OEM enclosure specifying the appropriate Laird Technology FCC identifier for this product.

Contains FCC ID: PI4xxxxx IC: 1931B-xxxxx

If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on visible on outside of device:

The enclosed 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

Label and text information should be in a size of type large enough to be readily legible, consistent with the dimensions of the equipment and the label. However, the type size for the text is not required to be larger than eight point.

CAUTION: The OEM should have their device which incorporates the BT900 tested by a qualified test house to verify compliance with FCC Part 15 Subpart B limits for unintentional radiators.

CAUTION: Any changes or modifications not expressly approved by Laird Technology could void the user's authority to operate the equipment.

Note: 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 not cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to correct the interference by one or more of the following measures:

- Re-orient or relocate the receiving antenna
- Increase the separation between the equipment and the receiver
- Connect the equipment to an outlet on a circuit that is different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

FCC Warning:

"THIS DEVICE COMPLIES WITH PART 15 OF THE FCC RULES AND INDUSTRY CANADA LICENSE-EXEMPT RSS STANDARD(S). 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.

Industry Canada (IC) Warning:

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.

French equivalent is:

Le présent appareil est conforme aux CNR d'Industrie Canada applicable 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.

IC Radiation Exposure Statement
This EUT is compliance with SAR for general population/uncontrolled exposure limits in IC RSS-102 and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528.

REMARQUE IMPORTANTE
Déclaration IC d'exposition aux radiations
Ce EUT est conforme avec SAR pour la population générale / limites d'exposition non contrôlée à IC RSS-102 et a été testé en conformité avec les méthodes de mesure et procédures spécifiées dans la norme IEEE 1528.

Modular Approval
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.).

Approbation modulaire
OEM intégrateur est toujours responsable de tester leur produit final pour les exigences de conformité supplémentaires nécessaires à ce module installé (par exemple, les émissions de périphériques numériques, les exigences de périphériques PC, etc.)

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

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

Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: " BT900-SA and BT900-SC Contient des IC: TBC".

10 JAPAN (MIC) REGULATORY

The BT900 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	Certificate Number	Antenna
BT900-SA	TBC	Ceramic
BT900-SC	TBC	uFL

10.1 Antenna Information

The BT900 was tested with antennas listed below. The OEM can choose a different manufacturers antenna but must make sure it is of same type and that the gain is lesser than or equal to the antenna that is approved for use.

Item	Part Number	Mfg.	Type	Gain (dBi)	Model
1	AT3216-B2R7HAA	ACX	Ceramic	0.5	BT900-SA
2	S181FL-L-RMM-2450S	Nearson	Dipole	2.0	BT900-SC
3	MAF94045	Laird	PCB Dipole	2.0	BT900-SC
4	MAF94017	Laird	Dipole	2.0	BT900-SC
5	MAF94019	Laird	Dipole	1.5	BT900-SC

11 CE REGULATORY

The BT900-SA / BT900-SC have been tested for compliance with relevant standards for the EU market. The BT900-SC module was tested with a 2.21 dBi antenna. The OEM can operate the BT900-SC module with any other type of antenna but must ensure that the gain does not exceed 2.21 dBi to maintain the Laird approval.

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.

11.1 Antenna Information

The antennas listed below were tested for use with the BT900. For CE mark countries, the OEM is free to use any manufacturer's antenna and type of antenna as long as the gain is less than or equal to the highest gain approved for use (2.21dBi) Contact a Laird representative for more information regarding adding antennas.

Item	Part Number	Mfg.	Type	Gain (dBi)	Model
1	AT3216-B2R7HAA	ACX	Ceramic	0.5	BT900-SA
2	S181FL-L-RMM-2450S	Nearson	Dipole	2.0	BT900-SC
3	MAF94045	Laird	PCB Dipole	2.0	BT900-SC
4	MAF94017	Laird	Dipole	2.0	BT900-SC
5	MAF94019	Laird	Dipole	1.5	BT900-SC

12 EU DECLARATIONS OF CONFORMITY

12.1 BT900-SA / BT900-SC

Manufacturer:	Laird
Product:	BT900-SA, BT900-SC
EU Directive:	RTTE 1995/5/EC
Conformity Assessment:	Annex IV

Reference standards used for presumption of conformity:

Article Number	Requirement	Reference standard(s)
3.1a	Health and Safety	EN60950-1:2006+A11:2009+A1:2010+A12:2011
3.1b	Protection requirements with respect to electromagnetic compatibility	EN 301 489-1 V1.9.2 (2011-09) EN 301 489-17 V2.2.1 (2012-09) Emissions: EN55022:2006/A1:2007 (Class B) Immunity: EN61000-4-2:2009 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 Saturn House, Mercury Park Wooburn Green HP100HH, United Kingdom tel: +44 (0)1628 858 940 fax: +44 (0)1628 528 382
Date of Issue:	Junel2014
Name of Authorized Person:	Andrew Dobbing, Engineering Manager
Signature:	

13 Ordering Information

Part Number	DESCRIPTION
BT900-SA-0x	Single Mode BLE Module featuring *smart*BASIC – integrated antenna
BT900-SC-0x	Single Mode BLE Module featuring *smart*BASIC – IPEX MHF4 connector
DVK – BT900-SA-0x	Development board with BT900-SA module soldered in place
DVK – BT900-SC-0x	Development board with BT900-SC module soldered in place

13.1 General Comments

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

14 Bluetooth SIG Qualification

The BT900 module is listed on the Bluetooth SIG website as qualified End Products.

Design Name	Owner	Declaration ID	Link to listing on the SIG website
BT900	Laird Technologies	TBC	https://www.bluetooth.org/tpg/QLI_viewQDL.cfm?qid=20700

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 registered as a member of the Bluetooth SIG – 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&vId=317486

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

In step 1, select the option, **Reference a Qualified Design** and enter 20700 in the End Product table entry. 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

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 Option 2

Europe: +44-1628-858-940

Hong Kong: +852 2923 0610

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

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Laird Technologies partners with its customers to find solutions for applications in various industries such as:

- Network Equipment
- Telecommunications
- Data Communications
- Automotive Electronics
- Computers
- Aerospace
- Military
- Medical Equipment
- Consumer Electronics

Laird offers its customers unique product solutions, dedication to research and development, as well as a seamless network of manufacturing and customer support facilities across the globe.

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CONN-HIG- BT900
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Limited Warranty, Disclaimer, Limitation of Liability

FEDERAL COMMUNICATION COMMISSION INTERFERENCE STATEMENT

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

-Reorient or relocate the receiving antenna.
-Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help.

FCC Caution: Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

IMPORTANT NOTE:

FCC Radiation Exposure Statement:

The product comply with the US portable RF exposure limit set forth for an uncontrolled environment and are safe for intended operation as described in this manual. The further RF exposure reduction can be achieved if the product can be kept as far as possible from the user body or set the device to lower output power if such function is available.

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

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

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

As long as 1 condition above is met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed

IMPORTANT NOTE

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

End Product Labeling

The final end product must be labeled in a visible area with the following: “Contains FCC ID: SQGBT900

Manual Information to the End User

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

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

INDUSTRY CANADA STATEMENT:

This device complies with Industry Canada licence-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.

Radiation Exposure Statement:
The product comply with the Canada portable RF exposure limit set forth for an uncontrolled environment and are safe for intended operation as described in this manual. The further RF exposure reduction can be achieved if the product can be kept as far as possible from the user body or set the device to lower output power if such function is available.

Déclaration d'exposition aux radiations:
Le produit est conforme aux limites d'exposition pour les appareils portables RF pour les Etats-Unis et le Canada établies pour un environnement non contrôlé. Le produit est sûr pour un fonctionnement tel que décrit dans ce manuel. La réduction aux expositions RF peut être augmentée si l'appareil peut être conservé aussi loin que possible du corps de l'utilisateur ou que le dispositif est réglé sur la puissance de sortie la plus faible si une telle fonction est disponible.

THIS DEVICE IS INTENDED ONLY FOR OEM INTEGRATORS UNDER THE FOLLOWING CONDITIONS:

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

As long as 1 condition above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

CET APPAREIL EST CONÇU UNIQUEMENT POUR LES INTÉGRATEURS OEM DANS LES CONDITIONS SUIVANTES:

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

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

IMPORTANT NOTE:

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

NOTE IMPORTANTE:

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

End Product Labeling

The final end product must be labeled in a visible area with the following: “Contains IC: 3147A-BT900”.

Plaque signalétique du produit final

Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 3147A-BT900".

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.
The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.
Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

(For transmitters equipped with detachable antennas)

This radio transmitter (identify the device by certification number, or model number if Category II) has been approved by Industry Canada to operate with the antenna types listed below 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 (IC: 3147A-BT900) 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.

Type	Manufacture	Gain	Connector
Chip	ACX (Advanced Ceramic X Corp.)	0.5dBi	N/A
Dipole	Nearson	2.0 dBi	IPEX u.FL
PCB Dipole	Laird Technologies	2.0 dBi	IPEX u.FL
Dipole	Laird Technologies	2.0 dBi	IPEX u.FL
Dipole	Laird Technologies	1.5 dBi	IPEX u.FL