Aug.2013

BCM20732S
Embedded Antenna BLE SIP Module

REVISION HISTORY

Version No.	Revised Date	Revised by	Description
1.0	2013-Aug 2	KM	Preliminary specification released

TABLE OF CONTENTS

1. Introduction

1.1 Description

The highly integrated BCM20732S requires minimal external components to make a standalone (ARM CortexTM-M3 built-in) BLE device in a very compact form factor (6.5 mm × 6.5 mm x 1.2 mm Max., 48-LGA package).

This data sheet provides a description of interfaces, pin assignments, and specifications of BCM20732S (Bluetooth Low Energy) Module. This is a document for designers responsible for adding the BCM20732S (Bluetooth Low Energy) Module to wireless input device applications including heart-rate monitors, blood-pressure monitors, proximity sensors, temperature sensors, and battery monitor.

The following profiles are supported in ROM:

- Battery status
- Blood pressure monitor
- Find me
- Heart rate monitor
- Proximity
- Thermometer
- Weight scale
- Time
- BGM (Blood Glucose Monitor)

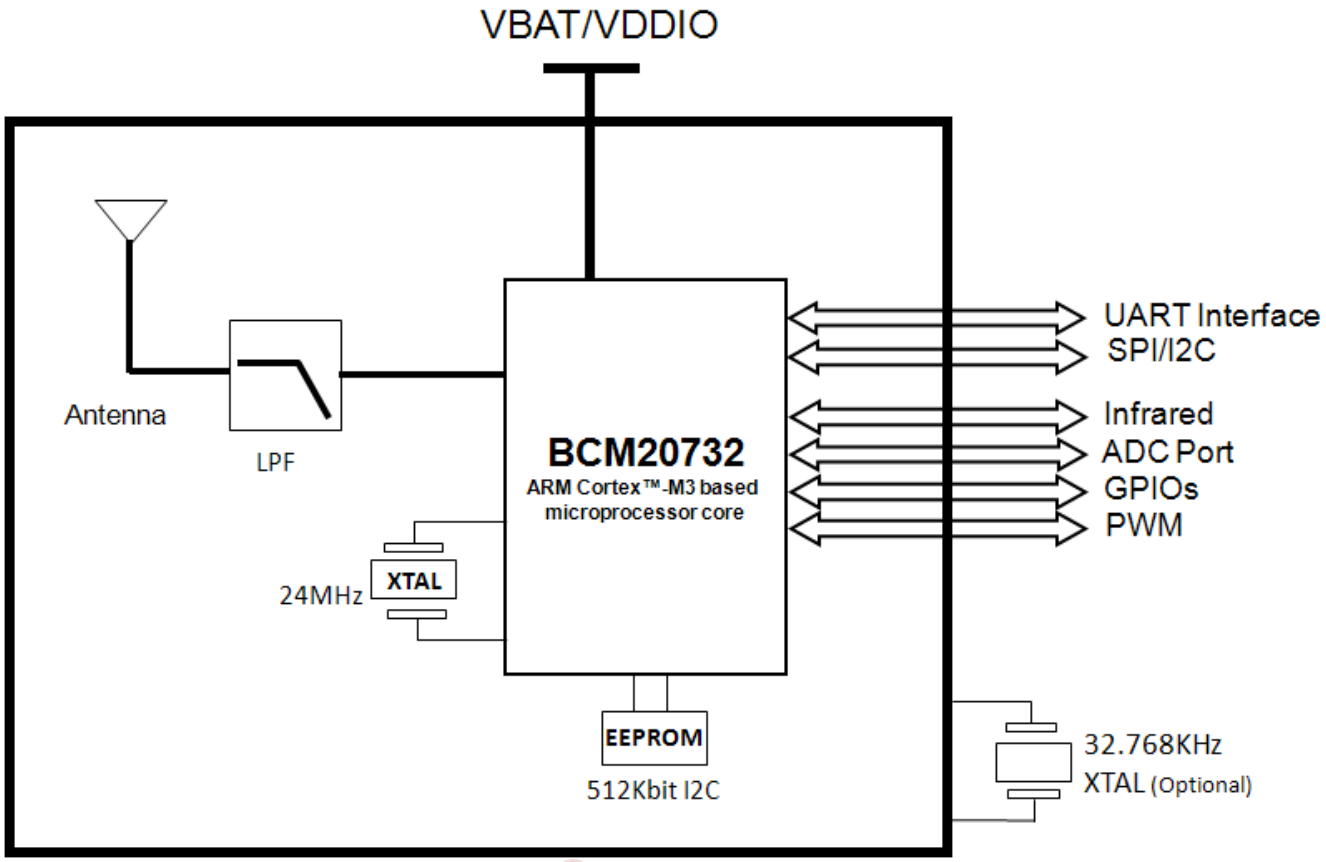
Additional profiles that can be supported from RAM include:

- Blood glucose monitor
- Temperature alarm
- Location
- Other custom profiles

Features

- **MCU** — **32bit Cortex™-M3**
- **Memory capacity** — **Embedded 512Kbits EEPROM**
- **Diverse serial interface** — **UART**
- **Sensor applications support** — **ADC, I2C, GPIO,PWM**
- **On-chip functionality Single-chip** — **MAC/BB/RF**
- **Frequency Band** — **2.4 GHz**
- **Network Standard** — **Bluetooth low energy**
- **Operating Temperature** — **-40℃ to 85℃**
- **MSL level 3**
- **Certification** — **FCC and CE compliant**

2. Block Diagram



ADC	**Analog to Digital Converter**
I2C	**Intelligent Interface Controller**
SPI	**Serial Peripheral Interface**
UART	**Universal synchronous/asynchronous receiver transmitters**

3. Electrical Specification

3.1 Absolute Maximum Rating

Supply Power	Max +4 Volt		
Storage Temperature	- 40° to 125° Celsius		
Voltage ripple	+/- 2%	Max. Values not exceeding Operating voltage	
	Power	min	Max
Power Supply Absolute Maximum Ratings	VBAT		3.8

3.2 Recommendable Operation Condition

3.2.1 Temperature, Humidity

The BCM20732S module complies with the operational requirements as listed in the table below.

Operating Temperature	-40° to 85° Celsius	
Humidity range	Max 95%	Non condensing, relative humidity

3.2.2 Voltage

Power supply for the BCM20732S module will be provided by the host via the power pins

Symbol	Parameter	Min	Typ	Max	Unit
VBAT		**1.62**		**3.63**	**V**

3.3 Current Consumption

3.3.1

Condition: Condition: 25deg.C

Item	Condition	Min	Nom	Max	Unit
Receive	Receiver and baseband are both operating, 100%		**23**		**mA**
Transmit	Transmitter and baseband are both operating, 100%		**20**		**mA**
Deep Sleep	Wakeup on interrupt		**1.27**		**uA**
Active idle (average)			**30**		**uA**

Note: Current consumption includes that from components (EEPROM. X-tal etc.) on the SIP

4. RF Specification

4.1 wireless Specification

The RF performance of BCM20732S is given as follows. The default voltage is 3.3V.

Parameter	Mode and Conditions	Min.	Typ.	Max.	Unit
Receiver Section					
Frequency range		2402	-	2480	MHz
RX sensitivity (standard)	Packets: 200, Payload: PRBS 9, Length: 37 Bytes, Dirty Transmitter: off. PER: 30.8%	-	-94	-	dBm
Maximum input		-10		-	dBm

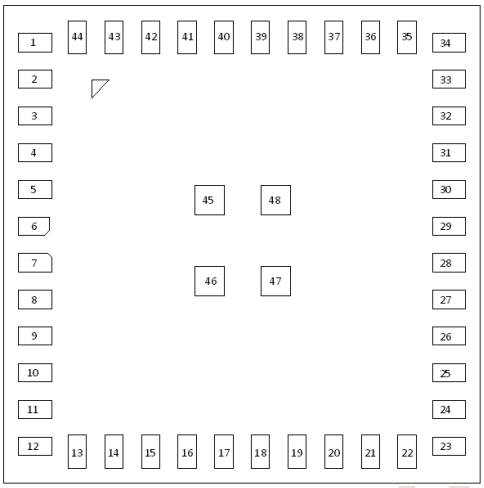
4.2 RF Transmitter Specification

Parameter	Mode and Conditions	Min.	Typ.	Max.	Unit
Transmitter Section					
Frequency range	-	2402	-	2480	MHz
Output power adjustment range	-	-20	-	10	dBm
Output power	-	-	2		dBm
Output power variation	-	-	2.5		dB
LO Performance					
Initial carrier frequency tolerance	-	-	-	±150	KHz
Frequency Drift					
Frequency drift	-	-	-	±50	kHz
Drift rate	-	-	-	20	kHz/50 µs
Frequency Deviation					
Average deviation in payload (sequence used is 00001111)	-	225	-	275	kHz
Average deviation in payload (sequence used is 10101010)	-	185	-	-	kHz
Channel spacing	-	-	2	-	MHz

*" indicates BT4.0 specification
*" Measurement by connected

5. Pin Definition

5.1 Pin Number sequence definition



TOP View

5.2 The detail pin definition information

	Pin Name	I/O Type	Description
Pin#1	GPIO: P27 PWM1		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- SPI_2: MOSI (master and slave) Current: 16 mA
Pin#2	GND	GND	GND
Pin#3	VBAT	I	Battery Supply Input.
Pin#4	GND	GND	GND
Pin#5	GND	GND	GND
Pin#6	GND	GND	GND
Pin#7	GND	GND	GND
Pin#8	GND	GND	GND
Pin#9	GND	GND	GND
Pin#10	BT ANT	I/O	Reserved Antenna Port for Bluetooth Tx/Rx, when using external antenna.
Pin#11	GND	GND	GND
Pin#12	GND	GND	GND
Pin#13	GND	GND	GND

	Pin Name	I/O Type	Description
Pin#14	GND	GND	GND
Pin#15	GND	GND	GND
Pin#16	GND	GND	GND
Pin#17	GND	GND	GND
Pin#18	UART_RX	I	UART_RX, this pin has been pulled down via 10K ohm inside module.
Pin#19	UART_TX	O PU	UART_TX
Pin#20	GND	GND	GND
Pin#21	SCL	I/O PU	Clock signal for an external I2C device
Pin#22	SDA	I/O PU	Data signal for an external I2C device
Pin#23	GND	GND	GND
Pin#24	GND	GND	GND
Pin#25	GPIO: P1		Default Direction: Input This pin was tied to WP pin of internal EEPROM inside module. After POR State: Input Floating Alternate Function Description: 1- A/D converter input 2- Peripheral UART: puart_rts 3- SPI_2: MOSO (master and slave) 4- IR_TX
Pin#26	TMC	I	Test mode control High: test mode Let it floating if not used. This Pin was connected to GND via 10K internally.
Pin#27	RESET_N	I/O PU	Active-low system reset with open-drain output
Pin#28	GPIO: P0		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- A/D converter input 2- Peripheral UART: puart_tx 3- SPI_2: MOSI (master and slave) 4- IR_RX 5- 60Hz_main
Pin#29	GND	GND	GND

	Pin Name	I/O Type	Description
Pin#30	GPIO: P3		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- Peripheral UART: puart_cts 2- SPI_2: SPI_CLK (master and slave)
Pin#31	GPIO: P2		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- Peripheral UART: puart_rx 2- SPI_2: SPI_CS (slave only) 3- SPI_2: SPI_MOSI (master only)
Pin#32	GPIO: P4		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- Peripheral UART: puart_rx 2- SPI_2: MOSI (master and slave) 3- IR_TX
Pin#33	GPIO: P8		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- A/D converter input 2- External T/R switch control: ~tx_pd
Pin#34	GPIO: P33		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- A/D converter input 2- SPI_2: MOSI (slave only) 3- Auxiliary clock output: ACLK1 4- Peripheral UART: puart_rx

	Pin Name	I/O Type	Description
Pin#35	GPIO: P32		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- A/D converter input 2- SPI_2: SPI_CS (slave only) 3- SPI_1: MISO (master only) 4- Auxiliary clock output: ACLK0 5- Peripheral UART: puart_tx
Pin#36	GPIO: P25		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- SPI_2: MISO (master and slave) 2- Peripheral UART: puart_rx
Pin#37	GPIO: P24		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- SPI_2: SPI_CLK (master and slave) 2- SPI_1: MISO (master only) 3- Peripheral UART: puart_tx
Pin#38	GND	GND	GND
Pin#39	GPIO: P13 PWM3		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- A/D converter input
	GPIO: P28 PWM2		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- A/D converter input 2- LED1 3- IR_TX Current: 16mA

	Pin Name	I/O Type	Description
Pin#40	GPIO: P14 PWM2		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- A/D converter input
	GPIO: P38		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- A/D converter input 2- SPI_2: MOSI (master and slave) 3- IR_TX
Pin#41	GPIO: P15		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- A/D converter input 2- IR_RX 3- 60 Hz_main
Pin#42	GPIO: P26 PWM0		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- SPI_2: SPI_CS (slave only) 2- SPI_1: MISO (master only) Current: 16 mA
Pin#43	GPIO: P12		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- A/D converter input 2- XTALO32K
	XTALO32K	O	Low-power oscillator (LPO) output. Alternative Function: • P12 • P26

	Pin Name	I/O Type	Description
Pin#44	GPIO: P11		Default Direction: Input After POR State: Input Floating Alternate Function Description: 1- A/D converter input 2- XTALI32K
	XTALI32K	I	Low-power oscillator (LPO) input is used. Alternative Function: • P11 • P27
Pin#45	GND	GND	GND
Pin#46	GND	GND	GND
Pin#47	GND	GND	GND
Pin#48	GND	GND	GND

6. Addition Information

6.1 ADC Specification

Table 9: ADC Specification

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Number of Input Channels	-	-	-	9	-	-
Channel switching rate	fch	-	-	-	133.33	Kch/s
Input signal range	Vinp	-	0	-	3.63	V
Reference settling time	-	Charging refsel	7.5	-	-	us
Input resistance	Rinp	Effective, single end	-	500	-	k Ω
Input capacitance	Cinp				5	pF
Conversion rate	Fc		5.859		187	kHz
Conversion time	Tc		5.35		170.7	us
Resolution	R			16		bits
Absolute voltage measurement error	-	Using on-chip ADC firmware driver	-	±2	-	%
Current	I	Iavdd1p2 + Iavdd3p3	-	-	1	mA
Power	P	-	-	1.5	-	wm
Leakage Current	Ileakage	T = 25°C	-	-	100	nA
Power-up time	Tpowerup	-	-	-	200	us
Integral nonlinearity	INL	In guaranteed performance range	-1	-	1	LSB
Differential nonlinearity	DNL	In guaranteed performance range	-1	-	1	LSB

Note: LSBs are expressed at the 10-bit level.

6.2 External Reset

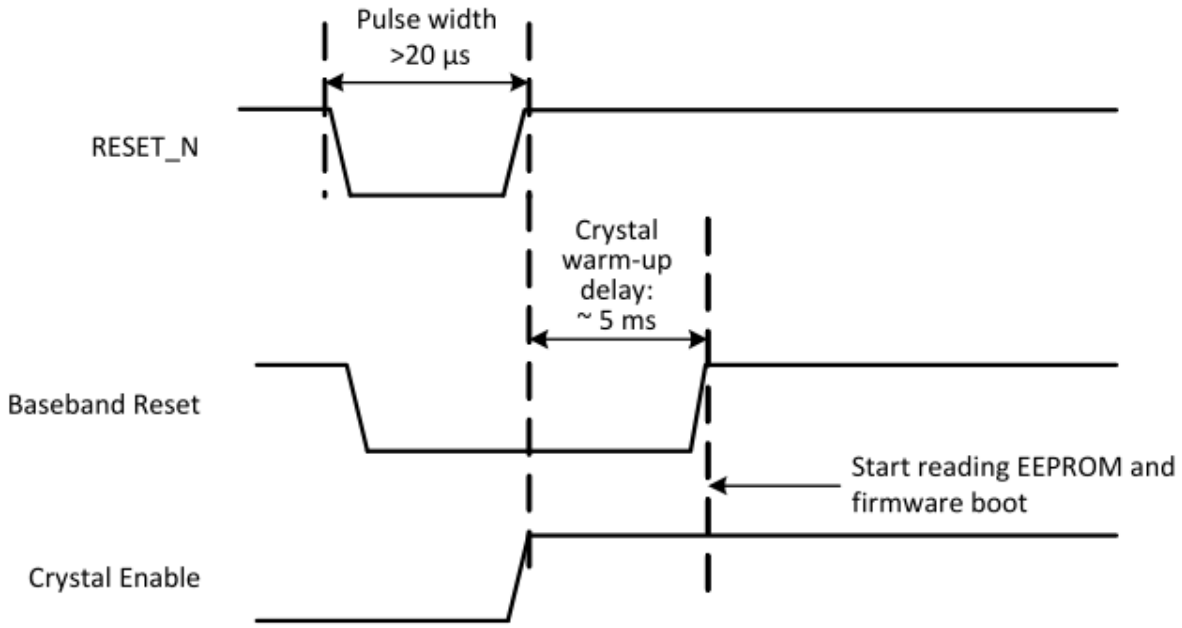


Figure 3 - External Reset Timing

6.3 32.768 kHz Oscillator

It is a standard Pierce oscillator using a comparator with hysteresis on the output to create a single-ended digital output. The hysteresis was added to eliminate any chatter when the input is around the threshold of the comparator and is ~100 mV. This circuit can be operated with a 32 kHz or 32.768 kHz crystal oscillator or be driven with a clock input at similar frequency.

Table 10: 32K XTAL Oscillator Characteristics

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output frequency	Foscout	-	-	32.768	-	KHz
Frequency tolerance		Crystal dependent	-	100		ppm
Start-up time	Tstartup	-	-	-	500	us
XTAL drive level	Pdrv	For crystal selection	0.5	-	-	μW
XTAL series resistance	Rseries	For crystal selection	-	-	70	kΩ
XTAL shunt capacitance	Cshunt	For crystal selection	-	-	1.3	pF

6.4 Timing and AC Characteristics

6.4.1 SPI TIMING

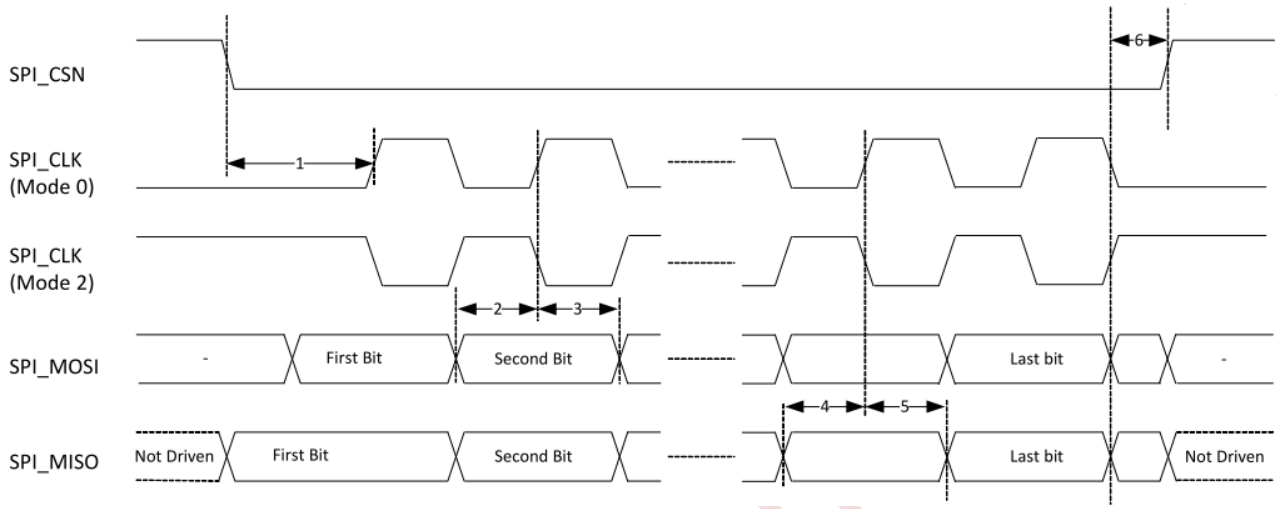


Figure 4 - SPI Timing – Mode 0 and 2

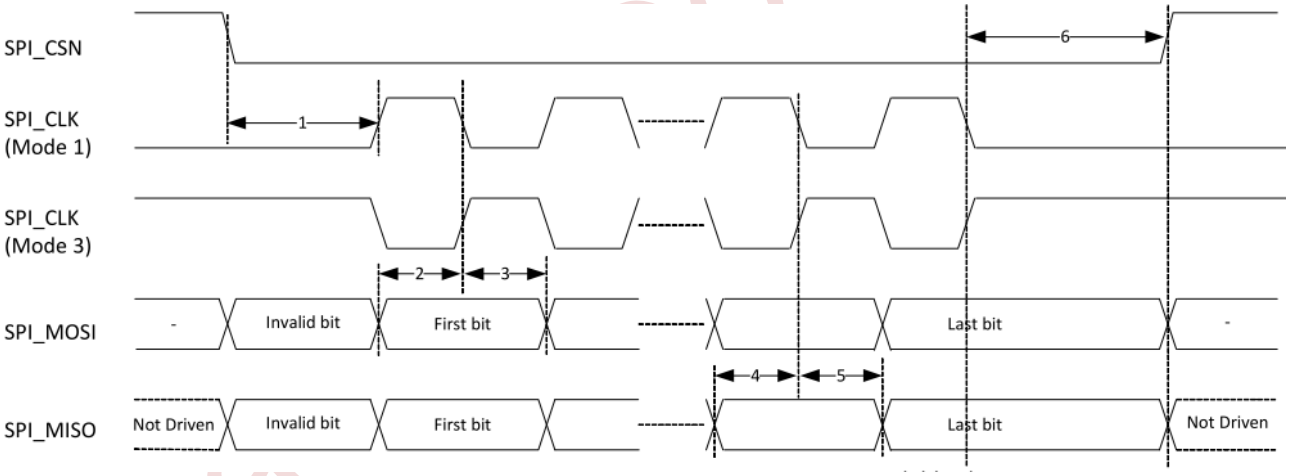


Figure 5 - SPI Timing – Mode 1 and 3

Table 11: SPI Interface Timing Specifications

Reference	Characteristics	Min	Typ	Max
1	Time from CSN asserted to first clock edge	1 SCK	100	∞
2	Master setup time	-	1/2SCK	-
3	Master hold time	1/2SCK	-	-
4	Slave setup time	-	1/2 SCK	-
5	Slave hold time	1/2 SCK	-	-
6	Time from last clock edge to CSN deasserted	SCK	10 SCK	100

6.4.2 BSC INTERFACE TIMING

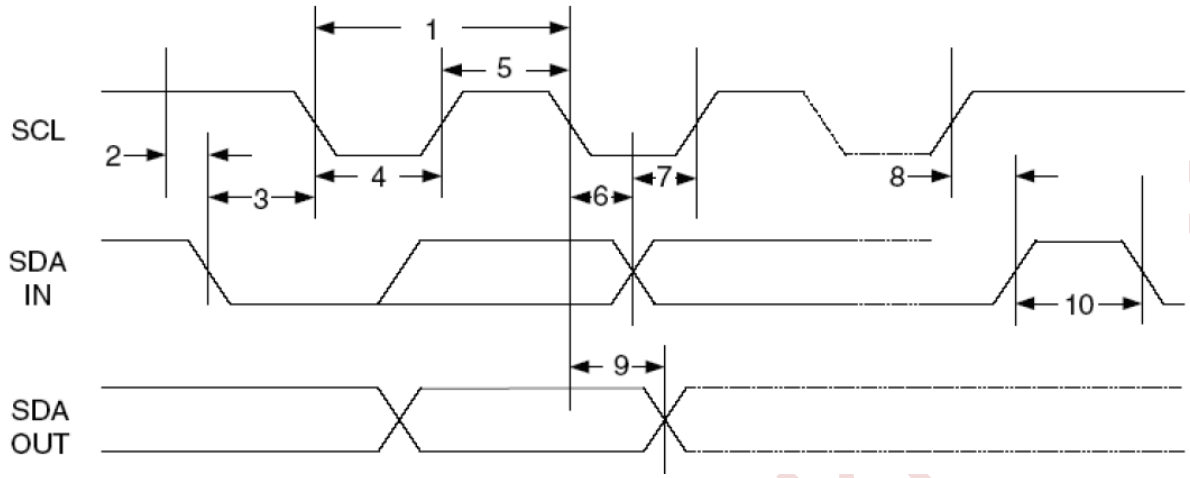


Figure 6 - BSC INTERFACE TIMING

Table 12: BSC INTERFACE Timing Specifications

Reference	Characteristics	Min	Max	Unit
1	Clock frequency		100 400 800 1000	KHz
2	START condition setup time	650	-	ns
3	START condition hold time	280	-	ns
4	Clock low time	650	-	ns
5	Clock high time	280	-	ns
6	Data input hold time	0	-	ns
7	Data input setup time	100	-	ns
8	STOP condition setup time	280	-	ns
9	Output valid from clock	-	400	ns
10	Bus free time	650		ns

6.4.3 UART Timing

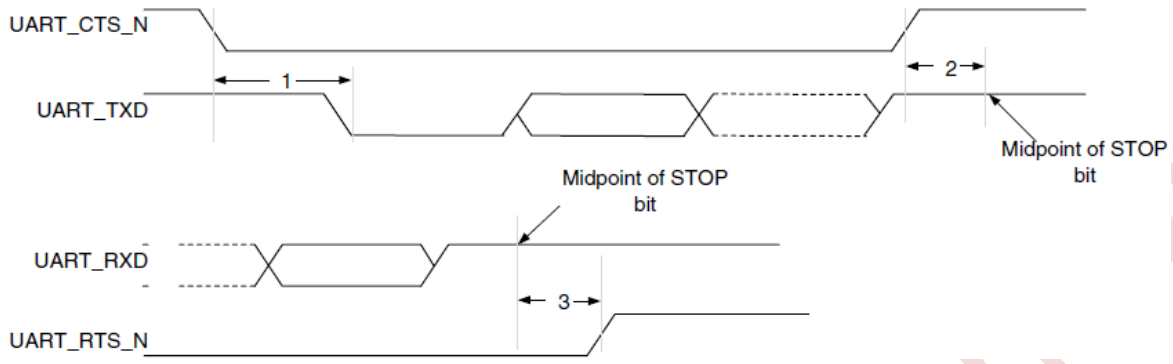


Figure 7 - UART Timing

Table 13: UART Timing Specifications

Reference	Characteristics	Min	Max	Unit
1	Delay time, UART_CTS_N low to UART_TXD valid	-	24	Baudout cycles
2	Setup time, UART_CTS_N high before midpoint of stop bit	-	10	ns
3	Delay time, midpoint of stop bit to UART_RTS_N high	-	2	Baudout cycles

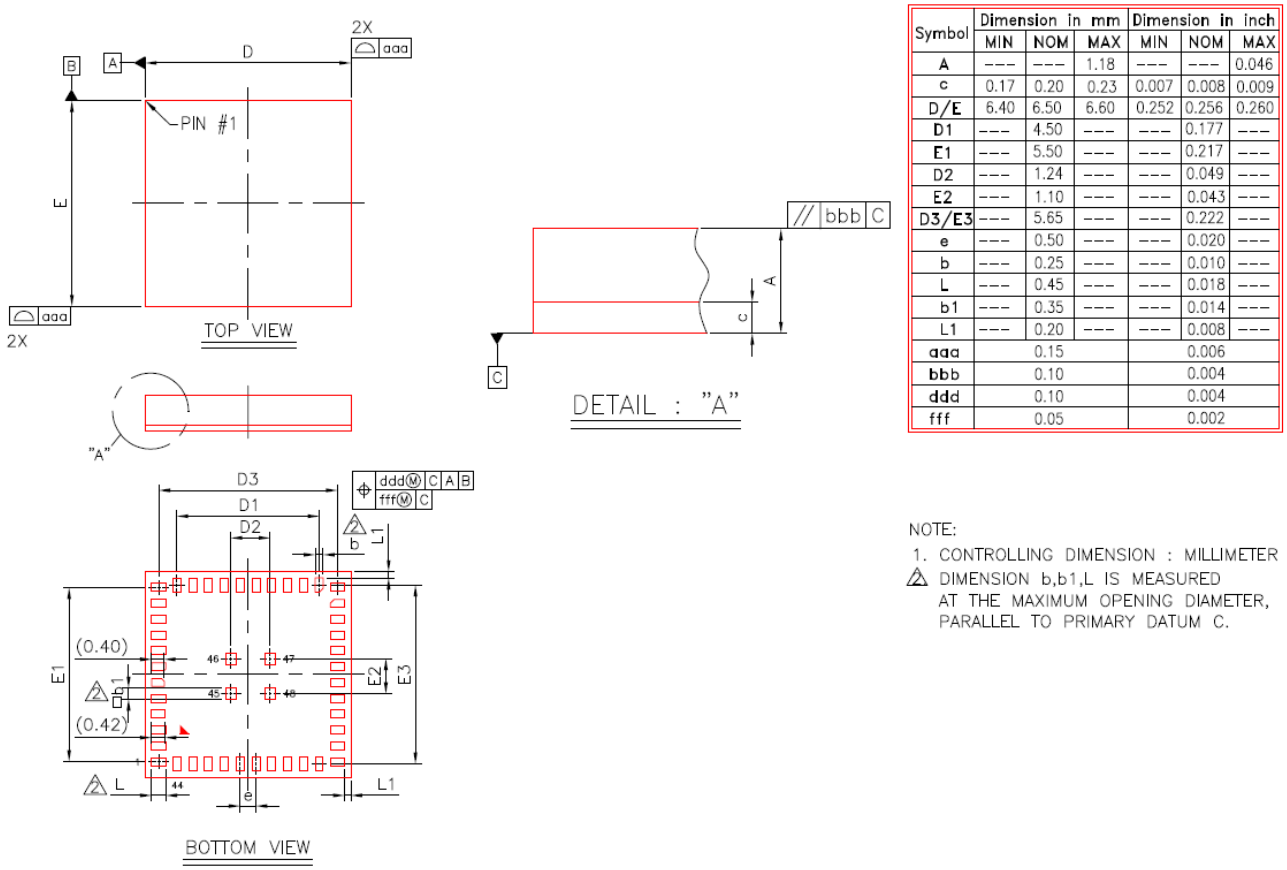
7. Mechanical Specification

7.1 Size of the Module

The following paragraphs provide the requirements for the size, weight.
The size and thickness of the BCM20732S module 6.5mm (W) x 6.5mm (L) x 1.18mm (H):
(Tolerance: +/- 0.1mm)

7.2 Mechanical Dimension

Dimension: 6.5 x 6.5 x 1.18 mm^3

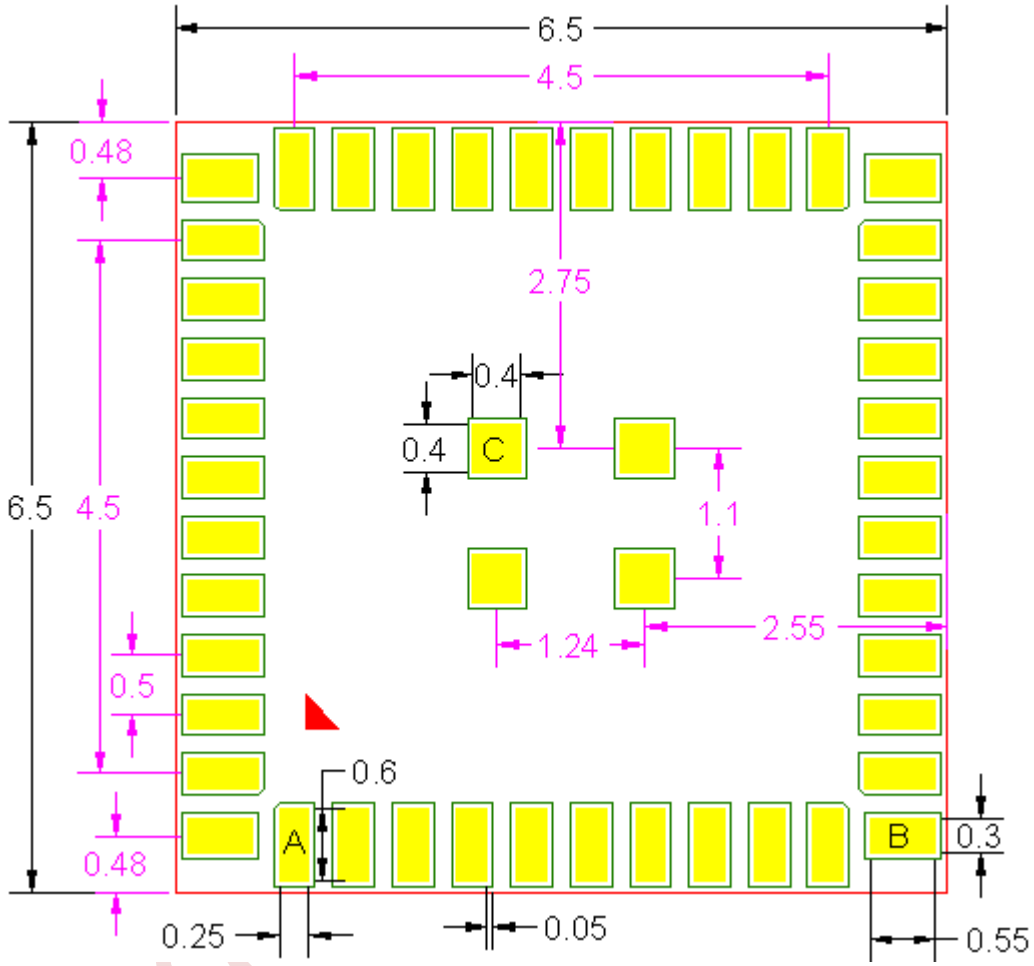


Symbol	Dimension in mm			Dimension in inch		
	MIN	NOM	MAX	MIN	NOM	MAX
A	---	---	1.18	---	---	0.046
c	0.17	0.20	0.23	0.007	0.008	0.009
D/E	6.40	6.50	6.60	0.252	0.256	0.260
D1	---	4.50	---	---	0.177	---
E1	---	5.50	---	---	0.217	---
D2	---	1.24	---	---	0.049	---
E2	---	1.10	---	---	0.043	---
D3/E3	---	5.65	---	---	0.222	---
e	---	0.50	---	---	0.020	---
b	---	0.25	---	---	0.010	---
L	---	0.45	---	---	0.018	---
b1	---	0.35	---	---	0.014	---
L1	---	0.20	---	---	0.008	---
aaa		0.15			0.006	
bbb		0.10			0.004	
ddd		0.10			0.004	
fff		0.05			0.002	

NOTE:
1. CONTROLLING DIMENSION : MILLIMETER
2. DIMENSION b,b1,L IS MEASURED AT THE MAXIMUM OPENING DIAMETER, PARALLEL TO PRIMARY DATUM C.

8. Recommend Footprint

8.1 Module Dimension Measurement
Unit: mm

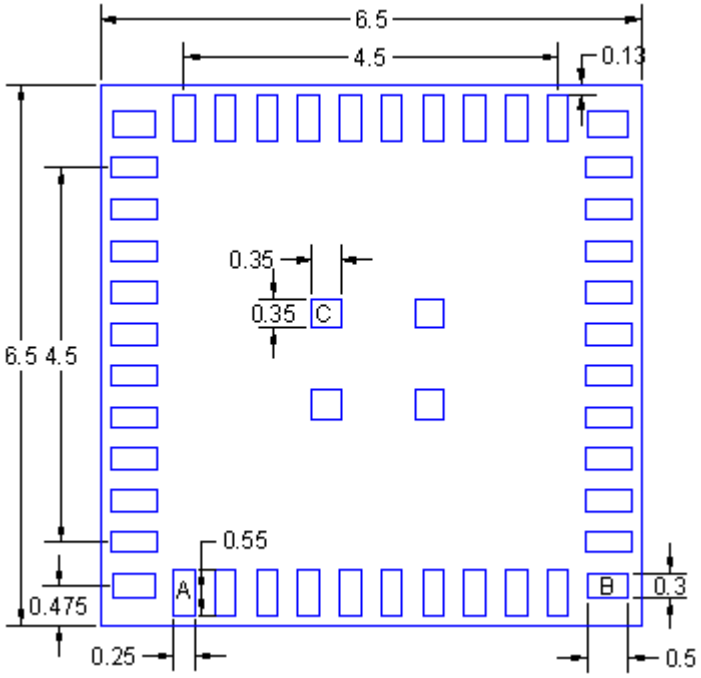


Bottom View

Note:
1. Please use Un-Solder Mask to design the Module Footprint.
2. There are two types pad size in the Module.
   - Type A:
     Pad size: 0.6 x 0.25 mm & Solder Mask Opening : 0.7 x 0.35mm
   - Type B
     Pad size: 0.55 x 0.3mm & Solder Mask Opening : 0.65 x 0.4mm
   - Type C:
     Pad size: 0.4 x 0.4mm & Solder Mask Opening : 0.5 x 0.5 mm
   -

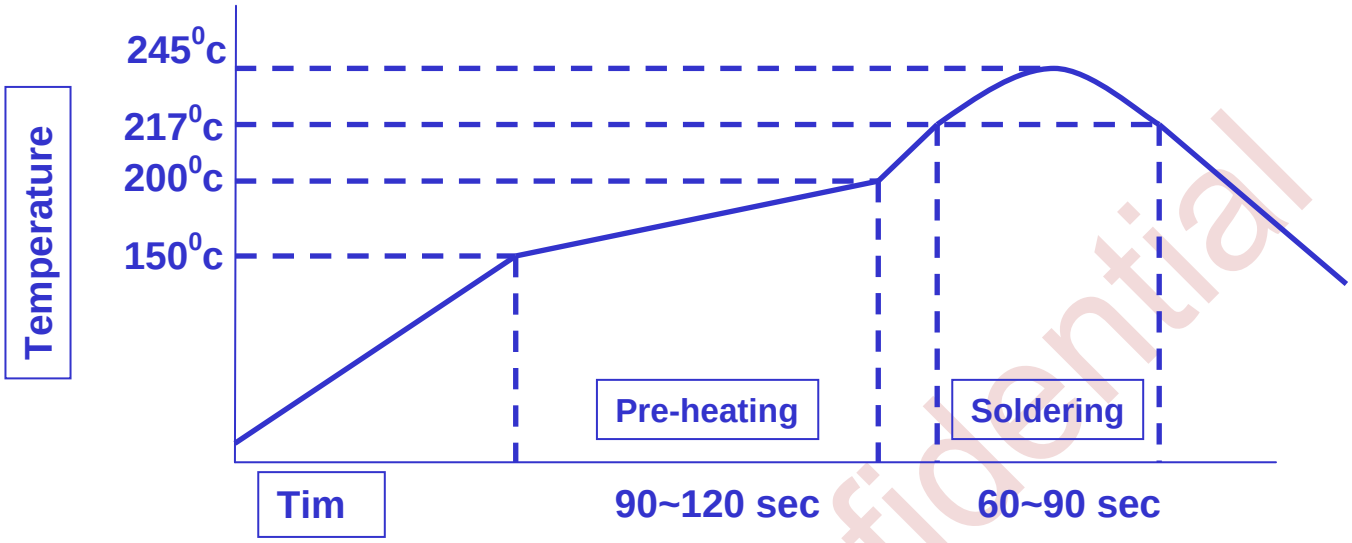
9. Recommend Stencil

Unit: mm



Bottom View

10. Recommended Reflow Profile



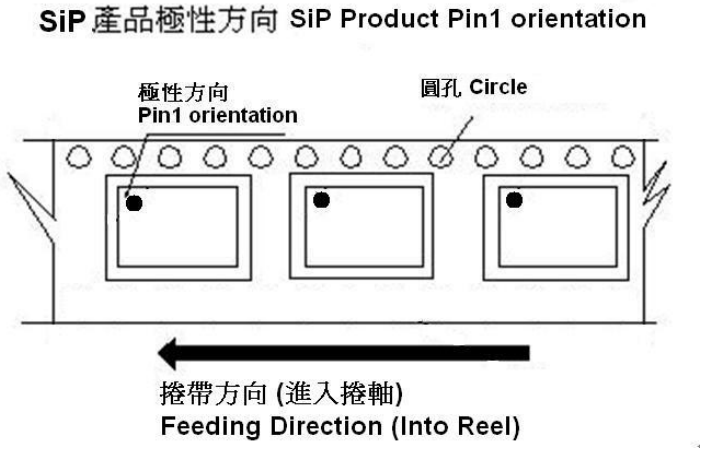
11. Package and Storage Condition

11.1 Package Dimension

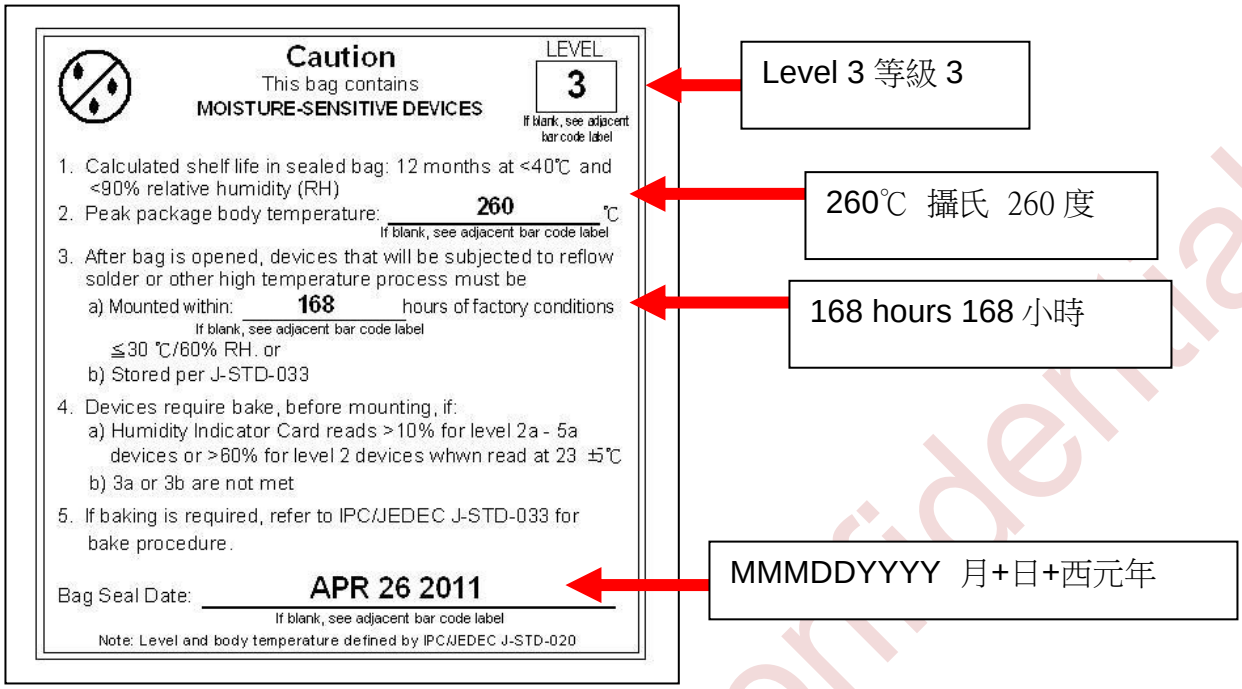
11.2 Laser Mark

TBD

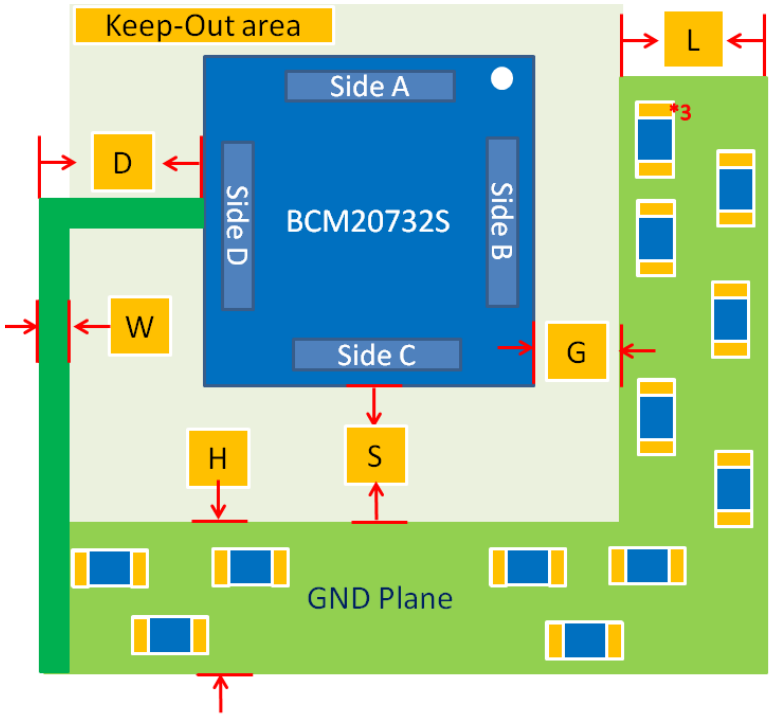
11.3 Pin 1 Location in the Tape/Reel



11.4 MSL & Moisture Sensitive LEVEL



Preliminary Arrangement Guideline for BCM20732S
(New Antenna Design)



Parameter	Unit: mm	Antenna Efficiency
L	3 (min.)	31% ~41%
G	3 (typ.)	
S	3 (typ.)	
H	3 (typ.)	
W	0.4 (typ.)	
D	4.5 (typ.)	

Note:

1. Please must Connect "GND" from system to module at side D (#17 pin of the module).
2. The L-shape GND plane is required for integrated antenna and please must keep the GND plane continuous, do not cut off the GND shape due to routings.
3. A L shape GND plane is required (Green color area). If the L shape GND plane is arranged on top layer of PCB, It's not recommended to place components in this area. If components need to be mounted in this area, the L shape GND plane need to be arranged in inner or bottom layers and avoid a complete GND plane on top layer. (This is to ensure the L shape GND plane for antenna is continuous)
4. The measured efficiency is based on the above layout guide. And will support > 50M range using iPhone 5 to test the module (without plastic housing). For real application, the adjustment of the layout may impact the antenna efficiency which will reduce the range.
5. Please bring signal traces out of module from Side C (between #27 and #30 of module) or Side D (between #16 and #19 of module) with overlapped routing to minimize metal trace in the keep-out area.
6. Please do not bring signal trace from either Side A or Side B.