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Bluetooth Low Energy System-in-Package (SiP) Module

GENERAL DESCRIPTION

The BCM20737S is a compact, highly integrated Bluetooth low energy (BLE) system-in-package (SiP) module. The BCM20737S SiP includes an embedded BLE antenna, 24 MHz clock, and 512 Kb EEPROM, so only a minimal set of external components is needed to create a standalone BLE device.

The BCM20737S is designed to accelerate time to market. The Bluetooth stack and several application profiles are built into the module, allowing customers to focus on their core applications. To further reduce application development time, the BCM20737S includes integrated software support, with one-click installation of the complete environment and a one-click compile/build/link/load cycle. All this, coupled with an ultrasmall form factor and support for a wide voltage range, makes the BCM20737S well suited for virtually any Bluetooth Smart application.

FEATURES

- ARM Cortex-M3 microcontroller unit (MCU)
- Embedded 512 Kb EEPROM
- Broadcom Serial Control (BSC), SPI, and UART interfaces
- · FCC and CE compliant
- RoHS compliant, certified lead- and halogen-free

FEATURES

- · Moisture Sensitivity Level (MSL) 3 compliant
- 6.5 mm × 6.5 mm × 1.2 mm Land Grid Array (LGA) 48-pin package

APPLICATIONS

Profiles supported in ROM:

- Battery status
- Blood pressure monitor
- · Find me
- Heart rate monitor
- Proximity
- Thermometer
- · Weight scale
- Time
- Blood glucose monitor
- Support for RSA security library
- Support for LE Audio
- Support for pairing using NFC tags

Additional profiles supported in RAM:

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

VBAT/VDDIO BCM20737S Antenna Bandpass Filter UART SPI/I²C BCM20737S Bluetooth Low Energy Infrared System-on-Chip with ARM ® Cortex™ M3-based ADC 24 MHz Microprocessor Core **GPIOs** XTAI PWM 32.768 kHz **EEPROM** Oscillator 512 Kb I²C (optional)

Figure 1: BCM20737S BLE SiP Block Diagram

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BCM20737S Data Sheet Revision History

Revision History

| Revision | Date | Change Description |
|----------------|------------|--|
| 20737S-DS101-R | 04/10/16 | Updated: |
| | | Table 5: "Current Consumption," on page 14 |
| 20737S-DS100-R | 09/26/2014 | Initial release |

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BCM20737S Data Sheet About This Document

About This Document

Purpose and Audience

This document provides descriptions of the interfaces, pin assignments, and specifications of Broadcom[®] BCM20737S Bluetooth Low Energy (BLE) System-in-Package (SiP) module. It is intended for designers who are responsible for adding the BCM20737S module to wireless input devices including heart-rate monitors, blood pressure monitors, proximity sensors, temperature sensors, and battery monitors.

Acronyms and Abbreviations

In most cases, acronyms and abbreviations are defined on first use.

For a comprehensive list of acronyms and other terms used in Broadcom documents, go to: http://www.broadcom.com/press/glossary.php.

Document Conventions

The following conventions may be used in this document:

| Convention | Description |
|------------|---|
| Bold | User input and actions: for example, type exit, click OK, press Alt+C |
| Monospace | Code: #include <iostream> HTML: Command line commands and parameters: wl [-1] <command/></iostream> |
| <> | Placeholders for required elements: enter your <username> or w1 <command/></username> |
| [] | Indicates optional command-line parameters: w1 [-1] Indicates bit and byte ranges (inclusive): [0:3] or [7:0] |

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BCM20737S Data Sheet Functional Description

Section 1: Functional Description

External Reset

External reset timing for the BCM20737S is illustrated in Figure 2.

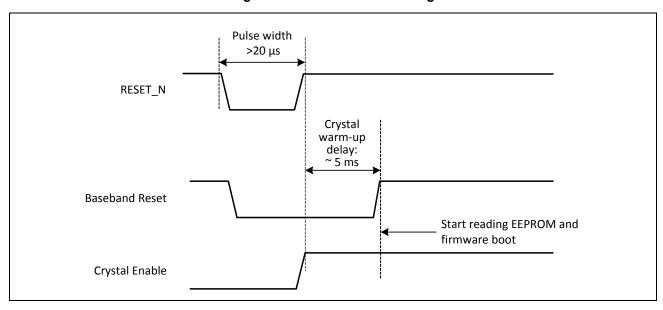


Figure 2: External Reset Timing

32.768 kHz Oscillator

The BCM20737S includes a standard Pierce oscillator. The oscillator circuit includes a comparator with hysteresis on the output to create a single-ended digital output. The hysteresis eliminates chatter when the input is near the comparator threshold (~100 mV). The oscillator circuit can is designed for a 32 kHz or 32.768 kHz crystal oscillator, and can also be driven by an external clock input with a similar frequency. Characteristics for a 32 kHz oscillator are defined in Table 1.

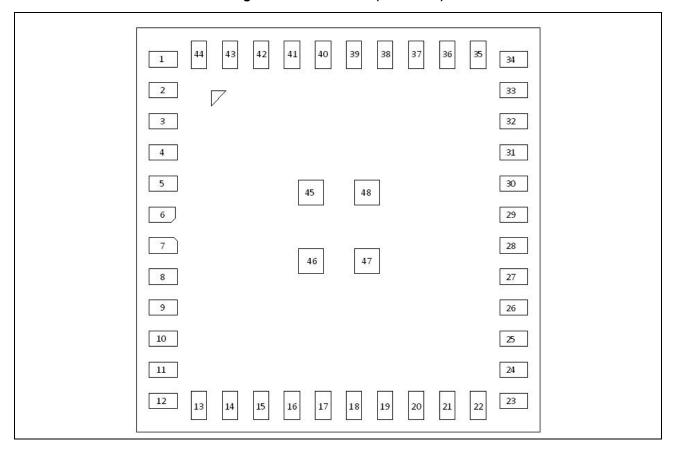
| Parameter | Symbol | Conditions | Min. | Тур. | Max. | Unit |
|---------------------------|----------------------|-----------------------|------|--------|------|------|
| Output frequency | F _{oscout} | _ | _ | 32.768 | _ | kHz |
| Frequency tolerance | F _{tol} | Crystal-dependent | _ | 100 | _ | ppm |
| Start-up time | T _{startup} | _ | _ | _ | 500 | μs |
| Crystal drive level | P _{drv} | For crystal selection | 0.5 | _ | _ | μW |
| Crystal series resistance | R _{series} | For crystal selection | _ | _ | 70 | kΩ |
| Crystal shunt capacitance | C _{shunt} | For crystal selection | _ | _ | 1.3 | pF |

Table 1: 32 kHz Crystal Oscillator Characteristics

Section 2: Pin Map and Signal Descriptions

The BCM20737S pin map is shown in Figure 3.

Figure 3: BCM20737S (TOP View)



The signal name, type, and description of each pin in the BCM20737S is listed in Table 2 on page 10. The symbols shown under I/O Type indicate pin directions (I/O = bidirectional, I = input, O = output) and the internal pull-up/pull-down characteristics (PU = weak internal pull-up resistor and PD = weak internal pull-down resistor), if any.

Table 2: Pin Descriptions

| Pin | Name | I/O Type | Description |
|-----|-----------|----------|--|
| 1 | GPIO: P27 | I | Default direction: Input. |
| | PWM1 | | After POR state: Input floating. |
| | | | Drain current: 16 mA |
| | OND | OND | Alternate function: MOSI (master and slave) for SPI_2 |
| 2 | GND | GND | GND |
| 3 | VBAT | <u> </u> | Battery supply input. |
| 4 | GND | GND | GND |
| 5 | GND | GND | GND |
| 6 | GND | GND | GND |
| 7 | GND | GND | GND |
| 8 | GND | GND | GND |
| 9 | GND | GND | GND |
| 10 | Reserved | _ | Leave floating |
| 11 | GND | GND | GND |
| 12 | GND | GND | GND |
| 13 | GND | GND | GND |
| 14 | GND | GND | GND |
| 15 | GND | GND | GND |
| 16 | GND | GND | GND |
| 17 | GND | GND | GND |
| 18 | UART_RX | ı | UART_RX. This pin is pulled low through an internal 10 $k\Omega$ resistor. |
| 19 | UART_TX | O, PU | UART_TX |
| 20 | GND | GND | GND |
| 21 | SCL | I/O, PU | SCL I/O, PU clock signal for an external I ² C device |
| 22 | SDA | I/O, PU | SDA I/O, PU data signal for an external I ² C device |
| 23 | GND | GND | GND |
| 24 | GND | GND | GND |
| 25 | GPIO: P1 | I | Default direction: Input. |
| | | | After POR state: Input floating. |
| | | | This pin is tied to the WP pin of the embedded EEPROM. |
| 00 | TNAC | | Requires an external 10K pull-up |
| 26 | TMC | I | Test mode control. Pull this pin high to invoke test mode; leave it floating if not used. This pin is connected to GND through an internal 10 k Ω resistor. |
| 27 | RESET_N | I/O PU | Active-low system reset with open-drain output |
| | | | |

Table 2: Pin Descriptions (Cont.)

| Pin | Name | I/O Type | Description |
|-----|-----------|----------|--|
| 28 | GPIO: P0 | I | Default direction: Input. After POR state: Input floating. Alternate functions: • A/D converter input • Peripheral UART TX (PUART_TX) • MOSI (master and slave) for SPI_2 • IR_RX • 60Hz_main |
| 29 | GND | GND | GND |
| 30 | GPIO: P3 | I | Default direction: Input. After POR state: Input floating. Alternate functions: Peripheral UART CTS (PUART_CTS) SPI_CLK (master and slave) for SPI_2 |
| 31 | GPIO: P2 | I | Default direction: Input. After POR state: Input floating. Alternate functions: Peripheral UART RX (PUART_RX) SPI_CS (slave only) for SPI_2 SPI_MOSI (master only) for SPI_2 |
| 32 | GPIO: P4 | I | Default direction: Input. After POR state: Input floating. Alternate functions: Peripheral UART RX (PUART_RX) MOSI (master and slave) for SPI_2. IR_TX |
| 33 | GPIO: P8 | I | Default direction: Input. After POR state: Input floating. Alternate functions: A/D converter input. |
| 34 | GPIO: P33 | I | Default direction: Input. After POR state: Input floating. Alternate functions: • A/D converter input • MOSI (slave only) for SPI_2 • Auxiliary clock output (ACLK1) • Peripheral UART RX (PUART_RX) |

Table 2: Pin Descriptions (Cont.)

| Pin | Name | I/O Type | Description |
|-----|-----------|----------|--|
| 35 | GPIO: P32 | | Default direction: Input. |
| | | | After POR state: Input floating. |
| | | | Alternate functions: |
| | | | A/D converter input |
| | | | SPI_CS (slave only) for SPI_2. |
| | | | Auxiliary clock output (ACLK0) |
| | | | Peripheral UART TX (PUART_TX) |
| 36 | GPIO: P25 | I | Default direction: Input. |
| | | | After POR state: Input floating. |
| | | | Alternate functions: |
| | | | MISO (master and slave) for SPI_2 |
| | | | Peripheral UART RX (PUART_RX) |
| 37 | GPIO: P24 | 1 | Default direction: Input. |
| | | | After POR state: Input floating. |
| | | | Alternate functions: |
| | | | SPI_CLK (master and slave) for SPI_2 |
| | | | Peripheral UART TX (PUART_TX) |
| 38 | NC | NC | No Connection (N/C). |
| 39 | GPIO: P13 | | Default Direction: Input |
| | PWM3 | | After POR State: Input Floating |
| | | | Drain current: 16 mA |
| | | | Alternate function: A/D converter input |
| | GPIO: P28 | 1 | Default direction: Input. |
| | PWM2 | | After POR state: Input floating. |
| | | | Drain current: 16 mA |
| | | | Alternate functions: |
| | | | A/D converter input |
| | | | • LED1 |
| | | | • IR_TX |
| 40 | GPIO: P14 | 1 | Default direction: Input. |
| | PWM2 | | After POR state: Input floating. |
| | | | Alternate function: A/D converter input |
| | GPIO: P38 | 1 | Default direction: Input. |
| | | | After POR state: Input floating. |
| | | | Alternate functions: |
| | | | A/D converter input |
| | | | MOSI (master and slave) for SPI_2 |
| | | | • IR_TX |

Page 12

Table 2: Pin Descriptions (Cont.)

| Pin | Name | I/O Type | Description |
|-----|-----------|----------|---|
| 41 | GPIO: P15 | I | Default direction: Input. |
| | | | After POR state: Input floating. |
| | | | Alternate functions: |
| | | | A/D converter input |
| | | | • IR_RX |
| | | | 60 Hz_main |
| 42 | GPIO: P26 | I | Default direction: Input. |
| | PWM0 | | After POR state: Input floating. |
| | | | Drain current: 16 mA |
| | | | Alternate function: SPI_CS (slave only) for SPI_2 |
| 43 | GPIO: P12 | I | Default direction: Input. |
| | | | After POR state: Input floating. |
| | | | Alternate functions: |
| | | | A/D converter input |
| | | | • XTALO32K |
| | XTALO32K | 0 | Low-power oscillator (LPO) output. |
| | | | Alternate functions: |
| | | | P12 |
| | | | P26 |
| 44 | GPIO: P11 | I | Default direction: Input. |
| | | | After POR state: Input floating. |
| | | | Alternate functions: |
| | | | A/D converter input |
| | | | • XTALI32K |
| | XTALI32K | I | Low-power oscillator (LPO) input. |
| | | | Alternate functions: |
| | | | • P11 |
| | | | • P27 |
| 45 | GND | GND | GND |
| 46 | GND | GND | GND |
| 47 | GND | GND | GND |
| 48 | GND | GND | GND |
| | | | |

BCM20737S Data Sheet Electrical Specifications

Section 3: Electrical Specifications

Absolute maximum ratings are defined in Table 3.

Table 3: Absolute Maximum Ratings

| Parameter | Min. | Max. | Unit |
|---|------|------|------|
| Supply power | NA | 3.63 | V |
| Storage temperature | -40 | 125 | °C |
| Voltage ripple | 0 | ±2 | % |
| Power supply (VBAT absolute maximum rating) | 1.62 | 3.63 | V |

Power for the BCM20737S module is provided by the host through the power pins.

Table 4: Voltage

| Symbol | Parameter | Min. | Тур. | Max. | Unit |
|--------|-----------------|------|------|------|------|
| VBAT | Battery voltage | 1.62 | _ | 3.63 | V |

Table 5: Current Consumption

| Operating Mode | Condition | Nominal | Maximum | Unit | | | |
|-------------------|---|---------|---------|------|--|--|--|
| Receive | Receiver and baseband are both operating, 100% | 24.0 | 28.0 | mA | | | |
| Transmit | Transmitter and baseband are both operating, 100% | 24.0 | 28.0 | mA | | | |
| Sleep | Wake in < 5 ms | 55.0 | 60.0 | μΑ | | | |
| Deep Sleep | Wake on interrupt | 2.0 | 2.5 | μΑ | | | |
| Note: All measure | Note: All measurements taken at 25°C | | | | | | |

Based on the current measurements in Table 5 on page 14, BCM20737S peak power values are:

RX: 101.6 mWTX: 101.6 mW

Sleep mode: 217.8 μW
Deep Sleep mode: 9.1 μW

BCM20737S Data Sheet **RF** Specifications

Section 4: RF Specifications

BCM20737S receiver specifications are defined in Table 6.

Table 6: Receiver Specifications

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

RF transmitter specifications are defined in Table 7.

Table 7: Transmitter Specifications

| Parameter | Min. | Тур. | Max. | Unit |
|-------------------------------------|--------------|------|------|-----------|
| Transmitter | | | | |
| Frequency range ^a | 2402 | _ | 2480 | MHz |
| Output power adjustment range | -20 | _ | 4 | 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 | 225 | _ | 275 | kHz |
| (sequence: 00001111) | | | | |
| Average deviation in payload | 185 | _ | _ | kHz |
| (sequence: 10101010) | | | | |
| Channel spacing | _ | 2 | _ | MHz |

a. This parameter is taken from the Bluetooth 4.0 specification.

BCM20737S Data Sheet ADC Specifications

Section 5: ADC Specifications

BCM20737S ADC specifications are defined in Table 8.

Table 8: ADC Specifications

| Parameter | Symbol | Conditions | Min. | Тур. | Max. | Unit |
|------------------------------------|----------------------|---|-------|------|--------|------------------|
| Number of input channels | _ | _ | _ | 9 | _ | - |
| Channel switching rate | f _{ch} | _ | _ | _ | 133.33 | Kch/s |
| Input signal range | V _{inp} | _ | 0 | _ | 3.63 | V |
| Reference settling time | _ | Charging refsel | 7.5 | - | _ | μs |
| Input resistance | R _{inp} | Effective, single-ended | - | 500 | _ | kΩ |
| Input capacitance | C _{inp} | _ | _ | _ | 5 | pF |
| Conversion rate | F _c | - | 5.859 | _ | 187 | kHz |
| Conversion time | T _c | - | 5.35 | _ | 170.7 | μs |
| Resolution | R | _ | | 16 | | Bits |
| Absolute voltage measurement error | _ | Using on–chip ADC firmware driver | - | ±2 | _ | % |
| Current | I | I _{avdd1p2} + I _{avdd3p3} | _ | _ | 1 | mA |
| Power | Р | - | _ | 1.5 | _ | mW |
| Leakage Current | I _{leakage} | T = 25°C | - | _ | 100 | nA |
| Power-up time | T _{powerup} | _ | _ | _ | 200 | μs |
| Integral nonlinearity | I _{NL} | In the guaranteed performance range | -1 | _ | 1 | LSB ^a |
| Differential nonlinearity | D _{NL} | In the guaranteed performance range | -1 | _ | 1 | LSB ^a |

a. LSBs are expressed at the 10-bit level.

Section 6: Timing and AC Characteristics

SPI Timing

SPI interface timing is illustrated in Figure 4 and Figure 5 and defined in Table 9 on page 18.

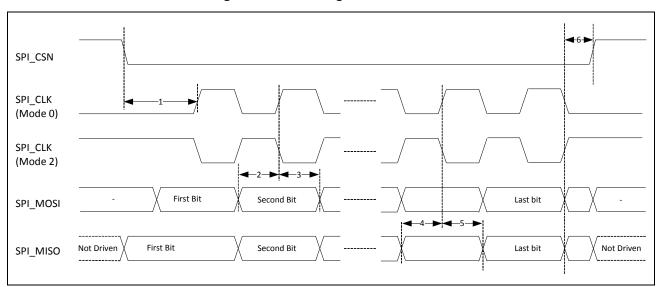
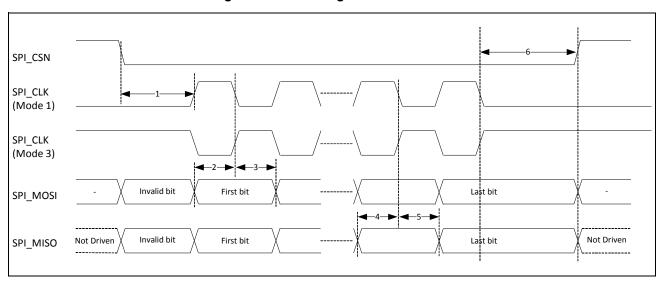


Figure 4: SPI Timing—Modes 0 and 2





BCM20737S Data Sheet BSC Interface Timing

Table 9: SPI Interface Timing Specifications

| Reference | Characteristics | Min. | Тур. | Мах. |
|-----------|---|---------|---------|------|
| 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 |

BSC Interface Timing

BSC interface timing is illustrated in Figure 6 and is defined in Table 10.

Figure 6: BSC Interface Timing

Table 10: BSC Interface Timing Specifications

| Reference | Characteristics | Min. | Мах. | 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 |

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BCM20737S Data Sheet UART Timing

UART Timing

UART timing is illustrated in Figure 7 and defined in Table 11.

Figure 7: UART Timing

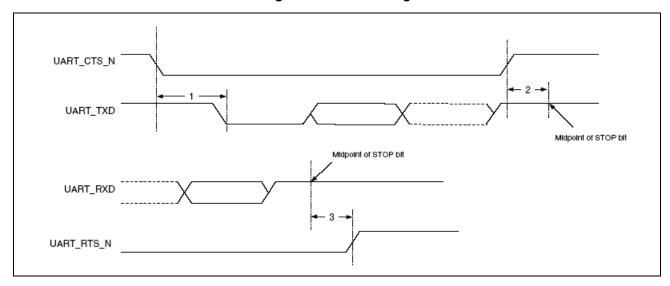


Table 11: UART Timing Specifications

| 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 |

Section 7: PCB Design and Manufacturing Recommendations

Pad and Solder Mask Opening Dimensions

BCM20737S pad and solder mask opening dimensions are defined in Table 12.

Table 12: Pad and Solder Mask Dimensions

| Pad Type | Pad Dimensions | Solder Mask Opening Dimensions Un | nit |
|----------|----------------|-----------------------------------|-----|
| Type A | 0.6 × 0.25 | 0.7 × 0.35 mn | m |
| Type B | 0.55 × 0.3 | 0.65 × 0.4 | |
| Type C | 0.4 × 0.4 | 0.5 × 0.5 | |

PCB Layout Recommendations

The following layout recommendations are referenced to Figure 8 on page 21.

- Connect to system ground from side D of the module (pins 13–22).
- The L-shaped ground plane is required for the embedded BLE antenna. Keep the GND continuous. Do not cut off the GND shape to accommodate trace routes.
- An L-shaped ground plane is required. If the L-shaped GND plane is located on the top layer of the PCB, do not place components on the ground plane. If this cannot be avoided, move the L-shaped ground plane to another layer.
- Antenna efficiency of 31–41% can be achieved based on the layout in Figure 8 on page 21 and the
 dimensions listed below. Following these layout recommendations is expected to yield 50+ meters of
 usable range; deviating from these recommendations may reduce the range of the antenna.
 - D: 4.5 mm (typical)
 - G, H, S: 3 mm (typical)
 - L: 3 mm (minimum)
 - W: 0.4 mm (typical)
- Route signal traces out of the module from side C (between pins 27 and 30) or side D (between pins 16 and 19) of the module. Traces can be overlapped to avoid routing through the keep-out area.
- Do not route traces from side A or side B.

Broadcom® BLE SiP Module

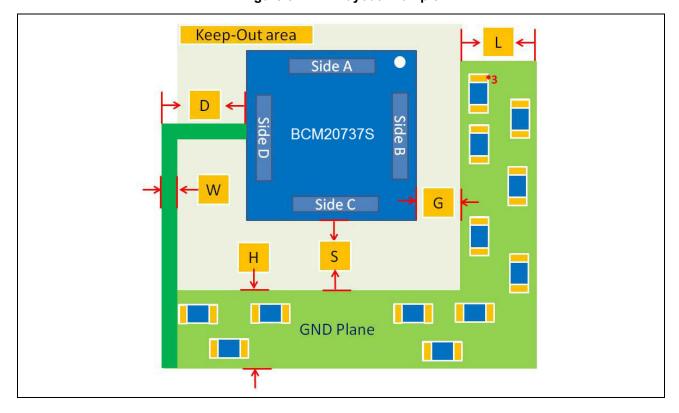


Figure 8: PCB Layout Example

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BCM20737S Data Sheet PCB Stencil

PCB Stencil

The recommended PCB stencil is shown in Figure 9 (all measurements in mm). Use an unsolder mask to set the module footprint.

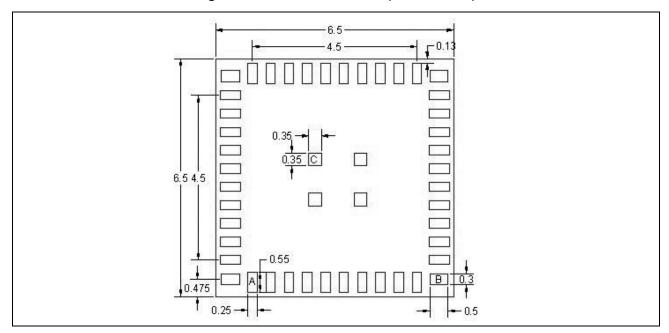


Figure 9: BCM20737S Stencil (Bottom View)

Solder Reflow

The recommended solder reflow profile for the BCM20737S is defined in Figure 10.

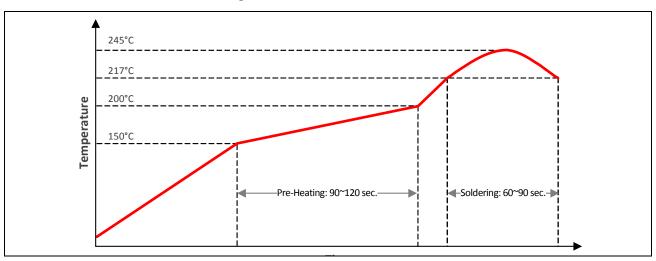


Figure 10: Solder Reflow Profile

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Section 8: Packaging and Storage Information

The BCM20737S is available in a tape and reel package and is shipped in an ESD-protected moisture-resistant (MSL-3) bag as shown in Figure 11. The storage temperature range is –40°C to +125°C.



Figure 11: BCM20737S ESD/Moisture Packaging

The moisture sensitivity label on the BCM20737S shipping bag is shown in Figure 12 on page 24.

LEVEL Caution 3 This bag contains MOISTURE-SENSITIVE DEVICES If blank, see adjacent Calculated shelf life in sealed bag: 12 months at <40℃ and <90% relative humidity (RH) 2. Peak package body temperature: If blank, see adjacent bar code label 3. After bag is opened, devices that will be subjected to reflow solder or other high temperature process must be 168 a) Mounted within: hours of factory conditions If blank, see adjacent bar code label ≤30 °C/60% RH. or b) Stored per J-STD-033 4. Devices require bake, before mounting, if: a) Humidity Indicator Card reads > 10% for level 2a - 5a devices or >60% for level 2 devices whwn read at 23 ±5℃ b) 3a or 3b are not met 5. If baking is required, refer to IPC/JEDEC J-STD-033 for bake procedure. APR 26 2011 Bag Seal Date: If blank, see adjacent bar code label Note: Level and body temperature defined by IPC/JEDEC J-STD-020

Figure 12: BCM20737S Moisture Sensitivity Label

Figure 13 shows the location of pin 1 on the BCM20737S relative to its orientation on the tape packaging.

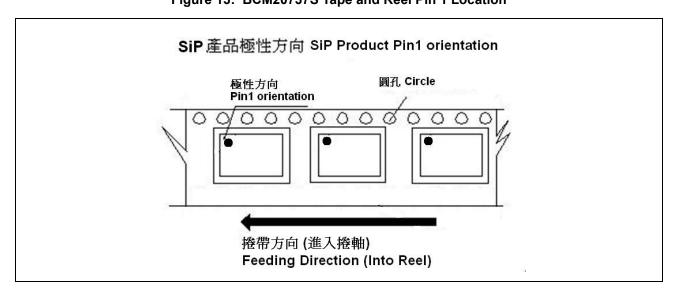


Figure 13: BCM20737S Tape and Reel Pin 1 Location

BCM20737S Data Sheet Mechanical Information

Section 9: Mechanical Information

Package dimensions for the BCM20737S are shown in Figure 14.

Dimension in mm Dimension in inch Symbol MIN NOM MAX MIN NOM MAX Α B 1.18 0.046 0.17 0.20 0.23 0.007 0.008 0.009 6.50 D/E 0.252 0.256 0.260 6.40 6.60 -PIN #1 D1 E1 5.50 0.217 1.24 0.049 D2 E2 1.10 0.043 // bbb C D3/E 0.50 0.020 0.25 0.010 b 0.45 0.018 b1 0.35 0.014 □ aaa TOP VIEW 0.20 0.008 L1 aaa C bbb 0.10 0.004 0.004 ddd DETAIL: 0.05 ⊕ ddd@ C A B D1 NOTE: 1. CONTROLLING DIMENSION: MILLIMETER △ DIMENSION b,b1,L IS MEASURED AT THE MAXIMUM OPENING DIAMETER, 中中0000000000000 PARALLEL TO PRIMARY DATUM C. (0.40)46 Ī A & 45-(0.42)<u>∓</u>0000db00000 L1 BOTTOM VIEW

Figure 14: BCM20737S Package Dimensions

Additional BCM20737S package dimensions are shown in Figure 15 on page 26.

BCM20737S Data Sheet Mechanical Information

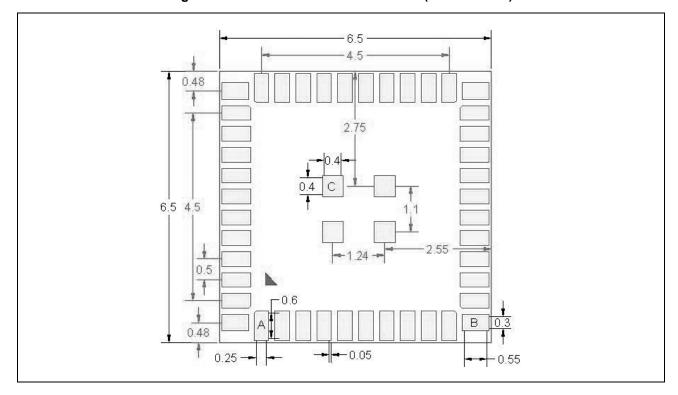


Figure 15: BCM20737S Pin Dimensions (Bottom View)

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BCM20737S Data Sheet Ordering Information

Section 10: Ordering Information

Table 13: Ordering Information

| Part Number | Package | Operating Temperature | Humidity |
|-------------|------------|-----------------------|-------------------------|
| BCM20737S | 48-pin LGA | –40°C to +85°C | 95% max., noncondensing |

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