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Reference Integration Note For BCM2070 QDID – B019305

Abstract: This document provides a conceptual description of the **BCM2070**, for Bluetooth Core v2.1, and summarizes the integration requirements as a guide for others integrating this design.

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1 PREFACE

This document forms the Reference Integration Note for BCM2070 BT version 2.1+EDR.

Design RIN Information

Product Name:	BCM2070
Bluetooth Qualified	B019305
Design ID (QD ID):	
Bluetooth Product Type:	Component (tested)
Product Name:	BCM2070
Hardware Version:	B0
Software Version:	002.001.032

2 PRODUCT OVERVIEW

Broadcom BCM2070 is a monolithic, single-chip, stand-alone baseband processor with a high performance integrated 2.4-GHz transceiver for Bluetooth(R) wireless technology applications. It is fully compliant with Bluetooth v2.1+EDR and all prior standard features. Processed using advanced 65-nm LP CMOS technology, the BCM2070 offers unmatched integrated solution with the smallest footprint and lowest cost. The use of the advanced 65-nm process enables the BCM2070 to achieve the lowest possible current consumption in all modes of operation.

2.1 HARDWARE FEATURES

This section identifies the top level hardware features of this design.

2.1.1 Product Type Declaration

- This product is listed as *Bluetooth Component Product*. If you use this product to implement Bluetooth in your product's design further qualification and listing is required in accordance with the Bluetooth Qualification Process (ref. PRD 2.0). To start the process for a new qualification, please visit <https://bluetooth.org/TPG/>.]

2.1.2 Hardware Overview

This section provides an overview of the features of this design.

The Broadcom BCM2070 is a monolithic, single-chip, Bluetooth 2.1 compliant, stand-alone baseband processor with an integrated 2.4 GHz transceiver.

Manufactured using the industry's most advanced 65 nm CMOS low-power process, the BCM2070 employs the highest level of integration, eliminating all critical external components, and thereby minimizing the device's footprint and costs associated with the implementation of Bluetooth solutions.

The BCM2070 is the optimal solution for voice and data applications that require a Bluetooth SIG standard Host Controller Interface (HCI) via USB, UART H4 or H5, and PCM audio interface support. The BCM2070 radio transceiver's enhanced radio performance meets the most stringent industrial temperature application requirements for compact integration into mobile handset and

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portable devices. The BCM2070 is fully compatible with all standard TCXO frequencies and provides full radio compatibility, enabling it to operate simultaneously with GPS and cellular radios.

The BCM2070 complies with Bluetooth® Core Specification, version 2.1 and is designed for use in standard Host Controller

Interface (HCI) UART and HCI USB applications. The combination of the Bluetooth Baseband Core (BBC), a Peripheral

Transport Unit (PTU), and an ARM®-based microprocessor with on-chip ROM provides a complete lower layer Bluetooth

protocol stack, including the Link Controller (LC), Link Manager (LM), and HCI.

Major features of the BCM2070 include:

- Full support for Bluetooth 2.1 + EDR additional features:
 - Secure Simple Pairing (SSP)
 - Encryption Pause Resume (EPR)
 - Enhance Inquiry Response (EIR)
 - Link Supervision Time Out (LSTO)
 - Sniff SubRating (SSR)
 - Erroneous Data (ED)
 - Packet Boundary Flag (PBF)
- Built-in Low Drop-Out (LDO) regulators (2)
 - 1.4 to 5.5V input voltage range
 - 1.8 to 3.3V intermediate programmable output voltage
- Integrated RF section
 - Single-ended, 50 ohm RF interface
 - Built-in TX/RX switch functionality
 - TX Class 1 output power capability
 - -90 dBm RX sensitivity
- Supports maximum Bluetooth data rates over HCI UART, USB, SPI, and SDIO interfaces
- Multipoint operation, with up to 7 active slaves
 - Maximum of 7 simultaneous active ACL links
 - Maximum of 3 simultaneous active SCO and eSCO links, with Scatternet support
- Scatternet operation, with up to 4 active piconets (with background scan and support for ScatterMode)
- High-speed HCI UART transport support:
 - H4 five-wire UART (four signal wires, one ground wire)
 - H5 three-wire UART (two signal wires, one ground wire)
 - Maximum UART baud rates of 4 Mbps

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- Low-power out-of-band BT_WAKE and HOST_WAKE signaling
- Device pass-through to UART
- VSC from host transport to UART
- HCI USB transport support
- USB version 2.0 full-speed compliant interface
- Full USB HUB, with downstream port
- Channel Quality-Driven Data Rate (CQDDR) and packet type selection
- Standard Bluetooth test modes
- Extended radio and production test mode features
- Full support for power savings modes:
 - Bluetooth standard Hold and Sniff
 - Deep sleep modes and regulator shutdown
 - Tagged Scan, Low Power Page, and Inquiry Scan
- Supports Wide-Band Speech (WBS) over PCM and Packet Loss Concealment (PLC) for better audio quality
- 2-, 3-, and 4-wire coexistence
- Power Amplifier (PA) shutdown for externally controlled coexistence, such as WIMAX
- Built-in LPO clock or operation using an external LPO clock
- TCXO input and auto-detection of all standard handset clock frequencies (supports low-power crystal, which can be used during Power Saving mode with better timing accuracy)
- Proprietary packet scheme, allowing more than two simultaneous A2DP applications
- Larger patch RAM space to support future enhancements
- Serial Flash Interface with native support for devices from several manufacturers
- Fast connect and reconnect for HID devices
- OR gate for combining a host clock request with a Bluetooth clock request (operates even when the Bluetooth core logic is powered off)

2.1.3 Standard Operating Conditions

This section indicates the standard operating conditions for the design, such as; Operating Temperature, Storage Temperature, Voltage Supply, Absolute Maximum Rating Supply Voltage, etc.

Table 1: *Absolute Maximum Voltages*

Note: All voltages listed in Table 1 are referenced to VDD.

Rating	Symbol	Minimum	Typical	Maximum	Unit
DC supply voltage for RF	VDD_RF ¹	-	1.2	1.32	V

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DC supply voltage for core	VDDC	–	1.2	1.32	V
DC supply voltage for I/O	VDDO ²	–	1.8	3.6	V
DC supply	VDDTF	–	1.12	3.3 ³	V
Voltage on input or output pin	VIMAX, VIMIN	V _{SS} – 0.3	–	VDDO + 0.3	V
Storage temperature range	TSTG	–40	–	125	°C

1. VDD_RF collectively refers to the VDDIF, VDDLNA, VDDPX, and VDDRF RF power supplies
2. If VDDO is not applied, voltage should never be applied to any digital I/O pins (I/O pins should never be driven or pulled high).
3. VDDTF for Class 2 must be connected to VREG (main LDO output). VDDTF for Class 1 must be connected to VREGHV (HV LDO output) or an external voltage source. Refer to the Broadcom compatibility guide for configuration details.

Table 2: Power Supply

Parameter	Symbol	Minimum	Typical	Maximum	Unit
DC supply voltage for RF	VDD_RF ¹	1.14	1.2	1.32	V
DC supply noise for RF, from 100 kHz to 1 MHz	VDD_RF ²	–	–	150	µV rms
DC supply voltage for core	VDDC	1.12	1.2	1.32	V
DC supply voltage for I/O	VDDO	1.7	–	3.6	V
DC supply voltage for USB	VDD_USB	3.0	3.3	3.6	V
DC supply	VDDTF ³	1.12	–	3.0 ⁴	V

1. VDD_RF collectively refers to the VDDIF, VDDLNA, VDDPX, VDDLO, VDDIFP, VDDRF RF power supplies
2. Overall performance defined using integrated regulation.
3. VDDTF for Class 2 must be connected to VREG (main LDO output). VDDTF for Class 1 must be connected to VREGHV (HV LDO output) or an external voltage source. Refer to the Broadcom compatibility guide for configuration details. VDDTF requires a capacitor to ground. The value of the capacitor must be tuned to ensure optimal RF RX sensitivity. Typical 10 pF for BGA packages and 6.2 pF for wafer package. The value may depend on board layout.
4. Can be 3.3V if the output power is limited to 9 dBm.

Table 3: Operating Conditions

Parameter	Conditions	Minimum	Typical	Maximum	Unit
Temperature	Commercial	–30.0	–	85	°C
Power supply	RF, Core	1.14	1.2	1.32	V
PA supply (VDDTF)	Reduced power level	1.14	3.0	3.3	V

Table 4: RF PIXIT information for BCM2070 Component

Chipset	2070
Bluetooth Core Ver	v2.1+EDR

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HW Version	B0
SW Version	
BCM specific	
EEPROM/RAM	
PICS	
Power Class	Class 1
Power Control	Y
1 Slot	Y
3 Slots	Y
5 Slots	Y
79 channels	Y
GFSK	Y
pi/4 DQPSK	Y
8 DPSK	Y
EPC(Enhanced Power Control)	N
PIXIT	
Timer for TX pwr ctrl	10 ms
Inband Image freq	4
Value n for Intermodulation test	5
Type of power source	switching/linear regulator
Low Voltage of DUT	3.00
Nom Voltage of DUT	3.30
High Voltage of DUT	3.60
Low Temp, (deg)C	-20
Nom Temp, (deg)C	22
High Temp, (deg)C	70
Antenna port value (gain in dBi)	0
Unmod before mod	12.75
Additional RF loss	0.7

NOTE

- 1) Temperature and voltage typically based off of nominal value. ("Typical" is used for reference designs. Customer-specific designs will of course vary.
- 2) LDO = LowDropOut regulator == switching/linear regulator

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2.1.4 Application

- Mobile handsets and smart phones
- Personal digital assistants
- Desktop and laptop personal computers
- Automotive telematic systems
- Computer peripheral devices (PCMCIA cards, CF cards, and USB dongles)

2.1.5 Block Diagram

This section shows the block diagram of the design.

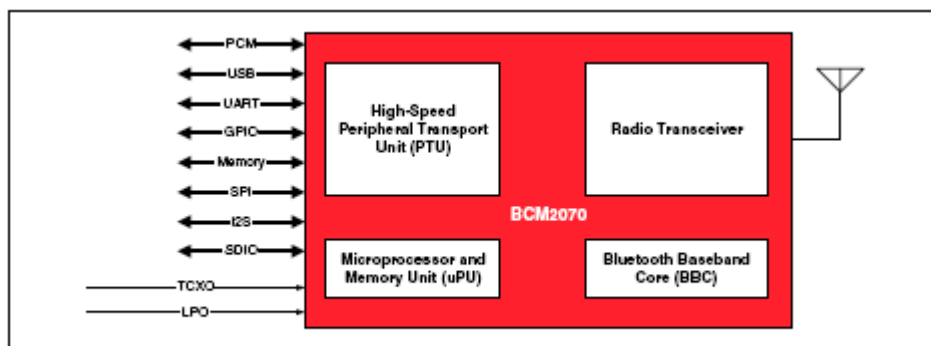


Figure 1: System Block Diagram

2.1.6 Hardware Features

This section identifies any hardware features of this design.

- Bluetooth 2.1 + EDR compliant
- Class 1 capable with built-in PA
- Programmable output power control meets Class 1, Class 2 or Class 3 requirements
- Use supply voltages up to 5.5V
- Support Broadcom SmartAudio™, wide-band speech, SBC codec, packet loss concealment, and DSP rate match
- Fractional-N synthesizer supports frequency references from 12 MHz to 52 MHz
- RF supports frequencies from 12 MHz to 52 MHz
- Automatic frequency detection for standard crystal and TCXO values when an external 32.768 KHz reference clock is provided.
- Ultra-low power consumption
- Support both parallel and serial flash interfaces
- Available in 42-Bump WLBGA, 50-Ball WFBGA, and 100-ball FBGA packages.
- ARM7TDMI-S™-based microprocessor with integrated ROM and RAM

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- Supports mobile and PC applications without external memory
- USB HUB with spare downstream port

2.1.7 Radio Modules

This section identifies any integrated radio modules encompassed within this design.

The BCM2070 has an integrated radio transceiver that has been optimized for use in 2.4-GHz Bluetooth wireless systems.

It has been designed to provide low-power, low-cost, robust communications for applications operating in the globally available 2.4 GHz unlicensed ISM band. The BCM2070 is fully compliant with the Bluetooth Radio Specification and enhanced data rate specification and meets or exceeds the requirements to provide the highest communication link quality of service.

2.1.8 Interfaces

This section identifies the interfaces of this design.

PCM INTERFACE

The BCM2070 PCM interface can connect to linear PCM Codec devices in master or slave mode. In master mode, the device generates the PCM_BCLK and PCM_SYNC signals. In slave mode, these signals are provided by another master on the PCM interface as inputs to the device.

The device supports up to three SCO or eSCO channels through the PCM interface and each channel can be independently mapped to any available slot in a frame.

The PCM interface configuration can be adjusted by the host using vendor-specific HCI commands.

USB INTERFACE

The USB device, configuration, and string descriptors are fully programmable. This allows the manufacturer to customize the descriptors, including the Vendor ID and Product ID, that the BCM2070 uses to identify itself on the USB port. The custom USB descriptor information can be stored in external EEPROM to make it available at boot time.

The USB port contains the following logical interfaces:

- Interface 0 Contains a Control Endpoint (Endpoint 0x00) for HCI commands, a Bulk In Endpoint (Endpoint 0x82) for receiving ACL data, a Bulk Out Endpoint (Endpoint 0x02) for transmitting ACL data, and an Interrupt Endpoint (Endpoint 0x81) for HCI events.
- Interface 1 Contains Isochronous In and Out Endpoints (Endpoints 0x83 and 0x03) for SCO traffic. Several alternate Interface 1 settings are available to reserve the proper bandwidth for isochronous data, depending on the application.
- Interface 2 Contains Bulk In and Bulk Out Endpoints (Endpoints 0x84 and 0x04) which are used for proprietary testing and debugging support and may be ignored during normal operation.

The BCM2070 supports USB HUB and device model with USB Protocol Revision 2.0 full-speed compliance. The BCM2070 handles all standard USB functions for the devices.

UART INTERFACE

The UART physical interface is a standard, 4-wire interface (RX, TX, RTS, CTS) with adjustable baud rates from 9600 bps to 4.0 Mbps. The interface features an automatic baud rate detection capability that returns a baud rate selection.

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Alternatively, the baud rate can be selected via a vendor-specific UART HCI command. The BCM2070 has a 1040-byte receive FIFO and a 1040-byte transmit FIFO to support EDR. The interface supports the Bluetooth 2.0 UART HCI (H4) specification. The default baud rate for H4 is 115.2 Kbaud.

Normally, the UART baud rate is set by a configuration record downloaded after reset or by automatic baud rate detection.

The host does not need to adjust the baud rate. Support for changing the baud rate during normal HCI UART operation is provided through a vendor-specific command.

The BCM2070 UART operates with the host UART correctly, provided the combined baud rate error of the two devices is within $\pm 5\%$.

HCI 3-WIRE TRANSPORT (UART H5):

The BCM2070 supports H5 UART transport for serial UART communications. H5 reduces the number of signal lines required by eliminating CTS and RTS, when compared to H4. In addition, sleep signalling is supported over the same interface so that the 4-wire UART and the 2-wire sleep signalling interface can be reduced to a 2-wire UART interface, saving four IOs on the host.

SDIO:

The BCM2070 supports the SDIO Bluetooth Card Type-A Specification. The SDIO interface is implemented as a point-to-point SDIO connection, with the BCM2070 configured as a slave I/O-only HCI device.

The following three SDIO signaling modes are supported with a full clock range of 0 to 25 MHz:

- SPI mode
- 1-bit SD data transfer mode
- 4-bit SD data transfer mode

SPI:

The BCM2070 supports a slave SPI HCI transport with an input clock range of up to 26 MHz. The physical interface between the SPI master and the BCM2070 consists of the four SPI signals (SPI_CSB, SPI_CLK, SPI_SI, and SPI_SO) and one interrupt signal (SPI_INT). The BCM2070 can be configured to accept active-low or active-high polarity on the SPI_CSB chip select signal. It can also be configured to drive an active-low or active-high SPI_INT interrupt signal. Bit ordering on the SPI_SI and SPI_SO data lines can be configured as either little-endian or big-endian. Additionally, proprietary sleep mode, half-duplex handshaking is implemented between the SPI master and the BCM2070.

The SPI interface does not support hardware flow control. Only the SPI master can stop the flow of bytes on the data lines, since it controls SPI_CSB and SPI_CLK. Flow control should be implemented in higher layer protocols.

2.1.9 Application Requirements

For specific application requirements pertaining to an End Product implementing a BCM2070 Component please contact Broadcom Project Support.

2.1.10 PIN Description

For a PIN Description please contact Broadcom Project Support.

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2.1.11 Bill of Material

Table 5: *Ordering Information*

<i>Part Number</i>	<i>Package</i>	<i>Operating Range</i>
BCM2070CB0KUFBG	Commercial 50-Ball 4.5 x 4 x 0.6 mm	-30°C to 85°C
BCM2070CB0KUFBXG	Commercial 50-Ball 4.5 x 4 x 0.6 mm	-30°C to 85°C
BCM2070PB1KWFBG	Commercial 50-Ball 4.5 x 4 x 0.8 mm	-30°C to 85°C
BCM2070B0KUBG	Commercial 42-Bump 3.02 x 2.51 x 0.55 mm	-30°C to 85°C
BCM2070B0KUBXG	Commercial 42-Bump 3.02 x 2.51 x 0.55 mm	-30°C to 85°C

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