

Technical Description

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Model no.: GE 86708
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1. General description

This device consists of a BlueCore2-Audio Plug-n-Go Chip that is a single chip radio and baseband chip for Bluetooth system. It is fully compliant with Bluetooth specification V1 and V1.2. It operates in the unlicensed ISM band at 2.4GHz and employ Time Division Duplex (TDD) for full duplex transmission. Details please refer to Bluetooth Specification in the appendix I.

2. Circuit description

- Crystal oscillator 16 MHz is used for Bluetooth IC: BC219159A
- Frequency band & channel = ISM band: 2400 to 2483.5 Mhz with 79 channels. Lower frequency channel is 2402 MHz, Middle Freq. channel 2441MHz and 2480MHz for high Freq. channel.
- Frequency hopping algorithm= Adaptive Frequency hopping algorithm
- Built-in charging circuit consists of Q7, Q8, ZD1 R101 & R20 that is used for stabilize and for battery charging. It is powered by a switching power adaptor or through USB port of computer. The USB port is only used for charging purpose.
- The Built-in Microphone and Earphone:
Q4, C15, C17, C19 & c30 are used to control the biasing current and filter the high frequency over 20KHz of microphone. Also the L1, L2, C25 & C26 are used to filter the high Frequency over 20KHz of Earphone.
- Build-in printed PCB inverted "F" antenna.

1. FREQUENCY BANDS AND CHANNEL ARRANGEMENT

The Bluetooth system operates in the 2.4 GHz ISM band. This frequency band is 2400 - 2483.5 MHz.

Regulatory Range	RF Channels
2.400-2.4835 GHz	$f=2402+k$ MHz, $k=0,\dots,78$

Table 1.1: Operating frequency bands

RF channels are spaced 1 MHz and are ordered in channel number k as shown in Table 1.1. In order to comply with out-of-band regulations in each country, a guard band is used at the lower and upper band edge.

Lower Guard Band	Upper Guard Band
2 MHz	3.5 MHz

Table 1.2: Guard Bands

Device Features

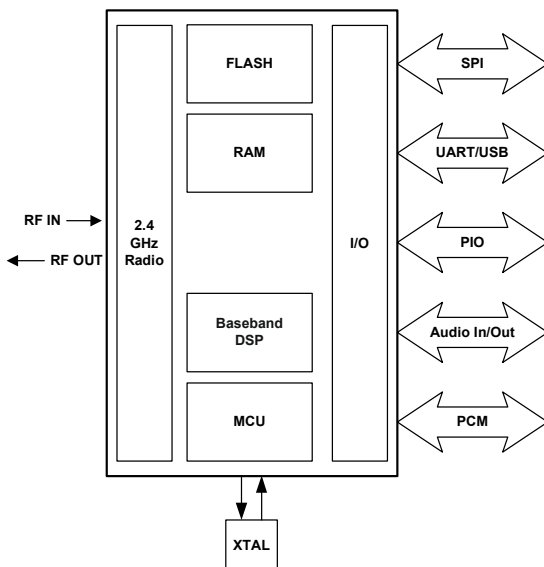
- Fully qualified Bluetooth system
- Bluetooth specification v1.1 and v1.2 compliant
- Guaranteed RF performance temperature range -40°C to +85°C
- Low power 1.8V operation
- Minimum external components
- Integrated 1.8V regulator
- Available in LFBGA package
- 50Ω matched connection to antenna

General Description

BlueCore2-Flash Plug-n-Go is a single chip radio and baseband chip for Bluetooth 2.4GHz systems. It is implemented in 0.18μm CMOS technology.

BlueCore2-Flash Plug-n-Go has the same pinout and electrical characteristics as available in BlueCore2-ROM Plug-n-Go and BlueCore2-Audio Plug-n-Go to enable development of custom code before committing to ROM.

The integrated mono audio CODEC allows for more compact designs and low power consumption for battery powered applications.



**BlueCore2-Flash Plug-n-Go
System Architecture**

BlueCore™ 2-Flash Plug-n-Go™

Single Chip Bluetooth® System

Production Information Data Sheet for

BC219159A-BN

Plug-n-Go Package

May 2004

Applications

- Headsets
- Cellular Handsets
- Personal Digital Assistants
- Mice
- Keyboards

BlueCore2-Flash Plug-n-Go has been designed to reduce the number of external components required which ensures production costs are minimised. The 0.8mm pitch BlueCore2-Flash Plug-n-Go can be used on either two or four layer PCB construction.

The device incorporates auto-calibration and built-in-self-test (BIST) routines to simplify development, type approval and production test. All hardware and device firmware is fully compliant with the Bluetooth specification v1.1 and v1.2.

1 Key Features

Radio

- Direct 50Ω connection to a common TX/RX antenna
- Meets all Bluetooth RF specifications with no external filters
- Extensive built-in-self-test minimises production test time
- No external trimming is required in production

Transmitter

- Up to +6dBm RF transmit power with level control from the on-chip 6-bit DAC over a dynamic range greater than 30dB
- Supports Class 2 and Class 3 radios without the need for an external power amplifier or TX/RX switch

Receiver

- Integrated channel filters
- Digital demodulator for improved sensitivity and co-channel rejection
- Digitised RSSI available in real time over the HCI interface
- Fast AGC for enhanced dynamic range

Synthesiser

- Fully integrated synthesizer; no external VCO varactor diode, resonator or loop filter
- Compatible with crystals between 8 and 32MHz (in multiples of 250kHz) or an external clock
- Accepts 7.68, 14.4, 15.36, 16.2, 16.8, 19.2, 19.44, 19.68, 19.8 and 38.4MHz TCXO frequencies for GSM and CDMA devices with either sinusoidal or logic level signals

Auxiliary Features

- Crystal oscillator with built-in digital trimming
- Power management includes digital shutdown and wake up commands and an integrated low power oscillator for ultra low Park/Sniff/Hold mode power consumption
- Device can be used with an external master oscillator and provides a 'clock request signal' to control external clock source

Auxiliary Features (Continued)

- On-chip linear regulator, producing 1.8V output from 2.2 – 4.2V input
- Power on reset cell detects low supply voltage
- Arbitrary sequencing of power supplies is permitted
- Uncommitted 8-bit ADC and 8-bit DAC are available to application programs

Baseband and Software

- Internal programmed 8Mbit flash for complete system solution
- 32kbyte on-chip RAM allows full speed Bluetooth data transfer, mixed voice and data, plus full seven slave piconet operation
- Dedicated logic for forward error correction, header error control, access code correlation, demodulation, cyclic redundancy check, encryption bitstream generation, whitening and transmit pulse shaping
- Transcoders for A-law, μ -law and linear voice from host and A-law, μ -law and CVSD voice over air

Physical Interfaces

- Synchronous serial interface up to 4Mbaud for system debugging
- UART interface with programmable baud rate up to 1.5M baud with an optional bypass mode
- Full speed USB interface supports OHCI and UHCI host interfaces. Compliant with USB v2.0
- Synchronous bi-directional serial programmable audio interface
- Optional I²C™ compatible interface

Bluetooth Stack

CSR's Bluetooth Protocol Stack runs on-chip in a variety of configurations:

- Standard HCI (UART or USB)
- Fully embedded to RFCOMM
- Customer specific builds with embedded application code

Audio CODEC

- 15-bit resolution with 8kHz sampling frequency
- Designed for use in voice applications such as headsets and hands-free kits
- Integrated input/output amplifiers capable of driving a microphone and speaker with minimum external components

Package Options

- 96-ball LFBGA 10x10x1.61mm 0.8mm pitch

5 Device Diagrams

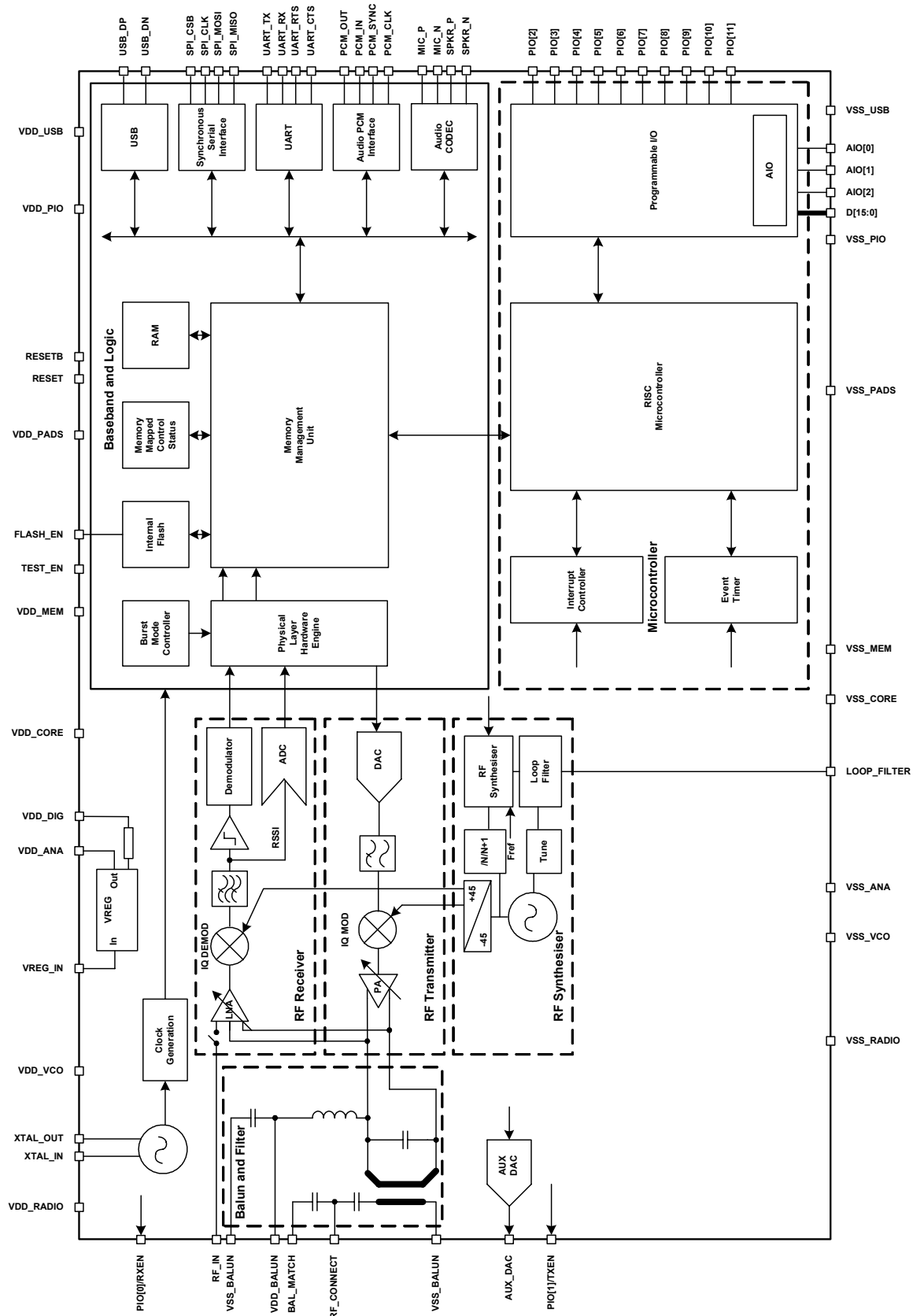


Figure 5.1: BlueCore2-Flash Plug-n-Go Device Diagram for 10 x 10mm LFBGA Package

6 Description of Functional Blocks

6.1 RF Receiver

The receiver features a near zero Intermediate Frequency (IF) architecture that allows the channel filters to be integrated on to the die. Sufficient out of band blocking specification at the Low Noise Amplifier (LNA) input allows the radio to be used in close proximity to Global System for Mobile Communications (GSM) and Wideband Code Division Multiple Access (W-CDMA) cellular phone transmitters without being desensitised. The use of a digital Frequency Shift Keying (FSK) discriminator means that no discriminator tank is needed, and its excellent performance in the presence of noise allows BlueCore2-Flash Plug-n-Go to exceed the Bluetooth requirements for co-channel and adjacent channel rejection.

6.1.1 Low Noise Amplifier

The LNA uses differential mode for Class 2 Bluetooth operation.

6.1.2 Analogue to Digital Converter

The analogue to digital converter (ADC) is used to implement fast automatic gain control (AGC). The ADC samples the Received Signal Strength Indicator (RSSI) voltage on a slot by slot basis. The front end LNA gain is changed according to the measured RSSI value, keeping the first mixer input signal within a limited range. This improves the dynamic range of the receiver, improving performance in interference limited environments.

6.2 RF Transmitter

6.2.1 IQ Modulator

The transmitter features a direct IQ modulator to minimise the frequency drift during a transmit timeslot which results in a controlled modulation index. A digital baseband transmit filter provides the required spectral shaping.

6.2.2 Power Amplifier

The internal power amplifier (PA) has a maximum output power of +6dBm allowing BlueCore2-Flash Plug-n-Go to be used in Class 2 and Class 3 radios without an external RF PA.

6.2.3 Auxiliary DAC

An 8-bit voltage Auxiliary DAC is provided for application support.

6.3 RF Synthesiser

The radio synthesiser is fully integrated onto the die with no requirement for an external voltage controlled oscillator (VCO) screening can, varactor tuning diodes, LC resonators or loop filter. The synthesiser is guaranteed to lock in sufficient time across the guaranteed temperature range to meet the Bluetooth specification v1.1 and v1.2.

6.4 Clock Input and Generation

The reference clock for the system is generated from a TCXO or crystal input between 8MHz and 40MHz. All internal reference clocks are generated using a phase locked loop (PLL), which is locked to the external reference frequency.

6.5 Baseband and Logic

6.5.1 Memory Management Unit

The memory management unit (MMU) provides a number of dynamically allocated ring buffers that hold the data which is in transit between the host and the air or vice versa. The dynamic allocation of memory ensures efficient use of the available random access memory (RAM) and is performed by a hardware MMU to minimise the overheads on the processor during data/voice transfers.

6.5.2 Burst Mode Controller

During radio transmission the burst mode controller (BMC) constructs a packet from header information previously loaded into memory mapped registers by the software and payload data/voice taken from the appropriate ring buffer in the RAM. During radio reception, the BMC stores the packet header in memory mapped registers and the payload data in the appropriate ring buffer in RAM. This architecture minimises the intervention required by the processor during transmission and reception.

6.5.3 Physical Layer Hardware Engine DSP

Dedicated logic is used to perform the following:

- Forward error correction (FEC)
- Header error control (HEC)
- Cyclic redundancy check (CRC)
- Encryption
- Data whitening
- Access code correlation
- Audio transcoding

The following voice data translations and operations are performed by firmware:

- A-law/ μ -law/linear voice data from host
- A-law/ μ -law/Continuously Variable Slope Delta (CVSD) over the air
- Voice interpolation for lost packets
- Rate mismatches

6.5.4 RAM

32kbytes of on-chip RAM is provided and is shared between the ring buffers used to hold voice/data for each active connection and the general purpose memory required by the Bluetooth stack.

6.5.5 Flash Memory

8Mbits of internal Flash is available. The Flash memory is provided for system firmware and the DSP co-processor code implementation.

6.5.6 USB

This is a full speed universal serial bus (USB) interface for communicating with other compatible digital devices. BlueCore2-Flash Plug-n-Go acts as a USB peripheral, responding to requests from a master host controller such as a PC.

6.5.7 Synchronous Serial Interface

This is a synchronous serial port interface (SPI) for interfacing with other digital devices. The SPI port can be used for system debugging.

6.5.8 UART

This is a standard Universal Asynchronous Receiver Transmitter (UART) interface for communicating with other serial devices.

6.5.9 Audio PCM Interface

The audio pulse code modulation (PCM) Interface supports continuous transmission and reception of PCM encoded audio data over Bluetooth.

6.6 Microcontroller

The microcontroller, interrupt controller and event timer run the Bluetooth software stack and control the radio and host interfaces. A 16-bit reduced instruction set computer (RISC) microcontroller is used for low power consumption and efficient use of memory.

6.6.1 Programmable I/O

BlueCore2-Flash Plug-n-Go has 15 (12 digital and 3 analogue) programmable I/O terminals. These are controlled by firmware running on the device.

6.6.2 Extended Programmable I/O Port

16 additional I/O lines are available. These are controlled by firmware running on the device. An example application for these extra lines could be keyboard scanning.

6.7 Audio CODEC

BlueCore2-Flash Plug-n-Go has a 15-bit Audio CODEC that has a 8kHz sampling frequency. This has been designed for use in voice applications such as headsets and hands-free kits. The CODEC has integrated input/output amplifiers capable of driving a microphone and speaker with minimum external components.

BlueCore2-Flash Plug-n-Go allows development of audio based designs before committing to a ROM based variant of the device.