

## Device Features

- Fully qualified Bluetooth v2.1 + EDR
- Full speed Bluetooth Operation with Piconet and Scatternet Support
- Best in Class Bluetooth Radio with +8dBm Transmit Power and -90dBm Receive Sensitivity
- Minimum External Components
- Internal 6-Mbit ROM
- 16-bit AuriStream (ADCPM) CODEC - 90dB SNR for DAC
- Low-Power 1.5V Operation, 1.8V to 3.6V I/O
- Integrated 1.5V and 1.9V Linear Regulators
- Integrated Switch-mode Regulator
- Integrated Battery Charger
- External CODEC Support
- 7 x 7 x 0.9mm QFN
- Green (RoHS and no Antimony or Halogenated Flame Retardants)

## General Description

BlueCore6-Audio ROM is a single-chip radio and baseband IC for Bluetooth 2.4GHz systems including *enhanced data rates* (EDR) to 3-Mbits/s.

With the on-chip CSR Bluetooth software stack, it provides a fully compliant Bluetooth system to v2.1 + EDR of the specification for data and voice communications.

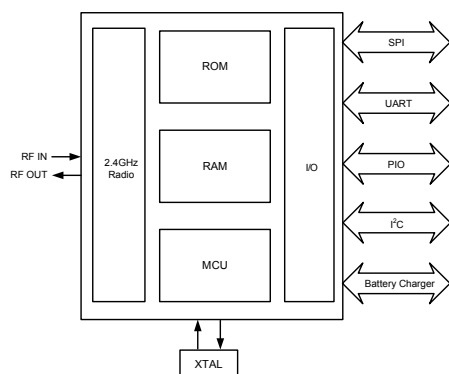


Figure: System Architecture

## BlueCore6™-Audio ROM Single Chip Bluetooth® v2.1 + EDR System

Advance Information

BC63C159A

October 2007

## Applications

- Headsets
- Automotive hands-free kits
- General purpose Bluetooth systems requiring an on-chip audio CODEC

BlueCore6-Audio ROM has been designed to reduce the number of external components required which ensures production costs are minimised.

BlueCore6-Audio ROM includes AuriStream, which offers significant power reduction over the CVSD based system when used at both ends of the link.

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 v2.1 + EDR specification (all mandatory features).

## Document History

| Revision | Date      | Change Reason                                                                                                                                                                                                                                                |
|----------|-----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | 19 OCT 07 | Original publication of this document                                                                                                                                                                                                                        |
| 2        | 19 OCT 07 | VDD_PADS information updated, Package Information > Device Terminal Functions section<br>If you have any comments about this document, email <a href="mailto:comments@csr.com">comments@csr.com</a> giving the number, title and section with your feedback. |

## Status Information

The status of this Product Data Sheet is **Advance Information**.

CSR Product Data Sheets progress according to the following format:

### Advance Information

Information for designers concerning CSR product in development. All values specified are the target values of the design. Minimum and maximum values specified are only given as guidance to the final specification limits and must not be considered as the final values.

All detailed specifications including pinouts and electrical specifications may be changed by CSR without notice.

### Pre-Production Information

Pinout and mechanical dimension specifications finalised. All values specified are the target values of the design. Minimum and maximum values specified are only given as guidance to the final specification limits and must not be considered as the final values.

All electrical specifications may be changed by CSR without notice.

### Production Information

Final Data Sheet including the guaranteed minimum and maximum limits for the electrical specifications.

Production Data Sheets supersede all previous document versions.

### ESD Precautions

BlueCore6-Audio ROM is classified as a JESD22-A224 class 0 product. Apply ESD static handling precautions during manufacturing.

### Life Support Policy and Use in Safety-Critical Applications

CSR's products are not authorised for use in life-support or safety-critical applications. Use in such applications is done at the sole discretion of the customer. CSR will not warrant the use of its devices in such applications.

### CSR Green Semiconductor Products and RoHS Compliance

BlueCore6-Audio ROM devices meet the requirements of Directive 2002/95/EC of the European Parliament and of the Council on the Restriction of Hazardous Substance (RoHS).

BlueCore6-Audio ROM devices are also free from halogenated or antimony trioxide-based flame retardants and other hazardous chemicals. For more information, see CSR's *Environmental Compliance Statement for CSR Green Semiconductor Products*.

### Trademarks, Patents and Licences

Unless otherwise stated, words and logos marked with <sup>™</sup> or <sup>®</sup> are trademarks registered or owned by CSR plc or its affiliates. Bluetooth<sup>®</sup> and the Bluetooth logos are trademarks owned by Bluetooth SIG, Inc. and licensed to CSR. Other products, services and names used in this document may have been trademarked by their respective owners.

The publication of this information does not imply that any license is granted under any patent or other rights owned by CSR plc.

CSR reserves the right to make technical changes to its products as part of its development programme.

While every care has been taken to ensure the accuracy of the contents of this document, CSR cannot accept responsibility for any errors.

## Contents

|          |                                                                   |           |
|----------|-------------------------------------------------------------------|-----------|
| <b>1</b> | <b>Device Details .....</b>                                       | <b>5</b>  |
| <b>2</b> | <b>Package Information .....</b>                                  | <b>6</b>  |
| 2.1      | BlueCore6-Audio ROM 7 x 7mm QFN Pinout Diagram .....              | 6         |
| 2.2      | Device Terminal Functions .....                                   | 7         |
| 2.3      | Package Dimensions .....                                          | 11        |
| 2.4      | PCB Design and Assembly Considerations .....                      | 12        |
| 2.5      | Typical Solder Reflow Profile .....                               | 12        |
| <b>3</b> | <b>CSR Green Semiconductor Products and RoHS Compliance .....</b> | <b>13</b> |
| 3.1      | RoHS Statement .....                                              | 13        |
| 3.1.1    | List of Restricted Materials .....                                | 13        |
| <b>4</b> | <b>Ordering Information .....</b>                                 | <b>14</b> |
| 4.1      | Tape and Reel Information .....                                   | 14        |
| <b>5</b> | <b>Document References .....</b>                                  | <b>15</b> |
|          | <b>Terms and Definitions .....</b>                                | <b>16</b> |

## List of Figures

|            |                                                      |    |
|------------|------------------------------------------------------|----|
| Figure 2.1 | BlueCore6-Audio ROM 7 x 7mm QFN Pinout Diagram ..... | 6  |
| Figure 2.2 | 48 Lead 7 x 7 x 0.9mm QFN Package .....              | 11 |

# 1 Device Details

## Radio

- Common TX/RX terminal simplifies external matching; eliminates external antenna switch
- BIST minimises production test time
- Bluetooth v2.1 + EDR Specification compliant

## Transmitter

- +8dBm RF transmit power with level control from on-chip 6-bit DAC over a dynamic range >30dB
- Class 2 and Class 3 support without the need for an external power amplifier or TX/RX switch

## Receiver

- Receiver sensitivity of -90dBm
- Integrated channel filters
- Digital demodulator for improved sensitivity and co-channel rejection
- Real-time digitised RSSI available on HCI interface
- Fast AGC for enhanced dynamic range

## Synthesiser

- Fully integrated synthesiser requires no external VCO varactor diode, resonator or loop filter
- Compatible with crystals between 12 and 52MHz or an external clock
- Accepts 14.40, 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 sinusoidal or logic level signals

## Baseband and Software

- Internal 6-Mbit ROM
- Internal 48-Kbyte RAM, allows full speed data transfer, mixed voice and data, and full piconet operation, including all EDR packet types
- Logic for forward error correction, header error control, access code correlation, CRC, demodulation, encryption bit stream generation, whitening and transmit pulse shaping. Supports all mandatory Bluetooth v2.1 + EDR features including eSCO and AFH
- Transcoders for A-law,  $\mu$ -law and linear voice from host and A-law,  $\mu$ -law and CVSD voice over air

## Auxiliary Features

- Crystal oscillator with built-in digital trimming
- Device can run in low power modes from an external 32768Hz clock signal
- Power management includes digital shutdown, and wake up commands with an integrated low power oscillator for ultra low power Park/Sniff/Hold mode
- On-chip regulators: 1.5V output from 1.7V to 2.8V input and 1.9V output from 2.7V to 5.6V input
- On-chip high-efficiency switched-mode regulator; 1.5V output from 2.2V to 4.9V input
- Power-on-reset cell detects low supply voltage
- Arbitrary sequencing of power supplies permitted
- 10-bit ADC and 8-bit DAC available to applications
- Battery charger with programmable current (25-100mA) for Lithium Ion/Polymer battery
- Two LED drivers with faders

## Physical Interfaces

- Synchronous serial interface up to 4Mbaud for system debugging
- UART interface with programmable baud rate up to 3Mbaud with optional bypass mode
- Optional I<sup>2</sup>C compatible interface

## Audio CODEC

- AurStream (16, 24, 32, 40 kbps) CODEC, which offers significant power reduction over the CVSD based system when used at both ends of the link
- 16-bit resolution, 8kHz sampling frequency
- Digital enhancements to add bass cut, side tone and treble boost
- Analogue enhancements to support single-ended speaker drive capability and reference availability

## Bluetooth Stack

CSR's Bluetooth Protocol Stack runs on the on-chip MCU in the following configuration:

- Standard HCI over UART

## Package Option

- 48-lead 7 x 7 x 0.9mm 0.5mm pitch QFN

## 2 Package Information

### 2.1 BlueCore6-Audio ROM 7 x 7mm QFN Pinout Diagram

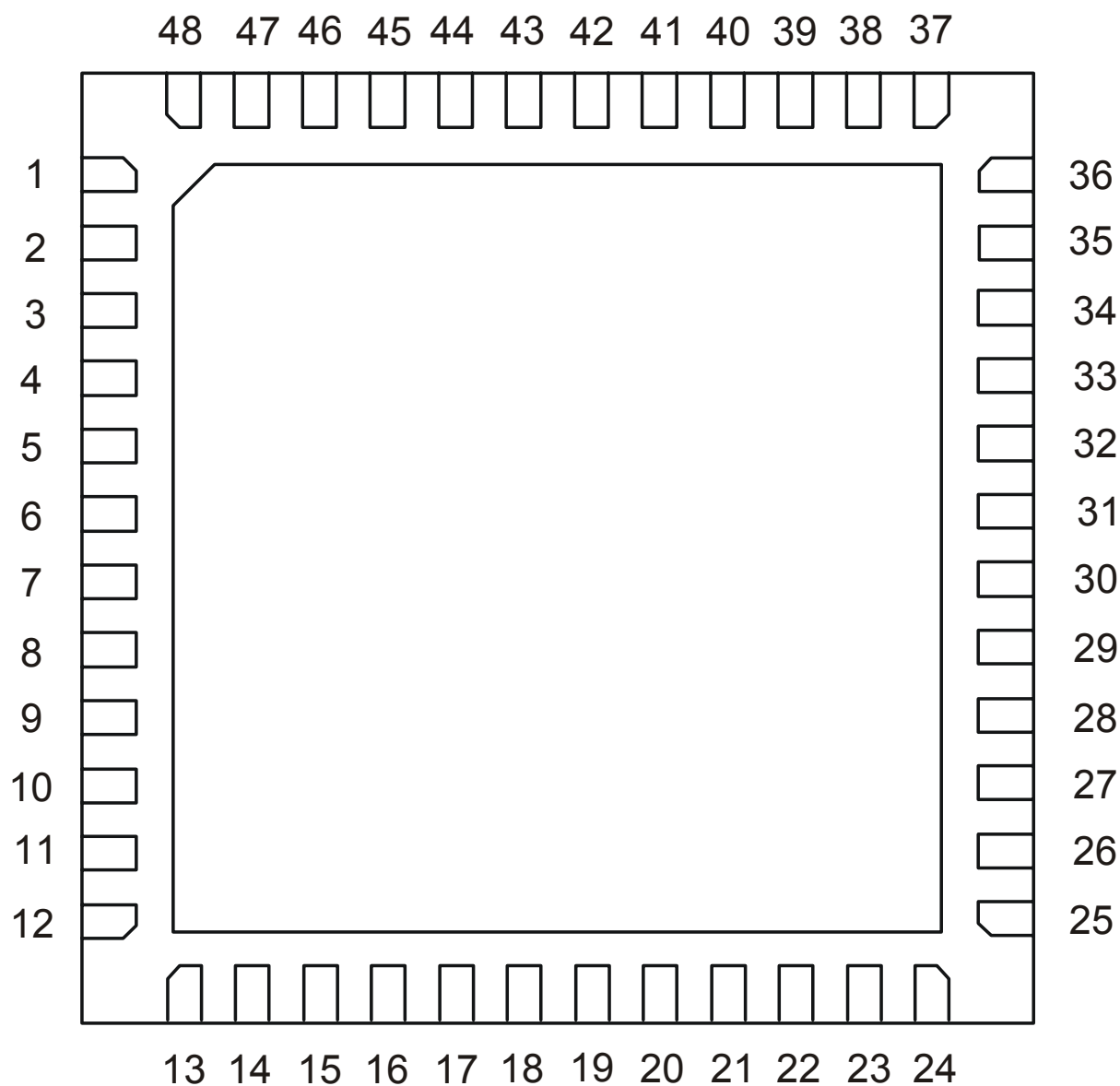


Figure 2.1: BlueCore6-Audio ROM 7 x 7mm QFN Pinout Diagram

## 2.2 Device Terminal Functions

| Bluetooth Radio | Lead | Pad Type | Supply Domain | Description                          |
|-----------------|------|----------|---------------|--------------------------------------|
| RF_N            | 8    | RF       | RADIO         | Transmitter output/switched receiver |
| RF_P            | 7    | RF       | RADIO         | Complement of RF_N                   |

| Synthesiser and Oscillator | Lead | Pad Type | Supply Domain | Description                                   |
|----------------------------|------|----------|---------------|-----------------------------------------------|
| XTAL_IN                    | 13   | Analogue | ANA           | For crystal or external clock input           |
| XTAL_OUT                   | 14   | Analogue | ANA           | Drive for crystal                             |
| LO_REF                     | 15   | Analogue | ANA           | Reference voltage to decouple the synthesiser |

| SPI Interface | Lead | Pad Type                                    | Supply Domain | Description                                                   |
|---------------|------|---------------------------------------------|---------------|---------------------------------------------------------------|
| SPI_MOSI      | 38   | Input, with weak internal pull-down         | PADS          | SPI data input                                                |
| SPI_CS#       | 40   | Bi-directional with weak internal pull-down | PADS          | Chip select for Serial Peripheral Interface (SPI), active low |
| SPI_CLK       | 39   | Bi-directional with weak internal pull-down | PADS          | SPI clock                                                     |
| SPI_MISO      | 41   | Bi-directional with weak internal pull-down | PADS          | SPI data output                                               |

| UART Interface | Lead | Pad Type                                        | Supply Domain | Description                   |
|----------------|------|-------------------------------------------------|---------------|-------------------------------|
| UART_TX        | 19   | Output, tri-state, with weak internal pull-down | PADS          | UART data output, active high |
| UART_RX        | 18   | Bi-directional with weak internal pull-down     | PADS          | UART data input, active high  |

| PIO Port | Lead | Pad Type                                                        | Supply Domain | Description                    |
|----------|------|-----------------------------------------------------------------|---------------|--------------------------------|
| PIO[11]  | 27   | Bi-directional with programmable strength internal pull-up/down | PADS          | Programmable input/output line |
| PIO[8]   | 44   | Bi-directional with programmable strength internal pull-up/down | PADS          | Programmable input/output line |
| PIO[7]   | 45   | Bi-directional with programmable strength internal pull-up/down | PADS          | Programmable input/output line |
| PIO[6]   | 46   | Bi-directional with programmable strength internal pull-up/down | PADS          | Programmable input/output line |
| PIO[3]   | 21   | Bi-directional with programmable strength internal pull-up/down | PADS          | Programmable input/output line |
| PIO[2]   | 22   | Bi-directional with programmable strength internal pull-up/down | PADS          | Programmable input/output line |
| PIO[1]   | 23   | Bi-directional with programmable strength internal pull-up/down | PADS          | Programmable input/output line |
| PIO[0]   | 24   | Bi-directional with programmable strength internal pull-up/down | PADS          | Programmable input/output line |
| AIO[0]   | 17   | Bi-directional                                                  | ANA           | Programmable input/output line |
| AIO[1]   | 16   | Bi-directional                                                  | ANA           | Programmable input/output line |



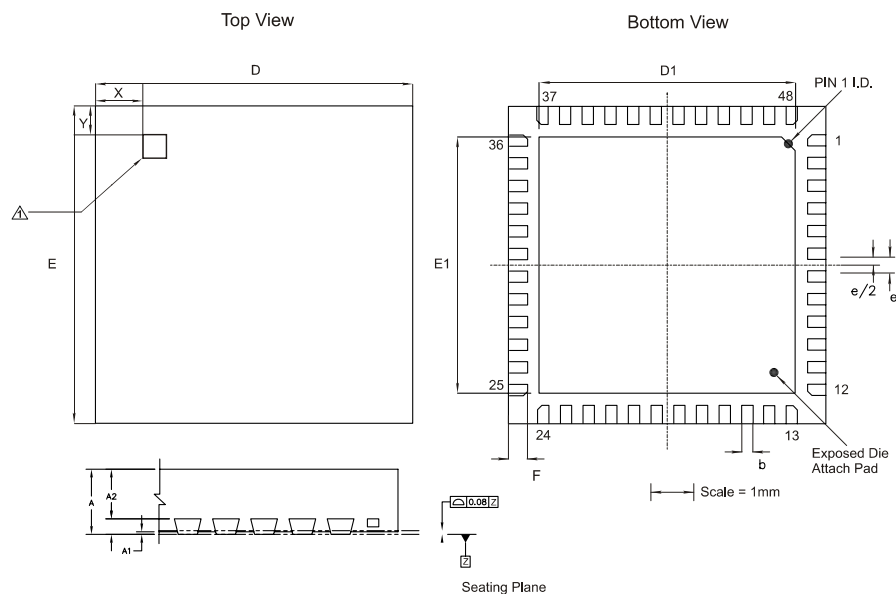
| Audio    | Lead | Pad Type | Supply Domain | Description                                            |
|----------|------|----------|---------------|--------------------------------------------------------|
| SPKR_N   | 3    | Analogue | AUDIO         | Speaker output, negative                               |
| SPKR_P   | 4    | Analogue | AUDIO         | Speaker output, positive                               |
| MIC_N    | 2    | Analogue | AUDIO         | Microphone input, negative                             |
| MIC_P    | 1    | Analogue | AUDIO         | Microphone input, positive                             |
| MIC_BIAS | 47   | Analogue | AUDIO, BAT_P  | Microphone bias                                        |
| AU_REF   | 5    | Analogue | AUDIO         | Decoupling of audio reference (for high quality audio) |

| LED Drivers | Lead | Pad Type          | Supply Domain | Description |
|-------------|------|-------------------|---------------|-------------|
| LED[1]      | 28   | Open drain output | Open drain    | LED driver  |
| LED[0]      | 29   | Open drain output | Open drain    | LED driver  |

| Test and Debug | Lead | Pad Type                             | Supply Domain | Description                                                            |
|----------------|------|--------------------------------------|---------------|------------------------------------------------------------------------|
| RST#           | 26   | Input with weak internal pull-up     | PADS          | Reset if low. Input debounced so must be low for >5ms to cause a reset |
| TEST_EN        | 25   | Input with strong internal pull-down | PADS          | For test purposes only (leave unconnected)                             |

| Power Supplies Control | Lead        | Description                                                                                              |
|------------------------|-------------|----------------------------------------------------------------------------------------------------------|
| VREGENABLE_L           | 10          | Take high to enable low-voltage regulator                                                                |
| VREGENABLE_H           | 33          | Take high to enable both high-voltage regulator and switch-mode regulator                                |
| VREGIN_L               | 11          | Input to internal low-voltage regulator                                                                  |
| VREGIN_H               | 32          | Input to internal high-voltage regulator                                                                 |
| LX                     | 35          | Switch-mode power regulator output                                                                       |
| VREGOUT_H              | 31          | High-voltage regulator output                                                                            |
| VDD_PADS               | 42, 43      | Positive supply for digital input/output ports including PIO [0:3, 6, 7, 8, 11]                          |
| VDD_CORE               | 30          | Positive supply for internal digital circuitry                                                           |
| VDD_RADIO              | 6           | Positive supply for RF circuitry                                                                         |
| VDD_ANA                | 12          | Positive supply for analogue circuitry, AIO[0]. Output from internal 1.5V regulator                      |
| VDD_LO                 | 9           | Positive supply for local oscillator circuitry                                                           |
| VDD_AUDIO              | 48          | Positive supply for audio                                                                                |
| BAT_P                  | 36          | Lithium ion/polymer battery positive terminal. Battery charger output and input to switch-mode regulator |
| VDD_CHG                | 37          | Lithium ion/polymer battery charger input                                                                |
| SMP_SENSE              | 34          | Positive supply for switch-mode control circuitry                                                        |
| VSS                    | Exposed Pad | Ground connections                                                                                       |

## 2.3 Package Dimensions



|             |                                         |         |         |                                                                                                                                                                         |
|-------------|-----------------------------------------|---------|---------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Description | 48 Lead Quad Flat No-lead (QFN) Package |         |         |                                                                                                                                                                         |
| Size        | 7 x 7 x 0.9mm                           |         |         |                                                                                                                                                                         |
| Pitch       | 0.5mm                                   |         |         |                                                                                                                                                                         |
| Dimension   | Minimum                                 | Typical | Maximum | Notes                                                                                                                                                                   |
| A           | 0.80                                    | 0.85    | 0.90    |  Top-side polarity mark. The dimensions of the square polarity mark are TBD x TBDmm. |
| A1          | 0.00                                    | 0.035   | 0.05    |                                                                                                                                                                         |
| A2          | -                                       | 0.65    | 0.67    |                                                                                                                                                                         |
| A3          | -                                       | 0.203   | -       |                                                                                                                                                                         |
| b           | 0.20                                    | 0.25    | 0.30    |                                                                                                                                                                         |
| D           |                                         | 7.00    |         |                                                                                                                                                                         |
| E           |                                         | 7.00    |         |                                                                                                                                                                         |
| e           |                                         | 0.5     |         |                                                                                                                                                                         |
| D1          | 5.55                                    | 5.65    | 5.75    |                                                                                                                                                                         |
| E1          | 5.55                                    | 5.65    | 5.75    |                                                                                                                                                                         |
| F           | 0.35                                    | 0.40    | 0.45    |                                                                                                                                                                         |
| X           |                                         | TBD     |         |                                                                                                                                                                         |
| Y           |                                         | TBD     |         |                                                                                                                                                                         |
| JEDEC       | MO-220                                  |         |         |                                                                                                                                                                         |
| Unit        | mm                                      |         |         |                                                                                                                                                                         |

Figure 2.2: 48 Lead 7 x 7 x 0.9mm QFN Package

## 2.4 PCB Design and Assembly Considerations

The following list details the recommendations to achieve maximum board-level reliability for BlueCore6-Audio ROM:

- *Non-solder mask defined* (NSMD) lands (lands smaller than the solder mask aperture) are preferred, because of the greater accuracy of the metal definition process compared to the solder mask process. With solder mask defined pads, the overlap of the solder mask on the land creates a step in the solder at the land interface, which can cause stress concentration and act as a point for crack initiation.
- PCB land width should be 0.3mm and PCB land length should be 0.9mm to achieve maximum reliability.
- Solder paste must be used during the assembly process.

## 2.5 Typical Solder Reflow Profile

See *Typical Solder Reflow Profile for Lead-free Device* for information.

## 3 CSR Green Semiconductor Products and RoHS Compliance

### 3.1 RoHS Statement

BlueCore6-Audio ROM where explicitly stated in this Data Sheet meets the requirements of Directive 2002/95/EC of the European Parliament and of the Council on the *Restriction of Hazardous Substance* (RoHS).

#### 3.1.1 List of Restricted Materials

BlueCore6-Audio ROM is compliant with RoHS in relation to the following substances:

- Cadmium
- Lead
- Mercury
- Hexavalent chromium
- Polybrominated Biphenyl
- Polybrominated Diphenyl Ether

In addition, the following substances are not intentionally added to BlueCore6-Audio ROM devices:

- Halogenated flame retardant
- Antimony (Sb) and Compounds, including Antimony Trioxide flame retardant
- Polybrominated Diphenyl and Biphenyl Oxides
- Tetrabromobisphenol-A bis (2,3-dibromopropylether)
- Asbestos or Asbestos compounds
- Azo compounds
- Organic tin compounds
- Mirex
- Polychlorinated naphthalenes
- Polychlorinated terphenyls
- Polychlorinated biphenyls
- Polychlorinated/Short chain chlorinated paraffins
- Polyvinyl Chloride (PVC) and PVC blends
- Formaldehyde
- Arsenic and compounds (except as a semiconductor dopant)
- Beryllium and its compounds
- Ethylene Glycol Monomethyl Ether or its acetate
- Ethylene Glycol Monoethyl Ether or its acetate
- Halogenated dioxins and furans
- Persistent Organic Pollutants (POP), including Perfluorooctane sulphonates
- Red phosphorous
- Ozone Depleting Chemicals (Class I and II): Chlorofluorocarbons (CFC) and Halons
- Radioactive substances

For further information, see CSR's *Environmental Compliance Statement for CSR Green Semiconductor Products*.

## 4 Ordering Information

| Interface Version | Package                  |                               |                 | Order Number                      |
|-------------------|--------------------------|-------------------------------|-----------------|-----------------------------------|
|                   | Type                     | Size                          | Shipment Method |                                   |
| UART              | QFN 48-lead<br>(Pb free) | 7 x 7 x 0.9mm,<br>0.5mm pitch | Tape and reel   | BC63C159A03-IQB-E4 <sup>(a)</sup> |

<sup>(a)</sup> Until BC63C159A reaches **Production** status, engineering samples order number applies. This is BC63C159A03-ES-IQB-E, with no minimum order quantity.

### Note:

At **Production** status **Minimum Order Quantity** is 2kpcs taped and reeled.

To contact a CSR representative, email [sales@csr.com](mailto:sales@csr.com) or go to [www.csr.com/contacts](http://www.csr.com/contacts)

### 4.1 Tape and Reel Information

For tape and reel packing and labelling see *IC Packing and Labelling Specification*.

## 5 Document References

| Document                                                                                                       | Reference, Date                  |
|----------------------------------------------------------------------------------------------------------------|----------------------------------|
| <i>Core Specification of the Bluetooth System</i>                                                              | v2.1 + EDR, 26 July 2007         |
| <i>Test Suite Structure (TSS) and Test Purposes (TP) System Specification 1.2/2.0/2.0 + EDR/ 2.1/2.1 + EDR</i> | RF.TS/2.1.E.0, 27 December 2006  |
| <i>Selection of PC EEPROMS for Use with BlueCore</i>                                                           | bcore-an-008P, 30 September 2003 |
| <i>IC Packing and Labelling Specification</i>                                                                  | CS-112584-SPP, January 2007      |
| <i>Typical Solder Reflow Profile for Lead-free Device</i>                                                      | CS-116434-ANP, 2007              |
| <i>Bluetooth and IEEE 802.11 b/g Co-existence Solutions Overview</i>                                           | bcore-an-066P, May 2005          |
| <i>Environmental Compliance Statement for CSR Green Semiconductor Products</i>                                 | CB-001036-ST, 27 September 2007  |

## Terms and Definitions

| Term       | Definition                                                                                            |
|------------|-------------------------------------------------------------------------------------------------------|
| ADC        | Analogue to Digital Converter                                                                         |
| AFH        | Adaptive Frequency Hopping                                                                            |
| AGC        | Automatic Gain Control                                                                                |
| AuriStream | CSR proprietary ADPCM CODEC                                                                           |
| BIST       | Built-In Self Test                                                                                    |
| BlueCore™  | Group term for CSR's range of Bluetooth wireless technology chips                                     |
| Bluetooth® | Set of technologies providing audio and data transfer over short-range radio connections              |
| CDMA       | Code Division Multiple Access                                                                         |
| CODEC      | COder DECoder                                                                                         |
| CRC        | Cyclic Redundancy Check                                                                               |
| CVSD       | Continuous Variable Slope Delta Modulation                                                            |
| DAC        | Digital to Analogue Converter or Device Access Code                                                   |
| EDR        | Enhanced Data Rate                                                                                    |
| eSCO       | Extended SCO                                                                                          |
| GSM        | Global System for Mobile communications                                                               |
| HCI        | Host Controller Interface                                                                             |
| I²C        | Inter-Integrated Circuit                                                                              |
| IC         | Integrated Circuit                                                                                    |
| LED        | Light Emitting Diode                                                                                  |
| MCU        | Micro Controller Unit                                                                                 |
| NSMD       | Non Solder Mask Defined                                                                               |
| QFN        | Quad-Flat No-lead                                                                                     |
| RAM        | Random Access Memory                                                                                  |
| RF         | Radio Frequency                                                                                       |
| RoHS       | The Restriction of Hazardous Substances in Electrical and Electronic Equipment Directive (2002/95/EC) |
| ROM        | Read Only Memory                                                                                      |
| RSSI       | Received Signal Strength Indication                                                                   |
| RX         | Receive or Receiver                                                                                   |
| TCXO       | Temperature Compensated crystal Oscillator                                                            |
| TX         | Transmit or Transmitter                                                                               |
| UART       | Universal Asynchronous Receiver Transmitter                                                           |
| VCO        | Voltage Controlled Oscillator                                                                         |