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.
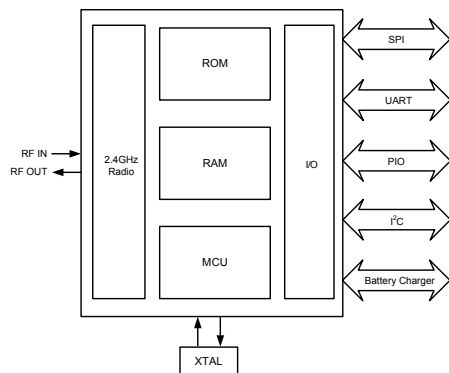

Figure: System Architecture

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

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).

BlueCore™6-Audio ROM Product Data Sheet

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 If you have any comments about this document, email comments@csr.com giving the number, title and section with your feedback.

BlueCore™6-Audio ROM Product Data Sheet

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 ™ or ® are trademarks registered or owned by CSR plc or its affiliates. Bluetooth® 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

List of Figures

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, µ-law and linear voice from host and A-law, µ-law and CVSD voice over air

Auxilliary 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^{2}C compatible interface

Audio CODEC

- AuriStream (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

BlueCore™6-Audio ROM Product Data Sheet

2 Package Information

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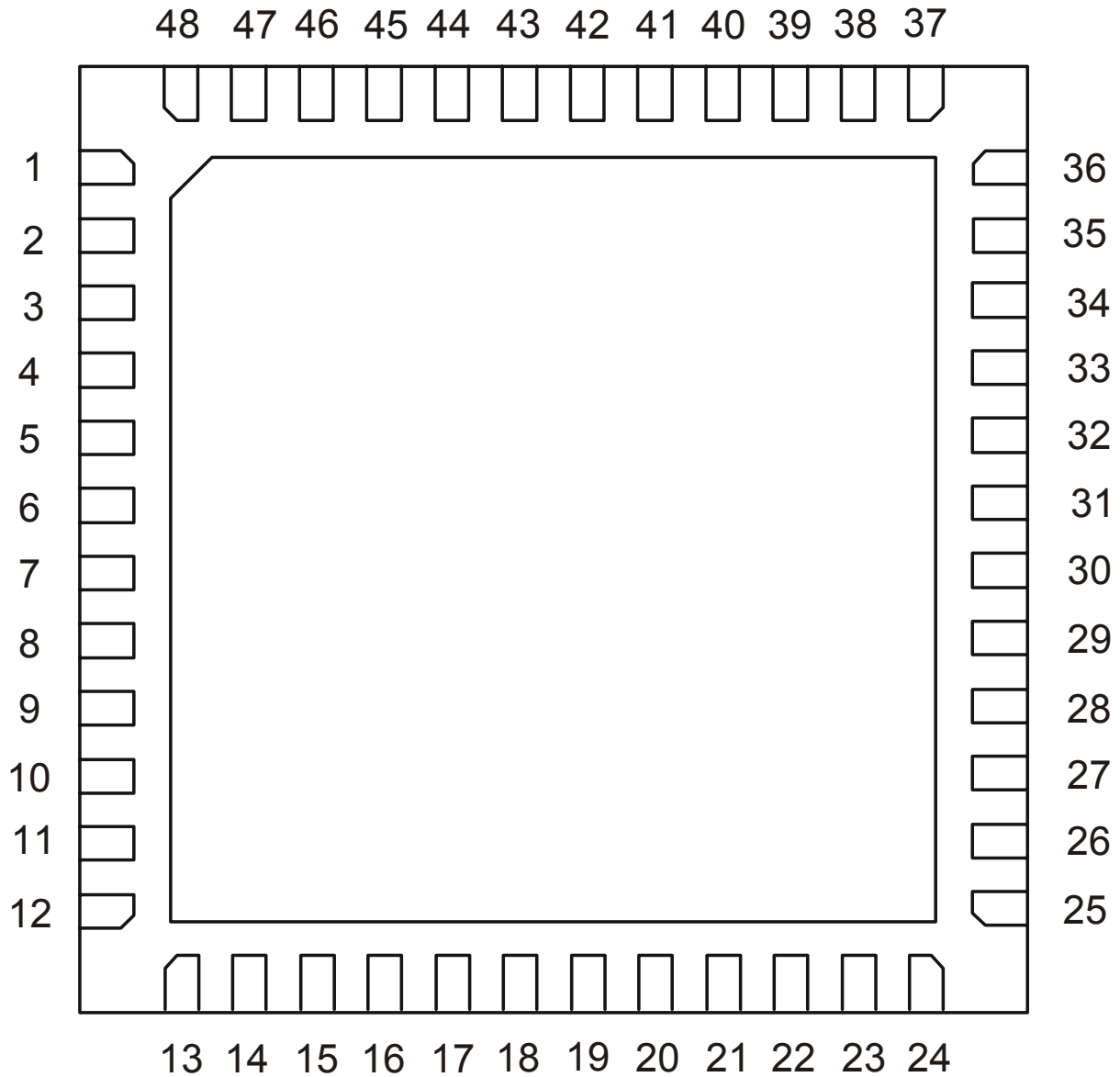
Figure 2.1: BlueCore6-Audio ROM 7 x 7mm QFN Pinout Diagram

BlueCore™6-Audio ROM Product Data Sheet

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

BlueCore™6-Audio ROM Product Data Sheet

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

BlueCoreTM6-Audio ROM Product Data Sheet

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)

BlueCore™6-Audio ROM Product Data Sheet

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

BlueCore™6-Audio ROM Product Data Sheet

2.3 Package Dimensions

Top View   Bottom View

Figure 2.2: 48 Lead 7 x 7 x 0.9mm QFN Package
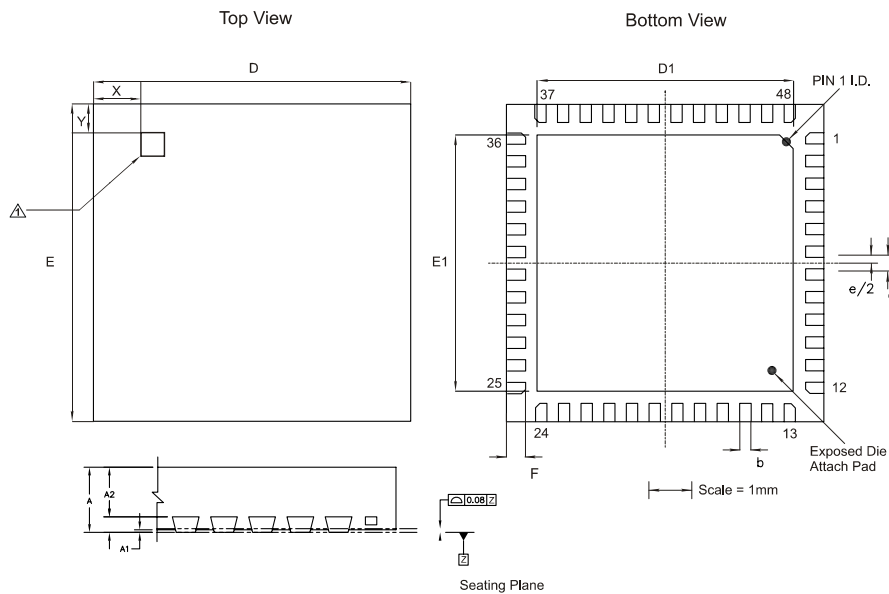
Description	48 Lead Quad Flat No-lead (QFN) Package			
Size	7 x 7 x 0.9mm			
Pitch	0.5mm			
Dimension	Minimum	Typical	Maximum	Notes
A	0.80	0.85	0.90	⚠ Top-side polarity mark. The dimensions of the square polarity mark are TBD x TBDmm.
A1	0.00	0.035	0.05	
A2	-	0.65	0.67	
A3	-	0.203	-	
b	0.20	0.25	0.30	
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			

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.

BlueCore™6-Audio ROM Product Data Sheet

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
- Antinomy (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 napthelenes
- 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.*

BlueCore™6-Audio ROM Product Data Sheet

4 Ordering Information

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

[a] 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 or go to www.csr.com/contacts

4.1 Tape and Reel Information

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

BlueCore™6-Audio ROM Product Data Sheet

5 Document References

Document	Reference, Date
Core Specification of the Bluetooth System	v2.1 + EDR, 26 July 2007
Test Suite Structure (TSS) and Test Purposes (TP) System Specification 1.2/2.0/2.0 + EDR/ 2.1/2.1 + EDR	RF.TS/2.1.E.0, 27 December 2006
Selection of I²C EEPROMS for Use with BlueCore	bcore-an-008P, 30 September 2003
IC Packing and Labelling Specification	CS-112584-SPP, January 2007
Typical Solder Reflow Profile for Lead-free Device	CS-116434-ANP, 2007
Bluetooth and IEEE 802.11 b/g Co-existence Solutions Overview	bcore-an-066P, May 2005
Environmental Compliance Statement for CSR Green Semiconductor Products	CB-001036-ST, 27 September 2007

BlueCore™6-Audio ROM Product Data Sheet

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
I^{2}C	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

BlueCore™6-Audio ROM Product Data Sheet