



Features

- 24.6mm x 15.0mm x 2.2mm
- CSR BlueCore5 chip set
- Bluetooth v3.0
- Class 1 radio, range typically exceeds 200m
- +18dB PA Output RF Gain
- +12dB LNA Input RF Gain
- Analog differential stereo inputs and outputs
- 9 programmable digital I/O pins
- External antenna port
- 16 Mbit flash memory
- USB, UART interfaces

Description

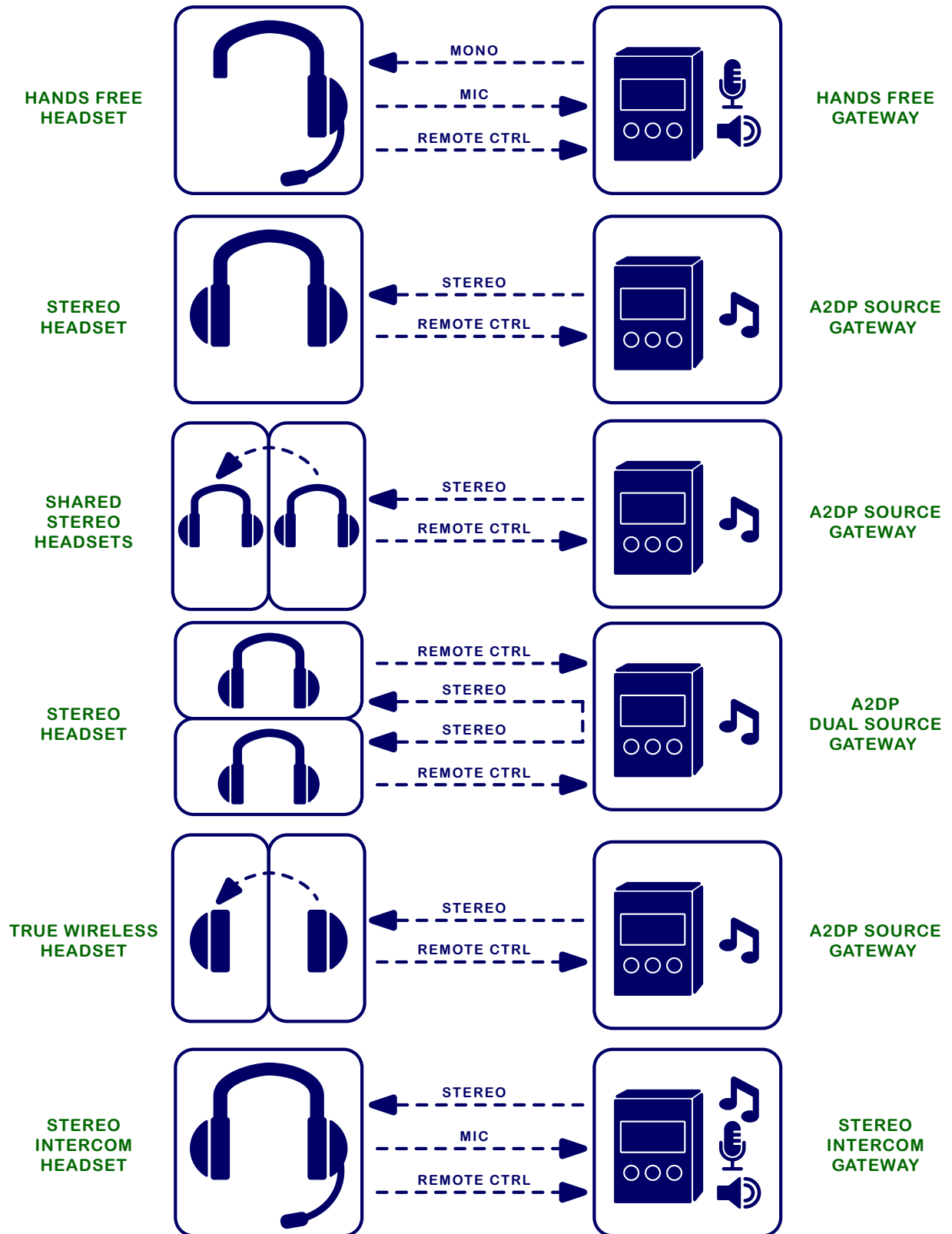
The KC-5012 Class 1 Bluetooth Hi Power Audio Module is a highly tuned and completely integrated wireless audio transceiver subsystem ready for installation in audio devices. The KC-5012 is a pre-engineered subsystem integrating a wireless radio, digital audio system, and programmed firmware profiles that define features, configurations, and user interface. All firmware offered by KC Wirefree can be customized for OEM clients. In many cases a few changes can produce great value by differentiating and improving your product. Firmware can be updated via USB. Please see our **Audio User Guides** for more information on specific features and operation.

Bluetooth Audio Profiles

- A2DP - Advanced Audio Distribution Profile
Stereo streaming with SBC, AAC, APTX compression options. Source or Sink profile.
- AVRCP - Audio Video Remote Control Profile
Standard remote audio playback controls. Controller or Target profile.
- AGHFP - Audio Gateway to HFP
Standard bi-directional mono cell phone gateway profile connects to HFP mono headsets.
- HFP - Hands Free Profile
Standard bi-directional mono cell phone headset profile.
- Custom Profiles Available
Contact us for non-standard or enhanced audio capabilities.



Audio Profiles Overview



kcAudioGateway Firmware Edition

The kcAudioGateway firmware is a transmitter system, offering A2DP source profile or AGHFP gateway profile (default), but not both simultaneously. A2DP mode provides stereo transmission to Headset/Speaker devices. Stereo audio is sampled from the MIC_L+, MIC_L-, MIC_R+, and MIC_R- pins at 44.1kHz, and will automatically transmit to a Headset device. AGHFP mode (default) provides two-way voice communications, sampled at 8kHz, to a standard Bluetooth cell phone headset. Additionally, the Headset Voice Command prompt will toggle a PTT pin on kcAudioGateway, which enables standard Bluetooth cell phone headsets to provide a PTT function.

Please refer to our *kcAudioGateway User Guide* for details.

kcAudioHeadset Firmware Edition

The kcAudioHeadset firmware is a receiver system, offering A2DP sink profile, and HFP profile. It can receive an A2DP wireless stereo signal, decompress, and convert to analog audio available on the SPK_L+, SPK_L-, SPK_R+, and SPK_R- pins. Additionally, it can “answer” phone calls, which will pause any A2DP stream, and switch modes, now providing two way mono communication channel.

Please refer to our *kcAudioHeadset User Guide* for details.

kcAudioTrueStereo Firmware Edition

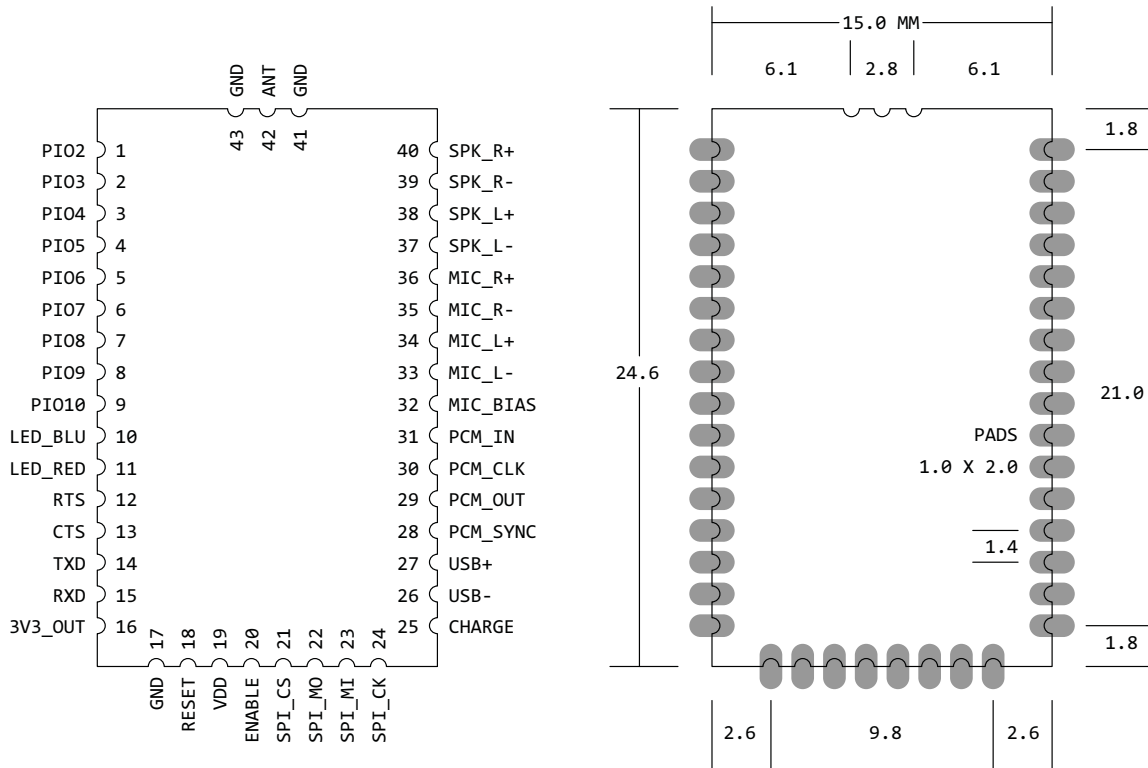
We have a stereo receiver profile, implementing CSR’s proprietary TrueWireless profile. TrueWireless offers separate left and right receivers, which requires two receiver modules with kcAudioTrueStereo. This firmware can also operate as a standard Bluetooth A2DP stereo headset and HFP mono headset.

KCSI Stereo + Intercom Profile

We have a custom profile available by special request, that offers a 3-channel (Stereo + Intercom) low latency communication system. There are two major features in the KCSI profile that do not exist in standard Bluetooth A2DP: the low latency connection, and the simultaneous return mic audio channel. As this is a non-standard profile, both a KCSI enabled kcAudioGateway and kcAudioHeadset device on each end is required.

Dimensions & Layout

KC-5012 Top View



Pin Assignments

Pin	Function	Type	Description
1	PIO2	I/O	Programmable I/O
2	PIO3	I/O	Programmable I/O
3	PIO4	I/O	Programmable I/O
4	PIO5	I/O	Programmable I/O
5	PIO6	I/O	Programmable I/O [I2C]
6	PIO7	I/O	Programmable I/O [I2C]
7	PIO8	I/O	Programmable I/O [I2C]
8	PIO9	I/O	Programmable I/O
9	PIO10	I/O	Programmable I/O
10	LED_BLU	Input	Blue LED Drain
11	LED_RED	Input	Red LED Drain
12	UART_RTS	Output	UART Request To Send
13	UART_CTS	Input	UART Clear To Send
14	UART_TXD	Output	UART Data Transmit
15	UART_RXD	Input	UART Data Receive
16	3V3_OUT	Output	Onboard 3.3V Regulator Output
17	GND	--	Ground
18	RESET	Input	Reset (Active Low >5ms)
19	VDD	Input	VDD/Battery Input (2.9V – 4.4V)
20	ENABLE	Input	System Enable (with internal latch)
21	SPI_CSB	Input	SPI Chip Select
22	SPI_MOSI	Input	SPI Master Out
23	SPI_MISO	Output	SPI Master In
24	SPI_CLK	Input	SPI Clock
25	CHARGE	Input	Battery Charging Supply (only use when VDD is battery powered)
26	USB-	I/O	USB Data Negative
27	USB+	I/O	USB Data Positive
28	PCM_SYNC	I/O	PCM Sync [I2S WS]
29	PCM_OUT	Output	PCM Out [I2S Out] [SPDIF Out]
30	PCM_CLK	I/O	PCM Clock [I2S Clk]
31	PCM_IN	Input	PCM In [I2S In] [SPDIF In]
32	MIC_BIAS	Output	Microphone Bias
33	MIC_L-	Input	Audio Input Left Negative
34	MIC_L+	Input	Audio Input Left Positive
35	MIC_R-	Input	Audio Input Right Negative
36	MIC_R+	Input	Audio Input Right Positive
37	SPK_L-	Output	Audio Output Left Negative
38	SPK_L+	Output	Audio Output Left Positive
39	SPK_R-	Output	Audio Output Right Negative
40	SPK_R+	Output	Audio Output Right Positive
41	GND	--	Ground
42	ANT	I/O	50Ω Antenna Port
43	GND	--	Ground

[Option features in brackets]

Interface Pins

PIO Pins [1-9]

PIO pins are LOW by default, and button presses used for device operation are HIGH signals. PIO inputs are debounced to 20ms.

Several PIO pins are assigned functions in default versions of firmware. Custom programmed functions are available. Inputs can be configured for weak pull-up, weak pull-down, strong pull-up, strong pull-down. Voltage input tolerance and output level is directly related to the VDD level.

Specific functions are enabled on designated PIO pins depending on firmware version. Please refer to the specific firmware **Audio User Guides** for complete information regarding PIO features and assignments.

LED Pins [10-11]

Two open-drain LED output pins are available. The LED's need a positive 3.3V (maximum) supply, and a current limiting resistor.

UART Pins [12-15]

The UART is compatible with the 16450 industry standard. Upcoming kcAudio firmware will implement an AT Command set for configuration and operation.

3V3_OUT Pin [16]

The module has several onboard regulators. The onboard 3V3 regulator supplies the PIO, PCM, SPI, UART, and USB Pins. The class 2 module has up to 100mA available from this pin. The class 1 module also uses the onboard 3V3 regulator to supply the RF Power Amp, and has less than 30mA available from this pin.

GND Pin [17,41,43]

VSS ground plane.

RESET Pin [18]

The module will reset when pulled LOW >5ms.

VDD Pin [19]

Minimum VDD is 2.9V.

Supplies several onboard regulators, and is also the designated Battery P terminal if powering directly from a Lithium Ion battery. The VDD pin may receive a recharge current supply when the voltage reading from this pin measures below 4.0V, the CHARGE Pin is connected to a power supply, and firmware has enabled battery monitoring and charging (default behavior). This VDD pin supplies the onboard Seiko S-1112 LDO 3V3 regulator. Note: the Seiko S-1112 has a 200mV dropout, so if VDD is < 3.5V, then the 3V3 supply rail will have a 0.2V dropout. The 3V3 rail supplies PIO, PCM, SPI, UART, and USB Pins. Power supply to module should have less than 10mVrms noise between 0-10MHz, and spikes should be minimal.

ENABLE Pin [20]

Enables internal voltage regulators. The ENABLE pin can be utilized in two different ways. Our current default firmware uses the ENABLE pin in Switch Power Mode, where it should be tied to the VDD pin, and used with an external power switch. In Switched Power Mode, our BTB functions are typically assigned to PIO 4. Please see specific firmware User Guides for details regarding PIO function assignments.

Alternatively, firmware can utilize the ENABLE pin in Battery Power Mode, which uses a momentary ON/OFF button to power up. Once powered up, the internal voltage regulators will latch on, and then the ENABLE pin is used for BTB assigned functions. This is typically intended for a battery powered headset application with minimal buttons. Separate firmware must be used that assigns this behavior to the ENABLE pin.

SPI Pins [21-24]

We highly recommend including test points for the four SPI signals, used for firmware loading and diagnostics. The SPI interface is unavailable for general usage, and only interfaces with chip manufacturer diagnostic applications.

CHARGE Pin [25]

Provide power supply for battery charging, when a battery is connected to VDD, and firmware enables battery monitoring and charging function (enabled by default). Do not connect without a Lithium Ion battery connected to VDD Pin.

USB Pins [26-27]

These interfaces are available with custom configuration. USB can be programmed for plug-n-play operation using standard USB Audio drivers available on PC, Mac, and Linux.

PCM Pins [28-31]

Pins are generally 3.3V level logic (dependent upon VDD).

MIC_BIAS Pin [32]

Provides a DC bias intended for electret microphones. Configurable 1.8V – 3.3V (default = 2.69V) with a current of 200uA – 1.229mA (default = 0.672mA).

MIC Pins [33-36]

Microphone or line level analog audio input. Impedance is 6.0k Ω - 30k Ω depending on volume setting. ADC operates at 8, 11.025, 16, 22.05, 32, and 44.1kHz. Input signal should be 4mVrms – 800mVrms. Input gain is adjustable from

SPK Pins [37-40]

Output gain is adjustable from -45dB to +3.5dB.

ANT Port [42]

The module already contains a balun-filter onboard, so the antenna port only requires a standard 2.4 GHz RF transmission line with a 50 ohm load. Design the antenna circuit according to the antenna manufacturer guidelines. Some designs may use a simple chip antenna without additional circuitry. Microstrip design is not critical if the antenna is less than 3mm from the RF pin. A few recommended chip antennas: Johanson 2450AT18B100E, Johanson 2450AT43A100E, or Antenova Rufa A5839. For PCB transmission line design, we recommend the following online calculator:
http://www.emclabinfo.com/emc_calc/microstrip.htm

Electrical Characteristics

(Conditions VDD = 3.3V and 25 °C)

Absolute Maximum Ratings	Min	Max	Unit
Storage temperature range	-40	+105	°C
Supply voltage VDD	-0.4	4.4	Volts
Supply voltage CHARGE	4.5	6.5	Volts
Supply voltage ENABLE	-0.4	4.9	Volts

Recommended Operating Conditions	Min	Typical	Max	Unit
Temperature range	-40	20	+85	°C
Supply voltage VDD	2.9	3.3	4.4	Volts
Supply voltage CHARGE	4.5	--	6.5	Volts
Supply voltage ENABLE	2.5	--	4.4	Volts

Current Consumption	Avg	Unit
Stereo	66	mA
Mono Headset	36	mA
No Connection	2	mA
Peak current	190	mA

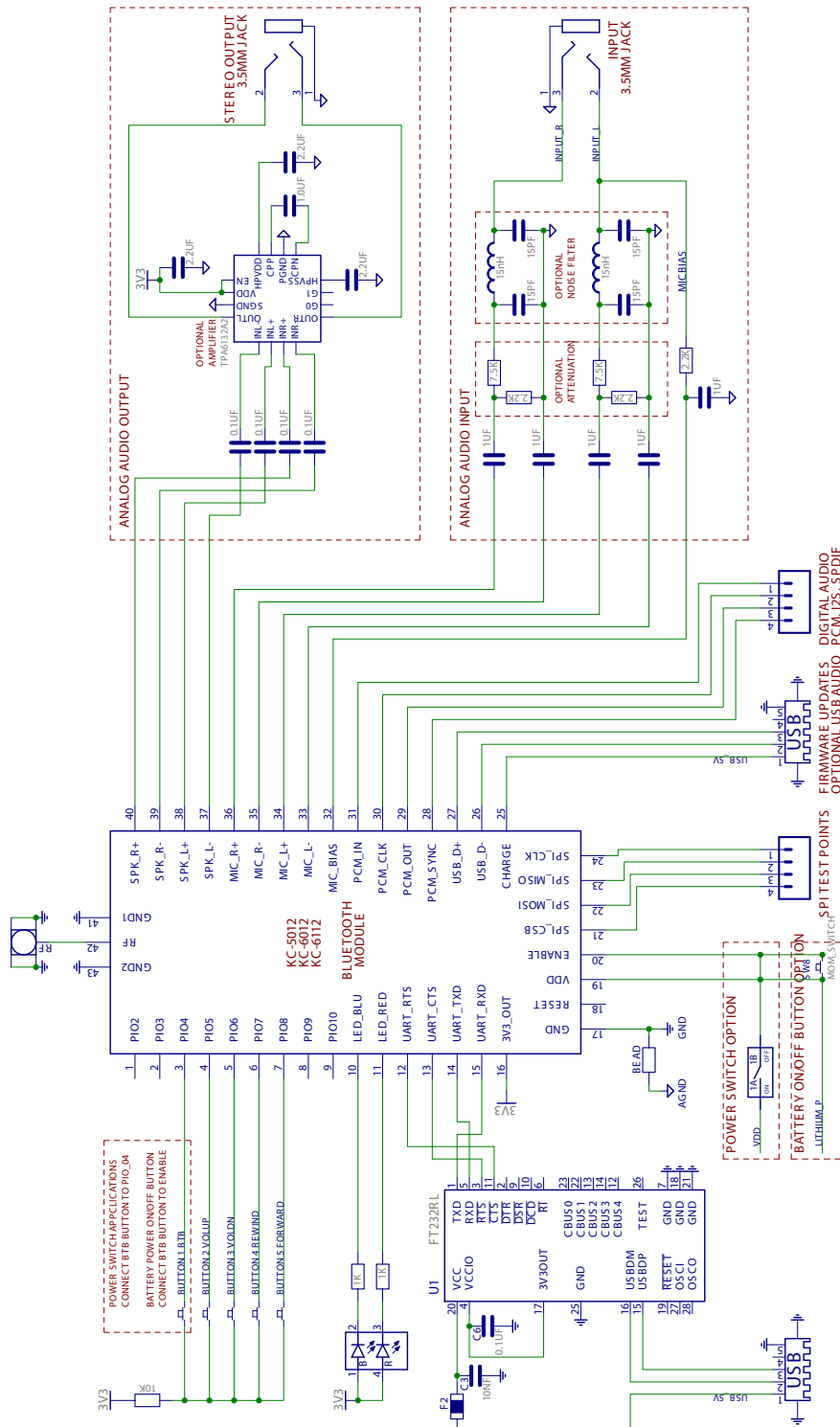
RF Characteristics	Min	Max	Unit
Carrier Frequency	2400	2483.5	MHz
Transmission Line	50	50	Ω
Transmission Power	0	+20	dBm
Receive Sensitivity	-20	-98	dBm

Audio DAC Characteristics	Min	Typical	Max	Unit
Output voltage full-scale swing (differential)	--	750	--	mV rms
Resolution	--	--	16	Bits
Sample Rate	8	--	48	kHz
SNR (@ 8KHz sampling)	--	95	--	dB
Digital Gain	-24	--	21.5	dB
Analog Gain	0	--	-21	dB
THD+N (@ 100kΩ load)	--	0.04	0.01	%
Audio ADC Characteristics	Min	Typical	Max	Unit
Input full scale at maximum gain (differential)	--	0.004	--	V _{rms}
Input full scale at minimum gain (differential)	--	0.800	--	V _{rms}
Resolution	--	--	16	Bits
Sample Rate (8, 11.025, 16, 22.050, 32, 44.1kHz)	8	--	44.1	kHz
SNR (@ 8KHz sampling)	--	79	--	dB
Digital Gain	-24	--	21.5	dB
Analog Gain	--	--	42	dB
3dB bandwidth	--	20	--	kHz
Input impedance	--	6.0	30	Ω
THD+N (microphone input) @30mV rms input	--	0.04	--	%

Programmable I/O Pins Operating Characteristics	Min	Typical	Max	Unit
Input Voltage Low Logic	-0.3	--	V _{DD_LDO} x 0.25	Volts
Input Voltage High Logic	V _{DD_LDO} x 0.625	--	V _{DD_LDO} + 0.3	Volts
Output Voltage Low Logic	0	--	0.125	Volts
Output Voltage High Logic	V _{DD_LDO} x 0.75	--	V _{DD_LDO}	Volts
Output Current Low Logic	--	4.0	--	mA
Output Current High Logic	--	-4.0	--	mA
Input Leakage Current	-100	0	100	nA
Input Schmitt voltage	V _{DD_LDO} x 0.25	--	V _{DD_LDO} x 0.625	Volts
Input Capacitance	1.0	--	5.0	pF
Weak pull up	500K	--	2M	Ω
Weak pull down	500K	--	2M	Ω
Strong pull up	10K	--	50K	Ω
Strong pull down	10K	--	50K	Ω

Circuit Example

Modules provide UART, USB, SPI, and PIO hardware interfaces. This section illustrates a typical implementation, and does not consider all cases. Our engineers are available to review designs and answer any other design questions. Contact our engineering department directly by email: support@kcwirefree.com



Pre Qualifications

Bluetooth

Usage of Bluetooth registered trademarks must be licensed directly from Bluetooth SIG. Please contact Bluetooth SIG regarding product licensing fees.

The KC-5012 is registered with, and licensed by Bluetooth SIG as a qualified design.

Qualification Design ID: 22882

Qualified Profiles: A2DP, AVRCP, BB, GAP, HCI, HFP, HSP, L2CAP, LM, RFCOMM, SDP, SPP

FCC

The KC-5012 has a granted modular approval by the Federal Communications Commission. The module meets the conducted and radiated emission requirements of the FCC "Code of Federal Regulations" Title 47, Part 15, Subpart C, Section 15.247 for Bluetooth spread spectrum transmitters.

With a written agreement, Original Equipment Manufacturers may use our FCC ID transmitter license. The following FCC ID must be visible on the exterior of final the product.

FCC ID: S22-BTAUDIO

CE

The KC-5012 complies with the following EMC Directives:

ETSI EN 300.328 V1.8.1

EN 301.489-1 V1.8.1

EN 60950-1

EN 62311

Industry Canada

IC Warning Statement: The device's user manual does not contain the following or equivalent statement as per RSS-GEN section 7.1.5: Operation of this device is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

With a written agreement, Original Equipment Manufacturers may use our IC ID transmitter license. The following IC ID must be visible on the exterior of final the product.

IC ID: 8193A-BTAUDIO

RoHS

RoHS compliant.

SAR

SAR compliant.

Ordering Information

Product Id	KC-5012
Product Version	2
Country of Manufacture	USA
Order Part Number	Description
KC-5012-GW	BlueAudio Module Class 1 w/ kcAudioGateway Firmware
KC-5012-HS	BlueAudio Module Class 1 w/ kcAudioHeadset Firmware
KC-5012-FW	BlueAudio Module Class 1 w/ Custom Firmware

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