Firmware User Guide

kcAudioHeadset v8.0 Build 42

Introduction

Our kcAudioHeadset firmware is primarily a speaker/headset receiver system. It can maintain a connection to a stereo transmitter (a remote A2DP Source device) and a connection to a cell phone (a remote AGHFP device) simultaneously. However, only one of the remote devices can stream audio at a time. Typically, kcAudioHeadset is receiving stereo, until an incoming phone call is signaled. Then, if the user accepts the phone call, the stereo device is paused while the phone call is streamed. Once the phone call ends, the stereo streaming is resumed. Our kcAudioHeadset can disable either of the audio profiles.

A rudimentary Serial Port Profile connection is available. This profile can transmit and receive data simultaneously with audio streaming. High bandwidth usage may negatively affect audio quality. Currently, the Serial Profile is not implemented with any features, and simply accepts incoming connection requests, where all data is seamlessly connected to the Uart for transmitting and receiving.

Hardware

This User Guide covers device operations specific to this firmware edition. Hardware features and capabilities are outlined in the module Datasheets.

Supported Bluetooth Profiles

Profile	Name	Version	Configured
A2DP	Advanced Audio Distribution Profile – Sink edition	1.2	Enabled
AVRCP	Audio Video Remote Control Profile – Controller edition	1.4	Enabled
HFP	Hands Free Profile	1.6	Enabled
HSP	Headset Profile	1.1	Enabled
MAP	Message Access Profile – Client edition	1.0	Optional
PBAP	Phonebook Access Profile – Client edition	1.2	Optional
SPP	Serial Port Profile – Client edition	--	Enabled

Firmware Editions

Our default kcAudioHeadset is released in two editions: our class 1 KC5012 edition, and our class 2 KC6012 edition (also intended for KC6112 modules).

Audio Codec Options

A2DP supports several audio codec formats. SBC (Sub-Band Coding) is the Bluetooth mandatory default. AAC is enabled by default, and subject to license fees for production products. ADPCM, APTX, and MP3 are optionally available. HFP support CVSD, aLAW, and uLaw codec formats, and are the Bluetooth mandatory defaults.

Firmware Change Log

Changes from kcAudioHS v8.0.41 include:

- Fixed Microphone input in WBS mode.

Changes from kcAudioHS v8.0.40 include:

- No customer features.

Changes from kcAudioHS v8.0.39 include:

- AVRCP metadata handled properly.
- WBS enabled.
- Updated AT Avrcp to fix buffer overflow.
- Pairing information of secondary devices preserved.
- Device reconnects to last paired device.

Changes from kcAudioHS v8.0.38 include:

- Device name initialization fixed.
- Updated AT Piotest to detect PIOs connected together (e.g. solder bridge).
- Added AT RESTRICT to limit allowed connection.
- Audio Channel dropped and restarted properly in applicable firmware.
- Disabled internal AVRCP track information requests.
- AVRCP service enabled by default.
- Improved test mode, forces device to discoverable and changes name to show full firmware edition.

Changes from kcAudioHS v8.0.35 include:

- Updated AT VolumeDefault to include default mic input gain setting.
- Updated AT InputGain to include + and – incremental gain adjustments.
- Added AT MicBias to provide bias voltage, current, and enable default settings.
- Added AT BtAddr to print device Bluetooth address.
- Added AT ShowSettings to print several default settings.

Automatic Behaviors

Feature
Reconnect on startup
Reconnect on link loss
Idle shutdown 4 hours

Feature Activation

PIO pins are used to activate firmware features. PIO default state is LOW (0V), and activates the assigned feature with a HIGH (3.3V) signal press, and LOW (0V) signal release. The “button presses” are debounced by 4 readings within 15ms. The following timings are configured for a “button press” to activate an assigned feature.

Press	Activation Time
Short	< 1.0 second
Double	Two Presses < 0.5 sec
Long	1.0+ seconds

Press	Activation Time
Very Long	2.5+ seconds
Very Very Long	5.0+ seconds
Hold	Repeat every 0.8 sec

LED Event and State Indicators

When battery is low, the Red led blinks instead of the Blue led.

Event	LED Action	Timing
System On	Blue Flash	1s on
System Off	Red Flash	1s on
Reset Pairing List	Blue+Red Triple Flash	100ms on/off/on/off/on/off
Enter Test Mode	Blue+Red Triple Flash	100ms on/off/on/off/on/off
Enter DFU Mode	Blue+Red Triple Flash	100ms on/off/on/off/on/off

State	LED Action	Timing
Connectable	Blue Blinking	100ms on, 2500ms off
Connected, No Audio	Blue Double Blinking	100ms on/off/on, 2500ms off
Connected, Audio Streaming	Blue Double Blinking	100ms on/off/on, 1500ms off
Discoverable	Red/Blue Alternate Fast Blinking	100ms on/off
Reconnecting	Blue Fast Blinking	100ms on/off

PIO Assignments

PIN Function	Name	I/O	Feature
ENABLE	POWR/BTB	Input	Power on/off. Multifunctional see below
PIO 2		Input	Enter DFU mode when HIGH during Power up
PIO 3	DISCONNECT	Input	Press: Disconnect
PIO 4	BTB	Input	Bluetooth button. Multifunctional see below
PIO 5	VOLUP	Input	Press: Volume up, Hold: Repeat
PIO 6	VOLDN	Input	Press: Volume down, Hold: Repeat
PIO 7	RR	Input	Press: Previous song, Hold: Rewind song
PIO 8	FF	Input	Press: Next song, Hold: Forward song
PIO 9	CONNECTED	Output	HIGH when device is connected
PIO 10	STREAMING	Output	HIGH when audio is streaming

Multifunctional ENABLE / BTB

The BTB – Bluetooth button is a multi-featured input button. Most of the features are activated differently based on the current operating mode of the device. For example, if the device is not currently connected, then a short BTB press will trigger the reconnection feature. However, if a phone call is incoming, then a short BTB press will answer the call instead.

The ENABLE pin is a dual purpose pin, and kcAudioHeadset firmware can operate both power switch and power button modes.

First, power button mode is supported, where the ENABLE pin is tied to a momentary button (typically supplied directly from a li-ion battery). In this usage model, the ENABLE pin is used as the BTB. A long press of ENABLE will power up the device, and a subsequent very long press will power off the device. When the device is on, this ENABLE pin will provide the same features as the BTB.

Secondly, power switch mode is supported, where an external system power switch is used, typically to supply a DC power source. In this mode the ENABLE pin will be tied to this switched power source, and will simply turn on/off the device. In this mode, since the ENABLE pin is held HIGH when powered on, then BTB features must be operated using the BTB assigned Pio 4.

The device provides both power switch and power button operations by latching the system ENABLE internally, thus allowing the ENABLE pin to turn on/off the device with simple button presses, and additionally triggering all the features of the BTB when subsequently pressed. However, if the system is powered up, and the ENABLE pin remains HIGH for over 10 seconds, then the ENABLE button disables the internal power latch, which will allow the device to power off immediately upon release of the ENABLE pin (LOW).

Button Controls

Note: The ENABLE button also inherits the same features as BTB when it is used as momentary power on/off button.

Feature	Button	Press	Condition
Power On	ENABLE	Very Long Press	Only when powered off
Power Off	ENABLE	Very Long Press	Only when powered on
Reconnect	BTB	Short Release	Only when connectable
Discoverable	BTB	Long Press	Only when connectable
Disconnect	BTB	Very Long Release	Only when connected
Cancel Discoverable	BTB	Short Release	Only when discoverable
Voice Command	BTB	Short Release	Only when connected
Answer Call	BTB	Short Release	Only when call incoming
Reject Call	BTB	Long Press	Only when call incoming
End Call	BTB	Short Release	Only when call active
Play/Pause	BTB	Short Press	Only when A2DP is active
Stop	BTB	Double Press	Only when A2DP is active
Volume Up	VOLUP	Short Press	Any
Volume Down	VOLDN	Short Press	Any
Previous Song	RR	Short Press	Only when connected
Rewind Song	RR	Hold	Only when streaming
Next Song	FF	Short Press	Only when connected
Fast Forward Song	FF	Hold	Only when streaming
Reset Pairing	VOLUP + VOLDN	Very Very Long	Any
Enter DFU Mode	PIO 2	Long	Only during power up
Enter Test Mode	RR + FF	Very Very Long	Any
Test Audio Loopback	FF	Short	Not Implemented
Test Audio Tone	RR	Short	Not Implemented

Output Volume

Default output volume for new connections is Level 14 = 0 dB. Volume level changes are saved for each device, and separately for each profile (A2DP & HFP).

Level	0	1	2	3	4	5	6	7
Gain	-45.0 dB	-39.0 dB	-35.5 dB	-33.0 dB	-29.5 dB	-27.0 dB	-23.5 dB	-21.0 dB

Level	8	9	10	11	12	13	14	15
Gain	-18.0 dB	-15.0 dB	-12.0 dB	-9.0 dB	-6.0 dB	-3.0 dB	0 dB	+3.5 dB

Input Gain

Default input gain is level 15 = 0.0 dB. This value may be changed with the AT VolumeDefault command.

Level	0	1	2	3	4	5	6	7
Gain	-45.0 dB	-41.5 dB	-39.0 dB	-35.5 dB	-33.0 dB	-29.5 dB	-27.0 dB	-23.5 dB

Level	8	9	10	11	12	13	14	15
Gain	-21.0 dB	-18.0 dB	-15.0 dB	-12.0 dB	-9.0 dB	-6.0 dB	-3.0 dB	0 dB

Level	16	17	18	19	20	21	22	
Gain	+3.5 dB	+6.0 dB	+9.5 dB	+12.0 dB	+15.5 dB	+18.0 dB	+21.5 dB	

MicBias Settings

Default MicBias voltage is level 11. This value may be changed with the AT MicBias command.

Level	0	1	2	3	4	5	6	7
Gain	1.71 V	1.76 V	1.82 V	1.87 V	1.95 V	2.02 V	2.10 V	2.18 V

Level	8	9	10	11	12	13	14	15
Gain	2.32 V	2.43 V	2.56 V	2.69 V	2.90 V	3.08 V	3.33 V	3.57 V

Default MicBias current is level 7. This value may be changed with the AT MicBias command.

Level	0	1	2	3	4	5	6	7
Gain	0.20 mA	0.28 mA	0.34 mA	0.42 mA	0.48 mA	0.53 mA	0.61 mA	0.67 mA

Level	8	9	10	11	12	13	14	15
Gain	0.75 mA	0.81 mA	0.86 mA	0.95 mA	1.00 mA	1.09 mA	1.14 mA	1.23 mA

Firmware Source Code

This is the most closely guarded secret at KC Wirefree. It is our secret recipe (source code) that allows KC Wirefree Bluetooth devices to have custom features and perform better than any other Bluetooth module vendor. Additionally, the code is quite complicated and development tools are expensive, so we offer our expert programming services for any changes or additions that you would want. We are a specialty systems programming company who have added many proprietary features and improved many standard features for overall system quality and performance. We have tweaked the Bluetooth and device firmware source code extensively. Sometimes little features and changes can greatly increase the value of your device. For custom features and capabilities, please contact us.

Internal System Events

The following systems events are available for operations and notifications. Many of these events are utilized in the basic firmware, and all others can be triggered or utilized in a custom edition of firmware. These are listed to provide a comprehensive understanding of the built in capabilities.

0x06	EventAnswer
0xBC	EventAudioTestMode
0x97	EventAvrcpFastForwardPress
0x98	EventAvrcpFastForwardRelease
0xA7	EventAvrcpNextGroup
0x93	EventAvrcpPlayPause
0xA8	EventAvrcpPreviousGroup
0x99	EventAvrcpRewindPress
0x9A	EventAvrcpRewindRelease
0x96	EventAvrcpSkipBackward
0x95	EventAvrcpSkipForward
0x94	EventAvrcpStop
0xA6	EventAvrcpToggleActive
0x08	EventCancelEnd
0x8C	EventCreateAudioConnection
0x4F	EventDialStoredNumber
0x50	EventDisableVoicePrompts
0xD5	EventDisconnect
0x4E	EventEnableVoicePrompts
0x46	EventEnterDFUMode
0x15	EventEnterDutMode
0x03	EventEnterPairing
0x3F	EventEnterPairingEmptyPDL
0x48	EventEnterServiceMode

0x2D	EventEnterTestState
0x1C	EventEstablishSLC
0x04	EventInitateVoiceDial
0x5A	EventInitateVoiceDial_AG2
0xBE	EventKeyTestMode
0x05	EventLastNumberRedial
0x59	EventLastNumberRedial_AG2
0x29	EventMuteOff
0x28	EventMuteOn
0x02	EventPowerOff
0x01	EventPowerOn
0x07	EventReject
0x14	EventResetPairedDeviceList
0x8A	EventSetWbsCodecs
0x8D	EventSetWbsCodecsSendBAC
0x67	EventStartPagingInConnState
0x68	EventStopPagingInConnState
0x64	EventStreamEstablish
0xD1	EventSwapMediaChannel
0x0A	EventToggleMute
0xBD	EventToneTestMode
0x0C	EventVolumeDown
0x0B	EventVolumeUp

AT Command Syntax

Syntax

Default UART setting is 115200-8-N-1, without hardware flow control.

Enter AT Commands via UART as standard strings, with a CR end of line marker (0x0D), and optionally LF (0x10). Output messages are terminated with CRLF (0x0D 0x0A).

Each AT Command accepts the "?" parameter, and will display a required and optional parameter listing.

AT Commands that accept parameter settings, can be issued without parameters, to display the current settings.

AT Command List

AT Commands provide operational controls.

```
AT AudioOption      AT DeepSleep      AT Name           AT Version
AT Avrcp            AT Dfu            AT Profiles       AT Volume
AT BtAddr           AT Help           AT PsRead         AT VolumeDefault
AT Build            AT InputGain      AT PsWrite
AT Codec            AT MicBias        AT Reset
```

AT Commands

AT AudioOption

The AudioOption command sets the system to analog or digital audio streaming. Digital options are not implemented in our default edition.

Command	`AT AudioOption <option>`
<option>	`PCM, I2S, SPDIF, or ANALOG`
Example	`AT AudioOption Analog` `-> AudioOption Analog`

AT Avrcp

The Avrcp command controls the media player. The FF (Fast Forward) and RR (Rewind) commands have several options. When FF or RR is pressed, the media begins playing in fast forward or rewind direction, until the Release is received. Also available is Skip which simply Skips to the next (FF) or previous (RR) track, and Group which skips to the next or previous playlist. The PP command is PlayPause, which will toggle the target device media playing status. The SP command will issue a stop to the remote audio device. Additionally, TG will toggle the audio connection.

Command	`AT Avrcp <cmd> <param*>`
<cmd>	`FF, RR, PP, SP, TG`
<param>	`Press, Release, Skip, Group (only used with FF or RR commands)`
Example	`AT Avrcp FF Press` `-> Avrcp FF Press`

AT BtAddr

The Build command outputs the full Bluetooth address.

Command	`AT BtAddr`
Example	`AT BtAddr` `-> BtAddr 64:6E:6C:00:00:03`

AT Build

The Build command outputs the full firmware version information.

Command	`AT Build`

Example	`AT Build`
	`-> [Build]`
	`-> Bluetooth: v3.0`
	`-> Hardware:  KC6012`
	`-> Firmware:  kcAudioHS`
	`-> Version:  v8.0.39`
	`-> Date:  Apr 02, 2014 12:15`

AT Codec

The Codec command can be enabled/disabled individual available codecs. This configuration is saved in flash memory. Note: MP3, AAC, APTX, APTXLL are subject to licensing fees, due to their respective owners. MP3 and AAC codecs are fully functional, and are provided for evaluation purposes only, but not licensed for production products. APTX and APTXLL are not functional without an additional license configuration. Please contact KC Wirefree for demo edition

licenses.

Command	`AT Codec <eeeee/ddddd (MP3/AAC/FAST/APTX/APTXLL)>`
<e/d>	`Enable/Disable for each audio compression codec MP3/AAC/FAST/APTX/APTXLL`
Example	`-> AT Codec DDEDD` `-> Codec MP3[D] AAC[D] FAST[E] APTX[D] APTXLL[D]`

AT DeepSleep

The DeepSleep command is used to enable and disenable DeepSleep mode. Please contact technical support on the usage of the command.

Command	`AT DeepSleep <e/d>`
Example	`AT DeepSleep e` `-> DeepSleep Enabled`

AT Dfu

The Dfu command is used to set the device into firmware update mode. The device will immediate reboot into the Dfu mode, where the DfuWizard application can download a new firmware image into the device via USB interface. Please see Firmware Update section regarding specific procedure details.

Command	`AT Dfu`
Example	`AT Dfu` `-> Dfu [Reboot]`

AT Help

The Help command will list all implemented AT Commands. Also, each command can accept an optional “?” parameter, which will output the list of command arguments.

Command	`AT Help`

Example	`AT Help`
	`-> AudioOption`
	`-> Avrcp`
	`-> Build`
	`-> Codec`
	`...etc`

AT InputGain

The InputGain command adjusts or sets the microphone input gain without modifying the default gain setting. The command without parameters returns the current setting. The adjusted input gain setting is not saved in memory. Use

AT VolumeDefault to set the default input gain.

Command	`AT InputGain <+/-/gain*>`
<+/-/gain>	`Either + increment gain, – decrement gain, or set level 0-22`
Example	`AT InputGain` `-> InputGain [6]`
Example	`AT InputGain +` `-> InputGain [7]`
Example	`AT InputGain 20` `-> InputGain [20]`

AT MicBias

The MicBias command is used to configure the physical bias settings on the input port. Please contact KC Wirefree technical support for further information on specific settings.

Command	`AT MicBias <voltage> <current> <enable>`
<voltage>	`Value 0-15`
<current>	`Value 0-15`
<enable>	`D=Disabled, E=Enabled Automatic, F=Forced On`
Example	`AT MicBias 11 7 e` `-> MicBias Voltage[7] Current[8] Enable[E]`

AT Name

The Name command is used to set the name of this device reported when other Bluetooth devices perform discoveries. The name is saved in flash memory.

Command	`AT Name <name*>`
<key>	`Up to 32 character name.`
Example	`AT Name My Speaker` `-> Name [My Speaker]`

AT Profiles

The Profile command enables or disables the A2DP, AVRCP, HFP, and SPP profiles available.

Command	`AT Profiles <eeee/dddd (A2DP/AVRCP/HFP/SPP)>`
<e/d>	`Enable/Disable for each profile A2DP/AVRCP/HFP/SPP`
Example	`AT Profiles EEDD` `-> Profiles A2DP[E] AVRCP[E] HFP[D] SPP[D]`

AT PsRead

The PsRead command reads the specified flash memory key. This command provides raw access to features and settings stored in flash memory. Different Keys will output different number of columns for improved formatting. Please contact technical support for additional information.

Command	`AT PsRead <key>`
<key>	`Memory user key 0-49`

Example	AT PsRead 4 -> PsRead key[4] words[14] -> [PsRead] -> [0x00FF] [0xFFFF] -> [0xFFFF] [0xFF0A] -> [0x1900] [0xFF00] -> [0x0000] [0x0000] -> [0x6085] [0x6085] -> [0x0000] [0x0000] -> [0x0000] [0xFFFF] -> [End PsRead]

AT PsWrite

The PsWrite command writes data to the specified flash memory key. This command provides raw access to features and settings stored in flash memory. Please contact technical support for additional information.

Command	AT PsWrite <key> <data>
<key>	Memory user key 0-49
<data>	Hexadecimal key data
Example	AT PsWrite 4 00FFFFFFFFFFFF0A1900FF000000000060856085000000000000FFFF -> PsWrite Words[14]
Example	AT PsWrite 4 00F -> PsWrite InvalidLength

AT Reset

The Reset command will simply cold reset the device.

Command	AT Reset
Example	AT Reset -> Reset [Reboot]

AT Volume

The Volume command increments and decrements the currently volume level of the currently active profile (A2DP or HFP). Volume levels are saved in flash memory per device, as separate levels for each A2DP and HFP.

Command	AT Volume <+/-/level*>
<+/->	Either + increment volume, or – decrement volume
Example	AT Volume +

	-> Volume Up [8]
Example	AT Volume - -> Volume Down [7]

AT VolumeDefault

Sets the default volume and input gain levels for new A2DP and HFP connections. These levels are saved in flash memory and used as the default level for any new devices. Using the '#' character in place of an argument will preserve its current level. The command without parameters returns the saved default values.

Command	AT VolumeDefault <A2DP Vol> <HFP Vol> <MIC Gain>
<A2DP Vol>	Volume level of 0-15, or # to leave unchanged
<HFP Vol>	Volume level of 0-15, or # to leave unchanged
<Mic Gain>	Gain level of 0-22, or # to leave unchanged
Example	AT VolumeDefault -> VolumeDefault A2DP[14] HFP[14] MIC[15]
Example	AT VolumeDefault 10 12 # -> VolumeDefault A2DP[10] HFP[12] MIC[15]
Example	AT VolumeDefault # # 2 -> VolumeDefault A2DP[10] HFP[12] MIC[2]

AT Version

The Version command simply outputs the complete version. Version 8.0 followed by the specified Build version.

Command	AT Version
Example	AT Version -> Version kcAudioHS v8.0.39

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