

BEHIND-THE-EAR (BTE) HEARING AID or PERSONAL SOUND AMPLIFIER HARDWARE

APPLICATION NOTE

7/2020-BTE-HARDWARE



HARDWARE BLOCK DIAGRAM:



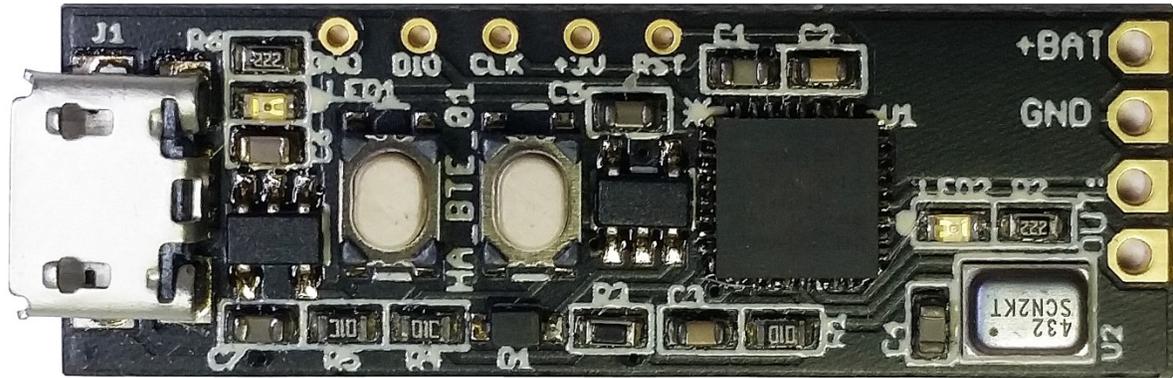
HARDWARE DESIGN DETAILS:

The Behind-The-Ear (BTE) hardware is powered by a lithium-polymer (LiPo) battery. The BTE hardware includes 2 buttons for volume up/down control and a green LED light for visual indications. The device powers on by momentarily pressing the volume up button. The device turns off by pressing down either button for more than 2 seconds. The BTE hardware uses a noise isolating earbud (dynamic receiver).

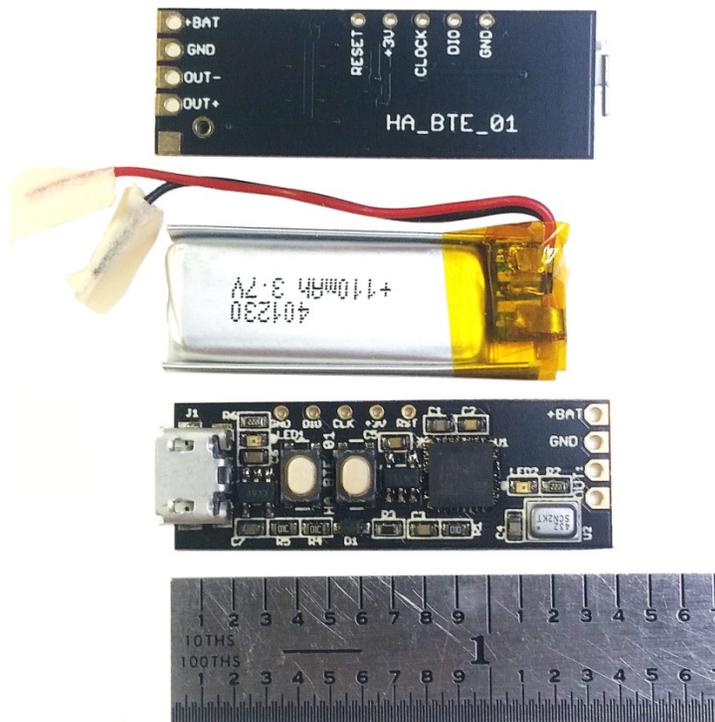
The BTE hardware includes a USB Micro-B Receptacle and charging circuit with a red charging LED indicator light.

The BTE hardware includes provisions for firmware development through a serial wire debug interface (RESET, SWCLK, SWDIO, POWER, and GROUND). The design includes 5 pogo pin receptors spaced on 1/10 inch centers for interface to a programmer/debugger such as the Microchip ATMEL-ICE.

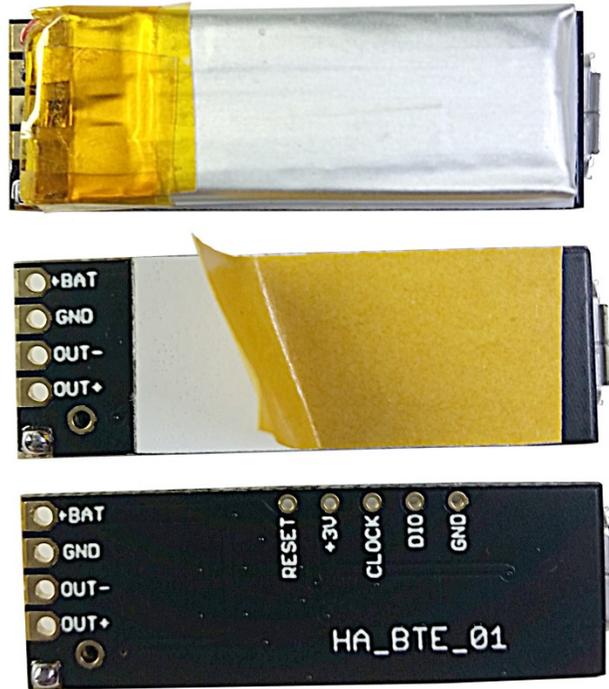
The 2-layer printed circuit board (PCB) measures: 35 millimeters (mm) by 12 mm. Programming receptors are pictured on the top edge of the PCB.



The LiPo battery measures: 30 mm by 12 mm by 4 mm.



The battery is attached to the back side of the PCB with double-sided tape.



Form a small air gap between the bottom port MEMS microphone and the yellow Kapton® tape to allow sound passage.



The earbud was attached to the OUT- and OUT+ terminals. Strain relief was added to the earbud cable with a short piece of white shrink wrap. Biocompatible Polyolefin 2:1 Clear Transparent Heat Shrink Tubing (thin walled, 12-13 mm pre-shrink diameter) was used to encase the BTE hardware. Note that flexible polyolefin allows the buttons to be pressed.



Detailed photos of construction and shrink tubing enclosure after trimming:



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HARDWARE WARNING: Small parts choking hazard.

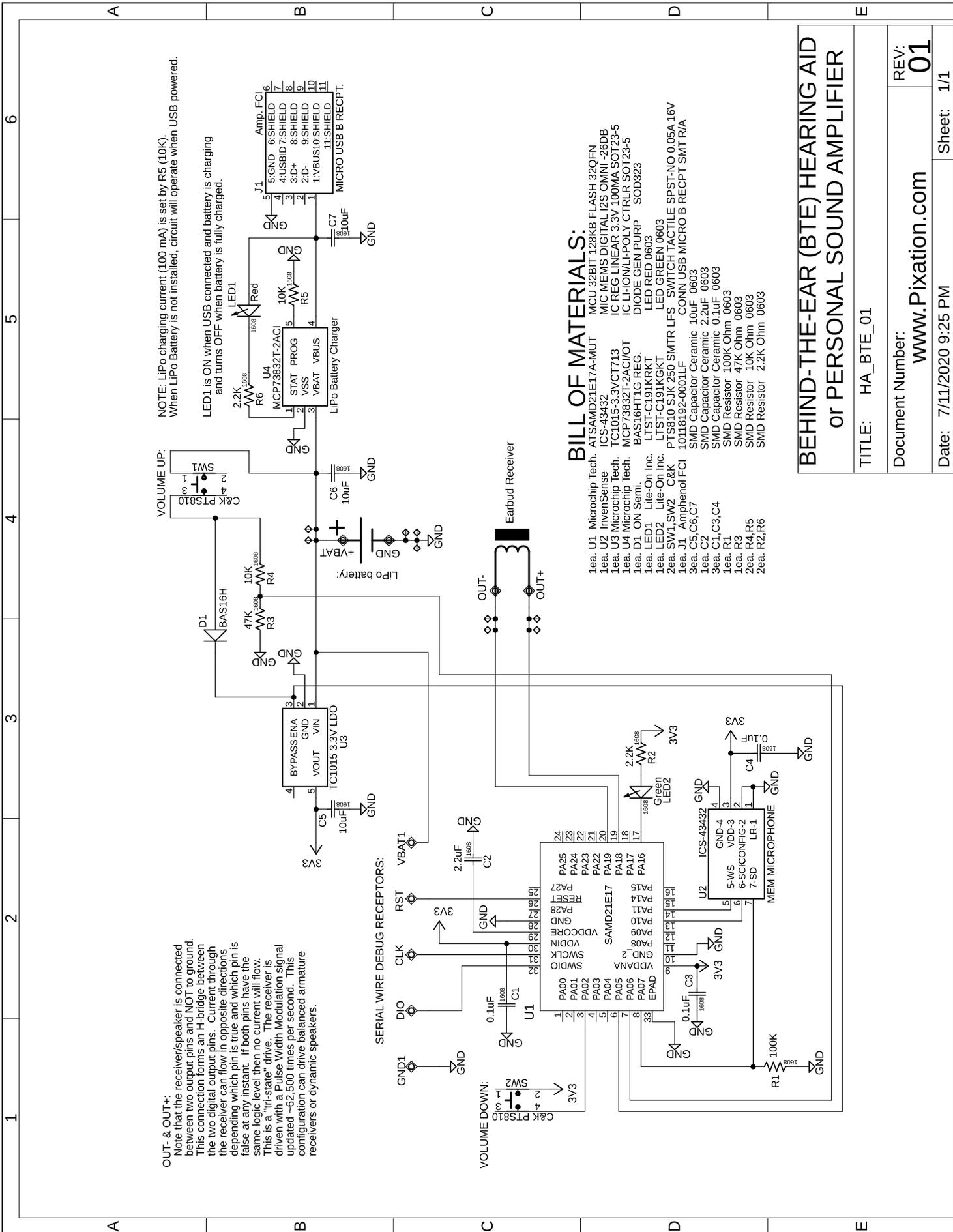
Safety guidance provided for the use of Pixation Corp. firmware follows:

1. Instructions to the end user shall include recommendations to avoid sound environments where sound levels exceed 85 decibels, A-weighted, as an 8-hour time-weighted average (85 dBA as an 8-hr TWA) using a 3-dB exchange rate (see: <https://www.cdc.gov/niosh/topics/noise/default.html>).
2. Instructions to the end user shall include recommendations to limit device usage to 8 hours/day.
3. Instructions to the end user shall include recommendations to limit device usage to no more than 40 hours/week.

Contact: Pixation@Pixation.com for firmware or printed circuit board (PCB) files.

See additional Application Notes at www.Pixation.com

Schematic and Bill of Materials (BOM) attached.



OUT- & OUT+:
 Note that the receiver/speaker is connected between two output pins and NOT to ground. This connection forms an H-bridge between the two digital output pins. Current through the receiver can flow in opposite directions depending which pin is true and which pin is false at any instant. If both pins have the same logic level then no current will flow. This is a "tri-state" drive. The receiver is driven with a Pulse Width Modulation signal updated ~62 500 times per second. This configuration can drive balanced armature receivers or dynamic speakers.

VOLUME UP:
 C&K PTS810

VOLUME DOWN:
 C&K PTS810

SERIAL WIRE DEBUG RECEPTORS:
 GND1, DIO, CLK, RST, VBAT1

NOTE: LiPo charging current (100 mA) is set by R5 (10K). When LiPo Battery is not installed, circuit will operate when USB powered.

LED1 is ON when USB connected and battery is charging and turns OFF when battery is fully charged.

BILL OF MATERIALS:

- 1ea. U1 Microchip Tech. ATSAM21E17A-MUT
- 1ea. U2 InvenSense ICS-43432
- 1ea. U3 Microchip Tech. TC1015-3.3VCT713
- 1ea. U4 Microchip Tech. MCP73832T-2ACIOT
- 1ea. D1 ON Semi. BAS16HTLIG REG.
- 1ea. LED1 Lite-On Inc. LTST-C191KRKT
- 1ea. LED2 Lite-On Inc. LTST-C191KGGKT
- 2ea. SW1,SW2 C&K PTS810 SJK 250 SMT RFS
- 1ea. J1 Amphenol FCI 10118192-0001LF
- 3ea. C5,C6,C7 SMD Capacitor Ceramic 10uF 0603
- 3ea. C1,C3,C4 SMD Capacitor Ceramic 2.2uF 0603
- 1ea. R1 SMD Resistor 100K Ohm 0603
- 1ea. R2 SMD Resistor 47K Ohm 0603
- 2ea. R4,R5 SMD Resistor 10K Ohm 0603
- 2ea. R2,R6 SMD Resistor 2.2K Ohm 0603
- 1ea. U1 Microchip Tech. ATSAM21E17A-MUT
- 1ea. U2 InvenSense ICS-43432
- 1ea. U3 Microchip Tech. TC1015-3.3VCT713
- 1ea. U4 Microchip Tech. MCP73832T-2ACIOT
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- 1ea. J1 Amphenol FCI 10118192-0001LF
- 3ea. C5,C6,C7 SMD Capacitor Ceramic 10uF 0603
- 3ea. C1,C3,C4 SMD Capacitor Ceramic 2.2uF 0603
- 1ea. R1 SMD Resistor 100K Ohm 0603
- 1ea. R2 SMD Resistor 47K Ohm 0603
- 2ea. R4,R5 SMD Resistor 10K Ohm 0603
- 2ea. R2,R6 SMD Resistor 2.2K Ohm 0603

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 or PERSONAL SOUND AMPLIFIER**

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