



**MOTOROLA**

## Theory of Operation

TITLE: Miniblue Bluetooth Earbud

Number:

Issue: T1

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### Miniblue Headset Theory of Operation

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### **1.0 INTRODUCTION**

This document provides a theory of operation. It will attempt to explain the purpose for circuitry in each of the individual sections. The major sections of the design are as follows: 1) Power-Up/Regulation Circuitry-this section embodies the methods in which the unit can be powered and the manner in which the platform reference voltage, battery voltage and current limits are achieved 2) The Audio Circuitry-the major components that enable the unit to operate as a headset will be discussed in this section 3) The echo / noise suppression section for audio quality 4) The RF / BlueTooth section. This document will not attempt to introduce any software operation other than logic levels inserted into the ICs.

### **2.0 Power-Up/Regulation Circuitry**

#### **2.1. Power-Up Circuitry**

The primary source of power is the internal lithium cell. The lithium cell is protected by a custom COB (Chip on Board), which houses a Mitsumi protection IC, MM3077YX, (along with the charge discharge FETs, Q1 and Q2). The power from the battery is transferred to the BC03MM chip via a switching regulator. As long as the cell's output voltage is greater than the under-voltage threshold of the COB the BC03MM will continue to run.

#### **2.2. 2.5V Switching Regulator (AAT1143)**

The AAT1143 regulator provides power for the BCO3MM. The AAT1143 can withstand an input of 6V which exceeds the maximum lithium cell voltage. The AAT1143 provides an improvement in efficiency over standard linear regulators, which equates to 33% less current draw from the internal lithium cell and longer talk time. The fixed output version of the AAT1143 requires only 3 external components (input capacitor, output capacitor, and inductor), which makes it ideal for densely populated designs. The 1.8V regulator is an internal BC03MM regulator.

#### **2.4. 2.5V Reference Regulator for the Microphones**

This reference is to provide the mics with a low current and shutdown option, as well as, providing a low noise bias. This reference is also controlled by the BC03MM



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### **2.5. Reset**

When a lock-up occurs, the user has the option to place the headset into its charger base. This will remove the power to the unit and reset the software.

### **2.6 Charging**

No charging components are internal to the Miniblue Headset. The Miniblue Headset will be charged via an external portable charger specifically designed to attach to the external contacts of the Miniblue Headset.

## **3.0 Hands-Free/Audio Circuitry**

### **3.1. Speaker Circuitry**

The headset speaker is 32ohms and is driven directly by the BC03MM.

### **3.2. Microphone Circuitry**

The microphone circuitry is biased by the 2.5V reference from above. There is no external gain on the mics...all taken care of by the BC03MM.

## **4.0 Echo / Noise Suppression**

This section is the Digital Signal Processor on the BC03MM with the Clarity Noise Suppression / Echo Cancellation algorithm. It controls the echo, duplex, and noise suppression. It relies heavily on the lack of distortion in the signals and the tight seal of the mechanics. The DSP is controlled by the BC03MM application. For information about the DSP, see the BC03MM specification.

## **5.0 RF / BlueTooth**

This section is anchored by the CSR BC03MM. It has the lower levels of the BT stack and the upper application stacks (with an internal flash). The unit operates at 2.4GHz. The RF section has been tuned to be 50ohm matched (i.e. 0.18mm traces). C47 is used to tune the antenna to 50 ohms. The PCB antenna was copied from the CSR Autosira design. The BCO3MM also controls three LEDs for charge, call, and mute indications. For more information, see the BCO3MM specification.