BH45F0031 Earphone Jack Communication Application Note

D/N: AN0438E

Introduction

The BH45F0031 is a Flash type 8-bit high performance RISC architecture microcontroller, which is designed for smart phone headset interface applications that can directly transmit data and communicate with the microcontroller using their audio earphone interface.

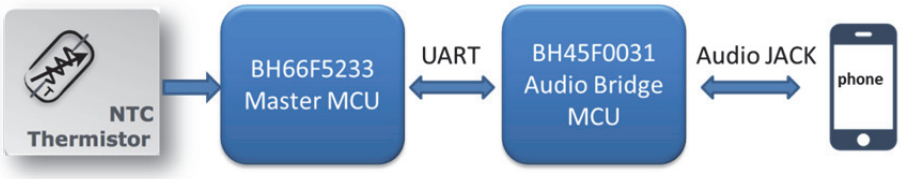
The BH45F0031 can convert the analog audio signals from mobile phones into digital data and transmit them to a master external MCU. The device can also convert the digital data from the master MCU into analog audio signals and transmit them to mobile phones.

A minimalist peripheral circuit greatly reduces the costs of communication with smart phones. Additionally, as an 8-pin SOP package type is used, this allows the device to fit easily into low profile products.

The BH45F0031 can be applied for use in various healthcare products which need to communicate with mobile phones, such as smart thermometers, glucose meters, etc.

An earphone jack thermometer application implemented using the BH45F0031 and BH66F5233 will be introduced to describe how to use the BH45F0031 for product development.

Functional Description



Application Block Diagram

BH66F5233 to Phone Communication

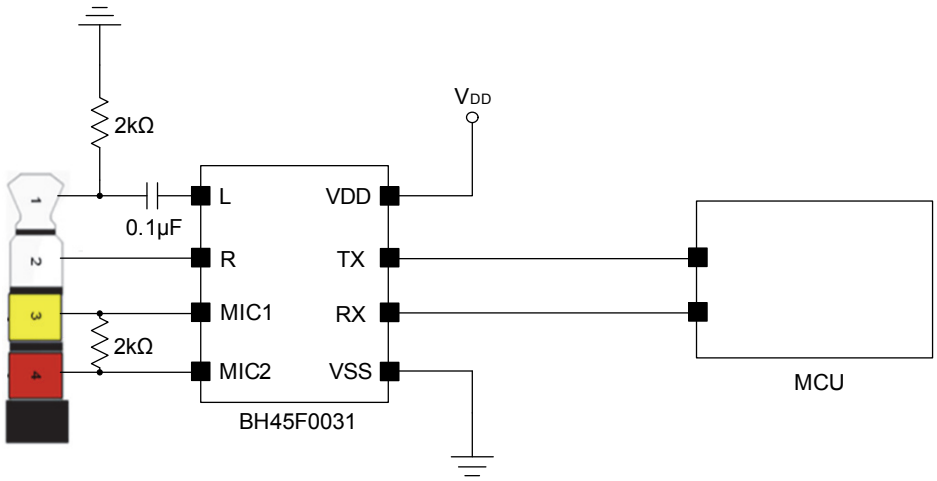
1. The BH66F5233 transmits the desired digital data to the BH45F0031 using the UART interface.
2. The BH45F0031 receives the digital data from the BH66F5233 and then converts them into analog audio signals using the audio jack.
3. A suitable mobile phone APP decodes the received audio signals and finally obtains the digital data sent from the BH66F5233.

Phone to BH66F5233 Communication

1. A suitable mobile phone APP converts the desired digital data into analog audio signals and transmits them to the BH45F0031.
2. The BH45F0031 receives the analog audio signals from the mobile phone and converts them into digital data.
3. The BH45F0031 transmits the decoded digital data to the BH66F5233 using the UART interface.

Operating Principles

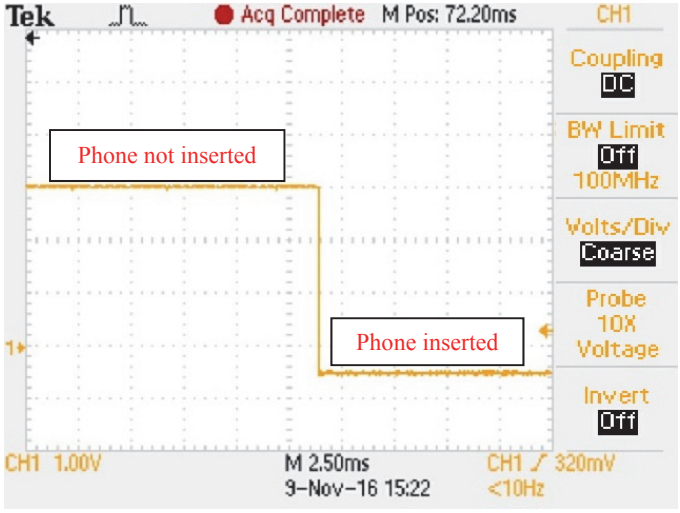
Application Circuit



Operating Description

Step 1. Earphone Insertion Detection

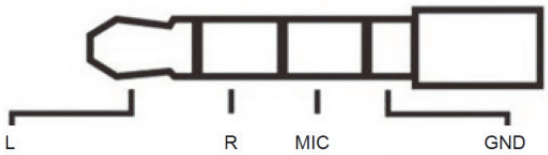
1. The BH45F0031 enters the Sleep Mode.
   - Both of the MIC1 and MIC2 pins are configured as general purpose I/O pins to output low levels.
   - The R pin is configured as an input with both pull-high and wake-up functions enabled. When the logic condition on the pin changes from high to low, the device will be woken up.
2. When there is no mobile phone inserted into the phone jack, the R pin remains at a logic high level.
3. When a mobile phone has been inserted into the phone jack, the R pin will change to a logic low level and be connected to GND via MIC1 and MIC2 to form a circuit loop thus waking up the BH45F0031.



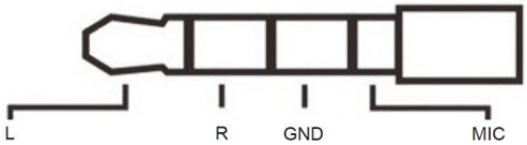
Earphone Insertion Detection – R Pin

Step 2. MIC/GND Pin Function Auto Switch – determines the phone jack type

Phone jacks fall into two types resulting in different MIC pin locations, as shown below.



Non-International Standard 4-Conductor Contact Pin Structure



International Standard 4-Conductor Contact Pin Structure

Earphone Interface Types

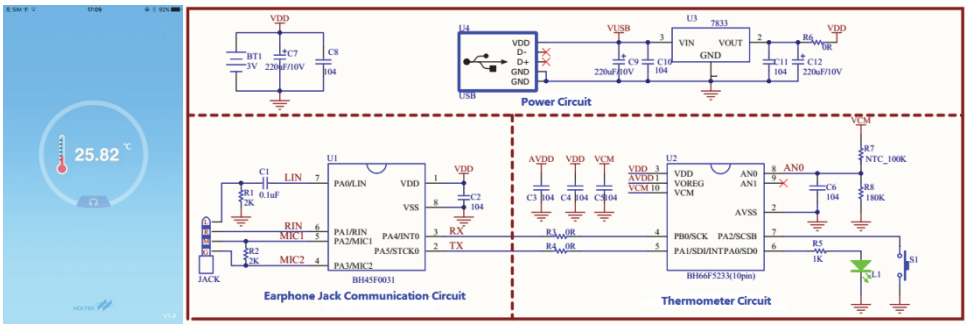
After the BH45F0031 has been woken up:

- The OVP MUX input path selects MIC2 and the 8-bit DAC is configured to generate a proper output voltage.
- MIC1 is configured as a general purpose I/O to output a low level.
- The OVPDA register content will count down from its preset value until the OVP output changes state after which it will record the current OVPDA value as OVPDA1.
- Switch the detection direction. The OVP MUX input path selects MIC1 and MIC2 is configured as a general purpose I/O to output a low level.
- The OVPDA register content will count down from its preset value until the OVP output changes state after which it will record the current OVPDA value as OVPDA2.
- If OVPDA1 is larger than OVPDA2, MIC2 will be configured as MIC and MIC1 as GND, otherwise MIC1 as MIC and MIC2 as GND.

Step 3. Start the Earphone Interface Communication

1. After Step 2 and Step 3 have completed, the earphone interface communication can be initiated.
2. The BH45F0031 outputs sine wave signals on the MIC pin and receives earphone interface signals via the L pin.
3. The integrated OVP circuit will convert the received earphone interface signals into digital signals which will be interpreted by the internal CTM and application programs.
4. Use the sine wave generator to generate sine waves which are output on the MIC pin which is located at MIC1 or MIC2. After a mobile phone has been inserted into the phone jack, the V_{PP} and V_{DC} value of the MIC pin can be increased by adjusting the sine wave generator output voltage which means adjusting the internal divider resistors and D/A converters.

Hardware Description



Earphone Jack Thermometer Application Circuit

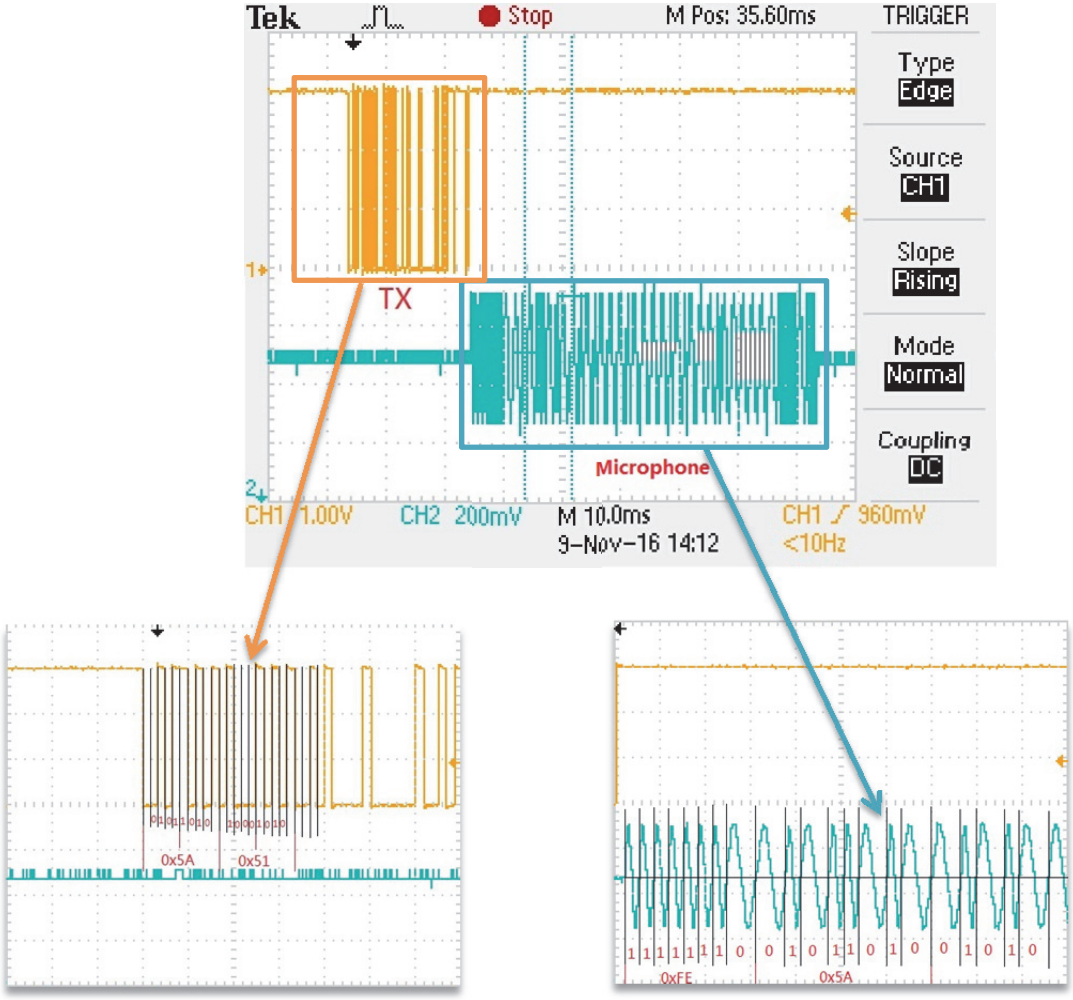
1. When the S1 button is pressed in a set way, the thermometer will enter the calibration mode.
2. The LED is used to indicate the operating status. When off, this means the system is in a sleep condition. When flashing, this means the system is in the normal measurement status.
3. The BH66F5233 uses its internal high resolution 24-bit Delta Sigma A/D Converter to sample the NTC voltage and then to work out the current temperature.
4. The BH66F5233 uses its UART interface to transmit the sampled temperature value to the BH45F0031.
5. The BH45F0031 transmits the received UART data to a mobile phone using the phone jack.
6. A suitable mobile phone APP will decode the received audio signals to obtain the current temperature value.
7. Similarly a mobile phone can also transmit data to the BH45F0031, which will then transparently transmit the data to the BH66F5233. In this way using a mobile phone to control smart devices can be easily implemented.

Software Description

1. Communications between the BH45F0031 and smart phones are implemented using the audio jack. The device supports both the Android and IOS systems.
2. Communications between the BH45F0031 and the master MCU are implemented using the UART interface. The baud rate is 2400 bit/s. The data format contains 1 Stop bit, 8 data bits and no Parity bit.
3. One data frame contains 5 bytes. The time interval between frames should be larger than 100ms. A value of 200ms is recommended.
4. It is strongly suggested to check every frame based on a certain protocol and add an ACK mechanism for important data. If there is no ACK response from the receiver side, resend the data after 200ms.
5. The BH45F0031 will transmit the received data directly without adding additional processing which is called transparent transmission.

The following section will use waveforms to illustrate thermometer temperature data.

- BH66F5233 → BH45F0031 → Phone

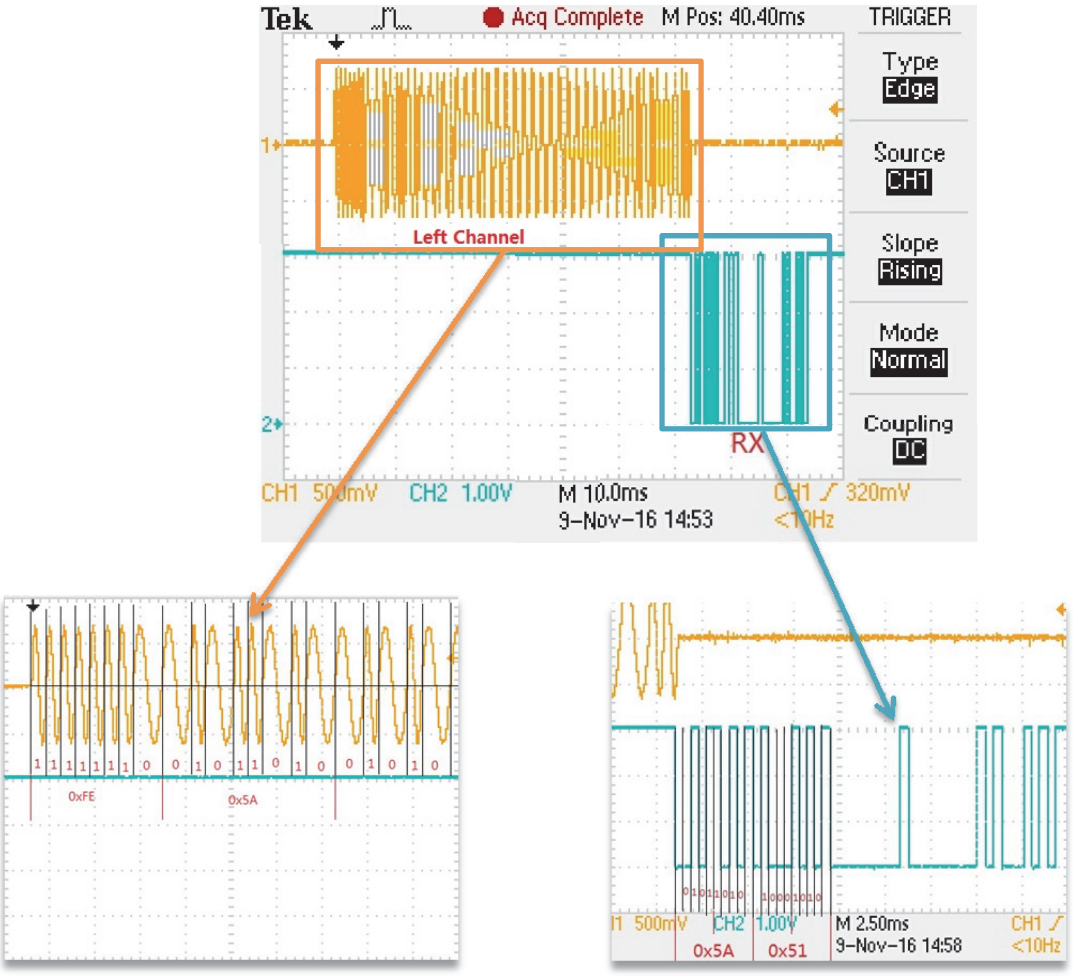


UART Interface: BH66F5233 → BH45F0031

Earphone Jack: BH45F0031 → Phone

1. A fixed header code “0xFE” is transmitted during the audio communication, which is used for mobile phone identification and synchronisation.
2. Earphone jack communication uses 1250Hz audio signals to indicate a logic “0” and 625Hz (1250Hz/2) audio signals to indicate a logic “1”.
3. The mobile phone will convert the received analog signals into digital data by analysing the signal frequencies.

- Phone → BH45F0031 → BH66F5233



Earphone Jack: Phone → BH45F0031

UART Interface: BH45F0031 → BH66F5233

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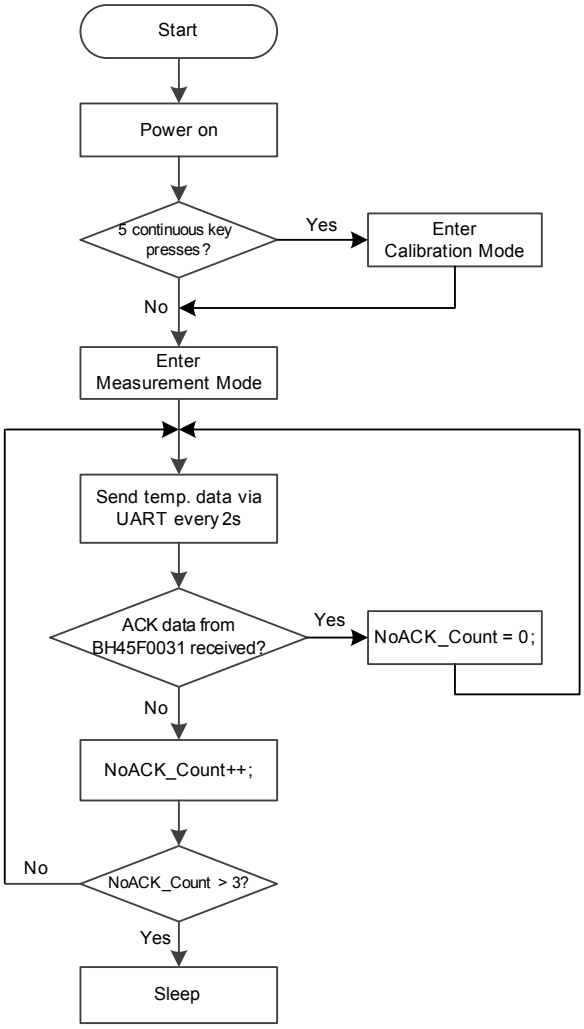
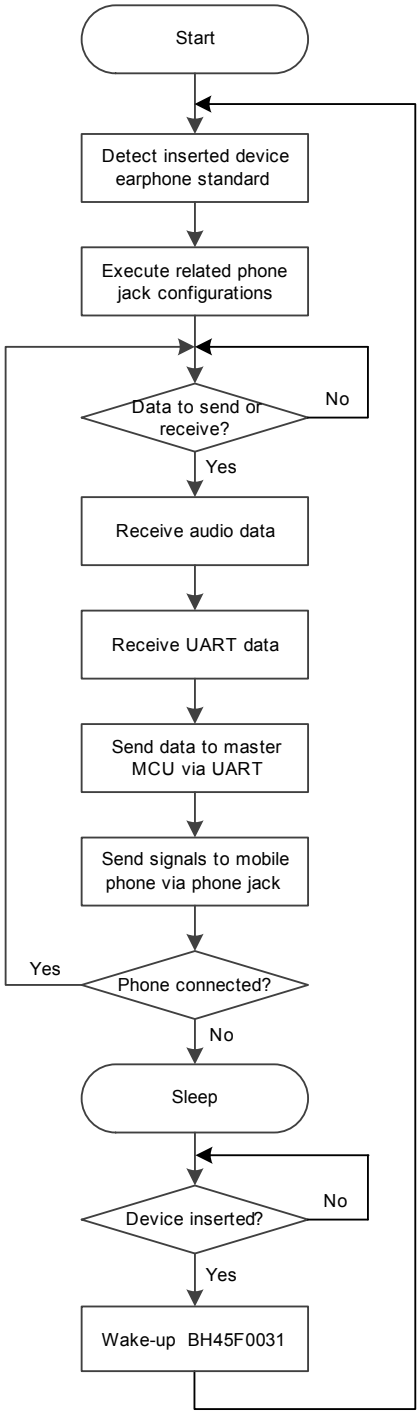
2. Earphone jack communication uses 1250Hz audio signals to indicate a logic “0” and 625Hz (1250Hz/2) audio signals to indicate a logic “1”.
3. The mobile phone will convert the digital data into analog signals using the rules described above.

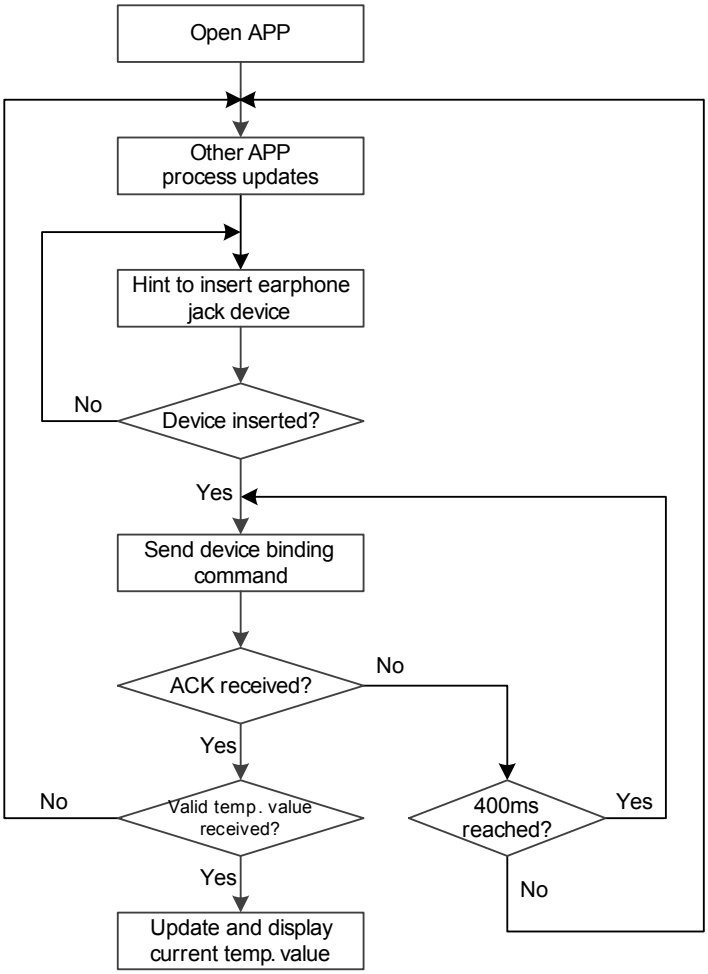
Flowchart



Master MCU BH66F5233 Operating Flowchart



BH45F0031 Operating Flowchart



APP Processing Flowchart

Conclusion

An earphone jack thermometer application has been provided which is composed of the BH66F5233 and BH45F0031 which has shown how to implement BH45F0031 earphone jack data communication.

The provided APP can be downloaded in the IOS APP Store by searching for HT thermometer. Contact Holtek for the demo.

Versions and Modification Information

Date	Author	Issue Release and Modification
2016.11.10	陳　挺	First Version

Reference File

Reference file: BH45F0031 DataSheet.

For more information refer to the Holtek's official website http://www.holtek.com.

Reference Attachment

Related document and source code.


BH66F5233_HeadPhone.pdf


software-bh45f0031.zip

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