BMduino-Shield
Creative Music Touch

# BMV56T123
# User Guide

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www.bestmodulescorp.com

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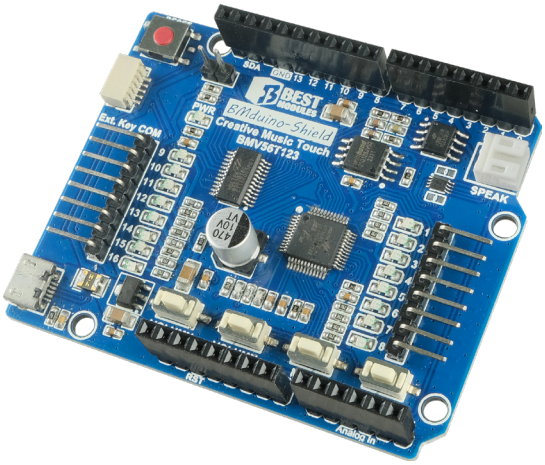
# Introduction

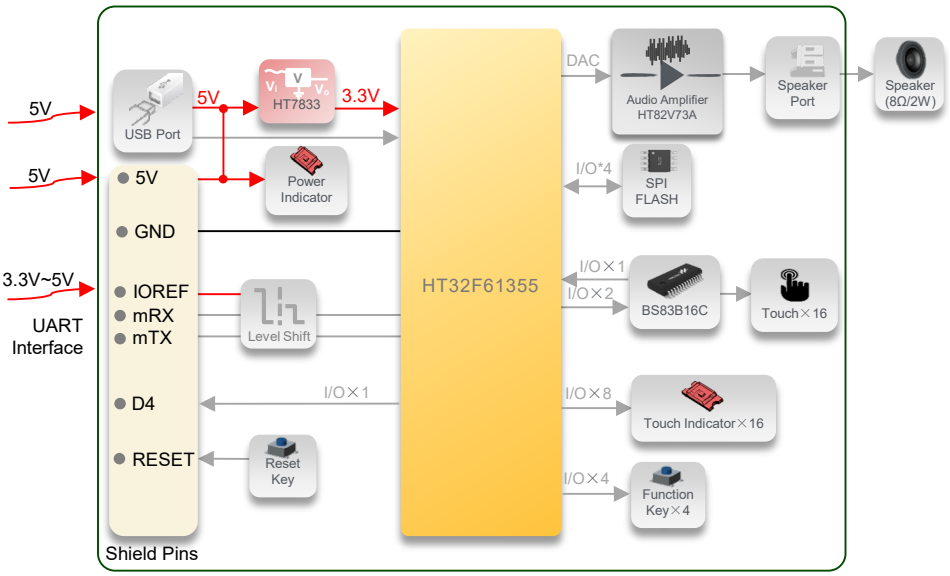
The BMV56T123 is a creative music touch shield from Best Modules, which is developed using an MCU, the HT32F61355, and a touch device, the BS83B16C. The shield has 16 on-board touch detection pins, by collecting touch information, it can play integrated MIDI or customised voice sources. The shield has two operating modes: stand-alone mode and networking mode. The shield board can be plugged in-and-out of the BMduino UNO development board, and use the UART communication method to implement functions such as volume setting and tone group selection. The shield board is suitable for use in creative music touch leisure products.



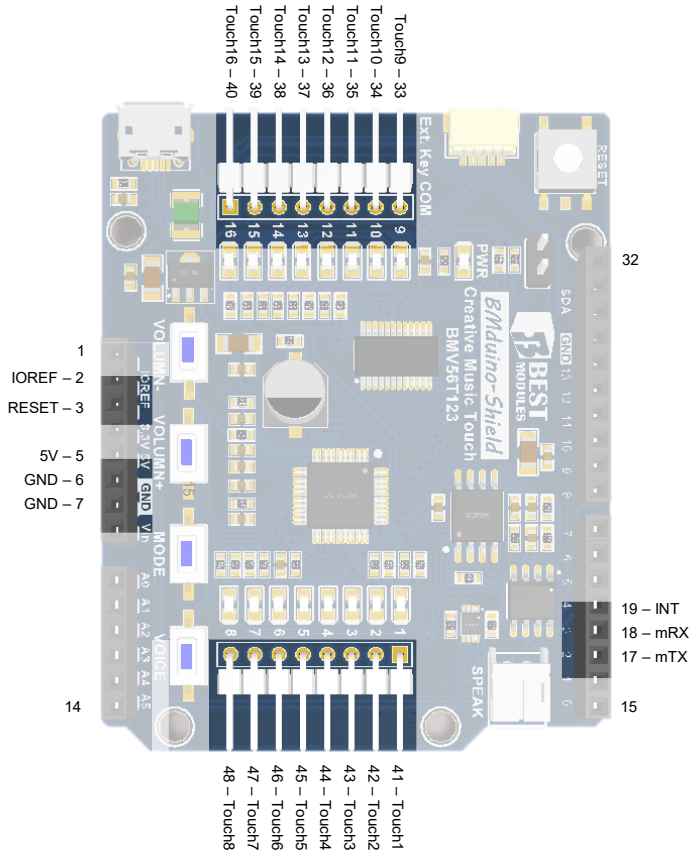

# Features

- Operating voltage: 5V
- Operating current: 76mA (All LEDs on, play 1kHz audio, the volume is 6)
- MCU: HT32F61355
- Operating mode: Stand-alone mode and networking mode
- On-board touch detection interface: Collect touch information to play integrated MIDI or customised voice sources using 16 touch pins
- Voice source:
  - ♦ Integrated MIDI voice source
  - ♦ Customised voice source: Can be updated by users
- Audio output: Used together with 8Ω/2W speaker
- On-board RESET key to reset the BMduino UNO development board
- Communication interfaces:
  - ♦ BMduino interface, can be plugged in-and-out of the BMduino UNO development board for use
  - ♦ Communication method: UART (baud rate: 115200bps)
- Arduino Lib application support
- Shield size: 67mm×53.34mm×23mm

# Block Diagram




# Pin Description



BMduino-Shield pins:

| Pin | Function | BMduino Pin | Description |
|---|---|---|---|
| 2 | IOREF | IOREF | Communication logic reference voltage pin |
| 3 | RESET | RESET | Reset BMduino UNO development board |
| 5 | 5V | 5V | 5V power supply |
| 6, 7 | GND | GND | Ground |
| 17 | mTX | D2 | UART serial data transmitting |
| 18 | mRX | D3 | UART serial data receiving |
| 19 | INT | D4 | Interrupt pin, output high when there is no touch action, output low when touch action occurs |

Touch detection pin:

| Pin | Function | Description |
|---|---|---|
| 33~48 | Touch | 16 touch detection pins |

# Technical Specifications

## Recommended Operation Conditions

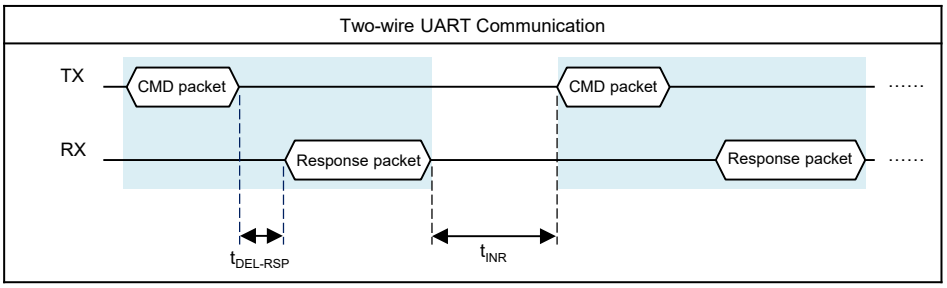
Ta=25°C

| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{DD}$ | Operating Voltage | — | — | 5 | — | V |
| $I_{DD}$ | Operating Current | All LEDs on, play 1kHz audio, the volume is 6 | — | 76 | — | mA |

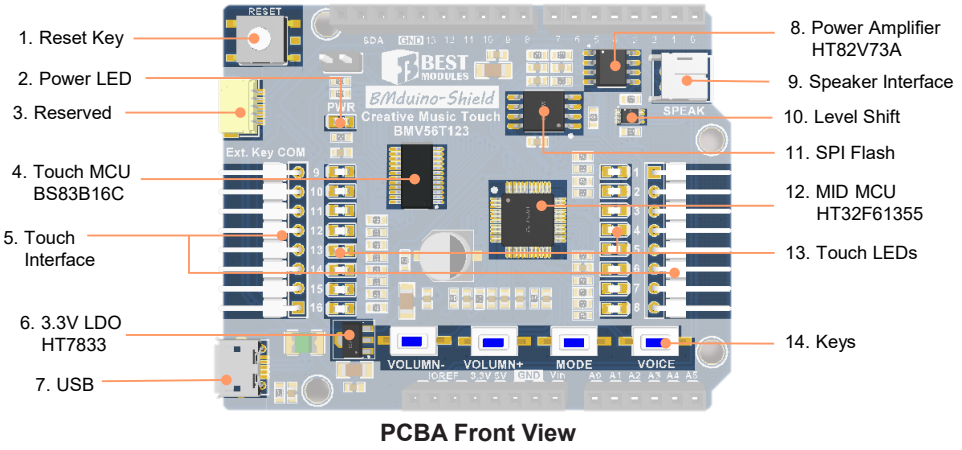
## Timing Specification

Ta=25°C

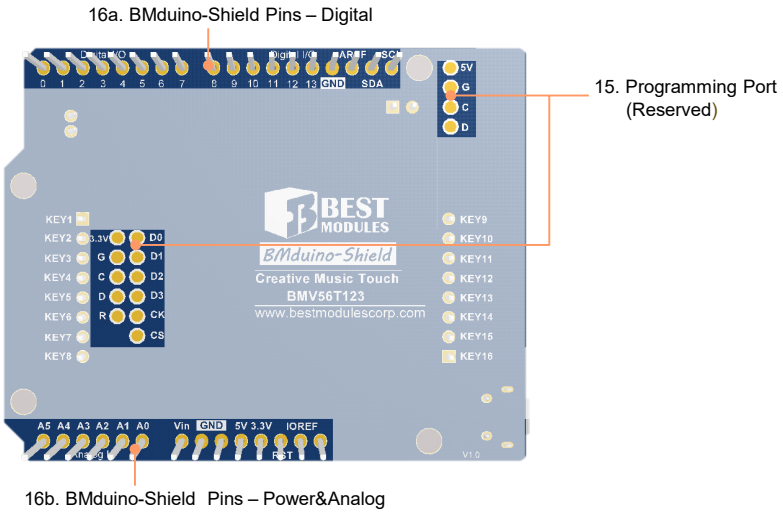
| Symbol | Parameter | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $t_{DEL-RSP}$ | Response Delay Time | $V_{DD}$=5V | — | 1 | — | ms |
| $t_{INR}$ | Interval Time | $V_{DD}$=5V | — | 1 | — | ms |



# Hardware Overview

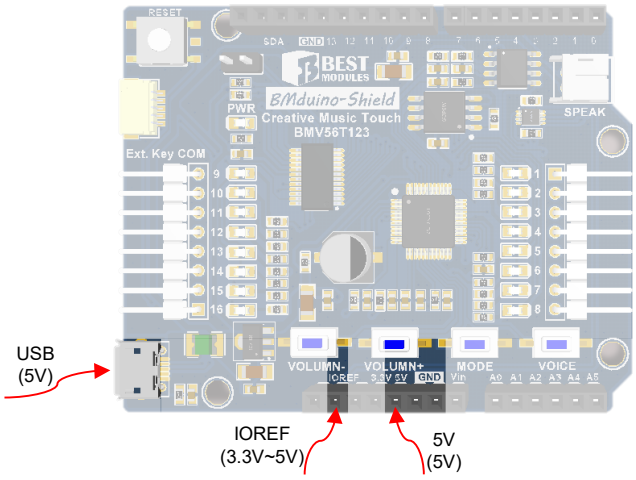



**PCBA Front View**




**PCBA Back View**

## Power Supply




- Provided by the USB interface input, 5V
- BMduino-Shield pin: Provided by the “5V” pin input, 5V

The shield communication reference voltage power requires input 3.3V~5V from the IOREF.

## INT Pin

| Shield | INT Level |
|---|---|
| No touch action | High |
| Touch action occurs | Low |

## LED Indicators

- Power indicator, red LED: LED on for power-on, LED off for power-off.
- Touch indicators: 16 touch detection pins correspond to 16 indicators. When touch action occurs, LED on; when there is no touch action, LED off.

## Operating Modes

The shield has two operating modes: Stand-alone mode and networking mode.

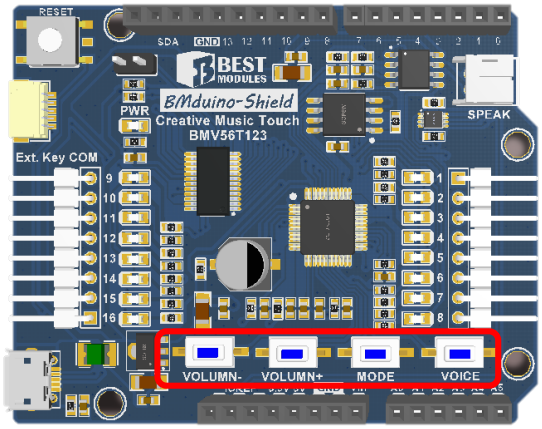
- Stand-alone mode:

  The shield can be used offline and powered by an USB interface. By collecting touch information from 16 touch detection pins and using keys, the shield can set the volume, voice source, tone and also play the sound effects. Refer to the Keys section for key function introduction.

- Networking mode:

  The shield board can be plugged in-and-out of the BMduino UNO development board for use. The shield uses the UART communication method to set the volume, voice source and tone by pressing keys or sending the “Set the volume”, “Set the touch playback voice source” and “Set the MIDI tone group” instructions. By collecting touch information from 16 touch detection pins or sending the “Play the sound effects” instruction, the shield can play the sound effects.

## Keys

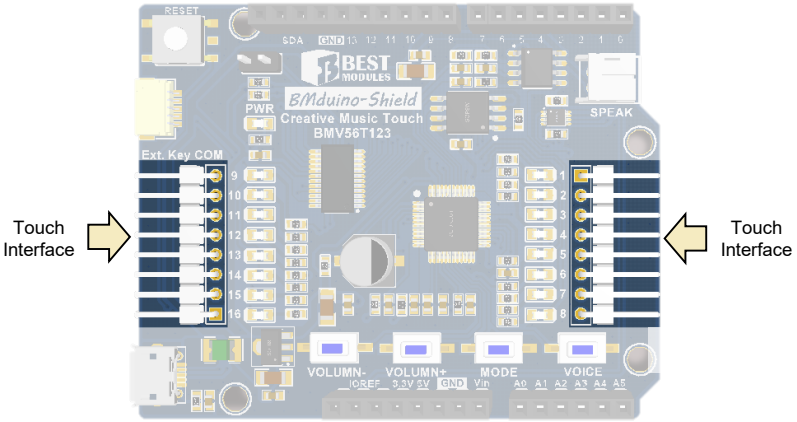



Function Key

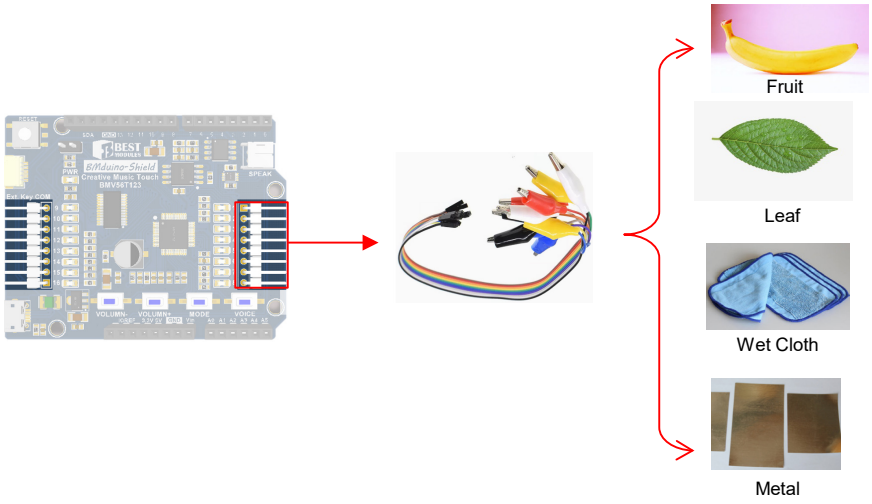
| No. | Key Symbol | Function | Note |
|---|---|---|---|
| 1 | VOLUMN- | Volume decrement (volume adjustment level 0~15) | 0 is the minimum (mute), 15 is the maximum |
| 2 | VOLUMN+ | Volume increment (volume adjustment level 0~15) | |
| 3 | MODE | Played voice source switching (switch between integrated MIDI voice source and customised voice source) | |
| 4 | VOICE | MIDI tone group switching (group number 0~12) | Tone group, refer to the Voice Source Introduction section |

## Touch Detection Pins

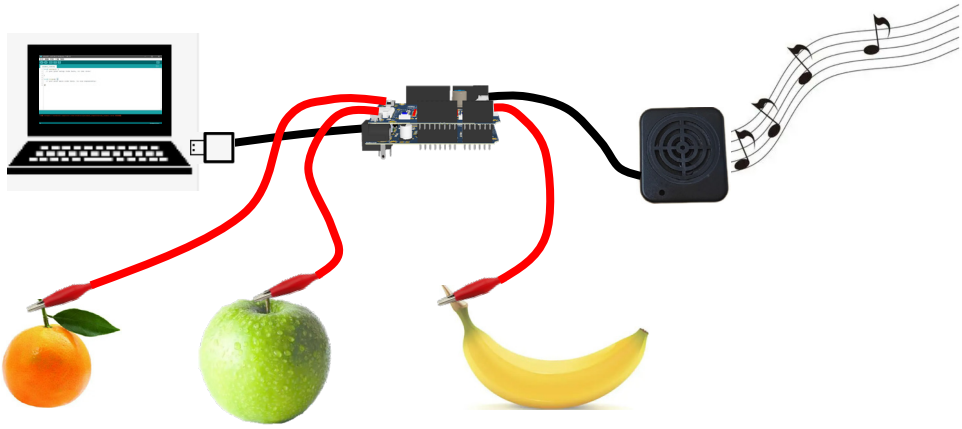
There are a total of 16 touch detection pins on the shield, with touch number 1~16 corresponding to different pitches.




Users can connect the touch detection pins to other objects using the dupont to alligator clip connection cable, thereby play the sound effects when touching objects. The connection method is as follows:




For example, combine multiple fruits into a simple musical instrument.



## Audio Output

The shield integrates a 1.5W power amplifier, which can be connected to an external speaker. Refer to the Accessories section for speaker specifications.

## Communication Interface

- Communication method: UART
- Baud rate: 115200bps
- Communication logic reference voltage: 3.3V~5V

## Communication Protocol

There are two instruction frame formats, known as general instruction frame and touch status acquisition instruction frame.

## General Instruction Frame

● **Host → Sheild**

| Header | CMD | Data | CheckSum |
|---|---|---|---|
| 0xA0 | 1-byte | 1-byte | 1-byte |

● **Sheild → Host**

| Status |
|---|
| 1-byte |

Frame content introduction:

- ♦ Header: Preamble code, fixed at 0xA0
- ♦ CMD: Command code, each command code corresponds to a different function
- ♦ Data: Data
- ♦ CheckSum=CMD+Data
- ♦ Status: Status code, 0xA0: Shield command reception correct; 0xE0: Shield command reception error

## Touch status acquisition instruction frame

● **Host → Sheild**

| Header | CMD | Data | CheckSum |
|---|---|---|---|
| 0xA0 | 0x07 | 0x00 | 0x07 |

● **Sheild → Host**

| Status | Data | CheckSum |
|---|---|---|
| 1-byte | 2-byte | 1-byte |

### ● General Instruction Set

| No. | Functional Description | CMD | Data | Note |
|---|---|---|---|---|
| 1 | Set the touch playback voice source | 0x01 | $D_1$: Voice source mode selection<br>0: Play the integrated MIDI voice source<br>1: Play the customised voice source | |
| 2 | Set the MIDI tone group | 0x02 | $D_1$: Tone group selection, ranging from 0~12 | Tone group, refer to the Voice Source Introduction section |
| 3 | Set the volume | 0x03 | $D_1$: Volume setting, ranging from 0~15<br>0 is the minimum (mute), 15 is the maximum | |
| 4 | Play the sound effects | 0x04 | 1~16, corresponding to 16 touch detection pins | |
| 5 | Turn on the LED | 0x05 | 1~16, corresponding to 16 touch detection pins | |
| 6 | Turn off the LED | 0x06 | 1~16, corresponding to 16 touch detection pins | |

### ● Touch Status Acquisition Instruction Set

| No. | Functional Description | CMD | ID | Response Data | Note |
|---|---|---|---|---|---|
| 7 | Read the touch value | 0x07 | 0x00 | $D_2D_1$ : Data of 16 touch detection pins bit0~bit15 correspond to touch detection pins 1~16 respectively<br>bit=0: Not pressed<br>bit=1: Pressed | |

# Voice Source Introduction

The shield board integrates 13 MIDI tone groups (group number 0~12), which can be switched by pressing the VOICE key or setting MIDI tone group introductions (refer to the following table for musical instrument names).

| Group Number | Instrument Name | Note |
|---|---|---|
| 0 | AcousticGrandPiano | Using 16 touch detection pins, users can play 16 different pitches of the selected instrument |
| 1 | RhodesPiano | |
| 2 | MusicBox | |
| 3 | TubularBells | |
| 4 | HammondOrgan | |
| 5 | PercussiveOrgan | |
| 6 | CleanElectricGitar | |
| 7 | SynthBass1 | |
| 8 | PizzicatoStrings | |
| 9 | Timpani | |
| 10 | Woodblock | |
| 11 | Gunshot | |
| 12 | Percussion, refer to the following table | 16 percussion instruments corresponding to 16 touch detection pins |

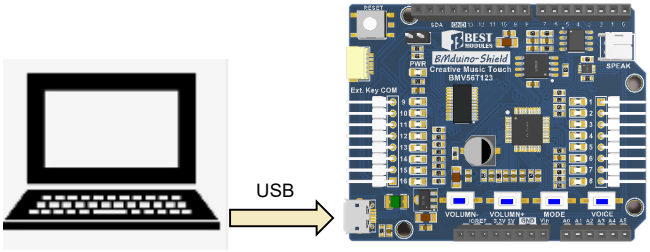
Where the 13th MIDI group (group number: 12) is percussion music, the touch sound effects table is shown below for reference

| Touch Number | Instrument Name | Touch Number | Instrument Name |
|---|---|---|---|
| 1 | Acoustic_Bass_Drum | 9 | Chinese_Cymbal |
| 2 | Elestric_Snare | 10 | Ride_Bell |
| 3 | Closed_HiHat | 11 | High_Bongo |
| 4 | High_Floor_Tom | 12 | Open_Hi_Conga |
| 5 | Pedal_HiHat_E1 | 13 | Low_Agogo |
| 6 | Open_HiHat | 14 | Maracas |
| 7 | Low_Mid_Tom | 15 | Long_Guiro_E3 |
| 8 | Crash_Cymbal | 16 | Claves |

# Customised Voice Source

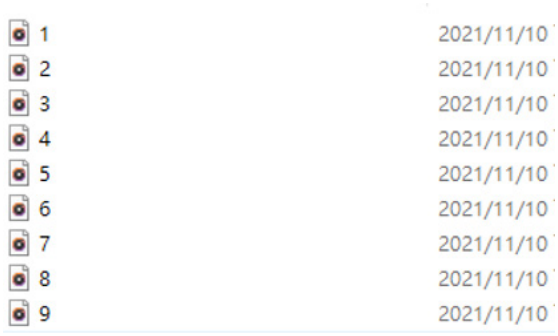
The shield integrates 128Mbit Flash memory to store the customised voice sources

- Update method: Users can add external voice sources by copying files via the USB.




- File format: 16kHz WAV voice source. Users can convert MP3 and other format voice source into standardized WAV voice source (16K sampling rate, single channel) through PC software (such as audacity).

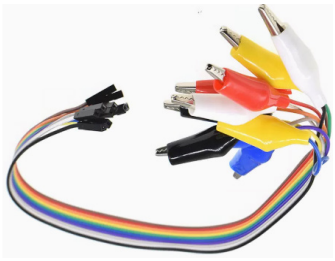
- File naming method: Named with number 1~16, corresponding to 16 touch number to trigger playback. The file name is shown in the following diagram:



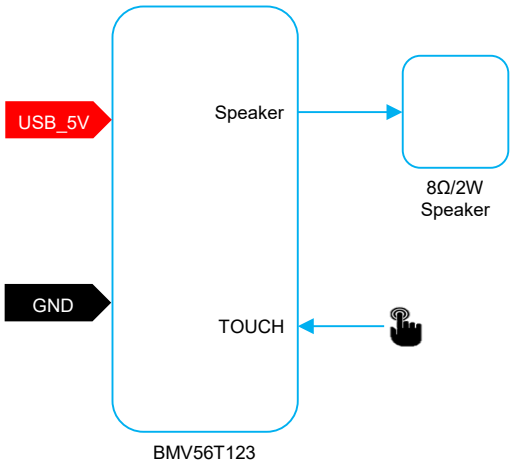

## Accessories

- Speaker specifications
  - Impedance: 8Ω
  - Power: 2W
  - Size (Length×Width×Height): 70mm×63mm×24mm
  - Connection method: Directly connect the 2.00mm 2P terminal to the PH2.00mm right angle pin connector on the shield

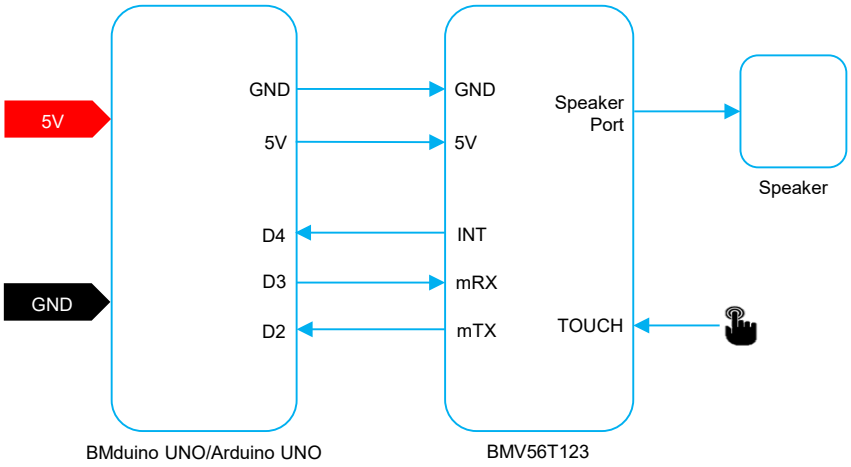
- Dupont to alligator clip connection cable
  - Cable length: 20cm
  - Number: 20



# Application Circuits

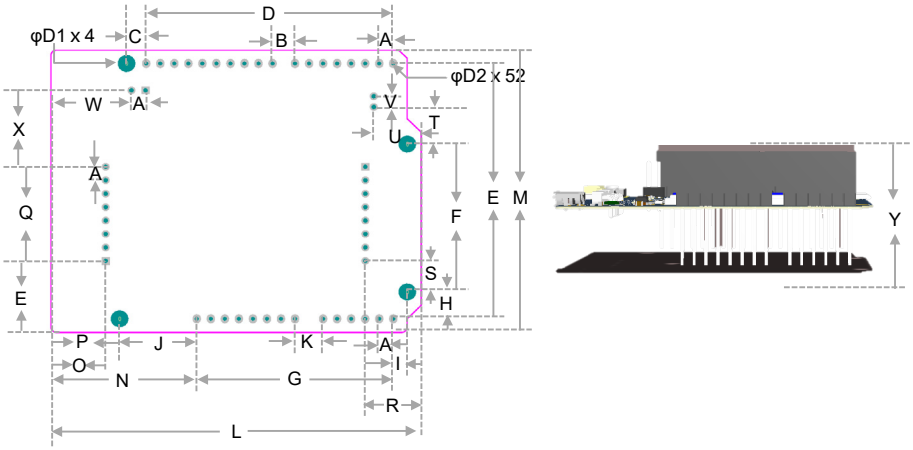



**Stand-alone Mode Connection Diagram**




**Networking Mode Connection Diagram**

# Dimensions




**Dimension Information**

| Symbol \ Unit | mm | inch |
|---|---|---|
| A | 2.540 | 0.100 |
| B | 4.064 | 0.160 |
| C | 3.556 | 0.140 |
| D | 44.704 | 1.760 |
| E | 48.260 | 1.900 |
| F | 27.940 | 1.100 |
| G | 35.560 | 1.400 |
| H | 5.080 | 0.200 |
| I | 2.540 | 0.100 |
| J | 13.970 | 0.550 |
| K | 5.080 | 0.200 |
| L (Board Length) | 67.000 | 2.638 |
| M (Board Width) | 53.340 | 2.100 |
| N | 26.400 | 1.039 |
| O | 9.910 | 0.390 |
| P | 12.430 | 0.490 |
| Q | 17.780 | 0.700 |
| R | 10.110 | 0.400 |
| S | 5.870 | 0.230 |
| T | 7.030 | 0.280 |
| U | 8.590 | 0.340 |
| V | 2.000 | 0.080 |
| W | 14.590 | 0.570 |
| X | 14.450 | 0.570 |
| Y | 23.000 | 0.906 |
| D1 | 3.251 | 0.128 |
| D2 | 0.800 | 0.031 |

**Dimension List**