AN0157
Application Note

AT32WB415 BLE MIDI user guide

Introduction

Musical Instrument Digital Interface (hereinafter referred to as MIDI) is an industry-standard protocol for communication between electronic musical instruments and computers. It is responsible for sending control signals rather than sound data. The USB and other similar interfaces in the past are used to send data to computers for sound combination. Today we can also use general specifications for data transfer over Bluetooth. This application note describes how to create a MIDI controller that is able to send control signals to mobile phones for playing sound.

Applicable products:

Model	AT32WB415

Contents

List of tables

List of figures

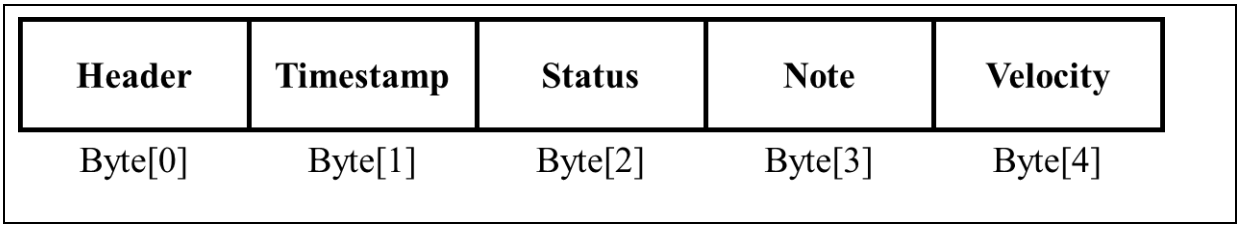
1 BLE MIDI Profile

The full specifications of BLE MIDI Profile is available on the official website of MIDI Association. The subsequent sections only present some of the most fundamental conditions in a brief way.

1.1 MIDI Packet

Figure 1 presents the MIDI packet format that is transported over BLE.

Figure 1. MIDI Packet



In Header, bit-7 is a start bit, forced to 1, and bit-6 is reserved, forced to 0. In Timestamp, bit-7 is a start bit, forced to 1. In other words, the bit 0 to bit 5 of Header refer to the six high bits of 13-bit timestamp. The bit 0 to bit 6 of Timestamp means the seven low bits of 13-bit timestamp.

Status, Note and Velocity are defined in the MIDI specifications. Table 1 shows some of the Note Hex values only, not a comprehensive list.

Table 1. Note Hex Value

Note	C	C#	D	D#	E	F	F#	G	G#	A
Hex Value	0x3C	0x3D	0x3E	0x3F	0x40	0x41	0x42	0x43	0x44	0x45

1.2 Connection interval

BLE MIDI device shall request a connection interval of 15 ms or less. Most MIDI applications prefer a shorter connection interval. In actual connection scenarios, a smaller/shorter connection interval between the central and the peripheral device is supported. In addition, Apple recommends starting with a request for a connection interval of 11.25 ms and going to 15 ms.

1.3 BLE MIDI service and characteristic

BLE MIDI Profile has not registered a short UUID in the Bluetooth SIG. Thus its service and characteristics is a 128-bit value. See Table 2 for details.

Table 2. BLE MIDI Service and Characteristic

Name	**UUID**
MIDI Service	03B80E5A-EDE8-4B33-A751-6CE34EC4C700
MIDI Data I/O Characteristic	7772E5DB-3868-4112-A1A9-F2669D106BF3

BLE MIDI properties are shown in Table 3. Note that the “Permission” part shall be strictly respected to avoid connection failure.

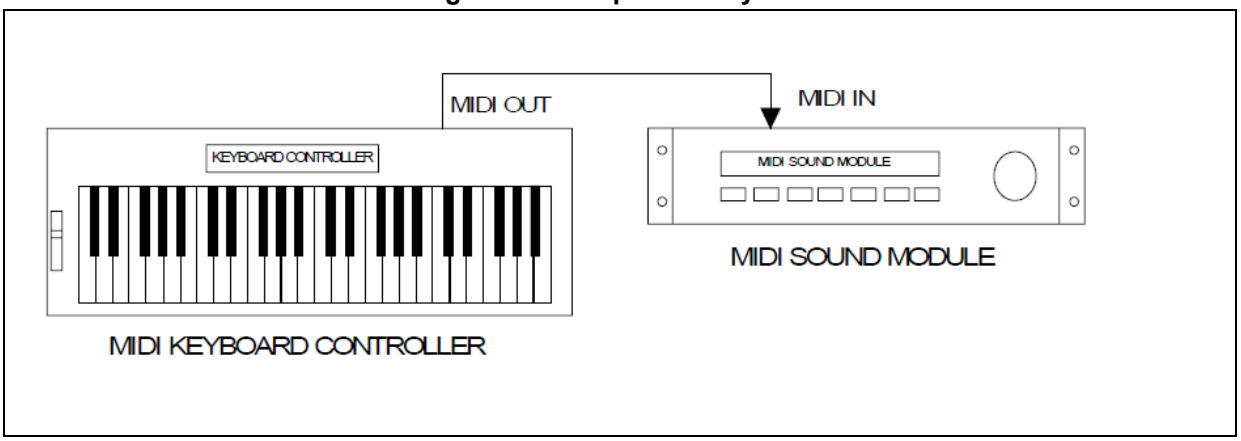
Table 3. BLE MIDI properties

Name	Permission	Properties	Comment
MIDI Data I/O	Read/Write/Notify	Pairing Required	It is recommend that Read/write/notify be encrypted. Read without payload, and write command.

1.4 Data transfer

In this application note, the AT32WB415 serves as a MIDI controller to be connected with a smart phone as shown in Figure 2.

Figure 2. A Simple MIDI System



The AT32WB415 works like a MIDI keyboard. It sends MIDI data to a mobile phone for decoding so that the phone is able to play music or melody.

2 MIDI controller

2.1 Functionality introduction

An example case is provided to demonstrate how MIDI controller works. By pressing the USER KEY on the evaluation board, MIDI data are sent to the connected target device for playing sound.

2.2 Resource requirements

1) Hardware

   Corresponding AT-START BOARD

2) Software

   SourceCode\at32wb415_ble_midi_ble_v2.0.0\projects\ble_app_gatt_midi

   SourceCode\at32wb415_ble_midi_mcu_v2.0.0\utilities\ble_midi_mcu\mdk_v5

2.3 Software design

1) Configuration procedures

   - Define data transmission format as a complete/full MIDI Message
   - Define a melody to be sent
   - Set USER Key so that it is able to send MIDI Message to Bluetooth after being pressed
   - Do not change Bluetooth code, and just send MCU data to the connected device

2) Code information

- midiCommand function

```
static void midiCommand(uint8_t status, uint8_t note, uint8_t velocity)
{
  /* | header | timestamp | status | note | velocity | */
  // MIDI data goes in the last three bytes of the midiMessage array:
  midiMessage[MIDI_STATUS_BYTE] = status;
  midiMessage[MIDI_NOTE_BYTE] = note;
  midiMessage[MIDI_VELOCITY_BYTE] = velocity;
}
```

- MIDI Message and Melody

```
/* | header | timestamp | status | note | velocity | */
static uint8_t midiMessage[] = {0x80, 0x80, 0x00, 0x00, 0x00};
/* Note value */
static uint8_t midiMelody[] = {64, 66, 71, 73, 74, 66, 64, 73, 71, 66, 74, 73};
```

2.4 Testing result

- A melody is sent once whenever USER KEY is pressed

3 Revision history

Table 4. Document revision history

Date	Revision	Changes
2022.12.19	2.0.0	Initial release

IMPORTANT NOTICE – PLEASE READ CAREFULLY

Purchasers are solely responsible for the selection and use of ARTERY's products and services, and ARTERY assumes no liability whatsoever relating to the choice, selection or use of the ARTERY products and services described herein.

No license, express or implied, to any intellectual property rights is granted under this document. If any part of this document deals with any third party products or services, it shall not be deemed a license grant by ARTERY for the use of such third party products or services, or any intellectual property contained therein, or considered as a warranty regarding the use in any manner whatsoever of such third party products or services or any intellectual property contained therein.

Unless otherwise specified in ARTERY's terms and conditions of sale, ARTERY provides no warranties, express or implied, regarding the use and/or sale of ARTERY products, including but not limited to any implied warranties of merchantability, fitness for a particular purpose (and their equivalents under the laws of any jurisdiction), or infringement of any patent, copyright or other intellectual property right.

Purchasers hereby agrees that ARTERY's products are not designed or authorized for use in: (A) any application with special requirements of safety such as life support and active implantable device, or system with functional safety requirements; (B) any air craft application; (C) any automotive application or environment; (D) any space application or environment, and/or (E) any weapon application. Purchasers' unauthorized use of them in the aforementioned applications, even if with a written notice, is solely at purchasers' risk, and is solely responsible for meeting all legal and regulatory requirement in such use.

Resale of ARTERY products with provisions different from the statements and/or technical features stated in this document shall immediately void any warranty grant by ARTERY for ARTERY products or services described herein and shall not create or expand in any manner whatsoever, any liability of ARTERY.