Introduction

The BM71-XPro board is a hardware platform designed to evaluate and test the capabilities of the BM71 Bluetooth® RF module. The BM71-XPro board provides multiple options for rapid prototyping and developing applications. The board is supported by Atmel Studio, an integrated development platform, which provides predefined applications and examples.

Features

• USB-UART Bridge (MCP2200) for Host PC Operation
• On Board 3.3V LDO for Power Regulation
• On Board SPI Flash for Storing Firmware Images (DFU OTA)
• Test Point for GPIO Pin (P1_3)
• Reset Push Button
• DIP Switch to Control:
  – BM71 operation mode
  – LED
  – GPIO pin
• Passive RC Filters for PWM and ADC Inputs
• Atmel Studio (ASF3), to Provide Predefined Application Examples
• XPRO Extension Header
• Header Pins for Current Measurement
• Two Power Sources:
  – Micro USB
  – XPRO Connector
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1. Kit Contents
The following figure shows the layout of the BM71-XPro board and illustrates the components available in the board:

Figure 1-1. BM71-XPro Board

Microchip offers several smartphone applications, available for free in both the App Store (iPhone®) and Google Play™ store (Android™), to evaluate the BM71 module. For details on the currently available apps, please refer to the BM71 XPro webpage.

1.1 Reference Documentation
For further information, refer to the following:
• **BM70/71 Bluetooth® Low Energy (BLE) Module Data Sheet (DS60001372)**
• **BM70/71 Bluetooth® Low Energy Module User’s Guide (DS50002542).**
2. **Hardware Features**

A description of some of the key features in the BM71-XPro board is provided below. Refer to Figure 1-1 for details of the kit contents.

2.1 **Power Supply**

Power the BM71-XPro kit using any of the power sources listed below:

- Micro USB port (J1)
- XPro Connector

Use the J2 header for selecting between these power supply options using a jumper. The green LED (LD1) indicates that the board is powered by a micro-USB. The micro-USB has ESD and overcurrent protection, and the input to the module is controlled via an LDO (U1). The BM71-XPro board can be operated in a standalone mode when powered via the micro-USB.

2.2 **USB-UART Bridge**

The MCP2200 in the BM71-XPro board provides the option to evaluate the BM71 module in Standalone mode. By default (out of the box), the BM71 module is set to operate in Auto mode. So, the module, once powered via the micro-USB, will be able to connect to a peer Bluetooth Low Energy device and open a data pipe for data transfer. Refer to 3.1 Connecting the BM71 XPRO to MBD App in Auto Mode for details. Apart from powering the board, the micro-USB port can also be used to evaluate and test the module via a host PC. Microchip provides emulation tools, such as a UI tool, auto pattern tool, and manual tool (refer to BM71 webpage for details) to evaluate the BM71 via a host PC. The BM71 module can be set to operate in Manual mode for complete control or in Auto mode for a simple data pipe application.

2.3 **XPRO Connector**

The BM71-XPro board has an Xplained Pro (XPRO) header to offer connectivity and control from a host MCU. The header is based on a standard extension header and its pin details are specified in the following table. The headers have a pitch of 2.54 mm. For details on the operating the BM71-XPro via a host MCU Xplained Pro board, refer to 3.3 Connecting the BM71-XPro to MBD App in Manual Mode (Host PC).

<table>
<thead>
<tr>
<th>Pin#</th>
<th>Pin name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ID</td>
<td>ID Chip communication</td>
</tr>
<tr>
<td>2</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>3</td>
<td>ADC1</td>
<td>Connected to pin P2_0 to set system configuration</td>
</tr>
<tr>
<td>4</td>
<td>ADC2</td>
<td>Connect to Reset pin of BM71</td>
</tr>
<tr>
<td>5</td>
<td>RTS/GPIO</td>
<td>Connected to host MCU RTS</td>
</tr>
<tr>
<td>6</td>
<td>CTS/GPIO</td>
<td>Connected to host MCU CTS</td>
</tr>
<tr>
<td>7</td>
<td>PWM+</td>
<td>PWM pin (+) of host MCU</td>
</tr>
<tr>
<td>8</td>
<td>PWM-</td>
<td>PWM pin (-) of host MCU</td>
</tr>
<tr>
<td>9</td>
<td>GPIO</td>
<td>Connected to GPIO pin P2_7 (TX_Ind)</td>
</tr>
<tr>
<td>10</td>
<td>GPIO</td>
<td>Connected to GPIO Pin P1_6 (RX_Ind)</td>
</tr>
</tbody>
</table>
2.4 DIP Switch

The DIP switch has three switches which provide the functions described in the following table.

Table 2-2. DIP Switch Functions

<table>
<thead>
<tr>
<th>Switch#</th>
<th>Function</th>
</tr>
</thead>
</table>
| 1       | Manually set the BM71 system configuration. Connected to pin P2_0.  
|         | • ON: Memory Programming mode  
|         | • OFF: Application mode |
| 2       | Turn the Blue LED (LD4) ON/OFF |
| 3       | Control the GPIO pin P1_3 |

2.5 Reset Switch

The Reset push button is connected to the BM71 module reset line. When the Reset button is pressed, it drives the reset line to ground. The BM71-XPro board has an on-board voltage detected reset IC (MCP112) connected to the Reset pin of the BM71.

2.6 Current Measurement Header

A J3 header can be used for current measurement. All power to the BM71-XPro is routed through these header pins. To measure the power consumption of the module, remove the jumper and replace it with an ammeter. To make sure only the power consumption of the BM71 module is measured, turn off the blue LED using switch #2 of the DIP switch.

2.7 On-board SPI Flash

An SST25VF080B SPI Flash memory is included in the BM71-XPro board for nonvolatile firmware storage. This can be used to update the device firmware for the BM71 or the host MCU.
Note: BM71 Xplained Pro board is intended for use for development, demonstration or evaluation purposes only. It is not a finished appliance, nor is it intended for incorporation into or reference design for finished appliances that are made commercially available.

Every effort has been made to minimize electromagnetic emissions from the product. However, under certain conditions, the system (this product connected to a host application circuit via Xplained Pro extension header for communicating with External SPI Flash) may emit individual electromagnetic component frequencies which exceed the maximum values allowed by the standards. The frequency and magnitude of the emissions will be determined by several factors, including layout and routing of the application with which the product is used. The recommendation is to add external series resistors on the Xplained Pro Extension Header SPI signals to the External SPI Flash if the product causes emissions above the permissible limits of the standard. For reference for the BM71 module placement and layout guidelines please refer the BM71 Module datasheet.
3. **Module Configuration**

The BM70/71 module supports following modes, which affect the overall Bluetooth Low Energy and hardware behavior:

- **Auto operation configuration or Auto mode**: By default, the BM70/71 module is set to operate in the Auto mode. The Auto mode restricts the available Bluetooth Low Energy operations by only allowing the Bluetooth Low Energy peripheral to act as a raw data pipe. This is compatible with hosts who only require the BM70/71 module to act as a virtual UART cable between the host and the remote peer device.

- **Manual operation configuration or Manual mode**: Manual operation provides the host MCU a lot more control and functional options over the BM71 Bluetooth Low Energy protocol and operation in comparison to the Auto Operation mode. This configuration is used by a host MCU to leverage the flexibility and feature set offered by both the Bluetooth Low Energy protocol and the BM71 module (for example: private services and characteristics).

**Note**: For more details, refer to the Section 1.1 Operation Overview in the BM70/71 Bluetooth Low Energy Module User’s Guide (DS50002542).

The simplest method to start evaluating the BM71 is to connect it to a host PC that supports USB CDC virtual COM (serial) ports and operates in Auto mode. In this mode, the user can directly connect to the BM71 from a peer device (phone app) and open a raw data pipe. Refer to 3.1 Connecting the BM71 XPRO to MBD App in Auto Mode for connection procedure. See 3.2 Configuring the BM71 Module to Operate in Manual Mode (Host PC) and 3.3 Connecting the BM71-XPro to MBD App in Manual Mode (Host PC) for an example of Manual mode of operation.

### 3.1 Connecting the BM71 XPRO to MBD App in Auto Mode

**Hardware/Software required:**

- BM71-XPro board; Mini-USB cable.
- A PC host supporting USB CDC virtual serial port. BM71-XPro board uses MCP2200 USB to UART bridge. The drivers can be downloaded from http://www.microchip.com/MCP2200.
- Terminal Emulator application. TeraTerm or CoolTerm is recommended.
- Microchip MBD app for iOS or Android. Available in:
  - **App Store** (iOS) for iPhones.
  - **Google Play Store** for Android phones.

By default, the BM71 module is set to operate in Auto mode. For details on the Auto mode of operation on the BM71 module, refer to section 1.1.2.1 in the BM70/71 User’s Guide (DS50002542).

The procedure to connect the BM71-XPro board to a peer device (phone/table) via host PC is given below:

1. Ensure that the BM71-XPro board is configured as follows:
   1.1. Jumper on the J2 header is closed to select USB power option.
   1.2. The current measurement jumper on J3 is present.
   1.3. Switch 1 (system configuration) on the DIP switch is set to OFF.
   1.4. Switch 2 (blue LED) on the DIP switch is set to ON.
2. Connect the BM71-XPro board to a host PC using the mini-USB cable. Ensure that green LED (LD1) is solid ON indicating USB power.
3. Connect BM71-XPro to a PC host using micro-USB cable.
   3.1. Verify the virtual COM port is enumerated on a host PC. If the COM port does not enumerate, the MCP2200 drivers may be missing from the host PC. If needed, the drivers can be downloaded from the www.microchip.com/MCP2200 webpage.
   3.2. Press the Reset button (SW1) and verify that the blue LED (LD4) is flashing intermittently.
4. Start the Terminal Emulator software. In this example, TeraTerm is used. Configure the serial port settings of the enumerated COM port as shown in the following figure.
5. Open the MBD app on the phone/tablet. Ensure that the Bluetooth is turned ON in the device.

6. On Dashboard, select “BM70”, see the following figure.

Figure 3-2. MBD Dashboard

7. In the follow-up screen, click Scan and “Scan” again at the bottom.

8. Once the scanning process completes, the BM71 module should appear as “BM71_BLE” by default.
9. Click on the “BM71_BLE” to start a connection process. Once connected, the transparent UART service available on the BM71 module should show up.

![Figure 3-3. MBD Scanning Process](image)

**Figure 3-3. MBD Scanning Process**

10. Click on “Transfer data to device”. The Transparent UART screen should open (see following figure). The data pipe is now open.

![Figure 3-4. MBD Connecting to BM71 XPRO](image)

**Figure 3-4. MBD Connecting to BM71 XPRO**
11. In the serial emulator application (TeraTerm), enter any text and this should show up in the transparent UART page in the app.

3.2 Configuring the BM71 Module to Operate in Manual Mode (Host PC)

Hardware/Software required:
- BM71-XPro board; Mini-USB cable.
- A PC host supporting USB CDC virtual serial port. BM71-XPro board uses MCP2200 USB to UART bridge. The drivers can be downloaded from http://www.microchip.com/MCP2200.
- BM71 emulator tools: UI Tool. These tools can be downloaded from the BM71 webpage.

The procedure to change the BM71 to Manual mode via host PC is given below:

1. Ensure that the BM71-XPro board is configured as follows:
   1.1. Middle jumper on J2 is closed to select USB power option.
   1.2. The current measurement jumper on J3 is present.
   1.3. Switch 2 (blue LED) on the DIP switch is set to ON.
2. Connect the BM71-XPro board to the host PC using the mini-USB cable. Ensure that the green LED (LD1) is solid ON indicating USB power.
3. Connect BM71-XPro board to the host PC using micro-USB cable. Verify the virtual COM port is enumerated on the host PC. If the COM port does not enumerate, the MCP2200 drivers may be missing from the host PC. If needed, the drivers can be downloaded from the http://www.microchip.com/MCP2200 web page.
4. Set switch 1 (system configuration) on the DIP switch to ON. Press the Reset button (SW1). The blue LED (LD4) should turn to a solid ON.
5. Open the UI tool (see the following figure) and Click on ‘Load’.
6. In the 'Loading Option' dialog box, select “Load Text File” option (see the following figure)

Figure 3-7. Loading Option

7. In the file browser, select “IS1871SF_102_BLEDK3v1.11_UI v1.00(BM71)_default.txt”
8. In the UI tool dialog box, click on “Edit”
9. Click ‘OK’ in ‘Feature’ dialog box.

10. In the UI Tool, under the ‘System Setup’:
   10.1. Set the UART_RX_IND (Low power operation) to ‘Disable’ from the drop-down menu.
   10.2. Set the Operation mode to “Manual Pattern” under the ‘Operation mode setting’ section.

11. Click ‘Finish’

12. In the UI Tool, click ‘Write’ (see following figure)
13. In the ‘Read/Write Flash’ dialog box, select an appropriate COM port and click on ‘Write’. In the confirmation window, click ‘Yes’ to update EFlash.

Figure 3-10. Read / Write Flash

14. After the successful Flash write, a confirmation message will be flashed as shown in the following figure.
15. Close the UI tool.
16. Set switch 1 (system configuration) on the DIP switch to ON. Press the Reset button (SW1). The blue LED (LD4) should blink intermittently.
17. The module is now set to work in Manual mode.

3.3 Connecting the BM71-XPro to MBD App in Manual Mode (Host PC)

Hardware/Software required:

- BM71-XPro board; Mini-USB cable.
- A PC host supporting USB CDC virtual serial port. BM71-XPro board uses MCP2200 USB to UART bridge. The drivers can be downloaded from http://www.microchip.com/MCP2200.
- BM71 emulator tools: UI Tool and Manual pattern tool. These tools can be download from the BM71 webpage.
- Microchip MBD app for iOS or Android. Available in:
  - App Store (iOS) for iPhones
  - Google Play Store for Android devices

To configure the module to operate in Manual mode, follow the procedure described in the 3.2 Configuring the BM71 Module to Operate in Manual Mode (Host PC). The procedure to connect to a peer device (phone/tablet) in Manual mode is given below:

1. Ensure that the BM71-XPro board is configured as follows:
   1.1. Middle jumper on J2 is closed to select USB power option.
   1.2. The current measurement jumper on J3 is present.
   1.3. Switch 1 (system configuration) on the DIP switch is set to OFF.
   1.4. Switch 2 (blue LED power) on the DIP switch is set to ON.
2. Connect the BM71-XPro board to the host PC using the mini-USB cable. Ensure that green LED (LD1) is solid ON indicating USB power.
3. Connect BM71-XPro to the host PC using micro-USB cable. Verify the virtual COM port is enumerated on host PC. If the COM port does not enumerate, the MCP2200 drivers may be missing from the host PC. If needed, the drivers can be downloaded from the http://www.microchip.com/MCP2200 webpage.
4. Press the Reset button (SW1) and verify that the blue LED (LD4) is flashing intermittently.
5. Open the manual pattern tool. Select the enumerated COM port for the BM71-XPro board in the COM port drop down list (top-left - see following figure) and click ‘Connect’. The ‘Connect’ button should change to ‘Disconnect’ upon a successful connection.
6. To verify the module information (not mandatory), in the ‘Common’ tab (left side), under the ‘Common Command’ section, select ‘0x01: Read Local Information’ for the ‘Opcode’ field. Click ‘Send’ (see following figure). The module will respond with the Bluetooth MAC address, firmware version and hardware version. The response is shown in the “Log view” window.
7. To begin advertising, enter the ‘GAP’ tab, under the ‘GAP Command’ section, select the following options for each field (see following figure):

7.1. Select “0x1C: Set Adv Enable” for Opcode field.
7.2. Select “0x01: Enter Standby Mode” for the Standby mode field.
7.3. Click “Send”.

8. Once the module enters the Standby mode (started advertising), the BT Status field will be updated (see the following figure).
9. Open the MBD app on the phone/tablet. Ensure that the Bluetooth is turned ON in the device.

10. On Dashboard, select “BM70”, see the following figure.
11. In the follow-up screen, click **Scan** and “Scan” again at the bottom.
12. Once the scanning process completes, the BM71 module should appear as “BM71_BLE” by default.

Figure 3-16. MBD Scanning Process

13. Click on the “BM71_BLE” to start a connection process. Once connected, the transparent UART service available on the BM71 module should show up.
14. The manual tool should show the connection details once the connection from the peer device (phone/tablet) is successfully executed (see the following figure).
15. On the MBD app, click on “Transfer data to device”. The Transparent UART screen should open. Ensure that the ‘Write with Response’ in the app is set to ON. The data pipe is now open.
16. The manual tool should provide the message for the data pipe in the log view (see following figure).
17. Go to the ‘Transparent’ tab on the manual tool. Check operation of the data pipe, by entering data in the app or in the ‘Send Data’ field in the manual tool.
18. The transparent UART data pipe is now operational in Manual mode.

3.4 Using the BM70/71 MCU drivers

Microchip offers a library of MCU drivers for the BM70/71 modules integrated into the Harmony and ASF3 for MPLAB® and Atmel Studio, respectively. This section describes how to access the BM71 MCU drivers from ASF3 library in Atmel Studio.

Hardware/software required:
- Atmel Studio 7.x7.0 with ASF3 installed (version 3.44.0 or later).
- SAML21 Xplained Pro board.
- BM71-XPro board.

To use the BM71 MCU drivers in ASF3, the BM71-XPro board needs to be connected to EXT1 header of the BM71-XPro board (see following figure).
1. Connect to the BM71-XPro board to EXT1 header of the SAML21 Xplained Pro board. Open Atmel Studio software. On the top menu, select ‘File’ → ‘New’ → ‘Example Project’.

2. In the ‘New Example Project’ dialog box

2.1. Select Device Family: as “SAML21” from the drop down list and enter ‘ble_host_sdk’ in the search field as shown in the following figure. The list of example projects should be available in the ‘All Projects’ tab. (If not visible, try clicking on the horizontal triangle to expand the list under ‘Atmel-Atmel Corp.’ header.)
3. The list of available example projects is provided. Select any project to get started. In the preceding figure, the iBeacon was selected as an example. Click OK in the succeeding dialog box to accept the terms and conditions. The iBeacon example will now be loaded as can be seen in the following Solution Explorer window.
Figure 3-24. Solution Explorer window in Atmel Studio

**Note:** For more instructions on executing the project, click on the ‘iBeacon_Demo_Getting_Started_Guide.pdf’ file for details.

4. Follow the instructions in the getting started guide to build, load, and test the project.
Appendix A. Updating the BM71 Module Firmware

The firmware in the BM71 module can be updated using a PC Tool isupdate.exe over the USB port. The latest BM71 firmware images and the isupdate.exe tool are available from the BM71 product webpage.

The procedure to change/update the firmware on the BM71 module using the host PC utility is given below:

1. Download the firmware zip file from the BM71 webpage and extract the contents. The zip file contains the isupdate.exe utility and a folder including the firmware images.
2. Connect the BM71-XPro board to the host PC using the micro-USB cable.
3. Verify that switch#1 of the DIP switch (SW2) is set to ON position. Press Reset button (SW1) and verify that the blue LED (LD4) is solid ON indicating that the BM71 is in Memory Programming mode.
4. Launch the isupdate.exe application. In the tool:
   4.1. Select the COM port used by the BM71-XPro board.
   4.2. Verify that other settings (baud, memory type, and address) are set as follows:
       4.2.1. Baudrate: 115200
       4.2.2. Memory type/subtype: Flash/Embedded
       4.2.3. Address: 0000

   Figure 4-1. Firmware Update Tool

4.3. Click the Connect button and verify that the "Port connect -> COMxx" is displayed in the text box.
4.4. Verify firmware update is successfully completed. The "End of Write Memory" message is displayed.
4.5. Click the Disconnect button to close the COM port.
4.6. Set switch 1 in DIP switch SW2 to the ‘1’ position for Application mode.
Appendix B. Schematics and Bill of Materials

The schematic and the Bill of Materials (BOM) for the BM71-XPro board are provided below.
<table>
<thead>
<tr>
<th>Quantity</th>
<th>Designator</th>
<th>Description_</th>
<th>Manufacturer 1</th>
<th>Manufacturer Part Number 1</th>
<th>Supplier 1</th>
<th>Supplier Part Number 1</th>
<th>Populated</th>
<th>Quantity</th>
<th>MCHP-ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C1</td>
<td>CAP CER 10000pF 50V 10% X7R SMD 0402</td>
<td>Murata</td>
<td>GRM155R71E103KA01D</td>
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6. **Agency Certification**

This equipment (SAM R34 Xplained Pro Evaluation Kit/A09-3167) is intended for evaluation purposes only. The following regulatory notices are to cover the requirements under the regulatory approval.

6.1 **Europe**

This equipment (A09-3167) has been assessed under the Radio Equipment Directive (RED) for use in European Union countries. A Declaration of Conformity must be issued for each of these standards and kept on file as described in Radio Equipment Directive.

Furthermore, the manufacturer must maintain a copy of the module’s documentation and ensure the final product does not exceed the specified power ratings, antenna specifications, and/or installation requirements as specified in the user manual. If any of these specifications are exceeded in the final product, a submission must be made to a notified body for compliance testing to all required standards.

**Important:** On account of the nature of radio equipment, the height of the CE marking affixed to radio equipment may be lower than 5 mm, provided that it remains visible and legible. More detailed information about CE marking requirements, refer Article 19 of "DIRECTIVE 2014/53/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL" of 16 April 2014.

**Simplified EU Declaration of Conformity**

Hereby, Microchip Technology Inc. declares that the radio equipment type [A09-3110] is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address (refer product specific pages): [http://www.microchip.com/design-centers/wireless-connectivity/](http://www.microchip.com/design-centers/wireless-connectivity/).
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