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Bluetooth® Low Energy (BLE) Module

Features

- Qualified for Bluetooth SIG v4.2 specifications
- Certified to FCC, IC, MIC, KCC, NCC and SRRC radio regulations
- European R&TTE Directive Assessed Radio module
- RoHS compliant
- Supports UART interface
- Supports transparent UART data service of BLE
- BM70 module supports 3-channel pulse-width modulation (PWM) and BM71 module supports 1-channel PWM
- Precision Temperature Sensor (PTS) for ambient temperature detection
- 12-bit ADC (ENOB=10 or 8 bits) supports for battery and voltage detection
- 8-channel ADC for BM70 module and 5-channel ADC for BM71 module are provided
- 18 general purpose I/O (GPIO) pins for BM70 module and 9 GPIO pins for BM71 module
- Integrated 32 MHz crystal
- Small and compact surface mount module
- Castellated surface mount pads for easy and reliable host PCB mounting

RF Features

- ISM band 2.402 GHz to 2.480 GHz operation
- Channels: 0-39
- Receive Sensitivity: typical -90 dBm (LE)
- Transmit Power: 0 dBm (typical)
- Received Signal Strength Indication (RSSI) monitor with 1 dB resolution

MAC/Baseband/Higher Layer Features

- Secure AES128 encryption
- Bluetooth 4.2: GAP, GATT, SMP, L2CAP and integrated public profile
- Create custom GATT services, refer to the "*BM70/71 Bluetooth® Low Energy Module User's Guide*" (DS50002542) for details on creating GATT services
- I/O capability for Bluetooth 4.0/4.2 authentication
- Configurable role as peripheral/central, client/server
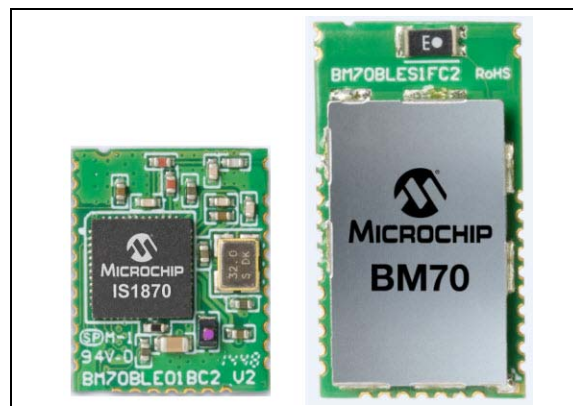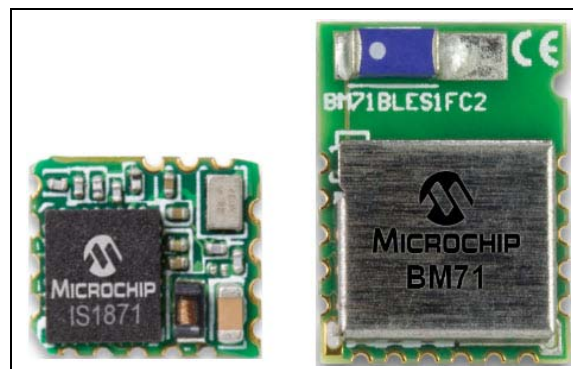
FIGURE 1: **BM70 MODULE**

FIGURE 2: **BM71 MODULE**

Antenna

- Integrated chip antenna (BM7xBLES1FC2)
- External antenna connection through RF pad (BM7xBLE01FC2)

Power Management

- Two low-power modes supported, wake-up through GPIO or internal timer
- Average current: Tx=3.3 mA and Rx=3.2 mA with buck at 3.0V VBAT input and 18.75 msec connection interval.

Operating Conditions

- Operating voltage range: 1.9V to 3.6V
- Operating temperature: -40ºC to +85ºC

BM70/71

Applications

- Internet of Things (IoT)
- Payment or Security
- Wearable Devices
- Home and Security
- Health and Fitness
- Beacons
- Industrial and Data Logger

General Description

The BM70/71 module offers BLE solution for embedded applications. It conforms to the Bluetooth core specification version 4.2 to enhance the throughput and security for the IoT applications. It also supports Beacon technology to enhance user experience for the IoT applications and enables users to control the cloud and receive data without opening the application through a smartphone.

The BM70/71 module has Bluetooth stack integrated and is available in different form factors to optimize the space, cost, and RF performance. The power-optimized design minimizes current consumption and extends battery life for portable and wearable applications.

BM70/71

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NOTES:

1.0 DEVICE OVERVIEW

The BM70/71 embedded 2.4 GHz Bluetooth 4.2 BLE module is built around Microchip Technology IS1870/71 BLE Integrated Circuit (IC). The IS1870/71 IC includes an on-board Bluetooth stack, a power management subsystem, a 2.4 GHz transceiver, and a RF power amplifier. The user can embed Bluetooth functionality into any end product using the BM70/71 module.

The BM70/71 module enables rapid product development and faster time to market. It is designed to provide simple Bluetooth solutions with the following features:

- Simple integration and programming
- Reduced development time
- Superior wireless module with low-cost system
- Interoperability with Apple® iOS and Android™ OS
- Wide range of applications

In addition, the BM70/71 module supports Beacon technology to improve the user experiences in IoT applications, such as auto connection/control and data to cloud.
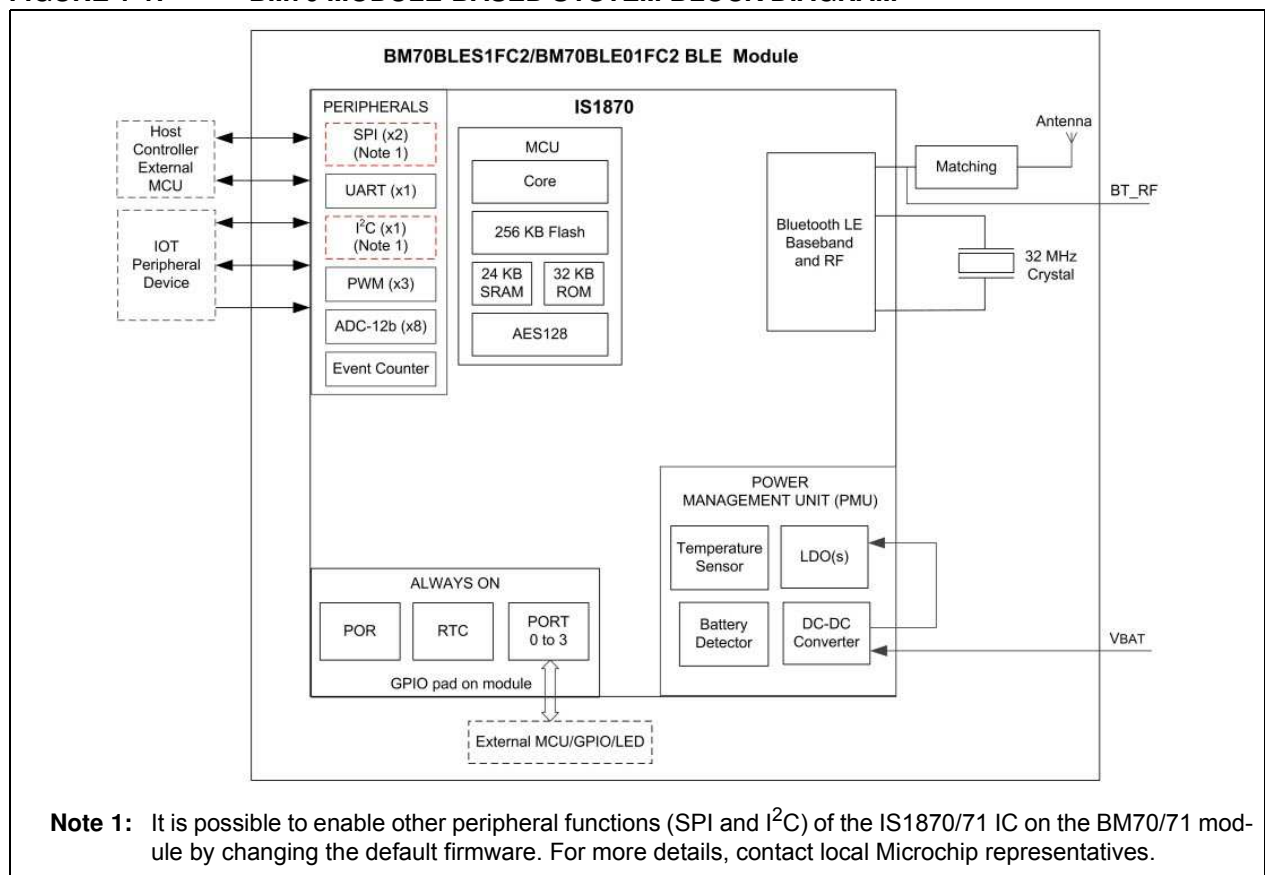
The BM70/71 module can independently maintain a low-power wireless connection. Low-power usage and flexible power management maximize the lifetime of the BM70/71 module in battery operated devices. A wide operating temperature range enable its applications in indoor and outdoor environments.

The BM70/71 module is a small, compact, and surface-mounted module with castellated pads for easy and reliable host PCB mounting. The relatively small form factor of the module is targeted for applications, such as wearable sports, fitness devices and so on.

1.1 Interface Description

Figure 1-1 and Figure 1-2 illustrate an example of the BM70/71 module-based system.

FIGURE 1-1: BM70 MODULE-BASED SYSTEM BLOCK DIAGRAM

Note 1: It is possible to enable other peripheral functions (SPI and I^{2}C) of the IS1870/71 IC on the BM70/71 module by changing the default firmware. For more details, contact local Microchip representatives.

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FIGURE 1-2: **BM71 MODULE-BASED SYSTEM BLOCK DIAGRAM**

Note 1: It is possible to enable other peripheral functions (SPI and I^{2}C) of the IS1870/71 IC on the BM70/71 module by changing the default firmware. For more details, contact local Microchip representatives.
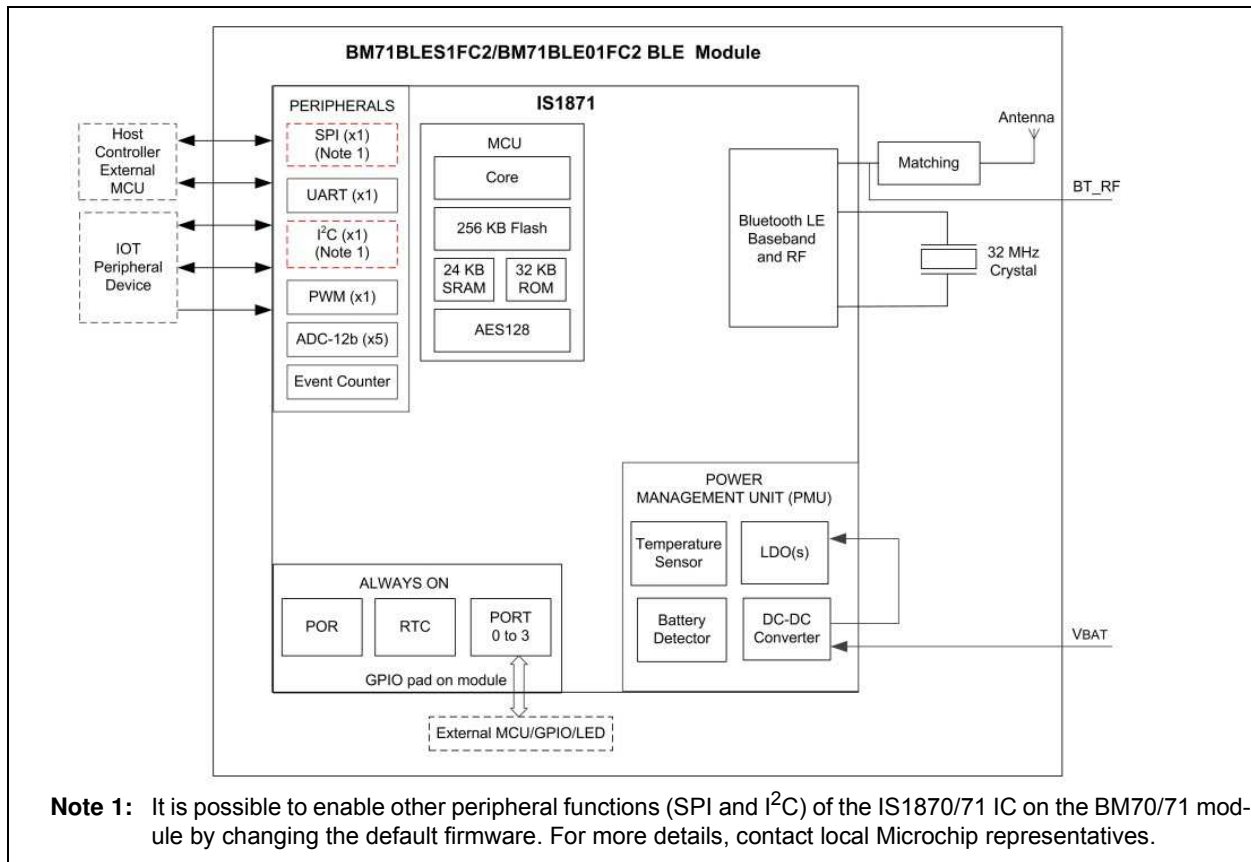
Figure 1-3 through Figure 1-6 illustrate the pin diagrams of the BM70/71 module.

FIGURE 1-3: **BM70BLE01FC2 PIN DIAGRAM**

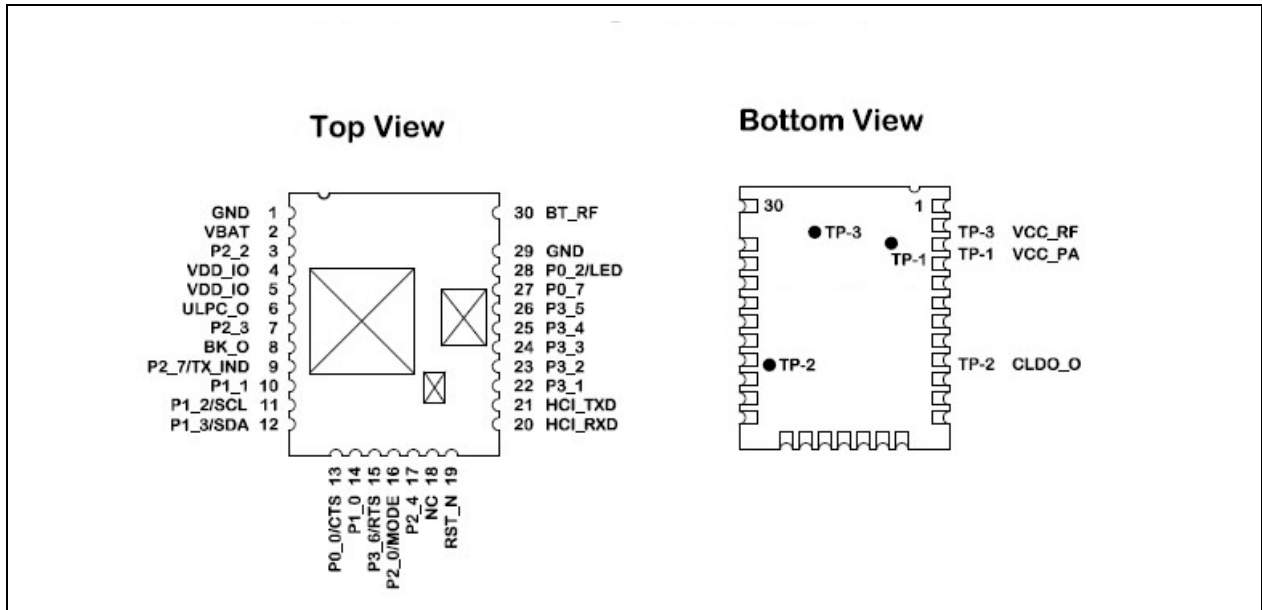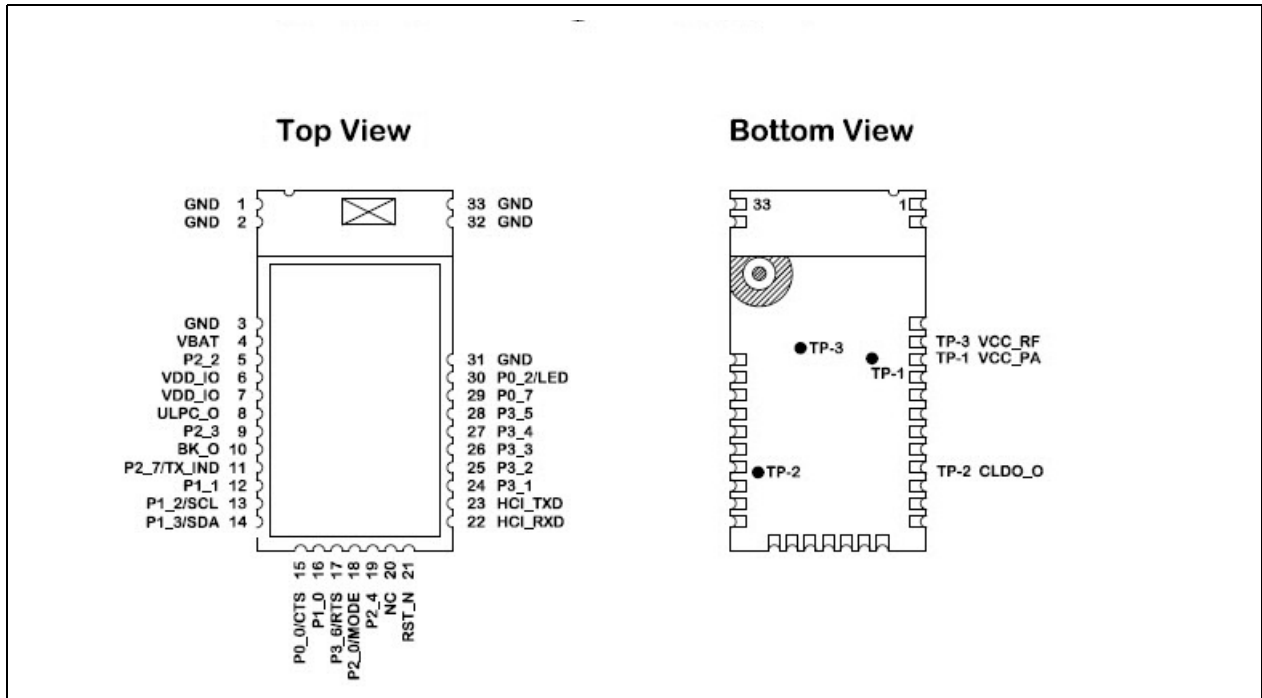**FIGURE 1-4:** **BM70BLES1FC2 PIN DIAGRAM**

BM70/71

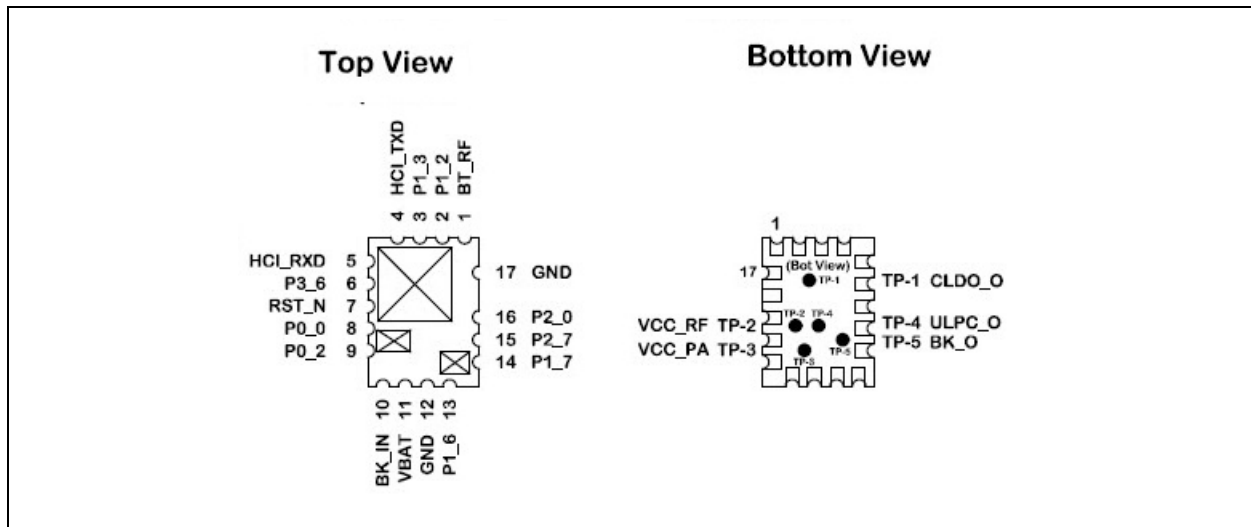**FIGURE 1-5:** **BM71BLE01FC2 PIN DIAGRAM**

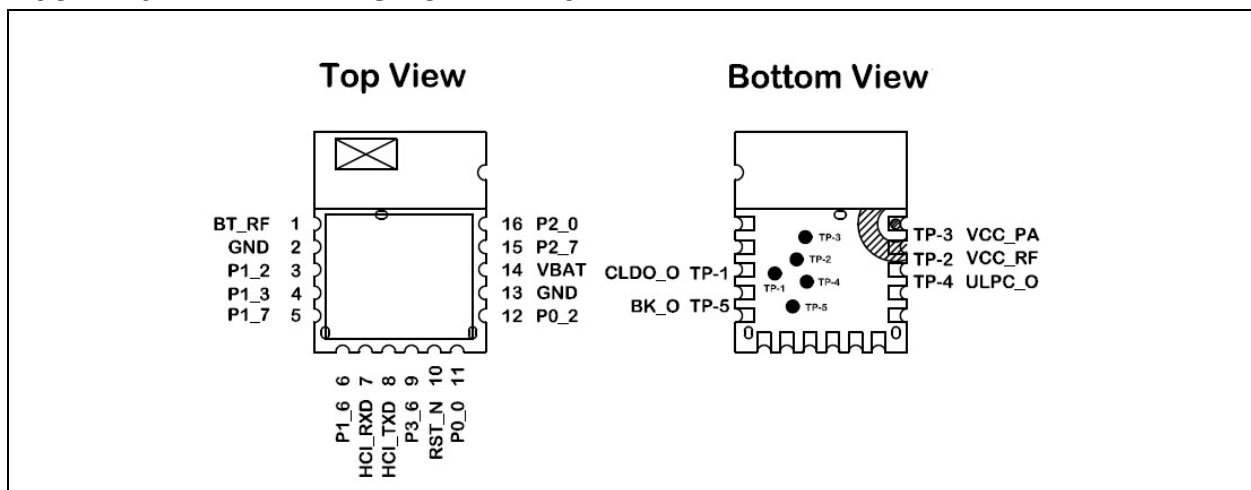**FIGURE 1-6:** **BM71BLES1FC2 PIN DIAGRAM**

Table 1-1 provides pin descriptions of the BM70/71 module.

TABLE 1-1:   BM70/71 PIN DESCRIPTION

BM70BLE01FC2	BM70BLES1FC2	BM71BLE01FC2	BM71BLES1FC2	Pin Name	Type	Description
—	1	—	—	GND	Power	Ground reference
—	2	—	—	GND	Power	Ground reference
1	3	12	13	GND	Power	Ground reference
2	4	11	14	VBAT	Power	Battery input. Voltage range: 1.9V to 3.6V
—	—	10	—	BK_IN	Power	Buck input. Voltage range: 1.9V to 3.6V
3	5	—	—	P2_2	DIO	GPIO, default pull-high input PWM1
4	6	—	—	VDD_IO	Power	I/O positive supply. Do not connect. Ensure VDD_IO and MCU I/O voltage are compatible
5	7	—	—	VDD_IO	Power	I/O positive supply. Do not connect. Ensure VDD_IO and MCU I/O voltage are compatible
6	8	—	—	ULPC_O	Power	1.2V programmable ULPC LDO output for AON-logic and retention memory supply. Internal use only, do not connect to other devices
7	9	—	—	P2_3	DI	GPIO, default pull-high input PWM2
8	10	—	—	BK_O	Power	1.55V buck output. Internal use only, do not connect to other devices
—	—	13	6	P1_6	DIO	P1_6
—	—	14	5	P1_7	DIO	P1_7
9	11	15	15	P2_7/TX_IND	DIO AI DO	GPIO: P2_7 ADC Input: AD14 TX_IND
10	12	—	—	P1_1	DIO AI	GPIO: P1_1 ADC Input: AD9
11	13	2	3	P1_2	DIO AI	GPIO, default pull-high input AD10
12	14	3	4	P1_3	DIO AI	GPIO, default pull-high input AD11
13	15	8	11	P0_0	DIO AI DI	GPIO, default pull-high input AD0 UART flow-control CTS
14	16	—	—	P1_0	DIO AI	GPIO, default pull-high input AD8
15	17	6	9	P3_6	DIO DO DO	GPIO, default pull-high input PWM0 UART flow-control RTS
16	18	16	16	P2_0	DI	System configuration, default pull-high input H: Application mode L: Test mode
17	19	—	—	P2_4	DIO	GPIO, default pull-high input
18	20	—	—	NC	—	No connection

Legend: A = Analog   D = Digital   I = Input   O = Output

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TABLE 1-1: **BM70/71 PIN DESCRIPTION (CONTINUED)**

BM70BLE01FC2 (Continued)	BM70BLES1FC2	BM71BLE01FC2	BM71BLES1FC2	Pin Name	Type	Description
19	21	7	10	RST_N	DI	Module Reset (active-low) (internal pull up)
20	22	5	7	HCI_RXD	DI	HCI UART data input
21	23	4	8	HCI_TXD	DO	HCI UART data output
22	24	—	—	P3_1	DIO	GPIO: P3_1
23	25	—	—	P3_2	DIO	GPIO: P3_2
24	26	—	—	P3_3	DIO	GPIO: P3_3
25	27	—	—	P3_4	DIO	GPIO: P3_4
26	28	—	—	P3_5	DIO DO	GPIO, default pull-high input LED1
27	29	—	—	P0_7	DIO AI	GPIO, default pull-high input AD7
28	30	9	12	P0_2/LED	DIO AI	P02 AD2
29	31	17	2	GND	Power	Ground reference
—	32	—	—	GND	Power	Ground reference
30	—	1	1	BT_RF	AI	External antenna connection (50 Ohm) Only for BM70BLE01FC2 and BM71BLE01FC2 No connection for BM71BLES1FC2
—	33	—	—	GND	Power	Ground reference

Legend: A = Analog   D = Digital   I = Input   O = Output

Table 1-2 provides the hardware features of the BM70/71 module.

> **Note:** The default firmware of the IS1870/71 IC on the BM70/71 module allows some internal peripheral functionality to be exposed. For details, refer to the "*BM70/71 Bluetooth® Low Energy Module User's Guide*" (DS50002542). It is possible to enable other peripheral functions (SPI and I^{2}C) of the IS1870/71 IC on the BM70/71 module by changing the default firmware. For more details, contact local Microchip representatives.

TABLE 1-2: BM70/71 MODULE HARDWARE FEATURES

Feature/ Modules	BM70BLES1FC2		BM70BLE01FC2		BM71BLES1FC2		BM71BLE01FC2	
Configuration	Module H/W	Default IS1870 Firmware	Module H/W	Default IS1870 Firmware	Module H/W	Default IS1871 Firmware	Module H/W	Default IS1871 Firmware
UART	1	1	1	1	1	1	1	1
GPIO (see **Note 2**)	18	13	18	13	9	4	9	4
12-bit ADC Channels	8	6	8	6	5	3	5	3
PWM	3	2	3	2	1	0	1	0
Total Pins	33	—	30	—	16	—	17	—
On-board Antenna with CAN	Yes	—	—	—	Yes	—	—	—
No Antenna	—	—	Yes	—	—	—	Yes	—
Government Regulatory RF Certified	Yes	—	—	—	Yes	—	—	—
Size (mm)	12x22x2.4	—	12x15x1.6	—	9x11.5x2.1	—	6x8x1.6	—

Note 1: The GPIO, ADC and PWM numbers used are based on disabling the LED indication and UART Hardware flow-control (RTS/CTS) functionality, see Table 1-1.

2: For a detailed explanation on GPIO, refer to the "*BM70/71 Bluetooth® Low Energy Module User's Guide*" (DS50002542).

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Table 1-3 provides the details of the test pads used for the production test on the bottom of the BM70/71 module, see Figure 1-3 through Figure 1-6 for more details.

TABLE 1-3: TEST PADS DETAILS

BM70BLE 01FC2	BM70BLE S1FC2	BM71BLE 01FC2	BM71BLE S1FC2	Pin Name	Type	Description
TP-1	TP-1	TP-3	TP-3	VCC_PA	Power	1.55V RF PA LDO
TP-2	TP-2	TP-1	TP-1	CLDO_O	Power	1.2V CLDO output
TP-3	TP-3	TP-2	TP-2	VCC_RF	Power	1.28V RF LDO output
—	—	TP-4	TP-4	ULPC_O	Power	1.2V ULPC LDO output
—	—	TP-5	TP-5	BK_O	Power	1.55V buck output

2.0 APPLICATION INFORMATION

2.1 Reference Schematics

Figure 2-1 through Figure 2-8 illustrate the BM70/71 module reference circuits for various Stock Keeping Units (SKUs). The GPIOs are configurable and the connection depends on the user's application circuit.

The power input range is 1.9V to 3.6V. If the battery is used, the battery reverse protection circuit is recommended. The VDD_IO voltage is same as power input. If the LED is used, ensure that the voltage is more than 3V to drive the LED. A 1.8V Reset IC is added as an optional circuit to prevent the Flash data crash, when VBAT power is unstable. It is recommended to implement the RF antenna matching circuit, as illustrated in Figure 2-3 and Figure 2-5 to fine tune the antenna impedance matching.
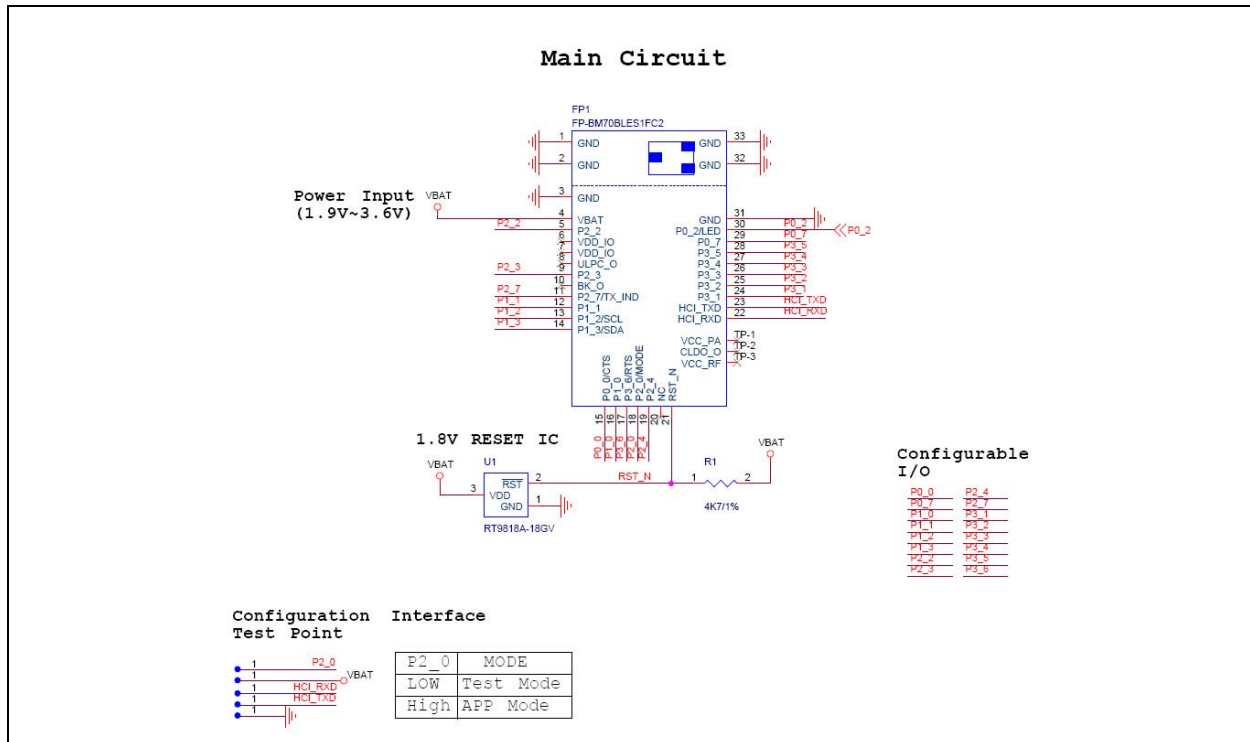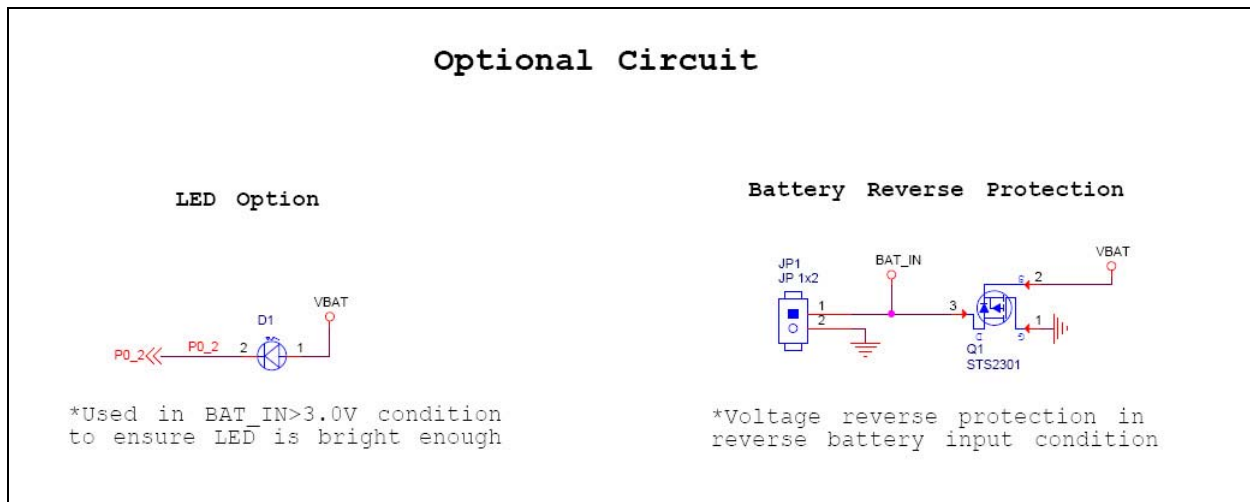
FIGURE 2-1: **BM70BLES1FC2 REFERENCE CIRCUIT**

FIGURE 2-2: **BM70BLES1FC2 REFERENCE CIRCUIT**

BM70/71

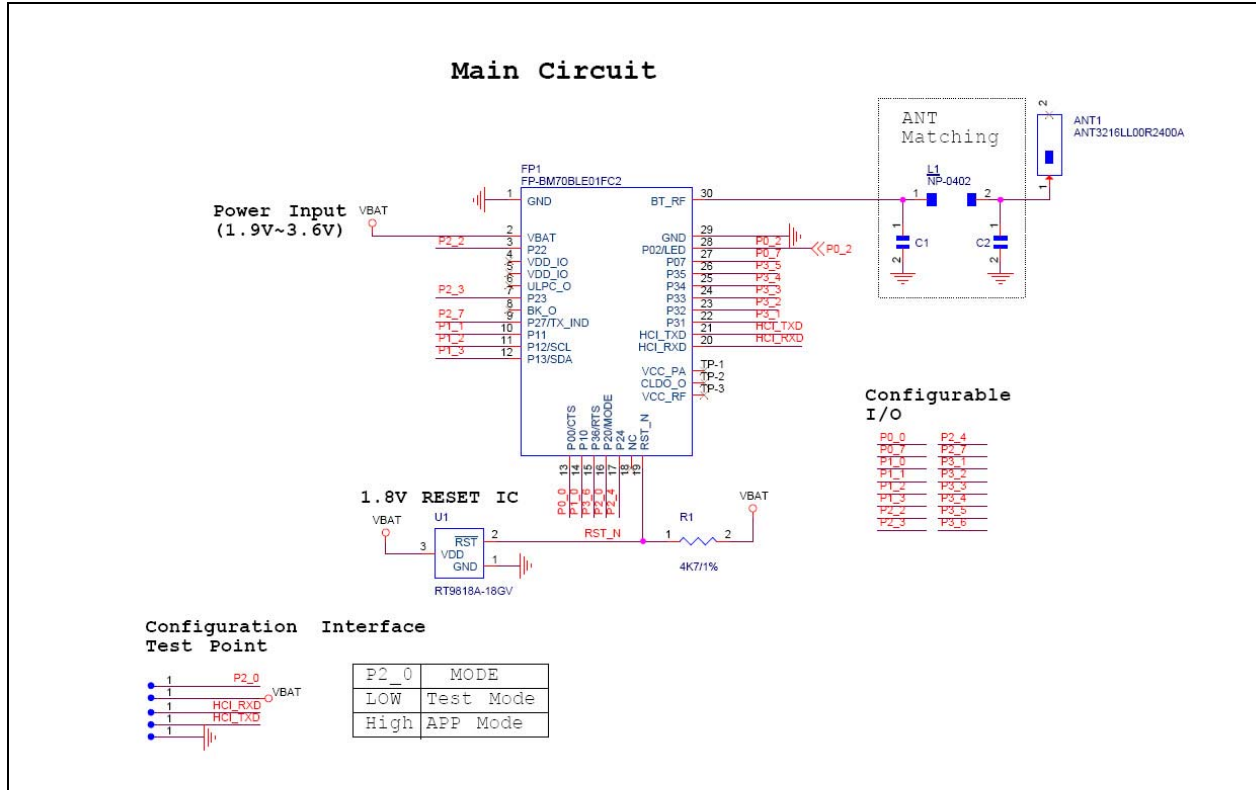**FIGURE 2-3:** **BM70BLE01FC2 REFERENCE CIRCUIT**

FIGURE 2-4: **BM70BLE01FC2 REFERENCE CIRCUIT**
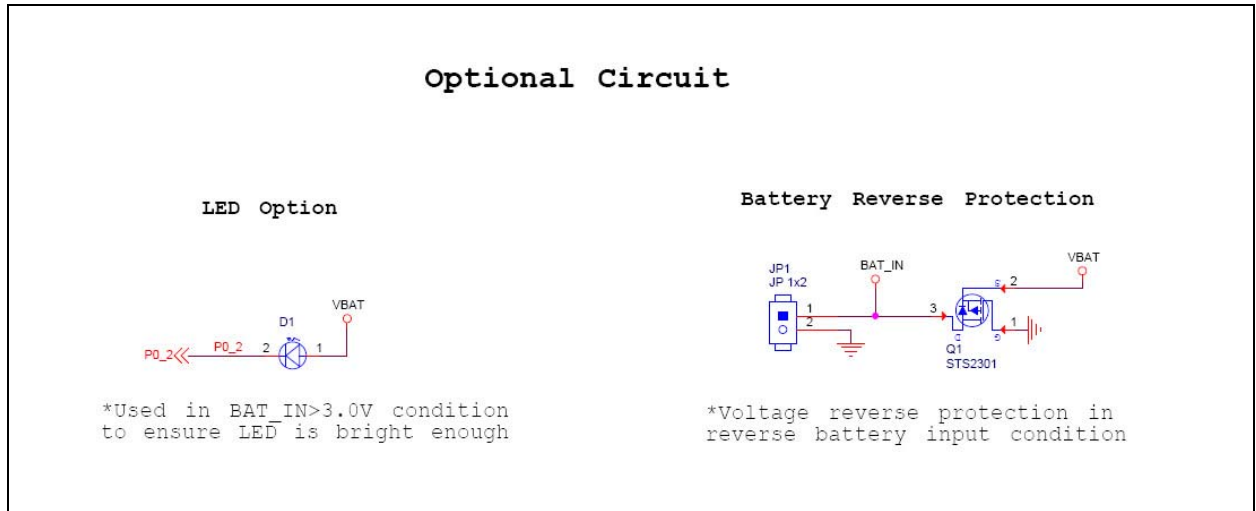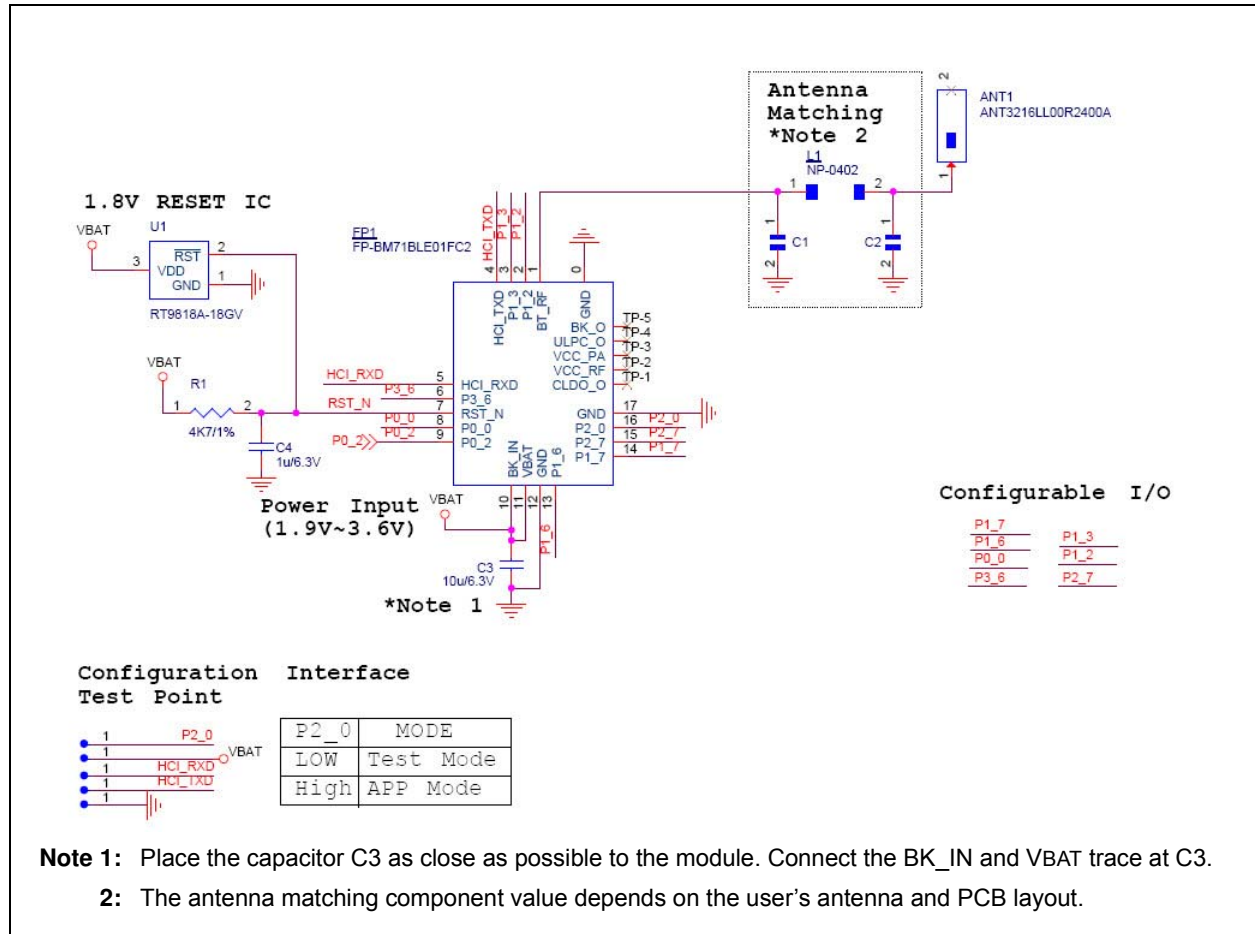
FIGURE 2-5:   BM71BLE01FC2 REFERENCE CIRCUIT

Note 1: Place the capacitor C3 as close as possible to the module. Connect the BK_IN and VBAT trace at C3.

    2: The antenna matching component value depends on the user's antenna and PCB layout.

FIGURE 2-6:   BM71BLE01FC2 REFERENCE CIRCUIT
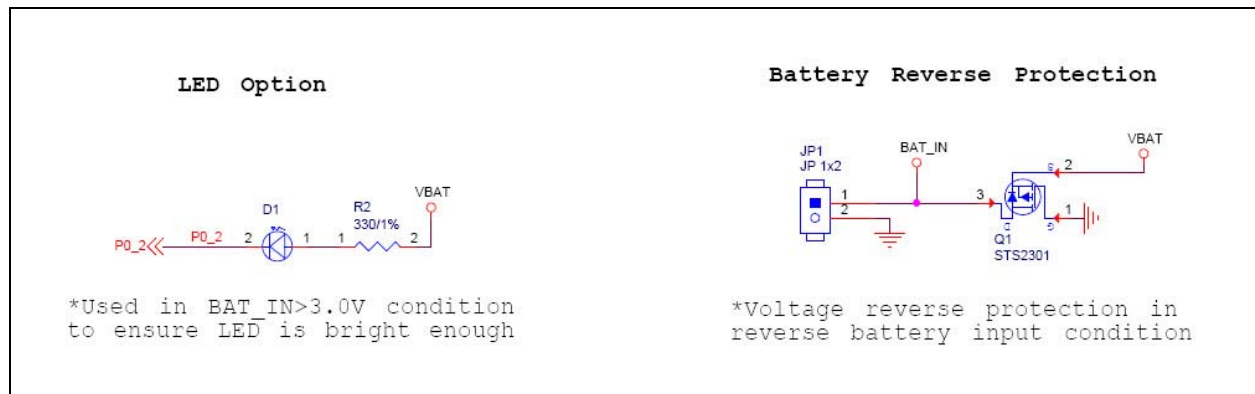
BM70/71

FIGURE 2-7: **BM71BLES1FC2 REFERENCE CIRCUIT**

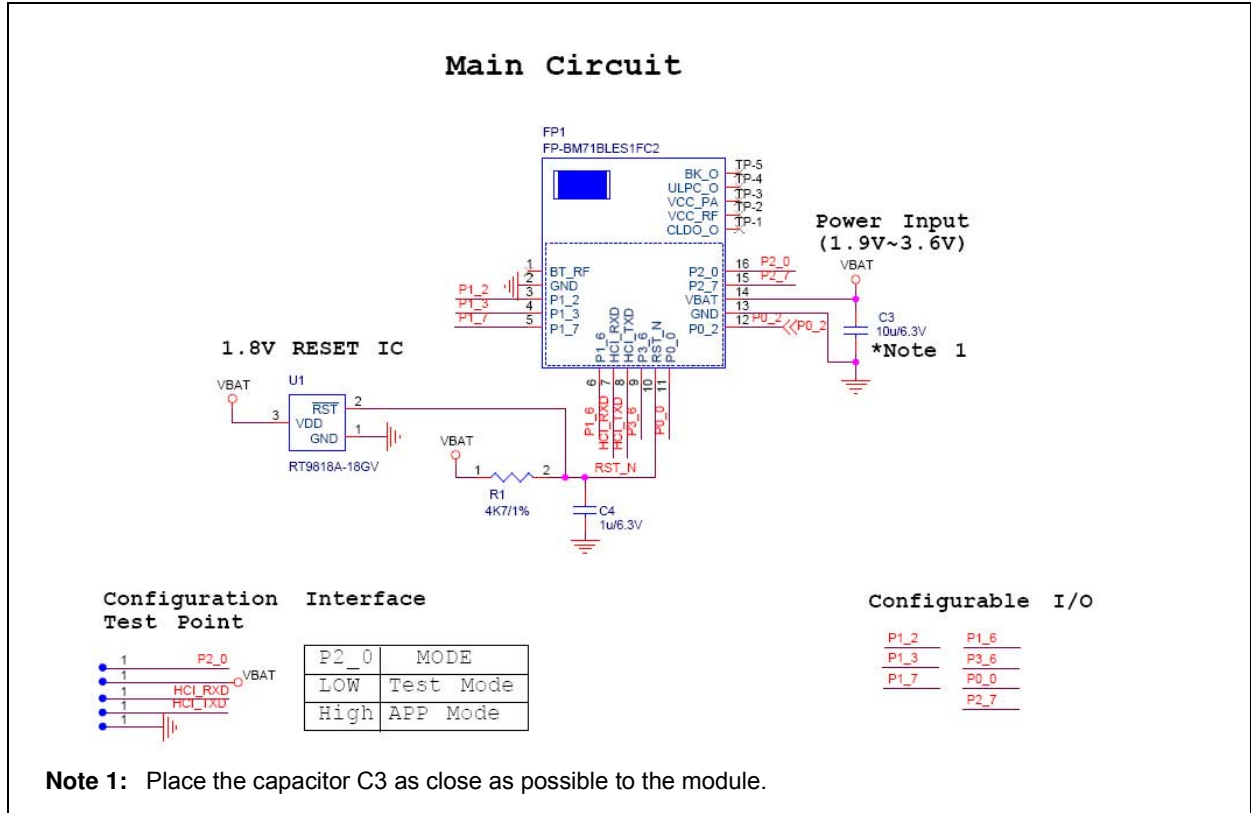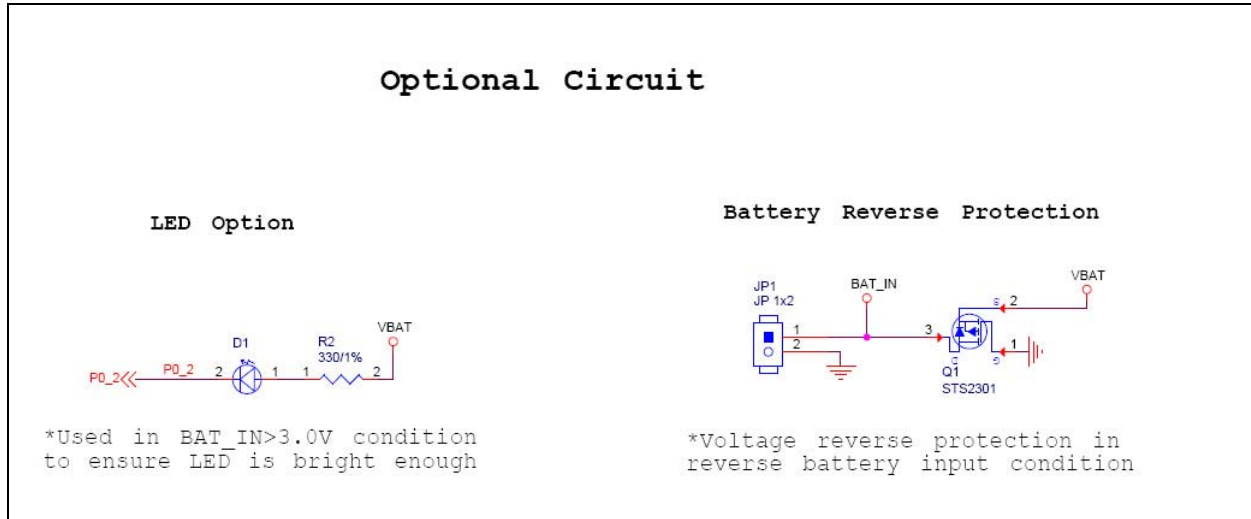**Note 1:** Place the capacitor C3 as close as possible to the module.

**FIGURE 2-8:** **BM71BLES1FC2 REFERENCE CIRCUIT - OPTIONAL**

2.2 External Configuration and Programming

The BM70/71 module can be configured and programmed by using an external configuration and programming tool. Figure 2-9 illustrates the minimum signals that must be included on the host PCB for the development.

Configuration and programming modes can be entered according to the system configuration I/O pins. For additional information, refer to **3.4 "System Configuration"**.

FIGURE 2-9: EXTERNAL CONFIGURATION AND PROGRAMMING
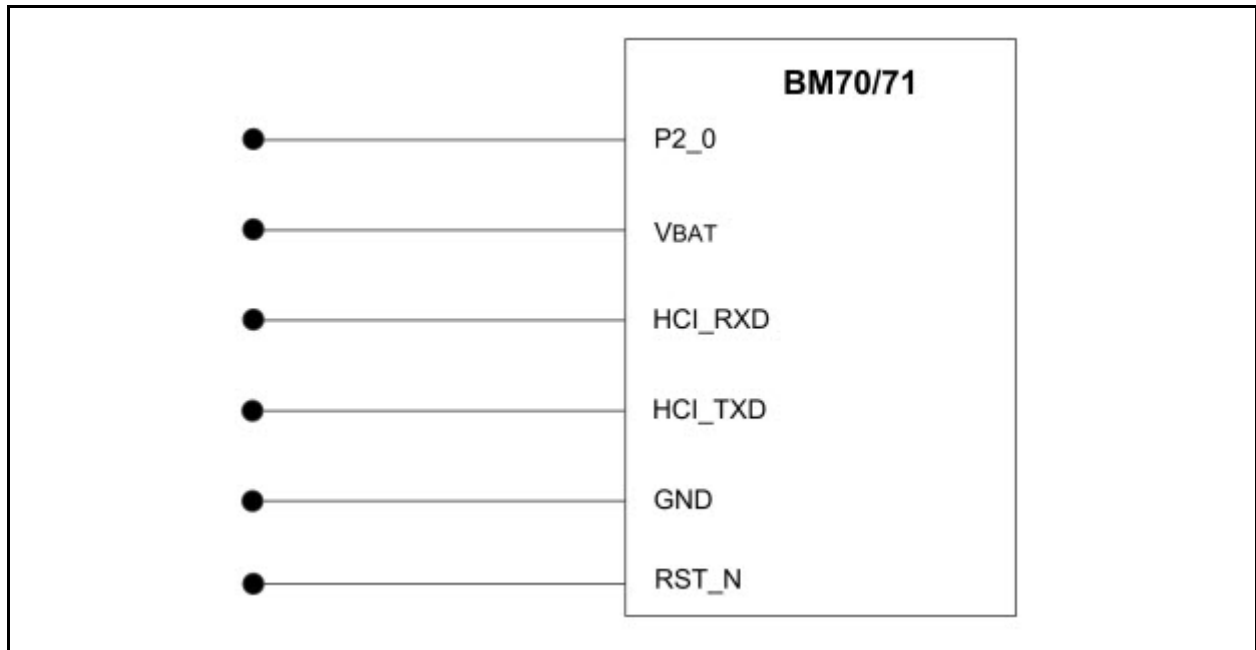
BM70/71

2.3 Host MCU Interface

2.3.1 HOST MCU INTERFACE OVER UART

Figure 2-10 and Figure 2-11 illustrate the BM70/71 module to host MCU interface over UART. The Host Control Interface (HCI) UART lines are used to commu-nicate between the BM70/71 module and MCU. The interface also illustrates the power scheme using a 3.3V Low-Drop Out (LDO) regulator that supply 3.3V to the BM70/71 (BAT_IN) and MCU VDD. This power scheme ensures that the BM70/71 module and MCU I/O voltages are compatible.
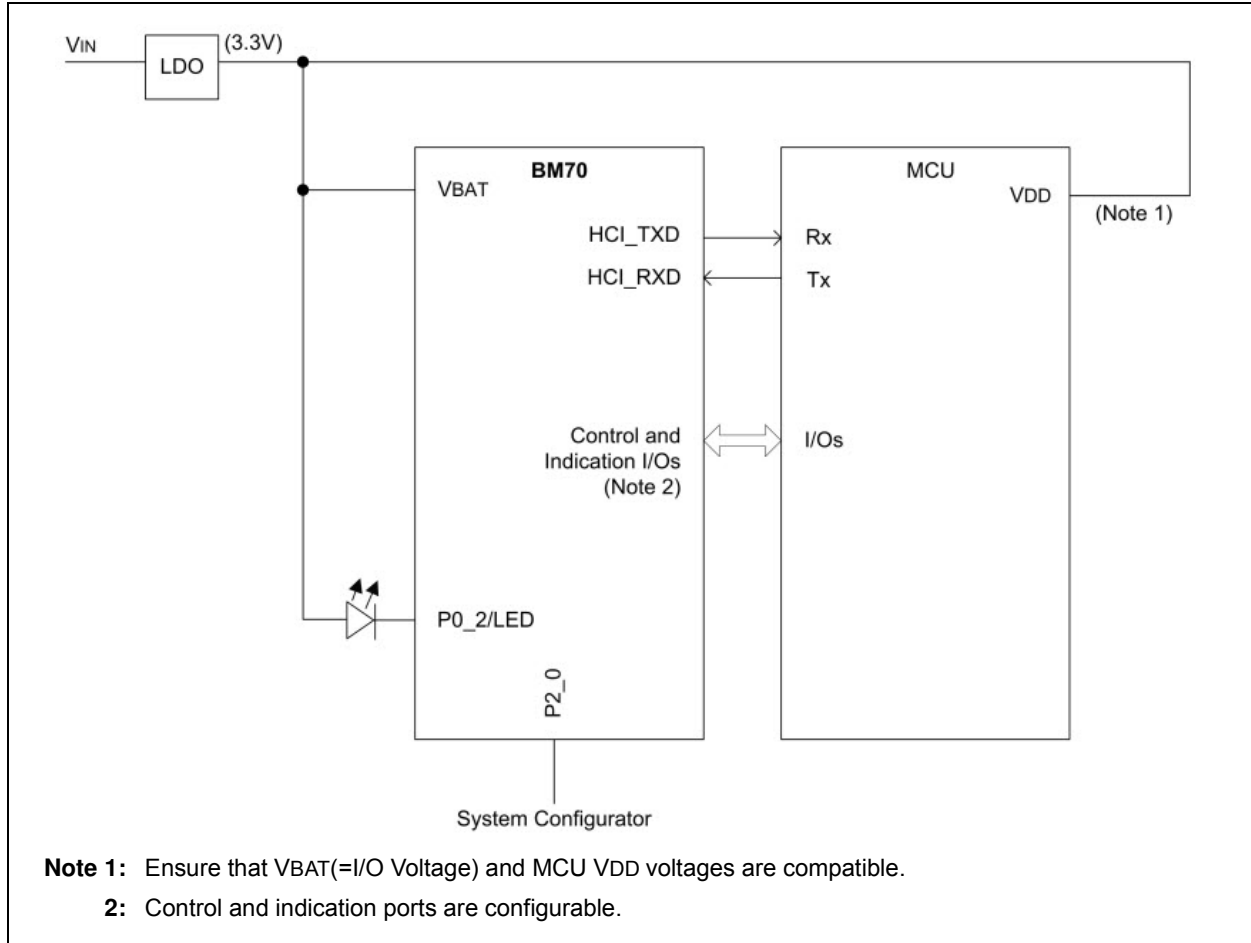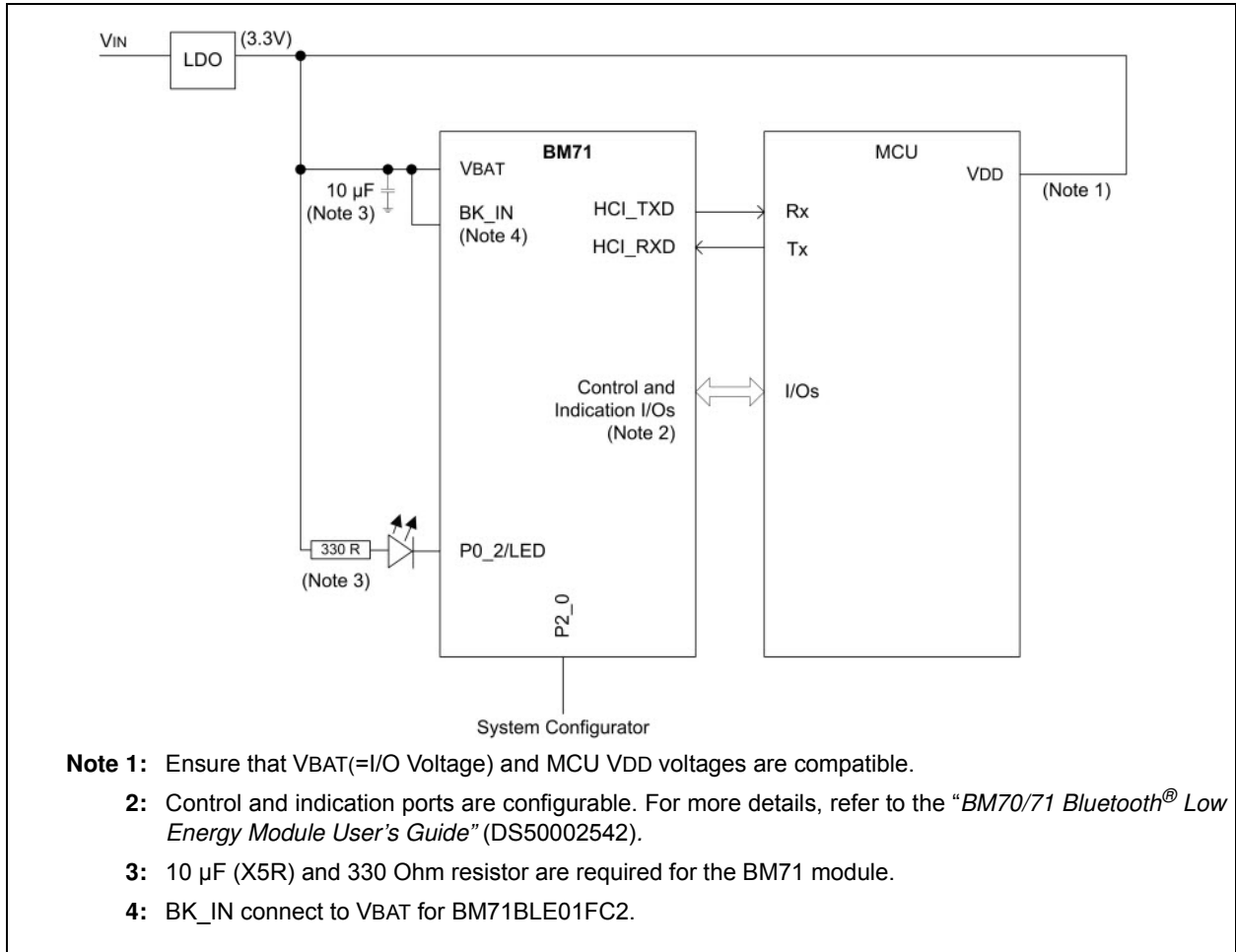
FIGURE 2-10: BM70 MODULE TO MCU INTERFACE

Note 1: Ensure that VBAT(=I/O Voltage) and MCU VDD voltages are compatible.

2: Control and indication ports are configurable.

FIGURE 2-11: **BM71 MODULE TO MCU INTERFACE**

Note 1: Ensure that V~BAT~(=I/O Voltage) and MCU V~DD~ voltages are compatible.

    2: Control and indication ports are configurable. For more details, refer to the "*BM70/71 Bluetooth^®^ Low Energy Module User's Guide*" (DS50002542).

    3: 10 µF (X5R) and 330 Ohm resistor are required for the BM71 module.

   **4:** BK_IN connect to V~BAT~ for BM71BLE01FC2.

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2.3.2 UART READY AFTER EXTERNAL RESET

In MCU applications, the time between Reset and the BM70/71 module UART port ready for Test mode and Application mode after an external Reset (RST_N) must be notified. Figure 2-12 illustrates the timing diagram of the BM70/71 module UART port ready for Test mode and Application mode after reset.

FIGURE 2-12: TIMING DIAGRAM OF BM70/71 MODULE UART READY FOR TEST MODE AFTER RESET

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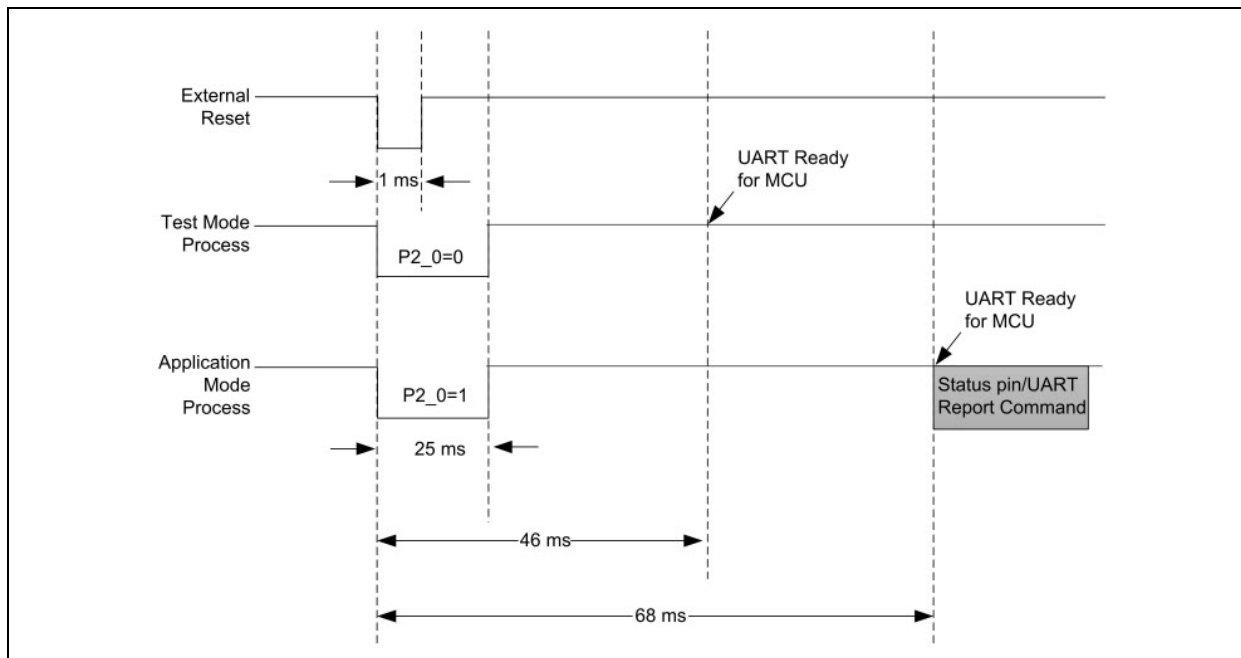
2.3.3 UART READY AFTER POWER-ON RESET

Figure 2-13 illustrates the timing diagram of the BM70 module UART port ready for Test mode and Application mode after Power-on Reset (POR).

In Application mode, when the BM70/71 module is ready to communicate with the host MCU after reset, the BM70/71 module may have internal status indi-cated by the status pins, or by a status report UART command. This status pin or status report UART command is sent to inform the MCU that the BM70/71 module is ready for communication.

FIGURE 2-13: TIMING DIAGRAM OF BM70 MODULE UART READY FOR TEST MODE AFTER POWER-ON
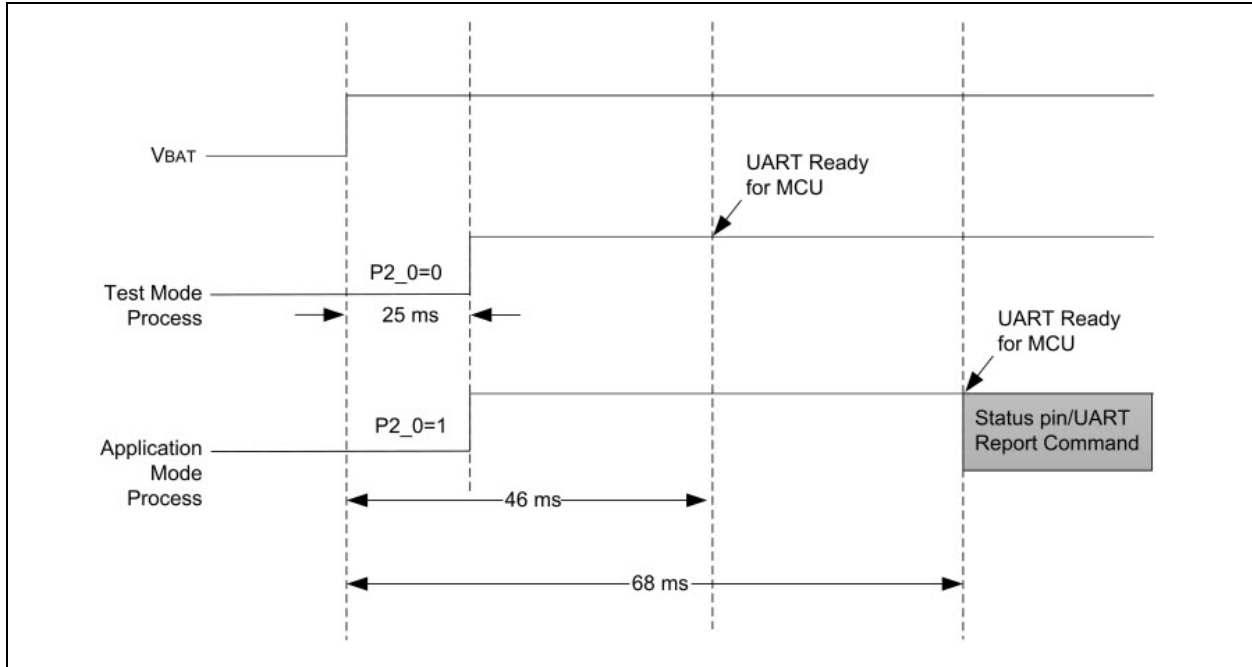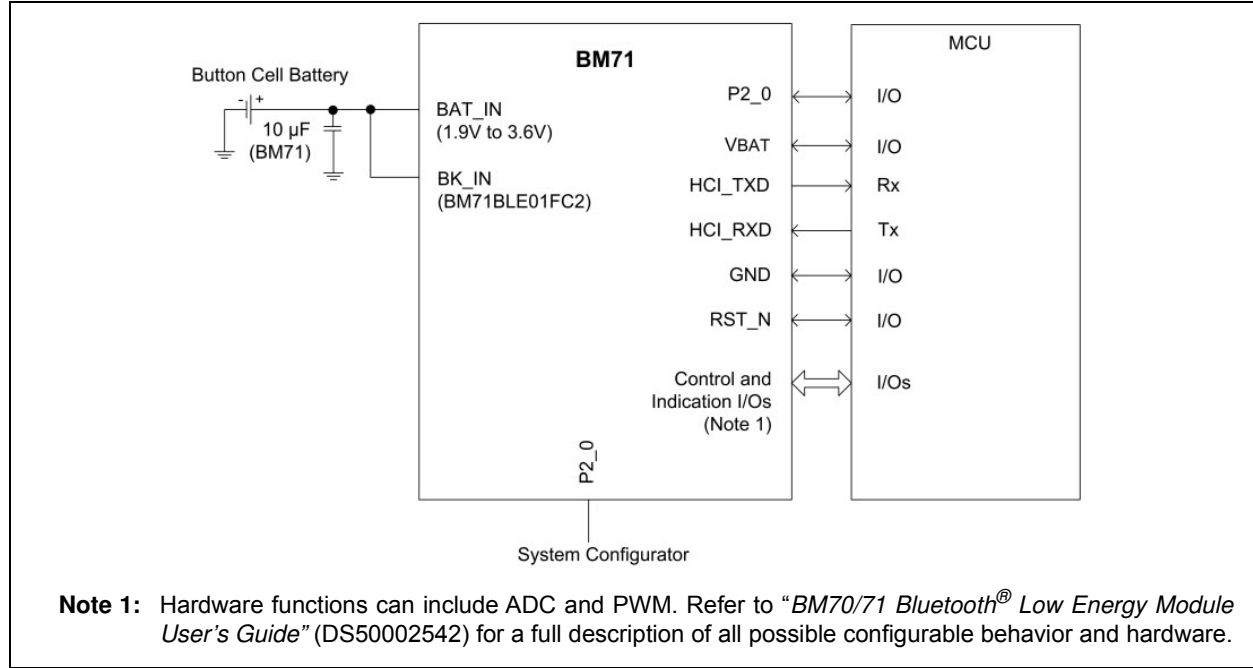
BM70/71

2.4 Typical Hosted Configuration

Figure 2-14 illustrates the typical hosted configuration for the BM71 module. It also illustrates an application using a coin cell battery at VBAT input. For the BM71 module, a 10 µF capacitor (X5R/X7R) is applied to the BAT_IN pin. Only on the BM71 module, the BK_IN pin of the module must be connected to the BAT_IN pin.

**FIGURE 2-14:** **BM71 MODULE TYPICAL HOSTED CONFIGURATION**

Note 1: Hardware functions can include ADC and PWM. Refer to "*BM70/71 Bluetooth® Low Energy Module User's Guide*" (DS50002542) for a full description of all possible configurable behavior and hardware.

2.5 Power-Drop Protection

To prevent the BM70/71 module from disruptions, when the voltage drops to less than 1.9V, an "Open Drain" Reset chip with a delay time of ≤ 10 ms that triggers Reset at 1.8V output voltage is recommended. Figure 2-15 illustrates the Reset circuit block diagram.

FIGURE 2-15:   RESET CIRCUIT BLOCK DIAGRAM
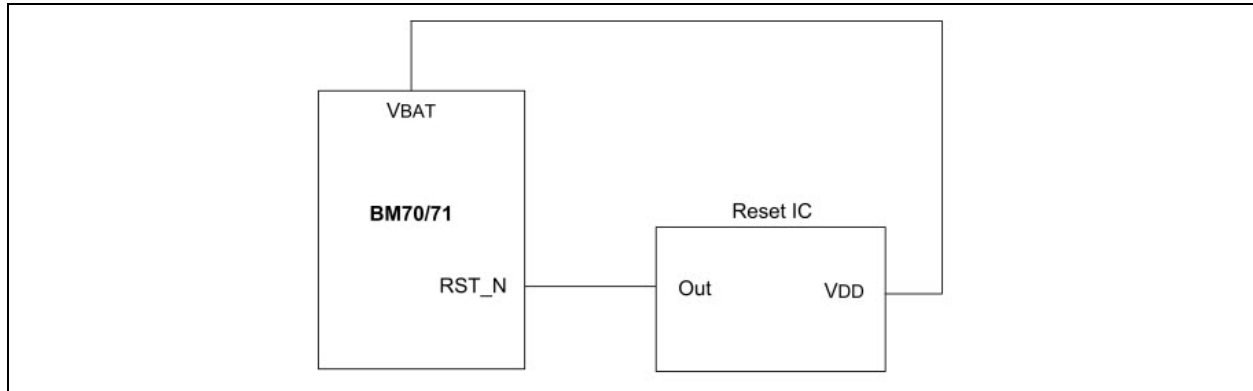
BM70/71

3.0 MODULE CONFIGURATION

The BM70/71 module features and services can be configured to fit a wide range of application requirements. Refer to the "*BM70/71 Bluetooth® Low Energy Module User's Guide*" (DS50002542) for details of all device behavior along with information on how to configure the IS8170/71 IC on the BM70/71 module. Refer to **3.1"UART Interface"** through **3.4"System Configuration"** that describe default behavior of the BM70/71 module, which can be easily changed.

3.1 UART Interface

The BM70/71 module UART pins, TXD and RXD, are connected to the UART pins of the host MCU. By default, the UART characteristics are set to a baud rate of 115200, with 8-bit data, 1 stop bit, no parity, and no hardware flow control. These characteristics are config-

urable, refer to the "*BM70/71 Bluetooth® Low Energy Module User's Guide*" (DS50002542) for the full description.

3.2 Control and Indication I/O Pins

The I/O pins on the BM70/71 module are configurable as either control or indication signal. The control signals are input to the BM70/71 module and the indication signals are output from the BM70/71 module. Table 3-1 and Table 3-2 provide default pin functions of the default firmware logic in the IS1870/71 IC on the BM70/71 module. For different BM70/71 module application requirements, the I/O pin assignment is configurable and can fit a wide range of application requirements. For additional information related to I/O pin assignment, refer to the "*BM70/71 Bluetooth® Low Energy Module User's Guide*" (DS50002542).

TABLE 3-1: CONFIGURATION AND INDICATION I/O ASSIGNMENTS FOR BM70 MODULE

PINS	N/C[1]	LOW_BATTERY_IND[1]	RSSI_IND[1]	LINK_DROP[1]	UART_RX_IND[1]	PAIRING_KEY[1]	RF_ACTIVE_IND[1]	STATUS1_IND[1]	If hardware function is enabled, UART_RTS is fixed to this pin	If hardware function is enabled, UART_CTS is fixed to this pin	If hardware function is enabled, TX_IND is fixed to this pin	If hardware function is enabled, LED0 is fixed to this pin
P1_0												
P3_1			Default									
P3_2				Default								
P3_3					Default							
P3_4						Default						
P0_7		Default										
P1_1								Default				
P2_2	Default											
P2_4	Default											
P3_5	Default											
P3_6									Default			
P0_0										Default		
P2_7											Default	
P0_2												Default

Note 1: These signals are part of the remappable hardware functionality and can be input/output on different GPIO pins of the module. Refer to the "*BM70/71 Bluetooth® Low Energy Module User's Guide*" (DS50002542) for details.