AN13049

Wi-Fi/Bluetooth/802.15.4 M.2 Key E Pinout Definition

Rev. 3 — 18 January 2022 Application Note

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1 Introduction

M.2 is a form factor for mobile adapters defined by the PCI-SIG (http://www.pcisig.com). The pinouts for M.2 sockets are defined in the PCI Express M.2 Specification.

M.2 sockets with mechanical Key E are used on platforms based on NXP MPUs and MCUs to support wireless connectivity modules based on NXP Wi-Fi/Bluetooth/802.15.4 radios.

Some of the signals defined in the pinout are used to connect optional sideband and debug signals used by NXP Wi-Fi/Bluetooth/802.15.4 radios.

To ensure the proper connection for sideband and debug signals, this document defines the pin assignments for M.2 sockets (mechanical Key E) on platforms based on NXP MPUs and MCUs.

This document defines M.2 usage for both NXP Wi-Fi/Bluetooth and Tri-Radio M.2 module design.

Figure 1 shows Wi-Fi/Bluetooth M.2 interface Block Diagram.

Figure 2 shows Tri-Radio M.2 interface Block Diagram. It must add SPI interface for 802.15.4 device, and add an I/O expander to support sideband control signals.

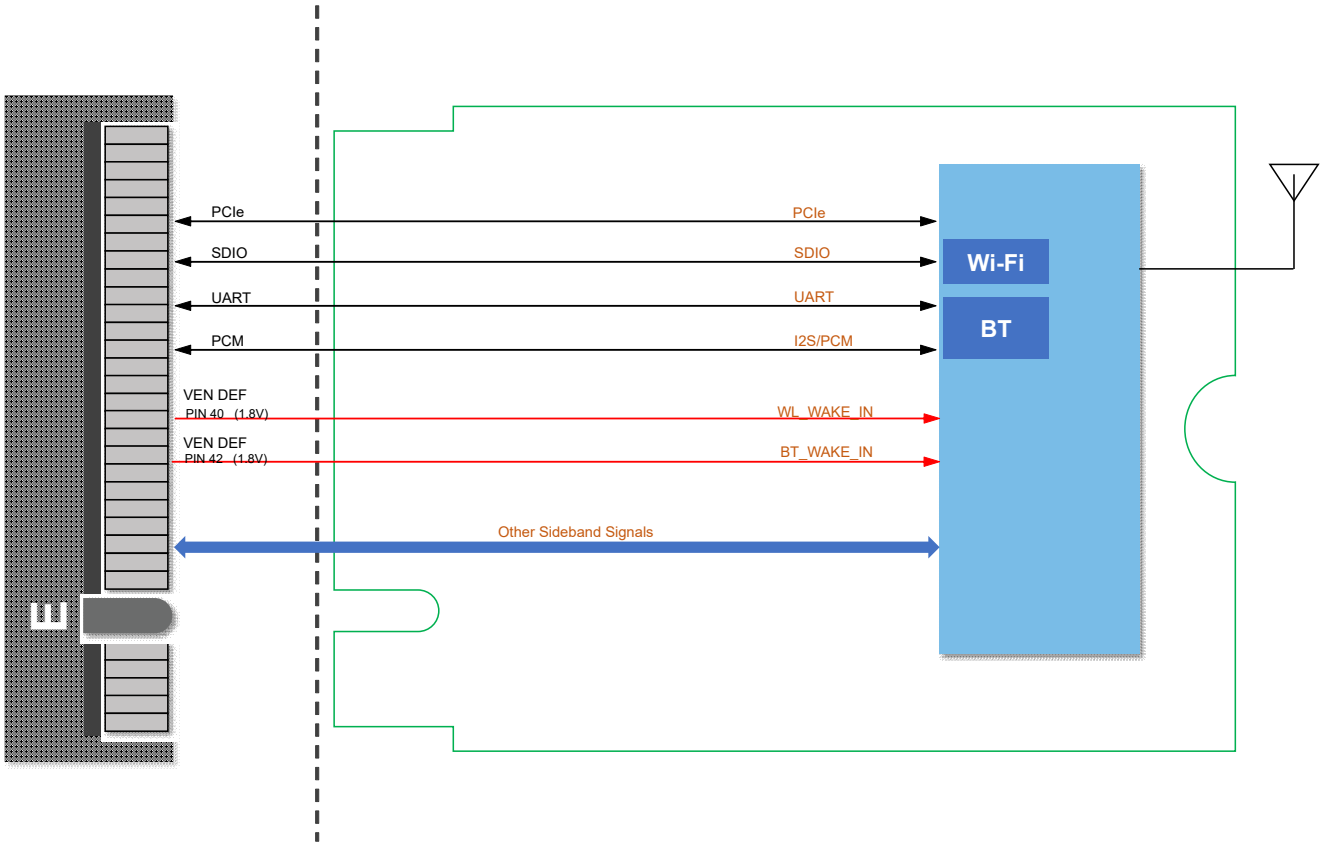

Figure 1. Wi-Fi/Bluetooth M.2 interface block diagram

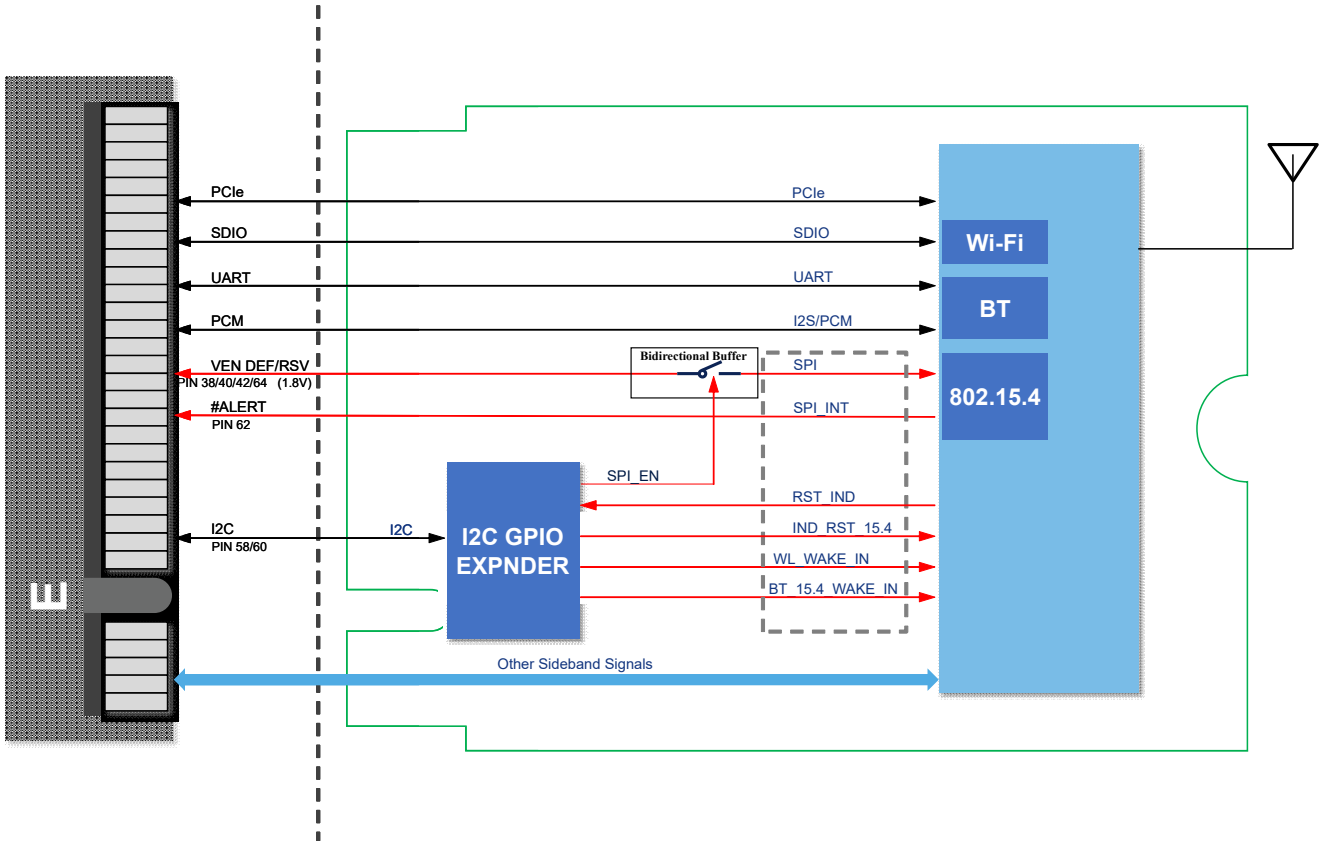

Figure 2. Tri-Radio M.2 interface block diagram

Before building your board, check the interface connector specification from the wireless module vendor to confirm the pinout used by the module.

For the full definition of the socket pinout, refer to the *PCI Express M.2 Specification*, available from PCI-SIG website (http://www.pcisig.com).

NOTE

All the pins that are not listed in this document are recommended to follow the PCI Express M.2 Type E specification or should *not be connected*.

2 Usage signals for Wi-Fi/Bluetooth and Tri-Radio

This section describes the NXP defined sideband control and SPI signals between the NXP Radio module and MPU/MCU.

Table 1 shows the pin assignments utilized for sideband and SPI signals.

Note: For details on the mandatory and optional lines, see the module datasheet.

Table 1. Sideband and SPI signals

Pin	PCIe M.2 Signal	Type[1]	Voltage	Usage for Wi-Fi/Bluetooth radio	Usage for Tri-radio
20	UART_WAKE#	I	3.3 V	BT_WAKE_OUT:	BT_15.4_WAKE_OUT: Bluetooth radio to wake up the MPU/MCU.

Table continues on the next page...

Table 1. Sideband and SPI signals (continued)

Pin	PCIe M.2 Signal	Type[1]	Voltage	Usage for Wi-Fi/Bluetooth radio	Usage for Tri-radio
				Bluetooth radio to wake up the MPU/MCU. Active Low by default. Connect to MPU/MCUGPIO Open drain. Pullup required on platform.	Active Low by default. Connect to MPU/MCUGPIO Open drain. Pullup required on platform.
21	SDIO_WAKE#	I	1.8 V	WL_WAKE_OUT: Wi-Fi radio to wakeup the MPU/MCU. Active Low by default. Connect to MPU/MCU Open drain. Pullup required on platform.	Same as Wi-Fi/Bluetooth radio.
23	SDIO_RESET#	O	1.8 V	IND_RST_WL: Independent software reset for Wi-Fi. Active Low by default. Connect to MPU/MCU GPIO.	Same as Wi-Fi/Bluetooth radio.
38	VENDOR DEFINED	O	1.8 V	NC	SPI_TXD: SPI transmit signal.
40	VENDOR DEFINED	I/O	1.8 V	WL_WAKE_IN: MPU/MCU to wake up the Wi-Fi radio. Active Low by default. Connect to MPU/MCU GPIO.	SPI_RXD: SPI receive signal. .
42	VENDOR DEFINED	O	1.8 V	BT_WAKE_IN: MPU/MCU to wake up the Bluetooth radio. Active Low by default. Connect to MPU/MCU GPIO.	SPI_CLK: SPI clock signal.
44	COEX3	I/O	1.8 V	COEX3: Radio Coexistence line 3.	Same as Wi-Fi/Bluetooth radio.
46	COEX2	I/O	1.8 V	COEX2: Radio Coexistence line 2.	Same as Wi-Fi/Bluetooth radio.
48	COEX1	I/O	1.8 V	COEX1: Radio Coexistence line 1.	Same as Wi-Fi/Bluetooth radio.

Table continues on the next page...

Table 1. Sideband and SPI signals (continued)

Pin	PCIe M.2 Signal	Type[1]	Voltage	Usage for Wi-Fi/Bluetooth radio	Usage for Tri-radio
54	W_DISABLE2#	O	3.3 V	IND_RST_BT: Independent software reset for Bluetooth. Active Low by default Connect to MPU/MCU GPIO.	Same as Wi-Fi/Bluetooth radio.
56	W_DISABLE1#	O	3.3 V	PDn: Full Power-down for the Wi-Fi/Bluetooth radio or controls the PMIC ENABLE signal. High = Normal Low = Full power-down mode Connect to MPU/MCU GPIO.	PDn: Full Power-down for the Tri-radio or controls the PMIC ENABLE signal. High = Normal Low = Full power-down mode Connect to MPU/MCU GPIO.
58	I2C_DATA	I/O	1.8 V	NC	I2C SDA: I2C data for I/O expander. Open drain. Pullup required on platform. See Table 2.
60	I2C_CLK	O	1.8 V	NC	I2C SCL: I2C clock from MPU/MCU for I/O expander. See Table 2.
62	ALERT#	I	1.8 V	NC	SPI_INT: SPI interrupt signal. Open drain. Pullup required on platform.
64	RESERVED	O	1.8 V	NC	SPI_FRM: SPI interrupt signal.

1. Type refers to the signal direction:
   - Type O means signal is an output from the MPU/MCU to the adapter.
   - Type I means signals is an input to the MPU/MCU from the adapter.

2.1 I2C I/O expander for sideband signals

For a Tri-Radio M.2 module, it uses an I2C expander to support sideband control signals. It is important to use an NXP PCAL6408A part. It is an 8-bit general-purpose I/O expander that provides GPIO expansion via the I2C-bus interface. See the I/O expander port assignment or the sideband signals in Table 2.

Table 2. I/O expander function

Symbol	Type	Voltage	NXP Usage	Description
P0	O	VIO	SPI Buffer enable	Enable SPI Buffer when Tri-Radio is designed. Active high by default.

Table continues on the next page...

Table 2. I/O expander function (continued)

Symbol	Type	Voltage	NXP Usage	Description
				Pull down required on M.2 board.
P1	O	VIO	IND_RST_15.4	Independent software reset for 802.15.4 radio. Active low by default.
P2	O	VIO	WL_WAKE_IN	MPU/MCU to wake up the Wi-Fi radio. Active low by default.
P3	O	VIO	BT_15.4_WAKE_IN	MPU/MCU to wake up the Bluetooth and 802.15.4 radio. Active low by default.
P4	I	VIO	RST_IND	Independent software reset indicator output signal to host.
P5-P7	Reserved			Not used. Recommend to add test pads on P5-P7.

3 Revision history

Table 3 summarizes the changes done to this document since the initial release.

Table 3. Revision history

Revision number	Date	Substantive changes
1	12 November 2020	Initial release
2	16 September 2021	Updated Introduction and Usage signals for Wi-Fi/Bluetooth and Tri-Radio.
3	17 January 2022	Added the usage for Tri-Radio design. Removed the JTAG signals from the M.2 pins.

A JTAG debug signals

The JTAG debug signals JTAG_TDI, JTAG_TDO, JTAG_TCK, and JTAG_TMS are used to support Software development. It is strongly recommend to keep a JTAG connector (Hirose FH12-10S-0.5SH(55)) or test pads on the M.2 module.

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