AN13049
Wi-Fi/Bluetooth/802.15.4 M.2 Key E Pinout Definition
Rev. 4 — 30 May 2023

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

M.2 is a form factor for mobile adapters defined by the PCI-SIG [http://www.pcisig.com](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 proper connection for the 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 NXP Single/Dual Radio M.2 interface block diagram.

**Figure 2** shows NXP 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.
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, see 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 data sheet.

### Table 1. Sideband and SPI signals

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>UART_WAKE#</td>
<td>I</td>
<td>3.3 V</td>
<td>BT_WAKE_OUT: Bluetooth radio to wake up the MPU/MCU. Active Low by default.</td>
<td>BT_15.4_WAKE_OUT: Bluetooth radio to wake up the MPU/MCU. Active Low by default.</td>
</tr>
<tr>
<td>Pin</td>
<td>PCIe M.2 Signal</td>
<td>Type(^1)</td>
<td>Voltage</td>
<td>Usage for NXP Single/Dual Radio</td>
<td>Usage for NXP Tri-Radio</td>
</tr>
<tr>
<td>-------</td>
<td>----------------</td>
<td>------------</td>
<td>---------</td>
<td>------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>21</td>
<td>SDIO_WAKE#</td>
<td>I</td>
<td>1.8 V</td>
<td>Connect to MPU/MCU GPIO open-drain. Pullup required on platform.</td>
<td>Connect to MPU/MCU GPIO open-drain. Pullup required on platform.</td>
</tr>
<tr>
<td>23</td>
<td>SDIO_RESET#</td>
<td>O</td>
<td>1.8 V</td>
<td>WL_WAKE_OUT: Wi-Fi radio to wake up the MPU/MCU. Active Low by default. Connect to MPU/MCU Open-drain. Pullup required on platform.</td>
<td>Same as single/dual radio.</td>
</tr>
<tr>
<td>38</td>
<td>VENDOR DEFINED</td>
<td>O</td>
<td>1.8 V</td>
<td>NC</td>
<td>SPI_TXD: SPI transmit signal.</td>
</tr>
<tr>
<td>40</td>
<td>VENDOR DEFINED</td>
<td>I/O</td>
<td>1.8 V</td>
<td>WL_WAKE_IN: MPU/MCU to wake up the Wi-Fi radio. Active Low by default. Connect to MPU/MCU GPIO.</td>
<td>SPI_RXD: SPI receive signal.</td>
</tr>
<tr>
<td>42</td>
<td>VENDOR DEFINED</td>
<td>O</td>
<td>1.8 V</td>
<td>BT_WAKE_IN: MPU/MCU to wake up the Bluetooth radio. Active Low by default. Connect to MPU/MCU GPIO.</td>
<td>SPI_CLK: SPI clock signal.</td>
</tr>
<tr>
<td>44(^2)</td>
<td>COEX3</td>
<td>I/O</td>
<td>1.8 V</td>
<td>Talk to NXP support team.</td>
<td>Same as single/dual radio.</td>
</tr>
<tr>
<td>46(^2)</td>
<td>COEX2</td>
<td>I</td>
<td>1.8 V</td>
<td>Talk to NXP support team.</td>
<td>Same as single/dual radio.</td>
</tr>
<tr>
<td>48(^2)</td>
<td>COEX1</td>
<td>O</td>
<td>1.8 V</td>
<td>Talk to NXP support team.</td>
<td>Same as single/dual radio.</td>
</tr>
<tr>
<td>54</td>
<td>W_DISABLE2#</td>
<td>O</td>
<td>3.3 V</td>
<td>IND_RST_BT: Independent software reset for Bluetooth. Active Low by default Connect to MPU/MCU GPIO.</td>
<td>Same as single/dual radio.</td>
</tr>
<tr>
<td>56</td>
<td>W_DISABLE1#</td>
<td>O</td>
<td>3.3 V</td>
<td>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.</td>
<td>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.</td>
</tr>
<tr>
<td>58</td>
<td>I2C_DATA</td>
<td>I/O</td>
<td>1.8 V</td>
<td>NC</td>
<td>I2C SDA: I2C data for I/O expander. Open-drain. Pullup required on platform. See Table 2.</td>
</tr>
<tr>
<td>60</td>
<td>I2C_CLK</td>
<td>O</td>
<td>1.8 V</td>
<td>NC</td>
<td>I2C SCL:</td>
</tr>
</tbody>
</table>

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\(^1\) Connection type (I/O) for internal EMI and noise considerations.

\(^2\) Connect to SW development pin for single/dual radio.

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Table 1. Sideband and SPI signals (continued)

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Table 1. Sideband and SPI signals...continued

<table>
<thead>
<tr>
<th>Pin</th>
<th>PCIe M.2 Signal</th>
<th>Type[1]</th>
<th>Voltage</th>
<th>Usage for NXP Single/Dual Radio</th>
<th>Usage for NXP Tri-Radi</th>
</tr>
</thead>
<tbody>
<tr>
<td>62</td>
<td>ALERT#</td>
<td>I</td>
<td>1.8 V</td>
<td>NC</td>
<td>SPI_INT:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SPI interrupt signal.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Open-drain. Pullup required on platform.</td>
</tr>
<tr>
<td>64[3]</td>
<td>RESERVED</td>
<td>O</td>
<td>1.8 V</td>
<td>NC</td>
<td>SPI_FRM:</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>SPI frame signal.</td>
</tr>
</tbody>
</table>

[1] Type refers to the signal direction:
- Type O means signal is an output from the MPU/MCU to the adapter.
- Type I means that the signal is an input to the MPU/MCU from the adapter.
[3] To avoid the potential risk on which 1.8 V is designed on other platform, optionally add a serial 100-1K ohm resistor on the path from SPI_FRM to M.2 PIN64.

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

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Type</th>
<th>Voltage</th>
<th>NXP Usage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0</td>
<td>O</td>
<td>VIO</td>
<td>SPI Buffer enable</td>
<td>Enable SPI Buffer when Tri-radio is designed. Active high by default. Pull down required on M.2 board.</td>
</tr>
<tr>
<td>P1</td>
<td>O</td>
<td>VIO</td>
<td>IND_RST_15.4</td>
<td>Independent software reset for 802.15.4 radio. Active low by default.</td>
</tr>
<tr>
<td>P2</td>
<td>O</td>
<td>VIO</td>
<td>WL_WAKE_IN</td>
<td>MPU/MCU to wake up the Wi-Fi radio. Active low by default.</td>
</tr>
<tr>
<td>P3</td>
<td>O</td>
<td>VIO</td>
<td>BT_15.4_W AKE_IN</td>
<td>MPU/MCU to wake up the Bluetooth and 802.15.4 radio. Active low by default.</td>
</tr>
<tr>
<td>P4</td>
<td>I</td>
<td>VIO</td>
<td>RST_IND</td>
<td>Independent software reset indicator output signal to host.</td>
</tr>
<tr>
<td>P5-P7</td>
<td>Reserved</td>
<td>VIO</td>
<td>Not used.</td>
<td>Recommend to add test pads on P5-P7.</td>
</tr>
</tbody>
</table>

3 Host and audio interfaces

The wireless connectivity module may support an audio interface.

The modules may also support various host interfaces including SDIO, UART[1], or PCI Express.

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[1] CTS and RTS flow control lines are requested for Bluetooth control.
For the pin assignments on these interfaces, see the PCI_Express_M.2_Spec document on http://www.pcisig.com.

4 JTAG debug signals

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

5 Revision history

Table 3 summarizes the changes to this document.

Table 3. Revision history

<table>
<thead>
<tr>
<th>Revision number</th>
<th>Date</th>
<th>Substantive changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12 November 2020</td>
<td>Initial release.</td>
</tr>
<tr>
<td>2</td>
<td>16 September 2021</td>
<td>Updated Section 1 and Section 2</td>
</tr>
<tr>
<td>3</td>
<td>17 January 2022</td>
<td>Added the usage for Tri-Radio design. Removed the JTAG signals from the M.2 pins.</td>
</tr>
<tr>
<td>4</td>
<td>30 May 2023</td>
<td>Updated Section 2 and added Section 3.</td>
</tr>
</tbody>
</table>
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