# TWR-WIFI-AR4100

## User's Manual

Rev. 1.1

# Contents



# Revision History

| Revision | Date | Changes |
|---|---|---|
| 1.0 | Jun 2011 | Initial Release |
| 1.1 | August 2011 | Updated to reflect Qualcomm Atheros and WPS 2.0 support |

# 1 Overview

The Qualcomm Atheros Wi-Fi Tower Module (TWR-WIFI-AR4100) is a low-cost evaluation, demonstration and development board that features an ultra-low power 802.11n solution from Qualcomm Atheros.

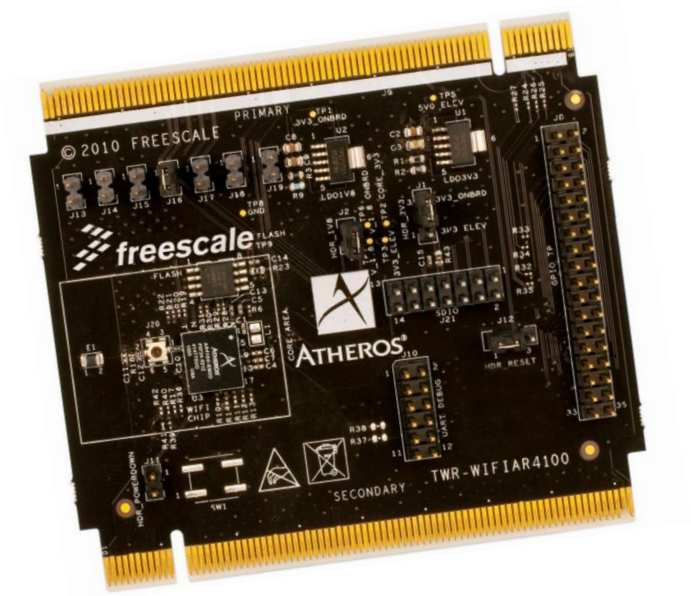


**Figure 1 - TWR-WIFI-AR4100 Image**

The TWR-WIFI-AR4100 Wi-Fi Tower System module features the AR4100 solution from Qualcomm Atheros. The following is a brief summary of the TWR-WIFI-AR4100's features:

- The Qualcomm Atheros AR4100, an ultra-low power, single stream (1x1) IEEE 802.11n System-in-package featuring:
  - Low energy and Low system resource requirements
  - Simple low cost wireless system integration
    - Near zero RBOM
    - Integrated RF front end, RF shield, and clocks
    - Direct connect to a 50-ohm antenna
    - FCC and Wi-Fi Certified
  - Qualcomm Atheros world class leading 802.11n Wi-Fi:
    - Integrated high-power, high efficiency Power Amplifier
    - Low Density Parity Check (LDPC) encoding for improved uplink robustness over range
    - Space Time Block Coding (STBC) for improved downlink robustness over range
    - Wi-Fi Protected Setup (WPS 2.0)
- Compatible with the Tower System, including MQX based driver support
- SPI interface to Tower MCU modules
- On-board SPI Flash for enabling minimal impact to MCU resources

A block diagram for the TWR-WIFI-AR4100 is shown in the figure below.

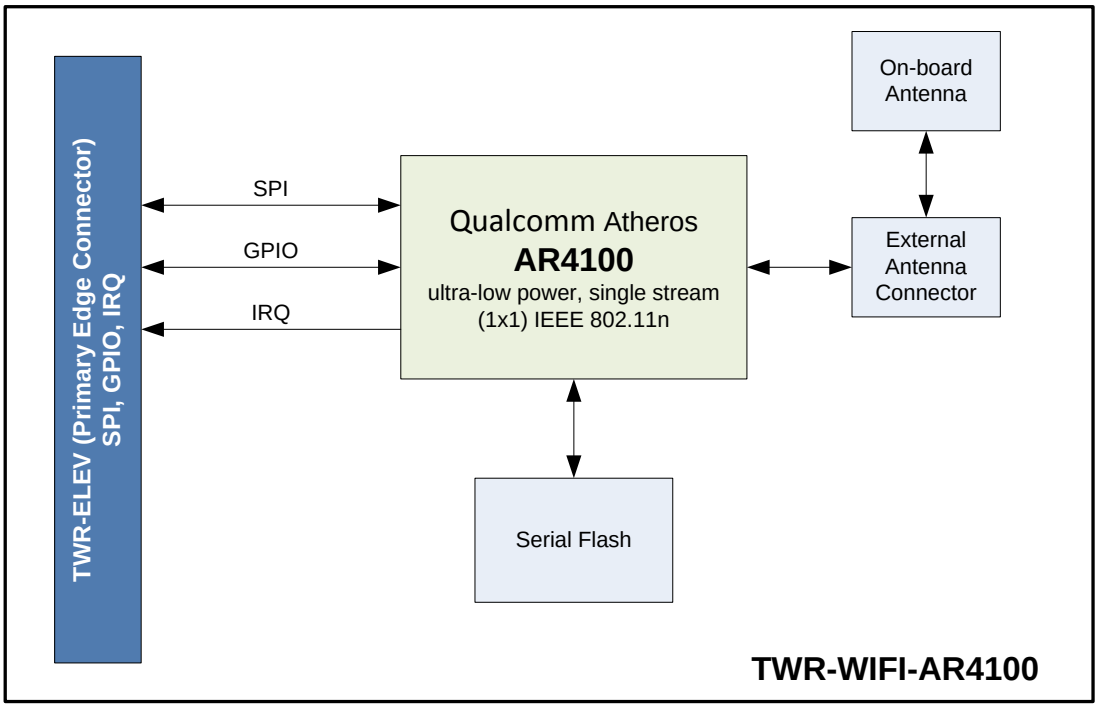


**Figure 2 - TWR-WIFI-AR4100 Block Diagram**

The TWR-WIFI-AR4100 module connects to the Freescale Tower platform using the SPI interface and can be easily integrated using the TCP/IP stack of the Freescale MQX system.

# 2 Reference Documents

The documents listed below should be referenced for more information on the Freescale Tower system and the TWR-WIFI-AR4100. Refer to *http://www.freesale.com/tower* for the latest revision of all Tower documentation.

- *TWR-WIFI-AR4100 Quick Start Guide*
- *TWR-WIFI-AR4100 Lab Tutorial*
- *TWR-WIFI-AR4100 Schematics*

For technical documents specific to the Qualcomm Atheros Wi-Fi module refer to http://www.qca.qualcomm.com/

# 3 Hardware Features

This section provides more details about the features and functionality of the TWR-WIFI-AR4100.

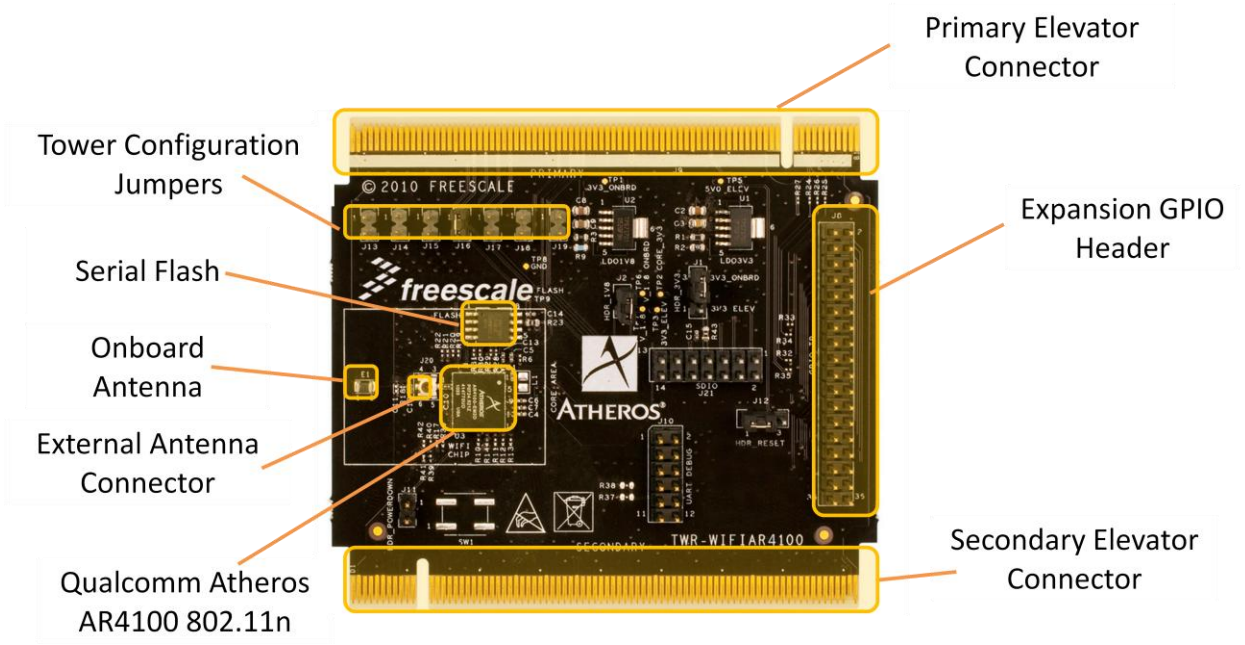


**Figure 3 - Callout Diagram for TWR-WIFI-AR4100**

## 3.1 AR4100 Module

The AR4100 is a small form-factor, single stream, 802.11 b/g/n Wi-Fi “System-in-Package” (SIP) solution. The AR4100 has been developed to support applications hosted by low-resource microcontrollers that send infrequent data packets over the network. Typically, these 802.11 applications will place a higher priority on system cost, power consumption, ease of use, and fast wake-up times as compared to high throughput. The AR4100 integrates all Wi-Fi functionality into a low-profile, 8.3mm x 9.2mm LGA package that can be easily mounted via low-cost PCB manufacturing flows. The device requires only a few external bypass capacitors and a connection to an antenna for a board level design. As an added cost reduction and convenience, the SIP module is pre-certified with the FCC and other major regulatory bodies.

The AR4100 employs the world's lowest power consumption embedded architecture. It has been optimized for client applications in the home and enterprise that have lower data rates, and transmit or receive data on an infrequent basis. The AR4100 features standby current consumption as low as 5uA. Additional optimizations, including a reduced host driver footprint, allow easy integration with low-cost microcontrollers.
The AR4100 also includes Qualcomm Atheros’ industry leading high-efficiency, high-output EPA™ power amplifier with zero calibration and integrated LNAs. RF matching circuits, a reference crystal, and a T/R switch are also integrated, eliminating the need for an external RF components and thus enabling direct antenna connection. The end result is a device that is the best-in-class for ease of system design.

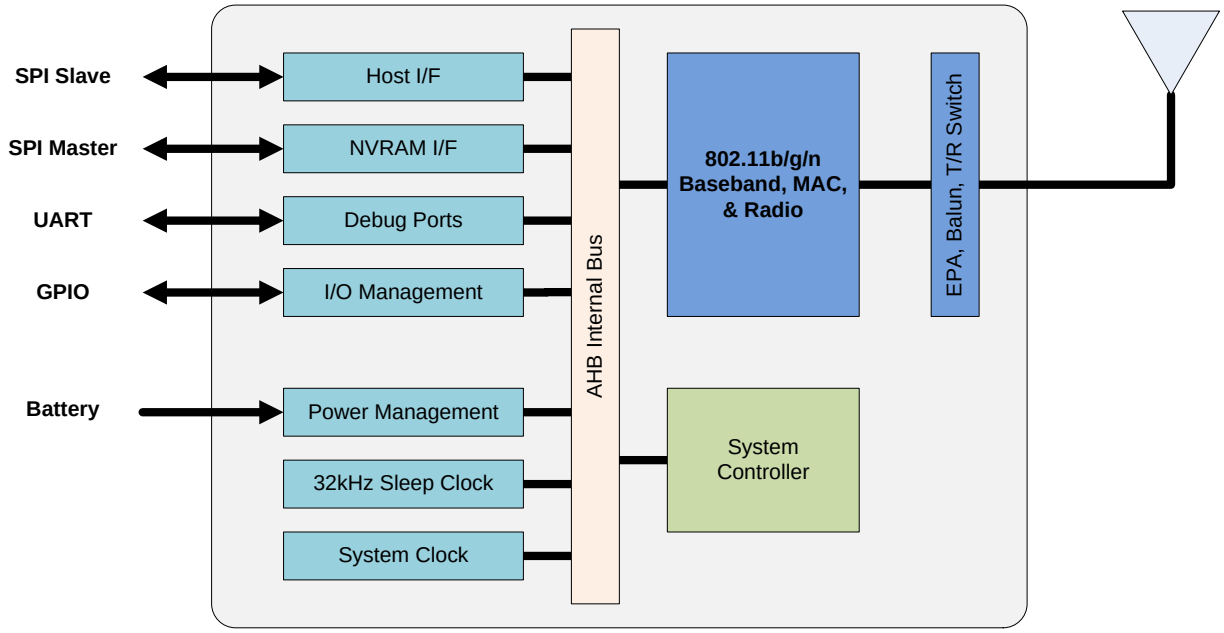


**Figure 4 - AR4100 Block Diagram**

## 3.2 System Power

The TWR-WIFI-AR4100 is powered by 3.3V from the Primary Elevator connector. There are number of jumpers that can be used to as test points to measure the voltage as well and current consumption.

| Jumper Name | Voltage Reference | Measurement Description |
|---|---|---|
| J23 | 3.3 V | Used to measure the power consumption of the entire TWR-WIFI-AR4100: including AR4100, Serial Flash, & 3.3V->1.8V Power Regulator |
| J1 | 3.3 V | Used to measure the power consumption of the AR4100: including the AR4100 & 3.3V->1.8V Power Regulator |
| J2 | 1.8V | Used to measure the Power consumption of the 1.8V rail of the AR4100 |

## 3.3 On-board Serial Flash

The TWR-WIFI-AR4100 includes a 16-Mbit Serial Flash memory. The Qualcomm Atheros AR4100 interfaces directly with the Serial Flash, allowing the AR4100 to access the required drivers and programming information with minimal impact to the MCU. If required the TWR-WIFI-AR4100 allows the interface to be switched from the AR4100 to the Tower MCU (via the TWR-ELEV connections). The interface to the Serial Flash can be switched by removing the following resistors (R32, R33, R34, R35) and populating the following resistors (R24, R25, R26, R27). Refer to the TWR-WIFI-AR4100 for additional details.

## 3.4 Debug UART Header

For advanced debug purposes, the TWR-WIFI-AR4100 provides access to a UART signals on J10. The following signals are accessible.

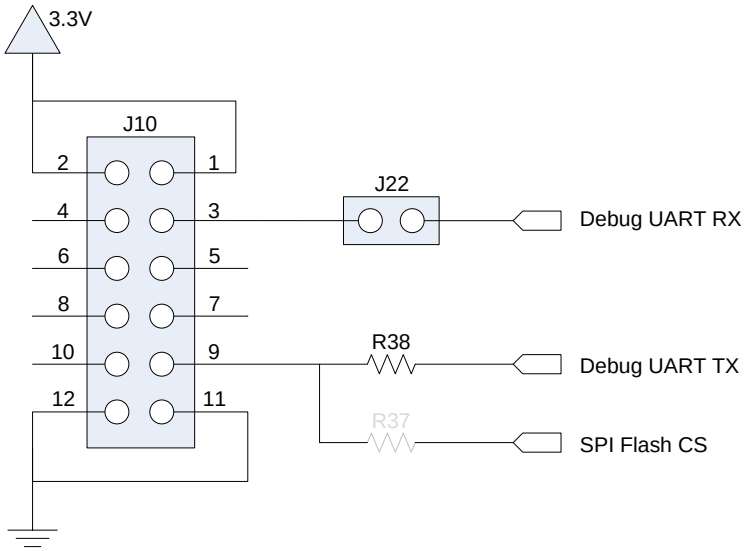


**Figure 5 - Debug UART Header**

The Debug UART RX signal is not configured as a UART signal by the AR4100 firmware. Prior to firmware reconfiguring this pin, DEBUG_UART_RX must not be connected to any external stimulus. Jumper J22 is provided to isolate DEBUG_UART_RX from J10. This allows the required debug hardware (UART transceiver) to remain connected to J10, requiring the user to only remove the J22 shunt when the part is reset.

## 3.5 Elevator Connections

The TWR-WIFI-AR4100 features two expansion card-edge connectors that interface to Elevator boards in a Tower system: the Primary and Secondary Elevator connectors. The Primary Elevator connector, comprised of sides A and B, is utilized by the TWR-WIFI-AR4100, while the Secondary Elevator connector only makes connections to ground (GND). Table 1 provides the pinout for the Primary Elevator Connector. An “X” in the “Used” column indicates that there is a connection from the TWR-WIFI-AR4100 to that pin on the Elevator connector. An “X” in the “Jmp” column indicates that a jumper is available that can configure or isolate the connection from the Elevator connector.

Table 1. TWR-WIFI-AR4100 Primary Elevator Connector Pin-out

| TWR-WIFI-AR4100 Primary Connector | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Side B | | | | | Side A | | | | |
| Pin # | Name | Usage | Used | Jmp | Pin # | Name | Usage | Used | Jmp |
| B1 | **5V** | **5.0V Power** | **X** | | A1 | **5V** | **5.0V Power** | **X** | |
| B2 | **GND** | **Ground** | **X** | | A2 | **GND** | **Ground** | **X** | |
| B3 | **3.3V** | **3.3V Power** | **X** | **X** | A3 | **3.3V** | **3.3V Power** | **X** | **X** |
| B4 | ELE_PS_SENSE | Elevator Power Sense | | | A4 | **3.3V** | **3.3V Power** | **X** | **X** |
| B5 | **GND** | **Ground** | **X** | | A5 | **GND** | **Ground** | **X** | |
| B6 | **GND** | **Ground** | **X** | | A6 | **GND** | **Ground** | **X** | |
| B7 | SPI1_CLK / SDHC1_CLK | Serial Flash SPI_CLK | **X** | | A7 | SCL0 | | | |
| B8 | SPI1_CS1 / SDHC1_CS1 | | | | A8 | SDA0 | | | |
| B9 | SPI1_CS0 / SDHC1_CS0 | Serial Flash SPI_CS | **X** | | A9 | GPIO9 / CTS1 | AR4100 GPIO2 | **X** | **X** |
| B10 | SPI1_MOSI / SDHC1_CMD | Serial Flash SPI_MOSI | **X** | | A10 | GPIO8 / SDHC_D2 | | | |
| B11 | SPI1_MISO / SDHC1_D0 | Serial Flash SPI_MISO | **X** | | A11 | GPIO7 / SD_WP_DET | | | |
| **Mechanical Key** | | | | | | | | | |
| B12 | ETH_COL | | | | A12 | ETH_CRS | | | |
| B13 | ETH_RXER | | | | A13 | ETH_MDC | | | |
| B14 | ETH_TXCLK | | | | A14 | ETH_MDIO | | | |
| B15 | ETH_TXEN | | | | A15 | ETH_RXCLK | | | |
| B16 | ETH_TXER | | | | A16 | ETH_RXDV | | | |
| B17 | ETH_TXD3 | | | | A17 | ETH_RXD3 | | | |
| B18 | ETH_TXD2 | | | | A18 | ETH_RXD2 | | | |
| B19 | ETH_TXD1 | | | | A19 | ETH_RXD1 | | | |
| B20 | ETH_TXD0 | | | | A20 | ETH_RXD0 | | | |
| ipB21 | GPIO1 | AR4100 GPIO0 | **X** | **X** | A21 | SSI_MCLK | | | |
| B22 | GPIO2 | | | | A22 | SSI_BCLK | | | |
| B23 | GPIO3 | AR4100 CHIP PWD | **X** | **X** | A23 | SSI_FS | | | |
| B24 | CLKIN0 | | | | A24 | SSI_RXD | | | |
| B25 | CLKOUT1 | | | | A25 | SSI_TXD | | | |
| B26 | **GND** | **Ground** | **X** | | A26 | **GND** | **Ground** | **X** | |
| B27 | AN7 | | | | A27 | AN3 | | | |
| B28 | AN6 | | | | A28 | AN2 | | | |
| B29 | AN5 | | | | A29 | AN1 | | | |
| B30 | AN4 | | | | A30 | AN0 | | | |
| B31 | **GND** | **Ground** | **X** | | A31 | **GND** | **Ground** | **X** | |
| B32 | DAC1 | | | | A32 | DAC0 | | | |
| B33 | TMR3 | | | | A33 | TMR1 | | | |
| B34 | TMR2 | | | | A34 | TMR0 | | | |
| B35 | GPIO4 | | | | A35 | GPIO6 | | | |
| B36 | **3.3V** | **3.3V Power** | **X** | **X** | A36 | **3.3V** | **3.3V Power** | **X** | **X** |
| B37 | PWM7 | | | | A37 | PWM3 | | | |
| B38 | PWM6 | | | | A38 | PWM2 | | | |
| B39 | PWM5 | | | | A39 | PWM1 | | | |
| B40 | PWM4 | | | | A40 | PWM0 | | | |
| B41 | CANRX | | | | A41 | RXD0 | | | |

| TWR-WIFI-AR4100 Primary Connector | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Side B | | | | | Side A | | | | |
| Pin # | Name | Usage | Used | Jmp | Pin # | Name | Usage | Used | Jmp |
| B42 | CANTX | | | | A42 | TXD0 | | | |
| B43 | 1WIRE | | | | A43 | RXD1 | | | |
| B44 | SPI0_MISO | AR4100 SPI_MISO | X | | A44 | TXD1 | | | |
| B45 | SPI0_MOSI | AR4100 SPI_MISO | X | | A45 | GPIO | | | |
| B46 | SPI0_CS0 | AR4100 SPI_CS | X | | A46 | GPIO | | | |
| B47 | SPI0_CS1 | | | | A47 | GPIO | | | |
| B48 | SPI0_CLK | AR4100 SPI_CLK | X | | A48 | GPIO | | | |
| B49 | **GND** | **Ground** | X | | A49 | **GND** | **Ground** | X | |
| B50 | SCL1 | | | | A50 | GPIO | | | |
| B51 | SDA1 | | | | A51 | GPIO | | | |
| B52 | GPIO5 | | | | A52 | GPIO | | | |
| B53 | USB_DP_PDOWN | | | | A53 | GPIO | | | |
| B54 | USB_DM_PDOWN | | | | A54 | USB_DM | | | |
| B55 | IRQ_H | | | | A55 | USB_DP | | | |
| B56 | IRQ_G | AR4100 SPI_INT | X | X | A56 | USB_ID | | | |
| B57 | IRQ_F | | | | A57 | USB_VBUS | | | |
| B58 | IRQ_E | AR4100 SPI_INT | X | X | A58 | TMR7 | | | |
| B59 | IRQ_D | | | | A59 | TMR6 | | | |
| B60 | IRQ_C | AR4100 SPI_INT | X | X | A60 | TMR5 | | | |
| B61 | IRQ_B | | | | A61 | TMR4 | | | |
| B62 | IRQ_A | AR4100 SPI_INT | X | X | A62 | RSTIN_b | | | |
| B63 | FB_ALE/FB_CS1_b | | | | A63 | RSTOUT_b | AR4100 CHIP PWD | X | X |
| B64 | FB_CS0_b | | | | A64 | CLKOUT0 | | | |
| B65 | **GND** | **Ground** | X | | A65 | **GND** | **Ground** | X | |
| B66 | FB_AD15 | | | | A66 | FB_AD14 | | | |
| B67 | FB_AD16 | | | | A67 | FB_AD13 | | | |
| B68 | FB_AD17 | | | | A68 | FB_AD12 | | | |
| B69 | FB_AD18 | | | | A69 | FB_AD11 | | | |
| B70 | FB_AD19 | | | | A70 | FB_AD10 | | | |
| B71 | FB_R/W_b | | | | A71 | FB_AD9 | | | |
| B72 | FB_OE_b | | | | A72 | FB_AD8 | | | |
| B73 | FB_D7 | | | | A73 | FB_AD7 | | | |
| B74 | FB_D6 | | | | A74 | FB_AD6 | | | |
| B75 | FB_D5 | | | | A75 | FB_AD5 | | | |
| B76 | FB_D4 | | | | A76 | FB_AD4 | | | |
| B77 | FB_D3 | | | | A77 | FB_AD3 | | | |
| B78 | FB_D2 | | | | A78 | FB_AD2 | | | |
| B79 | FB_D1 | | | | A79 | FB_AD1 | | | |
| B80 | FB_D0 | | | | A80 | FB_AD0 | | | |
| B81 | **GND** | **Ground** | X | | A81 | **GND** | **Ground** | X | |
| B82 | **3.3V** | **3.3V Power** | X | X | A82 | **3.3V** | **3.3V Power** | X | X |

# 4 Jumper Table

There are several jumpers provided for isolation, configuration, and feature selection. Refer to the following table for details. The default installed jumper settings are shown in **bold**.

| | Option | Setting | Description |
|---|---|---|---|
| J1 | AR4100 Power Source Selection | **1-2** | Supply 3.3V to AR4100 via Tower Elevator *(J1 can be used as a measurement point for AR4100 specific power usage)* |
| | | 2-3 | Not Used (On-board power regulation is not implemented by default) |
| J2 | AR4100 1.8V Power Regulation | **1-2** | Supply 1.8V to the AR4100 *(J2 can be used as a measurement point specific to the AR4100 1.8V)* |
| J11 | AR4100 Power Down | 1-2 | Power down the AR4100 |
| J12 | AR4100 Reset/Power Down Selection | **1-2** | Tower System RSTOUT_b will control reset / power down of AR4100 |
| | | 2-3 | Tower System GPIO3 will control reset / power down of AR4100 |
| J13 | Interrupt Select (IRQ_G) | 1-2 | Tower System IRQ_G will connect to AR4100 SPI_INT |
| J14 | Interrupt Select (IRQ_E) | 1-2 | Tower System IRQ_E will connect to AR4100 SPI_INT |
| J15 | Interrupt Select (IRQ_C) | 1-2 | Tower System IRQ_C will connect to AR4100 SPI_INT |
| J16 | Interrupt Select (IRQ_A) | **1-2** | Tower System IRQ_A will connect to AR4100 SPI_INT |
| J22 | Debug UART RX Enable | 1-2 | Connects Debug UART RX from AR4100 to J10. This jumper should not be connected until after SW reconfigures signals as UART RX. |
| J23 | TWR-WIFI-AR4100 Power Connection | **1-2** | Supply 3.3V to TWR-WIFI-AR4100 via Tower Elevator *(J23 can be used as a measurement point for the entire TWR-WIFI-AR4100 module)* |