USER GUIDE

SAMW25-MR210/510PA Hardware Design Guidelines - IEEE 802.11 b/g/n IoT Module

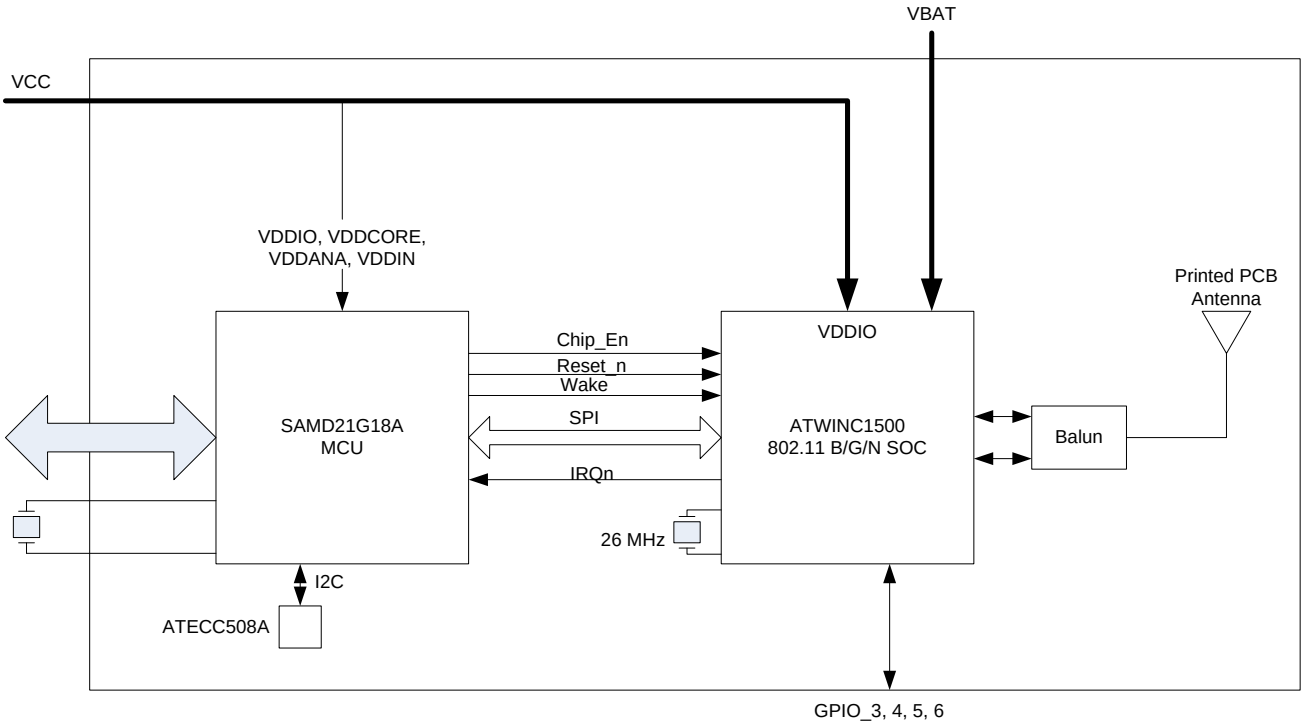
Atmel SmartConnect

Introduction

This document details the hardware design guidelines for a customer to design the Atmel® SAMW25-MR210/510PA module onto their board.

1 Block Diagram

Figure 1-1. Block Diagram of the Module



2 Pinout Information

2.1 Pin Description

Figure 2-1. Pin Assignment – Top View

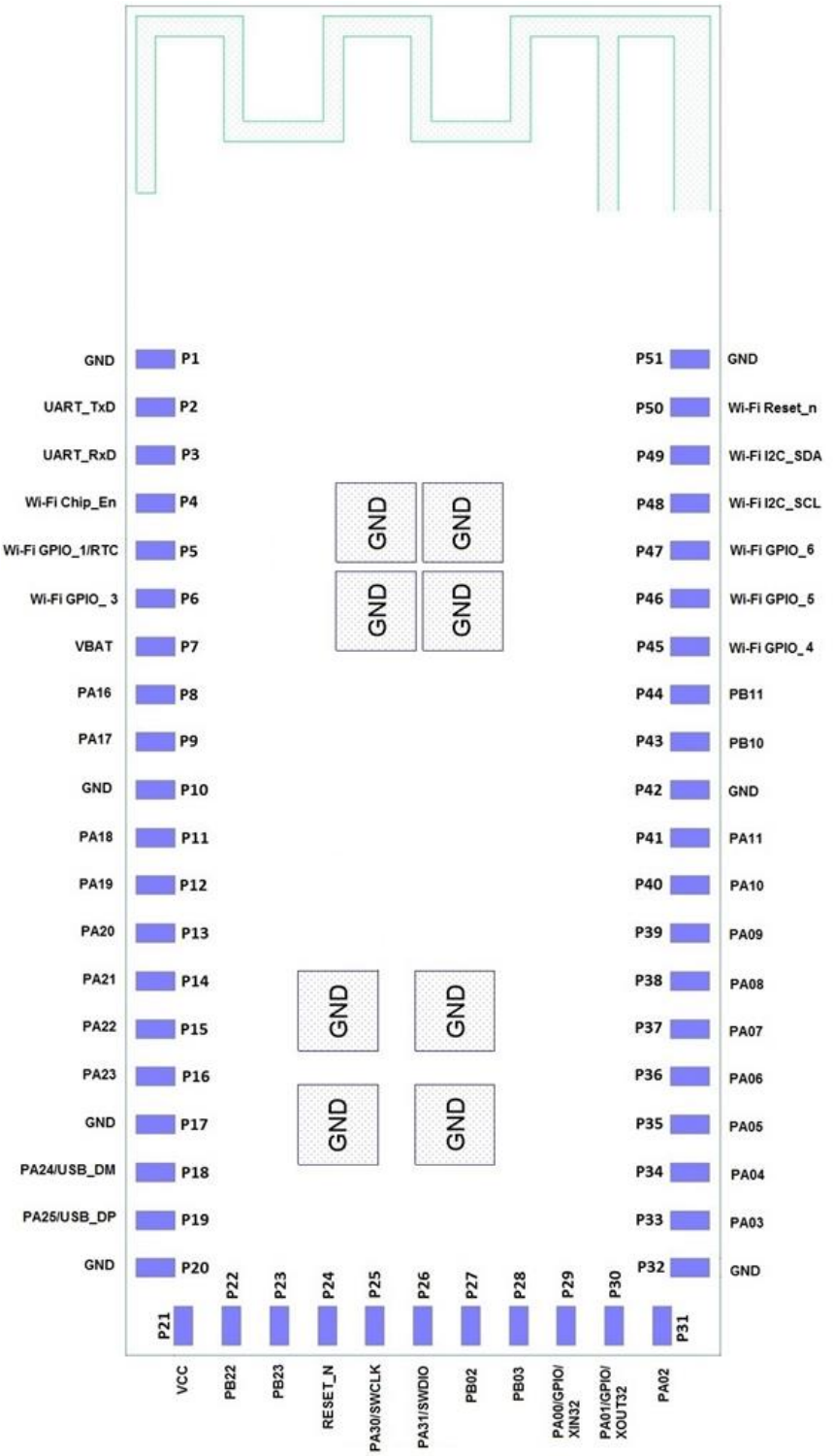


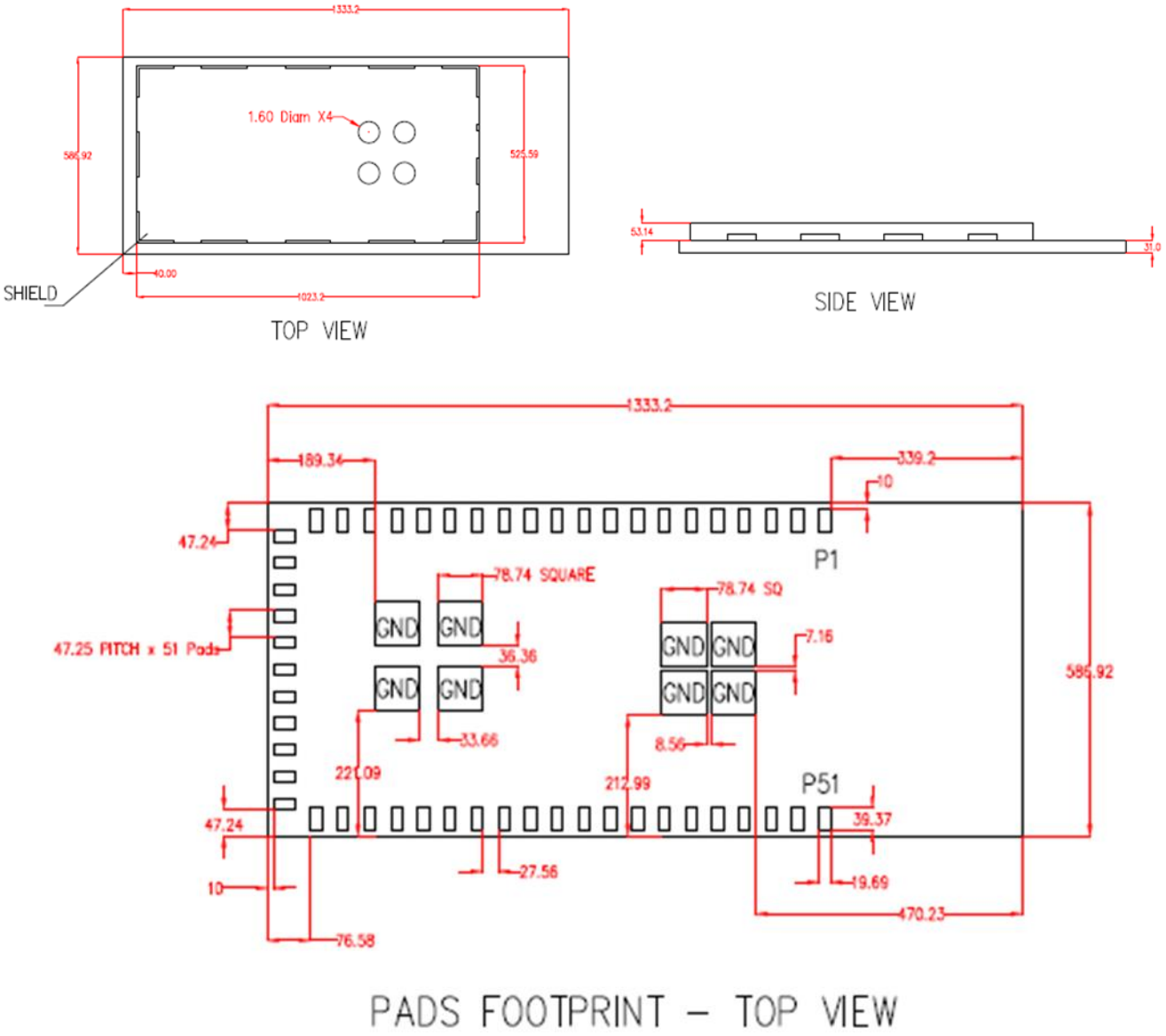
Table 2-1. Pin Description

Pin #	Pin Description	I/O Type	Function (default)	Programmable Pull-up/-down Resistor
1	GND	N/A	Common Ground	
2	UART_TxD	ATWINC1500 Output	Currently used only for Atmel debug. Not for customer use. Leave unconnected.	Yes – Pull-up
3	UART_RxD	ATWINC1500 Input	Currently used only for Atmel debug. Not for customer use. Leave unconnected.	Yes – Pull-up
4	Wi-Fi Chip_En	ATWINC1500 Input	Currently used only for Atmel debug. Not for customer use. Leave unconnected.	No
5	Wi-Fi GPIO_1/RTC	ATWINC1500 I/O	ATWINC1500 General purpose I/O. Can also be used to input a 32.768kHz Real Time Clock for accurate timing of Wi-Fi sleep intervals.	Yes – Pull-up
6	GPIO_3	ATWINC1500 I/O	ATWINC1500 General purpose I/O	Yes – Pull-up
7	VBAT	Power	Supply for Wi-Fi RF Power Amplifier and Internal 1.3V Switching Regulator.	
8	PA16	Multifunction	See SAM D21G Datasheet	Yes
9	PA17	Multifunction	See SAM D21G Datasheet	Yes
10	GND	Power	Ground	
11	PA18	Multifunction	See SAM D21G Datasheet	Yes
12	PA19	Multifunction	See SAM D21G Datasheet	Yes
13	PA20	Multifunction	See SAM D21G Datasheet	Yes
14	PA21	Multifunction	See SAM D21G Datasheet	Yes
15	PA22	Multifunction	See SAM D21G Datasheet	Yes
16	PA23	Multifunction	See SAM D21G Datasheet	Yes
17	GND	Power	Ground	
18	PA24/USB_DM	Multifunction	Host Interface USB Data Minus pin	Yes
19	PA25/USB_DP	Multifunction	Host Interface USB Data Plus pin	Yes
20	GND	Power	Ground	
21	VCC	Power	Power Supply for I/O	
22	PB22	Multifunction	See SAM D21G Datasheet	Yes
23	PB23	Multifunction	See SAM D21G Datasheet	Yes
24	RESET_N	Input, see SAM D21G Datasheet	System Reset. Low level on this pin resets the entire module.	Yes

Pin #	Pin Description	I/O Type	Function (default)	Programmable Pull-up/-down Resistor
25	PA30/SWCLK	Multifunction	Cortex® Serial Wire Debug Interface CLK	Yes
26	PA31/SWDIO	Multifunction	Cortex Serial Wire Debug Interface Data I/O	Yes
27	PB02	Multifunction	See SAM D21G Datasheet	Yes
28	PB03	Multifunction	See SAM D21G Datasheet	Yes
29	PA00/GPIO/XIN32	Multifunction	See SAM D21G Datasheet	Yes
30	PA01/GPIO/XOUT32	Multifunction	See SAM D21G Datasheet	Yes
31	PA02	I/O	See SAM D21G Datasheet	Yes
32	GND	Power	Ground	Yes
33	PA03	Multifunction	See SAM D21G Datasheet	Yes
34	PA04	Multifunction	See SAM D21G Datasheet	Yes
35	PA05	Multifunction	See SAM D21G Datasheet	Yes
36	PA06	Multifunction	See SAM D21G Datasheet	Yes
37	PA07	Multifunction	See SAM D21G Datasheet	Yes
38	PA08	Multifunction	See SAM D21G Datasheet	Yes
39	PA09	Multifunction	See SAM D21G Datasheet	Yes
40	PA10	Multifunction	See SAM D21G Datasheet	Yes
41	PA11	Multifunction	See SAM D21G Datasheet	Yes
42	GND	Power	Ground	
43	PB10	Multifunction	See SAM D21G Datasheet	Yes
44	PB11	Multifunction	See SAM D21G Datasheet	Yes
45	Wi-Fi GPIO_4	ATWINC1500 I/O	ATWINC1500 General purpose I/O	Yes – Pull-up
46	Wi-Fi GPIO_5	ATWINC1500 I/O	ATWINC1500 General purpose I/O	Yes – Pull-up
47	Wi-Fi GPIO_6	ATWINC1500 I/O	ATWINC1500 General purpose I/O	Yes – Pull-up
48	Wi-Fi I2C_SCL	ATWINC1500 I/O	Currently used only for Atmel debug. Not for customer use. Leave unconnected.	Yes – Pull-up
49	Wi-Fi I2C_SDA	ATWINC1500 I/O	Currently used only for Atmel debug. Not for customer use. Leave unconnected.	Yes – Pull-up
50	Wi-Fi Reset_n	ATWINC1500 Input	Currently used only for Atmel debug. Not for customer use. Leave unconnected.	No
51	GND	Power	Ground	

2.2 Module Outline Drawing

Figure 2-2. Module Drawings – Top and Bottom Views (unit = mils)

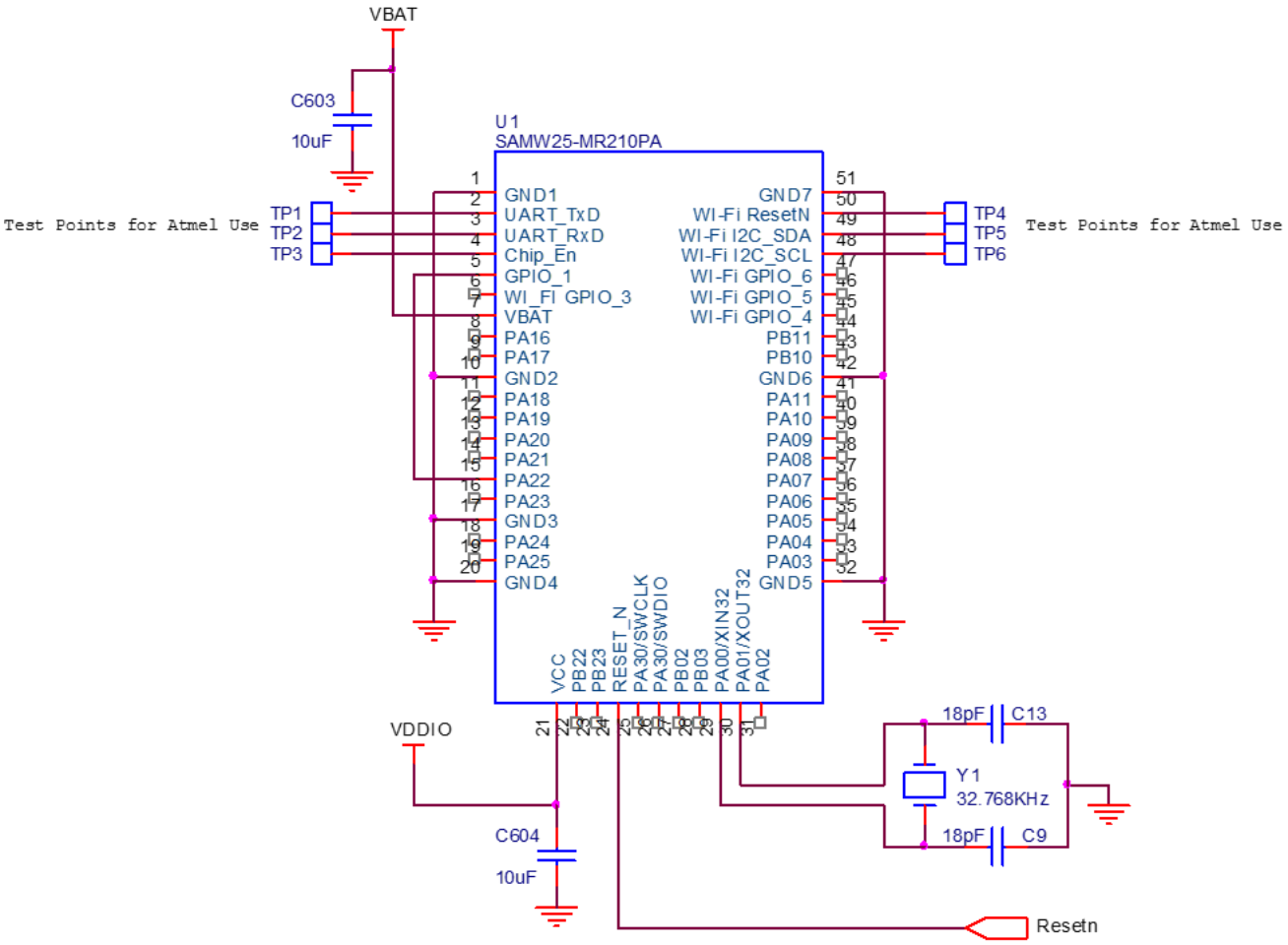


3 Reference Schematic

3.1 Schematic

Figure 3-1 shows the reference schematic for a system using the SAMW25-MR210/510 module.

Figure 3-1. Reference Schematic



4 Notes on Interfacing to the SAMW25 Module

4.1 Programmable Pull-up Resistors

The SAMW25-MR210PA provides programmable pull-up resistors on pins 2, 3, 45, 46, 47, 48, and 49. The purpose of these resistors is to keep any unused input pins from floating, which can cause excess current to flow through the input buffer from the VCC supply. Any unused module pin on the SAMW25-MR210PA should leave these pull-up resistors enabled so the pin will not float. The default state at power up is for the pull-up resistor to be enabled. However, any pin used should have the pull-up resistor disabled. The reason for this is that if any pins are driven to a low level while the SAMW25-MR210PA is in the low power sleep state, current will flow from the VCC supply through the pull-up resistors, increasing the current consumption of the module. Since the value of the pull-up resistor is approximately 100kΩ, the current through any pull-up resistor that is being driven low will be VCC/100kΩ. For VCC = 3.3V, the current through each pull-up resistor that is driven low would be approximately 3.3V/100kΩ = 33µA. Pins which are used and have had the programmable pull-up resistor disabled should always be actively driven to either a high or low level and not be allowed to float.

See the SAMW25-MR210PA Programming Guide for information on enabling/disabling the programmable pull up resistors.

4.2 Restrictions for Power States

When no power is supplied to the device, i.e., the DC/DC Converter output and VCC are both off (at ground potential). In this case, a voltage cannot be applied to the device pins because each pin contains an ESD diode from the pin to supply. This diode will turn ON when voltage higher than one diode-drop is supplied to the pin.

If a voltage must be applied to the signal pads while the chip is in a low power state, the VCC supply must be on, so the SLEEP or Power_Down state must be used.

Similarly, to prevent the pin-to-ground diode from turning on, do not apply a voltage that is more than one diode-drop below ground to any pin.

4.3 Power-up/-down Sequence

The power-up/-down sequence for SAMW25A is shown in Figure 4-1. The timing parameters are provided in Table 4-1.

Figure 4-1. Power-up/-down Sequence

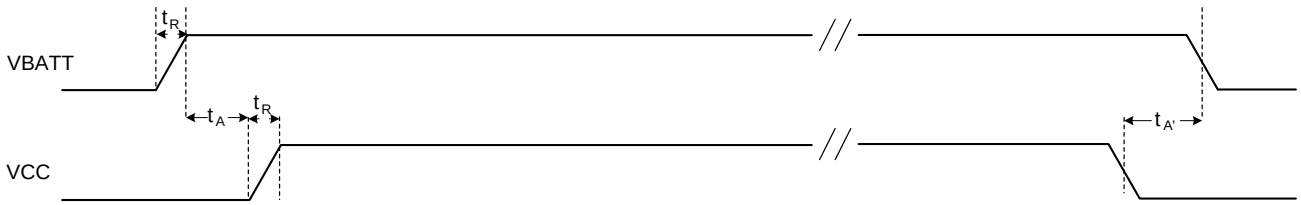


Table 4-1. Power-up/-down Sequence Timing

Parameter	Min.	Max.	Unit	Description	Notes
t_A	0		ms	VBATT rise to VCC rise	VBATT and VCC can rise simultaneously or can be tied together. VCC must not rise before VBATT.

Parameter	Min.	Max.	Unit	Description	Notes
$t_{A'}$	0		ms	VCC fall to VBATT fall	VBATT and VCC can fall simultaneously or can be tied together. VBATT must not fall before VCC.
t_R		0.1	V/µs	DC supply peripheral I/Os, internal regulator, and analog supply voltage	

5 Placement and Routing Guidelines

It is critical to follow the recommendations listed below to achieve the best RF performance:

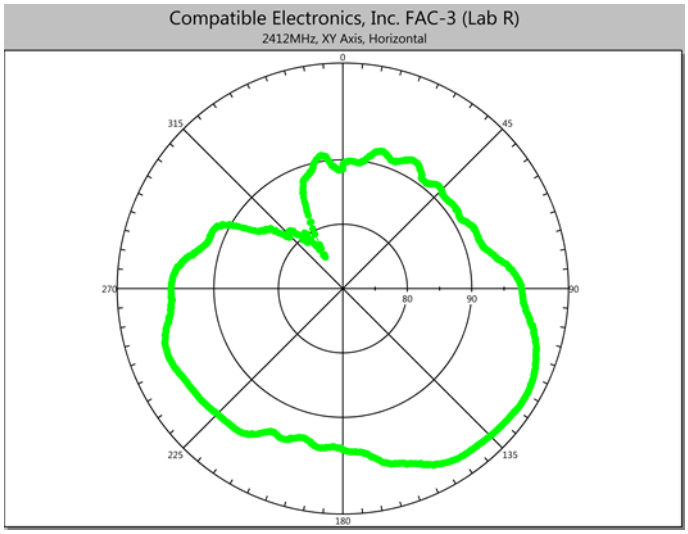
- When the module is placed on the motherboard, a provision for the antenna must be made. There should be nothing under the portion of the module which contains the antenna. This means the antenna should not be placed directly on top of the motherboard PCB. This can be accomplished by, for example, placing the module at the edge of the board such that the module edge with the antenna extends beyond the main board edge by 6.5mm. Alternatively, a cutout in the motherboard can be provided under the antenna. The cutout should be at least 22 x 6.5mm. Ground vias spaced 2.5mm apart should be placed all around the perimeter of the cutout. No large components should be placed near the antenna.
- Place a 10µF decoupling capacitor from VBAT to ground right next to pin 7. Place another 10µF capacitor from VCC to ground right next to pin 21.
- The main board should have a solid ground plane. Each ground pin of the module (including each of the center ground pads) should have a via placed either in the pad or right next to the pad going down to the ground plane.
- To avoid electromagnetic field blocking, keep large metal objects as far away from antenna as possible
- Do not enclose the antenna within a metal shield
- Keep any components which may radiate noise or signals within the 2.4 – 2.5GHz frequency band far away from the antenna or better yet, shield those components. Any noise radiated from the main board in this frequency band will degrade the sensitivity of the module.

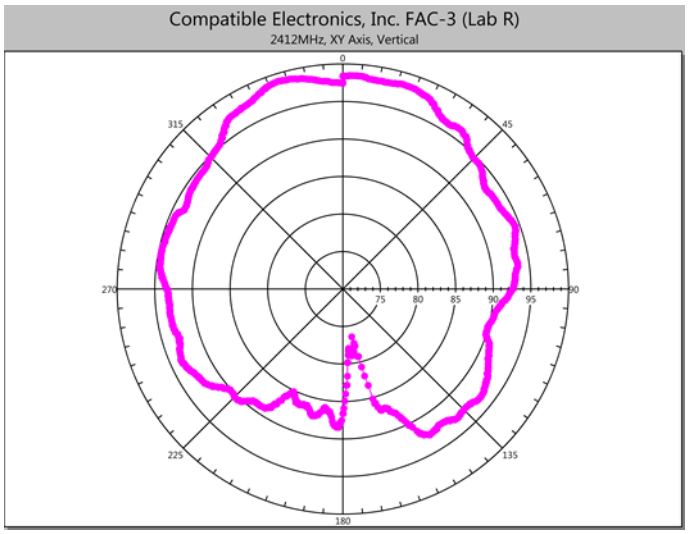
6 Antenna Performance

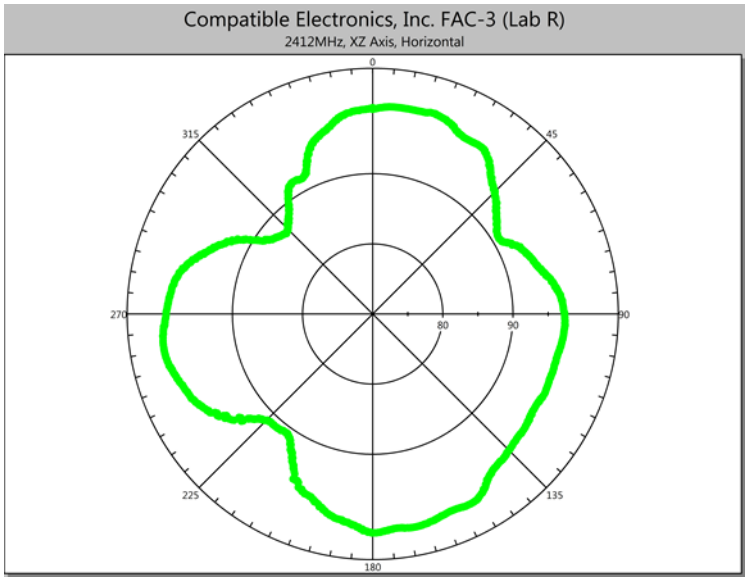
Printed PCB antenna on the SAMW25-MR210P is a meandered Inverted F Antenna (IFA). The antenna is fed via matching network which is matched for module installed on 1.5mm thick main board. Main board thickness deviation by ±1mm will change the RX/TX performance by ±1dB maximum referring to the RX/TX performance with default antenna matching network and installed on a 1.5mm thick main board.

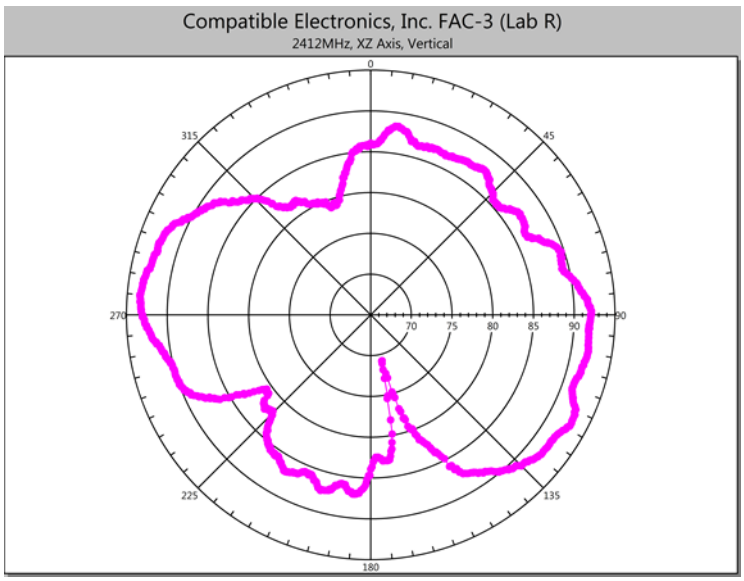
Measured antenna gain is -6.16dBi.

Radiated patterns in three directions for horizontal and vertical polarization are shown below.






Compatible Electronics, Inc. FAC-3 (Lab R)
2412MHz, XZ Axis, Horizontal
0
45
90
135
180
225
270
315
80
90


Compatible Electronics, Inc. FAC-3 (Lab R)
2412MHz, XZ Axis, Vertical
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70
75
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85
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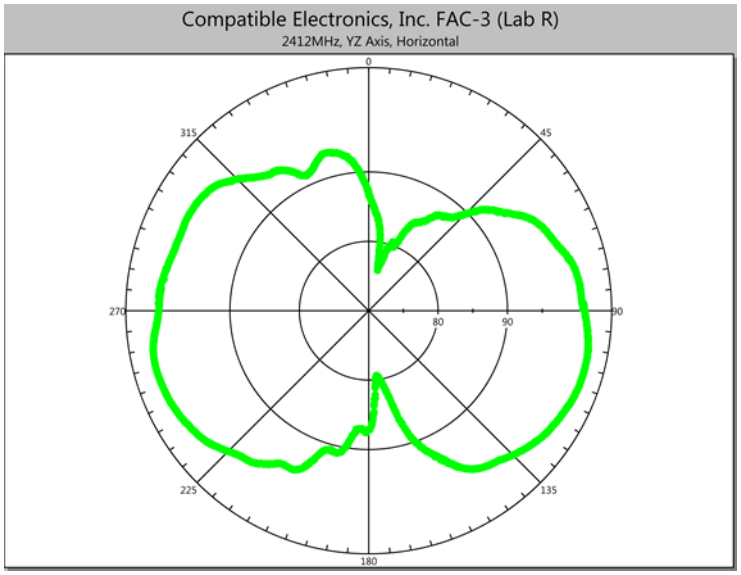
Compatible Electronics, Inc. FAC-3 (Lab R)
2412MHz, YZ Axis, Horizontal
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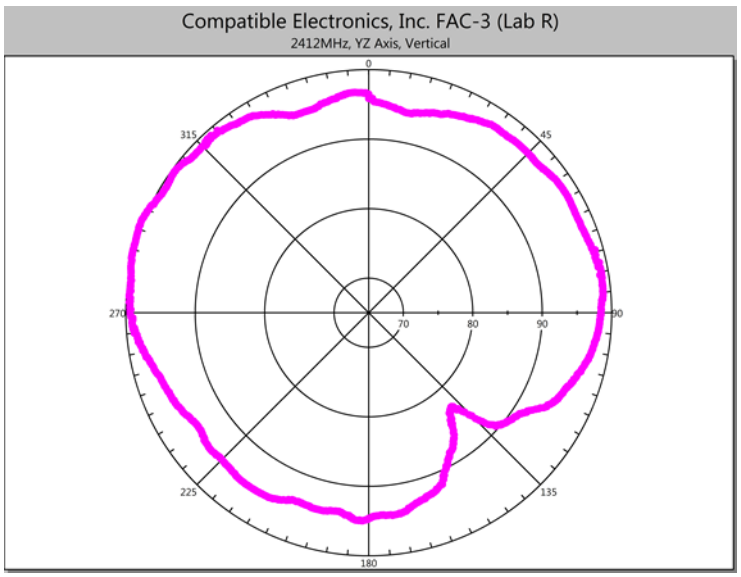
Compatible Electronics, Inc. FAC-3 (Lab R)
2412MHz, YZ Axis, Vertical
0
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225
270
315
70
80
90

7 FCC Compliance

United States (FCC)

This equipment complies with Part 15 of the FCC rules and regulations. To fulfill FCC Certification requirements, an OEM manufacturer must comply with the following regulations:

1. The SAMW25 modular transmitter must be labeled with its own FCC ID number, and, if the FCC ID is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following:

Contains Transmitter Module FCC ID: 2ADHKSAMW25 The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (i.) this device may not cause harmful interference and (ii.) this device must accept any interference received, including interference that may cause undesired operation.

Any similar wording that expresses the same meaning may be used.

IMPORTANT: Each module has a label with an FCC ID, however the product User Manual must contain the following statement: “This equipment complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation” (FCC 15.19).

The module must be installed into the end product to provide a separation distance of at least 6.5 cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

IMPORTANT: Modifications not expressly approved by this company could void the user's authority to operate this equipment (FCC section 15.21).

IMPORTANT: This equipment has been tested and found to comply with the limits for a class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the module/product.
- Increase the separation between the equipment and module/product.
- Consult the dealer or an experienced radio/TV technician for help.

8 Interfaces

All Communication with the SAMW25 is handled by the internal SAMD21 device. For further information on supported interfaces, timing, drive strengths, etc. refer to the SAMD21 HW design Guide.

9 Reference Documentation and Support

9.1 Reference Documents

Atmel offers a set of collateral documentation to ease integration and device ramp.

The following list of documents available on the Atmel web or integrated into development tools.

Table 9-1. Reference Documents

Title	Content
Datasheet	
Design Files Package	User Guide, Schematic, PCB layout, Gerber, BOM and System notes on: RF/Radio Full Test Report, radiation pattern, design guidelines, temperature performance, ESD.
Platform Getting started Guide	How to use package: Out of the Box starting guide, HW limitations and notes, SW Quick start guidelines
HW Design Guide	This document
SW Design Guide	Integration guide with clear description of: High level Arch, overview on how to write a networking application, list all API, parameters and structures. Features of the device, SPI/handshake protocol between device and host MCU, with flow/sequence/state diagram, timing.
SW Programmer guide	Explain in details the flow chart and how to use each API to implement all generic use cases (e.g. start AP, start STA, provisioning, UDP, TCP, http, TLS, p2p, errors management, connection/transfer recovery mechanism/state diagram) - usage and sample application note

For a complete listing of development-support tools and documentation, visit http://www.atmel.com/ or contact the nearest Atmel field representative.

10 Revision History

Doc Rev.	Date	Comments
42436A	03/2015	Initial document release.

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