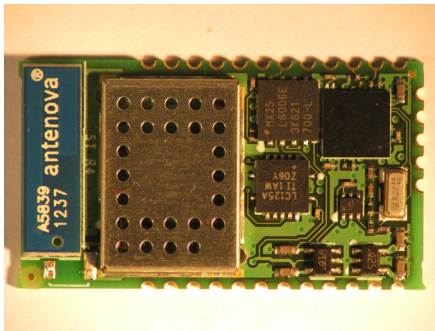
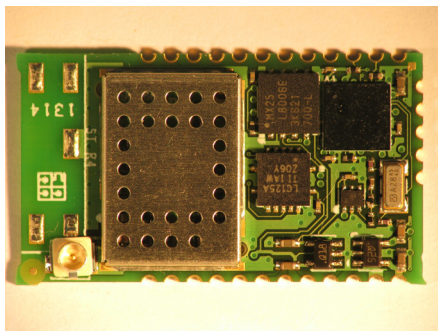


Serial-to-Wi-Fi b/g/n intelligent modules

Datasheet - production data

**SPWF01SA.11****SPWF01SC.11**

- Multiple antenna options:
 - Integrated antenna (SPWF01SA.xy versions)
 - Integrated U.FI connector (SPWF01SC.xy versions)
- Industrial operating temperature range
- FCC/CE/IC certified
- RoHS compliant
- Surface mount PCB module

Applications

- Smart appliances
- Industrial control and data acquisition
- Home automation and security systems
- Wireless sensors
- Cable replacement
- Medical equipment
- Machine-to-machine communication

Features

- 2.4 GHz IEEE 802.11 b/g/n transceiver
- STM32 ARM Cortex-M3
- Multiple Integrated Flash memory options:
 - 1.5 MB (SPWF01Sx.1y orderable parts)
 - 512 kB (SPWF01Sx.2y orderable parts)
- 64 KB RAM memory
- 32 kHz XTAL to support low power modes
- 16 GPIOs, serial port (UART, SPI, I2C) interfaces available
- Small form factor: 26.92 x 15.24 x 2.35 mm
- Up to +18 dBm output power
- Single voltage supply (3.3 V typ.)

1 Description

The SPWF01SA and the SPWF01SC intelligent Wi-Fi modules represent a plug and play and standalone 802.11 b/g/n solution for easy integration of wireless Internet connectivity features into existing or new products.

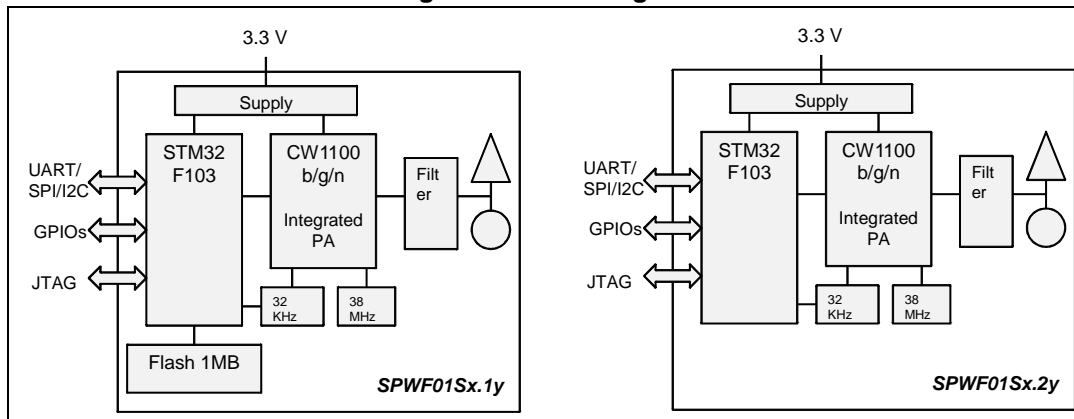
Configured around a single-chip 802.11 transceiver with integrated PA and an STM32 32-bit microcontroller with an extensive GPIO suite, the modules also incorporate timing clocks and voltage regulators. Two different options exist based on the integrated Flash memory. The SPWF01Sx.2y orderable parts integrate 1.5 MB of Flash, while The SPWF01Sx.2y orderable parts integrate 512 kB of Flash.

The module is available either configured with an embedded micro 2.45 GHz ISM band antenna (SPWF01SA), or with an u.FL connector for external antenna connection (SPWF01SC).

With low power consumption and small form factor, the modules are ideal for fixed and mobile wireless applications, as well as challenging battery-operated applications.

The SPWF01Sx.y1 orderable parts are released with an integrated full featured TCP/IP protocol stack with added web server and additional application service capabilities. The SW package also includes an AT command layer interface for user-friendly access to the stack functionalities via the UART serial port.

Figure 1. Block diagram



2 General electrical specifications

Table 1. Absolute maximum ratings

| Parameter | Test condition/comment | Min. | Typ. | Max. | Unit |
|---------------------------------------|------------------------|------|------|------|------|
| Voltage supply | - | -0.3 | | 4.0 | V |
| V _{in} for 5 V tolerant pins | - | -0.3 | | 5.5 | V |
| V _{in} for all other pins | - | -0.3 | | 2.8 | V |

Table 2. Operating conditions and input power specifications⁽¹⁾

| Parameter | Test condition/comment | Min. | Typ. | Max. | Unit | |
|-----------------------------|--------------------------------|--|------|------|----------------|----|
| Operating temperature range | Industrial | -40 | | 85 | °C | |
| 3.3 V supply | Input supply voltage | 3.3 V supply input | 3.1 | 3.3 | 3.6 | V |
| | Standby | Corresponds to have both the micro and the radio in standby power states | | 5 | | µA |
| | Sleep | Corresponds to have the micro in stop power state and the radio in sleep power state | | <1 | | mA |
| | Power state | Corresponds to have the micro active and the radio in sleep power state | | 15 | | mA |
| | Idle | Radio is deactivated | | 13 | | mA |
| | Not connected | Scanning Cycle (average) | | 25 | | mA |
| | Connected (RX, idle or active) | Correspond to have active both the processor and the radio | | 80 | | mA |
| | Connected (TX active) | Refer to 18 dBm output power | | 250 | ⁽²⁾ | mA |

1. Typical results are at room temperature only.
2. Max values are in the range of 400 mA and depend on operating conditions.

3 Digital interface specifications

Table 3. Digital interface specifications, I/O pins

| Parameter | | Test condition/comment | Min. | Typ. | Max. | Unit |
|---------------------------------------|-----|------------------------|------|------|------|------|
| Inputs | VIH | | 1.4 | | | V |
| | VIL | | 0.6 | | | V |
| Outputs | VOH | IOH=4 mA | 1.8 | | | V |
| | VOL | IOL=4 mA | | | 0.4 | V |
| Programmable pull up or down resistor | | When turned on | 80 | | 120 | kΩ |
| | | | | | | |

4 RF characteristics

Table 4. RF characteristics

| Parameter | | Test condition/comment | Min. | Typ. | Max. | Unit |
|-----------------------------------|--------------------|---|------|-------|------|------|
| | 11b, 1 Mbps | | | -96 | | dBm |
| RX Sensitivity ⁽¹⁾ | 11b, 2 Mbps | | | -93 | | dBm |
| | 11b, 5.5 Mbps | | | -91 | | dBm |
| | 11b, 11 Mbps | | | -87 | | dBm |
| | 11g, 9 Mbps | | | -89.5 | | dBm |
| | 11g, 18 Mbps | | | -86 | | dBm |
| | 11g, 36 Mbps | | | -80 | | dBm |
| | 11g, 54 Mbps | | | -74.5 | | dBm |
| | 11n, MCS1, 13 Mbps | | | -86.5 | | dBm |
| | 11n, MCS3, 26 Mbps | | | -81.5 | | dBm |
| | 11n, MCS5, 52 Mbps | | | -74 | | dBm |
| | 11n, MCS7, 65 Mbps | | | -71 | | dBm |
| Channel-to-channel de-sensitivity | CH1 to 14 | 11g, 54 Mbps, 10%PER | | 1 | | dB |
| Maximum input signal | CH7 | 11g, 54 Mbps | | -20 | | dBm |
| Adjacent channel rejection | 11Mbps | | | 38 | | dBc |
| | 9 Mbps | | | 20 | | dBc |
| | 54 Mbps | | | 4 | | dBc |
| | MCS1 | | | 24 | | dBc |
| | MCS7 | | | 3 | | dBc |
| TX output power ⁽¹⁾ | 11b, 1 Mbps | @802.11b spectral mask | | 18.3 | | dBm |
| | 11b, 11 Mbps | | | 18.3 | | dBm |
| | 11g, 9 Mbps | @802.11g spectral mask | | 18.3 | | dBm |
| | 11g, 54Mbps | EVM=-27dB, 4.5% | | 13.7 | | dBm |
| | 11n, MCS1 | @802.11n spectral mask | | 18.3 | | dBm |
| | 11n, MCS7 | EVM=-27 dB | | 13.5 | | dBm |
| On board antenna gain | | Average | | -1.2 | | dBi |
| External antenna gain | | SG901-1066 average including cable loss | | 2.8 | | dBi |

1. Output power and sensitivities are measured with a 50 Ω connection at the antenna port.

5 Pinout description

| SIGNAL Name | Type | PIN Number | Main function | Alternate functions ⁽¹⁾ | Notes |
|--|------|------------|--|---|---------------------------------|
| GPIO - general purpose input/output | | | | | |
| GPIO[0] | I/O | 16 | General purpose input/output Restore to factory settings ⁽²⁾ | SPI MISO | Input pull down and 5V tolerant |
| GPIO[1] | I/O | 17 | General purpose input/output | SPI MOSI | Input pull down and 5V tolerant |
| GPIO[2] | I/O | 19 | General purpose input/output | SPI Chip Select | Floating and 5V tolerant |
| GPIO[3] | I/O | 1 | General purpose input/output | SPI Clock | Input pull down and 5V tolerant |
| GPIO[6] | I/O | 22 | General purpose input/output Wake Up/Sleep Inhibit ⁽³⁾ | ADC 0 | Input pull down and 5V tolerant |
| GPIO[4] | I/O | 18 | General purpose input/output | UART3 Receive data input ⁽⁴⁾ | |
| GPIO[5] | I/O | 20 | General purpose input/output | UART3 Transmit data output ⁽⁴⁾ | |
| GPIO[7] | I/O | 13 | General purpose input/output STA/Mini AP switch ⁽⁵⁾ | ADC 1 | |
| GPIO[8] | I/O | 4 | General purpose input/output | UART2 Transmit data output ⁽⁴⁾ ADC2 | |
| GPIO[9] | I/O | 7 | General purpose input/output | UART2 Receive data input ⁽⁴⁾ ADC3 | |
| GPIO[11] | I/O | 11 | | I2C SCL | |
| GPIO[12] | I/O | 12 | General purpose input/output | I2C SDA | |
| GPIO[15] | I/O | 21 | General purpose input/output | DAC | |
| Monitoring purpose with no alternate function | | | | | |
| GPIO[10] | I/O | 5 | LED Drive, Blinking while run | | |
| GPIO[13] | I/O | 15 | LED Drive, WiFi Link up | | |

| | | | | | |
|-------------------------------|-----|----|------------------------------|--|---|
| GPIO[14] | I/O | 14 | LED Drive, Power Up | | |
| UART Pins | | | | | |
| RXD1 | I | 8 | UART1 Receive data input | | 5V tolerant |
| TXD1 | O | 6 | UART1 Transmit data output | | 5V Tolerant |
| CTS1_DN | I | 9 | UART1 Clear To Send input | | Active Low, 5V Tolerant |
| RTS1_DP | O | 10 | UART1 Request to send output | | Active Low, 5V tolerant |
| Reset | | | | | |
| RESETn | I | 3 | Reset input | | Active low for 5 ms with pull up to 2.5VDC. Not 5V tolerant |
| SUPPLY Pins and paddle | | | | | |
| 3.3 V | | 24 | Voltage Supply | | Decouple with 10uF capacitor |
| Ground | | 23 | Ground | | |
| Ground Paddle | | 25 | Ground | | Add plenty of ground vias for thermal dissipation and ground return |
| Boot loader | | | | | |
| BOOT0 | I | 2 | Boot loader ⁽⁶⁾ | | |

1. The activation of ALT function depends upon the firmware version or upon the variable configuration.
2. To perform the factory reset of the variables, pin GPIO0 must be high during powerup.
3. GPIO function running when low power mode variable is enabled.
4. Deprecated starting from the release 3.0 of at full stack
5. Introduced with the release 3.0 of AT Full stack. To enable the STAToMiniAP switch the GPIO[7] needs to be put low together with the HW reset
6. To enable the firmware download, pin BOOT0 needs to be high during power up. RESETn need to be pulled low at least 5 ms to initiate the firmware download sequence.

Application tip

As a general rule, when commutation issues may occur, we suggest to use a level translator to match the I/O pins voltage of the connected.

6 Module reflow

The SPWF01SA and SPWF01SC are surface mount modules with a 6-layer PCB. The recommended final assembly reflow profiles are indicated below.

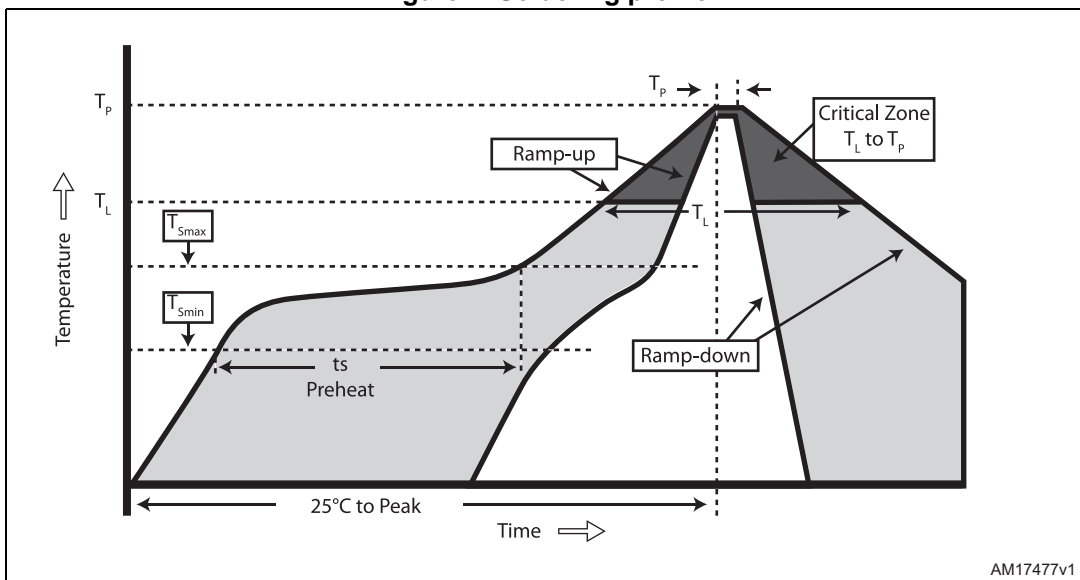
The soldering phase must be executed with care: in order to prevent an undesired melting phenomenon, particular attention must be paid to the setup of the peak temperature.

The following are some suggestions for the temperature profile based on the IPC/JEDEC J-STD-020C, July 2004 recommendations.

Table 5. Soldering values

| Profile feature | PB-free assembly |
|--|--------------------------------|
| Average ramp-up rate (T_{SMAX} to T_P) | 3 °C/sec max |
| Preheat: – Temperature min. (T_S min.) – Temperature max. (T_S max.) – Time (T_S min. to T_S max) (ts) | 150 °C 200 °C 60-100 sec |
| Critical zone: Temperature T_L Time T_L | 217 °C 60-70 sec |
| Peak temperature (T_P) | 240 + 0 °C |
| Time within 5 °C of actual peak temperature (T_P) | 10-20 sec |
| Ramp-down rate | 6 °C/sec |
| Time from 25 °C to peak temperature | 8 minutes max. |

Figure 2. Soldering profile



AM17477v1

7 Regulatory compliance

RF compliance

The RF certifications obtained are described in [Table 6](#) below.

Table 6. RF certification summary

| | | Comment |
|--------|-----------------|---|
| FCC ID | VRA-SG9011203 | On board antenna and external SG901-1066 with connector version |
| IC ID | 7420A-SG9011203 | On board antenna and external SG901-1066 with connector version |
| ETSI | Compliant | Approved with on board antenna and connector version |

Note: The SG901-1066 from Sagrad Inc. is the only approved antenna using the UFL connector version.

FCC and IC

This module has been tested and found to comply with the FCC part 15 and IC RSS-210 rules. These limits are designed to provide reasonable protection against harmful interference in approved installations. 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 may not occur in a particular installation.

This device complies with part 15 of the FCC rules. Operation is subject to the following two conditions:

1. The device must not cause harmful interference.

and

2. The device must accept any interference received, including interference that may cause undesired operation.

Modifications or changes to this equipment not expressly approved by the party responsible for compliance may render void the user's authority to operate this equipment.

Modular approval, FCC and IC

FCC ID: VRA-SG9011203

IC: 7420A-SG9011203

In accordance with FCC part 15, the modules SPWF01SA and SPWF01SC are listed above as a modular transmitter device.

Labeling instructions

When integrating the SPWF01SA and SPWF01Sc into the final product, it must be ensured that the FCC labeling requirements specified below are satisfied. Based on the Public Notice from FCC, the product into which the ST transmitter module is installed must display a label referring to the enclosed module. The label should use wording like the following:

Contains Transmitter Module

FCC ID: VRA-SG90112013

IC: 7420A-SG9011203

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

CE

This module complies with the following European EMI/EMC and safety directives and standards:

- EN 300 328 V 1.8.1 (2012-06)
- EN 301 489-17 V 2.2.1 (2012-09) & EN301 489-1 V.1.8.1 (2008-04)
- EN60950-1:2006 A1:2010

Figure 3. CE certified



8 Package mechanical data

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: www.st.com. ECOPACK® is an ST trademark.

Figure 4. Top view of the module shield

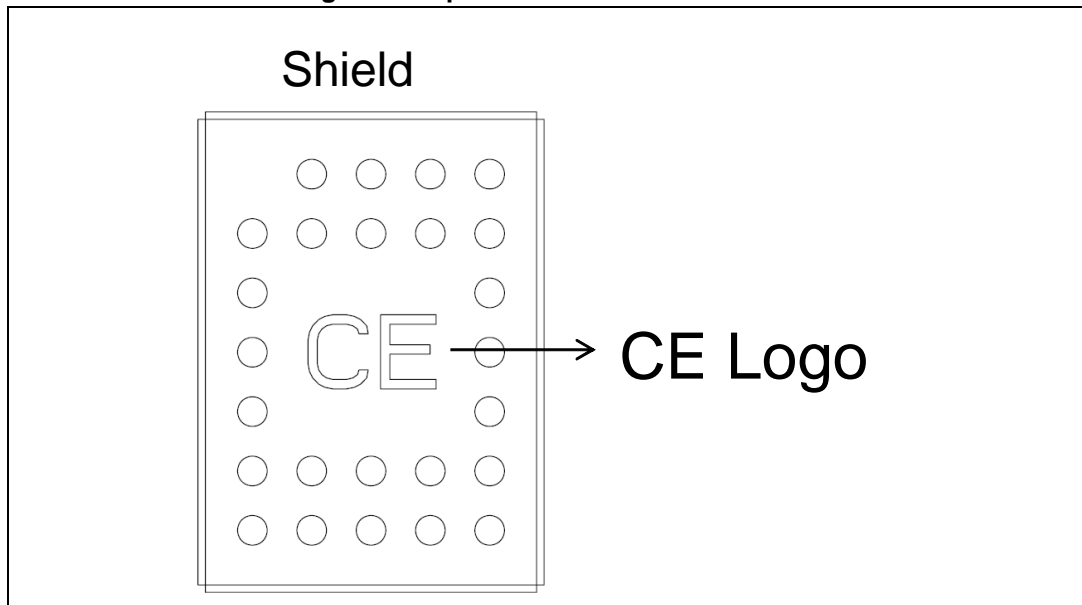


Figure 5. Bottom view of the module

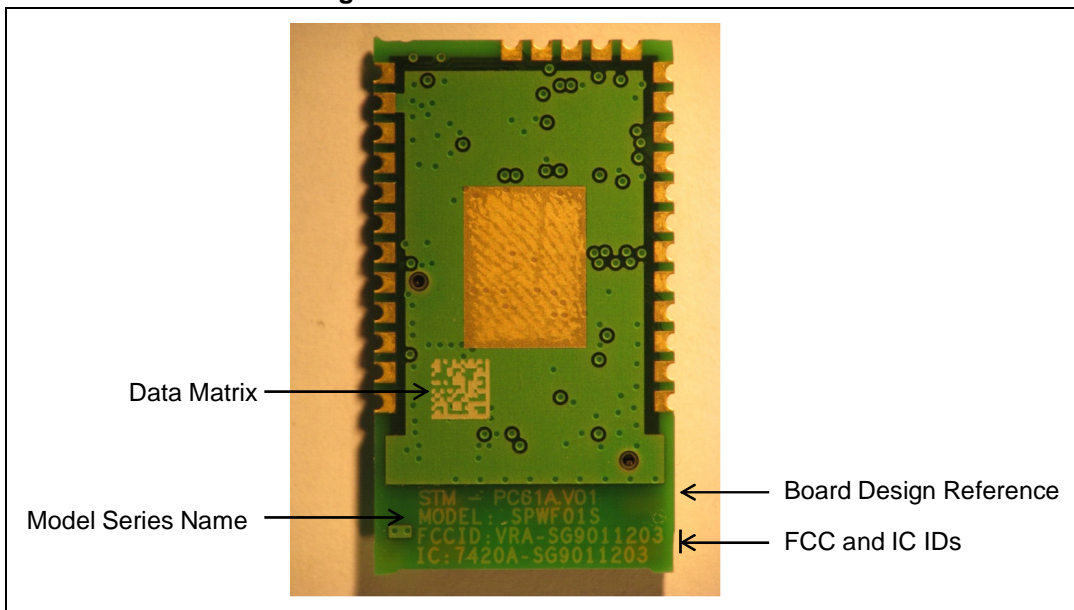
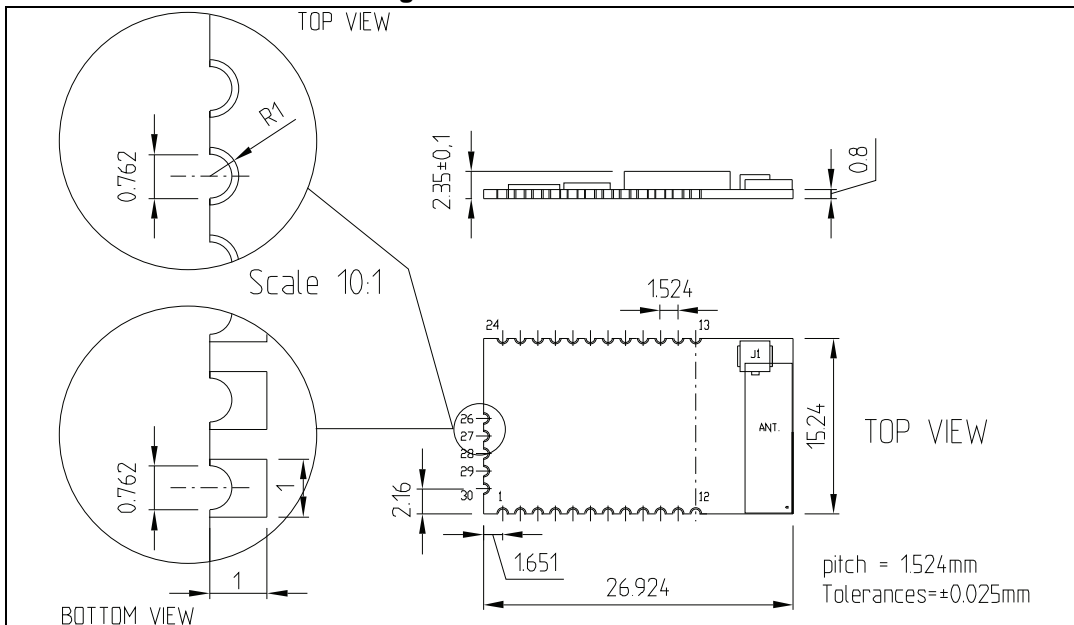
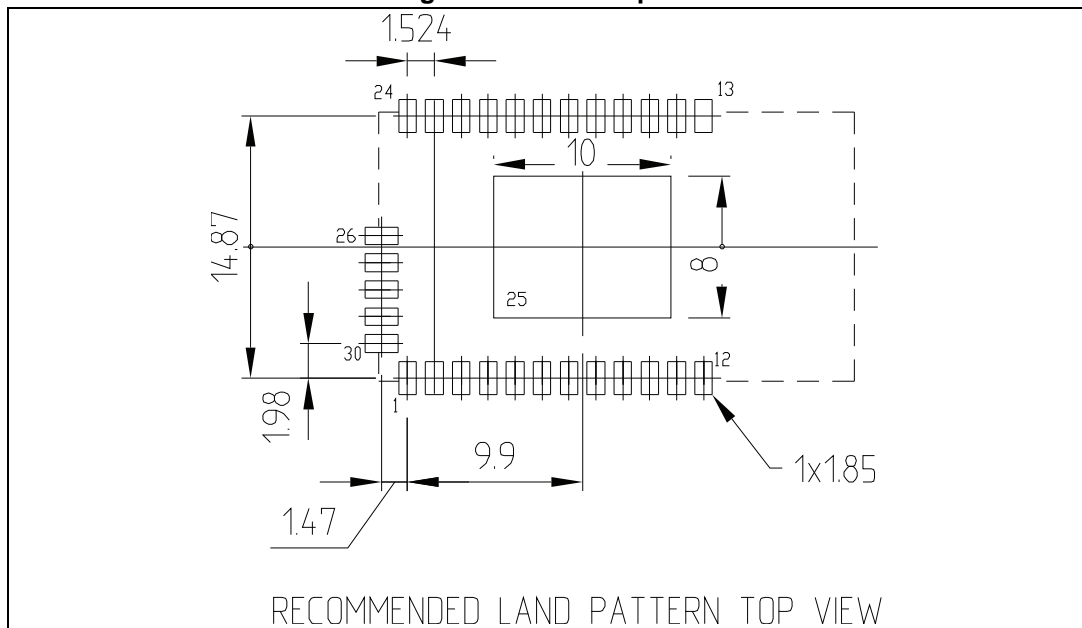


Figure 6. Wi-Fi dimensions



Note: An antenna area of 217 x 520 mils must be free of any ground metalization or traces under the unit. The area extending away from the antenna should be free from metal on the PCB and housing to meet expected performance levels. Pin 25 is the required paddle ground and is not shown in this diagram.

Figure 7. Wi-Fi footprint



PCB design requires a detailed review of the center exposed pad. This pad requires good thermal conductivity. Soldering coverage should be maximized and checked via x-ray for proper design. There is a trade-off between providing enough soldering for conductivity and applying too much, which allows the module to “float” on the paddle creating reliability issues. ST recommends two approaches, a large center via that allows excess solder to flow down into the host PCB with smaller vias around it, or many smaller vias with just enough space for the viscosity of the chosen solder/flux to allow some solder to flow into the smaller vias.

Either of these approaches must result in 60% or more full contact solder coverage on the paddle after reflow. ST strongly encourages PCB layout teams to work with their EMS providers to ensure vias and solder paste designs that will result in satisfactory performance.

9 Ordering information

Table 7. Ordering information

| Order codes | Description |
|-------------|---|
| SPWF01SA.11 | Wi-Fi module with integrated antenna, 1.5 MB of Flash and Wi-Fi full stack |
| SPWF01SC.11 | Wi-Fi module with integrated u.FL connector, 1.5 MB of Flash and Wi-Fi full stack |
| SPWF01SA.21 | Wi-Fi module with integrated antenna, 512 kBytes of Flash and Wi-Fi full stack |
| SPWF01SC.21 | Wi-Fi module with integrated U.FI. connector 512 kBytes of Flash and Wi-Fi full stack |

Note: Refer to the user manual for a complete list of features and commands available in the Wi-Fi full stack.

10 Revision history

Table 8. Document revision history

| Date | Revision | Changes |
|-------------|----------|---|
| 05-Dec-2013 | 1 | Initial release. |
| 22-Jan-2014 | 2 | <i>Figure 3</i> has been modified. |
| 16-Apr-2014 | 3 | Updated with references to modules with reduced Flash memory. |

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