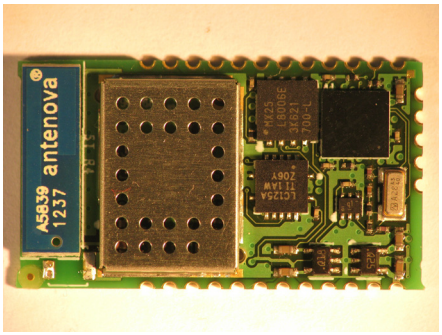
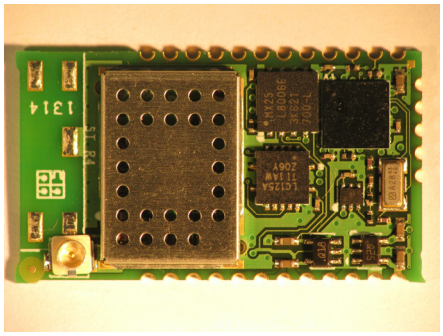
SPWF01SA
SPWF01SC

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

Datasheet - production data



SPWF01SA



SPWF01SC

- 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
- 1.5 MB Flash memory
- 64 KB RAM memory
- 32 kHz XTAL to support low power modes
- 16 GPIOs, JTAG and 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.)
- Multiple antenna options available: integrated antenna or integrated u.FL connector

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.

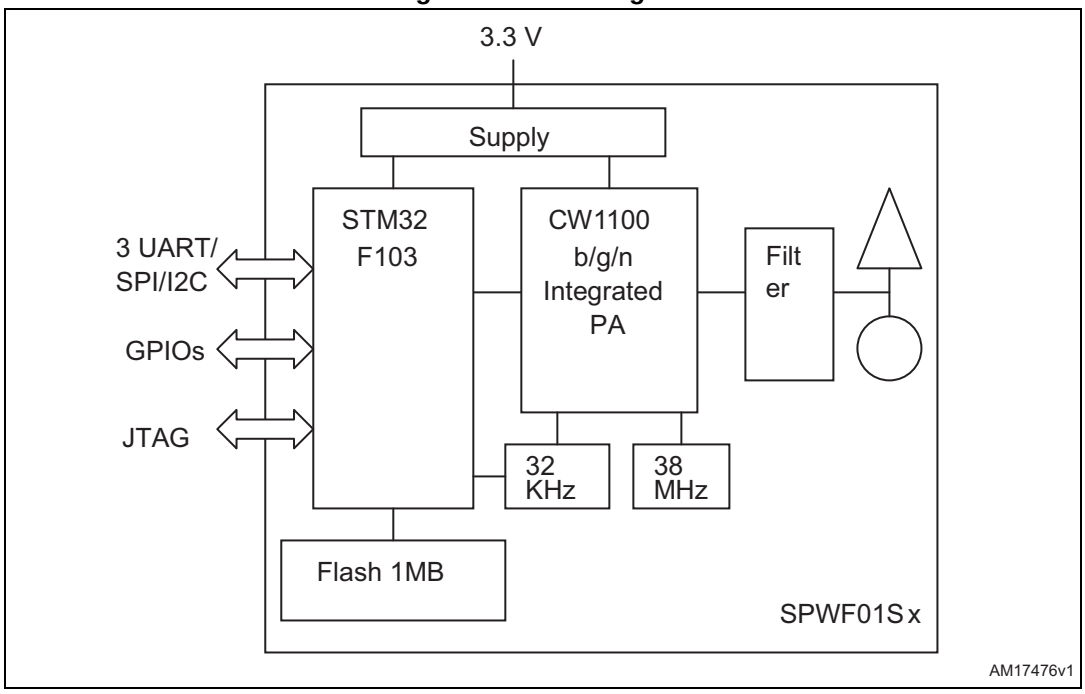
Configured around a single-chip 802.11 transceiver with integrated PA and an STM32 32-bit microcontroller with an extensive GPIO suite, the modules also incorporate timing clocks and voltage regulators.

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 SPWF01SA.11 and SPWF01SC.11 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
Vin for 5 V tolerant pins	-	-0.3		5.5	V
Vin 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
	Power save mode	No data retention, wakeup on event	2.5			mA
	Standby	Wi-Fi radio disabled	15			mA
	Standby	Wi-Fi scanning	25			mA
	Connected (RX, idle)	At 18 dBm	90			mA
	Connected (TX)	At 18 dBm	250	400		mA

1. Typical results are at room temperature only.

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
RX Sensitivity(1)	11b, 1 Mbps			-96		dBm
	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

Table 5. Pinout

Signal name	Pin number	Description/alternate function	Notes
GPIO pins and alternate SPI functions			
GPIO0_MISO	16	Alternate SPI MISO pin. Pull high on powerup to reset settings	Input pull down and 5 V tolerant
GPIO1_MOS1	17	Alternate SPI MOSI	Input pull down and 5 V tolerant
GPIO2_SPICS	19	Alternate SPI chip select	Floating and 5 V tolerant
GPIO3_SCLK	1	Alternate SPI clock	Input pull down and 5 V tolerant
GPIO6_ADC0	22	Wake up/sleep inhibit(1)	Input pull down and 5 V tolerant
Pins reserved for future use			
GPIO4_RXD3	18	Alternate UART3 receive data input (1)	
GPIO5_TXD3	20	Alternate UART3 transmit data output (1)	
GPIO7_ADC1	13		
GPIO8_ADC2	4	Alternate UART2 transmit data output (1)	
GPIO9_ADC3	7	Alternate UART2 receive data input (1)	
I^2C pins			
GPIO11_SCL	11		
GPIO12_SDA	12		
GPIO15_DAC	21		
For monitoring purposes with no alternate function (1)			
GPIO10	5	LED drive, blinking while running	
GPIO13	15	LED drive, Wi-Fi link	
GPIO14	14	LED drive, powerup	
UART pins			
RXD1	8	UART1 receive data input	5 V tolerant
TXD1	6	UART1 transmit data output	5 V tolerant
CTS1_DN	9	UART1 clear to send input	Active low, 5 V tolerant
RTS1_DP	10	UART1 request to send output	Active low, 5 V tolerant
Reset			
RESETn	3	Reset input	Active low for 5 ms with pull up to 2.5 V DC. Not 5 V tolerant
JTAG test pins (2)			

Table 5. Pinout (continued)

Signal name	Pin number	Description/alternate function	Notes
TRST_MISO3	28	JTAG TRST_N, Used for 1M Flash	5 V tolerant
TDI	27	JTAG TDI	5 V tolerant
TMS	26	JTAG TMS	5 V tolerant
TCK	29	JTAG TCK	5 V tolerant
TDO_SCK3	30	JTAG TDO, Used for 1M Flash	5 V tolerant
Supply pins and paddle			
3.3 V	24	Voltage supply	Decouple with 10 uF capacitor
Ground	23	Ground	
Ground Paddle	25	Ground	Add plenty of ground vias for thermal dissipation and ground return
Firmware load pin access			
BOOT0	2	(See firmware load description)	

1. Function configured in the Full Stack FW
2. To enable the firmware download, Pin BOOT0 must be high during powerup. RESETn must be pulled low at least 5 ms to initiate the firmware download sequence.

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.

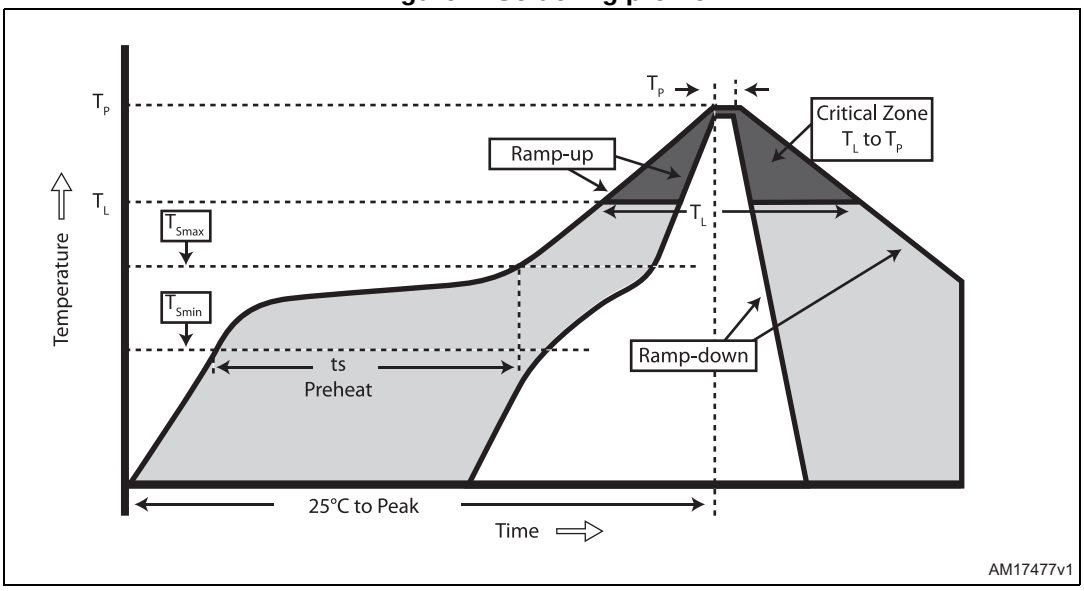
The soldering phase must be executed with care: in order to prevent an undesired melting phenomenon, particular attention must be paid to the setup of the peak temperature.

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

Table 6. 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



7 Regulatory compliance

RF compliance

The RF certifications obtained are described in *Table 7* below.

Table 7. 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

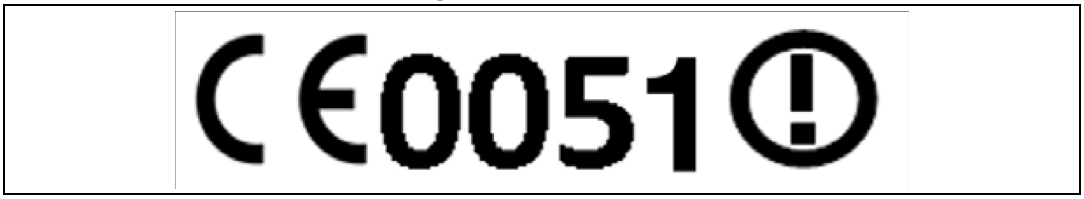
Any similar wording that expresses the same meaning may also be used.

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

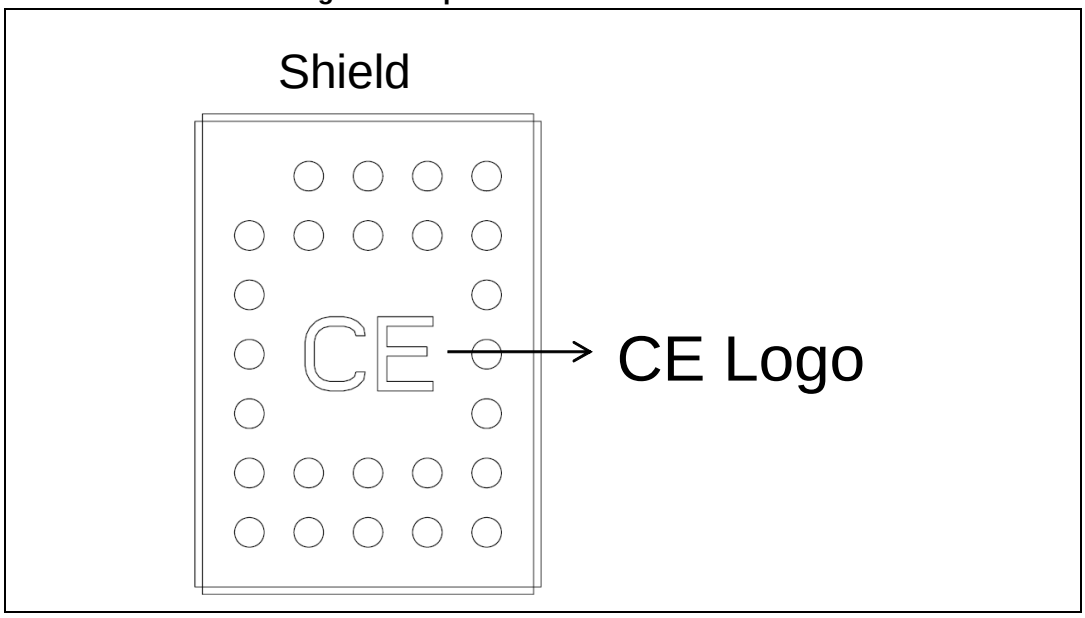


Figure 5. Bottom view of the module

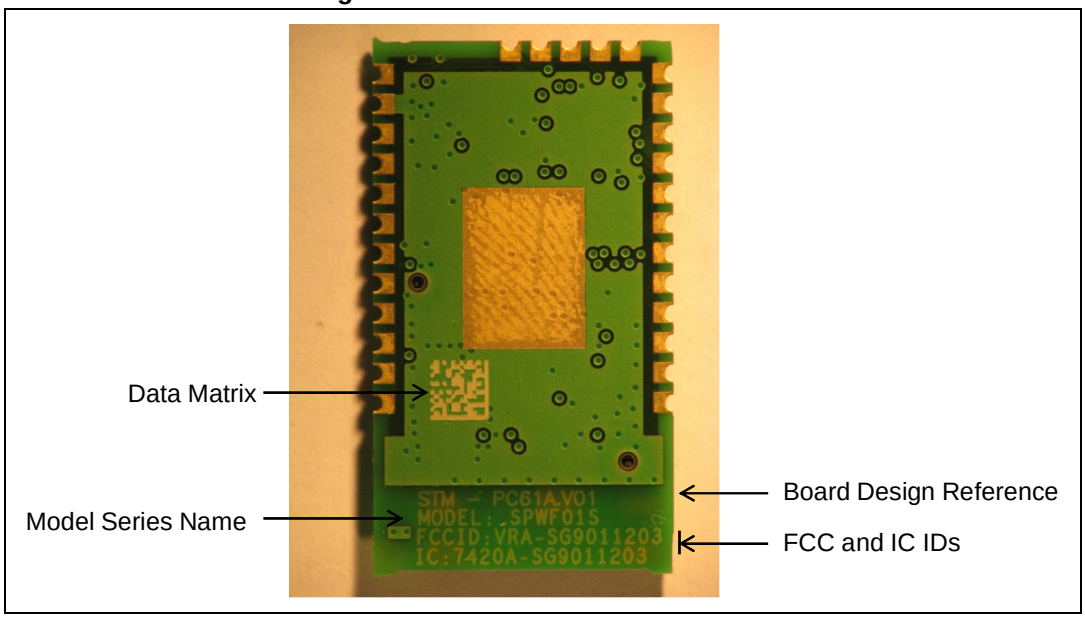
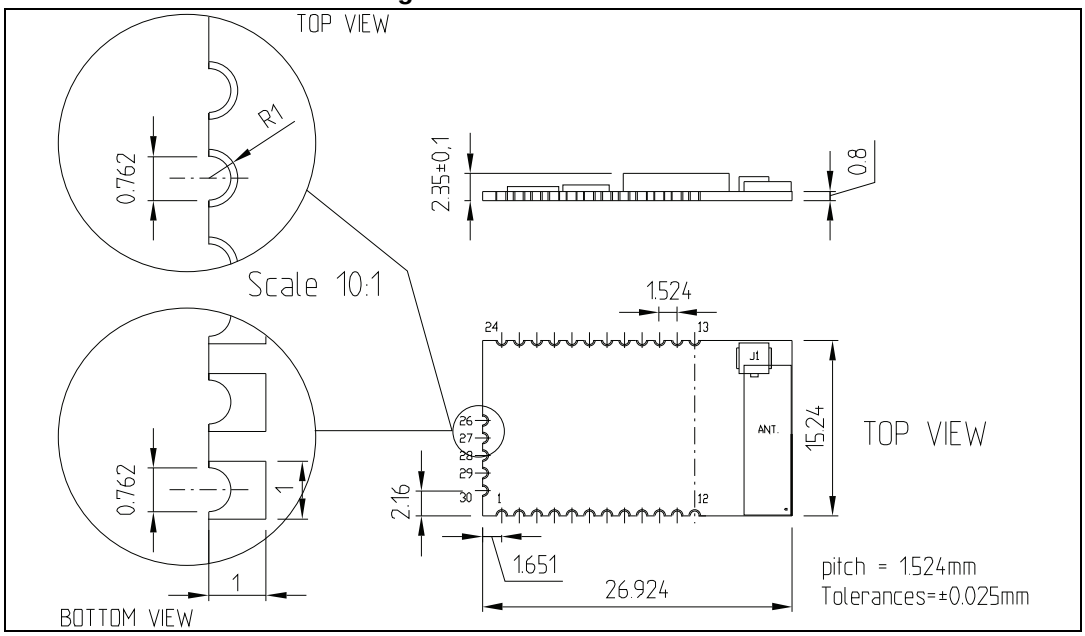
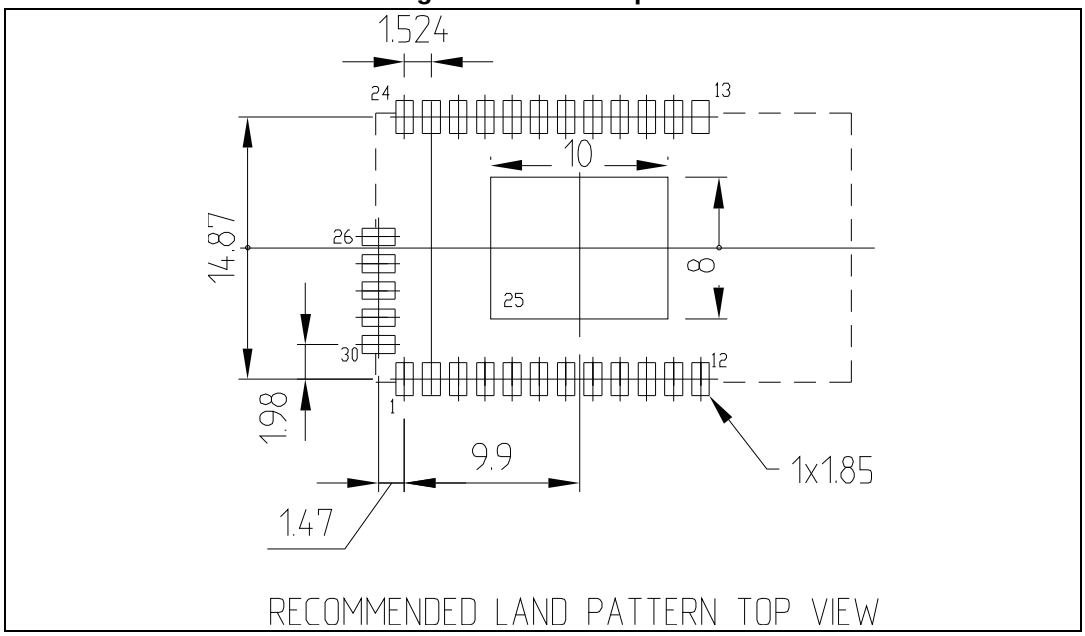


Figure 6. Wi-Fi dimensions



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 8. Ordering information

Order codes	Description
SPWF01SA.11	Wi-Fi module with integrated antenna and Wi-Fi full stack
SPWF01SC.11	Wi-Fi module with integrated u.FL connector 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 9. Document revision history

Date	Revision	Changes
05-Dec-2013	1	Initial release.

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