![ST life.augmented logo]

SPWF01SA
SPWF01SC

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

Datasheet - production data
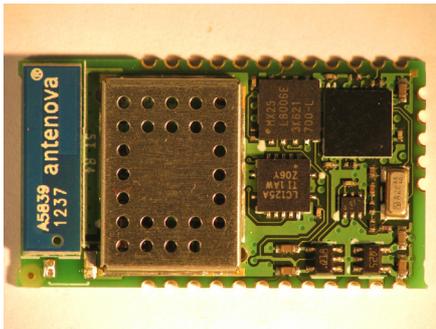
SPWF01SA.11
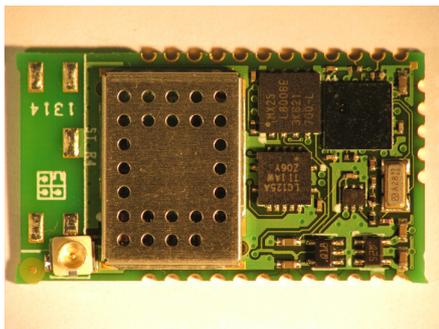
SPWF01SC.11

- Multiple antenna options:
  – Integrated antenna (SPWF01SA.xy versions)
  – Integrated U.Fl 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.1y 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
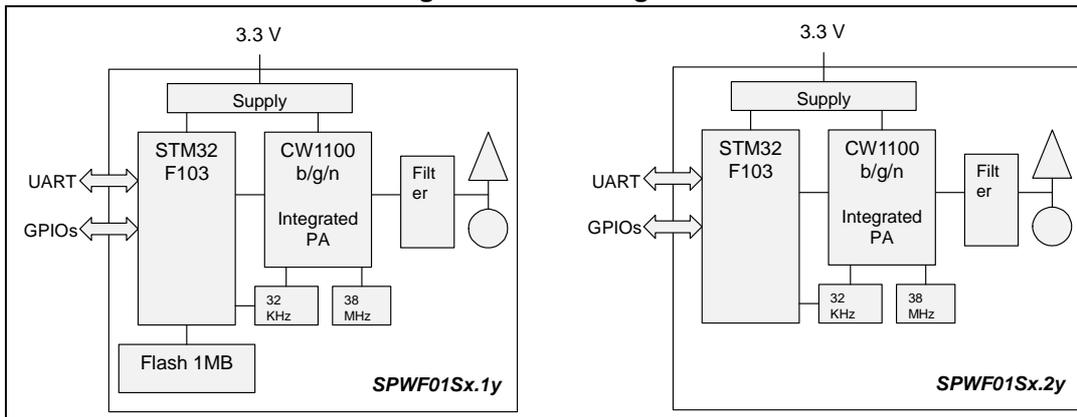
2   General electrical specifications

Table 1. Absolute maximum ratings

Parameter	Test condition/comment	Min.	Typ.	Max.	Unit
Voltage supply		-0.3		4.0	V
Vin for 5 V tolerant pins		-0.3		5.5	V
Vin for all other pins	-	-0.3	-	2.8	V
Storage temperature range		-55		105	°C

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		uA
	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		1.6		2.8	V
	VIL			-	0.9	V
Outputs	VOH	IOH=4 mA	2.1		2.5	V
	VOL	IOL=4 mA			0.4	V

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

Table 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]		Input pull down and 5V tolerant
GPIO[1]	I/O	17	General purpose input/output		Input pull down and 5V tolerant
GPIO[2]	I/O	19	General purpose input/output		Floating and 5V tolerant
GPIO[3]	I/O	1	General purpose input/output		Input pull down and 5V tolerant
GPIO[6]	I/O	22	General purpose input/output Wake Up/Sleep Inhibit[3]		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]		
GPIO[8]	I/O	4	General purpose input/output	UART2 Transmit data output [4]	
GPIO[9]	I/O	7	General purpose input/output	UART2 Receive data input [4]	
GPIO[11]	I/O	11			
GPIO[12]	I/O	12	General purpose input/output		
GPIO[15]	I/O	21	General purpose input/output		
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		

Table 5. Pinout description (continued)

Signal Name	Type	PIN Number	Main function	Alternate functions[1]	Notes
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.

PIN 26 to PIN 30 are Reserved and they can be left Floating in the final design

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 device.

We suggest to export the RESETn pin to the HOST processor. It is a useful design practice to recover unexpected behaviors using the HW reset.

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
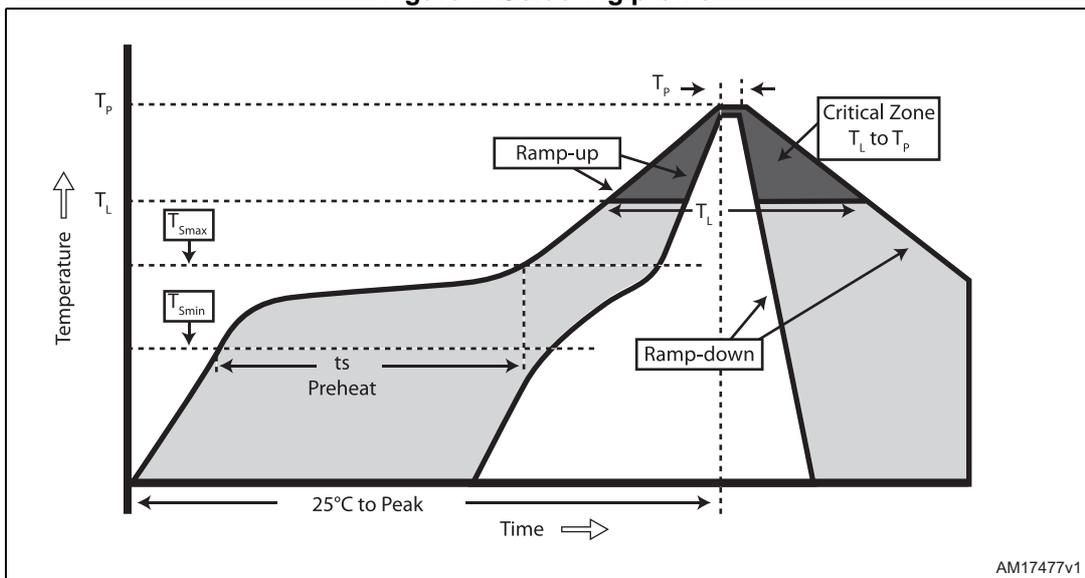
7 Regulatory compliance

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
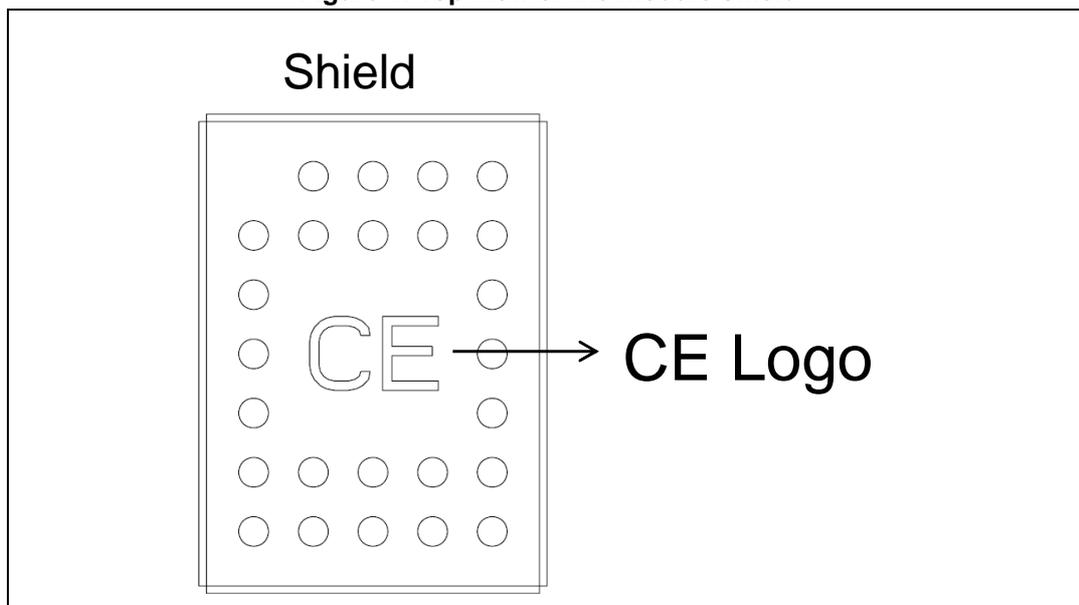
Figure 5. Bottom view of the module


Data Matrix

Board Design Reference

Model Series Name

FCC and IC IDs
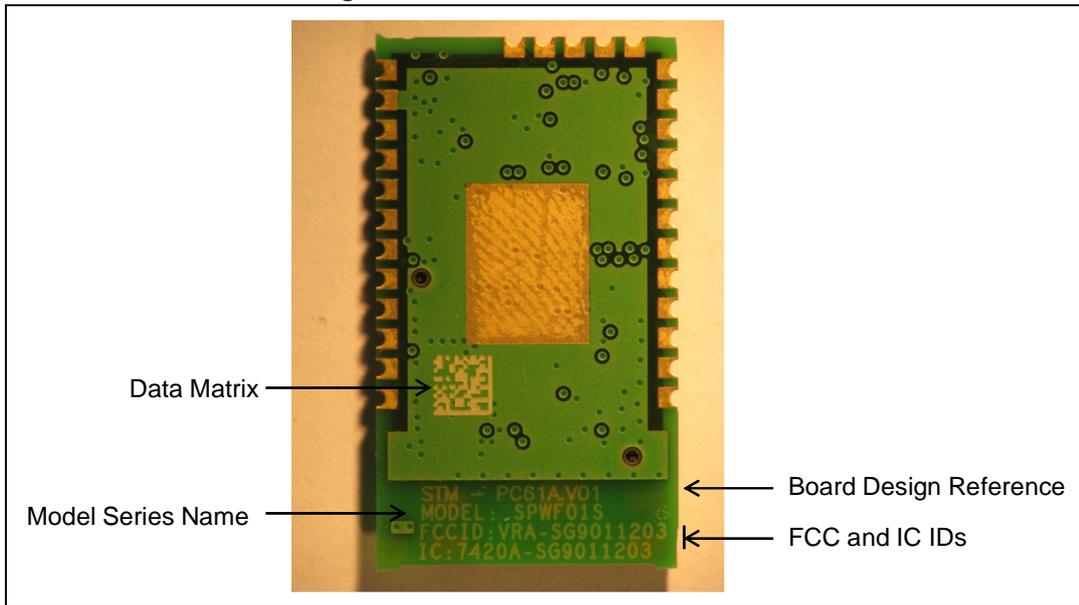
Figure 6. Wi-Fi dimensions
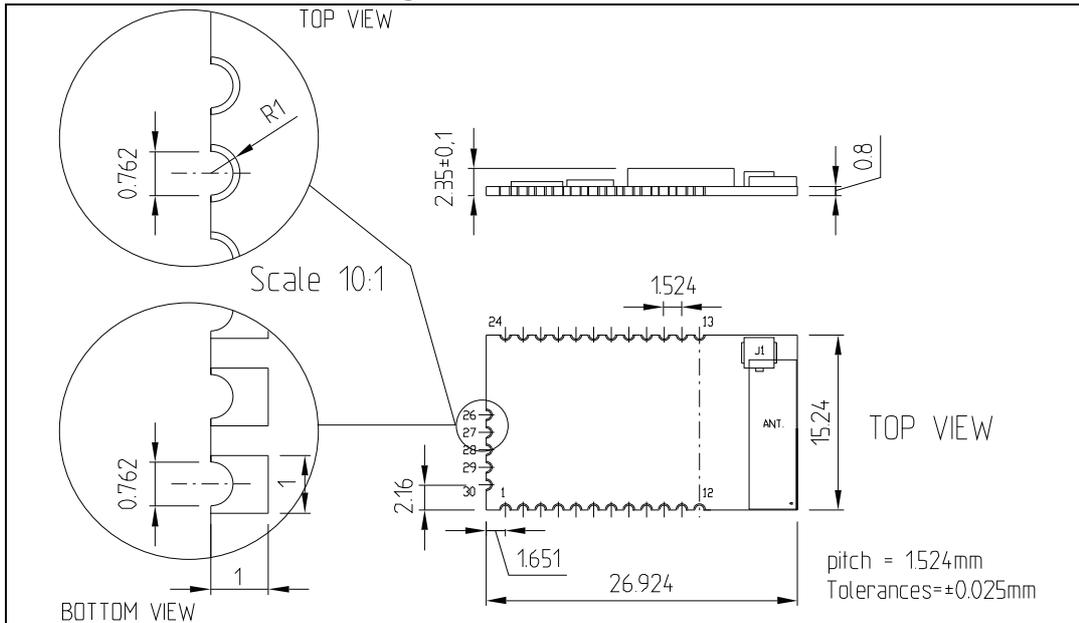
Note: *An antenna area of 217 x 520 mils must be free of any ground metalization or traces under the unit. The area extending away from the antenna should be free from metal on the PCB and housing to meet expected performance levels. Pin 25 is the required paddle ground and is not shown in this diagram.*

Figure 7. Wi-Fi footprint

RECOMMENDED LAND PATTERN TOP VIEW
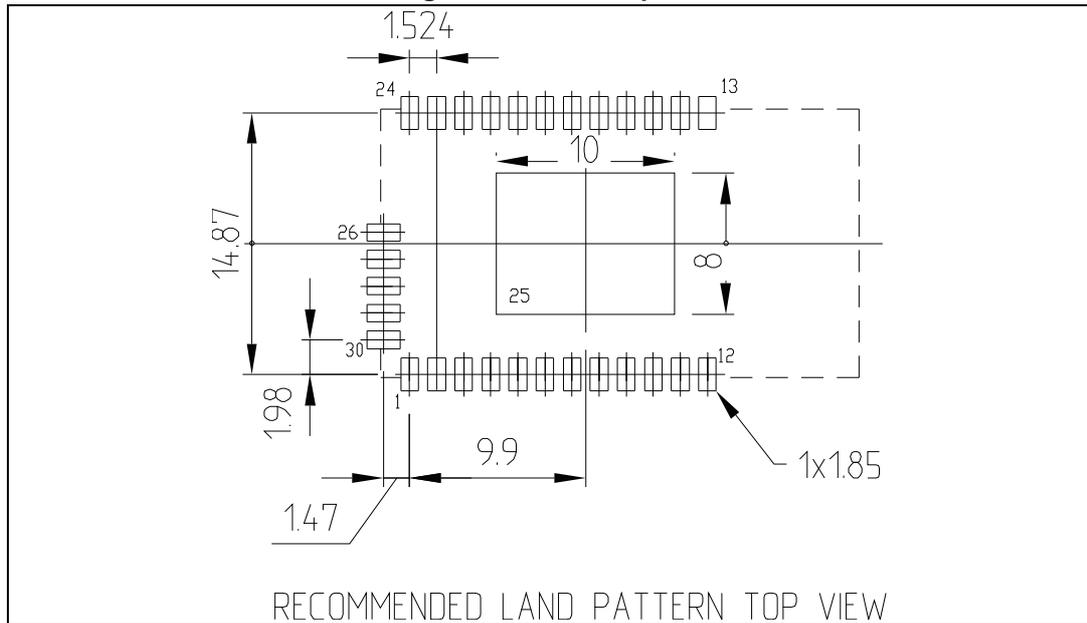
PCB design requires a detailed review of the center exposed pad. This pad requires good thermal conductivity. Soldering coverage should be maximized and checked via x-ray for proper design. There is a trade-off between providing enough soldering for conductivity and applying too much, which allows the 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, 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.Fl. 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 9. Document revision history

Date	Revision	Changes
05-Dec-2013	1	Initial release.
22-Jan-2014	2	*Figure 3* has been modified.
16-Apr-2014	3	Updated with references to modules with reduced Flash memory.
18-Sep-2014	4	Modified: *Figure 1* and *Table 3*

IMPORTANT NOTICE – PLEASE READ CAREFULLY