

**Electromagnetic compatibility
and Radio Spectrum Matters ERM
ERM TEST REPORT
300489-1-5**

Test Report

*Electromagnetic compatibility
and Radio spectrum Matters (ERM)*



Equipment Under Test: Wi-Fi module

Model: WF111-A
WF111-E
WF111-N

Trade Mark: Silicon Labs / Bluegiga

Manufacturer/Customer: Silicon Laboratories Finland Oy
Bertel Jungin aukio 3
FI-02600 Espoo
Finland

Tests have been performed according to the following standard(s)

Title of the standard	Reference standard	Version
Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz band; Harmonised Standard for access to radio spectrum	EN 300 328	V2.2.2

- *partial testing, see test suite for details*

Date: 14 December 2020

Issued by:

A blue ink signature of Henri Mäki.

Henri Mäki
Testing Engineer

Date:

14 December 2020

Checked by:

A blue ink signature of Mikko Halonen.

Mikko Halonen
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GENERAL REMARKS

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Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.

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RELEASE HISTORY

Version	Changes	Issued
1.0	Initial release	14 December 2020

PRODUCT DESCRIPTION

Equipment Under Test

Type:	Wi-Fi module
Model:	WF111-A, WF111-E, WF111-N
Trade Mark:	Silicon Labs / Bluegiga
Serial no:	-
Software version:	-
Hardware version:	-

General Description

The equipment under test is a 2.4 GHz Wi-Fi module, supporting IEEE 802.11b/g/n modes.

The difference between A-, E- and N-variant is that A has an integral antenna, E-variant has a U.FL connector, and N-variant has an RF pin for use of an external antenna. All variants have a common measuring point for conducted measurements, and therefore measuring A-variant is also deemed to cover the measurements for E- and N-variants.

The measurement results according to the standard versions V1.9.1 and V2.1.1 are presented in SGS Test Reports 281943-6 and 288405-4-1, respectively.

Samples and Modifications

No.	Name	Description
1	Conducted	WF111-A, modified by adding a U.FL connector and re-routing the RF signal to it

Specifications

Type of Modulation:	<input type="checkbox"/> FHSS <input checked="" type="checkbox"/> Other
Operating Frequency Range:	2412-2472 MHz
Conducted Power:	+16 dBm
Channels:	13
Channel Bandwidth:	15.4 MHz (measured)
Channel Separation:	5 MHz
Adaptivity:	<input checked="" type="checkbox"/> Adaptive <input type="checkbox"/> Non-adaptive
	<input checked="" type="checkbox"/> LBT based (if adaptive) <input type="checkbox"/> Load based (if adaptive)
Antenna Type:	Integral ceramic chip antenna (A-variant)
Antenna Gain:	2.14 dBi (highest gain declared by the manufacturer)
Antenna Count:	1
Geo-location Capability:	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes
Beam Forming Capability:	<input checked="" type="checkbox"/> No <input type="checkbox"/> Yes
EUT Dimensions:	-
Power Requirements:	2.0 – 3.8 V (tested with 3.3 V regulated by the development board)
Operating Temperature Range:	-

Ports and Cables

Cable / Port	Description
USB Port	The USB cable is used to connect the PC and the evaluation board to provide the regulated supply to the EUT and the capability to configure and monitor the EUT from the PC through the evaluation board.

SUMMARY OF TESTING

Test conditions

The EUT's radio was configured and monitored with software provided by the manufacturer. The module was connected to a Linux-based access point, and PER was measured during the Receiver blocking test by pinging from the access point. Normal modulation and maximum transmit power was used during the tests. IEEE 802.11b-mode was used during testing with 1 Mbps data rate.

Table 1: Normal and extreme test conditions

Test conditions:		Temperature [°C]:	Voltage [V]:
Normal		+20 - 25	3.3
Extreme	Minimum	-	
	Maximum	-	

Extreme temperature and voltage ranges were provided by the customer.

Table 2: The test frequencies used in testing

Channel	Frequency [MHz]
Low	2412
Mid	-
High	2462

Measurement Uncertainty

Parameter	Uncertainty	Limit
Occupied Channel Bandwidth	±0.0005 %	±5 %
RF output power, conducted	±0.349 dB	±1,5 dB
Power Spectral Density, conducted	±0.372 dB	±3 dB
Unwanted Emissions, conducted	±2.90 dB	±3 dB
All emissions, radiated	±5.29 dB	±6 dB
Temperature	±3 °C	±3 °C
Supply voltages	±3 %	±3 %
Time	±0.1 %	±5 %
Level of confidence 95.45 % (k = 2)		

Test suite

Measurement/Test	Test Specification	Result
RF Output Power	EN 300 328 V2.2.2 (2019-07)	N/T
Power Spectral Density	EN 300 328 V2.2.2 (2019-07)	N/T
Duty cycle, Tx-sequence, Tx-gap	EN 300 328 V2.2.2 (2019-07)	N/A ⁽¹⁾
Accumulated Transmit Time, Frequency Occupation and Hopping Sequence	EN 300 328 V2.2.2 (2019-07)	N/A ⁽²⁾
Hopping Frequency Separation	EN 300 328 V2.2.2 (2019-07)	N/A ⁽²⁾
Medium Utilization	EN 300 328 V2.2.2 (2019-07)	N/A ⁽¹⁾
Adaptivity	EN 300 328 V2.2.2 (2019-07)	N/T
Occupied Channel Bandwidth	EN 300 328 V2.2.2 (2019-07)	N/T
Transmitter unwanted spurious emissions in the out-of-band domain	EN 300 328 V2.2.2 (2019-07)	N/T
Transmitter unwanted spurious emissions in the spurious domain	EN 300 328 V2.2.2 (2019-07)	N/T
Receiver spurious emissions	EN 300 328 V2.2.2 (2019-07)	N/T
Receiver blocking	EN 300 328 V2.2.2 (2019-07)	PASS
Geo-location capability	EN 300 328 V2.2.2 (2019-07)	N/A ⁽⁵⁾
<p>Possible test case verdicts:</p> <p>Test case does not apply to the EUT: N/A</p> <p>EUT does meet the requirement: PASS</p> <p>EUT does not meet the requirement: FAIL</p> <p>Test was not performed: N/T</p> <p><i>The decision rule applied for the tests results stated in this test report is according to the requirements of section 5.2 of ETSI EN 300 328 V2.2.2.</i></p> <p>1) This requirement applies only to non-adaptive equipment or to adaptive equipment operating in a non-adaptive mode. This requirement does not apply for equipment with a maximum declared RF Output power of less than 10 dBm E.I.R.P.</p> <p>2) This requirement applies only to all types of FHSS equipment.</p> <p>3) This requirement does not apply to adaptive equipment unless operating in a non-adaptive mode. Also this requirement does not apply for equipment with a maximum declared RF Output power of less than 10 dBm E.I.R.P.</p> <p>4) This requirement applies only to adaptive equipment.</p> <p>5) Applicable only for equipment with geo-location capability.</p>		

Testing location / address:

SGS Fimko Ltd
Karakaarenkuja 4
FI-02610, Espoo
Finland

TEST RESULTS

Receiver Blocking

Standard: EN 300 328 V2.2.2
Tested by: HEM
Date: 20 November 2020
Temperature: 24 °C
Humidity: 20 %RH

Test result: **PASS**

Test plan

Measurements are performed according to ETSI EN 300 328 V2.2.2 clause 5.4.11.2.1

Receiver blocking is a measure of the ability of the equipment to receive a wanted signal on its operating channel without exceeding a given degradation in the presence of an unwanted signal (blocking signal) on frequencies other than those of the operating band.

The tests were performed while the EUT was set to low and high channels.

Antenna gain of the EUT was added to the wanted signal and blocking signal level.

Wanted signal level was calculated according to table 14 in clause 4.3.2.11.4. Measured Occupied Channel Bandwidths are used in the calculations.

Receiver category: 1

Minimum performance criteria:

Packet error rate (PER) shall be less than or equal to 10%.

Test results

Table 3: Results of receiver blocking (WF111-A)

Wanted signal level (dBm)	Blocking signal frequency (MHz)	Blocking signal level (dBm)	Type of blocking signal	PER (%)	Result
-65.9	2380	-31.9	CW	0	PASS
	2504			0	PASS
-71.9	2300			0	PASS
	2330			0	PASS
	2360			0	PASS
	2524			0	PASS
	2584			0	PASS
	2674			0	PASS

TEST EQUIPMENT

EQUIPMENT	MANUFACTURER	TYPE	INV OR SERIAL	PREV CALIB	NEXT CALIB
ATTENUATOR	ZYSEN	ZSJ70/1-06-2A2	inv:10332	NCR	NCR
SPECTRUM ANALYZER	ROHDE & SCHWARZ	FSV40	inv:10881	2019-02-07	2021-02-07
OSP BASE UNIT	ROHDE & SCHWARZ	OSP120	inv:10882	2019-02-28	2021-02-28
OSP-B157W 8 PORT	ROHDE & SCHWARZ	OSP-B157W8	inv:10883	2019-02-06	2021-02-06
OSP-B157WX	ROHDE & SCHWARZ	OSP-B157WX	inv:10884	2019-02-13	2021-02-13
RF SIGNAL GENERATOR	ROHDE & SCHWARZ	SMB100A	inv:9288	2020-06-08	2023-06-07

NCR = No calibration required

END OF REPORT