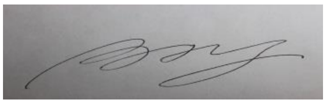
RF TEST REPORT

Report No.: CE_SL18040201-RIO-001 2.4GHz Rev_2.0
Supersede Report No.: CE_SL18040201-RIO-001_2.4GHz Rev_1.0

Applicant	Resin.io
Product Name	Raspberry Compute Module 3 Lite
Model No.	Balena Fin
Test Standard	EN 300 328 V2.1.1 (2016-11)
Test Method	EN 300 328 V2.1.1 (2016-11)
Date of test	05/01/2018 - 06/14/2018
Issue Date	01/07/2019
Test Result	**Pass** **Fail**

Equipment complied with the specification	**[x]**
Equipment did not comply with the specification	**[ ]**

	
Benjamin Jing	**Chen Ge**
Test Engineer	**Engineer Reviewer**

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Test result presented in this test report is applicable to the tested sample only

Issued By:
SIEMIC Laboratories
775 Montague Expressway, Milpitas, 95035 CA

TESTING CERT # 2742-01

Laboratory Introduction

SIEMIC, headquartered in the heart of Silicon Valley, with superior facilities in US and Asia, is one of the leading independent testing and certification facilities providing customers with one-stop shop services for Compliance Testing and Global Certifications.

In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

Accreditations for Conformity Assessment

Country/Region	Accreditation Body	Scope
USA	FCC, A2LA	EMC, RF/Wireless, Telecom
Canada	IC, A2LA, NIST	EMC, RF/Wireless, Telecom
Taiwan	BSMI, NCC, NIST	EMC, RF, Telecom, Safety
Hong Kong	OFTA, NIST	RF/Wireless, Telecom
Australia	NATA, NIST	EMC, RF, Telecom, Safety
Korea	KCC/RRA, NIST	EMI, EMS, RF, Telecom, Safety
Japan	VCCI, JATE, TELEC, RFT	EMI, RF/Wireless, Telecom
Mexico	NOM, COFETEL, Caniety	Safety, EMC, RF/Wireless, Telecom
Europe	A2LA, NIST	EMC, RF, Telecom, Safety
Israel	MOC, NIST	EMC, RF, Telecom, Safety

Accreditations for Product Certifications

Country	Accreditation Body	Scope
USA	FCC TCB, NIST	EMC, RF, Telecom
Canada	IC FCB, NIST	EMC, RF, Telecom
Singapore	iDA, NIST	EMC, RF, Telecom
EU	NB	EMC & R&TTE Directive
Japan	MIC (RCB 208)	RF, Telecom
Hong Kong	OFTA (US002)	RF, Telecom

CONTENTS

1 Report Revision History

Report No.	Report Version	Description	Issue Date
CE_SL18040201-RIO-001_2.4GHz	None	Original	06/15/2018
CE_SL18040201-RIO-001_2.4GHz Rev_1.0	Rev_1.0	Add Adaptivity Data	12/30/2019
CE_SL18040201-RIO-001_2.4GHz Rev_2.0	Rev_2.0	Updated Adaptivity Data	01/07/2020

2 Executive Summary

The purpose of this test program was to demonstrate compliance of following product

Company: Resin.io
Product: Raspberry Compute Module 3 Lite
Model: Balena Fin

against the current Stipulated Standards. The specified model product stated above has demonstrated compliance with the Stipulated Standard listed on 1st page.

3 Customer information

Applicant Name	Resin.io
Applicant Address	One London Wall 6th floor London EC2Y 5EB United Kingdom
Manufacturer Name	Resin.io
Manufacturer Address	One London Wall 6th floor London EC2Y 5EB United Kingdom

4 Test site information

Lab performing tests	SIEMIC Laboratories
Lab Address	775 Montague Expressway, Milpitas, CA 95035
FCC Test Site No.	881796
IC Test Site No.	4842D-2
VCCI Test Site No.	A0133

5 Modification

Index	Item	Description	Note
-	-	-	-

6 EUT Information

6.1 EUT Description

Product Name	Raspberry Compute Module 3 Lite
Model No.	Balena Fin
Trade Name	Resin.io
Serial No.	N/A
Host Model No.	N/A
Input Power	220VAC/50Hz
Power Adapter Manu/Model	VEL36US120-US-JA
Power Adapter SN	E317867
Date of EUT received	04/15/2018
Equipment Class/ Category	DTS, UNII
Port/Connectors	1 X RJ45 Ethernet , 2 X USB, 1 X mini USB, 1 X HDMI

6.2 Radio Description

Radio Type	802.11b	802.11g	802.11n-20M	802.11n-40M
Operating Frequency	2412-2462MHz	2412-2462MHz	2412-2462MHz	2422-2452MHz
Modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM-CCK (BPSK, QPSK, 16QAM, 64QAM, 256QAM)	OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)	OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)
Channel Spacing	5MHz	5MHz	5MHz	5MHz
Number of Channels	11	11	11	7
Antenna Type	External antenna : ¼ Dipole Omni Embedded antenna : SMT			
Antenna Gain (Peak)	External antenna : 2 dBi Embedded antenna : 1 dBi			
Antenna Connector Type	U.FL			

EUT Power Level Setting

Mode	Frequency (MHz)	Power setting
802.11-b	2412	14
802.11-b	2442	15
802.11-b	2472	15
802.11-g	2412	14
802.11-g	2442	15
802.11-g	2472	15
802.11-n-20	2412	14
802.11-n-20	2442	15
802.11-n-20	2472	15
802.11-n-40	2422	14
802.11-n-40	2442	14
802.11-n-40	2462	14

6.3 EUT Operational Condition

Item	Range		
Battery Voltage	N/A		
AC Adapter Voltage	220VAC		
Environmental Condition	Tnom = 25 °C	Tmax = 50 °C	Tmin = 0 °C

6.4 Adaptive Equipment

Adaptive Equipment			
☒	Adaptive Equipment without the possibility to switch to a non-adaptive mode:		
	☒	The equipment has implemented an LBT based DAA mechanism	
		☐	The equipment is Frame Based equipment
		☒	The equipment is Load Based equipment
		☐	The equipment can switch dynamically between Frame Based and Load Based equipment
	☐	The equipment has implemented and non-LBT based DAA mechanism	
	☐	The equipment can operate in more than one adaptive mode	
	☐	Adaptive Frequency Hopping using other forms of DAA (non-LBT based) / without Short Control Signaling Transmissions	
☐	Adaptive Equipment which can also operate in a non-adaptive mode		

6.5 EUT test modes/configuration Description

Test mode

Test Mode		Note
Pre_test_mode_1	Continuous Transmit	-
Pre_test_mode_2	Normal Operation Mode (duty cycle transmit power)	-

7 Supporting Equipment/Software and cabling Description

7.1 Supporting Equipment

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
1	Laptop	LATITUDE 3550	N/A	Dell	-
2	Router	WNR2000	N/A	Netgear	

7.2 Cabling Description

Name	Connection Start		Connection Stop		Length / shielding Info		Note
	From	I/O Port	To	I/O Port	Length (m)	Shielding	
Ethernet	RJ-45	EUT	RJ-45	Laptop	Ethernet 1 m	no	Unshielded

7.3 Test Software Description

Test Item	Software	Description
RF Testing	Dut Labtool	Set the EUT to transmit continuously in different test modes and channels

8 Test Summary

Summary for 2.4GHz WLAN

Test Item	Test standard	Test Method/Procedure	Pass / Fail
RF Output Power	EN 300 328 V2.1.1 (2016-11)	EN 300 328 V2.1.1 (2016-11)	Pass
Power Spectral Density	EN 300 328 V2.1.1 (2016-11)	EN 300 328 V2.1.1 (2016-11)	Pass
Duty Cycle, Tx-sequence, Tx-gap	EN 300 328 V2.1.1 (2016-11)	EN 300 328 V2.1.1 (2016-11)	N/A
Dwell time, Minimum Frequency Occupation & Hopping Sequence	EN 300 328 V2.1.1 (2016-11)	EN 300 328 V2.1.1 (2016-11)	N/A
Hopping Frequency Separation	EN 300 328 V2.1.1 (2016-11)	EN 300 328 V2.1.1 (2016-11)	N/A
Medium Utilisation	EN 300 328 V2.1.1 (2016-11)	EN 300 328 V2.1.1 (2016-11)	N/A
Adaptivity	EN 300 328 V2.1.1 (2016-11)	EN 300 328 V2.1.1 (2016-11)	Pass
Occupied Channel Bandwidth	EN 300 328 V2.1.1 (2016-11)	EN 300 328 V2.1.1 (2016-11)	Pass
TX Unwanted Emissions in the OOB domain	EN 300 328 V2.1.1 (2016-11)	EN 300 328 V2.1.1 (2016-11)	Pass
TX Unwanted Emissions in the spurious domain	EN 300 328 V2.1.1 (2016-11)	EN 300 328 V2.1.1 (2016-11)	Pass
Receiver spurious emissions	EN 300 328 V2.1.1 (2016-11)	EN 300 328 V2.1.1 (2016-11)	Pass
Receiver Blocking	EN 300 328 V2.1.1 (2016-11)	EN 300 328 V2.1.1 (2016-11)	Pass
Remark	1. All measurement uncertainties do not take into consideration for all presented test results. 2. The applicant shall ensure frequency stability by showing that an emission is maintained within the band of operation under all normal operating conditions as specified in the user's manual.		

9 Measurement Uncertainty

9.1 Radiated Emissions (30MHz to 1GHz)

The test is to measure the radiated emissions of the EUT.
Some error sources that can contribute to the total uncertainty:

- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- NSA Calibration
- Etc., details see the below table

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Filter Insertion Loss	0.25	Normal	2	1	0.125
Antenna Factor	0.65	Normal	2	1	0.325
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.86605081
PRF Response	1.5	Rectangular	1.732	1	0.86605081
Mismatch Filter - Receiver	0.25	U-Shape	1.414	1	0.1768033
NSA Calibration	4.0	U-Shape	1.414	1	2.8288543
Combined Standard Uncertainty					3.0059131
Expanded Uncertainty (K=2)					**6.0118262**

The total derived measurement uncertainty is +/- 6.00 dB.

9.2 Radiated Emissions (1GHz to 40GHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- VSWR Calibration
- Etc., details see the below table

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.0692840
Cable Insertion Loss	0.21	Normal	2	1	0.1050000
Filter Insertion Loss	0.25	Normal	2	1	0.1250000
Antenna Factor	0.65	Normal	2	1	0.3250000
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.8660508
PRF Response	1.5	Rectangular	1.732	1	0.8660508
Mismatch Filter - Receiver	0.25	U-Shape	1.414	1	0.1768033
VSWR Calibration	2.0	U-Shape	1.414	1	1.4144272
Combined Standard Uncertainty					4.2363
Expanded Uncertainty (K=2)					**8.4726**

The total derived measurement uncertainty is +/- 8.47 dB.

9.3 RF conducted measurement

The test is to measure the RF output power from the EUT.

Some error sources that can contribute to the total uncertainty:

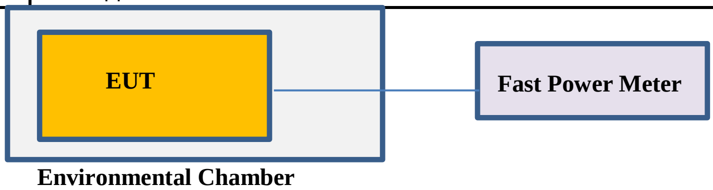
- Uncertainty of the Reference Level Uncertainty
- Uncertainty of variable attenuators
- Uncertainty of cables
- Uncertainty due to the mismatches

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Reference Level	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Attenuator	0.25	Normal	2	1	0.125
Mismatch	0.25	U-Shape	1.414	1	0.1768033
Combined Standard Uncertainty					0.476087
Expanded Uncertainty (K=2)					**0.952174**

The total derived measurement uncertainty is +/- 0.95 dB.

10 Measurements, Examination and Derived Results

10.1 RF Output Power

Spec	Item	Requirement	Applicable
EN 300 328 V2.1.1 (2016-11)	4.3.1	The maximum RF output power for adaptive Frequency Hopping equipment shall be equal to or less than 20 dBm.	☐
EN 300 328 V2.1.1 (2016-11)	4.3.1	The maximum RF output power for non-adaptive Frequency Hopping equipment, shall be equal to or less than the value declared by the supplier. This declared value shall be equal to or less than 20 dBm.	☐
EN 300 328 V2.1.1 (2016-11)	4.3.2	For adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be 20 dBm.	☒
EN 300 328 V2.1.1 (2016-11)	4.3.2	The maximum RF output power for non-adaptive equipment shall be declared by the supplier and shall not exceed 20 dBm.	☐
Test Setup			
Procedure	1. Use a fast power sensor suitable for 2,4 GHz and capable of 1 MS/s. 2. For conducted measurements on devices with one transmit chain: - Connect the power sensor to the transmit port, sample the transmit signal and store the raw data.Use these stored samples in all following steps. 3. For conducted measurements on devices with multiple transmit chains: - Connect one power sensor to each transmit port for a synchronous measurement on all transmits ports. - Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than half the time between two samples. - For each instant in time, sum the power of the individual samples of all ports and store them. Use these stored samples in all following steps. 4. Find the start and stop times of each burst in the stored measurement samples. 5. Between the start and stop times of each individual burst calculate the RMS power over the burst. Save these P_{burst} values, as well as the start and stop times for each burst. 6. The highest of all P_{burst} values (value "A" in dBm) will be used for maximum e.i.r.p. calculations. 7. Add the (stated) antenna assembly gain "G" in dBi of the individual antenna. 8. If applicable, add the additional beamforming gain "Y" in dB. - If more than one antenna assembly is intended for this power setting, the maximum overall antenna gain (G or G + Y) shall be used. 9. The RF Output Power (P) shall be calculated using the formula : P = A + G + Y		
Test Date	05/23/2018	Environmental condition	Temperature 24 °C Relative Humidity 42 % Atmospheric Pressure 1019 mbar
Remark	None		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☐ Yes (See below) ☒ N/A

Test was done by Benjamin Jing at radio test site .

Test Results

802.11b Low CH: 2412 MHz

Type	Condition	Antenna Gain (dBi)	Calculated EIRP (dBm)	Limit (dBm)
EIRP	Norm Temp (25⁰C)	2	17.1	20
	Low Temp (-20 ⁰C)	2	16.4	20
	Low Temp (-20 ⁰C)	2	16.4	20
	High Temp (55⁰C)	2	17.8	20
	High Temp (55⁰C)	2	17.8	20

802.11b Mid CH: 2442 MHz

Type	Condition	Antenna Gain (dBi)	Calculated EIRP (dBm)	Limit (dBm)
EIRP	Norm Temp (25⁰C)	2	17.9	20
	Low Temp (-20 ⁰C)	2	17.2	20
	Low Temp (-20 ⁰C)	2	17.2	20
	High Temp (55⁰C)	2	18.3	20
	High Temp (55⁰C)	2	18.3	20

802.11b High CH: 2472 MHz

Type	Condition	Antenna Gain (dBi)	Calculated EIRP (dBm)	Limit (dBm)
EIRP	Norm Temp (25⁰C)	2	17.3	20
	Low Temp (-20 ⁰C)	2	16.5	20
	Low Temp (-20 ⁰C)	2	16.5	20
	High Temp (55⁰C)	2	17.8	20
	High Temp (55⁰C)	2	17.8	20

802.11g Low CH: 2412 MHz

Type	Condition	Directional Antenna Gain (dBi)	Calculated EIRP (dBm)	Limit (dBm)
EIRP	Norm Temp (25⁰C)	2	16.2	20
	Low Temp (-20 ⁰C)	2	15.7	20
	Low Temp (-20 ⁰C)	2	15.7	20
	High Temp (55⁰C)	2	16.9	20
	High Temp (55⁰C)	2	16.9	20

802.11g Mid CH: 2442 MHz

Type	Condition	Antenna Gain (dBi)	Calculated EIRP (dBm)	Limit (dBm)
EIRP	Norm Temp (25⁰C)	2	16.6	20
	Low Temp (-20 ⁰C)	2	15.8	20
	Low Temp (-20 ⁰C)	2	15.8	20
	High Temp (55⁰C)	2	17.2	20
	High Temp (55⁰C)	2	17.2	20

802.11g High CH: 2472 MHz

Type	Condition	Antenna Gain (dBi)	Calculated EIRP (dBm)	Limit (dBm)
EIRP	Norm Temp (25⁰C)	2	16.4	20
	Low Temp (-20 ⁰C)	2	15.5	20
	Low Temp (-20 ⁰C)	2	15.5	20
	High Temp (55⁰C)	2	17.3	20
	High Temp (55⁰C)	2	17.3	20

802.11n-20 Low CH: 2412 MHz

Type	Condition	Antenna Gain (dBi)	Calculated EIRP (dBm)	Limit (dBm)
EIRP	Norm Temp (25^{0}C)	2	15.3	20
	Low Temp (-20 ^{0}C)	2	14.8	20
	Low Temp (-20 ^{0}C)	2	14.8	20
	High Temp (55^{0}C)	2	15.9	20
	High Temp (55^{0}C)	2	15.9	20

802.11n-20 Mid CH: 2442 MHz

Type	Condition	Antenna Gain (dBi)	Calculated EIRP (dBm)	Limit (dBm)
EIRP	Norm Temp (25^{0}C)	2	15.7	20
	Low Temp (-20 ^{0}C)	2	15.1	20
	Low Temp (-20 ^{0}C)	2	15.1	20
	High Temp (55^{0}C)	2	16.3	20
	High Temp (55^{0}C)	2	16.3	20

802.11n-20 High CH: 2472 MHz

Type	Condition	Antenna Gain (dBi)	Calculated EIRP (dBm)	Limit (dBm)
1EIRP	Norm Temp (25^{0}C)	2	15.6	20
	Low Temp (-20 ^{0}C)	2	14.9	20
	Low Temp (-20 ^{0}C)	2	14.9	20
	High Temp (55^{0}C)	2	16.1	20
	High Temp (55^{0}C)	2	16.1	20

802.11n-40M Low CH: 2422 MHz

Type	Condition	Antenna Gain (dBi)	Calculated EIRP (dBm)	Limit (dBm)
1EIRP	Norm Temp (25^{0}C)	2	11.3	20
	Low Temp (-20 ^{0}C)	2	10.7	20
	Low Temp (-20 ^{0}C)	2	10.7	20
	High Temp (55^{0}C)	2	11.8	20
	High Temp (55^{0}C)	2	11.8	20

802.11n-40M Mid CH: 2442 MHz

Type	Condition	Antenna Gain (dBi)	Calculated EIRP (dBm)	Limit (dBm)
EIRP	Norm Temp (25^{0}C)	2	10.9	20
	Low Temp (-20 ^{0}C)	2	10.2	20
	Low Temp (-20 ^{0}C)	2	10.2	20
	High Temp (55^{0}C)	2	11.4	20
	High Temp (55^{0}C)	2	11.4	20

802.11n-40M High CH: 2462 MHz

Type	Condition	Antenna Gain (dBi)	Calculated EIRP (dBm)	Limit (dBm)
EIRP	Norm Temp (25^{0}C)	2	10.6	20
	Low Temp (-20 ^{0}C)	2	10.1	20
	Low Temp (-20 ^{0}C)	2	10.1	20
	High Temp (55^{0}C)	2	11.2	20
	High Temp (55^{0}C)	2	11.2	20

10.2 Power Spectral Density

Spec	Item	Requirement	Applicable
EN 300 328 V2.1.1 (2016-11	4.3.2	For equipment using wide band modulations other than FHSS, the maximum Power Spectral Density is limited to 10 dBm per MHz	☒
Test Setup			
Procedure	1. Connect the UUT to the spectrum analyzer and use the following settings: - Start Frequency: 2 400 MHz - Stop Frequency: 2 483,5 MHz - Resolution BW: 10 kHz - Video BW: 30 kHz - Sweep Points: > 8 350 - Detector: RMS - Trace Mode: Max Hold - Sweep time: Auto For non-continuous signals, wait for the trace to be completed. Save the (trace) data set to a file. 2. For conducted measurements on smart antenna systems using either operating mode 2 or 3 (see clause 5.1.3.2), repeat the measurement for each of the transmit ports. For each frequency point, add up the amplitude (power) values for the different transmit chains and use this as the new data set. 3. Add up the values for amplitude (power) for all the samples in the file. 4. Normalize the individual values for amplitude so that the sum is equal to the RF Output Power (e.i.r.p.) measured. 5. Starting from the first sample in the file (lowest frequency), add up the power of the following samples representing a 1 MHz segment and record the results for power and position (i.e. sample #1 to #100). This is the Power Spectral Density (e.i.r.p.) for the first 1 MHz segment which shall be recorded. 6. Shift the start point of the samples added up in step 5 by 1 sample and repeat the procedure in step 5 (i.e. sample #2 to #101). 7. Repeat step 6 until the end of the data set and record the radiated Power Spectral Density values for each of the 1 MHz segments. From all the recorded results, the highest value is the maximum Power Spectral Density for the UUT. This value, which shall comply with the limit given in clause 4.3.2.2.2, shall be recorded in the test report.		
Test Date	05/23/2018	Environmental condition	Temperature 23 ºC Relative Humidity 42 % Atmospheric Pressure 1019 mbar
Remark	NONE		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☐ Yes (See below) ☒ N/A

Test was done by Benjamin Jing at radio test site .

PSD measurement results

Type	Freq (MHz)	Test mode	CH	Measured PSD (dBm/1MHz) (E.I.R.P)	Limit (dBm/1MHz) (E.I.R.P)	Result
Maximum PSD	2412	802.11b	Low	9.15	≤10	Pass
Maximum PSD	2442	802.11b	Mid	9.30	≤10	Pass
Maximum PSD	2472	802.11b	High	9.41	≤10	Pass
Maximum PSD	2412	802.11g	Low	7.62	≤10	Pass
Maximum PSD	2442	802.11g	Mid	8.96	≤10	Pass
Maximum PSD	2472	802.11g	High	8.83	≤10	Pass
Maximum PSD	2412	802.11n-20M	Low	7.49	≤10	Pass
Maximum PSD	2442	802.11n-20M	Mid	7.98	≤10	Pass
Maximum PSD	2472	802.11n-20M	High	8.46	≤10	Pass
Maximum PSD	2422	802.11n-40M	Low	5.71	≤10	Pass
Maximum PSD	2442	802.11n-40M	Mid	6.32	≤10	Pass
Maximum PSD	2462	802.11n-40M	High	5.14	≤10	Pass

10.3 Adaptivity

Requirement(s):

Spec	Item	Requirement		Applicable
EN 300 328 V2.1.1 (2016-11)	4.3.2.6.3	LBT based Detect and Avoid	Load Based Equipment with spectrum sharing mechanism IEEE Std. - LBT based spectrum sharing mechanism may implement IEEE Std. 802.11-2207 clauses 15, 17, 18 or 19, in IEEE Std. 802.11n-2009, clause 20 or in IEEE Std. 802.15.4-2006 - Detection Level = - 70 dBm/MHz + 10 * $\log_{10}$ (100mW / P_{out})	☒
EN 300 328 V2.1.1 (2016-11)	4.3.2.6.4	Short Control Signaling Transmissions - If implemented, Short Control Signalling Transmissions of adaptive equipment using wide band modulations other than FHSS shall have a maximum TxOn / (TxOn + TxOff) ratio of 10 % within any observation period of 50 ms.		☒
EN 300 328 V2.1.1 (2016-11)	4.3.2.6.3	See Table 11 below		☒

Table 11: Unwanted Signal parameters

Wanted signal mean power from companion device	Unwanted signal frequency (MHz)	Unwanted signal power (dBm)
sufficient to maintain the link (see note 2)	2 395 or 2 488,5 (see note 1)	-35 (see note 3)

NOTE 1: The highest frequency shall be used for testing operating channels within the range 2 400 MHz to 2 442 MHz, while the lowest frequency shall be used for testing operating channels within the range 2 442 MHz to 2 483,5 MHz. See clause 5.4.6.1.
NOTE 2: A typical value which can be used in most cases is -50 dBm/MHz.
NOTE 3: The level specified is the level in front of the UUT antenna. In case of conducted measurements, this level has to be corrected by the actual antenna assembly gain.

Test Setup

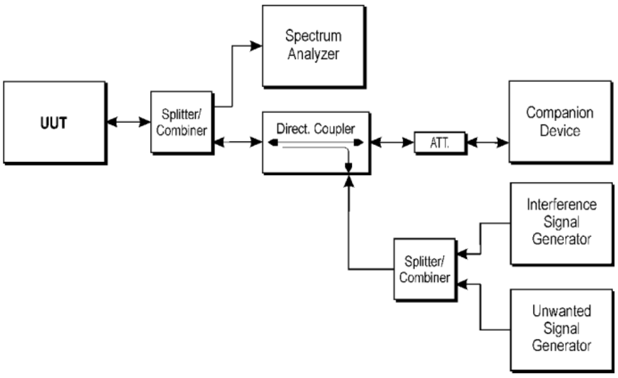


Figure 5: Test set-up for verifying the adaptivity of an equipment

Procedure	Refer to Clause 5.4.6 of ETSI EN 300 328 V2.1.1 (2016-11)
Remark	1. Interference signal: A 100 % duty cycle interference signal is injected centred on the frequency being tested which shall be a band limited noise signal with a flat Power Spectral Density, and shall have a bandwidth greater than the Occupied Channel Bandwidth of the UUT. The maximum ripple of this interfering signal shall be ±1.5 dB within the Occupied Channel Bandwidth. 2. Unwanted signal: A 100 % duty cycle CW signal centered at either 2 395 or 2 488.5 MHz (not centered on the frequency being tested) with a signal power of -35 dBm.
Result	☒ Pass ☐ Fail

Test Data ☒ Yes (See below) ☐ N/A
Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Shuo Zhang at RF test site.

Test Result for Adaptivity
COT:

Test Mode	Frequency (MHz)	Maximum Channel Occupancy Time (COT) (ms)	Limit (ms)	Result
802.11b	2412	0.095	≤13	Pass
802.11b	2472	0.095	≤13	Pass

CCA:

Test Mode	Frequency (MHz)	Clear Channel Assessment(CCA)(us)	Limit (ms)	Result
802.11b	2412	18.125	≥18	Pass
802.11b	2472	18.125	≥18	Pass

Short Control:

Test Mode	Frequency (MHz)	Adaptivity	Unwanted Signal
802.11b	2412	Pass	Pass
802.11b	2472	Pass	Pass
Note: Actual Adaptivity Detection Threshold Level (dBm) = -70 dBm Unwanted Signal Level (dBm) = - 35 dBm			

Test Result for Short Control Signaling Transmissions

Test Mode	Frequency (MHz)	Short Control Signaling Transmissions (ms)	Limit (ms)	Result
802.11b	2412	0	≤5	Pass
802.11b	2472	0	≤5	Pass

Test Plots

Normal EUT transmission

Injection of Unwanted signal

Injection of Interferer

EUT Control Signal

11b-2412M–Adaptivity (Unwanted signal at 2488.5MHz)

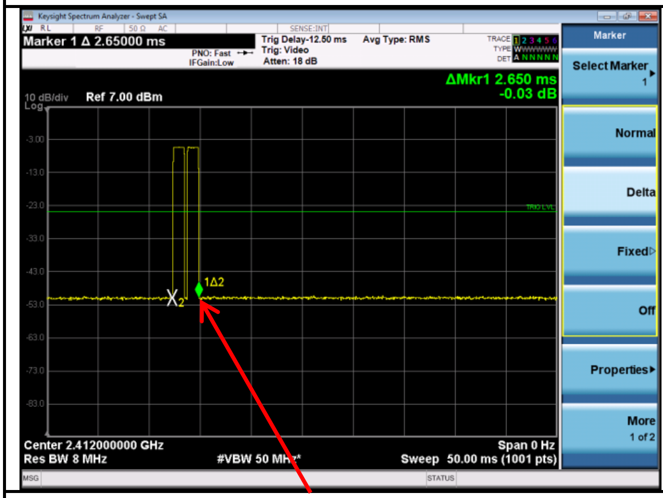
Normal EUT transmission

Injection of Unwanted signal

Injection of Interferer

EUT Control Signal

11b-2472M–Adaptivity (Unwanted signal at 2488.5MHz)

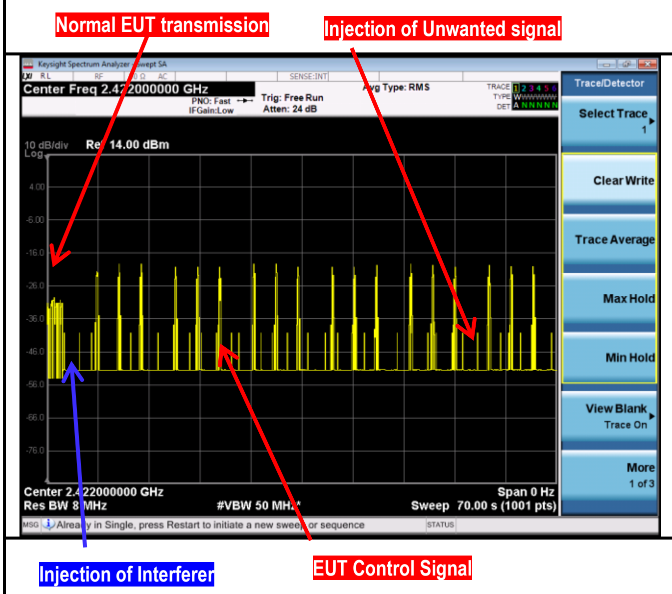


EUT Control Signal

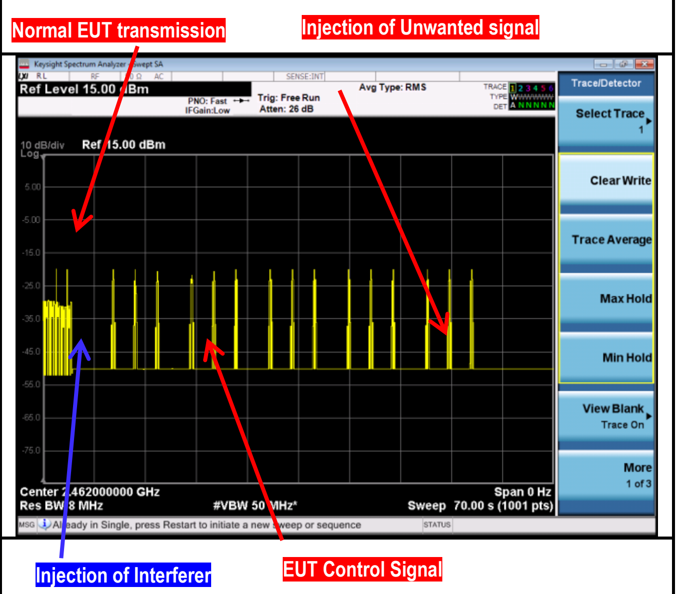
11b-2412M–Adaptivity Short control signal

EUT Control Signal

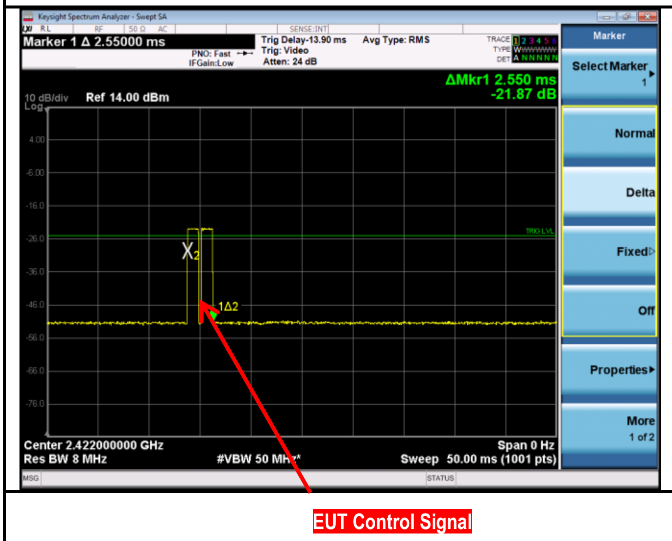
11b-2472M–Adaptivity Short control signal



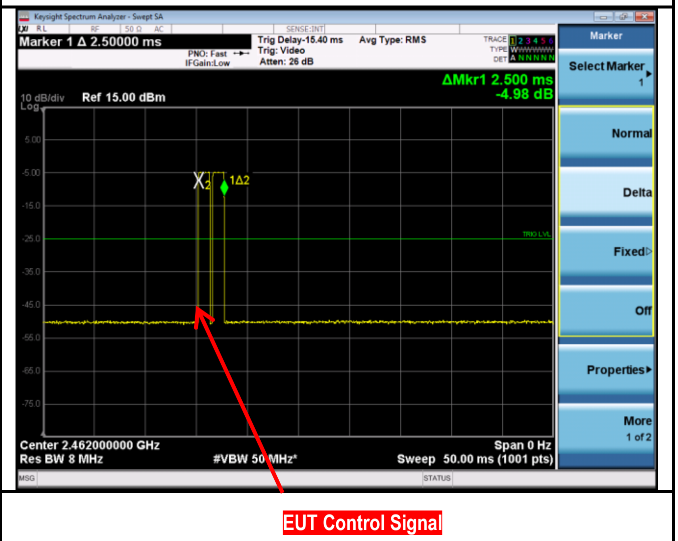
11n-HT40 2422M–Adaptivity (Unwanted signal at 2488.5MHz)



11n-2462M–Adaptivity (Unwanted signal at 2488.5MHz)



11n-HT40-2422M–Adaptivity Short control signal



11n-HT40-2462M–Adaptivity Short control signal

10.4 Occupied Channel Bandwidth

Spec	Item	Requirement			Applicable
EN 300 328 V1.9.1 (2015-02)	4.3.2	The Occupied Channel Bandwidth shall fall completely within the band of 2400 – 2483.5 MHz.			☒
EN 300 328 V1.9.1 (2015-02)	4.3.2	For non-adaptive systems using wide band modulations other than FHSS and with e.i.r.p greater than 10 dBm, the occupied channel bandwidth shall be less than 20 MHz			☐
Test Setup					
Procedure	1. Connect the UUT to the spectrum analyser and use the following settings: - Centre Frequency: The centre frequency of the channel under test - Resolution BW: ~ 1 % of the span without going below 1 % - Video BW: 3 × RBW - Frequency Span: 2 × Occupied Channel Bandwidth (e.g. 40 MHz for a 20 MHz channel) - Detector Mode: RMS 2. Wait until the trace is completed. Find the peak value of the trace and place the analyser marker on this peak. 3. Use the 99 % bandwidth function of the spectrum analyser to measure the Occupied Channel Bandwidth of the UUT. This value shall be recorded. NOTE: Make sure that the power envelope is sufficiently above the noise floor of the analyzer to avoid the noise signals left and right from the power envelope being taken into account by this measurement.				
Test Date	05/17/2018 –06/12/2018/	Environmental condition	Temperature Relative Humidity Atmospheric Pressure	24 °C 40 % 1019 mbar	
Remark	None				
Result	☒ Pass ☐ Fail				

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes ☐ N/A

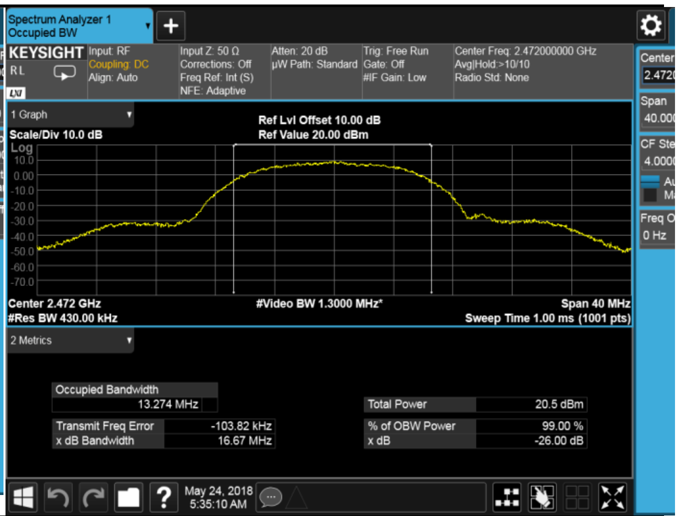
Test was done by Benjamin Jing at radio test site .

Test Result:

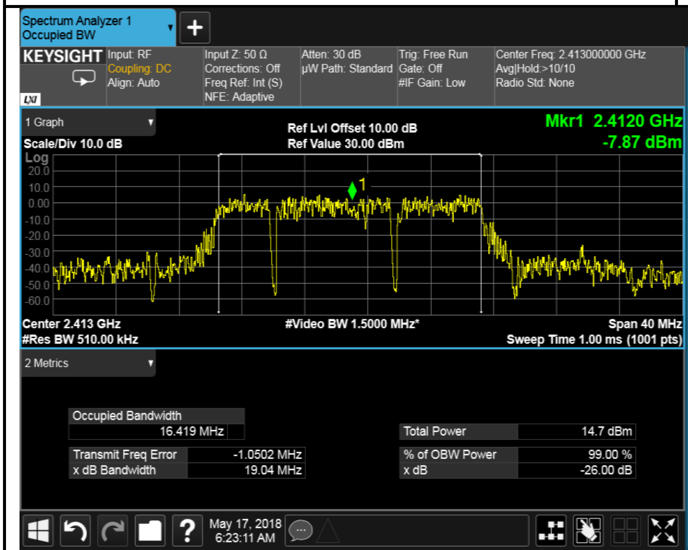
Type	Freq (MHz)	Test mode	99% Bandwidth (MHz)	FL at 99% Bandwidth (MHz)	FH at 99% Bandwidth (MHz)	Limit (FL/FH) (MHz)
99%OBW	2412	802.11b	13.3	2405.3	2418.7	2400.0
99%OBW	2472	802.11b	13.3	2465.3	2478.7	2483.5
99%OBW	2412	802.11g	16.4	2403.8	2420.2	2400.0
99%OBW	2472	802.11g	16.7	2463.6	2480.4	2483.5
99%OBW	2412	802.11n-20M	17.1	2403.4	2420.6	2400.0
99%OBW	2472	802.11n-20M	17.1	2463.4	2480.6	2483.5
99%OBW	2422	802.11n-40M	35.4	2404.3	2439.7	2400.0
99%OBW	2462	802.11n-40M	36.4	2443.8	2480.2	2483.5

Test Plots

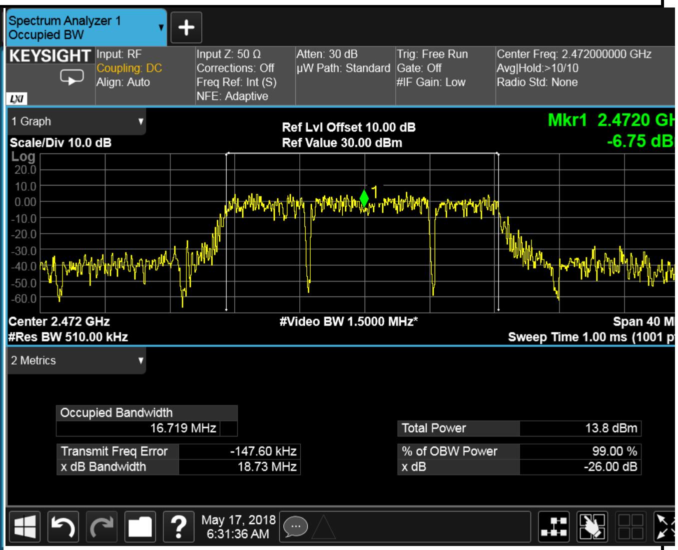
802.11b-Low



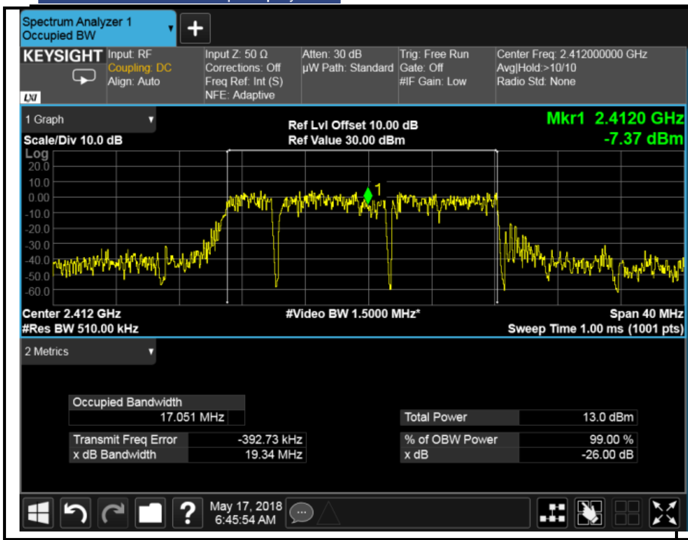
802.11b-High



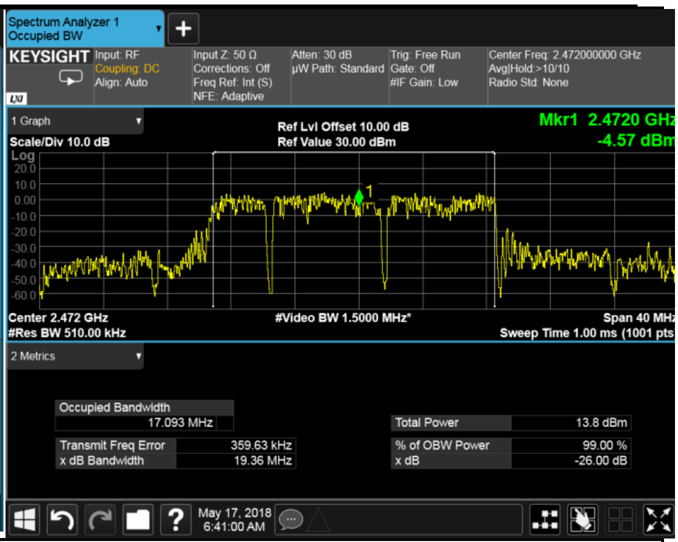
802.11g-Low



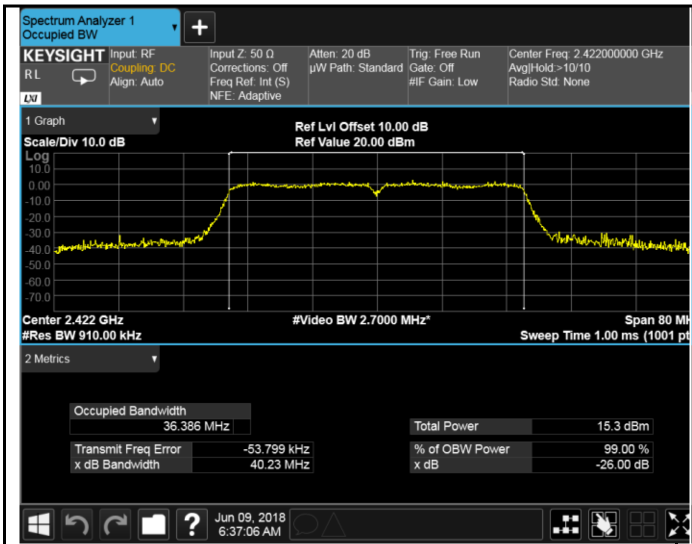
802.11g-High



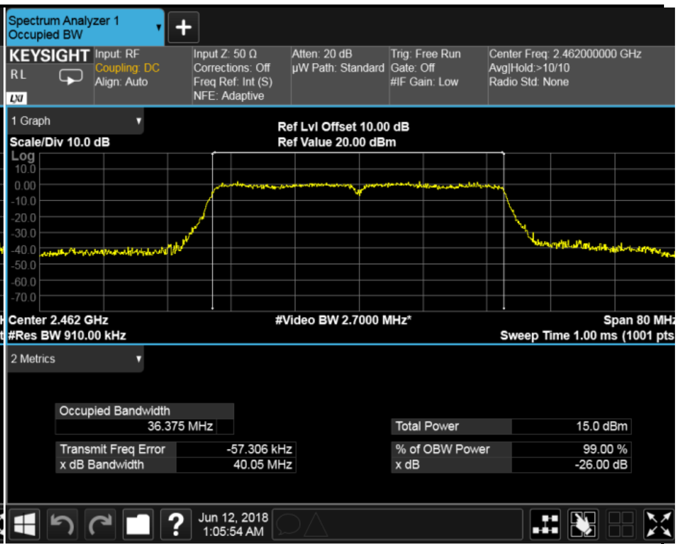
802.11n-20M-Low



802.11n-20M-High

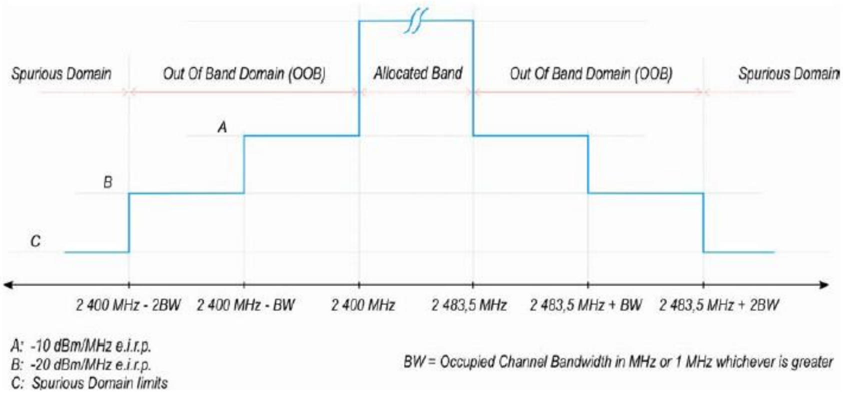


802.11n-40M-Low



802.11n-40M-High

10.5 TX Unwanted Emissions in the OOB domain

<table>
<tr><th>Spec</th><th>Item</th><th>Requirement</th><th>Applicable</th></tr>
<tr><td>EN 300 328 V1.9.1 (2015-02)</td><td>4.3.1, 4.3.2</td><td>The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask in figure at below,

</td><td>☒</td></tr>
<tr><td>Test Setup</td><td colspan="3">
</td></tr>
<tr><td>Procedure</td><td colspan="3">1. Connect the UUT to the spectrum analyser and use the following settings:
- Centre Frequency: 2 484 MHz
- Span: 0 Hz
- Resolution BW: 1 MHz
- Filter mode: Channel filter
- Video BW: 3 MHz
- Detector Mode: RMS
- Trace Mode: Clear / Write
- Sweep Mode: Continuous
- Sweep Points: 5 000
- Trigger Mode: Video trigger
- Sweep Time: Suitable to capture one transmission burst

2. (segment 2 483,5 MHz to 2 483,5 MHz + BW)
- Adjust the trigger level to select the transmissions with the highest power level.
- For frequency hopping equipment operating in a normal hopping mode, the different hops will result in signal bursts with different power levels. In this case the burst with the highest power level shall be selected.
- Set a window (start and stop lines) to match with the start and end of the burst and in which the RMS power shall be measured using the Time Domain Power function.
- Select RMS power to be measured within the selected window and note the result which is the RMS power within this 1 MHz segment (2 483,5 MHz to 2 484,5 MHz). Compare this value with the applicable limit provided by the mask.
- Increase the centre frequency in steps of 1 MHz and repeat this measurement for every 1 MHz segment within the range 2 483,5 MHz to 2 483,5 MHz + BW. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).</td></tr>
</table>

	3. (segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW) - Change the centre frequency of the analyser to 2 484 MHz + BW and perform the measurement for the first 1 MHz segment within range 2 483,5 MHz + BW to 2 483,5 MHz + 2BW. Increase the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + 2 BW - 0,5 MHz. 4. (segment 2 400 MHz - BW to 2 400 MHz) - Change the centre frequency of the analyser to 2 399,5 MHz and perform the measurement for the first 1 MHz segment within range 2 400 MHz - BW to 2 400 MHz Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz. 5. (segment 2 400 MHz - 2BW to 2 400 MHz - BW) - Change the centre frequency of the analyser to 2 399,5 MHz - BW and perform the measurement for the first 1 MHz segment within range 2 400 MHz - 2BW to 2 400 MHz - BW. Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz. 6. In case of conducted measurements on equipment with a single transmit chain, the declared antenna assembly gain "G" in dBi shall be added to the results for each of the 1 MHz segments and compared with the limits provided by the mask given in figures 1 or 3. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered. 7. In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the measurements need to be repeated for each of the active transmit chains. The declared antenna assembly gain "G" in dBi for a single antenna shall be added to these results. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered. Comparison with the applicable limits shall be done using any of the options given below: - Option 1: the results for each of the transmit chains for the corresponding 1 MHz segments shall be added. The additional beamforming gain "Y" in dB shall be added as well and the resulting values compared with the limits provided by the mask given in figures 1 or 3. - Option 2: the limits provided by the mask given in figures 1 or 3 shall be reduced by 10 x log10(Ach) and the additional beamforming gain "Y" in dB. The results for each of the transmit chains shall be individually compared with these reduced limits. NOTE 2: Ach refers to the number of active transmit chains.

Test Date	05/24/2018	Environmental condition	Temperature 24 °C Relative Humidity 40 % Atmospheric Pressure 1019 mbar
Remark	None		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes (See below) ☐ N/A
Test Plot ☐ Yes (See below) ☒ N/A

Test was done by Benjamin Jing at RF test site.

Test Result

Type	Frequency (MHz)	Mode	OOB Frequency (MHz)	OOB Emission level (dBm)	Limit (dBm)	Result
OOB	2412	802.11b	2398.4	-28.725	-10	Pass
OOB	2472	802.11b	2484.2	-32.338	-10	Pass
OOB	2412	802.11g	2399.7	-14.505	-10	Pass
OOB	2472	802.11g	2484.5	-14.574	-10	Pass
OOB	2412	802.11n-20	2391.4	-13.733	-10	Pass
OOB	2472	802.11n-20	2484.3	-13.050	-10	Pass
OOB	2422	802.11n-40	2393.7	-15.229	-10	Pass
OOB	2462	802.11n-40	2484.2	-13.952	-10	Pass

Note: The results above show only the worst case.

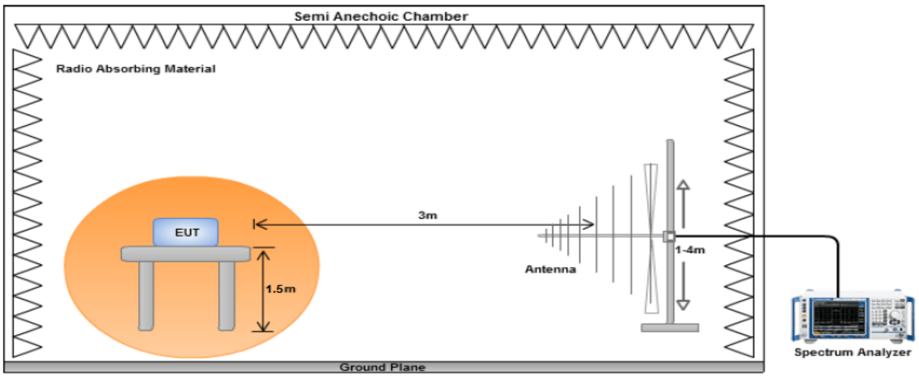
10.6 Radiated TX Unwanted Emissions in the spurious domain

Spec	Item	Requirement	Applicable
EN 300 328 V2.1.1 (2016-11)	4.3.1, 4.3.2	The spurious emissions of the transmitter shall not exceed the values in the tables below in the indicated bands.	☒

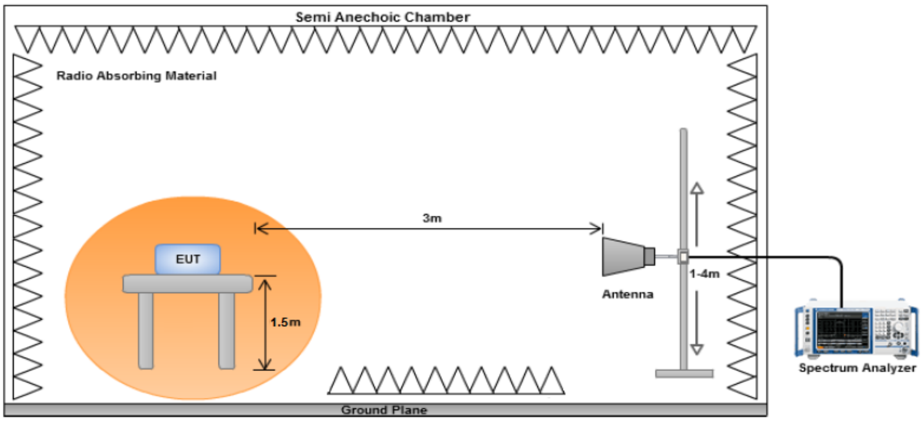
Transmitter limits for narrowband spurious emissions

Frequency range	Maximum power	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 KHz
47 MHz to 74 MHz	-54 dBm	100 KHz
74 MHz to 87.5 MHz	-36 dBm	100 KHz
87.5 MHz to 118 MHz	-54 dBm	100 KHz
118 MHz to 174 MHz	-36 dBm	100 KHz
174 MHz to 230 MHz	-54 dBm	100 KHz
230 MHz to 470 MHz	-36 dBm	100 KHz
470 MHz to 862 MHz	-54 dBm	100 KHz
862 MHz to 1 GHz	-36 dBm	100 KHz
1 GHz to 12.75 GHz	-30 dBm	1 MHz

Test Setup Below 1GHz



Test Setup Above 1GHz



Procedure	Refer to Clause 5.3.10.2.2 of EN 300 328 V2.1.1 (2016-11)
Remark	Both horizontal and vertical polarities were investigated. The results show only the worst case
Result	☒ Pass ☐ Fail

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☐ Yes (See below) ☒ N/A

Test was done by Benjamin Jing at 10m Chamber.

External Antenna

802.11b - Low CH 2412 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
189.63	-48.27	275	110	V	189.63	-73.45	0	1.28	-72.17	-54	-18.17
189.63	-44.46	96	229	H	189.63	-65.41	0	1.28	-64.13	-54	-10.13
4824	-65.13	236	165	V	4804	-42.05	10.54	4.32	-48.27	-30	-18.27
4824	-67.24	167	176	H	4804	-44.16	10.54	4.32	-50.38	-30	-20.38
7206	-78.16	264	168	V	7206	-46.86	10.13	4.36	-52.63	-30	-22.63
7206	-80.25	252	162	H	7206	-48.95	10.13	4.36	-54.72	-30	-24.72

802.11b - High CH 2472 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
206.12	-46.52	70	130	V	206.12	-67.17	0	1.31	-65.86	-54	-11.86
206.12	-40.48	142	220	H	206.12	-64.56	0	1.31	-63.25	-54	-9.25
4944	-66.34	236	165	V	4960	-43.26	10.52	4.35	-49.43	-30	-19.43
4944	-68.02	167	176	H	4960	-44.94	10.52	4.35	-51.11	-30	-21.11
7440	-78.64	264	168	V	7440	-47.34	10.67	4.38	-53.63	-30	-23.63
7440	-80.48	252	162	H	7440	-49.18	10.67	4.38	-55.47	-30	-25.47

802.11g - Low CH 2412 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
4824	-66.93	236	165	V	4804	-43.85	10.54	4.32	-50.07	-30	-20.07
4824	-68.22	167	176	H	4804	-45.14	10.54	4.32	-51.36	-30	-21.36
7206	-78.45	264	168	V	7206	-47.15	10.13	4.36	-52.92	-30	-22.92
7206	-80.32	252	162	H	7206	-49.02	10.13	4.36	-54.79	-30	-24.79

802.11g - High CH 2472 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
4944	-66.24	236	165	V	4960	-43.16	10.52	4.35	-49.33	-30	-19.33
4944	-68.45	167	176	H	4960	-45.37	10.52	4.35	-51.54	-30	-21.54
7440	-78.27	264	168	V	7440	-46.97	10.67	4.38	-53.26	-30	-23.26
7440	-79.13	252	162	H	7440	-47.83	10.67	4.38	-54.12	-30	-24.12

802.11n20 - Low CH 2412 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
4824	-65.13	236	165	V	4804	-42.05	10.54	4.32	-48.27	-30	-18.27
4824	-67.24	167	176	H	4804	-44.16	10.54	4.32	-50.38	-30	-20.38
7206	-78.16	264	168	V	7206	-46.86	10.13	4.36	-52.63	-30	-22.63
7206	-80.25	252	162	H	7206	-48.95	10.13	4.36	-54.72	-30	-24.72

802.11n20 - High CH 2472MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
4944	-66.34	236	165	V	4960	-43.26	10.52	4.35	-49.43	-30	-19.43
4944	-68.02	167	176	H	4960	-44.94	10.52	4.35	-51.11	-30	-21.11
7440	-78.64	264	168	V	7440	-47.34	10.67	4.38	-53.63	-30	-23.63
7440	-80.48	252	162	H	7440	-49.18	10.67	4.38	-55.47	-30	-25.47

802.11n40 - Low CH 2422 MHz

			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
206.12	-46.52	70	130	V	206.12	-67.17	0	1.31	-65.86	-54	-11.86
206.12	-40.48	142	220	H	206.12	-64.56	0	1.31	-63.25	-54	-9.25
4844	-66.93	236	165	V	4804	-43.85	10.54	4.32	-50.07	-30	-20.07
4844	-68.22	167	176	H	4804	-45.14	10.54	4.32	-51.36	-30	-21.36

802.11n40 - High CH 2462 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
207.03	-46.52	66	100	V	207.03	-68.17	0	1.31	-66.86	-54	-12.86
207.03	-40.48	138	229	H	207.03	-62.56	0	1.31	-61.25	-54	-7.25
4924	-66.24	236	165	V	4960	-43.16	10.52	4.35	-49.33	-30	-19.33
4924	-68.45	167	176	H	4960	-45.37	10.52	4.35	-51.54	-30	-21.54

Embedded Antenna

802.11b - Low CH 2412 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
227.03	-41.59	353	143	V	227.03	-63.29	0	1.35	-61.94	-54	-7.94
227.03	-35.63	116	159	H	227.03	-58.33	0	1.35	-56.98	-54	-2.98
4824	-65.13	236	165	V	4804	-42.05	10.54	4.32	-48.27	-30	-18.27
4824	-67.24	167	176	H	4804	-44.16	10.54	4.32	-50.38	-30	-20.38
7206	-78.16	264	168	V	7206	-46.86	10.13	4.36	-52.63	-30	-22.63
7206	-80.25	252	162	H	7206	-48.95	10.13	4.36	-54.72	-30	-24.72

802.11b - High CH 2472 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
206.12	-46.52	70	130	V	206.12	-67.17	0	1.31	-65.86	-54	-11.86
206.12	-40.48	142	220	H	206.12	-64.56	0	1.31	-63.25	-54	-9.25
4944	-66.34	236	165	V	4960	-43.26	10.52	4.35	-49.43	-30	-19.43
4944	-68.02	167	176	H	4960	-44.94	10.52	4.35	-51.11	-30	-21.11
7440	-78.64	264	168	V	7440	-47.34	10.67	4.38	-53.63	-30	-23.63
7440	-80.48	252	162	H	7440	-49.18	10.67	4.38	-55.47	-30	-25.47

802.11g - Low CH 2412 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
4824	-66.93	236	165	V	4804	-43.85	10.54	4.32	-50.07	-30	-20.07
4824	-68.22	167	176	H	4804	-45.14	10.54	4.32	-51.36	-30	-21.36
7206	-78.45	264	168	V	7206	-47.15	10.13	4.36	-52.92	-30	-22.92
7206	-80.32	252	162	H	7206	-49.02	10.13	4.36	-54.79	-30	-24.79

802.11g - High CH 2472 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
4944	-66.24	236	165	V	4960	-43.16	10.52	4.35	-49.33	-30	-19.33
4944	-68.45	167	176	H	4960	-45.37	10.52	4.35	-51.54	-30	-21.54
7440	-78.27	264	168	V	7440	-46.97	10.67	4.38	-53.26	-30	-23.26
7440	-79.13	252	162	H	7440	-47.83	10.67	4.38	-54.12	-30	-24.12

802.11n20 - Low CH 2412 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
4824	-65.13	236	165	V	4804	-42.05	10.54	4.32	-48.27	-30	-18.27
4824	-67.24	167	176	H	4804	-44.16	10.54	4.32	-50.38	-30	-20.38
7206	-78.16	264	168	V	7206	-46.86	10.13	4.36	-52.63	-30	-22.63
7206	-80.25	252	162	H	7206	-48.95	10.13	4.36	-54.72	-30	-24.72

802.11n20 - High CH 2472MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
4944	-66.34	236	165	V	4960	-43.26	10.52	4.35	-49.43	-30	-19.43
4944	-68.02	167	176	H	4960	-44.94	10.52	4.35	-51.11	-30	-21.11
7440	-78.64	264	168	V	7440	-47.34	10.67	4.38	-53.63	-30	-23.63
7440	-80.48	252	162	H	7440	-49.18	10.67	4.38	-55.47	-30	-25.47

802.11n40 - Low CH 2422 MHz

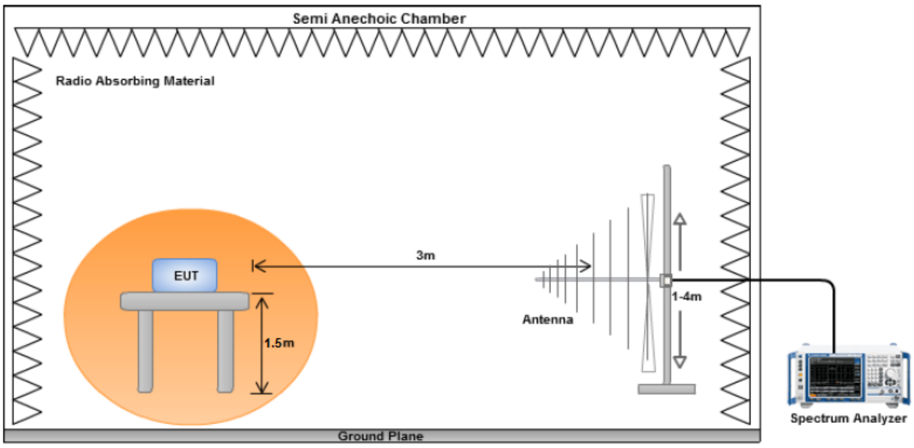
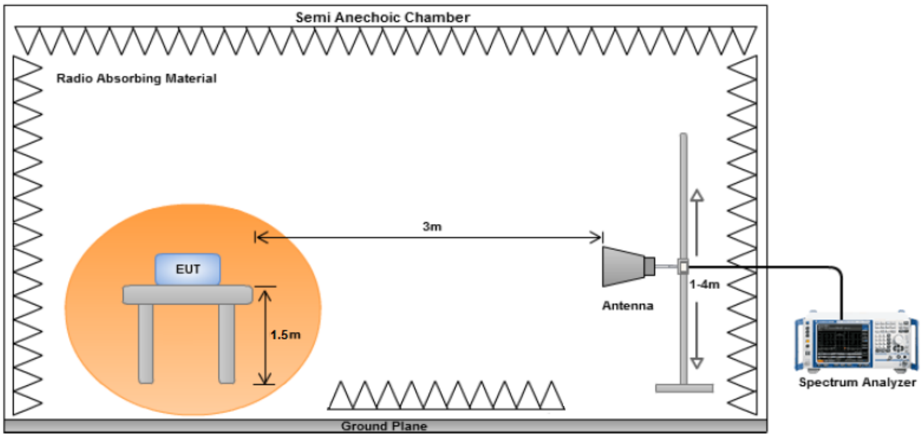
			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
206.12	-46.52	70	130	V	206.12	-67.17	0	1.31	-65.86	-54	-11.86
206.12	-40.48	142	220	H	206.12	-64.56	0	1.31	-63.25	-54	-9.25
4844	-66.93	236	165	V	4804	-43.85	10.54	4.32	-50.07	-30	-20.07
4844	-68.22	167	176	H	4804	-45.14	10.54	4.32	-51.36	-30	-21.36

802.11n40 - High CH 2462 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
207.03	-46.52	66	100	V	207.03	-68.17	0	1.31	-66.86	-54	-12.86
207.03	-40.48	138	229	H	207.03	-62.56	0	1.31	-61.25	-54	-7.25
4924	-66.24	236	165	V	4960	-43.16	10.52	4.35	-49.33	-30	-19.33
4924	-68.45	167	176	H	4960	-45.37	10.52	4.35	-51.54	-30	-21.54

10.7 Radiated Receiver Spurious Emissions

Requirement(s):

Spec	Item	Requirement	Applicable
EN 300 328 V2.1.1 (2016-11)	4.3.2.9	Receiver spurious emissions are emissions at any frequency when the equipment is in received mode. The spurious emissions of the receiver shall not exceed the values in the tables below in the indicated bands. **Frequency range** / **Maximum power** / **Bandwidth** 30 MHz to 1GHz / -57 dBm / 100 KHz 1 GHz to 12.75 GHz / -47 dBm / 1 MHz	☒
Test Setup Below 1GHz	 		
Test Setup Above 1GHz	 		
Procedure	Refer to Clause 5.3.11.2.1 of EN 300 328 V2.1.1 (2016-11)		
Remark	NONE		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☐ Yes (See below) ☒ N/A

Test was done by Benjamin at 10m chamber.

External Antenna

RX at 2412 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
207.5	-46.55	66	100	V	207.025	-68.42	0	1.31	-67.11	-57	-10.11
207.5	-40.47	138	229	H	207.025	-62.58	0	1.31	-61.27	-57	-4.27
1632	-79.27	264	150	V	1632	-68.53	10.08	1.78	-76.83	-47	-29.83
1632	-79.38	252	150	H	1632	-68.64	10.08	1.78	-76.94	-47	-29.94

RX at 2472 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
190.6	-48.14	280	100	V	190.656	-73.14	0	1.28	-71.86	-57	-14.86
190.6	-44.26	93	230	H	190.656	-66.27	0	1.28	-64.99	-57	-7.99
1952	-79.43	236	150	V	1952	-66.65	10.25	2.08	-74.82	-47	-27.82
1952	-79.76	167	150	H	1952	-66.98	10.25	2.08	-75.15	-47	-28.15

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case.

Embedded Antenna

RX at 2412 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
227.1	-41.18	353	143	V	227.031	-63.27	0	1.35	-61.92	-57	-4.92
227.1	-38.29	116	159	H	227.031	-61.31	0	1.35	-59.96	-57	-2.96
1632	-79.27	264	150	V	1632	-68.53	10.08	1.78	-76.83	-47	-29.83
1632	-79.38	252	150	H	1632	-68.64	10.08	1.78	-76.94	-47	-29.94

RX at 2472 MHz

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
227.3	-41.18	353	143	V	227.031	-63.27	0	1.35	-61.92	-57	-4.92
227.3	-38.29	116	159	H	227.031	-61.31	0	1.35	-59.96	-57	-2.96
1952	-79.43	236	150	V	1952	-66.65	10.25	2.08	-74.82	-47	-27.82
1952	-79.76	167	150	H	1952	-66.98	10.25	2.08	-75.15	-47	-28.15

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case.

10.8 Receiver Blocking

Requirement(s):

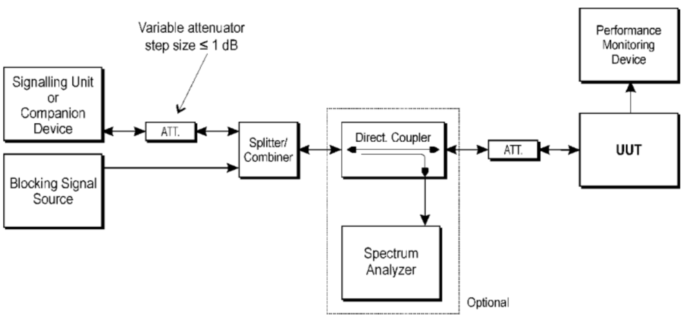
<table>
<tr><th>Spec</th><th>Item</th><th>Requirement</th><th>Applicable</th></tr>
<tr><td>EN 300 328 V2.1.1 (2016-11)</td><td>4.3.2.11</td><td>
4.3.2.11.4.2 Receiver Category 1
Table 14 contains the Receiver Blocking parameters for Receiver Category 1 equipment.
Table 14: Receiver Blocking parameters for Receiver Category 1 equipment
<table>
<tr><th>Wanted signal mean power from companion device (dBm)</th><th>Blocking signal frequency (MHz)</th><th>Blocking signal power (dBm) (see note 2)</th><th>Type of blocking signal</th></tr>
<tr><td>P_{min} + 6 dB</td><td>2 380
2 503,5</td><td>-53</td><td>CW</td></tr>
<tr><td>P_{min} + 6 dB</td><td>2 300
2 330
2 360</td><td>-47</td><td>CW</td></tr>
<tr><td>P_{min} + 6 dB</td><td>2 523,5
2 553,5
2 583,5
2 613,5
2 643,5
2 673,5</td><td>-47</td><td>CW</td></tr>
<tr><td colspan="4">NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 in the absence of any blocking signal.
NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.</td></tr>
</table>
</td><td>☒</td></tr>
<tr><td>EN 300 328 V2.1.1 (2016-11)</td><td>4.3.2.11</td><td>
4.3.2.11.4.3 Receiver Category 2
Table 15 contains the Receiver Blocking parameters for Receiver Category 2 equipment.
Table 15: Receiver Blocking parameters receiver category 2 equipment
<table>
<tr><th>Wanted signal mean power from companion device (dBm)</th><th>Blocking signal frequency (MHz)</th><th>Blocking signal power (dBm) (see note 2)</th><th>Type of blocking signal</th></tr>
<tr><td>P_{min} + 6 dB</td><td>2 380
2 503,5</td><td>-57</td><td>CW</td></tr>
<tr><td>P_{min} + 6 dB</td><td>2 300
2 583,5</td><td>-47</td><td>CW</td></tr>
<tr><td colspan="4">NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 in the absence of any blocking signal.
NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.</td></tr>
</table>
</td><td>☐</td></tr>
<tr><td>Test Setup</td><td colspan="3">


Figure 6: Test Set-up for receiver blocking
</td></tr>
<tr><td>Procedure</td><td colspan="3">Refer to Clause 5.4.11 of ETSI EN 300 328 V2.1.1 (2016-11)</td></tr>
<tr><td>Result</td><td colspan="3">☒ Pass ☐ Fail</td></tr>
</table>

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☐ Yes (See below) ☒ N/A

Test was done by Rachana Khanduri at RF test site.

Test Result for Receiver Blocking

WLAN:
802.11b Low CH: 2412 MHz

Type	Frequency (MHz)	Level (dBm)	Type	Result
Receiver Blocking	2380	-53	CW	Pass
	2503.5			Pass
	2300	-47		Pass
	2330			Pass
	2360			Pass
	2523.5	-47		Pass
	2553.5			Pass
	2583.5			Pass
	2613.5			Pass
	2643.5			Pass
	2673.5			Pass

802.11b Mid CH: 2442 MHz

Type	Frequency (MHz)	Level (dBm)	Type	Result
Receiver Blocking	2380	-53	CW	Pass
	2503.5			Pass
	2300	-47		Pass
	2330			Pass
	2360			Pass
	2523.5	-47		Pass
	2553.5			Pass
	2583.5			Pass
	2613.5			Pass
	2643.5			Pass
	2673.5			Pass

802.11b High CH: 2472 MHz

Type	Frequency (MHz)	Level (dBm)	Type	Result
Receiver Blocking	2380	-53	CW	Pass
	2503.5			Pass
	2300	-47		Pass
	2330			Pass
	2360			Pass
	2523.5	-47		Pass
	2553.5			Pass
	2583.5			Pass
	2613.5			Pass
	2643.5			Pass
	2673.5			Pass

Note: The EUT is category 1 receiver

Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Cycle	Cal Due	In use
Radiated Emissions						
Keysight EXA 44GHz Spectrum Analyzer	N9010A	MY51440112	08/02/2017	1 Year	08/02/2018	☑
Keysight Signal Generator	MXG N5182A	MY47071065	04/12/2018	1 Year	04/12/2019	☑
Pre-Amplifier (1 - 40GHz)	SAS-474	579	04/04/2018	1 Year	04/04/2019	☑
RF Preamplifier (100KHz-7GHz)	LPA-6-30	11170602	02/09/2018	1 Year	02/09/2019	☑
Bi-Log antenna (30MHz~2GHz)	JB1	A030702	01/13/2018	1 Year	01/13/2019	☑
Horn Antenna (1-26.5GHz)	3115	10SL0059	08/11/2017	1 Year	08/11/2018	☑
Horn Antenna (700MHz-18GHz)	SAS-571	411	04/13/2018	1 Year	04/13/2019	☑
Tuned Dipole Antenna 30 - 1000 MHz (4pcs set)	AD-100	40133	03/08/2018	1 Year	03/08/2019	☑
3 Meters SAC	3M	N/A	09/09/2017	1 Year	09/09/2018	☐
10 Meters SAC	10M	N/A	10/06/2017	1 Year	10/06/2018	☑
RF Conducted Measurement						
Agilent Spectrum Analyzer	N9010A	10SL0219	11/16/2017	1 Year	11/16/2018	☑
Test Equity Environment Chamber	1007H	61201	07/21/2017	1 Year	07/21/2018	☑
ETS-Lingren USB RF Power Sensor	7002-006	10SL0190	11/15/2017	1 Year	11/15/2018	☑
Receiver Blocking						
R & S Wideband Communication Tester	CMW500	108852	07/28/2017	1 Year	07/28/2018	☑

Annex B. SIEMIC Accreditation

ccreditations	Document	Scope / Remark
ISO 17025 (A2LA)		Please see the documents for the detailed scope
ISO Guide 65 (A2LA)		Please see the documents for the detailed scope
TCB Designation		A1, A2, A3, A4, B1, B2, B3, B4, C
FCC DoC Accreditation		FCC Declaration of Conformity Accreditation
FCC Site Registration		3 meter site
FCC Site Registration		10 meter site
IC Site Registration		3 meter site
IC Site Registration		10 meter site
EU NB		**Radio & Telecommunications Terminal Equipment:** EN45001 – EN ISO/IEC 17025
		Electromagnetic Compatibility: EN45001 – EN ISO/IEC 17025
Singapore iDA CB(Certification Body)		Phase I, Phase II
Vietnam MIC CAB Accreditation		Please see the document for the detailed scope
Hong Kong OFCA		**(Phase II)** OFCA Foreign Certification Body for Radio and Telecom
		(Phase I) Conformity Assessment Body for Radio and Telecom
Industry Canada CAB		**Radio:** Scope A – All Radio Standard Specification in Category I
		Telecom: CS-03 Part I, II, V, VI, VII, VIII

ccreditations	Document	Scope / Remark
ISO 17025 (A2LA)		Please see the documents for the detailed scope
ISO Guide 65 (A2LA)		Please see the documents for the detailed scope
TCB Designation		A1, A2, A3, A4, B1, B2, B3, B4, C
FCC DoC Accreditation		FCC Declaration of Conformity Accreditation

FCC Site Registration		3 meter site
FCC Site Registration		10 meter site
IC Site Registration		3 meter site
IC Site Registration		10 meter site
EU NB		**Radio & Telecommunications Terminal Equipment:** EN45001 – EN ISO/IEC 17025
		Electromagnetic Compatibility: EN45001 – EN ISO/IEC 17025
Singapore iDA CB(Certification Body)		Phase I, Phase II
Vietnam MIC CAB Accreditation		Please see the document for the detailed scope
Hong Kong OFCA		**(Phase II)** OFCA Foreign Certification Body for Radio and Telecom
		(Phase I) Conformity Assessment Body for Radio and Telecom
Industry Canada CAB		**Radio:** Scope A – All Radio Standard Specification in Category I
		Telecom: CS-03 Part I, II, V, VI, VII, VIII

Japan Recognized Certification Body Designation		**Radio**: A1. Terminal equipment for purpose of calling **Telecom**: B1. Specified radio equipment specified in Article 38-2, Paragraph 1, Item 1 of the Radio Law
Korea CAB Accreditation		**EMI:** KCC Notice 2008-39, RRL Notice 2008-3: CA Procedures for EMI KN22: Test Method for EMI **EMS:** KCC Notice 2008-38, RRL Notice 2008-4: CA Procedures for EMS KN24, KN61000-4-2, -4-3, -4-4, -4-5, -4-6, -4-8, -4-11: Test Method for EMS
		Radio: RRL Notice 2008-26, RRL Notice 2008-2, RRL Notice 2008-10, RRL Notice 2007-49, RRL Notice 2007-20, RRL Notice 2007-21, RRL Notice 2007-80, RRL Notice 2004-68
		Telecom: President Notice 20664, RRL Notice 2007-30, RRL Notice 2008-7 with attachments 1, 3, 5, 6; President Notice 20664, RRL Notice 2008-7 with attachment 4
Taiwan NCC CAB Recognition		LP0002, PSTN01, ADSL01, ID0002, IS6100, CNS14336, PLMN07, PLMN01, PLMN08

Taiwan BSMI CAB Recognition		CNS 13438
Japan VCCI		R-3083: Radiation 3 meter site C-3421: Main Ports Conducted Interference Measurement T-1597: Telecommunication Ports Conducted Interference Measuremet
Australia CAB Regocnition		**EMC:** AS/NZS CISPR 11, AS/NZS CISPR 14.1, AS/NZS CISPR22, AS/NZS 61000.6.3, AS/NZS 61000.6.4
		Radiocommunications: AS/NZS 4281, AS/NZS 4268, AS/NZS 4280.1, AS/NZS 4280.2, AS/NZS 4295, AS/NZS 4582, AS/NZS 4583, AS/NZS 4769.1, AS/NZS 4769.2, AS/NZS 4770, AS/NZS 4771
		Telecommunications: AS/ACIF S002:05, AS/ACIF S003:06, AS/ACIF S004:06 AS/ACIF S006:01, AS/ACIF S016:01, AS/ACIF S031:01, AS/ACIF S038:01, AS/ACIF S040:01, AS/ACIF S041:05, AS/ACIF S043.2:06, AS/ACIF S60950.1
Australia NATA Recognition		AS/ACIF S002, AS/ACIF S003, AS/ACIF S004, AS/ACIF S006, AS/ACIF S016,AS/ACIF S031, AS/ACIF S038, AS/ACIF S040, AS/ACIF S041, AS/ACIF S043.2