ETSI EN 300 328 V2.2.2: 2019 TEST REPORT

FOR

Shenzhen Zhencheng Technology Co., Ltd.

Dashcam

Model No.	:	M60
Trade Name	:	N/A
Report No.	:	RCT202312140204R
Date of Receipt	:	Dec. 14, 2023
Date of Test	:	Dec. 14, 2023 – Dec. 29, 2023
Prepared for	:	Shenzhen Zhencheng Technology Co., Ltd.
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1. TEST RESULT CERTIFICATION

Applicant:	:	Shenzhen Zhencheng Technology Co., Ltd.
		3/F Building C, NO.2 ,Road 1, Shangxue Industrial Area, Bantian Street, Longgang District, Shenzhen, China
Manufacture:	:	Shenzhen Zhencheng Technology Co., Ltd.
		3/F Building C, NO.2 ,Road 1, Shangxue Industrial Area, Bantian Street, Longgang District, Shenzhen, China
EUT	:	Dashcam
Model Name	:	M60
Trademark	:	N/A

Measurement Procedure Used:

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
ETSI EN 300 328 V2.2.2: 2019	PASS

The device described above is tested by Shenzhen RCT testing Technology Co., Ltd.. to determine the maximum emission levels emanating from the device and the severe levels of the device can endure and its performance criterion. The measurement results are contained in this test report and Shenzhen RCT testing Technology Co., Ltd. is assumed full of responsibility for the accuracy and completeness of these measurements. Also, this report shows that the EUT (Equipment Under Test) is technically compliant with the ETSI EN 300 328 V2.2.2: 2019 requirements.

This report applies to above tested sample only and shall not be reproduced in part without written approval of Shenzhen RCT testing Technology Co., Ltd.

Prepared by : Allen shi
Editor

Reviewer : Taylor Wang
Supervisor

Approved : Hannah Li
Manager

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2. EUT DESCRIPTION

Product	Dashcam	
Model Number	M60	
Wifi Type	Wifi	
WLAN Supported	802.11b(20MHz channel bandwidth) 802.11g(20MHz channel bandwidth) 802.11n(20MHz channel bandwidth) 802.11n(40MHz channel bandwidth)	
Data Rate	802.11b:1, 2, 5.5, 11Mbps; 802.11g:6, 9, 12, 18, 24, 36, 48, 54Mbps; 802.11n(HT20): MCS0-MCS15; 802.11n(HT40): MCS0-MCS15;	
Modulation	DSSS with DBPSK/DQPSK/CCK for 802.11b; OFDM with BPSK/QPSK/16QAM/64QAM for 802.11g/n;	
Frequency Range	Wifi	
	2412-2472MHz for 802.11b; 2412-2472MHz for 802.11g;	2412-2472MHz for 802.11n(HT20); 2422-2462MHz for 802.11n(HT40);
Number of Channels	Wifi	
	13 Channels for 802.11b; 13 Channels for 802.11g;	13 Channels for 802.11n(HT20); 9 Channels for 802.11n(HT40);
Antenna Port:	Antenna port A Antenna port B	
Antenna Type	Antenna A: FPC antenna Antenna B: FPC antenna	
Antenna Gain	Antenna A: 3.21 antenna Antenna B: 3.46 antenna	
Support Mode	SISO: 802.11b/g/n MIMO: 802.11n	
Max Power:	18.94dBm	
Temperature Range	-20°C ~ +60°C	

Note: for more details, please refer to the User's manual of the EUT.

3. INFORMATION AS REQUIRED BY EN 300 328 V2.1.1

EN 300 328	Information Is Provided By The Manufacturer	
The type of modulation used by the equipment	FHSS other forms of modulation	
Adaptive/non-adaptive equipment:	non-adaptive Equipment adaptive Equipment without the possibility to Dashcam to a non-adaptive mode adaptive Equipment which can also operate in a non-adaptive mode	
In case of adaptive equipment:	The maximum Channel Occupancy Time implemented by the equipment: 1.31ms The equipment has implemented an LBT based DAA mechanism ● In case of equipment using modulation different from FHSS: The equipment is Frame Based equipment The equipment is Load Based equipment The equipment can Dashcam dynamically between Frame Based and Load Based equipment The CCA time implemented by the equipment: 133μs The equipment has implemented an non-LBT based DAA mechanism The equipment can operate in more than one adaptive mode	
The worst case operational mode for each of the following tests:	RF Output Power	18.94dBm
	Power Spectral Density	4.61dBm/MHz
	Duty Cycle, Tx-Sequence, Tx-gap.	N/A
	Dwell Time, Minimum Frequency Occupation & Hopping Sequence (only for FHSS equipment)	N/A
	Hopping Frequency Separation (only for FHSS equipment)	N/A
	Medium Utilisation.	N/A
	Adaptivity & Receiver Blocking.	PASS
	Occupied Channel Bandwidth	36.437MHz
	Transmitter Unwanted Emissions in the OOB domain.	PASS
	Transmitter Unwanted Emissions in the spurious domain	PASS
	Receiver spurious emissions	PASS

The different transmit operating modes (tick all that apply):	Operating mode 1: Single Antenna Equipment Equipment with only 1 antenna Equipment with 2 diversity antennas but only 1 antenna active at any moment in time Smart Antenna Systems with 2 or more antennas, but operating in a (legacy) mode where only 1 antenna is used. (e.g. IEEE 802.11™ [i.3] legacy mode in smart antenna systems) Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming Single spatial stream / Standard throughput / (e.g. IEEE 802.11™ [i.3] legacy mode) High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1 High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2 Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming Single spatial stream / Standard throughput (e.g. IEEE 802.11™ [i.3] legacy mode) High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1 High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2
Operating Frequency Range(s) of the equipment:	Operating Frequency Range: 2412 MHz to 2472 MHz
Occupied Channel Bandwidth(s):	Occupied Channel Bandwidth: 36.437 MHz
Type of Equipment (stand-alone, combined, plug-in radio device, etc.):	Stand-alone Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment) Plug-in radio device (Equipment intended for a variety of host systems) Other
Describe the test modes available which can facilitate testing:	Modulation Mode: DSSS with DBPSK/DQPSK/CCK for OFDM with802.11b; BPSK/QPSK/16QAM/64QAM for 802.11g/n; Test Frequency: Low Frequency, Middle Frequency, High Frequency
The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3], proprietary, etc.):	802.11b/g/n(HT20)(HT40)
NOTE: N/A means not applicable	

Modified Information

Version	Report No.	Revision Date	Summary
V1.0	RCT202312140204R	Dec. 29, 2023	Original Report

4. SUMMARY OF TEST RESULT

Clause (EN 300 328)	Test Parameter	Verdict	Remark
4.3.2.2	RF Output Power	PASS	
4.3.2.3	Power Spectral Density	PASS	
4.3.2.4	Duty Cycle and Tx-Sequence and Tx-Gap	N/A (See Note1)	Only applicable for non-adaptive equipment Output Power >10dBm
4.3.2.5	Medium Utilisation Factor	N/A (See Note1)	Only applicable for non-adaptive equipment Output Power >10dBm
4.3.2.6	Adaptivity (adaptive equipment using modulations other than FHSS)	PASS	
4.3.2.7	Occupied Channel Bandwidth	PASS	
4.3.2.8	Transmitter Unwanted Emission in the Out-of Band	PASS	
4.3.2.9	Transmitter Unwanted Emissions in the Spurious Domain	PASS	
4.3.2.10	Receiver Spurious Emissions	PASS	
4.3.2.11	Receiver Blocking	PASS (See Note2)	Receiver category 1
4.3.2.12	Geo-location capability	N/A (See Note1)	Only applicable for have Geo-location function equipment

NOTE1: N/A (Not Applicable)

NOTE2: Receiver category 1(Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p. shall be considered as receiver category 1 equipment.)

Receiver category 2(Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or adaptive equipment with a maximum RF output power of10 dBm e.i.r.p. shall be considered as receiver category 2 equipment.)

Receiver category 3(Non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % or adaptive equipment with a maximum RF output power of 0 dBm e.i.r.p. shall be considered as receiver category 3 equipment.)

5. TEST METHODOLOGY

5.1 GENERAL DESCRIPTION OF APPLIED STANDARDS

According to its specifications, the EUT must comply with the requirements of the following standards:

ETSI EN 300 328 –Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

5.2 MEASUREMENT EQUIPMENT USED

For Spurious Emissions Test

Equipment Type	Manufacturer	Model No.	Serial Number	Last Cal.
EMI Test Receiver	Rohde & Schwarz	ESCI	101414	Dec. 20, 2023
EMI Test Receiver	Rohde & Schwarz	FSV40	132.1-3008K39-100967-AP	Dec. 20, 2023
Pre-Amplifier	LUNAR-EM	LNA30M3G-25	J10100000071	Dec. 20, 2023
Pre-Amplifier	Lunar EM	LNA1G18-48	J1011131010001	Dec. 20, 2023
Bilog Antenna	Schwarzbeck	VULB9163	660	Dec. 20, 2023
Horn Antenna	Schwarzbeck	BBHA 9120	1178	Dec. 20, 2023
Cable	H+B	NmSm-05-C15052	N/A	Dec. 20, 2023
Cable	H+B	NmSm-2-C15201	N/A	Dec. 20, 2023
Cable	H+B	NmNm-7-C15702	N/A	Dec. 20, 2023
Cable	H+B	SAC-40G-1	414	Dec. 20, 2023
Cable	H+B	SUCOFLEX104	MY14871/4	Dec. 20, 2023
Cable	H+B	BLU18A-NmSm-6500	D8501	Dec. 20, 2023
Band reject Filter(50dB)	WI/DE	WRCGV-2400(2400-2485MHz)	2	Dec. 20, 2023
Remark: *Each piece of equipment is scheduled for calibration once a year.*				

For other test items:

Equipment Type	Manufacturer	Model No.	Serial Number	Last Cal.
Vector Signal Generater	Agilent	N5182B	My53050553	Dec. 20, 2023
Analog Signal Generator	Agilent	N5171B	My53050878	Dec. 20, 2023
Signal Analyzer	Agilent	N9010A	My53470879	Dec. 20, 2023
Power Analyzer	Agilent	PS-X10-200	N/A	Dec. 20, 2023
Test Accessories	Agilent	PS-X10-100	N/A	Dec. 20, 2023
Temperature&Humidity test chamber	ESPEC	EL-02KA	12107166	Dec. 20, 2023
Blocking Box	Agilent	AD211	N/A	Dec. 20, 2023
Remark: *Each piece of equipment is scheduled for calibration once a year.*				

5.3 DESCRIPTION OF TEST MODES

The EUT has been tested under its typical operating condition.
The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.
The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

Test of channel included the lowest and middle and highest frequency to perform the test, then record on this report.

The EUT has been tested under its typical operating condition. so those data rates (802.11b: 1 Mbps; 802.11g: 6 Mbps; 802.11n(HT20): MCS0; 802.11n(HT40): MCS0) were used for all test.

Pre-defined engineering program for regulatory testing used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Frequency and Channel list for 802.11b/g/n(HT20):

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	5	2432	10	2457
2	2417	6	2437	11	2462
3	2422	7	2442	12	2467
4	2427	8	2447	13	2472
		9	2452		

Frequency and Channel list for 802.11n(HT40):

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
3	2422	6	2437	9	2452
4	2427	7	2442	10	2457
5	2432	8	2447	11	2462

Test Frequency and Channel for 802.11b/g/n(HT20):

Lowest Frequency		Middle Frequency		Highest Frequency	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	7	2442	13	2472

Test Frequency and channel for 802.11n(HT40):

Lowest Frequency		Middle Frequency		Highest Frequency	
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
3	2422	7	2442	11	2462

6. FACILITIES AND ACCREDITATIONS

6.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

Bldg 69, Majialong Industry Zone District, Nanshan District, Shenzhen, China
The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

6.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with preselectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

7. TEST SYSTEM UNCERTAINTY

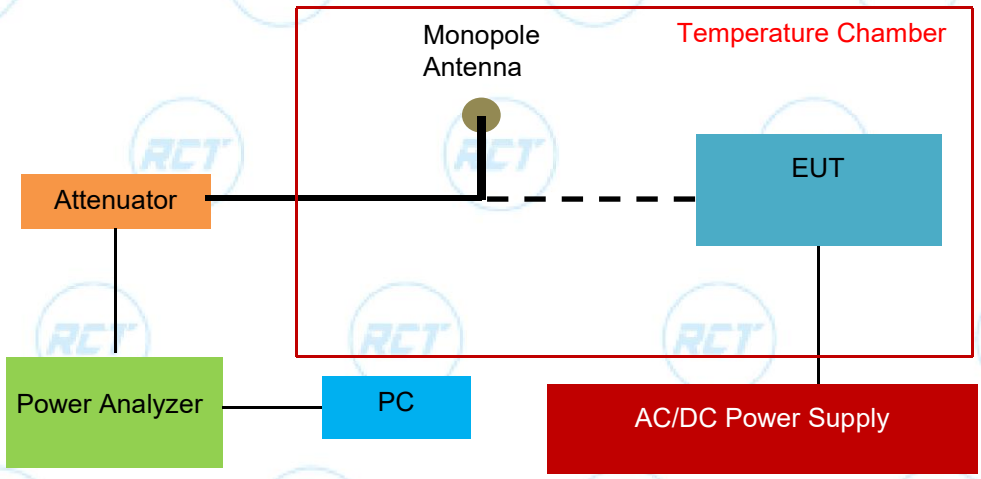
Maximum measurement uncertainty of the test system

Test Parameter	Measurement Uncertainty
RF Output Power	±1.0%
Power Spectral Density	±0.9%
Duty Cycle and Tx-Sequence and Tx-Gap	±1.3%
Medium Utilisation Factor	±1.5%
Occupied Channel Bandwidth	±2.3%
Transmitter Unwanted Emission in the Out-of Band	±1.2%
Transmitter Unwanted Emissions in the Spurious Domain	±2.7%
Receiver Spurious Emissions	±2.7%
Temperature	±3.2%
Humidity	±2.5%

8. SETUP OF EQUIPMENT UNDER TEST

8.1 SETUP CONFIGURATION OF EUT

Conducted measurements configuration of EUT shall be as follows:

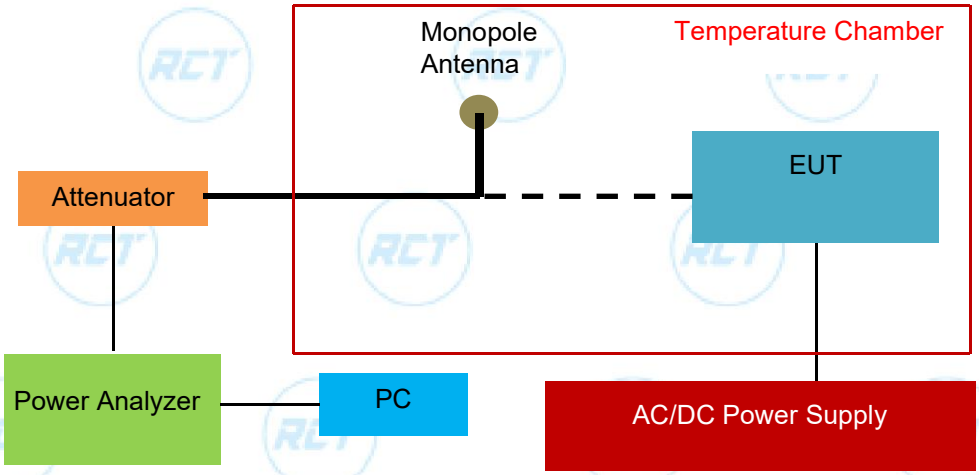


Remarks:
The Signal Analyzer could be connected to a monopole antenna or directly connected to the EUT, if the EUT has already employing an antenna connector.

Radiated measurements configuration of EUT shall be as follows:

Below 1GHz

Above 1GHz



8.2 SUPPORT EQUIPMENT

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
-	-	-	-	-	-

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

9. ETSI EN 300 328 REQUIREMENTS

9.1 RF OUTPUT POWER

9.1.1 Applicable standard

EN 300 328 Clause 4.3.2.2

9.1.2 Conformance Limit

The Maximum RF Output Power <= 100 mW (20 dBm) (EIRP) at both Normal and Extreme conditions.

9.1.3 Test Configuration

The measurements for RF output power shall be performed at both normal environmental conditions and at the extremes of the operating temperature range.

Radiated measurements shall only be used for integral antenna equipment that does not have a temporary antenna connector(s) provided.
Conducted measurements shall be used for antenna equipment provided a temporary antenna connector(s)

9.1.4 Test Procedure

1. Please refer to ETSI EN 300 328 clause 5.4.2.1 for the test conditions.
2. Please refer to ETSI EN 300 328 clause 5.4.2.2 for the measurement method.

The test procedure shall be as follows:
■ Conducted measurements
Step 1:
• Use a fast power sensor suitable for 2,4 GHz and capable of minimum 1 MS/s.
• Use the following settings:
- Sample speed 1 MS/s or faster.
- The samples shall represent the RMS power of the signal.
- Measurement duration: For non-adaptive equipment: equal to the observation period defined in clause 4.3.1.3.2 or clause 4.3.2.4.2. For adaptive equipment, the measurement duration shall be long
enough to ensure a minimum number of bursts (at least 10) are captured.
For adaptive equipment, to increase the measurement accuracy, a higher number of bursts may be used.
Step 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.
• For conducted measurements on devices with multiple transmit chains:
- Connect one power sensor to each transmit port for a synchronous measurement on all transmit 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 500 ns.
- For each individual sampling point (time domain), sum the coincident power samples of all ports and
store them. Use these summed samples in all following steps.
Step 3:
• Find the start and stop times of each burst in the stored measurement samples.
The start and stop times are defined as the points where the power is at least 30 dB below the highest value of the stored samples in step 2.
In case of insufficient dynamic range, the value of 30 dB may need to be reduced appropriately.
Step 4:
• Between the start and stop times of each individual burst calculate the RMS power over the burst

using the formula below. Save these Pburst values, as well as the start and stop times for each burst.

with k being the total number of samples and n the actual sample number.

Step 5:

• The highest of all Pburst values (value "A" in dBm) will be used for maximum e.i.r.p. calculations.

Step 6:

• Add the (stated) antenna assembly gain "G" in dBi of the individual antenna.

• 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.

• The RF Output Power (P) shall be calculated using the formula below: P = A + G + Y

• This value, which shall comply with the limit given in clause 4.3.1.2.3 or clause 4.3.2.2.3, shall be recorded in the test report.

■ Radiated measurements

This method shall only be used for integral antenna equipment that does not have a temporary antenna connector(s) provided.

When performing radiated measurements, the UUT shall be configured and antenna(s) positioned (including smart antenna systems and equipment capable of beamforming) for maximum e.i.r.p. towards the measuring antenna. This position shall be recorded.

A test site as described in annex B and applicable measurement procedures as described in annex C shall be used.

Taking into account the calibration factor from the measurement site, the test procedure for RF Output Power is further as described under clause 5.4.2.2.1.2, step 1 to step 5. The RF Output Power P is equal to the value A obtained in step 5. The test procedure for Duty Cycle, Tx-sequence, Tx-gap is further as described in clause 5.4.2.2.1.3 and the test procedure for Medium Utilization is further as described in clause 5.4.2.2.1.4.

9.1.5 Test Results

Temperature: Refer to the following table **Test Voltage:** DC 5V

Humidity: 55 % RH **Tested by:** KK

Antenna: A (SISO)

Transmitter Power (dBm)					
MODES	Normal Condition Temperature (℃)	CHANNEL	Measured power (dBm)	Antenna Gain (dBi)	EIRP (dBm)
802.11b 1Mbps	25	2412 MHz	13.44	3.21	16.65
		2442 MHz	13.70	3.21	16.91
		2472 MHz	13.72	3.21	16.93
802.11g 6Mbps	25	2412 MHz	11.55	3.21	14.76
		2442 MHz	12.13	3.21	15.34
		2472 MHz	11.81	3.21	15.02
802.11n (HT20) MCS 0	25	2412 MHz	11.46	3.21	14.67
		2442 MHz	12.07	3.21	15.28
		2472 MHz	11.50	3.21	14.71
802.11n (HT40) MCS0	25	2422 MHz	12.15	3.21	15.36
		2442 MHz	12.37	3.21	15.58
		2462 MHz	12.22	3.21	15.43
Limit			<= 20dBm		
Verdict			PASS		

Transmitter Power (dBm)					
MODES	Extreme Conditions Temperature (℃)	CHANNEL	Measured power (dBm)	Antenna Gain (dBi)	EIRP (dBm)
802.11b 1Mbps	-20	2412 MHz	13.24	3.21	16.45
		2442 MHz	13.67	3.21	16.88
		2472 MHz	13.70	3.21	16.91
802.11g 6Mbps	-20	2412 MHz	11.36	3.21	14.57
		2442 MHz	12.07	3.21	15.28
		2472 MHz	11.74	3.21	14.95
802.11n (HT20) MCS 0	-20	2412 MHz	11.34	3.21	14.55
		2442 MHz	12.04	3.21	15.25
		2472 MHz	11.43	3.21	14.64
802.11n (HT40) MCS0	-20	2422 MHz	12.03	3.21	15.24
		2442 MHz	12.26	3.21	15.47
		2462 MHz	12.02	3.21	15.23
Limit			<= 20dBm		
Verdict			PASS		

Transmitter Power (dBm)					
MODES	Extreme Conditions Temperature (℃)	CHANNEL	Measured power (dBm)	Antenna Gain (dBi)	EIRP (dBm)
802.11b 1Mbps	60	2412 MHz	13.26	3.21	16.47
		2442 MHz	13.69	3.21	16.9
		2472 MHz	13.68	3.21	16.89
802.11g 6Mbps	60	2412 MHz	11.38	3.21	14.59
		2442 MHz	12.06	3.21	15.27
		2472 MHz	11.80	3.21	15.01
802.11n (HT20) MCS 0	60	2412 MHz	11.41	3.21	14.62
		2442 MHz	12.03	3.21	15.24
		2472 MHz	11.43	3.21	14.64
802.11n (HT40) MCS0	60	2422 MHz	11.99	3.21	15.2
		2442 MHz	12.28	3.21	15.49
		2462 MHz	12.02	3.21	15.23
Limit			<= 20dBm		
Verdict			PASS		

Temperature: Refer to the following table **Test Voltage:** DC 5V

Humidity: 55 % RH **Tested by:** KK

Antenna: B(SISO)

Transmitter Power (dBm)					
MODES	Normal Condition Temperature (℃)	CHANNEL	Measured power (dBm)	Antenna Gain (dBi)	EIRP (dBm)
802.11b 1Mbps	25	2412 MHz	13.77	3.46	17.23
		2442 MHz	14.75	3.46	18.21
		2472 MHz	14.51	3.46	17.97
802.11g 6Mbps	25	2412 MHz	12.33	3.46	15.79
		2442 MHz	12.56	3.46	16.02
		2472 MHz	12.22	3.46	15.68
802.11n (HT20) MCS 0	25	2412 MHz	11.91	3.46	15.37
		2442 MHz	12.31	3.46	15.77
		2472 MHz	11.65	3.46	15.11
802.11n (HT40) MCS0	25	2422 MHz	11.71	3.46	15.17
		2442 MHz	12.57	3.46	16.03
		2462 MHz	12.37	3.46	15.83
Limit			<= 20dBm		
Verdict			PASS		

Transmitter Power (dBm)					
MODES	Extreme Conditions Temperature (℃)	CHANNEL	Measured power (dBm)	Antenna Gain (dBi)	EIRP (dBm)
802.11b 1Mbps	-20	2412 MHz	13.70	3.46	17.16
		2442 MHz	14.73	3.46	18.19
		2472 MHz	14.41	3.46	17.87
802.11g 6Mbps	-20	2412 MHz	12.25	3.46	15.71
		2442 MHz	12.50	3.46	15.96
		2472 MHz	12.03	3.46	15.49
802.11n (HT20) MCS 0	-20	2412 MHz	11.80	3.46	15.26
		2442 MHz	12.13	3.46	15.59
		2472 MHz	11.50	3.46	14.96
802.11n (HT40) MCS0	-20	2422 MHz	11.59	3.46	15.05
		2442 MHz	12.42	3.46	15.88
		2462 MHz	12.21	3.46	15.67
Limit			<= 20dBm		
Verdict			PASS		

Transmitter Power (dBm)					
MODES	Extreme Conditions Temperature (℃)	CHANNEL	Measured power (dBm)	Antenna Gain (dBi)	EIRP (dBm)
802.11b 1Mbps	60	2412 MHz	13.65	3.46	17.11
		2442 MHz	14.71	3.46	18.17
		2472 MHz	14.42	3.46	17.88
802.11g 6Mbps	60	2412 MHz	12.28	3.46	15.74
		2442 MHz	12.48	3.46	15.94
		2472 MHz	12.08	3.46	15.54
802.11n (HT20) MCS 0	60	2412 MHz	11.75	3.46	15.21
		2442 MHz	12.21	3.46	15.67
		2472 MHz	11.64	3.46	15.10
802.11n (HT40) MCS0	60	2422 MHz	11.61	3.46	15.07
		2442 MHz	12.57	3.46	16.03
		2462 MHz	12.33	3.46	15.79
Limit			<= 20dBm		
Verdict			PASS		

Temperature: Refer to the following table **Test Voltage:** DC 5V

Humidity: 55 % RH **Tested by:** KK

Antenna: A+B (MIMO)

Transmitter Power (dBm)					
MODES	Extreme Conditions Temperature (℃)	CHANNEL	Measured power (dBm)	Antenna Gain (dBi)	EIRP (dBm)
802.11n (HT20) MCS8	25	2412 MHz	14.70	3.46	18.16
		2442 MHz	15.20	3.46	18.66
		2472 MHz	14.59	3.46	18.05
802.11n (HT40) MCS8	25	2422 MHz	14.95	3.46	18.41
		2442 MHz	15.48	3.46	18.94
		2462 MHz	15.31	3.46	18.77
Limit			<= 20dBm		
Verdict			PASS		

Transmitter Power (dBm)					
MODES	Extreme Conditions Temperature (℃)	CHANNEL	Measured power (dBm)	Antenna Gain (dBi)	EIRP (dBm)
802.11n (HT20) MCS8	-20	2412 MHz	14.59	3.46	18.05
		2442 MHz	15.10	3.46	18.56
		2472 MHz	14.48	3.46	17.94
802.11n (HT40) MCS8	-20	2422 MHz	14.83	3.46	18.29
		2442 MHz	15.35	3.46	18.81
		2462 MHz	15.13	3.46	18.59
Limit			<= 20dBm		
Verdict			PASS		

Transmitter Power (dBm)					
MODES	Extreme Conditions Temperature (℃)	CHANNEL	Measured power (dBm)	Antenna Gain (dBi)	EIRP (dBm)
802.11n (HT20) MCS8	60	2412 MHz	14.59	3.46	18.05
		2442 MHz	15.13	3.46	18.59
		2472 MHz	14.55	3.46	18.01
802.11n (HT40) MCS8	60	2422 MHz	14.81	3.46	18.27
		2442 MHz	15.44	3.46	18.90
		2462 MHz	15.19	3.46	18.65
Limit			<= 20dBm		
Verdict			PASS		

The worst case test plots, please see the appendix I

9.2 POWER SPECTRAL DENSITY

9.2.1 Applicable standard

According to ETSI EN 300 328 clause 4.3.2.3

9.2.2 Conformance Limit

The Maximum Power Spectrum Density <=10 dBm/MHz

9.2.3 Test Configuration

The measurements for power spectral density shall only be performed at normal test conditions.

Radiated measurements shall only be used for integral antenna equipment that does not have a temporary antenna connector(s) provided.
Conducted measurements shall be used for antenna equipment provided a temporary antenna connector(s) provided.

9.2.4 Test Procedure

1. Please refer to ETSI EN 300 328 clause 5.4.3.1 for the test conditions.
2. Please refer to ETSI EN 300 328 clause 5.4.3.2 for the measurement method.

The test procedure shall be as follows:
nConducted measurement
lOption 1: For equipment with continuous and non-continuous transmissions
The transmitter shall be connected to a spectrum analyser and the Power Spectral Density (PSD) as defined in clause 4.3.2.3 shall be measured and recorded.
Step 1:
Connect the UUT to the spectrum analyser 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; for spectrum analysers not supporting this number of sweep points, the frequency band may be segmented
• Detector: RMS
• Trace Mode: Max Hold
• Sweep time: For non-continuous transmissions: 2 × Channel Occupancy Time × number of sweep
points
For continuous transmissions: 10 s; the sweep time may be increased further until a value where the sweep time has no further impact anymore on the RMS value of the signal.
For non-continuous signals, wait for the trace to stabilize.
Save the data (trace data) set to a file.
Step 2:
For conducted measurements on smart antenna systems using either operating mode 2 or operating mode 3 (see clause 5.3.2.2), repeat the measurement for each of the transmit ports. For each sampling point (frequency domain), add up the coincident power values (in mW) for the different transmit chains and use this as the new data set.
Step 3:
Add up the values for power for all the samples in the file using the formula below.

with k being the total number of samples and n the actual sample number.
Step 4:
Normalize the individual values for power (in dBm) so that the sum is equal to the RF Output Power (e.i.r.p.) measured in clause 5.4.2 and save the corrected data. The following formulas can be used:

$$C_{Corr} = P_{Sum} - P_{e.i.r.p.}$$
$$P_{Samplecorr}(n) = P_{Sample}(n) - C_{Corr}$$

with n being the actual sample number

Step 5:
Starting from the first sample $P_{Samplecorr}(n)$ (lowest frequency), add up the power (in mW) of the following samples representing a 1 MHz segment and record the results for power and position (i.e. sample #1 to sample #100). This is the Power Spectral Density (e.i.r.p.) for the first 1 MHz segment which shall be recorded.
Step 6:
Shift the start point of the samples added up in step 5 by one sample and repeat the procedure in step 5 (i.e. sample #2 to sample #101).
Step 7:
Repeat step 6 until the end of the data set and record the 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 (PSD) for the UUT. This value, which shall comply with the limit given in clause 4.3.2.3.3, shall be recorded in the test report.
lOption 2: For equipment with continuous transmission capability or for equipment operating (or with the capability to operate) with a constant duty cycle (e.g. Frame Based equipment)
This option is for equipment that can be configured to operate in a continuous transmit mode (100 % DC) or with a constant Duty Cycle (DC).
Step 1:
• Connect the UUT to the spectrum analyser and use the following settings:
- Centre Frequency: The centre frequency of the channel under test
- RBW: 1 MHz
- VBW: 3 MHz
- Frequency Span: 2 × Nominal Bandwidth (e.g. 40 MHz for a 20 MHz channel)
- Detector Mode: Peak
- Trace Mode: Max Hold
Step 2:
• When the trace is complete, find the peak value of the power envelope and record the frequency.
Step 3:
• Make the following changes to the settings of the spectrum analyser:
- Centre Frequency: Equal to the frequency recorded in step 2
- Frequency Span: 3 MHz
- RBW: 1 MHz
- VBW: 3 MHz
- Sweep Time: 1 minute
- Detector Mode: RMS
- Trace Mode: Max Hold
Step 4:
• When the trace is complete, the trace shall be captured using the "Hold" or "View" option on the spectrum analyser.
• Find the peak value of the trace and place the analyser marker on this peak. This level is recorded as the highest mean power (power spectral density) D in a 1 MHz band.
• Alternatively, where a spectrum analyser is equipped with a function to measure power spectral density, this function may be used to display the power spectral density D in dBm / MHz.
• In case of conducted measurements on smart antenna systems operating in a mode with multiple transmit chains active simultaneously, the power spectral density of each transmit chain shall be measured separately to calculate the total power spectral density (value D in dBm / MHz) for the UUT.
Step 5:
• The maximum Power Spectral Density (PSD) e.i.r.p. is calculated from the above measured power spectral density D, the observed Duty Cycle (DC) (see clause 5.4.2.2.1.3, step 4), the applicable antenna assembly gain G in dBi and if applicable the beamforming gain Y in dB, according to the formula below. This value shall be recorded in the test report. If more than one antenna assembly is intended for this power setting, the gain of the antenna assembly with the highest gain shall be used.

$$PSD = D + G + Y + 10 \times \log (1 / DC) \text{ (dBm / MHz)}$$

nRadiated measurement
When performing radiated measurements, the UUT shall be configured and antenna(s) positioned (including smart antenna systems and equipment capable of beamforming) for maximum e.i.r.p. towards the measuring antenna. A test site as described in annex B and applicable measurement procedures as described in annex C shall be used.
Taking into account the calibration factor from the measurement site, the test procedure is further as described under
clause 5.4.3.2.1.

9.2.5 Test Results

Temperature: 25°C **Test Date:** Dec. 29, 2023

Humidity: 55 % RH **Tested by:** KK

Antenna Port: A(SISO)

Test Condition		Measured Data (dBm/MHz)	Limit (dBm/MHz)	Verdict
802.11b 1Mbps	2412MHz	5.30	<=10	PASS
	2442 MHz	5.66	<=10	PASS
	2472 MHz	5.64	<=10	PASS
802.11g 6Mbps	2412MHz	2.71	<=10	PASS
	2442 MHz	3.38	<=10	PASS
	2472 MHz	3.01	<=10	PASS
802.11n (HT20) MCS 0	2412MHz	1.93	<=10	PASS
	2442 MHz	2.56	<=10	PASS
	2472 MHz	2.08	<=10	PASS
802.11n (HT40) MCS0	2422MHz	-2.71	<=10	PASS
	2442 MHz	-2.67	<=10	PASS
	2462 MHz	-2.77	<=10	PASS

Temperature: 25°C **Test Date:** Dec. 29, 2023

Humidity: 55 % RH **Tested by:** KK

Antenna: B(SISO)

Test Condition		Measured Data (dBm/MHz)	Limit (dBm/MHz)	Verdict
802.11b 1Mbps	2412MHz	5.51	<=10	PASS
	2442 MHz	6.51	<=10	PASS
	2472 MHz	6.02	<=10	PASS
802.11g 6Mbps	2412MHz	0.53	<=10	PASS
	2442 MHz	0.85	<=10	PASS
	2472 MHz	0.39	<=10	PASS
802.11n (HT20) MCS 0	2412MHz	-0.18	<=10	PASS
	2442 MHz	0.37	<=10	PASS
	2472 MHz	-0.34	<=10	PASS
802.11n (HT40) MCS0	2422MHz	-3.23	<=10	PASS
	2442 MHz	-2.40	<=10	PASS
	2462 MHz	-2.61	<=10	PASS

Temperature: 25°C **Test Date:** Dec. 29, 2023

Humidity: 55 % RH **Tested by:** KK

Antenna: A+B(MIMO)

Test Condition		Measured Data (dBm/MHz)	Limit (dBm/MHz)	Verdict
802.11n (HT20) MCS8	2412MHz	4.01	<=10	PASS
	2442 MHz	4.61	<=10	PASS
	2472 MHz	4.05	<=10	PASS
802.11n (HT40) MCS8	2422MHz	0.05	<=10	PASS
	2442 MHz	0.48	<=10	PASS
	2462 MHz	0.32	<=10	PASS

The worst case test plots, please see the appendix II

9.3 DUTY CYCLE AND TX-SEQUENCE AND TX-GAP

9.3.1 Applicable standard

ETSI EN 300 328 clause 4.3.2.4

9.3.2 Conformance Limit

These requirements apply to non-adaptive equipment or to adaptive equipment when operating in a non-adaptive mode.
The equipment is using wide band modulations other than FHSS.
These requirements do not apply for equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.
The Duty Cycle shall be equal to or less than the maximum value declared by the manufacturer.
The Tx-sequence time shall be equal to or less than 10 ms. The minimum Tx-gap time following a Tx-sequence shall be equal to the duration of that proceeding Tx-sequence with a minimum of 3,5 ms.

9.3.3 Test Configuration

The measurements for duty cycle shall be performed at normal environmental conditions of the operating temperature range.

Radiated measurements shall only be used for integral antenna equipment that does not have a temporary antenna connector(s) provided.

Conducted measurements shall be used for antenna equipment provided a temporary antenna connector(s).

9.3.4 TEST PROCEDURE

1. Please refer to ETSI EN 300 328 clause 5.4.2.1 for the test conditions.
2. Please refer to ETSI EN 300 328 clause 5.4.2.2.1.3 for the measurement method.

The test procedure, which shall only be performed for non-adaptive systems, shall be as follows:
Step 1:
• Use the same stored measurement samples from the procedure described in clause 5.4.2.2.1.2.
• The start and stop times are defined as the points where the power is at least 30 dB below the highest value of the stored samples. In case of insufficient dynamic range, the value of 30 dB may need to be reduced appropriately.
Step 2:
• Between the saved start and stop times of each individual burst, calculate the TxOn time. Save these TxOn values.
Step 3:
• Duty Cycle (DC) is the sum of all TxOn times between the end of the first gap (which is the start of the first burst within the observation period) and the start of the last burst (within this observation period) divided by the observation period. The observation period is defined in clause 4.3.1.3.2 or clause 4.3.2.4.2.
Step 4:
• For equipment using blacklisting, the TxOn time measured for a single (and active) hopping frequency shall be multiplied by the number of blacklisted frequencies. This value shall be added to the sum calculated in step 3 above. If the number of blacklisted frequencies cannot be determined, the minimum number of hopping frequencies (N) as defined in clause 4.3.1.4.3 shall be assumed.
• The calculated value for Duty Cycle (DC) shall be recorded in the test report. This value shall be equal to or less than the maximum value declared by the manufacturer.
Step 5:
• Use the same stored measurement samples from the procedure described in clause 5.4.2.2.1.2.
• Identify any TxOff time that is equal to or greater than the minimum Tx-gap time as defined in clause 4.3.1.3.3 or clause 4.3.2.4.3. These are the potential valid gap times to be further considered in this procedure.
• Starting from the second identified gap, calculate the time from the start of this gap to the end of

the preceding gap. This time is the Tx-sequence time for this transmission. Repeat this procedure until the last identified gap within the observation period is reached.

• A combination of consecutive Tx-sequence times and Tx-gap times followed by a Tx-gap time, which is at least as long as the duration of this combination, may be considered as a single Tx-sequence time and in which case it shall comply with the limits defined in clause 4.3.1.3.3 or clause 4.3.2.4.3.

• It shall be noted in the test report whether the UUT complies with the limits for the maximum Tx-sequence time and minimum Tx-gap time as defined in clause 4.3.1.3.3 or clause 4.3.2.4.3.

9.3.5 Test Results

Temperature:	25°C	Test Date:	/
Humidity:	55 % RH	Tested by:	/

Test Condition				Measured Data (ms)	Limited (ms)	Verdict
Pout >=10dBm	802.11b	Duty Cycle	2412MHz	---	<=1	N/A
			2442 MHz	---		N/A
			2472 MHz	---		N/A
		Tx-On	2412MHz	---	<=3.5-10	N/A
			2442 MHz	---		N/A
			2472 MHz	---		N/A
		Tx-Off	2412MHz	---	>=3.5-10	N/A
			2442 MHz	---		N/A
			2472 MHz	---		N/A
	802.11g	Duty Cycle	2412MHz	---	<=1	N/A
			2442 MHz	---		N/A
			2472 MHz	---		N/A
		Tx-On	2412MHz	---	<=3.5-10	N/A
			2442 MHz	---		N/A
			2472 MHz	---		N/A
		Tx-Off	2412MHz	---	>=3.5-10	N/A
			2442 MHz	---		N/A
			2472 MHz	---		N/A
	802.11n (HT20)	Duty Cycle	2412MHz	---	<=1	N/A
			2442 MHz	---		N/A
			2472 MHz	---		N/A
		Tx-On	2412MHz	---	<=3.5-10	N/A
			2442 MHz	---		N/A
			2472 MHz	---		N/A
		Tx-Off	2412MHz	---	>=3.5-10	N/A
			2442 MHz	---		N/A
			2472 MHz	---		N/A
	802.11n (HT40)	Duty Cycle	2422MHz	---	<=1	N/A
			2442 MHz	---		N/A
			2462 MHz	---		N/A
		Tx-On	2422MHz	---	<=3.5-10	N/A
			2442 MHz	---		N/A
			2462 MHz	---		N/A
		Tx-Off	2422MHz	---	>=3.5-10	N/A
			2442 MHz	---		N/A
			2462 MHz	---		N/A
Pout<=10dBm						N/A

NOTE: N/A means not applicable
Only applicable for non-adaptive equipment.

9.4 MEDIUM UTILISATION FACTOR

9.4.1 Applicable standard

ETSI EN 300 328 clause 4.3.2.5

9.4.2 Conformance Limit

This requirement does not apply to adaptive equipment unless operating in a non-adaptive mode. In addition, this requirement does not apply for equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.

For non-adaptive equipment using wide band modulations other than FHSS, the maximum Medium Utilization factor shall be 10 %.

9.4.3 Test Configuration

The measurements for Medium Utilisation factor shall be performed at normal environmental conditions of the operating temperature range.

Radiated measurements shall only be used for integral antenna equipment that does not have a temporary antenna connector(s) provided.
Conducted measurements shall be used for antenna equipment provided a temporary antenna connector(s).

9.4.4 Test Procedure

1. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.4.2.1 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.4.2.2.1.4 for the measurement method.

The test procedure, which shall only be performed for non-adaptive systems, shall be as follows:

Step 1:

• Use the same stored measurement samples from the procedure described in clause 5.4.2.2.1.2.

Step 2:

• For each burst calculate the product of (Pburst / 100 mW) and the TxOn time. Pburst is expressed in mW. TxOn time is expressed in ms.

Step 3:

• Medium Utilization is the sum of all these products divided by the observation period (expressed in ms) which is defined in clause 4.3.1.3.2 or clause 4.3.2.4.2. This value, which shall comply with the limit given in clause 4.3.1.6.3 or clause 4.3.2.5.3, shall be recorded in the test report.

If operation without blacklisted frequencies is not possible, the power of the bursts on blacklisted hopping

frequencies (for the calculation of the Medium Utilization) is assumed to be equal to the average value of the RMS power of the bursts on all active hopping frequencies.

9.4.5 Test Results

Temperature:	25°C	Test Date:	/
Humidity:	55 % RH	Tested by:	/

Test Condition			MU factor	Limited (%)	Verdict
Pout >=10dBm	802.11b	2412 MHz	---	<=10	N/A
		2442 MHz	---	<=10	N/A
		2472 MHz	---	<=10	N/A
	802.11g	2412 MHz	---	<=10	N/A
		2442 MHz	---	<=10	N/A
		2472 MHz	---	<=10	N/A
	802.11n (HT20)	2412 MHz	---	<=10	N/A
		2442 MHz	---	<=10	N/A
		2472 MHz	---	<=10	N/A
	802.11n (HT40)	2422 MHz	---	<=10	N/A
		2442 MHz	---	<=10	N/A
		2462 MHz	---	<=10	N/A
Pout<=10dBm					N/A
NOTE: N/A means not applicable Only applicable for non-adaptive equipment.					

9.5 OCCUPIED CHANNEL BANDWIDTH

9.5.1 Applicable standard

ETSI EN 300 328 clause 4.3.2.7

9.5.2 Conformance Limit

The requirement applies to all types of equipment using wide band modulation other than FHSS
The occupied channel bandwidth is the bandwidth that contains 99% of the power of the signal
The Occupied Channel Bandwidth shall fall completely within the band 2400-2483.5MHz
In addition, for non-adaptive equipment 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.

9.5.3 Test Configuration

The measurements for Occupied Channel Bandwidth shall only be performed at normal test conditions.

Radiated measurements shall only be used for integral antenna equipment that does not have a temporary antenna connector(s) provided.

Conducted measurements shall be used for antenna equipment provided a temporary antenna connector(s).

9.5.4 Test Procedure

1. Please refer to ETSI EN 300 328 clause 5.4.7.1 for the test conditions.
2. Please refer to ETSI EN 300 328 clause 5.4.7.2 for the measurement method.

nConducted measurement
The measurement procedure shall be as follows:
Step 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 × Nominal Channel Bandwidth
• Detector Mode: RMS
• Trace Mode: Max Hold
• Sweep time: 1 s
Step 2:
Wait for the trace to stabilize.
Find the peak value of the trace and place the analyser marker on this peak.
Step 3:
Use the 99 % bandwidth function of the spectrum analyser to measure the Occupied Channel Bandwidth of the UUT.
This value shall be recorded.
Make sure that the power envelope is sufficiently above the noise floor of the analyser to avoid the noise signals left and right from the power envelope being taken into account by this measurement.
nRadiated measurement
The test set up as described in annex B and the applicable measurement procedures described in annex C shall be used.
Alternatively, a test fixture may be used.
The test procedure is as described under clause 5.4.7.2.1.

9.5.5 Test Results

Temperature:	25°C	Test Date:	Dec. 29, 2023
Humidity:	55 % RH	Tested by:	KK
Antenna Port:	A		

Operation Mode	Frequency (MHz)	OBW (MHz)	Test Frequency (MHz)	Limited (MHz)	Verdict
802.11b	2412 MHz	11.358	2406.36	>2400.0	PASS
	2472 MHz	11.253	2477.64	<2483.5	PASS
802.11g	2412 MHz	16.682	2403.69	>2400.0	PASS
	2472 MHz	16.550	2480.31	<2483.5	PASS
802.11n(HT20)	2412 MHz	17.858	2403.08	>2400.0	PASS
	2472 MHz	17.512	2480.76	<2483.5	PASS
802.11n(HT40)	2422 MHz	36.393	2403.81	>2400.0	PASS
	2462 MHz	36.437	2480.21	<2483.5	PASS

The worst case test plots, please see the appendix III

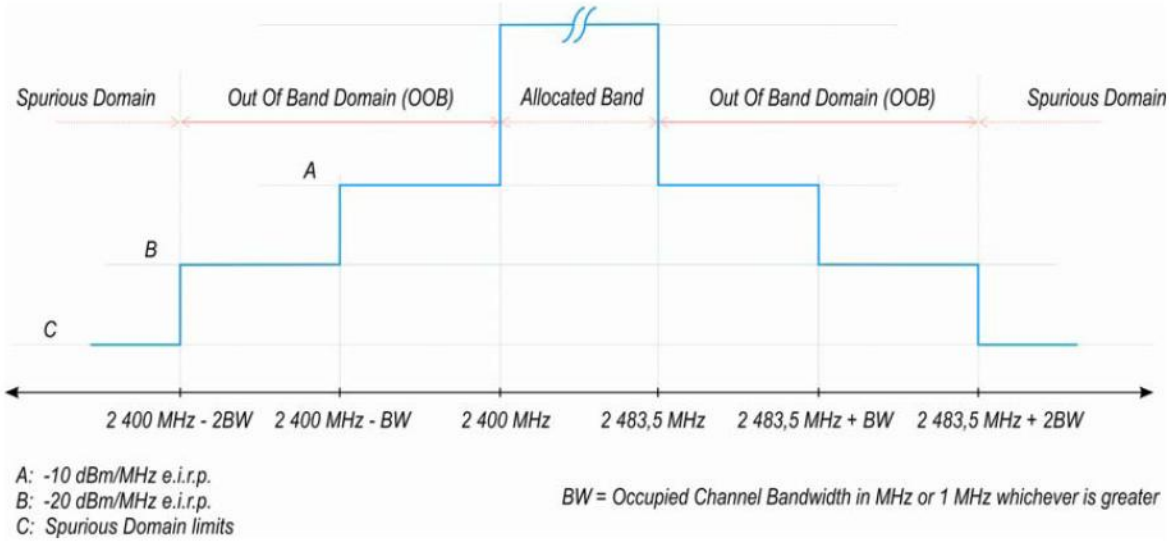
9.6 TRANSMITTER UNWANTED EMISSION IN THE OUT-OF BAND

9.6.1 Applicable standard

ETSI EN 300 328 clause 4.3.2.8

9.6.2 Conformance Limit

The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the limits of the mask given in below figure.



9.6.3 Test Configuration

The measurements for emission in the out-of band shall only be performed at normal test conditions.

Radiated measurements shall only be used for integral antenna equipment that does not have a temporary antenna connector(s) provided.

Conducted measurements shall be used for antenna equipment provided a temporary antenna connector(s).

9.6.4 Test Procedure

1. Please refer to ETSI EN 300 328 clause 5.4.8.1 for the test conditions.
2. Please refer to ETSI EN 300 328 clause 5.4.8.2 for the measurement method.

■ Conducted measurement

The applicable mask is defined by the measurement results from the tests performed under clause 5.4.7 (Occupied Channel Bandwidth).

The Out-of-band emissions within the different horizontal segments of the mask provided in figure 1 and figure 3 shall be measured using the procedure in step 1 to step 6 below. This method assumes the spectrum analyser is equipped with the Time Domain Power option.

Step 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: Max Hold
- Sweep Mode: Continuous

- Sweep Points: Sweep Time [s] / (1 µs) or 5 000 whichever is greater
- Trigger Mode: Video trigger; in case video triggering is not possible, an external trigger source may
be used
- Sweep Time: > 120 % of the duration of the longest burst detected during the measurement of the
RF Output Power

Step 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).

Step 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 (which means this may partly overlap with the previous 1 MHz segment).

Step 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 - BW + 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 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 (which means this may partly overlap with the previous 1 MHz segment).

Step 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 figure 1 or figure 3. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered.
• 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 figure 1 or figure 3.
- Option 2: the limits provided by the mask given in figure 1 or figure 3 shall be reduced by 10 × 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: Ach refers to the number of active transmit chains.

It shall be recorded whether the equipment complies with the mask provided in figure 1 or figure 3.

■ Radiated measurement

The test set up as described in annex B and the applicable measurement procedures described in annex C shall be used. Alternatively a test fixture may be used.

The test procedure is as described under clause 5.4.8.2.1.

9.6.5 Test Results

PASS.

All the modulation modes were tested, the data of the worst mode are described in appendix IV

Note: For the MIMO Mode, the test data has added the additional value. ($10 \times \log_{10}(A_{ch}) = 10 \times \log_{10}(2) = 3dB$)

9.7 TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

9.7.1 Applicable standard

ETSI EN 300 328 clause 4.3.2.9

9.7.2 Conformance Limit

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in below.
In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and as e.i.r.p. for emissions above 1 GHz.

Frequency Range	Maximum power	bandwidth
30 MHz to 47 MHz	-36dBm	100kHz
47 MHz to 74 MHz	-54dBm	100kHz
74 MHz to 87.5 MHz	-36dBm	100kHz
87.5MHz to108 MHz	-54dBm	100kHz
108 MHz to174MHz	-36dBm	100kHz
174MHz to 230MHz	-54dBm	100kHz
230 MHz to 470 MHz	-36dBm	100kHz
470 MHz to 862 MHz	-54dBm	100kHz
862 MHz to1 GHz	-36dBm	100kHz
1GHz to12.75 GHz	-30dBm	1MHz

9.7.3 Test Configuration

The measurements for emissions in the spurious domain shall only be performed at normal test conditions.

Radiated measurements shall be used for equipment.

Conducted measurements shall be used for equipment.

9.7.4 Test Procedure

1. Please refer to ETSI EN 300 328 clause 5.4.9.1 for the test conditions.
2. Please refer to ETSI EN 300 328 clause 5.4.9.2 for the measurement methods.

■ Conducted measurement
● Introduction
The spectrum in the spurious domain (see figure 1 or figure 3) shall be searched for emissions that exceed the limit values given in table 4 or table 12 or that come to within 6 dB below these limits. Each occurrence shall be recorded.
The measurement procedure contains 2 parts.
● Pre-scan
The test procedure below shall be used to identify potential unwanted emissions of the UUT.
Step 1:
The sensitivity of the measurement set-up should be such that the noise floor is at least 12 dB below the limits given in table 4 or table 12.
Step 2:
The emissions over the range 30 MHz to 1 000 MHz shall be identified.
Spectrum analyser settings:

• Resolution bandwidth: 100 kHz
Video bandwidth: 300 kHz
• Filter type: 3 dB (Gaussian)
• Detector mode: Peak
• Trace Mode: Max Hold
• Sweep Points: ≥ 19 400; For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented.
• Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 100 kHz frequency step, the measurement time is greater than two transmissions of the UUT, on any channel.
For Frequency Hopping equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies.
The above sweep time setting may result in long measuring times in case of frequency hopping equipment. To avoid such long measuring times, an FFT analyser could be used.
Allow the trace to stabilize. Any emissions identified during the sweeps above and that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.4.9.2.1.3 and compared to the limits given in table 4 or table 12.
Step 3:
The emissions over the range 1 GHz to 12,75 GHz shall be identified.
Spectrum analyser settings:
• Resolution bandwidth: 1 MHz
• Video bandwidth: 3 MHz
• Filter type: 3 dB (Gaussian)
• Detector mode: Peak
• Trace Mode: Max Hold
• Sweep Points: ≥ 23 500; For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented.
• Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 1 MHz frequency step, the measurement time is greater than two transmissions of the UUT, on any channel.
For Frequency Hopping equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies.
The above sweep time setting may result in long measuring times in case of frequency hopping equipment. To avoid such long measuring times, an FFT analyser could be used.
Allow the trace to stabilize. Any emissions identified during the sweeps above that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.4.9.2.1.3 and compared to the limits given in table 4 or table 12.
Frequency Hopping equipment may generate a block (or several blocks) of spurious emissions anywhere within the spurious domain. If this is the case, only the highest peak of each block of emissions shall be measured using the procedure in clause 5.4.9.2.1.3.
Step 4:
• In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), step 2 and step 3 need to be repeated for each of the active transmit chains (Ach).The limits used to identify emissions during this pre-scan need to be reduced with 10 × log10 (Ach) (number of active transmit chains).
● Measurement of the emissions identified during the pre-scan
The procedure in step 1 to step 4 below shall be used to accurately measure the individual unwanted emissions identified during the pre-scan measurements above. This method assumes the spectrum analyser has a Time Domain Power function.
Step 1:
The level of the emissions shall be measured using the following spectrum analyser settings:
• Measurement Mode: Time Domain Power
• Centre Frequency: Frequency of the emission identified during the pre-scan
• Resolution Bandwidth: 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
• Video Bandwidth: 300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
• Frequency Span: Zero Span
• Sweep mode: Single Sweep
• Sweep time: > 120 % of the duration of the longest burst detected during the measurement of

the
RF Output Power
• Sweep points: Sweep time [µs] / (1 µs) with a maximum of 30 000
• Trigger: Video (burst signals) or Manual (continuous signals)
• Detector: RMS
Step 2:
• Set a window where the start and stop indicators match the start and end of the burst with the highest level and record the value of the power measured within this window. If the spurious emission to be measured is a continuous transmission, the measurement window shall be set to match the start and stop times of the sweep.
Step 3:
In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), step 2 needs to be repeated for each of the active transmit chains (Ach).
Sum the measured power (within the observed window) for each of the active transmit chains.
Step 4:
The value defined in step 3 shall be compared to the limits defined in table 4 or table 12.
■ Radiated measurement
The test site as described in annex B and applicable measurement procedures as described in annex C shall be used.
The test procedure is further as described under clause 5.4.9.2.1.

9.7.5 Test Results

Radiation Spurious Emission

All the modulation modes were tested, the data of the worst mode are described in the following table

802.11b

■ Emissions In the Spurious Domain below 1GHz

Test Frequency: 2412MHz 2472MHz

Temperature: 25ºC Test Date: Dec. 29, 2023

Humidity: 55 % RH Tested by: KK

Frequency (MHz)	Antenna Polarization		Emission level (dBm)	Limit (dBm)	Verdict
169.68	V	conducted	-70.29	-36.00	PASS
380.17			-64.77	-36.00	PASS
400.54			-66.02	-36.00	PASS
430.61			-66.11	-36.00	PASS
600.36			-70.64	-54.00	PASS
714.82			-70.15	-54.00	PASS
118.27	H		-65.46	-36.00	PASS
169.68			-61.39	-36.00	PASS
339.43			-65.27	-36.00	PASS
531.49			-69.12	-54.00	PASS
594.54			-69.36	-54.00	PASS
742.95			-70.10	-54.00	PASS

■ Emissions In the Spurious Domain above 1GHz

Test Frequency: 2412MHz 2472MHz

Temperature: 25ºC Test Date: Dec. 29, 2023

Humidity: 55 % RH Tested by: KK

Frequency (MHz)	Antenna Polarization		Emission level (dBm)	Limit (dBm)	Verdict
9495.25	V	conducted	-38.26	-30.00	PASS
10364.75			-37.83	-30.00	PASS
10975.75			-37.67	-30.00	PASS
11281.25			-36.94	-30.00	PASS
11763.00			-35.90	-30.00	PASS
12409.25			-36.42	-30.00	PASS
9283.75	H		-38.33	-30.00	PASS
9812.50			-37.25	-30.00	PASS
10552.75			-37.10	-30.00	PASS
10987.50			-36.67	-30.00	PASS
11845.25			-36.11	-30.00	PASS
12503.25			-36.46	-30.00	PASS

Conducted Emission

All the modulation modes were tested, the data of the worst mode are described in appendix V.

9.8 RECEIVER SPURIOUS EMISSIONS

9.8.1 Applicable standard

ETSI EN 300 328 clause 4.3.2.10

9.8.2 Conformance Limit

The spurious emissions of the receiver shall not exceed the values given in below.

In case of equipment with antenna connectors, these limits apply to emissions at the antenna port (conducted). For emissions radiated by the cabinet or emissions radiated by integral antenna equipment (without antenna connectors), these limits are e.r.p. for emissions up to 1 GHz and e.i.r.p. for emissions above 1 GHz.

Frequency Range	Maximum power	Measurement Width
30 MHz to 1 GHz	-57 dBm	100kHz
1 GHz to 12.75 GHz	-47 dBm	1MHz

9.8.3 Test Configuration

The measurements for emissions in the spurious domain shall only be performed at normal test

conditions.

Radiated measurements shall be used for equipment.

Conducted measurements shall be used for equipment.

9.8.4 Test Procedure

1. Please refer to ETSI EN 300 328 clause 5.4.11.1 for the test conditions.
2. Please refer to ETSI EN 300 328 clause 5.4.11.2 for the measurement methods.

■ Conducted measurement

● Introduction

The spectrum in the spurious domain (see figure 1 or figure 3) shall be searched for emissions that exceed the limit values given in table 4 or table 12 or that come to within 6 dB below these limits. Each occurrence shall be recorded.

The measurement procedure contains 2 parts.

● Pre-scan

The test procedure below shall be used to identify potential unwanted emissions of the UUT.

Step 1:

The sensitivity of the measurement set-up should be such that the noise floor is at least 12 dB below the limits given in table 4 or table 12.

Step 2:

The emissions over the range 30 MHz to 1 000 MHz shall be identified.

Spectrum analyser settings:

• Resolution bandwidth: 100 kHz

Video bandwidth: 300 kHz

• Filter type: 3 dB (Gaussian)

• Detector mode: Peak

• Trace Mode: Max Hold

• Sweep Points: ≥ 19 400; For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented.

• Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 100 kHz frequency step, the measurement time is greater than two transmissions of the UUT, on any channel.

For Frequency Hopping equipment operating in a normal operating (hopping not disabled) mode,

the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies.
The above sweep time setting may result in long measuring times in case of frequency hopping equipment. To avoid such long measuring times, an FFT analyser could be used.
Allow the trace to stabilize. Any emissions identified during the sweeps above and that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.4.9.2.1.3 and compared to the limits given in table 4 or table 12.
Step 3:
The emissions over the range 1 GHz to 12,75 GHz shall be identified.
Spectrum analyser settings:
• Resolution bandwidth: 1 MHz
• Video bandwidth: 3 MHz
• Filter type: 3 dB (Gaussian)
• Detector mode: Peak
• Trace Mode: Max Hold
• Sweep Points: ≥ 23 500; For spectrum analysers not supporting this high number of sweep points, the frequency band may need to be segmented.
• Sweep time: For non continuous transmissions (duty cycle less than 100 %), the sweep time shall be sufficiently long, such that for each 1 MHz frequency step, the measurement time is greater than two transmissions of the UUT, on any channel.
For Frequency Hopping equipment operating in a normal operating (hopping not disabled) mode, the sweep time shall be further increased to capture multiple transmissions on any of the hopping frequencies.
The above sweep time setting may result in long measuring times in case of frequency hopping equipment. To avoid such long measuring times, an FFT analyser could be used.
Allow the trace to stabilize. Any emissions identified during the sweeps above that fall within the 6 dB range below the applicable limit or above, shall be individually measured using the procedure in clause 5.4.9.2.1.3 and compared to the limits given in table 4 or table 12.
Frequency Hopping equipment may generate a block (or several blocks) of spurious emissions anywhere within the spurious domain. If this is the case, only the highest peak of each block of emissions shall be measured using the procedure in clause 5.4.9.2.1.3.
Step 4:
• In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), step 2 and step 3 need to be repeated for each of the active transmit chains (Ach).The limits used to identify emissions during this pre-scan need to be reduced with 10 × log10 (Ach) (number of active transmit chains).
● Measurement of the emissions identified during the pre-scan
The procedure in step 1 to step 4 below shall be used to accurately measure the individual unwanted emissions identified during the pre-scan measurements above. This method assumes the spectrum analyser has a Time Domain Power function.
Step 1:
The level of the emissions shall be measured using the following spectrum analyser settings:
• Measurement Mode: Time Domain Power
• Centre Frequency: Frequency of the emission identified during the pre-scan
• Resolution Bandwidth: 100 kHz (< 1 GHz) / 1 MHz (> 1 GHz)
• Video Bandwidth: 300 kHz (< 1 GHz) / 3 MHz (> 1 GHz)
• Frequency Span: Zero Span
• Sweep mode: Single Sweep
• Sweep time: > 120 % of the duration of the longest burst detected during the measurement of the RF Output Power
• Sweep points: Sweep time [µs] / (1 µs) with a maximum of 30 000
• Trigger: Video (burst signals) or Manual (continuous signals)
• Detector: RMS
Step 2:
• Set a window where the start and stop indicators match the start and end of the burst with the highest level and record the value of the power measured within this window. If the spurious emission to be measured is a continuous transmission, the measurement window shall be set to match the start and stop times of the sweep.
Step 3:
In case of conducted measurements on smart antenna systems (equipment with multiple transmit

chains), step 2 needs to be repeated for each of the active transmit chains (Ach).
Sum the measured power (within the observed window) for each of the active transmit chains.
Step 4:
The value defined in step 3 shall be compared to the limits defined in table 4 or table 12.

■ Radiated measurement

The test site as described in annex B and applicable measurement procedures as described in annex C shall be used.
The test procedure is further as described under clause 5.4.9.2.1.

9.8.5 Test Results

Radiation Emission

All the modulation modes were tested, the data of the worst mode are described in the following table
802.11b Mode

■ Emissions In the Spurious Domain below 1GHz

Test Frequency: 2412MHz 2472MHz

Temperature: 25°C Test Date: Dec. 29, 2023

Humidity: 55 % RH Tested by: KK

Frequency (MHz)	Antenna Polarization		Emission level (dBm)	Limit (dBm)	Verdict
174.53	V	conducted	-69.79	-57.00	PASS
297.72			-69.57	-57.00	PASS
380.17			-64.53	-57.00	PASS
428.67			-65.04	-57.00	PASS
896.21			-66.97	-57.00	PASS
984.48			-65.09	-57.00	PASS
118.27	H		-66.15	-57.00	PASS
168.71			-61.11	-57.00	PASS
338.46			-64.91	-57.00	PASS
535.37			-68.15	-57.00	PASS
864.20			-67.69	-57.00	PASS
981.57			-65.56	-57.00	PASS

■ Emissions In the Spurious Domain above 1GHz

Test Frequency: 2412MHz 2472MHz

Temperature: 25°C Test Date: Dec. 29, 2023

Humidity: 55 % RH Tested by: KK

Frequency (MHz)	Antenna Polarization		Emission level (dBm)	Limit (dBm)	Verdict
7756.25	V	conducted	-55.47	-47.00	PASS
8719.75			-54.69	-47.00	PASS
10118.00			-53.58	-47.00	PASS
11422.25			-54.15	-47.00	PASS
12103.75			-53.43	-47.00	PASS
12491.50			-53.19	-47.00	PASS
7838.50	H		-54.94	-47.00	PASS
8590.50			-54.81	-47.00	PASS
9154.50			-54.08	-47.00	PASS
10094.50			-54.41	-47.00	PASS
10964.00			-53.27	-47.00	PASS
12738.25			-52.61	-47.00	PASS

Conducted Emission

All the modulation modes were tested, the data of the worst mode are described in appendix VI

9.9 Adaptivity (adaptive equipment using modulations other than FHSS)

9.9.1 Applicable standard

ETSI EN 300 328 clause 4.3.2.6

9.9.2 Conformance Limit

Only for adaptive equipment and RF output power >=10dBm(ERP)
n For LBT based Detect and avoid equipment shall comply with the following requirement
Load Based Equipment may implement an LBT based spectrum sharing mechanism based on the Clear Channel
Assessment (CCA) mode using energy detect as described in IEEE 802.11™-2012 [i.3], clause 9, clause 10, clause 16, clause 17, clause 19 and clause 20, or in IEEE 802.15.4™-2011 [i.4], clause 4, clause 5 and clause 8 providing the equipment complies with the conformance requirements referred to in clause 4.3.2.6.3.4. Load Based Equipment not using any of the mechanisms referenced above shall comply with the following minimum set of requirements:
1) Before a transmission or a burst of transmissions, the equipment shall perform a Clear Channel Assessment (CCA) check using energy detect. The equipment shall observe the operating channel for the duration of the CCA observation time which shall be not less than 18 µs. The channel shall be considered occupied if the energy level in the channel exceeds the threshold given in step 5 below. If the equipment finds the channel to be clear, it may transmit immediately.
2) If the equipment finds the channel occupied, it shall not transmit on this channel (see also the next paragraph). The equipment shall perform an Extended CCA check in which the channel is observed for a random duration in the range between 18 µs and at least 160 µs. If the extended CCA check has determined the channel to be no longer occupied, the equipment may resume transmissions on this channel. If the Extended CCA time has determined the channel still to be occupied, it shall perform new Extended CCA checks until the channel is no longer occupied.
NOTE: The Idle Period in between transmissions is considered to be the CCA or the Extended CCA check
as there are no transmissions during this period. The equipment is allowed to Dashcam to a non-adaptive mode and to continue transmissions on this channel providing it complies with the requirements applicable to non-adaptive equipment. Alternatively, the equipment is also allowed to continue Short Control Signalling Transmissions on this channel providing it complies with the requirements given in clause 4.3.2.6.4.
3) The total time that an equipment makes use of a RF channel is defined as the Channel Occupancy Time. This Channel Occupancy Time shall be less than 13 ms, after which the device shall perform a new CCA as described in step 1 above.
4) The equipment, upon correct reception of a packet which was intended for this equipment can skip CCA and immediately (see also next paragraph) proceed with the transmission of management and control frames (e.g. ACK and Block ACK frames are allowed but data frames are not allowed). A consecutive sequence of transmissions by the equipment without a new CCA shall not exceed the maximum channel occupancy time as defined in step 3 above.
For the purpose of multi-cast, the ACK transmissions (associated with the same data packet) of the individual devices are allowed to take place in a sequence.
5) The energy detection threshold for the CCA shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the CCA threshold level (TL) shall be equal to or less than -70 dBm/MHz at the input to the receiver assuming a 0 dBi (receive) antenna assembly. This threshold level (TL) may be corrected for the (receive) antenna assembly gain (G); however, beamforming gain (Y) shall not be taken into account. For power levels less than 20 dBm e.i.r.p., the CCA threshold level may be relaxed to:
TL = -70 dBm/MHz + 10 × log10 (100 mW / Pout) (Pout in mW e.i.r.p.)
6) The equipment shall comply with the requirements defined in step 1 to step 4 of the present clause in the presence of an unwanted CW signal as defined in below.

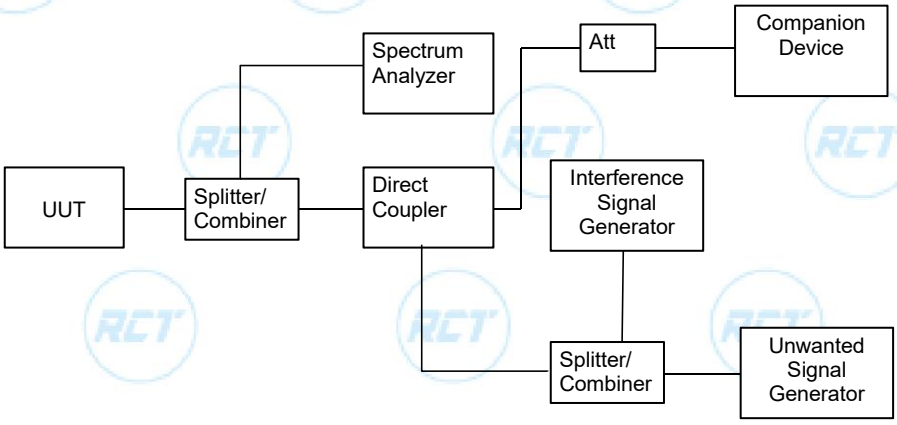
Unwanted Signal parameters

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.

n 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.

9.9.3 Test Configuration



9.9.4 Test Procedure

1. Please refer to ETSI EN 300 328 clause 5.4.6.1 for the test conditions.
2. Please refer to ETSI EN 300 328 clause 5.4.6.2 for the measurement method.

Step 1 to step 7 below define the procedure to verify the efficiency of the LBT based adaptive mechanism of equipment using wide band modulations other than FHSS. This method can be applied on Load Based Equipment and Frame Based Equipment.
Step 1:
• The UUT shall connect to a companion device during the test. The interference signal generator, the unwanted signal generator, the spectrum analyser, the UUT and the companion device are connected using a set-up equivalent to the example given by figure 5 although the interference and unwanted signal generator do not generate any signals at this point in time. The spectrum analyser is used to monitor the transmissions of both the UUT and the companion device and it should be possible to distinguish between either transmission. In addition, the spectrum analyser is used to monitor the transmissions of the UUT in response to the interfering and the unwanted signals.
• Adjust the received signal level (wanted signal from the companion device) at the UUT to the value defined in table 10 (clause 4.3.2.6.3.2.2) for Frame Based Equipment or in table 11 (clause 4.3.2.6.3.2.3) for Load Based Equipment.
Testing of Unidirectional equipment does not require a link to be established with a companion device.
• The analyser shall be set as follows:
- RBW: ≥ Occupied Channel Bandwidth (if the analyser does not support this setting, the highest available setting shall be used)
- VBW: 3 × RBW (if the analyser does not support this setting, the highest available setting shall

be used)
- Detector Mode: RMS
- Centre Frequency: Equal to the centre frequency of the operating channel
- Span: 0 Hz
- Sweep time: > maximum Channel Occupancy Time
- Trace Mode: Clear Write
- Trigger Mode: Video

Step 2:

• Configure the UUT for normal transmissions with a sufficiently high payload resulting in a minimum
transmitter activity ratio (TxOn / (TxOn + TxOff)) of 0,3. Where this is not possible, the UUT shall be
configured to the maximum payload possible.

• For Frame Based Equipment, using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in
clause 4.3.2.6.3.2.2, step 3. When measuring the Idle Period of the UUT, it shall not include the transmission time of the companion device.

• For Load Based equipment, using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that the UUT complies with the maximum Channel Occupancy Time and minimum Idle Period defined in
clause 4.3.2.6.3.2.3, step 2 and step 3. When measuring the Idle Period of the UUT, it shall not include the transmission time of the companion device.

For the purpose of testing Load Based Equipment referred to in the first paragraph of clause 4.3.2.6.3.2.3 (IEEE 802.11™ [i.3] or IEEE 802.15.4™ [i.4] equipment), the limits to be applied for the minimum Idle Period and the maximum Channel Occupancy Time are the same as defined for other types of Load Based Equipment (see clause 4.3.2.6.3.2.3, step 2 and step 3). The Idle Period is considered to be equal to the CCA or Extended CCA time defined in clause 4.3.2.6.3.2.3, step 1 and step 2.

Step 3: Adding the interference signal

• An interference signal as defined in clause B.7 is injected on the current operating channel of the UUT. The power spectral density level (at the input of the UUT) of this interference signal shall be equal to the detection threshold defined in clause 4.3.2.6.3.2.2, step 5 (frame based equipment) or clause 4.3.2.6.3.2.3, step 5 (load based equipment).

Step 4: Verification of reaction to the interference signal

• The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating
channel with the interfering signal injected. This may require the spectrum analyser sweep to be triggered by the start of the interfering signal.

• Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that:

i) The UUT shall stop transmissions on the current operating channel.
The UUT is assumed to stop transmissions within a period equal to the maximum Channel Occupancy
Time defined in clause 4.3.2.6.3.2.2 (frame based equipment) or clause 4.3.2.6.3.2.3 (load based equipment).

ii) Apart from Short Control Signalling Transmissions, there shall be no subsequent transmissions while the interfering signal is present.
To verify that the UUT is not resuming normal transmissions as long as the interference signal is present,
the monitoring time may need to be 60 s or more.

iii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while
the interfering signal is present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2.
The verification of the Short Control Signalling transmissions may require the analyser settings to be
changed (e.g. sweep time).

iv) Alternatively, the equipment may Dashcam to a non-adaptive mode.

Step 5: Adding the unwanted signal

• With the interfering signal present, a 100 % duty cycle CW signal is inserted as the unwanted

signal. The
frequency and the level are provided in table 10 (clause 4.3.2.6.3.2.2) for Frame Based Equipment or in
table 11 (clause 4.3.2.6.3.2.3) for Load Based Equipment.
• The spectrum analyser shall be used to monitor the transmissions of the UUT on the selected operating
channel. This may require the spectrum analyser sweep to be triggered by the start of the unwanted signal.
• Using the procedure defined in clause 5.4.6.2.1.5, it shall be verified that:
i) The UUT shall not resume normal transmissions on the current operating channel as long as both the
interference and unwanted signals remain present.
To verify that the UUT is not resuming normal transmissions as long as the interference and unwanted
signals are present, the monitoring time may need to be 60 s or more.
ii) The UUT may continue to have Short Control Signalling Transmissions on the operating channel while
the interfering and unwanted signals are present. These transmissions shall comply with the limits defined in clause 4.3.2.6.4.2.
The verification of the Short Control Signalling transmissions may require the analyser settings to be
changed (e.g. sweep time).
Step 6: Removing the interference and unwanted signal
• On removal of the interference and unwanted signals the UUT is allowed to start transmissions again on this channel; however, this is not a requirement and, therefore, does not require testing.
Step 7:
• Step 2 to step 6 shall be repeated for each of the frequencies to be tested.

9.9.5 Test Results

All of the modes were tested the data of the worst mode are recorded in the following pages.

Antenna Port A

Minimum Clear Channel Assessment (CCA) time

MODULATION MODE	NOMINAL BANDWIDTH	TEST FREQUENCY	CCA (us)	LIMIT (us)	TEST RESULT
802.11b	20MHz	2412	62	18~160	PASS
		2472	65	18~160	PASS
802.11g	20MHz	2412	58	18~160	PASS
		2472	58	18~160	PASS
802.11n(HT20)	20MHz	2412	52	18~160	PASS
		2472	51	18~160	PASS
802.11n(HT40)	40MHz	2422	45	18~160	PASS
		2462	45	18~160	PASS
Pout<=10dBm					N/A
NOTE: 1. N/A means not applicable					

Channel Occupancy Time(C.O.T)

MODULATION MODE	NOMINAL BANDWIDTH	TEST FREQUENCY	C.O.T (ms)	LIMIT (ms)	TEST RESULT
802.11b	20MHz	2412	1.32	<13	PASS
		2472	1.27	<13	PASS
802.11g	20MHz	2412	1.15	<13	PASS
		2472	1.14	<13	PASS
802.11n(HT20)	20MHz	2412	1.02	<13	PASS
		2472	1.01	<13	PASS
802.11n(HT40)	40MHz	2422	1.00	<13	PASS
		2462	1.04	<13	PASS
Pout<=10dBm					N/A
NOTE: 1. N/A means not applicable					

Short Control Signaling Transmission (S.C.S.T)

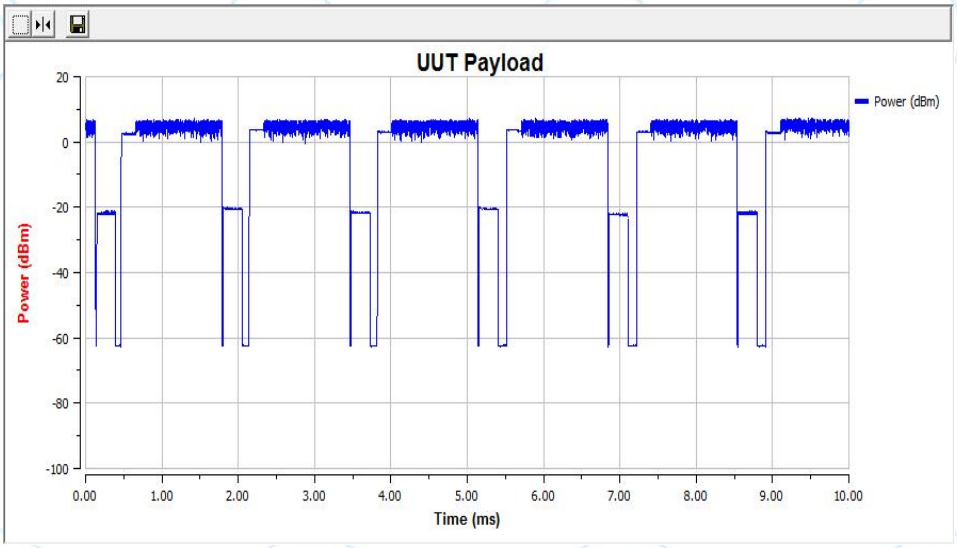
MODULATION MODE	NOMINAL BANDWIDTH	TEST FREQUENCY	S.C.S.T (%)	LIMIT (%)	TEST RESULT
802.11b	20MHz	2412	2.59	<10	PASS
		2472	2.52	<10	PASS
802.11g	20MHz	2412	2.42	<10	PASS
		2472	2.22	<10	PASS
802.11n(HT20)	20MHz	2412	2.02	<10	PASS
		2472	2.04	<10	PASS
802.11n(HT40)	40MHz	2422	2.03	<10	PASS
		2462	1.87	<10	PASS
Pout<=10dBm					N/A
NOTE: N/A means not applicable					

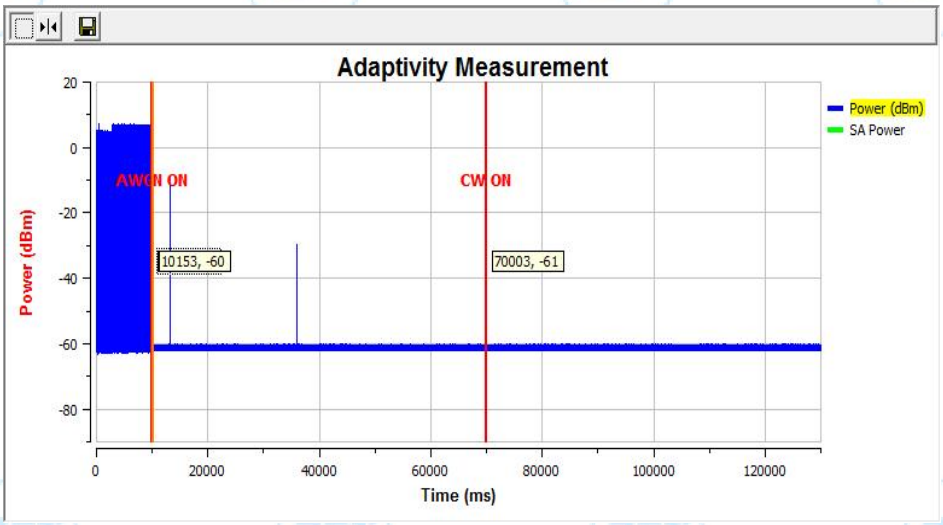
CCA threshold level

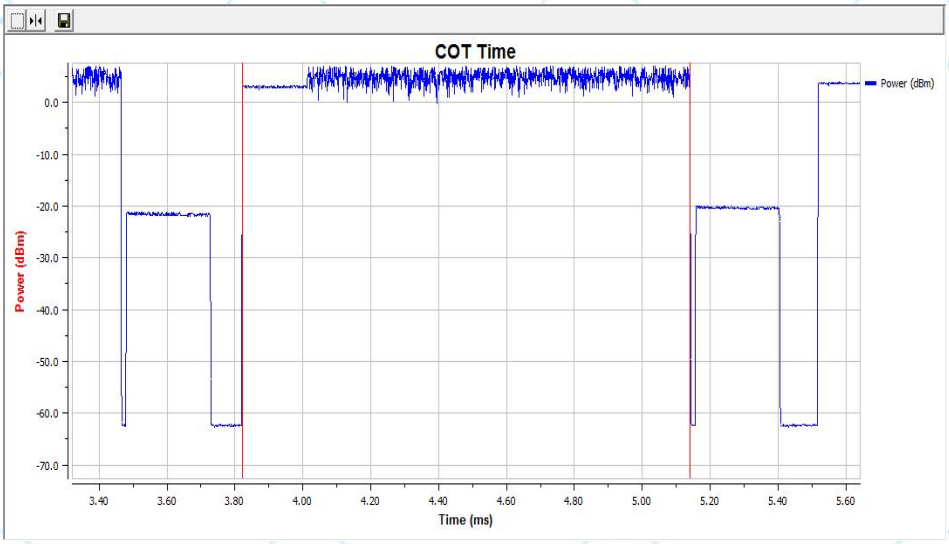
MODULATION MODE	NOMINAL BANDWIDTH	TEST FREQUENCY	CCA level (dBm)	CCA threshold LIMIT(dBm)	TEST RESULT
802.11b	20MHz	2412	-66.65	-70 dBm/MHz + 10 × log10 (100 mW / Pout) (Pout in mW e.i.r.p.)	PASS
		2472	-66.93		PASS
802.11g	20MHz	2412	-64.76		PASS
		2472	-65.02		PASS
802.11n(HT20)	20MHz	2412	-64.67		PASS
		2472	-64.71		PASS
802.11n(HT40)	40MHz	2422	-65.36		PASS
		2462	-65.43		PASS

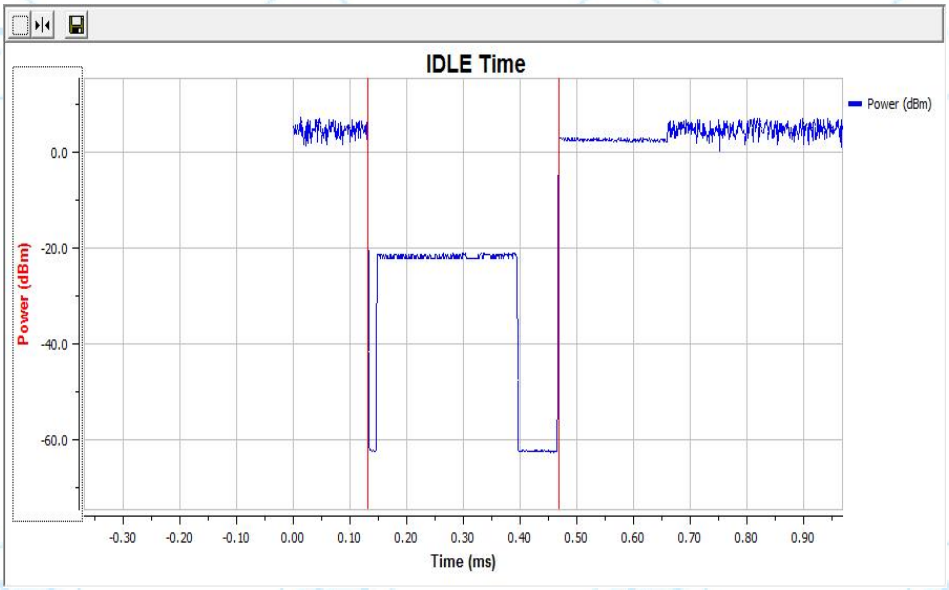
The data of the worst mode are described in the following pages

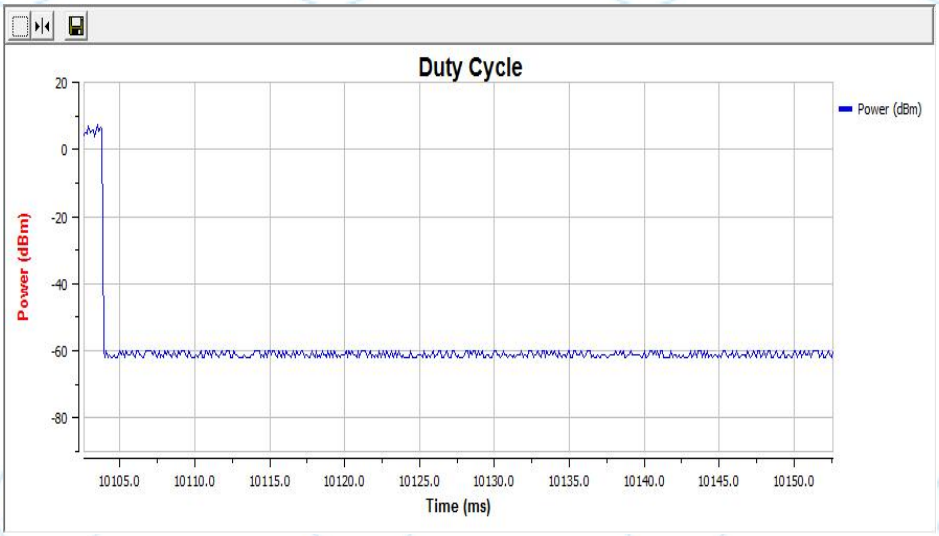
UUT Payload (%)	**67.35**
CCA Time (us)	**62.000**
Max COT (ms)	**1.32**
Idle Period Time (us)	**0.34**
Interference Start Time (ms)	**10003.10**
Block Signal Start Time (ms)	**70003.10**
SCST TxOn / (TxOn + TxOff) (%)	**2.59**
Pulse Width within 50ms (ms)	**1.31**


UUT Payload
Power (dBm)
Power (dBm)
Time (ms)
20
0
-20
-40
-60
-80
-100
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
10.00


Adaptivity Measurement
Power (dBm)
SA Power
AWGN ON
CW ON
10153, -60
70003, -61
Power (dBm)
Time (ms)
20
0
-20
-40
-60
-80
0
20000
40000
60000
80000
100000
120000


COT Time
Power (dBm)
0.0
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
3.40
3.60
3.80
4.00
4.20
4.40
4.60
4.80
5.00
5.20
5.40
5.60
Time (ms)


IDLE Time
Power (dBm)
0.0
-20.0
-40.0
-60.0
-0.30
-0.20
-0.10
0.00
0.10
0.20
0.30
0.40
0.50
0.60
0.70
0.80
0.90
Time (ms)


Duty Cycle
Power (dBm)
20
0
-20
-40
-60
-80
10105.0
10110.0
10115.0
10120.0
10125.0
10130.0
10135.0
10140.0
10145.0
10150.0
Time (ms)

9.10 Receiver Blocking

9.10.1 Applicable standard

ETSI EN 300 328 clause 4.3.2.11

9.10.2 Conformance Limit

The minimum performance criterion shall be a PER less than or equal to 10 %. The manufacturer may declare alternative performance criteria as long as that is appropriate for the intended use of the equipment (see clause 5.4.1.t)).

n General

While maintaining the minimum performance criteria as defined in clause 4.3.2.11.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in below.

lReceiver Category 1

Receiver Blocking parameters for Receiver Category 1 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
Pmin + 6 dB	2 380 2 503,5	-53	CW
Pmin + 6 dB	2 300 2 330 2 360	-47	CW
Pmin + 6 dB	2 523,5 2 553,5 2 583,5 2 613,5 2 643,5 2 673,5	-47	CW
NOTE 1: Pmin 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.			

lReceiver Category 2

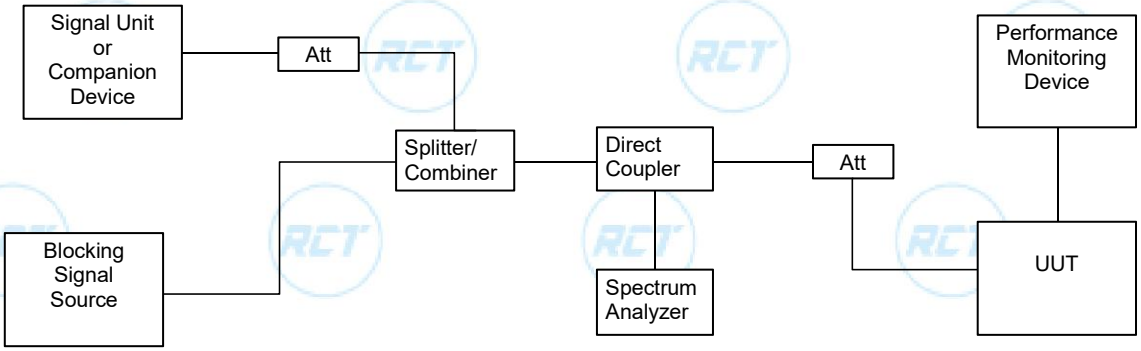
Receiver Blocking parameters receiver category 2 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
Pmin + 6 dB	2 380 2 503,5	-57	CW
Pmin + 6 dB	2 300 2 583,5	-47	CW
NOTE 1: Pmin 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.			

lReceiver Category 3
Receiver Blocking parameters receiver category 3 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
Pmin + 12 dB	2 380 2 503,5	-57	CW
Pmin + 12 dB	2 300 2 583,5	-47	CW
NOTE 1: Pmin 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.			

9.10.3 Test Configuration



9.10.4 Test Procedure

1. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.4.11.1 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.4.11.2 for the measurement method.

■ Conducted measurement
Adaptive Frequency Hopping equipment using DAA
Step 1:
• For non-frequency hopping equipment, the UUT shall be set to the lowest operating channel.
Step 2:
• The blocking signal generator is set to the first frequency as defined in the appropriate table corresponding to the receiver category and type of equipment.
Step 3:
• With the blocking signal generator Dashcamed off, a communication link is established between the UUT and the associated companion device using the test setup shown in figure 6. The attenuation of the variable attenuator shall be increased in 1 dB steps to a value at which the minimum performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still met. The resulting level for the wanted signal at the input of the UUT is Pmin.
• This signal level (Pmin) is increased by the value provided in the table corresponding to the receiver category and type of equipment.
Step 4:
• The blocking signal at the UUT is set to the level provided in the table corresponding to the receiver category and type of equipment. It shall be verified and recorded in the test report that the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is met.
Step 5:
• Repeat step 4 for each remaining combination of frequency and level for the blocking signal as provided in the table corresponding to the receiver category and type of equipment.
Step 6:
• For non-frequency hopping equipment, repeat step 2 to step 5 with the UUT operating at the highest operating channel.
■ Radiated measurements
When performing radiated measurements on equipment with dedicated antennas, measurements

shall be repeated for each alternative dedicated antenna.
A test site as described in annex B and applicable measurement procedures as described in annex C shall be used.
The test procedure is further as described under clause 5.4.11.2.1.
The level of the blocking signal at the UUT referred to in step 4 is assumed to be the level in front of the UUT antenna(s). The UUT shall be positioned with its main beam pointing towards the antenna radiating the blocking signal. The position recorded in clause 5.4.2.2.2 can be used.

9.10.5 Test Results

Receiver category

	Receiver category 1	Adaptive equipment with a maximum RF output power greater than 10 dBm e.i.r.p. shall be considered as receiver category 1 equipment.
	Receiver category 2	Non-adaptive equipment with a Medium Utilization (MU) factor greater than 1 % and less than or equal to 10 % or adaptive equipment with a maximum RF output power of 10 dBm e.i.r.p. shall be considered as receiver category 2 equipment.
	Receiver category 3	Non-adaptive equipment with a maximum Medium Utilization (MU) factor of 1 % or adaptive equipment with a maximum RF output power of 0 dBm e.i.r.p. shall be considered as receiver category 3 equipment.

All of the modes were tested the data of the worst mode are recorded in the following pages.

Operation Mode:	802.11b	802.11g	802.11n(HT20)	802.11n(HT40)
Test Frequency:	2412MHz	2422MHz	2462MHz	2472MHz
Temperature:	24°C	Test Date:	Dec. 29, 2023	
Antenna Port:	A	P_{min}:	-90.11dBm	
Humidity:	53 % RH	Tested by:	KK	

Blocking signal frequency (MHz)	Blocking signal power (dBm)	Type of blocking signal	PER(%)	Result
2 380	-53	CW	3.02	Pass
2 503,5	-53	CW	2.87	Pass
2 300	-47	CW	0.81	Pass
2 330	-47	CW	0.93	Pass
2 360	-47	CW	2.35	Pass
2 523,5	-47	CW	1.78	Pass
2 553,5	-47	CW	1.45	Pass
2 583,5	-47	CW	1.77	Pass
2 613,5	-47	CW	1.12	Pass
2 643,5	-47	CW	0.94	Pass
2 673,5	-47	CW	1.32	Pass

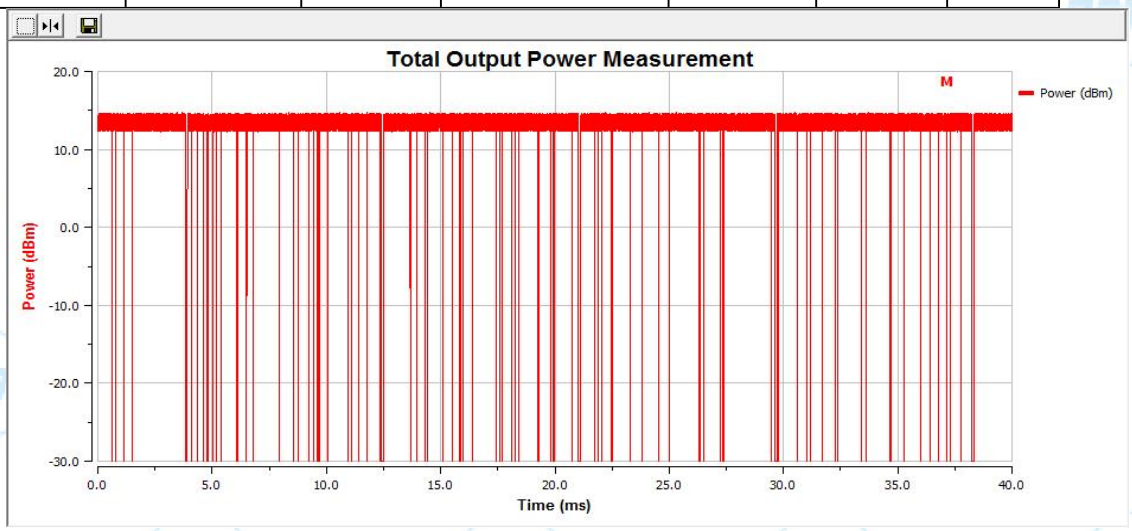
Pout<=10dBm
NOTE: N/A means not applicable

10. APPENDIX

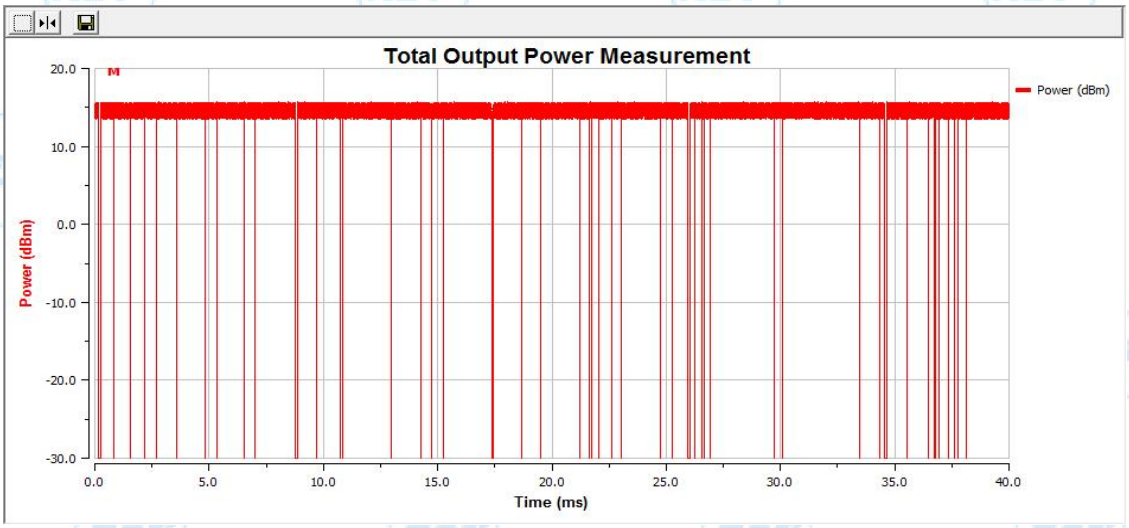
10.1 APPENDIX I RF OUTPUT POWER

For Antenna Style B, 802.11B, Antenna Port A

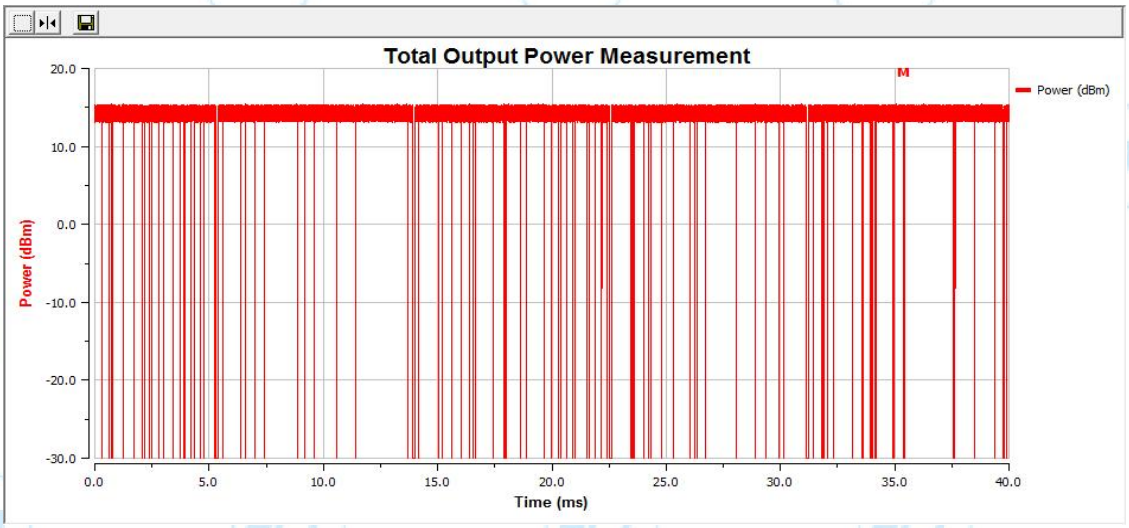
Modulation	Test Freq (MHz)	Voltage	Conducted Power (dBm)	EIRP (dBm)	Limit (dBm)	Status
802.11 b	2412	Normal	13.77	17.23	< 20	Pass



Modulation	Test Freq (MHz)	Voltage	Conducted Power (dBm)	EIRP (dBm)	Limit (dBm)	Status
802.11 b	2442	Normal	14.75	18.21	< 20	Pass



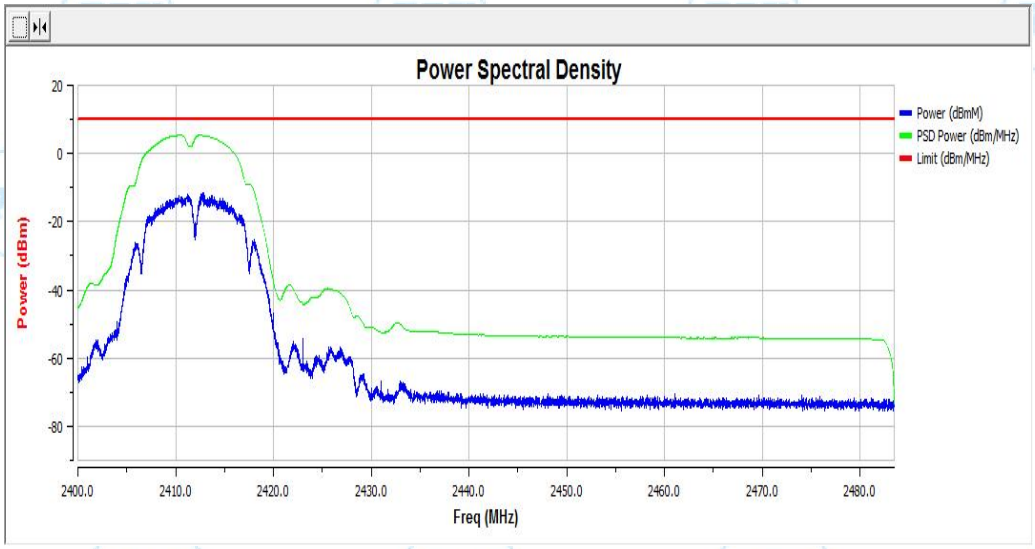
Modulation	Test Freq (MHz)	Voltage	Conducted Power (dBm)	EIRP (dBm)	Limit (dBm)	Status
802.11 b	2472	Normal	14.51	17.97	< 20	Pass



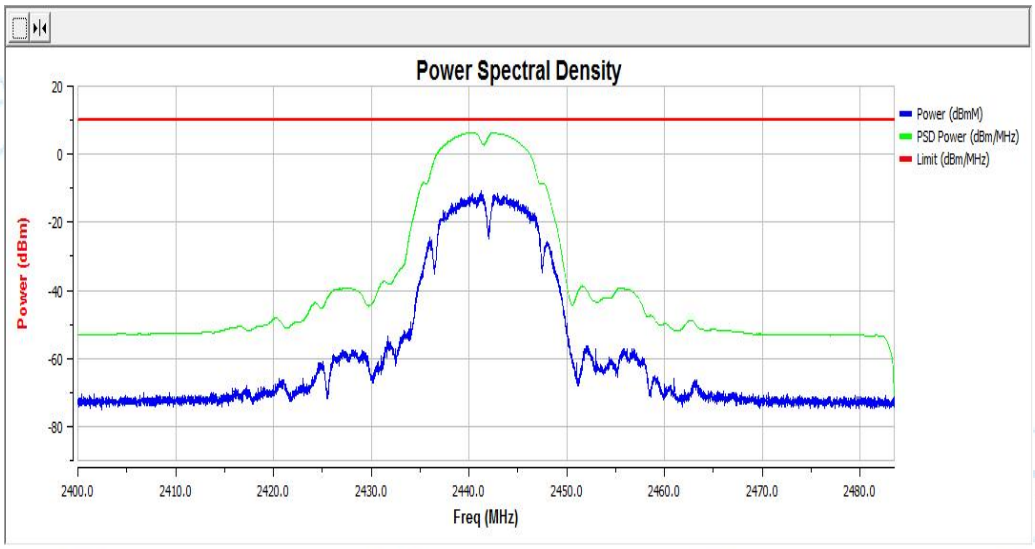
10.2 APPENDIX II POWER SPECTRAL DENSITY

For Antenna Style B, 802.11B, Antenna Port A

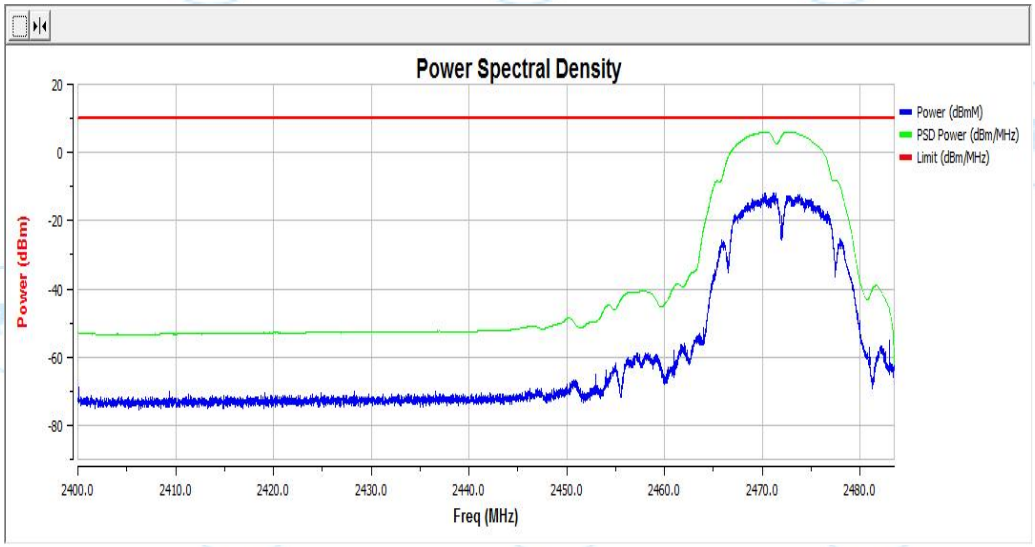
Modulation	Test Freq (MHz)	Max Power Spectral Density (dBm/MHz)	Limit (dBm/MHz)	Status
802.11 b	2412	5.51	< 10	Pass



Modulation	Test Freq (MHz)	Max Power Spectral Density (dBm/MHz)	Limit (dBm/MHz)	Status
802.11 b	2442	6.51	< 10	Pass



Modulation	Test Freq (MHz)	Max Power Spectral Density (dBm/MHz)	Limit (dBm/MHz)	Status
802.11 b	2472	6.02	< 10	Pass

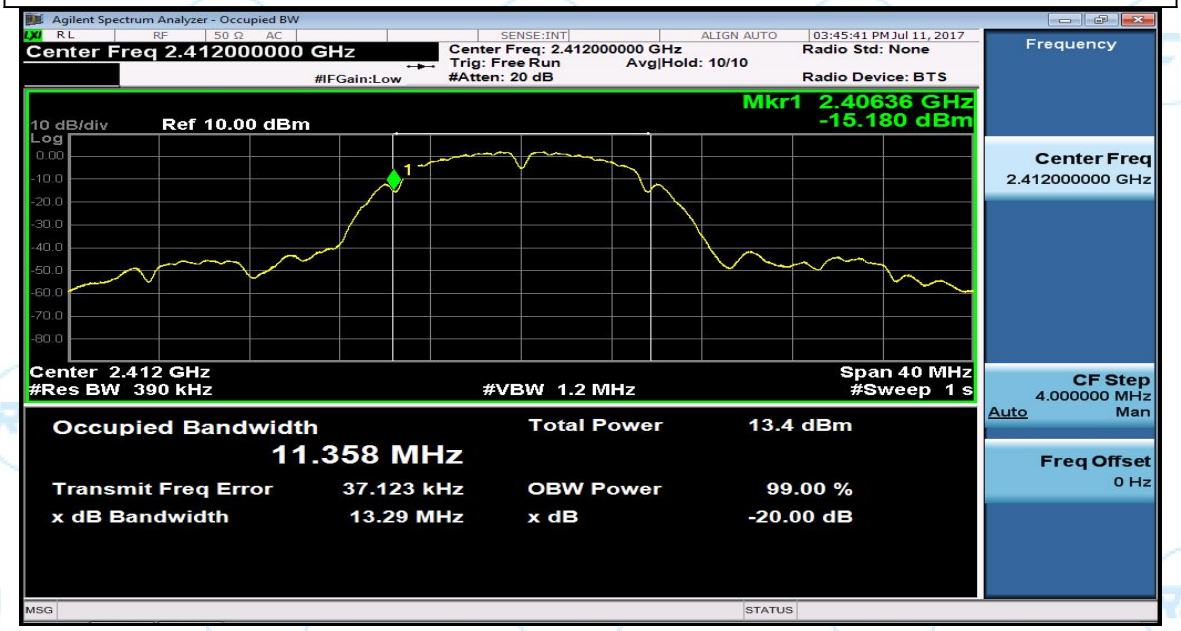


10.3 APPENDIX III OCCUPIED CHANNEL BANDWIDTH

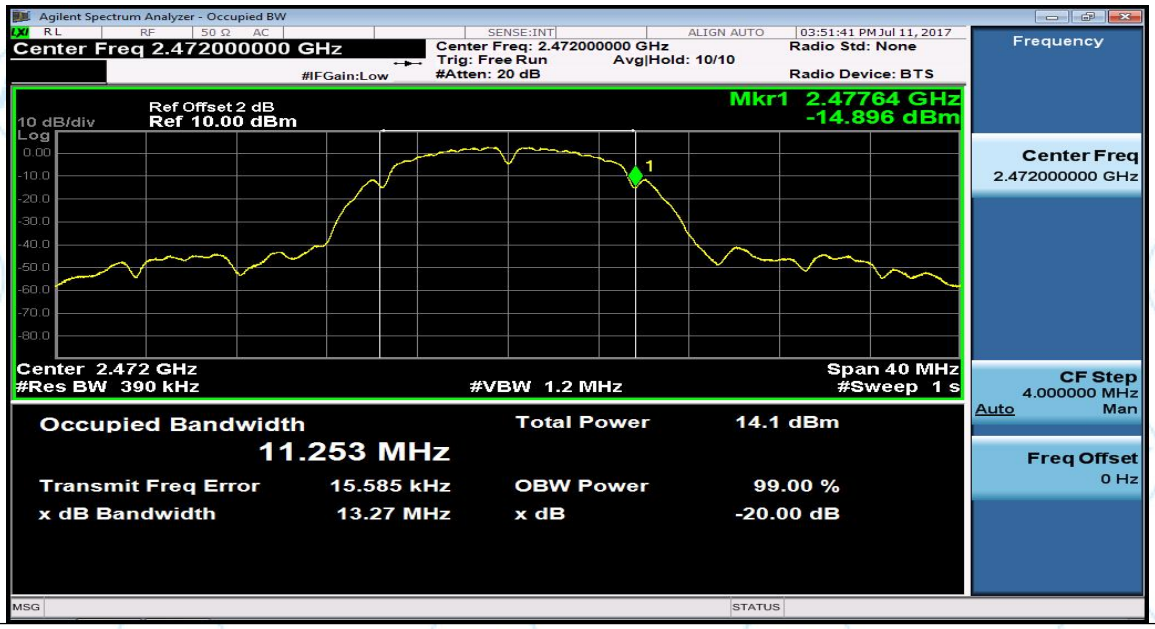
Antenna Port A

802.11 b

Modulation	Measured Channel	Occupied BandWidth (MHz)	Measured Freq (MHz)	Limit (MHz)	Status
802.11 b	2412	11.358	2406.36	> 2400	Pass

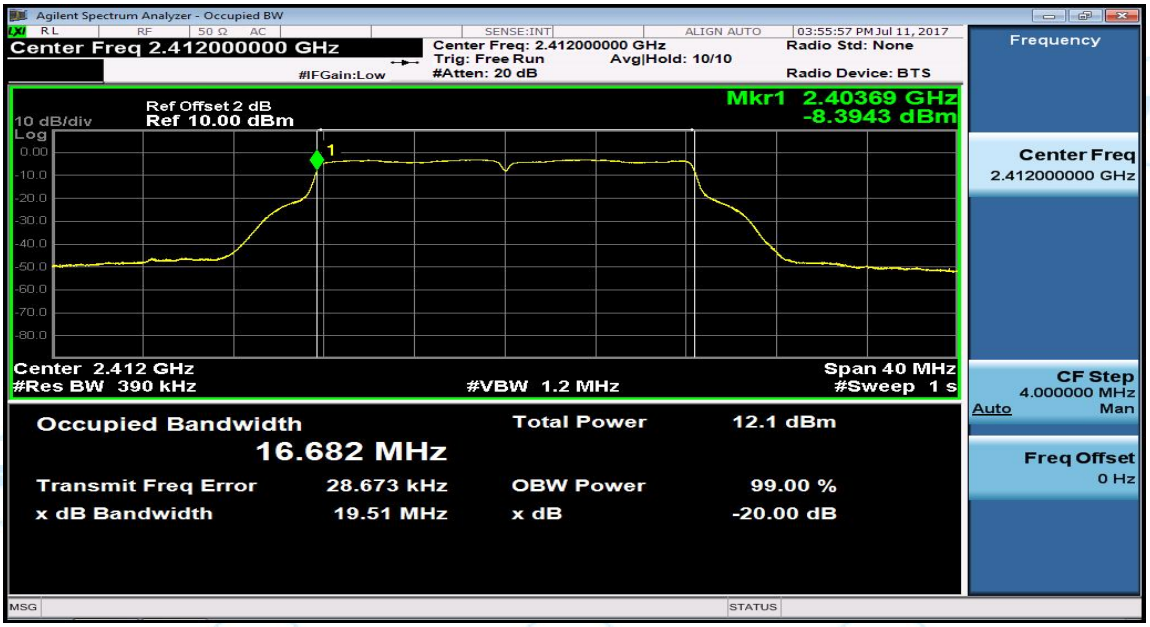


Modulation	Measured Channel	Occupied BandWidth (MHz)	Measured Freq (MHz)	Limit (MHz)	Status
802.11 b	2472	11.253	2477.64	< 2483.5	Pass

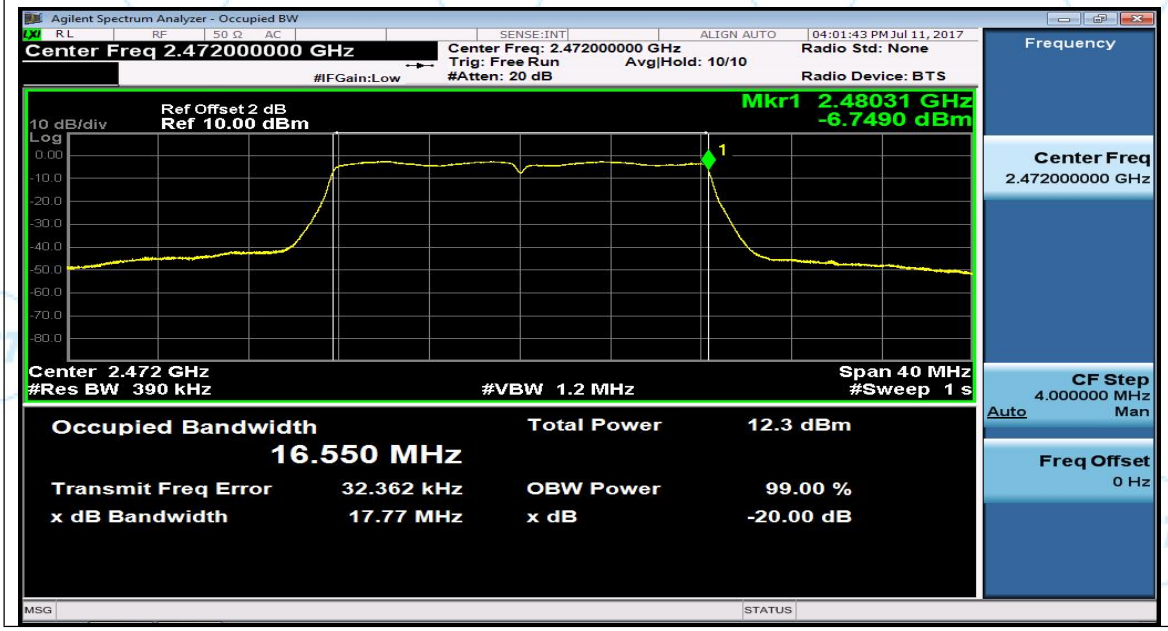


802.11 g

Modulation	Measured Channel	Occupied BandWidth (MHz)	Measured Freq (MHz)	Limit (MHz)	Status
802.11 g	2412	16.682	2403.69	> 2400	Pass

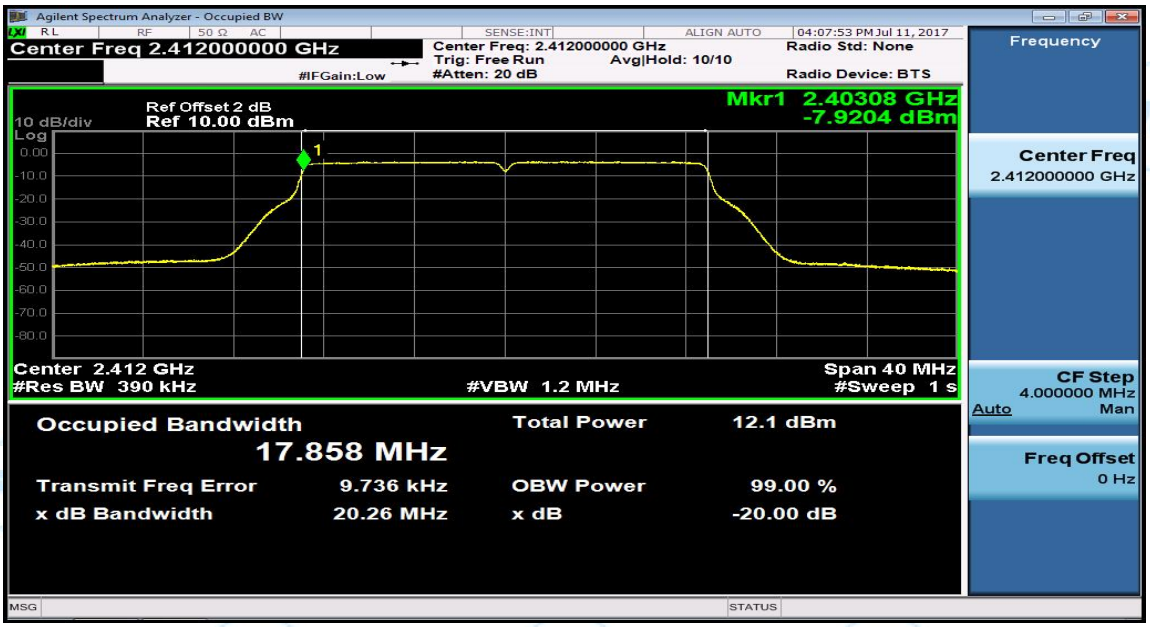


Modulation	Measured Channel	Occupied BandWidth (MHz)	Measured Freq (MHz)	Limit (MHz)	Status
802.11 g	2472	16.550	2480.31	< 2483.5	Pass

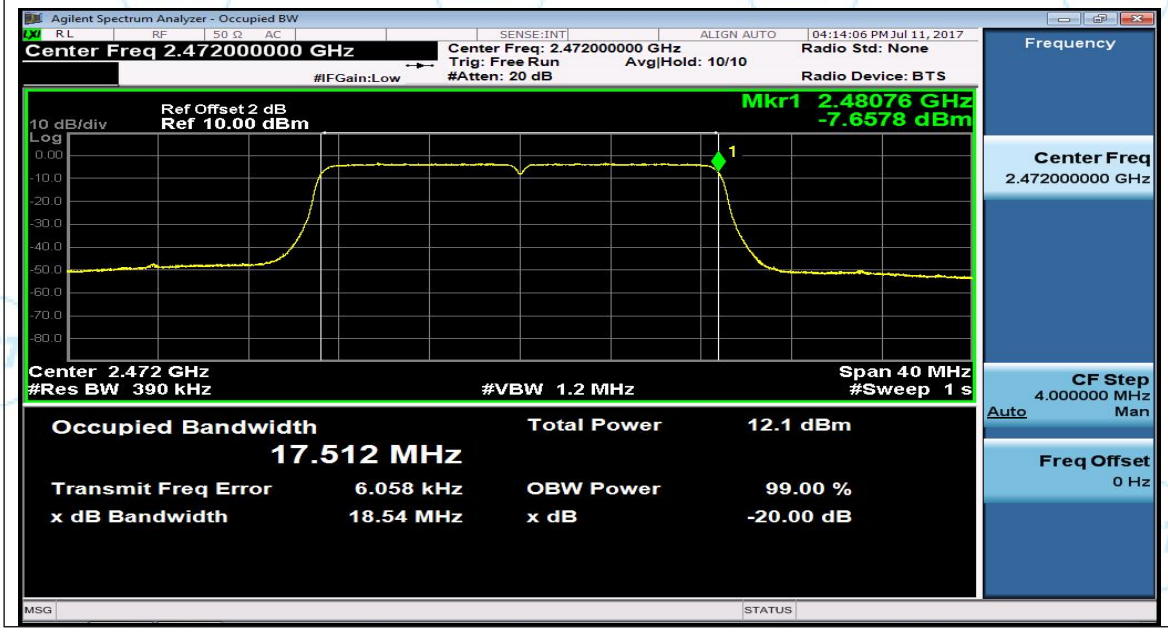


802.11 n20

Modulation	Measured Channel	Occupied BandWidth (MHz)	Measured Freq (MHz)	Limit (MHz)	Status
802.11 n20	2412	17.858	2403.08	> 2400	Pass

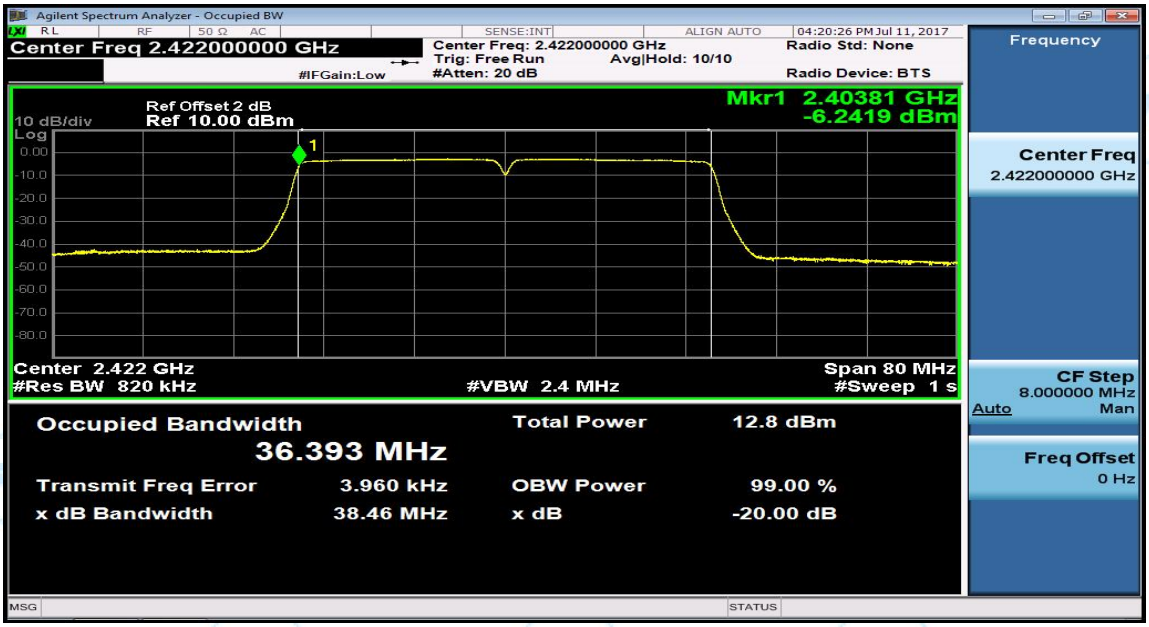


Modulation	Measured Channel	Occupied BandWidth (MHz)	Measured Freq (MHz)	Limit (MHz)	Status
802.11 n20	2472	17.512	2480.76	< 2483.5	Pass

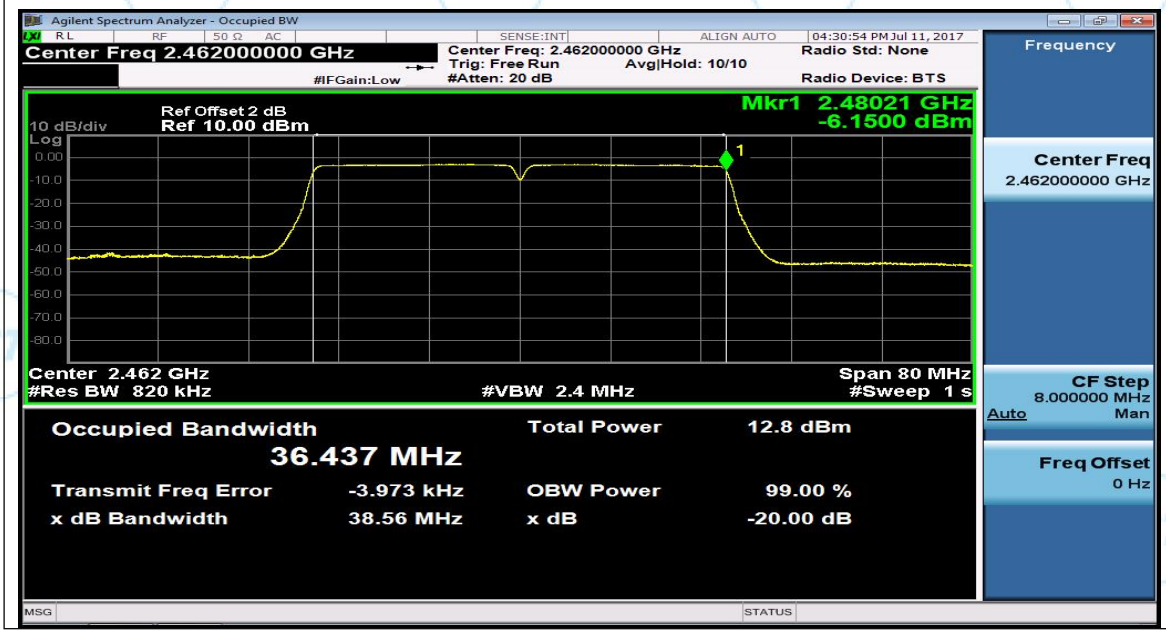


802.11 n40

Modulation	Measured Channel	Occupied BandWidth (MHz)	Measured Freq (MHz)	Limit (MHz)	Status
802.11 n40	2422	36.393	2403.81	> 2400	Pass

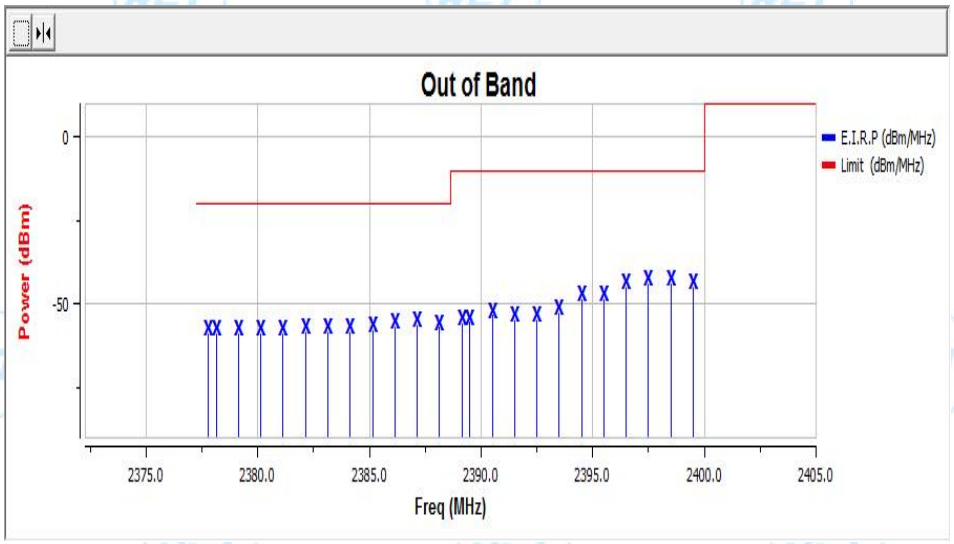


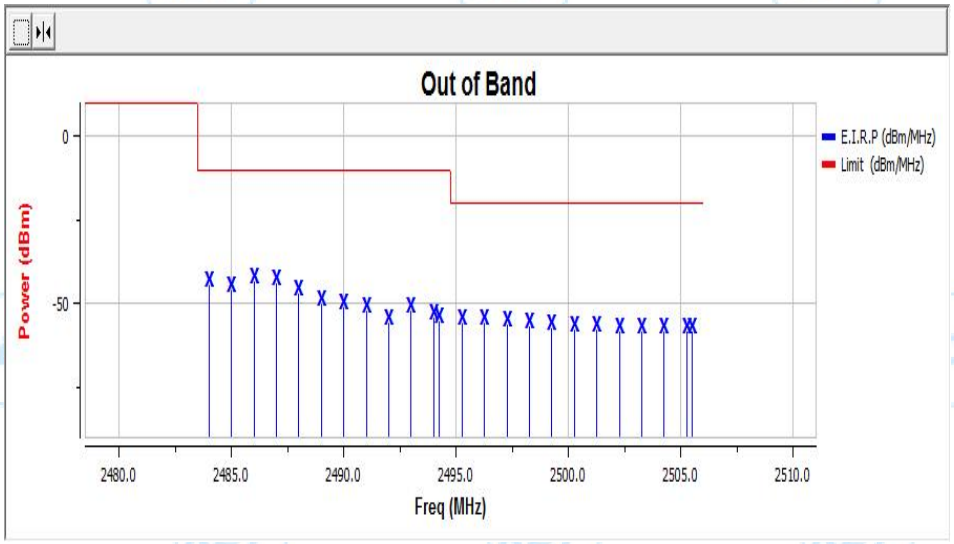
Modulation	Measured Channel	Occupied BandWidth (MHz)	Measured Freq (MHz)	Limit (MHz)	Status
802.11 n40	2462	36.437	2480.21	< 2483.5	Pass



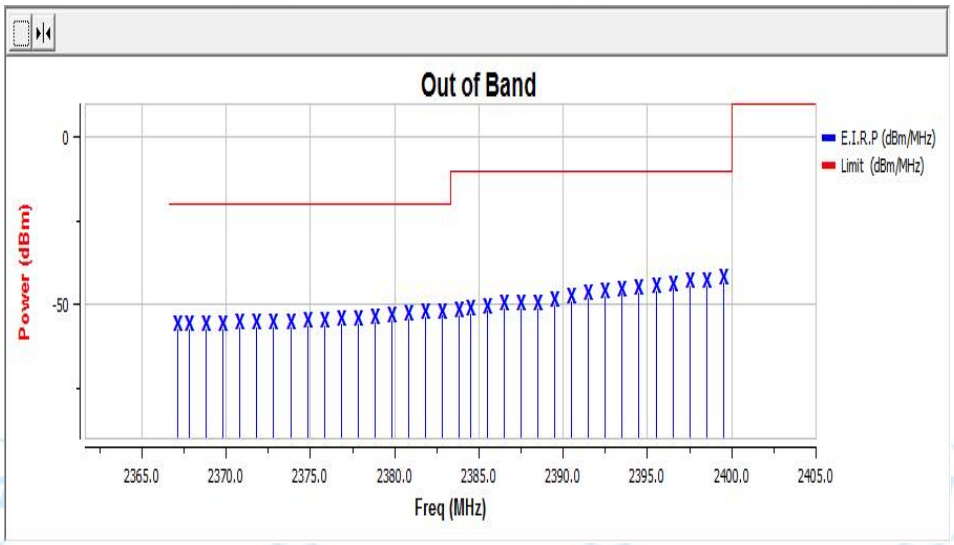
10.4 APPENDIX IV TRANSMITTER UNWANTED EMISSION IN THE OUT-OF BAND

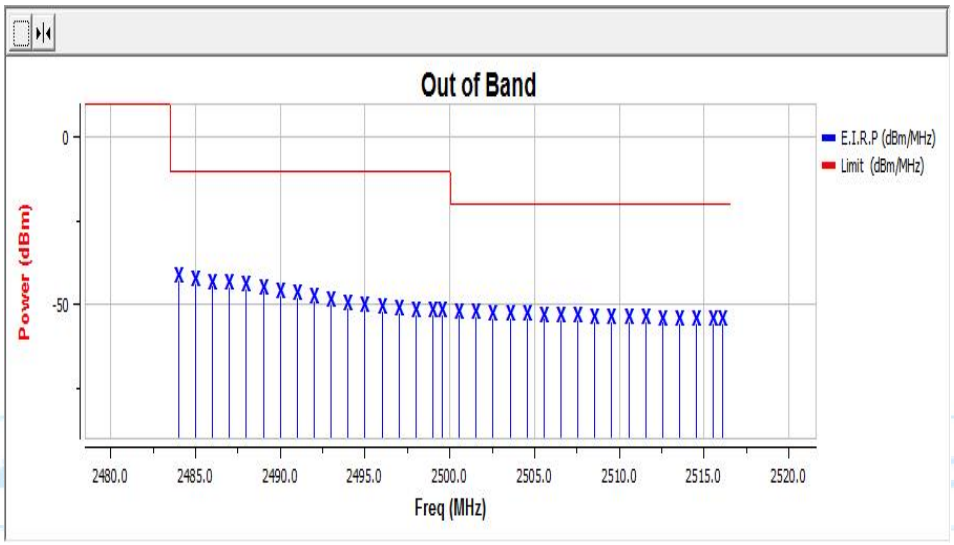
SISO Mode: Antenna A-802.11b



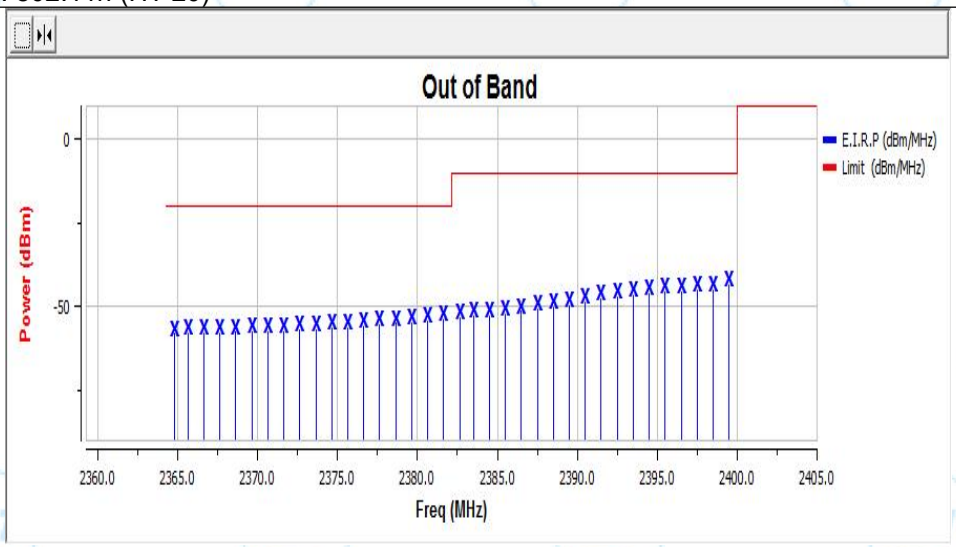


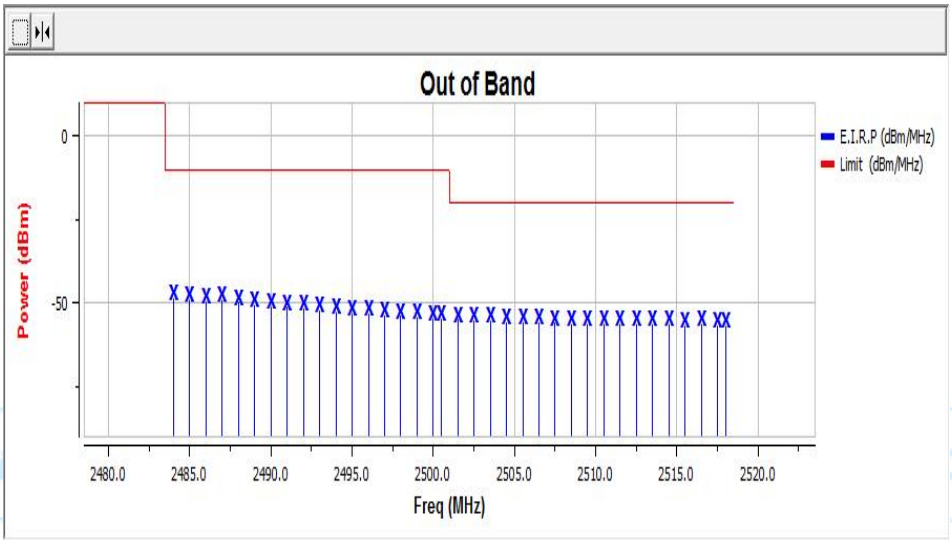
SISO Mode: Antenna A-802.11g



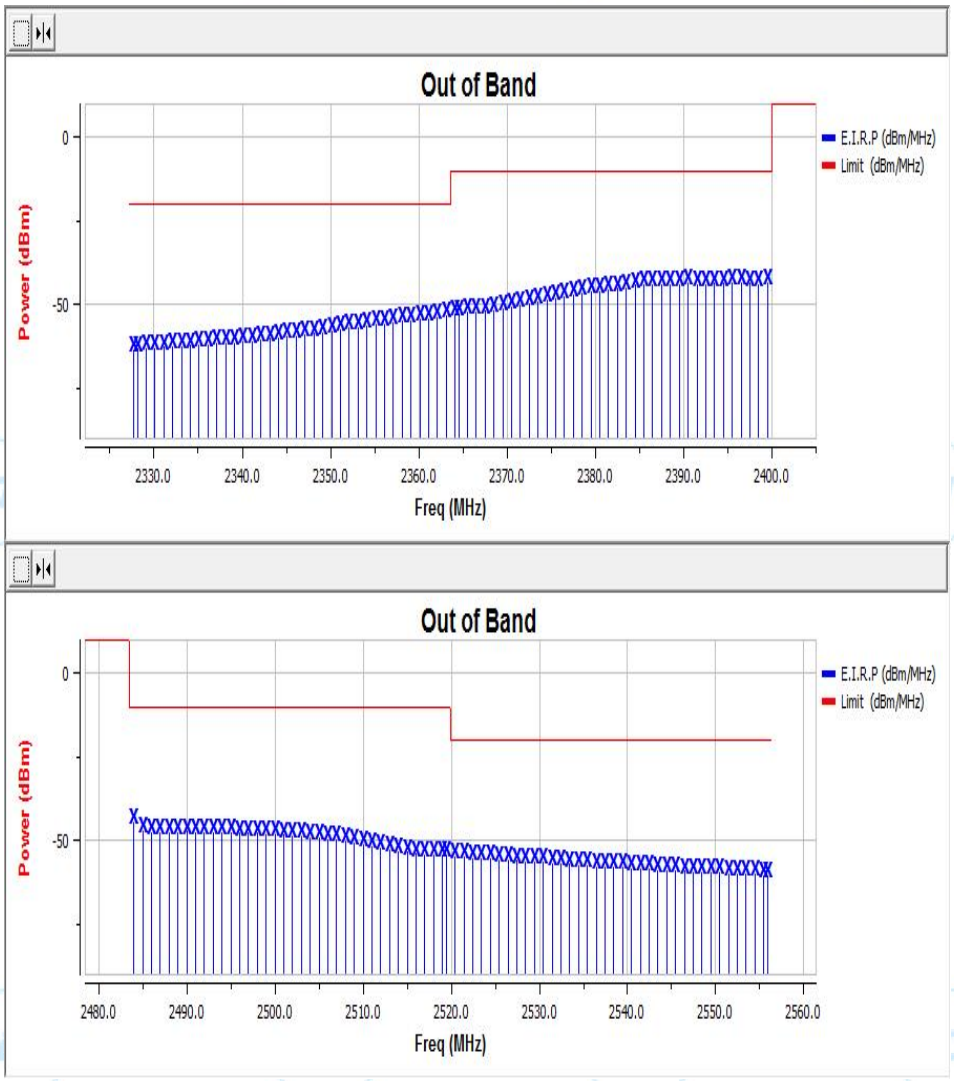


MIMO Mode: 802.11n (HT 20)





MIMO Mode: 802.11n (HT 40)

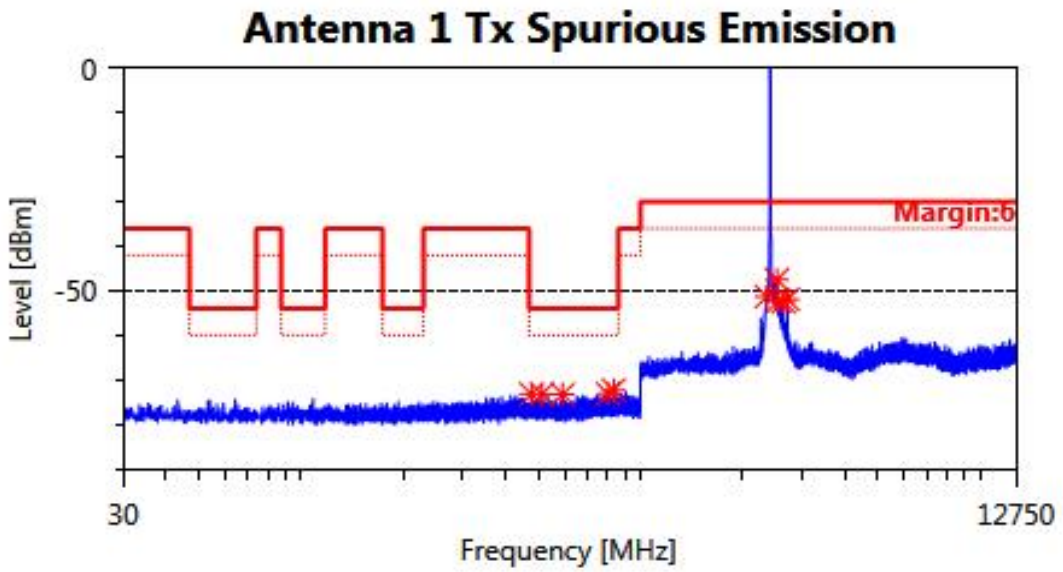


10.5 APPENDIX V TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

Antenna A-802.11b

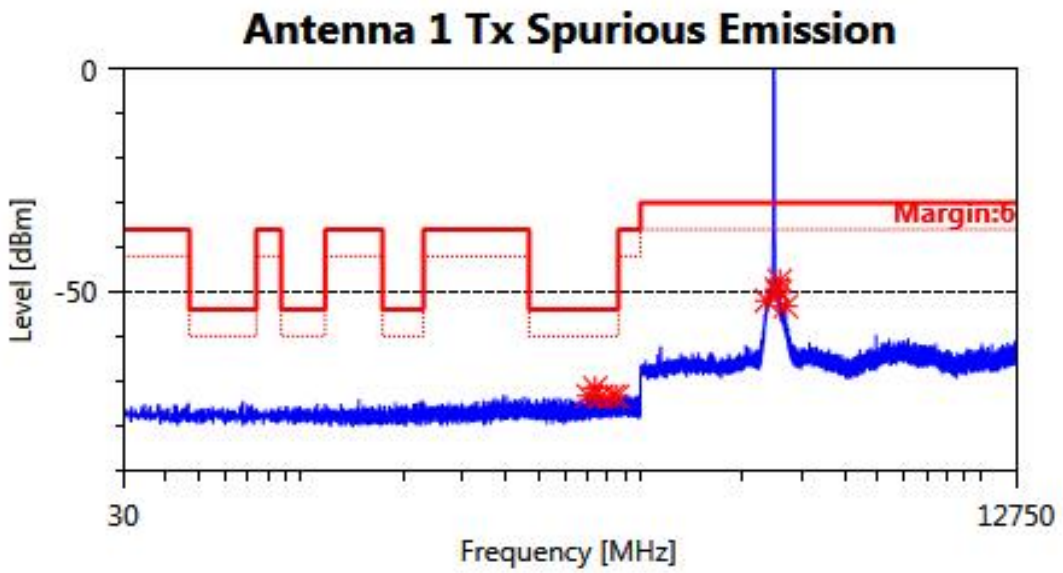
2412MHz	2472MHz

Freq (MHz)	Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Status
477.550	-73.22	-54.00	-19.22	Pass
513.600	-73.22	-54.00	-19.22	Pass
590.700	-73.28	-54.00	-19.28	Pass
803.350	-73.17	-54.00	-19.17	Pass
834.750	-72.32	-54.00	-18.32	Pass
2357.500	-51.31	-30.00	-21.31	Pass
2525.500	-47.48	-30.00	-17.48	Pass
2551.500	-52.26	-30.00	-22.26	Pass
2638.500	-52.41	-30.00	-22.41	Pass
2713.500	-51.90	-30.00	-21.90	Pass



Antenna A-802.11b	
2412MHz	2472MHz

Freq (MHz)	Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Status
703.350	-73.38	-54.00	-19.38	Pass
736.050	-71.59	-54.00	-17.59	Pass
761.800	-73.56	-54.00	-19.56	Pass
829.350	-73.42	-54.00	-19.42	Pass
853.400	-73.47	-54.00	-19.47	Pass
2357.500	-52.00	-30.00	-22.00	Pass
2525.000	-49.35	-30.00	-19.35	Pass
2549.500	-50.20	-30.00	-20.20	Pass
2574.000	-47.47	-30.00	-17.47	Pass
2678.500	-53.26	-30.00	-23.26	Pass

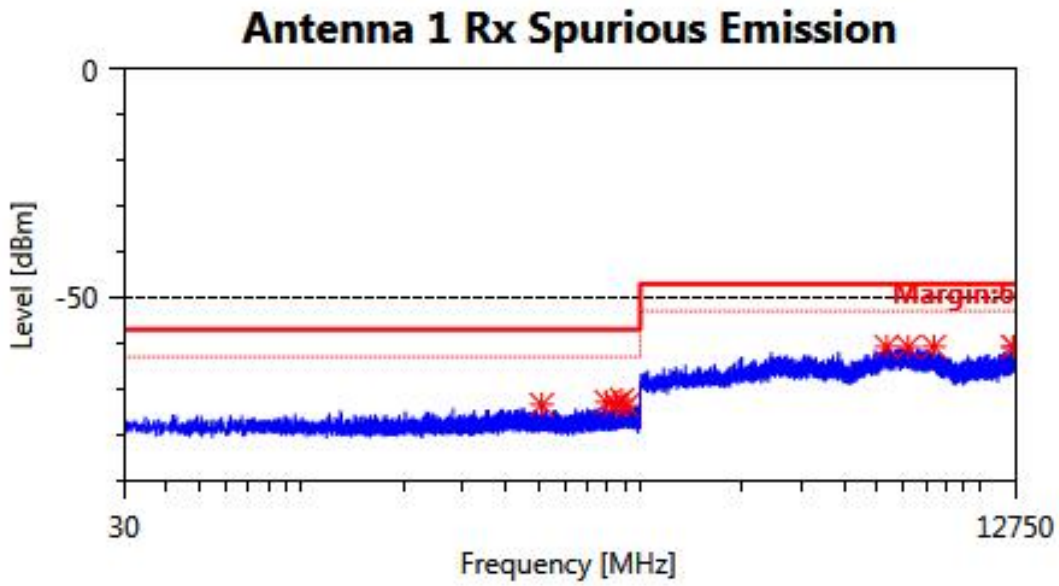


10.6 APPENDIX VI RECEIVER SPURIOUS EMISSIONS

Antenna A-802.11b

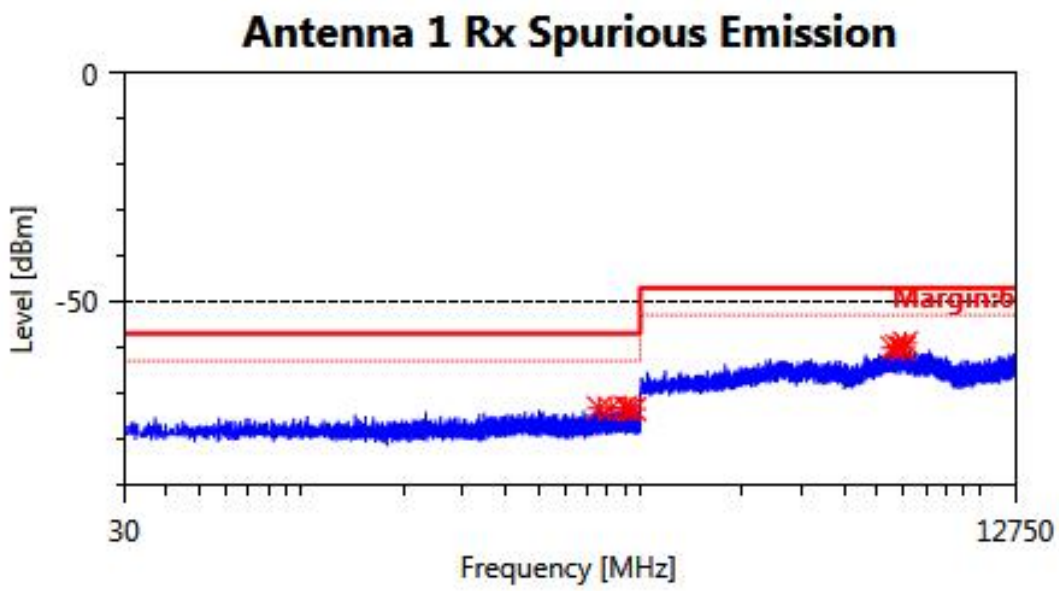
2412MHz | 2472MHz

Freq (MHz)	Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Status
512.750	-73.51	-57.00	-16.51	Pass
797.050	-72.97	-57.00	-15.97	Pass
847.650	-73.37	-57.00	-16.37	Pass
883.350	-72.46	-57.00	-15.46	Pass
913.850	-73.71	-57.00	-16.71	Pass
5337.000	-60.80	-47.00	-13.80	Pass
6183.500	-60.85	-47.00	-13.85	Pass
7360.000	-60.78	-47.00	-13.78	Pass
12591.000	-60.84	-47.00	-13.84	Pass
12650.500	-60.80	-47.00	-13.80	Pass



Antenna A-802.11b	
2412MHz	2472MHz

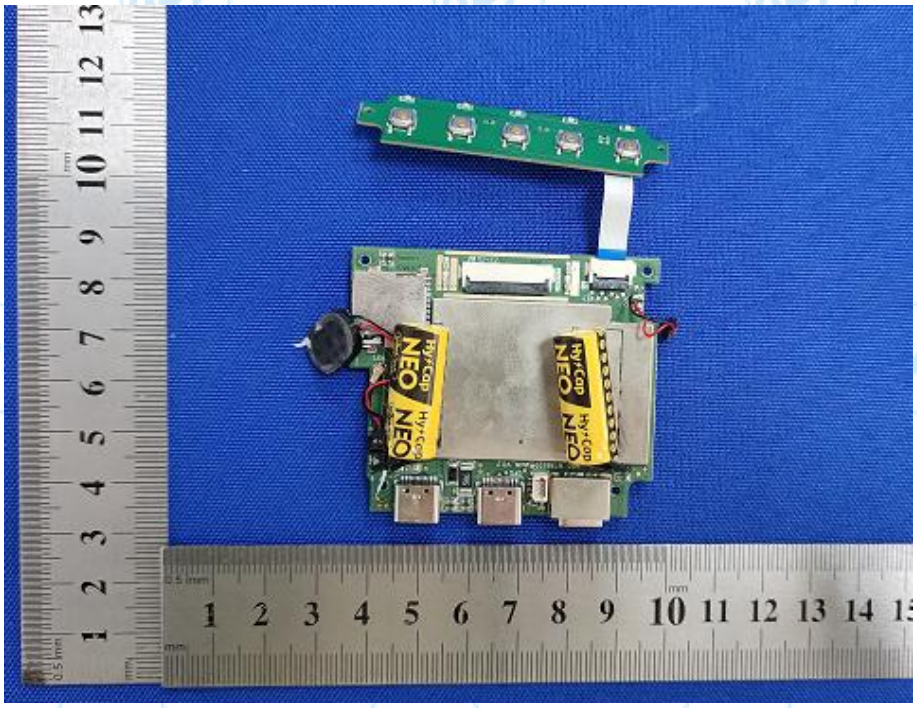
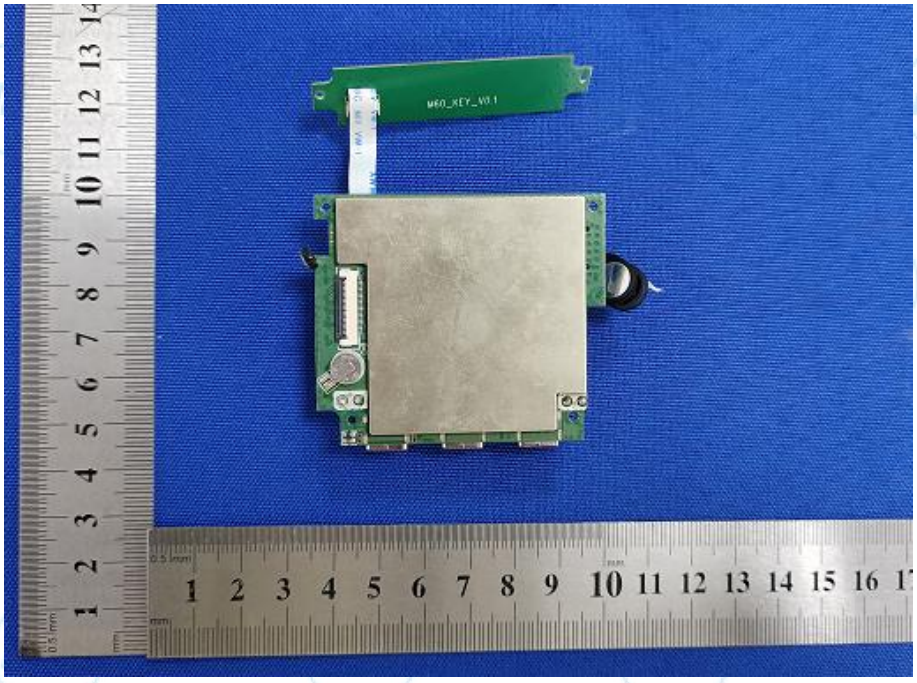
Freq (MHz)	Emission Level (dBm)	Limit (dBm)	Over Limit (dB)	Status
756.300	-73.39	-57.00	-16.39	Pass
818.050	-73.49	-57.00	-16.49	Pass
904.400	-73.28	-57.00	-16.28	Pass
932.050	-73.53	-57.00	-16.53	Pass
961.100	-73.59	-57.00	-16.59	Pass
5560.000	-60.20	-47.00	-13.20	Pass
5756.000	-59.86	-47.00	-12.86	Pass
5944.500	-60.36	-47.00	-13.36	Pass
5967.000	-60.20	-47.00	-13.20	Pass
6054.500	-59.19	-47.00	-12.19	Pass



APPENDIXI VII PHOTOGRAPHS OF EUT

Over view of EUT	
Over view of EUT	

Over view of EUT	
Over view of EUT	

Internal view of EUT	
Internal view of EUT	

END OF REPORT