

ETSI EN 300 328 V2.1.1: 2016

TEST REPORT

For

UP-Core board

Trade Name: AAEON

Model: xUPC-CHT01x (x-where x may be any combination of alphanumeric characters or “-“ or blank)

Issued to

AAEON Technology Inc.

5F, No.135, Lane 235, Pao Chiao Rd, Hsin-Tien Dist., New Taipei City, Taiwan, R.O.C

Issued by

Compliance Certification Services Inc.

Wugu Laboratory

**No.11, Wugong 6th Rd., Wugu Dist.,
New Taipei City 24891, Taiwan. (R.O.C.)**

<http://www.ccsrf.com>

service@ccsrf.com

Issued Date: January 16, 2018



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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	January 16, 2018	Initial Issue	ALL	May Lin

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1. TEST RESULT CERTIFICATION

Applicant: AAEON Technology Inc.
5F, No.135, Lane 235, Pao Chiao Rd, Hsin-Tien Dist., New Taipei City, Taiwan, R.O.C

Manufacturer: AAEON Technology Inc.
5F, No.135, Lane 235, Pao Chiao Rd, Hsin-Tien Dist., New Taipei City, Taiwan, R.O.C

Equipment Under Test: UP-Core board

Trade Name: AAEON

Model Number: xUPC-CHT01x (x-where x may be any combination of alphanumeric characters or “-“ or blank)

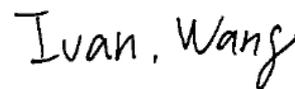
Date of Test: November 10, ~ December 20, 2017

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
ETSI EN 300 328 v2.1.1.: 2016	No non-compliance noted

The above equipment was tested by Compliance Certification Services Inc. for compliance with the requirements set forth in ETSI EN 300 328. The results of testing in this report apply only to the product/system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Approved by:

Tested by:

Sam Chuang
Manager
Compliance Certification Services Inc.

Ivan Wang
Engineer
Compliance Certification Services Inc.

2. EUT DESCRIPTION

Product	UP-Core board		
Trade Name	AAEON		
Model Number	xUPC-CHT01x (x-where x may be any combination of alphanumeric characters or "-" or blank)		
Model Discrepancy	All the above models are identical except for the designation of model numbers. The suffix of (x-where x may be any combination of alphanumeric characters or "-" or blank) on model number is just for marketing purpose only.		
Received Date	October 27, 2017		
EUT Power Rating	5VDC from AC adapter I/P:100~240VAC 0.6A 50~60Hz O/P: 5VDC 4A		
Frequency Range	IEEE 802.11b/g/ IEEE 802.11n 20 MHz Mode: 2412 ~ 2472 MHz Bluetooth: 2402 ~ 2480 MHz		
Modulation Technique	IEEE 802.11b Mode: DSSS IEEE 802.11g Mode: OFDM IEEE 802.11n 20 MHz Mode: OFDM Bluetooth 4.0: GFSK		
Number of Channels	IEEE 802.11b/g Mode: 13 Channels IEEE 802.11n 20 MHz Mode: 13 Channels Bluetooth 4.0: 40 Channels (37 hopping + 3 advertising Channel)		
Transmit Power (mean EIRP)	Mode	Transmit Power (dBm)	Transmit Power (mW)
	IEEE 802.11b Mode	17.41	55.08
	IEEE 802.11g Mode	16.14	41.11
	IEEE 802.11n 20 MHz Mode	15.15	32.73
	Bluetooth 4.0	2.84	1.92
Antenna Specification	Dipole Antenna / Gain: 2dBi		
Temperature Range	0°C ~ 60°C		
S.W Version	V1.0		
H.W: Version	V1.00		

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

3. TEST METHODOLOGY

3.1 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; Harmonized Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

3.2 DESCRIPTION OF TEST MODES

The EUT (model: UPC-CHT01-A20-0464) had been tested under operating and standby condition.

Software used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

IEEE 802.11b Mode:

Channel Low (2412MHz) and Channel High (2472MHz) with 1Mbps data rate were chosen for full testing.

IEEE 802.11g Mode:

Channel Low (2412MHz) and Channel High (2472MHz) with 6Mbps data rate were chosen for full testing.

IEEE 802.11n 20 MHz Mode:

Channel Low (2412MHz) and Channel High (2472MHz) with 6.5Mbps data rate were chosen for full testing.

Bluetooth 4.0

Tested Channel	Frequency (MHz)
Low	2402
High	2480

3.2.1 The worst mode of measurement

2.4GHz

Radiated Emission Measurement	
Test Condition	Band edge, Emission for Unwanted and Fundamental
Voltage/Hz	230V / 50Hz
Test Mode	Mode 1: EUT power by adapter.
Worst Mode	<input checked="" type="checkbox"/> Mode 1 <input type="checkbox"/> Mode 2 <input type="checkbox"/> Mode 3 <input type="checkbox"/> Mode 4
Position	<input type="checkbox"/> Placed in fixed position. <input checked="" type="checkbox"/> Placed in fixed position at X-Plane (E2-Plane) <input type="checkbox"/> Placed in fixed position at Y-Plane (E1-Plane) <input type="checkbox"/> Placed in fixed position at Z-Plane (H-Plane)

Remark:

1. The worst mode was record in this test report.
2. The EUT pre-scanned in three axis, X, Y, Z and two polarity, Horizontal and Vertical for radiated measurement. The worst case (X-Plane) were recorded in this report.

BT 4.0

Radiated Emission Measurement	
Test Condition	Band edge, Emission for Unwanted and Fundamental
Voltage/Hz	230V / 50Hz
Test Mode	Mode 1: EUT power by adapter.
Worst Mode	<input checked="" type="checkbox"/> Mode 1 <input type="checkbox"/> Mode 2 <input type="checkbox"/> Mode 3 <input type="checkbox"/> Mode 4
Position	<input type="checkbox"/> Placed in fixed position. <input checked="" type="checkbox"/> Placed in fixed position at X-Plane (E2-Plane) <input type="checkbox"/> Placed in fixed position at Y-Plane (E1-Plane) <input type="checkbox"/> Placed in fixed position at Z-Plane (H-Plane)

Remark:

1. The worst mode was record in this test report.
2. The EUT pre-scanned in three axis, X, Y, Z and two polarity, Horizontal and Vertical for radiated measurement. The worst case (X-Plane) were recorded in this report.

4 INSTRUMENT CALIBRATION

4.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

4.2 MEASUREMENT EQUIPMENT USED

Equipment Used for Emissions Measurement

RF Conducted Test Site					
Name of Equipment	Manufacturer	Model	Serial Number	Cal. Date	Cal. Due
Power Meter	Anritsu	ML2495A	1033009	04/11/2017	04/10/2018
Power Sensor	Anritsu	MA2411B	917072	07/03/2017	07/02/2018
Spectrum Analyzer	Keysight	N9010B	MY55460167	06/14/2017	06/13/2018
Thermostatic/Hrgrosatic Chamber	GWINSTEK	GTC-288MH-CC	TH160402	05/23/2017	05/22/2018

Wugu Fully Chamber B					
Name of Equipment	Manufacturer	Model	Serial Number	Cal. Date	Cal. Due
Signal Analyzer	Agilent	E4407B	MY44212686	04/07/2017	04/06/2018
Pre-Amplifier	EMEC	EM01M62G	60570	08/01/2017	07/31/2018
Bilog Antenna	Sunol Sciences	JB1	A052609	03/17/2017	03/16/2018
Horn Antenna	SCHWARZBECK	BBHA 9120D	779	03/08/2017	03/07/2018
Pre-Amplifier	Anritsu	MH648A	M89145	06/27/2017	06/26/2018
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R
cable	HUBER SUHNER	SUCOFLEX 104PEA	23452	07/31/2017	07/30/2018
cable	HUBER SUHNER	SUCOFLEX 104PEA	33960	07/31/2017	07/30/2018
Filter	N/A	1800-2000	N/A	N/A	N/A
Filter	N/A	2400-2500	N/A	N/A	N/A
Filter	N/A	800-1G	N/A	N/A	N/A
Filter	N/A	0-1G	N/A	N/A	N/A
Filter	N/A	0-2G	N/A	N/A	N/A
Filter	N/A	5150-5350	N/A	N/A	N/A
Filter	N/A	5470-5725	N/A	N/A	N/A
Filter	N/A	5725-5875	N/A	N/A	N/A

Remark:

1. Each piece of equipment is scheduled for calibration once a year and Precision Dipole is scheduled for calibration once three years.
2. N.C.R. = No Calibration Required.

Adaptivity Room					
Name of Equipment	Manufacturer	Model	Serial Number	Cal. Date	Cal. Due
SMA Power Divider	CCS	STI08-0015	008	07/27/2017	07/26/2018
RF Power Splitter	Marvelous Microwave	MVE 8586	6011206	07/26/2017	07/25/2018
Attenuator	E-INSTPVMMENT	EPA-600H	EC1400050	N.C.R	N.C.R
Directional Coupler	Agilent	87301D	MY44350252	07/25/2017	07/24/2018
Mini-Circuits Power Splitter	CCS	ZN2PD-9G-S	777	07/25/2017	07/24/2018
Vector Signal Generator-Blocking	R&S	SMU 200A	103439	04/25/2017	04/24/2018
Vector Signal Generator-Adaptivity	R&S	SMU 200A	101480	02/16/2017	02/15/2018
Spectrum Analyzer	R&S	FSU 20Hz....26.5GHz	100258	06/27/2017	06/26/2018
WLAN Test Set	Anritsu	MT8860	1211004	03/15/2017	03/14/2018
Spectrum Analyzer	R&S	FSU 8GHz	200114	07/24/2017	07/23/2018
Wideband Radio Communication Tester	R&S	CMW500	116875	04/25/2017	04/24/2018

Remark:

1. Each piece of equipment is scheduled for calibration once a year and Precision Dipole is scheduled for calibration once three years.
2. N.C.R. = No Calibration Required.

4.3 MEASUREMENT UNCERTAINTY

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR 100 028-1 [2] and shall correspond to an expansion factor (coverage factor) $k = 1,96$ or $k = 2$ (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)).

Table 7 is based on such expansion factors.

Table 7: Maximum measurement uncertainty

Parameter	Uncertainty
Occupied Channel Bandwidth	+/- 5%
RF output power, conducted	+/- 1,5 dB
Power Spectral Density, conducted	+/- 3 dB
Unwanted Emissions, conducted	+/- 3 dB
All emissions, radiated	+/- 6 dB
Temperature	+/- 3°C
Supply voltages	+/- 3%
Time	+/- 5%

5 FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

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

- No. 199, Chungsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.
Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029
- No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.)
Tel: 886-2-2299-9720 / Fax: 886-2-2298-4045

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

5.2 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."

6 SETUP OF EQUIPMENT UNDER TEST

6.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix I for the actual connections between EUT and support equipment.

6.2 SUPPORT EQUIPMENT

No.	Device Type	Brand	Model	Series No.	FCC ID	Cable length & Type Discribe
1	AC power Source	Extech	6805	N/A	N/A	N/A
2	Mini-Circuits 15542	CCS	ZFBT-4R2GW	Mini-Circuits 15542	N/A	N/A

Remark:

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.*

7 ETSI EN 300 328 REQUIREMENTS

7.1 RF OUTPUT POWER

LIMIT

EN 300 328

FHSS:

The maximum RF output power for adaptive Frequency Hopping equipment shall be equal to or less than 20 dBm. The maximum RF output power for non-adaptive Frequency Hopping equipment, shall be declared by the supplier. See clause 5.3.1 m). The maximum RF output power for this equipment shall be equal to or less than the value declared by the supplier. This declared value shall be equal to or less than 20 dBm.

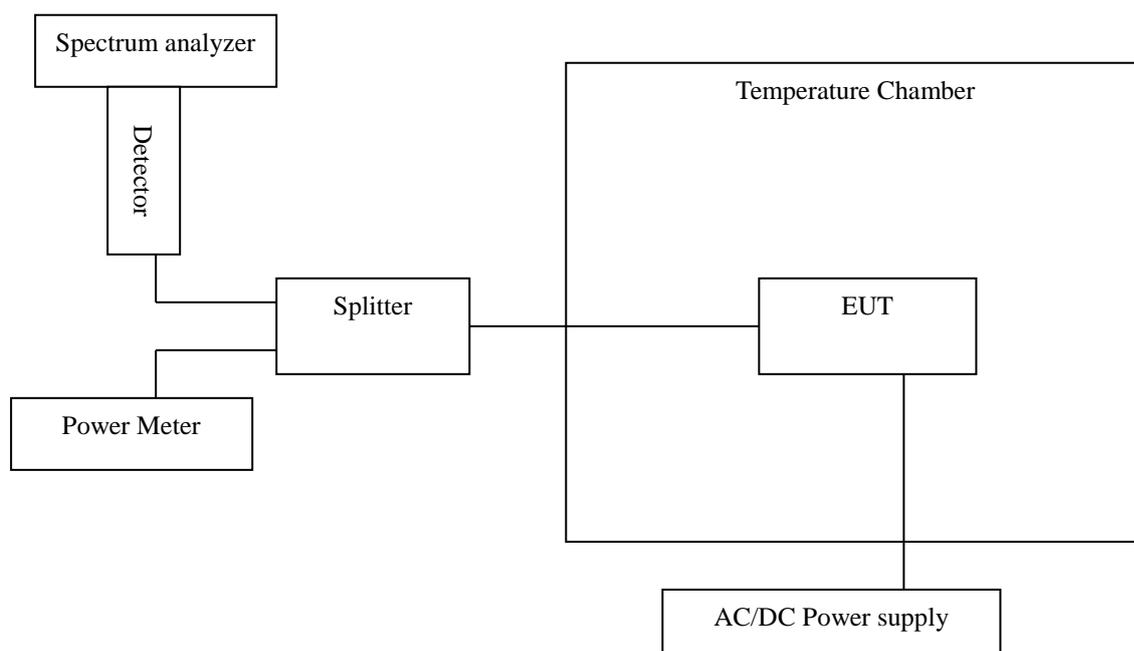
Other than FHSS:

For adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be 20 dBm. The maximum RF output power for non-adaptive equipment shall be declared by the supplier and shall not exceed 20 dBm. See clause 5.3.1 m). For non-adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be equal to or less than the value declared by the supplier.

This limit shall apply for any combination of power level and intended antenna assembly.

Test Configuration

Temperature and Voltage Measurement (under normal and extreme test conditions)



TEST PROCEDURE

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

TEST RESULTS

No non-compliance noted.

Test Results: PASS **Test Mode:** IEEE 802.11b
Tested By: Eric Lee **Test Date:** November 17, 2017

Antenna Gain =		2 dBi		
Test Conditions		Transmitter Power (dBm)		
		Temp (20)°C	Temp (0)°C	Temp (60)°C
Channel	Voltage Power	5v	5v	5v
Low	EIRP	16.22	16.34	15.96
Mid	EIRP	16.89	16.97	16.76
High	EIRP	17.35	*17.41	17.13
Limit		Average Limit= 20 dBm		
Measurement Uncertainty		+/- 1.20dB		

Test Results: PASS **Test Mode:** IEEE 802.11g
Tested By: Eric Lee **Test Date:** November 17, 2017

Antenna Gain =		2 dBi		
Test Conditions		Transmitter Power (dBm)		
		Temp (20)°C	Temp (0)°C	Temp (60)°C
Channel	Voltage Power	5v	5v	5v
Low	EIRP	14.84	15.03	14.46
Mid	EIRP	15.53	15.68	15.44
High	EIRP	16.08	*16.14	16.05
Limit		Average Limit= 20 dBm		
Measurement Uncertainty		+/- 1.20dB		

Remark: *EIRP=A+G+CL*
A = Reading
G = Antenna Gain
CL = Cable Loss

Test Results: PASS **Test Mode:** IEEE 802.11n 20 MHz Mode
Tested By: Eric Lee **Test Date:** November 17, 2017

Antenna Gain =		2 dBi		
Test Conditions		Transmitter Power (dBm)		
		Temp (20)°C	Temp (0)°C	Temp (60)°C
Channel	Voltage	5v	5v	5v
	Power			
Low	EIRP	13.84	14.01	13.53
Mid	EIRP	14.71	14.81	14.47
High	EIRP	15.11	*15.15	14.73
Limit		Average Limit= 20 dBm		
Measurement Uncertainty		+/- 1.20dB		

Remark: $EIRP=A+G+CL$
A = Reading
G = Antenna Gain
CL = Cable Loss

Bluetooth for 4.0

Test Results: PASS **Test Mode:** Bluetooth
Tested By: Eric Lee **Test Date:** November 10, 2017

Antenna Gain =		2 dBi		
Test Conditions		Transmitter Power (dBm)		
		Temp (20)°C	Temp (0)°C	Temp (60)°C
Channel	Voltage	5v	5v	5v
	Power			
Low	EIRP	0.04	0.64	-0.21
Mid	EIRP	1.04	1.38	0.92
High	EIRP	2.62	*2.84	2.48
Limit		Average Limit= 20 dBm		
Measurement Uncertainty		+/- 1.20dB		

Remark: $EIRP=A+G+CL$
A = Reading
G = Antenna Gain
CL = Cable Loss

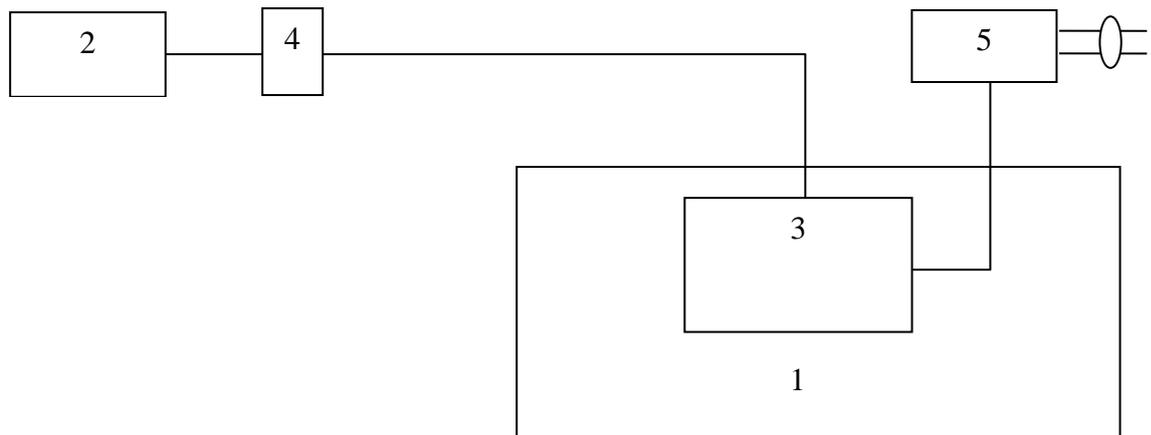
7.2 MAXIMUM SPECTRAL POWER DENSITY

LIMIT

ETSI EN 300 328

For equipment using wide band modulations other than FHSS, the maximum Power Spectral Density is limited to 10 dBm per MHz.

Test Configuration



Legend

1. Wooden table
2. Spectrum analyzer
3. EUT
4. DC block
5. Power supply (Refer to power rating of section 2)

TEST PROCEDURE

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

For MIMO operation that employs simultaneous transmission at two chains of the transmission, measurements were done, and point of sample is captured at respective chain individually, and sums out to produce the final result.

TEST RESULTS

No non-compliance noted.

Test Results: PASS **Test Mode:** IEEE 802.11b
Tested By: Eric Lee **Test Date:** November 17, 2017

Test Conditions		Reading (dBm/MHz) (A)	Antenna Gain (dBi) (B)	Measured Power Density (dBm/MHz) (A+B)
Measured Power Density	Low	3.95	2.0	5.95
	Mid	4.67		6.67
	High	4.07		6.07
Limit		10 dBm/MHz		
Measurement Uncertainty		+1.5dB / -1.4dB		

Test Results: PASS **Test Mode:** IEEE 802.11g
Tested By: Eric Lee **Test Date:** November 17, 2017

Test Conditions		Reading (dBm/MHz) (A)	Antenna Gain (dBi) (B)	Measured Power Density (dBm/MHz) (A+B)
Measured Power Density	Low	0.48	2.0	2.48
	Mid	1.31		3.31
	High	1.59		3.59
Limit		10 dBm/MHz		
Measurement Uncertainty		+1.5dB / -1.4dB		

Test Results: PASS
Tested By: Eric Lee

Test Mode: IEEE 802.11n 20 MHz Mode
Test Date: November 17, 2017

Test Conditions		Reading (dBm/MHz) (A)	Antenna Gain (dBi) (B)	Measured Power Density (dBm/MHz) (A+B)
Measured Power Density	Low	0.21	2.0	2.21
	Mid	1.00		3.00
	High	1.53		3.53
Limit		10 dBm/MHz		
Measurement Uncertainty		+1.5dB / -1.4dB		

For Bluetooth 4.0

Test Results: PASS **Test Mode:** Bluetooth
Tested By: Eric Lee **Test Date:** November 10, 2017

Test Conditions		Reading (dBm/MHz) (A)	Antenna Gain (dBi) (B)	Measured Power Density (dBm/MHz) (A+B)
Measured Power Density	Low	-4.11	2.0	-2.11
	Mid	-2.70		-0.70
	High	-0.38		1.62
Limit		10 dBm/MHz		
Measurement Uncertainty		+1.5dB / -1.4dB		

7.3 DUTY CYCLE, TX-SEQUENCE, TX-GAP

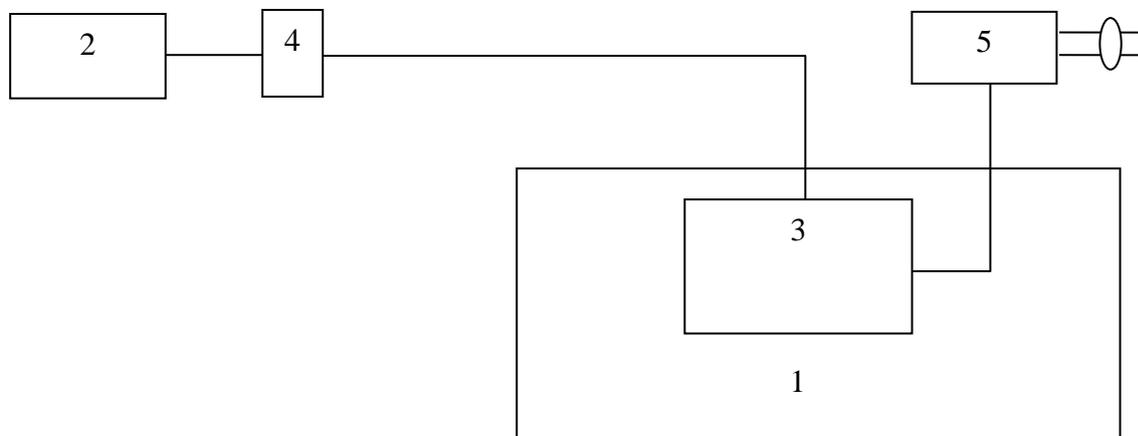
LIMIT

ETSI EN 300 328

For non-adaptive FHSS equipment, the Duty Cycle shall be equal to or less than the maximum value declared by the supplier. In addition, the maximum Tx-sequence time shall be 5 ms while the minimum Tx-gap time shall be 5 ms.

For non-adaptive equipment or to adaptive equipment when operating in a non-adaptive mode. The equipment is using wide band modulations other than FHSS. The Duty Cycle shall be equal to or less than the maximum value declared by the supplier

Test Configuration



Legend

1. Wooden table
2. Spectrum analyzer
3. EUT
4. DC block
5. Power supply (Refer to power rating of section 2)

TEST PROCEDURE

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

TEST RESULTS

N/A for Modulation Technology other than non-adaptive FHSS or non-adaptive wide band modulations other than FHSS.

7.4 DWELL TIME, MINIMUM FREQUENT OCCUPATION AND HOPPING SEQUENCE

LIMIT

ETSI EN 300 328

Non-adaptive frequency hopping systems

The accumulated Dwell Time on any hopping frequency shall not be greater than 15 ms within any period of 15 ms multiplied by the minimum number of hopping frequencies (N) that have to be used. Non-adaptive medical devices requiring reverse compatibility with other medical devices placed on the market when earlier versions of the present document were harmonised, are allowed to have an operating mode in which the maximum dwell time is 400 ms. The hopping sequence(s) shall contain at least N hopping frequencies where N is 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater. The Minimum Frequency Occupation Time shall be equal to one dwell time within a period not exceeding four times the product of the dwell time per hop and the number of hopping frequencies in use.

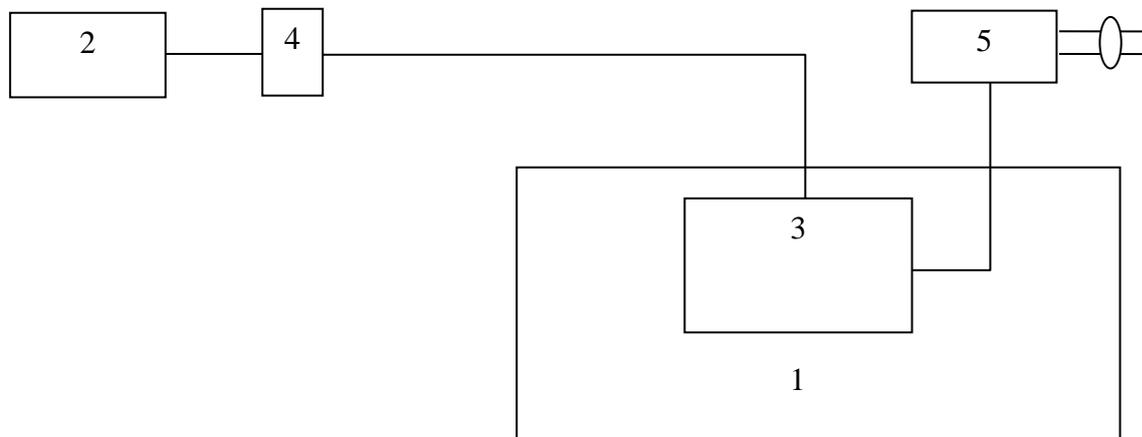
Adaptive frequency hopping systems

Adaptive Frequency Hopping systems shall be capable of operating over a minimum of 70 % of the band specified in clause 1. The maximum accumulated dwell time on any hopping frequency shall be 400 ms within any period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used. The hopping sequence(s) shall contain at least N hopping frequencies at all times, where N is 15 or 15 divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater. The Minimum Frequency Occupation Time shall be equal to one dwell time within a period not exceeding four times the product of the dwell time per hop and the number of hopping frequencies in use.

Other Requirements

Frequency Hopping equipment shall transmit on a minimum of two hopping frequencies. For non-Adaptive Frequency Hopping equipment, when not transmitting on a hopping frequency, the equipment has to occupy that frequency for the duration of the typical dwell time.

For Adaptive Frequency Hopping systems using LBT based DAA, if a signal is detected during the CCA, these systems may jump immediately to the next frequency in the hopping sequence (see clause 4.3.1.6.1.2 point 2) provided the limit for maximum dwell is respected.

Test Configuration**Legend**

1. Wooden table
2. Spectrum analyzer
3. EUT
4. DC block
5. Power supply (Refer to power rating of section 2)

TEST PROCEDURE

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

TEST RESULTS

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

TEST RESULTS

Dwell Time: N/A for Modulation Technology other than FHSS.

Minimum Frequency Occupation Time Result: N/A for Modulation Technology other than FHSS

7.5 HOPPING FREQUENCY SEPARATION

LIMIT

ETSI EN 300 328

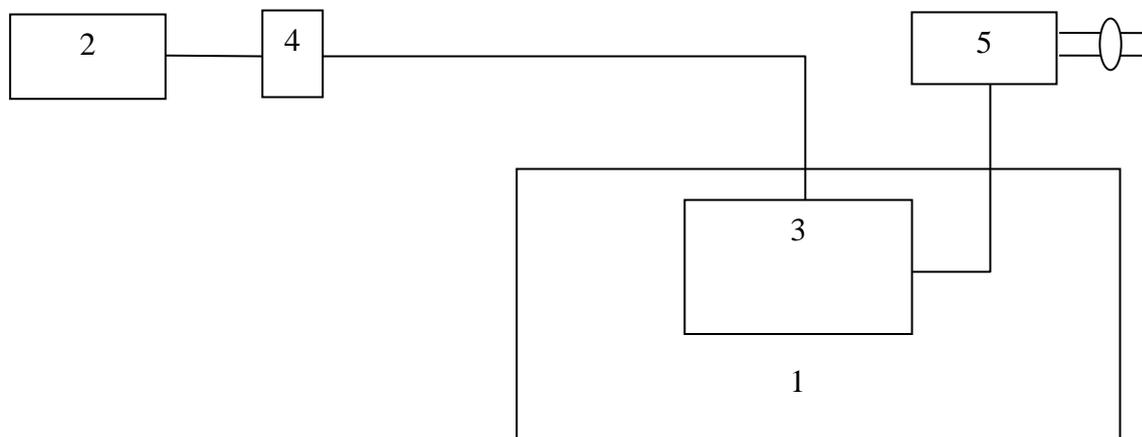
Non-adaptive frequency hopping systems

The minimum Hopping Frequency Separation shall be equal to Occupied Channel Bandwidth (see clause 4.3.1.7) of a single hop, with a minimum separation of 100 kHz.

Adaptive frequency hopping systems

The minimum Hopping Frequency Separation shall be 100 kHz.

Test Configuration



Legend

1. Wooden table
2. Spectrum analyzer
3. EUT
4. DC block
5. Power supply (Refer to power rating of section 2)

TEST PROCEDURE

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

TEST RESULTS

N/A for Modulation Technology other than FHSS

7.6 MEDIUM UTILISATION

LIMIT

ETSI EN 300 328

The maximum Medium Utilisation factor for non-adaptive Frequency Hopping equipment shall be 10 %.

TEST PROCEDURE

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

TEST RESULTS

N/A for equipments that employs the adaptive mechanism. This given UE implements adaptive mechanism to identify transmission of likely presence in the band.

7.7 ADAPTIVITY

LIMIT

ETSI EN 300 328

Adaptive Frequency Hopping using LBT based DAA

Adaptive Frequency Hopping equipment using LBT based DAA shall comply with the following

minimum set of requirements:

- 1) At the start of every dwell time, before transmission on a hopping frequency, the equipment shall perform a Clear Channel Assessment (CCA) check using energy detect. The CCA observation time shall be not less than 0,2 % of the Channel Occupancy Time (see step 3) with a minimum of 18 μ s. If the equipment finds the hopping frequency to be clear, it may transmit immediately (see step 3).
- 2) If it is determined that a signal is present with a level above the detection threshold defined in step 5. the hopping frequency shall be marked as 'unavailable'. Then the equipment may jump to the next frequency in the hopping scheme even before the end of the dwell time, but in that case the 'unavailable' channel can not be considered as being 'occupied' and shall be disregarded with respect to the requirement to maintain a minimum of 15 hopping frequencies. Alternatively, the equipment can remain on the frequency during the remainder of the dwell time. However, if the equipment remains on the frequency with the intention to transmit, it shall perform an extended CCA check in which the (unavailable) channel is observed for a random duration between the value defined for the CCA observation time in step 1 and 5 % of the Channel Occupancy Time defined in step 3. If the extended CCA check has determined the frequency to be no longer occupied, the hopping frequency becomes available again. The CCA observation time used by the equipment shall be declared by the supplier.
- 3) The total time during which an equipment has transmissions on a given hopping frequency without re-evaluating the availability of that frequency is defined as the Channel Occupancy Time. The Channel Occupancy Time for a given hopping frequency, which starts immediately after a successful CCA, shall be less than 60 ms followed by an Idle Period of minimum 5 % of the Channel Occupancy Time with a minimum of 100 μ s. After this, the procedure as in step 1 shall be repeated before having new transmissions on this hopping frequency during the same dwell time.

EXAMPLE: A system with a dwell time of 400 ms can have 6 transmission sequences of 60 ms each, Separated with an Idle Period of 3 ms. Each transmission sequence was preceded with a successful CCA check of 120 μ s.

NOTE: For LBT based frequency hopping systems with a dwell time < 60 ms, the maximum Channel Occupancy Time is limited by the dwell time.

- 4) Unavailable' channels may be removed from or may remain in the hopping sequence, but in any case:
- there shall be no transmissions on 'unavailable' channels;
 - a minimum of 15 hopping frequencies shall always be maintained.
- 5) The detection threshold shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the detection threshold level (TL) shall be equal or lower than -70 dBm/MHz at the input to the receiver (assuming a 0 dBi receive antenna). For power levels below 20 dBm e.i.r.p., the detection threshold level may be relaxed to $TL = -70 \text{ dBm/MHz} + 20 - P_{out} \text{ e.i.r.p. (Pout in dBm)}$.

Adaptive Frequency Hopping using other forms of DAA (non-LBT based)

Adaptive Frequency Hopping equipment using non-LBT based DAA, shall comply with the following minimum set of requirements:

- 1) During normal operation, the equipment shall evaluate the presence of a signal for each of its hopping frequencies. If it is determined that a signal is present with a level above the detection threshold defined in step 5, the hopping frequency shall be marked as 'unavailable'.
- 2) The frequency shall remain unavailable for a minimum time equal to 1 second or 5 times the actual number of hopping frequencies multiplied with the Channel Occupancy Time whichever is the longest. There shall be no transmissions during this period on this frequency. After this, the hopping frequency may be considered again as an 'available' frequency.
- 3) The total time during which an equipment has transmissions on a given hopping frequency without re-evaluating the availability of that frequency is defined as the Channel Occupancy Time. The Channel Occupancy Time for a given hopping frequency shall be less than 40 ms. For equipment using a dwell time > 40 ms that want to have other transmissions during the same hop (dwell time) an Idle Period (no transmissions) of minimum 5 % of the Channel Occupancy Period with a minimum of 100 μ s shall be implemented. After this, the procedure as in step 1 need to be repeated before having new transmissions on this hopping frequency during the same dwell time.

EXAMPLE: A system with a dwell time of 400 ms can have 9 transmission sequences of 40 ms each, Separated with an Idle Period of 3 ms.

NOTE: For non-LBT based frequency hopping systems with a dwell time < 40 ms, the maximum Channel Occupancy Time may be non-contiguous, i.e. spread over a number of hopping sequences (equal to 40 msec divided by the dwell time [msec]).

- 4) 'Unavailable' channels may be removed from or may remain in the hopping sequence, but in any case:
 - there shall be no transmissions on 'unavailable' channels;
 - a minimum of 15 hopping frequencies shall always be maintained.
- 5) The detection threshold shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the detection threshold level (TL) shall be equal or lower than -70 dBm/MHz at the input to the receiver (assuming a 0 dBi receive antenna). For power levels below 20 dBm e.i.r.p., the detection threshold level may be relaxed to $TL = -70 \text{ dBm/MHz} + 20 - P_{out}$ e.i.r.p. (P_{out} in dBm).

Non-LBT based Detect and Avoid

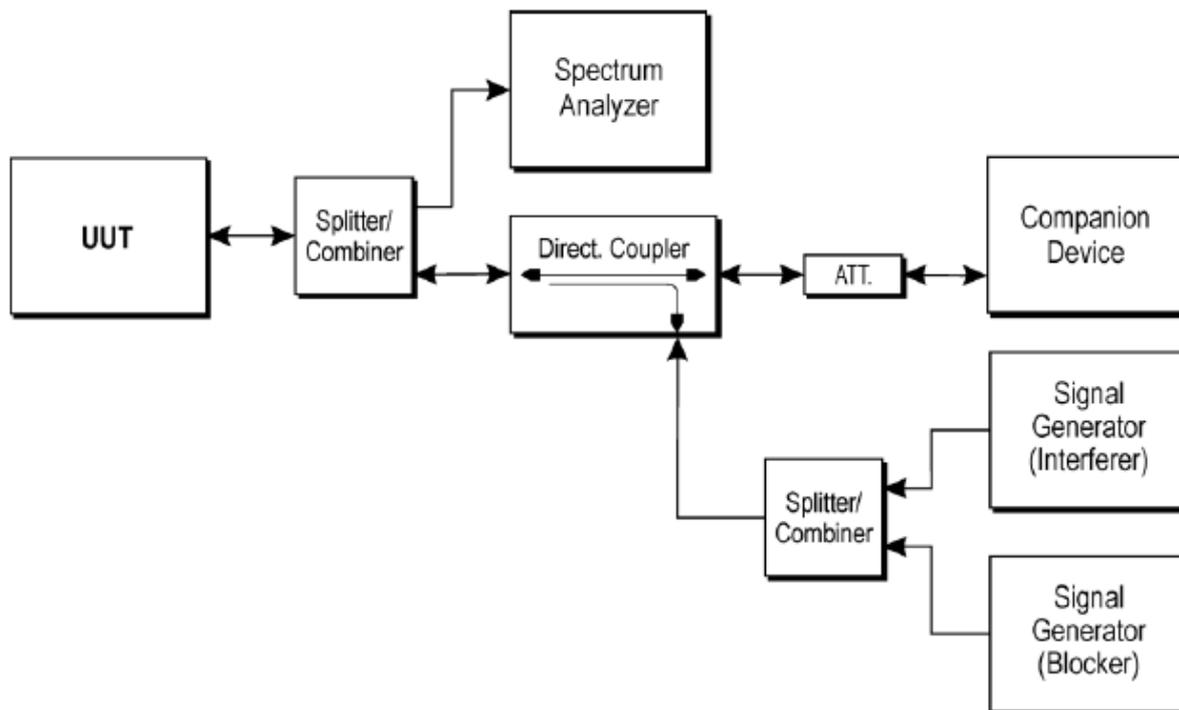
Equipment using a modulation other than FHSS and using the non-LBT based Detect and Avoid mechanism, shall comply with the following minimum set of requirements:

- 1) During normal operation, the equipment shall evaluate the presence of a signal on its current operating channel. If it is determined that a signal is present with a level above the detection threshold defined in 4), the channel shall be marked as 'unavailable'.
- 2) The channel shall remain unavailable for a minimum time equal to 1 s after which the channel may be Considered again as an 'available' channel.
- 3) The total time during which an equipment has transmissions on a given channel without re-evaluating The availability of that channel, is defined as the Channel Occupancy Time.
- 4) The Channel Occupancy Time shall be less than 40 ms. Each such transmission sequence shall be followed with an Idle Period (no transmissions) of minimum 5 % of the Channel Occupancy Time with a minimum of 100 μ s. After this, the procedure as in step 1 needs to be repeated.
- 5) The detection threshold shall be proportional to the transmit power of the transmitter: for a 20 dBm e.i.r.p. transmitter the detection threshold level (TL) shall be equal or lower than -70 dBm/MHz at the input to the receiver (assuming a 0 dBi receive antenna). For power levels below 20 dBm e.i.r.p., the detection threshold level may be relaxed to $TL = -70 \text{ dBm/MHz} + 20 - P_{out} \text{ e.i.r.p.}$ (P_{out} in dBm).

LBT based Detect and Avoid

The present document defines 2 types of adaptive equipment using wide band modulations other than FHSS and that uses an LBT based Detect and Avoid mechanism: Frame Based Equipment and Load Based Equipment. Adaptive equipment which is capable of operating as either Load Based Equipment or as Frame Based Equipment is allowed to switch dynamically between these types of operation.

Test Configuration



TEST PROCEDURE

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

The spectrum analyser sweep was triggered by the start of the interfering signal, with the interfering signal present, a 100 % duty cycle CW signal is inserted as the blocking signal.

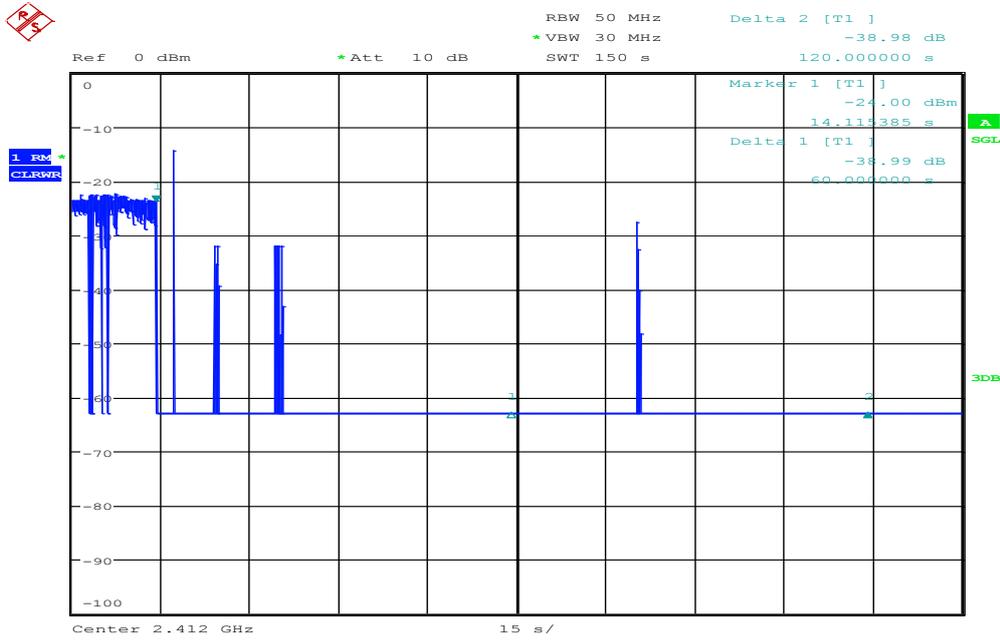
TEST RESULTS

IEEE 802.11b Mode	Signal duration after interfering (s)	
	2412	2472
	Pass	Pass

IEEE 802.11g Mode	Signal duration after interfering (s)	
	2412	2472
	Pass	Pass

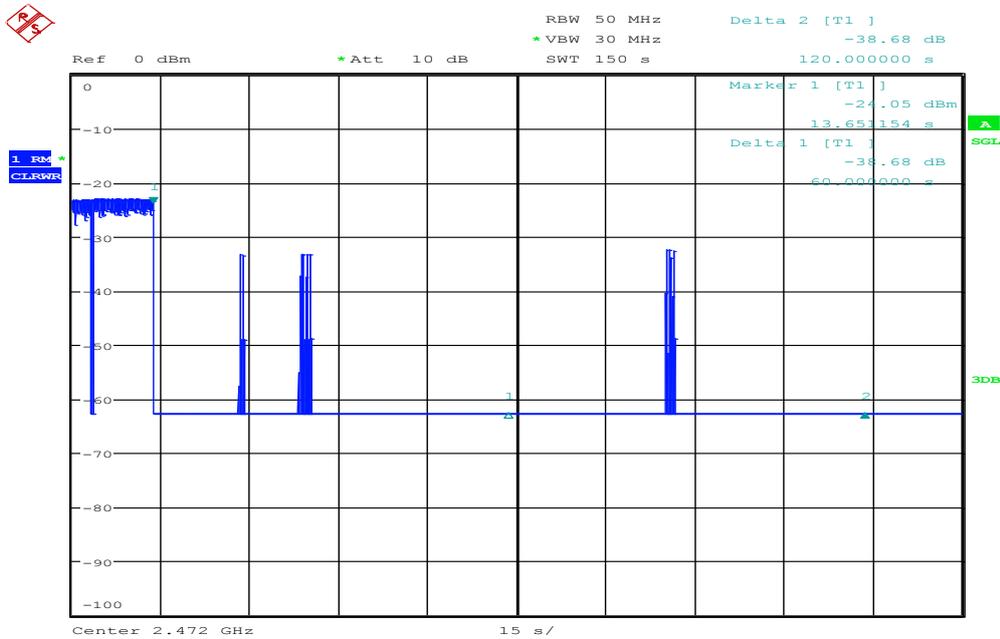
IEEE 802.11n 20 MHz Mode	Signal duration after interfering (s)	
	2412	2472
	Pass	Pass

Test results: IEEE 802.11b Mode, Low



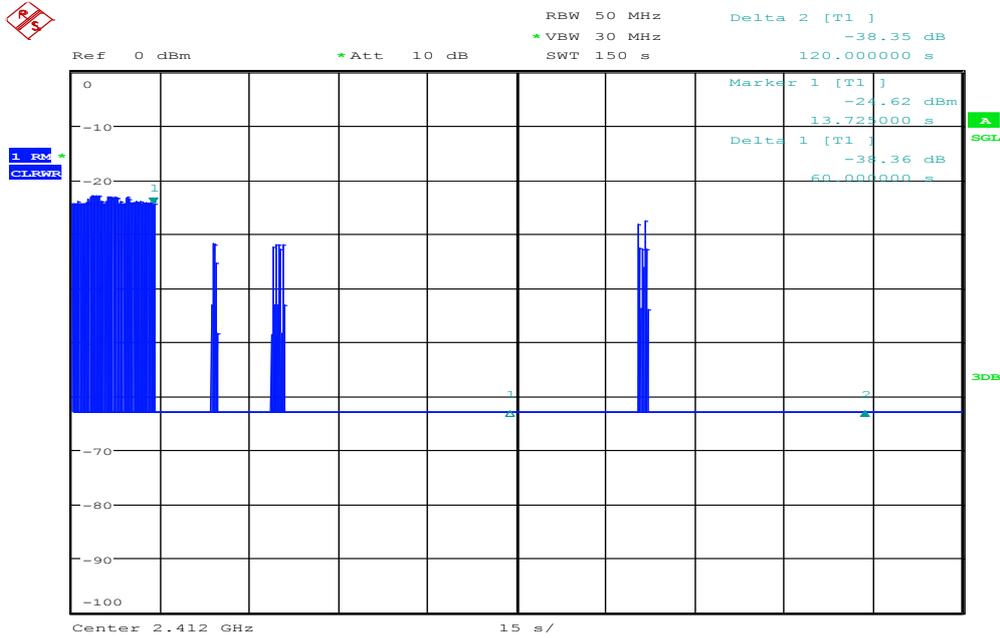
Date: 20.DEC.2017 15:12:14

Test results: IEEE 802.11b Mode, High



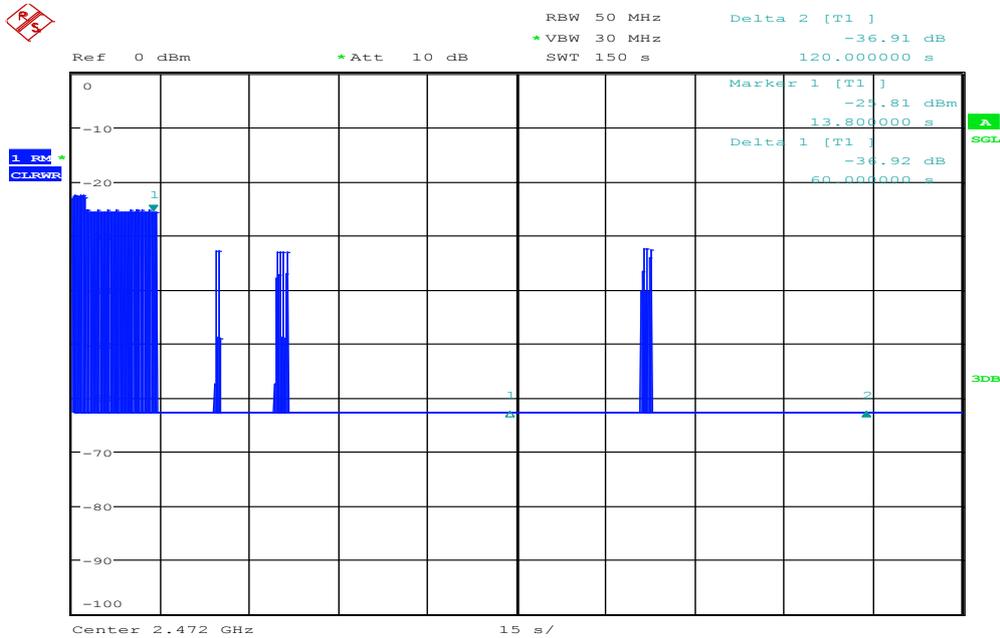
Date: 20.DEC.2017 15:27:59

Test results: IEEE 802.11g Mode, Low



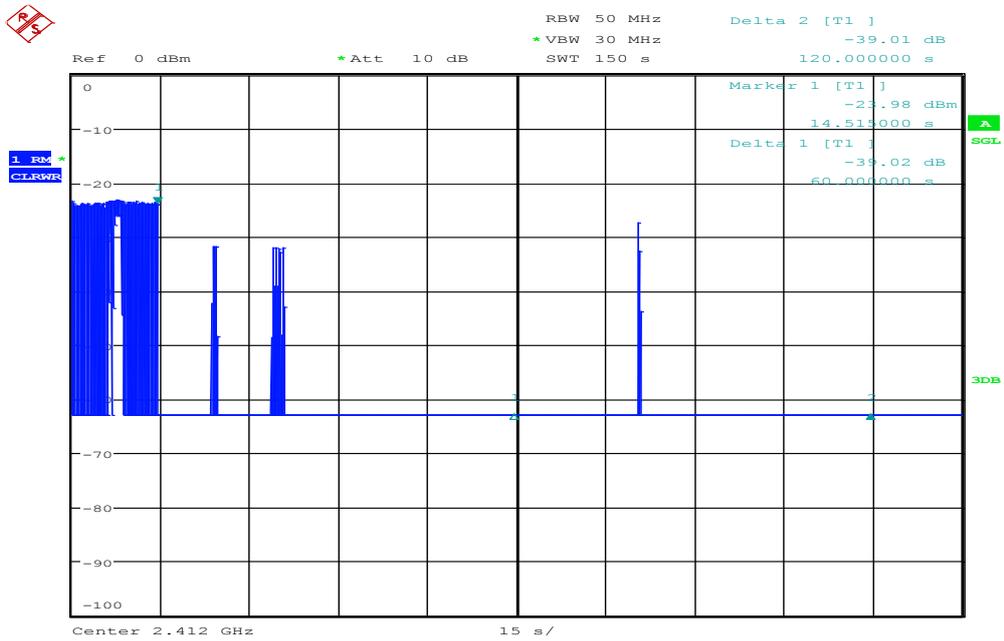
Date: 20.DEC.2017 15:43:08

Test results: IEEE 802.11g Mode, High



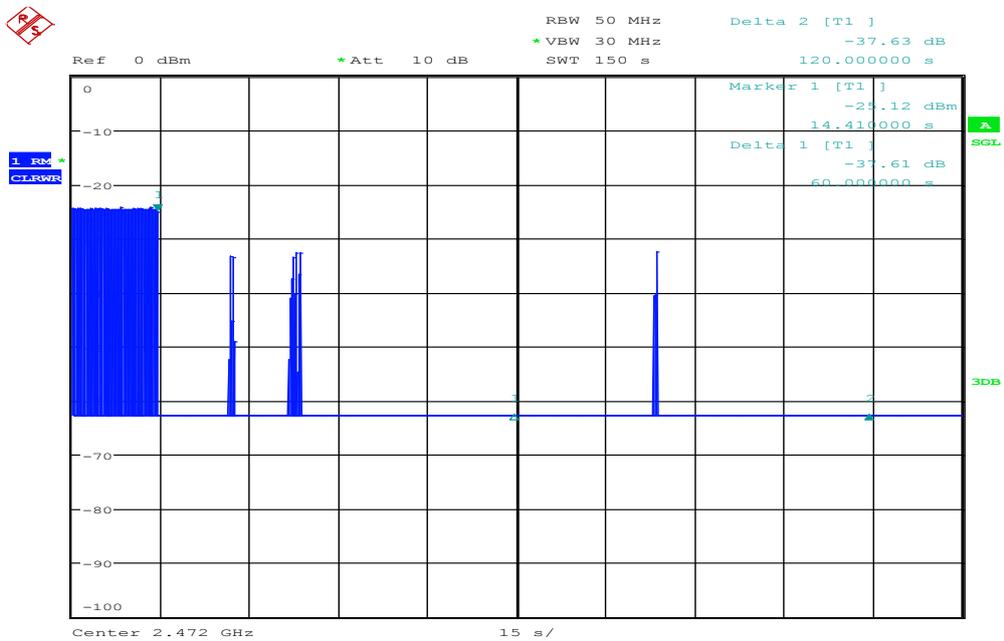
Date: 20.DEC.2017 15:53:08

Test results: IEEE 802.11n 20 MHz Mode, Low



Date: 20.DEC.2017 14:55:30

Test results: IEEE 802.11n 20 MHz Mode, High



Date: 20.DEC.2017 14:28:59

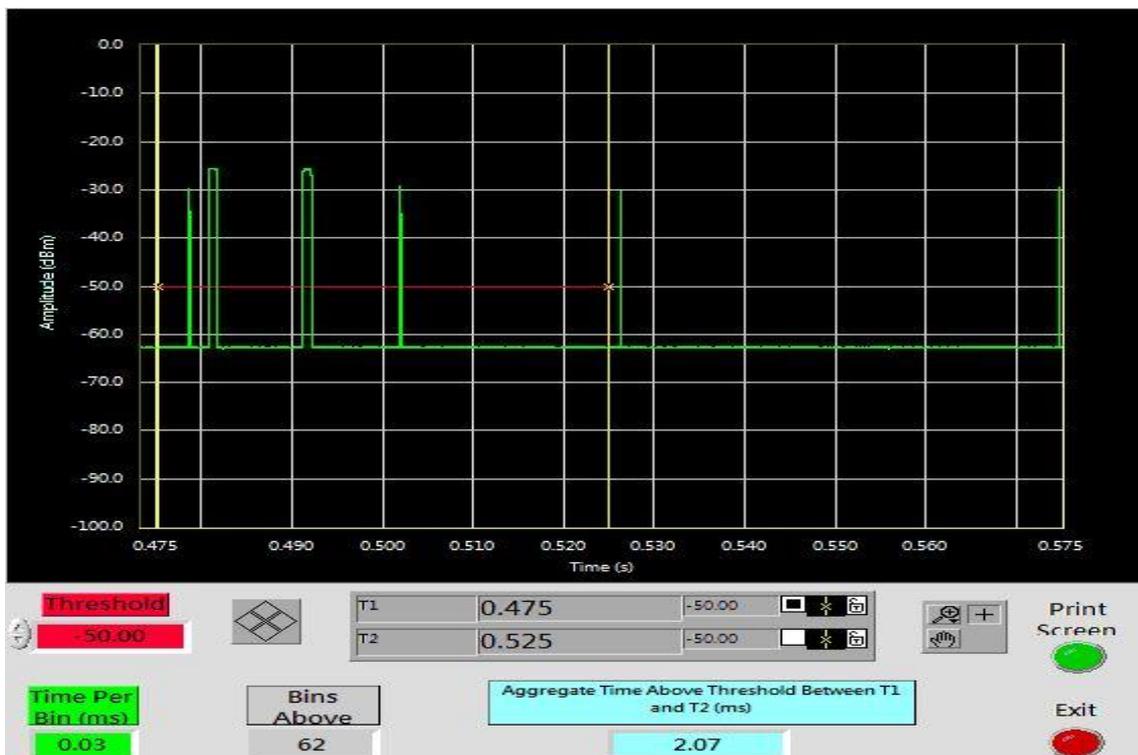
TEST RESULTS

Short Control Signalling Transmissions			
Mode	Maximum duty cycle(ms)		Limit(ms)
	2412	2472	
IEEE 802.11b Mode	4.00	2.07	5
IEEE 802.11g Mode	3.97	4.03	5
IEEE 802.11n 20 MHz Mode	4.00	3.97	5

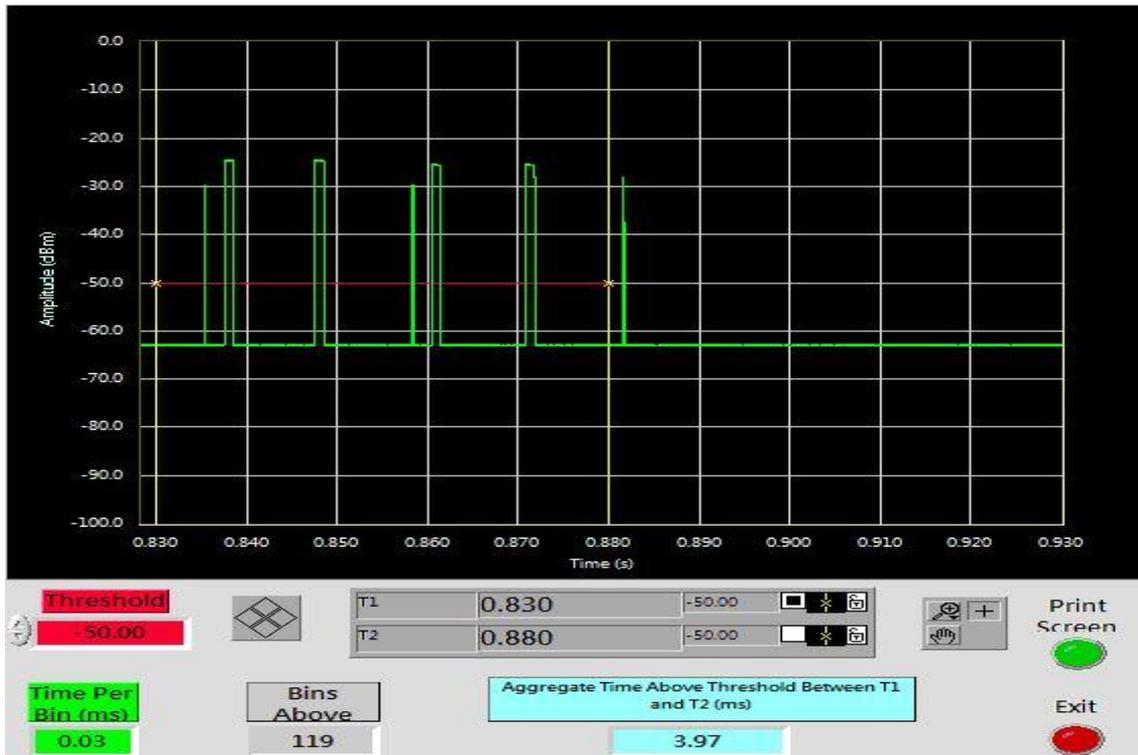
Test results: IEEE 802.11b / Low



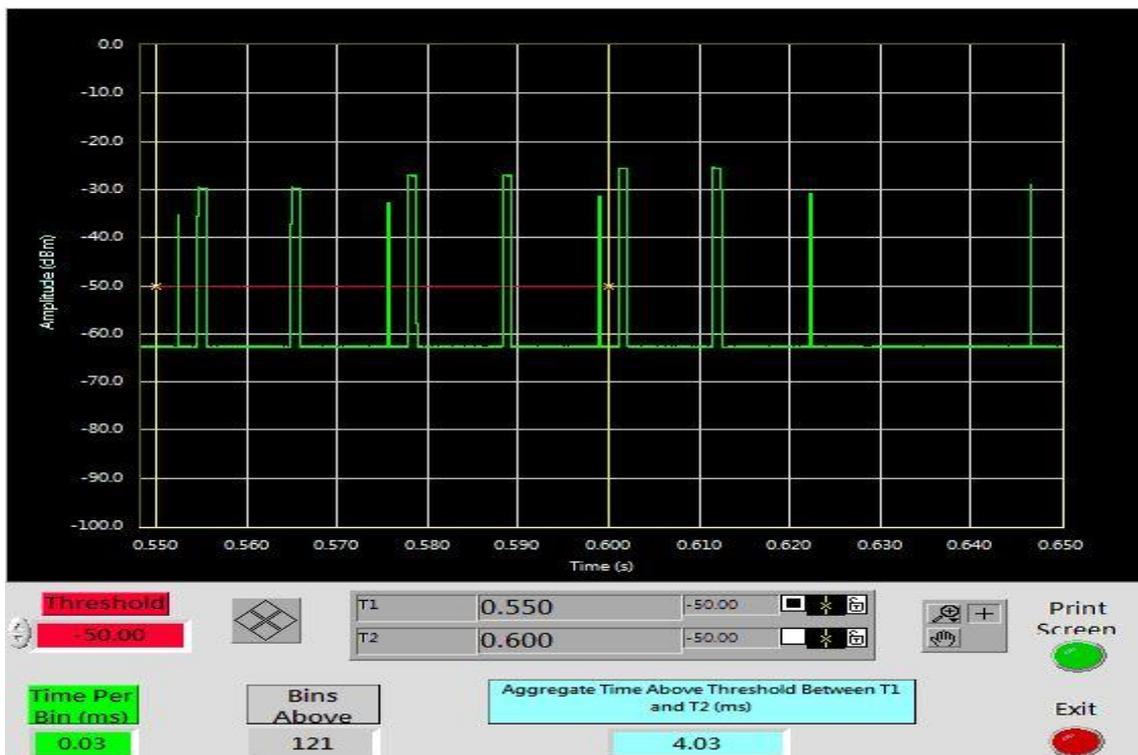
Test results: IEEE 802.11b / High



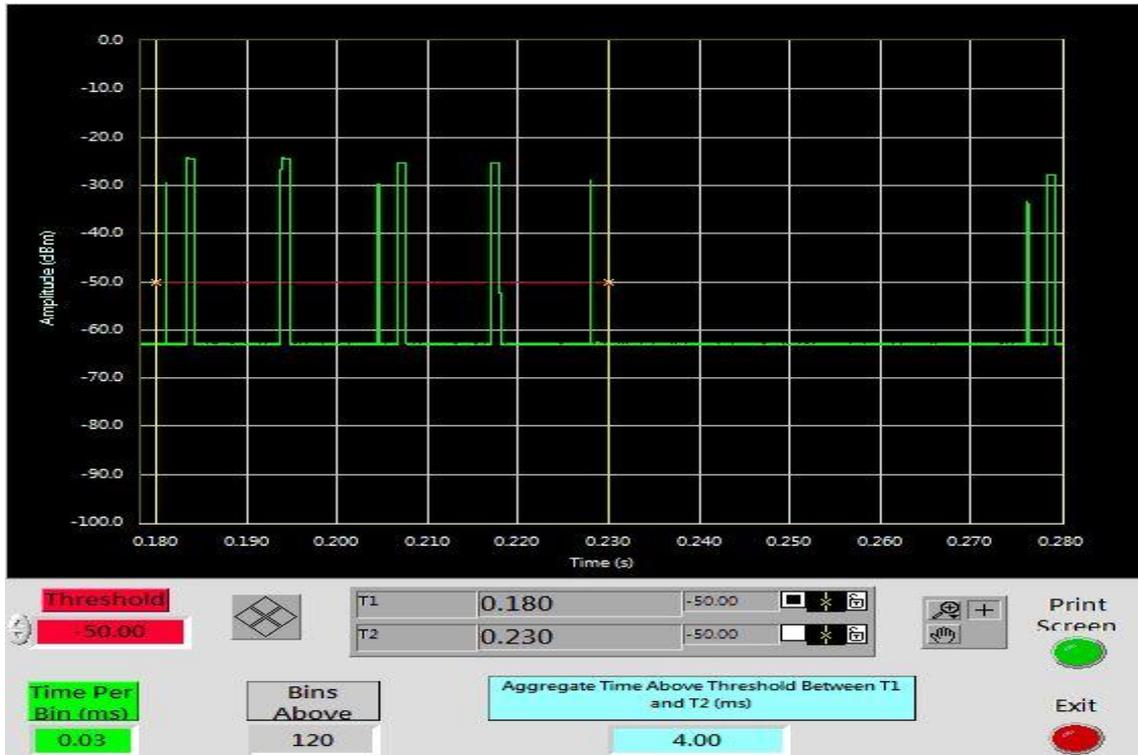
Test results: IEEE 802.11g / Low



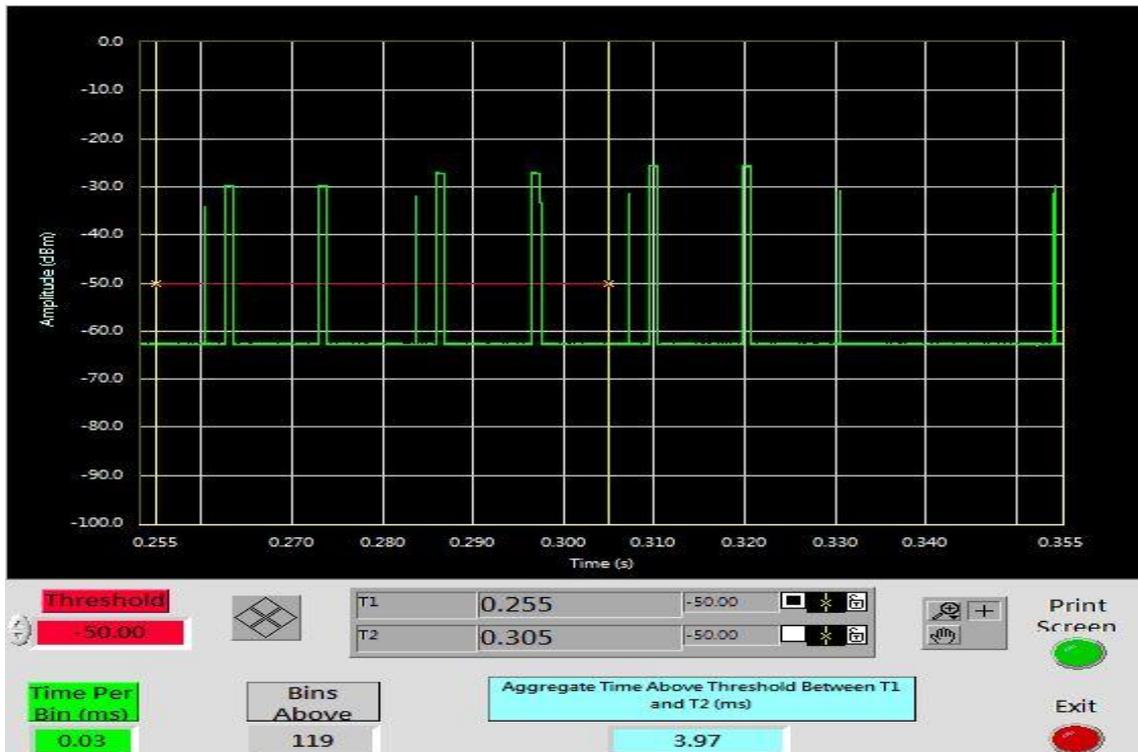
Test results: IEEE 802.11g / High



Test results: IEEE 802.11n 20 / Low

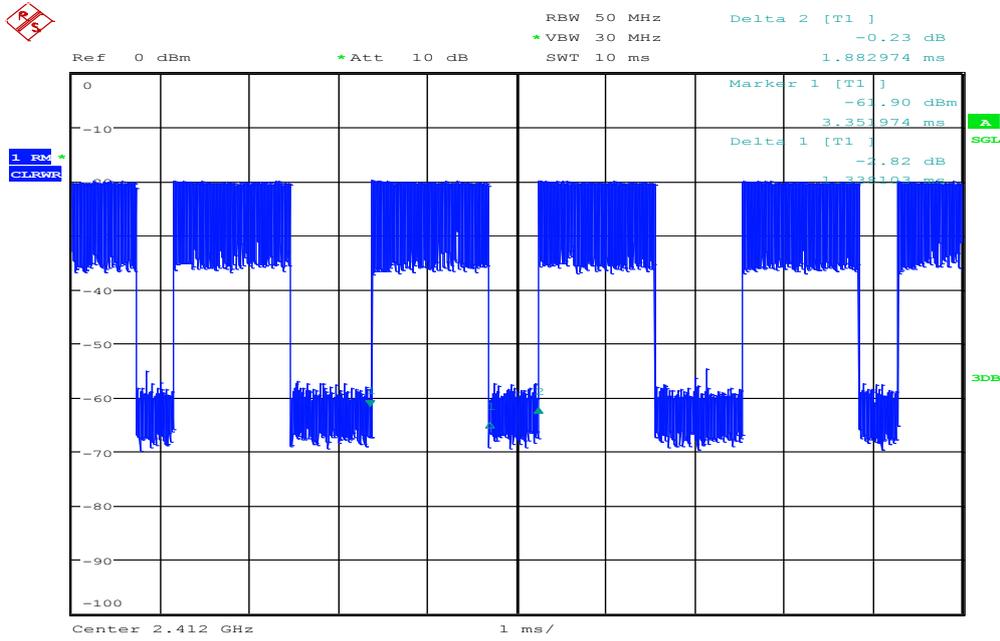


Test results: IEEE 802.11n 20 / High



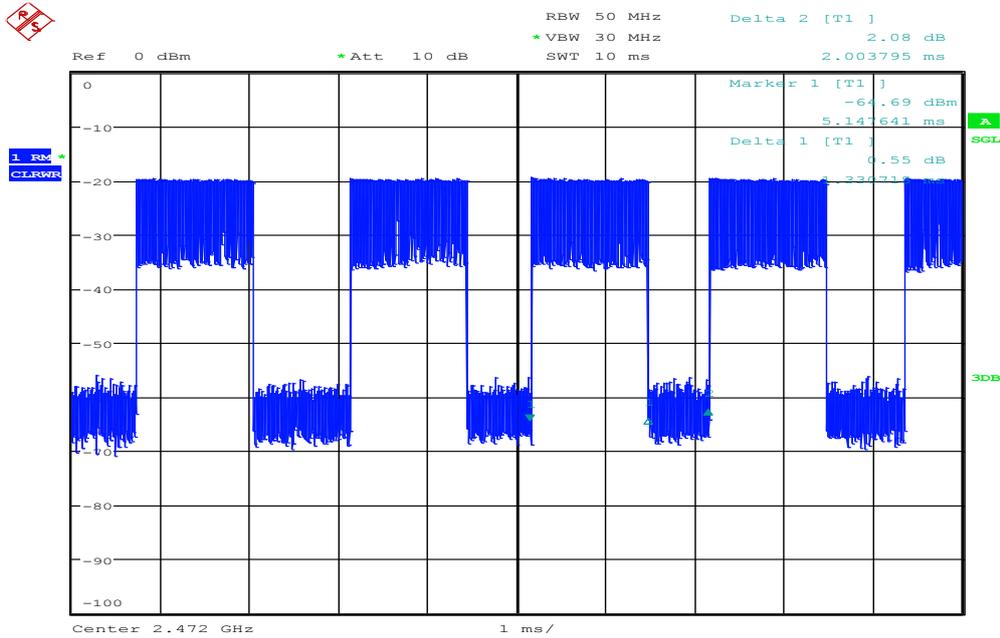
Occupancy time

Test results: IEEE 802.11b Mode / Low



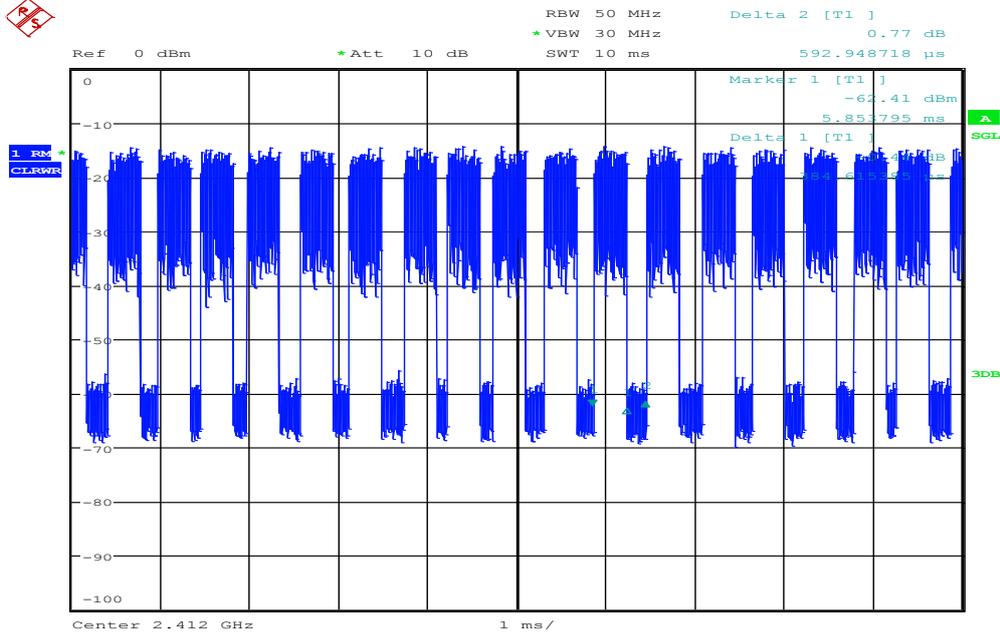
Date: 20.DEC.2017 15:08:14

Test results: IEEE 802.11b Mode / High



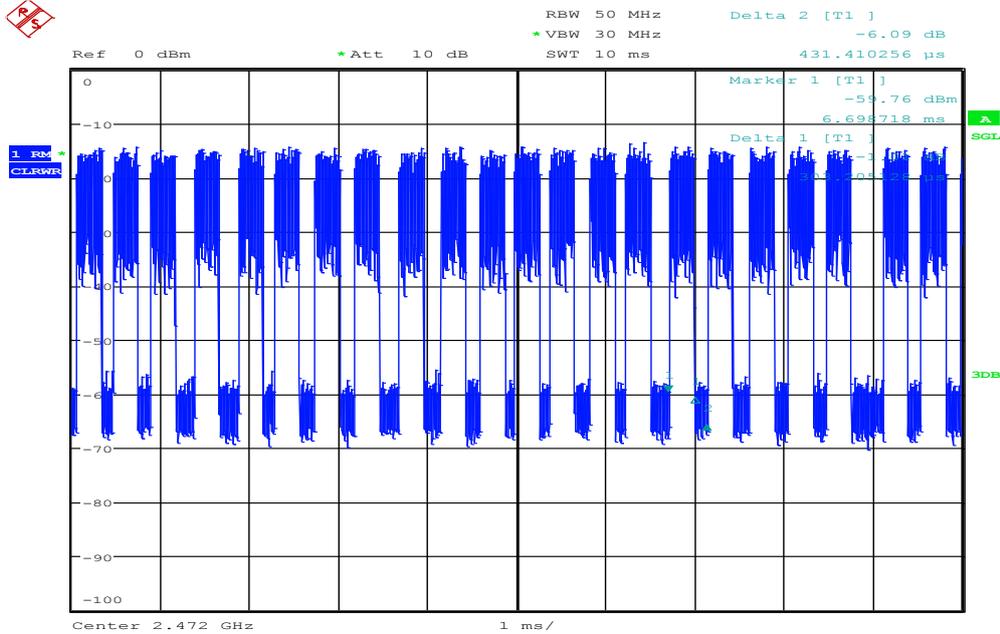
Date: 20.DEC.2017 15:23:49

Test results: IEEE 802.11g Mode / Low



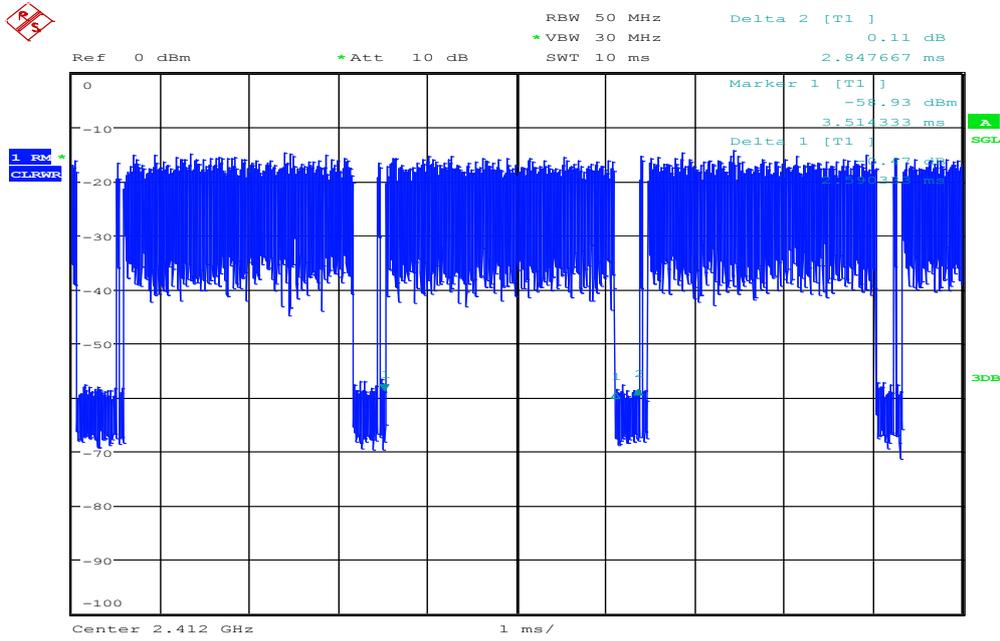
Date: 20.DEC.2017 15:37:13

Test results: IEEE 802.11g Mode / High



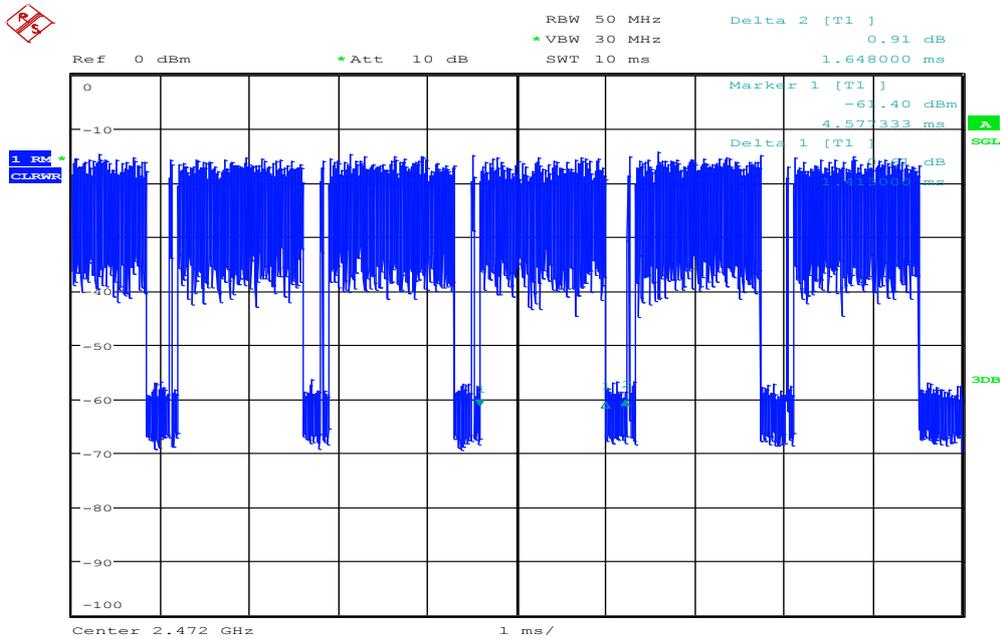
Date: 20.DEC.2017 15:49:33

Test results: IEEE 802.11n 20 MHz Mode / Low



Date: 20.DEC.2017 14:48:50

Test results: IEEE 802.11n 20 MHz Mode / High



Date: 20.DEC.2017 14:24:52

7.8 OCCUPIED CHANNEL BANDWIDTH

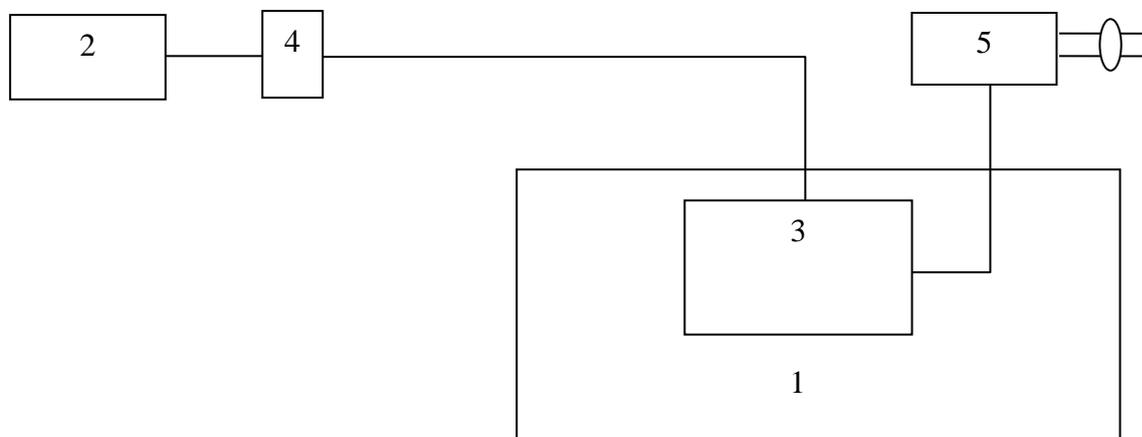
LIMIT

ETSI EN 300 328

For non-adaptive systems using wide band modulations other than FHSS and with e.i.r.p greater than 10 dBm, the occupied channel bandwidth shall be less than 20 MHz.

For non-adaptive Frequency Hopping equipment with e.i.r.p greater than 10 dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than the value declared by the supplier. This declared value shall not be greater than 5 MHz.

Test Configuration



Legend

1. Wooden table
2. Spectrum analyzer
3. EUT
4. DC block
5. Power supply (Refer to power rating of section 2)

TEST PROCEDURE

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

TEST RESULTS

No non-compliance noted.

IEEE 802.11b

Channel	Frequency (MHz)	Bandwidth (MHz)
Low	2412	14.12
High	2472	14.11

Data Rate	Frequency	FL at 99% Bandwidth(MHz)	FH at 99% Bandwidth(MHz)	Limit	Result
1 Mbps	2412	2404.9671	2419.0045	2400	Pass
	2472	2464.9963	2479.0042	2483.5	Pass

IEEE 802.11g

Channel	Frequency (MHz)	Bandwidth (MHz)
Low	2412	16.68
High	2472	16.71

Data Rate	Frequency	FL at 99% Bandwidth(MHz)	FH at 99% Bandwidth(MHz)	Limit	Result
6 Mbps	2412	2403.7515	2420.2495	2400	Pass
	2472	2463.7513	2480.2499	2483.5	Pass

IEEE 802.11n 20 MHz Mode

Channel	Frequency (MHz)	Bandwidth (MHz)
Low	2412	17.85
High	2472	17.87

Data Rate	Frequency	FL at 99% Bandwidth(MHz)	FH at 99% Bandwidth(MHz)	Limit	Result
MCS 8	2412	2403.1434	2420.9824	2400	Pass
	2472	2463.1436	2480.9735	2483.5	Pass

Bluetooth for 4.0

Channel	Frequency (MHz)	Bandwidth (MHz)
Low	2402	1.08
High	2480	1.08

Data Rate	Frequency (MHz)	FL at 99% Bandwidth (MHz)	FH at 99% Bandwidth (MHz)	Limit (MHz)	Result
BLE	2402	2401.5166	2402.6174	2400	Pass
	2480	2479.5136	2480.6146	2483.5	Pass

7.9 TRANSMITTER UNWANTED EMISSIONS IN THE OOB DOMAIN

LIMIT

ETSI EN 300 328

The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask in figure 1.

NOTE: Within the 2 400 MHz to 2 483,5 MHz band, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement in clause 4.3.1.7.

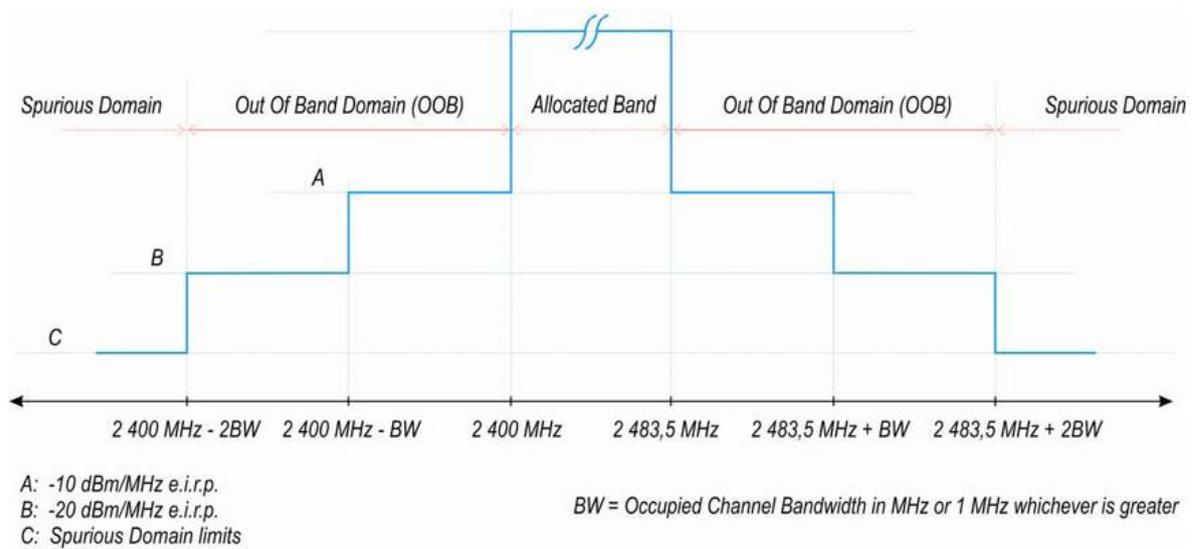
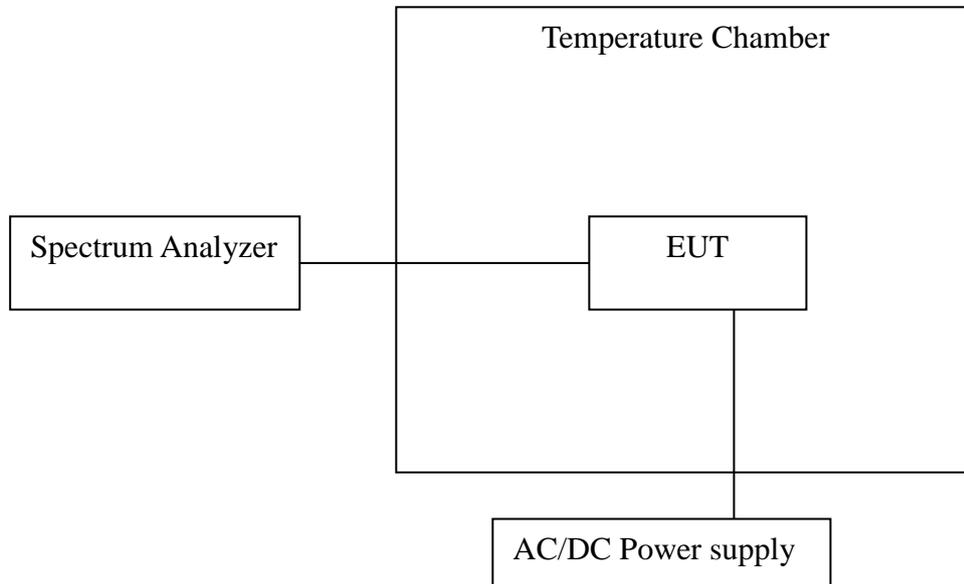


Figure 1: Transmit mask

Test Configuration**Temperature and Voltage Measurement (under normal and extreme test conditions)****TEST PROCEDURE**

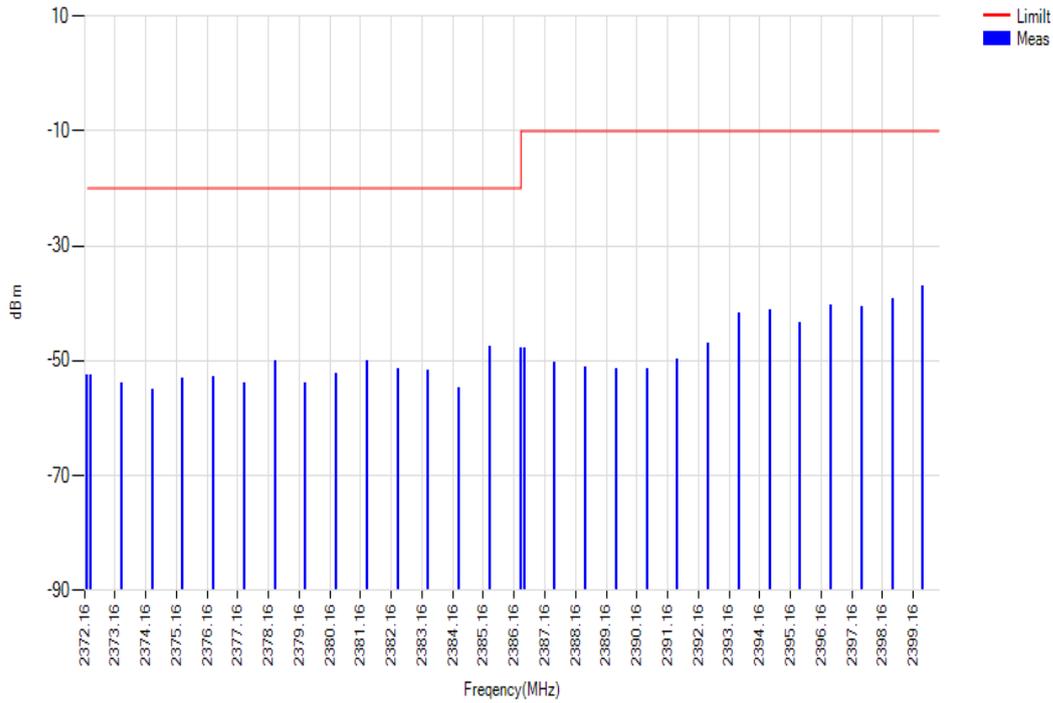
1. Please refer to ETSI EN 300 328 (V2.1.1) for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.1.1) for the measurement method.

TEST RESULTS

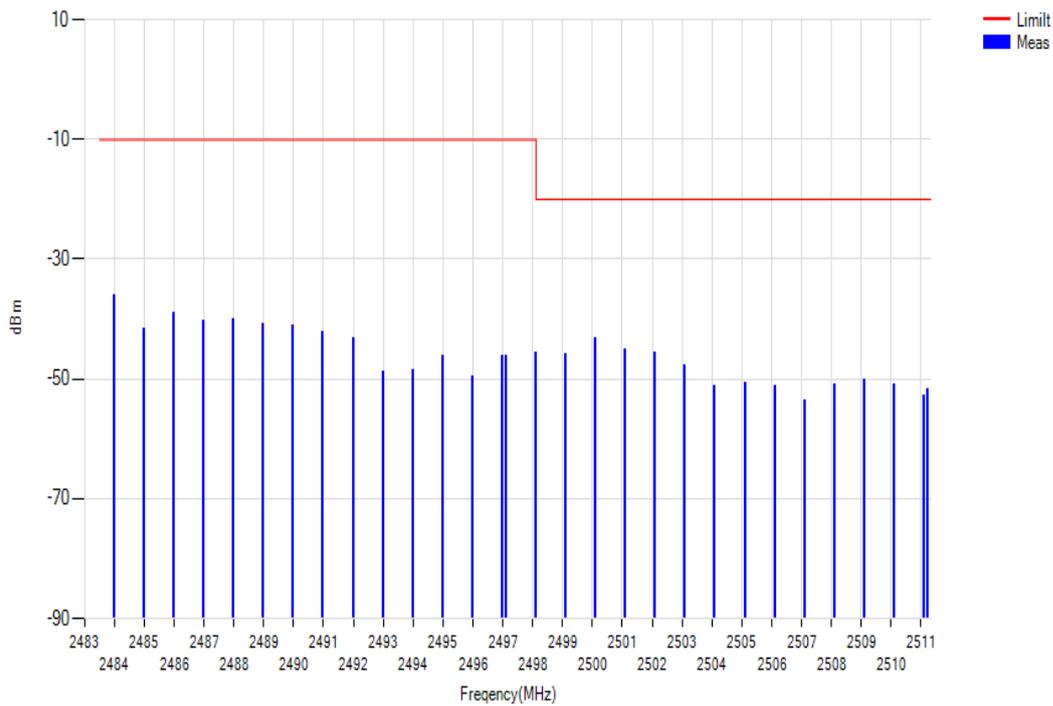
No non-compliance noted.

Test results: 802.11b

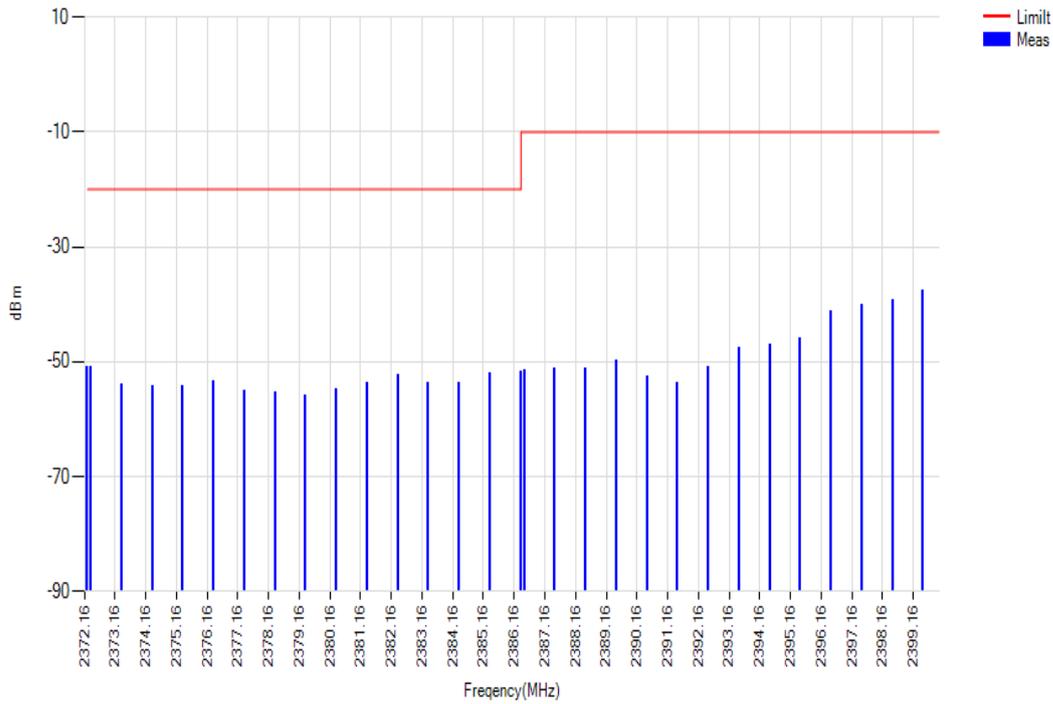
20°C /5v CH Low



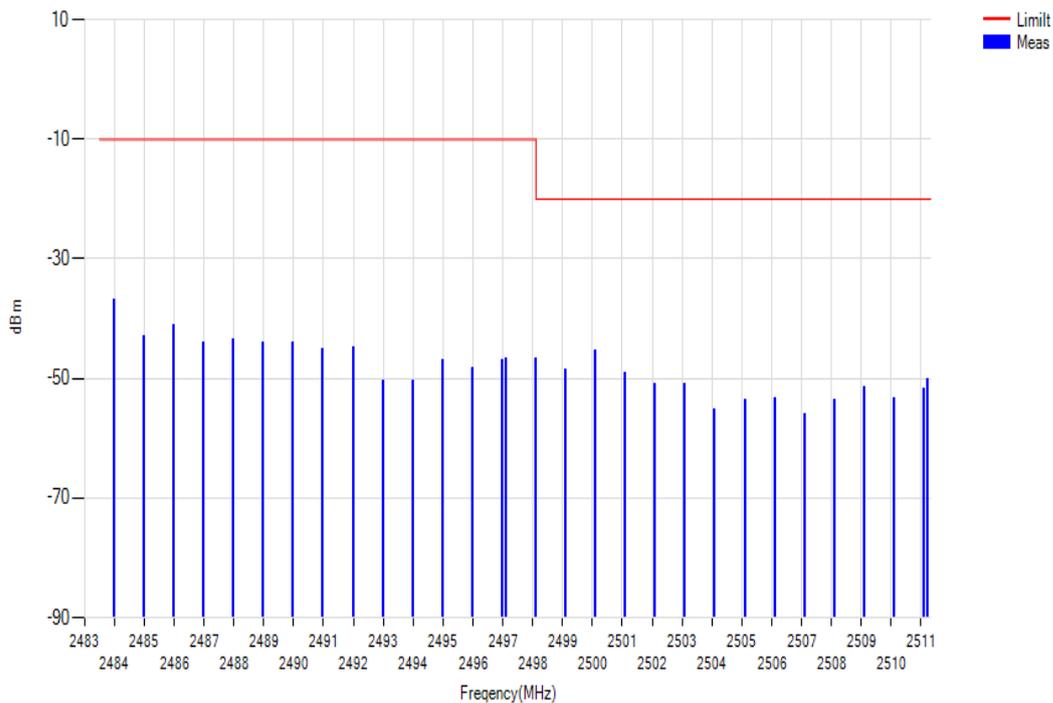
20°C /5v CH High



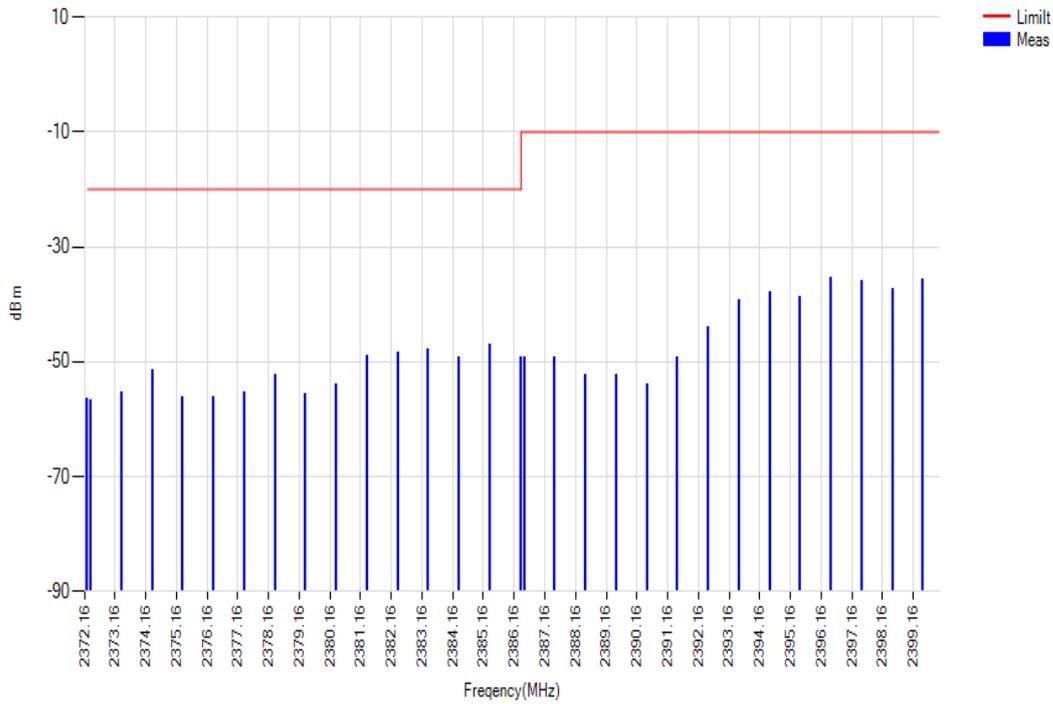
0°C /5v CH Low



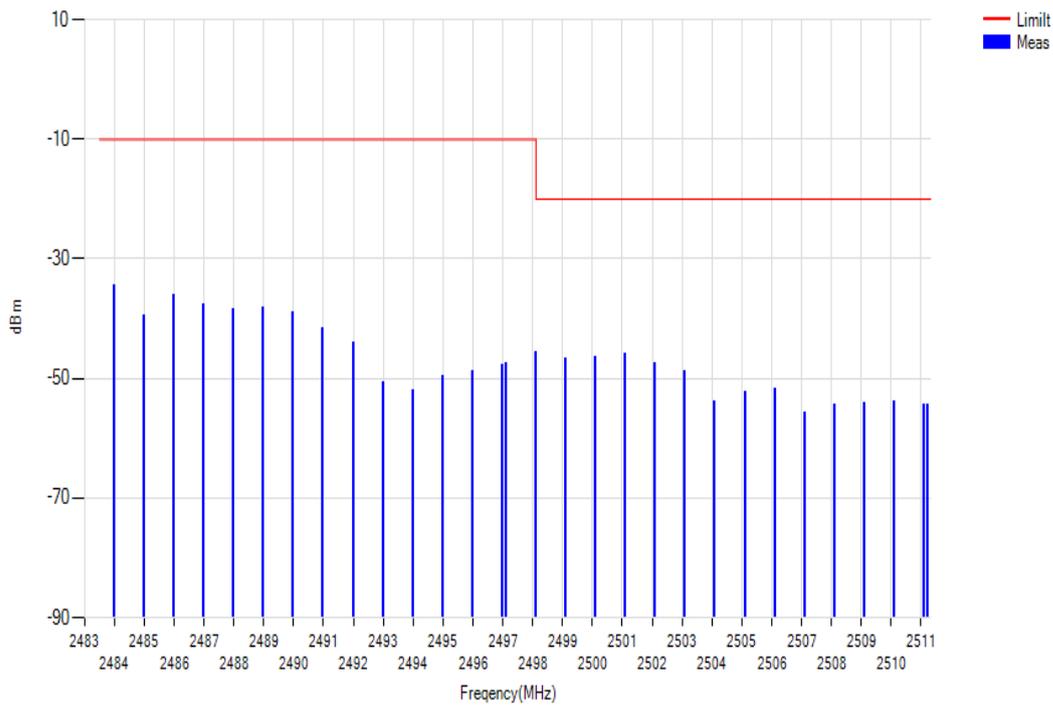
0°C /5v CH High



60°C /5v CH Low

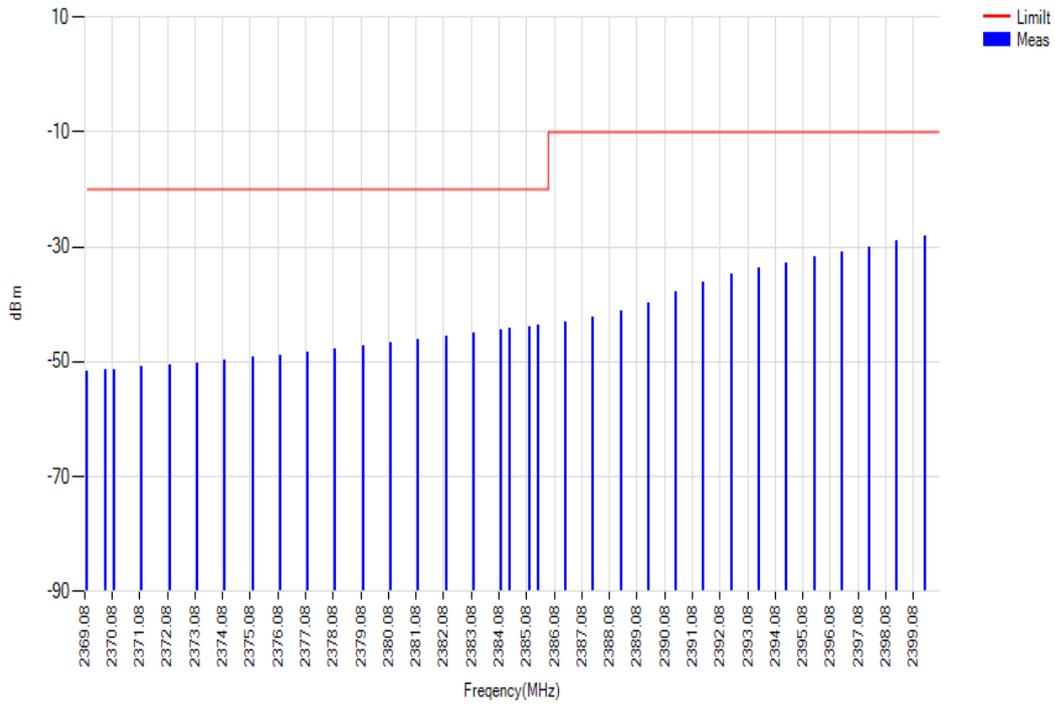


60°C /5v CH High

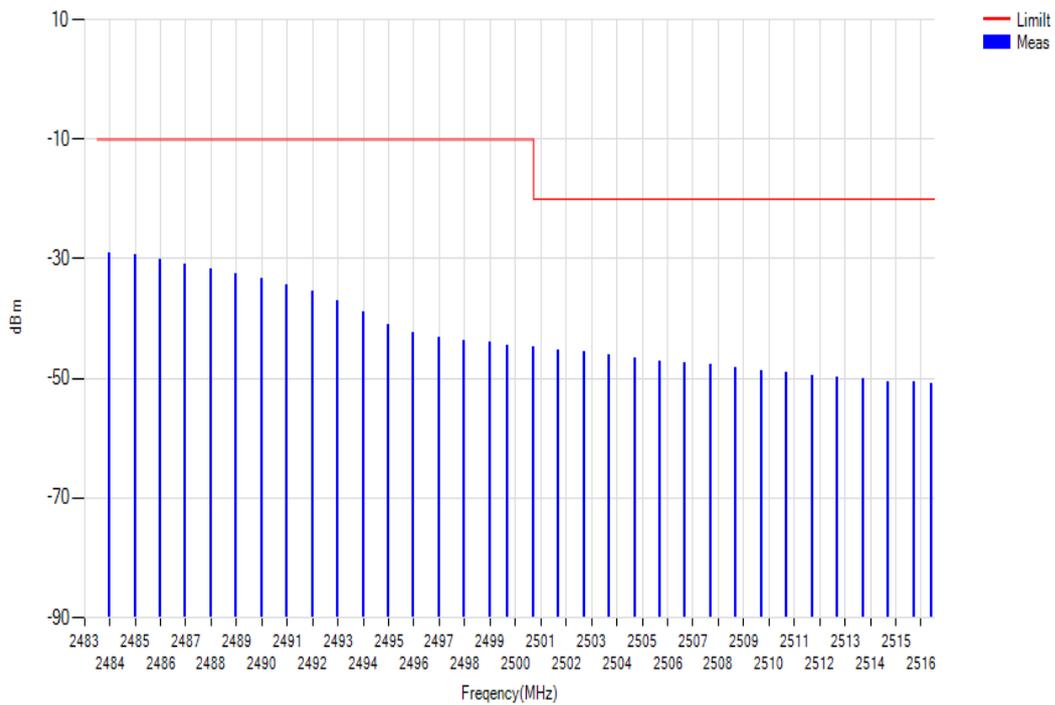


Test results: 802.11g

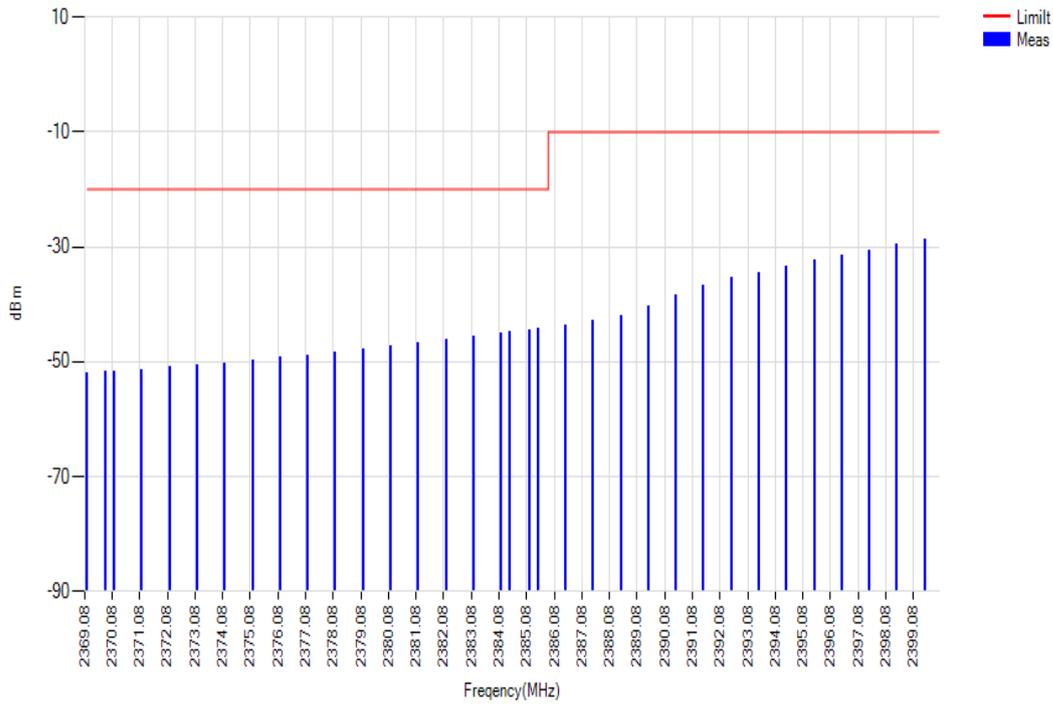
20°C /5v CH Low



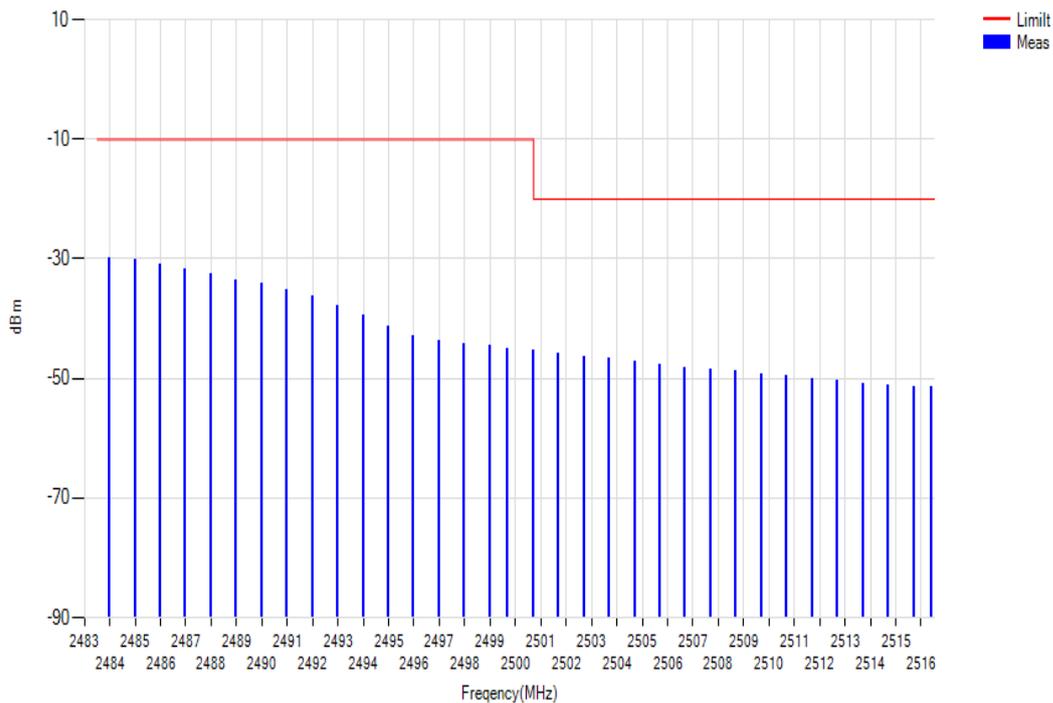
20°C /5v CH High



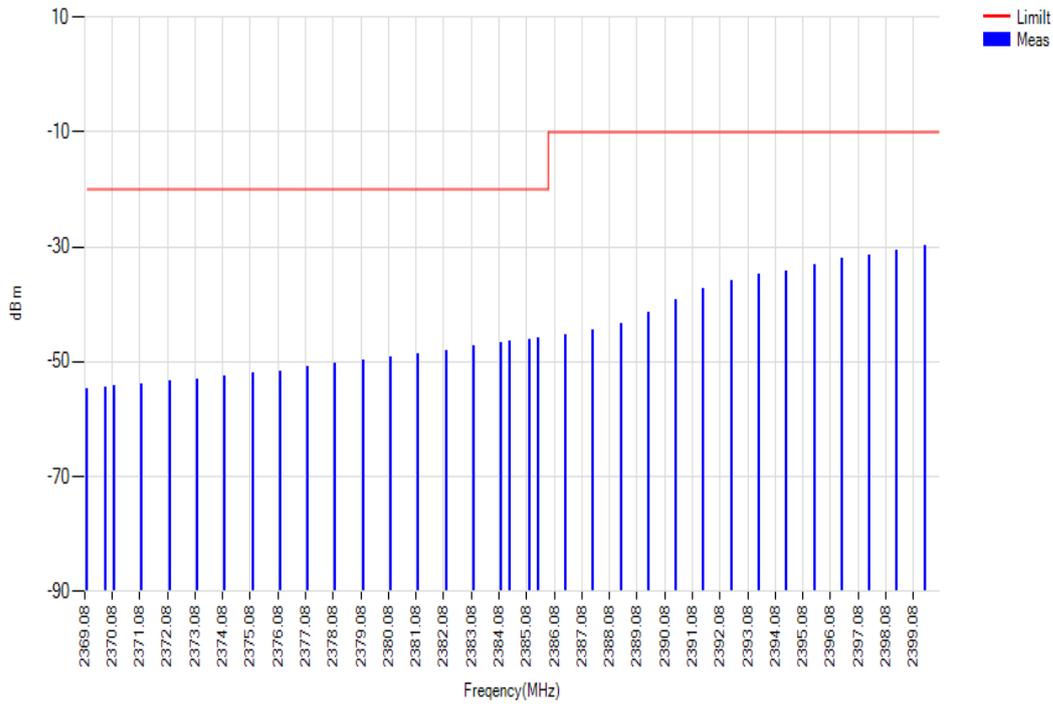
0°C /5v CH Low



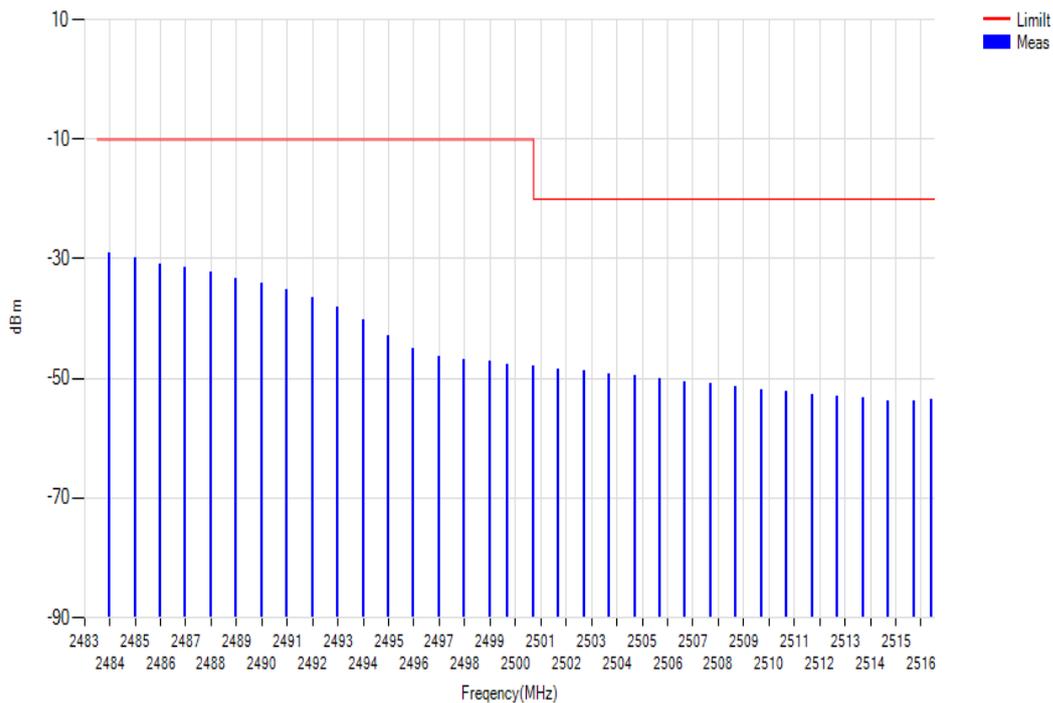
0°C /5v CH High



60°C /5v CH Low

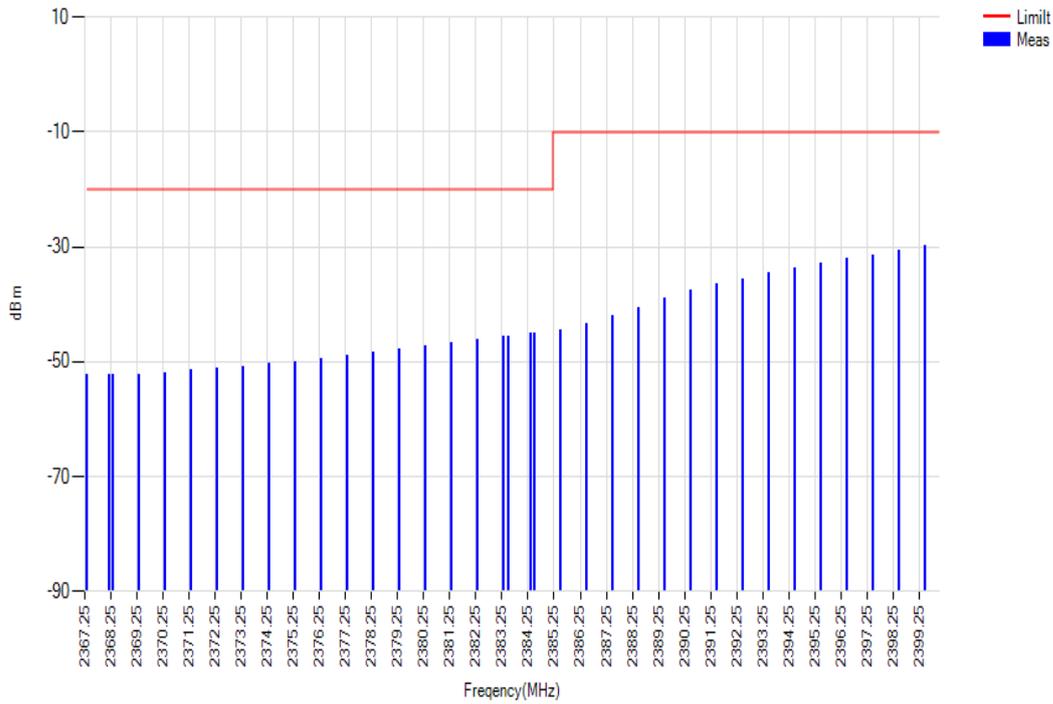


60°C /5v CH High

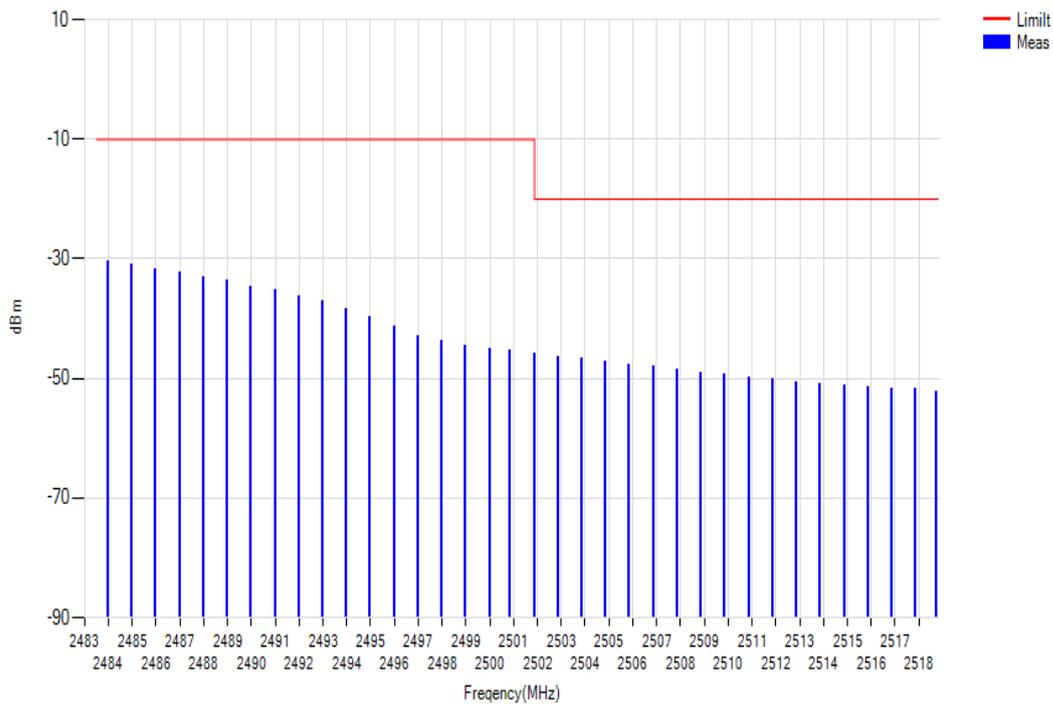


Test results: IEEE 802.11n 20 MHz Mode:

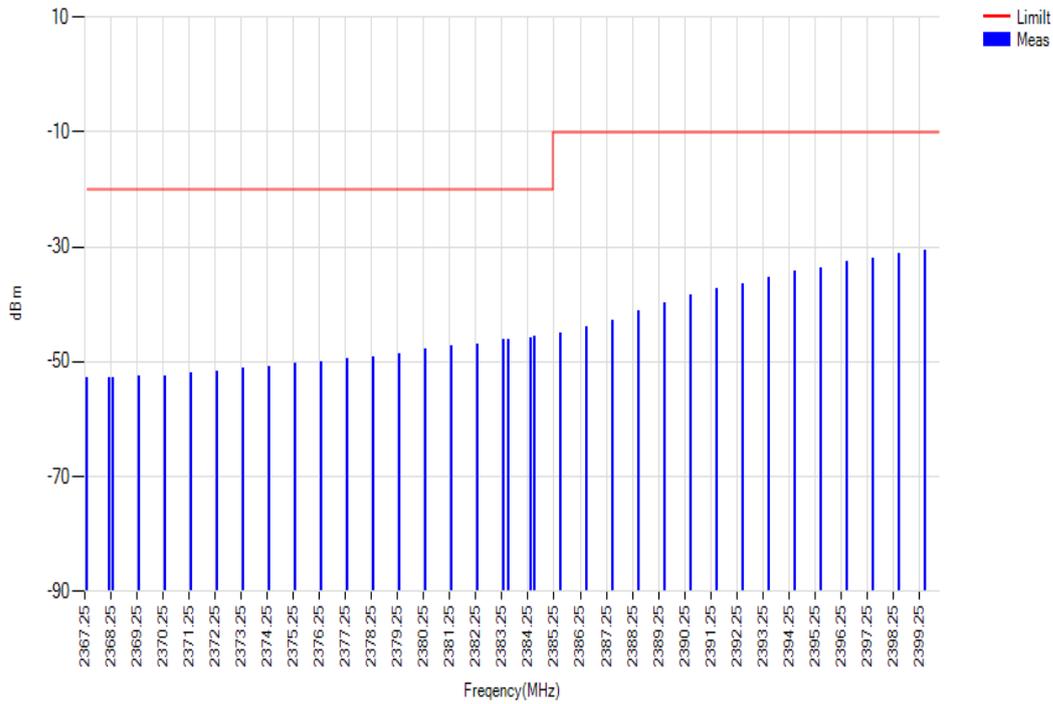
20°C /5v CH Low



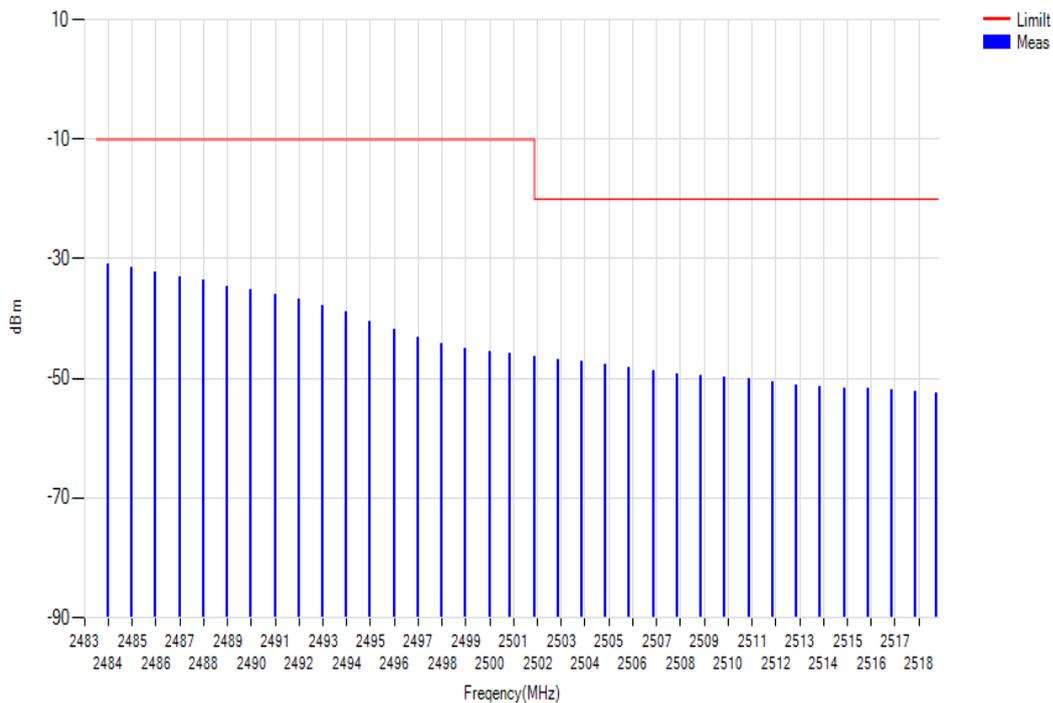
20°C /5v CH High



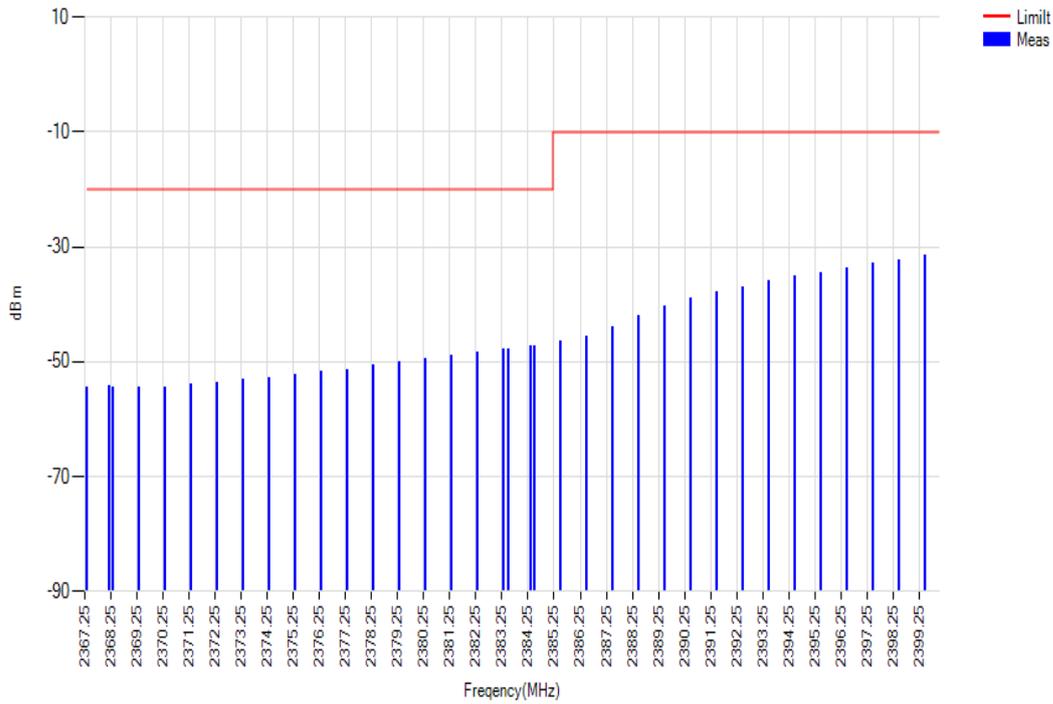
0°C /5v CH Low



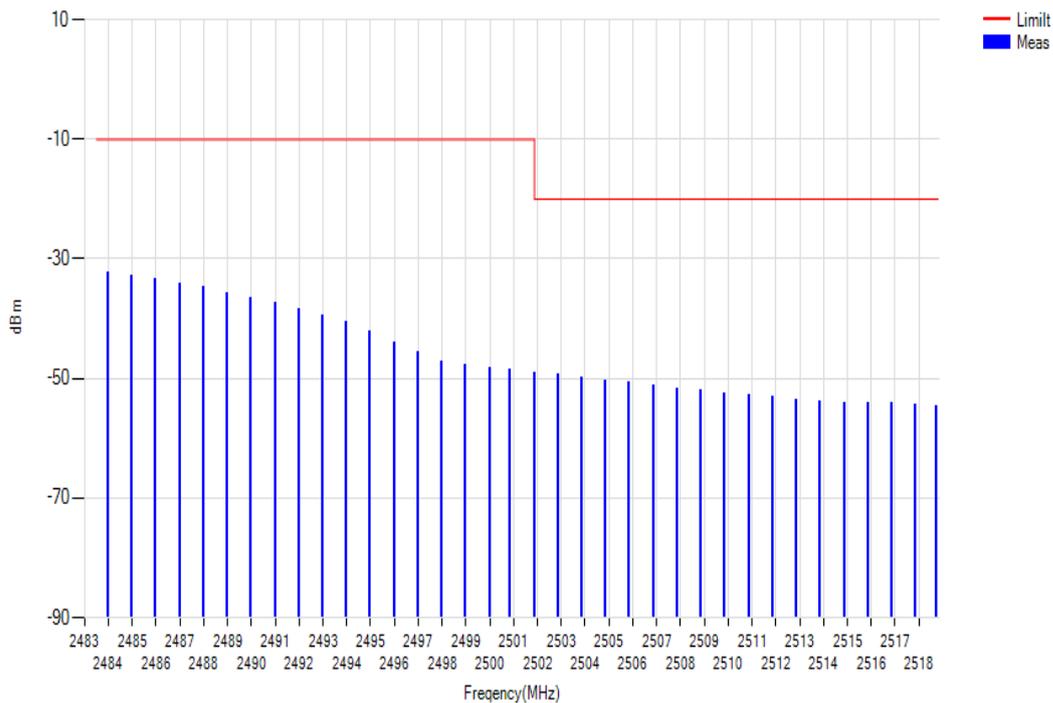
0°C /5v CH High



60°C /5v CH Low

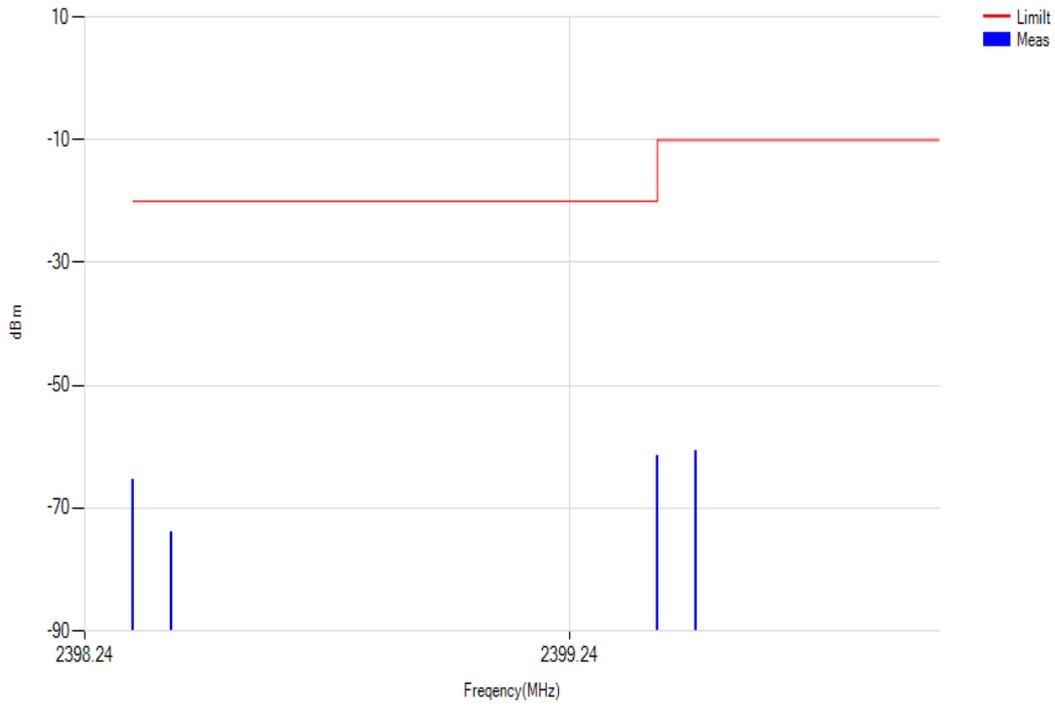


60°C /5v CH High

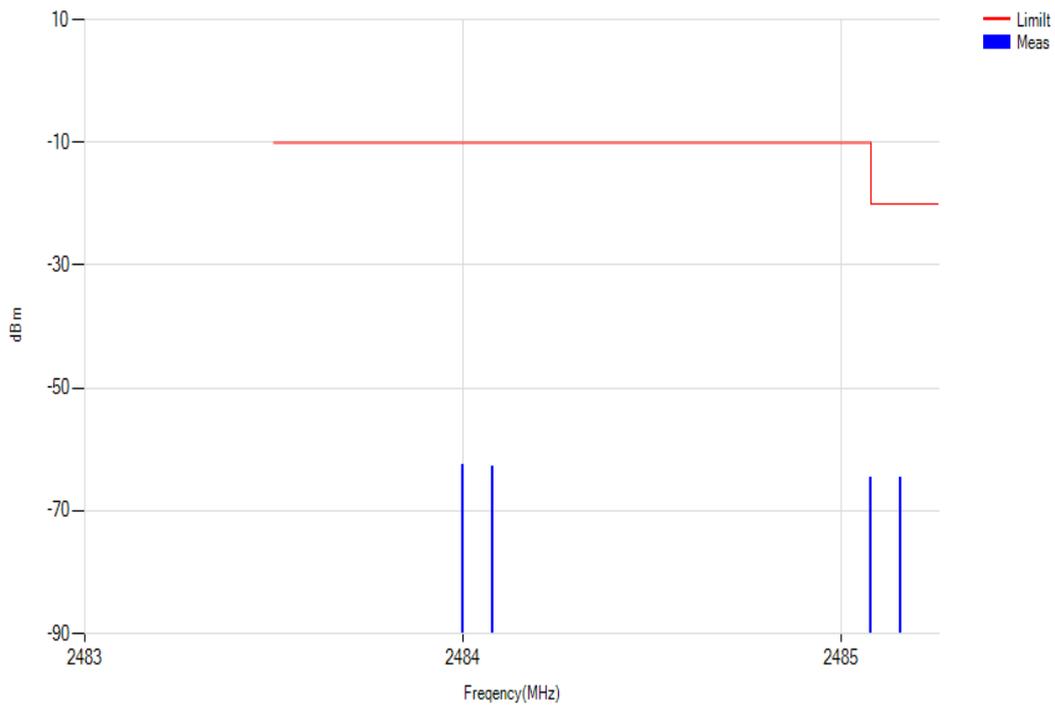


Test results: Bluetooth 4.0

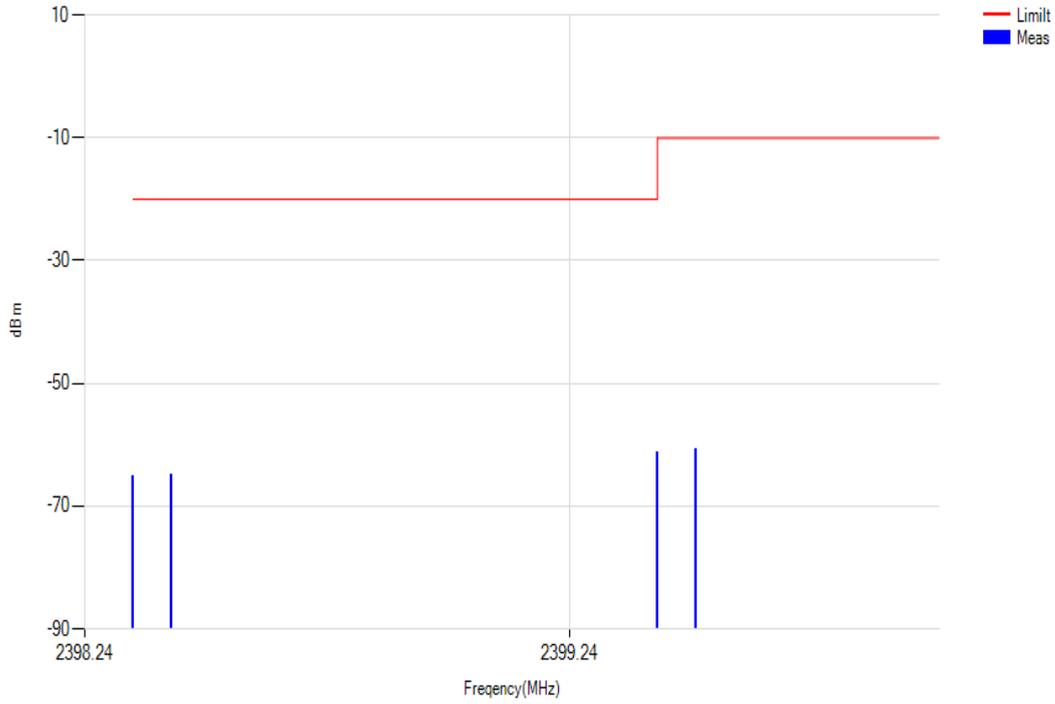
20°C /5v CH Low



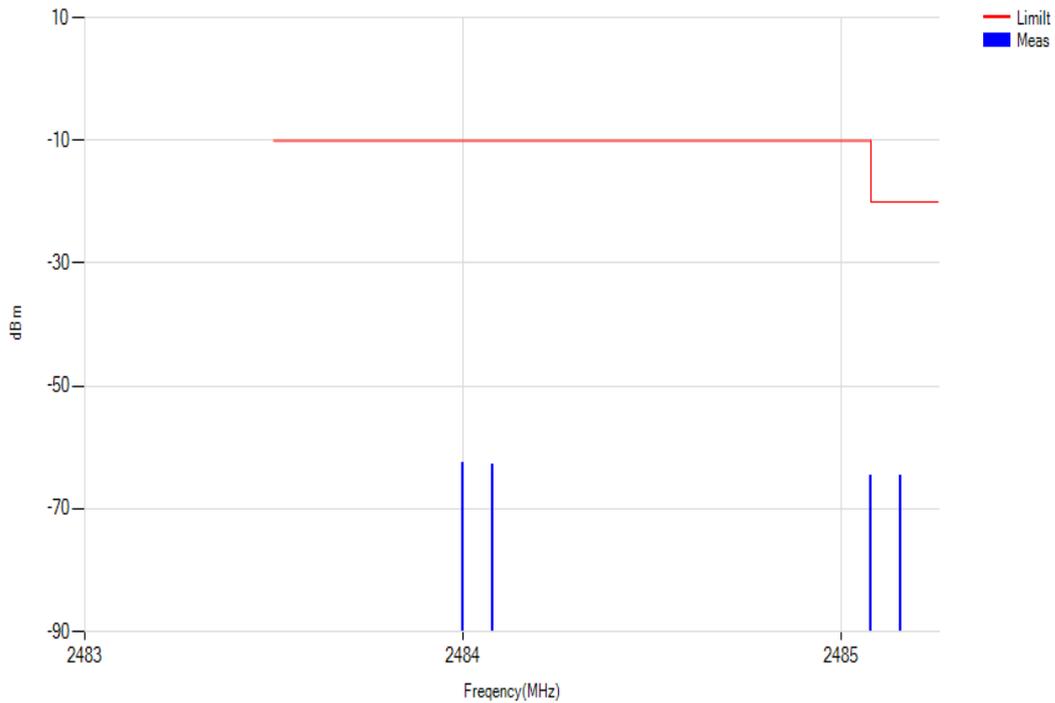
20°C /5v CH High



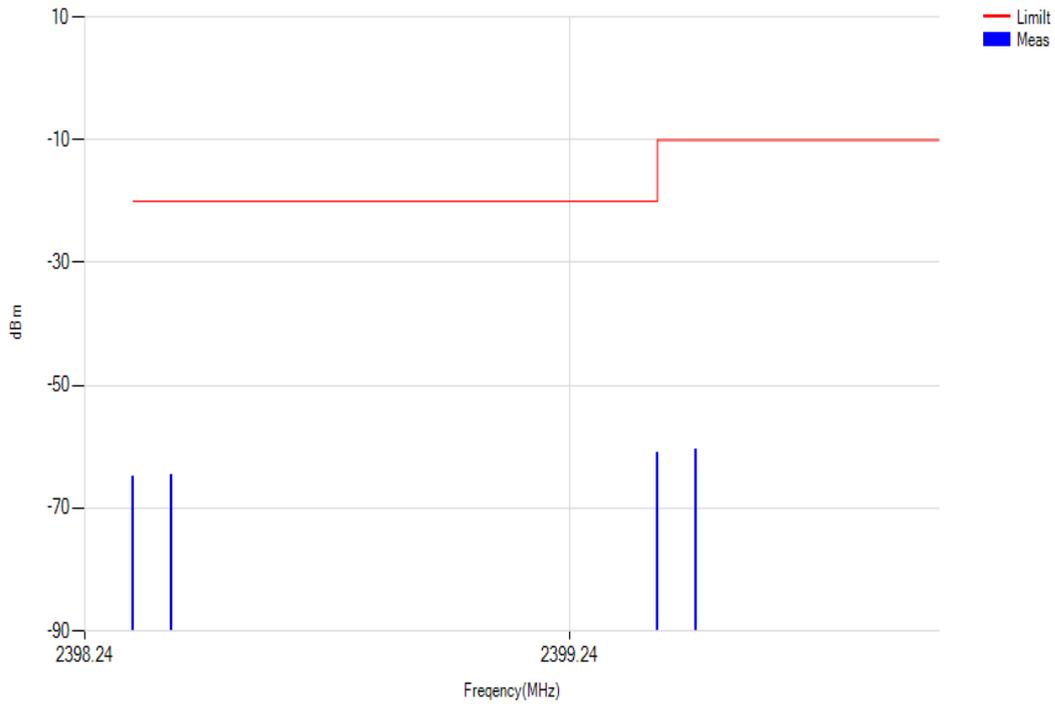
0°C /5v CH Low



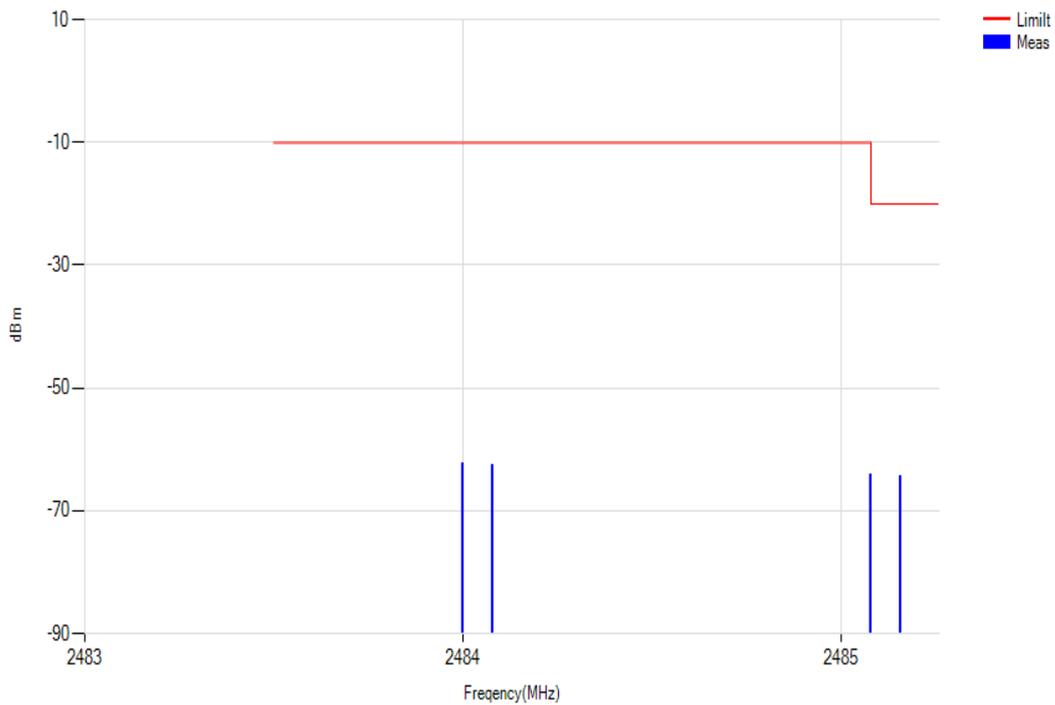
0°C /5v CH High



60°C /5v CH Low



60°C /5v CH High



IEEE 802.11b Mode:

TEST CONDITION				Out of Band Emissions		
				Frequency	Measured Power	Limit
Temp.		Voltage		MHz	dBm/MHz(e.i.r.p)	dBm/MHz(e.i.r.p)
20	°C	Vnom	5.00	2399.5000	-37.02	-10.00
				2385.3800	-47.47	-20.00
				2484.0000	-36.08	-10.00
				2498.1100	-45.58	-20.00
0	°C	Vnom	5.00	2399.5000	-37.68	-10.00
				2372.3800	-50.93	-20.00
				2484.0000	-36.83	-10.00
				2500.1100	-45.35	-20.00
60	°C	Vnom	5.00	2396.5000	-35.44	-10.00
				2385.3800	-47.16	-20.00
				2484.0000	-34.31	-10.00
				2498.1100	-45.51	-20.00

IEEE 802.11g Mode:

TEST CONDITION				Out of Band Emissions		
				Frequency	Measured Power	Limit
Temp.		Voltage		MHz	dBm/MHz(e.i.r.p)	dBm/MHz(e.i.r.p)
20	°C	Vnom	5.00	2399.5000	-28.32	-10.00
				2384.1800	-44.60	-20.00
				2484.0000	-28.99	-10.00
				2500.7100	-44.86	-20.00
0	°C	Vnom	5.00	2399.5000	-28.81	-10.00
				2384.1800	-45.06	-20.00
				2484.0000	-29.76	-10.00
				2500.7100	-45.42	-20.00
60	°C	Vnom	5.00	2399.5000	-29.79	-10.00
				2384.1800	-46.87	-20.00
				2484.0000	-29.19	-10.00
				2500.7100	-48.01	-20.00

IEEE 802.11n 20 MHz Mode:

TEST CONDITION				Out of Band Emissions		
				Frequency	Measured Power	Limit
Temp.	Voltage		MHz	dBm/MHz(e.i.r.p)	dBm/MHz(e.i.r.p)	
20	°C	Vnom	5.00	2399.5000	-29.84	-10.00
				2383.3500	-45.53	-20.00
				2484.0000	-30.37	-10.00
				2501.8700	-45.74	-20.00
0	°C	Vnom	5.00	2399.5000	-30.58	-10.00
				2383.3500	-46.29	-20.00
				2484.0000	-30.98	-10.00
				2501.8700	-46.42	-20.00
60	°C	Vnom	5.00	2399.5000	-31.65	-10.00
				2383.3500	-47.91	-20.00
				2484.0000	-32.22	-10.00
				2501.8700	-49.07	-20.00

Bluetooth 4.0

TEST CONDITION				Out of Band Emissions		
				Frequency	Measured Power	Limit
Temp.		Voltage		MHz	dBm/MHz(e.i.r.p)	dBm/MHz(e.i.r.p)
20	°C	Vnom	5.00	2399.5000	-60.73	-10.00
				2398.3400	-65.30	-20.00
				2484.0000	-62.50	-10.00
				2485.0800	-64.52	-20.00
0	°C	Vnom	5.00	2399.5000	-60.65	-10.00
				2398.4200	-64.98	-20.00
				2484.0000	-62.54	-10.00
				2485.0800	-64.53	-20.00
60	°C	Vnom	5.00	2399.5000	-60.36	-10.00
				2398.4200	-64.65	-20.00
				2484.0000	-62.24	-10.00
				2485.0800	-64.19	-20.00

7.10 TRANSMITTER UNWANTED EMISSIONS IN THE SPURIOUS DOMAIN

LIMIT

ETSI EN 300 328

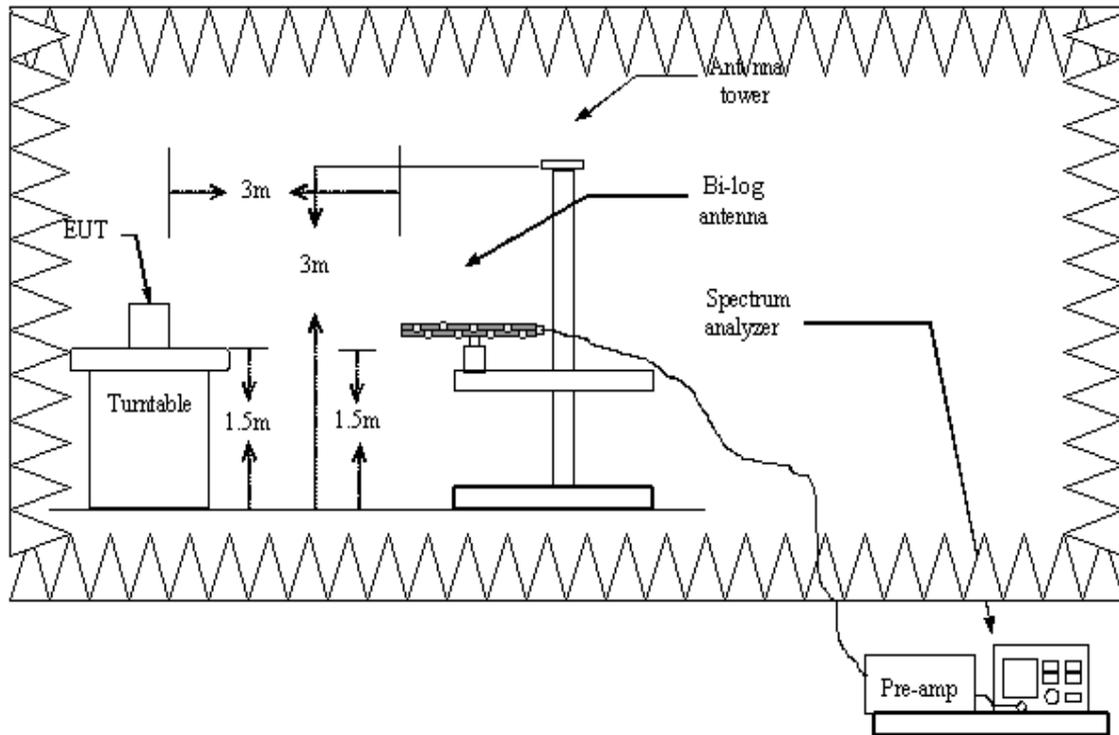
The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 1.

Table 1: Transmitter limits for spurious emissions

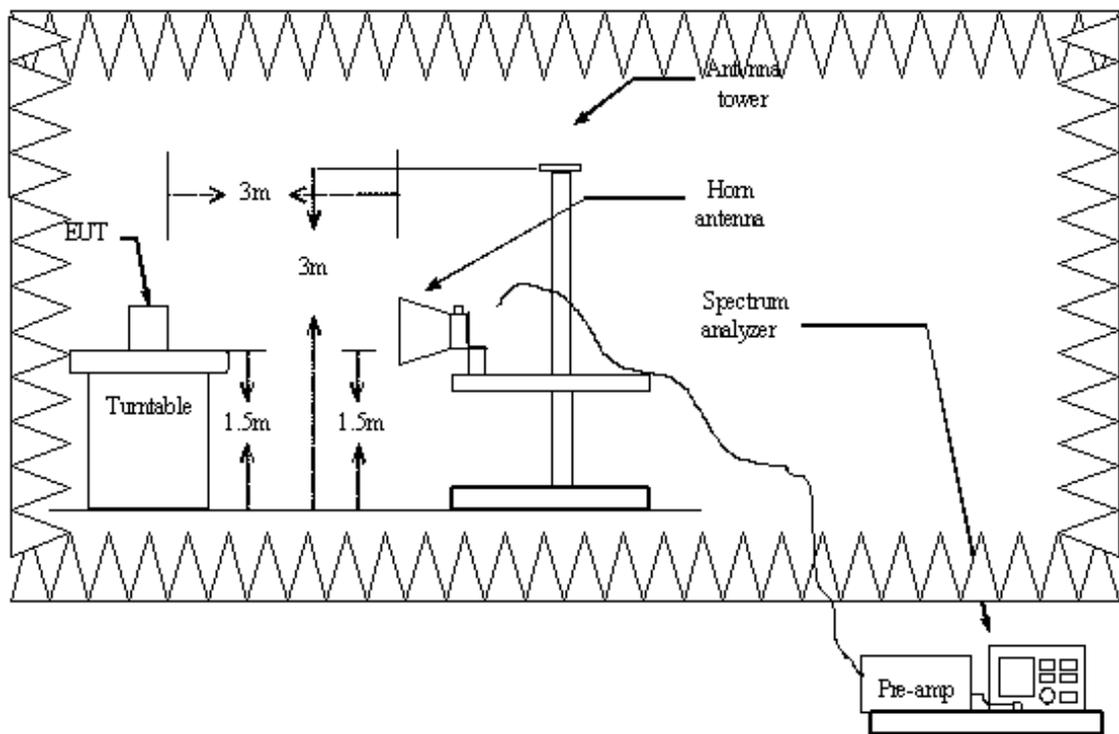
Frequency range	Maximum power, e.r.p. (≤ 1 GHz) e.i.r.p. (> 1 GHz)	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

Test Configuration

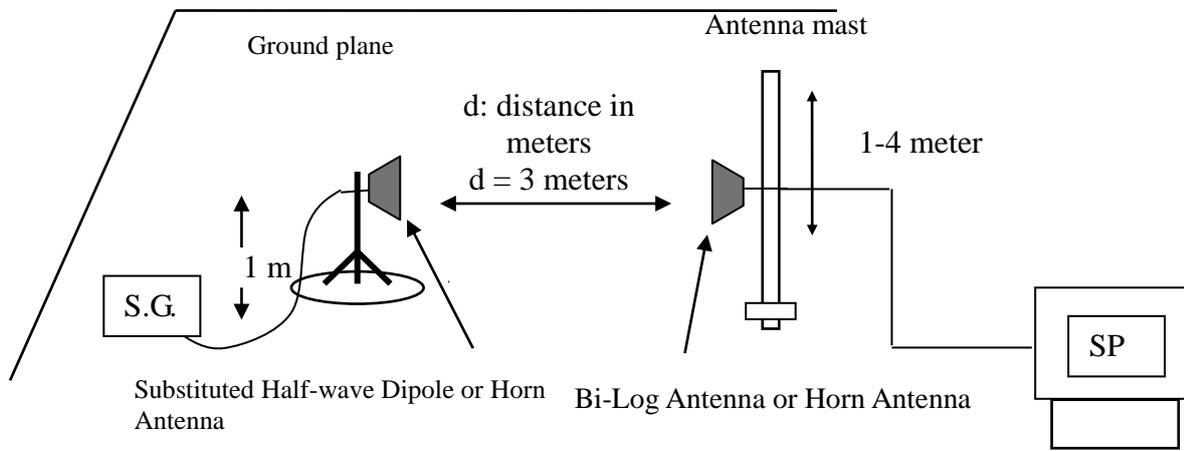
Below 1GHz



Above 1GHz



Substituted Method Test Set-up



TEST PROCEDURE

1. Please refer to ETSI EN 300 328 (V2.1.1) for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.1.1) for the measurement methods.

Measurement Uncertainty

The measurement uncertainty of the test is ± 2.65 dB.

TEST RESULTS

No value of the measurement limit is within 6dB, and therefore no further investigation and identification to measure emission with point of measurement is required.

Below 1GHz

Test Mode: Normal Link

Tested by: Ivan Wang

Ambient temperature: 23°C

Relative humidity: 54%RH

Date: November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
199.7500	-81.52	-7.69	-89.21	-54.00	-35.21	V
350.1000	-75.72	-5.45	-81.17	-36.00	-45.17	V
451.9500	-81.15	-2.51	-83.66	-36.00	-47.66	V
551.3750	-79.72	-0.91	-80.63	-54.00	-26.63	V
650.8000	-82.42	0.89	-81.53	-54.00	-27.53	V
750.2250	-83.98	2.11	-81.87	-54.00	-27.87	V
250.6750	-75.44	-8.59	-84.03	-36.00	-48.03	H
350.1000	-72.34	-5.45	-77.79	-36.00	-41.79	H
451.9500	-73.79	-2.51	-76.30	-36.00	-40.30	H
551.3750	-77.76	-0.91	-78.67	-54.00	-24.67	H
650.8000	-80.06	0.89	-79.17	-54.00	-25.17	H
750.2250	-81.97	2.11	-79.86	-54.00	-25.86	H

Test Mode: Bluetooth

Tested by: Ivan Wang

Ambient temperature: 23°C

Relative humidity: 54%RH

Date: November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
250.6750	-78.39	-8.59	-86.98	-36.00	-50.98	V
350.1000	-74.77	-5.45	-80.22	-36.00	-44.22	V
451.9500	-82.77	-2.51	-85.28	-36.00	-49.28	V
551.3750	-78.95	-0.91	-79.86	-54.00	-25.86	V
650.8000	-82.15	0.89	-81.26	-54.00	-27.26	V
750.2250	-82.74	2.11	-80.63	-54.00	-26.63	V
250.6750	-75.14	-8.59	-83.73	-36.00	-47.73	H
350.1000	-71.69	-5.45	-77.14	-36.00	-41.14	H
451.9500	-76.45	-2.51	-78.96	-36.00	-42.96	H
551.3750	-77.71	-0.91	-78.62	-54.00	-24.62	H
650.8000	-80.43	0.89	-79.54	-54.00	-25.54	H
750.2250	-80.79	2.11	-78.68	-54.00	-24.68	H

Remark:

1. *The emission behaviour belongs to narrowband spurious emission.*
2. *Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.*

Above 1GHz

Test Mode: IEEE 802.11b / TX (CH Low)

Tested by: Ivan Wang

Ambient temperature: 23°C **Relative humidity:** 54%RH **Date:** November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
4824.000	-66.04	2.97	-63.07	-30.00	-33.07	V
7236.000	-67.47	9.18	-58.29	-30.00	-28.29	V
N/A						
4824.000	-66.04	2.97	-63.07	-30.00	-33.07	H
7236.000	-66.08	9.18	-56.90	-30.00	-26.90	H
N/A						

Test Mode: IEEE 802.11b / TX (CH High)

Tested by: Ivan Wang

Ambient temperature: 23°C **Relative humidity:** 54%RH **Date:** November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
4944.000	-65.62	3.46	-62.16	-30.00	-32.16	V
7416.000	-66.18	9.60	-56.58	-30.00	-26.58	V
N/A						
4944.000	-66.74	3.46	-63.28	-30.00	-33.28	H
7416.000	-65.43	9.60	-55.83	-30.00	-25.83	H
N/A						

Remark:

1. *The emission behaviour belongs to narrowband spurious emission.*
2. *Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor*

Test Mode: IEEE 802.11g / TX (CH Low)

Tested by: Ivan Wang

Ambient temperature: 23°C

Relative humidity: 54%RH **Date:** November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
4824.000	-65.53	2.97	-62.56	-30.00	-32.56	V
7236.000	-67.16	9.18	-57.98	-30.00	-27.98	V
N/A						
4824.000	-66.00	2.97	-63.03	-30.00	-33.03	H
7236.000	-67.11	9.18	-57.93	-30.00	-27.93	H
N/A						

Test Mode: IEEE 802.11g / TX (CH High)

Tested by: Ivan Wang

Ambient temperature: 23°C

Relative humidity: 54%RH **Date:** November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
4944.000	-66.83	3.46	-63.37	-30.00	-33.37	V
7416.000	-67.54	9.60	-57.94	-30.00	-27.94	V
N/A						
4944.000	-67.17	3.46	-63.71	-30.00	-33.71	H
7416.000	-67.61	9.60	-58.01	-30.00	-28.01	H
N/A						

Remark:

1. The emission behaviour belongs to narrowband spurious emission.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.

Test Mode: IEEE 802.11n 20 MHz Mode / TX (CH Low) **Tested by:** Ivan Wang

Ambient temperature: 23°C **Relative humidity:** 54%RH **Date:** November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
4824.000	-66.27	2.97	-63.30	-30.00	-33.30	V
7236.000	-66.95	9.18	-57.77	-30.00	-27.77	V
N/A						
4824.000	-65.75	2.97	-62.78	-30.00	-32.78	H
7236.000	-67.27	9.18	-58.09	-30.00	-28.09	H
N/A						

Test Mode: IEEE 802.11n 20 MHz Mode / TX (CH High) **Tested by:** Ivan Wang

Ambient temperature: 23°C **Relative humidity:** 54%RH **Date:** November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
4944.000	-66.57	3.46	-63.11	-30.00	-33.11	V
7416.000	-67.43	9.60	-57.83	-30.00	-27.83	V
N/A						
4944.000	-67.10	3.46	-63.64	-30.00	-33.64	H
7416.000	-64.82	9.60	-55.22	-30.00	-25.22	H
N/A						

Remark:

1. The emission behaviour belongs to narrowband spurious emission.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.

Bluetooth for 4.0

Test Mode: Bluetooth / TX (CH Low)

Tested by: Ivan Wang

Ambient temperature: 23°C **Relative humidity:** 54%RH **Date:** November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
4804.000	-62.49	2.89	-59.60	-30.00	-29.60	V
7206.000	-66.88	9.11	-57.77	-30.00	-27.77	V
N/A						
4804.000	-65.79	2.89	-62.90	-30.00	-32.90	H
7206.000	-67.34	9.11	-58.23	-30.00	-28.23	H
N/A						

Test Mode: Bluetooth / TX (CH High)

Tested by: Ivan Wang

Ambient temperature: 23°C **Relative humidity:** 54%RH **Date:** November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
4960.000	-67.16	3.51	-63.65	-30.00	-33.65	V
7440.000	-68.00	9.65	-58.35	-30.00	-28.35	V
N/A						
4960.000	-67.10	3.51	-63.59	-30.00	-33.59	H
7440.000	-67.23	9.65	-57.58	-30.00	-27.58	H
N/A						

Remark:

1. The emission behaviour belongs to narrowband spurious emission.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.

7.11 RECEIVER SPURIOUS EMISSIONS

LIMIT

The spurious emissions of the receiver shall not exceed the values given in table 2.

Table 2: Spurious emission limits for receivers

Frequency range	Maximum power e.r.p. (≤ 1 GHz) e.i.r.p. (> 1 GHz)	Measurement bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz

Test Configuration

Radiated Spurious Emissions:

(Same as section 7.10 in this test report)

TEST PROCEDURE

1. Please refer to ETSI EN 300 328 (V2.1.1) for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.1.1) for the measurement methods.

Measurement Uncertainty

The measurement uncertainty of the test is ± 2.65 dB.

TEST RESULTS

No non-compliance noted.

Below 1GHz

Test Mode: RX

Tested by: Ivan Wang

Ambient temperature: 23°C **Relative humidity:** 54%RH **Date:** November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
250.6750	-78.64	-8.59	-87.23	-57.00	-30.23	V
350.1000	-74.61	-5.45	-80.06	-57.00	-23.06	V
451.9500	-80.20	-2.51	-82.71	-57.00	-25.71	V
551.3750	-80.59	-0.91	-81.50	-57.00	-24.50	V
650.8000	-82.49	0.89	-81.60	-57.00	-24.60	V
791.4500	-84.82	2.69	-82.13	-57.00	-25.13	V
250.6750	-74.30	-8.59	-82.89	-57.00	-25.89	H
350.1000	-71.55	-5.45	-77.00	-57.00	-20.00	H
451.9500	-73.20	-2.51	-75.71	-57.00	-18.71	H
551.3750	-77.83	-0.91	-78.74	-57.00	-21.74	H
650.8000	-79.38	0.89	-78.49	-57.00	-21.49	H
750.2250	-81.51	2.11	-79.40	-57.00	-22.40	H

Test Mode: Bluetooth

Tested by: Ivan Wang

Ambient temperature: 23°C **Relative humidity:** 54%RH **Date:** November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
250.6750	-78.97	-8.59	-87.56	-57.00	-30.56	V
350.1000	-75.39	-5.45	-80.84	-57.00	-23.84	V
451.9500	-81.29	-2.51	-83.80	-57.00	-26.80	V
551.3750	-80.56	-0.91	-81.47	-57.00	-24.47	V
650.8000	-83.53	0.89	-82.64	-57.00	-25.64	V
750.2250	-82.94	2.11	-80.83	-57.00	-23.83	V
250.6750	-75.85	-8.59	-84.44	-57.00	-27.44	H
350.1000	-70.63	-5.45	-76.08	-57.00	-19.08	H
451.9500	-74.82	-2.51	-77.33	-57.00	-20.33	H
551.3750	-76.89	-0.91	-77.80	-57.00	-20.80	H
650.8000	-79.15	0.89	-78.26	-57.00	-21.26	H
750.2250	-79.39	2.11	-77.28	-57.00	-20.28	H

Remark:

1. The emission behaviour belongs to narrowband spurious emission.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.

Above 1GHz

Test Mode: RX

Tested by: Ivan Wang

Ambient temperature: 23°C **Relative humidity:** 54%RH **Date:** November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
3660.000	-62.42	-1.28	-63.70	-47.00	-16.70	V
6355.000	-76.97	6.45	-70.52	-47.00	-23.52	V
N/A						
3660.000	-60.45	-1.28	-61.73	-47.00	-14.73	H
7335.000	-72.32	9.42	-62.90	-47.00	-15.90	H
N/A						

Test Mode: Bluetooth / RX

Tested by: Ivan Wang

Ambient temperature: 23°C **Relative humidity:** 54%RH **Date:** November 16, 2017

Frequency (MHz)	Reading (dBm)	Correction Factor (dB)	Emission level (dBm)	Limit (dBm)	Margin (dB)	Antenna Polarization (V/H)
3625.000	-63.47	-1.41	-64.88	-47.00	-17.88	V
7002.500	-75.64	8.65	-66.99	-47.00	-19.99	V
N/A						
3625.000	-63.98	-1.41	-65.39	-47.00	-18.39	H
7370.000	-74.50	9.49	-65.01	-47.00	-18.01	H
N/A						

Remark:

1. The emission behaviour belongs to narrowband spurious emission.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.

7.12 RECEIVER BLOCKING

Limit

Receiver Category	<input checked="" type="checkbox"/> 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. <input type="checkbox"/> 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. <input type="checkbox"/> 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
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Category 1			
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 wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 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.

Category 2			
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 4.3.1.12.3 in the absence of any blocking signal.

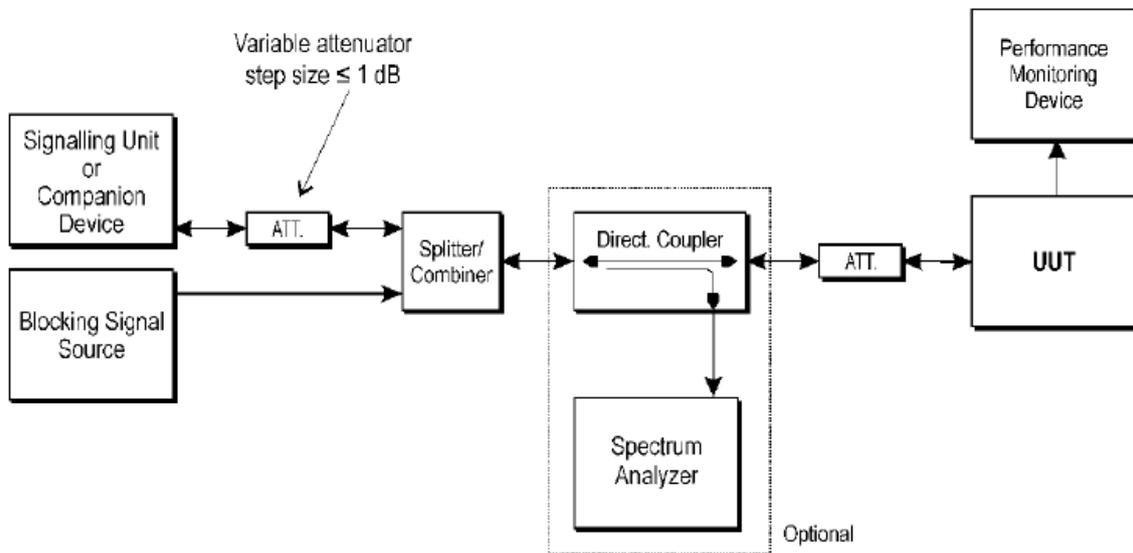
NOTE 2:
The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.

Category 3			
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 4.3.1.12.3 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.

Test Configuration



TEST PROCEDURE

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

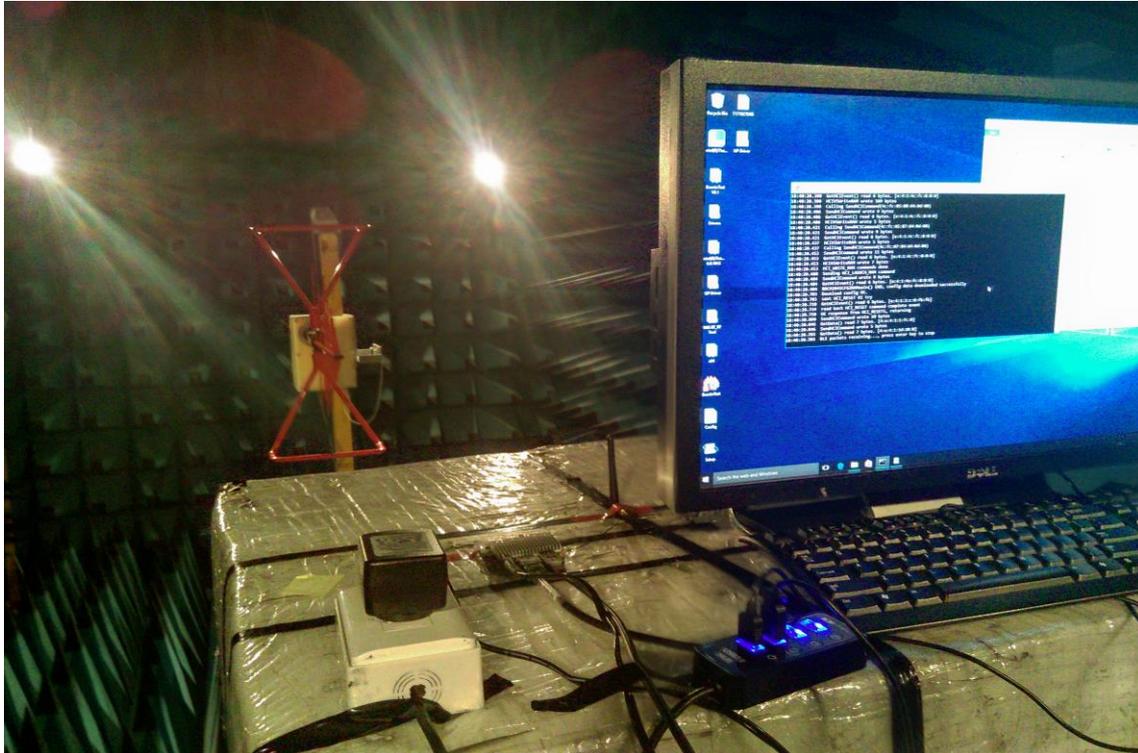
TEST RESULTS

Configuration	Frequency (MHz)	Blocking signal frequency(MHz)	Receiver Blocking signal power (dBm)	Wanted signal mean power from companion device (dBm) [Pmin]	Pmin + 6dB Per Values (dBm)	Per Results	Limit (%)	Result
IEEE 802.11b Mode	2412	2380	-53	-84	-78	1.00%	10.00%	Pass
		2503.5		-84	-78	2.00%	10.00%	Pass
		2300	-47	-84	-78	2.00%	10.00%	Pass
		2330		-84	-78	1.00%	10.00%	Pass
		2360		-84	-78	1.00%	10.00%	Pass
		2523.5	-47	-84	-78	1.00%	10.00%	Pass
		2553.5		-84	-78	2.00%	10.00%	Pass
		2583.5		-84	-78	2.00%	10.00%	Pass
		2613.5		-84	-78	2.00%	10.00%	Pass
		2643.5		-84	-78	2.00%	10.00%	Pass
2673.5	-84	-78	2.00%	10.00%	Pass			
IEEE 802.11b Mode	2472	2380	-53	-81	-75	4.00%	10.00%	Pass
		2503.5		-81	-75	3.00%	10.00%	Pass
		2300	-47	-81	-75	3.00%	10.00%	Pass
		2330		-81	-75	2.00%	10.00%	Pass
		2360		-81	-75	4.00%	10.00%	Pass
		2523.5	-47	-81	-75	2.00%	10.00%	Pass
		2553.5		-81	-75	2.00%	10.00%	Pass
		2583.5		-81	-75	1.00%	10.00%	Pass
		2613.5		-81	-75	2.00%	10.00%	Pass
		2643.5		-81	-75	4.00%	10.00%	Pass
2673.5	-81	-75	3.00%	10.00%	Pass			

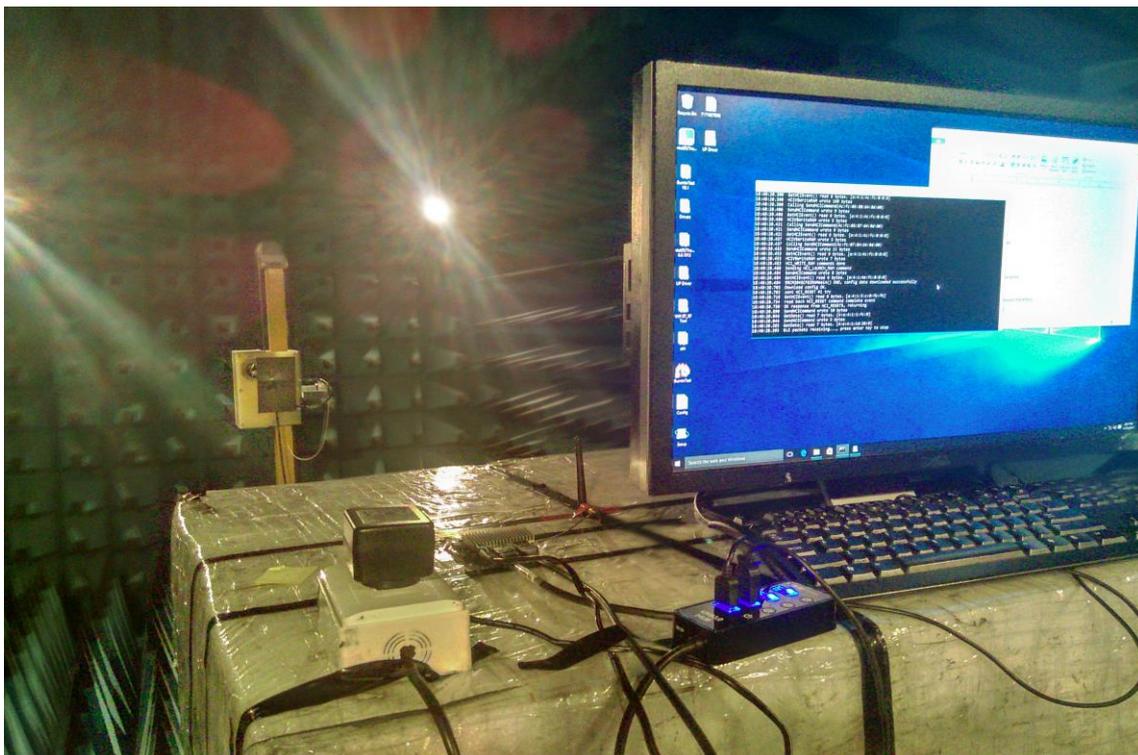
Configuration	Frequency (MHz)	Blocking signal frequency(MHz)	Receiver Blocking signal power (dBm)	Wanted signal mean power from companion device (dBm) [Pmin]	Pmin + 6dB Per Values (dBm)	Per Results	Limit (%)	Result
BLE Mode	2402	2380	-53	-80	-74	0.76%	10.00%	Pass
		2503.5		-80	-74	0.78%	10.00%	Pass
		2300	-47	-80	-74	0.81%	10.00%	Pass
		2330		-80	-74	0.83%	10.00%	Pass
		2360		-80	-74	0.85%	10.00%	Pass
		2523.5	-47	-80	-74	0.88%	10.00%	Pass
		2553.5		-80	-74	0.85%	10.00%	Pass
		2583.5		-80	-74	0.86%	10.00%	Pass
		2613.5		-80	-74	0.84%	10.00%	Pass
		2643.5		-80	-74	0.79%	10.00%	Pass
2673.5	-80	-74	0.83%	10.00%	Pass			
BLE Mode	2480	2380	-53	-80	-74	0.83%	10.00%	Pass
		2503.5		-80	-74	0.85%	10.00%	Pass
		2300	-47	-80	-74	0.89%	10.00%	Pass
		2330		-80	-74	0.88%	10.00%	Pass
		2360		-80	-74	0.88%	10.00%	Pass
		2523.5	-47	-80	-74	0.86%	10.00%	Pass
		2553.5		-80	-74	0.86%	10.00%	Pass
		2583.5		-80	-74	0.90%	10.00%	Pass
		2613.5		-80	-74	0.92%	10.00%	Pass
		2643.5		-80	-74	0.95%	10.00%	Pass
2673.5	-80	-74	0.95%	10.00%	Pass			

APPENDIX I PHOTOGRAPHS OF TEST SETUP

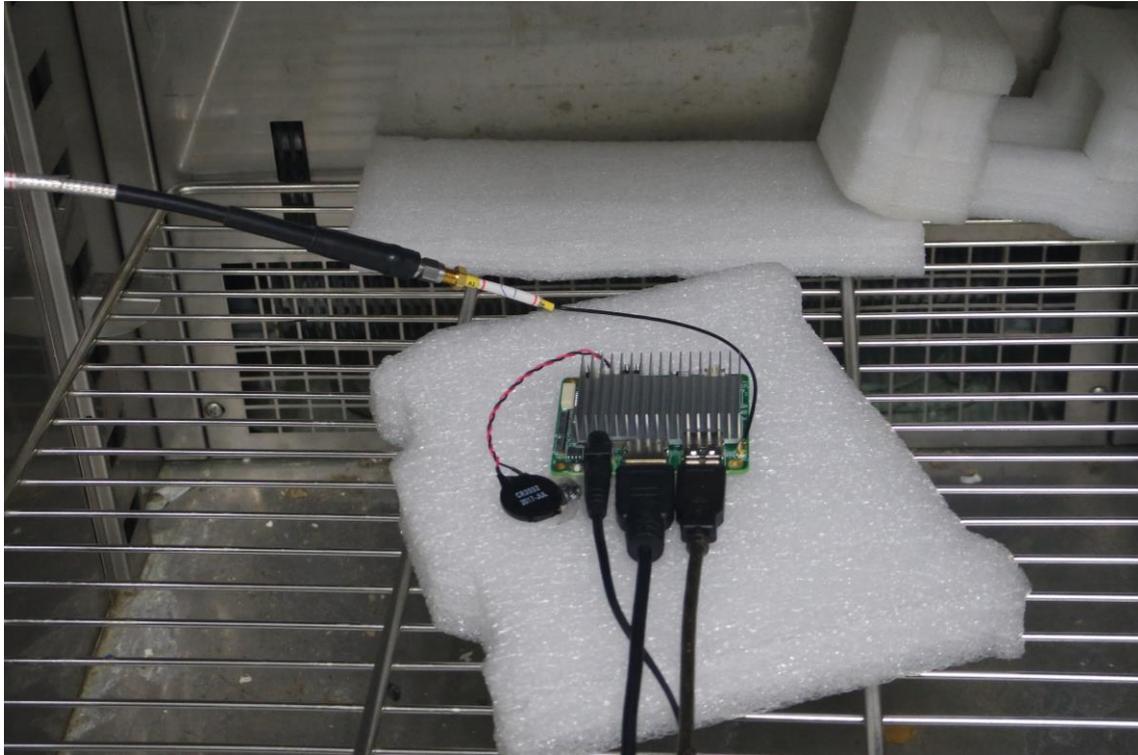
Below 1GHz



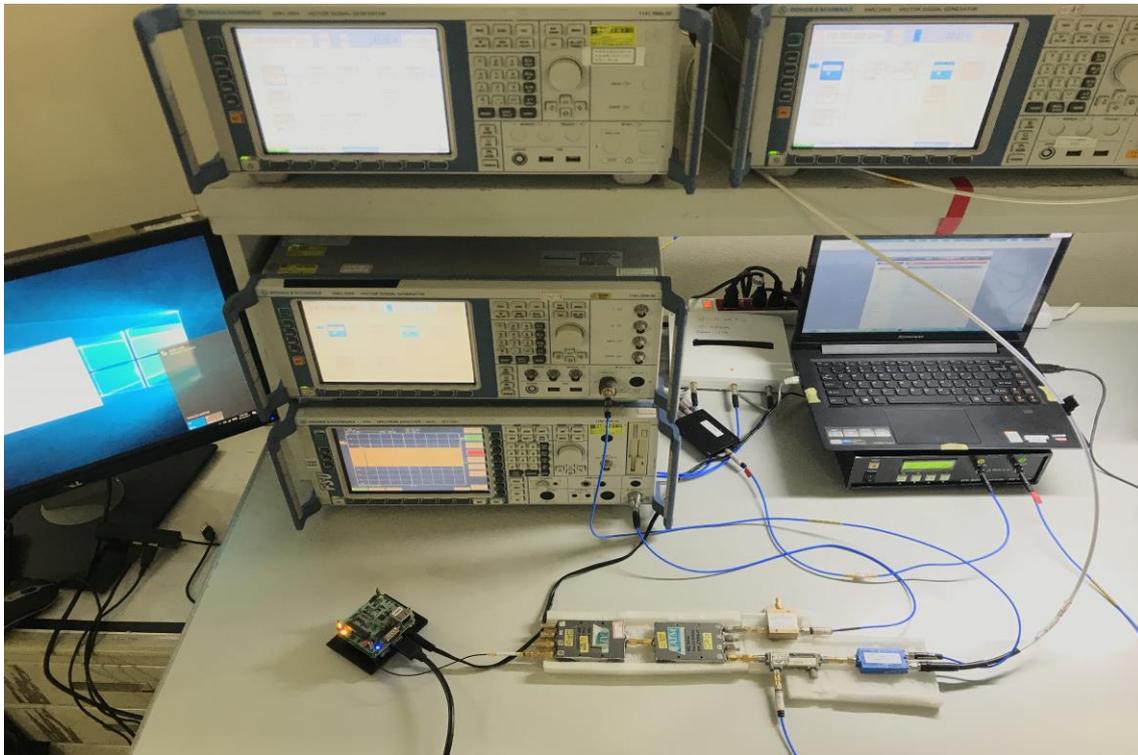
Above 1GHz



Conducted

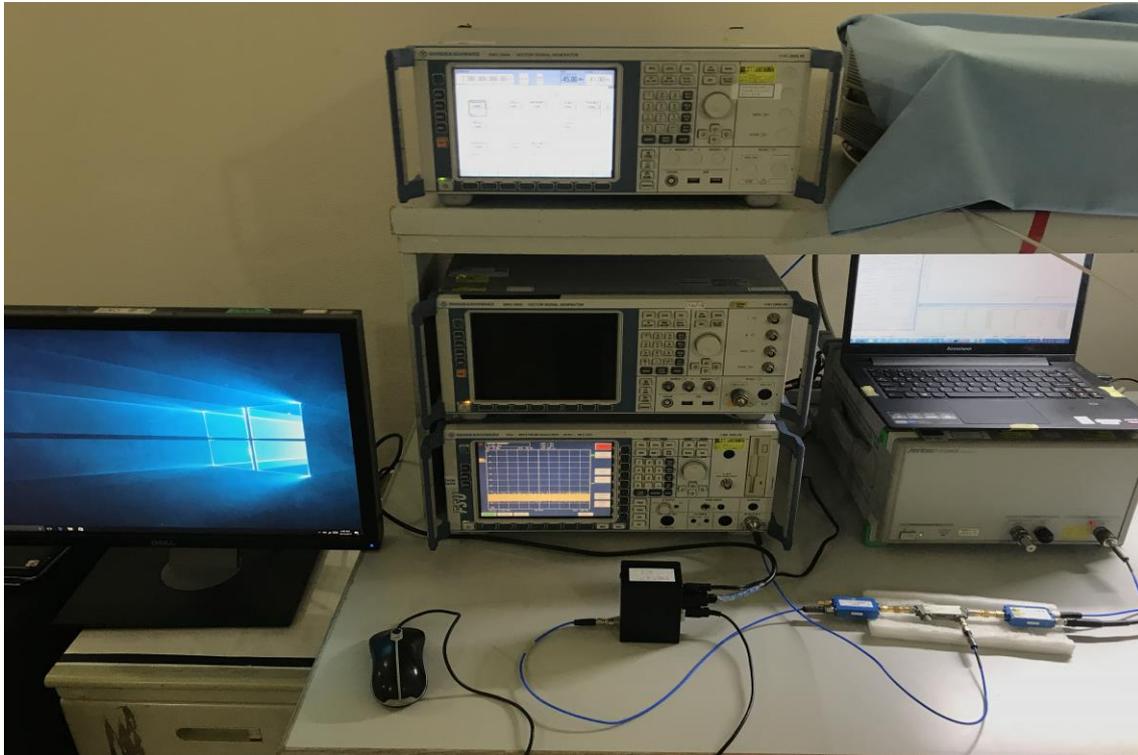


Adaptivity



Receiver Blocking

2.4GHz



Bluetooth for 4.0

