SPECTRUM REPORT
(BLE)

Applicant:	Shanghai Wenheng Electronics Technology Co., Ltd.
Address of Applicant:	Room 611, Building5, Xizi International Center No.898 Xiuwen Street, Minhang District, ShangHai
Equipment Under Test (EUT)	
Product Name:	Serial to Bluetooth Module
Model No.:	WH-BLE102, WH-BLE103, WH-BLE104, WH-BLE105, WH-BLE106, WH-BLE107, WH-BLE108, WH-BLE109, WH-BLE201, WH-BLE202, WH-BLE203, WH-BLE204, WH-BLE205, WH-BLE206, WH-BLE207, WH-BLE208, WH-BLE209, WH-BT200, WH-BT201, WH-BT202, WH-BT203, WH-BT204, WH-BT205, WH-BT206, WH-BT207, WH-BT208, WH-BT209
Applicable standards:	ETSI EN 300 328 V2.1.1 (2016-11)
Date of sample receipt:	08 Aug., 2018
Date of Test:	08 Aug., to 28 Aug., 2018
Date of report issue:	29 Aug., 2018
Test Result:	PASS*

* In the configuration tested, the EUT detailed in this report complied with the standards specified above.

The CE mark as shown below can be used, under the responsibility of the manufacturer, after completion of an EC Declaration of Conformity and compliance with all relevant EC Directives. The protection requirements with respect to electromagnetic compatibility contained in Directive 2014/53/EU are considered.

ZHONGJIAN NANFANG TESTING CO., LTD SHENZHEN CCIS

Bruce Zhang
Laboratory Manager

2 Version

Version No.	Date	Description
00	*29 Aug., 2018*	*Original*

Tested by:	YT Yang	***Date:***	*29 Aug., 2018*
	Test Engineer		
Reviewed by:	Winner Zhang	***Date:***	*29 Aug., 2018*
	Project Engineer		

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4 Test Summary

Test Items	Test Requirement	Test method	Limit/Severity	Result
Radio Spectrum Matter (RSM) Part of Tx				
RF Output Power	Clause 4.3.2.2	Clause 5.4.2.2.1.2	Clause 4.3.2.2.3	PASS
Power Spectral Density	Clause 4.3.2.3	Clause 5.4.3	Clause 4.3.2.3.3	PASS
Duty Cycle, Tx-sequence, Tx-gap	Clause 4.3.2.4	Clause 5.4.2.2.1.3	Clause 4.3.2.4.3	N/A
Medium Utilisation (MU) factor	Clause 4.3.2.5	Clause 5.4.2.2.1.4	Clause 4.3.4.5.3	N/A
Adaptivity (Adaptive Equipment using Modulations Other Than FHSS)	Clause 4.3.2.6	Clause 5.4.6.2	Clause 4.3.2.6	N/A
Occupied Channel Bandwidth	Clause 4.3.2.7	Clause 5.4.7.2	Clause 4.3.2.7.3	PASS
Transmitter unwanted emissions in the out-of-band domain	Clause 4.3.2.8	Clause 5.4.8.2	Clause 4.3.2.8.3	PASS
Transmitter unwanted emissions in the spurious domain	Clause 4.3.2.9	Clause 5.4.9.2	Clause 4.3.2.9.3	PASS
Radio Spectrum Matter (RSM) Part of Rx				
Receiver spurious emissions	Clause 4.3.2.10	Clause 5.4.10.2	Clause 4.3.2.10.3	PASS
Receiver Blocking	Clause 4.3.2.11	Clause 5.4.11.2	Clause 4.3.2.11.4	PASS

Remark:
Tx: In this whole report Tx (or tx) means Transmitter.
Rx: In this whole report Rx (or rx) means Receiver.
Pass: Meet the requirement.
N/A: Not Applicable for Non-adaptive equipment.

5 General Information

5.1 Client Information

Applicant:	Shanghai Wenheng Electronics Technology Co., Ltd.
Address:	Room 611, Building5, Xizi International Center No.898 Xiuwen Street, Minhang District, ShangHai
Manufacturer:	Shanghai Wenheng Electronics Technology Co., Ltd.
Address:	Room 611, Building5, Xizi International Center No.898 Xiuwen Street, Minhang District, ShangHai

5.2 General Description of E.U.T.

Product Name:	Serial to Bluetooth Module
Model No.:	WH-BLE102, WH-BLE103, WH-BLE104, WH-BLE105, WH-BLE106, WH-BLE107, WH-BLE108, WH-BLE109, WH-BLE201, WH-BLE202, WH-BLE203, WH-BLE204, WH-BLE205, WH-BLE206, WH-BLE207, WH-BLE208, WH-BLE209, WH-BT200, WH-BT201, WH-BT202, WH-BT203, WH-BT204, WH-BT205, WH-BT206, WH-BT207, WH-BT208, WH-BT209
Hardware version:	V1.1
Software version:	V1.0.5
Operation Frequency:	2402MHz ~ 2480MHz
Channel number:	40
Channel separation:	2MHz
Modulation type:	other forms of modulation
Equipment Type:	Adaptive equipment
Modulation Technology:	GFSK
Antenna Type:	PCB Antenna
Antenna gain:	0.5 dBi (declare by Applicant)
Power supply:	AC 230V/50Hz

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	10	2422MHz	20	2442MHz	30	2462MHz
1	2404MHz	11	2424MHz	21	2444MHz	31	2464MHz
2	2406MHz	12	2426MHz	22	2446MHz	32	2466MHz
3	2408MHz	13	2428MHz	23	2448MHz	33	2468MHz
4	2410MHz	14	2430MHz	24	2450MHz	34	2470MHz
5	2412MHz	15	2432MHz	25	2452MHz	35	2472MHz
6	2414MHz	16	2434MHz	26	2454MHz	36	2474MHz
7	2416MHz	17	2436MHz	27	2456MHz	37	2476MHz
8	2418MHz	18	2438MHz	28	2458MHz	38	2478MHz
9	2420MHz	19	2440MHz	29	2460MHz	39	2480MHz
Remark: The EUT operation in above frequency list, and used test software to control the EUT for staying in continuous transmitting and receiving mode. Channel 0, 20 and 39 of BLE were chosen for testing.							

5.3 Test environment and mode

Operating Environment:	
Temperature:	Normal: 15℃ ~ 35℃, Extreme: -20℃ ~ +55℃
Humidity:	52 % RH
Atmospheric Pressure:	1008 mbar
Voltage:	Nominal: 230Vdc, Extreme: Low 207Vdc, High 253Vdc
Test mode:	
Transmitting mode:	Keep the EUT in continuously transmitting mode with modulation.
Receiving mode:	Keep the EUT in receiving mode.
We have verified the construction and function in typical operation. All the test items were carried out with the EUT in above test modes.	

5.4 Description of Support Units

Manufacturer	Description	Model	S/N	FCC ID/DoC
LENOVO	Laptop	SL510	2847A65	DoC
/	Adapter	DQS051-0501200-HC	N/A	N/A
/	Test component	USR-BLE-EVK	N/A	N/A

5.5 Measurement Uncertainty

Parameter	Expanded Uncertainty (Confidence of 95%)
Occupied Channel Bandwidth	±5%
RF output power, conducted	±1.5 dB
Power Spectral Density, conducted	±3.0 dB
Unwanted Emissions, conducted	±3.0 dB
Temperature	±3 °C
Supply voltages	±3 %
Time	±5%
Radiated Emission (30MHz ~ 1000MHz)	±4.28 dB
Radiated Emission (1GHz ~ 18GHz)	±5.72 dB

5.6 Laboratory Facility

The test facility is recognized, certified, or accredited by the following organizations:

- **FCC - Registration No.: 727551**

Shenzhen Zhongjian Nanfang Testing Co., Ltd. has been accredited as a testing laboratory by FCC (Federal Communications Commission). The Registration No. is 727551.

- **IC - Registration No.: 10106A-1**

The 3m Semi-anechoic chamber of Shenzhen Zhongjian Nanfang Testing Co., Ltd. has been Registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 10106A-1.

- **CNAS - Registration No.: CNAS L6048**

Shenzhen Zhongjian Nanfang Testing Co., Ltd. is accredited to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration laboratories for the competence of testing. The Registration No. is CNAS L6048.

- **A2LA - Registration No.: 4346.01**

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 General requirements for the competence of testing and calibration laboratories. The test scope can be found as below link: https://portal.a2la.org/scopepdf/4346-01.pdf

5.7 Laboratory Location

Shenzhen Zhongjian Nanfang Testing Co., Ltd.
Address: No. B-C, 1/F., Building 2, Laodong No.2 Industrial Park, Xixiang Road,
Bao'an District, Shenzhen, Guangdong, China
Tel: +86-755-23118282, Fax: +86-755-23116366
Email: info@ccis-cb.com, Website: http://www.ccis-cb.com

5.8 Test Instruments list

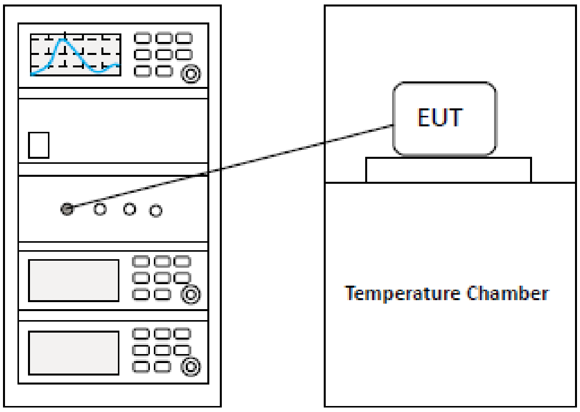
Radiated Emission:					
Test Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal.Date (mm-dd-yy)**	**Cal. Due date (mm-dd-yy)**
3m SAC	SAEMC	9m*6m*6m	966	07-22-2017	07-21-2020
BiConiLog Antenna	SCHWARZBECK	VULB9163	497	03-16-2018	03-15-2019
Biconical Antenna	SCHWARZBECK	VUBA9117	359	06-22-2017	06-21-2020
Horn Antenna	SCHWARZBECK	BBHA9120D	916	03-16-2018	03-15-2019
Horn Antenna	SCHWARZBECK	BBHA9120D	1805	06-22-2017	06-21-2020
EMI Test Software	AUDIX	E3	Version: 6.110919b		
Pre-amplifier	HP	8447D	2944A09358	03-07-2018	03-06-2019
Pre-amplifier	CD	PAP-1G18	11804	03-07-2018	03-06-2019
Spectrum analyzer	Rohde & Schwarz	FSP30	101454	03-07-2018	03-06-2019
EMI Test Receiver	Rohde & Schwarz	ESRP7	101070	03-07-2018	03-06-2019
Signal Generator	Rohde & Schwarz	SMX	835454/016	03-07-2018	03-06-2019
Signal Generator	R&S	SMR20	1008100050	03-07-2018	03-06-2019
Cable	ZDECL	Z108-NJ-NJ-81	1608458	03-07-2018	03-06-2019
Cable	MICRO-COAX	MFR64639	K10742-5	03-07-2018	03-06-2019
Cable	SUHNER	SUCOFLEX100	58193/4PE	03-07-2018	03-06-2019
RF Switch Unit	MWRFTEST	MW200	N/A	N/A	N/A
Test Software	MWRFTEST	MTS8200	Version: 2.0.0.0		

Conducted method:					
Test Equipment	**Manufacturer**	**Model No.**	**Serial No.**	**Cal. Date (mm-dd-yy)**	**Cal. Due date (mm-dd-yy)**
Spectrum Analyzer	Agilent	N9020A	MY50510123	11-10-2017	11-09- 2018
Vector Signal Generator	Agilent	N5182A	MY49060014	11-10-2017	11-09- 2018
Signal Generator	R&S	SMR20	1008100050	03-07-2018	03-06-2019
Power Sensor	D.A.R.E	RPR3006W	17I00015SNO27	11-10-2017	11-09- 2018
Power Sensor	D.A.R.E	RPR3006W	17I00015SNO28	11-10-2017	11-09- 2018
RF Switch Unit	Ascentest	AT890-RFB	N/A	N/A	N/A
Test Software	MWRFTEST	MTS 8310	Version: 2.0.0.0		
DC Power Supply	XinNuoEr	WYK-10020K	1409050110020	11-10-2017	11-09- 2018
Temperature Humidity Chamber	HengPu	HPGDS-500	20140828008	11-10-2017	11-09- 2018

6 Radio Technical Specification in ETSI EN 300 328

6.1 Transmitter Requirement

6.1.1 RF Output Power

Test Requirement:	ETSI EN 300 328 clause 4.3.2.2
Test Method:	ETSI EN 300 328 clause 5.4.2.2.1.2
Limit:	20dBm
Test setup:	
Test procedure:	1. Use a fast power sensor suitable for 2,4 GHz and capable of 1 MS/s. 2. Connect the power sensor to the transmit port, sample the transmit signal and store the raw data, every channel 25 bursts. Use these stored samples in all following steps. 3. Find the start and stop times of each burst in the stored measurement samples. 4. Between the start and stop times of each individual burst calculate the RMS power over the burst. Save these Pburst values, as well as the start and stop times for each burst. 5. The highest of all P_{burst} values (value "A" in dBm) will be used for maximum e.i.r.p. calculations. 6. Add the (stated) antenna assembly gain "G" in dBi of the individual antenna. The RF Output Power (P) shall be calculated using the formula below: P = A + G
Test Instruments:	See section 5.8
Test mode:	Transmitting mode
Test Result:	Pass

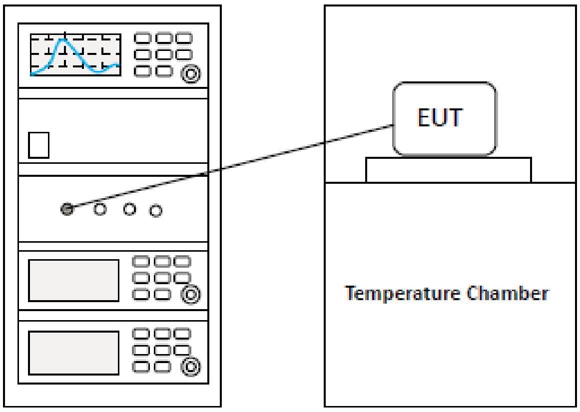
Measurement Data:

Test conditions	Channel	Read Level (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Result
NTNV	00	6.08	0.5	6.58	20	Pass
	20	5.28	0.5	5.78		
	39	5.47	0.5	5.97		
LTNV	00	6.05	0.5	6.55		
	20	5.26	0.5	5.76		
	39	5.43	0.5	5.93		
HTNV	00	6.00	0.5	6.50		
	20	5.21	0.5	5.71		
	39	5.45	0.5	5.95		

Remark:

1. NTNV: Normal Temperature Normal Voltage, LTNV: Low Temperature Normal Voltage, HTNV: High Temperature Normal Voltage.
2. Antenna Gain = 0.5 dBi, which declared by applicant.

6.1.2 Power Spectral Density

Test Requirement:	ETSI EN 300 328 clause 4.3.2.3
Test Method:	ETSI EN 300 328 clause 5.4.3
Limit:	10 dBm/MHz
Test setup:	
Test procedure:	1. Connect the UUT to the spectrum analyser and use the following settings: Start Frequency= 2400MHz; Stop Frequency= 2483.5MHz; Resolution BW= 10kHz; Video BW= 30kHz; Sweep Points ＞ 8350; Detector= RMS; Trace Mode= Max Hold; Sweep time= Auto. 2. For conducted measurements on smart antenna systems using either operating mode 2 or 3 (see clause 5.1.3.2), repeat the measurement for each of the transmit ports. For each frequency point, add up the amplitude (power) values for the different transmit chains and use this as the new data set. 3. Add up the values for amplitude (power) for all the samples in the file. 4. Normalize the individual values for amplitude so that the sum is equal to the RF Output Power (e.i.r.p.) measured in clause 5.3.2. 5. Starting from the first sample in the file (lowest frequency), add up the power of the following samples representing a 1 MHz segment and record the results for power and position (i.e. sample #1 to #100). This is the Power Spectral Density (e.i.r.p.) for the first 1 MHz segment which shall be recorded. 6. Shift the start point of the samples added up in step 5 by 1 sample and repeat the procedure in step 5 (i.e. sample #2 to #101). 7. Repeat step 6 until the end of the data set and record the radiated Power Spectral Density values for each of the 1 MHz segments.
Test Instruments:	See section 5.8
Test mode:	Transmitting mode
Test Result:	Pass

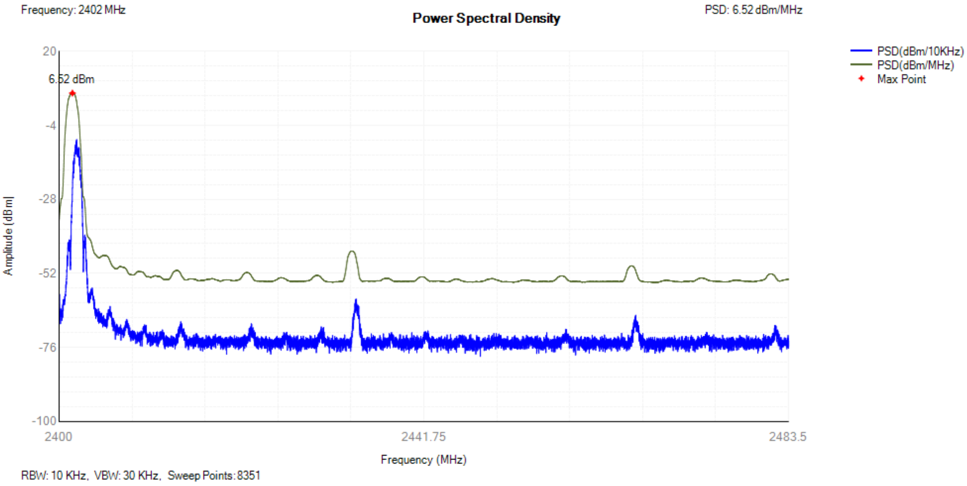
Measurement Data:

Test conditions	Channel	PSD (dBm/MHz)	Limit (dBm/MHz)	Result
NTNV	00	6.52	10	Pass
	20	5.72		
	39	5.90		

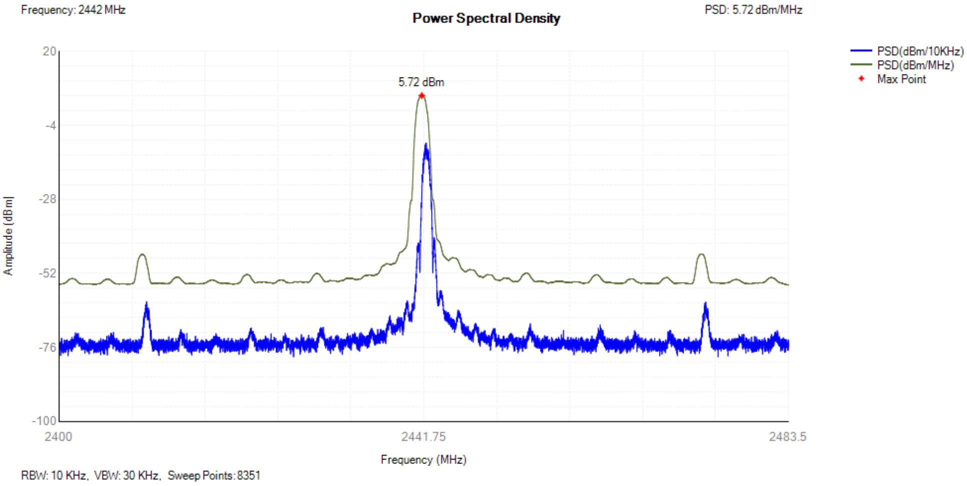
Test Plots:

NTNV

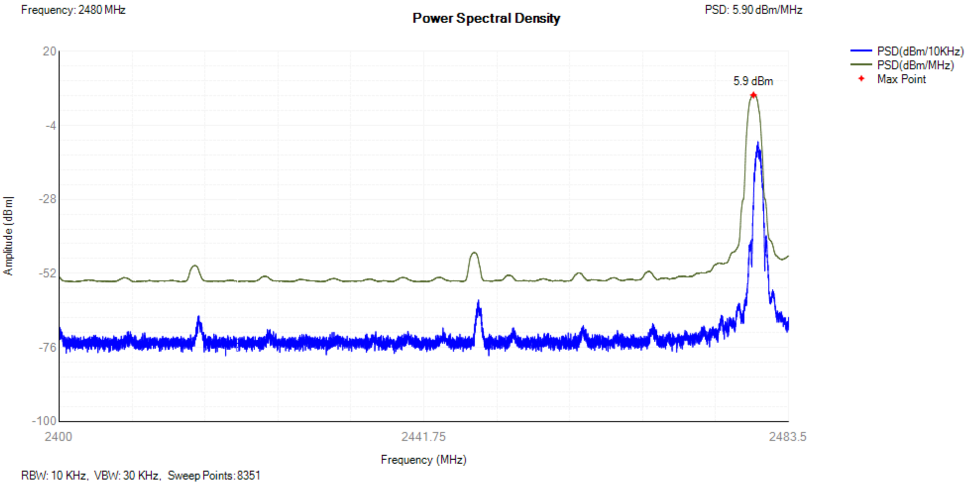
Ch. 00



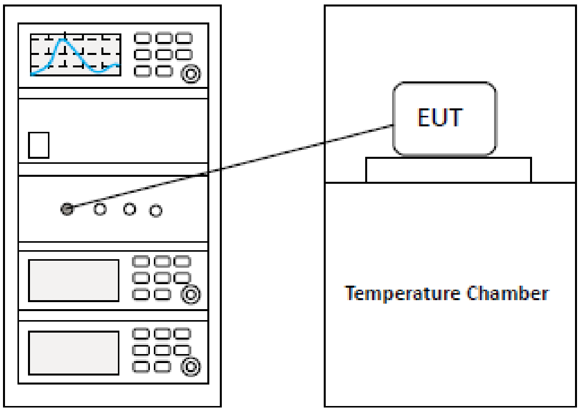
Ch.20



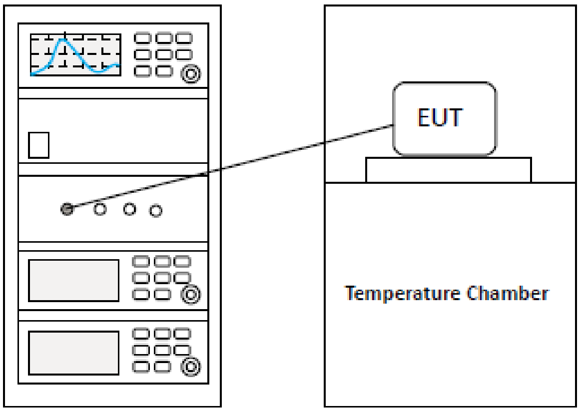
Ch. 39



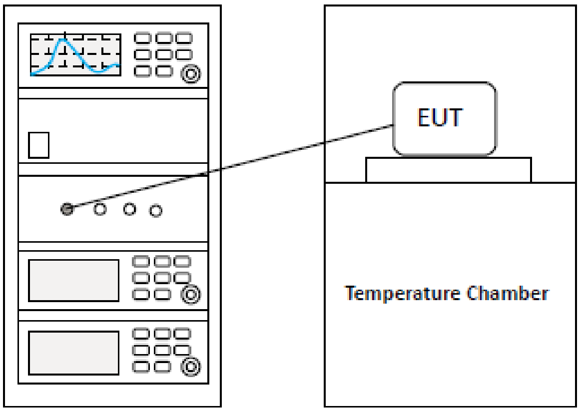
6.1.3 Duty Cycle, Tx-sequence, Tx-gap

Test Requirement:	ETSI EN 300 328 clause 4.3.2.4
Test Method:	ETSI EN 300 328 clause 5.4.2.2.1.3
Limit:	The Duty Cycle shall be equal to or less than the maximum value declared by the supplier. The maximum Tx-sequence Time and the minimum Tx-gap Time shall be according to the formula below: Maximum Tx-Sequence Time = Minimum Tx-gap Time = M where M is in the range of 3,5 ms to 10 ms.
Test setup:	
Test procedure:	1. Use the same stored measurement samples from the procedure in section 6.2.1 2. Between the saved start and stop times of each individual burst, calculate the Tx_{On} time. Save these Tx_{On} values. Between the saved stop and start times of two subsequent bursts, calculate the Tx_{Off} time. Save these Tx_{Off} values. 3. Duty Cycle is the sum of all Tx_{On} times divided by the observation period. 4. For equipment using blacklisting, the Tx_{On} 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 the previous bullet point. If the number of blacklisted frequencies cannot be determined, the minimum number of hopping frequencies shall be assumed. 5. The above calculated value for Duty Cycle shall be recorded in the test report. This value shall be equal to or less than the maximum value declared by the supplier. 6. Any Tx_{Off} time that is greater than the minimum Tx-gap time is considered a Tx-gap. The lowest Tx-gap time shall be recorded in the test report. 7. The Tx-sequence time is the time between two subsequent Tx-gaps. The maximum Tx-sequence time shall be recorded in the test report.
Test Instruments:	See section 5.8
Test mode:	Transmitting mode
Test Result:	Not required for e.i.r.p less than 10 dBm

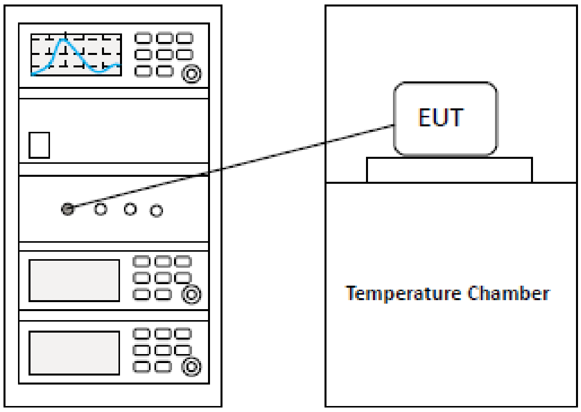
6.1.4 Medium Utilisation (MU) factor

Test Requirement:	ETSI EN 300 328 clause 4.3.2.5
Test Method:	ETSI EN 300 328 clause 5.4.2.2.1.4
Limit:	≤ 10%
Test setup:	
Test procedure:	1. Use a fast power sensor suitable for 2,4 GHz and capable of 1 MS/s. 2. Connect the power sensor to the transmit port, sample the transmit signal and store the raw data.Use these stored samples in all following steps. 3. Find the start and stop times of each burst in the stored measurement samples. 4. Between the start and stop times of each individual burst calculate the RMS power over the burst. Save these Pburst values, as well as the start and stop times for each burst. 5. The highest of all P_{burst} values (value "A" in dBm) will be used for maximum e.i.r.p. calculations. 6. Add the (stated) antenna assembly gain "G" in dBi of the individual antenna. The RF Output Power (P) shall be calculated using the formula below: P = A + G 7. The Medium Utilisation (MU) factor is a measure to quantify the amount of resources (Power and Time) used by non-adaptive equipment. The Medium Utilisation factor is defined by the formula: MU = (P/100 mW) × DC where: MU is Medium Utilisation factor in %. P is the RF output power expressed in mW. DC is the Duty Cycle expressed in %.
Test Instruments:	See section 5.8
Test mode:	Transmitting mode
Test Result:	Not required for e.i.r.p less than 10 dBm

6.1.5 Adaptivity (Adaptive equipment using modulations other than FHSS)

Test Requirement:	ETSI EN 300 328 clause 4.3.2.6
Test mothod:	ETSI EN 300 328 clause 5.4.6.2
Test setup:	
Test procedure:	1. The UUT may connect to a companion device during the test. 2. Configure the UUT for normal transmissions with a sufficiently high payload to allow demonstration of compliance of the adaptive mechanism on the hopping frequency being tested. 3. Adding the interference signal 4. Verification of reaction to the interference signal 5. Adding the blocking signal 6. Removing the interference and blocking signal 7. The steps 2 to 6 shall be repeated for each of the hopping frequencies to be tested.
Test Instruments:	See section 5.8
Test mode:	Transmitting mode
Test Result:	Not required for e.i.r.p less than 10 dBm

6.1.6 Occupied Channel Bandwidth

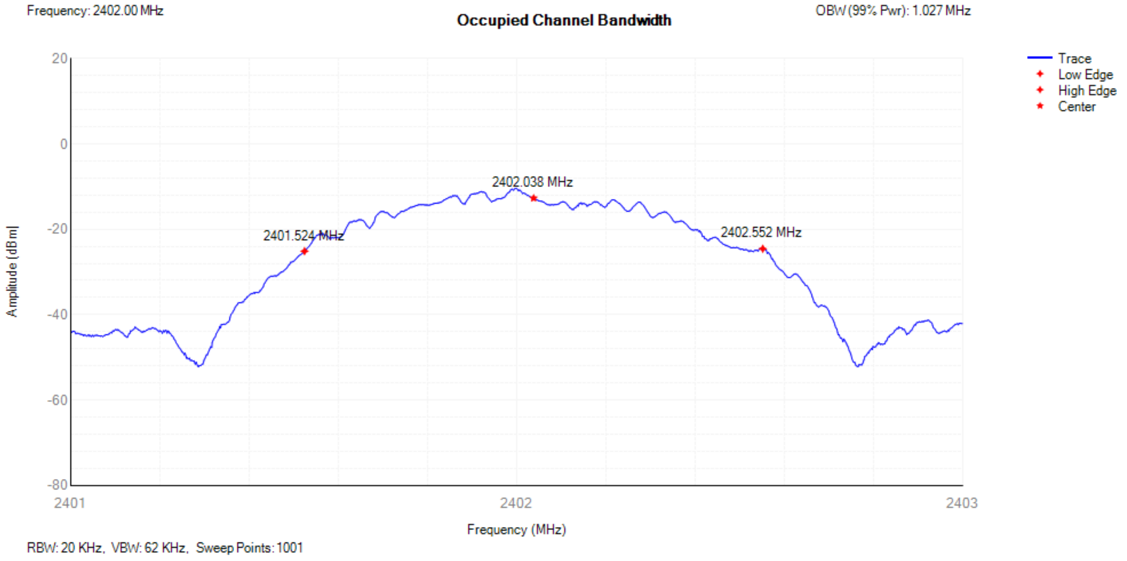
Test Requirement:	ETSI EN 300 328 clause 4.3.2.7
Test Method:	ETSI EN 300 328 clause 5.4.7.2
Limit:	2400 MHz~2483.5MHz
Test setup:	
Test procedure:	1. Connect EUT antenna terminal to the spectrum analyzer with a low loss cable and use the following setting: Centre Frequency: The centre frequency of the channel under test Resolution BW: ~ 1 % of the span without going below 1 %RBW=1% of the Span, VBW=3×RBW Frequency Span: 2 × Occupied Channel Bandwidth (e.g. 40 MHz for a 20 MHz channel), Detector Mode: RMS, Trace Mode: Max Hold 2. Wait until the trace is completed. Find the peak value of the trace and place the analyser marker on this peak. 3. Use the 99 % bandwidth function of the spectrum analyser to measure the Occupied Channel Bandwidth of the UUT. This value shall be recorded. NOTE: Make sure that the power envelope is sufficiently above the noise floor of the analyser to avoid the noise signals left and right from the power envelope being taken into account by this measurement.
Test Instruments:	See section 5.8
Test mode:	Transmitting mode
Test Result:	Pass

Measurement Data:

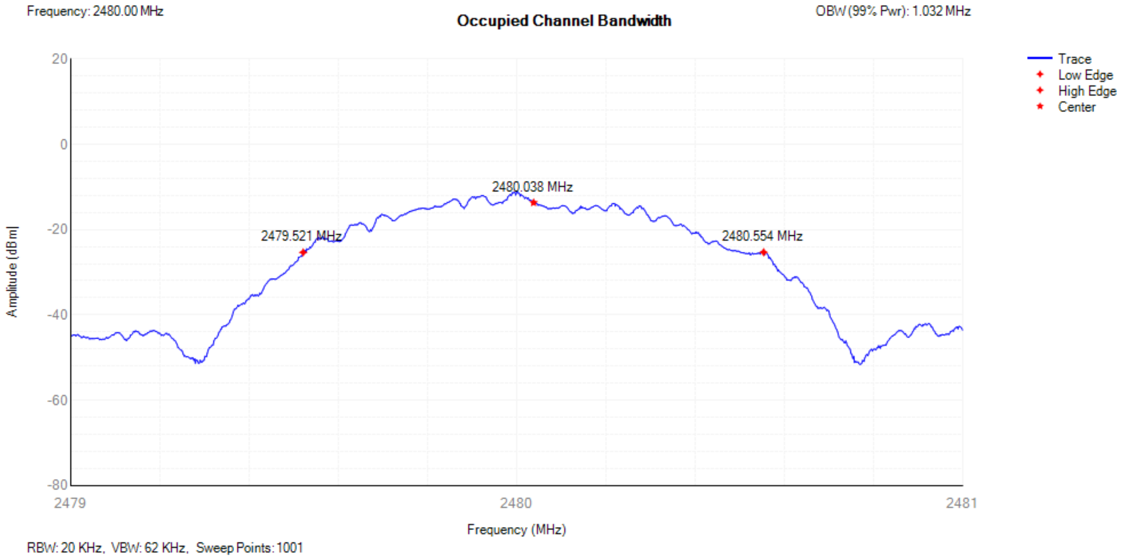
Channel	Occupied Channel Bandwidth [MHz]	Band edge [MHz]	Limit (MHz)	Result
00	1.027	2401.524	2400.00	PASS
39	1.032	2480.554	2483.50	PASS

Test Plots:

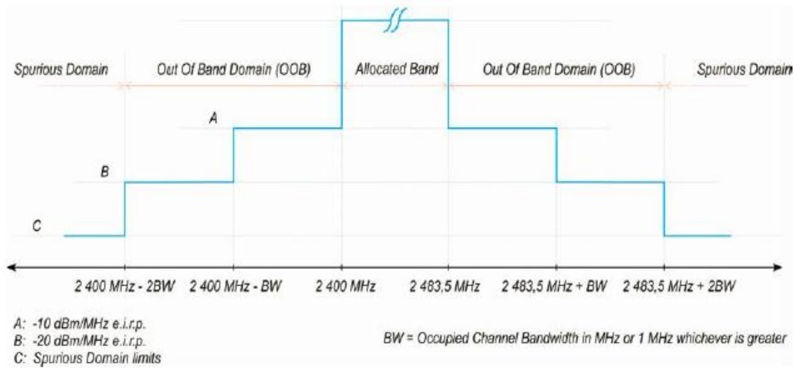
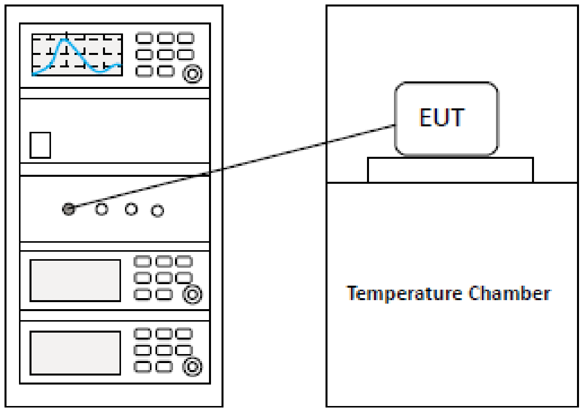
Ch.00



Ch.39



6.1.7 Transmitter unwanted emissions in the out-of-band domain

Test Requirement:	ETSI EN 300 328 clause 4.3.2.8
Test Method:	ETSI EN 300 328 clause 5.4.8.2
Limit:	
Test setup:	
Test procedure:	1. Connect EUT antenna terminal to the spectrum analyzer with a low loss cable and use the following setting: Centre Frequency: 2484 MHz, Span: Span: 0 Hz RBW=1 MHz, VBW=3 MHz, Detector Mode: RMS, Trace Mode:Clear/Write, Sweep mode: Continous,Sweep Points: 5000, Trigger mode: Video Trigger 2. Segment 2483,5 MHz to 2483,5 MHz + BW 3. Segment 2483,5 MHz + BW to 2483,5 MHz + 2BW 4. Segment 2400 MHz - BW to 2400 MHz 5. Segment 2400 MHz - 2BW to 2400 MHz - BW 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. 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.
Test Instruments:	See section 5.8
Test mode:	Transmitting mode
Test Result:	Pass

Measurement Data:

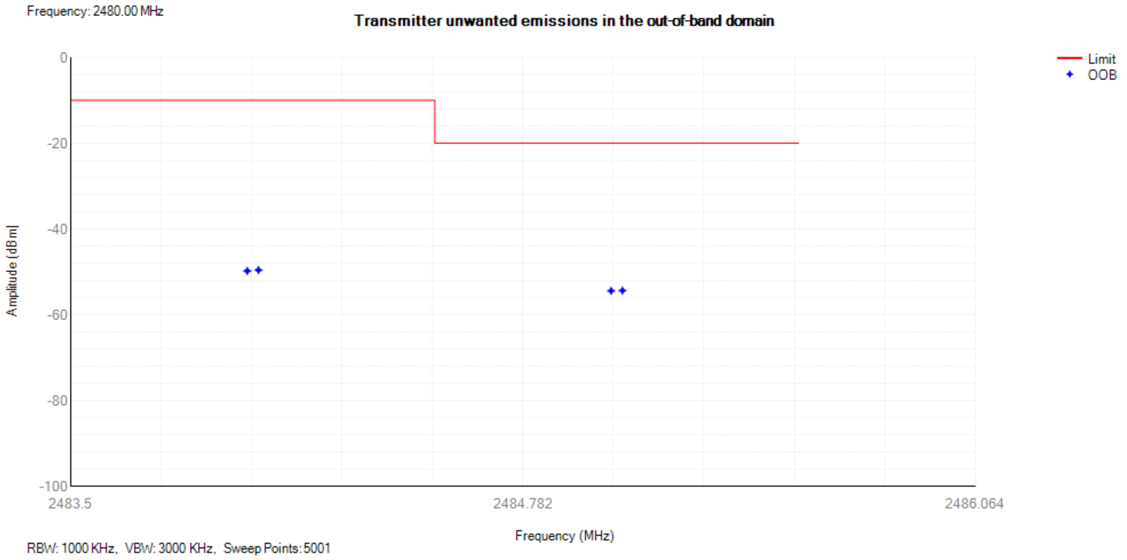
Bluetooth LE					
Test conditions	Channel	Segment (MHz)	Level (dBm)	Limit (dBm)	Result
NTNV	00	2400-BW~2400	-46.40	-10	Pass
		2400-2BW~2400-BW	-51.30	-20	
	39	2483.5~2483.5+BW	-49.63	-10	
		2483.5+BW~2483.5+2BW	-54.42	-20	
LTNV	00	2400-BW~2400	-46.44	-10	
		2400-2BW~2400-BW	-51.33	-20	
	39	2483.5~2483.5+BW	-49.66	-10	
		2483.5+BW~2483.5+2BW	-54.48	-20	
HTNV	00	2400-BW~2400	-46.48	-10	
		2400-2BW~2400-BW	-51.36	-20	
	39	2483.5~2483.5+BW	-49.69	-10	
		2483.5+BW~2483.5+2BW	-54.50	-20	

Remark:
1. NTNV: Normal Temperature Normal Voltage, LTNV: Low Temperature Normal Voltage, HTNV: High Temperature Normal Voltage.
2. Antenna Gain = 0.5 dBi, which declared by applicant.
3. The above data is only reflects of the worst test data.

Test Plots:

NTNV

Ch.00



Ch.39

6.1.8 Spurious emissions

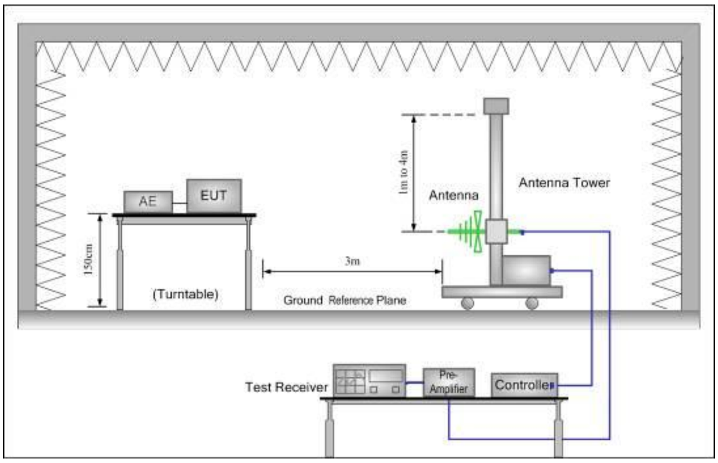
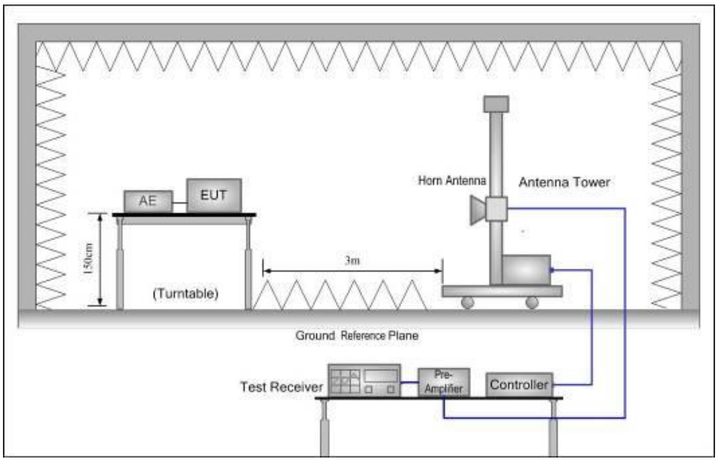
Test Requirement:	ETSI EN 300 328 clause 4.3.2.9
Test Method:	ETSI EN 300 328 clause 5.4.9.2
Receiver setup:	RBW=100kHz, VBW=300kHz, Detector= peak for Below 1 GHz RBW=1MHz, VBW=3MHz, Detector=Peak for Above 1 GHz
Test Frequency range:	30MHz to 12.75GHz
Limit:	**Table 1: Transmitter limits for spurious emissions** (see table below)
Test setup:	Below 1GHz  Above 1GHz 
Test procedure:	**Below 1GHz:** 1. On the test site as test setup graph above,the EUT shall be placed at

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

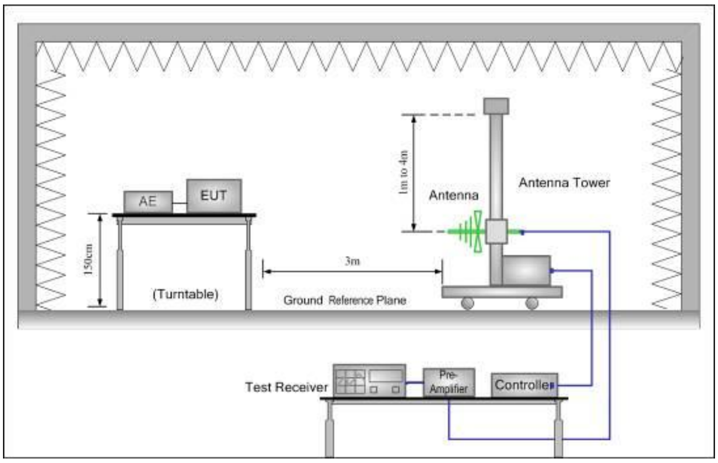
	the 1.5m support on the turntable and in the position closest to normal use as declared by the provider. 2. The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.The output of the test antenna shall be connected to the measuring receiver. 3. The transmitter shall be switched on, if possible, without modulation and the measuring receiver shall be tuned to the frequency of the transmitter under test. 4. The test antenna shall be raised and lowered from 1m to 4m until a maximum signal level is detected by the measuring receiver. Then the turntable should be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver. 5. Repeat step 4 for test frequency with the test antenna polarized horizontally. 6. Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At the lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground. 7. Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a nonradiating cable. With the antennas at both ends vertically polarized, and with the signal generator tuned to a particular test frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output. 8. Repeat step 7 with both antennas horizontally polarized for each test frequency. 9. Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps 7 and 8 by the power loss in the cable between the generator and the antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna by the following formula: ERP(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dBd) where:Pg is the generator output power into the substitution antenna. **Above 1GHz**: Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber, and the test antenna do not need to raise from 1 to 4m, just test in 1.5m height.
Test Instruments:	See section 5.8
Test mode:	Transmitting mode
Test Result:	Pass

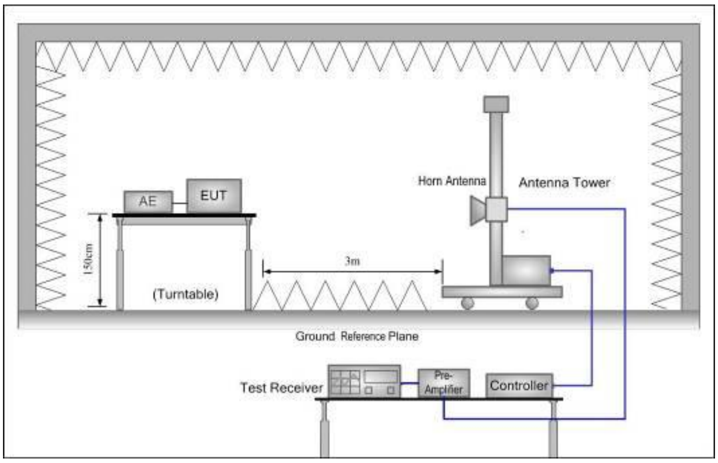
Measurement Data:

The lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	Polarization	Level (dBm)		
66.50	Vertical	-78.84	-54.00	Pass
200.69	V	-73.47		
39.99	V	-76.89	-36.00	
162.61	V	-74.67		
4804.00	V	-43.43	-30.00	
66.50	Horizontal	-85.74	-54.00	
192.42	H	-79.19		
152.13	H	-83.12	-36.00	
165.49	H	-83.10		
4804.00	H	-40.79	-30.00	
The highest channel				
Frequency (MHz)	**Spurious Emission**		**Limit (dBm)**	**Test Result**
	Polarization	**Level (dBm)**		
66.50	Vertical	-77.21	-54.00	Pass
200.69	V	-73.28		
39.99	V	-75.50	-36.00	
162.61	V	-75.13		
4960.00	V	-43.33	-30.00	
66.50	Horizontal	-83.52	-54.00	
192.42	H	-78.18		
152.13	H	-82.05	-36.00	
165.49	H	-83.30		
4960.00	H	-42.12	-30.00	

6.2 Receiver requirement

6.2.1 Spurious emissions

<table>
<tr><td>Test Requirement:</td><td>ETSI EN 300 328 clause 4.3.2.10</td></tr>
<tr><td>Test Method:</td><td>ETSI EN 300 328 clause 5.4.10.2</td></tr>
<tr><td>Receiver setup:</td><td>RBW = 100kHz, VBW = 300kHz, Detector = Peak for Below 1 GHz
RBW = 1MHz, VBW = 3MHz, Detector = Peak for Above 1 GHz</td></tr>
<tr><td>Test Frequency range:</td><td>30MHz to 12.75GHz</td></tr>
<tr><td>Limit:</td><td>Table 2: Spurious emission limits for receivers
<table>
<tr><th>Frequency range</th><th>Maximum power
e.r.p. (≤ 1 GHz)
e.i.r.p. (> 1 GHz)</th><th>Measurement bandwidth</th></tr>
<tr><td>30 MHz to 1 GHz</td><td>-57 dBm</td><td>100 kHz</td></tr>
<tr><td>1 GHz to 12,75 GHz</td><td>-47 dBm</td><td>1 MHz</td></tr>
</table></td></tr>
<tr><td>Test setup:</td><td>Below 1GHz


Above 1GHz

</td></tr>
<tr><td>Test procedure:</td><td>Below 1GHz:
1. On the test site as test setup graph above,the EUT shall be placed at the 1.5m support on the turntable and in the position closest to normal use as declared by the provider.
2. The test antenna shall be oriented initially for vertical polarization and shall be chosen to correspond to the frequency of the transmitter.The output of the test antenna shall be connected to the measuring receiver.
3. The transmitter shall be switched on, if possible, without modulation</td></tr>
</table>

	and the measuring receiver shall be tuned to the frequency of the transmitter under test. 4. The test antenna shall be raised and lowered from 1m to 4m until a maximum signal level is detected by the measuring receiver. Then the turntable should be rotated through 360° in the horizontal plane, until the maximum signal level is detected by the measuring receiver. 5. Repeat step 4 for test frequency with the test antenna polarized horizontally. 6. Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At the lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground. 7. Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a nonradiating cable. With the antennas at both ends vertically polarized, and with the signal generator tuned to a particular test frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output. 8. Repeat step 7 with both antennas horizontally polarized for each test frequency. 9. Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps 7 and 8 by the power loss in the cable between the generator and the antenna, and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna by the following formula: ERP(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dBd) where: Pg is the generator output power into the substitution antenna. **Above 1GHz:** Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber, and the test antenna do not need to raise from 1 to 4m, just test in 1.5m height.
Test Instruments:	See section 5.8
Test mode:	Receiving mode
Test Result:	Pass

Measurement Data:

The lowest channel				
Frequency (MHz)	Spurious Emission		Limit (dBm)	Test Result
	Polarization	Level(dBm)		
162.61	Vertical	-74.64	-57.00	Pass
200.69	V	-73.47		
4804.00	V	-50.41	-47.00	
165.49	Horizontal	-83.10	-57.00	
192.42	H	-79.19		
4804.00	H	-51.28	-47.00	
The highest channel				
Frequency (MHz)	**Spurious Emission**		**Limit (dBm)**	**Test Result**
	Polarization	**Level(dBm)**		
162.61	Vertical	-73.62	-57.00	Pass
200.69	V	-72.19		
4960.00	V	-51.32	-47.00	
165.49	Horizontal	-82.77	-57.00	
192.42	H	-79.05		
4960.00	H	-51.86	-47.00	

6.2.2 Receiver Blocking

Test Requirement:	ETSI EN 300 328 clause 4.3.2.11
Test mothod:	ETSI EN 300 328 clause 5.4.11.2
Test Limit:	While maintaining the minimum performance criteria as defined in clause 4.3.1.12.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in table 6, table 7 or table 8.

Table 6: 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
P_{min} + 6 dB	2 380 2 503,5	-53	CW
P_{min} + 6 dB	2 300 2 330 2 360	-47	CW
P_{min} + 6 dB	2 523,5 2 553,5 2 583,5 2 613,5 2 643,5 2 673,5	-47	CW

NOTE 1: P_{min} 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.

Table 7: 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
P_{min} + 6 dB	2 380 2 503,5	-57	CW
P_{min} + 6 dB	2 300 2 583,5	-47	CW

NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 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.

Table 8: 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
P_{min} + 12 dB	2 380 2 503,5	-57	CW
P_{min} + 12 dB	2 300 2 583,5	-47	CW

NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 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 setup:

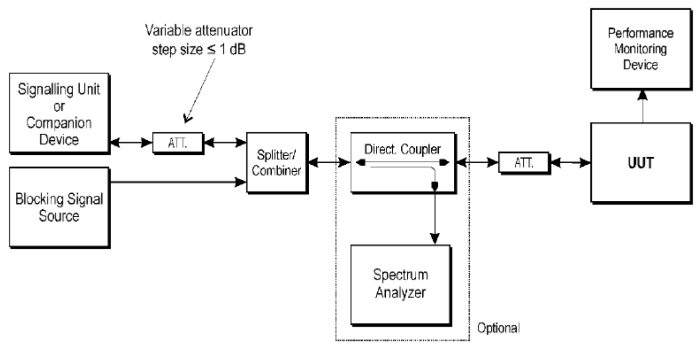


Figure 6: Test Set-up for receiver blocking

Test procedure:

1. For non-frequency hopping equipment, the UUT shall be set to the lowest operating channel.
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. 3. With the blocking signal generator switched 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 P_{min}. 4. This signal level (P_{min}) is increased by the value provided in the table corresponding to the receiver category and type of equipment. 5. 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. 6. 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. 7. For non-frequency hopping equipment, repeat step 2 to step 5 with the UUT operating at the highest operating channel.
Test Instruments:	See section 5.8
Test mode:	Receiving mode
Test Result:	Pass

Measurement Data:

Lowest Channel					
Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power(dBm) CW	PER measurement level (%)	PER Limit (%)	Results
-79.00 (Pmin+6dBm)	2380	-57	3	10	Pass
	2503.5		4		
-79.00 (Pmin+6dBm)	2300	-47	3	10	Pass
	2583.5		2		

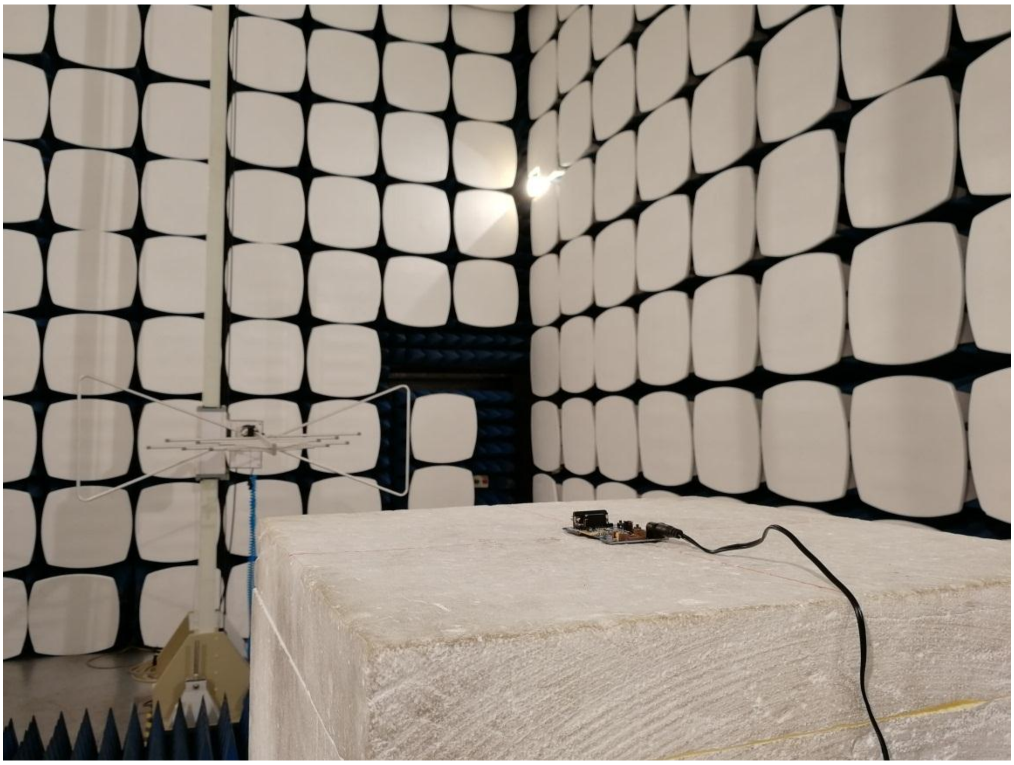
NOTE:
(1) The minimum performance criterion shall be PER less than or equal to 10 %.
(2) Manufacturer declared the sensitivity level is -85 dBm.
(3) The EUT belongs to receiver category 2 equipment.

Highest Channel					
Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power(dBm) CW	PER measurement level (%)	PER Limit (%)	Results
-79.00 (Pmin+6dBm)	2380	-57	3	10	Pass
	2503.5		2		
-79.00 (Pmin+6dBm)	2300	-47	2	10	Pass
	2583.5		3		

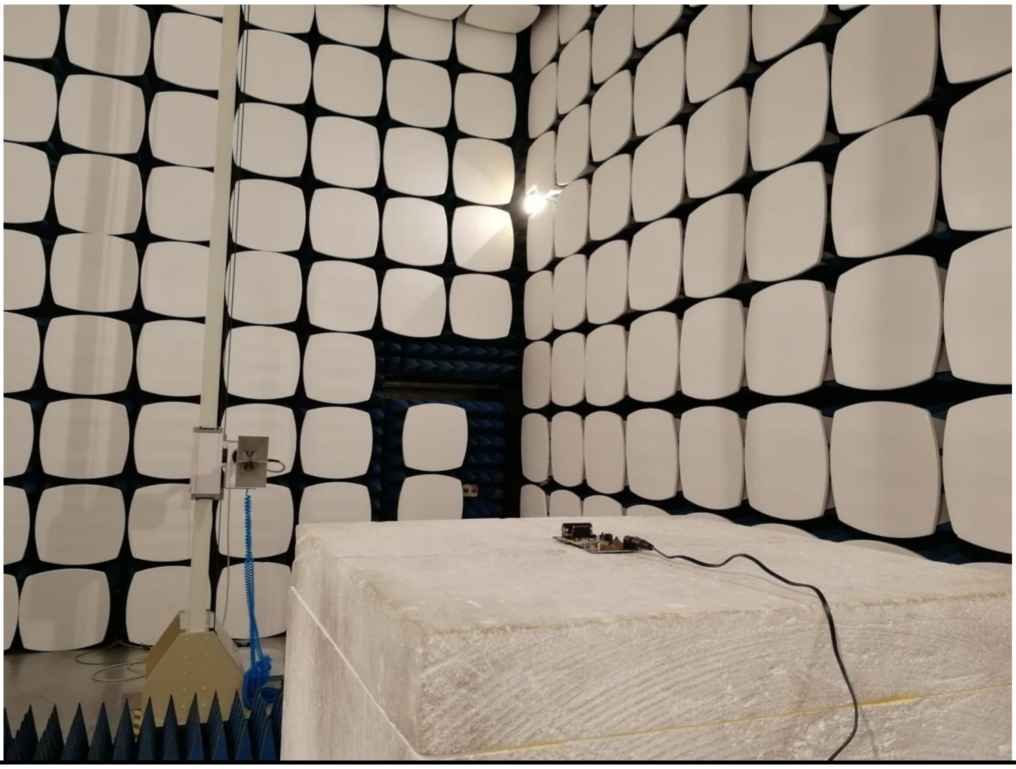
NOTE:
(1) The minimum performance criterion shall be PER less than or equal to 10 %.
(2) Manufacturer declared the sensitivity level is -85 dBm.
(3) The EUT belongs to receiver category 2 equipment.

7 Test setup photo

Radiated Emission Below 1GHz



Radiated Emission Above 1GHz



8 EUT Constructional Details

Reference to the test report No. CCISE180802401

ANNEX Application form for testing

In accordance with EN 300 328 V2.1.1, clause 5.4.1, the following information is provided by the supplier.

a) The type of modulation used by the equipment:

☐ FHSS

☒ Other forms of modulation

b) In case of FHSS modulation:

- In case of non-Adaptive Frequency Hopping equipment:
  The number of Hopping Frequencies: ...
- In case of Adaptive Frequency Hopping Equipment:
  The maximum number of Hopping Frequencies: …
  The minimum number of Hopping Frequencies: …
- The Dwell Time: …
- The Minimum Channel Occupation Time: …

c) Adaptive / non-adaptive equipment:

☐ Non-adaptive Equipment
☒ Adaptive Equipment without the possibility to switch to a non-adaptive mode
☐ Adaptive Equipment which can also operate in a non-adaptive mode

d) In case of adaptive equipment:

The Channel Occupancy Time implemented by the equipment: ____ ms

☐ 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 switch dynamically between Frame Based and Load Based equipment
The CCA time implemented by the equipment: ____µs
The value q as referred to in clause 4.3.2.5.2.2.2: ....
☐ The equipment has implemented an non-LBT based DAA mechanism
☐ The equipment can operate in more than one adaptive mode

e) In case of non-adaptive Equipment:

The maximum RF Output Power (e.i.r.p.): ___dBm
The maximum (corresponding) Duty Cycle: ____ %
Equipment with dynamic behaviour, that behaviour is described here. (e.g. the different combinations of duty cycle and corresponding power levels to be declared):

f) The worst case operational mode for each of the following tests:

- RF Output Power GFSK
- Power Spectral Density GFSK
- Duty cycle, Tx-Sequence, Tx-gap ...
- Dwell time, Minimum Frequency Occupation & Hopping Sequence (only for FHSS equipment) …
- Hopping Frequency Separation (only for FHSS equipment) …
- Medium Utilisation …
- Adaptivity & Receiver Blocking GFSK
- Occupied Channel Bandwidth GFSK
- Transmitter unwanted emissions in the OOB domain GFSK
- Transmitter unwanted emissions in the spurious domain GFSK
- Receiver spurious emissions GFSK

g) 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

NOTE: Add more lines if more channel bandwidths are supported.

☐ 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

NOTE: Add more lines if more channel bandwidths are supported.

h) In case of Smart Antenna Systems:

- The number of Receive chains: ....
- The number of Transmit chains: ....

☐ Symmetrical power distribution

☐ asymmetrical power distribution

In case of beam forming, the maximum beam forming gain: ....

NOTE: Beam forming gain does not include the basic gain of a single antenna.

i) Operating Frequency Range(s) of the equipment:

- Operating Frequency Range 1: 2402 MHz to 2480 MHz
- Operating Frequency Range 2: .... MHz to........... MHz

NOTE: Add more lines if more Frequency Ranges are supported.

j) Occupied Channel Bandwidth(s):

- Occupied Channel Bandwidth 1: 1.032 MHz
- Occupied Channel Bandwidth 2: .... MHz

NOTE: Add more lines if more channel bandwidths are supported.

k) 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...

l) The extreme operating conditions that apply to the equipment:

Operating temperature range: -20 ° C to +55° C

Operating voltage range: 207 V to 253 V ☒ AC ☐ DC

Details provided are for the: ☒ stand-alone equipment

☐ combined (or host) equipment

☐ test jig

m) The intended combination(s) of the radio equipment power settings and one or more antenna assemblies and their corresponding e.i.r.p levels:

- Antenna Type:

☒ Integral Antenna

☒ Antenna Gain: 0.5 dBi

If applicable, additional beamforming gain (excluding basic antenna gain): ____dB

☐ Temporary RF connector provided

☐ No temporary RF connector provided

☐ Dedicated Antennas (equipment with antenna connector)

☐ Single power level with corresponding antenna(s)

☐ Multiple power settings and corresponding antenna(s) Number of different

Power Levels: ...
Power Level 1: ____dBm
Power Level 2: ____dBm
Power Level 3: ____dBm

NOTE 1: Add more lines in case the equipment has more power levels.

NOTE 2: These power levels are conducted power levels (at antenna connector).

- For each of the Power Levels, provide the intended antenna assemblies, their corresponding gains (G) and the resulting e.i.r.p. levels also taking into account the beamforming gain (Y) if applicable

Power Level 1: ____dBm

Number of antenna assemblies provided for this power level: ....

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	Part number or model name
1			
2			
3			
4			

Power Level 2: ____dBm

Number of antenna assemblies provided for this power level: ....

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	Part number or model name
1			
2			
3			
4			

Power Level 3: ____dBm

Number of antenna assemblies provided for this power level: ....

Assembly #	Gain (dBi)	e.i.r.p. (dBm)	Part number or model name
1			
2			
3			
4			

n) The nominal voltages of the stand-alone radio equipment or the nominal voltages of the combined (host) equipment or test jig in case of plug-in devices:

Details provided are for the: ☒ stand-alone equipment
☐ combined (or host) equipment
☐ test jig

Supply Voltage ☒ AC mains State AC voltage 230 V
☐ DC State DC voltage ____V

In case of DC, indicate the type of power source

☐ Internal Power Supply
☒ External Power Supply or AC/DC adapter
☒ Battery
☐ Other: .....

o) Describe the test modes available which can facilitate testing:

Continuous transmitting mode control in engineer mode.

p) The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3], proprietary, etc.): Bluetooth

Configuration for testing

From all combinations of conducted power settings and intended antenna assembly(ies) specified in clause 5.4.1 m), specify the combination resulting in the highest e.i.r.p. for the radio equipment.

Unless otherwise specified in EN 300 328, this power setting is to be used for testing against the requirements of EN 300 328. In case there is more than one such conducted power setting resulting in the same (highest) e.i.r.p. level, the highest power setting is to be used for testing. See also EN 300 328, clause 5.3.2.3.

Highest overall e.i.r.p. value: 6.58 dBm

Corresponding Antenna assembly gain: 0.5 dBi   Antenna Assembly #: 1

Corresponding conducted power setting: 6.08 dBm   Listed as Power Setting #: 7

(also the power level to be used for testing)

Additional information provided by the applicant

Modulation:

ITU Class(es) of emission: DSSS

Can the transmitter operate unmodulated? ☐ yes ☒ no

Duty Cycle

The transmitter is intended for:

☐ Continuous duty
☐ Intermittent duty
☒ Continuous operation possible for testing purposes

About the UUT

☒ The equipment submitted are representative production models
☐ If not, the equipment submitted are pre-production models?
☐ If pre-production equipment are submitted, the final production equipment will be identical in all respects with the equipment tested
☐ If not, supply full details

....

☐ The equipment submitted is CE marked
☐ In addition to the CE mark, the Class-II identifier (Alert Sign) is affixed.

Additional items and/or supporting equipment provided

☐ Spare batteries (e.g. for portable equipment)
☒ Battery charging device
☒ External Power Supply or AC/DC adapter
☐ Test Jig or interface box
☐ RF test fixture (for equipment with integrated antennas)
☐ Host System Manufacturer: ....
Model #: ....
Model name: ....
☐ Combined equipment Manufacturer: ....
Model #: ....
Model name: ....
☒ User Manual
☒ Technical documentation (Handbook and circuit diagrams)

------End of report------