TEST REPORT

Reference No.	:	WTF18F03106889W
Applicant	:	Mid Ocean Brands B.V.
Address	:	Unit 201 2/F., Laford Centre, 838 Lai Chi Kok Road, Cheung Sha Wan, Kowloon, Hong Kong.
Manufacturer	:	103221
Product Name	:	Bluetooth Speaker
Model No.	:	CX1449
Standards	:	**Article 3.1a Health** (EN 62479:2010) **Article 3.1a Electrical Safety** (EN 60950-1:2006+A11:2009+A1:2010 +A12:2011+A2:2013)* **Article 3.1b EMC** (EN 55032:2015, EN 55024:2010+A1:2015)** **Article 3.1b EMC** (ETSI EN 301 489-1 V2.1.1:2017, ETSI EN 301 489-17 V3.1.1: 2017) **Article 3.2 Radio spectrum** (ETSI EN 300 328 V2.1.1:2016)
Date of Receipt sample	:	2018-05-08
Date of Test	:	2018-05-08 to 2018-05-10
Date of Issue	:	2018-05-11
Test Result	:	**Pass**

Remarks:
*Refer to test report WTF18F03106888S for details.
**Refer to test report WTF18F03106886R1E for details.
The results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

Prepared By:
Waltek Services (Foshan) Co., Ltd.
Address: No. 13-19, 2/F, 2nd Building, Sunlink International Machinery City, Chencun Town, Shunde District, Foshan, Guangdong, China.
Tel:+86-757-23811398
Fax:+86-757-23811381

Compiled by:

Roy Hong / Project Engineer

Approved by:

Tom Xiao / Manager

1 Test Summary

Radio Spectrum			
Test	Test Requirement	Limit / Severity	Result
RF output power	ETSI EN 300 328 V2.1.1:2016	≤20dBm	Pass
Duty Cycle, Tx-sequence, Tx-gap	ETSI EN 300 328 V2.1.1:2016	-	N/A
Accumulated Transmit Time, Frequency Occupation and Hopping Sequence	ETSI EN 300 328 V2.1.1:2016	Clause 4.3.1.4.3	Pass
Hopping Frequency Separation	ETSI EN 300 328 V2.1.1:2016	≥100kHz	Pass
Medium Utilization	ETSI EN 300 328 V2.1.1:2016	-	N/A
Adaptivity (Adaptive Frequency Hopping)	ETSI EN 300 328 V2.1.1:2016	-	N/A
Occupied Channel Bandwidth	ETSI EN 300 328 V2.1.1:2016	Within the band 2400-2483.5MHz	Pass
Transmitter unwanted in the OOB domain	ETSI EN 300 328 V2.1.1:2016	Figure 1	Pass
Transmitter unwanted emissions in the spurious domain	ETSI EN 300 328 V2.1.1:2016	Table 4	Pass
Receiver spurious emissions	ETSI EN 300 328 V2.1.1:2016	Table 5	Pass
Receiver Blocking	ETSI EN 300 328 V2.1.1:2016	Clause 4.3.1.12.4	Pass
EMC			
Test	Test Requirement	Class / Severity	Result
Radiation Emission	ETSI EN 301 489-17 V3.1.1:2017	Class B	Pass
Conducted Emissions	ETSI EN 301 489-17 V3.1.1:2017	Class B	N/A
Harmonic Current Emissions	ETSI EN 301 489-17 V3.1.1:2017	Clause 7 of EN 61000-3-2	N/A
Voltage Fluctuations and Flicker	ETSI EN 301 489-17 V3.1.1:2017	Clause 5 of EN 61000-3-3	N/A
Radio frequency electromagnetic field (80 MHz to 6 000MHz)	ETSI EN 301 489-17 V3.1.1:2017	3V/m, 80%, 1kHz, Amp. Mod.	Pass
Electrostatic Discharge (ESD)	ETSI EN 301 489-17 V3.1.1:2017	±4 kV Contact ±2/±4/±8 kV Air	Pass
Fast Transients Common Mode (EFT)	ETSI EN 301 489-17 V3.1.1:2017	AC±0.5/1.0kV	N/A
Voltage Dips and Interruptions	ETSI EN 301 489-17 V3.1.1:2017	0 % UT* for 0.5per 0 % UT* for 1per 70 % UT* for 25per 0 % UT* for 250per	N/A
RF common mode 0,15 MHz to 80 MHz (CS)	ETSI EN 301 489-17 V3.1.1:2017	3Vrms(emf), 80%, 1kHz Amp. Mod.	N/A
Surge	ETSI EN 301 489-17 V3.1.1:2017	±1kV D.M.† ±2kV C.M.‡	N/A

HEALTH			
Test	Test Method	Class / Severity	Result
RF Exposure	EN 62479:2010	-	Pass

Remark:

Pass Test item meets the requirement

N/A Not Applicable

RF In this whole report RF means Radio Frequency

2 Contents

3 General Information

3.1 General Description of E.U.T.

Product Name ..... : Bluetooth Speaker

Model No. ..... : CX1449

Remark ..... : ---

3.2 Details of E.U.T.

Frequency Range ..... : 2402-2480MHz, 79 Channels in total

Nominal Channel Bandwidth..... : 1MHz

Maximum RF Output Power ..... : -5.89 dBm

Bluetooth Version ..... : Bluetooth V4.2+ BR+ EDR

Type of Modulation ..... : GFSK, π/4DQPSK

Antenna installation ..... : PCB Printed Antenna

Antenna Gain ..... : 0dBi

The lowest oscillator..... : 24MHz

Receiver Category..... : 3

Supply Voltage..... : Battery 3.7V or DC 5V by USB port

3.3 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
1	2402	**2**	2403	**3**	2404	**4**	2405
5	2406	**6**	2407	**7**	2408	**8**	2409
9	2410	**10**	2411	**11**	2412	**12**	2413
13	2414	**14**	2415	**15**	2416	**16**	2417
17	2418	**18**	2419	**19**	2420	**20**	2421
21	2422	**22**	2423	**23**	2424	**24**	2425
25	2426	**26**	2427	**27**	2428	**28**	2429
29	2430	**30**	2431	**31**	2432	**32**	2433
33	2434	**34**	2435	**35**	2436	**36**	2437
37	2438	**38**	2439	**39**	2440	**40**	2441
41	2442	**42**	2443	**43**	2444	**44**	2445
45	2446	**46**	2447	**47**	2448	**48**	2449
49	2450	**50**	2451	**51**	2452	**52**	2453
53	2454	**54**	2455	**55**	2456	**56**	2457
57	2458	**58**	2459	**59**	2460	**60**	2461
61	2462	**62**	2463	**63**	2464	**64**	2465
65	2466	**66**	2467	**67**	2468	**68**	2469
69	2470	**70**	2471	**71**	2472	**72**	2473
73	2474	**74**	2475	**75**	2476	**76**	2477
77	2478	**78**	2479	**79**	2480	-	-

3.4 Additional information

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: ***N/A***

• In case of Adaptive Frequency Hopping Equipment:

The maximum number of Hopping Frequencies: ***79***

The minimum number of Hopping Frequencies: ***79***

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 equipment has implemented an LBT based DAA mechanism

☒ The equipment has implemented a 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.): ***N/A***dBm

The maximum (corresponding) Duty Cycle: ***N/A*** %

Equipment with dynamic behaviour, that behaviour is described here. (e.g. the different combinations of duty cycle and corresponding power levels to be declared): ***N/A***

f) The different transmit operating modes (tick all that apply):

☒ Operating mode 1: Single Antenna Equipment

- ☒ Equipment with only one antenna
- ☐ Equipment with two diversity antennas but only one antenna active at any moment in time
- ☐ Smart Antenna Systems with two or more antennas, but operating in a (legacy) mode where only one 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 Nominal Channel Bandwidth 1
- ☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2

☐ Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming

- ☐ Single spatial stream / Standard throughput (e.g. IEEE 802.11™ [i.3] legacy mode)
- ☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 1
- ☐ High Throughput (> 1 spatial stream) using Nominal Channel Bandwidth 2

g) 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 .....

h) The normal and the extreme operating conditions that apply to the equipment:

Normal operating conditions (if applicable):

Operating temperature: ***25***° C

Extreme operating conditions:

Operating temperature range: Minimum: ***-10*** ° C Maximum ***+50***° C

i) 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 (information to be provided in case of conducted measurements)

Antenna Gain:0dBi

☐ Dedicated Antennas (equipment with antenna connector)

☐ Single power level with corresponding antenna(s)

☐ Multiple power settings and corresponding antenna(s)

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

The EUT can be into the Engineer mode for testing.

k) The equipment type (e.g. Bluetooth®, IEEE 802.11™ [i.3], IEEE 802.15.4™ [i.4], proprietary, etc.):

Bluetooth

l) Geo-location capability supported by the equipment:

☐ Yes

☐ The geographical location determined by the equipment as defined in clause 4.3.1.13.2 or clause 4.3.2.12.2 is not accessible to the user

☒ No

3.5 Subcontracted

Whether parts of tests for the product have been subcontracted to other labs:

☒ Yes ☐ No

If Yes, list the related test items and lab information:

Test items: Receiver Blocking

Lab information: Waltek Services (Shenzhen) Co., Ltd.

3.6 Abnormalities from Standard Conditions

None.

4 Equipment Used during Test

4.1 Equipment List

3m Semi-anechoic Chamber for Radiation Emission and Spurious Emission						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	EMI TEST RECEIVER	RS	ESR7	101566	2018-01-18	2019-01-17
2	Spectrum Analyzer	Agilent	N9020A	MY48011796	2018-01-18	2019-01-17
3	Trilog Broadband Antenna	SCHWARZBECK	VULB9162	9162-117	2018-01-18	2019-01-17
4	Coaxial Cable (below 1GHz)	H+S	CBL3-NN-12+3 m	214NN320	2018-01-18	2019-01-17
5	Broad-band Horn Antenna	SCHWARZBECK	BBHA 9120 D	01561	2018-01-18	2019-01-17
6	Broadband Preamplifier (below 1GHz)	SCHWARZBECK	BBV 9743	BBV 9743#170	2018-01-18	2019-01-17
7	Broadband Preamplifier (Above 1GHz)	Lunar E M	LNA1G18-40	20160501002	2018-01-18	2019-01-17
8	Coaxial Cable (above 1GHz)	Times-Micorwave	CBL5-NN	-	2018-01-18	2019-01-17
RF Conducted test						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	Environmental Chamber	KSON	THS-D4C-100	5244K	2018-01-18	2019-01-17
2	Spectrum Analyzer	Agilent	N9020A	MY48011796	2018-01-18	2019-01-17
3	ESG VECTOR SIGNAL GENERATOR	Agilent	N5182A	MY50141533	2018-01-18	2019-01-17
4	EXG Analog Signal Generator	Agilent	N5181A	MY48080720	2018-01-18	2019-01-17
5	RF Control Unit	CHANGCHUANG	JS0806-2	-	2018-01-18	2019-01-17
6	USB Wideband Power Sensor	KEYSIGHT	U2021A	MY56510008	2018-01-18	2019-01-17
Mains Terminal Disturbance Voltage (Conducted Emission)						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	EMI Test Receiver	R&S	ESCI	101178	2018-01-18	2019-01-17
2	LISN	R&S	ENV216	101215	2018-01-18	2019-01-17
3	LISN	SCHWARZBECK	NSLK 8128	8128-289	2018-01-18	2019-01-17
4	Cable	HUBER+SUHNER	CBL2-NN-3M	2230300	2018-01-18	2019-01-17

5	Switch	ESE	RSU/M2	---	2018-01-18	2019-01-17
Harmonics and Flicker Measuring System						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	Harmonics and Flicker Measuring System	TESEQ	PROFLINE2105-400	1133A01498	2018-01-18	2019-01-17
ESD						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	ESD Simulator	TESEQ	NSG437	521	2018-01-18	2019-01-17
Injected Currents						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	Conducted Immunity test system	TESEQ	NSG4070-75	31469	2018-01-18	2019-01-17
2	CDN	TESEQ	M016	31586	2018-01-18	2019-01-17
3	Clamp	TESEQ	KEMZ801	32362	2018-01-18	2019-01-17
Surge						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	Surge Simulator	TESEQ	NSG3060	1395	2018-01-18	2019-01-17
EFT & Voltage Dips and Interruptions						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	EMS test system	TESEQ	NSG3040	1858	2018-01-18	2019-01-17
2	Clamp	TESEQ	CDN8014	31405	2018-01-18	2019-01-17
Radio-frequency electromagnetic fields						
Item	**Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Last Calibration Date**	**Calibration Due Date**
1	RF Power Amplifier	OPHIR	5225F	1051/1712	2018-01-18	2019-01-17
2	RF Power Amplifier	OPHIR	5293F	1051/171.	2018-01-18	2019-01-17
3	Stacked double logarithmic periodic antenna	SCHWARZBECK	STLP9128E-SPECIAL	STLP 9128E	2018-01-18	2019-01-17
4	Stacked double logarithmic periodic antenna	SCHWARZBECK	STLP 9149	STLP 9149 #476	2018-01-18	2019-01-17
5	RF signal generator	Agilent	N5181A	MY48080720	2018-01-18	2019-01-17

4.2 Support equipment

Item	Equipment	Technical Data	Manufacturer	Model No.	Serial No.
1.	Notebook	AC 230V/50Hz	Lenovo	ThinkPad Edge E430	00426-OEM-8992662-00400

4.3 Measurement Uncertainty

Parameter	Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±1.5dB
Power Spectral Density, conducted	±3dB
Unwanted Emissions, conducted	±3dB
All emissions, radiated	±6dB
Time	±5%
Duty Cycle	±5%
Temperature	±1℃
Humidity	±5%
DC and low frequency voltages	±3%
Conduction disturbance (150kHz~30MHz)	±2.66dB
Radiated Emission(30MHz~1000MHz)	±4.56dB
Radiated Emission(1000MHz~18000MHz)	±4.66dB

5 RF Requirements

5.1 RF Output power

Test Requirement ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.2

Test Procedure ..... : ETSI EN 300 328 V2.1.1, Clause 5.4.2.2.1.2

Limit ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.2.3

Test Result ..... : Pass

5.1.1 E.U.T. Operation

Environmental Conditions:

Temperature ..... : 25°C

Humidity ..... : 49%RH

Test Mode:

Input Voltage ..... : DC 5V

Operating mode ..... : Transmit mode

Remark ..... : Pre-Scan has been conducted to determine the worst-case mode from all available modulations. Modulation type π/4DQPSK was selected for the final test.

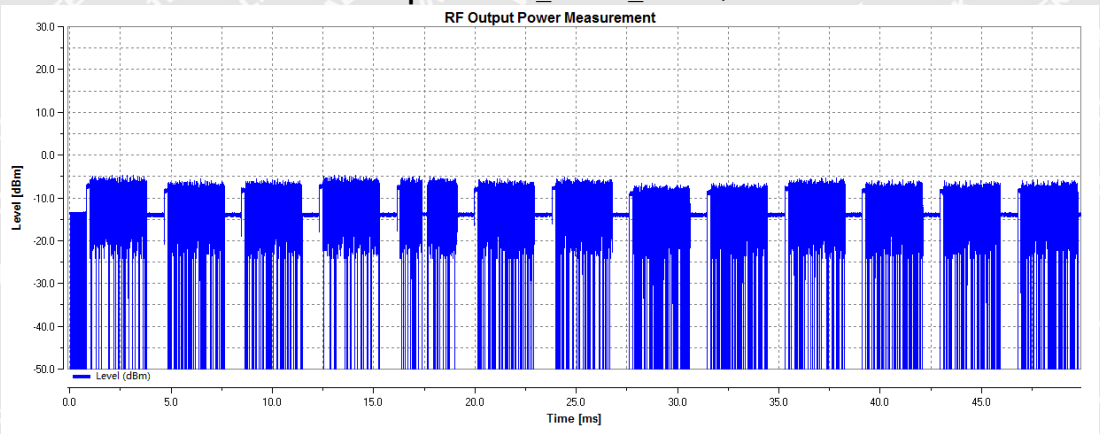
5.1.2 Test Result

Modulation Type	Test conditions		EIRP (dBm)	Limit (dBm)	Verdict
	Voltage (Vdc)	Temperature (℃)			
π/4DQPSK	V_{nor}=5	T_{min}=-10	-5.9	20.00	Pass
		T_{nor}=+25	-5.89		
		T_{max}=+50	-5.91		

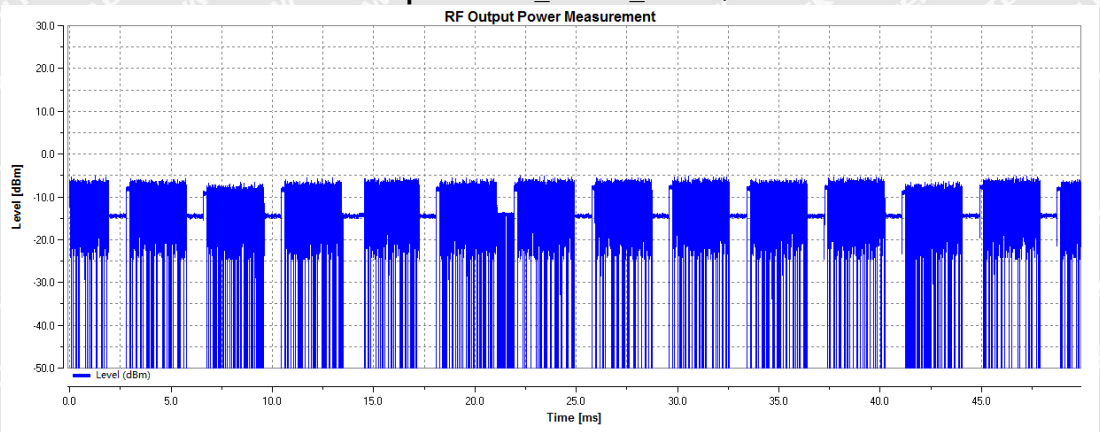
Remark: EIRP=Conducted output power + ANT gain

Test Graphs:

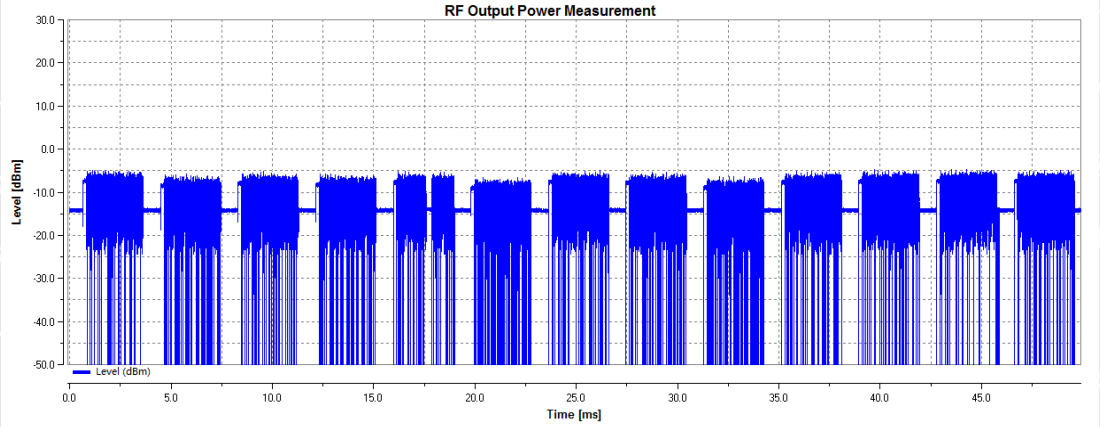
RF Output Power_TLVN _π/4DQPSK



RF Output Power_TNVN _π/4DQPSK



RF Output Power_THVN _π/4DQPSK



5.2 Accumulated Transmit Time, Minimum Frequency Occupation and Hopping Sequence

Test Requirement ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.4

Test Procedure ..... : ETSI EN 300 328 V2.1.1, Clause 5.4.4.2

Limit ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.4.3

Test Result ..... : Pass

5.2.1 E.U.T. Operation

Environmental Conditions:

Temperature ..... : 25°C

Humidity ..... : 49%RH

Test Mode:

Input Voltage ..... : DC 5V

Operating mode ..... : Transmit mode

Remark ..... : Pre-Scan has been conducted to determine the worst-case mode from all available modulations. Modulation type GFSK was selected for the final test of Minimum Frequency Occupation and Hopping Sequence. Modulation type π/4DQPSK was selected for the final test of Accumulated Dwell Time.

5.2.2 Test Result

◆ **Accumulated Dwell Time**

Modulation Type	Test Condition	Test Channel	Accumulated Transmit Time (ms)	Limit (ms)	Verdict
π/4DQPSK	TNVN	2402MHz	350.760	400	Pass
π/4DQPSK	TNVN	2441MHz	381.307	400	Pass
π/4DQPSK	TNVN	2480MHz	391.840	400	Pass

◆ **Minimum Frequency Occupation**

Modulation Type	Test Condition	Test Channel	Frequency occupation times (N)	Limit (N)	Verdict
GFSK	TNVN	2402MHz	1	≥1	Pass
GFSK	TNVN	2441MHz	3		Pass
GFSK	TNVN	2480MHz	3		Pass

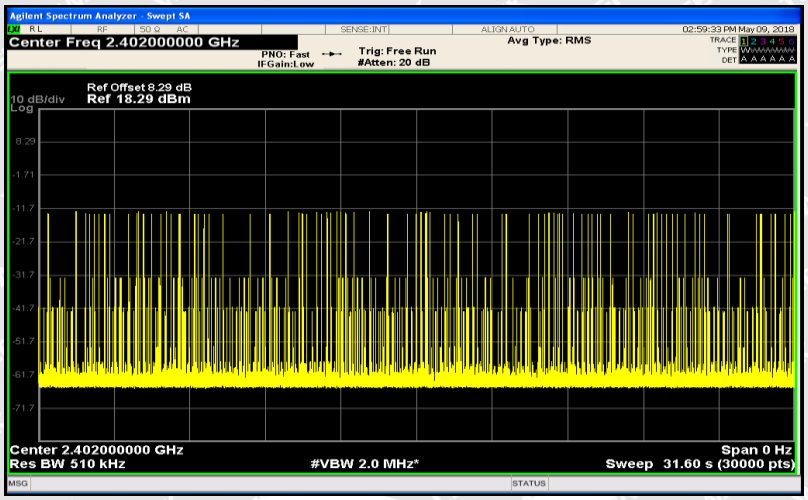
◆ **Hopping Sequence**

Modulation Type	Test Condition	Number of Hopping Channel	Limit	-20 dB Bandwidth(%)	Limit	Verdict
GFSK	TNVN	79	≥15	95.12	70 % of the band 2400MHz-2483.5MHz	Pass

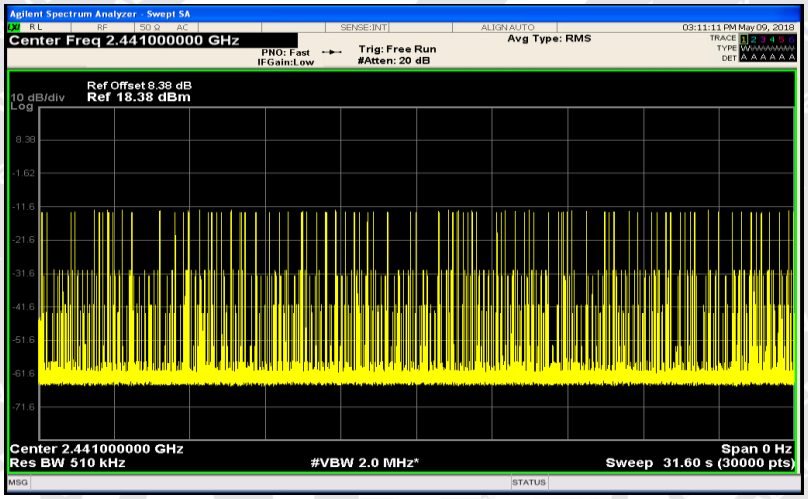
Test Graphs:

◆ **Accumulated Dwell Time**

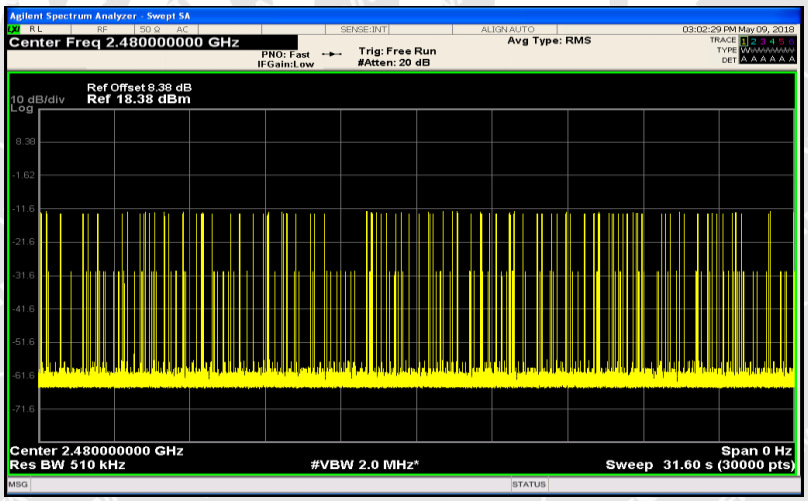
Accumulated Dwell time_TNVN_π/4DQPSK_2402



Accumulated Dwell time_TNVN_π/4DQPSK_2441

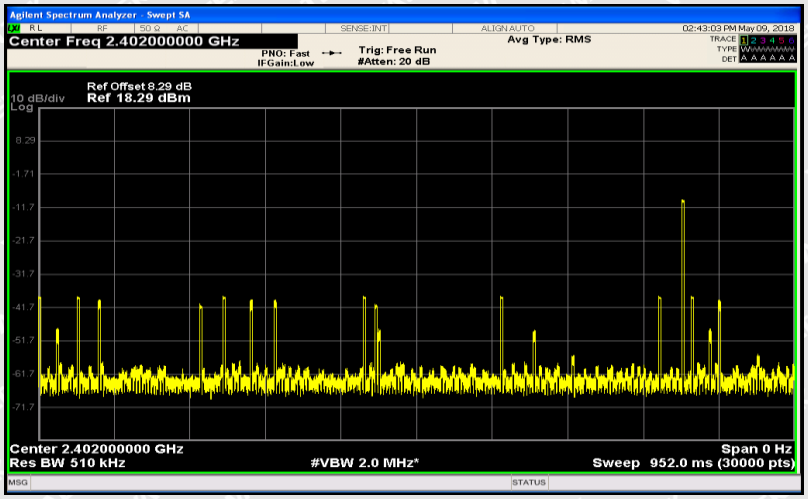


Accumulated Dwell time_TNVN_π/4DQPSK_2480

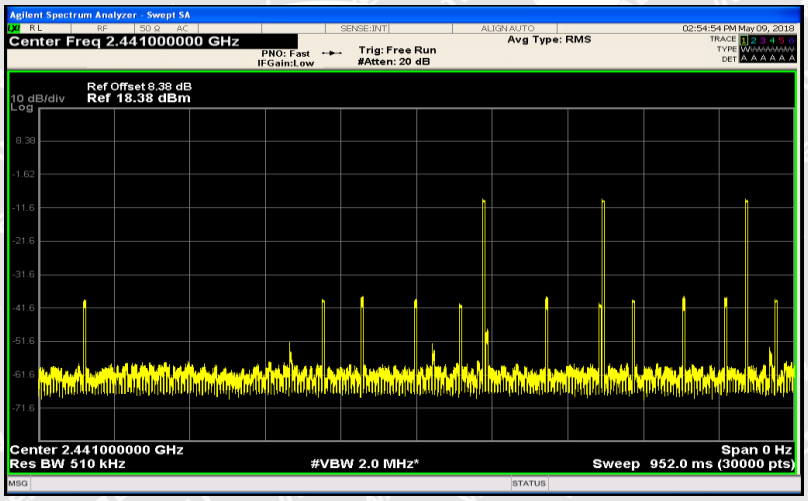


◆ **Minimum Frequency Occupation**

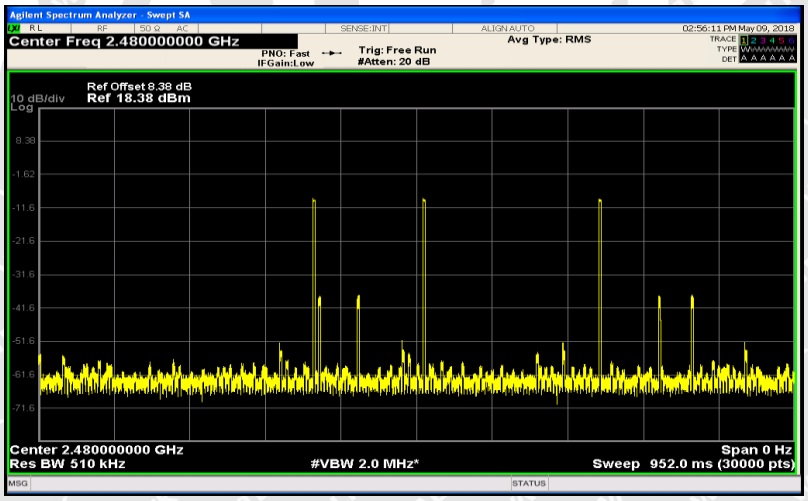
Minimum Frequency Occupation_TNVN_GFSK_2402



Minimum Frequency Occupation_TNVN_GFSK_2441

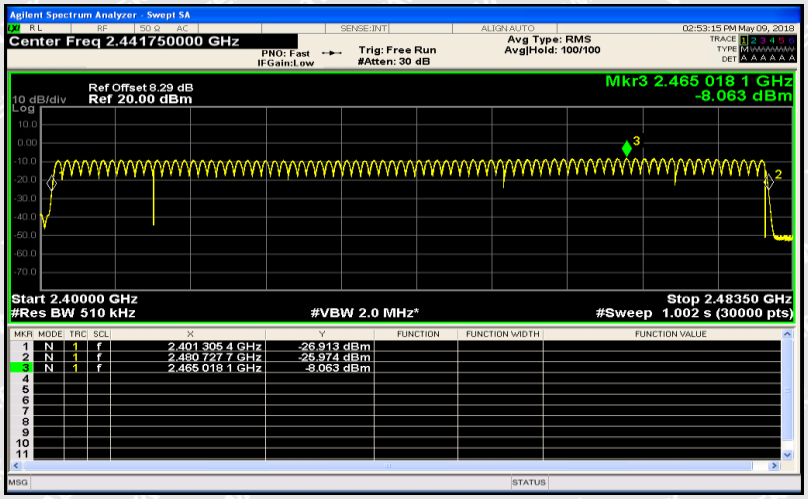


Minimum Frequency Occupation_TNVN_GFSK_2480



◆ **Hopping Sequence**

Hopping Sequence_TNVN_GFSK



5.3 Hopping Frequency Separation

Test Requirement ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.5

Test Procedure ..... : ETSI EN 300 328 V2.1.1, Clause 5.4.5.2

Test Method ..... : Option 1 of Clause 5.4.5.2

Limit ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.5.3

Test Result ..... : Pass

5.3.1 E.U.T. Operation

Environmental Conditions:

Temperature ..... : 25°C

Humidity ..... : 49%RH

Test Mode:

Input Voltage ..... : DC 5V

Operating mode ..... : Transmit mode

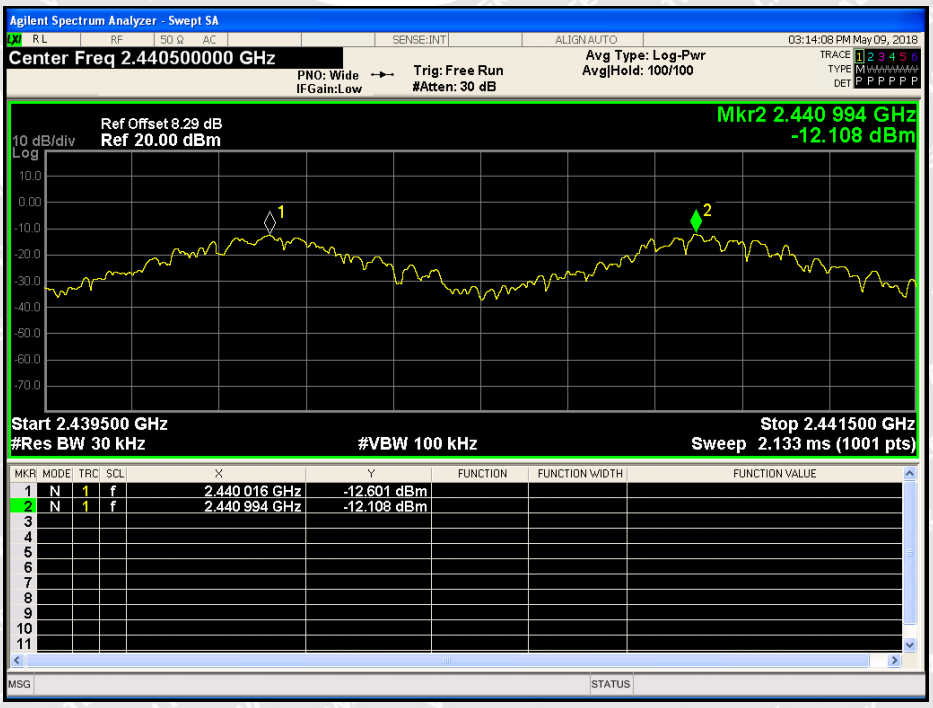
Remark ..... : Pre-Scan has been conducted to determine the worst-case mode from all available modulations. Modulation type GFSK was selected for the final test.

5.3.2 Test Result

Modulation Type	Test Condition	Test Channel	Channel Separation (MHz)	Limit(kHz)	Verdict
GFSK	TNVN	2441MHz	0.978	≥100	Pass

Test Graphs:

Hopping Frequency Separation_TNVN_GFSK_2441



5.4 Occupied Channel Bandwidth

Test Requirement ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.8

Test Procedure ..... : ETSI EN 300 328 V2.1.1, Clause 5.4.7.2

Limit ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.8.3

Test Result ..... : Pass

5.4.1 E.U.T. Operation

Environmental Conditions:

Temperature ..... : 25°C

Humidity ..... : 49%RH

Test Mode:

Input Voltage ..... : DC 5V

Operating mode ..... : Transmit mode

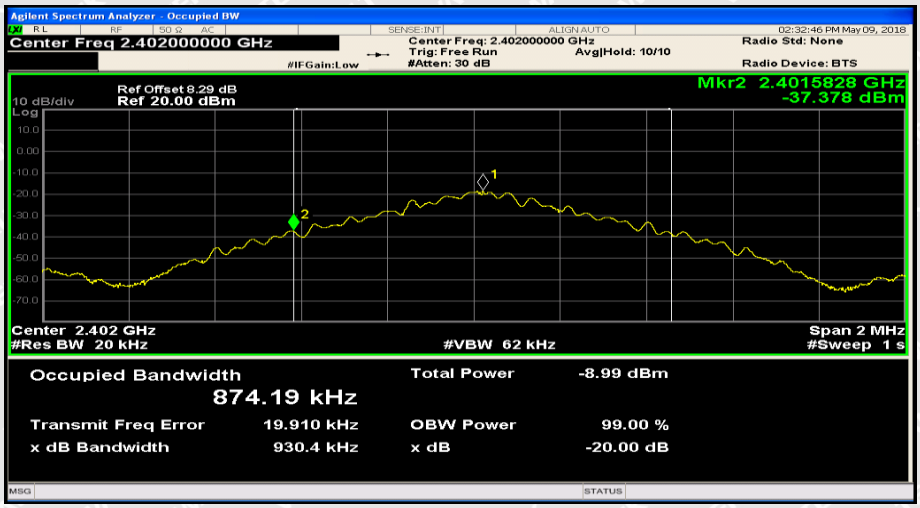
Remark ..... : Pre-Scan has been conducted to determine the worst-case mode from all available modulations. Modulation type GFSK was selected for the final test.

5.4.2 Test Result

Modulation Type	Test Condition	Test Channel	OBW (MHz)	FL@OBW	FH@OBW	Verdict
GFSK	TNVN	2402MHz	0.87419	2401.582815	---	Pass
GFSK	TNVN	2480MHz	0.87118	---	2480.45422	Pass

Test Graphs:

Occupied Channel Bandwidth_TNVN_GFSK_2402



Occupied Channel Bandwidth_TNVN_GFSK_2480

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

Test Requirement ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.9

Test Procedure ..... : ETSI EN 300 328 V2.1.1, Clause 5.4.8.2

Limit ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.9.3

Test Result ..... : Pass

5.5.1 E.U.T. Operation

Environmental Conditions:

Temperature ..... : 25°C

Humidity ..... : 49%RH

Test Mode:

Input Voltage ..... : DC 5V

Operating mode ..... : Transmit mode

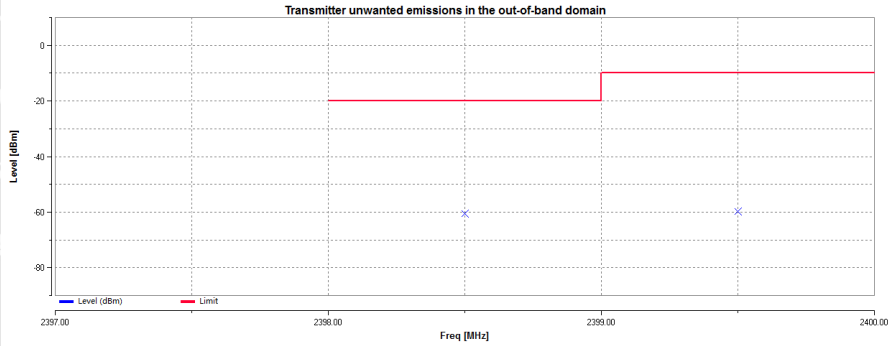
Remark ..... : Pre-Scan has been conducted to determine the worst-case mode from all available modulations. Modulation type GFSK was selected for the final test.

5.5.2 Test Result

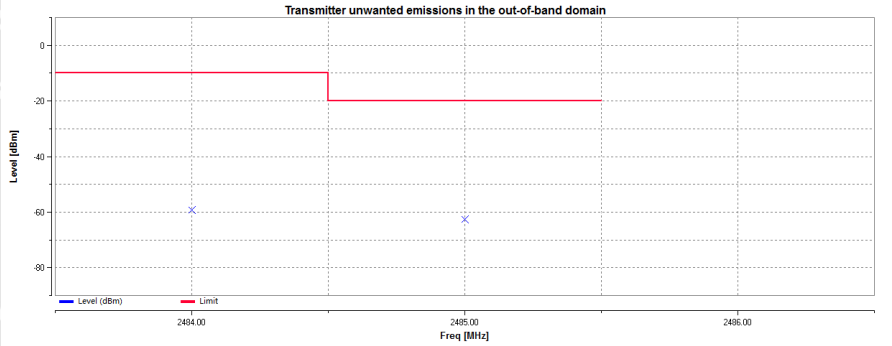
Modulation Type	Test Condition	Test Channel	Frequency (MHz)	Result (dBm)	Limit (dBm)	Verdict
GFSK	TNVN	2402	2398.500	-60.58	<=-20	Pass
GFSK	TNVN	2402	2399.500	-59.73	<=-10	Pass
GFSK	TNVN	2402	2484.000	-59.20	<=-10	Pass
GFSK	TNVN	2402	2485.000	-62.72	<=-20	Pass
GFSK	TNVN	2480	2398.500	-59.73	<=-20	Pass
GFSK	TNVN	2480	2399.500	-60.76	<=-10	Pass
GFSK	TNVN	2480	2484.000	-62.19	<=-10	Pass
GFSK	TNVN	2480	2485.000	-58.86	<=-20	Pass

Test Graphs:

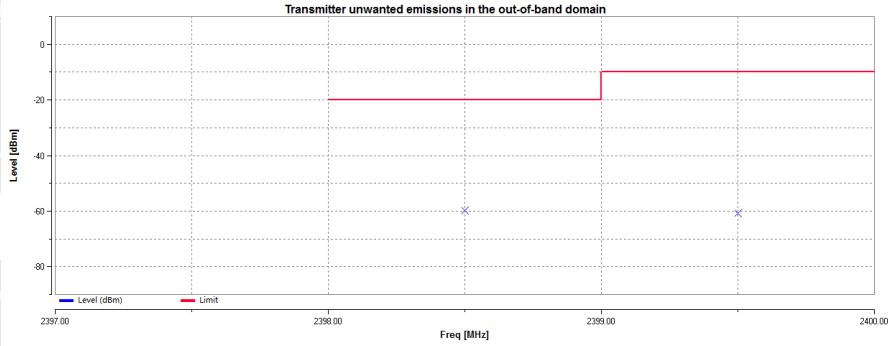
Transmitter unwanted emissions in the OOB domain_TNVN_GFSK_2402_2400MHz-2BW to 2400MHz



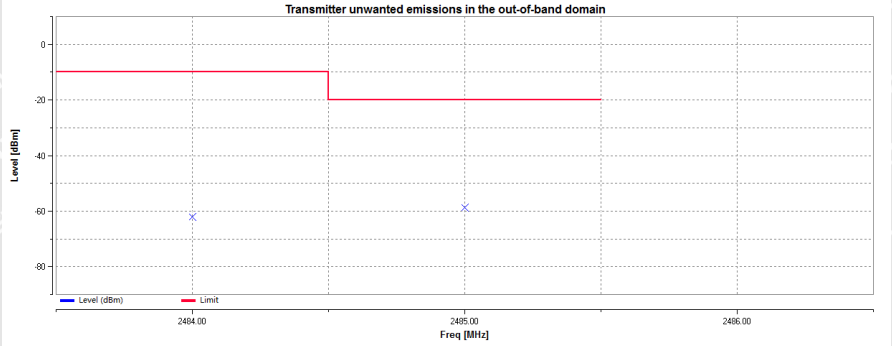
Transmitter unwanted emissions in the OOB domain_TNVN_GFSK_2402_2483.5MHz to 2483.5MHz+2BW



Transmitter unwanted emissions in the OOB domain_TNVN_GFSK_2480_2400MHz-2BW to 2400MHz



Transmitter unwanted emissions in the OOB domain_TNVN_GFSK_2402_2483.5MHz to 2483.5MHz+2BW



5.6 Transmitter unwanted emissions in the spurious domain

Test Requirement ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.10

Test Procedure ..... : ETSI EN 300 328 V2.1.1, Clause 5.4.9.2

Limit ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.10.3, Table 4

Test Result ..... : Pass

5.6.1 E.U.T. Operation

Environmental Conditions:

Temperature ..... : 25°C

Humidity ..... : 49%RH

Test Mode:

Input Voltage ..... : DC 5V

Operating mode ..... : Transmit mode

Remark ..... : Pre-Scan has been conducted to determine the worst-case mode from all available modulations. Modulation type GFSK was selected for the final test.

5.6.2 Test Result

Frequency (MHz)	Receiver Reading (dBμV)	Turn table Angle (°)	RX Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (m)	Polar (H/V)	SG Level (dBm)	Cable (dB)	Antenna Gain (dB)			
TX_TNVN_GFSK_2402										
823.46	20.90	102	1.1	H	-74.61	0.22	0.00	-74.39	-54	-20.39
823.46	20.20	245	1.2	V	-75.46	0.22	0.00	-75.24	-54	-21.24
4804.36	50.65	206	1.8	H	-40.52	2.64	12.70	-50.58	-30	-20.58
4804.36	49.99	169	1.4	V	-38.25	2.64	12.70	-48.31	-30	-18.31
6558.04	36.90	282	1.5	H	-51.50	2.98	13.00	-61.52	-30	-31.52
6558.04	36.55	210	1.2	V	-51.49	2.98	13.00	-61.51	-30	-31.51
TX_TNVN_GFSK_2480										
578.68	24.71	210	1.6	H	-74.66	0.18	0.00	-74.48	-54	-20.48
578.68	23.41	109	1.2	V	-76.00	0.18	0.00	-75.82	-54	-21.82
4960.04	45.75	166	1.1	H	-43.76	2.72	12.70	-53.74	-30	-23.74
4960.04	44.79	204	1.7	V	-44.05	2.72	12.70	-54.03	-30	-24.03
5991.99	37.33	173	1.5	H	-51.07	2.98	13.00	-61.09	-30	-31.09
5991.99	37.52	134	1.2	V	-50.52	2.98	13.00	-60.54	-30	-30.54

5.7 Receiver spurious emissions

Test Requirement ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.11

Test Procedure ..... : ETSI EN 300 328 V2.1.1, Clause 5.4.10.2

Limit ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.11.3, Table 5

Test Result ..... : Pass

5.7.1 E.U.T. Operation

Environmental Conditions:

Temperature ..... : 25°C

Humidity ..... : 49%RH

Test Mode:

Input Voltage ..... : DC 5V

Operating mode ..... : Receive mode

Remark ..... : Pre-Scan has been conducted to determine the worst-case mode from all available modulations. Modulation type GFSK was selected for the final test.

5.7.2 Test Result

Frequency (MHz)	Receiver Reading (dBμV)	Turn table Angle (°)	RX Antenna		Substituted			Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (m)	Polar (H/V)	SG Level (dBm)	Cable (dB)	Antenna Gain (dB)			
RX_TNVN_GFSK_2402										
710.46	24.90	201	1.2	H	-74.77	0.20	0.00	-74.57	-57	-17.57
710.46	23.76	162	1.6	V	-75.16	0.20	0.00	-74.96	-57	-17.96
4800.54	45.67	237	1.7	H	-45.50	2.64	12.70	-55.56	-47	-8.56
4800.54	44.04	138	1.2	V	-44.20	2.64	12.70	-54.26	-47	-7.26
RX_TNVN_GFSK_2480										
885.83	19.87	169	1.3	H	-75.52	0.22	0.00	-75.30	-57	-18.30
885.83	18.89	264	1.2	V	-76.35	0.22	0.00	-76.13	-57	-19.13
4800.54	44.54	201	1.5	H	-46.63	2.64	12.70	-56.69	-47	-9.69
4800.54	46.33	198	1.6	V	-41.91	2.64	12.70	-51.97	-47	-4.97

5.8 Receiver Blocking

Test Requirement ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.12

Test Procedure ..... : ETSI EN 300 328 V2.1.1, Clause 5.4.11.2

Limit ..... : ETSI EN 300 328 V2.1.1, Clause 4.3.1.12.4, table 8

Receiver Category ..... : 3

Test Result ..... : Pass

5.8.1 E.U.T. Operation

Environmental Conditions:

Temperature ..... : 25°C

Humidity ..... : 49%RH

Test Mode:

Input Voltage ..... : DC 5V

Operating mode ..... : Receive mode

Remark ..... : Pre-Scan has been conducted to determine the worst-case mode from all available modulations. Modulation type GFSK was selected for the final test.

5.8.2 Test Result

Pmin=-79.32dBm, Receiver Category: 3							
Modulation Type	Wanted Signal mean Power (dBm)	Blocking Signal Frequency (MHz)	Blocking Signal Power (dB)	Type of Blocking Signal	Measured PER (%)	Limit PER (%)	Performance Criteria
GFSK	P_{min}+12dB	2380	-57	CW	0.045	≤10	Compliance
GFSK	P_{min}+12dB	2503.5	-57	CW	0.052	≤10	Compliance
GFSK	P_{min}+12dB	2300	-47	CW	0.055	≤10	Compliance
GFSK	P_{min}+12dB	2583.5	-47	CW	0.053	≤10	Compliance

Remark: The minimum performance criterion shall be a PER less than or equal to 10%.

6 EMC Requirements for Emissions

6.1 Radiated Emission

Test Requirement	:	ETSI EN 301 489-17
Test Method	:	ETSI EN 301 489-1, EN 55032, Class B
Frequency Range	:	30MHz to 1GHz, 1GHz to 6GHz
Class/Severity	:	Class B/ Table A.4 and A.5 of EN 55032
Detector	:	Peak for pre-scan (120kHz Resolution Bandwidth Below 1GHz; 1MHz Resolution Bandwidth Above 1GHz)

6.1.1 EUT Operation:

Operating Environment:

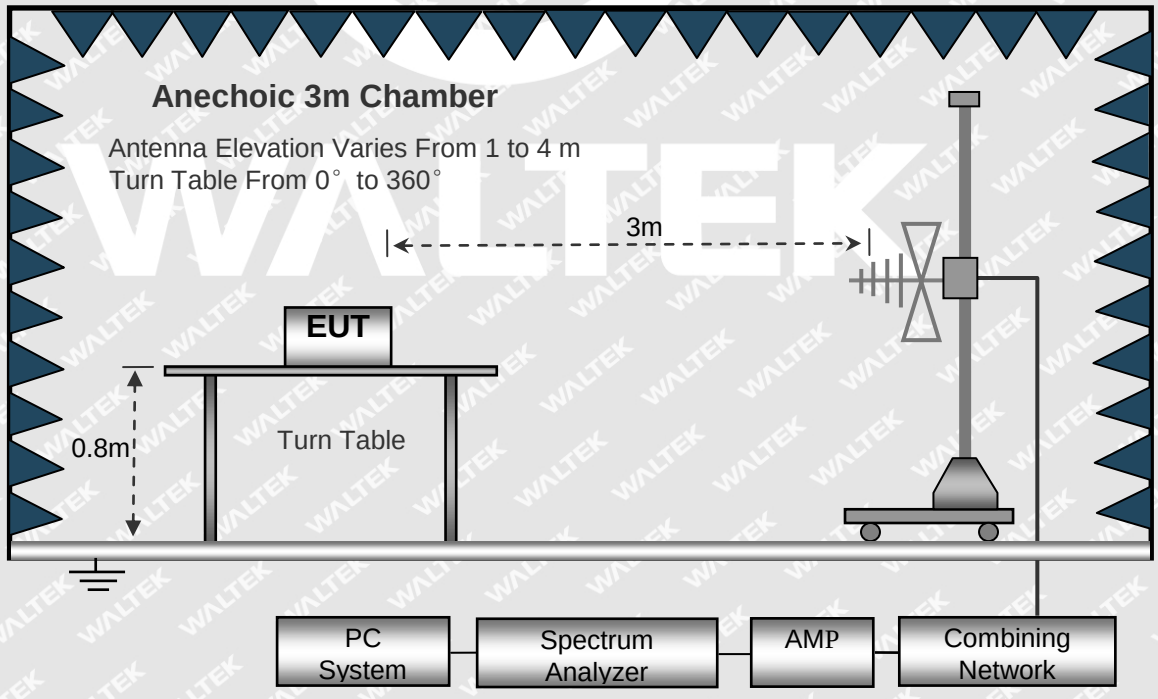
Temperature	:	23.5°C
Humidity	:	48.9%RH
Atmospheric Pressure	:	101.2kPa

EUT Operation:

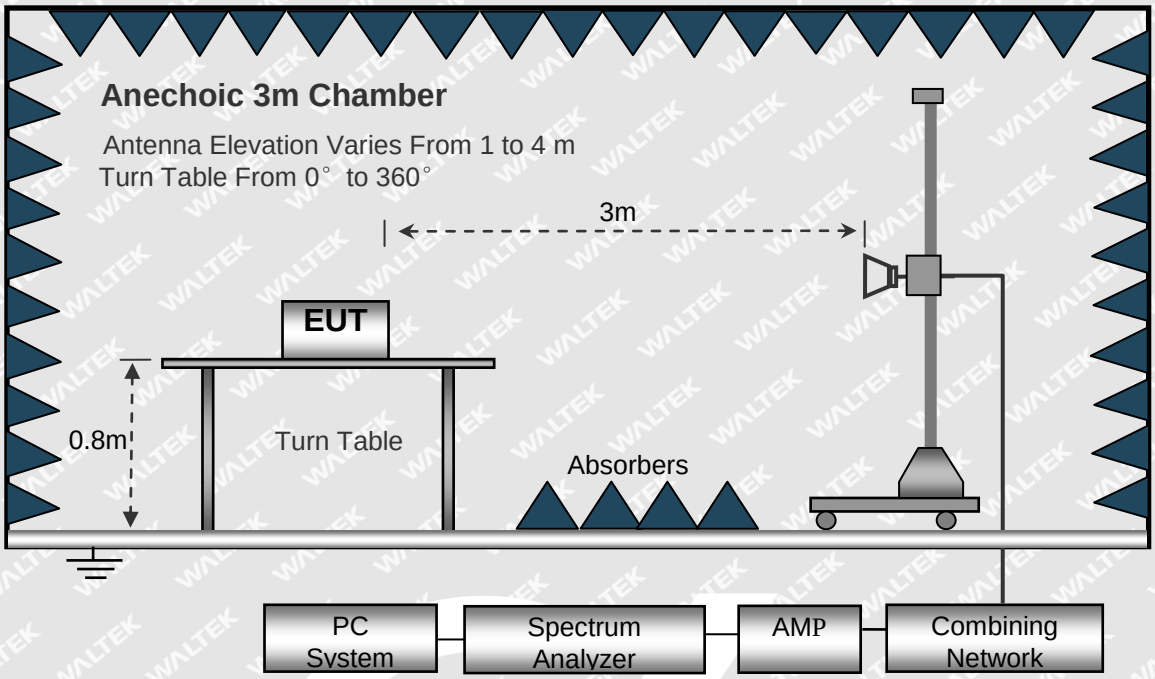
Input Voltage	:	DC 5V by USB port, or battery 3.7V
Operating Mode	:	Bluetooth+ charging mode, or Bluetooth+ discharging mode

6.1.2 Test Setup

The radiated emission tests were performed using the setup accordance with the EN 55032.
Frequency Range: Below 1 000MHz



Frequency Range: Above 1 000MHz



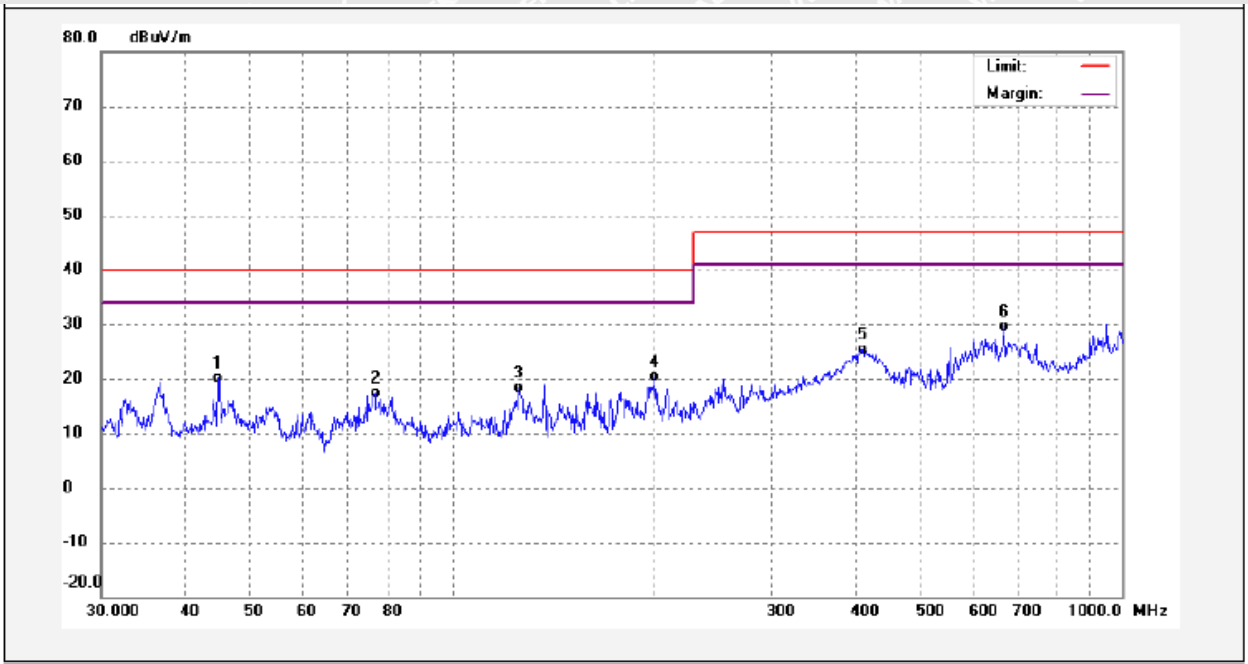
6.1.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:
Corr. Ampl. = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain
The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit for Class B. The equation for margin calculation is as follows:
Margin = Corr. Ampl. – Class B Limit

6.1.4 Test Result

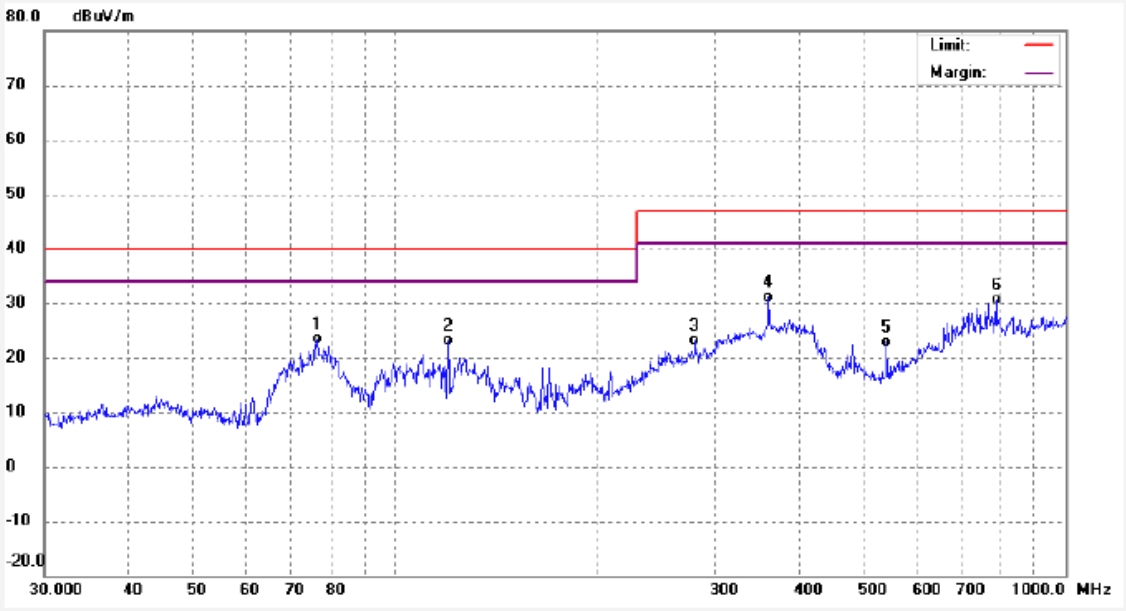
Frequency Range: 30MHz ~ 1000MHz

Antenna Polarization: Vertical (Bluetooth+ charging mode)



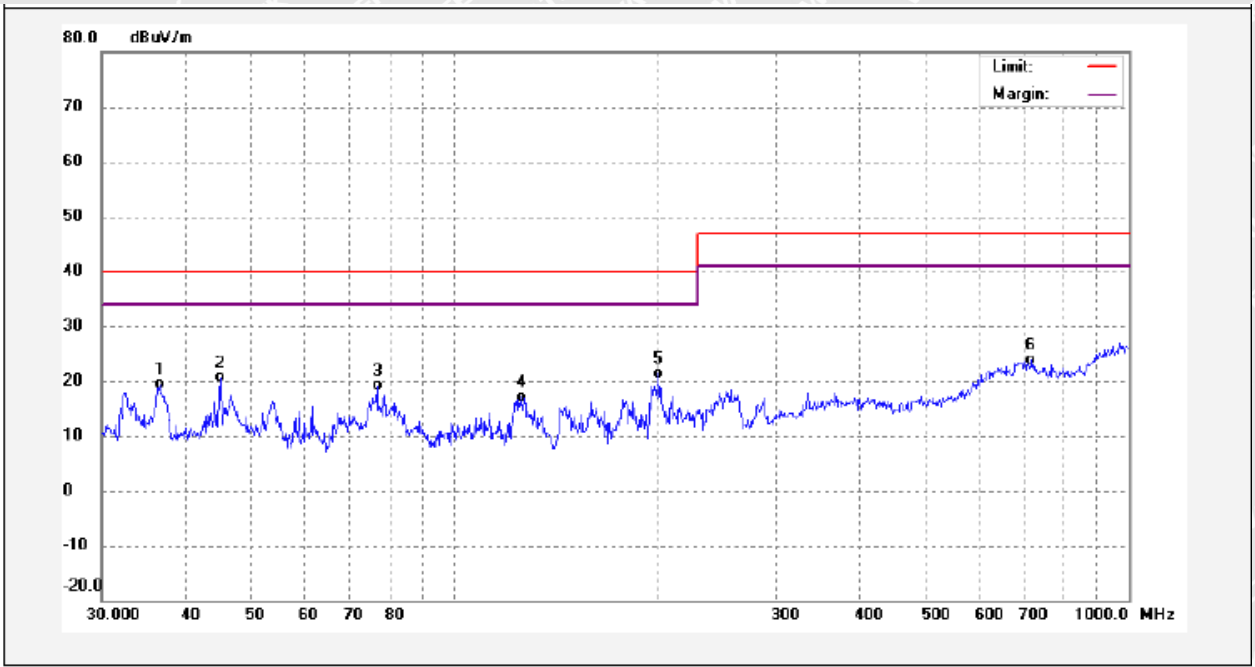
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	44.7433	32.72	-12.62	20.10	40.00	-19.90	QP	
2	76.7808	37.36	-20.08	17.28	40.00	-22.72	QP	
3	125.8864	35.44	-17.16	18.28	40.00	-21.72	QP	
4	200.6881	36.79	-16.47	20.32	40.00	-19.68	QP	
5	410.3825	34.09	-8.67	25.42	47.00	-21.58	QP	
6	665.8035	32.61	-2.91	29.70	47.00	-17.30	QP	

Antenna Polarization: Horizontal (Bluetooth+ charging mode)



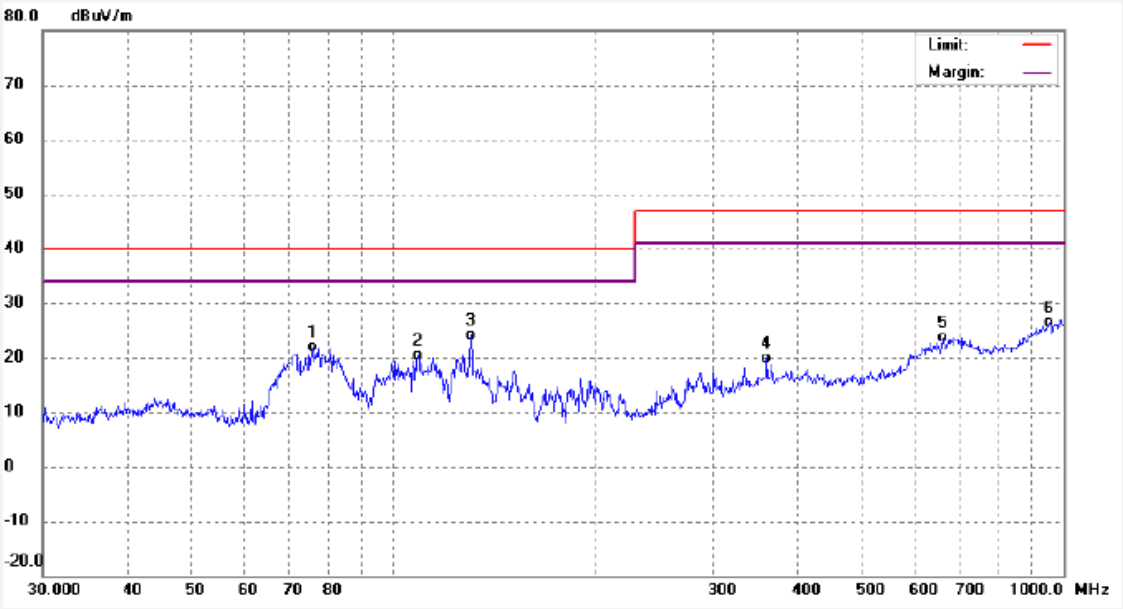
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	76.5121	43.45	-20.02	23.43	40.00	-16.57	QP	
2	119.8556	39.83	-16.58	23.25	40.00	-16.75	QP	
3	280.0237	35.98	-12.88	23.10	47.00	-23.90	QP	
4	360.4476	39.98	-8.87	31.11	47.00	-15.89	QP	
5	541.3725	31.07	-8.11	22.96	47.00	-24.04	QP	
6	787.8513	33.87	-3.26	30.61	47.00	-16.39	QP	

Antenna Polarization: Vertical (Bluetooth+ discharging mode)



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	36.5092	33.87	-14.55	19.32	40.00	-20.68	QP	
2	44.9006	33.41	-12.66	20.75	40.00	-19.25	QP	
3	76.7808	39.24	-20.08	19.16	40.00	-20.84	QP	
4	125.4457	34.19	-17.10	17.09	40.00	-22.91	QP	
5	200.6881	37.75	-16.47	21.28	40.00	-18.72	QP	
6	716.6820	25.79	-1.99	23.80	47.00	-23.20	QP	

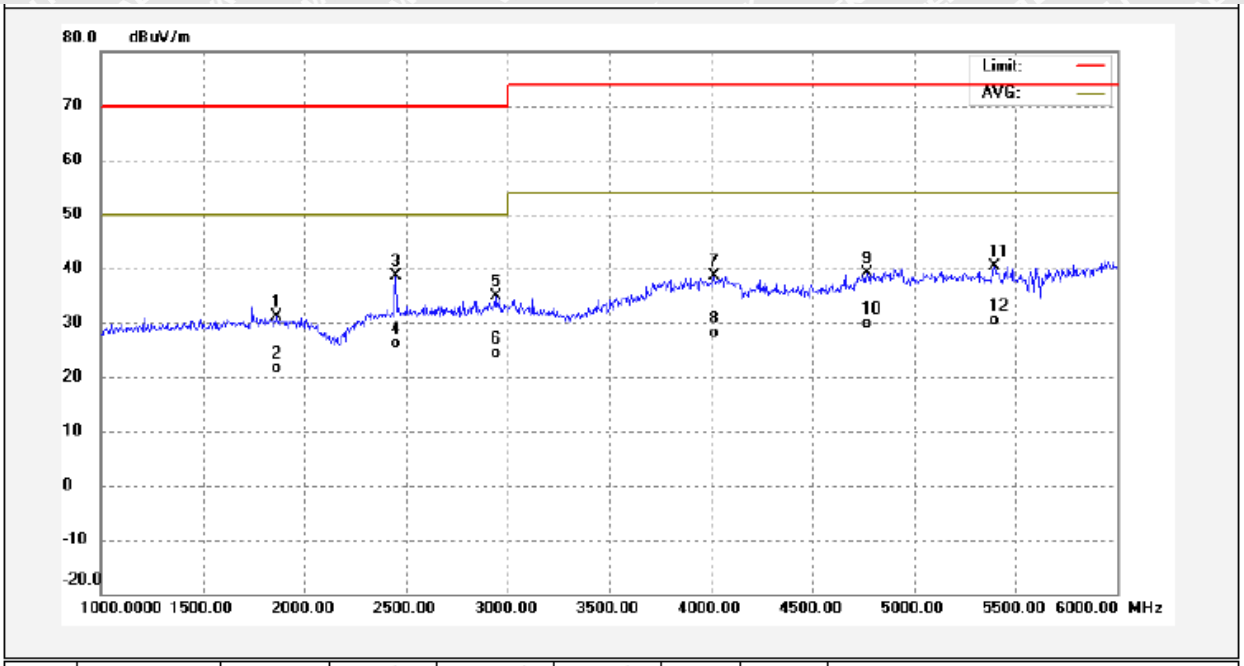
Antenna Polarization: Horizontal (Bluetooth+ discharging mode)



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	75.7114	41.83	-20.01	21.82	40.00	-18.18	QP	
2	108.6470	36.43	-16.05	20.38	40.00	-19.62	QP	
3	130.3789	41.88	-17.75	24.13	40.00	-15.87	QP	
4	360.4476	28.84	-8.87	19.97	47.00	-27.03	QP	
5	661.1505	26.63	-3.00	23.63	47.00	-23.37	QP	
6	952.0937	25.08	1.24	26.32	47.00	-20.68	QP	

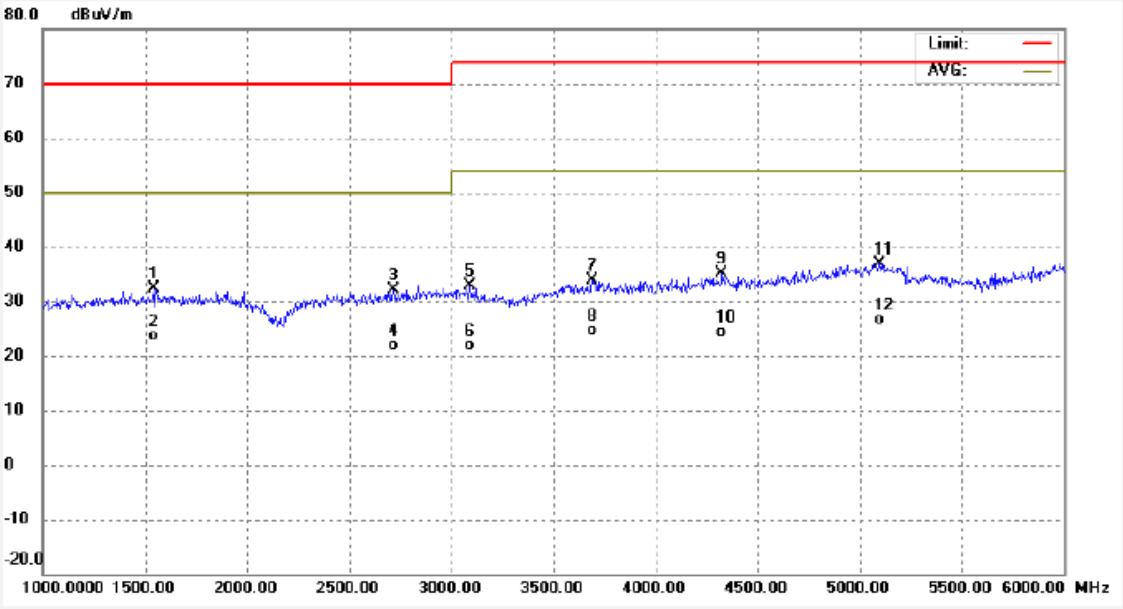
Frequency Range: 1000MHz ~ 6000MHz

Antenna Polarization: Vertical (Bluetooth+ charging mode)



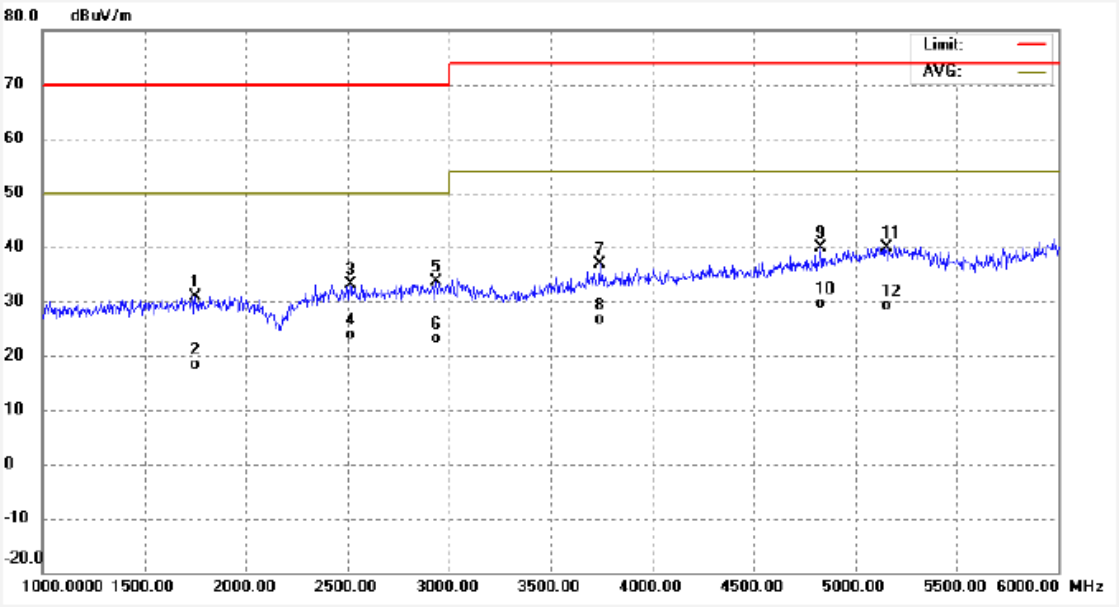
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	1865.000	46.00	-14.87	31.13	70.00	-38.87	peak	
2	1865.000	36.44	-14.87	21.57	50.00	-28.43	AVG	
3	2450.000	51.23	-12.70	38.53	70.00	-31.47	peak	
4	2450.000	38.89	-12.70	26.19	50.00	-23.81	AVG	
5	2940.000	46.43	-11.48	34.95	70.00	-35.05	peak	
6	2940.000	35.77	-11.48	24.29	50.00	-25.71	AVG	
7	4015.000	47.35	-8.70	38.65	74.00	-35.35	peak	
8	4015.000	36.71	-8.70	28.01	54.00	-25.99	AVG	
9	4770.000	45.59	-6.51	39.08	74.00	-34.92	peak	
10	4770.000	36.42	-6.51	29.91	54.00	-24.09	AVG	
11	5395.000	45.82	-5.39	40.43	74.00	-33.57	peak	
12	5395.000	35.87	-5.39	30.48	54.00	-23.52	AVG	

Antenna Polarization: Horizontal (Bluetooth+ charging mode)



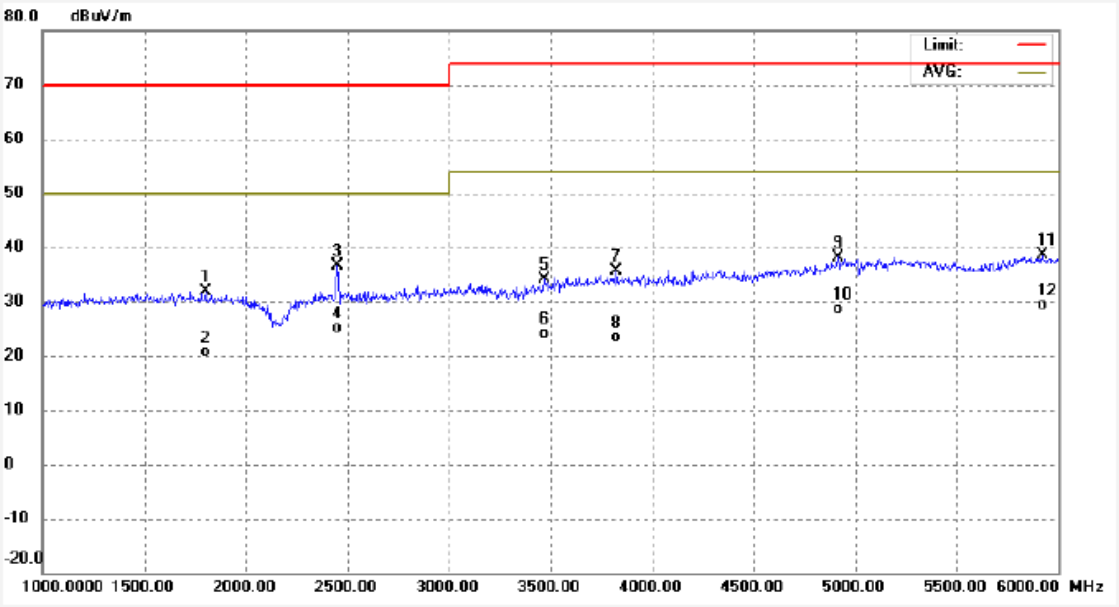
No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	1540.000	48.04	-15.78	32.26	70.00	-37.74	peak	
2	1540.000	39.46	-15.78	23.68	50.00	-26.32	AVG	
3	2715.000	46.35	-14.12	32.23	70.00	-37.77	peak	
4	2715.000	35.99	-14.12	21.87	50.00	-28.13	AVG	
5	3090.000	46.00	-13.18	32.82	74.00	-41.18	peak	
6	3090.000	35.06	-13.18	21.88	54.00	-32.12	AVG	
7	3690.000	46.15	-12.28	33.87	74.00	-40.13	peak	
8	3690.000	36.90	-12.28	24.62	54.00	-29.38	AVG	
9	4325.000	46.27	-11.21	35.06	74.00	-38.94	peak	
10	4325.000	35.54	-11.21	24.33	54.00	-29.67	AVG	
11	5095.000	46.44	-9.56	36.88	74.00	-37.12	peak	
12	5095.000	36.24	-9.56	26.68	54.00	-27.32	AVG	

Antenna Polarization: Vertical (Bluetooth+ discharging mode)



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	1750.000	46.07	-15.17	30.90	70.00	-39.10	peak	
2	1750.000	33.63	-15.17	18.46	50.00	-31.54	AVG	
3	2515.000	45.67	-12.47	33.20	70.00	-36.80	peak	
4	2515.000	36.39	-12.47	23.92	50.00	-26.08	AVG	
5	2935.000	45.03	-11.50	33.53	70.00	-36.47	peak	
6	2935.000	34.67	-11.50	23.17	50.00	-26.83	AVG	
7	3740.000	46.58	-9.63	36.95	74.00	-37.05	peak	
8	3740.000	36.32	-9.63	26.69	54.00	-27.31	AVG	
9	4830.000	46.17	-6.23	39.94	74.00	-34.06	peak	
10	4830.000	35.76	-6.23	29.53	54.00	-24.47	AVG	
11	5155.000	45.44	-5.45	39.99	74.00	-34.01	peak	
12	5155.000	34.60	-5.45	29.15	54.00	-24.85	AVG	

Antenna Polarization: Horizontal (Bluetooth+ discharging mode)



No.	Freq. (MHz)	Reading (dBuV/m)	Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Remark
1	1800.000	47.55	-15.63	31.92	70.00	-38.08	peak	
2	1800.000	36.21	-15.63	20.58	50.00	-29.42	AVG	
3	2450.000	51.29	-14.78	36.51	70.00	-33.49	peak	
4	2450.000	39.96	-14.78	25.18	50.00	-24.82	AVG	
5	3470.000	46.71	-12.61	34.10	74.00	-39.90	peak	
6	3470.000	36.70	-12.61	24.09	54.00	-29.91	AVG	
7	3825.000	47.82	-12.10	35.72	74.00	-38.28	peak	
8	3825.000	35.39	-12.10	23.29	54.00	-30.71	AVG	
9	4915.000	48.07	-9.82	38.25	74.00	-35.75	peak	
10	4915.000	38.54	-9.82	28.72	54.00	-25.28	AVG	
11	5920.000	46.54	-8.03	38.51	74.00	-35.49	peak	
12	5920.000	37.43	-8.03	29.40	54.00	-24.60	AVG	

7 EMC Requirement for Immunity

7.1 Performance Criteria

7.1.1 General performance criteria

The performance criteria are:

• performance criteria A for immunity tests with phenomena of a continuous nature;

• performance criteria B for immunity tests with phenomena of a transient nature;

• performance criteria C for immunity tests with power interruptions exceeding a certain time.

The equipment shall meet the minimum performance criteria as specified in the following clauses.

7.1.2 Performance table

Criteria	During test	After test
A	Shall operate as intended. May show degradation of performance (see note 1). Shall be no loss of function. Shall be no unintentional transmissions.	Shall operate as intended. Shall be no degradation of performance (see note 2). Shall be no loss of function. Shall be no loss of stored data or user programmable functions.
B	May show loss of function (one or more). May show degradation of performance (see note 1). No unintentional transmissions.	Functions shall be self-recoverable. Shall operate as intended after recovering. Shall be no degradation of performance (see note 2). Shall be no loss of stored data or user programmable functions.
C	May be loss of function (one or more).	Functions shall be recoverable by the operator. Shall operate as intended after recovering. Shall be no degradation of performance (see note 2).

NOTE 1:
Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

NOTE 2:
No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.
If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

7.2 Electrostatic Discharge(ESD)

Test Requirement	:	ETSI EN 301 489-17
Test Method	:	ETSI EN 301 489-1, EN 61000-4-2
Discharge Impedance	:	330 Ω / 150 pF
Discharge Voltage	:	Air Discharge: +/-2,4,8 KV Contact Discharge:+/-2,4 kV HCP & VCP: +/-2,4 kV
Polarity	:	Positive & Negative
Discharge Repeat Times	:	At Least 20 times at each test point
Discharge Mode	:	Single Discharge
Discharge Period	:	1 second minimum

7.2.1 E.U.T. Operation

Operating Environment:

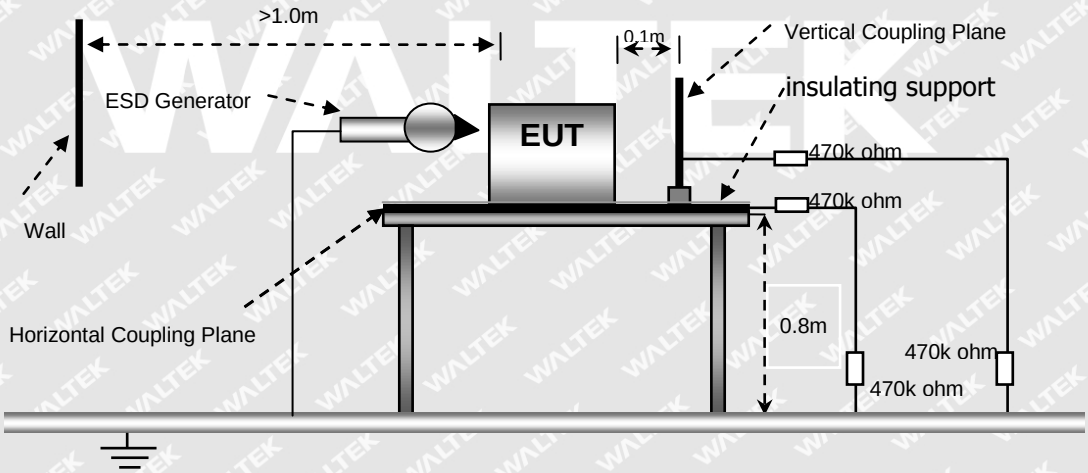
Temperature	:	23.1°C
Humidity	:	58.3%RH
Atmospheric Pressure	:	100.2kPa

EUT Operation:

Input Voltage	:	DC 5V by USB port, or battery 3.7V
Operating Mode	:	Bluetooth+ charging mode, or Bluetooth+ discharging mode

7.2.2 Block Diagram of Setup

The ESD test was performed in accordance with the EN 61000-4-2.



7.2.3 Test Result

Direct Discharge			Performance Criteria	
Discharge Level (kV)	Performance Criterion	Test Point	Contact Discharge	Air Discharge
±8	B	1	N/A	Pass*
±4	B	2	Pass*	N/A

Remark:

Test points 1. All Exposed Surface & Seams; 2. All metallic part

* During the test no deviation was detected to the selected operation mode(s)

Indirect Discharge			Performance Criteria	
Discharge Level (kV)	Performance Criterion	Test Point	Horizontal Coupling	Vertical Coupling
±4	B	1	Pass*	Pass*

Remark:

Test points 1. All sides

* During the test no deviation was detected to the selected operation mode(s)

7.3 RF Electromagnetic Field (80MHz to 6 000MHz) (RS)

Test Requirement ..... : ETSI EN 301 489-17

Test Method ..... : ETSI EN 301 489-1, EN 61000-4-3

Face of EUT ..... : Front, Back, Left, Right

Frequency Range ..... : 80MHz to 6 000MHz

Test Level ..... : 3V/m

Modulation ..... : 80%, 1kHz Amplitude Modulation.

Antenna polarisation ..... : Horizontal& Vertical

7.3.1 E.U.T. Operation

Operating Environment:

Temperature ..... : 20.1°C

Humidity ..... : 58.2%RH

Atmospheric Pressure ..... : 100.1kPa

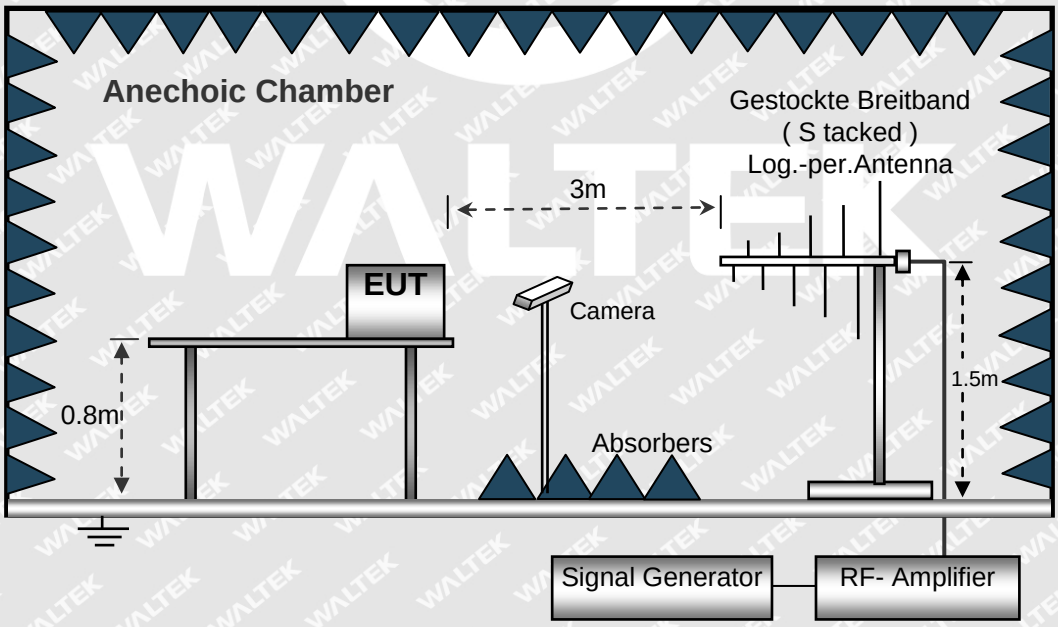
EUT Operation:

Input Voltage ..... : DC 5V by USB port, or battery 3.7V

Operating Mode ..... : Bluetooth+ charging mode, or Bluetooth+ discharging mode

7.3.2 Block Diagram of Setup

The Radiated Immunity test was performed in accordance with the EN 61000-4-3.



7.3.3 Test Result

Frequency	Face of EUT	Antenna polarisation	Test Level	Step Size	Dwell Time	Performance Criterion	Result
80MHz to 1000MHz	Front, Back, Left, Right	Horizontal	3V/m	1%	1s	A	Pass*
80MHz to 1000MHz	Front, Back, Left, Right	Vertical	3V/m	1%	1s	A	Pass*
1000MHz to 6000MHz	Front, Back, Left, Right	Horizontal	3V/m	1%	1s	A	Pass*
1000MHz to 6000MHz	Front, Back, Left, Right	Vertical	3V/m	1%	1s	A	Pass*

Remark:

* During the test no deviation was detected to the selected operation mode(s)

8 Health Requirements

8.1 Limits

According to Council Recommendation: the criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation.

Reference levels for electric, magnetic and electromagnetic fields (10MHz to 300GHz).

Low-power electronic and electrical equipment is deemed to comply with the provisions of this standard if it can be demonstrated using routes B, C or D that the available antenna power and/or the average total radiated power is less than or equal to the applicable low-power exclusion level Pmax.

Annex A contains example values for Pmax derived from existing exposure limits listed in the bibliography, such as the ICNIRP guidelines [1], IEEE Std C95.1-1999 [2], and IEEE Std C95.1-2005 [3].

For wireless devices operated close to a person's body with available antenna powers and/or average total radiated powers higher than the Pmax values given in Annex A, the alternative Pmax values (called Pmax′), described in Annex B can also be used.

For low power equipment using pulsed signals, other limits may apply in addition to those considered in Annex A and Annex B. Both ICNIRP guidelines [1] and IEEE standards [2], [3] have specific restrictions on exposures to pulsed fields, and the requirements of those standards with respect to exposure to pulses shall be met. Annex C discusses this topic further.

8.2 Test Result of RF Exposure Evaluation

Test Mode	Transmit
Limit (Pmax)	20mW/13dBm

After performed the test at low/middle/high channel, the below recorded is the worst.

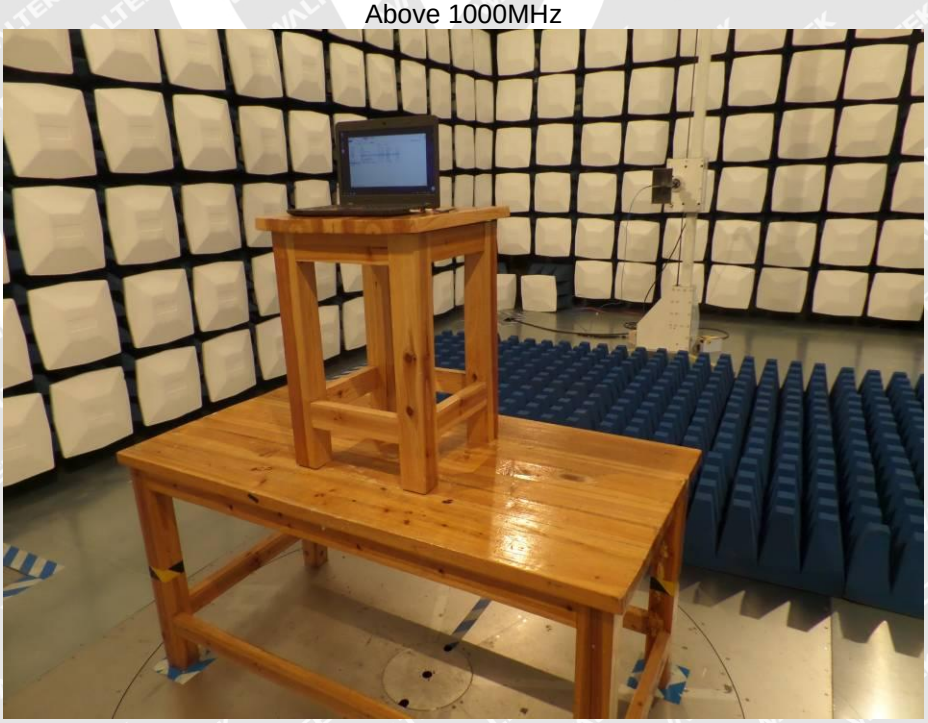
The worst e.i.r.p. (dBm)	Pmax(dBm)	Result
-5.89	13	Complies

9 Photographs —Test Setup

9.1 Photograph –Spurious Emissions Test Setup

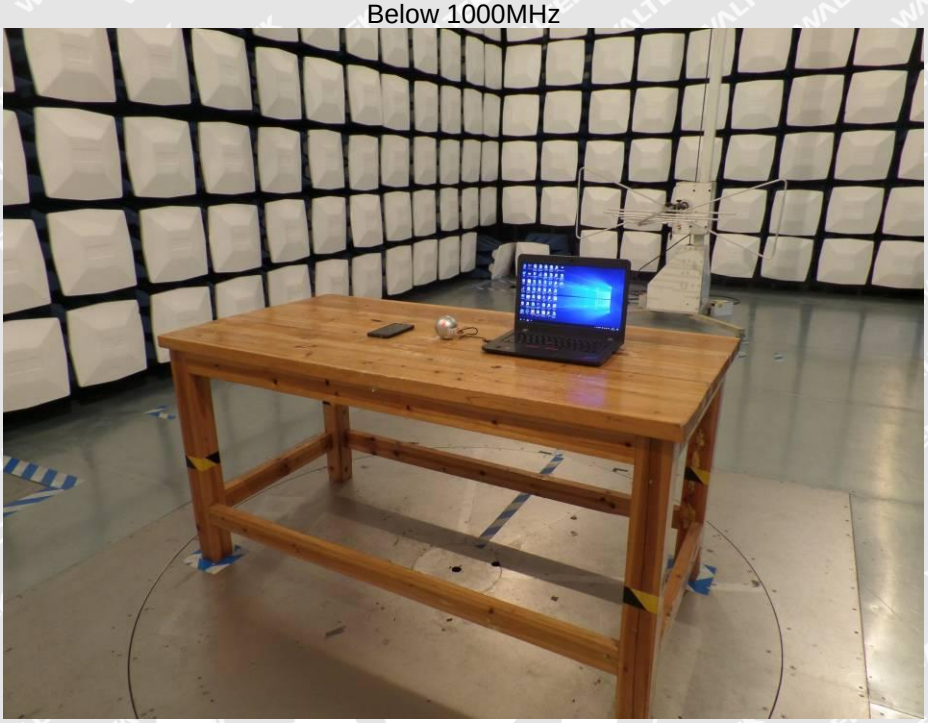
Below 1000MHz

Above 1000MHz

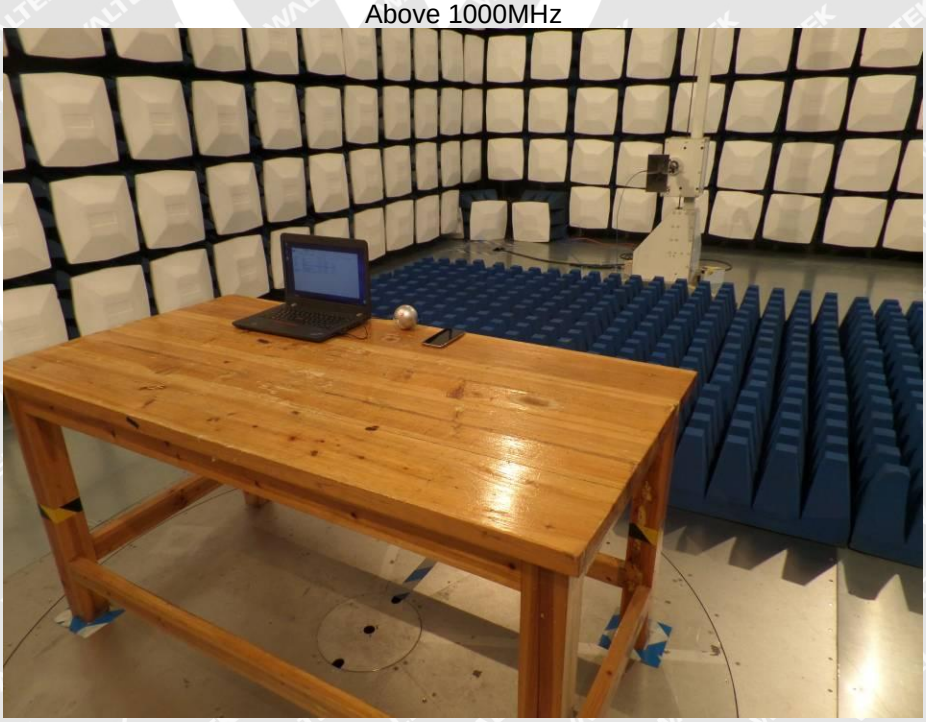


9.2 Photograph - Radiated Emissions Test Setup

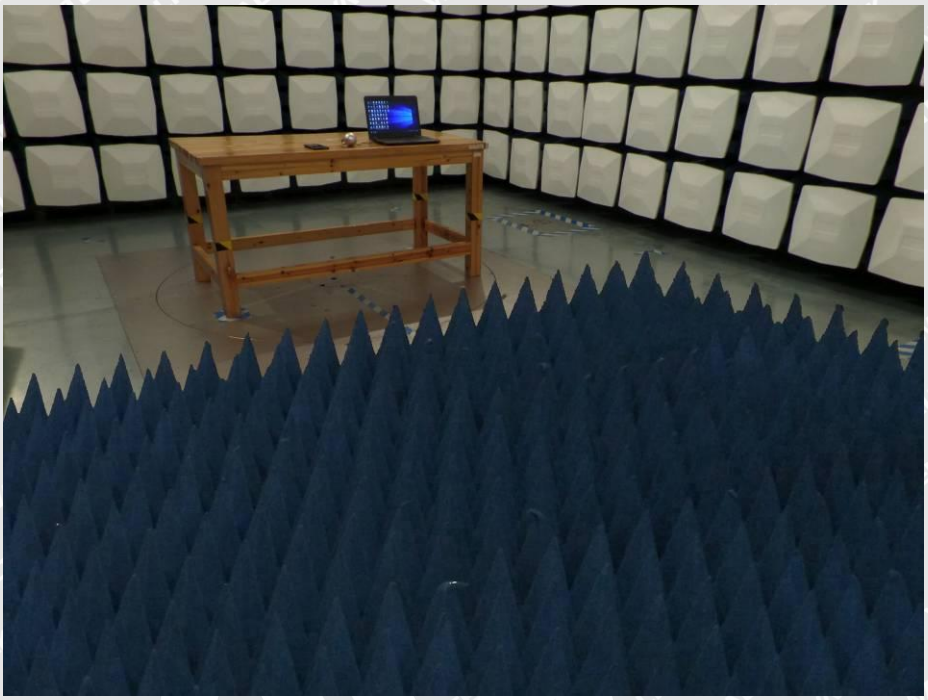
Below 1000MHz



Above 1000MHz



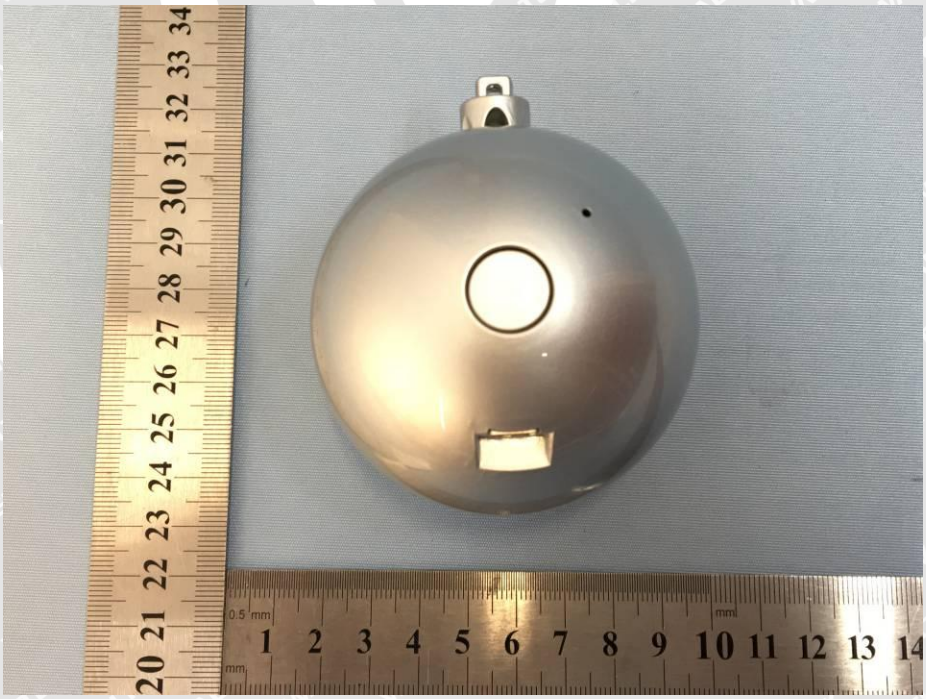
9.3 Photograph - RF Electromagnetic Field Test Setup

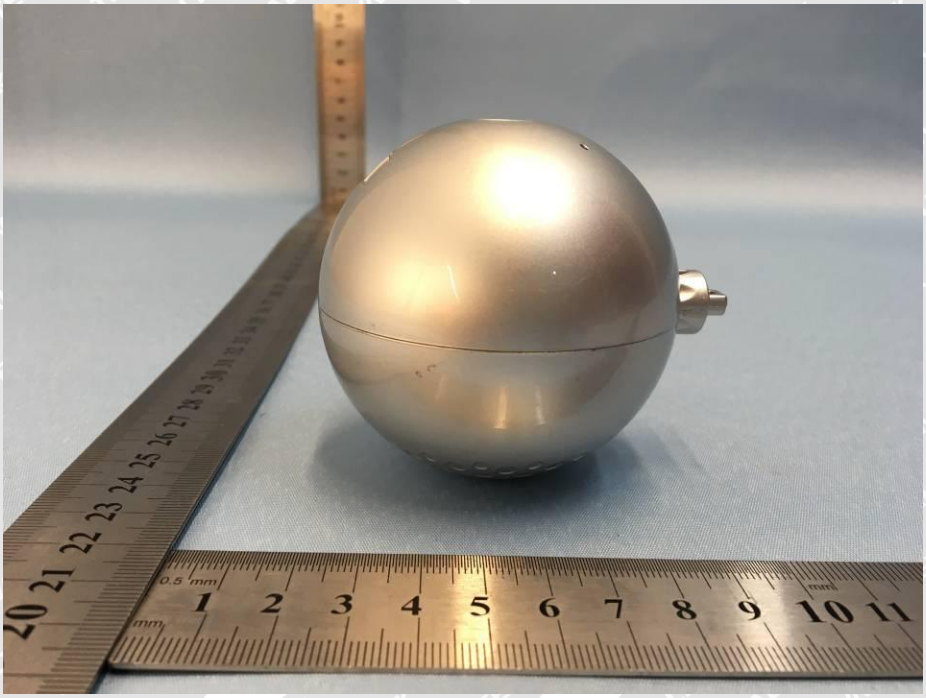


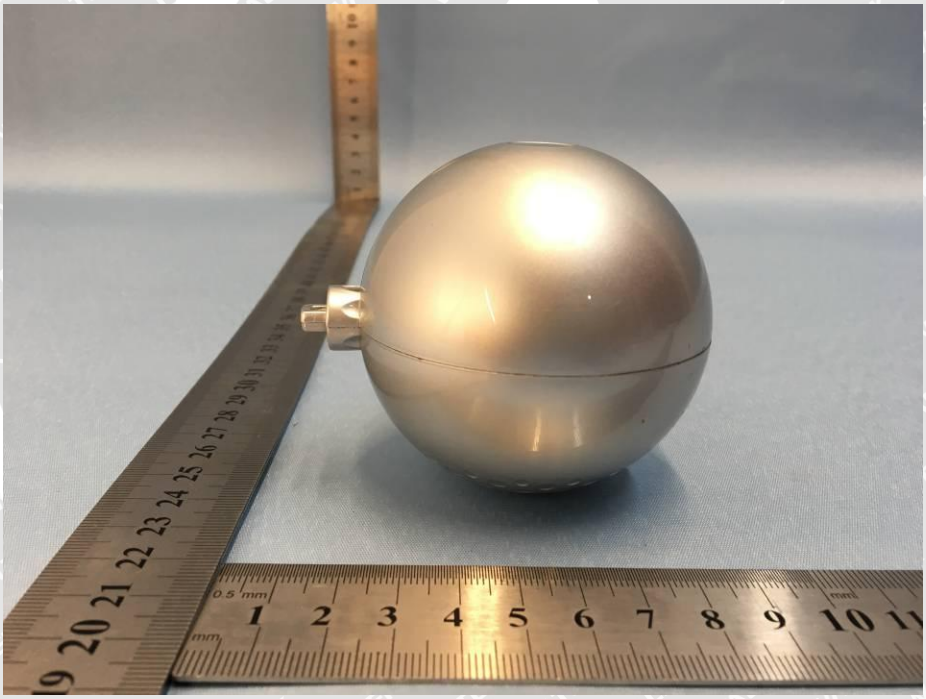
9.4 Photograph - ESD Test Setup

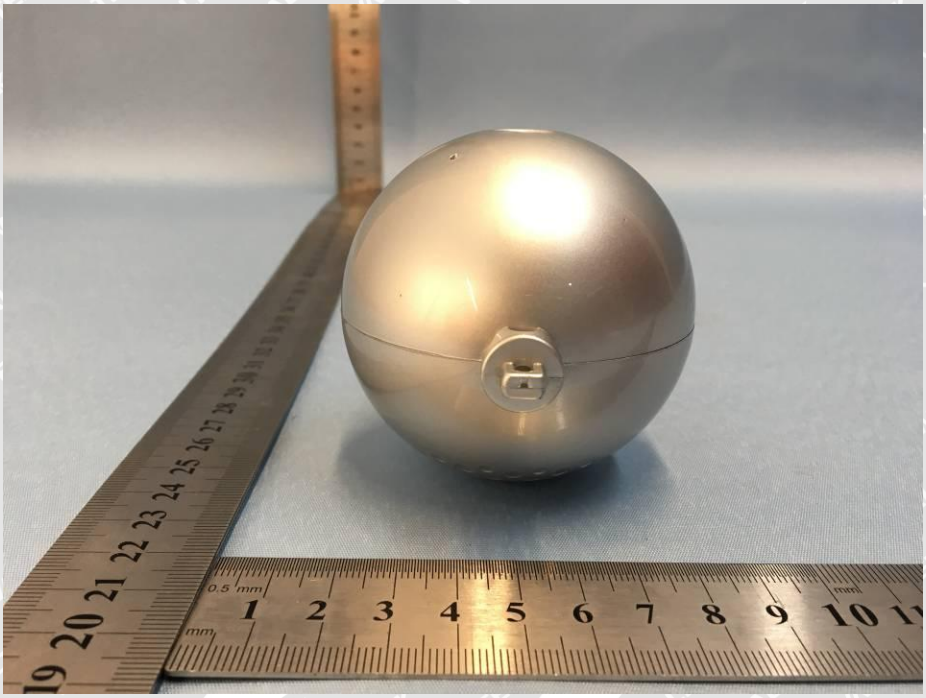
10 Photographs - Constructional Details

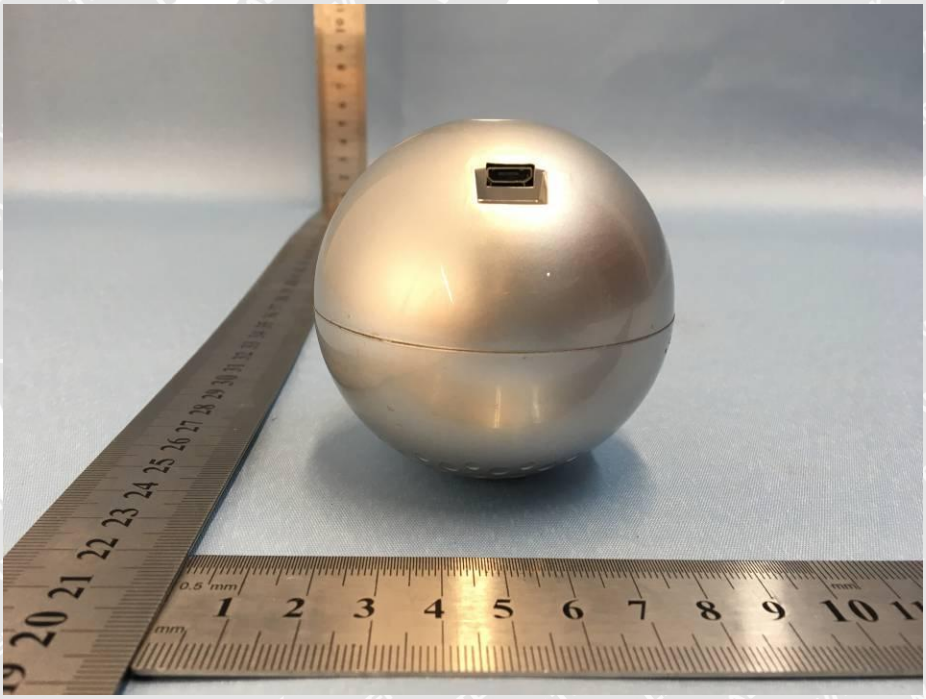
10.1 EUT – External Photos











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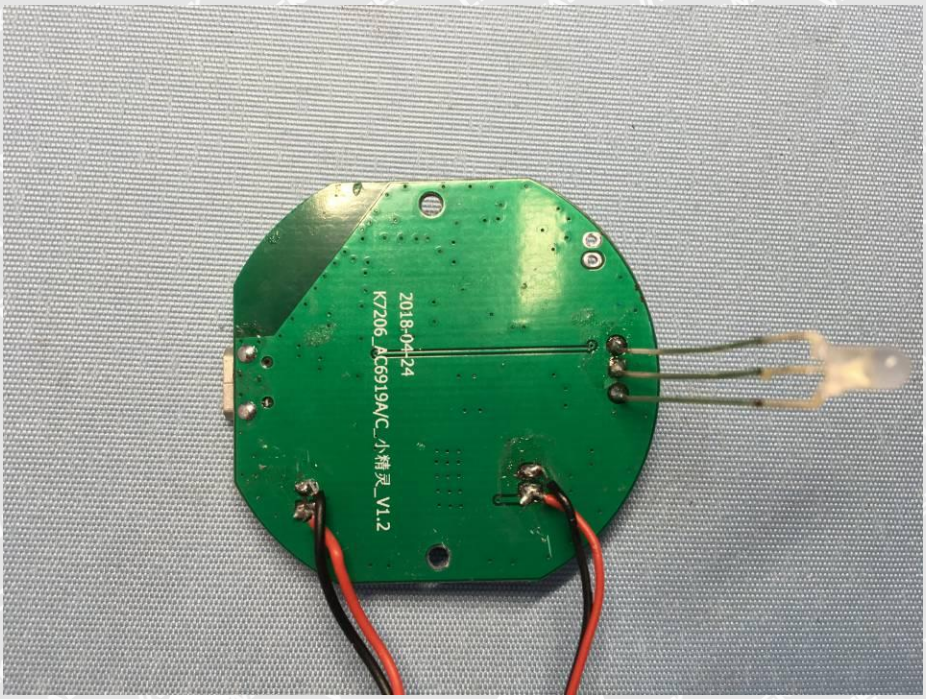
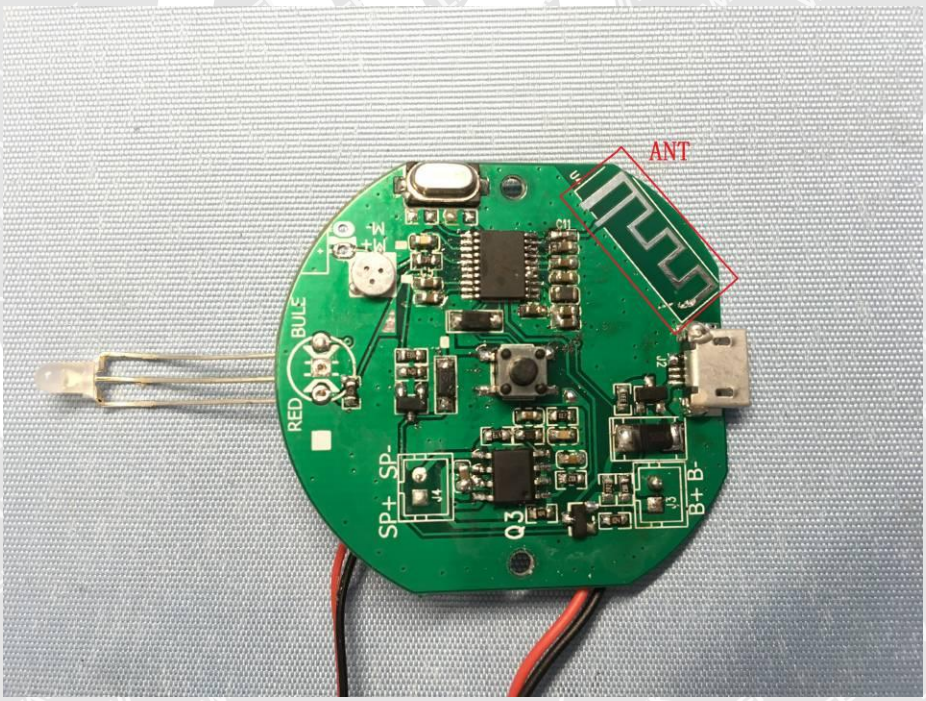
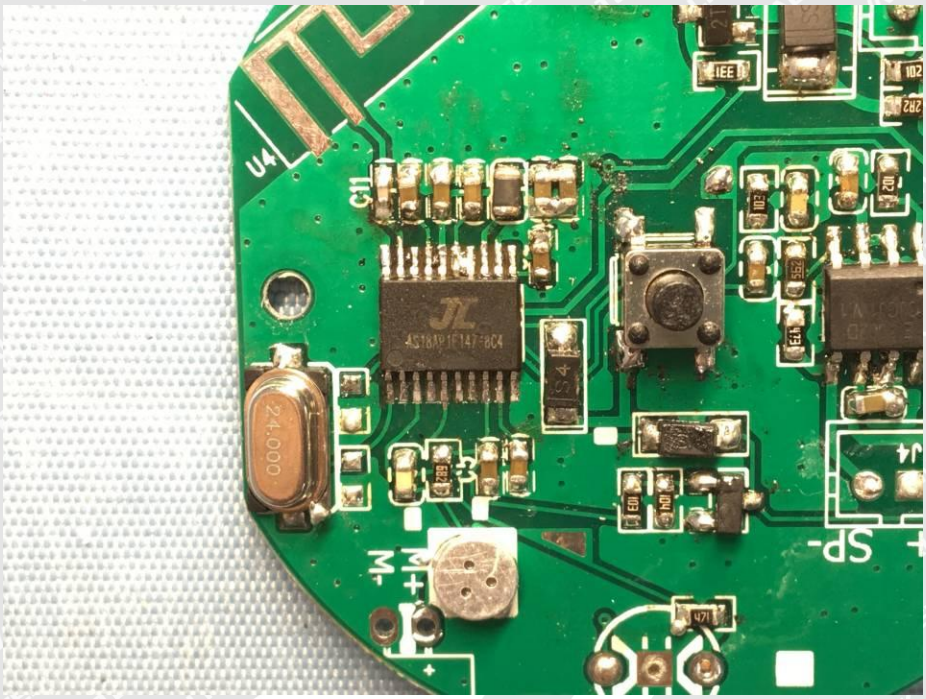
10.2 EUT – Internal Photos







======End of Report======