ETSI EN 300 328 V2.2.2 (2019-07)
TEST REPORT

for

Headphones

Model: T13064

Trade Mark: TOZO

Test Report Number: WSCT-R&E250400167A-BT2

Issued Date: 11 April 2025

Issued for

Shenzhen Worgo Technology Co., Ltd.

26th Floor, Building 1, COFCO Innovation R&D Center, 69 District, Xingdong Community, Xin'an Street, Bao'an District, Shenzhen, China

Issued By

World Standardization Certification & Testing Group(Shenzhen) Co., Ltd.

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Report No. WSCT-R&E250400167A-BT2 Issued: 11 April 2025 Revised: None

Revision History Of Report

Rev.	Issue No.	Revisions	Effect Page	Revised By
00	WSCT-R&E250400167A-BT2	Initial Issue	ALL	Li Huaibi

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1. TEST CERTIFICATION

Product:	Headphones
Model:	T13064
Trade Mark:	TOZO
Applicant:	**Shenzhen Worgo Technology Co., Ltd.** 26th Floor, Building 1, COFCO Innovation R&D Center, 69 District, Xingdong Community, Xin'an Street, Bao'an District, Shenzhen, China
Manufacturer:	**Shenzhen Worgo Technology Co., Ltd.** 26th Floor, Building 1, COFCO Innovation R&D Center, 69 District, Xingdong Community, Xin'an Street, Bao'an District, Shenzhen, China
Tested:	31 March 2025 ~ 11 April 2025
Applicable Standards:	ETSI EN 300 328 V2.2.2 (2019-07)

Deviation from Applicable Standard
None

The above equipment has been tested by World Standardization Certification & Testing Group (Shenzhen) Co., Ltd. And found compliance with the requirements set forth in the technical standards mentioned above. The results of testing in this report apply only to the product system, which was tested. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Tested By: Wang Xiang (Wang Xiang)

Checked By: Qin Shuiquan (Qin Shuiquan)

Approved By: Li Huaibi (Li Huaibi)

Date: 11 April 2025

2. EUT DESCRIPTION

2.1. General information

Product	Headphones
Model	T13064
Trade Mark	TOZO
Software Version	V018
Hardware version	V1.1
EUT Type	☒ Engineering Sample. ☐ Product Sample, ☐ Mass Product Sample.
Antenna Type	FPC Antenna
Type of the Equipment	Portable Equipment
Frequency Range	2400-2483.5MHz(TX/RX)
Modulation type	GFSK

Note: N/A stands for no applicable.

Channels list:

Channel	Frequency (GHz)	Channel	Frequency (GHz)
0	2.402	20	2.442
1	2.404	21	2.444
2	2.406	22	2.446
3	2.408	23	2.448
4	2.410	24	2.450
5	2.412	25	2.452
6	2.414	26	2.454
7	2.416	27	2.456
8	2.418	28	2.458
9	2.420	29	2.460
10	2.422	30	2.462
11	2.424	31	2.464
12	2.426	32	2.466
13	2.428	33	2.468
14	2.430	34	2.470
15	2.432	35	2.472
16	2.434	36	2.474
17	2.436	37	2.476
18	2.438	38	2.478
19	2.440	39	2.480

2.2. Information provided by the supplier.

a) The type of modulation used by the equipment:

DSSS

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:_____

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 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.): ……. 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

N/A

- Dwell time, Minimum Frequency Occupation & Hopping Sequence (only for FHSS equipment)

N/A

- Hopping Frequency Separation (only for FHSS equipment)

N/A

- Medium Utilisation

N/A

- Adaptivity & Receiver Blocking

N/A

- 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 (additional) beam forming gain: ..... dB

NOTE: The additional 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: 2400 MHz to 2483.5 MHz.

j) Nominal Channel Bandwidth(s):

• Nominal Channel Bandwidth 1: 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 V 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: 0° C to 45 ° C

Operating voltage range: 3.0 V to 4.4 V 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:

☒ FPC Antenna

Antenna Gain: -2.36 dBi(Left)

Antenna Gain: -1.66 dBi(Right)

Note：Antenna gain provided by the applicant.

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 …….. V

DC State DC voltage 3.85V

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:

N/A

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

Bluetooth

q) If applicable, the statistical analysis referred to in clause 5.3.1 q)

N/A

r) If applicable, the statistical analysis referred to in clause 5.3.1 r)

N/A

s) Geo-location capability supported by the equipment:

Not applicable

3. TEST RESULT SUMMARY

3.1. Test Methodology

All measurements contained in this report were conducted with ETSI EN 300 328 V2.2.2 (2019-07).

ETSI EN 300 328 V2.2.2 (2019-07)	Description of Test	Test Result
4.3.2.2	RF Output Power	Compliance
4.3.2.3	Power Spectral Density	Compliance
4.3.2.4	Duty cycle, Tx-Sequence, Tx-gap	N/A (Note 1,2)
4.3.2.5	Medium Utilization (MU) factor	N/A (Note 1)
4.3.2.6	Adaptively	N/A (Note 3)
4.3.2.7	Occupied Channel Bandwidth	Compliance
4.3.2.8	Transmitter unwanted emission in the OOB domain	Compliance
4.3.2.9	Transmitter unwanted emissions in the spurious domain	Compliance
4.3.2.10	Receiver Spurious Emissions	Compliance
4.3.2.11	Receiver Blocking	Compliance
4.3.2.12	Goe-location	N/A

Remark:

Note 1: These requirements apply to non-adaptive equipment or to adaptive equipment when operating in a non-adaptive mode. These requirements do not apply for equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p.

Note 2: The equipment is using wide band modulations other than FHSS.

Note 3: This requirement does not apply to non-adaptive equipment or adaptive equipment operating in a non-adaptive mode. This requirement does not apply for equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p.

3.2. Measurement Uncertainty

The reported uncertainty of measurement **y ± U**，where expended uncertainty **U** is based on a standard uncertainty multiplied by a coverage factor of **k=2**，providing a level of confidence of approximately **95** %。

No.	Item	Uncertainty
1	Occupied Channel Bandwidth	±3.0%
2	RF power, conducted	±0.16dB
3	Power Spectral Density, conducted	±1.3dB
4	Unwanted Emissions, conducted	±1.3dB
5	All emissions, radiated	±4.7dB
6	Temperature	±0.5°C
7	Humidity	±2%
8	DC and low frequency voltages	±1.5%
9	Time	±1.0%
10	Duty Cycle	±3.0%

4 FACILITIES AND ACCREDITATIONS

4.1. FACILITIES

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

World Standardization Certification & Testing Group (Shenzhen) Co., Ltd.
Building J-7F and Building D, Dongjiang Science & Technology Park, Tangjia Community, Fenghuang Street, Guangming District, Shenzhen City, Guangdong Province, China

The sites are constructed in conformance with the requirements of ANSI C63.4 and CISPR Publication 32. All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

4.2. ACCREDITATIONS

Our laboratories are accredited and approved by the following approval agencies according to ISO/IEC 17025.

China	**CNAS (Registration Number: L3732)**

Copies of granted accreditation certificates are available for downloading from our web site, http://www.wsct-cert.com

5. TEST EQUIPMENTS

Kind of Equipment	Manufacturer	Type No.	Serial No.	Last Calibrated	Calibrated until	Use or Not
Test the software	-	EZ-EMC	-	-	-	☒
EMI Test Receiver	R&S	ESR7	102817	2024-04-18	2025-04-17	☒
Bi-log Antenna	SCHWARZBECK	VULB9168	01664	2024-04-20	2025-04-19	☒
Horn Antenna	R&S	BBHA 9120D	01801	2024-04-19	2025-04-18	☒
pre-amplifier	SCHWARZBECK	CC-AMP-N-6G	231023-6GHZ	2024-04-18	2025-04-17	☒
Spectrum analyzer	Agilent Technologies	N9020A	MY53371004	2025-03-06	2026-03-05	☒
Spectrum analyzer	Agilent Technologies	N9010B	MY63390117	2024-04-18	2025-04-17	☒
Vector Signal Source	Agilent Technologies	N5182A	MY48180819	2025-03-06	2026-03-05	☒
Analog signal source	R&S	E8257D	MY49280264	2025-03-06	2026-03-05	☒
Power meter	Agilent Technologies	E9340A	US39400100	2025-03-06	2026-03-05	☒
Anechoic chamber	mr-emc	966	-	2023-05-30	2026-05-29	☒
Universal Radio Communication Tester	R&S	CMW500	139123	2025-03-06	2026-03-05	☒

6. STANDARD REQUIREMENT

6.1. RF output power

Limit

According to ETSI EN 300 328 V2.2.2 (2019-07) §4.3.2.1.2,

For adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be 20 dBm.

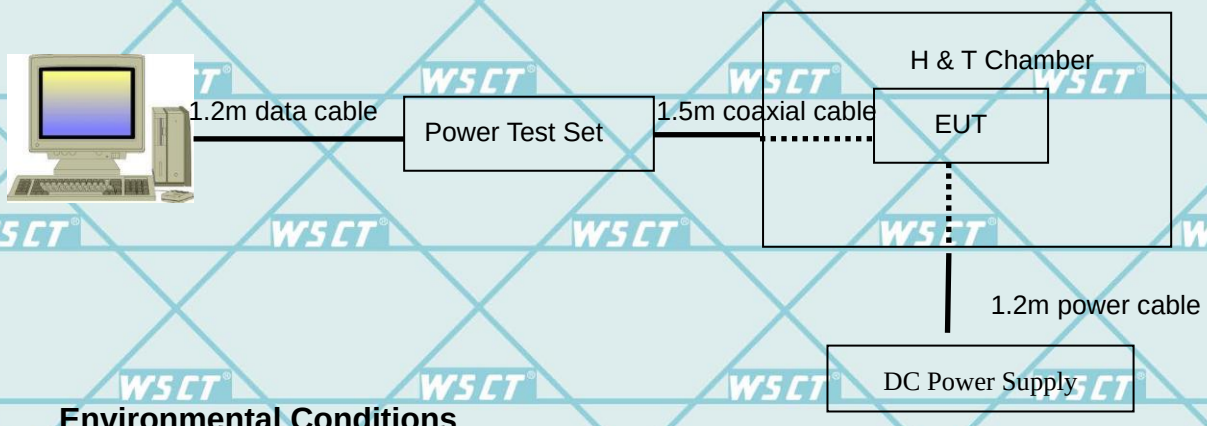
The maximum RF output power for non-adaptive equipment shall be declared by the supplier and shall not exceed 20 dBm. See clause 5.3.1 m). For non-adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be equal to or less than the value declared by the supplier.

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

Test Procedure

According to ETSI EN 300 328 V2.2.2 (2019-07) §5.4.2.2.1.1, conducted method.

Test setup



Environmental Conditions

Temperature:	0°C	25°C	45°C
Relative Humidity:	30%	56%	60%
ATM Pressure:	100.0 kPa	100.0 kPa	100.0 kPa

Test Data

Test Mode: Transmitting

Left:

Channel	Power (VDC)	Condition(°C)			Limits (dBm)	Detector
		25	0	45		
		EIRP Power (dBm)				
BLE 1M						
Low	3.85	3.66	3.55	3.21	20	RMS
Middle	3.85	**4.30**	4.00	3.79	20	RMS
High	3.85	3.93	3.75	3.41	20	RMS
BLE 2M						
Low	3.85	3.66	3.44	3.37	20	RMS
Middle	3.85	4.24	3.89	3.70	20	RMS
High	3.85	3.88	3.80	3.59	20	RMS

Right:

Channel	Power (VDC)	Condition(°C)			Limits (dBm)	Detector
		25	-10	55		
		EIRP Power (dBm)				
BLE 1M						
Low	3.8	3.49	3.44	3.32	20	RMS
Middle	3.8	**4.38**	4.34	4.12	20	RMS
High	3.8	3.91	3.74	3.60	20	RMS
BLE 2M						
Low	3.8	0.49	0.22	0.17	20	RMS
Middle	3.8	**4.38**	4.23	4.15	20	RMS
High	3.8	2.01	1.90	1.81	20	RMS

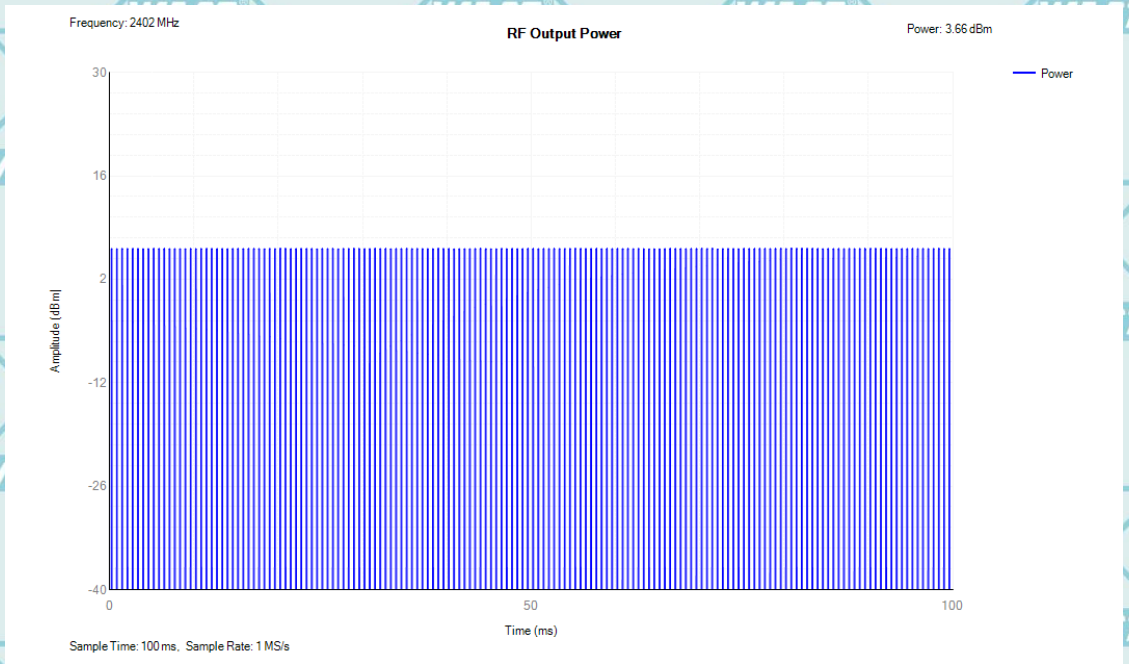
Note: Cable loss and antenna gain was combined in the calculated result.

Test Graphs

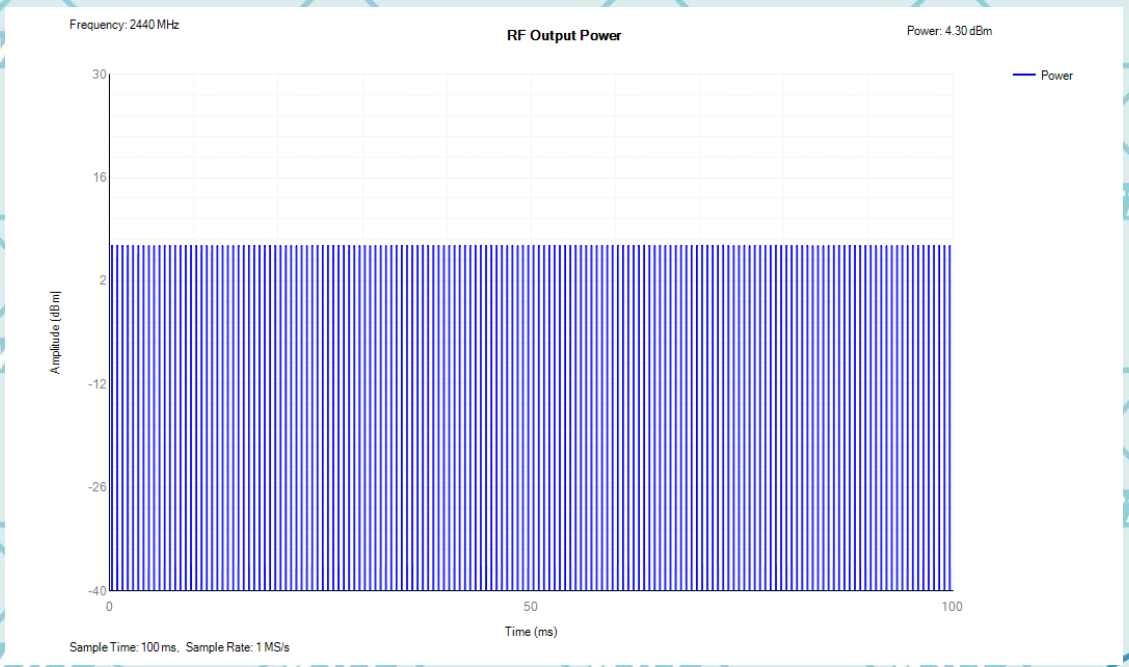
Left:

BLE 1M

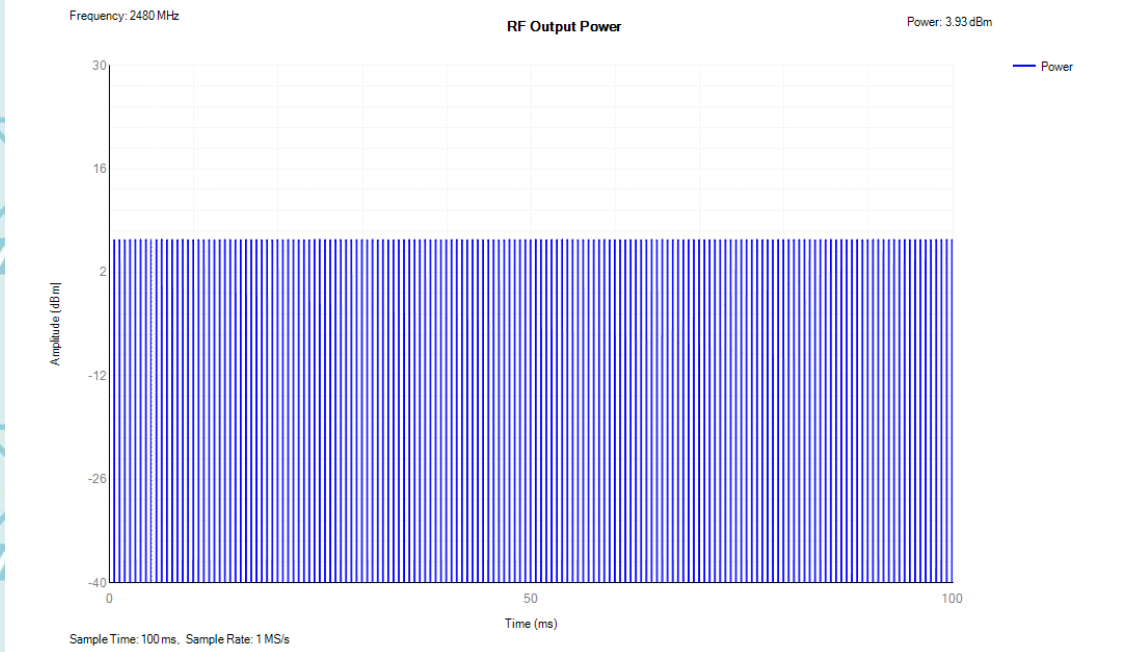
Power –*2402MHz*



Power –*2440MHz*

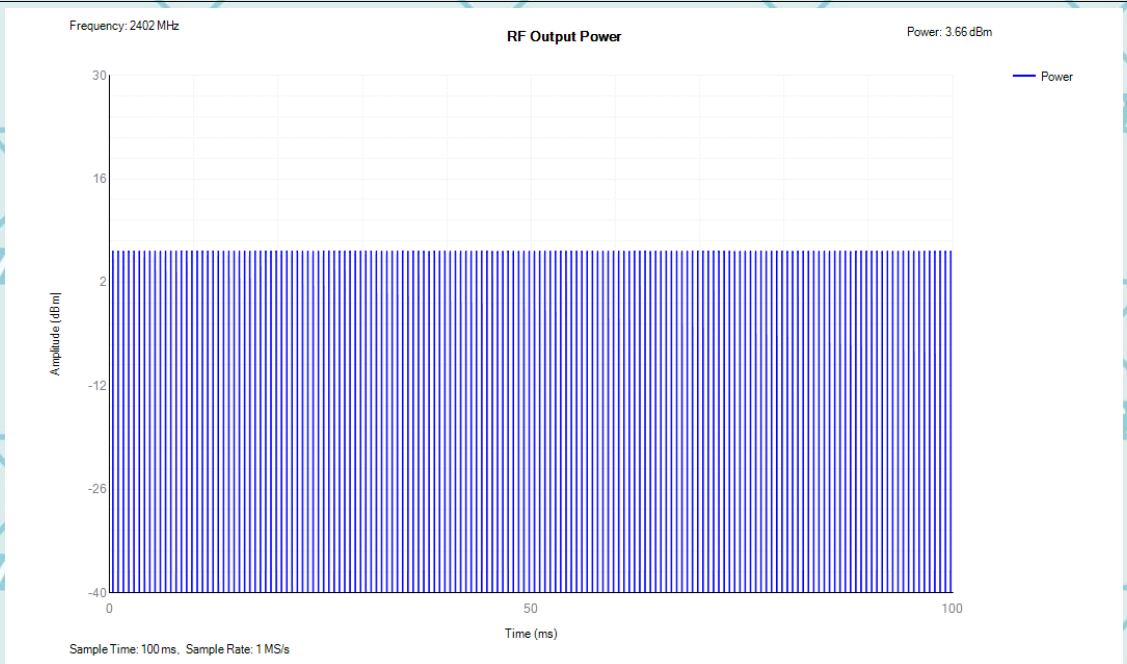


Power –*2480MHz*

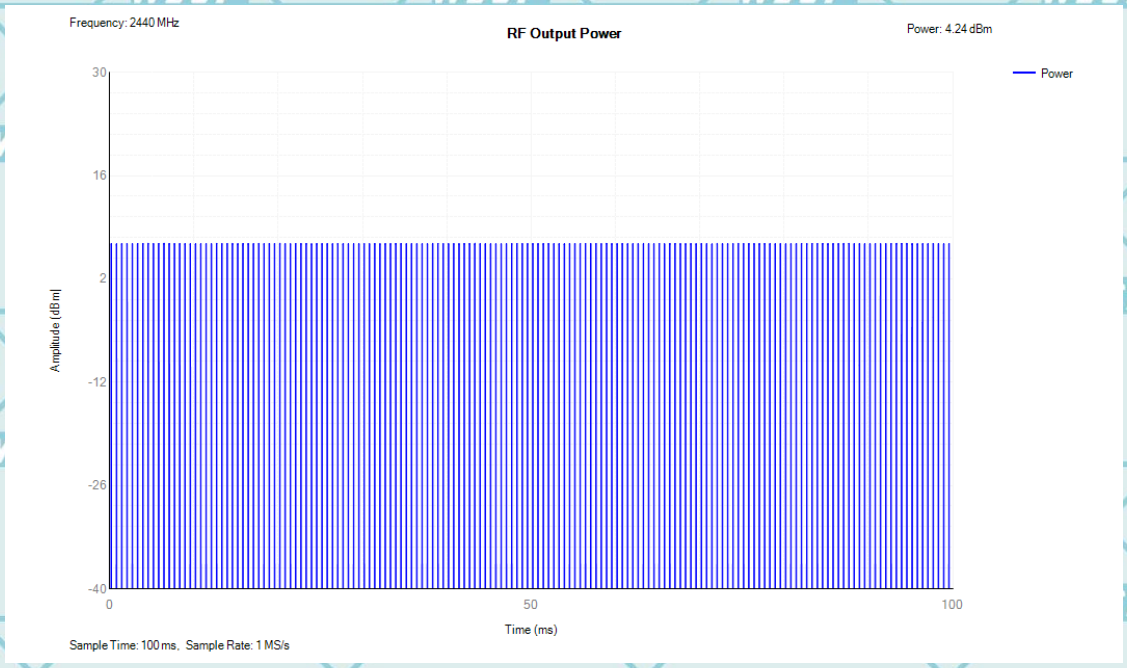


BLE 2M

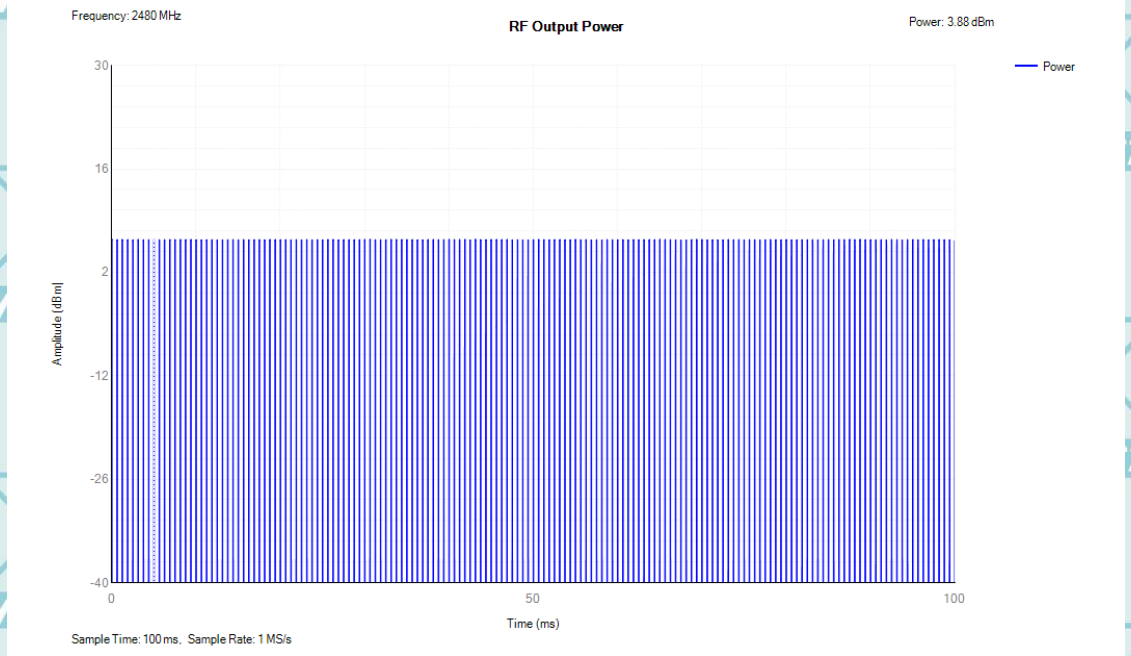
Power –*2402MHz*



Power –*2440MHz*

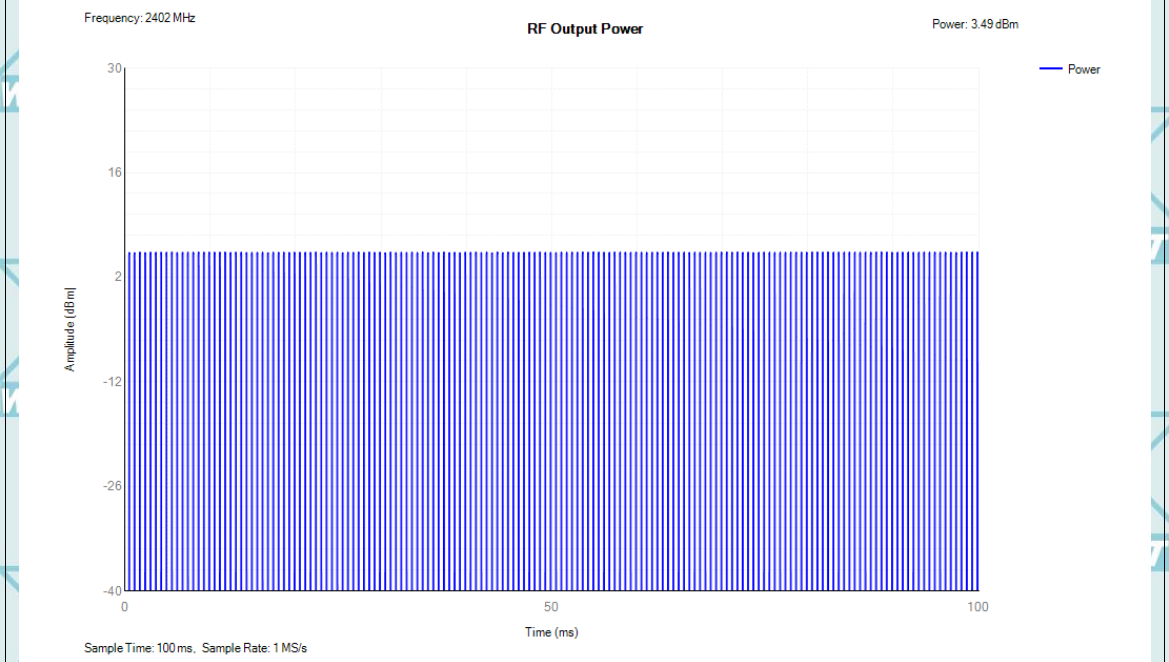


Power –*2480MHz*

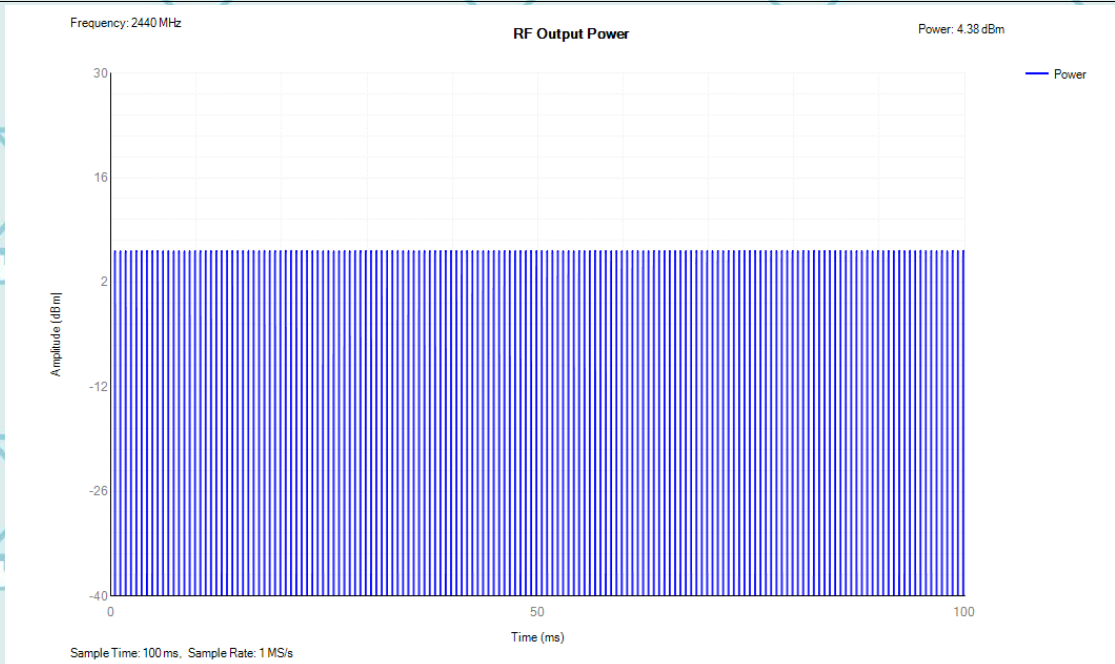


Right:

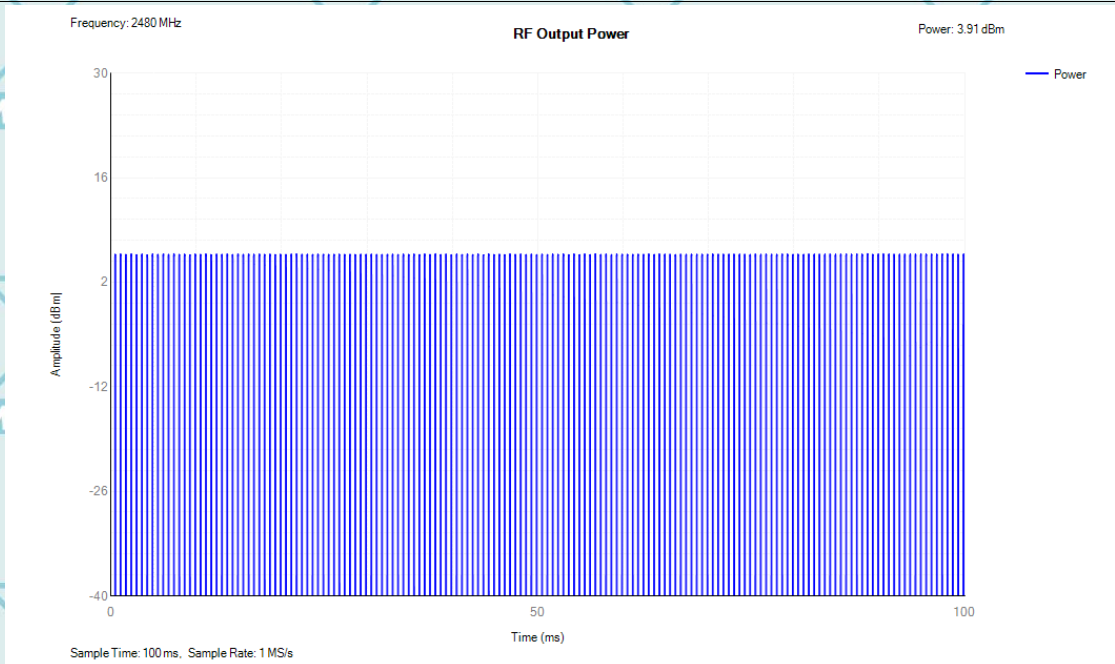
Power NVNT BLE 1M 2402MHz Ant1



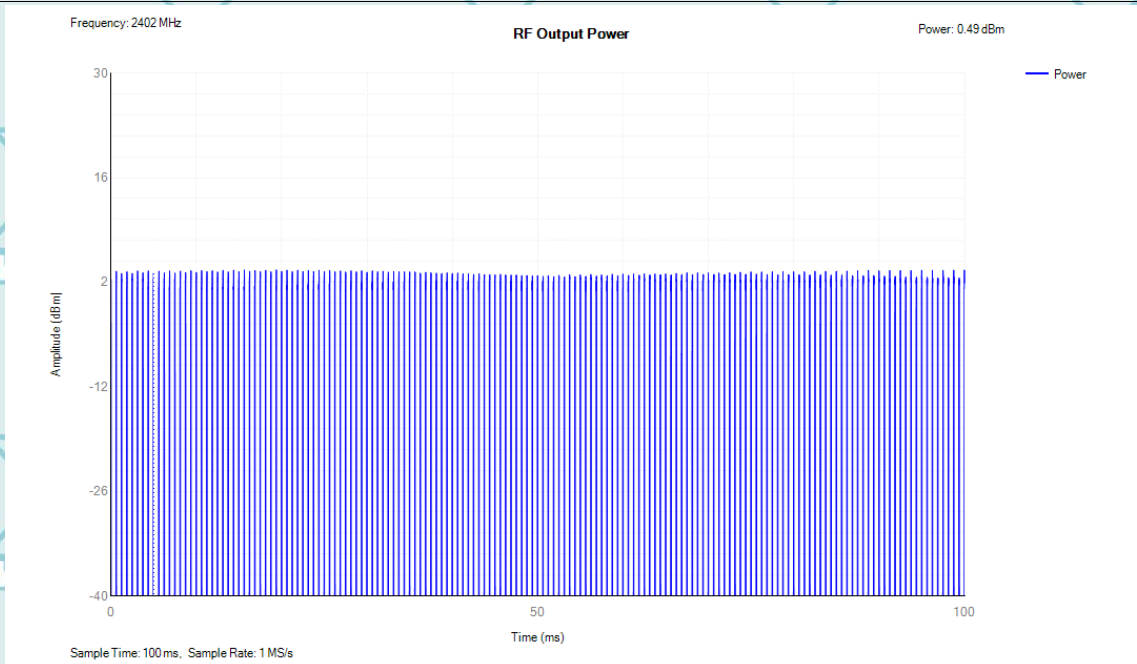
Power NVNT BLE 1M 2440MHz Ant1



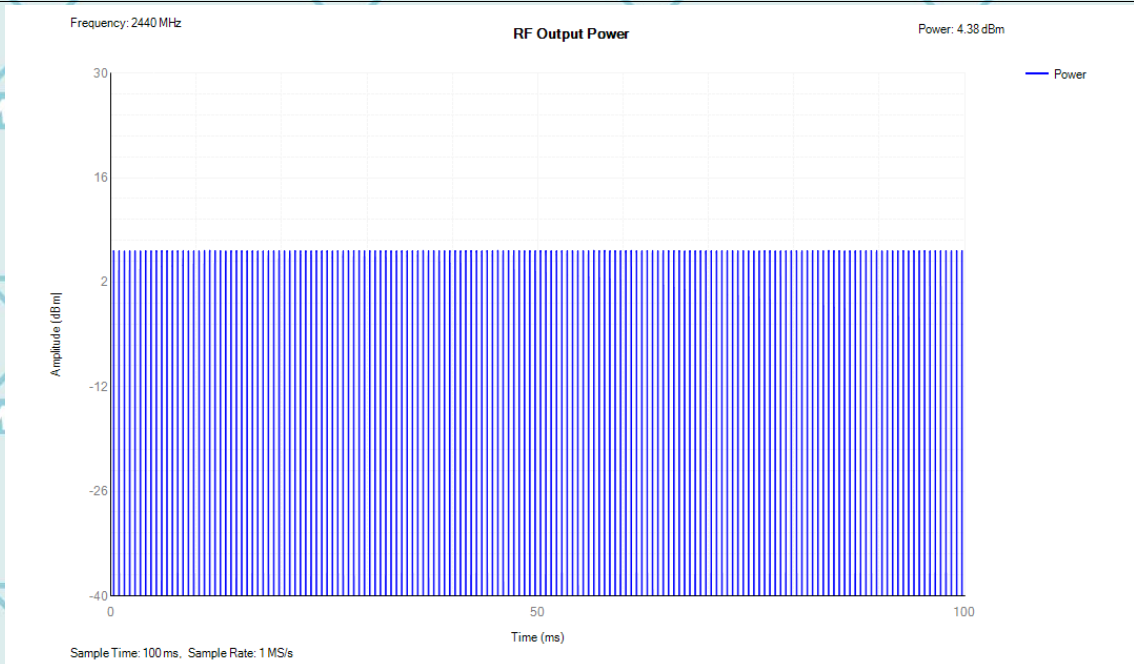
Power NVNT BLE 1M 2480MHz Ant1



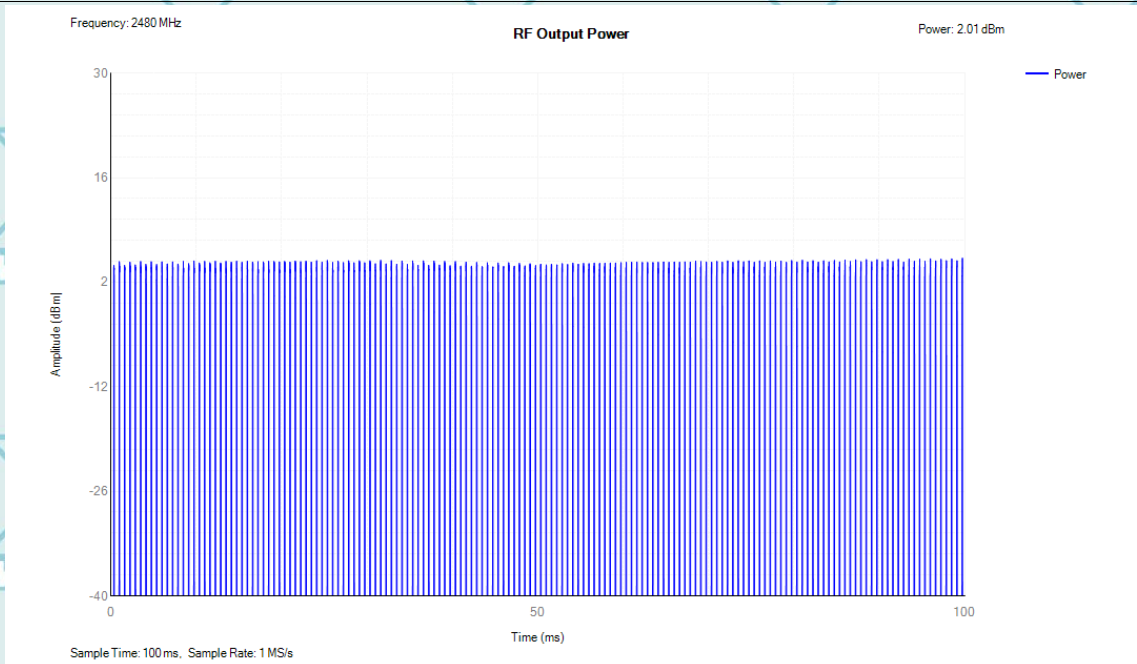
Power NVNT BLE 2M 2402MHz Ant1



Power NVNT BLE 2M 2440MHz Ant1



Power NVNT BLE 2M 2480MHz Ant1



Test result:

Pass

6.2. Power Spectral Density

Limit

According to ETSI EN 300 328 V2.2.2 (2019-07) §4.3.2.3.3,

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

Test Procedure

According to ETSI EN 300 328 V2.2.2 (2019-07) §5.4.3.2.1, conducted method.

The test procedure shall be as follows:

Step 1:

Connect the UUT to the spectrum analyzer and use the following settings:

• Start Frequency: 2 400 MHz

• Stop Frequency: 2 483.5 MHz

• Resolution BW: 10 kHz

• Video BW: 30 kHz

• Sweep Points: > 8 350

NOTE: For spectrum analyzers not supporting this number of sweep points, the frequency band may be segmented.

• Detector: RMS

• Trace Mode: Max Hold

• Sweep time: 10 s; the sweep time may be increased further until a value where the sweep time has no impact on the RMS value of the signal

For non-continuous signals, wait for the trace to be completed. Save the (trace) data set to a file.

Step 2:

For conducted measurements on smart antenna systems using either operating mode 2 or operating mode 3 (see clause 5.1.3.2), repeat the measurement for each of the transmit ports. For each sampling point (frequency domain), add up the coincident power values (in mW) for the different transmit chains and use this as the new data set.

Step 3:

Add up the values for power for all the samples in the file using the formula below.

$$P_{Sum} = \sum_{n=1}^{k} P_{sample}(n)$$

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

Step 4:

Normalize the individual values for power (in dBm) so that the sum is equal to the RF Output Power (e.i.r.p.) measured in clause 5.3.2 and save the corrected data. The following formulas can be used:

$$C_{Corr} = P_{Sum} - P_{e.i.r.p.}$$

$$P_{Samplecorr}(n) = P_{Sample}(n) - C_{Corr}$$

with 'n' being the actual sample number

Step 5:

Starting from the first sample PSamplecorr (n) (lowest frequency), add up the power (in mW) of the following samples representing a 1 MHz segment and record the results for power and position (i.e. sample #1 to sample #100). This is the Power Spectral Density (e.i.r.p.) for the first 1 MHz segment which shall be recorded.

Step 6:

Shift the start point of the samples added up in step 5 by 1 sample and repeat the procedure in step 5 (i.e. sample #2 to #101).

Step 7:

Repeat step 6 until the end of the data set and record the Power Spectral Density values for each of the 1 MHz segments. From all the recorded results, the highest value is the maximum Power Spectral Density for the UUT. This value, which shall comply with the limit given in clause 4.3.2.3.3, shall be recorded in the test report.

Test Setup

Environmental Conditions

Temperature:	25℃
Relative Humidity:	56 %
ATM Pressure:	100.0 kPa

Test Data

Left:

BLE 1M

POWER DENSITY (Max.)			
Channel frequency(MHz)	**Power Density (dBm/MHz)**	**Test Limit (dBm/MHz)**	**Pass / Fail**
Low	3.6	10	Pass
Middle	4.24	10	Pass
High	3.88	10	Pass

BLE 2M

POWER DENSITY (Max.)			
Channel frequency(MHz)	**Power Density (dBm/MHz)**	**Test Limit (dBm/MHz)**	**Pass / Fail**
Low	3.13	10	Pass
Middle	3.71	10	Pass
High	3.36	10	Pass

Right:

BLE 1M

POWER DENSITY (Max.)			
Channel frequency(MHz)	Power Density (dBm/MHz)	Test Limit (dBm/MHz)	Pass / Fail
Low	3.43	10	Pass
Middle	4.32	10	Pass
High	3.85	10	Pass

BLE 2M

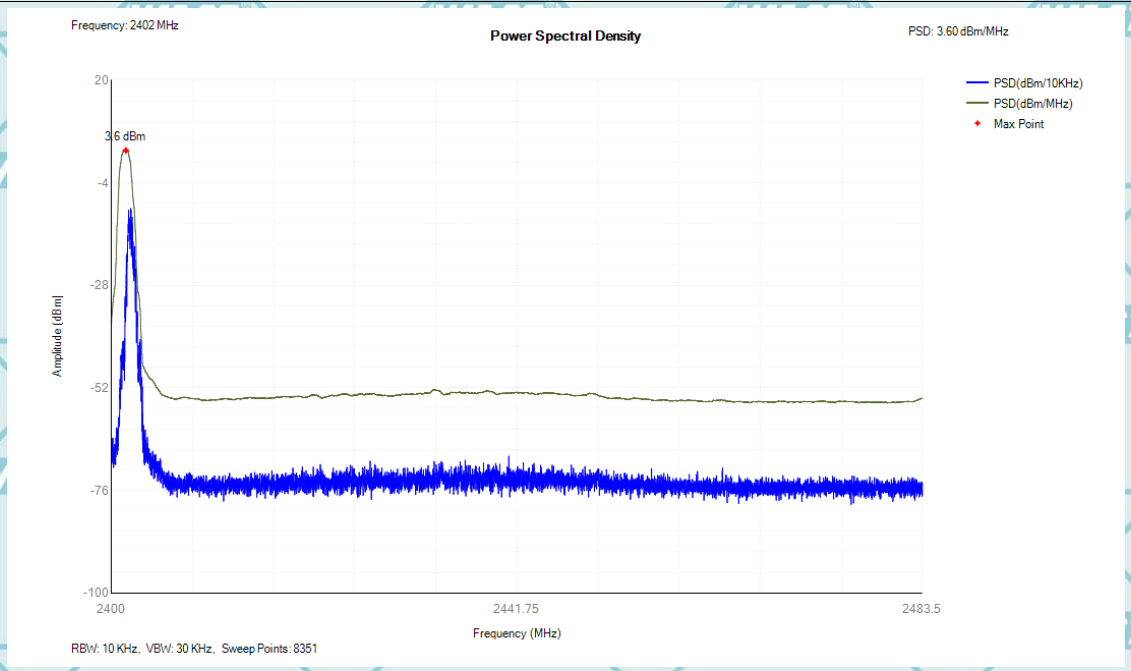
POWER DENSITY (Max.)			
Channel frequency(MHz)	Power Density (dBm/MHz)	Test Limit (dBm/MHz)	Pass / Fail
Low	-0.05	10	Pass
Middle	3.85	10	Pass
High	1.47	10	Pass

Test Graphs

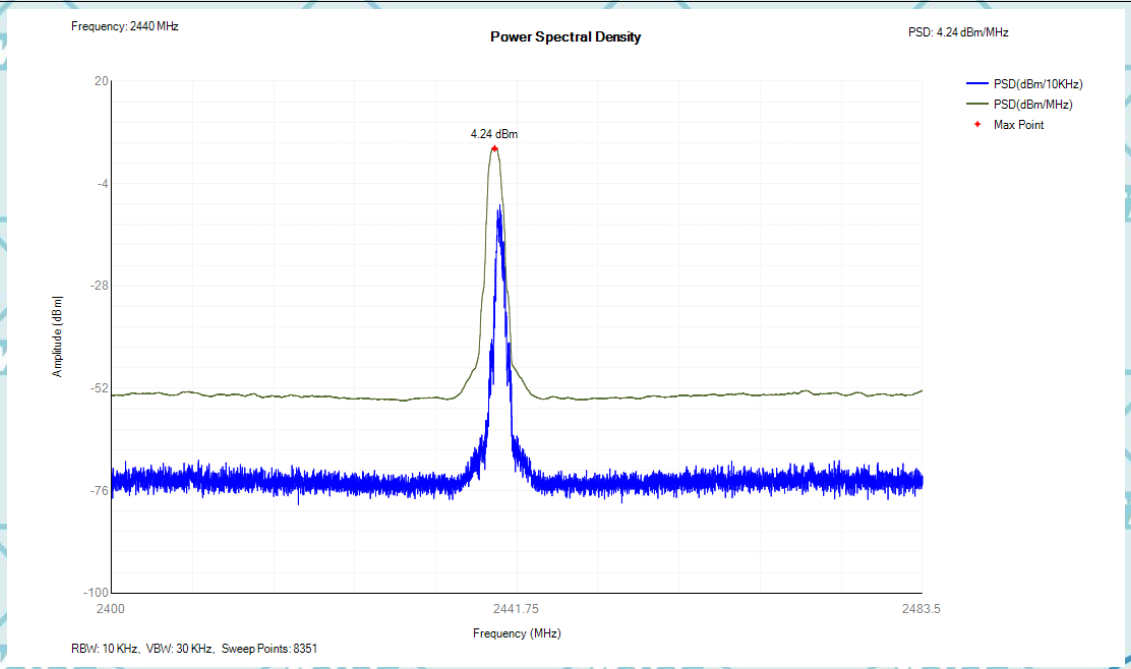
Left:

BLE 1M

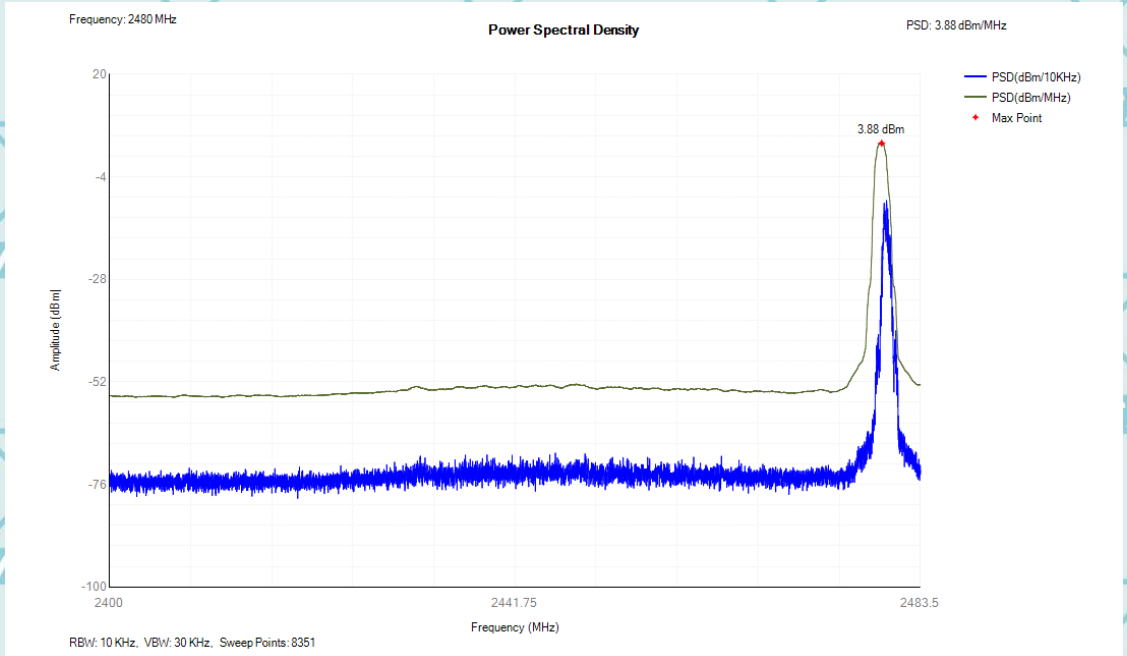
PSD –*2402MHz*



PSD –*2440MHz*

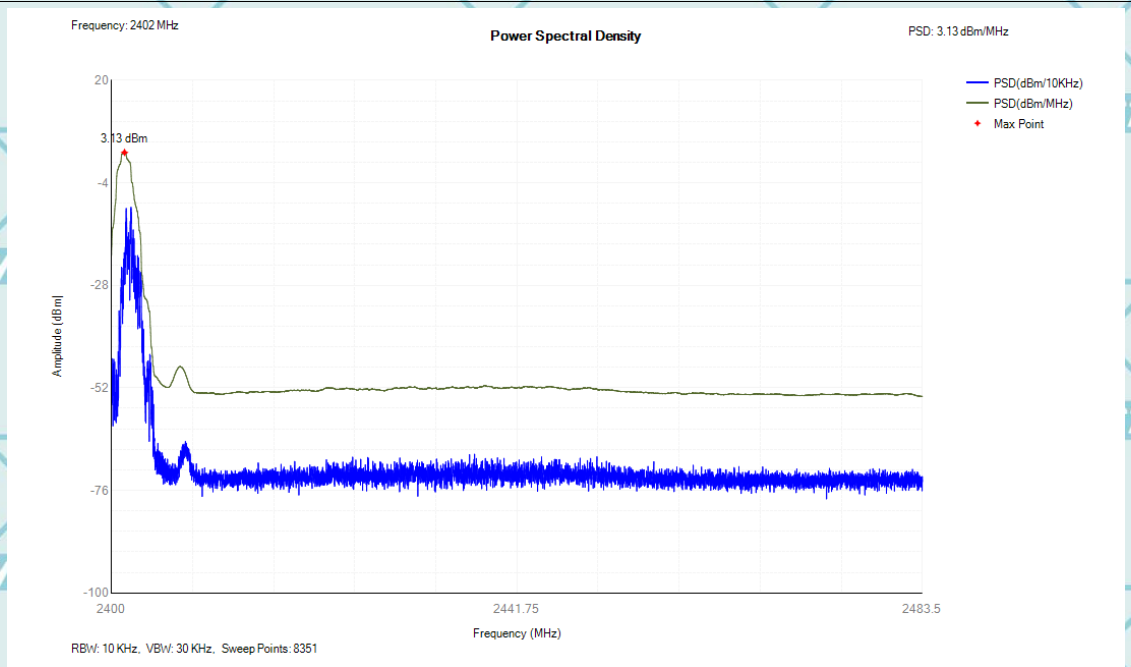


PSD –*2480MHz*

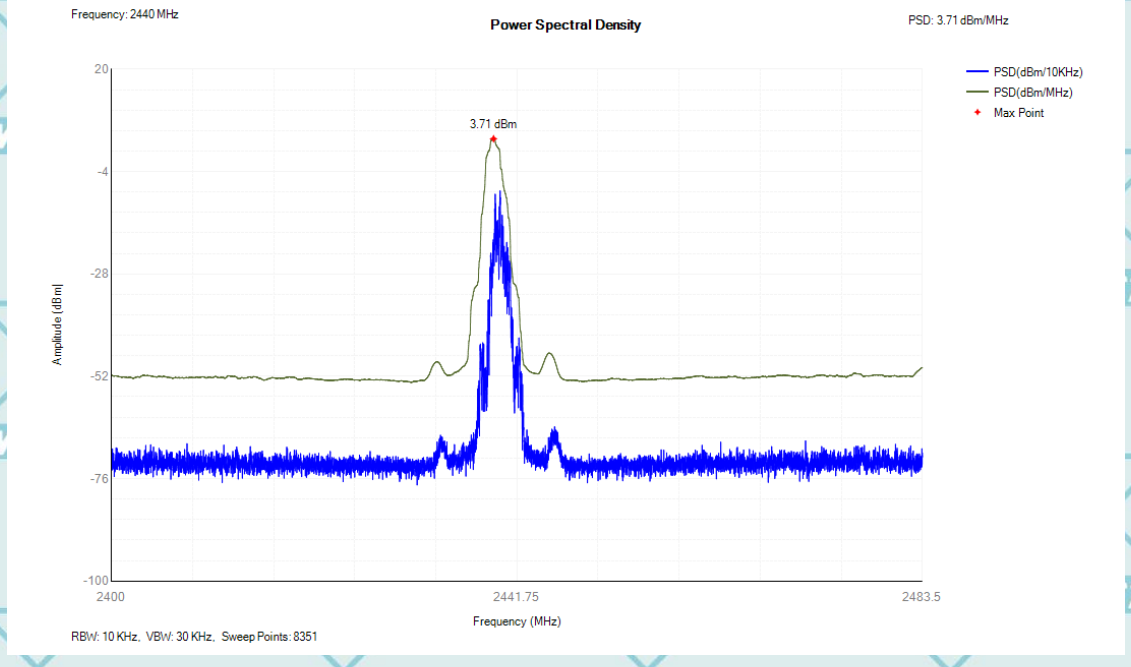

Frequency: 2480 MHz
Power Spectral Density
PSD: 3.88 dBm/MHz
PSD(dBm/10KHz)
PSD(dBm/MHz)
Max Point
3.88 dBm
20
-4
-28
-52
-76
-100
Amplitude (dBm)
2400
2441.75
2483.5
Frequency (MHz)
RBW: 10 KHz, VBW: 30 KHz, Sweep Points: 8351

BLE 2M

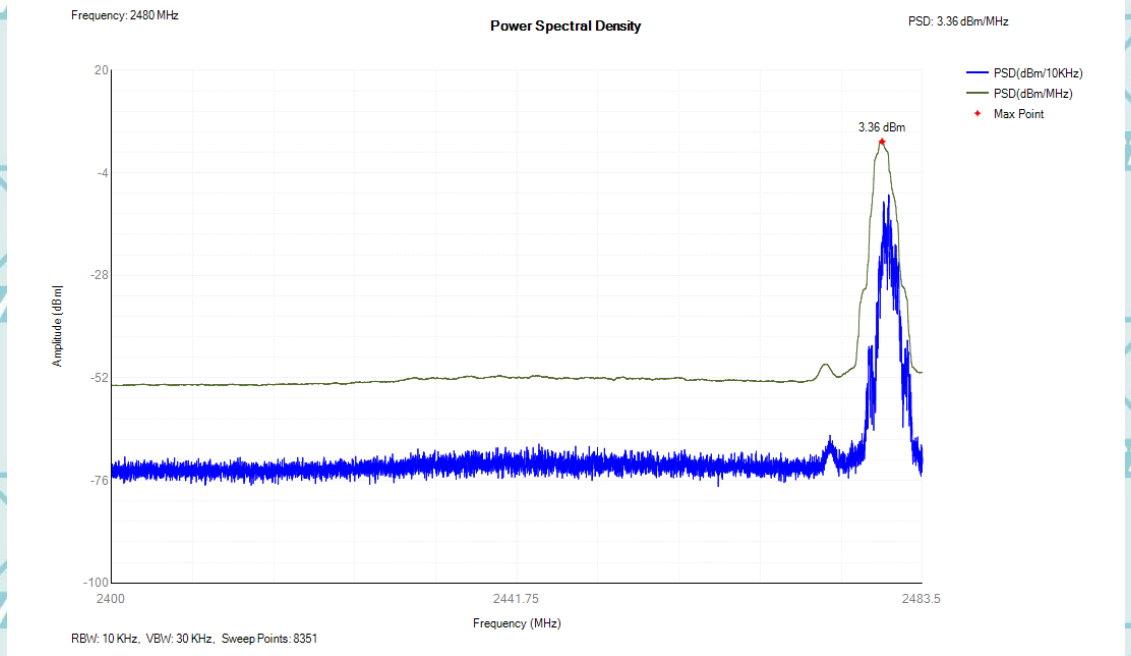
PSD –*2402MHz*



PSD –*2440MHz*

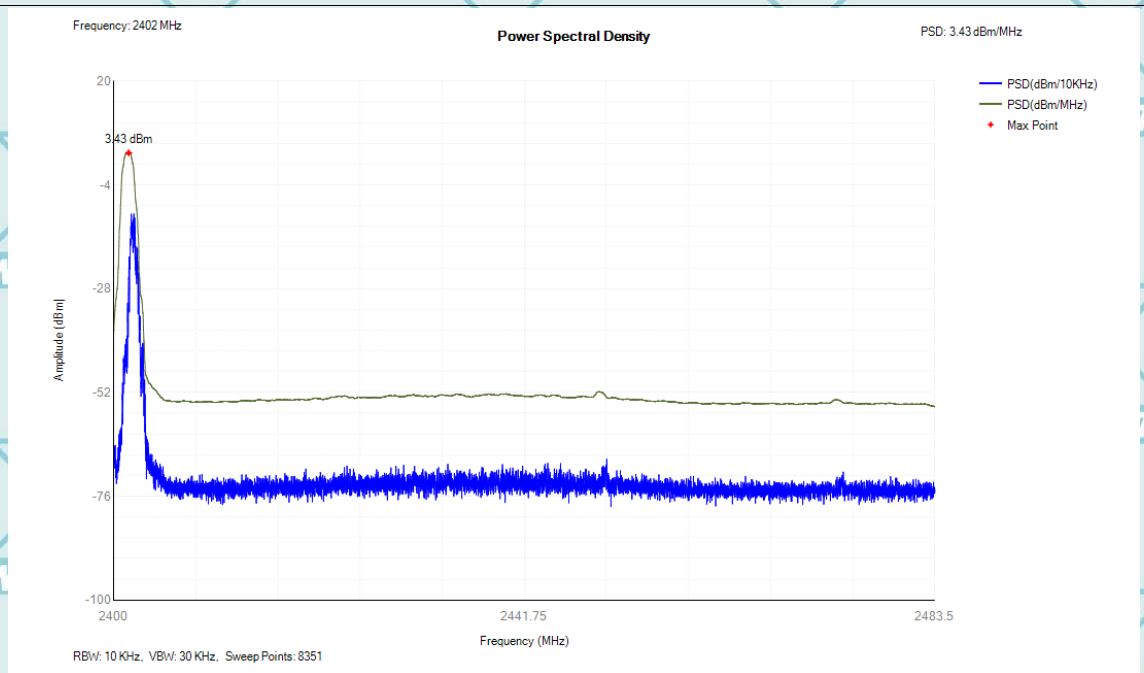


PSD –*2480MHz*

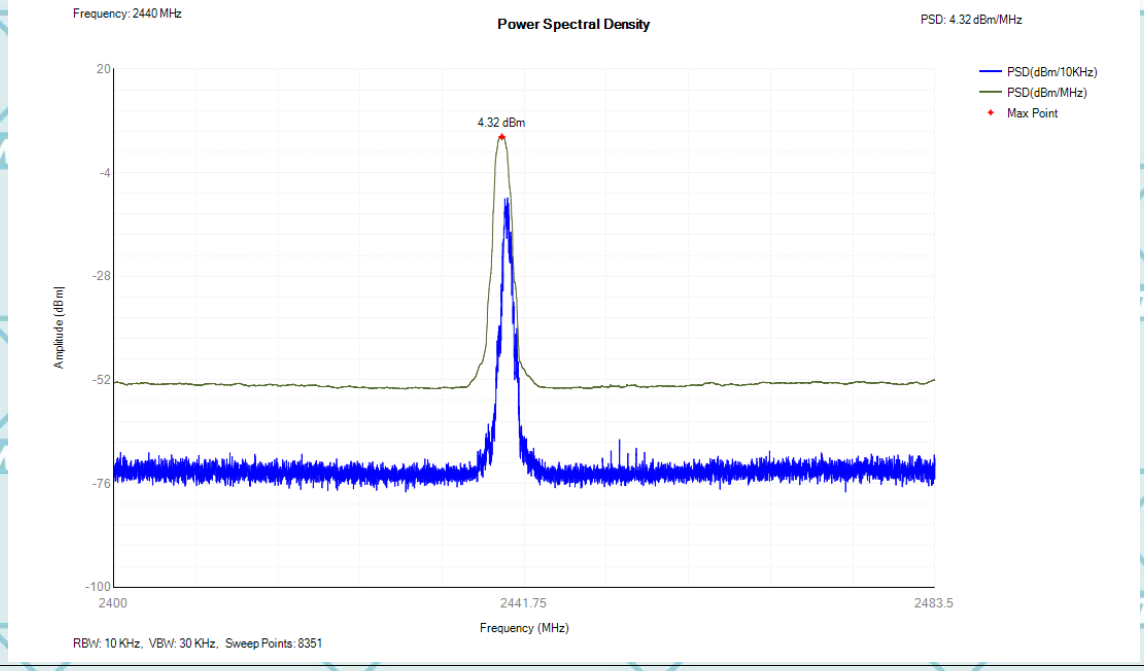

Frequency: 2480 MHz
Power Spectral Density
PSD: 3.36 dBm/MHz
PSD(dBm/10KHz)
PSD(dBm/MHz)
Max Point
3.36 dBm
20
-4
-28
-52
-76
-100
Amplitude (dBm)
2400
2441.75
2483.5
Frequency (MHz)
RBW: 10 KHz, VBW: 30 KHz, Sweep Points: 8351

Right:

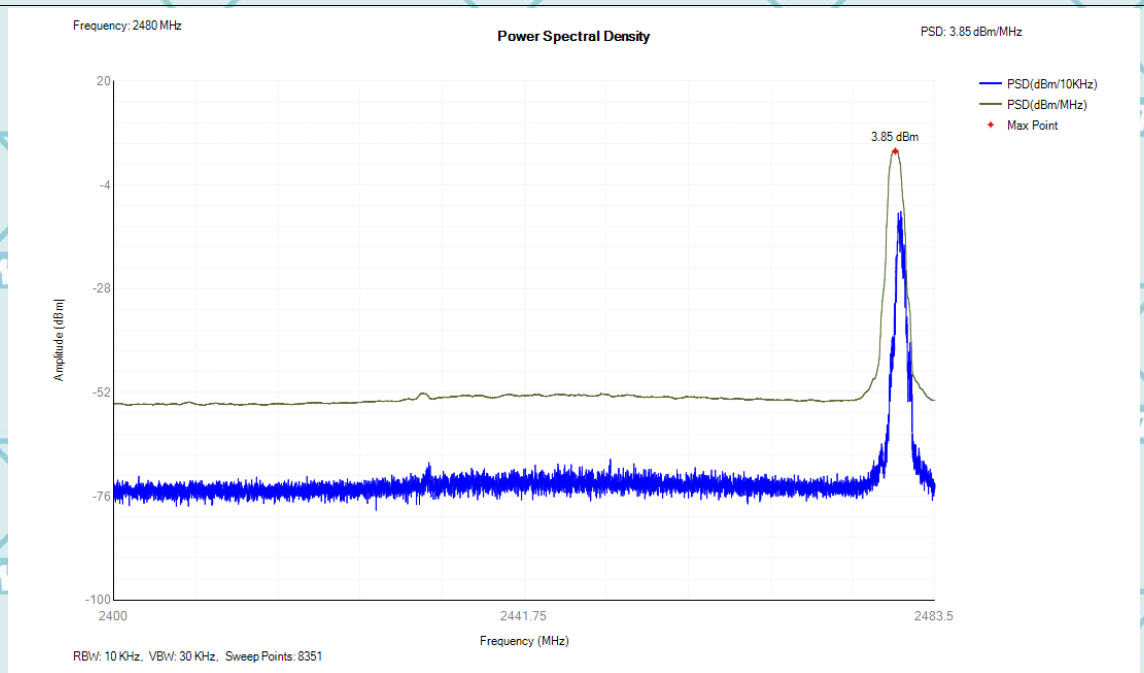
PSD NVNT BLE 1M 2402MHz Ant1



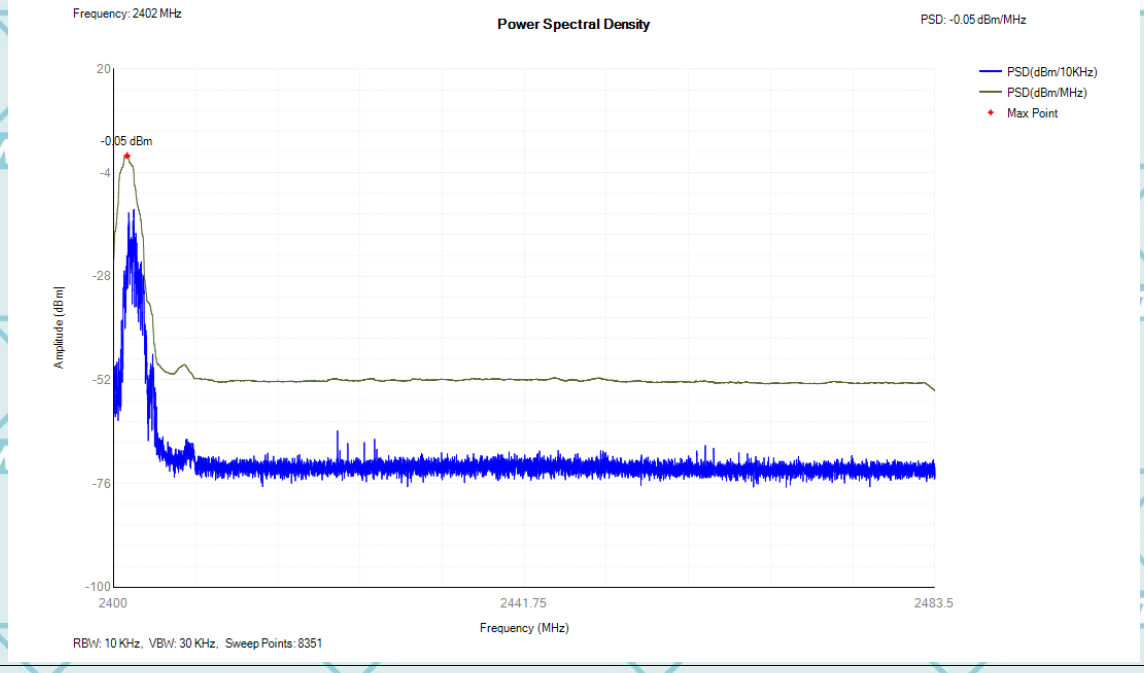
PSD NVNT BLE 1M 2440MHz Ant1



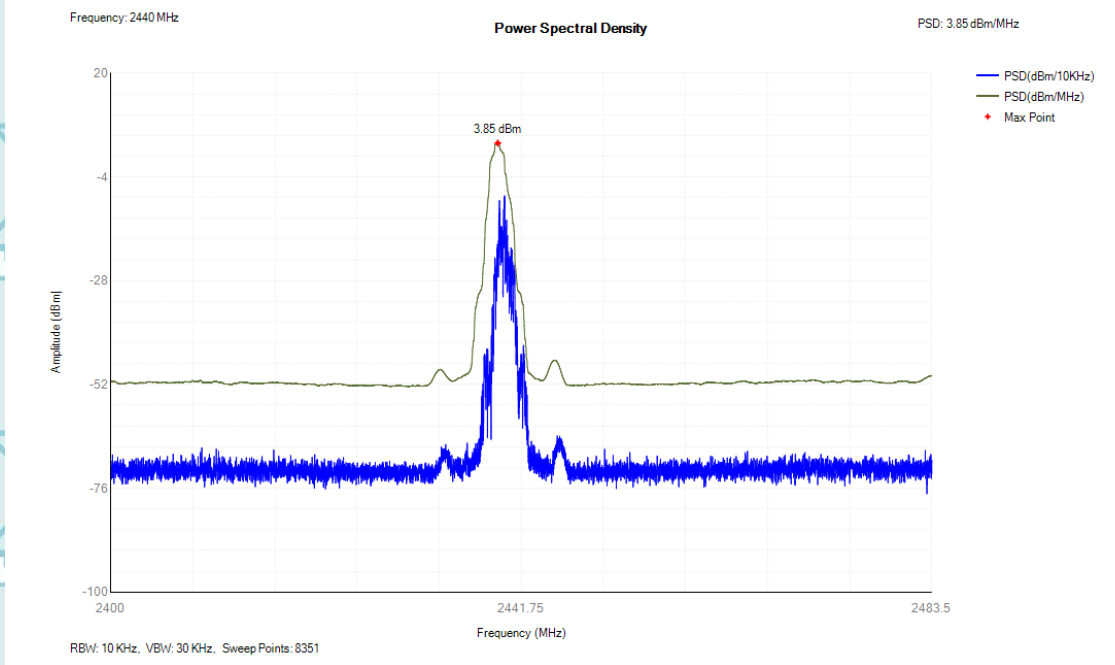
PSD NVNT BLE 1M 2480MHz Ant1



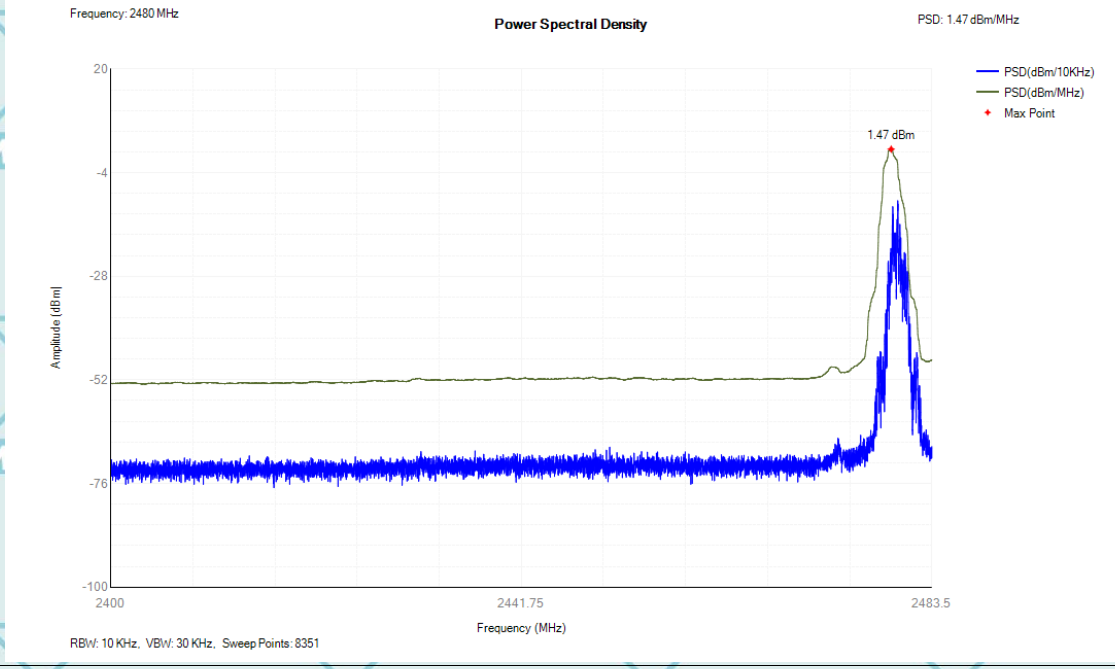
PSD NVNT BLE 2M 2402MHz Ant1



PSD NVNT BLE 2M 2440MHz Ant1



PSD NVNT BLE 2M 2480MHz Ant1



Test result:

Pass

6.3. Occupied Channel Bandwidth

Limit

According to ETSI EN 300 328 V2.2.2 (2019-07) 4.3.2.7.3,

The Occupied Channel Bandwidth shall fall completely within the band given in clause 1.

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

Test Procedure

According to ETSI EN 300 328 V2.2.2 (2019-07) §5.4.9.2.1, conducted method.

Step 1:

Connect the UUT to the spectrum analyser and use the following settings:

• Centre Frequency: The centre frequency of the channel under test

• Resolution BW: ~ 1 % of the span without going below 1 %

• Video BW: 3 × RBW

• Frequency Span for frequency hopping equipment: Lowest frequency separation that is used within the hopping sequence

• Frequency Span for other types of equipment: 2 × Nominal Channel Bandwidth (e.g. 40 MHz for a 20 MHz channel)

• Detector Mode: RMS

• Trace Mode: Max Hold

• Sweep time: 1 s

Step 2:

Wait for the trace to stabilize.

Find the peak value of the trace and place the analyser marker on this peak.

Step 3:

Use the 99 % bandwidth function of the spectrum analyser to measure the Occupied Channel Bandwidth of the UUT. This value shall be recorded.

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 Setup

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	56 %
ATM Pressure:	100.0 kPa

Test Data

Note: result the worst case in this part.

Left:

BLE 1M

CHANNEL	CHANNEL FREQUENCY (MHz)	99%OCCUPIED BANDWIDTH (MHz)	Measured frequencies		Limit	PASS /FAIL
			FL (MHz)	FH (MHz)		
00	2402	1.025	2401.515	2402.539	FL>2400MHz and FH<2483.5 MHz	PASS
39	2480	1.02	2479.519	2480.539		PASS

BLE 2M

CHANNEL	CHANNEL FREQUENCY (MHz)	99%OCCUPIED BANDWIDTH (MHz)	Measured frequencies		Limit	PASS /FAIL
			FL (MHz)	FH (MHz)		
00	2402	2.025	2401.017	2403.042	FL>2400MHz and FH<2483.5 MHz	PASS
39	2480	2.023	2479.02	2481.043		PASS

Right:

BLE 1M

CHANNEL	CHANNEL FREQUENCY (MHz)	99%OCCUPIED BANDWIDTH (MHz)	Measured frequencies		Limit	PASS /FAIL
			FL (MHz)	FH (MHz)		
00	2402	1.031	2401.516	2402.546	FL>2400MHz and FH<2483.5 MHz	PASS
39	2480	1.022	2479.521	2480.543		PASS

BLE 2M

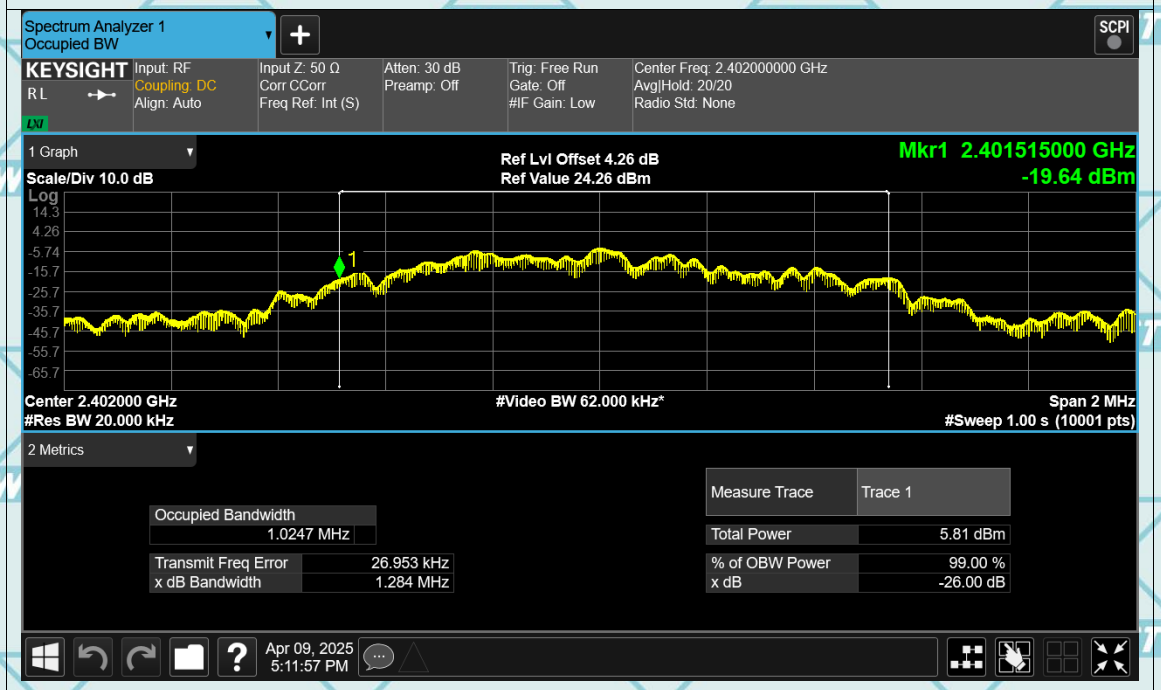
CHANNEL	CHANNEL FREQUENCY (MHz)	99%OCCUPIED BANDWIDTH (MHz)	Measured frequencies		Limit	PASS /FAIL
			FL (MHz)	FH (MHz)		
00	2402	2.026	2401.026	2403.052	FL>2400MHz and FH<2483.5 MHz	PASS
39	2480	2.029	2479.027	2481.056		PASS

Test Graphs

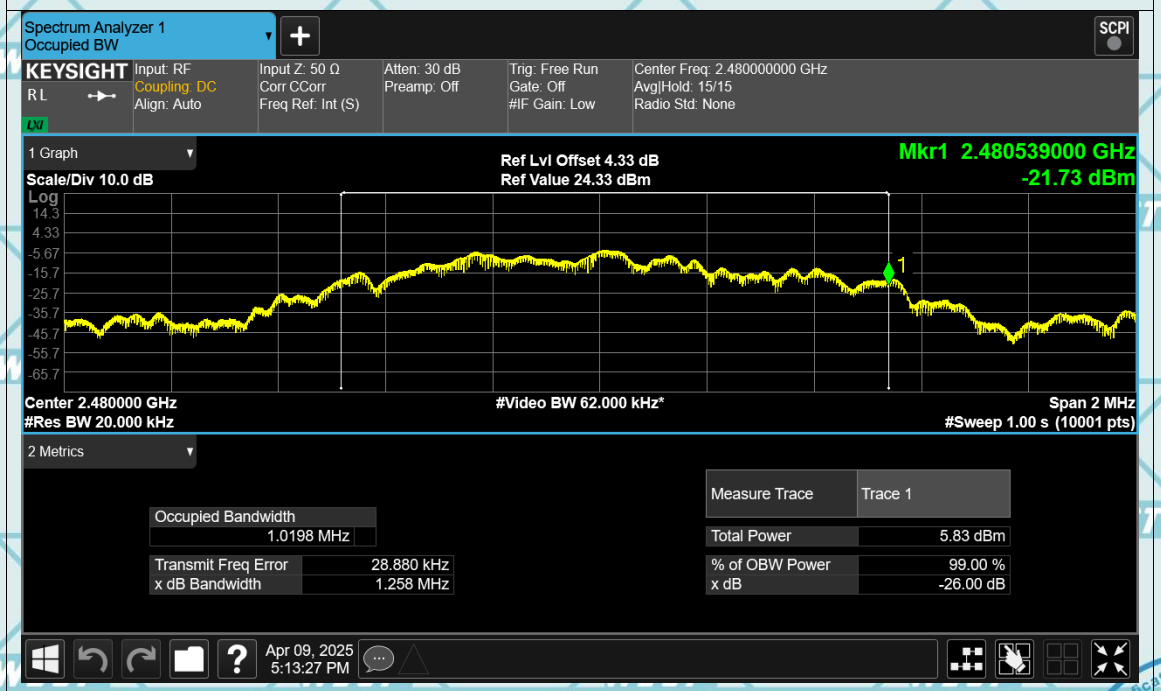
Left:

BLE 1M

OBW –*2402MHz*



OBW –*2480MHz*



BLE 2M

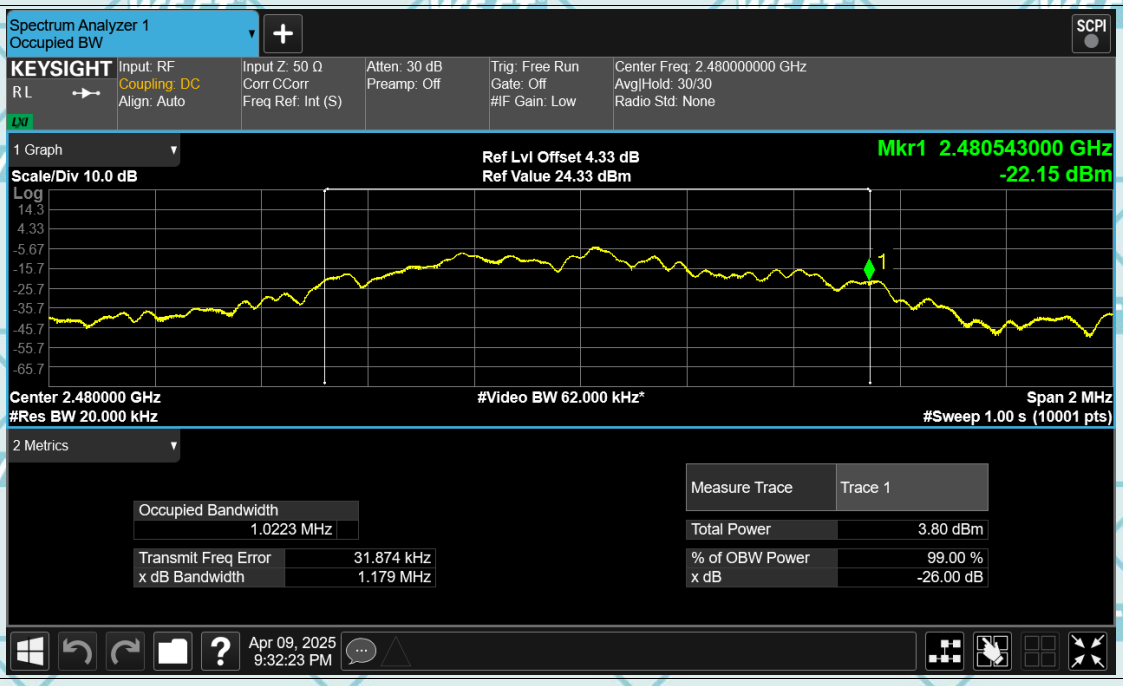
OBW –2402MHz

OBW –2480MHz

Right:

OBW NVNT BLE 1M 2402MHz Ant1

OBW NVNT BLE 1M 2480MHz Ant1



OBW NVNT BLE 2M 2402MHz Ant1

OBW NVNT BLE 2M 2480MHz Ant1

Test result:

Pass

6.4. Transmitter unwanted emissions in the out-of-band domain

Limit

According to ETSI EN 300 328 V2.2.2 (2019-07) 4.3.2.8.3

The transmitter unwanted emissions in the out-of-band domain but outside the allocated band, shall not exceed the values provided by the mask in figure 3.

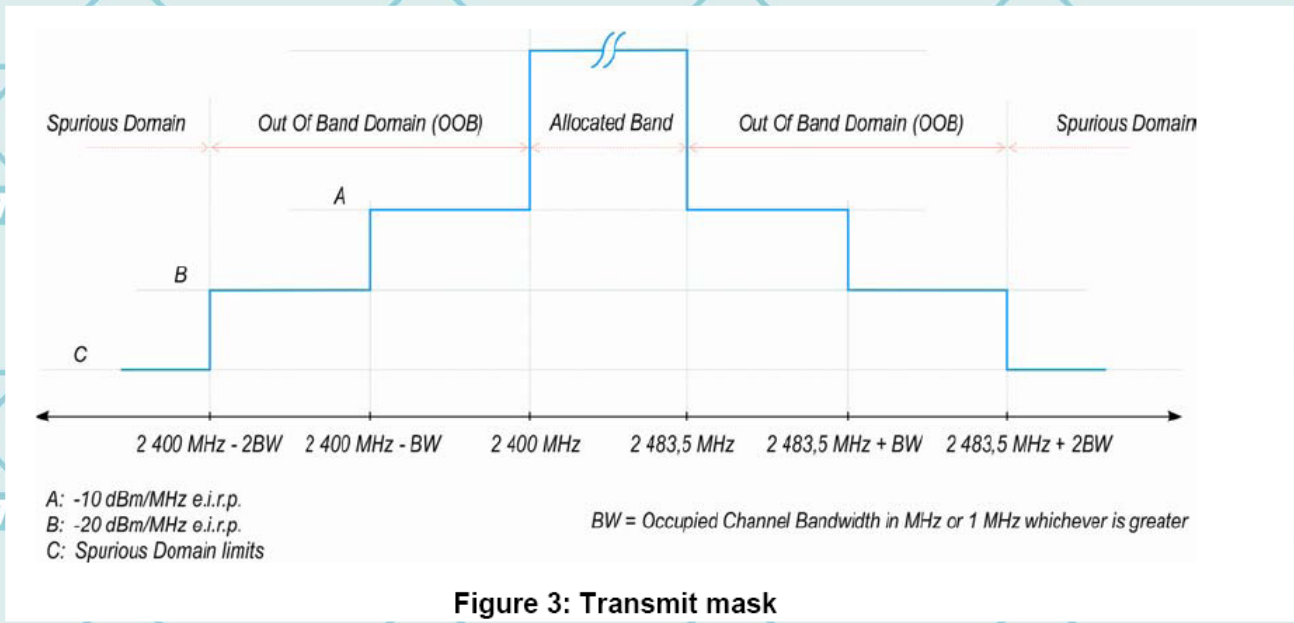


Figure 3: Transmit mask

Test Procedure

According to ETSI EN 300 328 V2.2.2 (2019-07) §5.4.9.2.1, conducted method.

Connect the UUT to the spectrum analyser and use the following settings:

- Centre Frequency: evaluated frequency
- Span: 0 Hz
- Resolution BW: 1 MHz
- Filter mode: Channel filter
- Video BW: 3 MHz
- Detector Mode: RMS
- Trace Mode: Max Hold
- Sweep Mode: Continuous
- Sweep Points: Sweep Time [s] / (1 µs) or 5 000 whichever is greater
- Trigger Mode: Video trigger

NOTE 1: In case video triggering is not possible, an external trigger source may be used.

- Sweep Time: > 120 % of the duration of the longest burst detected during the measurement of the RF Output Power

Test Setup

Environmental Conditions

Temperature:	25°C
Relative Humidity:	56%
ATM Pressure:	100.0 kPa

Test Data

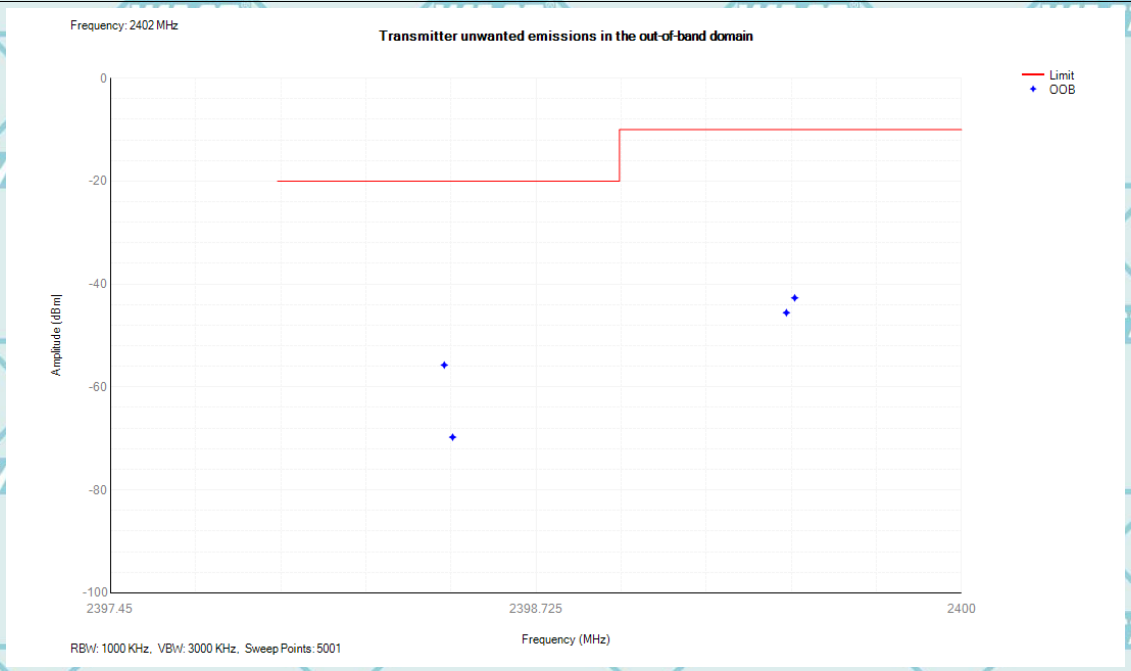
Note: result the worst case (Normal condition) in this part.

Test Graphs

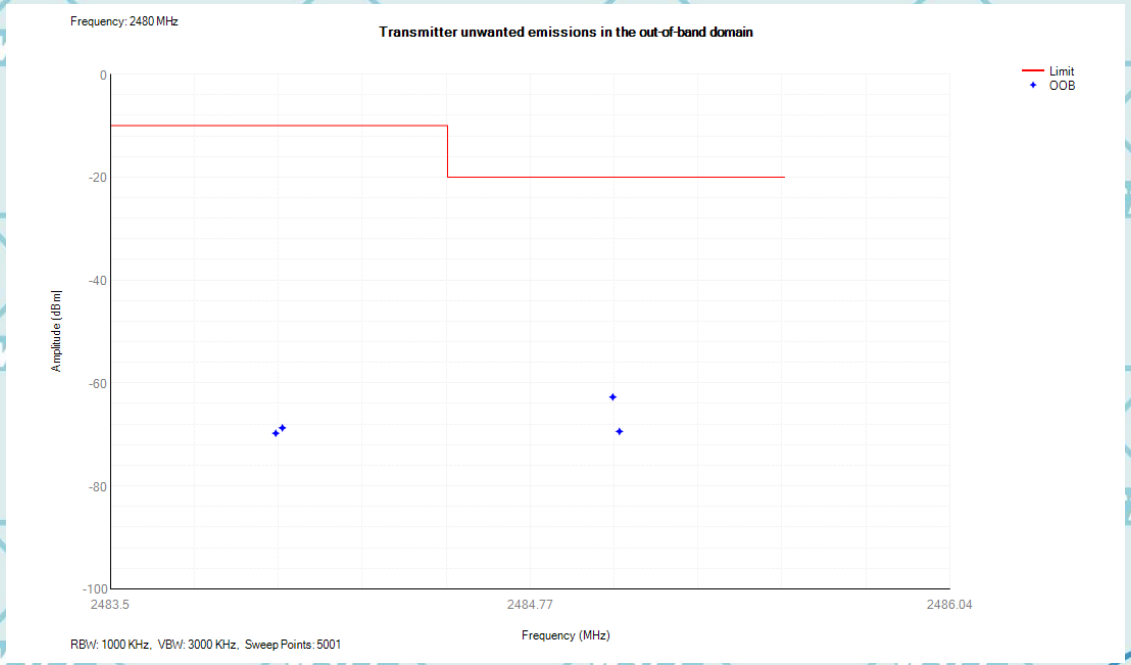
Left

BLE 1M

Tx. Emissions OOB

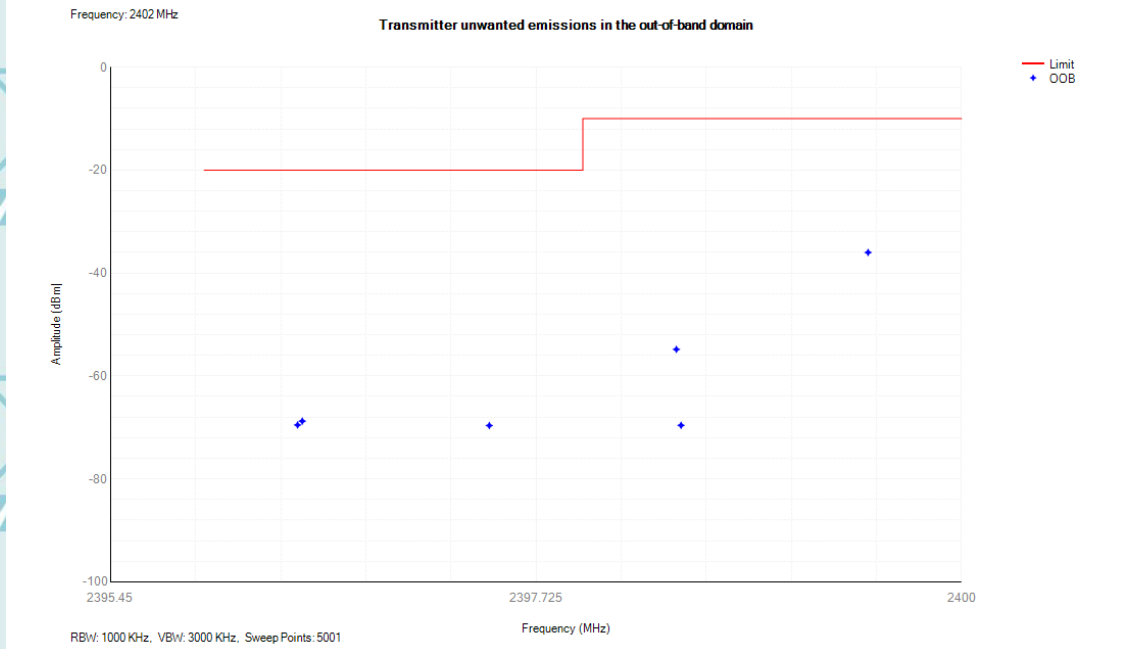


Tx. Emissions OOB

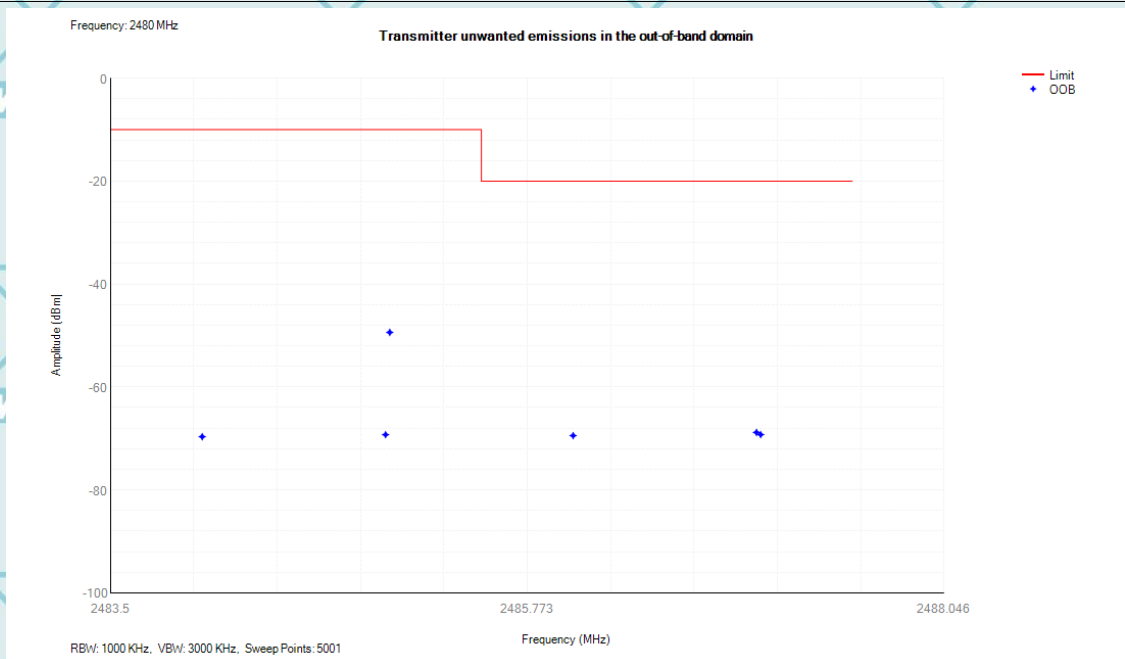


BLE 2M

Tx. Emissions OOB

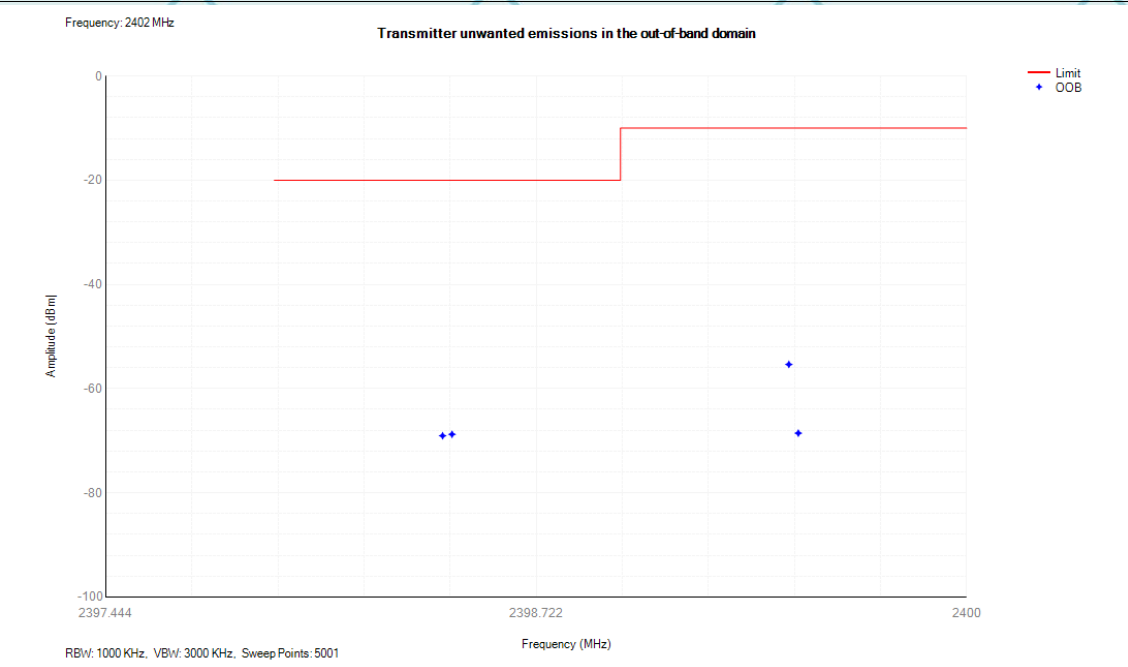


Tx. Emissions OOB

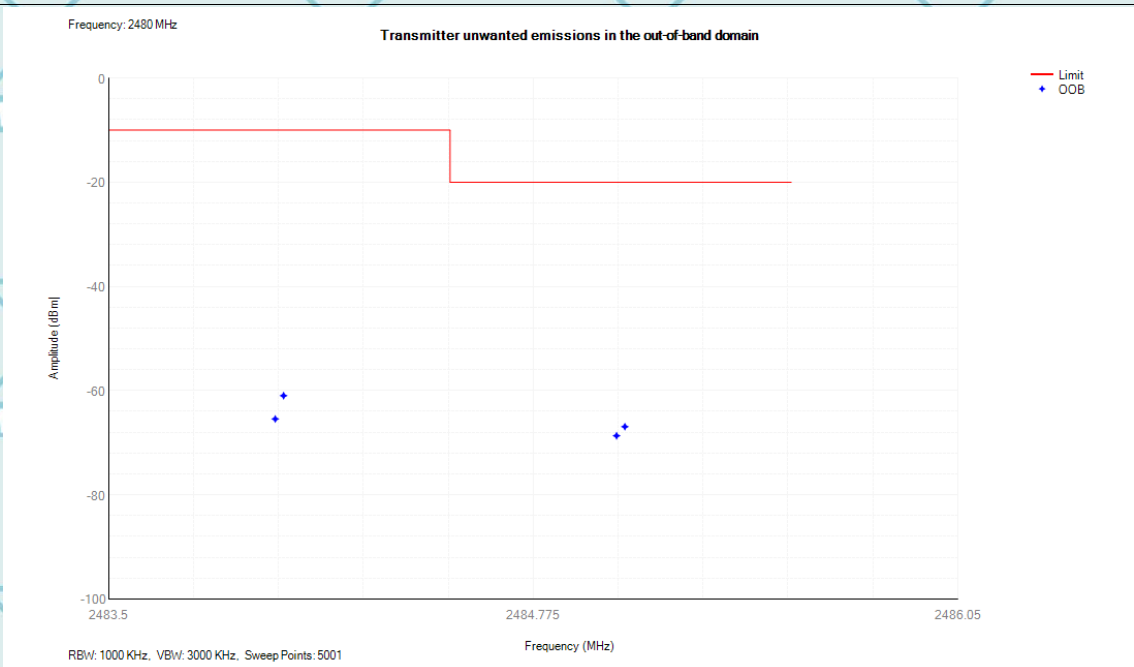


Right

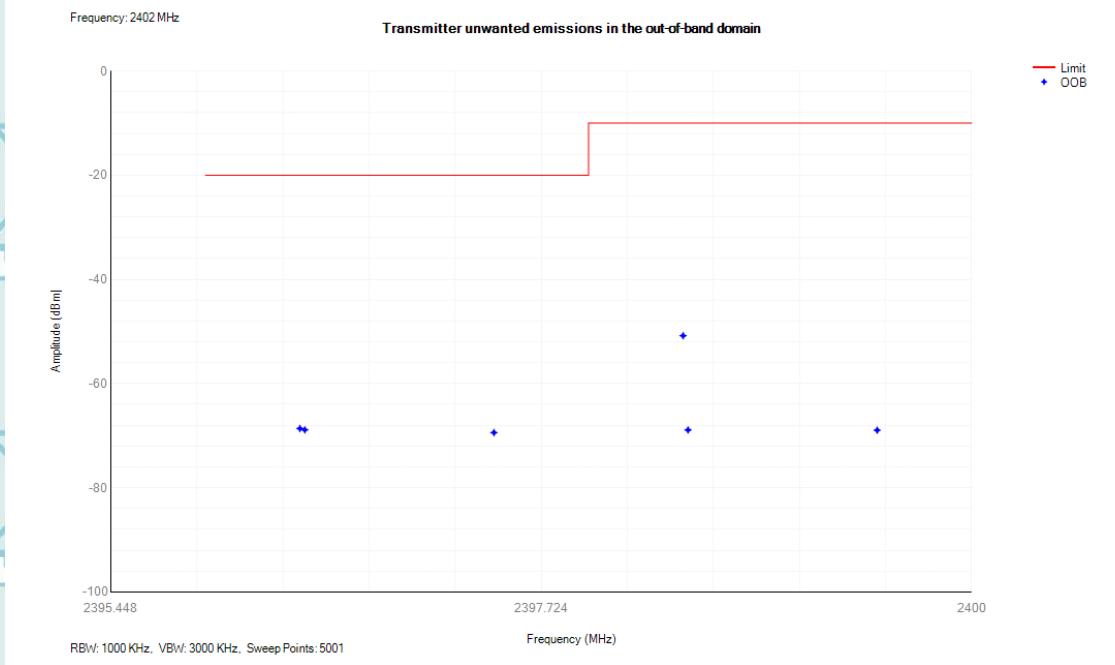
Test Graphs
Tx. Emissions OOB NVNT BLE 1M 2402MHz Ant1



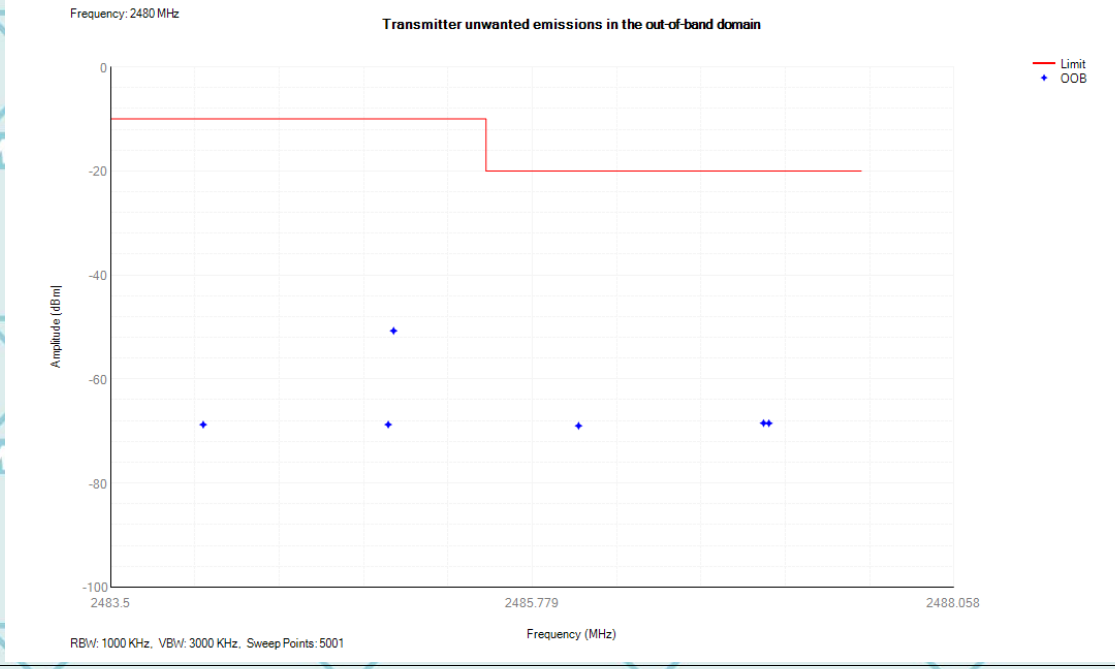
Tx. Emissions OOB NVNT BLE 1M 2480MHz Ant1



Tx. Emissions OOB NVNT BLE 2M 2402MHz Ant1



Tx. Emissions OOB NVNT BLE 2M 2480MHz Ant1



Test result:

Pass

6.5. Transmitter unwanted emissions in the spurious domain

Limit

According to ETSI EN 300 328 V2.2.2 (2019-07) §4.3.2.9.3

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 4.

Table 12: Transmitter limits for spurious emissions

Frequency range	Maximum power	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 694 MHz	-54 dBm	100 kHz
694 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1 MHz

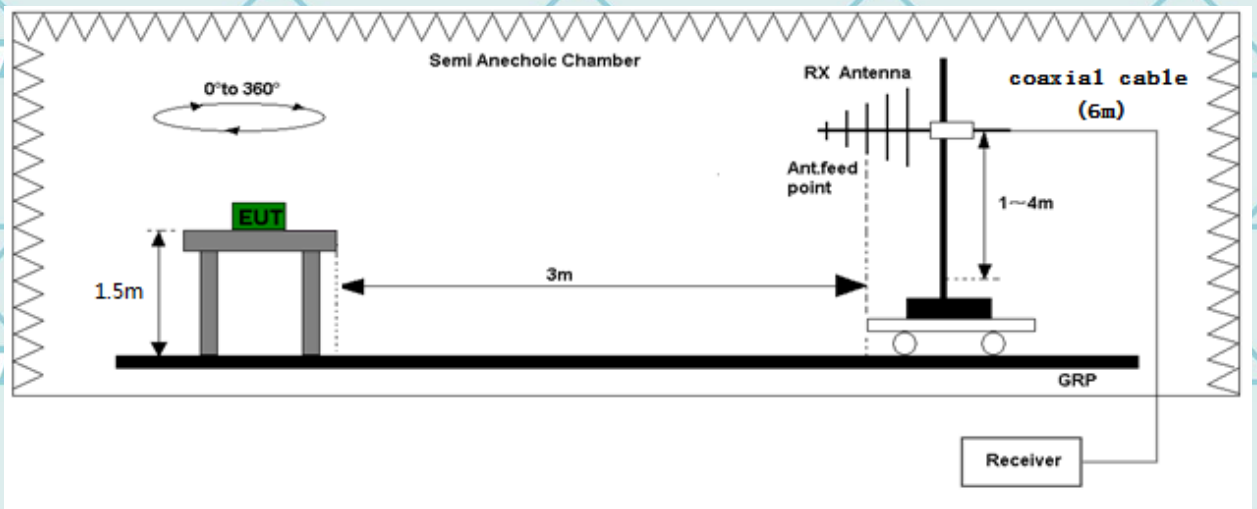
Test Procedure

According to ETSI EN 300 328 V2.2.2 (2019-07) §5.4.10.2.2, Radiated measurement.

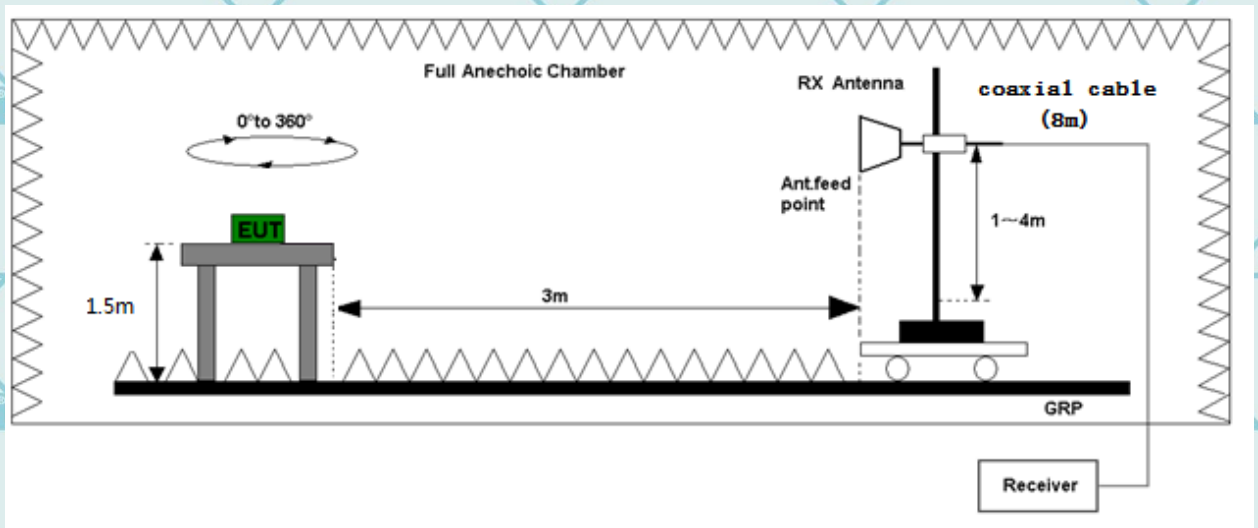
Test Setup

Test Configuration

Below 1GHz



Above 1GHz



Environmental Conditions

Temperature:	25 °C
Relative Humidity:	56 %
ATM Pressure:	100.0 kPa

Test Data

Below 1GHz（The worst case for CH Low of GFSK）

Fre. (MHz)	ANT. Pol.	Result (dBm)	Limit	Margin	Conclusion
531.63	V	-62.99	-54	-8.99	PASS
529.06	H	-59.30	-54	-5.30	PASS

GFSK

Above 1 GHz to 12.75 GHz

Fre. (MHz)	ANT. Pol.	Result (dBm)	Limit	Margin	Conclusion
4804	H	-43.90	-30	-13.90	PASS
4804	V	-42.99	-30	-12.99	PASS
7206	H	-43.98	-30	-13.98	PASS
7206	V	-42.49	-30	-12.49	PASS

Below 1GHz（The worst case for CH High of GFSK）

Fre. (MHz)	ANT. Pol.	Result (dBm)	Limit	Margin	Conclusion
487.85	V	-60.83	-54	-6.83	PASS
487.34	H	-61.49	-54	-7.49	PASS

GFSK

Above 1 GHz to 12.75 GHz

Fre. (MHz)	ANT. Pol.	Result (dBm)	Limit	Margin	Conclusion
4960	H	-44.05	-30	-14.05	PASS
4960	V	-43.17	-30	-13.17	PASS
7440	H	-45.98	-30	-15.98	PASS
7440	V	-45.75	-30	-15.75	PASS

Note: 1. No record for margin above 20dB.

2. Cable loss and antenna gain was combined in the calculated result.

6.6. Receiver spurious emissions

Limit

According to ETSI EN 300 328 V2.2.2 (2019-07) §4.3.2.10.3

The spurious emissions of the receiver shall not exceed the values given in table 5.

Table 5: Spurious emission limits for receivers

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

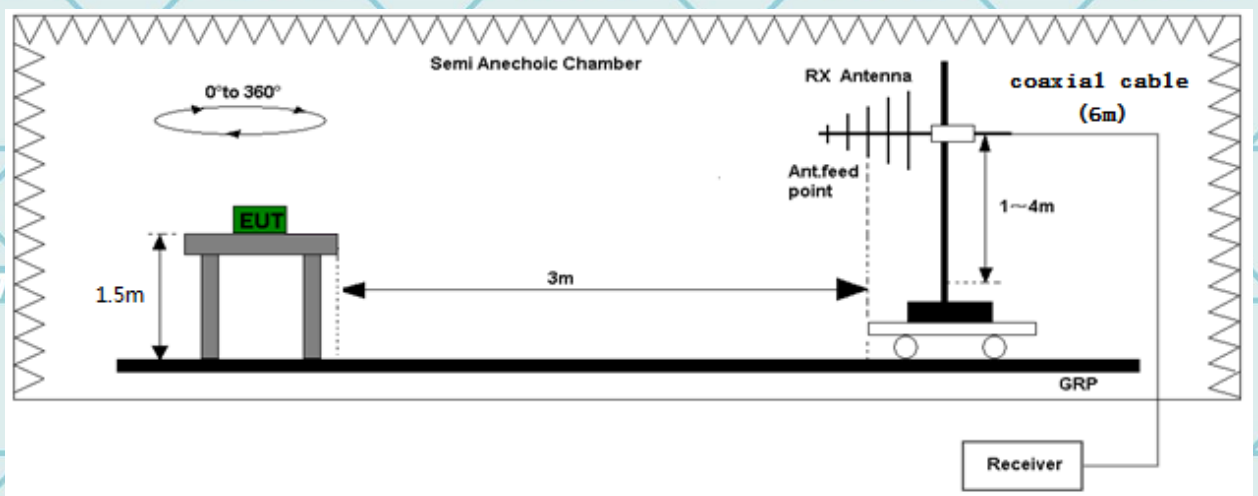
Test Procedure

According to ETSI EN 300 328 V2.2.2 (2019-07) §5.4.11.2.2, Radiated measurement.

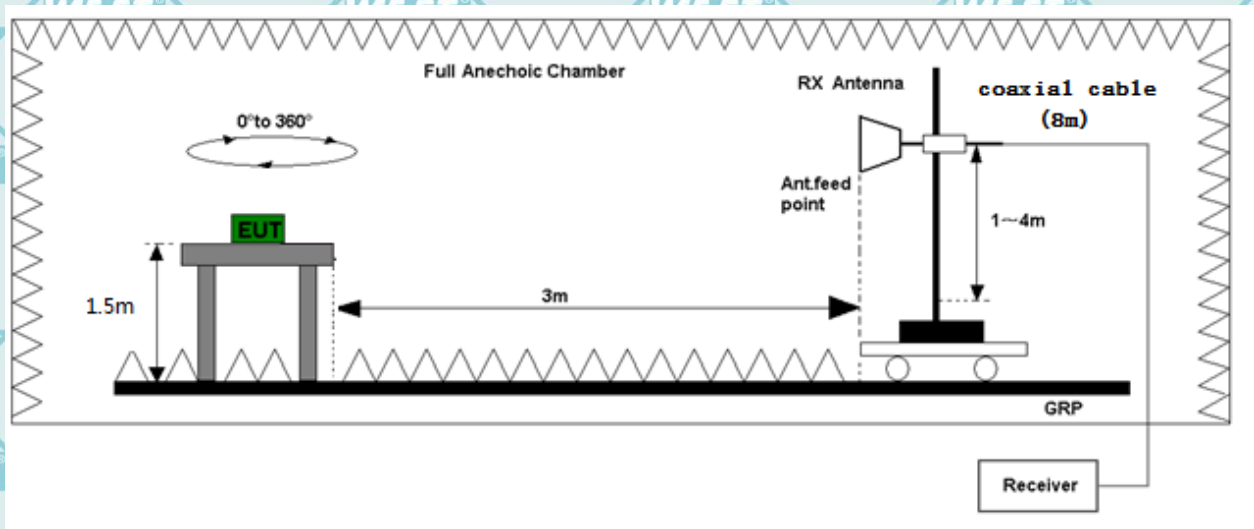
Test Setup

Test Configuration

Below 1GHz



Above 1GHz



Environmental Conditions

Temperature:	25 °C
Relative Humidity:	56 %
ATM Pressure:	100.0 kPa

Test Data

GFSK (The worst case):

Below 1GHz

Fre. (MHz)	ANT. Pol.	Result (dBm)	Limit	Margin	Conclusion
657.31	V	-63.06	-57	-6.06	PASS
653.27	H	-65.74	-57	-8.74	PASS

Above 1 GHz to 12.75 GHz

Fre. (MHz)	ANT. Pol.	ERP (dBm)	Limit	Margin	Conclusion
Test Mode：Lowest frequency					
1552.587	H	-56.93	-47	-9.93	PASS
1552.587	V	-58.13	-47	-11.13	PASS
Test Mode：Highest frequency					
2689.243	H	-57.93	-47	-10.93	PASS
2689.243	V	-56.81	-47	-9.81	PASS

Note: 1. Cable loss and antenna gain was combined in the calculated result.

6.7. Receiver Blocking

Limit

According to ETSI EN 300 328 V2.2.2 (2019-07) §4.3.2.11.4

While maintaining the minimum performance criteria as defined in clause 4.3.2.11.3, the blocking levels at specifiedfrequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided intable 14, table 15 or table 16.

Performance Criteria

For equipment that supports a PER or FER test to be performed, the minimum performance criterion shall be a PER orFER less than or equal to 10 %.

For equipment that does not support a PER or a FER test to be performed, the minimum performance criterion shall beno loss of the wireless transmission function needed for the intended use of the equipment.

Table 14: Receiver Blocking parameters for Receiver Category 1 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 4)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 4)	Type of blocking signal
(-133 dBm + 10 × $\log_{10}$(OCBW)) or -68 dBm whichever is less (see note 2)	2 380 2 504	-34	CW
(-139 dBm + 10 × $\log_{10}$(OCBW)) or -74 dBm whichever is less (see note 3)	2 300 2 330 2 360 2 524 2 584 2 674		

NOTE 1: OCBW is in Hz.

NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 26 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.

NOTE 3: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 20 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.

NOTE 4: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.

Table 15: Receiver Blocking parameters receiver Category 2 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × $\log_{10}$(OCBW) + 10 dB) or (-74 dBm + 10 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW

NOTE 1: OCBW is in Hz.
NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 26 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.
NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.

Table 16: Receiver Blocking parameters receiver Category 3 equipment

Wanted signal mean power from companion device (dBm) (see notes 1 and 3)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 3)	Type of blocking signal
(-139 dBm + 10 × $\log_{10}$(OCBW) + 20 dB) or (-74 dBm + 20 dB) whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW

NOTE 1: OCBW is in Hz.
NOTE 2: In case of radiated measurements using a companion device and the level of the wanted signal from the companion device cannot be determined, a relative test may be performed using a wanted signal up to P_{min} + 30 dB where P_{min} is the minimum level of wanted signal required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal.
NOTE 3: The level specified is the level at the UUT receiver input assuming a 0 dBi antenna assembly gain. In case of conducted measurements, this level has to be corrected for the (in-band) antenna assembly gain (G). In case of radiated measurements, this level is equivalent to a power flux density (PFD) in front of the UUT antenna with the UUT being configured/positioned as recorded in clause 5.4.3.2.2.

Test Procedure

According to ETSI EN 300 328 V2.2.2 (2019-07) §5.4.11.2.1, Conducted measurements

Step 1:

•For non-FHSS equipment, the UUT shall be set to the lowest operating channel on which the blocking test hasto be performed.

Step 2:

•The blocking signal generator is set to the first frequency as defined in the appropriate table corresponding tothe receiver category and type of equipment.

Step 3:

•With the blocking signal generator switched off, a communication link is established between the UUT and theassociated companion device using the test setup shown in figure 6.

• Unless the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, the level ofthe wanted signal shall be set to the value provided in the table corresponding to the receiver category and typeof equipment. The test procedure defined in clause 5.4.2, and more in particular clause 5.4.2.2.1.2, can be usedto measure the (conducted) level of the wanted signal however no correction shall be made for antenna gain ofthe companion device (step 6 in clause 5.4.2.2.1.2 shall be ignored). This level may be measured directly at theoutput of the companion device and a correction is made for the coupling loss into the UUT. The actual levelfor the wanted signal shall be recorded in the test report.

• When the option provided in note 2 of the applicable table referred to in clause 5.4.11.2.1 is used, 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 thewanted signal at the input of the UUT is Pmin. This signal level (Pmin) is increased by the value provided innote 2 of the applicable table corresponding to the receiver category and type of equipment.

Step 4:

• The blocking signal at the UUT is set to the level provided in the table corresponding to the receiver categoryand type of equipment.

• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 are met then proceed to step 6.

Step 5:

• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been increased with a value equal to the Occupied Channel Bandwidth except:

- For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by 3 dB.
- For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by 3 dB.

• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still not met, step 3 and step 4 shall be repeated after that the frequency of the blocking signal set in step 2 has been decreased with a value equal to the Occupied Channel Bandwidth except:

- For the blocking frequency 2 380 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be decreased by3 dB.
- For the blocking frequency 2 503,5 MHz, where this frequency offset shall be less than or equal to 10 MHz. If this frequency offset is more than 7 MHz, the level of the wanted signal shall be increased by3 dB.

• If the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is still not met, the UUT fails to comply with the Receiver Blocking requirement and step 6 and step 7 are no longer required.

Step 6:

•Repeat step 4 and step 5 for each remaining combination of frequency and level for the blocking signal as provided in the table corresponding to the receiver category and type of equipment.

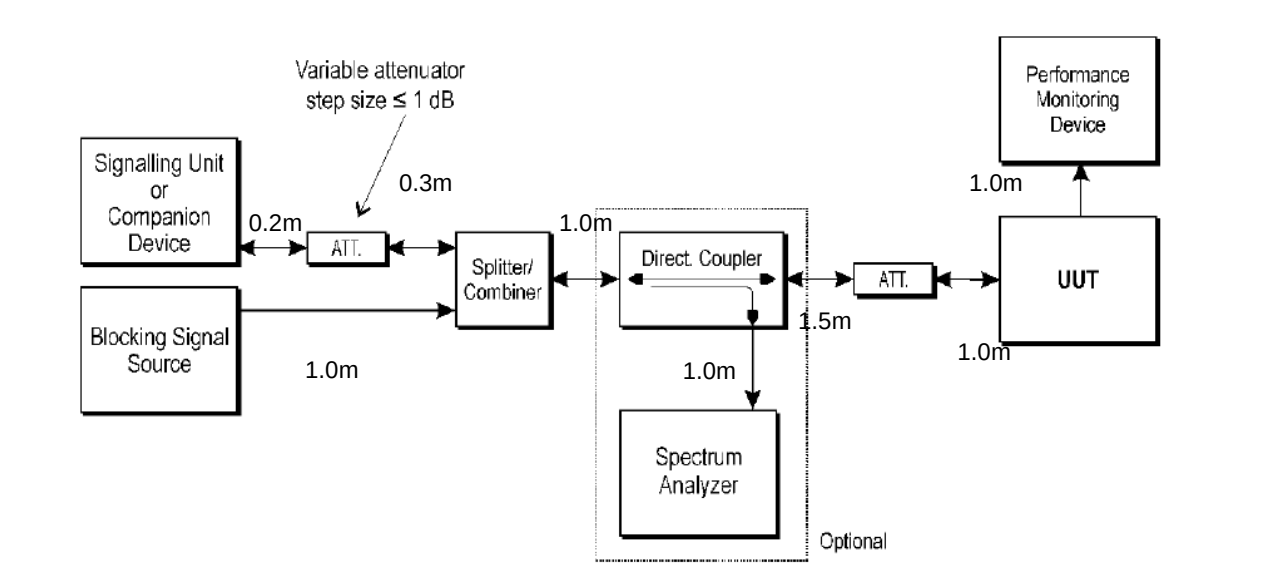
Step 7:

• For non-FHSS equipment, repeat step 2 to step 6 with the UUT operating at the highest operating channel onwhich the blocking test has to be performed (see clause 5.4.11.1).

Step 8:

• It shall be assessed and recorded in the test report whether the UUT complies with the Receiver Blocking requirement

Test Setup



Note: all cable is coaxial cable in this test

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	56 %
ATM Pressure:	100.0 kPa

Test result:

Left:

Wanted signal mean power form companion device(dBm)	Blocking signal frequency(MHz)	Blocking signal power(dBm)	PER (%)	Limit	Result
(-139 dBm + 10 × log10(OCBW)+ 10 dB)or (-74 dBm + 10 dB) whichever is less+(gain) （-71.27 ）	2380	-34	0.00	⩽10%	Pass
	2504	-34	0.00		Pass
	2300	-34	0.00		Pass
	2584	-34	0.00		Pass

Channel 39@Result

Wanted signal mean power form companion device(dBm)	Blocking signal frequency(MHz)	Blocking signal power(dBm)	PER (%)	Limit	Result
(-139 dBm + 10 × log10(OCBW) + 10 dB)or (-74 dBm + 10 dB) whichever is less+(gain) （-71.25 ）	2380	-34	0.00	⩽10%	Pass
	2504	-34	0.00		Pass
	2300	-34	0.00		Pass
	2584	-34	0.00		Pass

Right:

Wanted signal mean power form companion device(dBm)	Blocking signal frequency(MHz)	Blocking signal power(dBm)	PER (%)	Limit	Result
(-139 dBm + 10 × log10(OCBW)+ 10 dB)or (-74 dBm + 10 dB) whichever is less+(gain) （-70.57 ）	2380	-34	0.00	⩽10%	Pass
	2504	-34	0.00		Pass
	2300	-34	0.00		Pass
	2584	-34	0.00		Pass

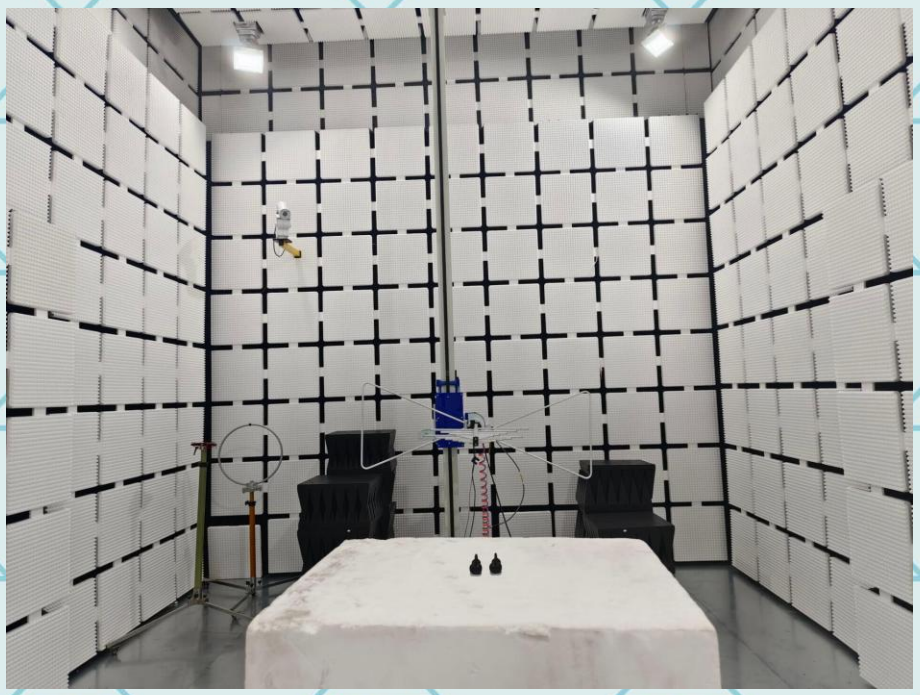
Channel 39@Result

Wanted signal mean power form companion device(dBm)	Blocking signal frequency(MHz)	Blocking signal power(dBm)	PER (%)	Limit	Result
(-139 dBm + 10 × log10(OCBW) + 10 dB)or (-74 dBm + 10 dB) whichever is less+(gain) （-70.53 ）	2380	-34	0.00	⩽10%	Pass
	2504	-34	0.00		Pass
	2300	-34	0.00		Pass
	2584	-34	0.00		Pass

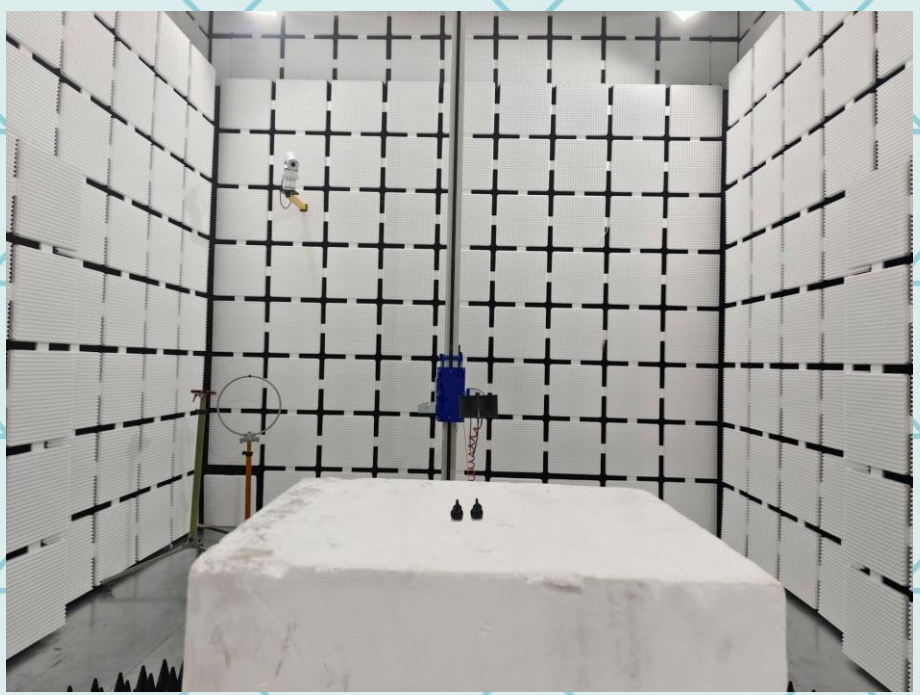
Note：1. According to section 6.1 test result, the equipment shall be considered as receiver category 2 equipment.

7. TEST SETUP PHOTOGRAPHS

RADIATED EMISSION TEST



RADIATED EMISSION TEST



——END OF REPORT——