

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

TEST REPORT

For

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Tested Model : NOTE 9

Report Type: Original Report	Product Type: Smartphone
Report Number: SZ1210419-12396E-22B	
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Smartphone
Tested Model	NOTE 9
Trade mark	CUBOT
Frequency Range	BLE: 2402~2480MHz
Transmit Power	BLE: 8.46dBm
Modulation Technique	BLE: GFSK
Antenna Specification*	Internal Antenna: 1.23dBi(It is provided by the manufacturer)
Voltage Range	DC 3.85V from battery or DC 5V from adapter.
Date of Test	2021-04-27
Sample serial number	SZ1210419-12396E -RF-S1
Received date	2021-04-05
Sample/EUT Status	Good condition
Normal/Extreme Condition*	N.V.: Nominal Voltage: 3.85V _{DC} L.T.: Low Temperature 0°C; N.T.: Normal Temperature +25°C; H.T.: High Temperature +45°C (They are provided by the manufacturer)
Adapter 1 information	Model: HJ-0501500-UK Input: AC 100-240V, 50/60Hz, 0.3A Output: DC 5V, 1.5A
Adapter 2 information	Model: HJ-0501500W2-EU Input: AC 100-240V, 50/60Hz, 0.3A Output: DC 5V, 1.5A

Objective

This report is in accordance with ETSI EN 300 328 V2.2.2 (2019-07), Wideband transmission systems; Data transmission equipment operating in the 2,4 GHz band; Harmonised Standard for access to radio spectrum.

The objective is to determine the compliance of EUT with ETSI EN 300 328 V2.2.2 (2019-07).

Related Submittal(s)/Grant(s)

No related submittal(s).

Test Methodology

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

Measurement Uncertainty

Parameter		Uncertainty
Spurious Emissions, Radiated	9k-30MHz	$\pm 2.66\text{dB}$
	30MHz-1000MHz	$\pm 4.28\text{dB}$
	1GHz-18GHz	$\pm 4.98\text{dB}$
	18GHz-26.5GHz	$\pm 5.06\text{dB}$

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

EUT Exercise Software

No software was used to test and the power level is 2.

Special Accessories

No special accessory.

Equipment Modifications

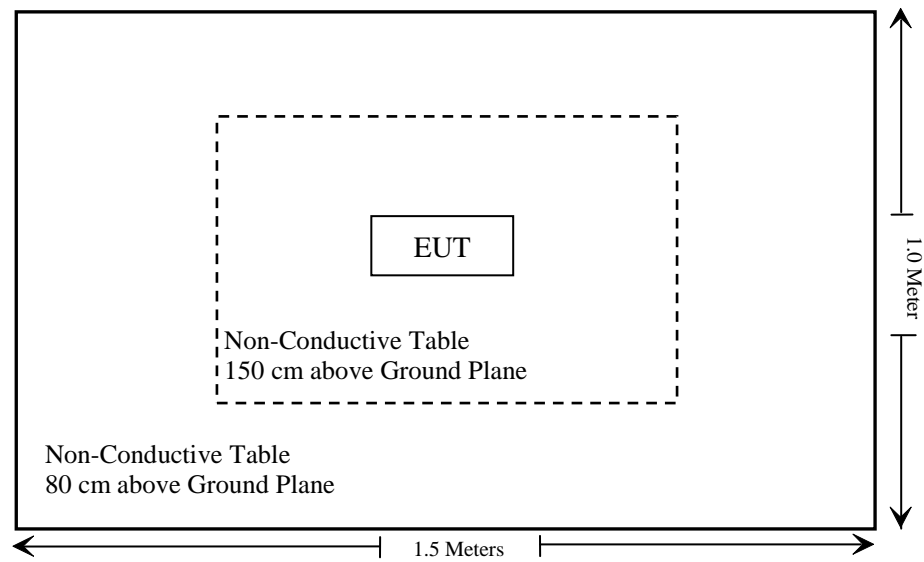
No modification was made to the EUT.

Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

Cable Description	Length (m)	From Port	To
/	/	/	/

Block Diagram of Test Setup

SUMMARY OF TEST RESULTS

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	Not Applicable
§ 4.3.2.5	Medium Utilization (MU) factor	Not Applicable
§ 4.3.2.6	Adaptivity	Not Applicable*
§ 4.3.2.7	Occupied Channel Bandwidth	Compliance
§ 4.3.2.8	Transmitter unwanted emissions in the out-of-band 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	Geo-location capability	Not Applicable**

Note:

The supplier declared that the equipment is adaptive equipment

Not Applicable – This item only for non-adaptive equipment

Not Applicable* –The test item does not apply for equipment within a maximum RF output power level of less than 10 dBm (e.i.r.p).

Not Applicable** –The supplier declared that the equipment has no this function.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
Rohde & Schwarz	Test Receiver	ESR	101817	2020/12/24	2021/12/23
SONOMA INSTRUMENT	Amplifier	310 N	186131	2020/07/08	2021/07/07
A.H. Systems, inc.	Preamplifier	PAM-0118P	531	2020/12/25	2021/12/24
Schwarzbeck	Bilog Antenna	VULB9163	9163-194	2020/01/05	2023/01/04
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2020/01/05	2023/01/04
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-655	2020/01/05	2023/01/04
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2020/12/24	2021/12/23
Rohde & Schwarz	Signal Generator	SMB100A	108362	2020/12/24	2021/12/23
Wainwright Instruments	Highpass Filter	WHKX3.6/18 G-10SS	5	2020/12/25	2021/12/24
Wainwright Instruments	Band Reject Filter	WRCG2400/2485-2375/25 10-60/11SS	10	2020/12/25	2021/12/24
Radiated Emission Test Software: EZ EMC V1.1.4.2					
RF Conducted test					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2020/12/24	2021/12/23
Rohde & Schwarz	Vector Signal Generator	SMBV100A	260434	2020/12/24	2021/12/23
Rohde & Schwarz	Signal Generator	SMB100A	108362	2020/12/24	2021/12/23
Rohde & Schwarz	Open Switch and Control Unit	OSP120 + OSP-B157	101244 + 100866	2020/12/24	2021/12/23
Rohde & Schwarz	Wideband Radio Communication Tester	CMW500	154606	2020/12/25	2021/12/24
AGILENT	Vector Signal Generator	N5182A	MY50143401	2020/12/25	2021/12/24
Gongwen	Temp. & Humid. Chamber	JB913R	GZ-WS004	2020/12/25	2021/12/24

* **Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd. attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

ETSI EN 300 328 V2.2.2 (2019-07) §4.3.2.2 – RF OUTPUT POWER

Applicable Standard

This requirement applies to all types of equipment using wide band modulations other than FHSS.

The RF output power is defined as the mean equivalent isotropic radiated power (e.i.r.p.) of the equipment during a transmission burst.

Limit

The RF output power for non-FHSS equipment shall be equal to or less than 20 dBm.

NOTE: For Non-adaptive FHSS equipment, the manufacturer may have declared a reduced RF Output Power (see clause 5.4.1 m)) and associated Duty Cycle (see clause 5.4.1 e)) that will ensure that the equipment meets the requirement for the Medium Utilization (MU) factor further described in clause 4.3.2.5. This is verified by the conformance test referred to in clause 4.3.2.5.4.

For non-adaptive non-FHSS equipment, where the manufacturer has declared an RF output power of less than 20 dBm e.i.r.p., the RF output power shall be equal to or less than that declared value.

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

Test Procedure

The test procedure shall be as follows:

Step 1:

- Use a fast power sensor with a minimum sensitivity of -40 dBm and capable of minimum 1 MS/s.
 - Use the following settings:
 - Sample speed 1 MS/s or faster.
 - The samples shall represent the RMS power of the signal.
 - Measurement duration: For non-adaptive equipment: equal to the observation period defined in clause 4.3.1.3.2 or clause 4.3.2.4.2. For adaptive equipment, the measurement duration shall be long enough to ensure a minimum number of bursts (at least 10) is captured.
- For adaptive equipment, to increase the measurement accuracy, a higher number of bursts may be used.

Step 2:

- For conducted measurements on devices with one transmit chain:
 - Connect the power sensor to the transmit port, sample the transmit signal and store the raw data. Use these stored samples in all following steps.
- For conducted measurements on devices with multiple transmit chains:
 - Connect one power sensor to each transmit port for a synchronous measurement on all transmit ports.
 - Trigger the power sensors so that they start sampling at the same time. Make sure the time difference between the samples of all sensors is less than 500 ns.
 - For each individual sampling point (time domain), sum the coincident power samples of all ports and store them. Use these summed samples as the new stored data set.

Step 3:

- Find the start and stop times of each burst in the stored measurement samples.

The start and stop times are defined as the points where the power is at least 30 dB below the highest value of the stored samples in step 2.

In case of insufficient sensitivity of the power sensor (e.g. in case of radiated measurements), the value of 30 dB may need to be reduced appropriately.

Step 4:

- Between the start and stop times of each individual burst calculate the RMS power over the burst using the formula below. The start and stop points shall be included. Save these P_{burst} values, as well as the start and stop times for each burst.

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

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

Step 5:

- The highest of all P_{burst} values (value A in dBm) will be used for maximum e.i.r.p. calculations.

Step 6:

- Add the (stated) antenna assembly gain G in dBi of the individual antenna.
- In case of smart antenna systems operating in mode with beamforming (see clause 5.3.2.2.4), add the additional beamforming gain Y in dB.
- If more than one antenna assembly is intended for this power setting, the maximum overall antenna gain (G or G + Y) shall be used.
- The RF Output Power (P_{out}) shall be calculated using the formula below:

$$P_{out} = A + G + Y$$
- This value, which shall comply with the limit given in clause 4.3.1.2.3 or clause 4.3.2.2.3, shall be recorded in the test report.

Test Data**Environmental Conditions**

Temperature:	21 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Fan Yang on 2021-04-27.

EUT operation mode: Transmitting

Test Result: Compliant, please refer to following table.

Test Condition	Antenna	Channel	EIRP[dBm]	Limit[dBm]	Verdict
NTNV	Ant1	2402	6.71	20	PASS
		2440	8.43	20	PASS
		2480	6.55	20	PASS
LTNV	Ant1	2402	6.72	20	PASS
		2440	8.46	20	PASS
		2480	6.53	20	PASS
HTNV	Ant1	2402	6.70	20	PASS
		2440	8.44	20	PASS
		2480	6.54	20	PASS

Note:

1. The number of power test burst is 40.
2. The maximum antenna gain is 1.23dBi, which is provided by the customer. The effect of antenna gain has been taken into account when we test EIRP. All the information (For example: antenna gain) which is provided by customer may affect the validity of the results, The customer will be responsible for it.

ETSI EN 300 328 V2.2.2 (2019-07) §4.3.2.3 - POWER SPECTRAL DENSITY

Applicable Standard

The Power Spectral Density is the mean equivalent isotropically radiated power (e.i.r.p.) spectral density in a 1 MHz bandwidth during a transmission burst.

The maximum Power Spectral Density for non-FHSS equipment is 10 dBm per MHz.

Test Procedure

Option 1: For equipment with continuous and non-continuous transmissions

The transmitter shall be connected to a spectrum analyser and the Power Spectral Density as defined in clause 4.3.2.3 shall be measured and recorded.

The test procedure shall be as follows:

Step 1:

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

- Start Frequency: 2 400 MHz
- Stop Frequency: 2 483,5 MHz
- Resolution BW: 10 kHz
- Video BW: 30 kHz
- Sweep Points: > 8 350; for spectrum analysers not supporting this number of sweep points, the frequency band may be segmented
- Detector: RMS
- Trace Mode: Max Hold
- Sweep time: For non-continuous transmissions: $2 \times \text{Channel Occupancy Time} \times \text{number of sweep points}$

For non-adaptive equipment use the maximum TX-sequence time in the formula above instead of the Channel Occupancy Time

For continuous transmissions: 10 s; the sweep time may be increased further until a value where the sweep time has no further impact anymore on the RMS value of the signal

For non-continuous signals, wait for the trace to stabilize.

Save the data (trace data) set to a file.

Step 2:

For conducted measurements on smart antenna systems using either operating mode 2 or operating mode 3 (see clause 5.3.2.2), repeat the measurement for each of the transmit ports. For each sampling point (frequency domain), add up the coincident power values (in mW) for the different transmit chains and use this as the new data set.

Step 3:

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

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

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 5.4.2 and save the corrected data. The following formulas can be used:

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

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

with 'n' being the actual sample number

Step 5:

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

Step 6:

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

Step 7:

Repeat step 6 until the end of the data set and record the Power Spectral Density values for each of the 1 MHz segments.

From all the recorded results, the highest value is the maximum Power Spectral Density 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.

Option 2: For equipment with continuous transmission capability.

This option is for equipment that can be configured to operate in a continuous transmit mode (100 % DC) .

Step 1:

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

Centre Frequency: The centre frequency of the channel under test

RBW: 1 MHz

VBW: 3 MHz

Frequency Span: $2 \times$ Nominal Bandwidth (e.g. 40 MHz for a 20 MHz channel)

Detector Mode: Peak

Trace Mode: Max Hold

Step 2:

When the trace is complete, find the peak value of the power envelope and record the frequency.

Step 3:

Make the following changes to the settings of the spectrum analyser:

Centre Frequency: Equal to the frequency recorded in step 2

Frequency Span: 3 MHz

RBW: 1 MHz

VBW: 3 MHz

Sweep Time: 1 minute

Detector Mode: RMS

Trace Mode: Max Hold

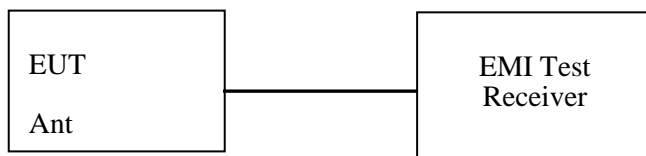
Step 4:

- Wait until the trace has stabilized, the trace shall be captured using the "Hold" or "View" option on the spectrum analyser.
- Find the peak value of the trace and place the analyser marker on this peak. This level is recorded as the highest mean power (power spectral density) D in a 1 MHz band.
- Alternatively, where a spectrum analyser is equipped with a function to measure power spectral density, this function may be used to display the power spectral density D in dBm / MHz.
- In case of conducted measurements on smart antenna systems operating in a mode with multiple transmit chains active simultaneously, the power spectral density of each transmit chain shall be measured separately to calculate the total power spectral density (value D in dBm / MHz) for the UUT.

Step 5:

• The maximum Power Spectral Density (PSD) e.i.r.p. is calculated from the above measured power spectral density D, the applicable antenna assembly gain G in dBi and if applicable the beamforming gain Y in dB, according to the formula below. This value shall be recorded in the test report. If more than one antenna assembly is intended for this power setting, the gain of the antenna assembly with the highest gain shall be used.

$$\text{PSD} = D + G + Y \text{ (dBm / MHz)}$$

Test Setup Block diagram**Test Data****Environmental Conditions**

Temperature:	21 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

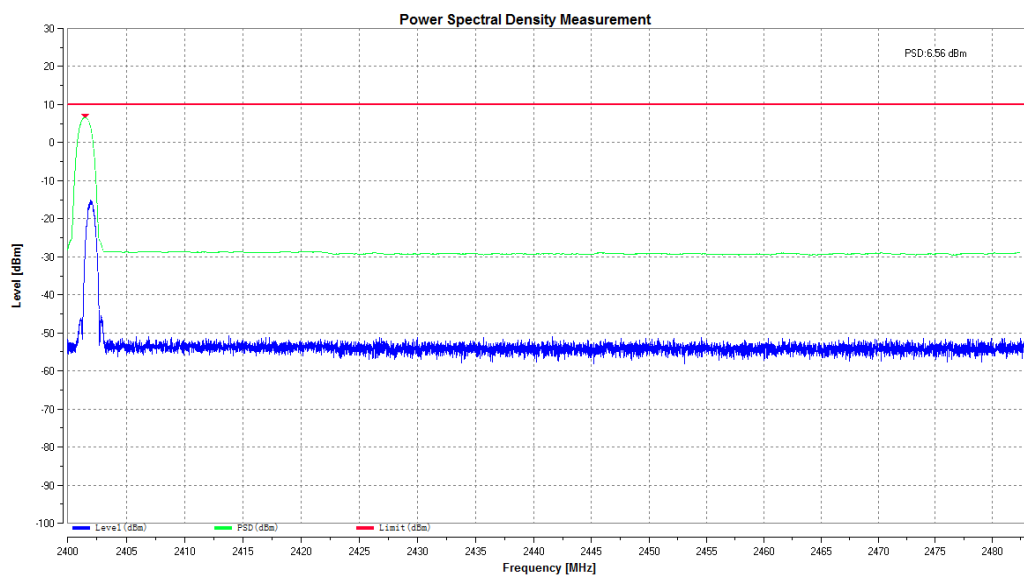
The testing was performed by Fan Yang on 2021-04-27.

EUT operation mode: Transmitting

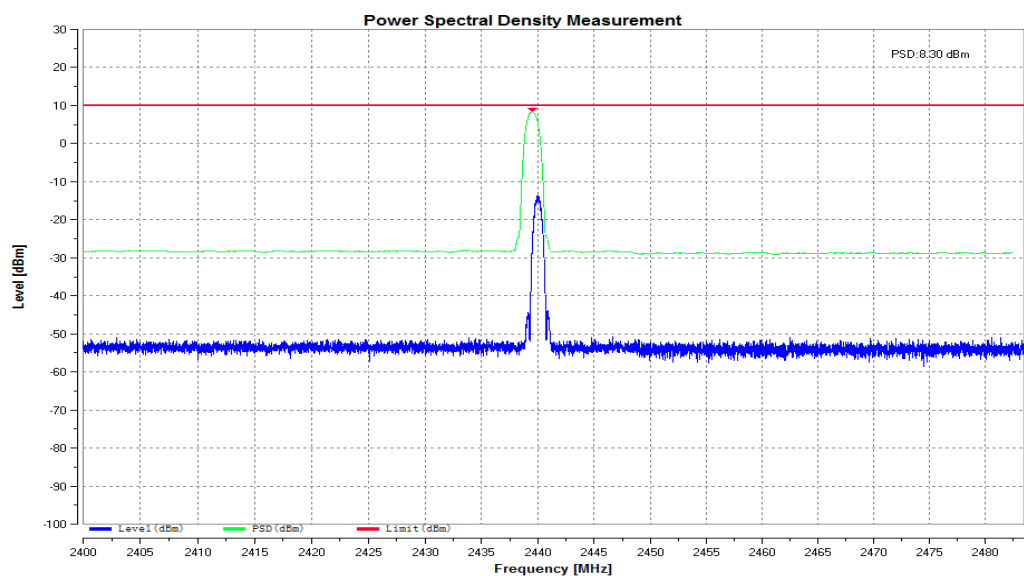
Antenna	Channel	PSD[dBm/MHz]	Limit[dBm/MHz]	Verdict
Ant1	2402	6.56	10	PASS
	2440	8.30	10	PASS
	2480	6.38	10	PASS

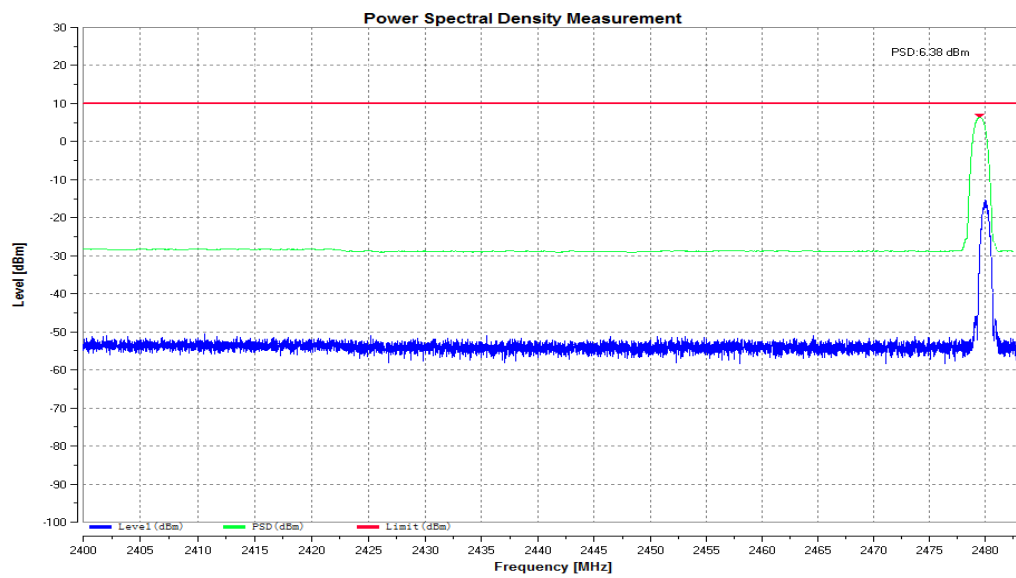
Test Result: Compliant, please refer to following plots.

Low Channel: 2402 MHz



Middle Channel: 2440 MHz



High Channel: 2480 MHz

Note: The antenna gain was added into the final result.

ETSI EN 300 328 V2.2.2 (2019-07) §4.3.2.7 – OCCUPIED CHANNEL BANDWIDTH

Applicable Standard

The Occupied Channel Bandwidth is the bandwidth that contains 99 % of the power of the signal.

Limit:

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

In addition, for non-adaptive non-FHSS equipment with e.i.r.p. greater than 10 dBm, the Occupied Channel Bandwidth shall be equal to or less than 20 MHz.

Test Procedure

For Conducted measurement, the measurement procedure shall be as follows:

Step 1:

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

- Centre Frequency: The centre frequency of the channel under test
- Resolution BW: $\sim 1\%$ of the span without going below 1%
- Video BW: $3 \times \text{RBW}$
- Frequency Span: $2 \times \text{Nominal Channel Bandwidth}$
- Detector Mode: RMS
- Trace Mode: Max Hold
- Sweep time: 1 s

Step 2:

Wait for the trace to stabilize.

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

Step 3:

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

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.

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

The test procedure is as described under clause 5.4.7.2.1.

Test Data**Environmental Conditions**

Temperature:	21 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

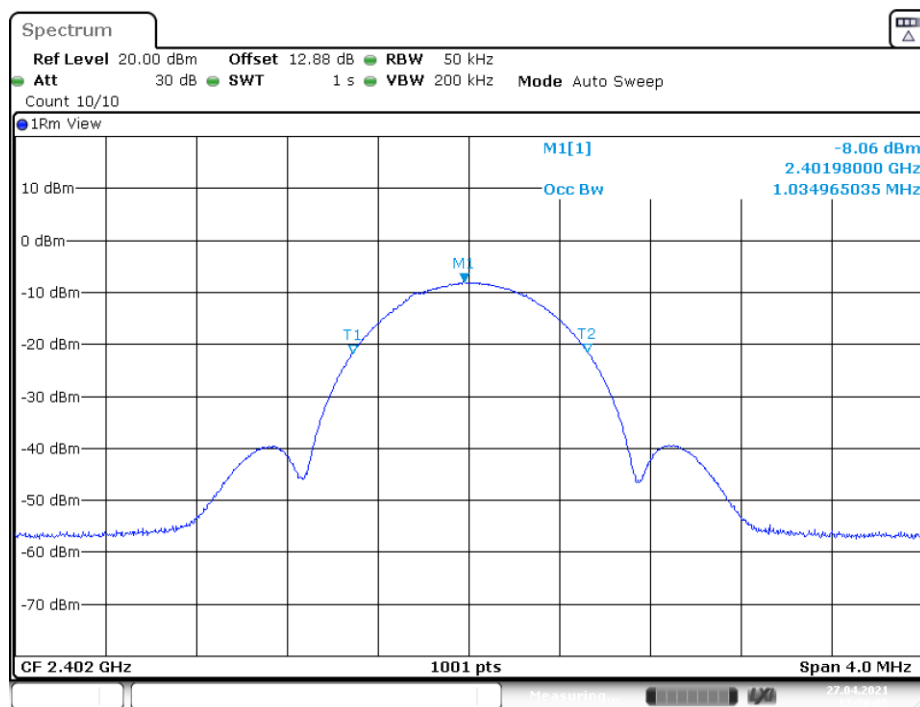
The testing was performed by Fan Yang on 2021-04-27.

EUT operation mode: Transmitting

Test Result: Compliant, please refer to following table and plots.

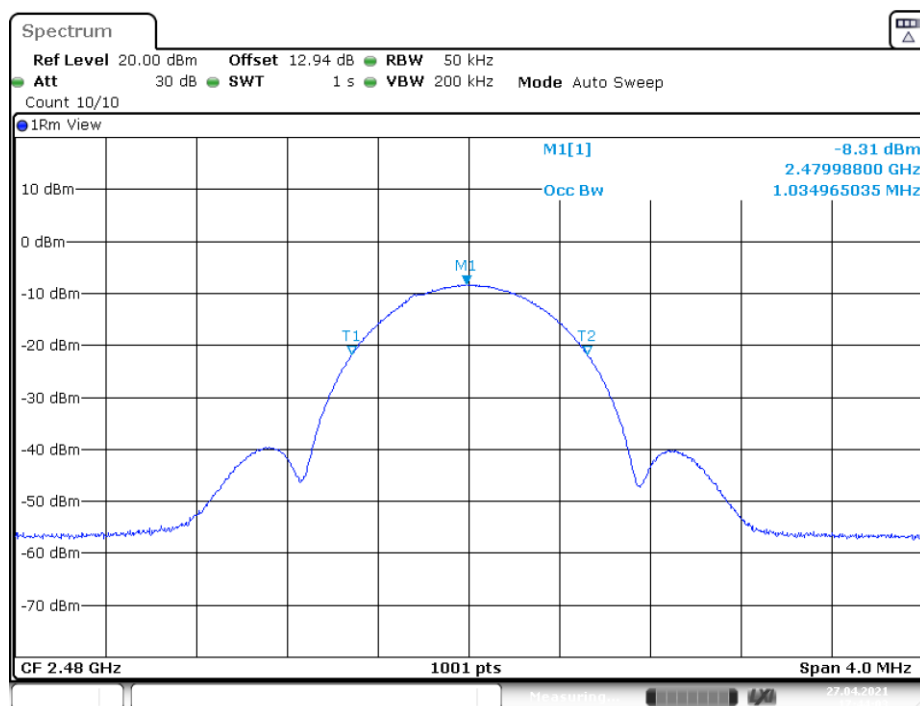
Mode	Frequency (MHz)	Occupied Bandwidth (MHz)
BLE	2402	1.035
	2480	1.035

Low Channel



Date: 27.APR.2021 17:30:05

High Channel



Date: 27.APR.2021 17:44:03

ETSI EN 300 328 V2.2.2 (2019-07) §4.3.2.8 – TRANSMITTER UNWANTED EMISSION IN THE OUT-OF-BAND DOMAIN

Applicable Standard

In the present document, transmitter unwanted emissions in the out-of-band domain are emissions when the equipment is in Transmit mode, on frequencies immediately outside the allocated band, but excluding unwanted emissions in the spurious domain

Limit:

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

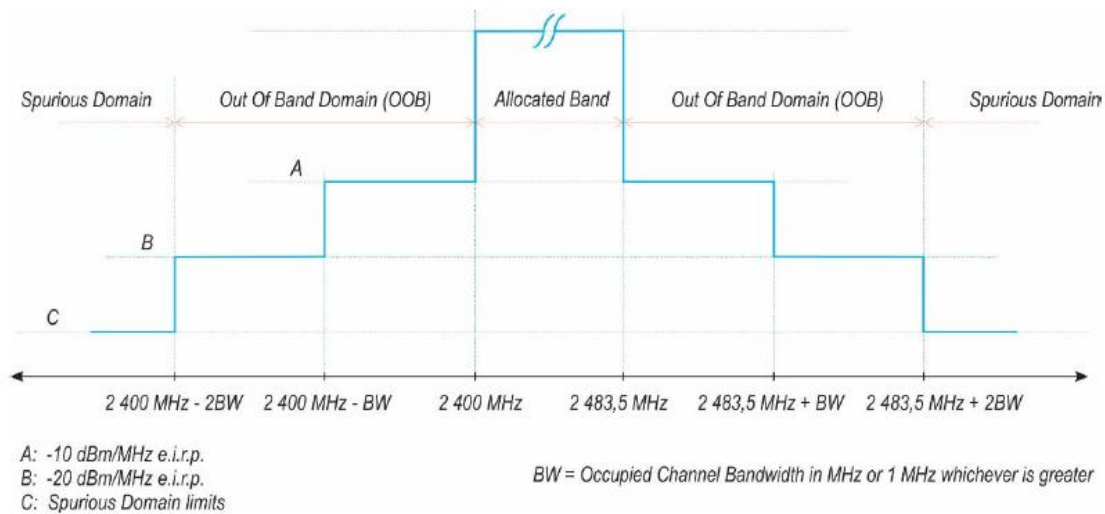


Figure 3: Transmit mask

Test Procedure

The conformance tests for this requirement are defined in clause 5.4.8.

Test Data**Environmental Conditions**

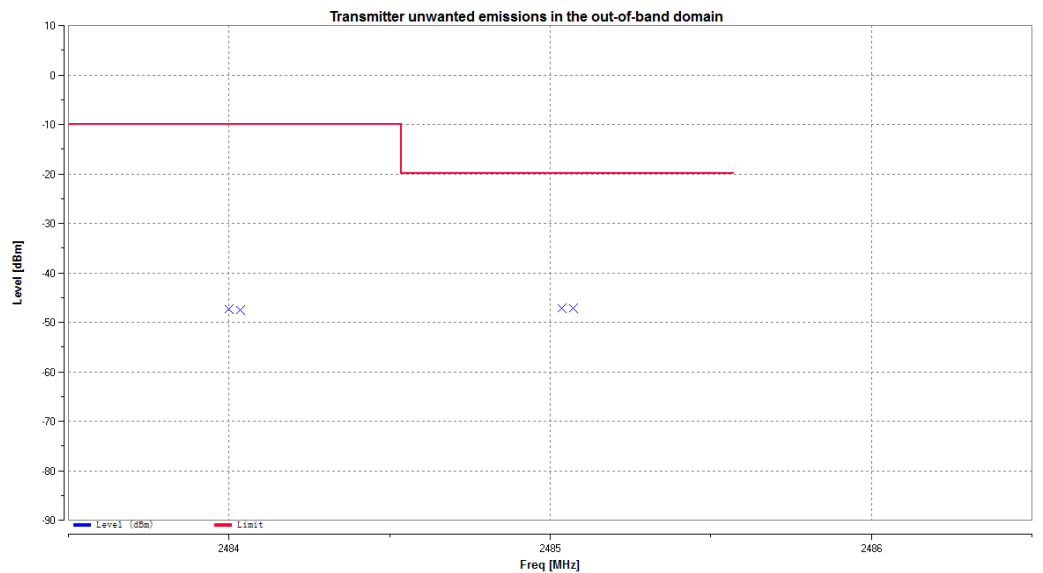
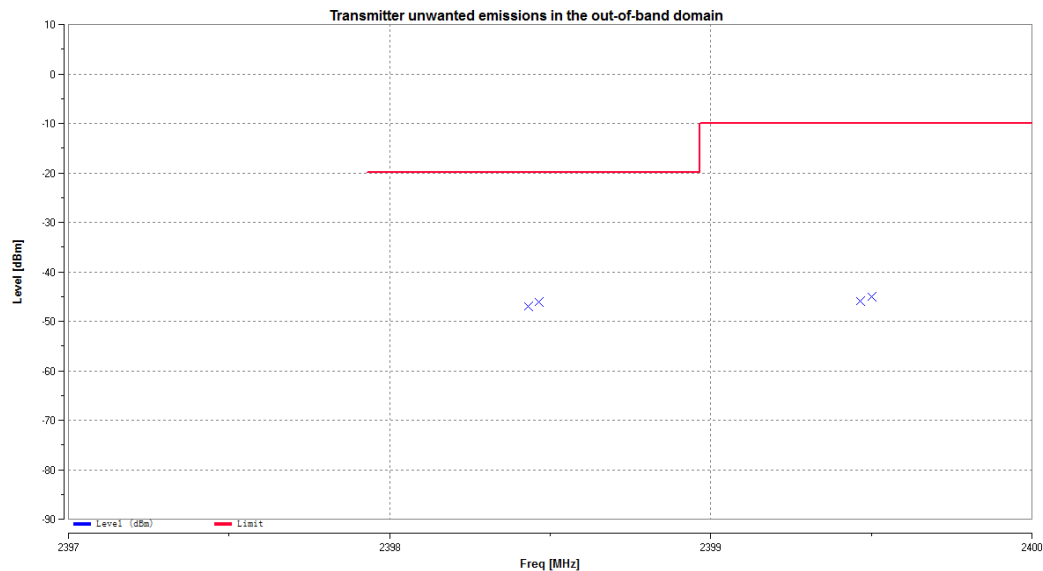
Temperature:	21 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Fan Yang on 2021-04-27.

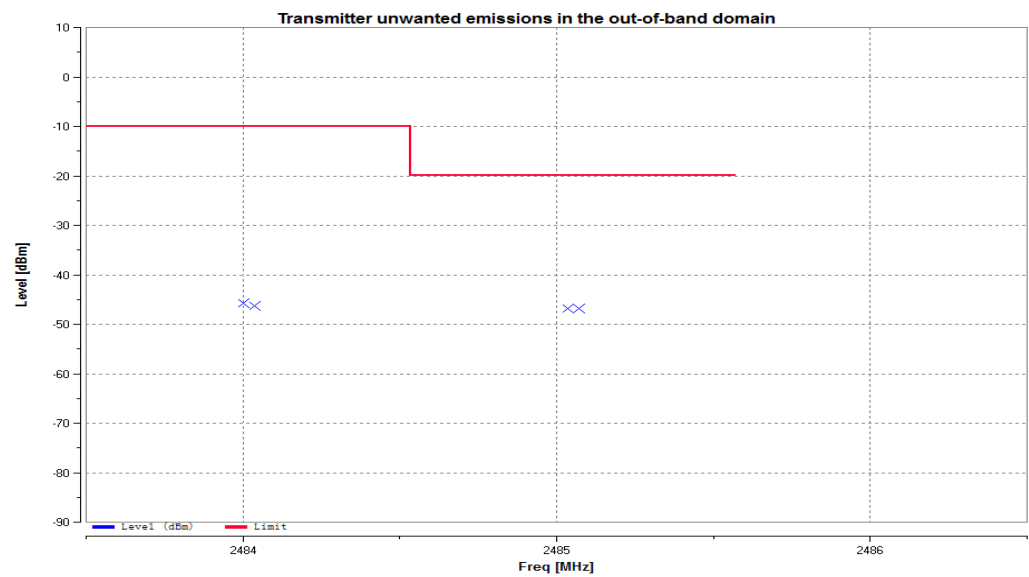
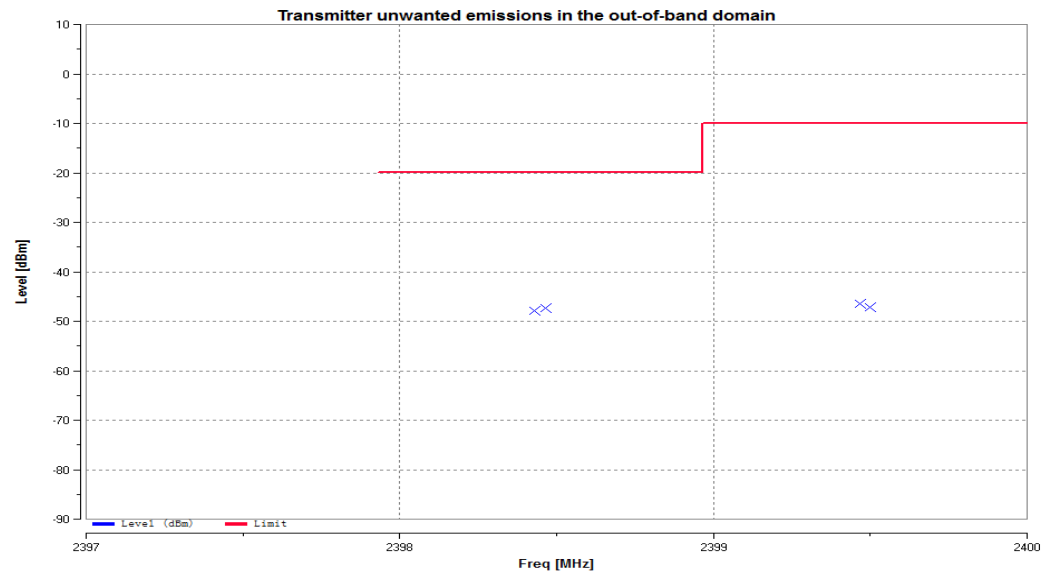
EUT operation mode: Transmitting

TestMode	Channel	Freq. [MHz]	Level[dBm]	Limit[dBm]	Verdict
BLE	2402	2398.43	-46.97	-20.00	PASS
		2398.465	-46.05	-20.00	PASS
		2399.465	-45.91	-10.00	PASS
		2399.5	-45.10	-10.00	PASS
		2484	-47.41	-10.00	PASS
		2484.035	-47.61	-10.00	PASS
		2485.035	-47.19	-20.00	PASS
		2485.07	-47.15	-20.00	PASS
	2480	2398.43	-47.81	-20.00	PASS
		2398.465	-47.41	-20.00	PASS
		2399.465	-46.39	-10.00	PASS
		2399.5	-47.09	-10.00	PASS
		2484	-45.79	-10.00	PASS
		2484.035	-46.34	-10.00	PASS
		2485.035	-46.90	-20.00	PASS
		2485.07	-46.74	-20.00	PASS

Low channel:



High channel:



ETSI EN 300 328 V2.2.2 (2019-07) §4.3.2.9 – TRANSMITTER UNWANTED EMISSION IN THE SPURIOUS DOMAIN

Applicable Standard

In the present document, transmitter unwanted emissions in the spurious domain are emissions outside the allocated band and outside the Out-of-band Domain as indicated in figure 3 when the equipment is in Transmit mode.

The transmitter unwanted emissions in the spurious domain shall not exceed the values given in table 12.

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

Transmitter limits for spurious emissions

Frequency Range	Maximum power e.r.p (≤ 1 GHz) e.i.r.p (> 1 GHz)	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 694 MHz	-54 dBm	100 kHz
694 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 GHz	-30 dBm	1MHz

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

Test Procedure

Conducted measurement

In case of conducted measurements, the radio equipment shall be connected to the measuring equipment via a suitable attenuator.

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

The measurement procedure refer to ETSI EN 300 328 V2.2.2 (2019-07) §5.4.9.2.1

Radiated measurement:

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

The test procedure is further as described under clause 5.4.9.2.1.

Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Fan Yang on 2021-04-27.

EUT operation mode: Transmitting.

30MHz-12.75GHz

Frequency (MHz)	Receiver Reading (dBm)	Turntable Degree	Rx Antenna		Substituted Factor (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (m)	Polar (H/V)				
BLE 2402MHz TX, Low Channel								
175.04	-66.91	139	1.70	H	-5.27	-72.18	-54	18.18
181.28	-72.83	87	1.50	V	-6.69	-79.52	-54	25.52
4804.00	-48.23	193	1.80	H	8.30	-39.93	-30	9.93
4804.00	-47.89	298	1.60	V	9.19	-38.70	-30	8.70
BLE 2480MHz TX, High Channel								
174.42	-65.82	114	1.00	H	-5.22	-71.04	-54	17.04
172.60	-70.34	203	1.80	V	-6.38	-76.72	-36	40.72
4960.00	-48.79	85	1.70	H	8.32	-40.47	-30	10.47
4960.00	-47.45	293	1.30	V	9.43	-38.02	-30	8.02

Note:

Absolute Level = Reading Level + Substituted Factor

Substituted Factor contains: SG Level - Cable loss+ Antenna Gain

Margin = Limit - Absolute Level

ETSI EN 300 328 V2.2.2 (2019-07) §4.3.2.10 – RECEIVER SPURIOUS EMISSIONS

Applicable Standard

According to ETSI EN 300 328 V2.2.2 (2019-07) §4.3.2.10, the receiver spurious emissions are emissions at any frequency when the equipment is in receive mode.

The spurious emissions of the receiver shall not exceed the values given in table 13.

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

Frequency range	Maximum power, 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

Conducted measurement:

In case of conducted measurements, the radio equipment shall be connected to the measuring equipment via a suitable attenuator.

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

The measurement procedure refer to ETSI EN 300 328 V2.2.2 (2019-07) §5.4.10.2.1

Radiated measurement

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

The test procedure is further as described under clause 5.4.10.2.1.

Test Data

Environmental Conditions

Temperature:	25 °C
Relative Humidity:	55 %
ATM Pressure:	101.0 kPa

The testing was performed by Fan Yang on 2021-04-27.

EUT operation mode: Receiving

30MHz-12.75GHz

Frequency (MHz)	Receiver Reading (dBm)	Turntable Degree	Rx Antenna		Substituted Factor (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
			Height (m)	Polar (H/V)				
BLE 2402MHz RX, Low Channel								
175.03	-66.68	34	1.7	H	-5.27	-71.95	-57	14.95
181.28	-72.17	91	1.4	V	-6.69	-78.86	-57	21.86
9859.47	-68.17	339	1.2	H	16.83	-51.34	-47	4.34
9859.47	-67.19	226	1.8	V	15.15	-52.04	-47	5.04
BLE 2480MHz RX, High Channel								
174.42	-65.35	177	1.6	H	-5.22	-70.57	-57	13.57
172.60	-69.59	94	1.7	V	-6.38	-75.97	-57	18.97
9441.91	-68.38	242	1.7	H	16.22	-52.16	-47	5.16
9441.91	-66.98	179	1.4	V	14.78	-52.2	-47	5.2

Note:

Absolute Level = Reading Level + Substituted Factor

Substituted Factor contains: SG Level - Cable loss+ Antenna Gain

Margin = Limit - Absolute Level

ETSI EN 300 328 V2.2.2 (2019-07) §4.3.2.11 - RECEIVER BLOCKING

Applicable Standard

This requirement applies to all receiver categories as defined in clause 4.2.3.

Receiver blocking is a measure of the ability of the equipment to receive a wanted signal on its operating channel without exceeding a given degradation due to the presence of an unwanted input signal (blocking signal) at frequencies other than those of the operating band and spurious responses.

Performance Criteria:

For equipment that supports a PER or FER test to be performed, the minimum performance criterion shall be a PER or FER 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 be no loss of the wireless transmission function needed for the intended use of the equipment.

Limit:

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

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
$(-133 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}))$ or -68 dBm whichever is less (see note 2)	2 380 2 504	-34	CW
$(-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}))$ 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 $P_{\min} + 26 \text{ dB}$ 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 $P_{\min} + 20 \text{ dB}$ 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
$(-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}) + 10 \text{ dB})$ or $(-74 \text{ dBm} + 10 \text{ dB})$ whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
<p>NOTE 1: OCBW is in Hz.</p> <p>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 $P_{\min} + 26 \text{ dB}$ 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.</p> <p>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.</p>			

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
$(-139 \text{ dBm} + 10 \times \log_{10}(\text{OCBW}) + 20 \text{ dB})$ or $(-74 \text{ dBm} + 20 \text{ dB})$ whichever is less (see note 2)	2 380 2 504 2 300 2 584	-34	CW
<p>NOTE 1: OCBW is in Hz.</p> <p>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 $P_{\min} + 30 \text{ dB}$ 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.</p> <p>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.</p>			

Test Procedure

Conducted measurement:

For systems using multiple receive chains only one chain (antenna port) need to be tested. All other receiver inputs shall be terminated.

Figure 6 shows the test set-up which can be used for performing the receiver blocking test.

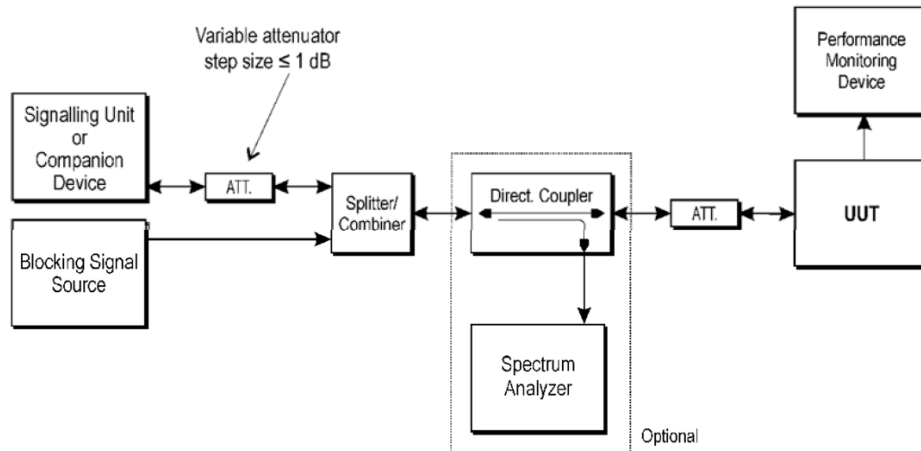


Figure 6: Test Set-up for receiver blocking

The procedure in step 1 to step 6 below shall be used to verify the receiver blocking requirement as described in clause 4.3.1.12 or clause 4.3.2.11. The performance monitoring device is capable of verifying the performance criteria as defined in clause 4.3.1.12.3 or clause 4.3.2.11.3.

Table 6, table 7 and table 8 in clause 4.3.1.12.4 contain the applicable blocking frequencies and blocking levels for each of the receiver categories for testing Receiver Blocking on FHSS equipment.

Table 14, table 15 and table 16 in clause 4.3.2.11.4 contain the applicable blocking frequencies and blocking levels for each of the receiver categories for testing Receiver Blocking on non-FHSS equipment.

Step 1:

- For non-FHSS equipment, the UUT shall be set to the lowest operating channel on which the blocking test has to be performed (see clause 5.4.11.1).

Step 2:

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

Step 3:

- With the blocking signal generator switched off, a communication link is established between the UUT and the associated 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 of the wanted signal shall be set to the value provided in the table corresponding to the receiver category and type of equipment. The test procedure defined in clause 5.4.2, and more in particular clause 5.4.2.2.1.2, can be used to measure the (conducted) level of the wanted signal however no correction shall be made for antenna gain of the companion device (step 6 in clause 5.4.2.2.1.2 shall be ignored). This level may be measured directly at the output of the companion device and a correction is made for the coupling loss into the UUT. The actual level for 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 the wanted signal at the input of the UUT is P_{min} . This signal level (P_{min}) is increased by the value provided in note 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 category and 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 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 increased 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, the UUT fails to comply with the Receiver Blocking requirement and step 6 and step 7 are no longer required.
- It shall be recorded in the test report whether the shift of blocking frequencies as described in the present step was used.

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 on which 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 Data**Environmental Conditions**

Temperature:	21 °C
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by Fan Yang on 2021-04-27.

EUT operation mode: Receiving (Worst Case)

The Maximum EIRP is 8.46dBm<10dBm and the EUT is an adaptive device, so it belongs to the receiver category 2.

Test Mode	Channel	Pmin [dBm]	Wanted Signal [dBm]	Freq. [MHz]	CW [dBm]	PER [%]	Limit [%]	Verdict
BLE	2402	---	-69	2300	-32.77	0.10	<=10	PASS
		---	-69	2380	-32.77	0.40	<= 10	PASS
	2480	---	-69	2504	-32.77	0.50	<=10	PASS
		---	-69	2584	-32.77	0.60	<= 10	PASS

Test Result: Compliance

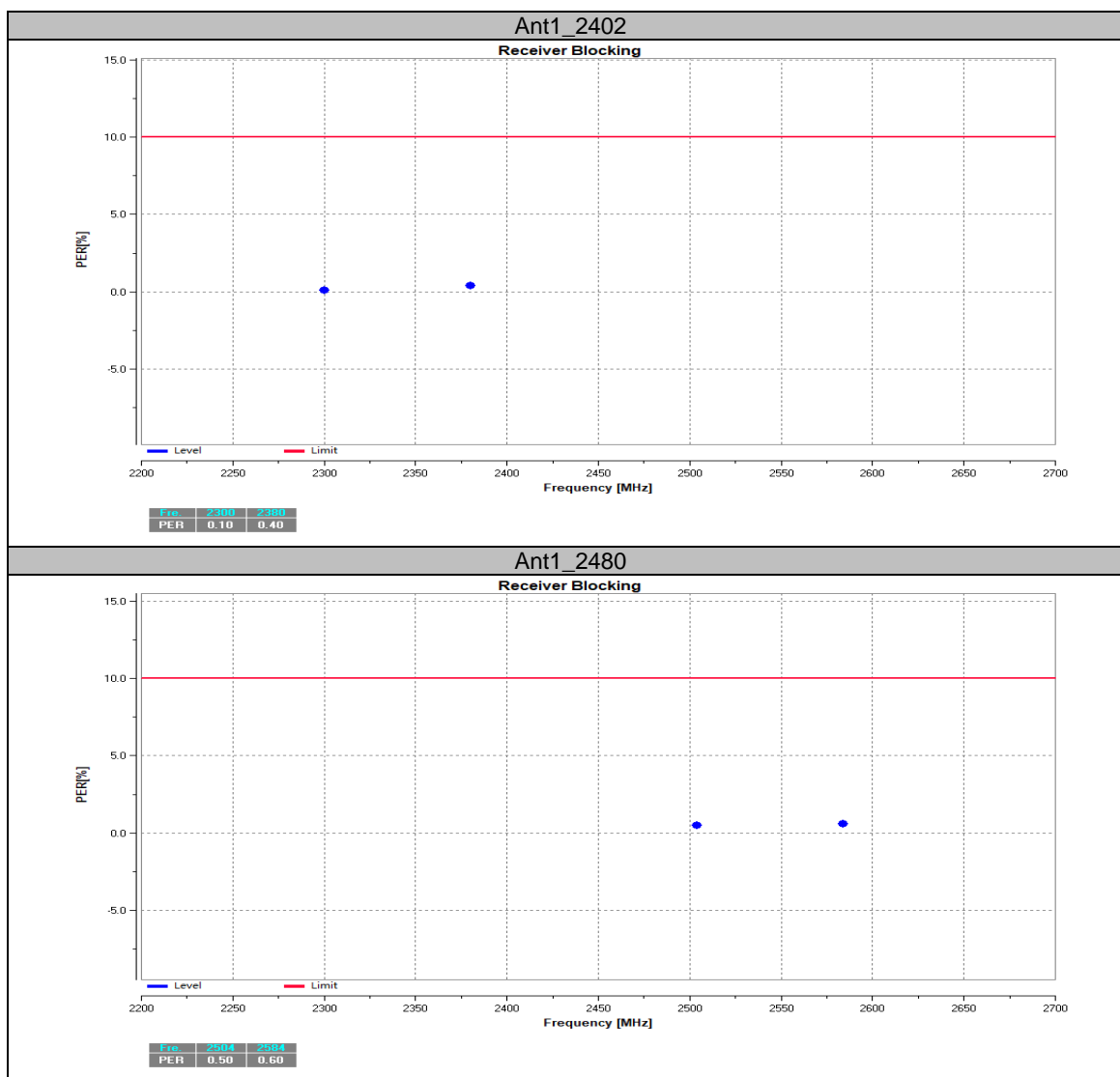


EXHIBIT A - E.2 INFORMATION AS REQUIRED BY EN 300 328 V2.2.2, CLAUSE 5.4.1

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

a) The type of modulation used by the equipment:

- ☐ FHSS
☒ other forms of modulation

b) In case of FHSS modulation:

In case of non-Adaptive Frequency Hopping equipment:

The number of Hopping Frequencies: _____.

In case of Adaptive Frequency Hopping Equipment:

The maximum number of Hopping Frequencies: _____;

The minimum number of Hopping Frequencies: _____;

The (average) 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 an non-LBT based DAA mechanism
☐ The equipment can operate in more than one adaptive mode

e) In case of non-adaptive Equipment:

The maximum RF Output Power (e.i.r.p.): _____dBm

The maximum (corresponding) Duty Cycle: _____ %

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

_____.

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

RF Output Power: 8.46dBm;
 Power Spectral Density 8.30dBm/MHz;
 Duty cycle, Tx-Sequence, Tx-gap N/A;
 Accumulated Transmit 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 N/A;
 Receiver Blocking Pass;
 Occupied Channel Bandwidth 1MHz;
 Transmitter unwanted emissions in the OOB domain -46.05dBm/MHz;
 Transmitter unwanted emissions in the spurious domain -38.02dBm;
 Receiver spurious emissions -51.34dBm;

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

- ☒ Operating mode 1: Single Antenna Equipment
☒ Equipment with only 1 antenna
☐ Equipment with 2 diversity antennas but only 1 antenna active at any moment in time
☐ Smart Antenna Systems with 2 or more antennas, but operating in a (legacy) mode where only 1 antenna is used.
 (e.g. IEEE 802.11™ [i.3] legacy mode in smart antenna systems)
- ☐ Operating mode 2: Smart Antenna Systems - Multiple Antennas without beam forming
☐ Single spatial stream / Standard throughput / (e.g. IEEE 802.11™ [i.3] legacy mode)
☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1
☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2
 Note: Add more lines if more channel bandwidths are supported.
- ☐ Operating mode 3: Smart Antenna Systems - Multiple Antennas with beam forming
☐ Single spatial stream / Standard throughput (e.g. IEEE 802.11™ [i.3] legacy mode)
☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 1
☐ High Throughput (> 1 spatial stream) using Occupied Channel Bandwidth 2
 Note: Add more lines if more channel bandwidths are supported.

h) In case of Smart Antenna Systems:

The number of Receive chains: _____;
 The number of Transmit chains: _____;

- ☐ symmetrical power distribution
☐ asymmetrical power distribution

In case of beam forming, the maximum beam forming gain: N/A;

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

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

Operating Frequency Range 1: 2402 MHz to 2480 MHz
 Operating Frequency Range 2: _____ MHz to _____ MHz

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

j) Nominal Channel Bandwidth(s):

Occupied Channel Bandwidth 1: 1 MHz
Occupied Channel Bandwidth 2: _____ MHz

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

k) Type of Equipment (stand-alone, combined, plug-in radio device, etc.):

- ☒ Stand-alone
☐ Combined Equipment (Equipment where the radio part is fully integrated within another type of equipment)
☐ Plug-in radio device (Equipment intended for a variety of host systems)
☐ Other _____;

l) The normal and the extreme operating conditions that apply to the equipment:**Normal operating conditions (if applicable):**

Operating temperature range: +25 °C
Other (please specify if applicable): _____

Extreme operating conditions:

Operating temperature range: Minimum: 0 °C Maximum +45 °C
Other (please specify if applicable): _____ Minimum: _____ Maximum _____

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

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

Antenna Type:

- ☒ Integral Antenna (information to be provided in case of conducted measurements)

Antenna Gain: 1.23 dBi

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

- ☐ Temporary RF connector provided
☐ No temporary RF connector provided

☐ Dedicated Antennas (equipment with antenna connector)
☐ Single power level with corresponding antenna(s)
☐ Multiple power settings and corresponding antenna(s)

Number of different Power Levels: _____;
Power Level 1: _____ dBm
Power Level 2: _____ dBm
Power Level 3: _____ dBm

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

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

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

Power Level 1: _____ dBm

Number of antenna assemblies provided for this power level:

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

Note 3: Add more rows in case more antenna assemblies are supported for this power level.

Power Level 2: _____ dBm

_Number of antenna assemblies provided for this power level:

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

Note 4: Add more rows in case more antenna assemblies are supported for this power level.

Power Level 2: _____ dBm

_Number of antenna assemblies provided for this power level:

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

Note 5: Add more rows in case more antenna assemblies are supported for this power level.

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 100-240 V
☒ DC State DC voltage 3.85 V

In case of DC, indicate the type of power source

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

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

The measurements shall be performed during continuously transmitting.

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)

(to be provided as separate attachment)

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

(to be provided as separate attachment)

s) 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.

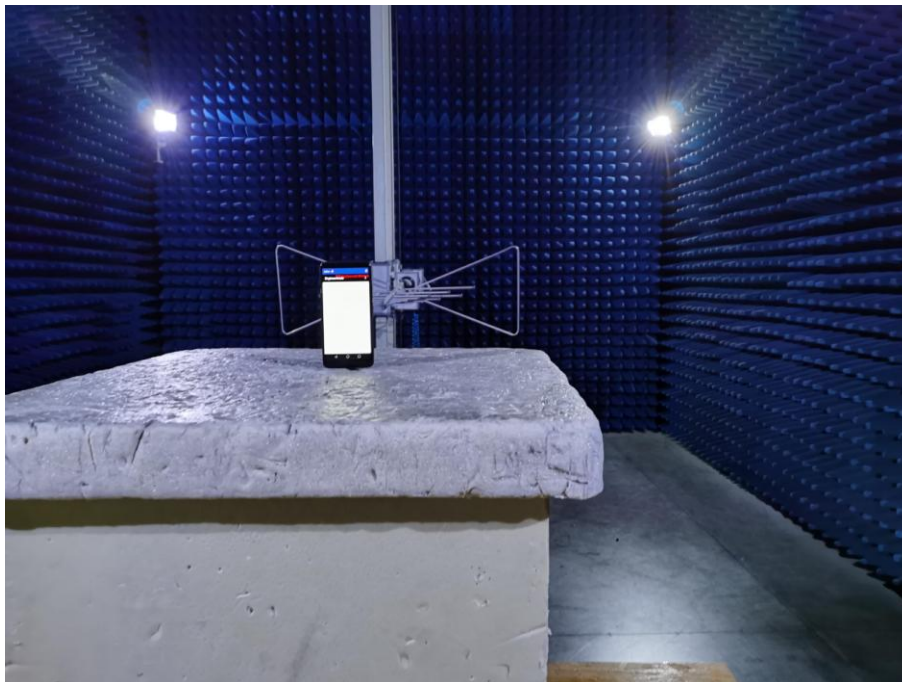
☒ No

EXHIBIT B - EUT PHOTOGRAPHS

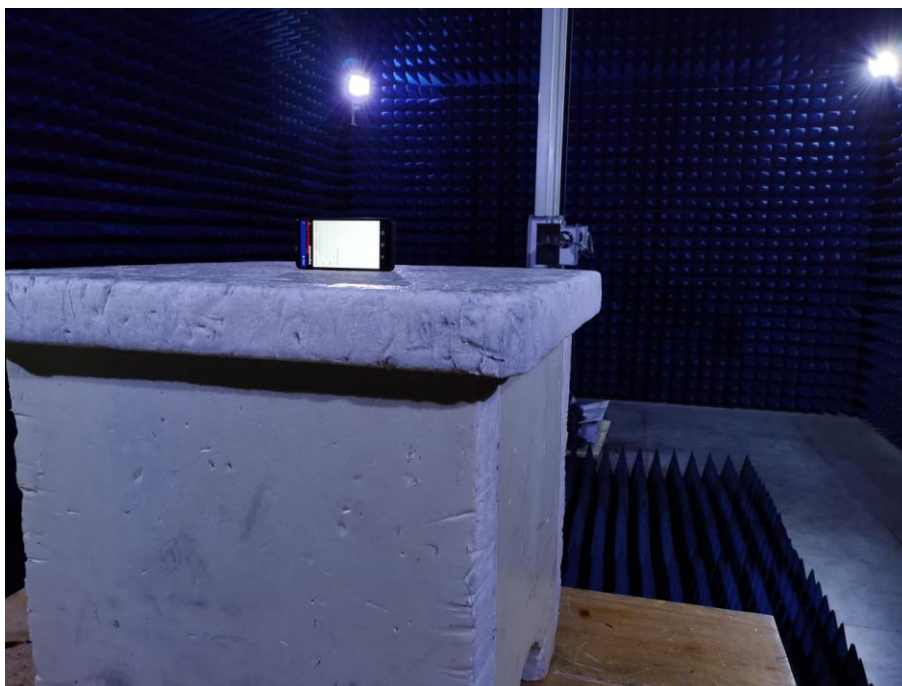
Please refer to the Attachment.

EXHIBIT C - TEST SETUP PHOTOGRAPHS

Radiated Spurious Emissions Test View (Below 1GHz)



Radiated Spurious Emissions Test View (Above 1GHz)



***** END OF REPORT *****