ETSI EN 300 328 V2.1.1 (2016-11)

TEST REPORT

For

Shenzhen Xin Yuan Electronic Technology Co., Ltd.

401 4F Bldg.building B. No.5, 1st Rd Bantianshangxue Technology Park ,Bantian St, Longgang Dist.,Shenzhen Guangdong China

Model: T-MICRO32

Report Type:	**Product Type:**
Original Report	Module

Report Number: RSZ190325004-22A

Report Date: 2019-07-17

Reviewed By: Nancy Wang
RF Engineer

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Module
Model	T-MICRO32
Frequency Range	Bluetooth: 2402~2480MHz
Transmit Power	Bluetooth: 6.90dBm
Modulation Technique	Bluetooth: GFSK, π/4-DQPSK, 8DPSK
Antenna Specification	Ceramic Antenna: 0dBi
Voltage Range	DC3.3V from testing jig
Date of Test	2019-07-01 to 2019-07-09
Sample serial number	190325004
Received date	2019-03-25
Sample/EUT Status	Good condition
Normal/Extreme Condition	N.V.: Nominal Voltage: 3.3V_{DC} L.T.: Low Temperature -20℃; N.T.: Normal Temperature +25℃; H.T.: High Temperature +55℃

Objective

This report is prepared on behalf of Shenzhen Xin Yuan Electronic Technology Co., Ltd. in accordance with ETSI EN 300 328 V2.1.1 (2016-11), Wideband transmission systems; Data transmission equipment operating in the 2, 4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU.

The objective is to determine the compliance of EUT with ETSI EN 300 328 V2.1.1 (2016-11).

Related Submittal(s)/Grant(s)

No related submittal(s).

Test Methodology

All measurements contained in this report were conducted with ETSI EN 300 328 V2.1.1 (2016-11).

Measurement Uncertainty

Parameter	Flab	Maximum allow uncertainty
Occupied Channel Bandwidth	±5%	±5%
RF output power, conducted	±0.73dB	±1.5dB
Unwanted Emission, conducted	±1.6dB	±3dB
Below 1GHz emissions, radiated	±4.75dB	±6dB
Above 1GHz emissions, radiated	±4.88dB	±6dB
Temperature	±1℃	±3℃
Supply voltages	±0.4%	±3%
Time	±1%	±5%

Note: 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

“espRFTool.exe” Software was used, and the power level is 8.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT.

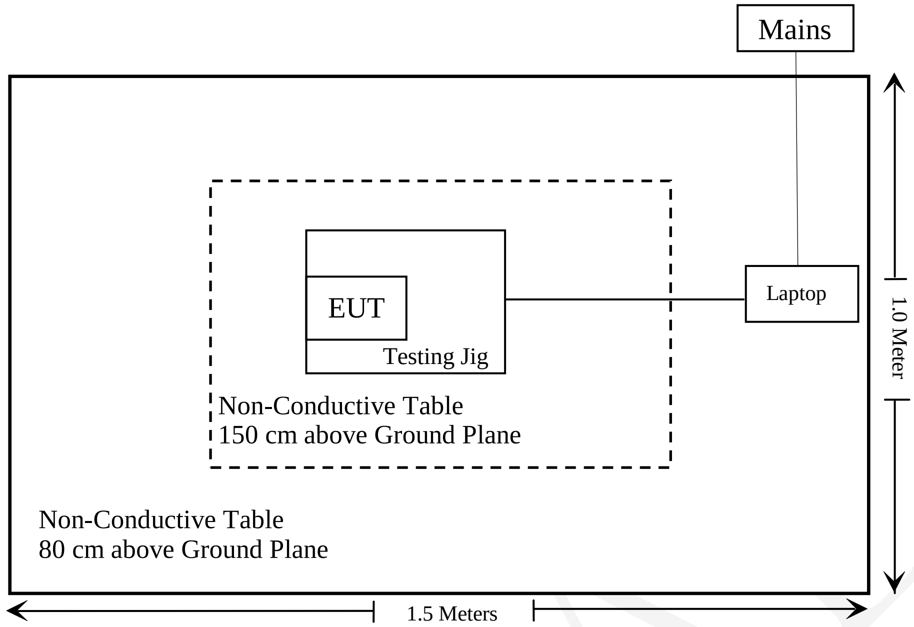
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Xin Yuan	Testing Jig	N/A	N/A
Toshiba	Laptop	Satellite C600	PSCZNQ-00G006
Toshiba	AC/DC Adapter	PA3715E-1AC3	T0311043001798DA

External I/O Cable

Cable Description	Length (m)	From Port	To
Unshielded Detachable USB Cable	1.0	Laptop	Testing Jig

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

ETSI EN 300 328 V2.1.1 (2016-11)	Description of Test	Test Result
§4.3.1.2	RF output power	Compliance
§4.3.1.3	Duty Cycle, Tx-sequence, Tx-gap	Not Applicable
§4.3.1.4	Accumulated Transmit Time, Frequency Occupation and Hopping Sequence	Compliance
§4.3.1.5	Hopping Frequency Separation	Compliance
§4.3.1.6	Medium Utilisation (MU) factor	Not Applicable
§4.3.1.7	Adaptivity (Adaptive Frequency Hopping)	Not Applicable*
§4.3.1.8	Occupied Channel Bandwidth	Compliance
§4.3.1.9	Transmitter unwanted emissions in the out-of-band domain	Compliance
§4.3.1.10	Transmitter unwanted emissions in the spurious domain	Compliance
§4.3.1.11	Receiver spurious emissions	Compliance
§4.3.1.12	Receiver Blocking	Compliance
§4.3.1.13	Geo-location capability	Not Applicable**

Note:

The supplier declared that the equipment is adaptive equipment

Not Applicable – This item only for non-adaptive mode

Not Applicable* – The test item was not required for adaptive frequency hopping equipment of the output power less than 10mW (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					
Sunol Sciences	Horn Antenna	DRH-118	A052604	2017-12-22	2020-12-21
Rohde & Schwarz	Signal and Spectrum Analyzer	FSV40-N	102259	2019-06-22	2020-06-22
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2017-12-22	2020-12-21
COM-POWER	Pre-amplifier	PA-122	181919	2018-11-12	2019-11-12
Sonoma Instrument	Amplifier	310N	186238	2018-11-12	2019-11-12
Agilent	Signal Generator	N5183A	MY51040755	2018-12-03	2019-12-03
Rohde & Schwarz	EMI Test Receiver	ESR	1316.3003K03-101746-zn	2018-07-11	2019-07-11
COM-POWER	Dipole Antenna	AD-100	41000	NCR	NCR
A.H. System	Horn Antenna	SAS-200/571	135	2018-09-01	2021-08-31
RF Conducted test					
Agilent	USB wideband power meter	U2021XA	MY54250003	2019-06-23	2020-06-23
ESPEC	Temperature & Humidity Chamber	EL-10KA	9107726	2019-01-05	2020-01-05
Agilent	Signal Generator	N5183A	MY51040755	2018-12-03	2019-12-03
HP	Adjustable attenuator	8496B	2827A12453	Each time	
Agilent	Adjustable attenuator	8494B	2812A17263	Each time	
Rohde & Schwarz	Wideband Radio Communication Tester	CMW500	1201.002K50-146520-wh	2019-06-23	2020-06-23
Rohde & Schwarz	Spectrum Analyzer	FSU26	200120	2019-03-02	2020-03-01

*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) 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 V2.1.1 (2016-11) §4.3.1.2 – RF OUTPUT POWER

Applicable Standard

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

Limit

The maximum RF output power for adaptive Frequency Hopping equipment shall be equal to or less than 20 dBm.

The maximum RF output power for non-adaptive Frequency Hopping equipment shall be declared by the manufacturer. See clause 5.4.1 m). The maximum RF output power for this equipment shall be equal to or less than the value declared by the manufacturer. This declared value shall be equal to or less than 20 dBm.

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 suitable for 2,4 GHz and capable of 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) are captured.

NOTE 1: 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 transmits 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.

NOTE 2: In case of insufficient dynamic range, 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.
• If applicable, 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) shall be calculated using the formula below:

P = A + G + Y

• This value, which shall comply with the limit given in clauses 4.3.1.2.3 or clause 4.3.2.2.3, shall be recorded in the test report.

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by George Zhong on 2019-07-09.

EUT operation mode: Transmitting

Test Result: Compliant, please refer to following tables.

BDR Mode (GFSK):

Test Condition			Reading (dBm)	Antenna gain (dBi)	EIRP (dBm)	Limit (dBm)
Channel	Temperature	Voltage				
Hopping Channel	L.T.	N.V.	6.73	0	6.73	20
	N.T.	N.V.	6.65	0	6.65	20
	H.T.	N.V.	6.62	0	6.62	20

EDR Mode (π/4-DQPSK):

Test Condition			Reading (dBm)	Antenna gain (dBi)	EIRP (dBm)	Limit (dBm)
Channel	Temperature	Voltage				
Hopping Channel	L.T.	N.V.	6.90	0	6.90	20
	N.T.	N.V.	6.87	0	6.87	20
	H.T.	N.V.	6.84	0	6.84	20

EDR Mode (8DPSK):

Test Condition			Reading (dBm)	Antenna gain (dBi)	EIRP (dBm)	Limit (dBm)
Channel	Temperature	Voltage				
Hopping Channel	L.T.	N.V.	6.70	0	6.70	20
	N.T.	N.V.	6.69	0	6.69	20
	H.T.	N.V.	6.65	0	6.65	20

ETSI EN 300 328 V2.1.1 (2016-11) §4.3.1.4 –ACCUMULATED TRANSMIT TIME, FREQUENCY OCCUPATION AND HOPPING SEQUENCE

Applicable Standard

The Accumulated Transmit Time is the total of the transmitter 'on' times, during an observation period, on a particular hopping frequency.

The Frequency Occupation is the number of times that each hopping frequency is occupied within a given period. A hopping frequency is considered to be occupied when the equipment selects that frequency from the hopping sequence.The equipment may be transmitting, receiving or stay idle during the Accumulated Transmit Time spent on that hopping frequency.

The Hopping Sequence of a frequency hopping equipment is the unrepeated pattern of the hopping frequencies used by the equipment.

Limit:

For Non-adaptive frequency hopping systems:

The Accumulated Transmit Time on any hopping frequency shall not be greater than 15 ms within any period of 15 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

In order for the equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options:

Option 1: Each hopping frequency of the hopping sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use.

Option 2: The occupation probability for each frequency shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use.

The hopping sequence(s) shall contain at least N hopping frequencies where N is either 5 or the result of 15 MHz divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater. According to clause 4.3.1.5.3.1 the minimum Hopping Frequency Separation for non-adaptive equipment is equal to the Occupied Channel Bandwidth with a minimum of 100 kHz.

For Adaptive frequency hopping systems:

Adaptive Frequency Hopping equipment shall be capable of operating over a minimum of 70 % of the band specified in clause 1.

The Accumulated Transmit Time on any hopping frequency shall not be greater than 400 ms within any observation period of 400 ms multiplied by the minimum number of hopping frequencies (N) that have to be used.

In order for the equipment to comply with the Frequency Occupation requirement, it shall meet either of the following two options:

Option 1: Each hopping frequency of the hopping sequence shall be occupied at least once within a period not exceeding four times the product of the dwell time and the number of hopping frequencies in use.

Option 2: The occupation probability for each frequency shall be between ((1 / U) × 25 %) and 77 % where U is the number of hopping frequencies in use.

The hopping sequence(s) shall contain at least N hopping frequencies at all times, where N is either 15 or the result of 15 MHz divided by the minimum Hopping Frequency Separation in MHz, whichever is the greater.

Test Procedure

The test procedure shall be as follows:

Step 1:

- The output of the transmitter shall be connected to a spectrum analyzer or equivalent.
- The analyzer shall be set as follows:
  - Centre Frequency: Equal to the hopping frequency being investigated
  - Frequency Span: 0 Hz
  - RBW: ~ 50 % of the Occupied Channel Bandwidth
  - VBW: ⩾ RBW
  - Detector Mode: RMS
  - Sweep time: Equal to the applicable observation period (see clause 4.3.1.4.3.1 or clause 4.3.1.4.3.2)
  - Number of sweep points: 30 000
  - Trace mode: Clear / Write
  - Trigger: Free Run

Step 2:

- Save the trace data to a file for further analysis by a computing device using an appropriate software application or program.

Step 3:

- Indentify the data points related to the frequency being investigated by applying a threshold.

  The data points resulting from transmissions on the hopping frequency being investigated are assumed to have much higher levels compared to data points resulting from transmissions on adjacent hopping frequencies. If a clear determination between these transmissions is not possible, the RBW in step 1 shall be further reduced. In addition, a channel filter may be used.

- Count the number of data points identified as resulting from transmissions on the frequency being investigated and multiply this number by the time difference between two consecutive data points.

Step 4:

- The result in step 3 is the Accumulated Transmit Time which shall comply with the limit provided in clauses 4.3.1.4.3.1 or clause 4.3.1.4.3.2 and which shall be recorded in the test report.

Step 5:

This step is only applicable for equipment implementing Option 1 in clause 4.3.1.4.3.1 or Option 1 in clause 4.3.1.4.3.2 for complying with the Frequency Occupation requirement and the manufacturer decides to demonstrate compliance with this requirement via measurement.

- Make the following changes on the analyzer and repeat steps 2 and 3.

  Sweep time: 4 × Accumulated Transmit Time × Actual number of hopping frequencies in use

The hopping frequencies occupied by the system without having transmissions during the dwell time (blacklisted frequencies) should be taken into account in the actual number of hopping frequencies in use. If this number can not be determined (number of blacklisted frequencies unknown) it shall be assumed that the equipment uses the minimum number of hopping frequencies.

• The result shall be compared to the limit for the Frequency Occupation defined in clause 4.3.1.4.3.1, Option 1 or clause 4.3.1.4.3.2, Option 1. The result of this comparison shall be recorded in the test report.

Step 6:

• Make the following changes on the analyzer:
- Start Frequency: 2 400 MHz
- Stop Frequency: 2 483,5 MHz
- RBW: ~ 50 % of the Occupied Channel Bandwidth (single hopping frequency)

- VBW: ⩾ RBW
- Detector Mode: RMS
- Sweep time: 1 s; this setting may result in long measuring times. To avoid such long measuring times, an FFT analyser may be used
- Trace Mode: Max Hold
- Trigger: Free Run

• Wait for the trace to stabilize. Identify the number of hopping frequencies used by the hopping sequence.

• The result shall be compared to the limit (value N) defined in clauses 4.3.1.4.3.1 or clause 4.3.1.4.3.2. This value shall be recorded in the test report.

For equipment with blacklisted frequencies, it might not be possible to verify the number of hopping frequencies in use. However, they shall comply with the requirement for Accumulated Transmit Time and Frequency Occupation assuming the minimum number of hopping frequencies (N) defined in clause 4.3.1.4.3.1 or clause 4.3.1.4.3.2 is used.

Step 7:

• For adaptive frequency hopping equipment, it shall be verified whether the equipment uses 70 % of the band specified in table 1. This verification can be done using the lowest and highest -20 dB points from the total spectrum envelope obtained in step 6. The result shall be recorded in the test report.

Test Data

Environmental Conditions

Temperature:	25 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by George Zhong on 2019-07-09.

EUT operation mode: Transmitting

Test Result: Compliance. Please refer to the following table and plots:

Accumulated Transmit time:

Mode	Channel	Occupancy Time For Single Hop (ms)	Real Observed Period (s)	Hops in Observed Period	Accumulated Transmit time (s)	Limit (s)
3DH5	Low	2.913	31.6	89	0.259	0.4
	High	2.913	31.6	91	0.265	0.4
	Note:Observed Period=79*400ms=31.6 s					

Minimum Frenquency Occupation:

Mode	Channel	Dwell Time (ms)	Real Observed Period (ms)	Hops in Observed Period	Limit
3DH5	Low	3.75	1185	5	≥1
	High	3.75	1185	4	≥1
	Note:Observed Period=Dwell Time*79*4 ms				

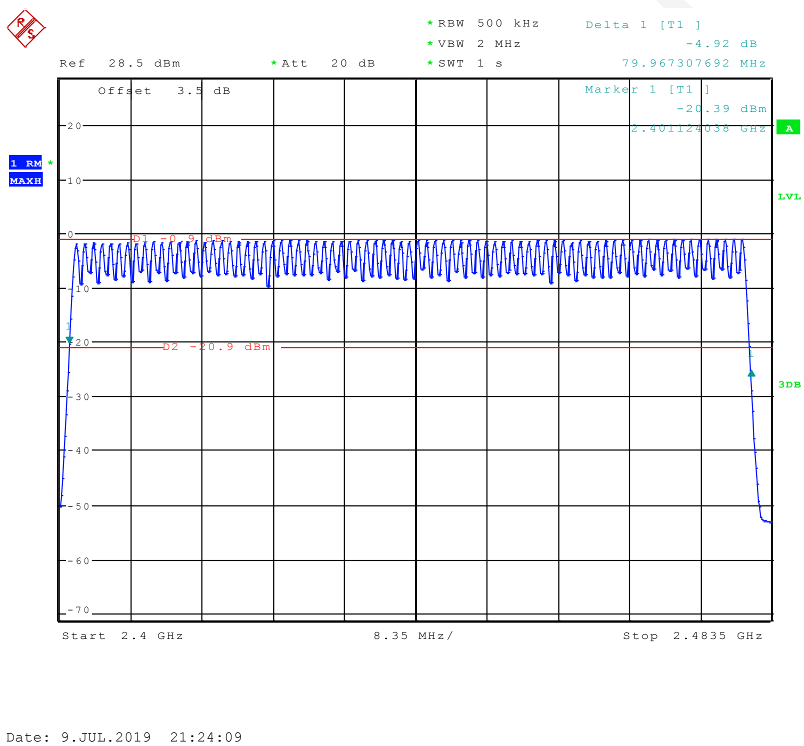
Hopping Sequence:

The frequency hopping systems operating in 2400-2483.5 MHz band employ 79 nonoverlapping channels.

Test Mode	Frequency Range (MHz)	Number of Hopping Channel	Limit	-20dB Occupied Bandwidth (MHz)	Limit (MHz)
GFSK		79		79.97	
π/4-DQPSK	2400.0-2483.5	79	≥15	80.29	≥58.45
8DPSK		79		80.29	

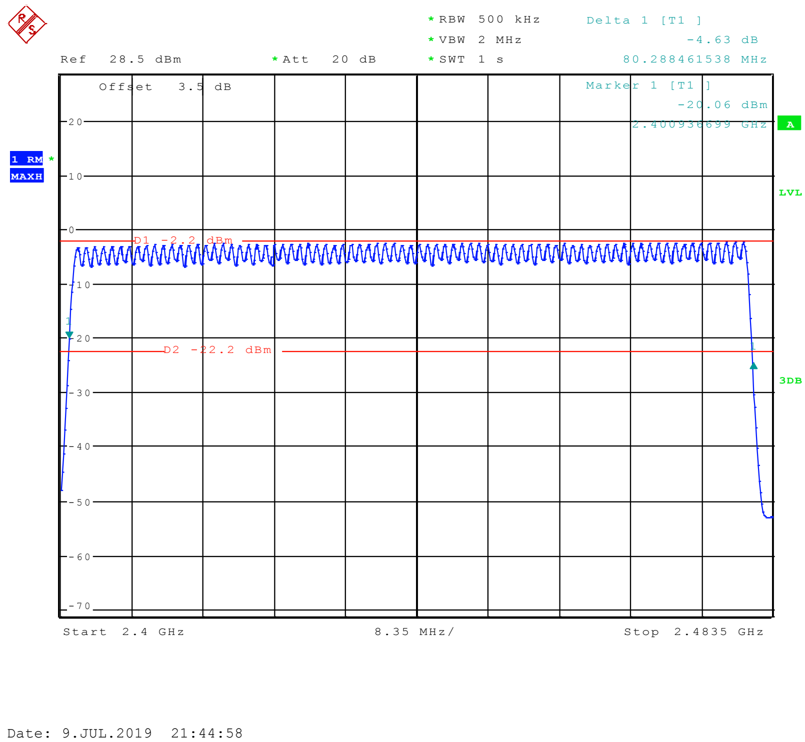
BDR Mode (GFSK):

Number of Hopping Channels



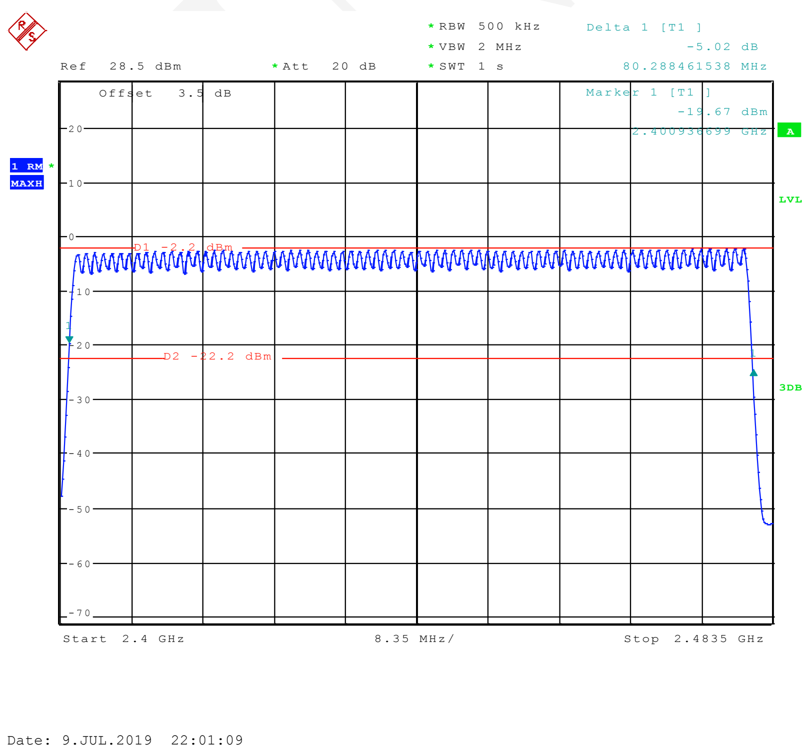
EDR Mode(π /4-DQPSK):

Number of Hopping Channels



EDR Mode(8DPSK):

Number of Hopping Channels



ETSI EN 300 328 V2.1.1 (2016-11) §4.3.1.5 – HOPPING FREQUENCY SEPARATION

Applicable Standard

The Hopping Frequency Separation is the frequency separation between two adjacent hopping frequencies.

Limit:

For Non-adaptive frequency hopping equipment

For non-adaptive Frequency Hopping equipment, the Hopping Frequency Separation shall be equal or greater than the Occupied Channel Bandwidth (see clause 4.3.1.8), with a minimum separation of 100 kHz.

For equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for non-adaptive Frequency Hopping equipment operating in a mode where the RF Output power is less than 10 dBm e.i.r.p. only the minimum Hopping Frequency Separation of 100 kHz applies.

For Adaptive frequency hopping equipment

The minimum Hopping Frequency Separation shall be 100 kHz.

Adaptive Frequency Hopping equipment that switched to a non-adaptive mode for one or more hopping frequencies because interference was detected on these hopping frequencies with a level above the threshold level defined in clause 4.3.1.7.2.2, point 5 or clause 4.3.1.7.3.2, point 5, is allowed to continue to operate with a minimum Hopping Frequency Separation of 100 kHz as long as the interference remains present on these hopping frequencies. The equipment shall continue to operate in an adaptive mode on other hopping frequencies.

Adaptive Frequency Hopping equipment which decided to operate in a non-adaptive mode on one or more hopping frequencies without the presence of interference, shall comply with the limit for Hopping Frequency Separation for non-adaptive equipment defined in clause 4.3.1.5.3.1 (first paragraph) for these hopping frequencies as well as with all other requirements applicable to non-adaptive frequency hopping equipment.

Test Procedure

Option 1, the test procedure shall be as follows:

Step 1:

- The output of the transmitter shall be connected to a spectrum analyzer or equivalent.
- The analyzer shall be set as follows:
  Centre Frequency: Centre of the two adjacent hopping frequencies
  Frequency Span: Sufficient to see the complete power envelope of both hopping frequencies
  RBW: 1 % of the span
  VBW: 3 × RBW
  Detector Mode: Max Peak
  Trace Mode: Max Hold
  Sweep time: Auto

Step 2:

- Wait for the trace to stabilize.
- Use the marker function of the analyser to define the frequencies corresponding to the lower -20 dBr point and the upper -20 dBr point for both hopping frequencies F1 and F2. This will result in $F1_L$ and $F1_H$ for hopping frequency F1 and in F2L and F2H for hopping frequency F2. These values shall be recorded in the report.

Step 3:

- Calculate the centre frequencies $F1_C$ and $F2_C$ for both hopping frequencies using the formulas below. These values shall be recorded in the report.

$$F1_C = \frac{F1_L + F1_H}{2} \quad F2_C = \frac{F2_L + F2_H}{2}$$

- Calculate the Hopping Frequency Separation (F_{HS}) using the formula below. This value shall be recorded in the report.

$$F_{HS} = F2_C - F1_C$$

• Compare the measured Hopping Frequency Separation with the limit defined in clause 4.3.1.5.3. In addition, for non-Adaptive Frequency Hopping equipment, the Hopping Frequency Separation shall be equal to or greater than the Occupied Channel Bandwidth as defined in clause 4.3.1.8 or:

$$F_{HS} \geq \text{Occupied Channel Bandwidth}$$

- See figure 4:

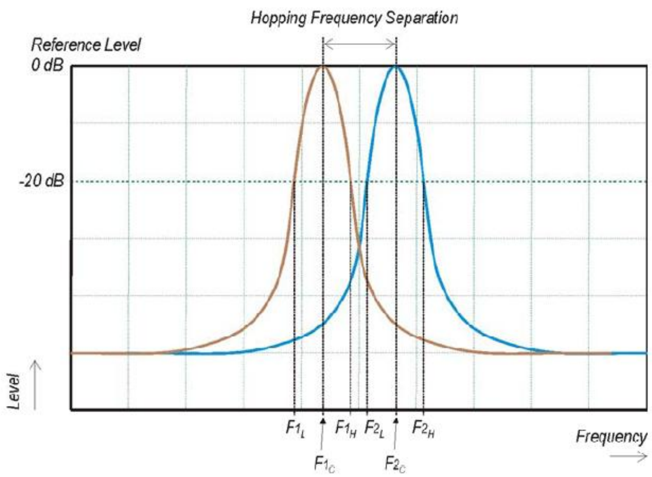


Figure 4: Hopping Frequency Separation

For adaptive systems, in case of overlapping channels which will prevent the definition of the -20 dBr reference points $F1_H$ and $F2_L$, a higher reference level (e.g. -10 dBr or - 6 dBr) may be chosen to define the reference points $F1_L$; $F1_H$; $F2_L$ and $F2_H$.

Alternatively, special test software may be used to:

- force the UUT to hop or transmit on a single Hopping Frequency by which the -20 dBr reference points can be measured separately for the two adjacent Hopping Frequencies; and/or;

- force the UUT to operate without modulation by which the centre frequencies F1C and F2C can be measured directly.

The method used to measure the Hopping Frequency Separation shall be documented in the test report.

Option 2, the test procedure shall be as follows:

Step 1:

- The output of the transmitter shall be connected to a spectrum analyzer or equivalent.
- The analyzer shall be set as follows:
  Centre Frequency: Centre of the two adjacent hopping frequencies
  Frequency Span: Sufficient to see the complete power envelope of both hopping frequencies
  RBW: 1 % of the span
  VBW: 3 × RBW
  Detector Mode: Max Peak
  Trace Mode: Max Hold
  Sweep Time: Auto

NOTE: Depending on the nature of the signal (modulation), it might be required to use a much longer sweep time, e.g. in case switching transients are present in the signals to be investigated.

Step 2:

- Wait for the trace to stabilize.
- Use the marker-delta function to determine the Hopping Frequency Separation between the centres of the two adjacent hopping frequencies (e.g. by indentifying peaks or notches at the centre of the power envelope for the two adjacent signals). This value shall be compared with the limits defined in clause 4.3.1.5.3 and shall be recorded in the test report.

Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	50 %
ATM Pressure:	100.0 kPa

The testing was performed by George Zhong on 2019-07-09.

EUT operation mode: Transmitting

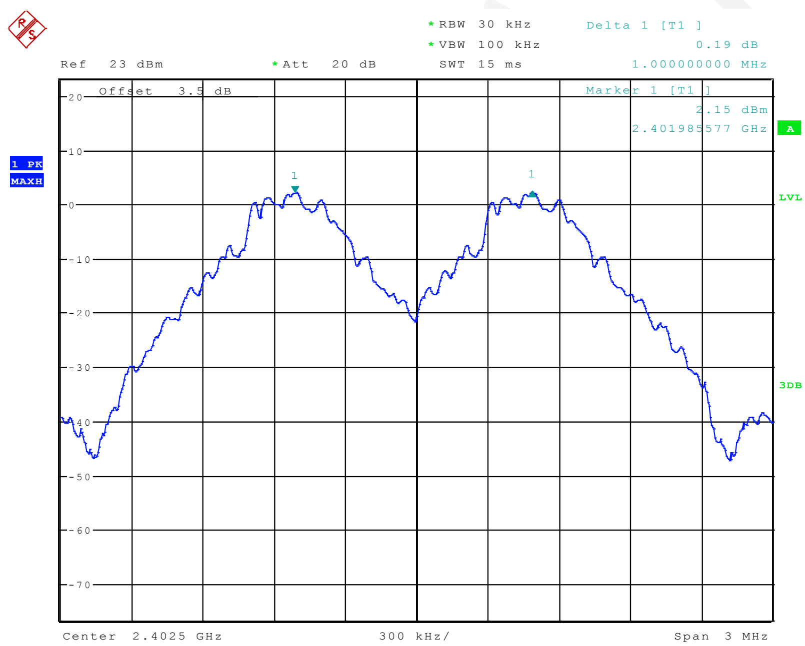
Test with option 2 method.

Test Result: Compliance. Please refer to the following tables and plots:

BDR Mode (GFSK):

Channel	Channel Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)	Result
Low Channel	2402	1.000	0.1	Pass
Adjacency Channel	2403			
Middle Channel	2441	1.000	0.1	Pass
Adjacency Channel	2442			
High Channel	2480	1.000	0.1	Pass
Adjacency Channel	2479			

Low Channel



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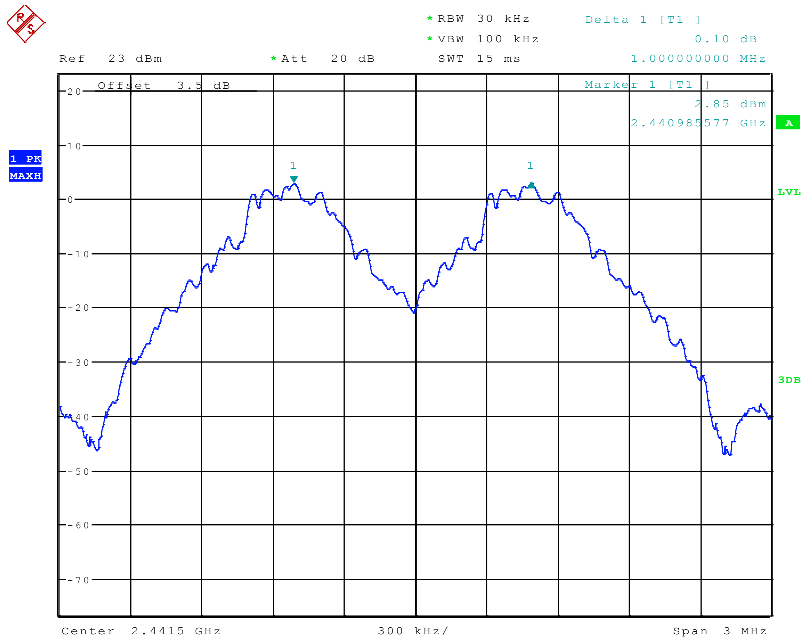
Middle Channel



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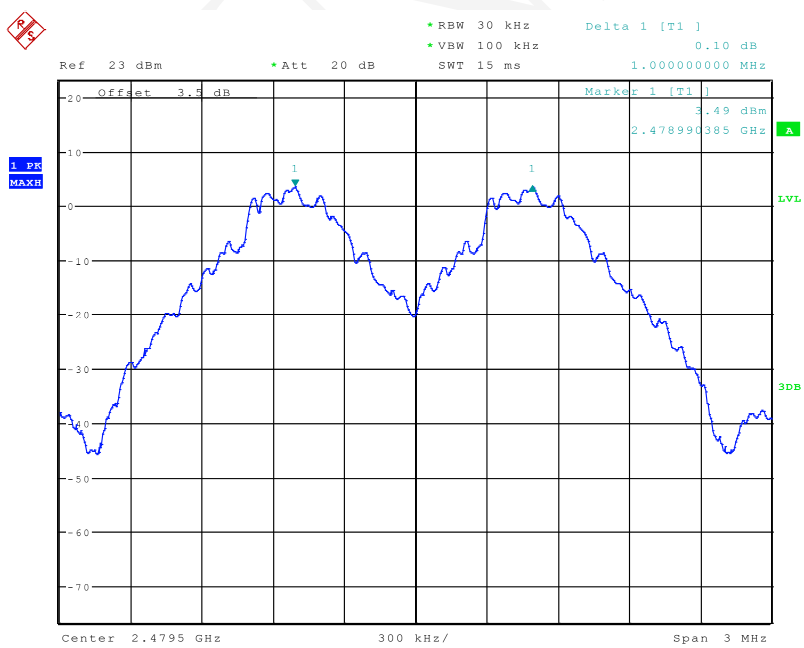
High Channel



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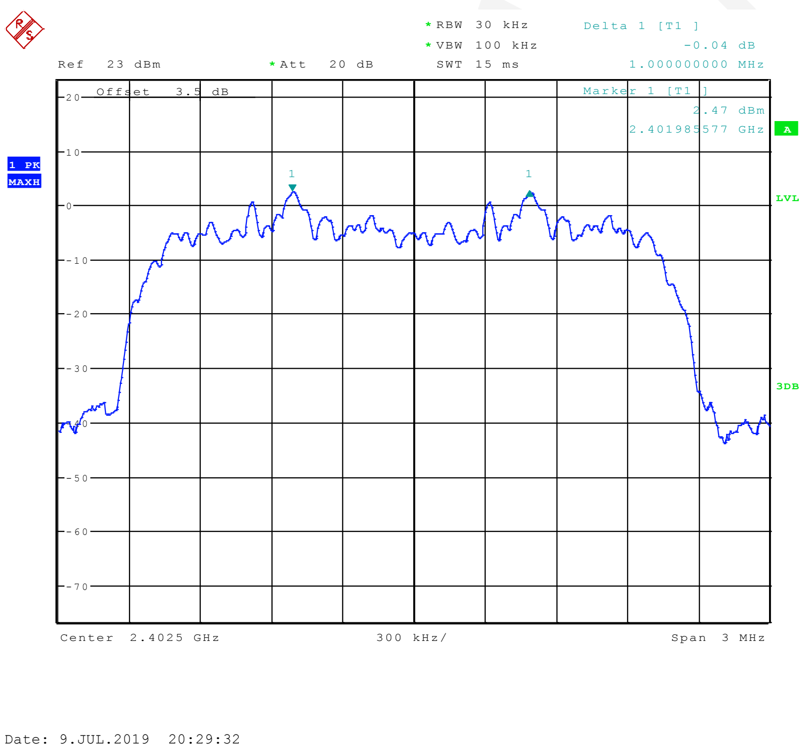
EDR Mode (π/4-DQPSK):

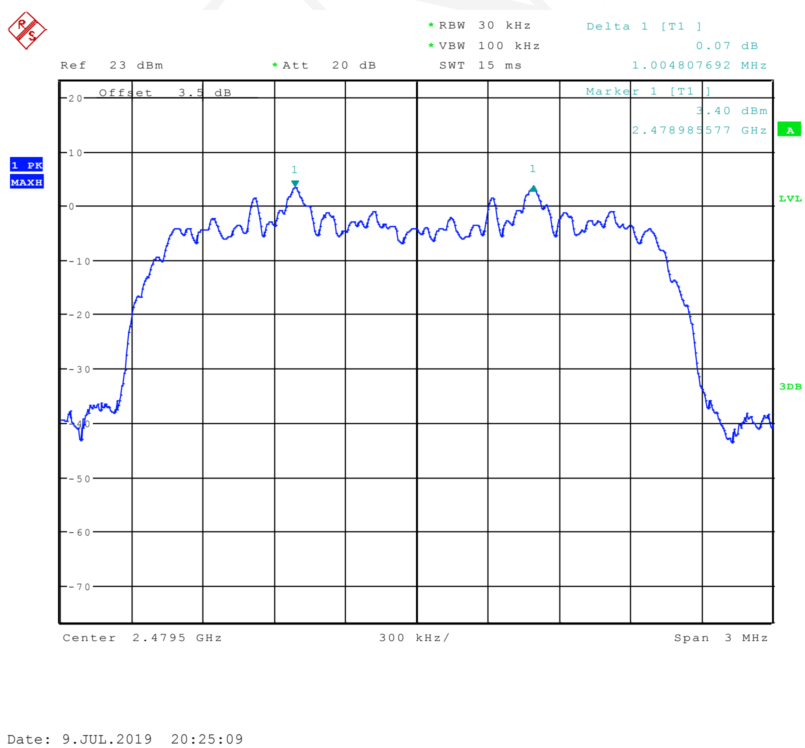
Channel	Channel Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)	Result
Low Channel	2402	1.000	0.1	Pass
Adjacency Channel	2403			
Middle Channel	2441	1.005	0.1	Pass
Adjacency Channel	2442			
High Channel	2480	1.005	0.1	Pass
Adjacency Channel	2479			

Low Channel



Middle Channel

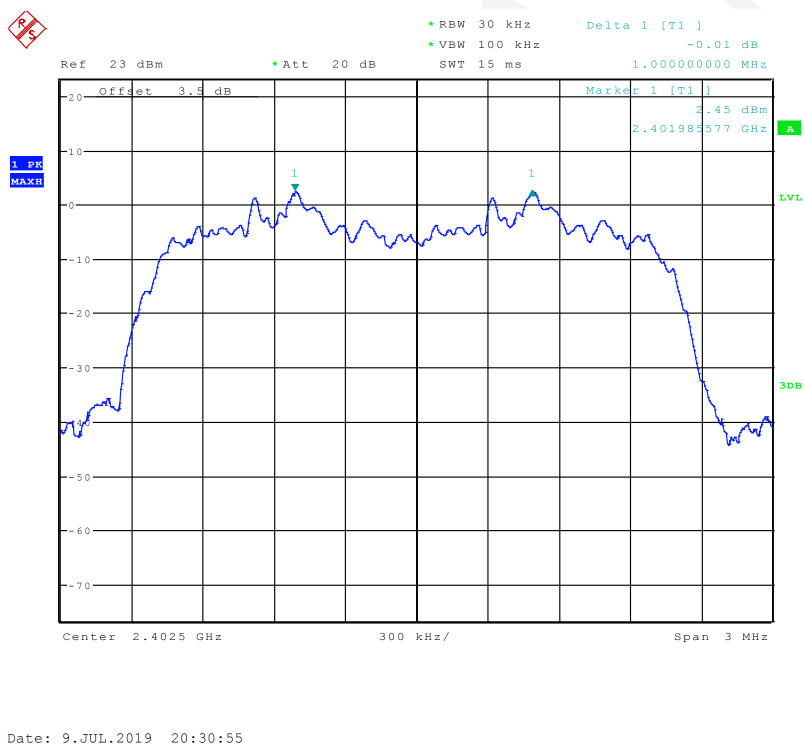
High Channel



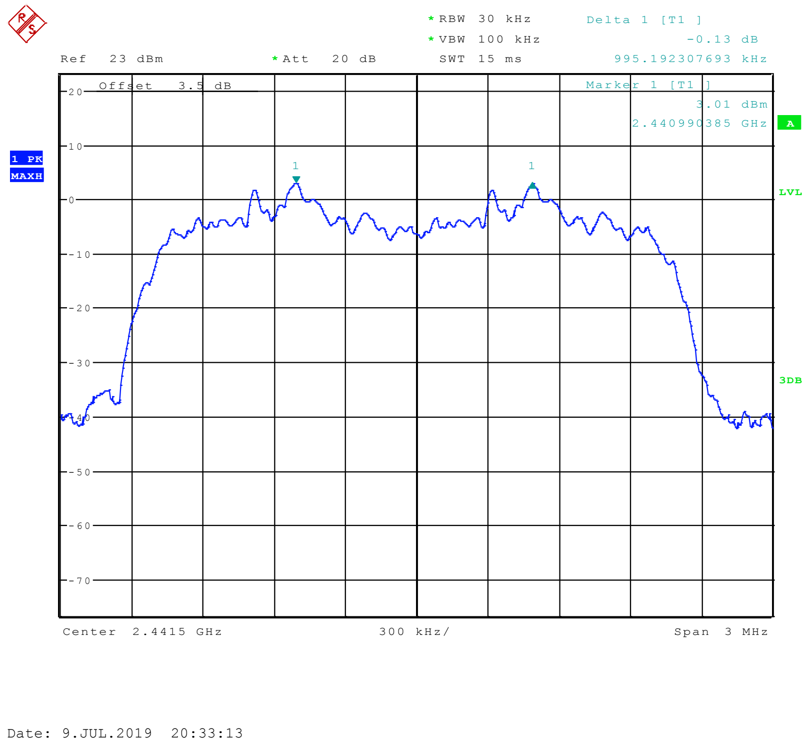
EDR Mode (8DPSK):

Channel	Channel Frequency (MHz)	Channel Separation (MHz)	Limit (MHz)	Result
Low Channel	2402	1.000	0.1	Pass
Adjacency Channel	2403			
Middle Channel	2441	0.995	0.1	Pass
Adjacency Channel	2442			
High Channel	2480	1.000	0.1	Pass
Adjacency Channel	2479			

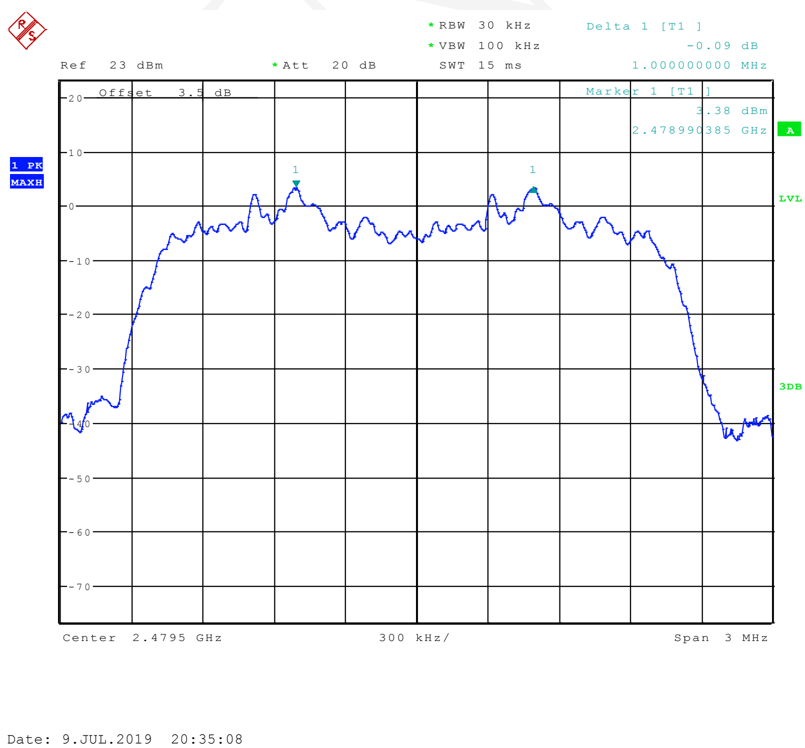
Low Channel



Middle Channel



High Channel



ETSI EN 300 328 V2.1.1 (2016-11) §4.3.1.8 – OCCUPIED CHANNEL BANDWIDTH

Applicable Standard

The Occupied Channel Bandwidth is the bandwidth that contains 99 % of the power of the signal when considering a single hopping frequency.

Limit:

The Occupied Channel Bandwidth for each hopping frequency shall fall completely within the band given in clause 1.

For non-adaptive Frequency Hopping equipment with e.i.r.p. greater than 10 dBm, the Occupied Channel Bandwidth for every occupied hopping frequency shall be equal to or less than the Nominal Channel Bandwidth declared by the manufacturer. See clause 5.4.1 j). This declared value shall not be greater than 5 MHz.

Test Procedure

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: ~ 1 % of the span without going below 1 %
- Video BW: 3 × RBW
- Frequency Span: 2 × 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.

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 Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	50 %
ATM Pressure:	100.0 kPa

The testing was performed by George Zhong on 2019-07-09.

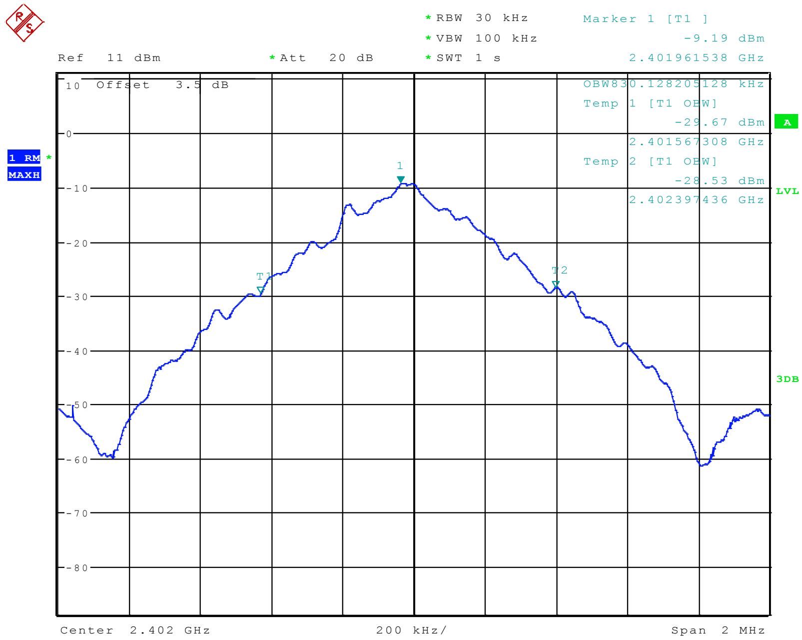
EUT operation mode: Transmitting

Test Result: Compliance, please refer to the below table and plots.

Test mode	Channel	Frequency (MHz)	Occupied Bandwidth (MHz)
BDR Mode (GFSK)	Low	2402	0.830
	High	2480	0.830
EDR Mode (π/4-DQPSK)	Low	2402	1.163
	High	2480	1.167
EDR Mode (8DPSK)	Low	2402	1.163
	High	2480	1.163

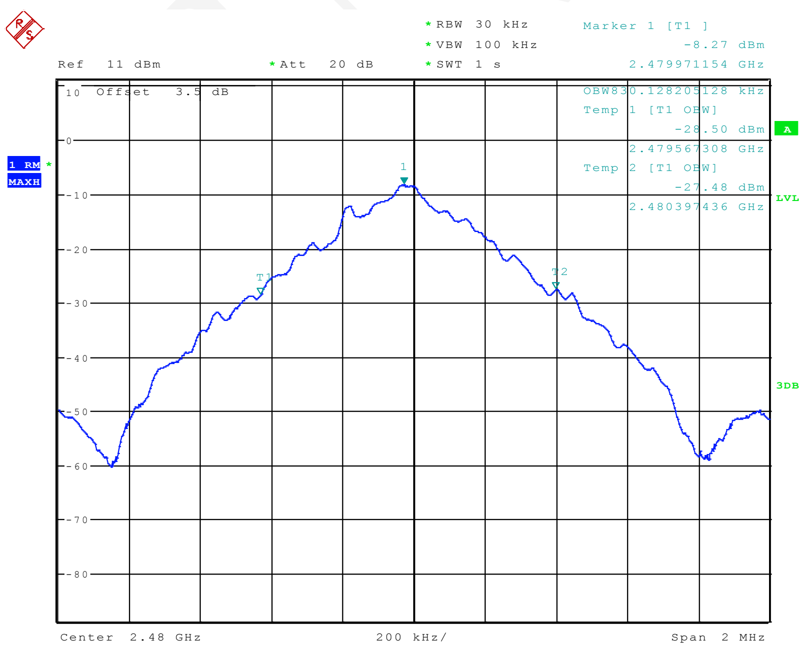
BDR Mode (GFSK):

Low Channel



Date: 9.JUL.2019 19:09:15

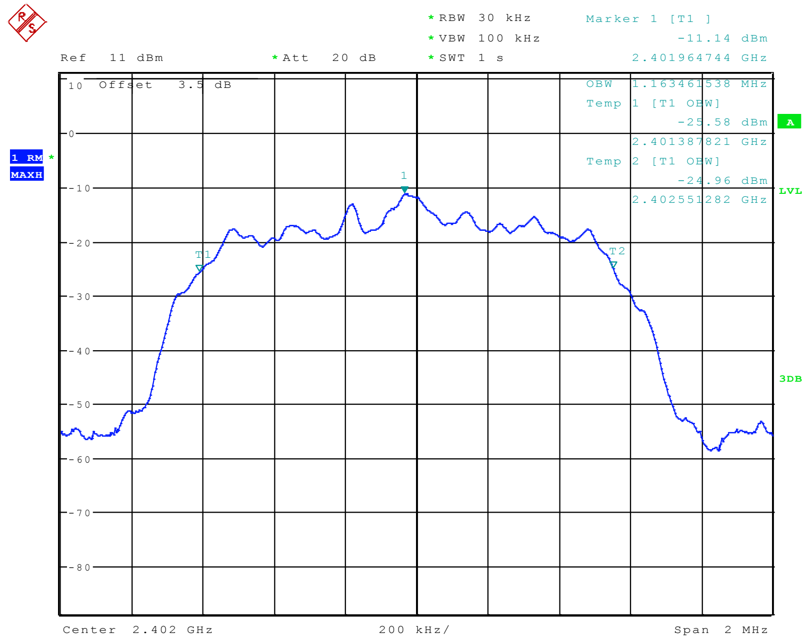
High Channel



Date: 9.JUL.2019 19:08:40

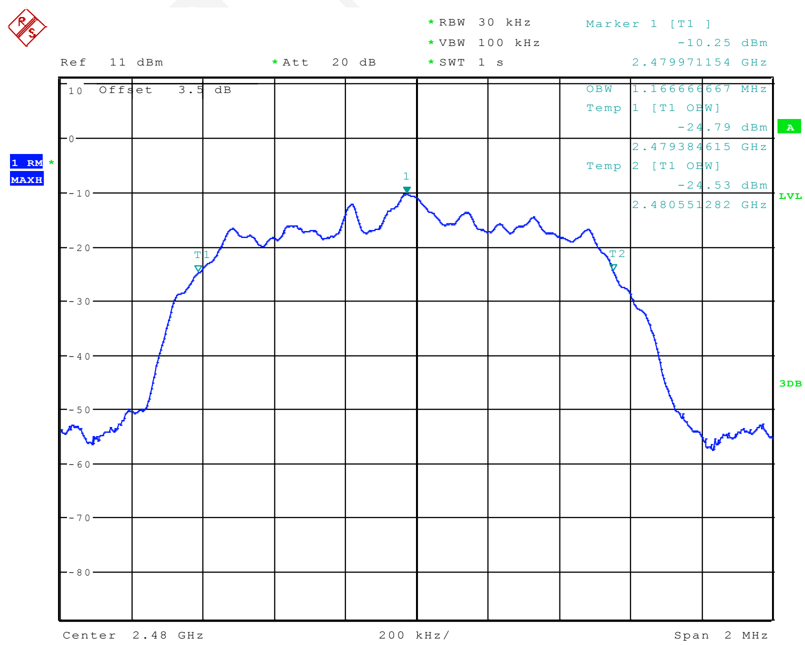
EDR Mode (π/4-DQPSK):

Low Channel



Date: 9.JUL.2019 19:07:30

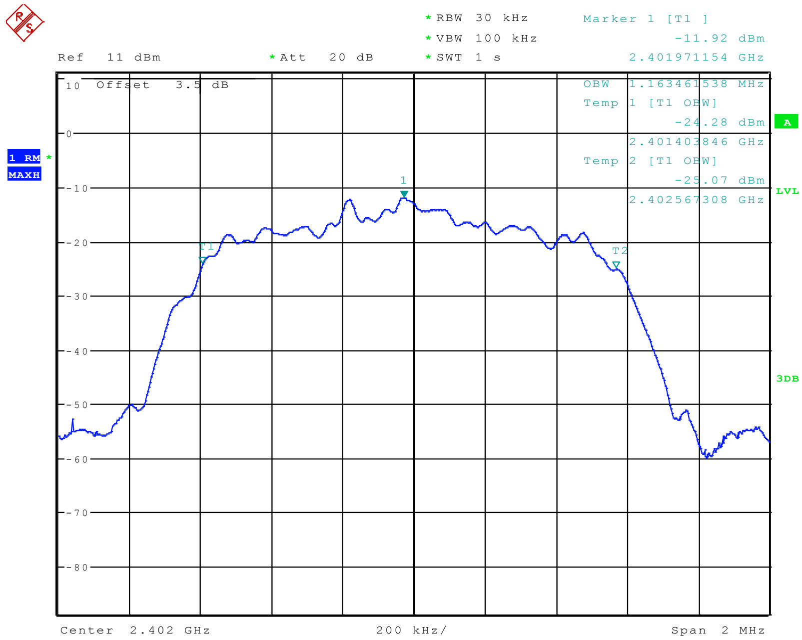
High Channel



Date: 9.JUL.2019 19:08:08

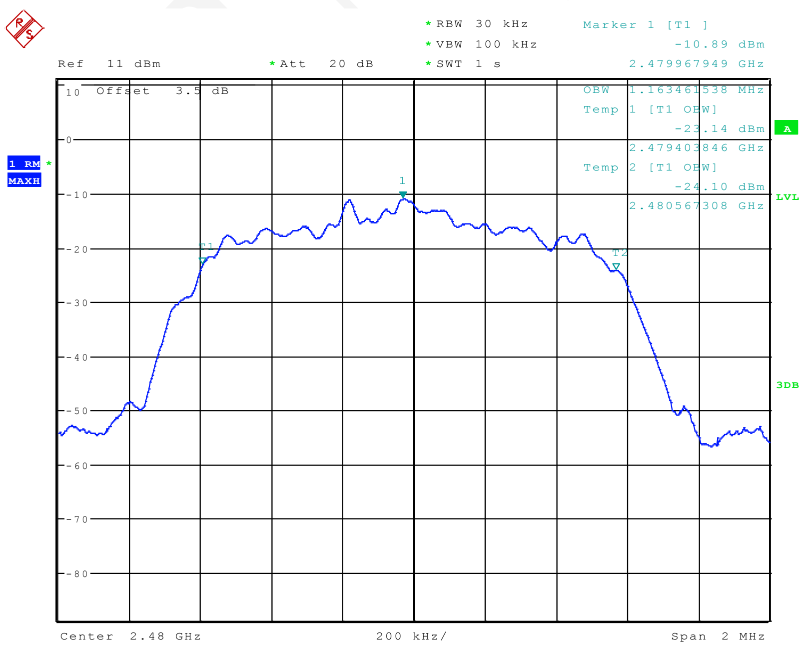
EDR Mode (8DPSK):

Low Channel



Date: 9.JUL.2019 19:06:39

High Channel



Date: 9.JUL.2019 19:05:58

ETSI EN 300 328 V2.1.1 (2016-11) §4.3.1.9 – TRANSMITTER UNWANTED EMISSION IN THE OUT-OF-BAND DOMAIN

Applicable Standard

Transmitter unwanted emissions in the out-of-band domain are emissions when the equipment is in Transmit mode, on frequencies immediately outside the necessary bandwidth which results from the modulation process, but excluding spurious emissions.

Limit:

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

Within the 2 400 MHz to 2 483,5 MHz band, the Out-of-band emissions are fulfilled by compliance with the Occupied Channel Bandwidth requirement in clause 4.3.1.8.

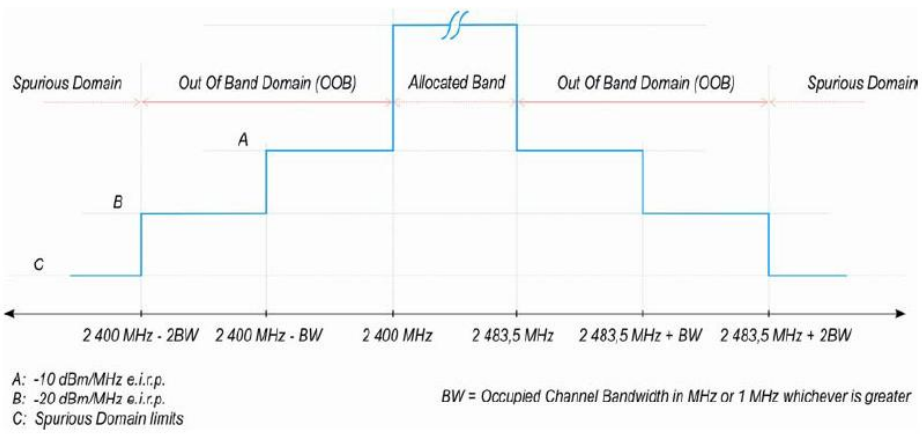


Figure 1: Transmit mask

Test Procedure

Conducted measurement:

The applicable mask is defined by the measurement results from the tests performed under clause 5.4.7 (Occupied Channel Bandwidth).

The Out-of-band emissions within the different horizontal segments of the mask provided in figure 1 and figure 3 shall be measured using the procedure in step 1 to step 6 below. This method assumes the spectrum analyser is equipped with the Time Domain Power option.

Step 1:

- Connect the UUT to the spectrum analyser and use the following settings:
  - Centre Frequency: 2 484 MHz
  - 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; 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.

Step 2: (segment 2 483,5 MHz to 2 483,5 MHz + BW)

- Adjust the trigger level to select the transmissions with the highest power level.
- For frequency hopping equipment operating in a normal hopping mode, the different hops will result in signal bursts with different power levels. In this case the burst with the highest power level shall be selected.
- Set a window (start and stop lines) to match with the start and end of the burst and in which the RMS power shall be measured using the Time Domain Power function.
- Select RMS power to be measured within the selected window and note the result which is the RMS power within this 1 MHz segment (2 483,5 MHz to 2 484,5 MHz). Compare this value with the applicable limit provided by the mask.
- Increase the centre frequency in steps of 1 MHz and repeat this measurement for every 1 MHz segment within the range 2 483,5 MHz to 2 483,5 MHz + BW. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + BW - 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

Step 3: (segment 2 483,5 MHz + BW to 2 483,5 MHz + 2BW)

- Change the centre frequency of the analyser to 2 484 MHz + BW and perform the measurement for the first 1 MHz segment within range 2 483,5 MHz + BW to 2 483,5 MHz + 2BW. Increase the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 483,5 MHz + 2 BW - 0,5 MHz.

Step 4: (segment 2 400 MHz - BW to 2 400 MHz)

- Change the centre frequency of the analyser to 2 399,5 MHz and perform the measurement for the first 1 MHz segment within range 2 400 MHz - BW to 2 400 MHz Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz.

Step 5: (segment 2 400 MHz - 2BW to 2 400 MHz - BW)

- Change the centre frequency of the analyser to 2 399,5 MHz - BW and perform the measurement for the first 1 MHz segment within range 2 400 MHz - 2BW to 2 400 MHz - BW. Reduce the centre frequency in 1 MHz steps and repeat the measurements to cover this whole range. The centre frequency of the last 1 MHz segment shall be set to 2 400 MHz - 2BW + 0,5 MHz.

Step 6:

- In case of conducted measurements on equipment with a single transmit chain, the declared antenna assembly gain "G" in dBi shall be added to the results for each of the 1 MHz segments and compared with the limits provided by the mask given in figures 1 or 3. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered.
- In case of conducted measurements on smart antenna systems (equipment with multiple transmit chains), the measurements need to be repeated for each of the active transmit chains. The declared antenna assembly gain "G" in dBi for a single antenna shall be added to these results. If more than one antenna assembly is intended for this power setting, the antenna with the highest gain shall be considered. Comparison with the applicable limits shall be done using any of the options given below:

- Option 1: the results for each of the transmit chains for the corresponding 1 MHz segments shall be added. The additional beamforming gain "Y" in dB shall be added as well and the resulting values compared with the limits provided by the mask given in figures 1 or 3.

- Option 2: the limits provided by the mask given in figures 1 or 3 shall be reduced by 10 x $\log_{10}(A_{ch})$ and the additional beamforming gain "Y" in dB. The results for each of the transmit chains shall be individually compared with these reduced limits.

NOTE: A_{ch} refers to the number of active transmit chains.

It shall be recorded whether the equipment complies with the mask provided in figures 1 or 3.

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 5.4.8.2.1.

Test Data

Environmental Conditions

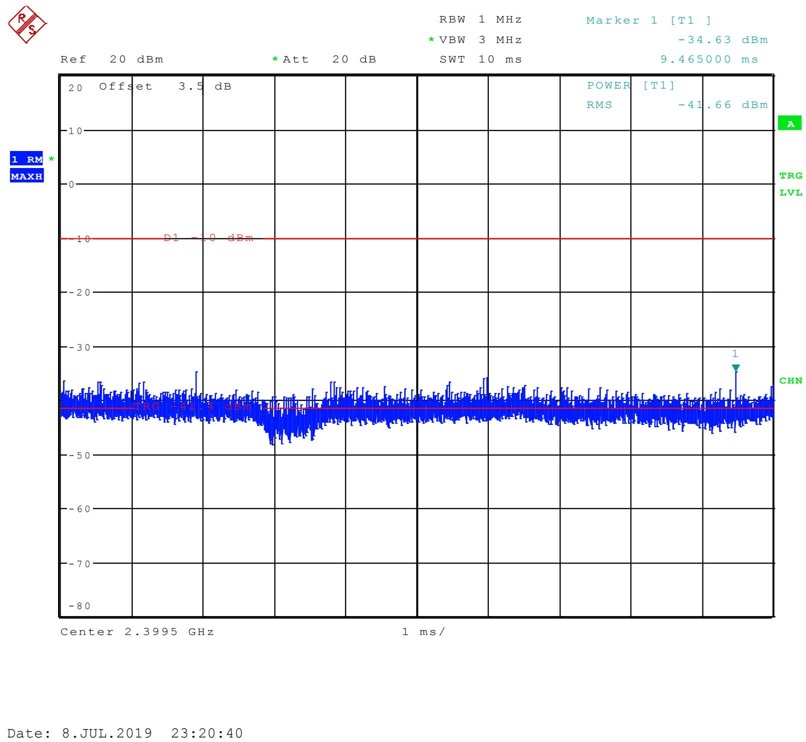
Temperature:	23 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

The testing was performed by George Zhong on 2019-07-08.
EUT operation mode: Transmitting

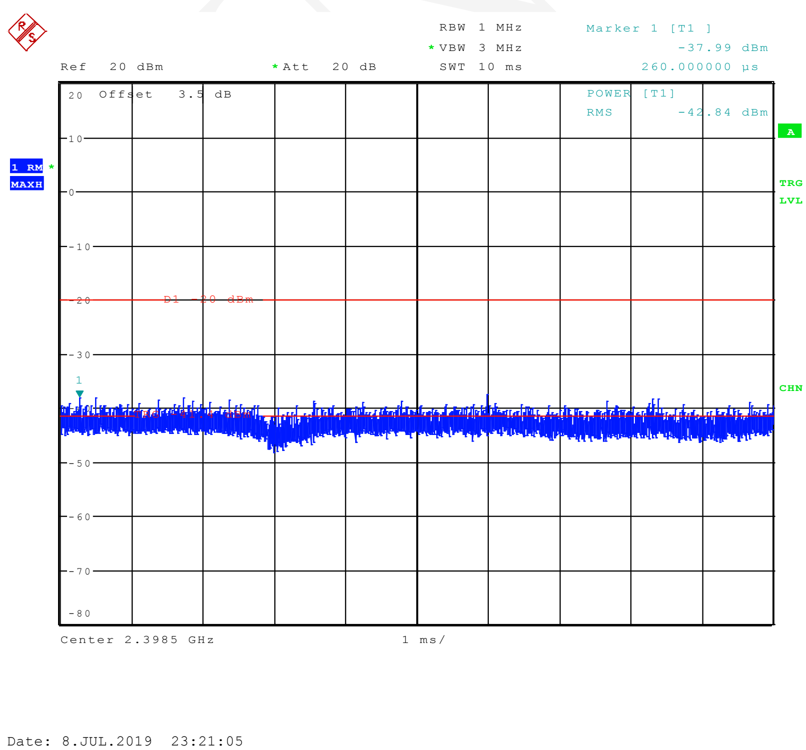
Note: Pretest with BDR mode, EDR mode (π/4-DQPSK) and EDR mode (8DPSK), the worst case was BDR mode.

Test Result: Compliance, please refer to the below plots for the worst case.

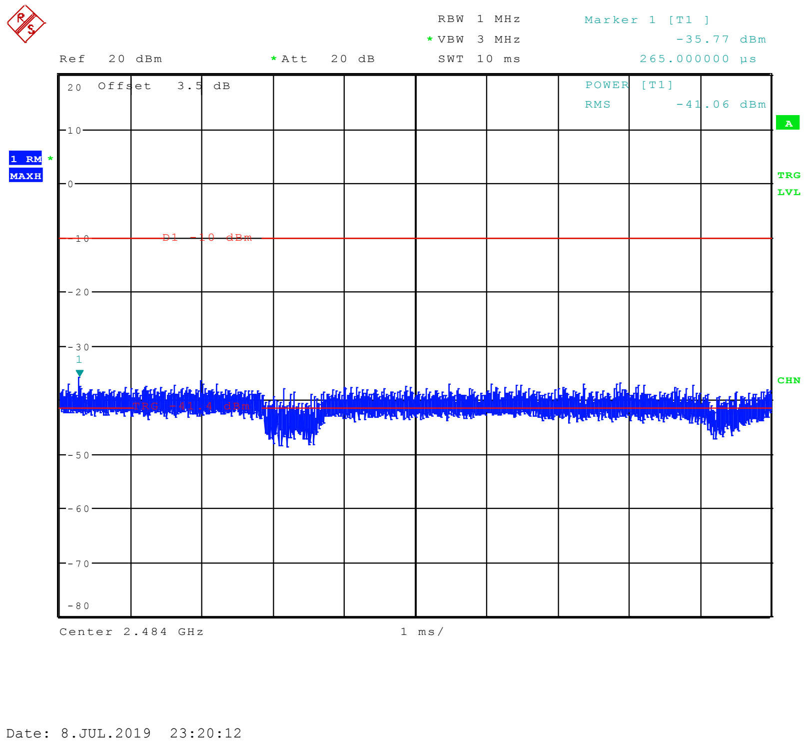
2400 MHz-BW



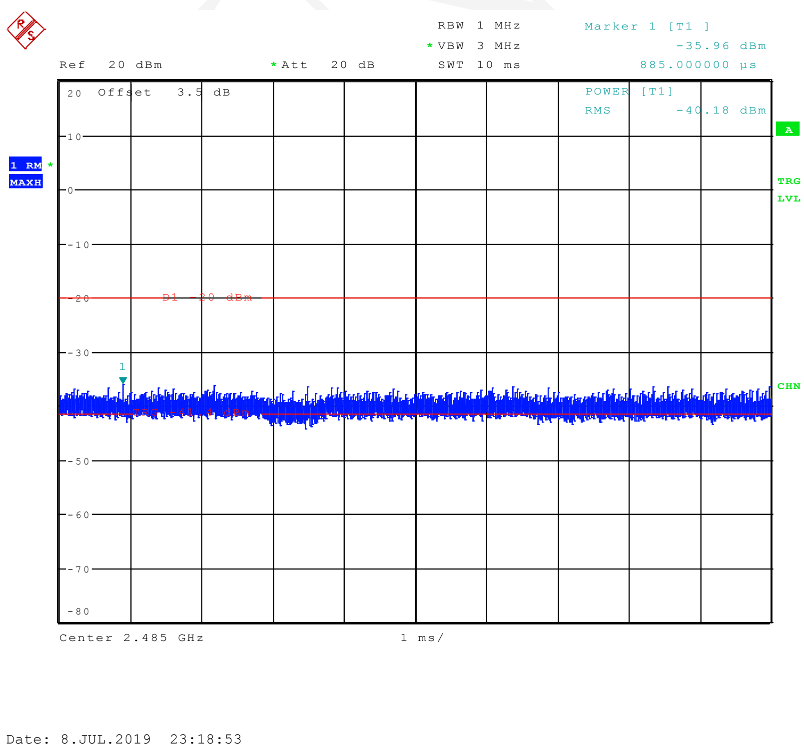
2400 MHz-2BW



2483.5 MHz+BW



2483.5 MHz+2BW



ETSI EN 300 328 V2.1.1 (2016-11) §4.3.1.10 – TRANSMITTER UNWANTED EMISSION IN THE SPURIOUS DOMAIN

Applicable Standard

Transmitter unwanted emissions in the spurious domain are emissions outside the allocated band and outside the out-of-band domain as indicated in figure 1 when the equipment is in Transmit mode.

The spurious emissions of the transmitter shall not exceed the values in following table:

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 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 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12.75 GHz	-30 dBm	1 MHz

Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

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 V2.1.1 (2016-11) §5.4.9.2.1

Radiated measurement:

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

The test procedure is further as described under clause 5.4.9.2.1.

Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	50 %
ATM Pressure:	100.0 kPa

The testing was performed by Curry Xiang on 2019-07-01.

EUT operation mode: Transmitting

Note: Pretest with BDR mode, EDR mode (π/4-DQPSK) and EDR mode (8DPSK), the worst case was BDR mode.

Test Result: Compliance, please refer to the below table for the worst case.

30 MHz ~ 12.75 GHz:

Frequency (MHz)	Receiver Reading (dBμV)	Turntable Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	EN 300 328	
			Height (m)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd/dBi)		Limit (dBm)	Margin (dB)
BDR-Low Channel										
123.52	32.90	354	2.4	H	-64.1	0.26	0	-64.36	-36	28.36
123.52	33.84	108	1.9	V	-63.2	0.26	0	-63.46	-36	27.46
4804.00	46.30	156	2.1	H	-54.7	1.60	12.10	-44.20	-30	14.20
4804.00	45.94	195	2.0	V	-54.0	1.60	12.10	-43.50	-30	13.50
BDR-High Channel										
123.52	33.40	217	1.5	H	-63.6	0.26	0	-63.86	-36	27.86
123.52	32.43	22	1.6	V	-64.6	0.26	0	-64.86	-36	28.86
4960.00	51.71	267	1.4	H	-48.9	1.70	12.00	-38.60	-30	8.60
4960.00	50.86	83	1.5	V	-49.2	1.70	12.00	-38.90	-30	8.90

Note 1: The unit of antenna gain is dBd for frequency below 1GHz and is dBi for frequency above 1GHz.
Note 2:
Absolute Level = SG Level - Cable loss + Antenna Gain
Margin = Limit- Absolute Level

ETSI EN 300 328 V2.1.1 (2016-11) §4.3.1.11 - RECEIVER SPURIOUS EMISSIONS

Applicable Standard

Receiver spurious emissions are emissions at any frequency when the equipment is in receive mode.

Limit:

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

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 e.i.r.p. for emissions above 1 GHz.

Spurious emission limits for receivers

Frequency range	Maximum power e.r.p. (≤ 1 GHz) e.i.r.p. (> 1 GHz)	Measurement bandwith
30 MHz to 1GHz	-57 dBm	100 kHz
1 GHz to 12.75GHz	-47 dBm	1 MHz

Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

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 V2.1.1 (2016-11) §5.4.10.2.1

Radiated measurement

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

The test procedure is further as described under clause 5.4.10.2.1.

Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	50 %
ATM Pressure:	100.0 kPa

The testing was performed by Curry Xiang on 2019-07-01.

EUT operation mode: Receiving

Note: Pretest with BDR mode, EDR mode (π/4-DQPSK) and EDR mode (8DPSK), the worst case was BDR mode.

Test Result: Compliance, please refer to the below table for the worst case.

30 MHz ~ 12.75 GHz

Frequency (MHz)	Receiver Reading (dBµV)	Turntable Angle Degree	Rx Antenna		Substituted			Absolute Level (dBm)	EN 300 328	
			Height (m)	Polar (H/V)	SG Level (dBm)	Cable Loss (dB)	Antenna Gain (dBd/dBi)		Limit (dBm)	Margin (dB)
Low Channel										
123.52	30.49	69	2.0	H	-66.5	0.26	0	-66.76	-57	9.76
123.52	30.86	200	2.1	V	-66.1	0.26	0	-66.36	-57	9.36
1425.38	41.70	30	1.6	H	-66.2	1.60	8.30	-59.50	-47	12.50
1425.38	41.43	3	2.0	V	-66.8	1.60	8.30	-60.10	-47	13.10
High Channel										
123.52	29.92	220	1.7	H	-67.1	0.26	0	-67.36	-57	10.36
123.52	30.36	223	1.7	V	-66.6	0.26	0	-66.86	-57	9.86
1425.38	41.44	230	2.4	H	-66.5	1.60	8.30	-59.80	-47	12.80
1425.38	40.53	119	1.8	V	-67.7	1.60	8.30	-61.00	-47	14.00

Note 1: The unit of antenna gain is dBd for frequency below 1GHz and is dBi for frequency above 1GHz.
Note 2:
Absolute Level = SG Level - Cable loss + Antenna Gain
Margin = Limit- Absolute Level

ETSI EN 300 328 V2.1.1 (2016-11) §4.3.1.12 - RECEIVER BLOCKING

Applicable Standard

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

Limit:

The minimum performance criterion shall be a PER less than or equal to 10 %. The manufacturer may declare alternative performance criteria as long as that is appropriate for the intended use of the equipment (see clause 5.4.1.t)).

While maintaining the minimum performance criteria as defined in clause 4.3.1.12.3, the blocking levels at specified frequency offsets shall be equal to or greater than the limits defined for the applicable receiver category provided in table 6, table 7 or table 8.

Table 6: Receiver Blocking parameters for Receiver Category 1 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 6 dB	2 380 2 503,5	-53	CW
P_{min} + 6 dB	2 300 2 330 2 360	-47	CW
P_{min} + 6 dB	2 523,5 2 553,5 2 583,5 2 613,5 2 643,5 2 673,5	-47	CW
NOTE 1: P_{min} is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

Table 7: Receiver Blocking parameters receiver category 2 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 6 dB	2 380 2 503,5	-57	CW
P_{min} + 6 dB	2 300 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

Table 8: Receiver Blocking parameters receiver category 3 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 12 dB	2 380 2 503,5	-57	CW
P_{min} + 12 dB	2 300 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.1.12.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

Test 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.

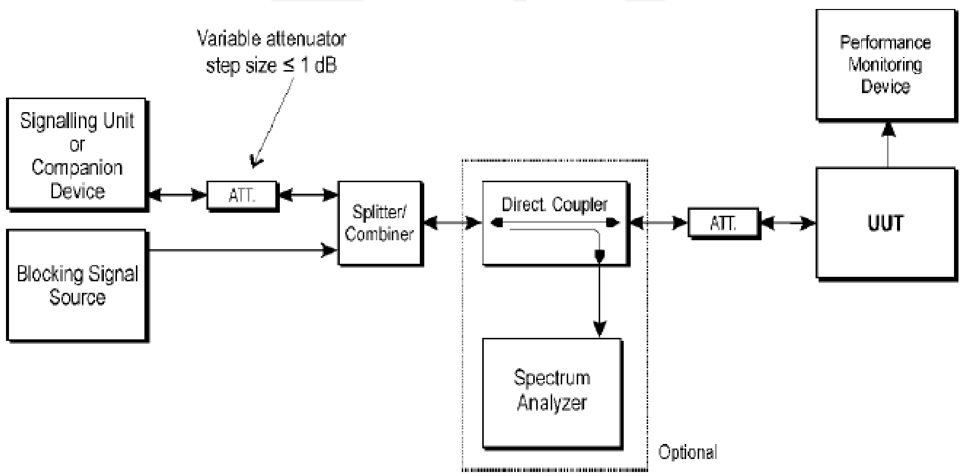


Figure 6: Test Set-up for receiver blocking

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.

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 frequency hopping 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 equipment using wide band modulations other than FHSS.

Step 1:

- For non-frequency hopping equipment, the UUT shall be set to the lowest operating channel.

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. 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 Pmin.

- This signal level (Pmin) is increased by the value provided in the 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. It shall be verified and recorded in the test report that the performance criteria as specified in clause 4.3.1.12.3 or clause 4.3.2.11.3 is met.

Step 5:

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

Step 6:

- For non-frequency hopping equipment, repeat step 2 to step 5 with the UUT operating at the highest operating channel.

Test Data

Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	50 %
ATM Pressure:	100.0 kPa

The testing was performed by George Zhong on 2019-07-09.

EUT operation mode: Receiving (Worst Case at BDR mode)

The Maximum EIRP is 6.90dBm<10dBm and the EUT is an adaptive device, so it belongs to the receiver category 2.

Mode	Blocking Signal Frequency (MHz)	Type Of Blocking Signal	PER (%)	Limit (%)
Normal Operation (BDR mode)	2380	CW	4	≤10
	2503.5	CW	4	
	2300	CW	4	
	2583.5	CW	4	

Test Result: Compliance

EXHIBIT A - E.2 INFORMATION AS REQUIRED BY EN 300 328 V2.1.1, 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:__79___;
The minimum number of Hopping Frequencies: __79___;

The (average) Dwell time:__3.75ms____;

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 maximum 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: 6.90dBm;
Power Spectral Density N/A;
Duty cycle, Tx-Sequence, Tx-gap N/A;
Accumulated Transmit Time, Minimum Frequency Occupation & Hopping Sequence (only for FHSS equipment) 0.265s, 4, 79;
Hopping Frequency Separation (only for FHSS equipment) 1.005MHz;
Medium Utilisation N/A;
Adaptivity N/A;
Receiver Blocking Pass;
Nominal Channel Bandwidth 1.167MHz;
Transmitter unwanted emissions in the OOB domain -40.18dBm/MHz;
Transmitter unwanted emissions in the spurious domain -38.60dBm;
Receiver spurious emissions -66.36dBm;

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: 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: 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:_ BDR Mode (GFSK) 0.830 _ MHz
Occupied Channel Bandwidth 2:_ EDR Mode (π/4-DQPSK) 1.167 _ MHz
Occupied Channel Bandwidth 3:_ EDR Mode (8DPSK) 1.163 _ 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:___ -20 __ °C Maximum ___ +55 ___ °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:__ 0 __ dBi

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

☐ Temporary RF connector provided
☐ No temporary RF connector provided

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

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

Note 1: Add more lines in case the equipment has more power levels.
Note 2: These power levels are conducted power levels (at antenna connector).

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

Power Level 1:_____dBm

Number of antenna assemblies provided for this power level:

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

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 ____V
☒ DC State DC voltage ___3.3____ V

In case of DC, indicate the type of power source
☐ Internal Power Supply
☐ External Power Supply or AC/DC adapter
☐ Battery
☒ Other:____testing jig 3.3V_{DC} ________________________________.

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], IEEE 802.15.4™ [i.4], proprietary, etc.):
_____Bluetooth®_____.

q) If applicable, the statistical analysis referred to in clause 5.4.1 q)

(to be provided as separate attachment)

r) If applicable, the statistical analysis referred to in clause 5.4.1 r)

(to be provided as separate attachment)

s) Geo-location capability supported by the equipment:

☐ Yes

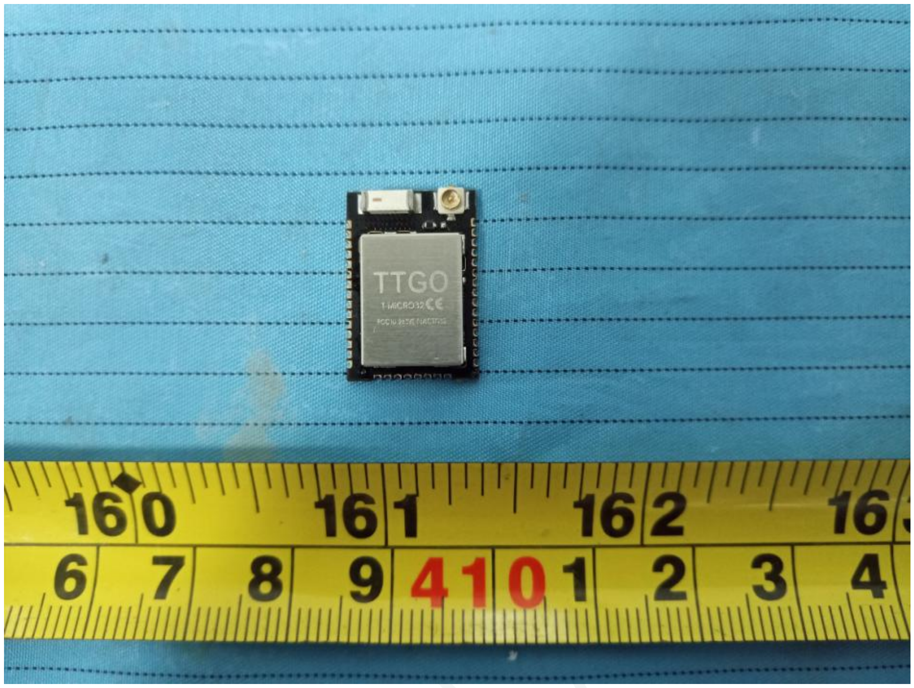
☐ The geographical location determined by the equipment as defined in clause 4.3.1.13.2 or clause 4.3.2.12.2 is not accessible to the user.

☒ No

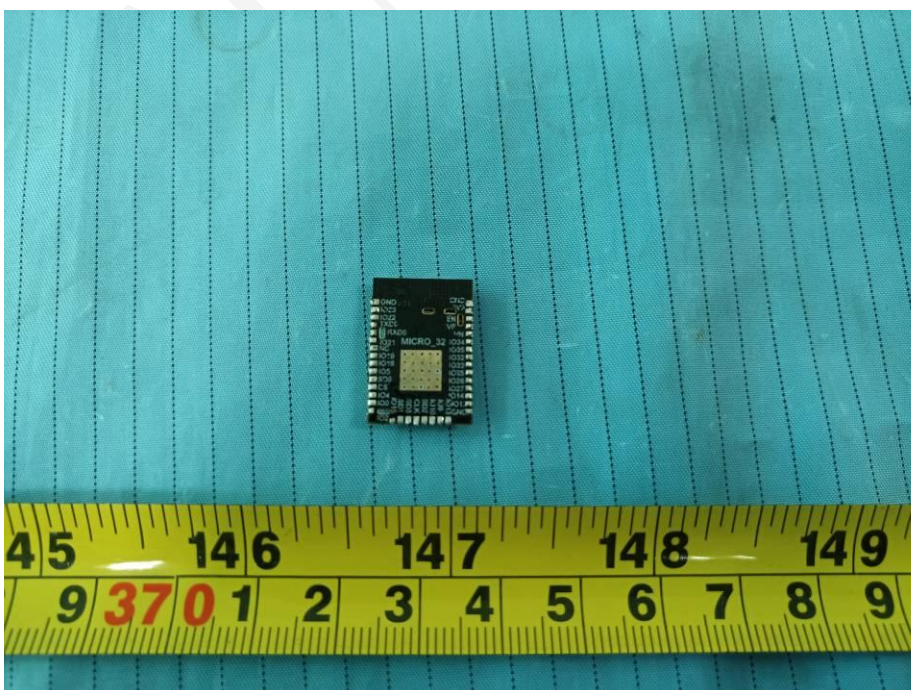
t) Describe the minimum performance criteria that apply to the equipment (see clause 4.3.1.12.3 or clause 4.3.2.11.3): ______4%__________.

EXHIBIT B - EUT PHOTOGRAPHS

EUT – Front View



EUT – Rear View



EUT – Main Board View

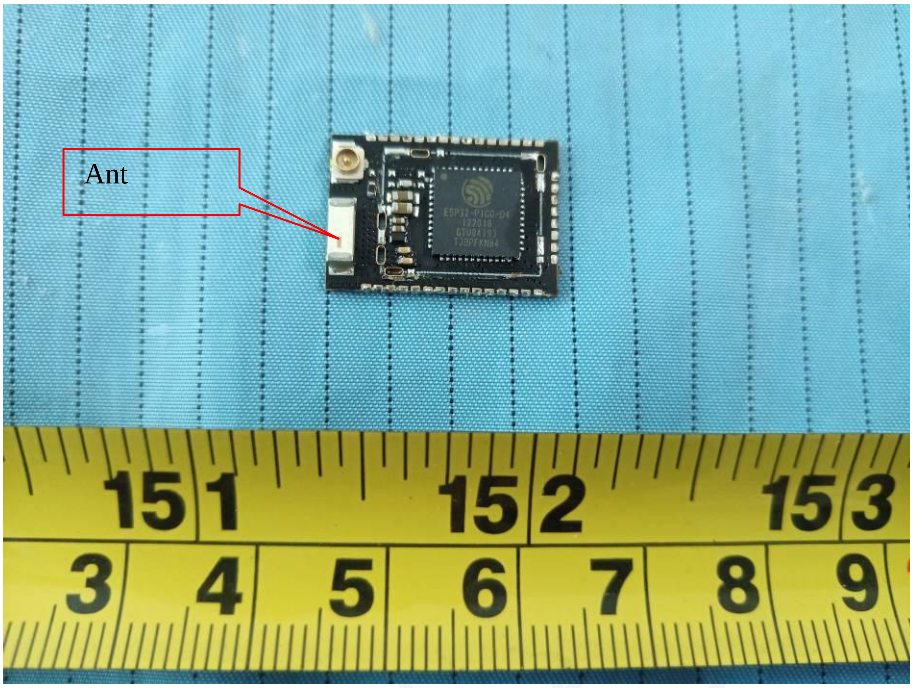
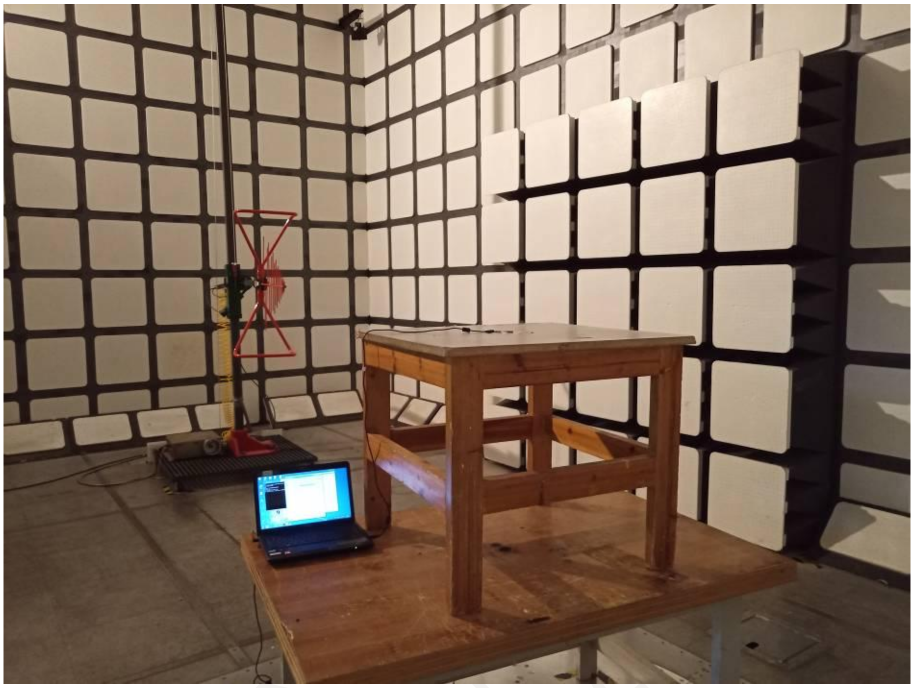


EXHIBIT C - TEST SETUP PHOTOGRAPHS

Radiated Spurious Emissions Test View (Below 1GHz)



Radiated Spurious Emissions Test View (Above 1GHz)

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