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BLUETOOTH LOW ENERGY REPORT

CE Certification

Applicant Name:
WISOL CO., LTD.

531-7, Gajang-ro, Osan-Si, Gyeonggi-do, 18103, Rep. of KOREA

Date of Issue:
October 16, 2017

Location:
HCT CO., LTD.,
74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

Report No.: HCT-R-1710-C002

MODEL:	**SFM20R1**
APPLICANT:	**WISOL CO., LTD.**

Use of Report:	Approval for CE
Eut Type:	Sigfox Quad-mode module
Tx Frequency:	2 402 MHz ~ 2 480 MHz
Rx Frequency:	2 402 MHz ~ 2 480 MHz
Testing Environment:	Temperature : (24.3 ± 3.0)℃ Relative Humidity : (37.0 ± 3.0) %
Date of Test:	April 21, 2017 ~ October 13, 2017
Applicable Standard:	ETSI EN 300 328 V2.1.1 (2016-11)

All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Report prepared by : Jung Rae Cho
Engineer of Telecommunication Testing Center

Report approved by : Yong Hyun Lee
Manager of Telecommunication Testing Center

Report Revision

TEST REPORT NO.	DATE	DESCRIPTION
HCT-R-1710-C002	October 16, 2017	- First Approval Report.

Result of Test

CONTENTS

1. CLIENT INFORMATION

The EUT has been tested by request of

Company	**WISOL CO., LTD.** 531-7, Gajang-ro, Osan-Si, Gyeonggi-do, 18103, Rep. of KOREA

2. EQUIPMENT UNDER TEST (EUT)

Equipment	Sigfox Quad-mode module
Model	SFM20R1
Serial number	-
Manufacturer	WISOL CO., LTD.
Rating	DC 3.3 V

3. DESCRIPTION OF THE EQUIPMENT UNDER TEST

3.1 Manufacturers declarations

No. of units:	One (Transceiver)	
No. of deviating variants:	None	
Application:	Sigfox Quad-mode module	
Equipment category:	Short Range Device	
Model No.:	SFM20R1	
Serial No.:	-	
Type of modulation:	GFSK	
Bluetooth version	4.2	
Specification(s):	ETSI EN 300 328 V2.1.1 (2016-11)	
Receiver Category:	2	
Type of unit:	Stand-alone equipment	
Type of Equipment	☒Adaptive Equipment without the possibility to switch to a non-adaptive mode	
	☐Non-adaptive Equipment	
	☐Adaptive Equipment which can also operate in a non-adaptive mode	
Operating frequency range:	2 400 MHz ~2 483.5 MHz	
Frequency alignment range:	2 402 MHz ~ 2 480 MHz	
Beamforming	Not applicable	
Channels :	40	
Version:	Hardware : 1.0	
	Software : SFM20R_V204	
Power source:	Normal voltage :	DC 3.30 V
	Extreme lower voltage :	DC 3.20 V
	Extreme upper voltage :	DC 5.00 V
Temperature range:	Normal Temperature :	+24.3℃
	Extreme lower Temperature :	-30.0℃
	Extreme upper Temperature :	+85.0℃
Antenna type:	Dipole Antenna	
Max. antenna gain:	4.44 dBi	

Note:
At the request of the customer, all test requirements were performed ETSI EN 300 328 V2.1.1 (2016-11)

3.2 Channel List

Bluetooth Low Energy					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2 402	14	2 430	28	2 458
01	2 404	15	2 432	29	2 460
02	2 406	16	2 434	30	2 462
03	2 408	17	2 436	31	2 464
04	2 410	18	2 438	32	2 466
05	2 412	19	2 440	33	2 468
06	2 414	20	2 442	34	2 470
07	2 416	21	2 444	35	2 472
08	2 418	22	2 446	36	2 474
09	2 420	23	2 448	37	2 476
10	2 422	24	2 450	38	2 478
11	2 424	25	2 452	39	2 480
12	2 426	26	2 454	-	-
13	2 428	27	2 456	-	-

3.3 Operating frequency range during under the test

Operating frequency	Frequency(MHz)
Bottom	2 402
Middle	2 440
Top	2 480

4. TEST SUMMARY

Clause	Parameter	Test method	Result
4.3.2.2	RF Output Power	Conducted	Pass
4.3.2.3	Power Spectral Density	Conducted	Pass
4.3.2.4	Duty cycle, Tx-Sequence, Tx-gap	N/A	(See note1)
4.3.2.5	Medium Utilisation	N/A	(See note1)
4.3.2.6	Adaptivity	N/A	(See note1)
4.3.2.7	Occupied Channel Bandwidth	Conducted	Pass
4.3.2.8	Transmitter unwanted emissions in the OOB domain	Conducted	Pass
4.3.2.9	Transmitter unwanted emissions in the spurious domain	Radiated	Pass
4.3.2.10	Receiver Spurious emissions	Radiated	Pass
4.3.2.11	Receiver Blocking	Conducted	Pass
4.3.2.12	Geo-location capability	N/A	(See note2)

Note:

1. These requirements do not apply for equipment with a maximum declared RF Output power of less than 10 dBm e.i.r.p or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.
2. Geo-location capability is implemented in this product and can't be accessible to the user.
3. At the request of the customer, all test requirements were performed EN 300 328 V2.1.1 (2016-11).

5. TEST EQUIPMENT

No.	Instrument	Model No.	Due to Calibration	Manufacture	Serial No.
☒	Signal Analyzer (20 Hz ~ 40.0 GHz)	FSV40-N	2018-09-27	ROHDE & SCHWARZ	101068-SZ
☒	Signal Analyzer (20 Hz ~ 26.5 GHz)	N9020A	2018-01-05	AGILENT	MY50200666
☒	SIGNAL GENERATOR (100kHz~40GHz)	SMB100A	2018-07-18	Rohde&Schwarz	177633
☒	Communication Tester	CMW500	2018-02-21	Rohde&Schwarz	157452
☒	Power Measurement Set	OSP 120(See note3)	2018-08-03	Rohde&Schwarz	101231
☒	High Pass Filter (3.0 GHz ~ 18 GHz)	WHKX10-2700-3000-18000-40SS	2018-07-20	Wainwright Instrument	3
☒	Band rejection filter (2 400 MHz ~ 2 483.5 MHz/ DC ~ 4 GHz)	WRCJ2400/2483.5-2370/2520-60/12SS	2018-06-30	WAINWRIGHT INSTRUMET	2
☒	BI-LOG Antenna (30 MHz ~ 1 GHz)	VULB9160	2018-10-14	Schwarzbeck	3368
☒	Full anechoic chamber	10m×5m×5m	-	EMERSON&CUMING	-
☒	Fixed Attenuator (10 dB, DC ~ 26.5 GHz)	56-10	2017-11-03	WEINSCHEL	72324
☒	Fixed Attenuator (20 dB, DC ~ 26.5 GHz)	8493C	2018-06-22	HP	17280
☒	DC power supply	E3632A	2018-03-14	HP	KR75303962
☒	Temp & Humidity Chamber	SU-642	2018-03-31	ESPEC	93008124
☒	POWER AMP (0.1 GHz ~ 18 GHz)	CBLU1183540B-01	2018-06-12	CERNEX	26822
☒	Horn Antenna (1 GHz ~ 18 GHz)	BBHA9120D	2018-10-14	Schwarzbeck	9120D-1298
☒	STEP ATTENUATOR (1 W, DC ~ 18 GHz)	AF9003-69-31	2017-10-24	WEINSCHEL	11787
☒	POWER SPLITTER (Dc to 26.5 GHz)	11667B	2018-05-04	HP	11275

Note:

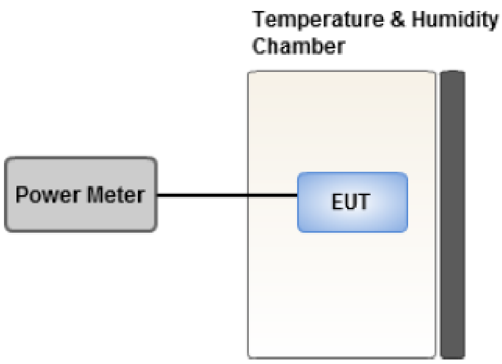
1. All equipment is calibrated with traceable calibrations.
2. Each calibration is traceable to the national or international standards.
3. OSP120 spec :

- RMS integration over a significant portion of signal
- Fast response time for accurate burst detection
- Sampling rate 1 MS/s
- Storage of max. 32 Million samples in total
- Synchronous measurement channels for 4 antenna ports
- Maximum DUT output power 12 dBm linear without attenuator, with included attenuators 22 dBm linear (and 32 dBm linear optional)
- Measurement tolerances better than ETSI requirements

6. TRANSMITTER MEASUREMENTS – RESULTS

6.1 Maximum transmit power (Conducted)

6.1.1 Test Setup



6.1.2 Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.2.2

Step 1:

• Use a fast power sensor suitable for 2,4 GHz 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 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 Pburst 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 Pburst 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 clause 4.3.1.2.3 or clause 4.3.2.2.3, shall be recorded in the test report.

6.1.3 Limit

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

The maximum RF output power for non-adaptive equipment shall be declared by the manufacturer and shall not exceed 20 dBm. See clause 5.4.1 m). For non-adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be equal to or less than the value declared by the manufacturer.

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

6.1.4 Test Result

Test Conditions:	Modulation	RF Output Power (dBm)		
		Bottom Frequency	Middle Frequency	Top Frequency
T nom	GFSK	7.65	8.00	8.00
T low		8.94	8.82	8.91
T high		5.92	5.93	5.98
Measurement Uncertainty : 0.35 dB (about 95 %, *k* = 2)				

Note :

1. P = A + G + Y

(P : RF Output Power, A : Highest of all Pburst values.G : Antenna assembly gain, Y : Beamforming gain)

6.2 Power spectral density

6.2.1 Test Setup

6.2.2 Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.3.2

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

• Detector: RMS

• Trace Mode: Max Hold

• Sweep time: 2 × Channel Occupancy Time × number of sweep points

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.

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

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 *PSamplecorr(n)* (lowest frequency), add up the power (in mW) of the following samples representing a 1 MHz segment and record the results for power and position (i.e. sample #1 to sample #100).

This is the Power Spectral Density (e.i.r.p.) for the first 1 MHz segment which shall be recorded.

Step 6:

Shift the start point of the samples added up in step 5 by 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 (PSD) 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.

6.2.3 Limit

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

6.2.4 Test Result

TEST CONDITIONS:		Power Spectral Density(dBm/MHz)		
		2 402 MHz	2 440 MHz	2 480 MHz
T nom	V nom	7.39	7.74	7.80
Measurement Uncertainty : 1.18 dB (about 95 %, *k* = 2)				

Note:

1. Modulation type : GFSK

6.3 Occupied channel bandwidth

6.3.1 Test Setup

6.3.2 Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.7.2

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 × Occupied Channel Bandwidth

• Detector Mode: RMS

• Trace Mode: Max Hold

• Sweep time: 1 s

Step 2:

Wait until the trace is completed.

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.

6.3.3 Limit

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

• clause 1.: 2,4 GHz to 2,4835 GHz.

In addition, for non-adaptive equipment using wide band modulations other than FHSS and with e.i.r.p greater than10 dBm, the occupied channel bandwidth shall be less than 20 MHz

6.3.4 Test Result

TEST CONDITIONS:		Occupied Channel Bandwidth (MHz)	
		Lowest Frequency	Highest Frequency
T nom	V nom	1.05	1.06
Range to OBW(MHz)		2 401.48 ~ 2 480.54	
Limit(MHz)		2 400 ~ 2 483.5	
Measurement Uncertainty : 95 kHz (about 95 %, *k* = 2)			

Note:

1. Modulation type : GFSK

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

6.4.1 Test Setup

6.4.2 Test Procedure

Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.8.2

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

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

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

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 to2 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 (which means this may partly overlap with the previous 1 MHz segment).

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 - BW + 0,5 MHz (which means this may partly overlap with the previous 1 MHz segment).

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 (which means this may partly overlap with the previous 1 MHz segment).

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 figure 1 or figure 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 figure 1 or figure 3.

- Option 2: the limits provided by the mask given in figure 1 or figure 3 shall be reduced by 10 × log10(Ach) 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: Ach refers to the number of active transmit chains.

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

6.4.3 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 3.

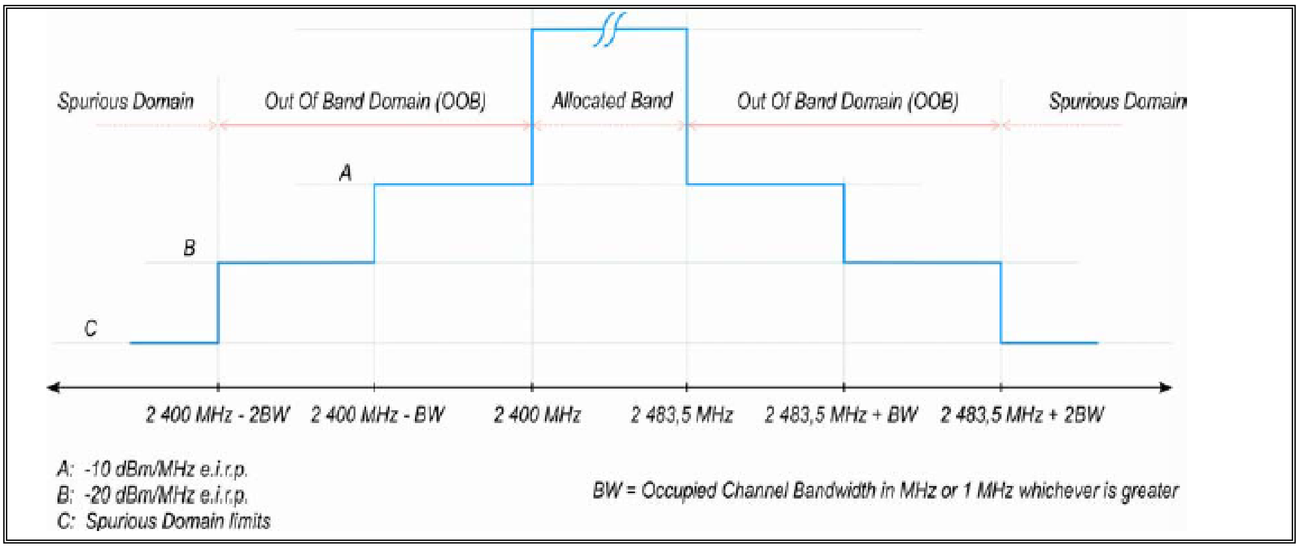


figure 3 : Transmit mask

6.4.4 Test Result

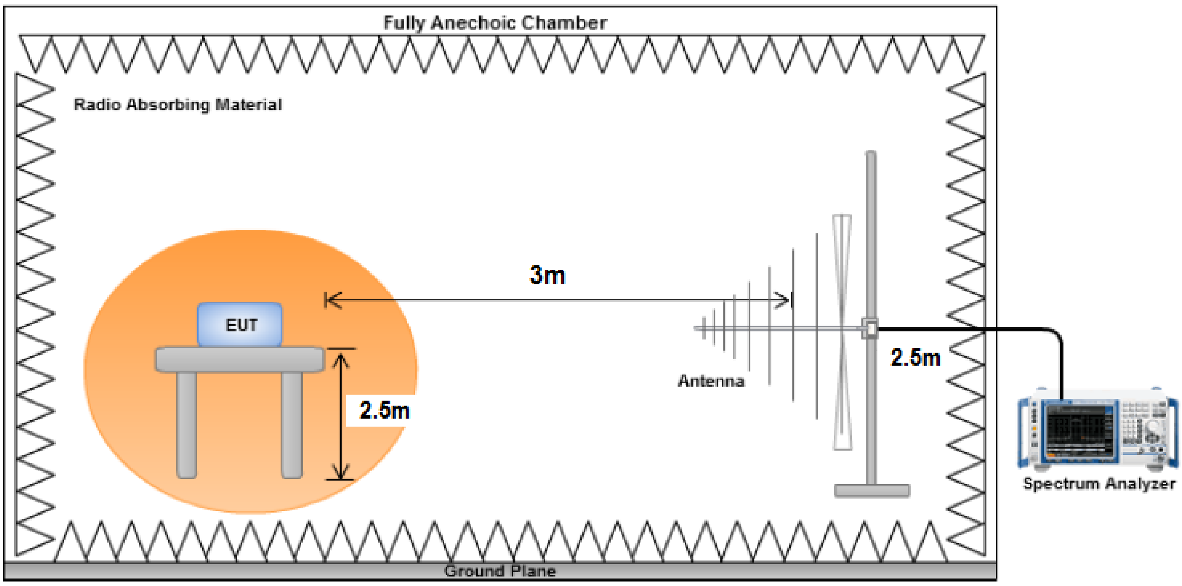
Test Conditions	Modulation	Measured Burst Power (dBm/ MHz)			
		Lowest Frequency		Highest Frequency	
		2400 MHz – 2BW ~ 2400 MHz -BW	2400 MHz – BW ~ 2400 MHz	2483.5 MHz ~ 2483.5 MHz + BW	2483.5 MHz + BW ~ 2483.5 MHz + 2BW
T nom	GFSK	-31.31	-29.06	-28.98	-30.30
Measurement Uncertainty : 0.70 dB (about 95 %, *k* = 2)					

Note:

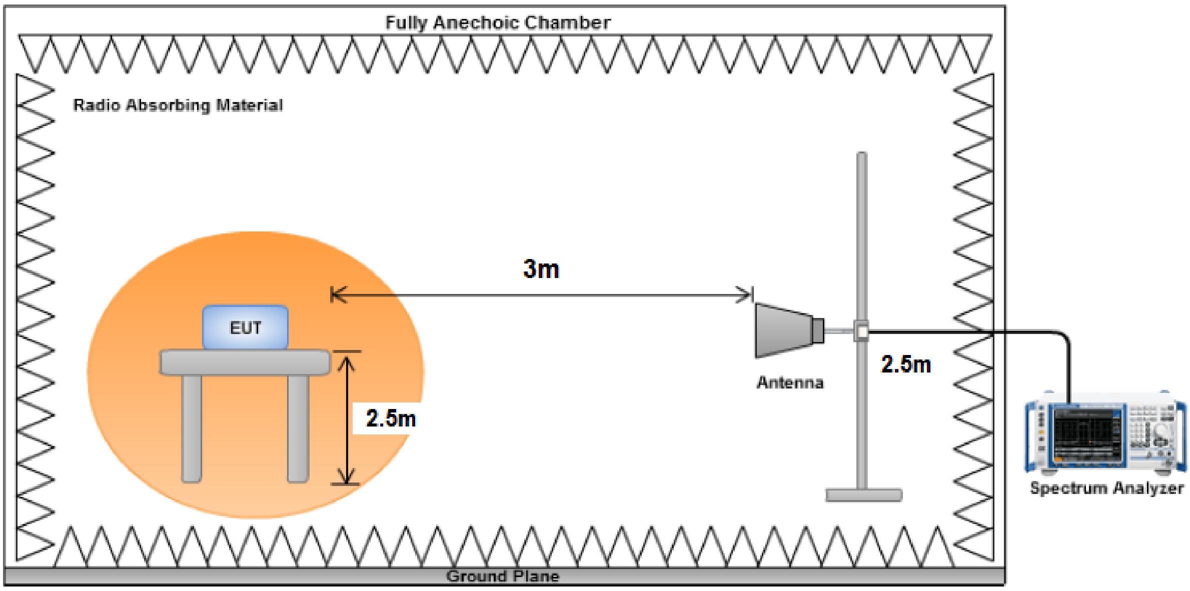
1. Modulation type : GFSK

6.5 Transmitter unwanted emissions in the spurious domain
6.5.1 Test Setup

Below 1GHz



Above 1GHz



6.5.2 Test Procedure

- Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.9.2
- 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.

6.5.3 Test Site

- Fully Anechoic Room

6.5.4 Test Method

- Correction values from a verified site calibration was used.
- During the tests, the measurement antenna polarization and EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.
- The test was performed by placing the EUT on 3 orthogonal axis(X, Y, Z) and shown the worst case on this report.
- If the test data is very low, the data is not reported.

6.5.5 Limit

Frequency range	Maximum power	Bandwidth
30 MHz to 47 MHz	-36 dBm	100 kHz
47 MHz to 74 MHz	-54 dBm	100 kHz
74 MHz to 87,5 MHz	-36 dBm	100 kHz
87,5 MHz to 118 MHz	-54 dBm	100 kHz
118 MHz to 174 MHz	-36 dBm	100 kHz
174 MHz to 230 MHz	-54 dBm	100 kHz
230 MHz to 470 MHz	-36 dBm	100 kHz
470 MHz to 862 MHz	-54 dBm	100 kHz
862 MHz to 1 GHz	-36 dBm	100 kHz
1 GHz to 12,75 Hz	-30 dBm	1 MHz

6.5.6 Test Result

Measurement Frequency(MHz)	Polarization	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
952.62	V	-56.28	-30.00	26.28	Peak
2377.18	V	-43.68	-30.00	13.68	Peak
4804.00	V	-51.43	-30.00	21.43	Peak
7206.00	V	-43.70	-30.00	13.70	Peak
9608.00	V	-41.99	-30.00	11.99	Peak
Measurement Uncertainty		Below 1 GHz : 5.16 dB (about 95 %, *k* = 2) Above 1 GHz : 5.57 dB (about 95 %, *k* = 2)			

Note

1. Modulation type : GFSK
2. Test Frequency : 2 402 MHz

Measurement Frequency(MHz)	Polarization	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
955.72	V	-56.01	-30.00	26.01	Peak
2509.09	V	-43.54	-30.00	13.54	Peak
4960.00	V	-51.55	-30.00	21.55	Peak
7440.00	V	-43.31	-30.00	13.31	Peak
9920.00	V	-42.20	-30.00	12.20	Peak
Measurement Uncertainty		Below 1 GHz : 5.16 dB (about 95 %, *k* = 2) Above 1 GHz : 5.57 dB (about 95 %, *k* = 2)			

Note

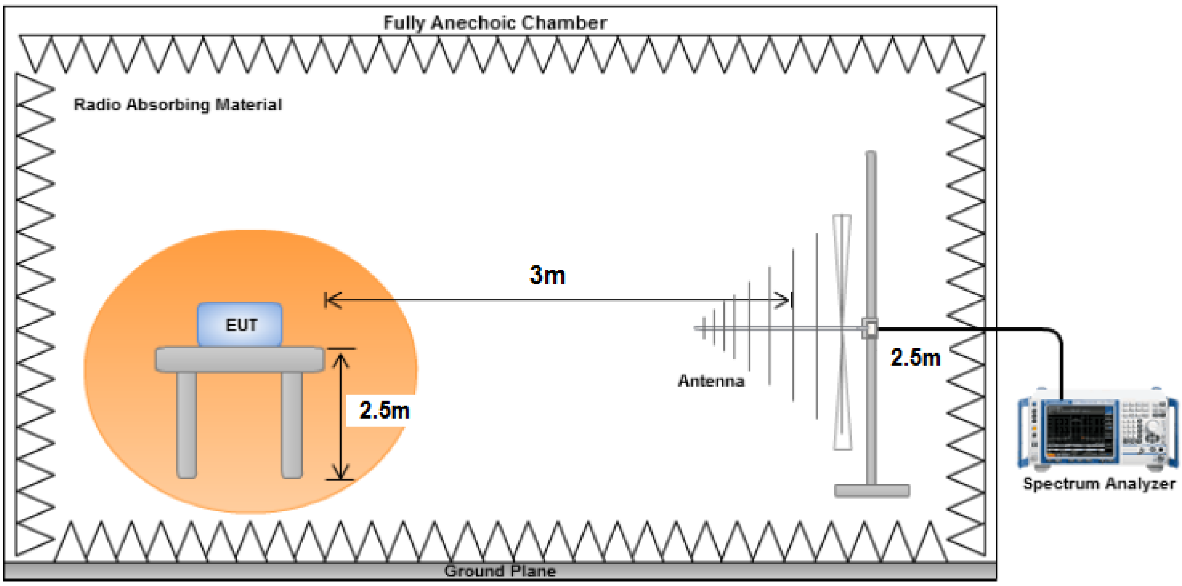
1. Modulation type : GFSK
2. Test Frequency : 2 480 MHz

7. RECEIVER MEASUREMENTS – RESULTS

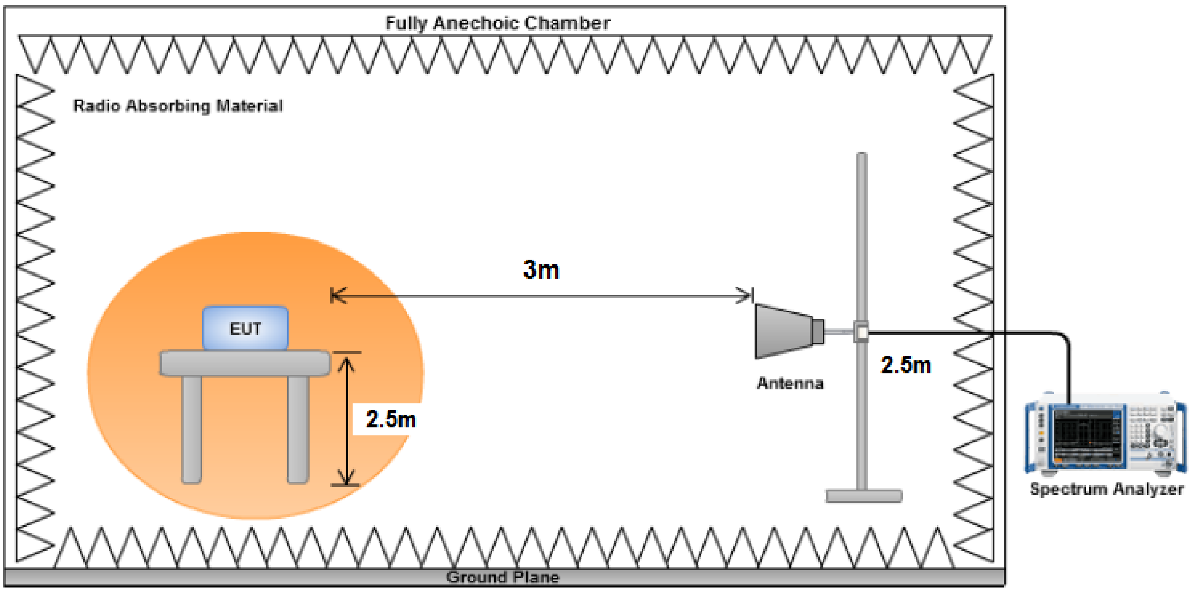
7.1 Receiver Spurious Emissions

7.1.1 Test Setup

Below 1GHz



Above 1GHz



7.1.2 Test Procedure

- Refer to ETSI EN 300 328 V2.1.1 (2016-11) Clause 5.4.10.2
- 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.

7.1.3 Test Site

- Fully Anechoic Room

7.1.4 Test Method

- Correction values from a verified site calibration was used.
- During the tests, the measurement antenna polarization and EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.
- The test was performed by placing the EUT on 3 orthogonal axis(X, Y, Z) and shown the worst case on this report.
- If the test data is very low, the data is not reported.

7.1.5 Limit

Frequency range	Maximum power	Measurement bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12.75 GHz	-47 dBm	1 MHz

7.1.6 Test Result

Measurement Frequency(MHz)	Polarization	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
No Peak Found					
Measurement Uncertainty		Below 1 GHz : 5.16 dB (about 95 %, *k* = 2) Above 1 GHz : 5.57 dB (about 95 %, *k* = 2)			

Note

1. Modulation type : GFSK
2. Test Frequency : 2 402 MHz

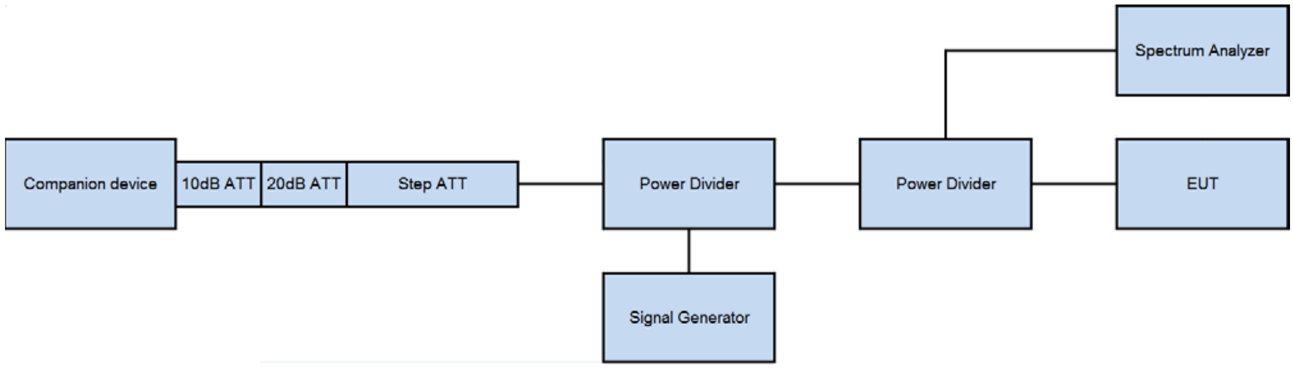
Measurement Frequency(MHz)	Polarization	Level (dBm)	Limit (dBm)	Margin (dB)	Detector
No Peak Found					
Measurement Uncertainty		Below 1 GHz : 5.16 dB (about 95 %, *k* = 2) Above 1 GHz : 5.57 dB (about 95 %, *k* = 2)			

Note

1. Modulation type : GFSK
2. Test Frequency : 2 480 MHz

7.2 Receiver Blocking

7.2.1 Test Setup



- Companion device : CMW500
- Signal Generator : N5182A
- 30 dB attenuator : 8493C-030
- Power divider : 11636B
- We performed PER test using the Hidden Menu.
  (Hidden Menu(Keystring) → Bluetooth LE Test Enable → Rx test)

7.2.2 Test Procedure

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.

7.2.3 Limit

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

While maintaining the minimum performance criteria, 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 below.

- **Receiver Category 1**

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm)	Type of blocking signal
Pmin + 6 dB	2 380 2 503,5	-53	CW
Pmin + 6 dB	2 300 2 330 2 360	-47	CW
Pmin + 6 dB	2 523,5 2 553,5 2 583,5 2 613,5 2 643,5 2 673,5	-47	CW

- **Receiver Category 2**

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm)	Type of blocking signal
Pmin + 6 dB	2 380 2 503,5	-57	CW
Pmin + 6 dB	2 300 2 583,5	-47	CW

- **Receiver Category 3**

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm)	Type of blocking signal
Pmin + 12 dB	2 380 2 503,5	-57	CW
Pmin + 12 dB	2 300 2 583,5	-47	CW

7.2.4 Test Result

Companion device (dBm)	Blocking signal power (dBm)	Blocking signal frequency (MHz)	Packets Transmitted	Packets Received	Performance criterion (%)
Pmin + 6 dB	-57	2 380	10000	10000	0.00
		2 503,5	10000	10000	0.00
Pmin + 6 dB	-47	2 300	10000	10000	0.00
		2 583,5	10000	10000	0.00

Note:

1. Receiver Category : 2
2. Type of blocking signal : CW
3. Pmin : Pmin is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria in the absence of any blocking signal = -92.30 dBm
4. Minimum performance criterion : PER less than or equal to 10 %.
5. Test Frequency : 2 402 MHz

Companion device (dBm)	Blocking signal power (dBm)	Blocking signal frequency (MHz)	Packets Transmitted	Packets Received	Performance criterion (%)
Pmin + 6 dB	-57	2 380	10000	10000	0.00
		2 503,5	10000	10000	0.00
Pmin + 6 dB	-47	2 300	10000	10000	0.00
		2 583,5	10000	10000	0.00

Note:

1. Receiver Category : 2
2. Type of blocking signal : CW
3. Pmin : Pmin is the minimum level of wanted signal (in dBm) required to meet the minimum performance criteria in the absence of any blocking signal = -93.30 dBm
4. Minimum performance criterion : PER less than or equal to 10 %.
5. Test Frequency : 2 480 MHz

8. GEO-LOCATION CAPABILITY

8.1 Definition

Geo-location capability is a feature of the equipment to determine its geographical location with the purpose to configure itself according to the regulatory requirements applicable at the geographical location where it operates.

The geo-location capability may be present in the equipment or in an external device (temporary) associated with the equipment operating at the same geographical location during the initial power up of the equipment. The geographical location may also be available in equipment already installed and operating at the same geographical location.

8.2 Requirements

The geographical location determined by the equipment as defined in clause 8.1 shall not be accessible to the user.

8.3 Declaration by the Manufacturer

Geo-location capability is implemented in this product and can’t be accessible to the user.

9. PHOTOGRAPHS OF THE EUT

Photographs is described in Appendix A. Please refer to Appendix A.

10. SETUP PHOTO

Setup photo is described in Appendix B. Please refer to Appendix B.