AS/NZS Test Report

Equipment	:	**2.4 GHz Bluetooth Low Energy Module**
Model No.	:	**SaBLE-x-R2**
Brand Name	:	**Laird**
Applicant	:	**Laird Technologies, Inc.**
Address	:	**W66N220 Commerce Court, Cedarburg, Wisconsin 53012, USA**
Standard	:	**AS/NZS 4268:2017**
Received Date	:	**Apr. 25, 2017**
Tested Date	:	**May 04 ~ Jun. 02, 2017**

We, International Certification Corp., would like to declare that the tested sample has been evaluated and in compliance with the requirement of the above standards. The test results contained in this report refer exclusively to the product. It may be duplicated completely for legal use with the approval of the applicant. It shall not be reproduced except in full without the written approval of our laboratory.

Reviewed by: **Approved by:**

James Fan / Assistant Manager **Gary Chang / Manager**

Testing Laboratory 2732

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Release Record

Report No.	Version	Description	Issued Date
AR742502	Rev. 01	Initial issue	Jun. 12, 2017

Summary of Test Results

Ref. Std. Clause (ACMA 4268)	Ref. Std. Clause (EN 300 328)	Test Items	Measured	Result
6.3	4.3.2.2	RF Output Power	7.68 dBm.	Pass
---	4.3.2.3	Power Spectral Density	Meet the requirement of limit.	Pass
---	4.3.2.4	Duty Cycle, Tx-sequence, Tx-gap	Only for non-adaptive equipment.	N/A
---	4.3.2.5	Medium Utilisation (MU) factor	Only for non-adaptive equipment.	N/A
---	4.3.2.6	Adaptivity	The RF Output power is less than 10 dBm e.i.r.p. This item is not applicable.	Pass
6.5	4.3.2.7	Emission Bandwidth	Meet the requirement of limit.	Pass
6.6	4.3.2.7	Operating Frequencies	Meet the requirement of limit.	Pass
6.4	4.3.2.8	Transmitter unwanted emissions in the out of band domain	Meet the requirement of limit.	Pass
6.4	4.3.2.9	Transmitter unwanted emissions in the spurious domain	Meet the requirement of limit.	Pass
7.2	4.3.2.10	Receiver spurious emissions	Meet the requirement of limit.	Pass
---	4.3.2.11	Receiver Blocking	Meet the requirement of limit.	Pass
---	4.3.2.12	Geo-location Capability	The device has no this capability.	N/A

1 General Description

1.1 Information

1.1.1 Specification of the Equipment under Test (EUT)

RF General Information				
Frequency Range (MHz)	**Bluetooth Mode**	**Ch. Frequency (MHz)**	**Channel Number**	**Data Rate**
2400-2483.5	V5.0 LE	2402-2480	0-39 [40]	125 kbps
				500 kbps
				1 Mbps
2400-2483.5	V5.0 LE	2402-2480	0-39 [40]	2 Mbps
Note 1: Bluetooth LE (Low energy) uses GFSK modulation.				

1.1.2 Antenna Details

Ant. No.	Model	Type	Gain (dBi)	Connector
1	LSR 001-0001 center-fed 2.4 GHz dipole antenna	Dipole	SMA	2
2	LSR 001-0014 2.4 GHz FlexPIFA antenna	PIFA	U.FL	2
3	LSR 001-0015 2.4 GHz FlexNotch antenna	Notch	U.FL	2
4	On module PCB trace antenna	On-Board Trace antenna	N/A	0

1.1.3 EUT Operational Condition

Power Supply Type	DC 1.8V & DC 3.3V from host		
SW Version	1.0		
Operational Climatic	☒ Tnom (20°C)	☒ Tmax (85°C)	☒ Tmin (-40°C)

1.1.4 Accessories

N/A

1.1.5 Channel List

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
37	2402	12	2430	26	2458
0	2404	13	2432	27	2460
1	2406	14	2434	28	2462
2	2408	15	2436	29	2464
3	2410	16	2438	30	2466
4	2412	17	2440	31	2468
5	2414	18	2442	32	2470
6	2416	19	2444	33	2472
7	2418	20	2446	34	2474
8	2420	21	2448	35	2476
9	2422	22	2450	36	2478
10	2424	23	2452	39	2480
38	2426	24	2454	---	---
11	2428	25	2456	---	---

1.1.6 Test Tool and Duty Cycle

Test Tool	Bluetooth RF Eval Tool		
Duty Cycle and Duty Factor	**Modulation Mode**	**Duty cycle (%)**	**Duty factor (dB)**
	GFSK-125kbps	83.73	0.77
	GFSK-500kbps	72.43	1.40
	GFSK-1Mbps	69.35	1.59
	GFSK-2Mbps	33.87	4.70

1.1.7 Power Setting

Modulation Mode	**Test Frequency (MHz)**		
	2402	**2440**	**2480**
GFSK-125kbps	Default	Default	Default
GFSK-500kbps	Default	Default	Default
GFSK-1Mbps	Default	Default	Default
GFSK-2Mbps	Default	Default	Default

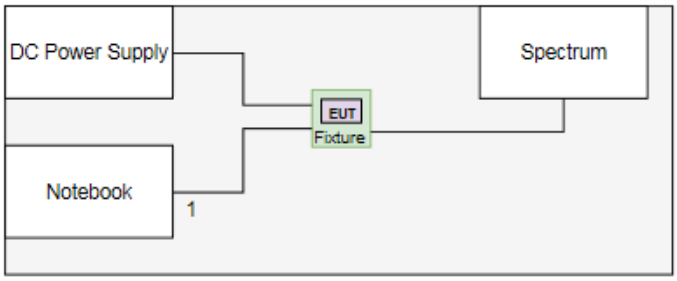
1.2 Local Support Equipment List

Support Equipment List					
No.	**Equipment**	**Brand**	**Model**	**FCC ID**	**Signal cable / Length (m)**
1	Notebook	DELL	Latitude E6430	DoC	USB, 1m shielded.
2	50Ω terminator	---	---	---	---
3	DC Power Supply	GWINSTEK	GPC-6030D	---	---
4	Fixture	---	---	---	---

Note: Fixture is provided by applicant.

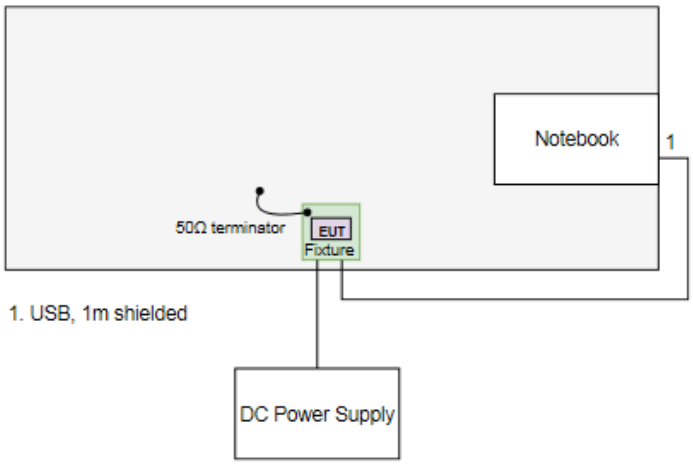
1.3 Test Setup Chart

Test Setup Diagram (Conducted)



1. USB, 1m shielded

Test Setup Diagram (Radiated)



1. USB, 1m shielded

Kept in control area

1.4 Test Equipment List and Calibration Data

Test Item	Radiated Emissions				
Test Site	Fully-anechoic chamber 2 / (05CH02-WS)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	Agilent	N9010A	MY52221474	Oct. 14, 2016	Oct. 13, 2017
Bilog Antenna 30-1000MHz	SCHWARZBECK	VULB9168	9168-563	Jan. 05, 2017	Jan. 04, 2018
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	9120D-1205	Jan. 05, 2017	Jan. 04, 2018
Horn Antenna 18G-40G	SCHWARZBECK	BBHA 9170	BBHA 9170508	Dec. 29, 2016	Dec. 28, 2017
Preamplifier	Agilent	83017A	MY53270013	Jan. 10, 2017	Jan. 09, 2018
Preamplifier 30-1000MHz	EMC	EMC02325	980188	Dec. 13, 2016	Dec. 12, 2017
Preamplifier	EMC	EMC184045B	980192	Aug. 24, 2016	Aug. 23, 2017
RF cable-1M	HUBER+SUHNER	SUCOFLEX104	MY22622/4	Dec. 13, 2016	Dec. 12, 2017
RF cable-1M	HUBER+SUHNER	SUCOFLEX104	MY22623/4	Dec. 14, 2016	Dec. 13, 2017
RF cable-3M	HUBER+SUHNER	SUCOFLEX104	MY22621/4	Dec. 14, 2016	Dec. 13, 2017
RF cable-4M	HUBER+SUHNER	SUCOFLEX104	MY22579/4	Dec. 14, 2016	Dec. 13, 2017
LF cable-0.8M	EMC	EMC8D-NM-NM-800	EMC8D-NM-NM-800-002	Dec. 14, 2016	Dec. 13, 2017
LF cable-3M	EMC	EMC8D-NM-NM-3000	131102	Dec. 14, 2016	Dec. 13, 2017
LF cable-10M	EMC	EMC8D-NM-NM-10000	131101	Dec. 14, 2016	Dec. 13, 2017
Measurement Software	AUDIX	e3	6.120210g	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	RF Conducted				
Test Site	(TH01-WS)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101486	Nov. 15, 2016	Nov. 14, 2017
TEMP&HUMIDITY CHAMBER	GIANT FORCE	GCT-225-40-SP-SD	MAF1212-002	Nov. 21, 2016	Nov. 20, 2017
Power Sensor	Agilent	U2021XA	MY53480019	Feb. 06, 2017	Feb. 05, 2018
DC POWER SOURCE	GW INSTEK	GPC-6030D	EM892433	Oct. 20, 2016	Oct. 19, 2017
Measurement Software	Sporton	Sporton_1	1.3.30	NA	NA
Measurement Software	Agilent	EN RF test	1.1501125	NA	NA
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Receiver Blocking				
Test Site	(05CH01-WS)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Wireless connectivity tester	ROHDE&SCHWARZ	CMW270	100856	Nov. 07, 2016	Nov. 06, 2017
Signal Generator	R&S	SMB100A	175727	Oct. 19, 2016	Oct. 18, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX_104	500202/4	Dec. 16, 2016	Dec. 15, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX_104	296088/4	Dec. 16, 2016	Dec. 15, 2017
RF Cable	HUBER+SUHNER	SUCOFLEX_104	329023/4	Dec. 16, 2016	Dec. 15, 2017
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emissions				
Test Site	(10CH01-HY)				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESI7	838496/009	Sep. 26, 2016	Sep. 25, 2017
Amplifier	Agilent	8447D	2944A10825	Apr. 19, 2017	Apr. 18, 2018
Amplifier	Agilent	8447D	2944A10826	Apr. 12, 2017	Apr. 11, 2018
RF Cable-R10m	BELDEN	RG8/U	CB023-INSIDE	Nov. 11, 2016	Nov. 10, 2017
RF Cable-R10m	Suhner Switzerland + Rosenberger	RG223/U + UAA220A-0	CB022-DOOR	Nov. 11, 2016	Nov. 10, 2017
Loop Antenna	TESEQ	HLA 6120	31244	Mar. 02, 2017	Mar. 01, 2018
Software	Audix	E3	6.12.0210c	---	---
Note: Calibration Interval of instruments listed above is one year.					

1.5 Testing Applied Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

AS/NZS 4268:2017
EN 300 328 V2.1.1 (2016-11)

1.6 Measurement Uncertainty

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level (based on a coverage factor (k=2)

Measurement Uncertainty		
Parameters	**Uncertainty**	**Limit**
Occupied Channel Bandwidth	±0.0034 %	±5 %
RF output power, conducted	±0.537 dB	±1.5 dB
Power Spectral Density, conducted	±0.463 dB	±3 dB
Unwanted Emissions, conducted	±2.505 dB	±3 dB
All emissions, radiated	±3.401 dB	±6 dB
Temperature	±0.6 ^{o}C	±3 °C
Supply voltages	±0.16 %	±3 %
Time	±0.1 %	±5 %

2 Test Configuration

2.1 Testing Condition

Testing Location					
☒	ICC Lab	ADD : No.3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan (R.O.C.) TEL : 886-3-271-8666 FAX : 886-3-318-0155			
☒	Sporton Lab	ADD : No. 52, Huaya 1st Rd., Guishan Dist., Taoyuan City, Taiwan (R.O.C.) TEL : 886-3-327-3456 FAX : 886-3-327-0973			
Test Item		**Test Site**	**Ambient Condition**	**Tested By**	
RF Conducted		TH01-WS	25°C / 65%	Chris Zeng	
Radiated Emission > 30 MHz		05CH01-WS	24°C / 65%	Penguin Jiang	
Receiver Blocking		05CH01-WS	23°C / 63%	Penguin Jiang	
Radiated Emission ≤ 30 MHz		10CH01-HY*	22.1°C / 61%	Jack Li	

Note: * ICC lab subcontracts this test item to Sporton Lab (TAF:1190).
Sporton Lab is a TAF accreditation test firm and also is an approved provider of ICC lab.

2.2 The Worst Test Modes and Channel Details

Test item	Modulation Mode	Test Frequency (MHz)	Test Configuration
RF Output Power	GFSK/125kbps GFSK/500kbps GFSK/1Mbps GFSK/2Mbps	2402 / 2440 / 2480 2402 / 2440 / 2480 2402 / 2440 / 2480 2402 / 2440 / 2480	---
Power Spectral Density			
Emission Bandwidth and Operating frequencies	GFSK/125kbps GFSK/500kbps GFSK/1Mbps GFSK/2Mbps	2402 / 2480 2402 / 2480	---
Transmitter unwanted emissions in the out of band domain			
Transmitter Spurious Emissions ≤ 30 MHz	GFSK/1Mbps GFSK/2Mbps	2402 / 2480 2402 / 2480	---
Transmitter Spurious Emissions			
Receiver Spurious Emissions			
Receiver Blocking	GFSK/125kbps	2402 / 2480	---

NOTE:

1. The EUT was pretested with 3 data rates for power measurement – 125kbps, 500kbps, and 1Mbps. The **1Mbps** results were found as the worst case and were performed for all emission measurements.
2. The EUT was pretested with 3 orientations placed on the table for the radiated emission measurement – X, Y, and Z-plane. The **Y-plane** results were found as the worst case and were shown in this report.
3. The EUT supports two DC voltage options, DC 1.8V & DC 3.3V. Both options were assessed and **DC 3.3V** was found to be the worst case and was selected for the final test.

3 Transmitter Test Results

3.1 RF Output Power

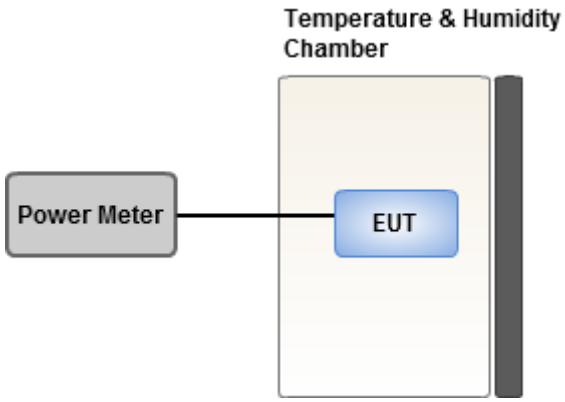
3.1.1 Limit of RF Output Power

The maximum RF output power shall be equal to or less than 20 dBm

3.1.2 Test Procedures

Reference to clause 5.4.2.2 of ETSI EN 300 328 V2.1.1 (2016-11).

3.1.3 Test Setup



3.1.4 Test Result of RF Output Power

RF Output Power (dBm)					
Condition	**Modulation Mode**	**Freq. (MHz)**	**EIRP Power**	**Limit (dBm)**	**Results**
$T_{nom}V_{nom}$	GFSK/125kbps	2402	7.02	20	Pass
$T_{min}V_{nom}$	GFSK/125kbps	2402	7.49	20	Pass
$T_{max}V_{nom}$	GFSK/125kbps	2402	6.58	20	Pass
$T_{nom}V_{nom}$	GFSK/125kbps	2440	6.78	20	Pass
$T_{min}V_{nom}$	GFSK/125kbps	2440	7.14	20	Pass
$T_{max}V_{nom}$	GFSK/125kbps	2440	6.45	20	Pass
$T_{nom}V_{nom}$	GFSK/125kbps	2480	6.57	20	Pass
$T_{min}V_{nom}$	GFSK/125kbps	2480	7.00	20	Pass
$T_{max}V_{nom}$	GFSK/125kbps	2480	6.23	20	Pass
$T_{nom}V_{nom}$	GFSK/500kbps	2402	7.09	20	Pass
$T_{min}V_{nom}$	GFSK/500kbps	2402	7.57	20	Pass
$T_{max}V_{nom}$	GFSK/500kbps	2402	6.64	20	Pass
$T_{nom}V_{nom}$	GFSK/500kbps	2440	6.83	20	Pass
$T_{min}V_{nom}$	GFSK/500kbps	2440	7.19	20	Pass
$T_{max}V_{nom}$	GFSK/500kbps	2440	6.50	20	Pass
$T_{nom}V_{nom}$	GFSK/500kbps	2480	6.61	20	Pass
$T_{min}V_{nom}$	GFSK/500kbps	2480	7.04	20	Pass
$T_{max}V_{nom}$	GFSK/500kbps	2480	6.27	20	Pass

RF Output Power (dBm)					
Condition	**Modulation Mode**	**Freq. (MHz)**	**EIRP Power**	**Limit (dBm)**	**Results**
$T_{nom}V_{nom}$	GFSK/1Mbps	2402	7.14	20	Pass
$T_{min}V_{nom}$	GFSK/1Mbps	2402	7.65	20	Pass
$T_{max}V_{nom}$	GFSK/1Mbps	2402	6.72	20	Pass
$T_{nom}V_{nom}$	GFSK/1Mbps	2440	6.87	20	Pass
$T_{min}V_{nom}$	GFSK/1Mbps	2440	7.26	20	Pass
$T_{max}V_{nom}$	GFSK/1Mbps	2440	6.57	20	Pass
$T_{nom}V_{nom}$	GFSK/1Mbps	2480	6.66	20	Pass
$T_{min}V_{nom}$	GFSK/1Mbps	2480	7.10	20	Pass
$T_{max}V_{nom}$	GFSK/1Mbps	2480	6.33	20	Pass
$T_{nom}V_{nom}$	GFSK/2Mbps	2402	7.17	20	Pass
$T_{min}V_{nom}$	GFSK/2Mbps	2402	7.68	20	Pass
$T_{max}V_{nom}$	GFSK/2Mbps	2402	6.75	20	Pass
$T_{nom}V_{nom}$	GFSK/2Mbps	2440	6.89	20	Pass
$T_{min}V_{nom}$	GFSK/2Mbps	2440	7.28	20	Pass
$T_{max}V_{nom}$	GFSK/2Mbps	2440	6.59	20	Pass
$T_{nom}V_{nom}$	GFSK/2Mbps	2480	6.61	20	Pass
$T_{min}V_{nom}$	GFSK/2Mbps	2480	7.05	20	Pass
$T_{max}V_{nom}$	GFSK/2Mbps	2480	6.28	20	Pass

3.2 Power Spectral Density

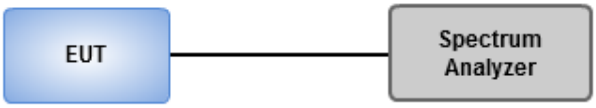
3.2.1 Limit of Power Spectral Density

For equipment using wide band modulations other than FHSS (e.g. DSSS, OFDM, etc.), the maximum Power Spectral Density is limited to 10 dBm per MHz.

3.2.2 Test Procedures

Reference to clause 5.4.3.2 of ETSI EN 300 328 V2.1.1 (2016-11).

3.2.3 Test Setup



3.2.4 Test Result of Power Spectral Density

Modulation Mode	Freq. (MHz)	Power Density (dBm/1MHz)	Limit (dBm/1MHz)	Results
GFSK/125kbps	2402	6.71	10	Pass
GFSK/125kbps	2440	6.43	10	Pass
GFSK/125kbps	2480	6.18	10	Pass
GFSK500kbps	2402	6.82	10	Pass
GFSK500kbps	2440	6.54	10	Pass
GFSK500kbps	2480	6.23	10	Pass
GFSK/1Mbps	2402	6.89	10	Pass
GFSK/1Mbps	2440	6.58	10	Pass
GFSK/1Mbps	2480	6.28	10	Pass
GFSK/2Mbps	2402	6.12	10	Pass
GFSK/2Mbps	2440	5.81	10	Pass
GFSK/2Mbps	2480	5.58	10	Pass

3.3 Emission Bandwidth and Operating Frequencies

3.3.1 Limit of Emission Bandwidth and Operating Frequencies

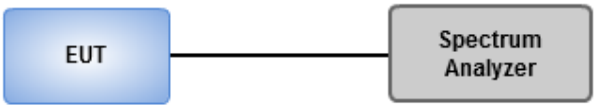
The Emission Bandwidth for each frequency shall fall completely within 2.4~2.4835 GHz.

For non-adaptive Frequency Hopping equipment with e.i.r.p greater than 10 dBm, the Emission Bandwidth for every occupied hopping frequency shall be equal to or less than the value declared by the supplier. This declared value shall not be greater than 5 MHz.

3.3.2 Test Procedures

Reference to clause 5.4.7.2 of ETSI EN 300 328 V2.1.1 (2016-11).

3.3.3 Test Setup

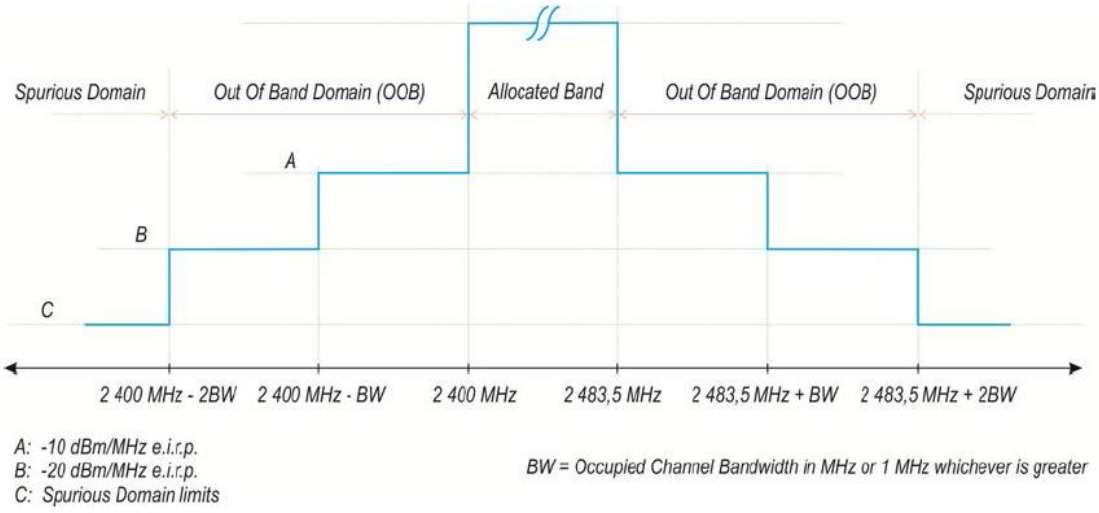


3.3.4 Test Result of Emission Bandwidth and Operating Frequencies

Modulation Mode	Frequency (MHz)	99% Bandwidth (MHz)	F_L at 99% BW (MHz)	F_H at 99% BW (MHz)	Limit F_L / F_H (MHz)
GFSK/125kbps	2402	1.03	2401.4790	2402.5137	2400.0
GFSK/125kbps	2480	1.04	2479.4717	2480.5209	2483.5
GFSK500kbps	2402	1.03	2401.4790	2402.5137	2400.0
GFSK500kbps	2480	1.04	2479.4717	2480.5209	2483.5
GFSK/1Mbps	2402	1.04	2401.4963	2402.5426	2400.0
GFSK/1Mbps	2480	1.05	2479.4877	2480.5470	2483.5
GFSK/2Mbps	2402	2.05	2401.0014	2403.0564	2400.0
GFSK/2Mbps	2480	2.06	2478.9942	2481.0636	2483.5

3.4 Transmitter Unwanted Emissions in the Out-Of-Band Domain

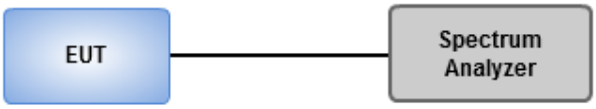
3.4.1 Limit of Transmitter Unwanted Emissions in the Out-Of-Band Domain



3.4.2 Test Procedures

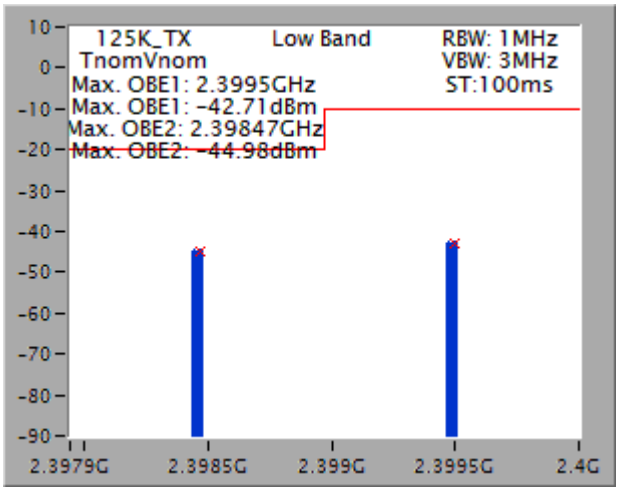
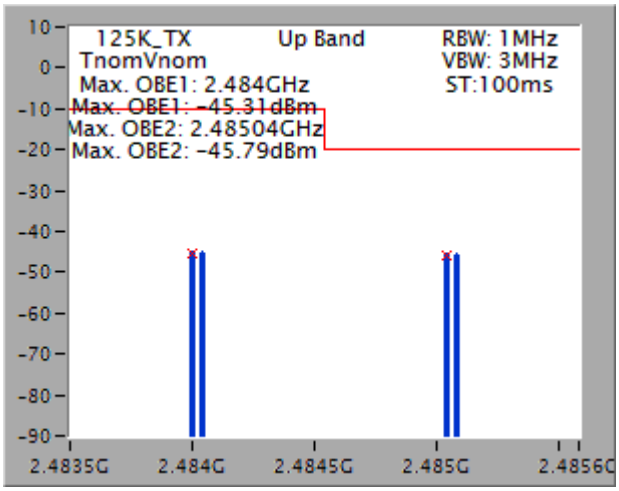
Reference to clause 5.4.8.2 of ETSI EN 300 328 V2.1.1 (2016-11).

3.4.3 Test Setup

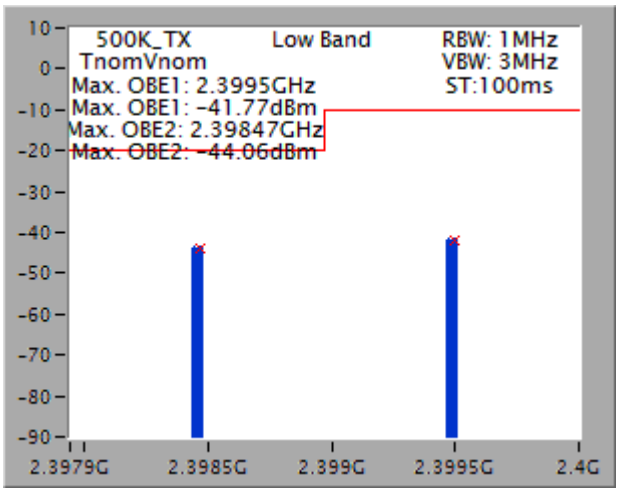
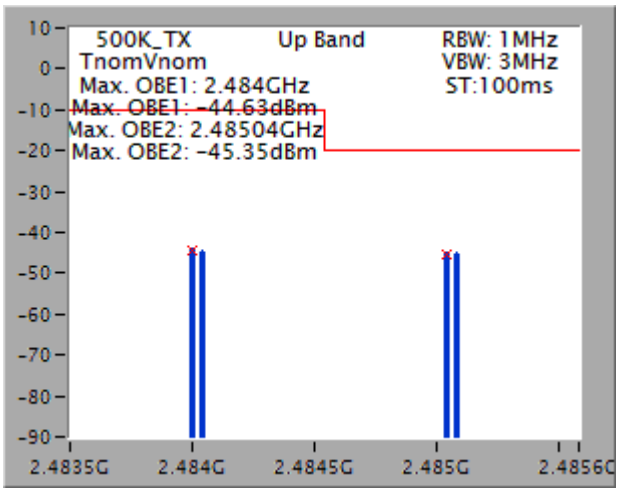


3.4.4 Test Result of Transmitter Unwanted Emissions in the Out-Of-Band Domain

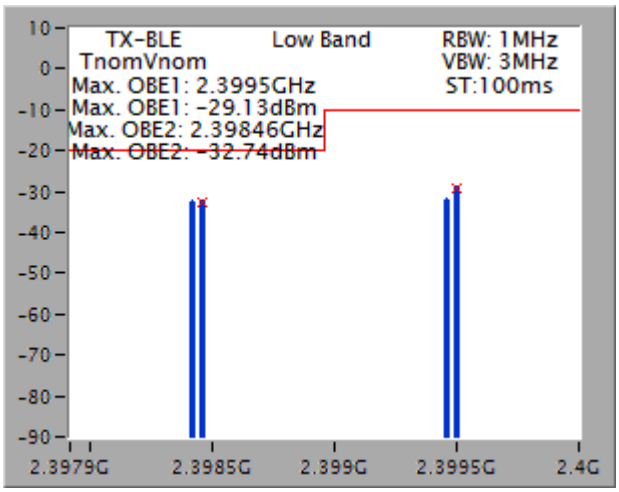
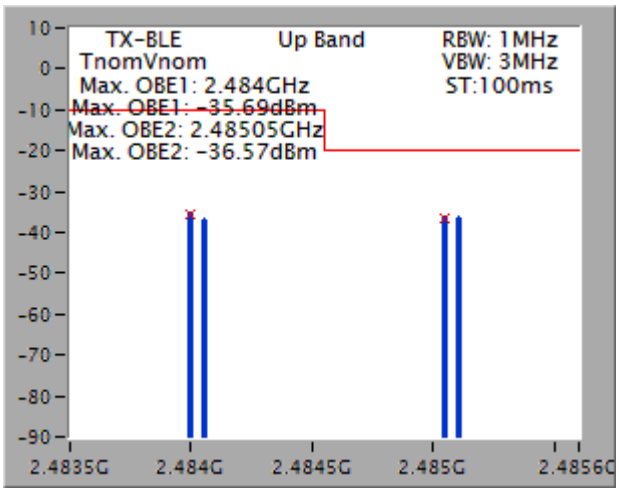
Condition	Modulation Mode	Freq. (MHz)	OOB Freq. (MHz)	OOB Emissions (dBm)	Limit (dBm)
TnomVnom	GFSK/125kbps	2402	2399.50	-42.71	-10
TnomVnom	GFSK/125kbps	2402	2398.47	-44.98	-20
TnomVnom	GFSK/125kbps	2480	2484.00	-45.31	-10
TnomVnom	GFSK/125kbps	2480	2485.04	-45.79	-20

Low Band	Up Band
	

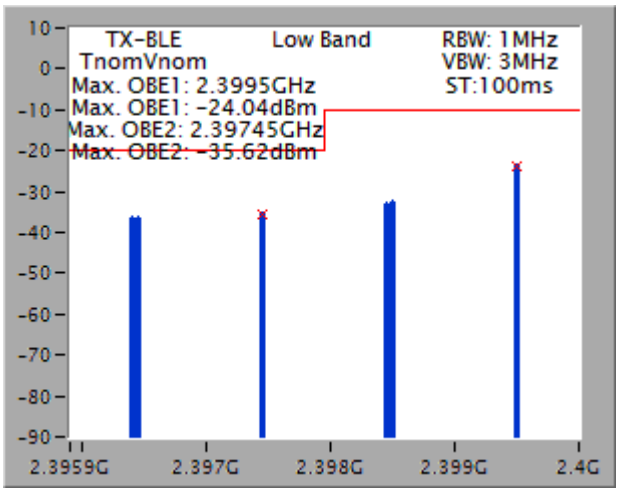
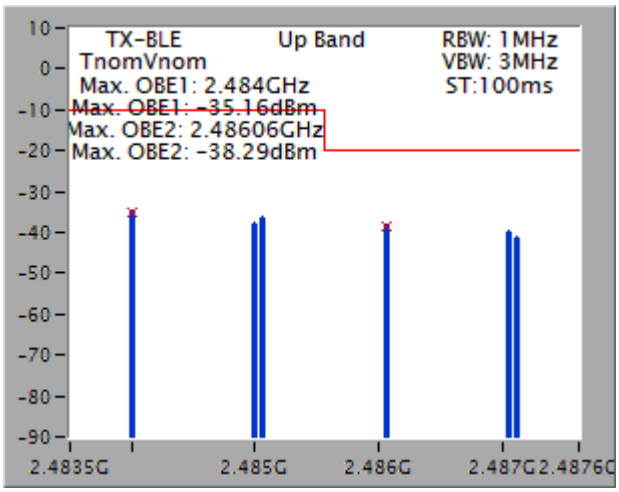
Condition	Modulation Mode	Freq. (MHz)	OOB Freq. (MHz)	OOB Emissions (dBm)	Limit (dBm)
TnomVnom	GFSK500kbps	2402	2399.50	-41.77	-10
TnomVnom	GFSK500kbps	2402	2398.47	-44.06	-20
TnomVnom	GFSK500kbps	2480	2484.00	-44.63	-10
TnomVnom	GFSK500kbps	2480	2485.04	-45.35	-20

Low Band	Up Band
	

Condition	Modulation Mode	Freq. (MHz)	OOB Freq. (MHz)	OOB Emissions (dBm)	Limit (dBm)
TnomVnom	GFSK-1Mbps	2402	2399.50	-29.13	-10
TnomVnom	GFSK-1Mbps	2402	2398.46	-32.74	-20
TnomVnom	GFSK-1Mbps	2480	2484.00	-35.69	-10
TnomVnom	GFSK-1Mbps	2480	2485.05	-36.57	-20

Low Band	Up Band
	

Condition	Modulation Mode	Freq. (MHz)	OOB Freq. (MHz)	OOB Emissions (dBm)	Limit (dBm)
TnomVnom	GFSK/2Mbps	2402	2399.50	-24.04	-10
TnomVnom	GFSK/2Mbps	2402	2397.45	-35.62	-20
TnomVnom	GFSK/2Mbps	2480	2484.00	-35.16	-10
TnomVnom	GFSK/2Mbps	2480	2460.06	-38.29	-20

Low Band	Up Band
	

3.5 Transmitter Unwanted Emissions in the Spurious Domain

3.5.1 Limit of Transmitter Unwanted Emissions in the Spurious Domain

Spurious Emissions Limit (Peak Power)	Frequency Range	Measurement Bandwidth
-56 dBW (2.5μW) e.i.r.p (59 dBμV/m at 10 metres)	< 150 kHz	1 kHz
	150 kHz – 30 MHz	10 kHz

Emission Limits		
Frequency Range (MHz)	**Maximum power (dBm)**	**Bandwidth (kHz)**
30 to 47	-36	100
47 to 74	-54	100
74 to 87.5	-36	100
87.5 to 118	-54	100
118 to 174	-36	100
174 to 230	-54	100
230 to 470	-36	100
470 to 862	-54	100
862 to 1000	-36	100
1000 to 12750	-30	1000

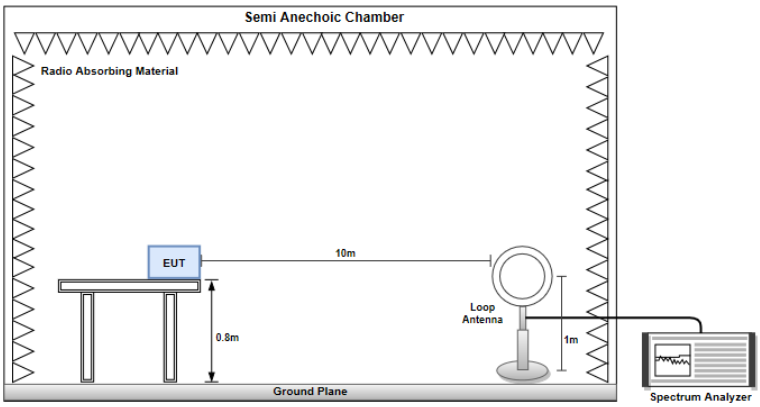
3.5.2 Test Procedures

Reference to clause 5.4.9.2 of ETSI EN 300 328 V2.1.1 (2016-11).

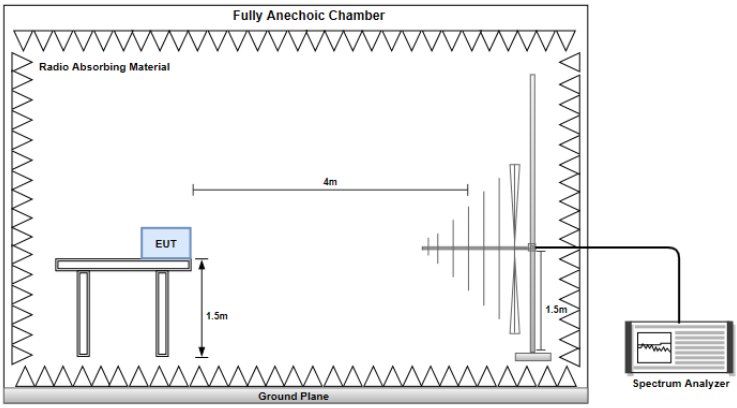
3.5.3 Test Setup

Radiated Emission

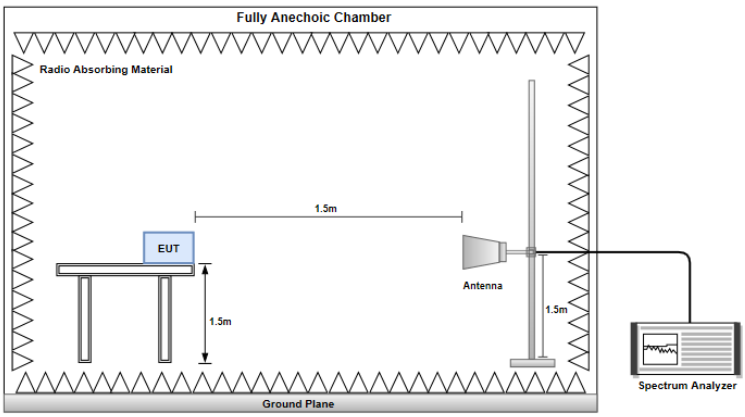
Below 30MHz



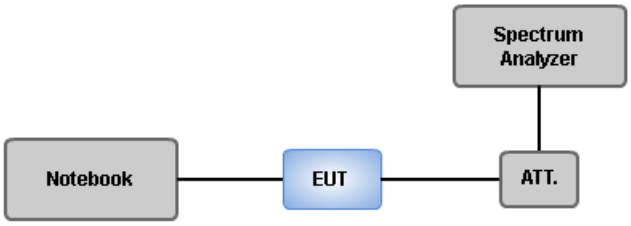
Below 1GHz



Above 1 GHz



Conducted Emission



3.5.4 Transmitter Radiated Unwanted Emissions (≤ 30MHz)

Dipole antenna

Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	SA Reading (dBuV)	Factor (dB)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.009	40.94	20.94	20	18.06	59	Pass
2480		Ch78		0.009	43.74	23.74	20	15.26	59	Pass
2402	BLE	Ch00	2M	0.009	40.89	20.89	20	18.11	59	Pass
2480		Ch78		0.009	42.38	22.38	20	16.62	59	Pass

PIFA antenna

Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	SA Reading (dBuV)	Factor (dB)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.009	40.18	20.18	20	18.82	59	Pass
2480		Ch78		0.009	41.56	21.56	20	17.44	59	Pass
2402	BLE	Ch00	2M	0.009	42.9	22.9	20	16.1	59	Pass
2480		Ch78		0.009	43.89	23.89	20	15.11	59	Pass

Notch antenna

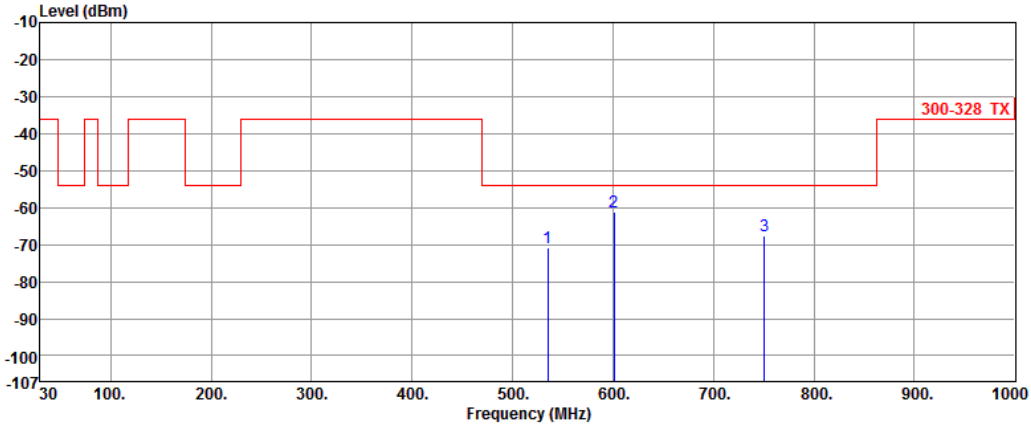
Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	SA Reading (dBuV)	Factor (dB)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.009	40.58	20.58	20	18.42	59	Pass
2480		Ch78		0.009	39.58	19.58	20	19.42	59	Pass
2402	BLE	Ch00	2M	0.009	42	22	20	17	59	Pass
2480		Ch78		0.009	42.86	22.86	20	16.14	59	Pass

On-Board Trace antenna

Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	SA Reading (dBuV)	Factor (dB)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.009	41.28	21.28	20	17.72	59	Pass
2480		Ch78		0.009	41.05	21.05	20	17.95	59	Pass
2402	BLE	Ch00	2M	0.009	41.08	21.08	20	17.92	59	Pass
2480		Ch78		0.009	43.21	23.21	20	15.79	59	Pass

3.5.5 Transmitter Conducted Unwanted Emissions (Below 1GHz)

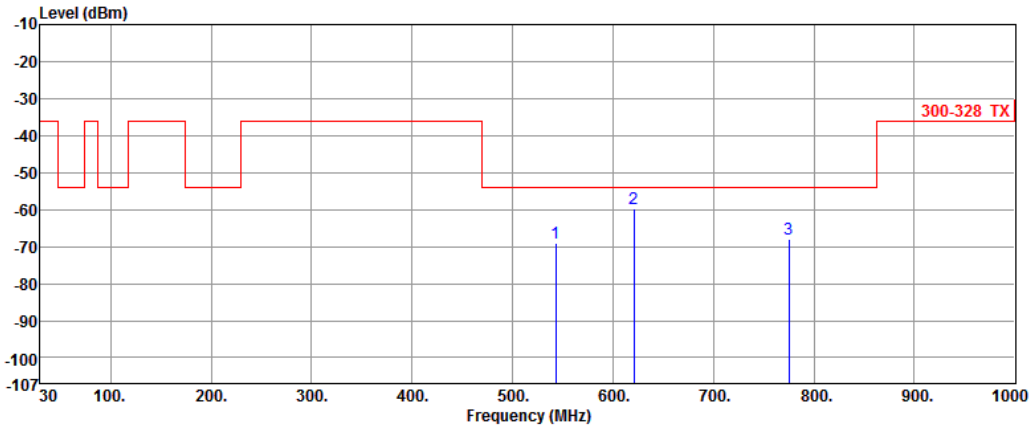
Modulation	GFSK/1Mbps	**Test Freq. (MHz)**	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	535.37	-70.91	-54.00	-16.91	0.00	-70.91
2	601.33	-61.10	-54.00	-7.10	0.00	-61.10
3	750.71	-67.72	-54.00	-13.72	0.00	-67.72

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

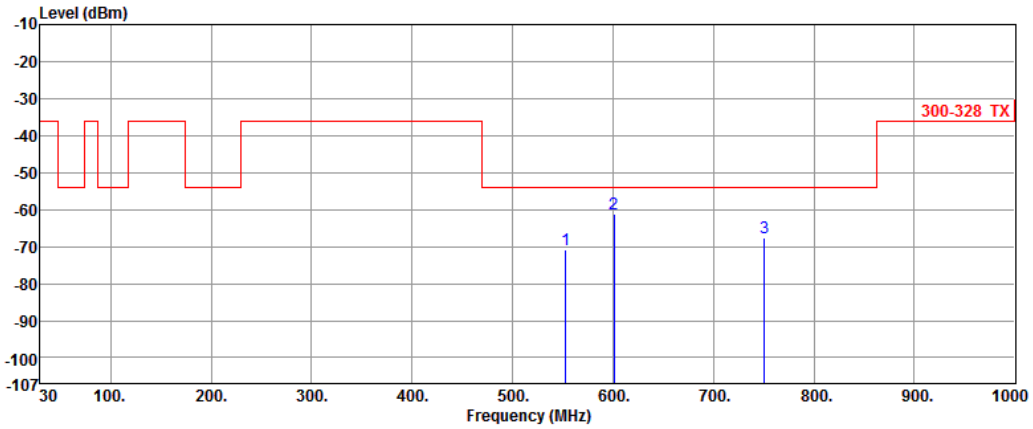
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	543.13	-69.23	-54.00	-15.23	0.00	-69.23
2	620.73	-59.70	-54.00	-5.70	0.00	-59.70
3	774.96	-68.16	-54.00	-14.16	0.00	-68.16

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

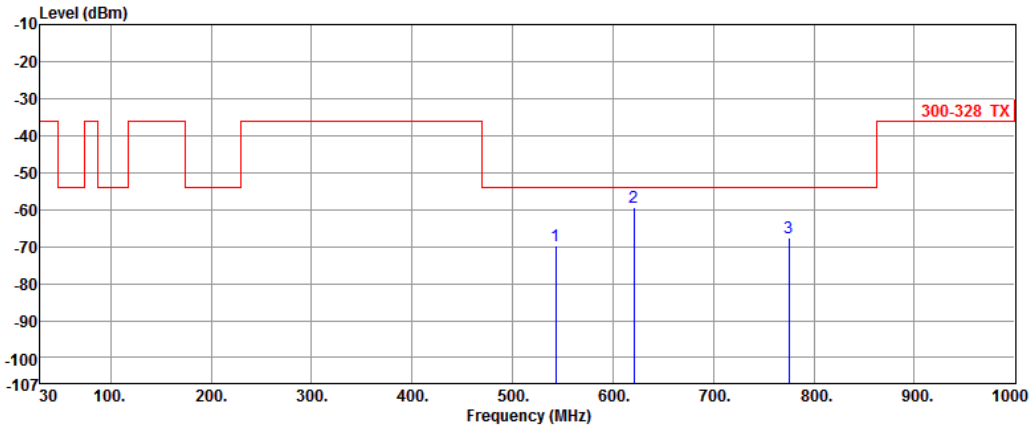
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	552.83	-70.97	-54.00	-16.97	0.00	-70.97
2	601.33	-61.12	-54.00	-7.12	0.00	-61.12
3	750.71	-67.79	-54.00	-13.79	0.00	-67.79

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480

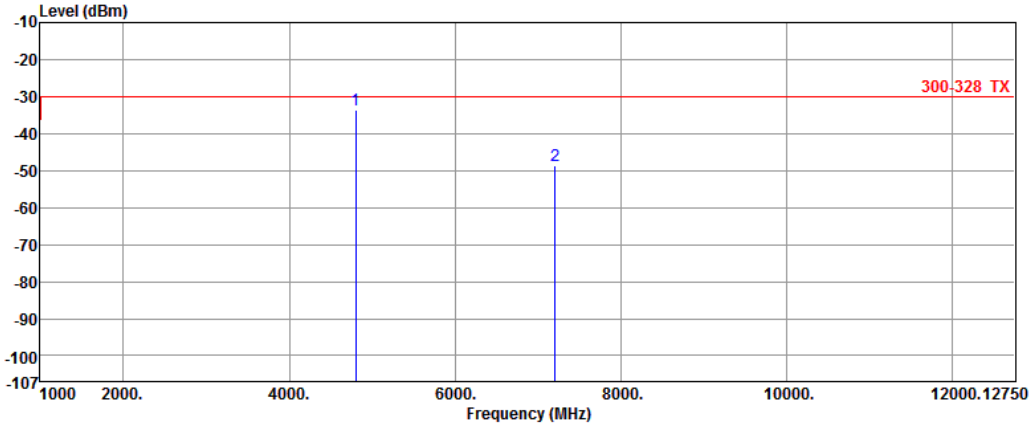


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	543.13	-69.89	-54.00	-15.89	0.00	-69.89
2	620.73	-59.48	-54.00	-5.48	0.00	-59.48
3	774.96	-67.69	-54.00	-13.69	0.00	-67.69

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

3.5.6 Transmitter Conducted Unwanted Emissions (Above 1GHz)

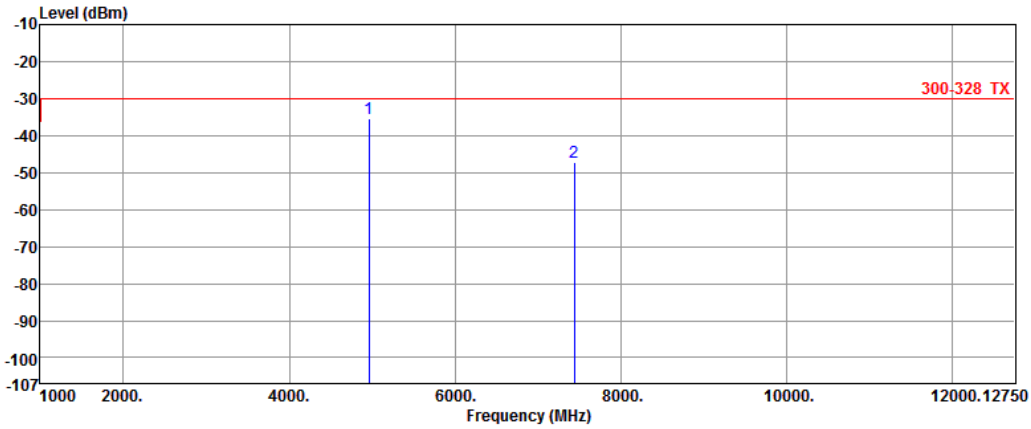
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4803.36	-33.65	-30.00	-3.65	0.00	-33.65
2	7205.20	-48.72	-30.00	-18.72	0.00	-48.72

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

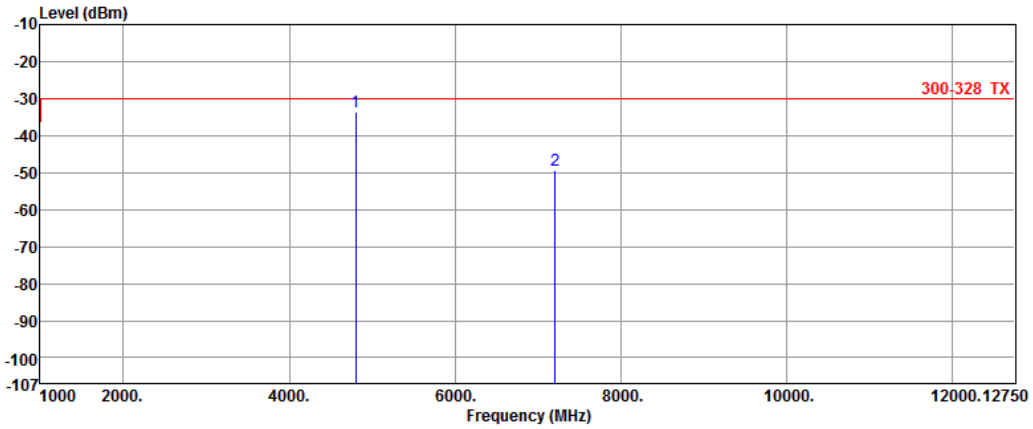
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4959.50	-35.54	-30.00	-5.54	0.00	-35.54
2	7439.70	-47.36	-30.00	-17.36	0.00	-47.36

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

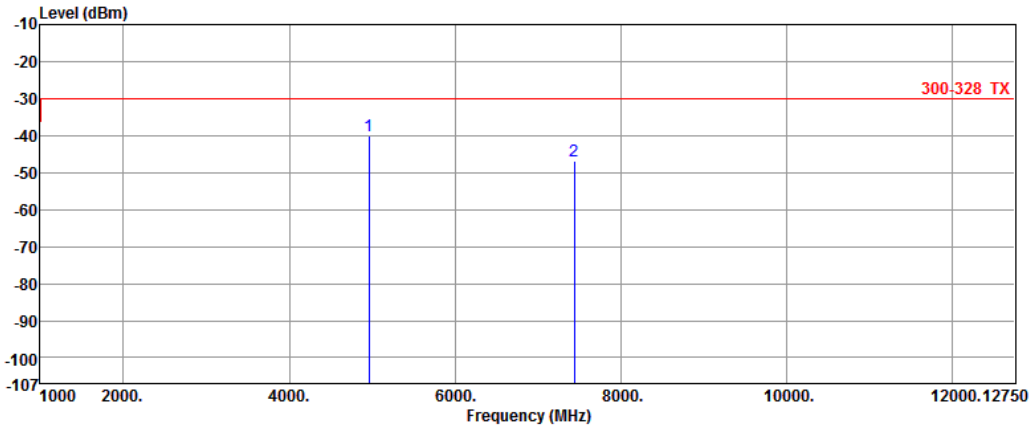
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4803.40	-33.62	-30.00	-3.62	0.00	-33.62
2	7204.82	-49.29	-30.00	-19.29	0.00	-49.29

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480

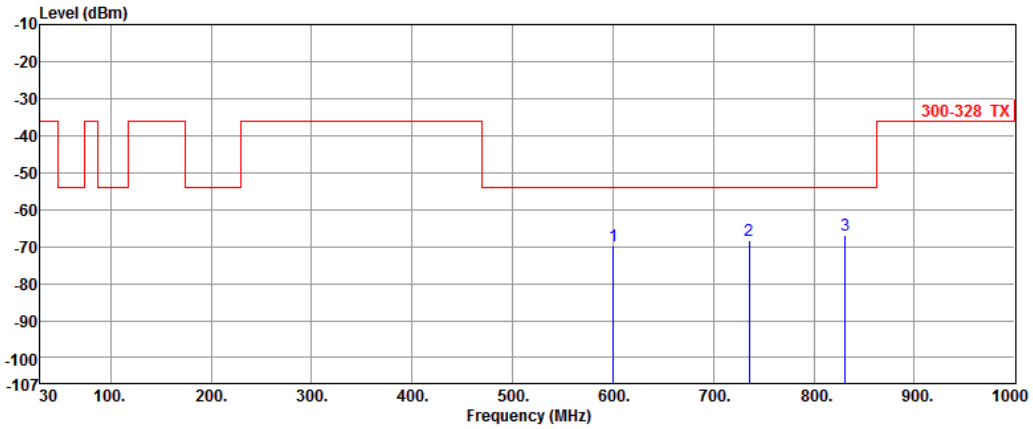


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4958.94	-40.17	-30.00	-10.17	0.00	-40.17
2	7440.00	-46.75	-30.00	-16.75	0.00	-46.75

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

3.5.7 Transmitter Radiated Unwanted Emissions (Below 1GHz)

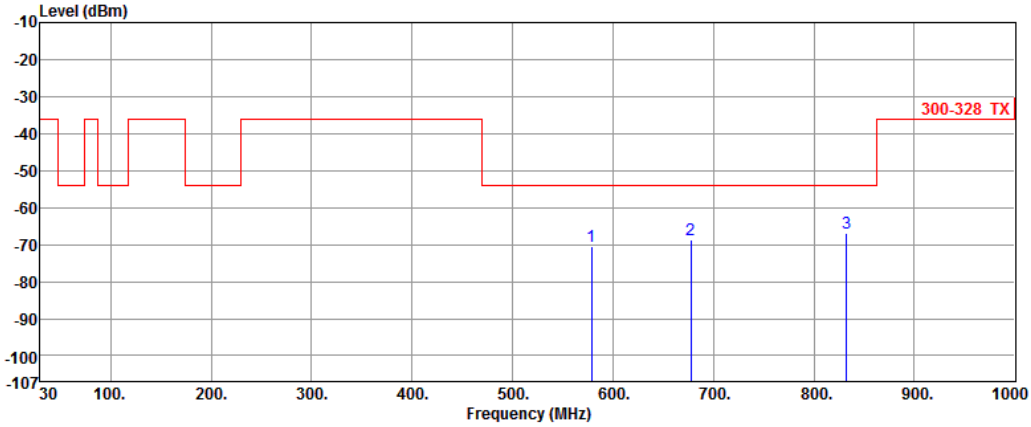
Modulation	GFSK/1Mbps	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	600.25	-69.79	-54.00	-15.79	6.81	-76.60
2	735.78	-68.23	-54.00	-14.23	9.17	-77.40
3	831.33	-66.87	-54.00	-12.87	10.02	-76.89

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

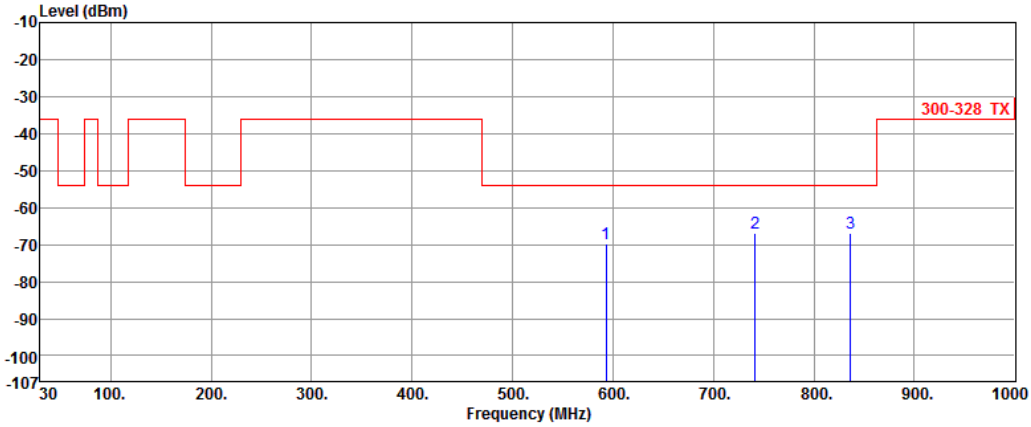
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	578.80	-70.53	-54.00	-16.53	6.68	-77.21
2	677.28	-68.80	-54.00	-14.80	7.23	-76.03
3	832.30	-67.04	-54.00	-13.04	9.94	-76.98

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

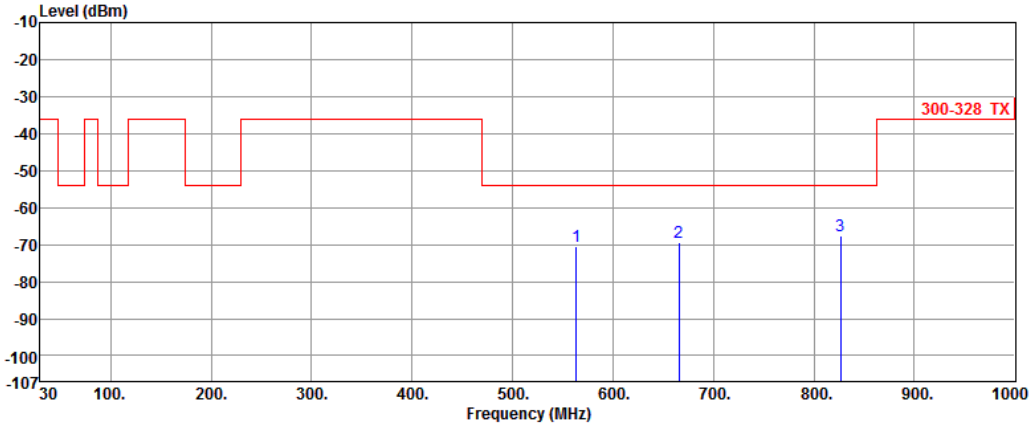
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	593.43	-69.65	-54.00	-15.65	6.52	-76.17
2	741.63	-66.92	-54.00	-12.92	9.32	-76.24
3	836.20	-66.75	-54.00	-12.75	9.96	-76.71

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

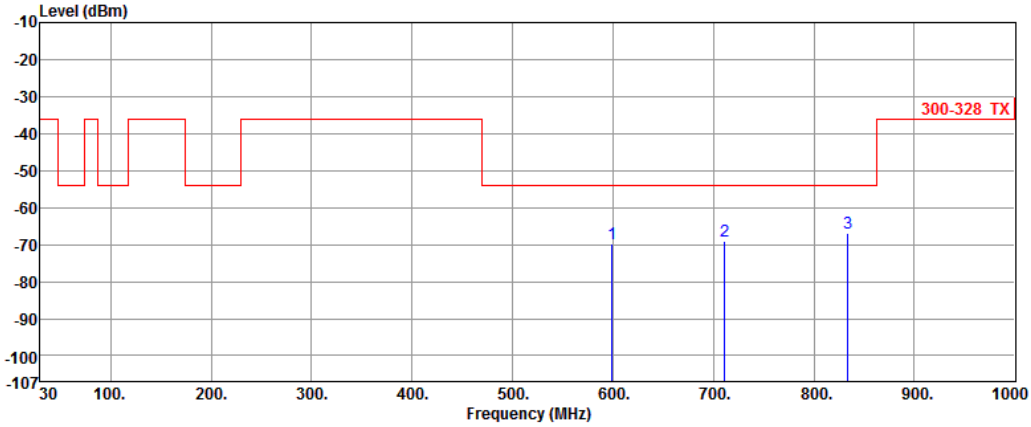
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	563.20	-70.65	-54.00	-16.65	6.02	-76.67
2	665.58	-69.36	-54.00	-15.36	7.05	-76.41
3	826.45	-67.55	-54.00	-13.55	9.99	-77.54

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

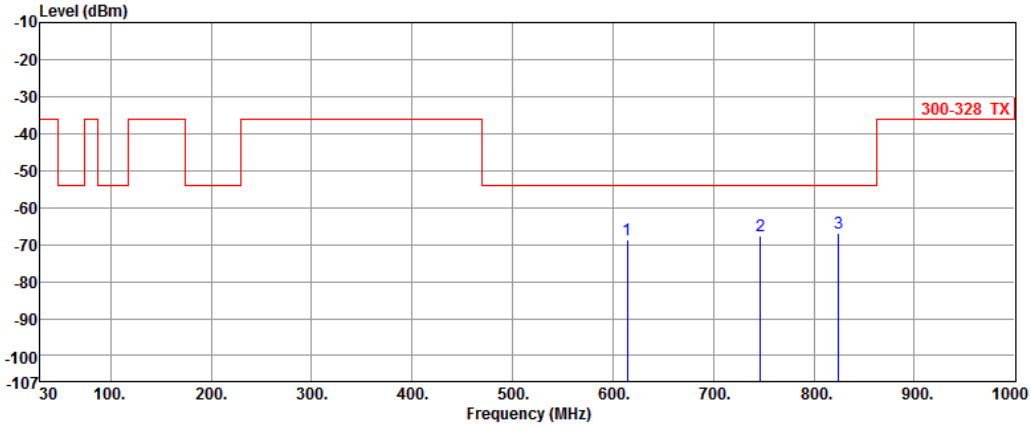
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	599.39	-69.80	-54.00	-15.80	6.78	-76.58
2	710.94	-68.92	-54.00	-14.92	8.27	-77.19
3	834.13	-66.92	-54.00	-12.92	9.98	-76.90

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

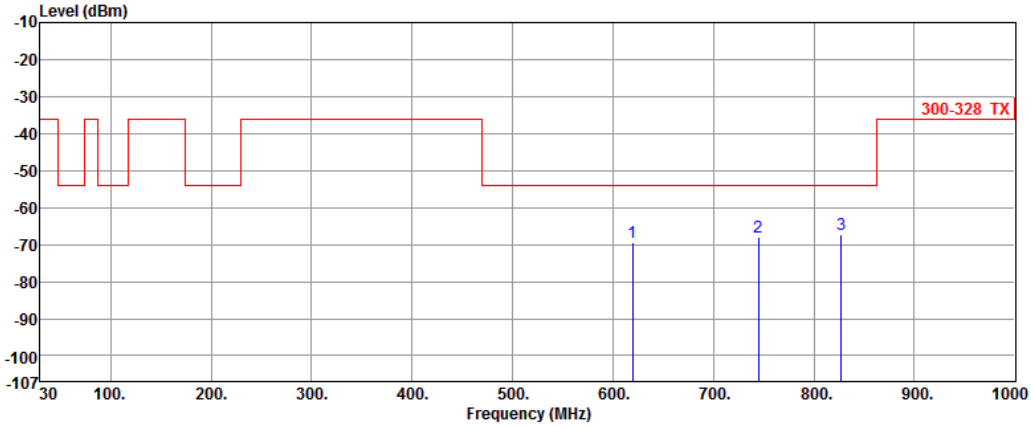
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	613.94	-68.79	-54.00	-14.79	7.32	-76.11
2	746.83	-67.80	-54.00	-13.80	8.47	-76.27
3	824.43	-66.83	-54.00	-12.83	9.98	-76.81

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

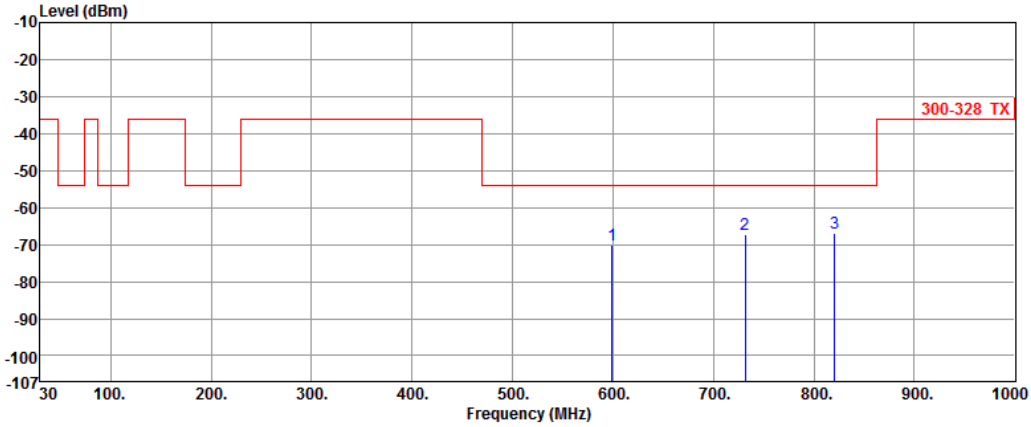
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	619.75	-69.58	-54.00	-15.58	7.22	-76.80
2	744.55	-68.03	-54.00	-14.03	8.46	-76.49
3	827.43	-67.18	-54.00	-13.18	9.97	-77.15

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480
Polarization	Vertical		

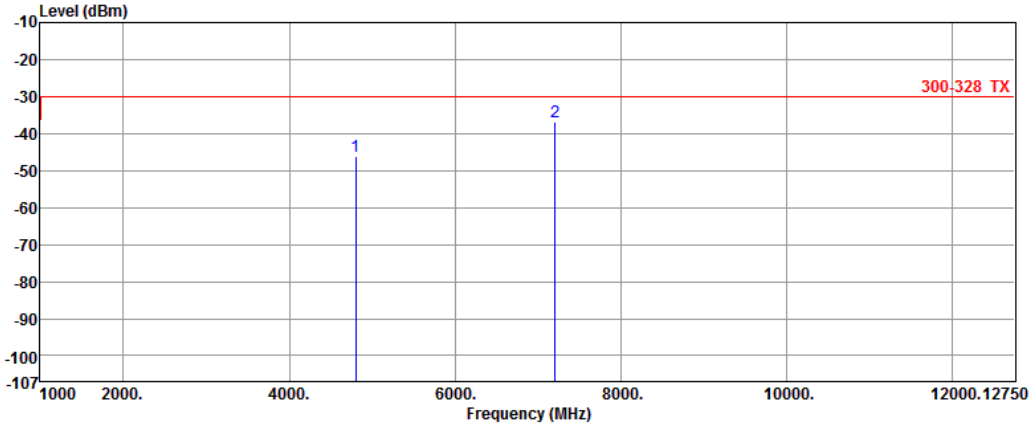


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	599.39	-70.02	-54.00	-16.02	6.78	-76.80
2	731.31	-67.37	-54.00	-13.37	9.04	-76.41
3	820.55	-66.86	-54.00	-12.86	9.96	-76.82

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

3.5.8 Transmitter Radiated Unwanted Emissions (Above 1GHz)

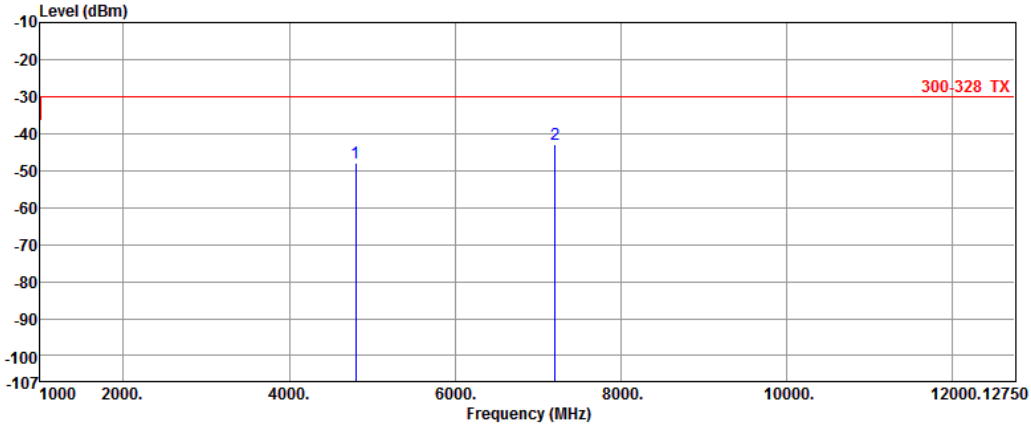
Modulation	GFSK/1Mbps	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4804.00	-46.24	-30.00	-16.24	11.64	-57.88
2	7206.28	-36.70	-30.00	-6.70	17.38	-54.08

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

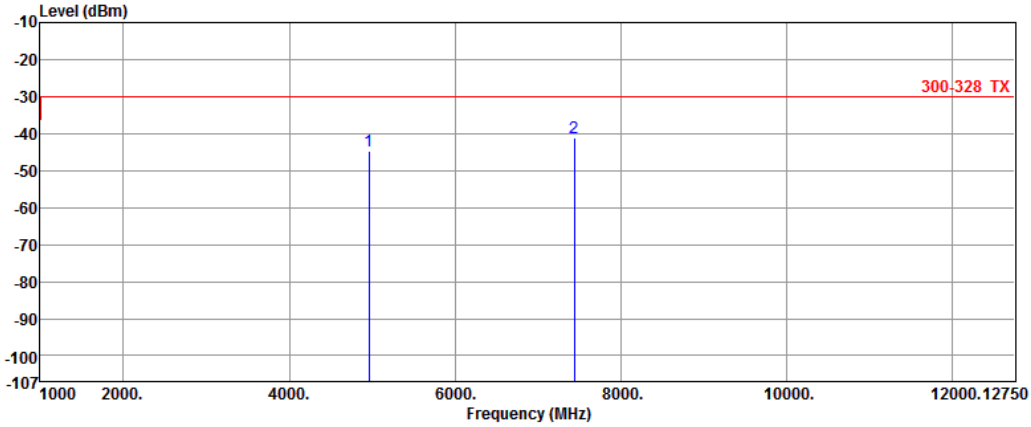
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4804.11	-47.89	-30.00	-17.89	11.89	-59.78
2	7206.35	-42.81	-30.00	-12.81	17.16	-59.97

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

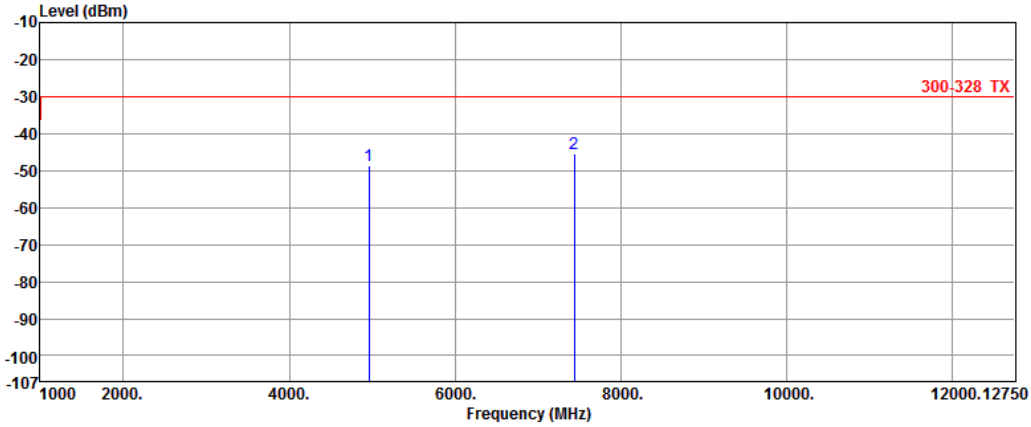
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4960.33	-44.72	-30.00	-14.72	12.23	-56.95
2	7440.54	-40.98	-30.00	-10.98	17.00	-57.98

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

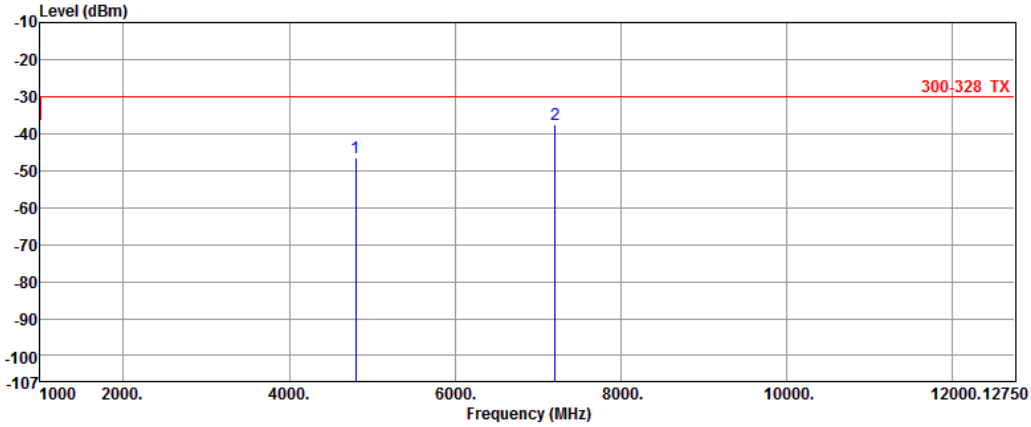
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4959.44	-48.68	-30.00	-18.68	11.66	-60.34
2	7440.58	-45.27	-30.00	-15.27	17.71	-62.98

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

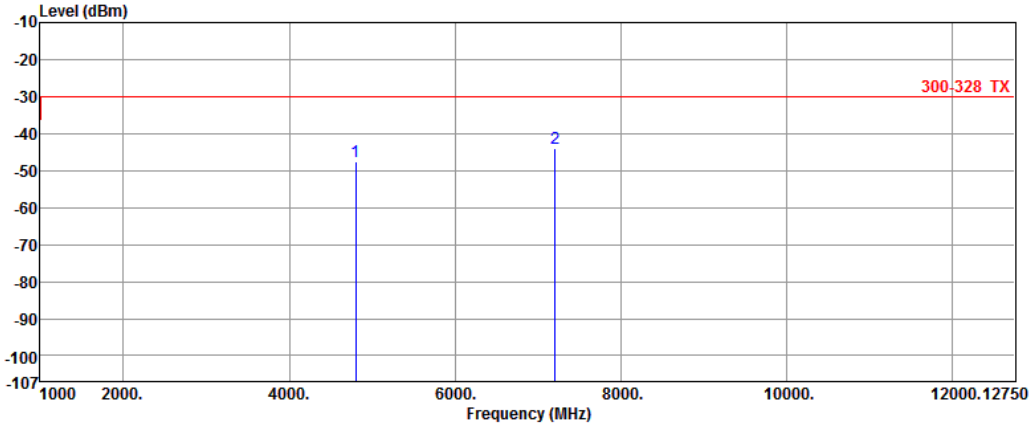
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4803.24	-46.39	-30.00	-16.39	11.64	-58.03
2	7206.08	-37.49	-30.00	-7.49	17.38	-54.87

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

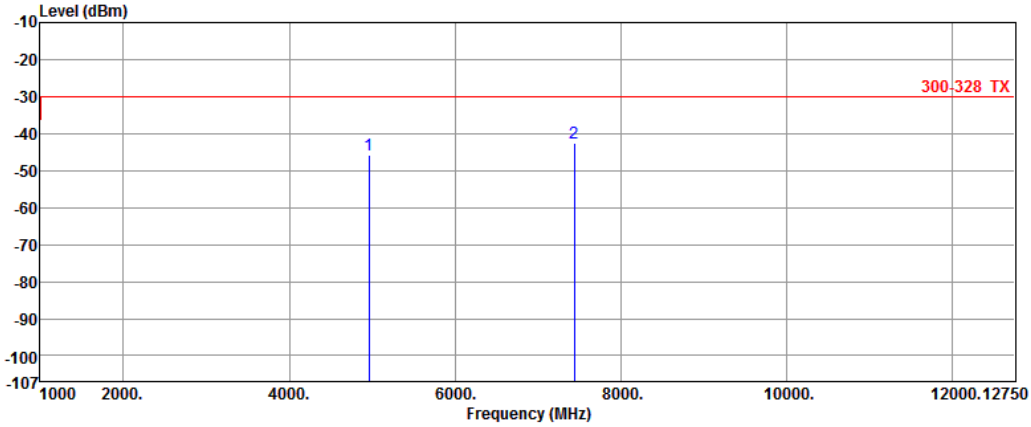
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4803.11	-47.73	-30.00	-17.73	11.90	-59.63
2	7205.71	-44.08	-30.00	-14.08	17.16	-61.24

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

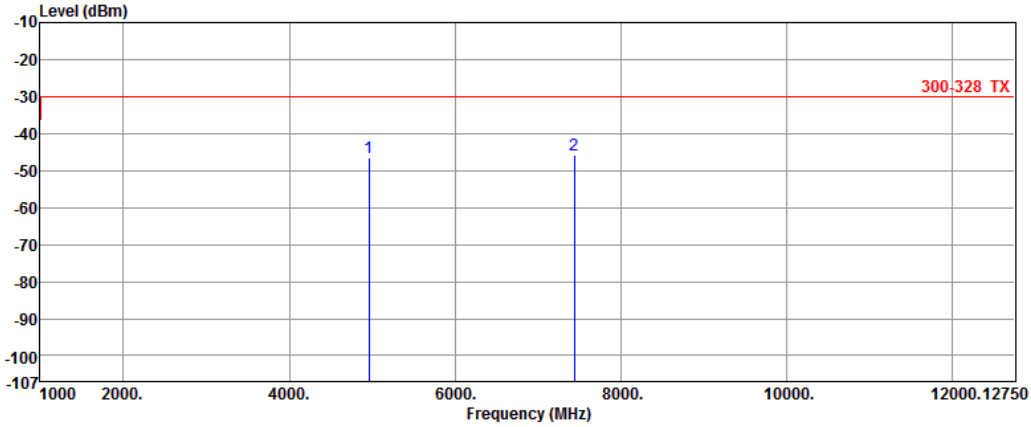
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4959.05	-45.89	-30.00	-15.89	12.22	-58.11
2	7440.48	-42.52	-30.00	-12.52	17.00	-59.52

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4958.95	-46.66	-30.00	-16.66	11.65	-58.31
2	7440.47	-45.64	-30.00	-15.64	17.71	-63.35

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

4 Receiver Test Results

4.1 Receiver Spurious Emissions

4.1.1 Limit of Receiver Spurious Emissions

Spurious Emissions Limit (Peak Power)	Frequency Range	Measurement Bandwidth
-56 dBW (2.5μW) e.i.r.p (59 dBμV/m at 10 metres)	< 150 kHz	1 kHz
	150 kHz – 30 MHz	10 kHz

Emission Limits		
Frequency Range	**Maximum power (dBm)**	**Measurement bandwidth (kHz)**
30 MHz to 1 GHz	-57	100
Above 1 GHz to 12.75 GHz	-47	1000

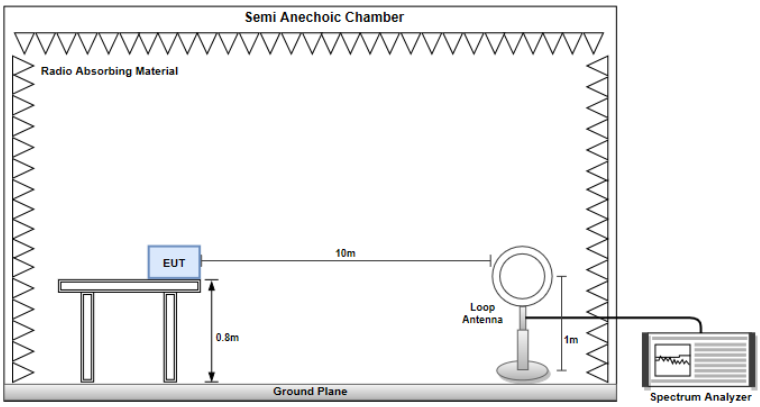
4.1.2 Test Procedures

Reference to clause 5.4.10.2 of ETSI EN 300 328 V2.1.1 (2016-11).

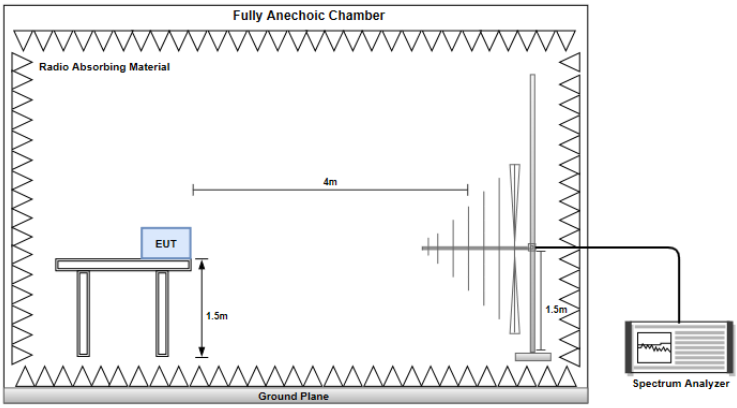
4.1.3 Test Setup

Radiated Emission

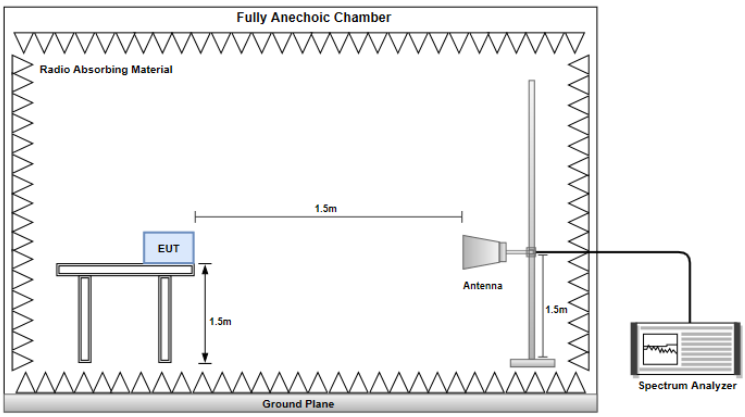
Below 30MHz



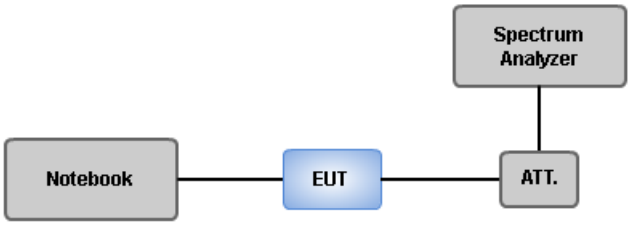
Below 1GHz



Above 1 GHz



Conducted Emission



4.1.4 Receiver Radiated Unwanted Emissions (≤ 30MHz)

Dipole antenna

Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	SA Reading (dBuV)	Factor (dB)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.009	42.51	22.51	20	16.49	59	Pass
2480		Ch78		0.009	46.56	26.56	20	12.44	59	Pass
2402	BLE	Ch00	2M	0.009	41	21	20	18	59	Pass
2480		Ch78		0.009	44.34	24.34	20	14.66	59	Pass

PIFA antenna

Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	SA Reading (dBuV)	Factor (dB)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.009	43.34	23.34	20	15.66	59	Pass
2480		Ch78		0.009	42.97	22.97	20	16.03	59	Pass
2402	BLE	Ch00	2M	0.009	46.41	26.41	20	12.59	59	Pass
2480		Ch78		0.009	41.64	21.64	20	17.36	59	Pass

Notch antenna

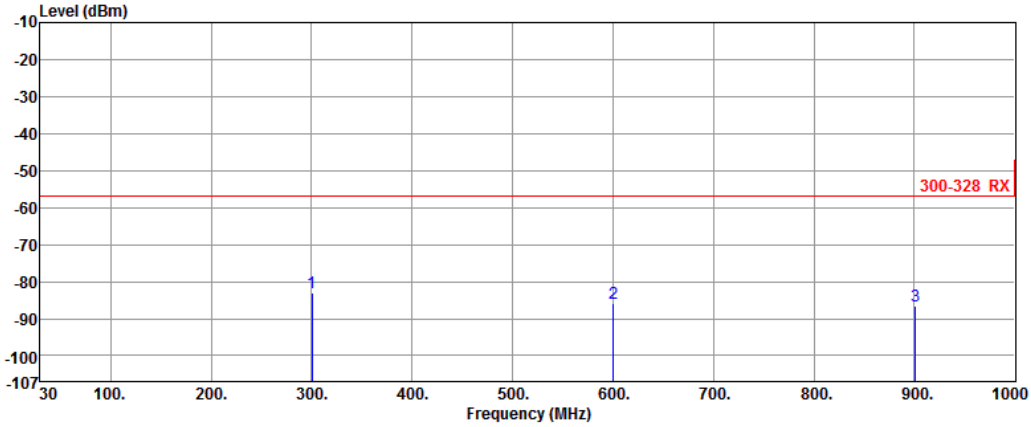
Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	SA Reading (dBuV)	Factor (dB)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.009	40.72	20.72	20	18.28	59	Pass
2480		Ch78		0.009	41.25	21.25	20	17.75	59	Pass
2402	BLE	Ch00	2M	0.009	41.54	21.54	20	17.46	59	Pass
2480		Ch78		0.009	44.37	24.37	20	14.63	59	Pass

On-Board Trace antenna

Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	SA Reading (dBuV)	Factor (dB)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.009	44.32	24.32	20	14.68	59	Pass
2480		Ch78		0.009	42.76	22.76	20	16.24	59	Pass
2402	BLE	Ch00	2M	0.009	41.68	21.68	20	17.32	59	Pass
2480		Ch78		0.009	42.96	22.96	20	16.04	59	Pass

4.1.5 Receiver Conducted Unwanted Emissions (Below 1GHz)

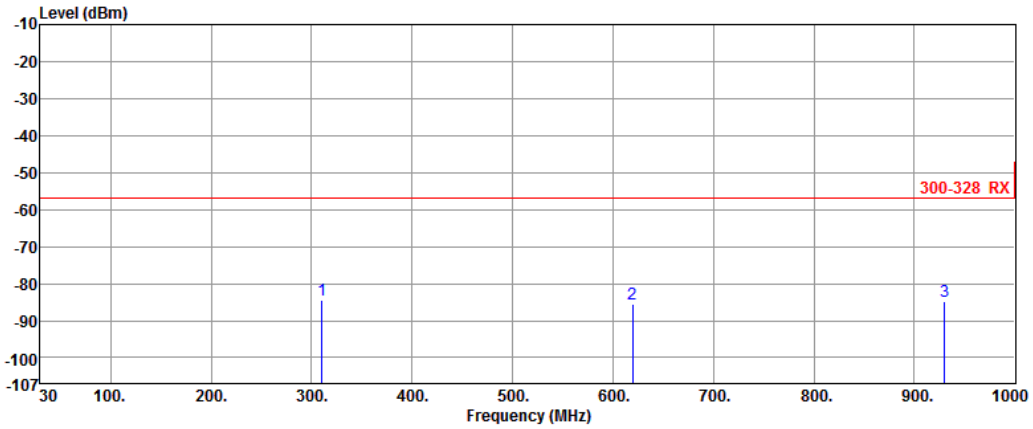
Modulation	GFSK/1Mbps	**Test Freq. (MHz)**	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	300.63	-82.85	-57.00	-25.85	0.00	-82.85
2	600.36	-85.96	-57.00	-28.96	0.00	-85.96
3	901.06	-86.65	-57.00	-29.65	0.00	-86.65

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

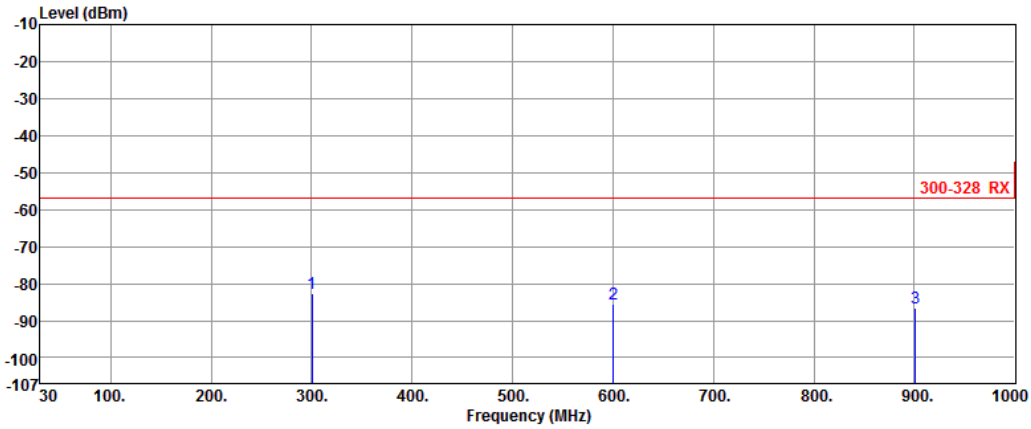
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	310.33	-84.39	-57.00	-27.39	0.00	-84.39
2	619.76	-85.35	-57.00	-28.35	0.00	-85.35
3	930.16	-84.63	-57.00	-27.63	0.00	-84.63

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

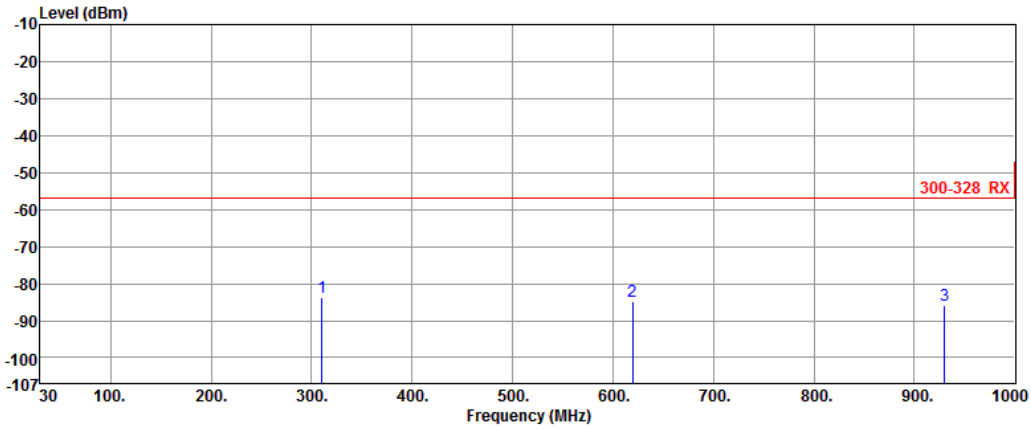
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	300.63	-82.69	-57.00	-25.69	0.00	-82.69
2	600.36	-85.66	-57.00	-28.66	0.00	-85.66
3	901.06	-86.68	-57.00	-29.68	0.00	-86.68

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480

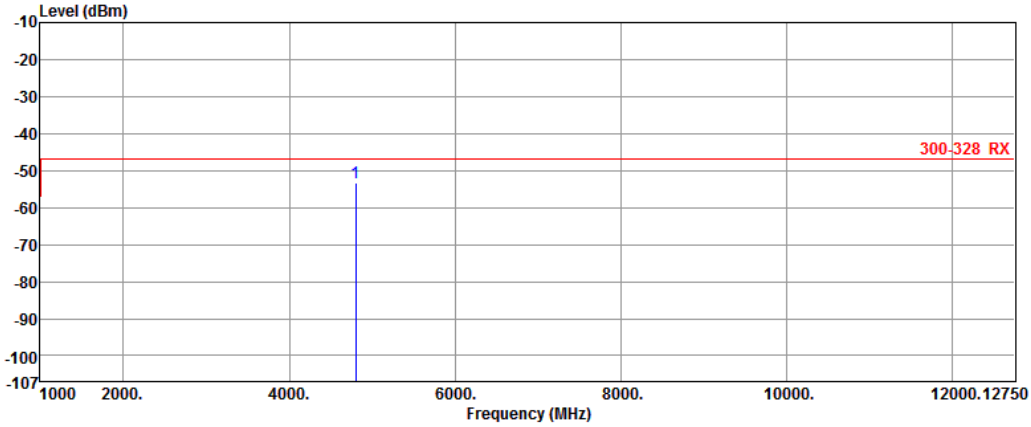


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	310.33	-83.91	-57.00	-26.91	0.00	-83.91
2	619.76	-84.93	-57.00	-27.93	0.00	-84.93
3	930.16	-85.79	-57.00	-28.79	0.00	-85.79

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

4.1.6 Receiver Conducted Unwanted Emissions (Above 1GHz)

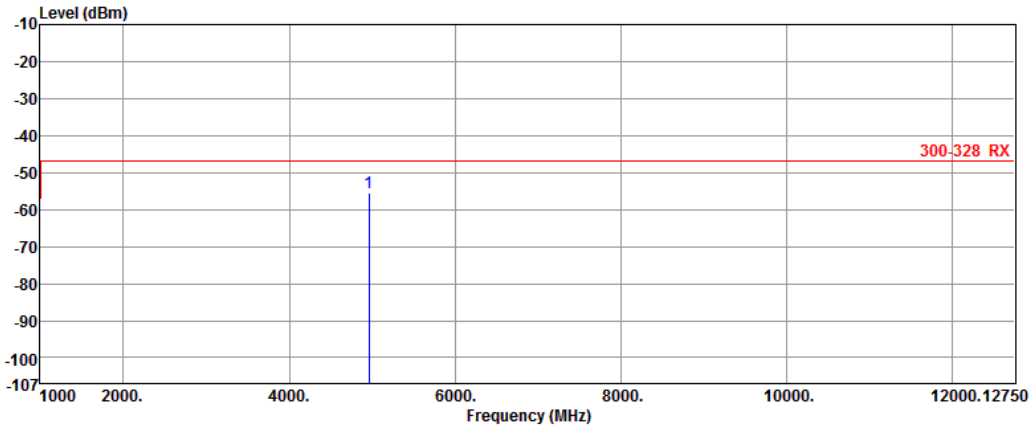
Modulation	GFSK/1Mbps	**Test Freq. (MHz)**	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4801.96	-53.38	-47.00	-6.38	0.00	-53.38

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

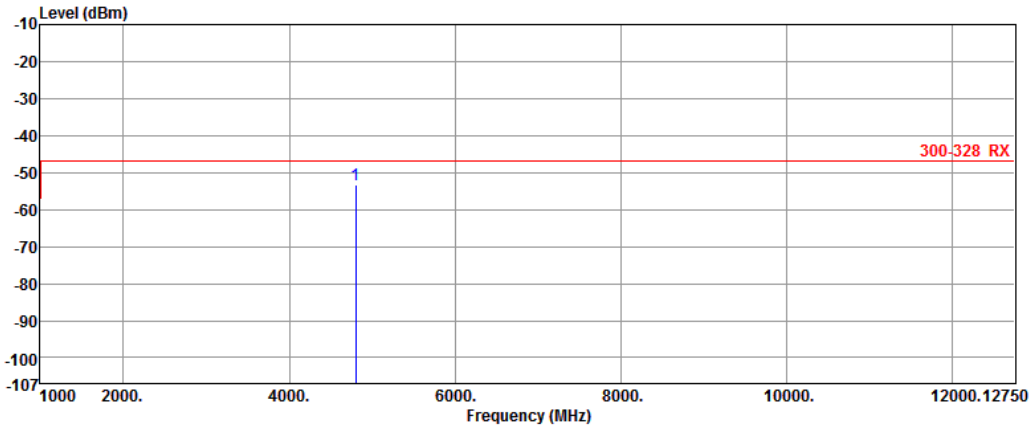
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4958.06	-55.31	-47.00	-8.31	0.00	-55.31

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

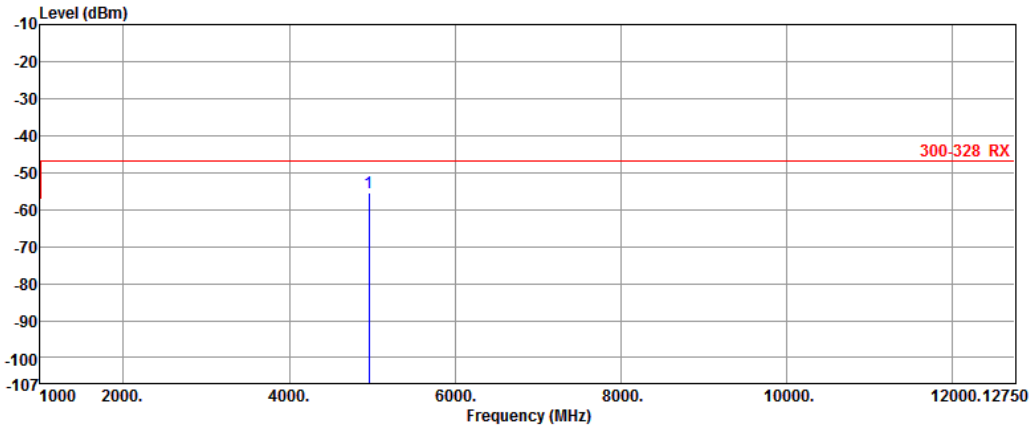
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4801.96	-53.35	-47.00	-6.35	0.00	-53.35

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480

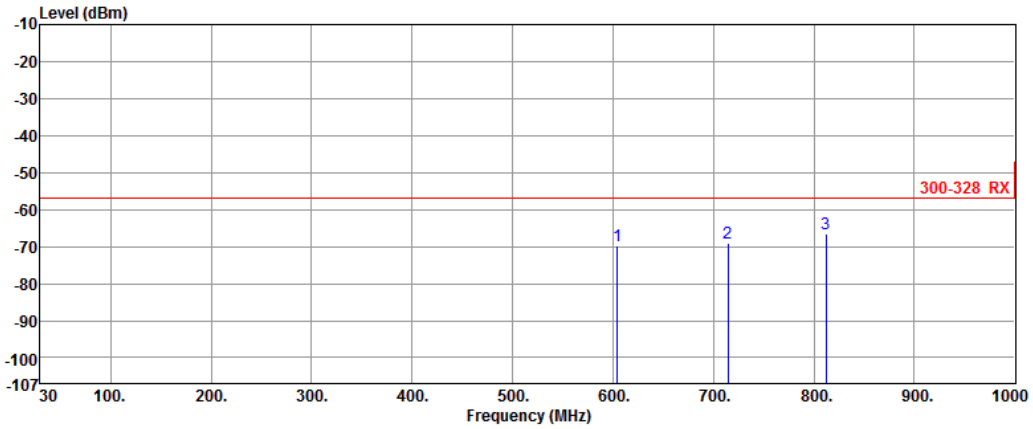


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4958.03	-55.32	-47.00	-8.32	0.00	-55.32

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

4.1.7 Receiver Radiated Unwanted Emissions (Below 1GHz)

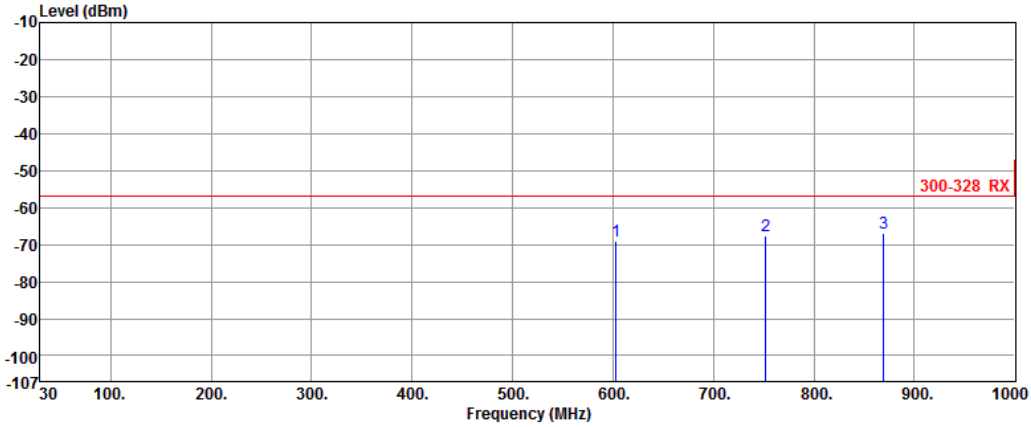
Modulation	GFSK/1Mbps	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	604.15	-69.95	-57.00	-12.95	6.94	-76.89
2	714.33	-68.97	-57.00	-11.97	8.26	-77.23
3	811.83	-66.64	-57.00	-9.64	9.77	-76.41

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

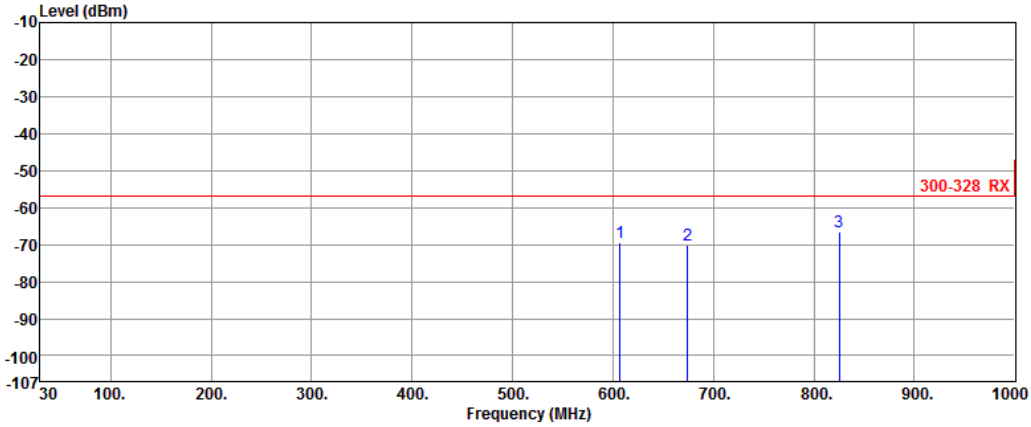
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	603.18	-69.16	-57.00	-12.16	7.38	-76.54
2	752.35	-67.46	-57.00	-10.46	8.47	-75.93
3	869.35	-66.98	-57.00	-9.98	10.40	-77.38

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

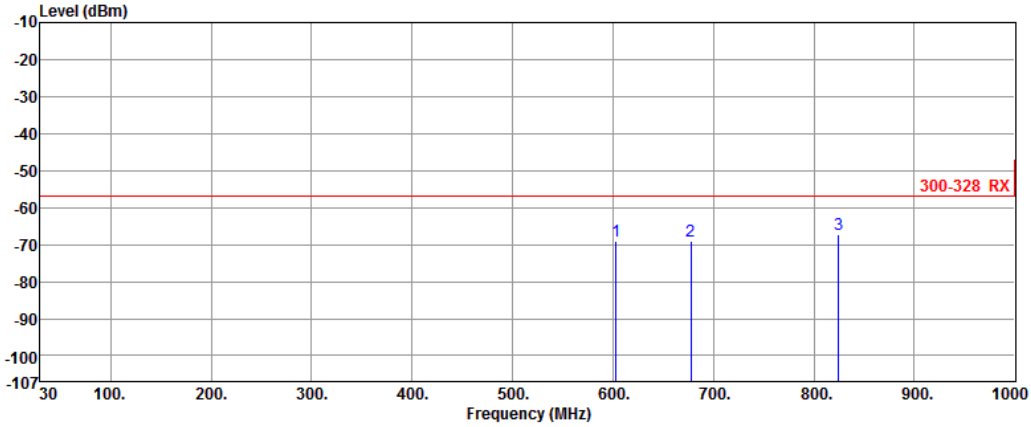
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	607.08	-69.58	-57.00	-12.58	6.21	-75.79
2	674.35	-69.98	-57.00	-12.98	7.13	-77.11
3	825.48	-66.72	-57.00	-9.72	10.01	-76.73

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

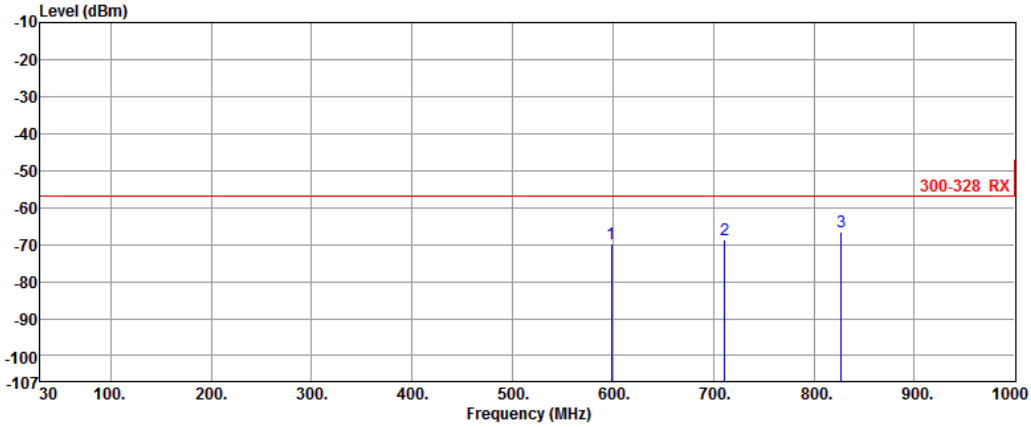
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	603.18	-69.00	-57.00	-12.00	7.38	-76.38
2	677.28	-69.02	-57.00	-12.02	7.23	-76.25
3	824.50	-67.38	-57.00	-10.38	9.99	-77.37

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

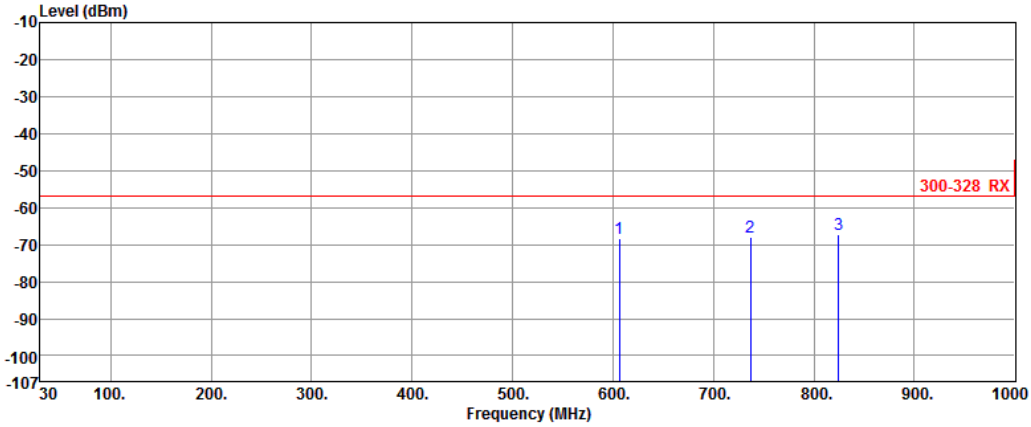
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	598.30	-69.77	-57.00	-12.77	6.73	-76.50
2	711.40	-68.69	-57.00	-11.69	8.26	-76.95
3	827.43	-66.55	-57.00	-9.55	10.03	-76.58

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

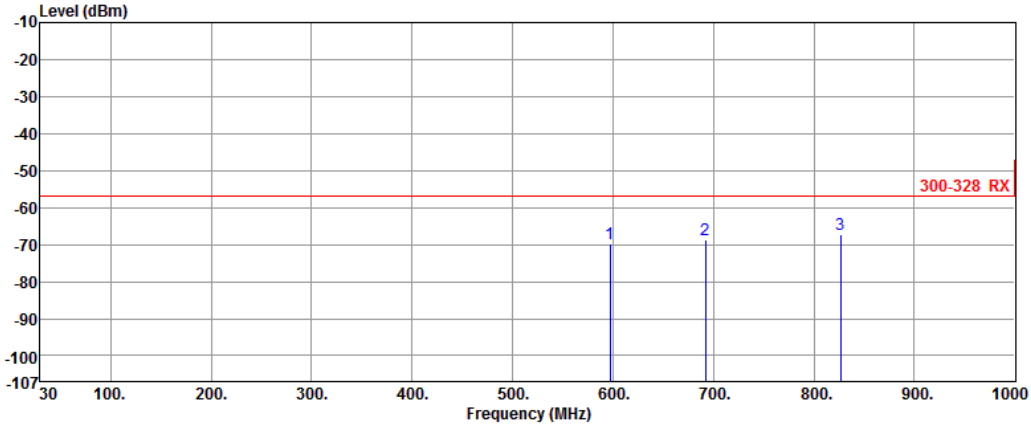
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	606.10	-68.49	-57.00	-11.49	7.48	-75.97
2	736.75	-67.82	-57.00	-10.82	8.07	-75.89
3	824.50	-67.18	-57.00	-10.18	9.99	-77.17

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

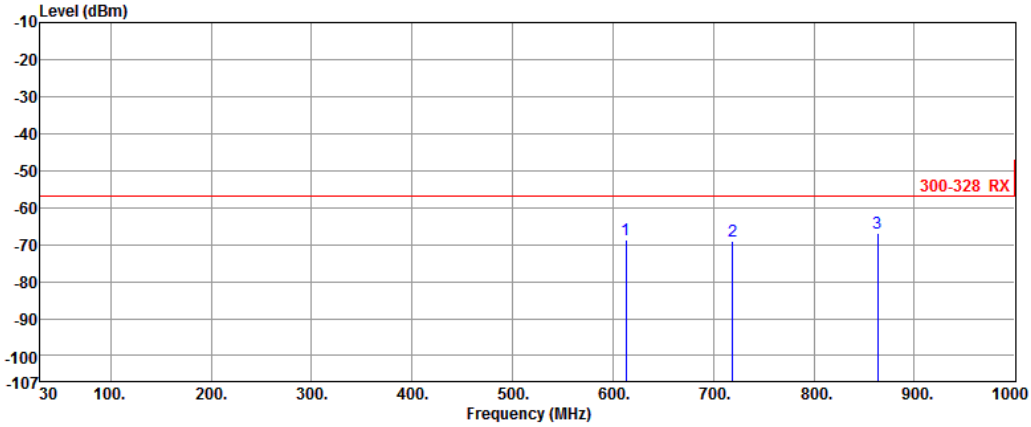
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	597.33	-69.68	-57.00	-12.68	6.69	-76.37
2	691.90	-68.63	-57.00	-11.63	7.73	-76.36
3	826.45	-67.30	-57.00	-10.30	10.03	-77.33

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480
Polarization	Vertical		

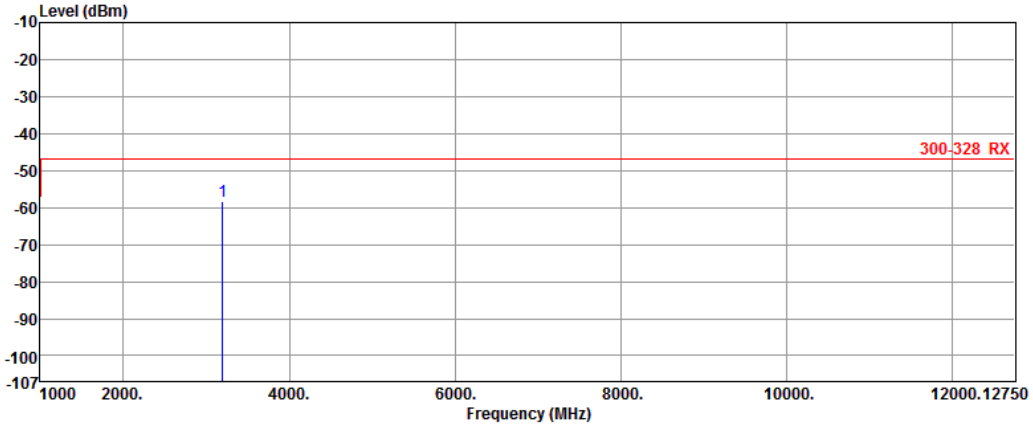


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	612.93	-68.82	-57.00	-11.82	7.32	-76.14
2	719.20	-69.14	-57.00	-12.14	7.34	-76.48
3	863.50	-66.86	-57.00	-9.86	10.18	-77.04

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

4.1.8 Receiver Radiated Unwanted Emissions (Above 1GHz)

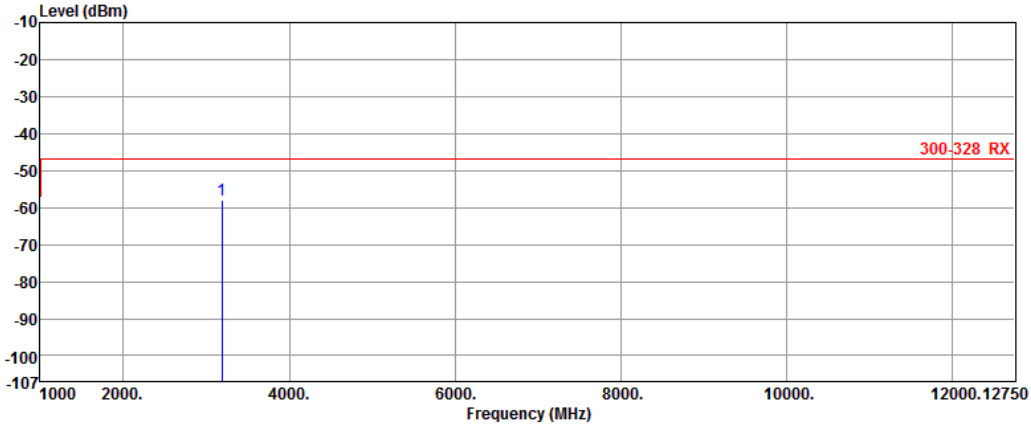
Modulation	GFSK/1Mbps	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	3194.42	-58.41	-47.00	-11.41	6.81	-65.22

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

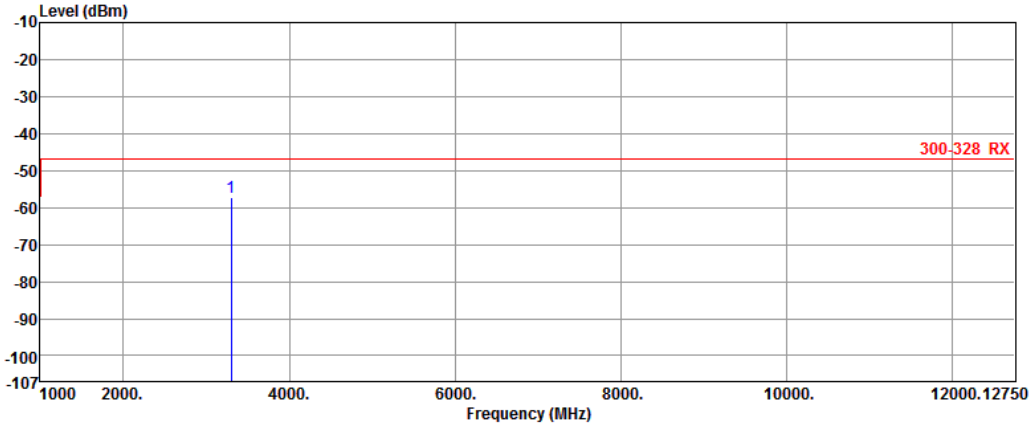
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	3192.77	-58.10	-47.00	-11.10	6.85	-64.95

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

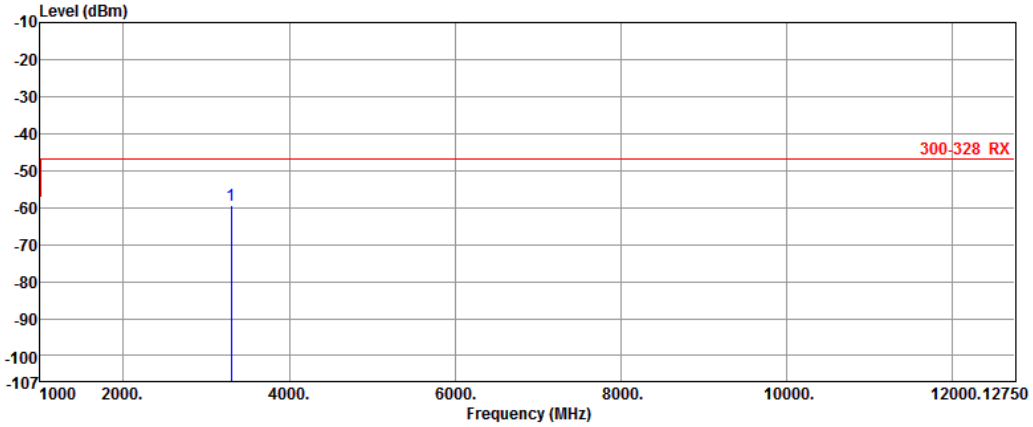
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	3298.36	-57.31	-47.00	-10.31	7.50	-64.81

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

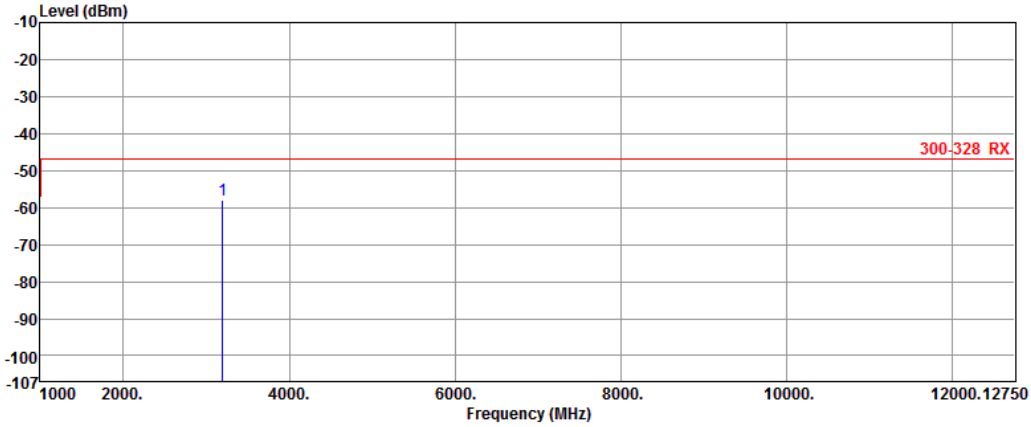
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	3297.93	-59.38	-47.00	-12.38	5.66	-65.04

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

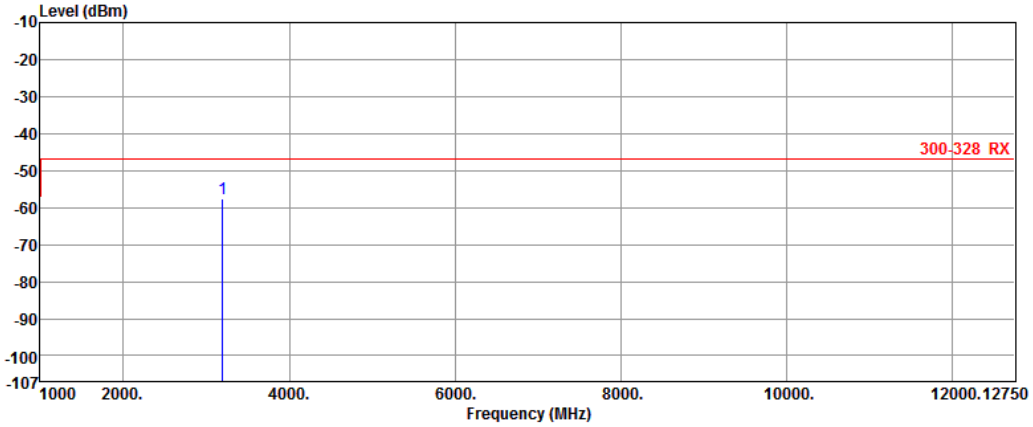
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	3195.79	-57.89	-47.00	-10.89	6.80	-64.69

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

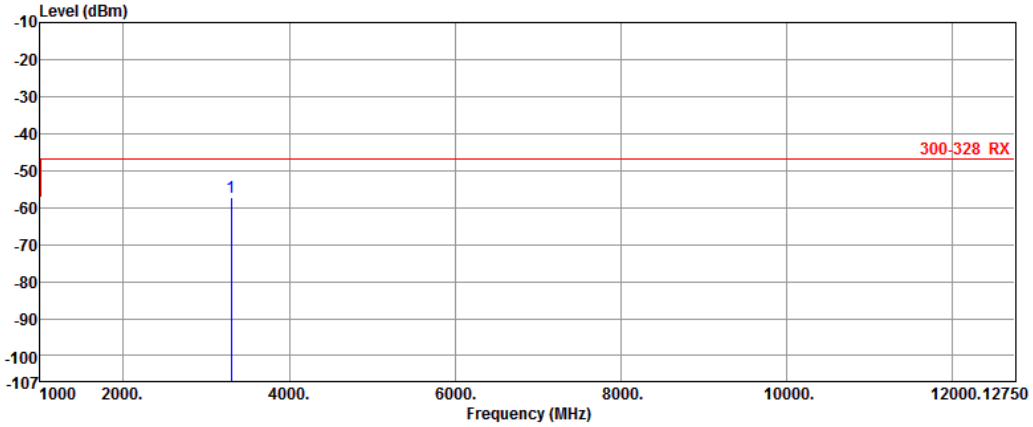
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	3193.68	-57.74	-47.00	-10.74	6.85	-64.59

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

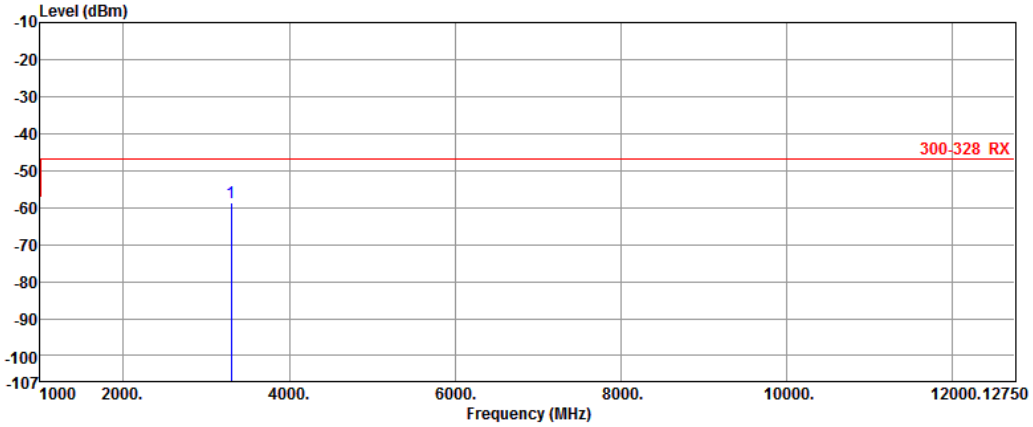
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	3299.54	-57.20	-47.00	-10.20	7.51	-64.71

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	3298.91	-58.73	-47.00	-11.73	5.64	-64.37

Note 1: Measured Value (dBm) = Reading (dBm) + Factor (dB)
Note 2: Margin (dB) = Measured Value (dBm) – Limit (dBm)

5 Receiver Blocking Test Results

5.1 Receiver Blocking

5.1.1 Limit of Receiver Blocking

Receiver Blocking Parameters for Receiver Category 1 Equipment Limit			
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 the wanted signal (in dBm) required to meet the minimum performance criteria (The minimum performance criterion shall be a PER less than or equal to 10 %) 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.			

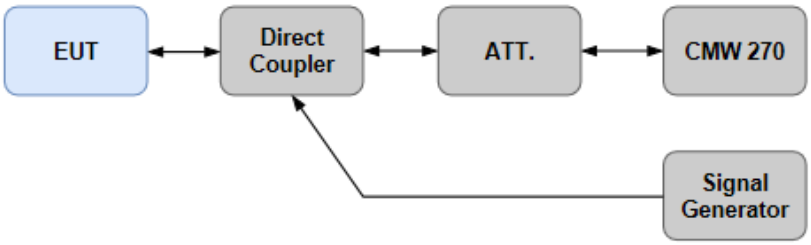
Receiver Blocking Parameters for Receiver Category 2 Equipment Limit			
Wanted Signal Mean Power from Companion Device (dBm)	**Blocking Signal Frequency (MHz)**	**Blocking Signal Power (dBm) (see Note 2)**	**Type of Blocking Signal**
P_{min} + 6 dB	2 380 2 503,5	-57	CW
P_{min} + 6 dB	2 300 2 583,5	-47	CW
Note 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria (The minimum performance criterion shall be a PER less than or equal to 10 %) 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.			

Receiver Blocking Parameters for Receiver Category 3 Equipment Limit			
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 (The minimum performance criterion shall be a PER less than or equal to 10 %) 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.			

5.1.2 Test Procedures

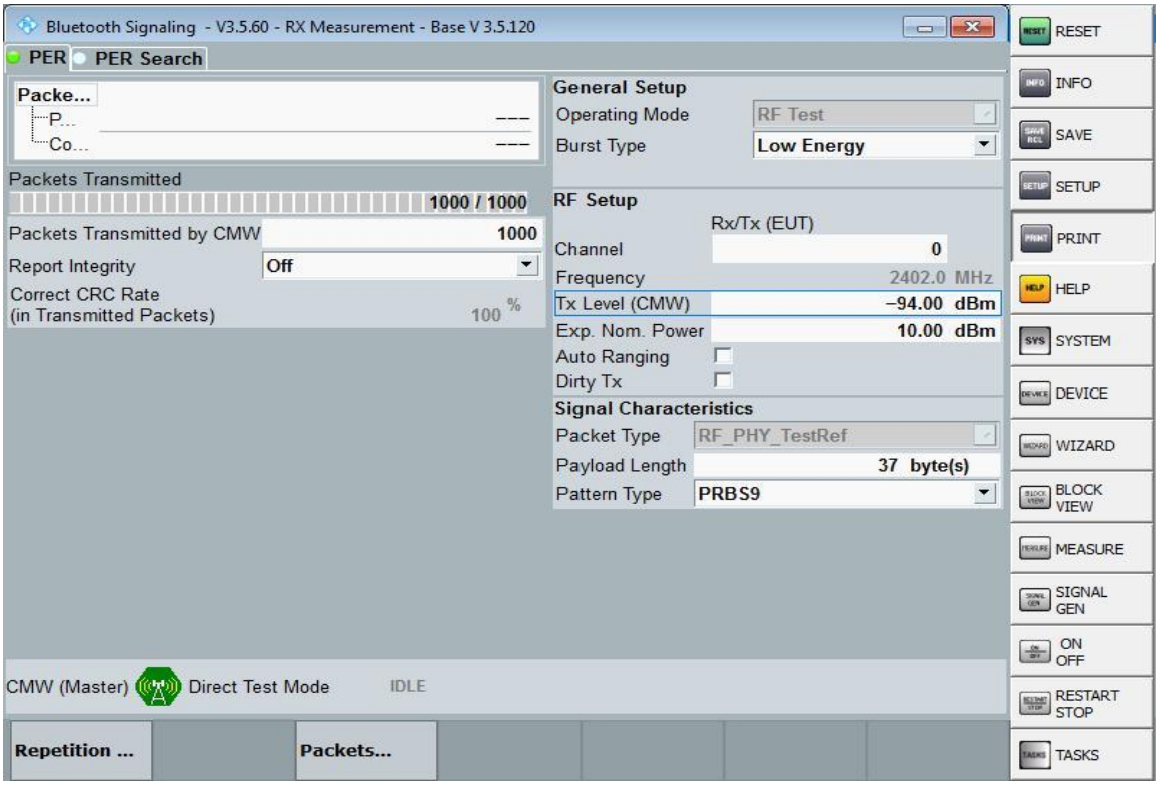
Reference to clause 5.4.11.2 of ETSI EN 300 328 V2.1.1 (2016-11).

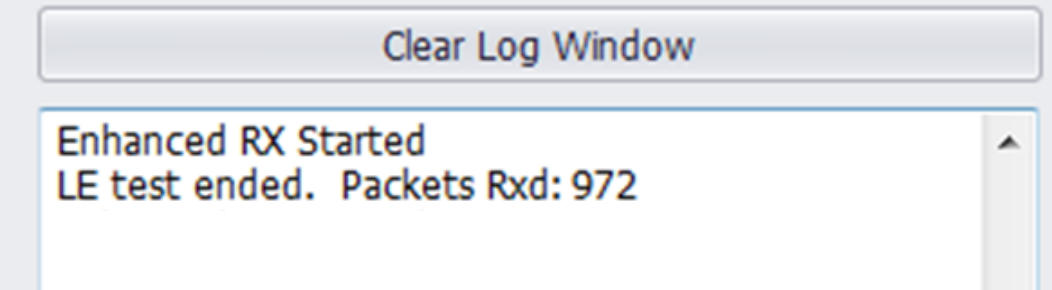
5.1.3 Test Setup



5.1.4 Test Result of Receiver Blocking

2402 MHz

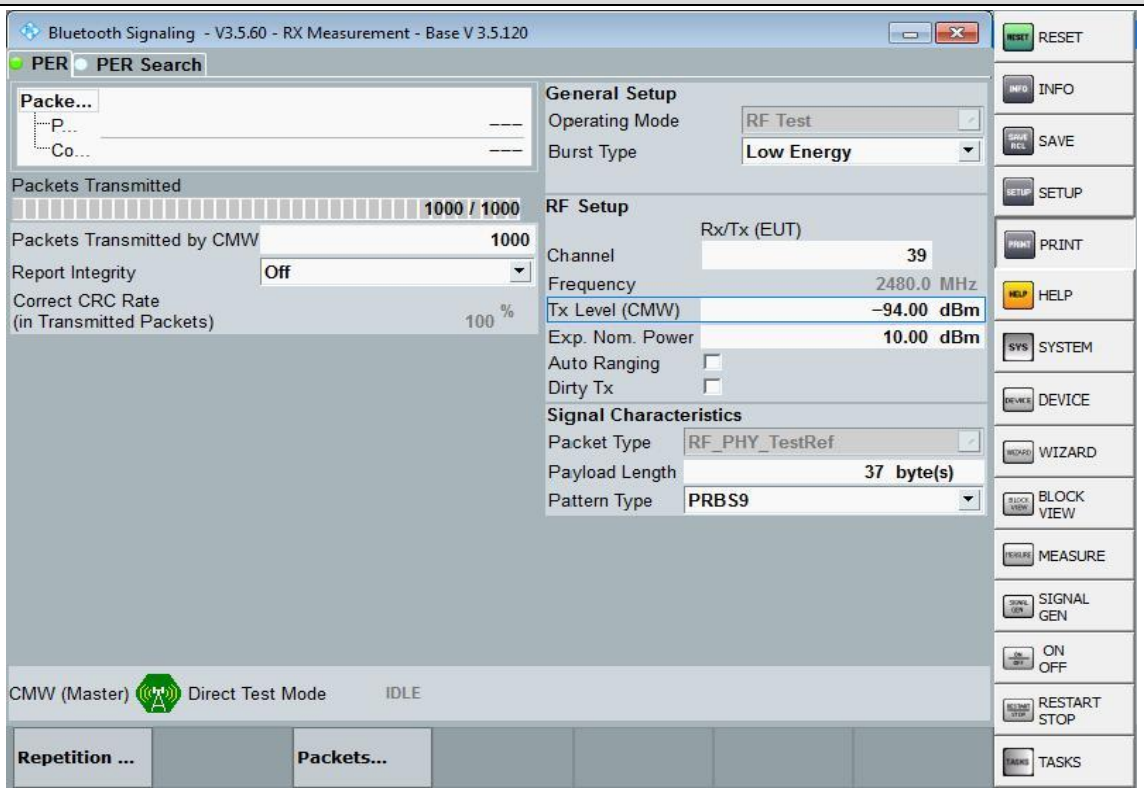


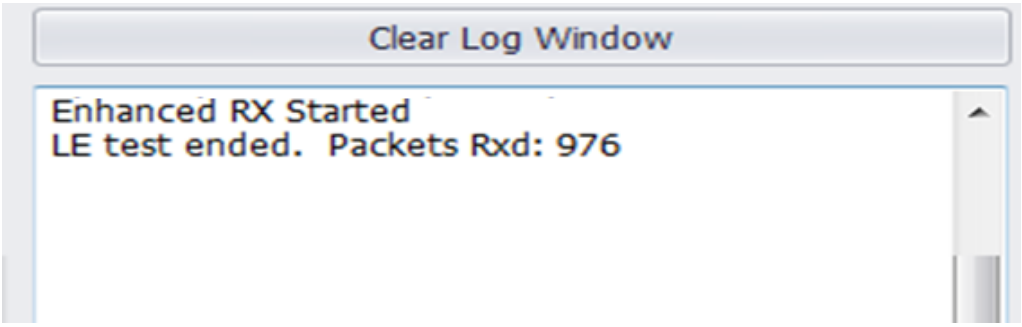


Packet Sent Numbers	1000
Packet Received Numbers	972
PER(%)	2.8

Sensitivity Level	-94		dBm
Want Signal Mean Power form Companion Device (dBm)	**Blocking Signal Frequency (MHz)**	**Blocking Signal Power (dBm)**	**Test Result**
-88	2380.0	-55	Pass
-88	2503.5		Pass
-88	2300.0	-45	Pass
-88	2583.5		Pass

2480 MHz



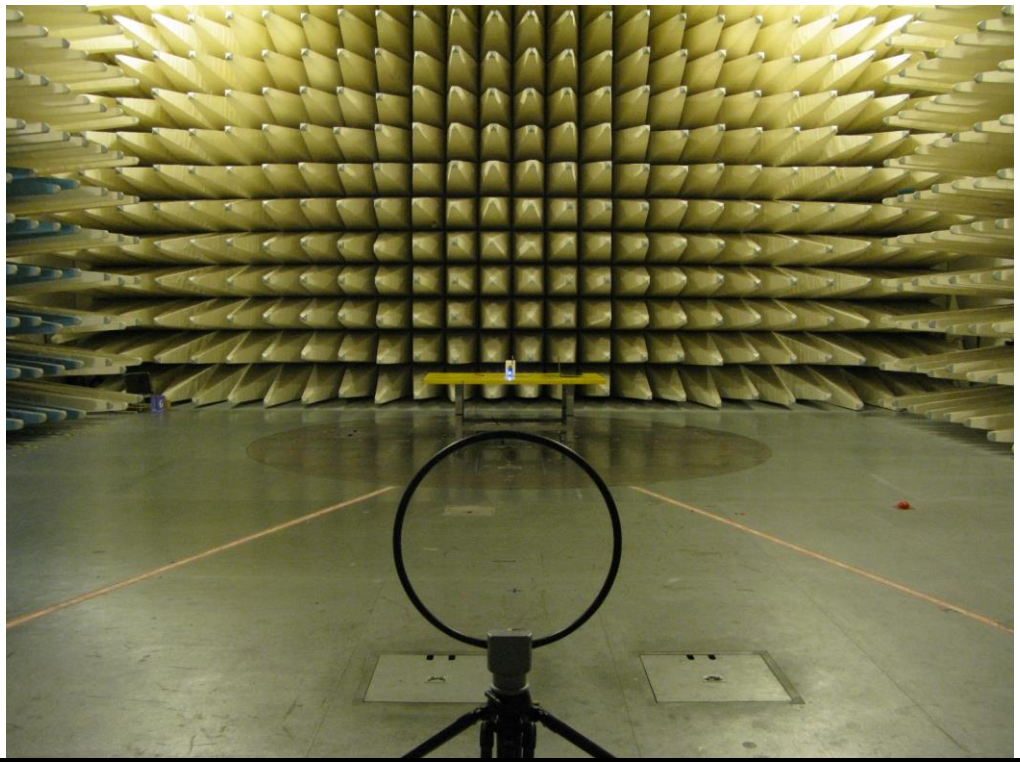


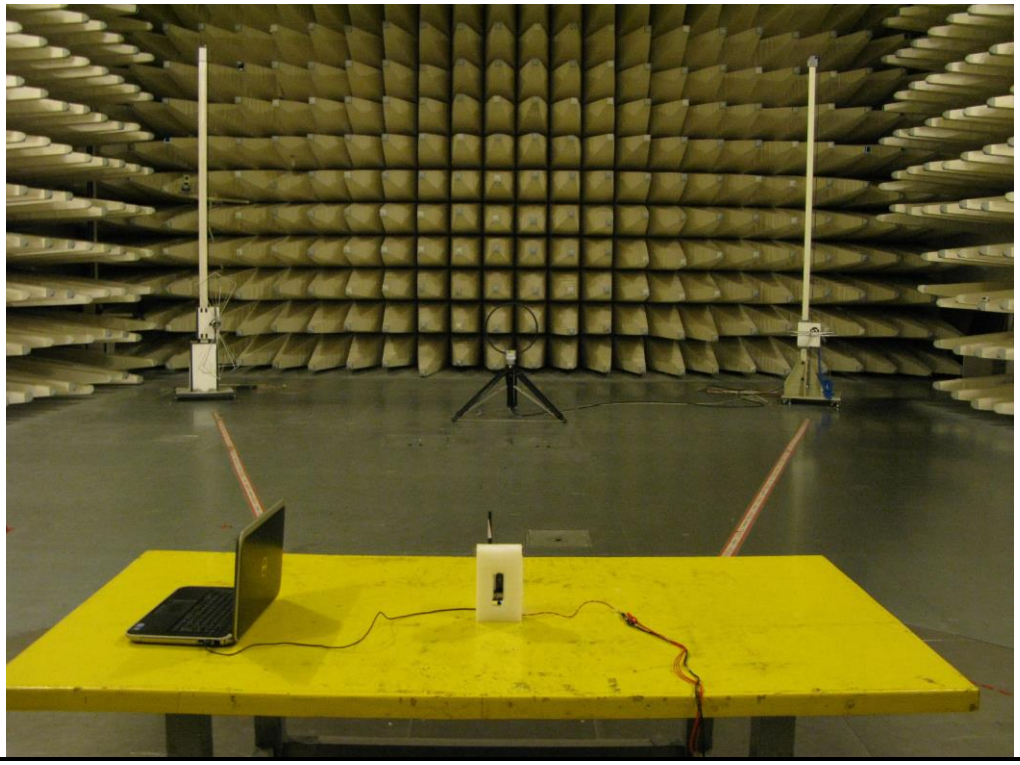
Packet Sent Numbers	1000
Packet Received Numbers	976
PER(%)	2.4

Sensitivity Level	-94		dBm
Want Signal Mean Power form Companion Device (dBm)	**Blocking Signal Frequency (MHz)**	**Blocking Signal Power (dBm)**	**Test Result**
-88	2380.0	-55	Pass
-88	2503.5		Pass
-88	2300.0	-45	Pass
-88	2583.5		Pass

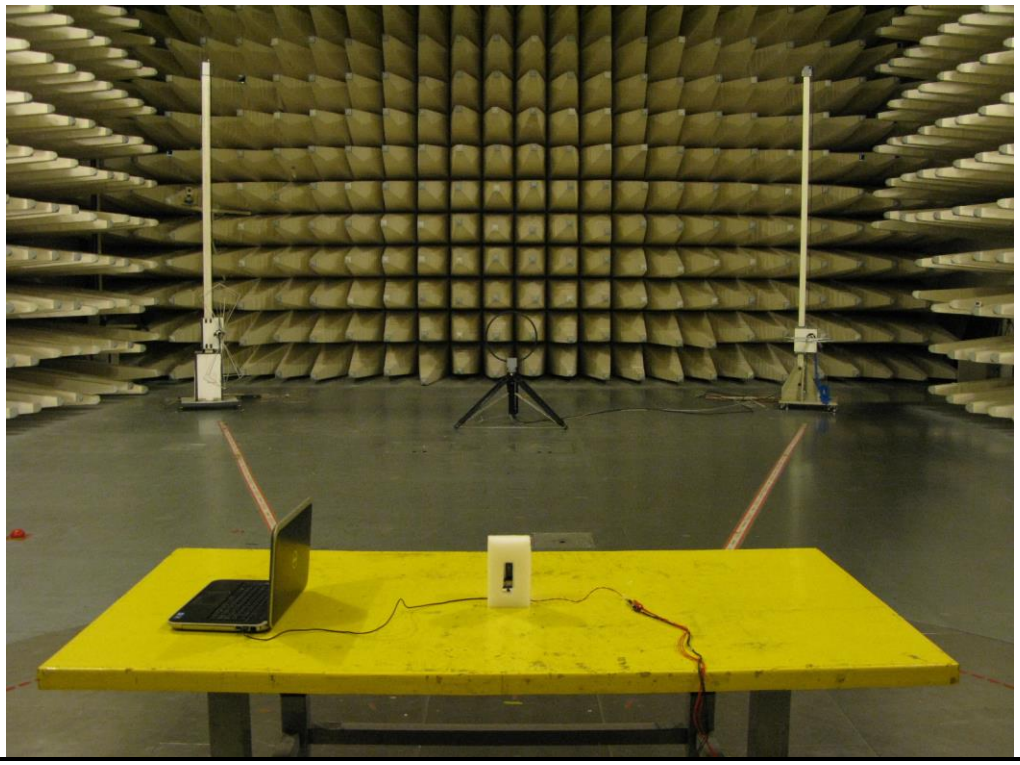
6 Photographs of the Test Configuration

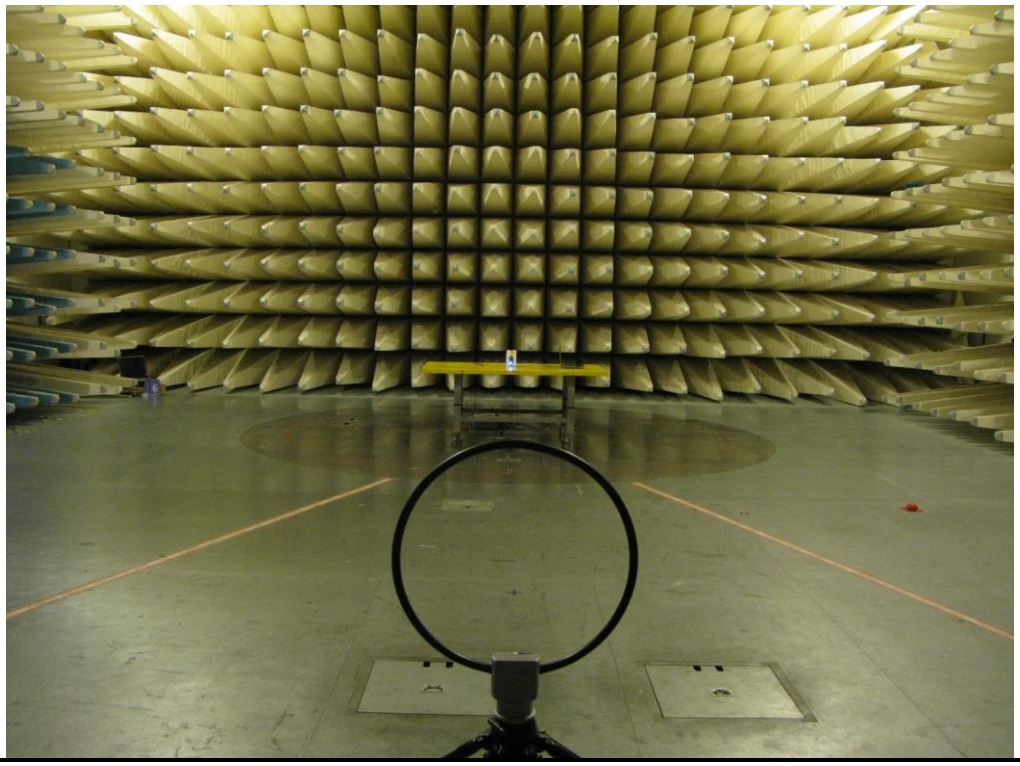
Spurious Emission Test below 30MHz (Dipole antenna)



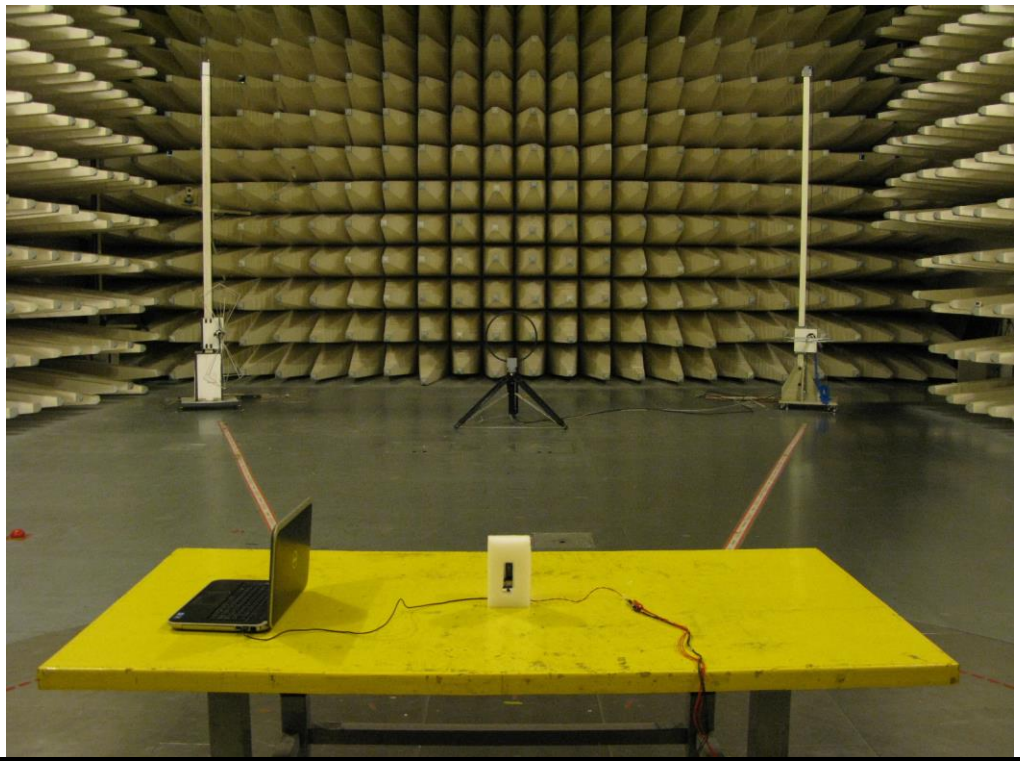


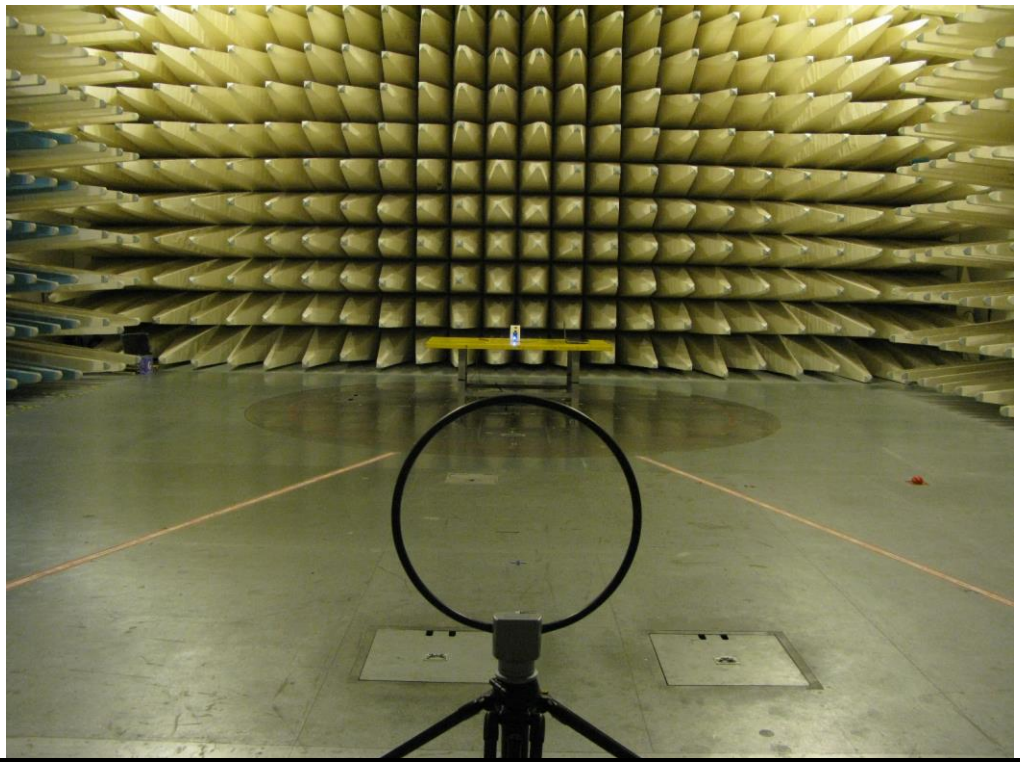
Spurious Emission Test below 30MHz (PIFA antenna)



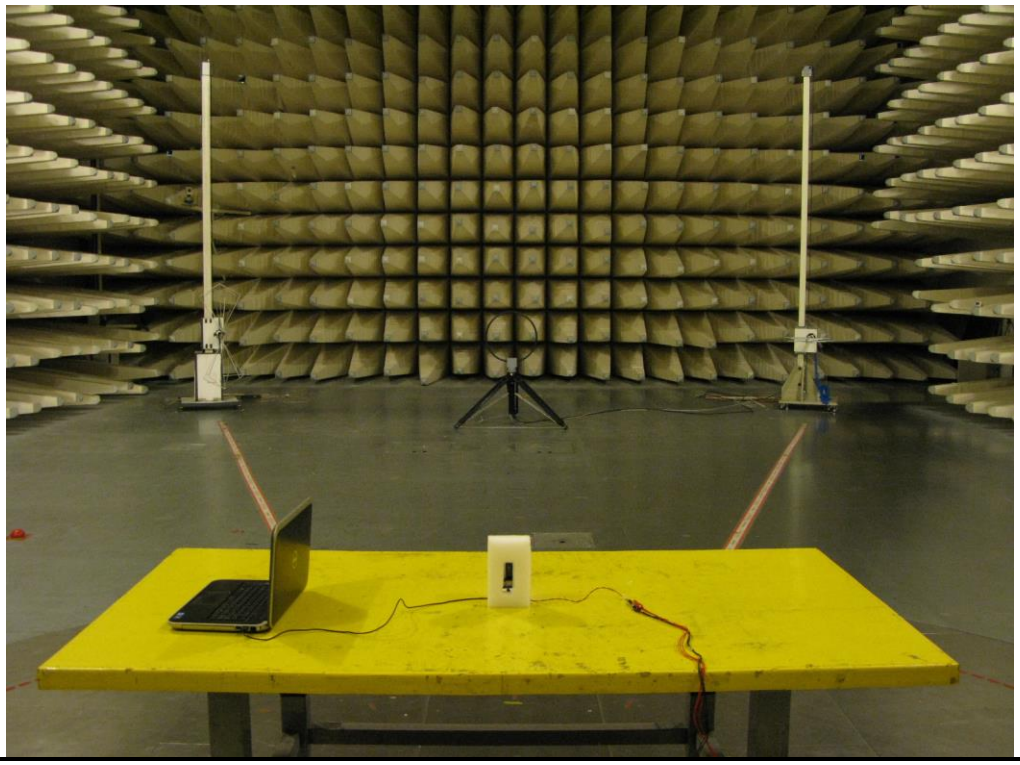


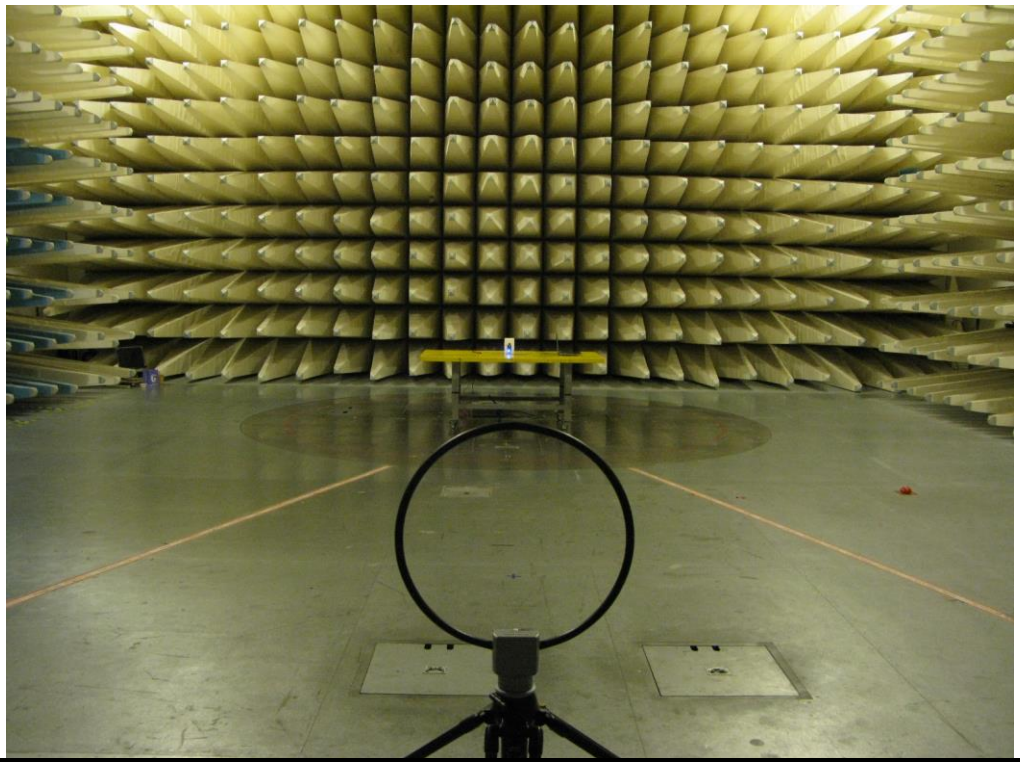
Spurious Emission Test below 30MHz (Notch antenna)



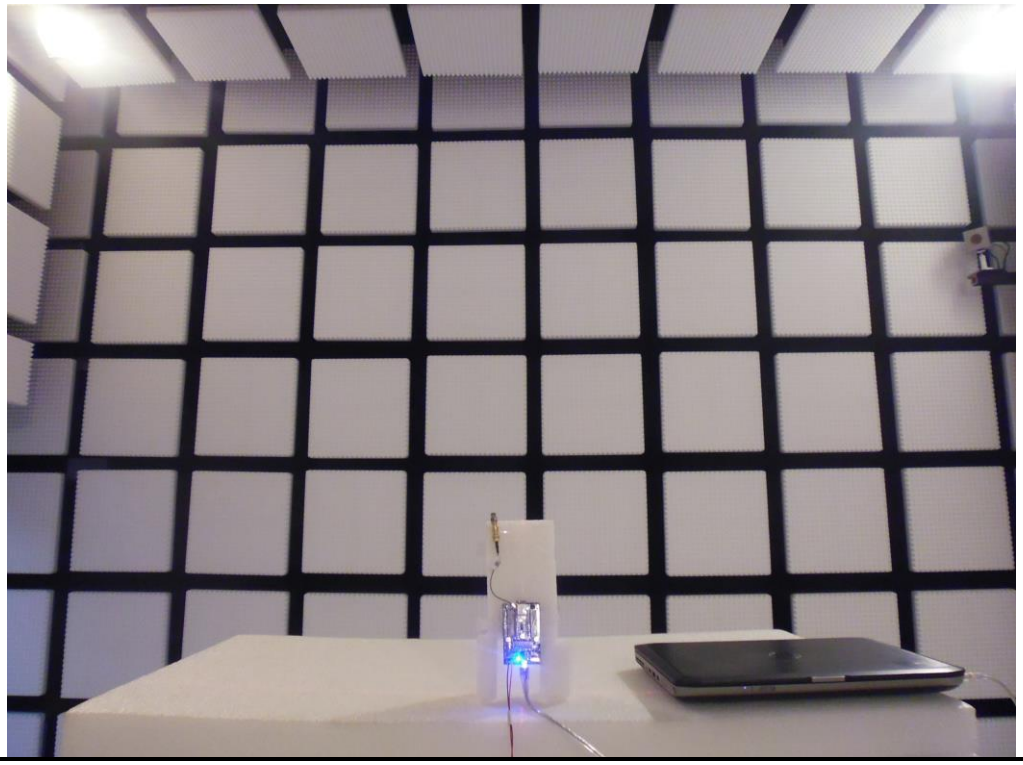


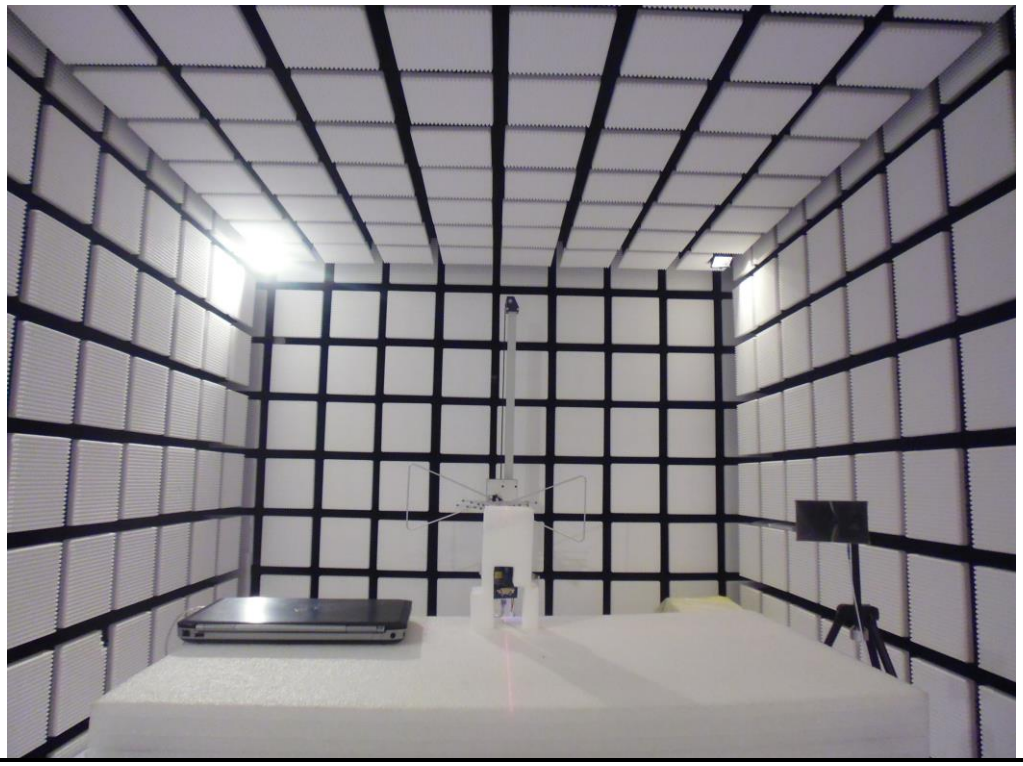
Spurious Emission Test below 30MHz (On-board Trace antenna)



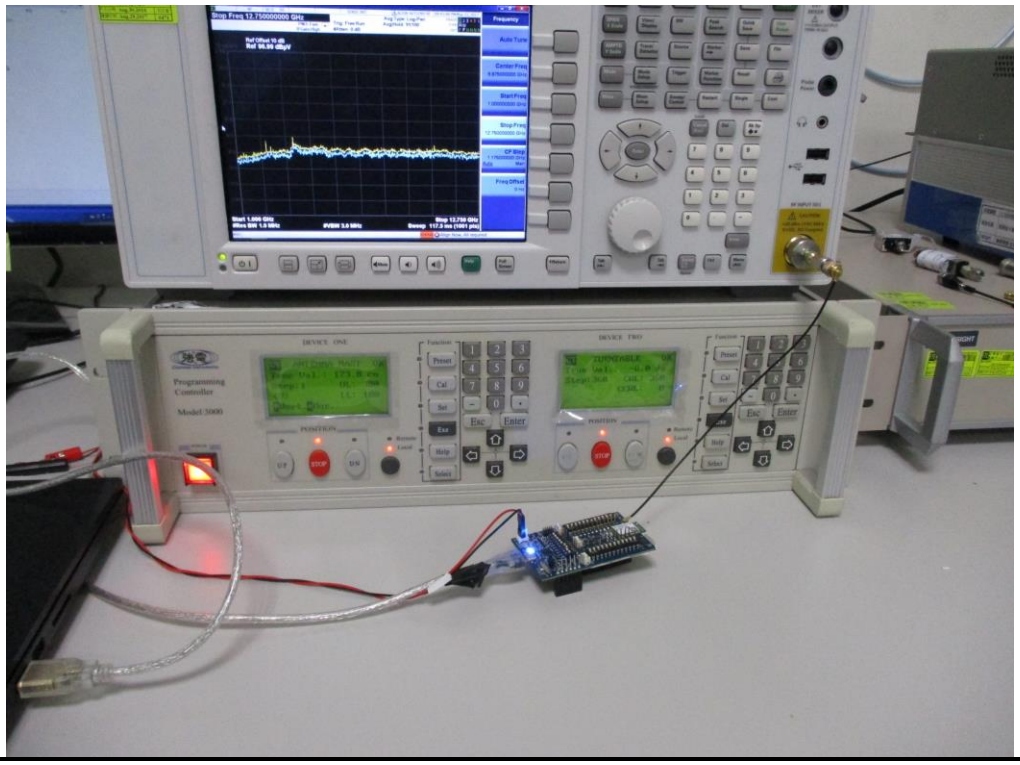


Radiated Spurious Emission Test above 30MHz

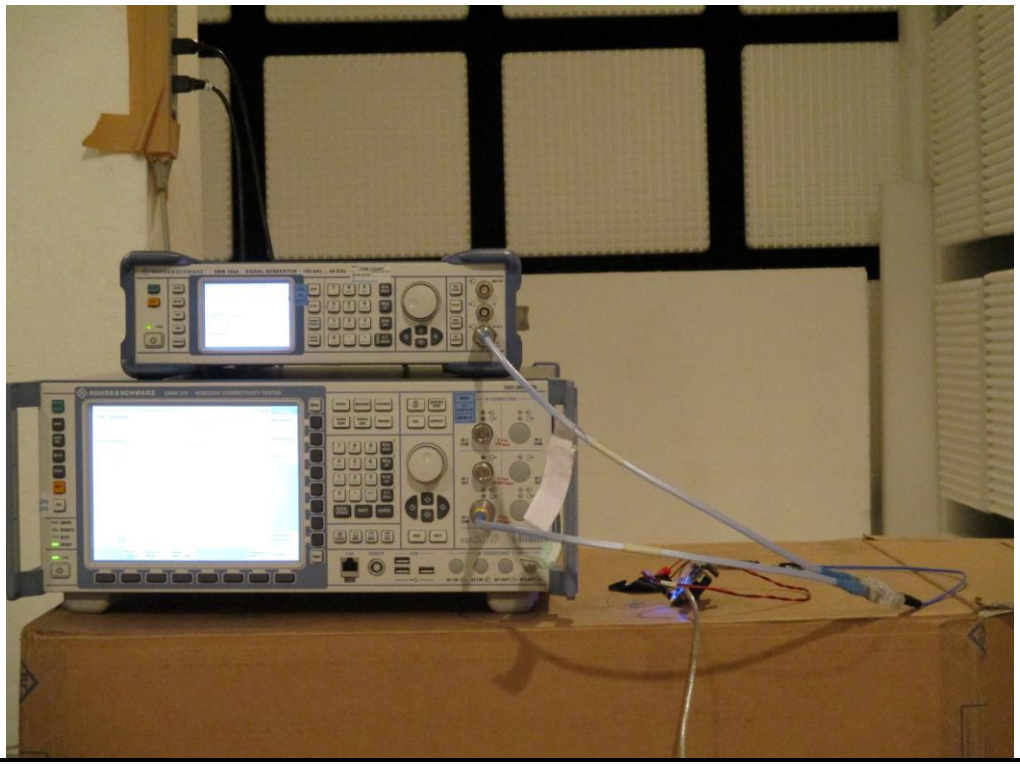




Conducted Spurious Emission Test



Receiver Blocking Test



7 Test laboratory information

Established in 2012, ICC provides foremost EMC & RF Testing and advisory consultation services by our skilled engineers and technicians. Our services employ a wide variety of advanced edge test equipment and one of the widest certification extents in the business.

International Certification Corp (EMC and Wireless Communication Laboratory), it is our definitive objective is to institute long term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise and devotion to a certified value structure. Our passion is to grant our clients with best EMC / RF services by oriented knowledgeable and accommodating staff.

Our Test sites are located at Linkou District and Kwei Shan District. Location map can be found on our website http://www.icertifi.com.tw.

Linkou	**Kwei Shan**	**Kwei Shan Site II**
Tel: 886-2-2601-1640	Tel: 886-3-271-8666	Tel: 886-3-271-8640
No. 30-2, Ding Fwu Tsuen, Lin Kou District, New Taipei City, Taiwan, R.O.C.	No. 3-1, Lane 6, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C.	No. 14-1, Lane 19, Wen San 3rd St., Kwei Shan District, Tao Yuan City 333, Taiwan, R.O.C..

If you have any suggestion, please feel free to contact us as below information

Tel: 886-3-271-8666
Fax: 886-3-318-0155
Email: ICC_Service@icertifi.com.tw

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