AS/NZS Test Report

Equipment	:	**Bluetooth 5.0 BLE Data Module**
Model No.	:	**BL654**
Brand Name	:	**Laird**
Applicant	:	**Laird Technologies**
Address	:	**W66N220 Commerce Court, Cedarburg, Wisconsin 53012, USA**
Standard	:	**AS/NZS 4268:2017**
Received Date	:	**Jan. 30, 2018**
Tested Date	:	**May 02 ~ May 09, 2018**

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
AR813002	Rev. 01	Initial issue	Jun. 25, 2018

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	9.34 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.	N/A
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.	
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 Product Details

The following models are provided to this EUT.

Brand Name	Model Name	Product Name	Description
Laird	BL654	Bluetooth 5.0 BLE Data Module	With Printed PCB Antenna
			With Connector Type Antenna

1.1.2 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.				

1.1.3 Antenna Details

Ant. No.	Brand	Model	Type	Connector	Gain (dBi)	Remark
1	Laird	NanoBlue	PCB Dipole	IPEX MHF4	2	Connector Type Antenna
2	Laird	FlexPIFA	PCB Dipole	IPEX MHF4	2	Connector Type Antenna
3	Laird	FlexNotch	PCB Dipole	IPEX MHF4	2	Connector Type Antenna
4	Mag.Layers	EDA-8709-2G4C1-B27-CY	Dipole	IPEX MHF4	2	Connector Type Antenna
5	Laird	mFlexPIFA	PIFA	IPEX MHF4	2	Connector Type Antenna
6	Laird	Laird NFC	NFC	N/A	N/A	Printed PCB Antenna & Connector Type Antenna
7	Laird	BL654-SA PCB printed antenna	Printed PCB	N/A	0	Printed PCB Antenna
8	Walsin	RFDPA870900SBAB8G1	Dipole	SMA	2	Connector Type Antenna

Note: Antenna 4 was chosen for final test

1.1.4 EUT Operational Condition

Power Supply Type	1.8Vdc & 3.3Vdc from host		
SW Version	29.1.1.0		
Operational Climatic	☒ Tnom (20°C)	☒ Tmax (85°C)	☒ Tmin (-40°C)

1.1.5 Accessories

N/A

1.1.6 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	---	---

1.1.7 Test Tool and Duty Cycle

Test Tool	UwTerminal v7.94	
Modulation Mode	**Duty Cycle Of Test Signal (%)**	**Duty Factor (dB)**
GFSK-125kbps	63	2.01
GFSK-500kbps	63	2.01
GFSK-1Mbps	63	2.01
GFSK-2Mbps	33.27	4.78

1.1.8 Power Setting

Modulation Mode	Test Frequency (MHz)		
	2402	**2440**	**2480**
GFSK-125kbps	8	8	8
GFSK-500kbps	8	8	8
GFSK-1Mbps	8	8	8
GFSK-2Mbps	8	8	8

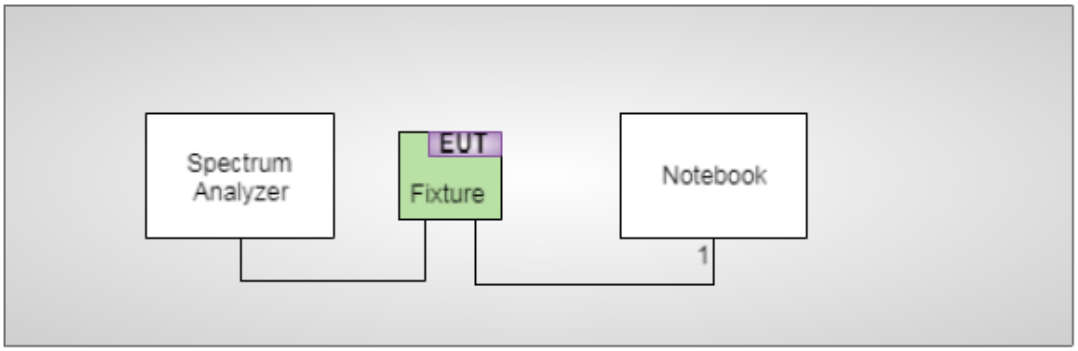
1.2 Local Support Equipment List

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	Fixture	---	---	---	---

Note: Fixture is provided by applicant.

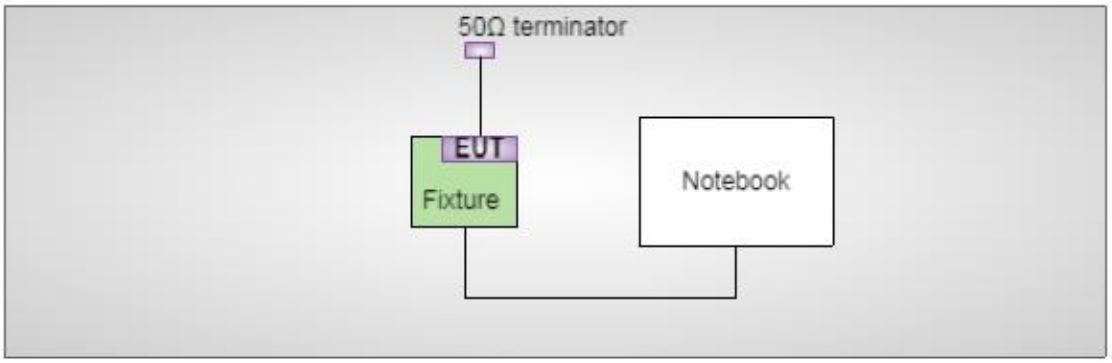
1.3 Test Setup Chart

Test Setup Diagram (Conducted)



1. USB cable, 1m shielded.

Test Setup Diagram (Radiated)



1. USB cable, 1m shielded.

1.4 Test Equipment List and Calibration Data

Test Item	Radiated Emissions				
Test Site	Fully-anechoic chamber 1 / (05CH01-WS)				
Tested Date	May 02, 2018				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	Agilent	N9010A	MY54200247	Sep. 28, 2017	Sep. 27, 2018
Bilog Antenna	SCHWARZBECK	VULB9168	VULB9168-524	Oct. 27, 2017	Oct. 26, 2018
Horn Antenna 1G-18G	SCHWARZBECK	BBHA 9120 D	BBHA 9120 D 1094	Nov. 10, 2017	Nov. 09, 2018
Preamplifier	Agilent	83017A	MY39501310	Nov. 28, 2017	Nov. 27, 2018
Preamplifier	EMC	EMC02325	980146	Oct. 13, 2017	Oct. 12, 2018
Preamplifier	EMC	EMC184045B	980192	Aug. 22, 2017	Aug. 21, 2018
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY22626/4	Nov. 24, 2017	Nov. 23, 2018
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16608/4	Nov. 24, 2017	Nov. 23, 2018
RF Cable	HUBER+SUHNER	SUCOFLEX104	MY16617/4	Nov. 24, 2017	Nov. 23, 2018
LF cable 3M	Woken	CFD400NL-LW	CFD400NL-005	Nov. 24, 2017	Nov. 23, 2018
LF cable 10M	Woken	CFD400NL-LW	CFD400NL-006	Nov. 24, 2017	Nov. 23, 2018
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)				
Tested Date	May 03, 2018				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	R&S	FSV40	101486	Nov. 21, 2017	Nov. 20, 2018
Power Sensor	Agilent	U2021XA	MY53480019	Jan. 29, 2018	Jan. 28, 2019
Power Sensor	Agilent	U2021XA	MY53510003	Jan. 29, 2018	Jan. 28, 2019
Power Sensor	Agilent	U2021XA	MY54070003	Feb. 08, 2018	Feb. 07, 2019
Power Sensor	Agilent	U2021XA	MY54060013	Feb. 08, 2018	Feb. 07, 2019
DC POWER SOURCE	GW INSTEK	GPC-6030D	EM892433	Oct. 26, 2017	Oct. 25, 2018
Combiner(1X2)	woken	0120A02201801O	DOM2AEW1A23	Dec. 04, 2017	Dec. 03, 2018
Combiner(1X4)	woken	0120A04056002D	111204	Dec. 04, 2017	Dec. 03, 2018
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)				
Tested Date	May 17, 2018				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Wireless connectivity tester	ROHDE&SCHWARZ	CMW270	100856	Nov. 13, 2017	Nov. 12, 2018
Signal Generator	R&S	SMB100A	175727	Oct. 26, 2017	Oct. 25, 2018
RF Cable	HUBER+SUHNER	SUCOFLEX_104	500202/4	Dec. 07, 2017	Dec. 06, 2018
RF Cable	HUBER+SUHNER	SUCOFLEX_104	296088/4	Dec. 07, 2017	Dec. 06, 2018
RF Cable	HUBER+SUHNER	SUCOFLEX_104	329023/4	Dec. 07, 2017	Dec. 06, 2018
Note: Calibration Interval of instruments listed above is one year.					

Test Item	Radiated Emissions				
Test Site	(10CH02-HY)				
Tested Date	May 08, 2018				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Receiver	R&S	ESI	838496/008	Sep. 01, 2017	Sep. 01, 2018
Preamplifier	EMC	EMC02325	980225	Jul. 28, 2017	Jul. 27, 2018
RF Cable-R03m	Jye Bao	RG142	CB031	Dec. 29, 2017	Dec. 28, 2018
RF Cable-10m	MTJ	RG223/U+RG8/U	CB026-DOOR	Dec. 29, 2017	Dec. 28, 2018
Loop Antenna	R&S	HFH2-Z2	100330	Nov. 13, 2017	Nov. 12, 2018
Software	Audix	E3	4.03260c	N/A	N/A
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	23°C / 65%	Chris Zeng
Radiated Emission > 30 MHz	05CH01-WS	25°C / 65%	Mars Lai
Receiver Blocking	05CH01-WS	24°C / 58%	Chris Zeng
Radiated Emission ≤ 30 MHz	10CH02-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	1
Power Spectral Density			
Emission Bandwidth and Operating frequencies	GFSK/125kbps GFSK/500kbps GFSK/1Mbps GFSK/2Mbps	2402 / 2480 2402 / 2480	1
Transmitter unwanted emissions in the out of band domain			
Transmitter Spurious Emissions ≤ 30 MHz Receiver Spurious Emissions ≤ 30 MHz	GFSK/1Mbps GFSK/2Mbps	2402 / 2480	1, 2, 3
Transmitter Spurious Emissions	GFSK/1Mbps GFSK/2Mbps	2402 / 2480 2402 / 2480	1
Receiver Spurious Emissions			
Receiver Blocking	GFSK/125kbps	2402 / 2480	1

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.
4. Test configurations are listed as below:
   1) Configuration 1: Antenna: Laird NFC + EDA-8709-2G4C1-B27-CY
   2) Configuration 2: Antenna: Laird NFC + mFlexPIFA
   3) Configuration 3: Antenna: Laird NFC + BL654-SA PCB printed antenna

3 Transmitter Test Results

3.1 RF Output Power

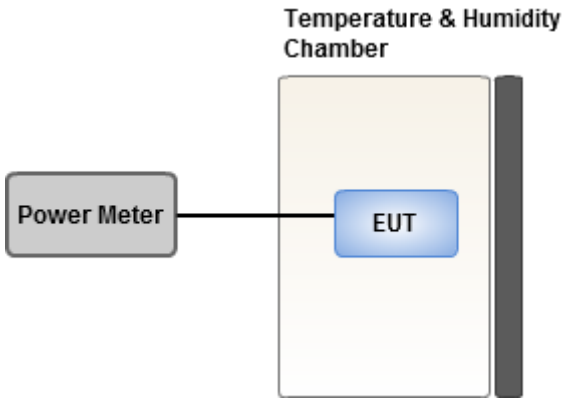
3.1.1 Limit of RF Output Power

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	9.17	20	Pass
$T_{min}V_{nom}$	GFSK/125kbps	2402	9.34	20	Pass
$T_{max}V_{nom}$	GFSK/125kbps	2402	8.88	20	Pass
$T_{nom}V_{nom}$	GFSK/125kbps	2440	9.07	20	Pass
$T_{min}V_{nom}$	GFSK/125kbps	2440	9.27	20	Pass
$T_{max}V_{nom}$	GFSK/125kbps	2440	8.71	20	Pass
$T_{nom}V_{nom}$	GFSK/125kbps	2480	8.75	20	Pass
$T_{min}V_{nom}$	GFSK/125kbps	2480	8.91	20	Pass
$T_{max}V_{nom}$	GFSK/125kbps	2480	8.37	20	Pass
$T_{nom}V_{nom}$	GFSK/500kbps	2402	9.16	20	Pass
$T_{min}V_{nom}$	GFSK/500kbps	2402	9.33	20	Pass
$T_{max}V_{nom}$	GFSK/500kbps	2402	8.87	20	Pass
$T_{nom}V_{nom}$	GFSK/500kbps	2440	9.08	20	Pass
$T_{min}V_{nom}$	GFSK/500kbps	2440	9.28	20	Pass
$T_{max}V_{nom}$	GFSK/500kbps	2440	8.72	20	Pass
$T_{nom}V_{nom}$	GFSK/500kbps	2480	8.77	20	Pass
$T_{min}V_{nom}$	GFSK/500kbps	2480	8.93	20	Pass
$T_{max}V_{nom}$	GFSK/500kbps	2480	8.39	20	Pass

RF Output Power (dBm)					
Condition	**Modulation Mode**	**Freq. (MHz)**	**EIRP Power**	**Limit (dBm)**	**Results**
$T_{nom}V_{nom}$	GFSK/1Mbps	2402	9.17	20	Pass
$T_{min}V_{nom}$	GFSK/1Mbps	2402	9.34	20	Pass
$T_{max}V_{nom}$	GFSK/1Mbps	2402	8.88	20	Pass
$T_{nom}V_{nom}$	GFSK/1Mbps	2440	9.09	20	Pass
$T_{min}V_{nom}$	GFSK/1Mbps	2440	9.29	20	Pass
$T_{max}V_{nom}$	GFSK/1Mbps	2440	8.73	20	Pass
$T_{nom}V_{nom}$	GFSK/1Mbps	2480	8.77	20	Pass
$T_{min}V_{nom}$	GFSK/1Mbps	2480	8.93	20	Pass
$T_{max}V_{nom}$	GFSK/1Mbps	2480	8.39	20	Pass
$T_{nom}V_{nom}$	GFSK/2Mbps	2402	9.16	20	Pass
$T_{min}V_{nom}$	GFSK/2Mbps	2402	9.33	20	Pass
$T_{max}V_{nom}$	GFSK/2Mbps	2402	8.87	20	Pass
$T_{nom}V_{nom}$	GFSK/2Mbps	2440	9.08	20	Pass
$T_{min}V_{nom}$	GFSK/2Mbps	2440	9.28	20	Pass
$T_{max}V_{nom}$	GFSK/2Mbps	2440	8.72	20	Pass
$T_{nom}V_{nom}$	GFSK/2Mbps	2480	8.75	20	Pass
$T_{min}V_{nom}$	GFSK/2Mbps	2480	8.91	20	Pass
$T_{max}V_{nom}$	GFSK/2Mbps	2480	8.37	20	Pass

3.2 Power Spectral Density

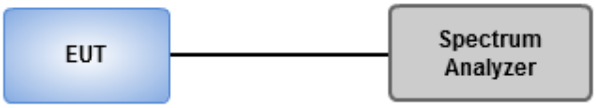
3.2.1 Limit of Power Spectral Density

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	9.16	10	Pass
GFSK/125kbps	2440	9.10	10	Pass
GFSK/125kbps	2480	8.80	10	Pass
GFSK500kbps	2402	9.18	10	Pass
GFSK500kbps	2440	9.12	10	Pass
GFSK500kbps	2480	8.81	10	Pass
GFSK/1Mbps	2402	9.10	10	Pass
GFSK/1Mbps	2440	9.02	10	Pass
GFSK/1Mbps	2480	8.70	10	Pass
GFSK/2Mbps	2402	8.21	10	Pass
GFSK/2Mbps	2440	8.11	10	Pass
GFSK/2Mbps	2480	7.74	10	Pass

3.3 Emission Bandwidth and Operating Frequencies

3.3.1 Limit of Emission Bandwidth and Operating Frequencies

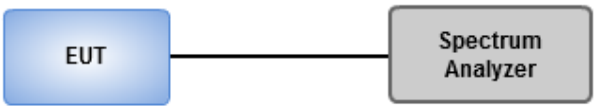
The Emission Bandwidth for each frequency shall fall completely within 2.4~2.4835 GHz.

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

Summary

Mode	OBW (Hz)	ITU-Code
2.4-2.4835GHz	-	-
LE(125kbps)_Nss1_1TX	1.052M	1M05D1D

OBW = 99% occupied bandwidth;

Result

Mode	Result	Limit (Hz)	fl-OBW (Hz)	fh-OBW (Hz)	OBW (Hz)	N dB (Hz)
LE(125kbps)_Nss1_1TX	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.4-2.4835G	2.401472G	2.402519G	1.046M	527k
2480MHz_TnomVnom	Pass	2.4-2.4835G	2.479468G	2.480521G	1.052M	527k

fl-OBW = fl lower edge 99% occupied bandwidth; **fh-OBW** = fh higher edge 99% occupied bandwidth; **OBW** = 99% occupied bandwidth; **N dB** = 6dB down bandwidth;

Summary

Mode	OBW (Hz)	ITU-Code
2.4-2.4835GHz	-	-
LE-(500kbps)_Nss1_1TX	1.042M	1M04D1D

OBW = 99% occupied bandwidth;

Result

Mode	Result	Limit (Hz)	fl-OBW (Hz)	fh-OBW (Hz)	OBW (Hz)	N dB (Hz)
LE-(500kbps)_Nss1_1TX	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.4-2.4835G	2.401481G	2.402514G	1.032M	528k
2480MHz_TnomVnom	Pass	2.4-2.4835G	2.479475G	2.480518G	1.042M	528k

fl-OBW = fl lower edge 99% occupied bandwidth; **fh-OBW** = fh higher edge 99% occupied bandwidth; **OBW** = 99% occupied bandwidth; **N dB** = 6dB down bandwidth;

Summary

Mode	OBW (Hz)	ITU-Code
2.4-2.4835GHz	-	-
BT-LE(1Mbps)	1.054M	1M05F1D

OBW = 99% occupied bandwidth;

Result

Mode	Result	Limit (Hz)	fl-OBW (Hz)	fh-OBW (Hz)	OBW (Hz)	N dB (Hz)
BT-LE(1Mbps)	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.4-2.4835G	2.401483G	2.402531G	1.047M	667k
2480MHz_TnomVnom	Pass	2.4-2.4835G	2.479479G	2.480534G	1.054M	668k

fl-OBW = fl lower edge 99% occupied bandwidth; **fh-OBW** = fh higher edge 99% occupied bandwidth; **OBW** = 99% occupied bandwidth; **N dB** = 6dB down bandwidth;

Summary

Mode	OBW (Hz)	ITU-Code
2.4-2.4835GHz	-	-
BT-LE(2Mbps)_Nss1_1TX	2.089M	2M09F1D

OBW = 99% occupied bandwidth;

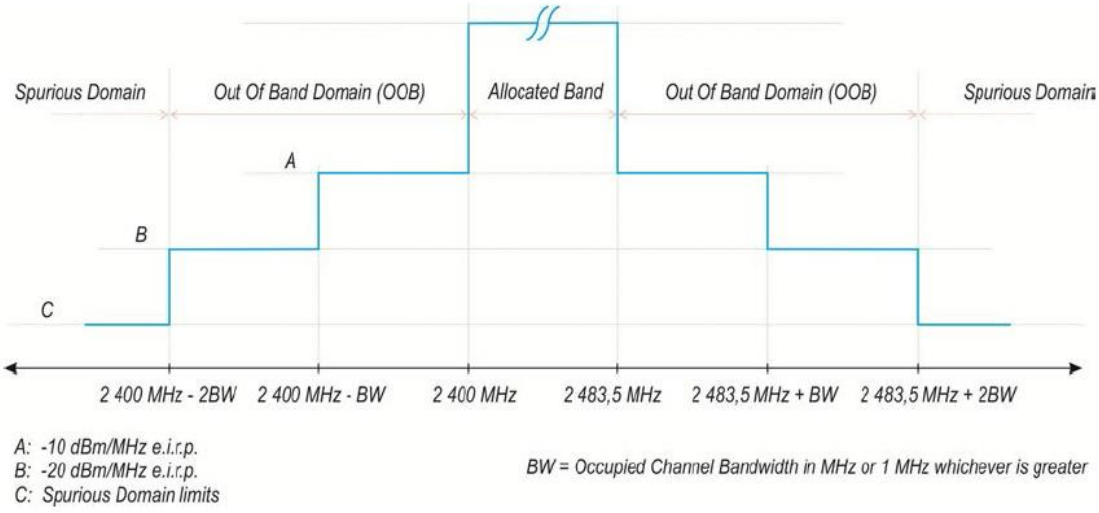
Result

Mode	Result	Limit (Hz)	fl-OBW (Hz)	fh-OBW (Hz)	OBW (Hz)	N dB (Hz)
BT-LE(2Mbps)_Nss1_1TX	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.4-2.4835G	2.400976G	2.403049G	2.074M	1.09M
2480MHz_TnomVnom	Pass	2.4-2.4835G	2.478971G	2.481059G	2.089M	1.1M

fl-OBW = fl lower edge 99% occupied bandwidth; **fh-OBW** = fh higher edge 99% occupied bandwidth; **OBW** = 99% occupied bandwidth; **N dB** = 6dB down bandwidth;

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

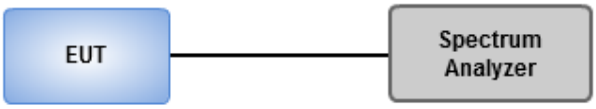
3.4.1 Limit of Transmitter Unwanted Emissions in the Out-Of-Band Domain



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

Summary

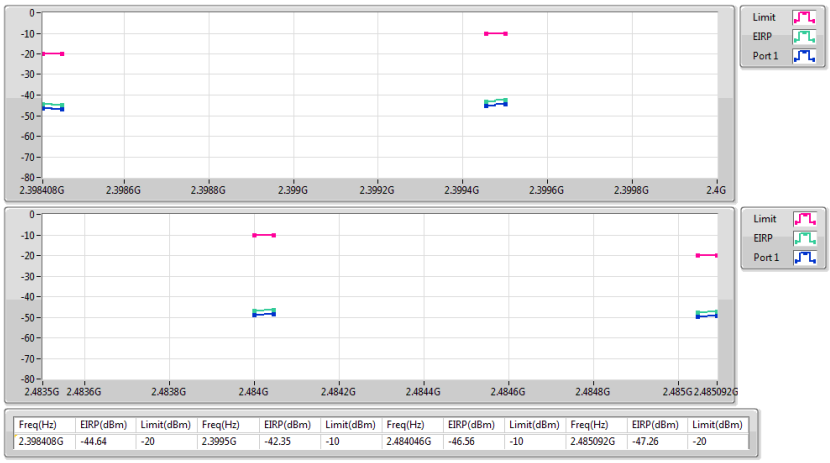
Mode	EIRP-A (dBm)	Limit-A (dBm)	EIRP-B (dBm)	Limit-B (dBm)
2.4-2.4835GHz	-	-	-	-
LE(125kbps)_Nss1_1TX	-42.35	-10	-44.64	-20

Result

Mode	Result	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)
LE(125kbps)_Nss1_1TX	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.398408G	-44.64	-20	2.3995G	-42.35	-10	2.484046G	-46.56	-10	2.485092G	-47.26	-20
2480MHz_TnomVnom	Pass	2.398448G	-46.93	-20	2.3995G	-45.32	-10	2.484052G	-44.19	-10	2.485052G	-45.51	-20

LE(125kbps)_Nss1_1TX **Mask**

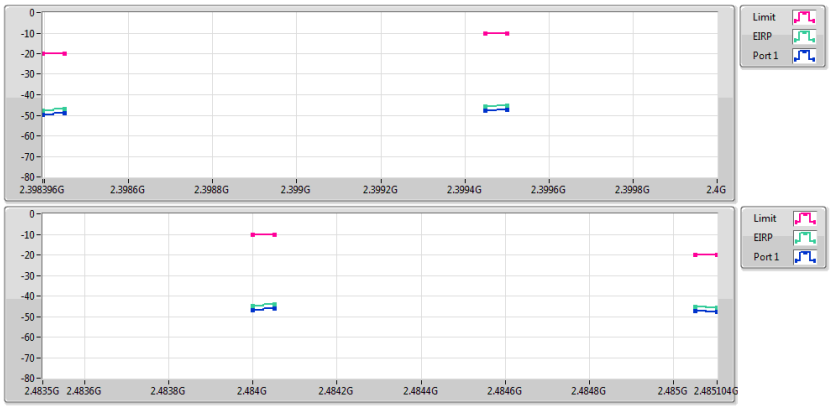
2402MHz_TnomVnom



Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)
2.398408G	-44.64	-20	2.3995G	-42.35	-10	2.484046G	-46.56	-10	2.485092G	-47.26	-20

LE(125kbps)_Nss1_1TX **Mask**

2480MHz_TnomVnom



Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)
2.398448G	-46.93	-20	2.3995G	-45.32	-10	2.484052G	-44.19	-10	2.485052G	-45.51	-20

Summary

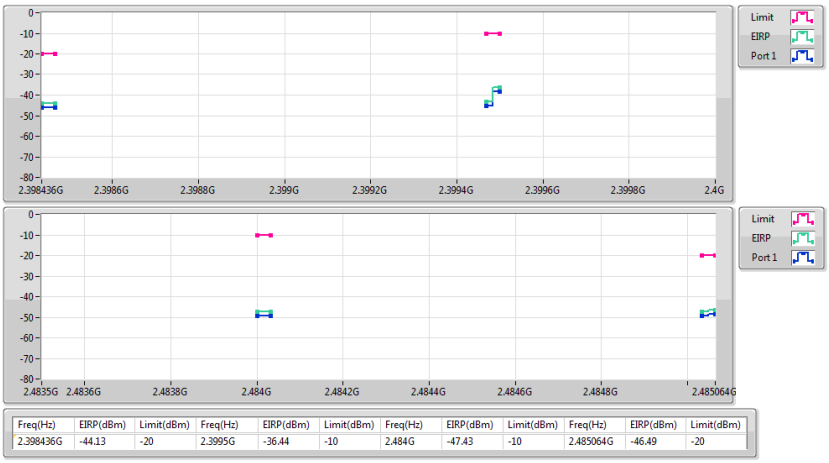
Mode	EIRP-A (dBm)	Limit-A (dBm)	EIRP-B (dBm)	Limit-B (dBm)
2.4-2.4835GHz	-	-	-	-
LE-(500kbps)_Nss1_1TX	-36.44	-10	-43.57	-20

Result

Mode	Result	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)
LE-(500kbps)_Nss1_1TX	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.398436G	-44.13	-20	2.3995G	-36.44	-10	2.484G	-47.43	-10	2.485064G	-46.49	-20
2480MHz_TnomVnom	Pass	2.398416G	-46.81	-20	2.3995G	-46.55	-10	2.484G	-43.53	-10	2.485042G	-43.57	-20

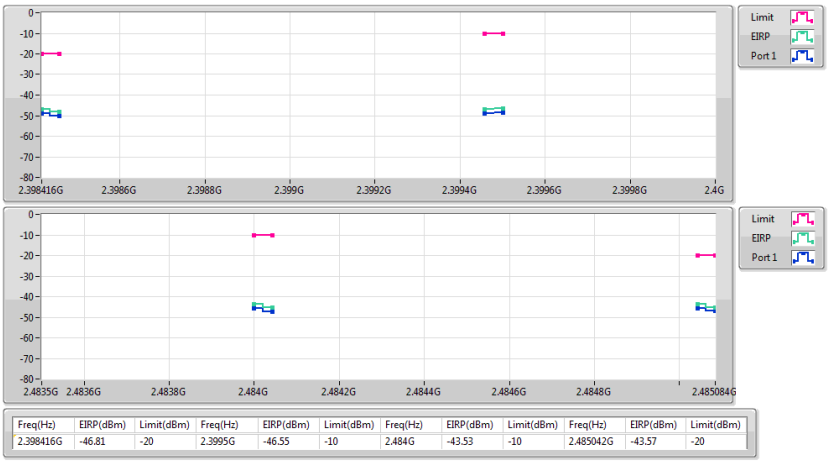
LE-(500kbps)_Nss1_1TX **Mask**

2402MHz_TnomVnom



LE-(500kbps)_Nss1_1TX **Mask**

2480MHz_TnomVnom



Summary

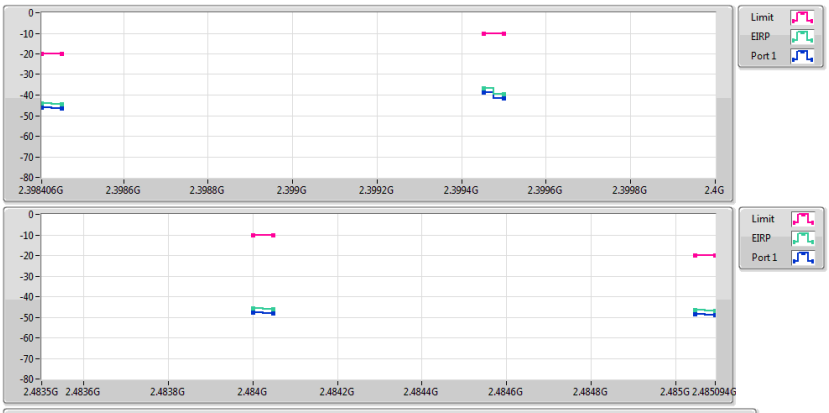
Mode	EIRP-A (dBm)	Limit-A (dBm)	EIRP-B (dBm)	Limit-B (dBm)
2.4-2.4835GHz	-	-	-	-
BT-LE(1Mbps)	-36.73	-10	-43.94	-20

Result

Mode	Result	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)
BT-LE(1Mbps)	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.398406G	-43.94	-20	2.399453G	-36.73	-10	2.484G	-45.80	-10	2.485047G	-46.65	-20
2480MHz_TnomVnom	Pass	2.398392G	-46.14	-20	2.399446G	-46.67	-10	2.484054G	-42.86	-10	2.485108G	-45.04	-20

BT-LE(1Mbps) **Mask**

2402MHz_TnomVnom



Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)
2.398406G	-43.94	-20	2.399453G	-36.73	-10	2.484G	-45.80	-10	2.485047G	-46.65	-20

BT-LE(1Mbps) **Mask**

2480MHz_TnomVnom

Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)
2.398392G	-46.14	-20	2.399446G	-46.67	-10	2.484054G	-42.86	-10	2.485108G	-45.04	-20

Summary

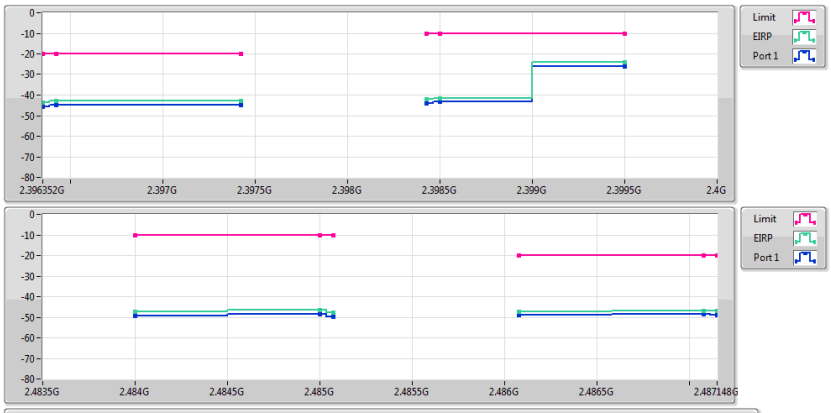
Mode	EIRP-A (dBm)	Limit-A (dBm)	EIRP-B (dBm)	Limit-B (dBm)
2.4-2.4835GHz	-	-	-	-
BT-LE(2Mbps)_Nss1_1TX	-24.16	-10	-42.77	-20

Result

Mode	Result	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)	Freq (Hz)	EIRP (dBm)	Limit (dBm)
BT-LE(2Mbps)_Nss1_1TX	-	-	-	-	-	-	-	-	-	-	-	-	-
2402MHz_TnomVnom	Pass	2.397426G	-42.77	-20	2.3995G	-24.16	-10	2.485G	-46.54	-10	2.487074G	-46.77	-20
2480MHz_TnomVnom	Pass	2.397411G	-46.77	-20	2.3995G	-47.20	-10	2.484G	-40.67	-10	2.486089G	-44.43	-20

BT-LE(2Mbps)_Nss1_1TX **Mask**

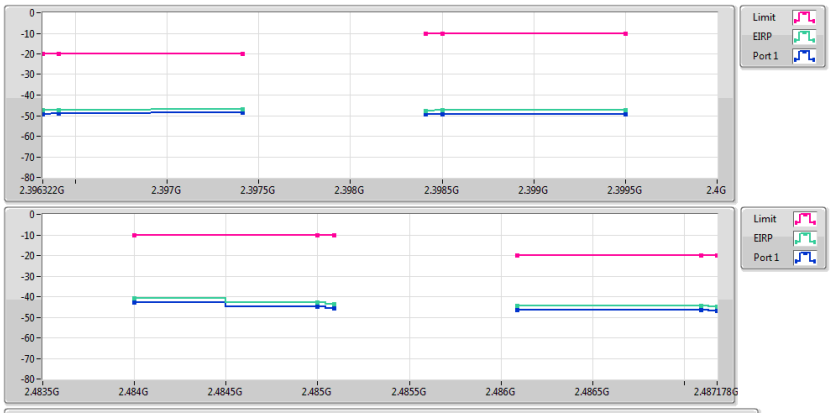
2402MHz_TnomVnom



Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)
2.397426G	-42.77	-20	2.3995G	-24.16	-10	2.485G	-46.54	-10	2.487074G	-46.77	-20

BT-LE(2Mbps)_Nss1_1TX **Mask**

2480MHz_TnomVnom



Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)	Freq(Hz)	EIRP(dBm)	Limit(dBm)
2.397411G	-46.77	-20	2.3995G	-47.20	-10	2.484G	-40.67	-10	2.486089G	-44.43	-20

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

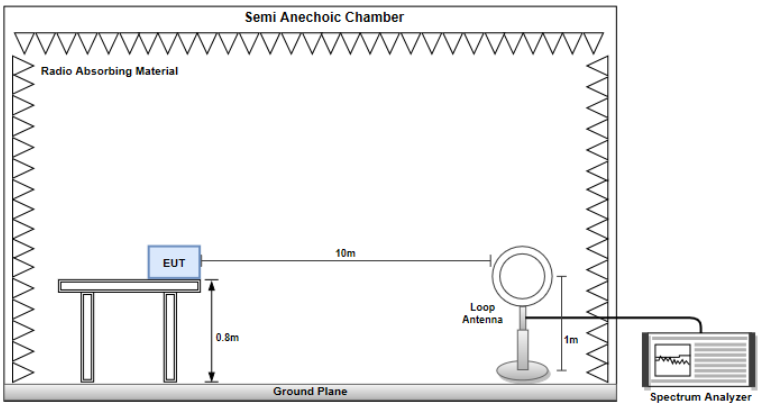
3.5.2 Test Procedures

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

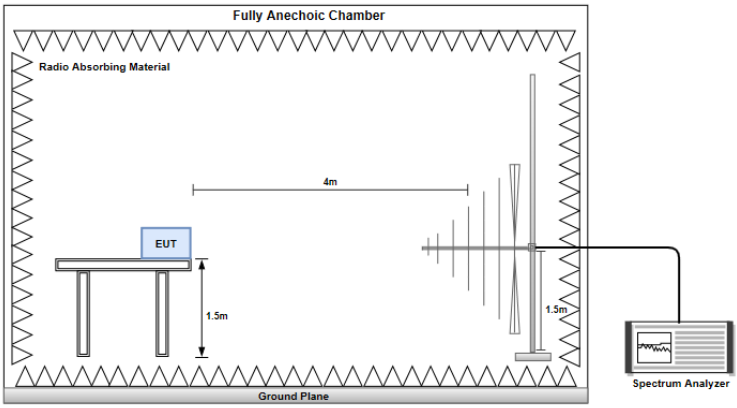
3.5.3 Test Setup

Radiated Emission

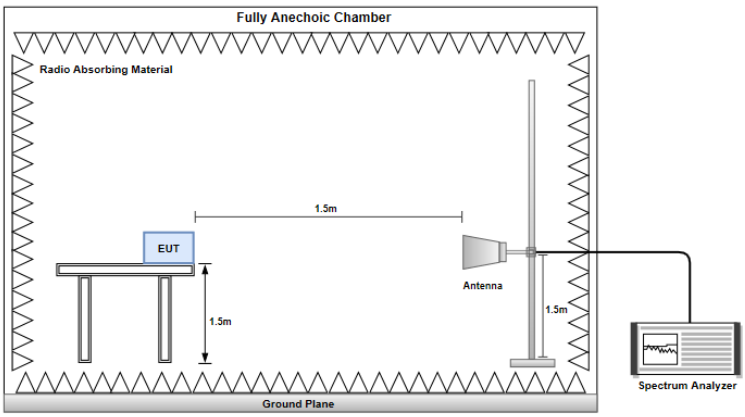
Below 30MHz



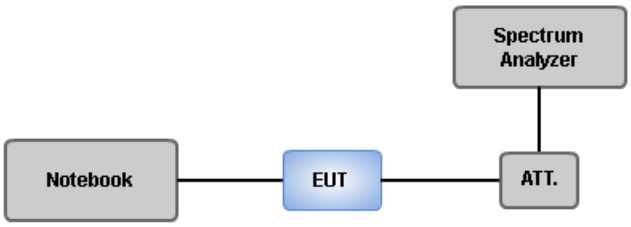
Below 1GHz



Above 1 GHz



Conducted Emission



3.5.4 Transmitter Radiated Unwanted Emissions (≤ 30MHz)

Test Configuration 1

Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.031	45.54	-13.46	59	Pass
2480		Ch39		0.031	46.14	-12.86	59	Pass
2402	BLE	Ch00	2M	0.031	43.84	-15.16	59	Pass
2480		Ch39		0.031	46.46	-12.54	59	Pass

Test Configuration 2

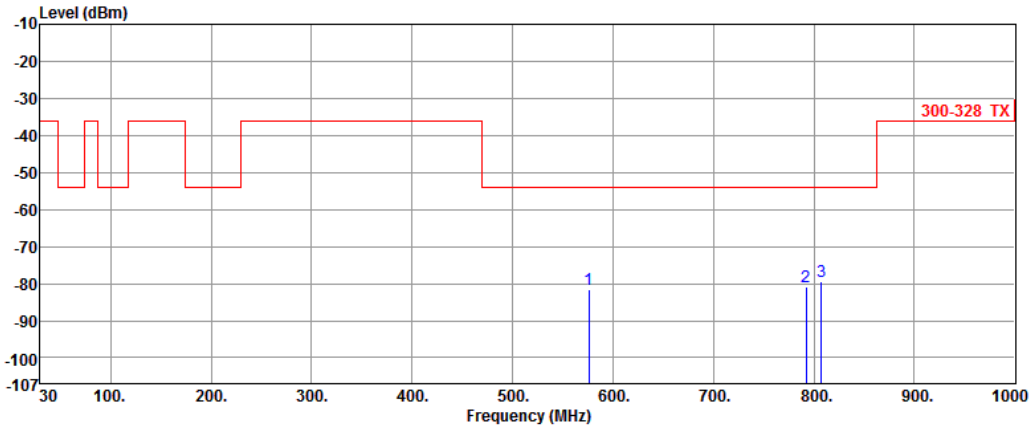
Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.031	43.89	-15.11	59	Pass
2480		Ch39		0.031	46.94	-12.06	59	Pass
2402	BLE	Ch00	2M	0.031	44.12	-14.88	59	Pass
2480		Ch39		0.031	45.78	-13.22	59	Pass

Test Configuration 3

Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.031	45.02	-13.98	59	Pass
2480		Ch39		0.031	46.43	-12.57	59	Pass
2402	BLE	Ch00	2M	0.031	45.5	-13.5	59	Pass
2480		Ch39		0.031	46.4	-12.6	59	Pass

3.5.5 Transmitter Conducted Unwanted Emissions (Below 1GHz)

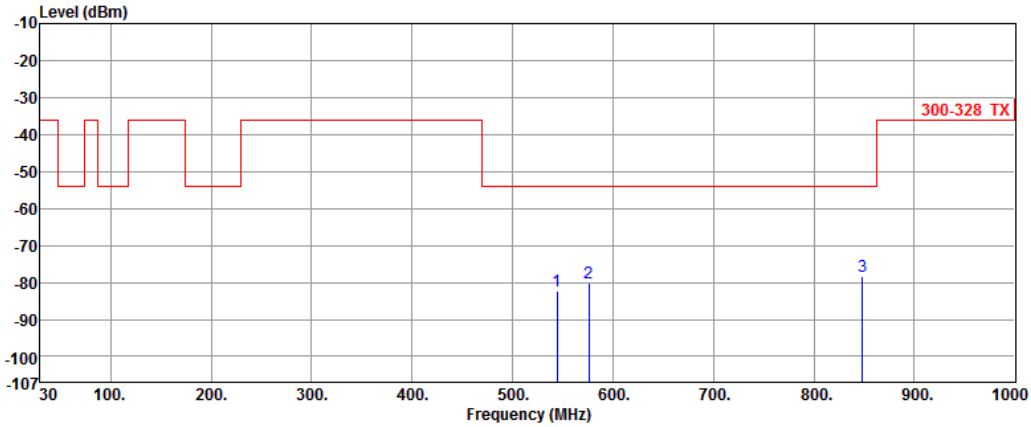
Modulation	GFSK/1Mbps	**Test Freq. (MHz)**	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	576.22	-81.69	-54.00	-27.69	0.00	-81.69
2	792.36	-80.73	-54.00	-26.73	0.00	-80.73
3	807.65	-79.32	-54.00	-25.32	0.00	-79.32

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

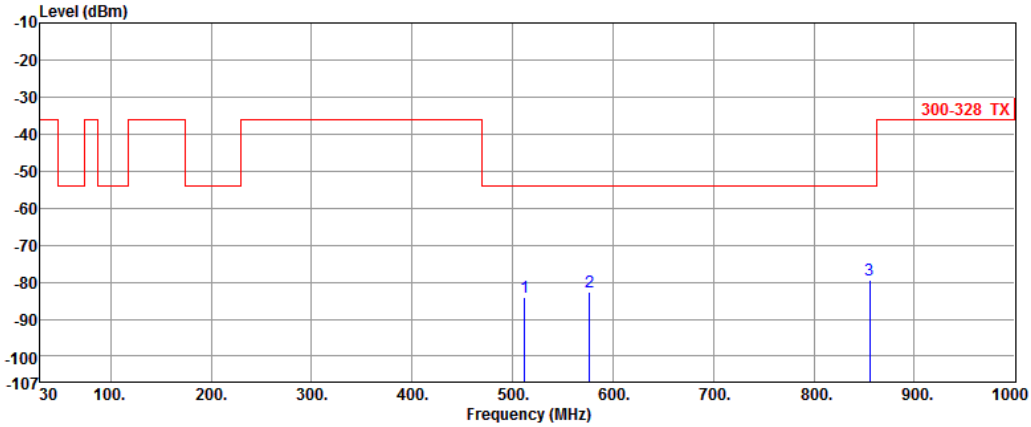
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	544.14	-82.32	-54.00	-28.32	0.00	-82.32
2	575.89	-80.06	-54.00	-26.06	0.00	-80.06
3	848.32	-78.23	-54.00	-24.23	0.00	-78.23

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

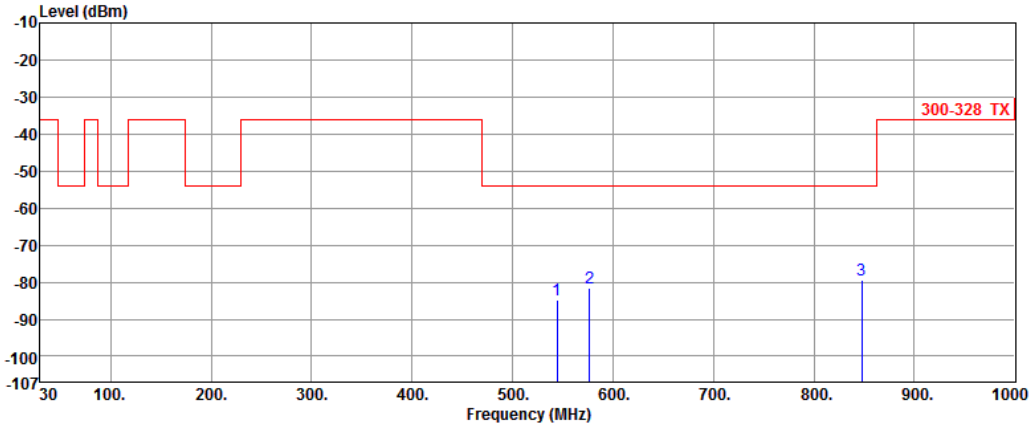
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	512.35	-84.06	-54.00	-30.06	0.00	-84.06
2	576.35	-82.51	-54.00	-28.51	0.00	-82.51
3	855.71	-79.35	-54.00	-25.35	0.00	-79.35

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

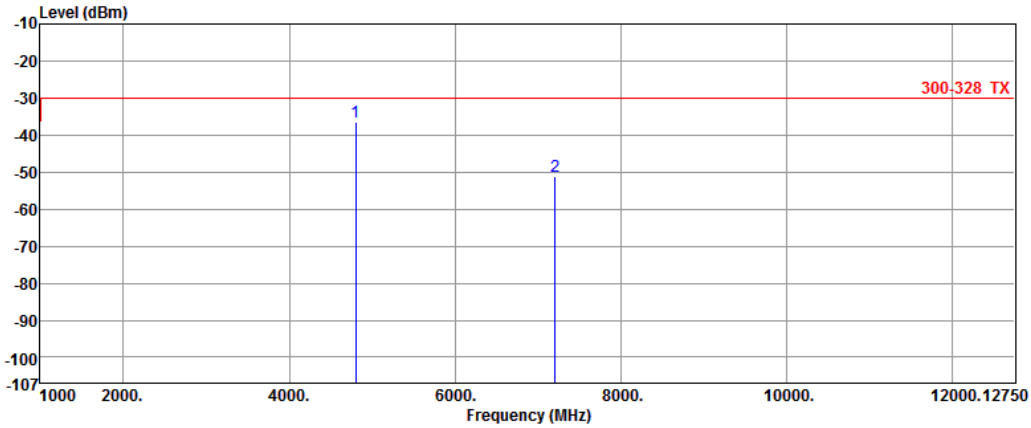


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	544.61	-84.81	-54.00	-30.81	0.00	-84.81
2	576.71	-81.65	-54.00	-27.65	0.00	-81.65
3	847.46	-79.47	-54.00	-25.47	0.00	-79.47

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)

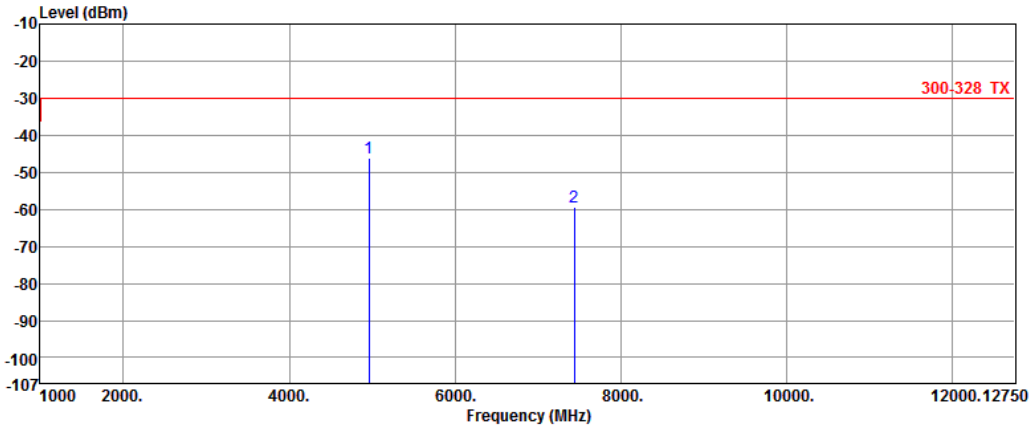
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4804.35	-36.65	-30.00	-6.65	0.00	-36.65
2	7206.41	-51.13	-30.00	-21.13	0.00	-51.13

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

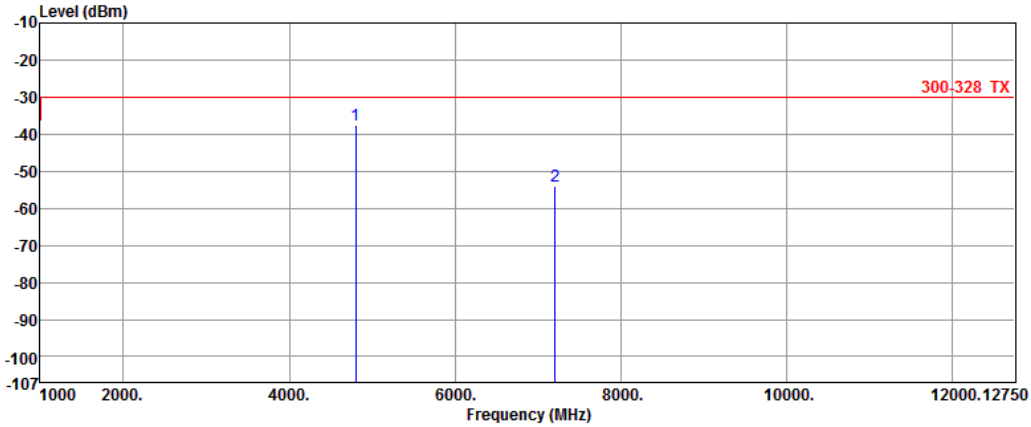
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4959.69	-46.23	-30.00	-16.23	0.00	-46.23
2	7440.20	-59.22	-30.00	-29.22	0.00	-59.22

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

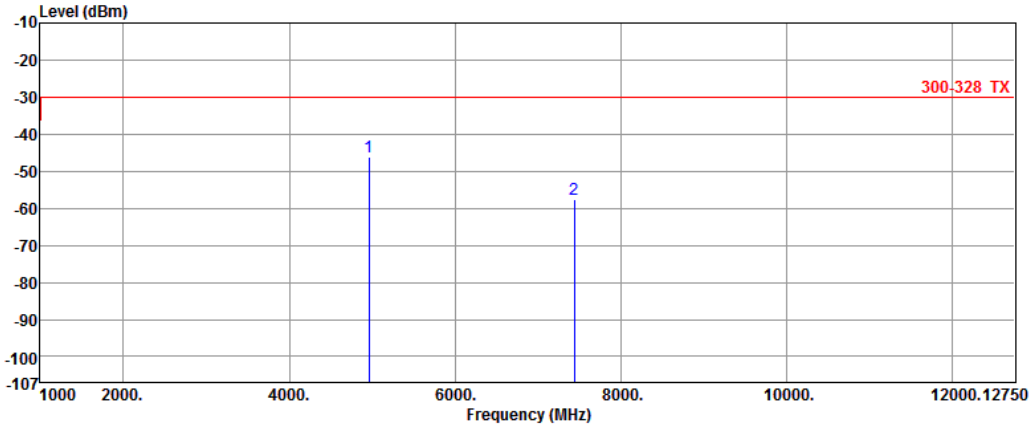
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4803.38	-37.52	-30.00	-7.52	0.00	-37.52
2	7204.31	-54.13	-30.00	-24.13	0.00	-54.13

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

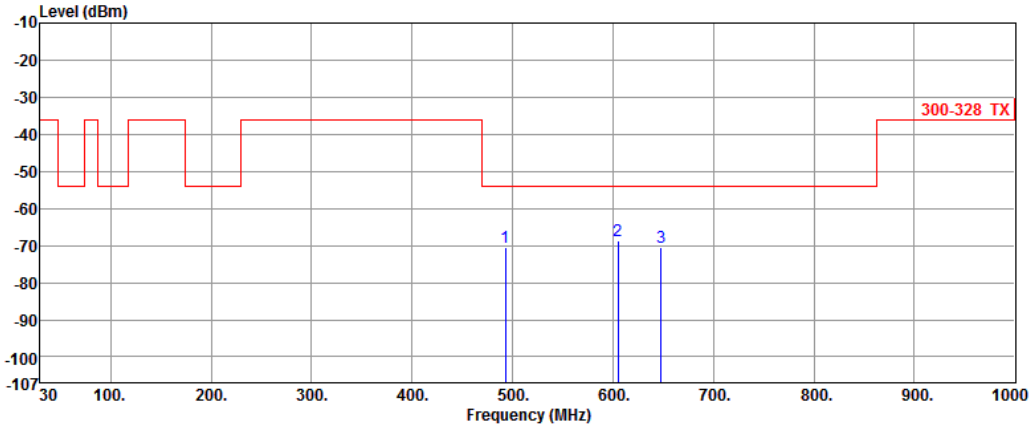


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4959.32	-46.13	-30.00	-16.13	0.00	-46.13
2	7438.56	-57.63	-30.00	-27.63	0.00	-57.63

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)

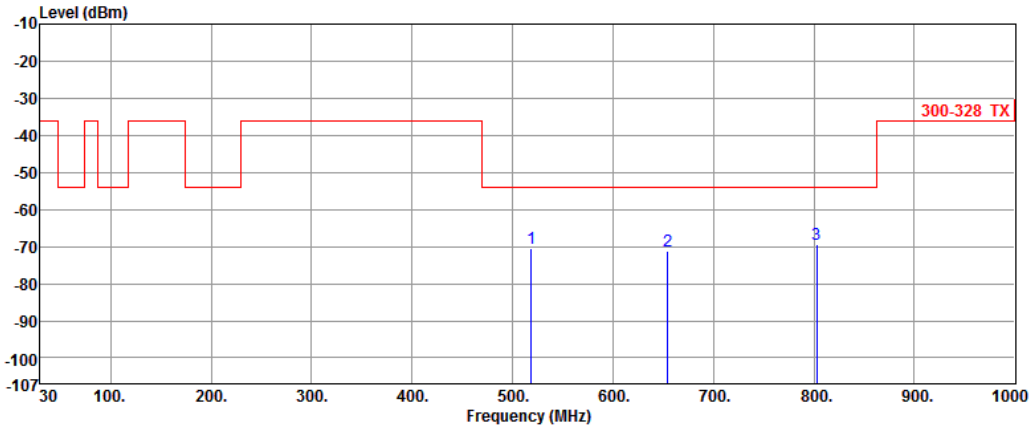
Modulation	GFSK/1Mbps	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	492.69	-70.42	-54.00	-16.42	2.34	-72.76
2	605.21	-68.65	-54.00	-14.65	8.69	-77.34
3	647.89	-70.45	-54.00	-16.45	5.74	-76.19

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

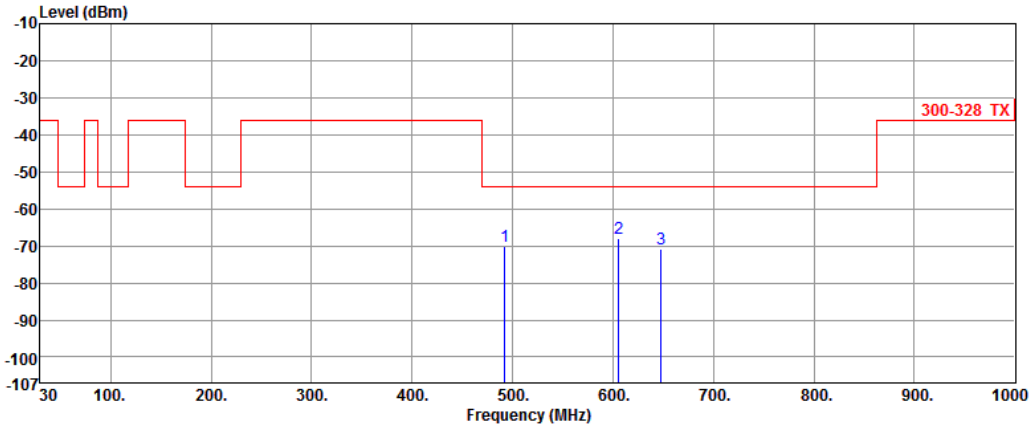
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	518.88	-70.35	-54.00	-16.35	3.33	-73.68
2	654.68	-71.16	-54.00	-17.16	5.62	-76.78
3	803.09	-69.34	-54.00	-15.34	8.17	-77.51

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

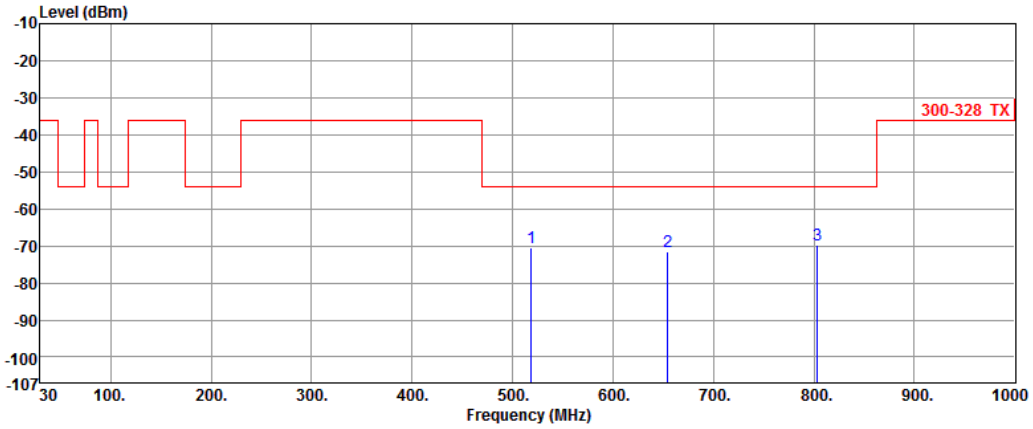
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	492.51	-70.12	-54.00	-16.12	2.34	-72.46
2	605.62	-68.09	-54.00	-14.09	8.44	-76.53
3	647.73	-70.99	-54.00	-16.99	5.72	-76.71

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

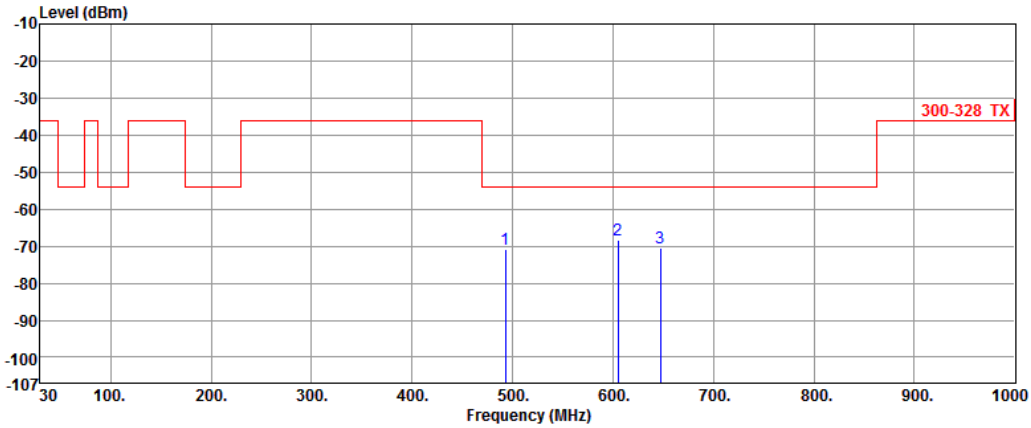
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	518.42	-70.49	-54.00	-16.49	3.32	-73.81
2	654.73	-71.40	-54.00	-17.40	5.62	-77.02
3	803.66	-69.81	-54.00	-15.81	8.17	-77.98

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

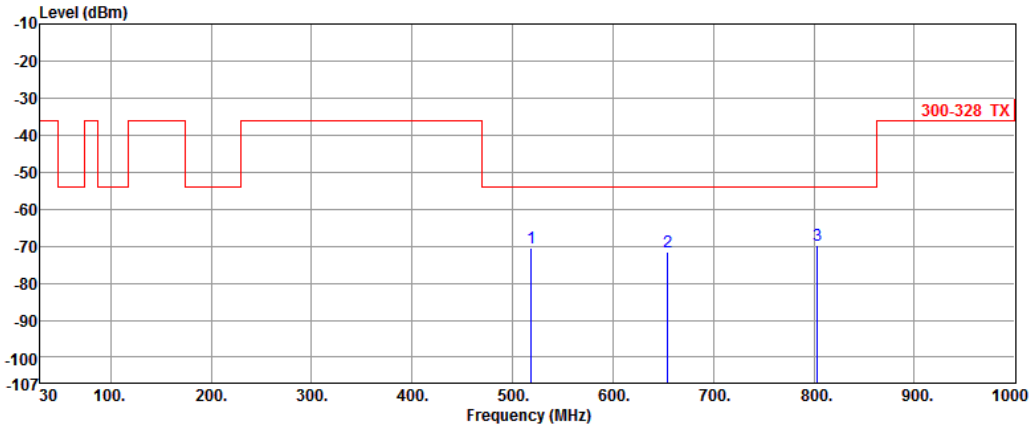
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	492.61	-70.81	-54.00	-16.81	2.34	-73.15
2	605.31	-68.41	-54.00	-14.41	8.62	-77.03
3	647.23	-70.51	-54.00	-16.51	5.66	-76.17

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

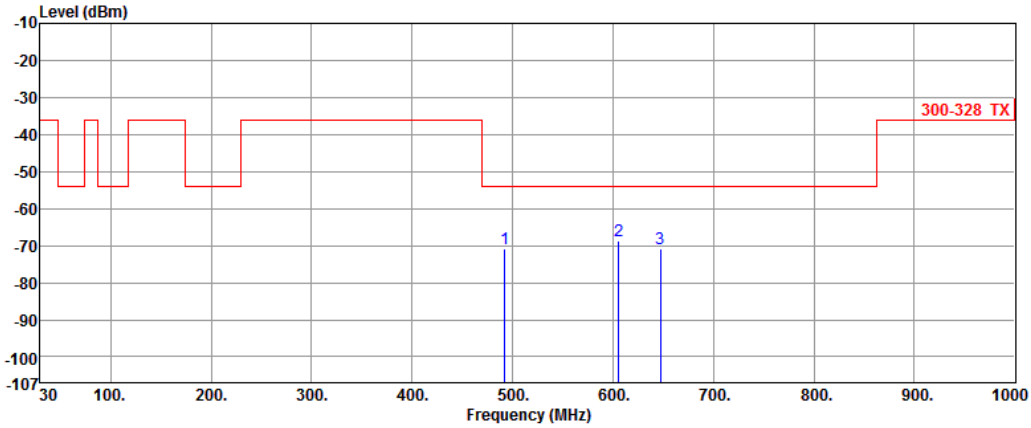
Modulation	GFSK/2Mbps	**Test Freq. (MHz)**	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	518.48	-70.41	-54.00	-16.41	3.32	-73.73
2	654.23	-71.71	-54.00	-17.71	5.63	-77.34
3	803.23	-69.71	-54.00	-15.71	8.17	-77.88

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

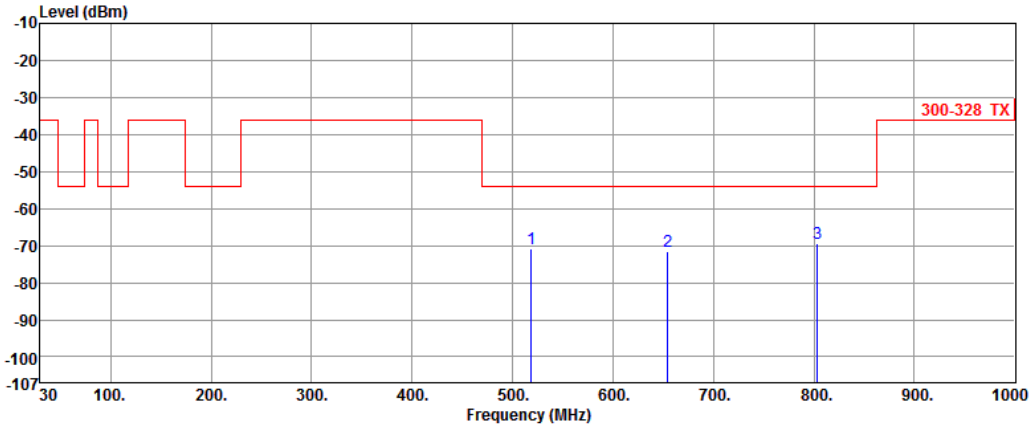
Modulation	GFSK/2Mbps	**Test Freq. (MHz)**	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	492.39	-70.70	-54.00	-16.70	2.34	-73.04
2	605.65	-68.70	-54.00	-14.70	8.42	-77.12
3	647.31	-70.73	-54.00	-16.73	5.66	-76.39

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		

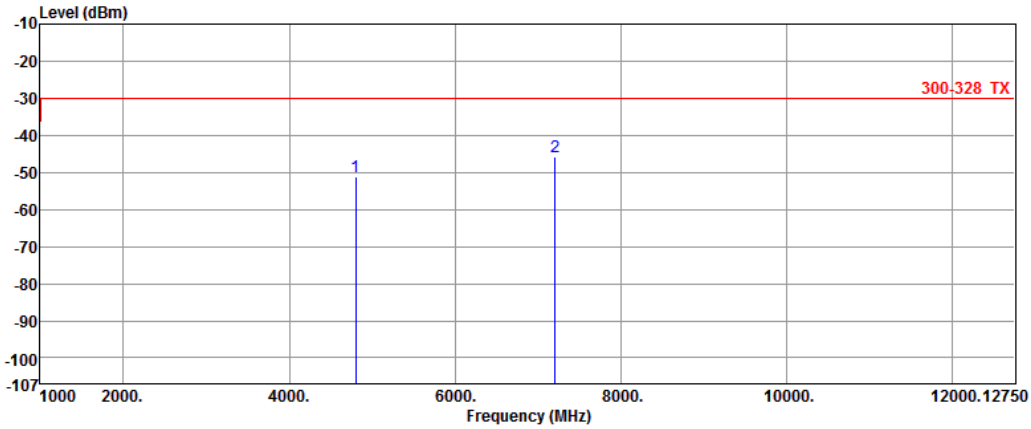


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	518.43	-70.71	-54.00	-16.71	3.32	-74.03
2	654.42	-71.59	-54.00	-17.59	5.62	-77.21
3	803.17	-69.49	-54.00	-15.49	8.17	-77.66

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)

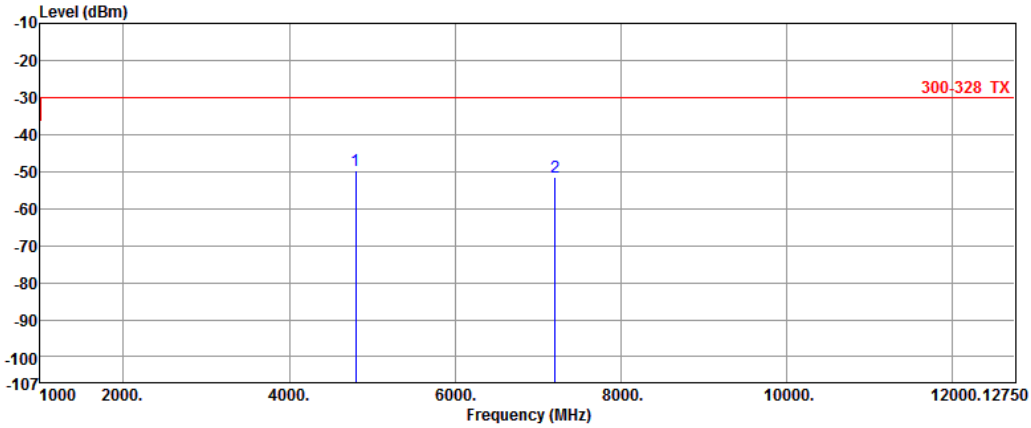
Modulation	GFSK/1Mbps	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4803.50	-51.32	-30.00	-21.32	9.11	-60.43
2	7205.09	-45.93	-30.00	-15.93	15.82	-61.75

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

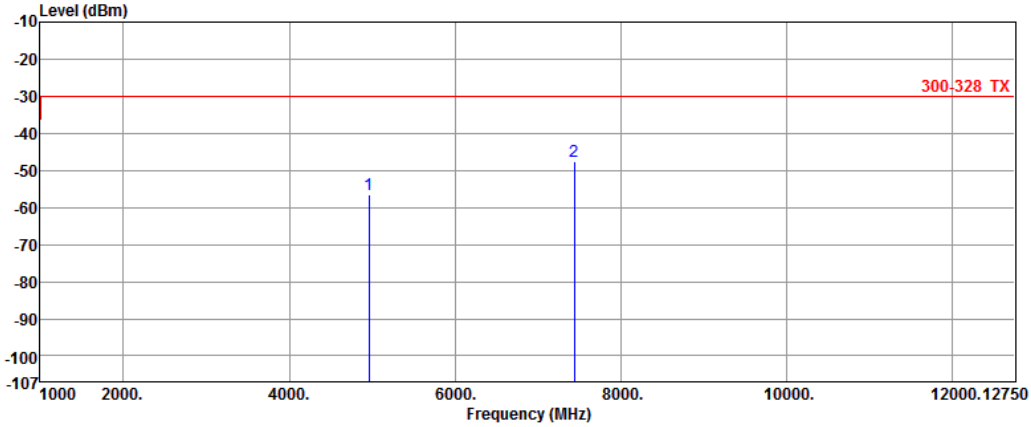
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4803.49	-49.83	-30.00	-19.83	9.42	-59.25
2	7205.93	-51.48	-30.00	-21.48	15.72	-67.20

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

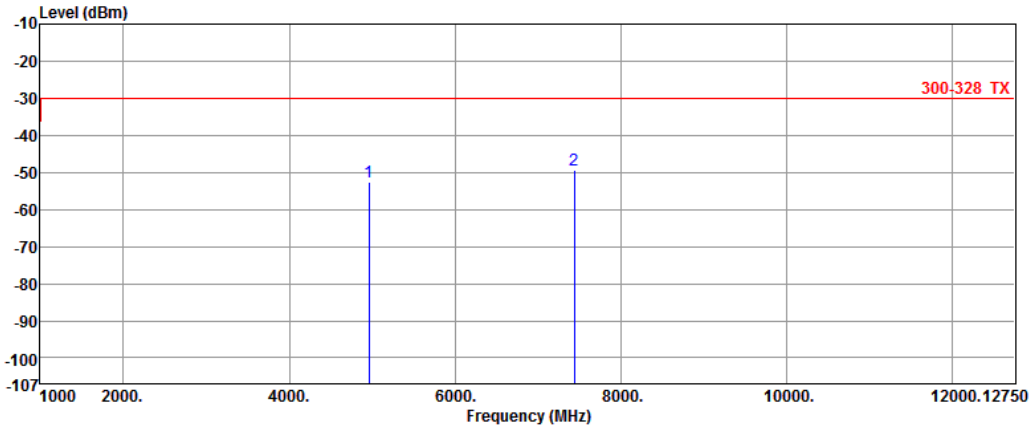
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4959.94	-56.57	-30.00	-26.57	10.45	-67.02
2	7439.56	-47.72	-30.00	-17.72	16.22	-63.94

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

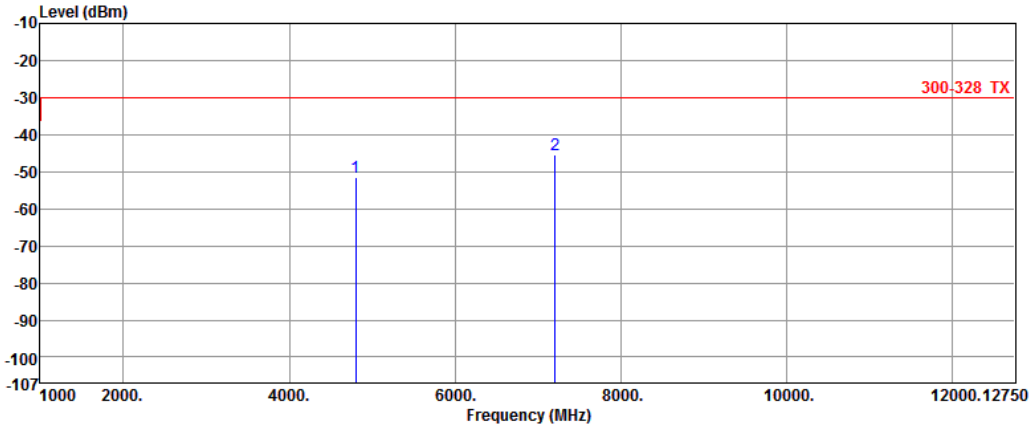
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4960.45	-52.54	-30.00	-22.54	10.54	-63.08
2	7439.99	-49.27	-30.00	-19.27	16.26	-65.53

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

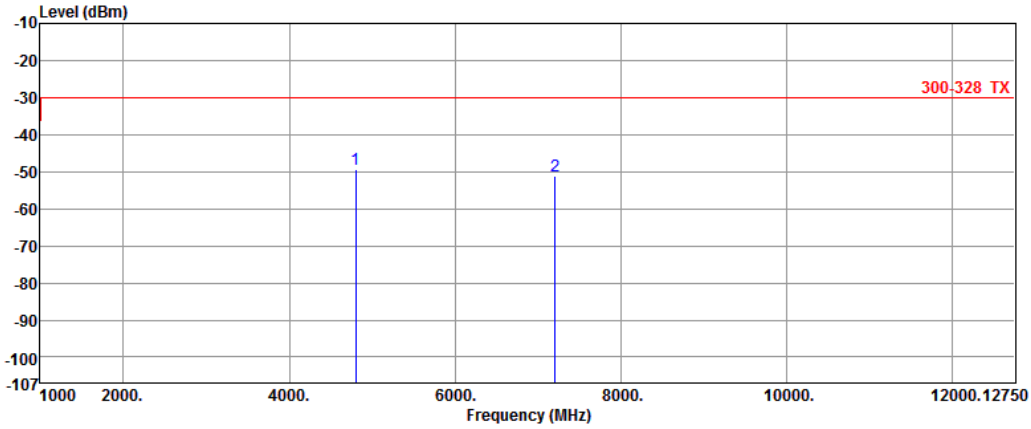
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4803.09	-51.35	-30.00	-21.35	9.11	-60.46
2	7205.41	-45.32	-30.00	-15.32	15.81	-61.13

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

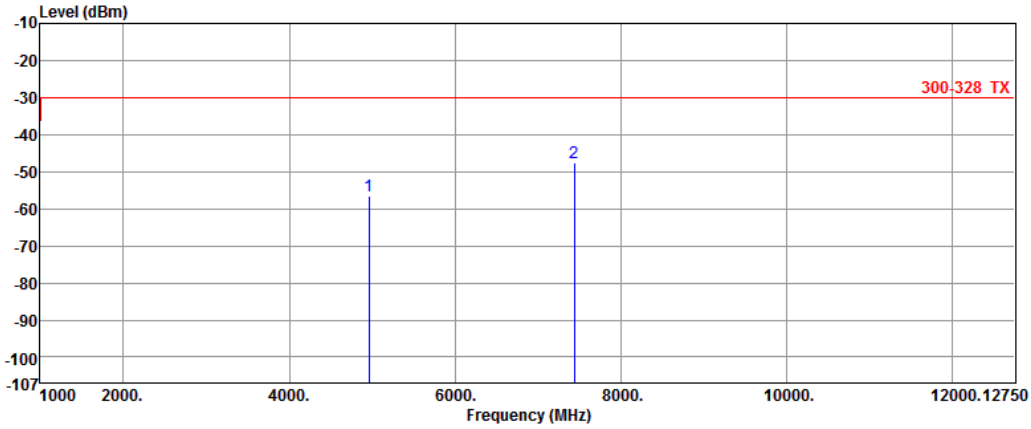
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4803.32	-49.54	-30.00	-19.54	9.42	-58.96
2	7205.32	-51.23	-30.00	-21.23	15.72	-66.95

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

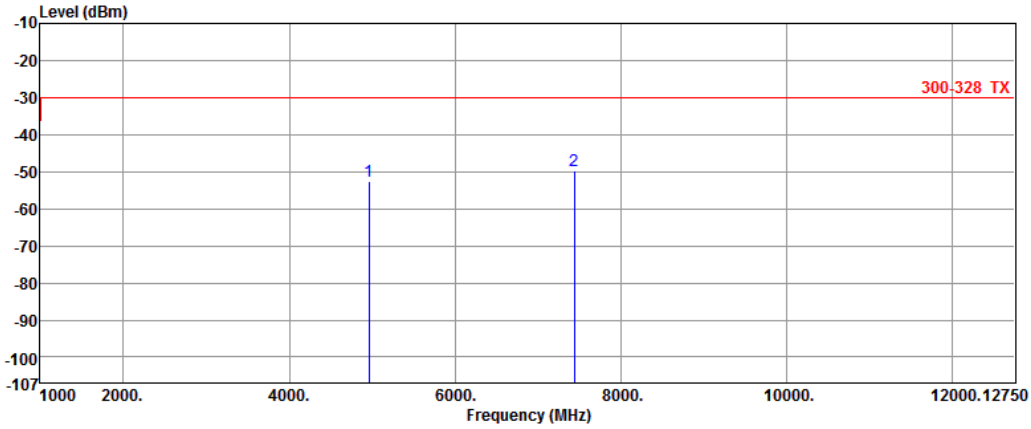
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4959.55	-56.54	-30.00	-26.54	10.45	-66.99
2	7439.77	-47.41	-30.00	-17.41	16.22	-63.63

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

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



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4960.54	-52.56	-30.00	-22.56	10.54	-63.10
2	7439.32	-49.56	-30.00	-19.56	16.26	-65.82

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

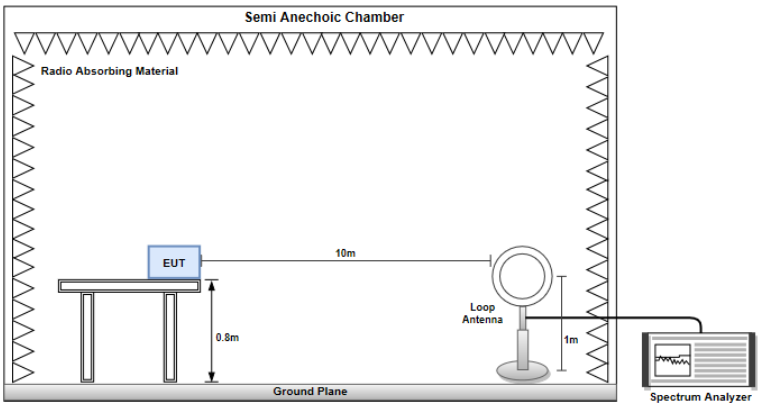
4.1.2 Test Procedures

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

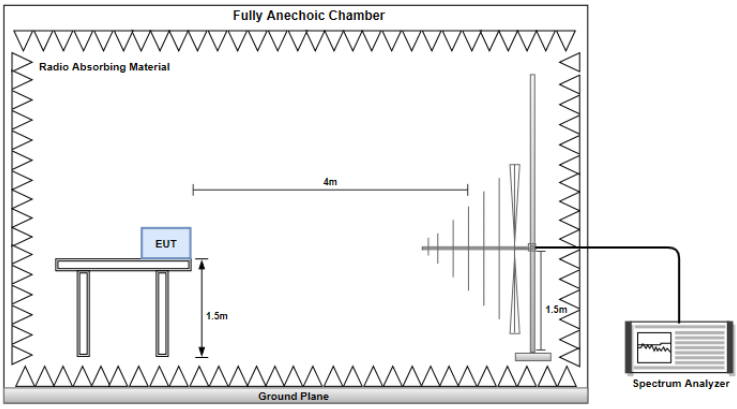
4.1.3 Test Setup

Radiated Emission

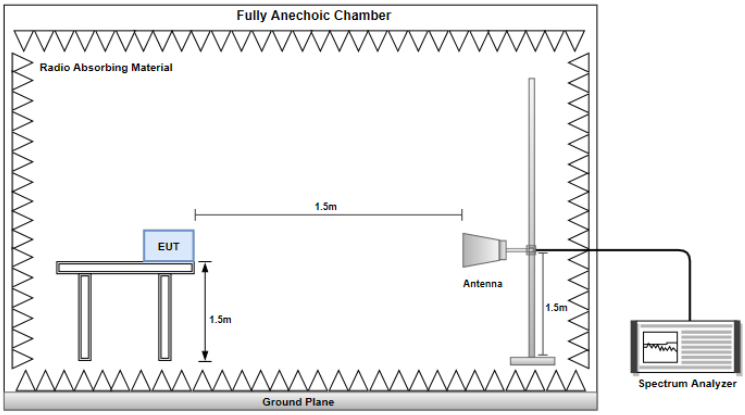
Below 30MHz



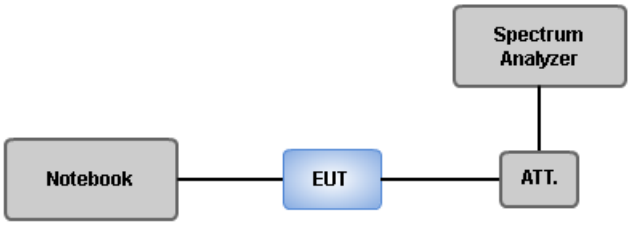
Below 1GHz



Above 1 GHz



Conducted Emission



4.1.4 Receiver Radiated Unwanted Emissions (≤ 30MHz)

Test Configuration 1

Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.031	45.08	-13.92	59	Pass
2480		Ch39		0.031	45.61	-13.39	59	Pass
2402	BLE	Ch00	2M	0.031	44.62	-14.38	59	Pass
2480		Ch39		0.031	46.64	-12.36	59	Pass

Test Configuration 2

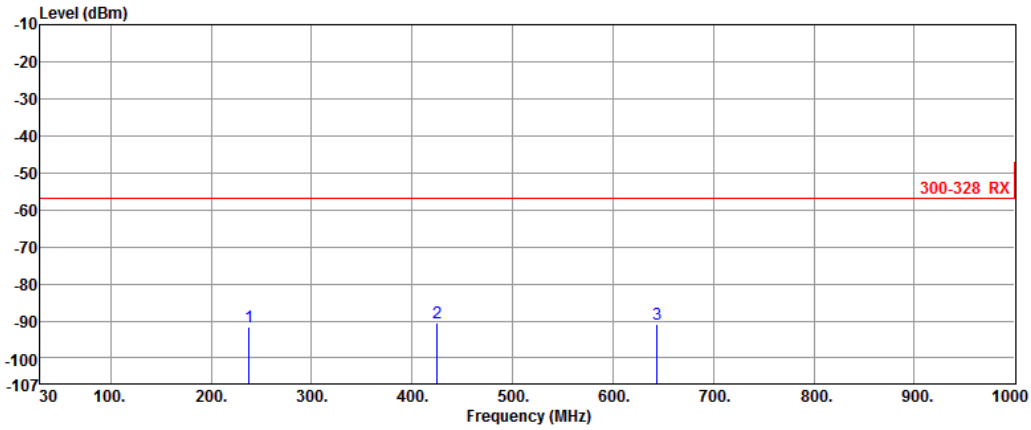
Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.031	43.28	-15.72	59	Pass
2480		Ch39		0.031	46.35	-12.65	59	Pass
2402	BLE	Ch00	2M	0.031	43.62	-15.38	59	Pass
2480		Ch39		0.031	45.78	-13.22	59	Pass

Test Configuration 3

Freq. (MHz)	Modulation	Channel	Data Rate	Freq. (MHz)	Emission Value (dBuV/m)	Margin (dBuV/m)	Limit (dBuV/m)	Result
2402	BLE	Ch00	1M	0.031	44.87	-14.13	59	Pass
2480		Ch39		0.031	45.62	-13.38	59	Pass
2402	BLE	Ch00	2M	0.031	45.33	-13.67	59	Pass
2480		Ch39		0.031	45.41	-13.59	59	Pass

4.1.5 Receiver Conducted Unwanted Emissions (Below 1GHz)

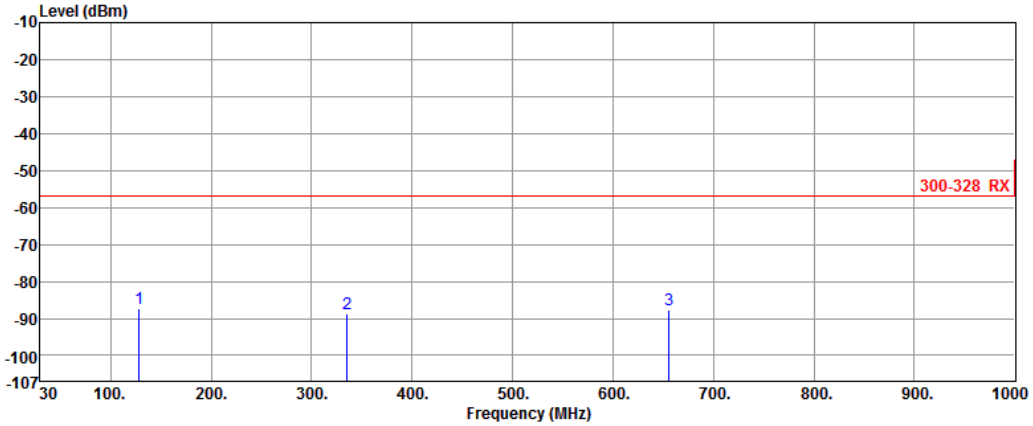
Modulation	GFSK/1Mbps	**Test Freq. (MHz)**	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	237.58	-91.44	-57.00	-34.44	0.00	-91.44
2	424.79	-90.43	-57.00	-33.43	0.00	-90.43
3	644.01	-90.98	-57.00	-33.98	0.00	-90.98

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

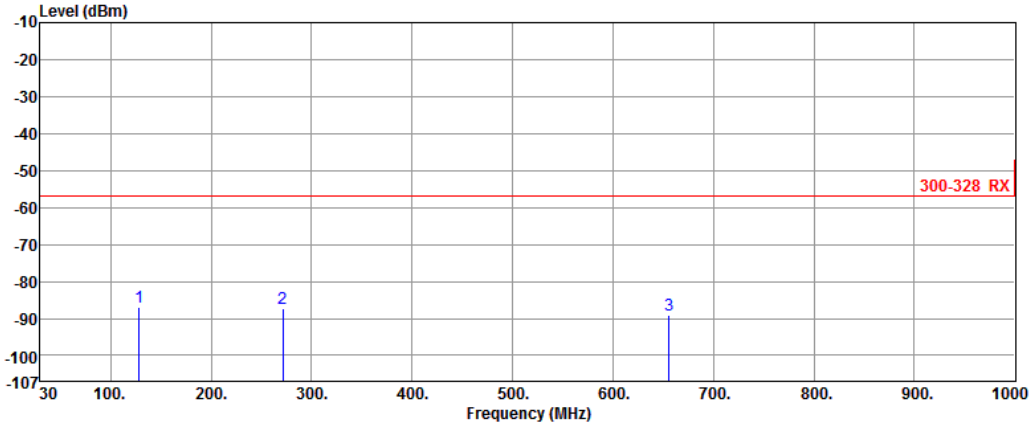
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	127.97	-87.25	-57.00	-30.25	0.00	-87.25
2	335.55	-88.73	-57.00	-31.73	0.00	-88.73
3	655.65	-87.67	-57.00	-30.67	0.00	-87.67

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

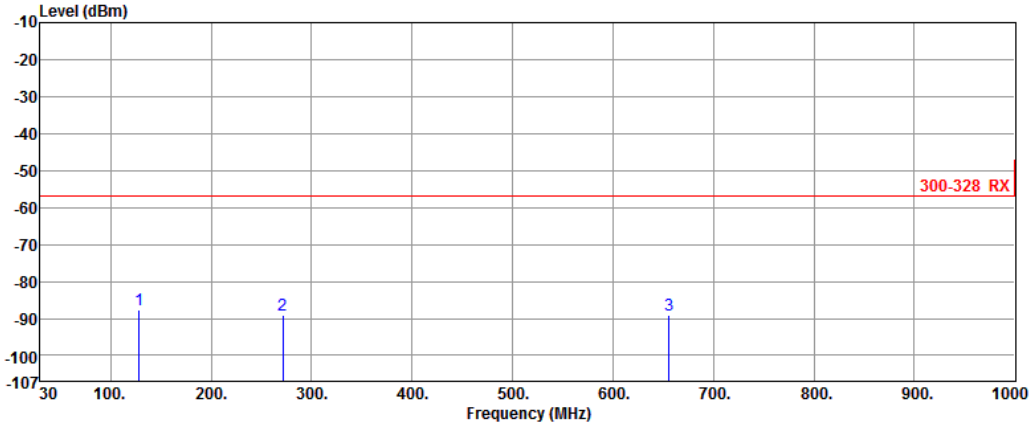
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	127.97	-87.02	-57.00	-30.02	0.00	-87.02
2	271.53	-87.31	-57.00	-30.31	0.00	-87.31
3	655.65	-89.08	-57.00	-32.08	0.00	-89.08

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

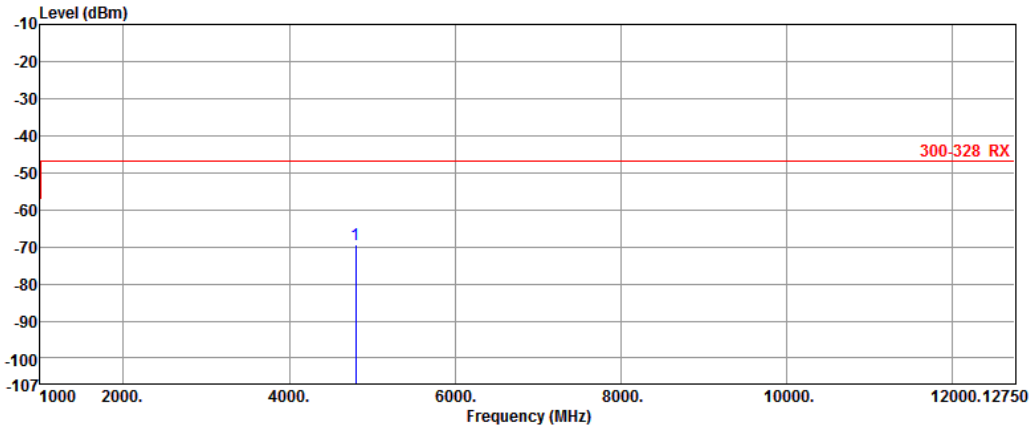


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	127.97	-87.76	-57.00	-30.76	0.00	-87.76
2	271.53	-89.00	-57.00	-32.00	0.00	-89.00
3	655.65	-89.05	-57.00	-32.05	0.00	-89.05

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)

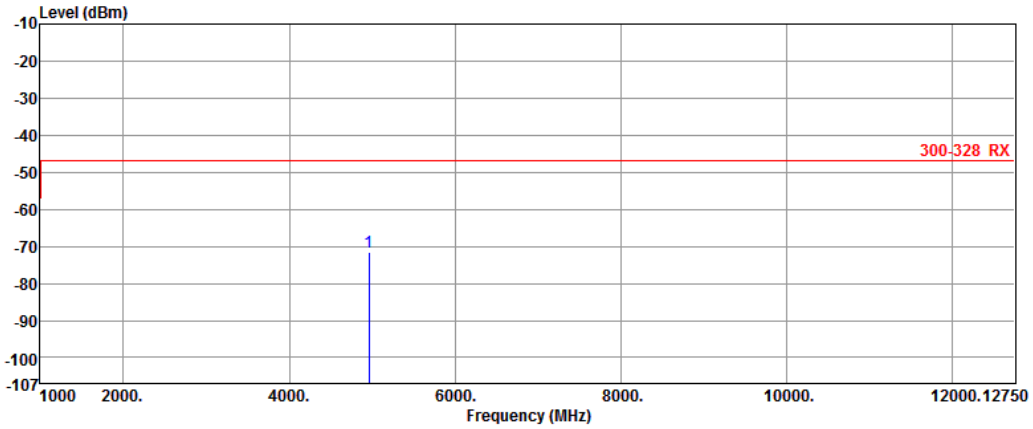
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4802.01	-69.42	-47.00	-22.42	0.00	-69.42

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

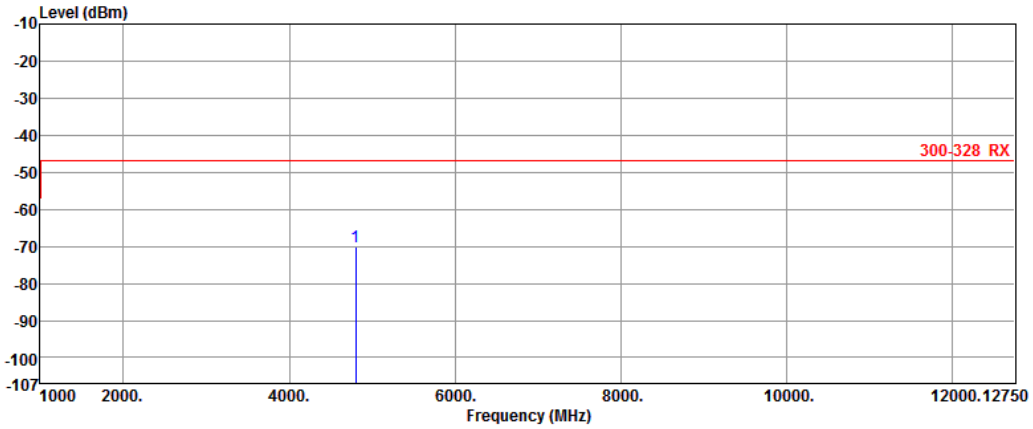
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4958.10	-71.45	-47.00	-24.45	0.00	-71.45

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

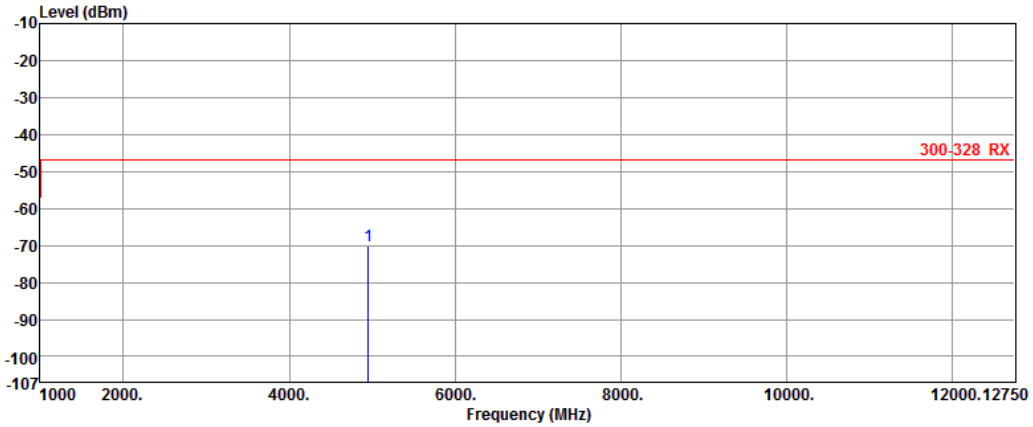
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4799.79	-70.12	-47.00	-23.12	0.00	-70.12

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

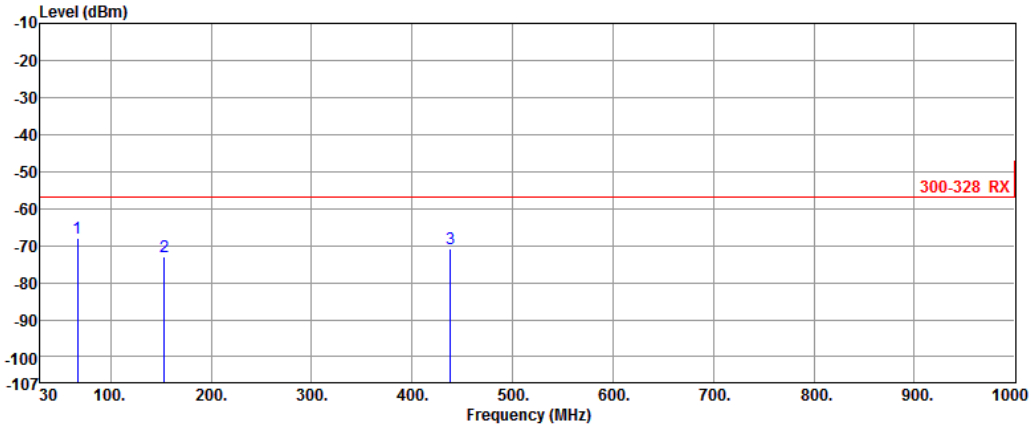


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4955.73	-70.05	-47.00	-23.05	0.00	-70.05

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)

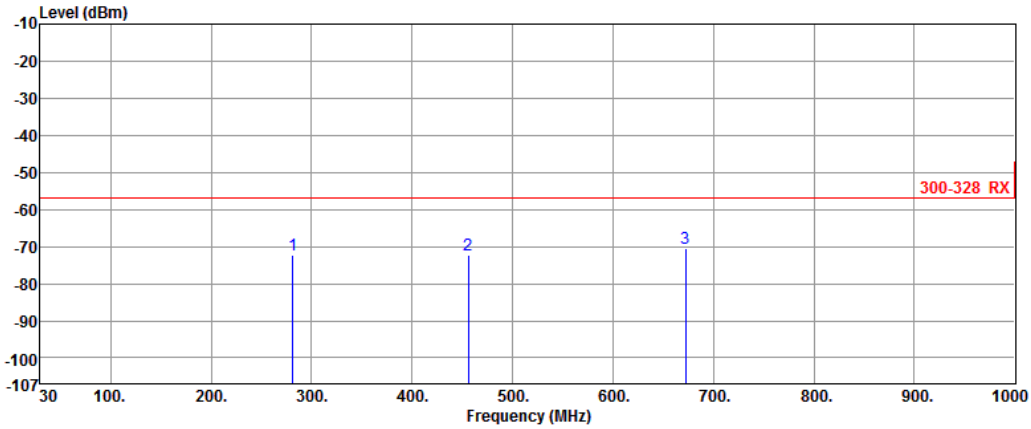
Modulation	GFSK/1Mbps	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	66.86	-68.07	-57.00	-11.07	-3.41	-64.66
2	153.19	-73.09	-57.00	-16.09	-0.29	-72.80
3	438.37	-70.91	-57.00	-13.91	2.07	-72.98

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

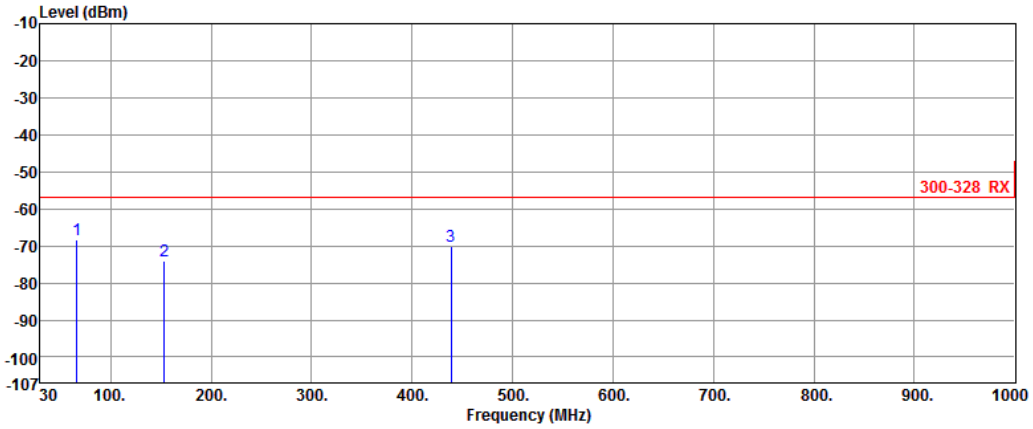
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	281.23	-72.28	-57.00	-15.28	-2.12	-70.16
2	455.83	-72.40	-57.00	-15.40	2.05	-74.45
3	672.14	-70.61	-57.00	-13.61	5.81	-76.42

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

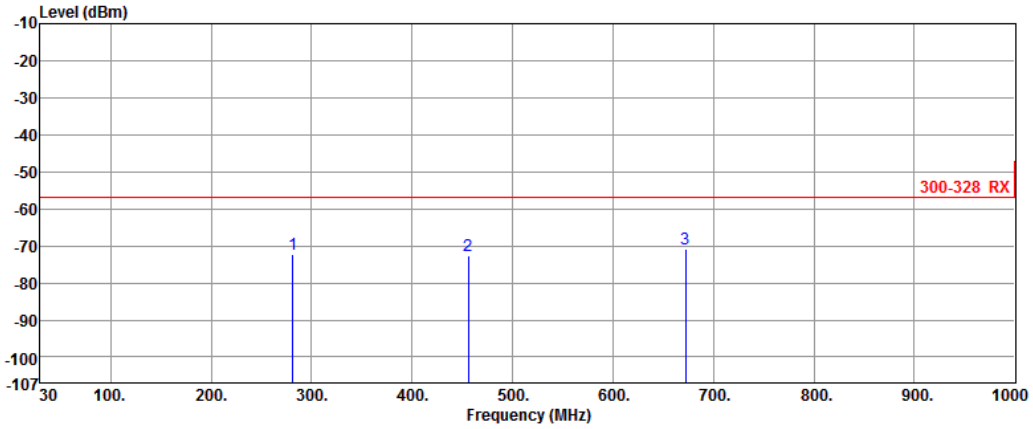
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	66.17	-68.21	-57.00	-11.21	-3.05	-65.16
2	153.44	-73.99	-57.00	-16.99	-0.26	-73.73
3	438.71	-70.11	-57.00	-13.11	2.08	-72.19

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

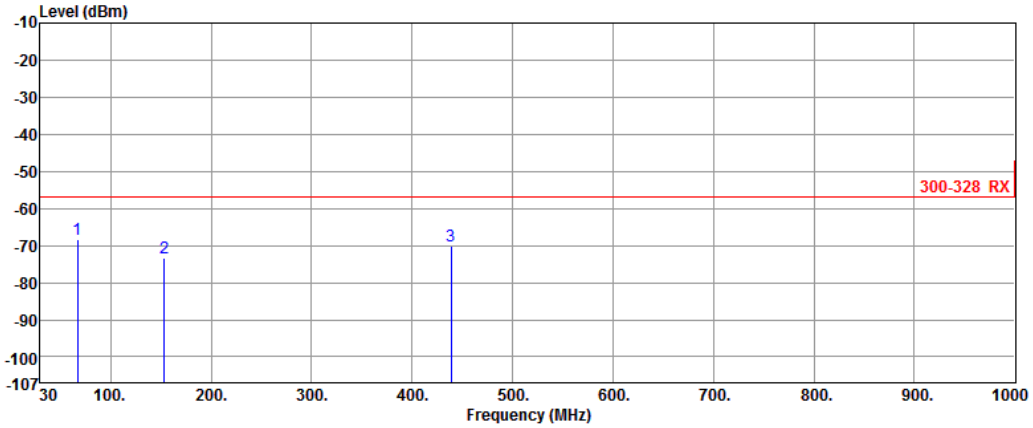
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	281.41	-72.23	-57.00	-15.23	-2.11	-70.12
2	455.87	-72.56	-57.00	-15.56	2.05	-74.61
3	672.14	-70.71	-57.00	-13.71	5.81	-76.52

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

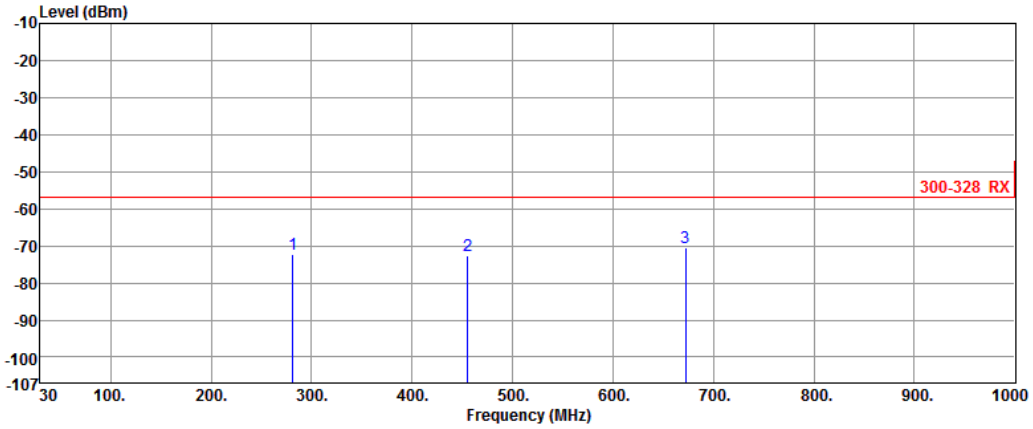
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	66.75	-68.21	-57.00	-11.21	-3.35	-64.86
2	153.21	-73.45	-57.00	-16.45	-0.29	-73.16
3	438.55	-70.19	-57.00	-13.19	2.07	-72.26

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

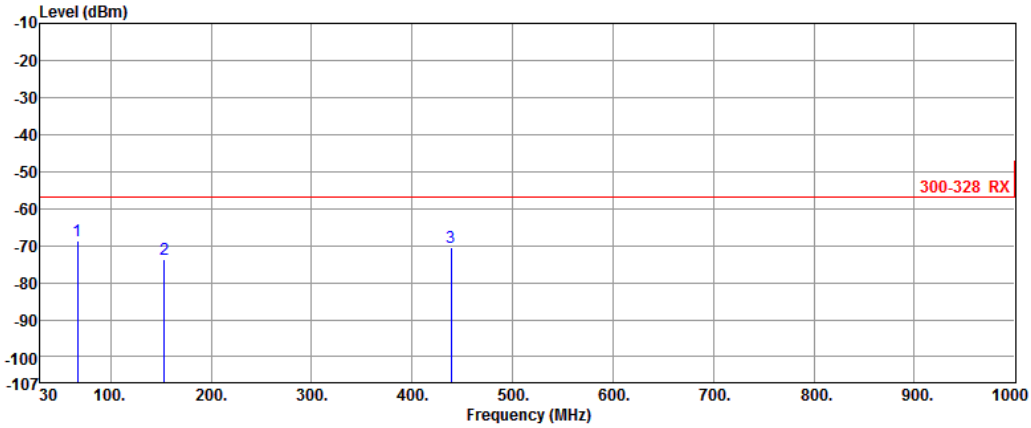
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	281.21	-72.41	-57.00	-15.41	-2.12	-70.29
2	455.11	-72.79	-57.00	-15.79	2.05	-74.84
3	672.41	-70.32	-57.00	-13.32	5.81	-76.13

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

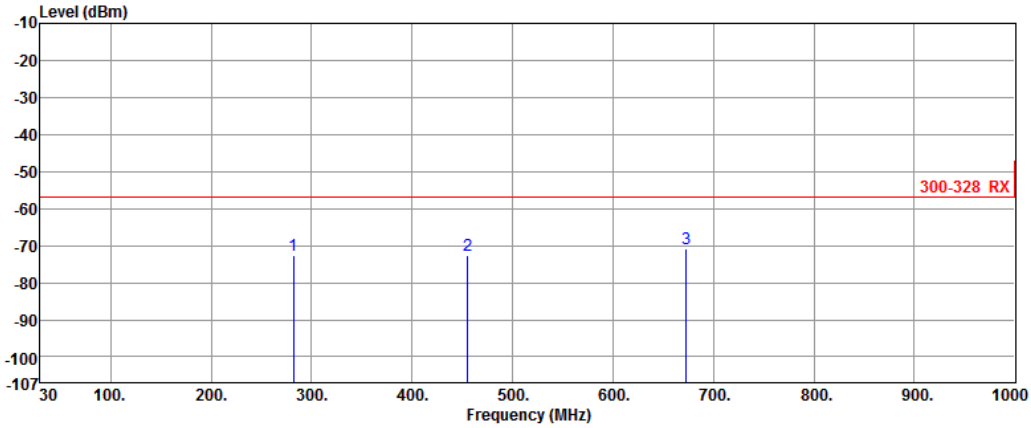
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	66.68	-68.71	-57.00	-11.71	-3.32	-65.39
2	153.23	-73.71	-57.00	-16.71	-0.29	-73.42
3	438.72	-70.43	-57.00	-13.43	2.08	-72.51

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		

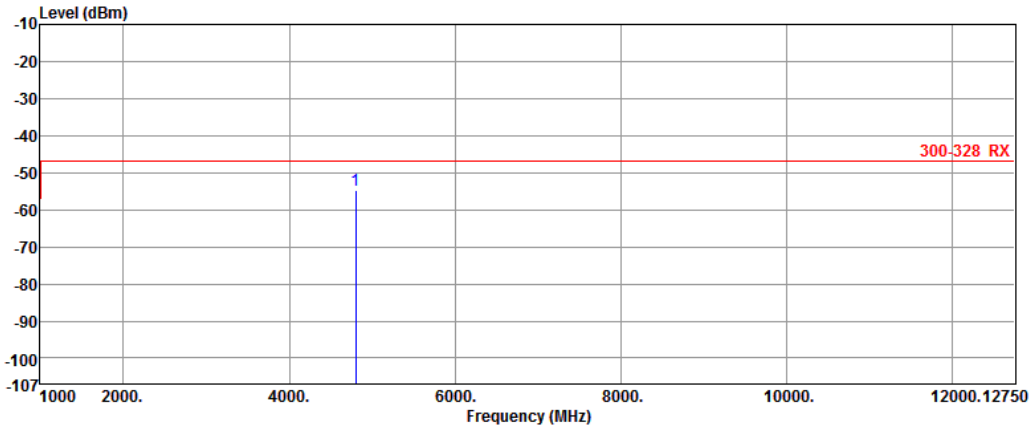


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	281.96	-72.71	-57.00	-15.71	-2.08	-70.63
2	455.63	-72.71	-57.00	-15.71	2.05	-74.76
3	672.63	-70.81	-57.00	-13.81	5.82	-76.63

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)

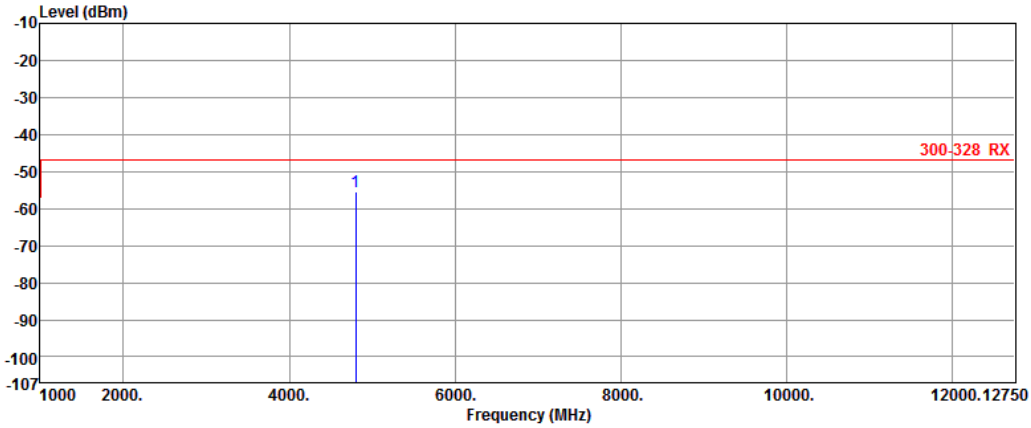
Modulation	GFSK/1Mbps	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4803.97	-54.76	-47.00	-7.76	9.11	-63.87

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

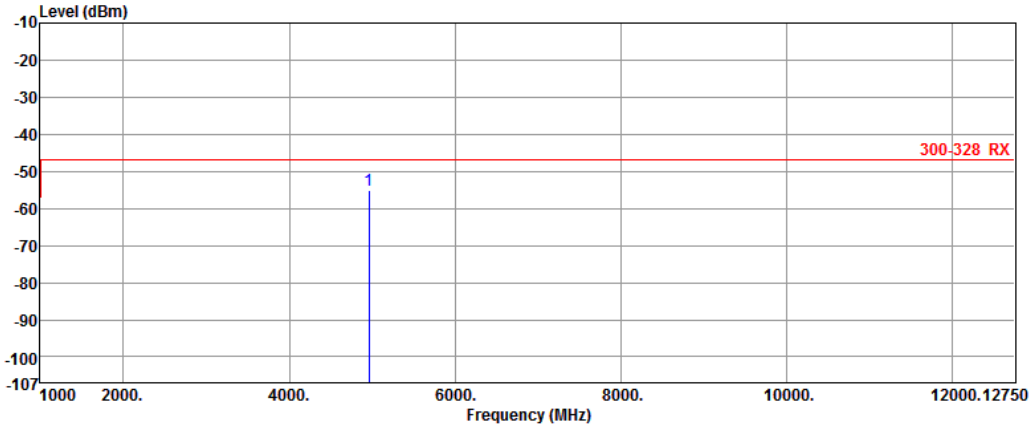
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4804.09	-55.41	-47.00	-8.41	9.42	-64.83

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

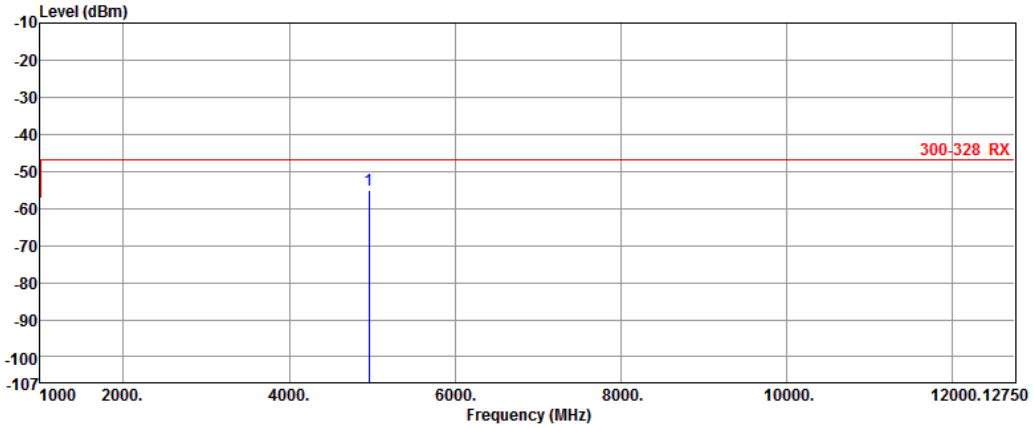
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4959.92	-55.00	-47.00	-8.00	10.45	-65.45

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

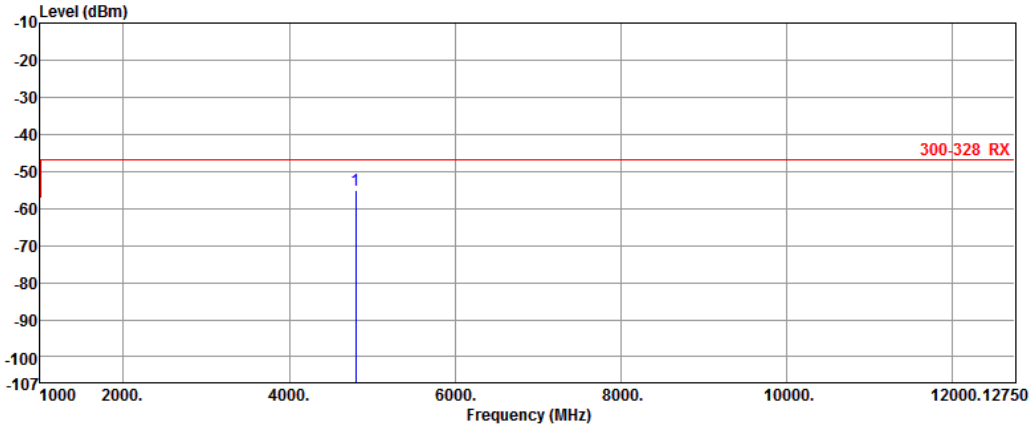
Modulation	GFSK/1Mbps	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4960.16	-55.26	-47.00	-8.26	10.53	-65.79

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

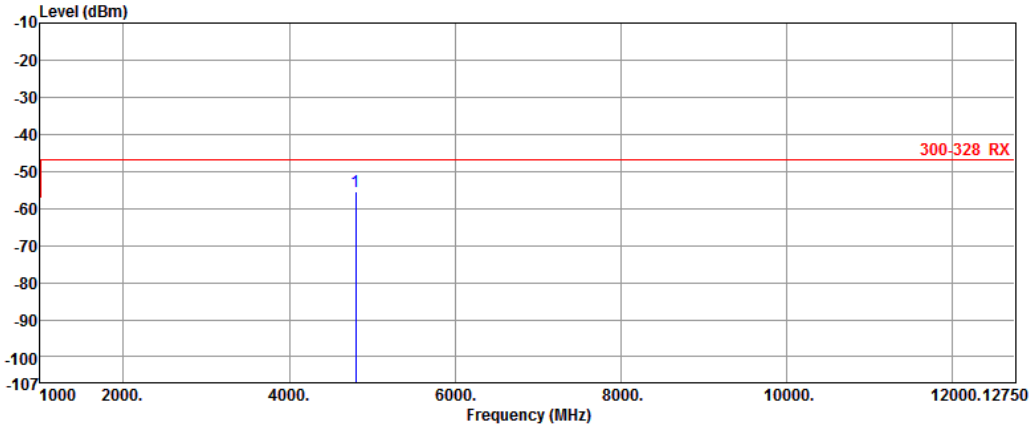
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4804.09	-55.13	-47.00	-8.13	9.11	-64.24

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

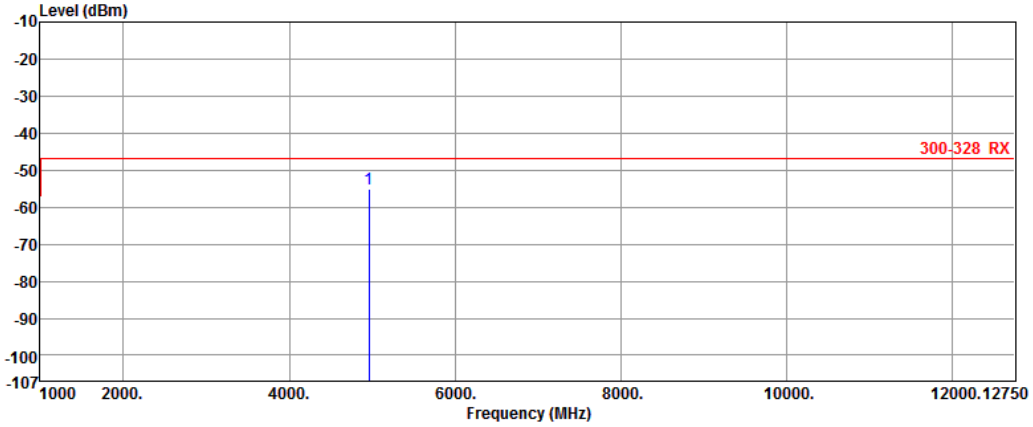
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4803.86	-55.61	-47.00	-8.61	9.42	-65.03

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

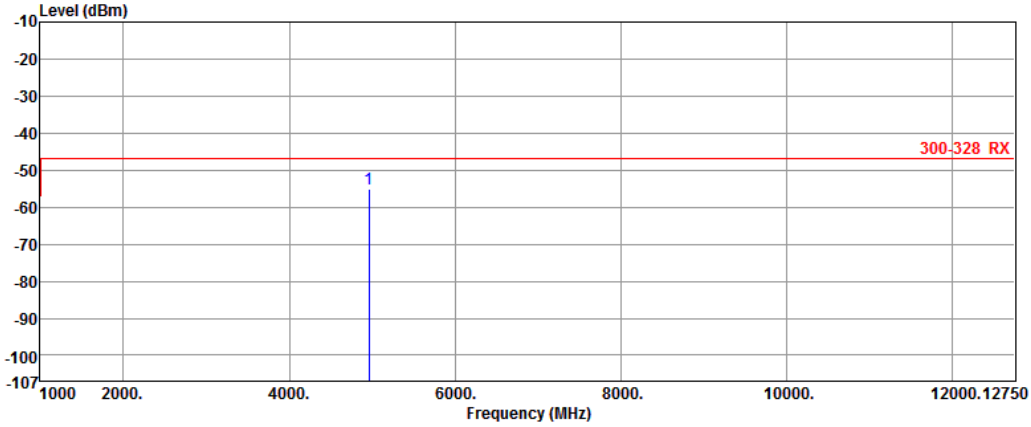
Modulation	GFSK/2Mbps	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4960.24	-55.20	-47.00	-8.20	10.46	-65.66

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	4959.90	-55.26	-47.00	-8.26	10.53	-65.79

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.			

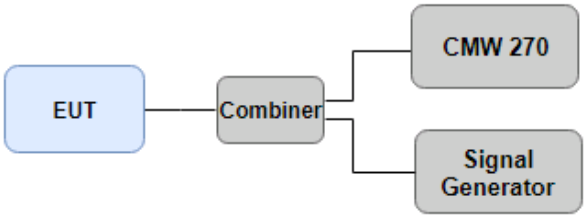
Receiver Blocking Parameters for Receiver Category 2 Equipment Limit			
Wanted Signal Mean Power from Companion Device (dBm)	**Blocking Signal Frequency (MHz)**	**Blocking Signal Power (dBm) (see Note 2)**	**Type of Blocking Signal**
P_{min} + 6 dB	2 380 2 503,5	-57	CW
P_{min} + 6 dB	2 300 2 583,5	-47	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.			

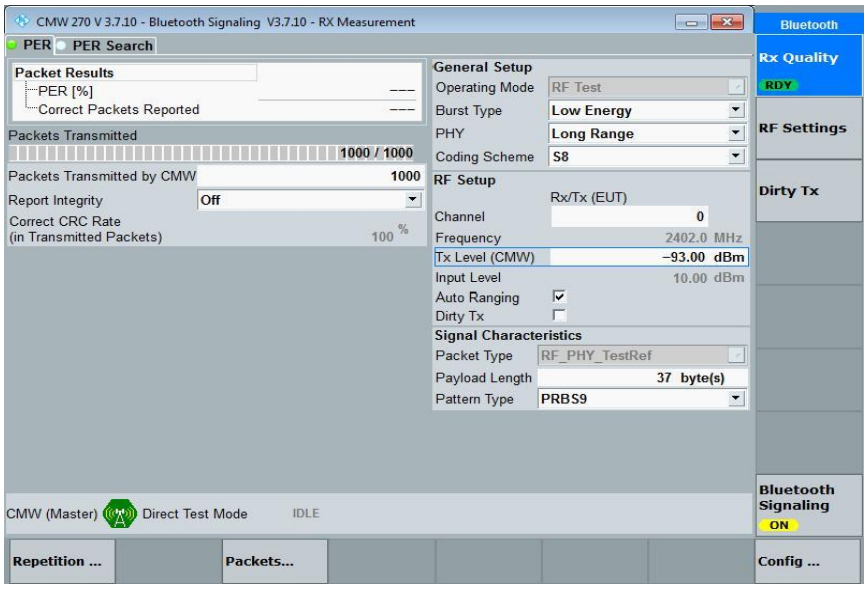
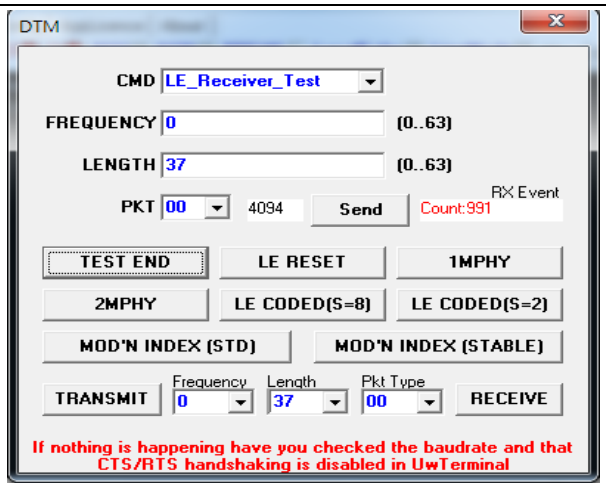
5.1.2 Test Procedures

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

5.1.3 Test Setup



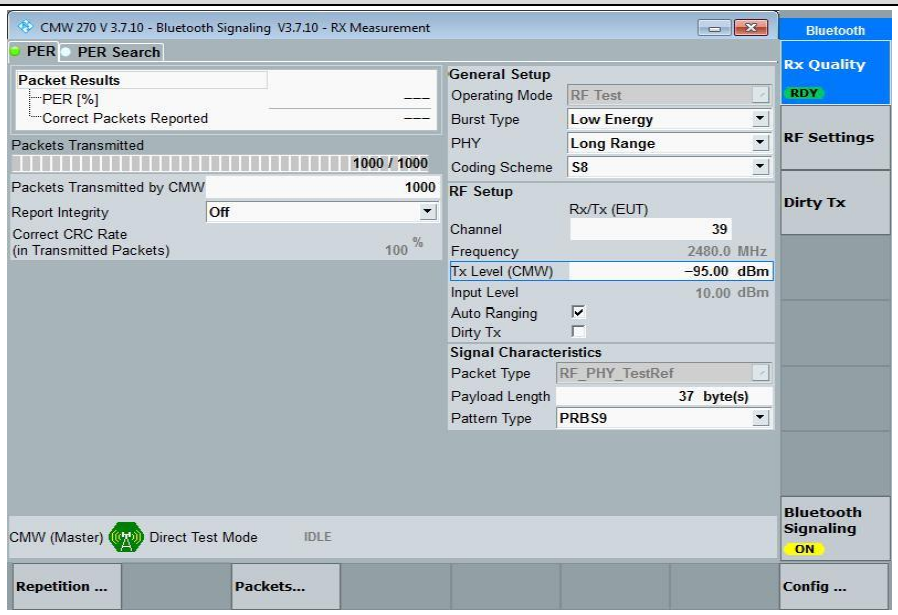
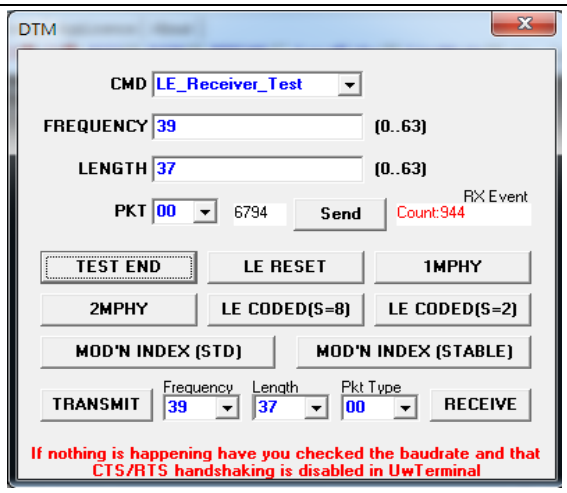
5.1.4 Test Result of Receiver Blocking

2402 MHz



Packet Sent Numbers	1000
Packet Received Numbers	991
PER(%)	0.9

Note: BLE mode of this product can't fully control by our BT tester, so PER result was reported through "DTM" software

PER Minimum Performance Criteria	10 %		
Sensitivity Level	-93		**dBm**
Wanted Signal Mean Power from Companion Device (dBm)	**Blocking Signal Frequency (MHz)**	**Blocking Signal Power (dBm)**	**Test Result**
-87	2380.0	-55	Pass
-87	2503.5		Pass
-87	2300.0	-45	Pass
-87	2583.5		Pass

2480 MHz



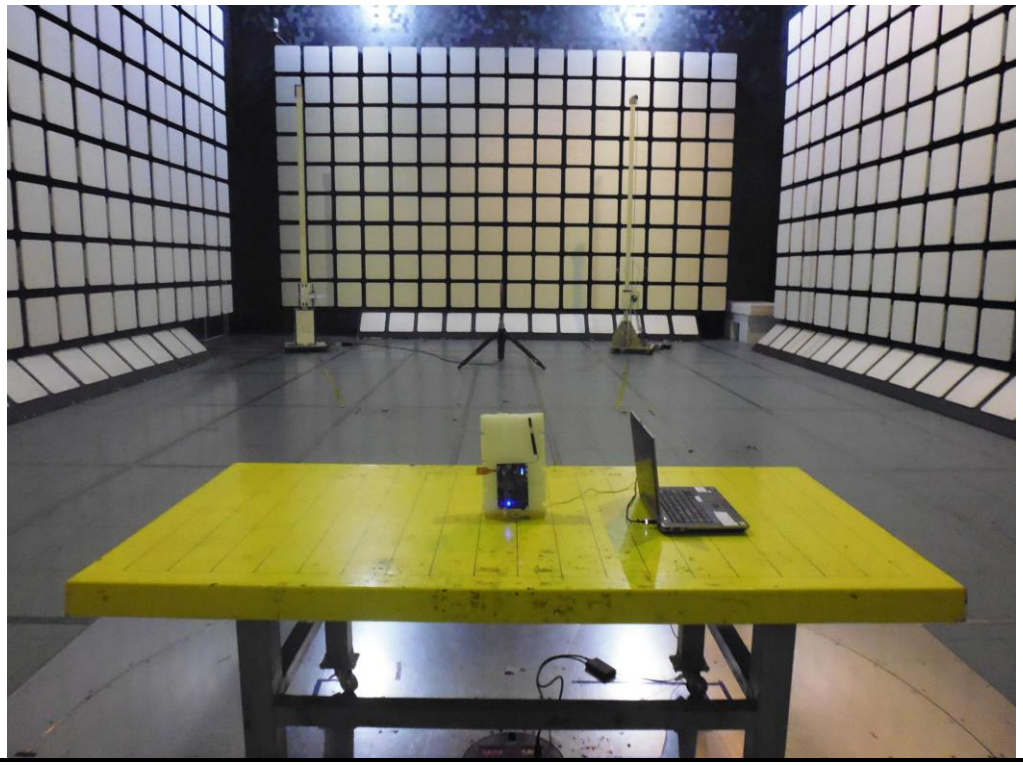
Packet Sent Numbers	1000
Packet Received Numbers	944
PER(%)	5.6

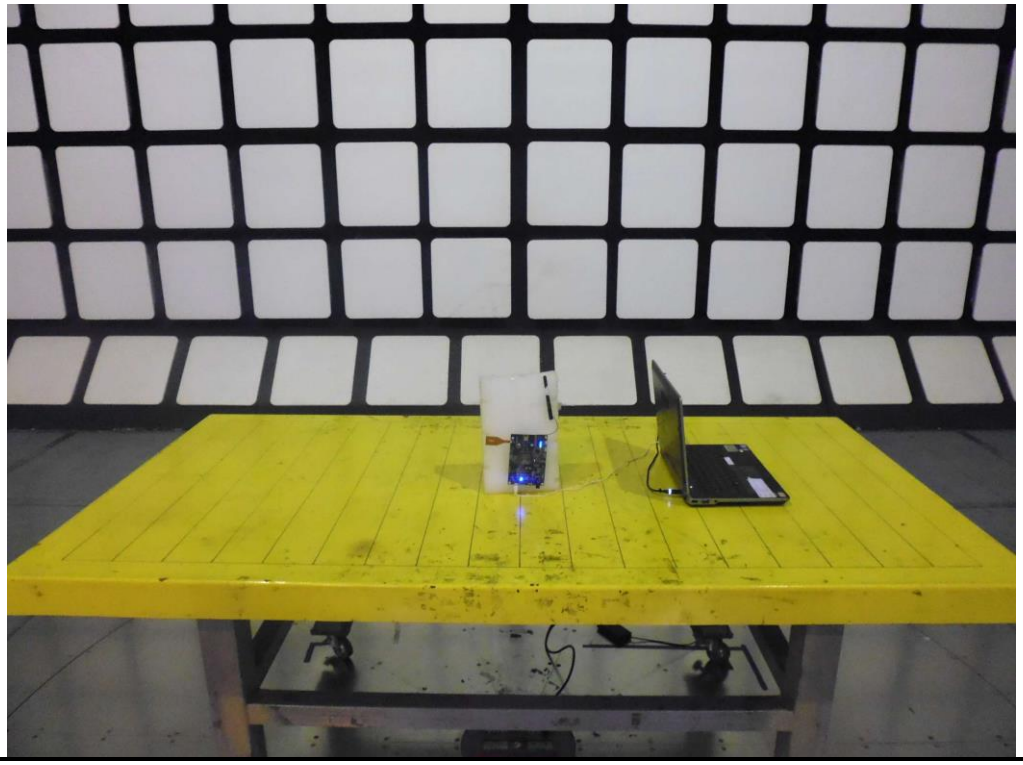
Note: BLE mode of this product can't fully control by our BT tester, so PER result was reported through "DTM" software

PER Minimum Performance Criteria	10 %		
Sensitivity Level	-95		**dBm**
Wanted Signal Mean Power from Companion Device (dBm)	**Blocking Signal Frequency (MHz)**	**Blocking Signal Power (dBm)**	**Test Result**
-89	2380.0	-55	Pass
-89	2503.5		Pass
-89	2300.0	-45	Pass
-89	2583.5		Pass

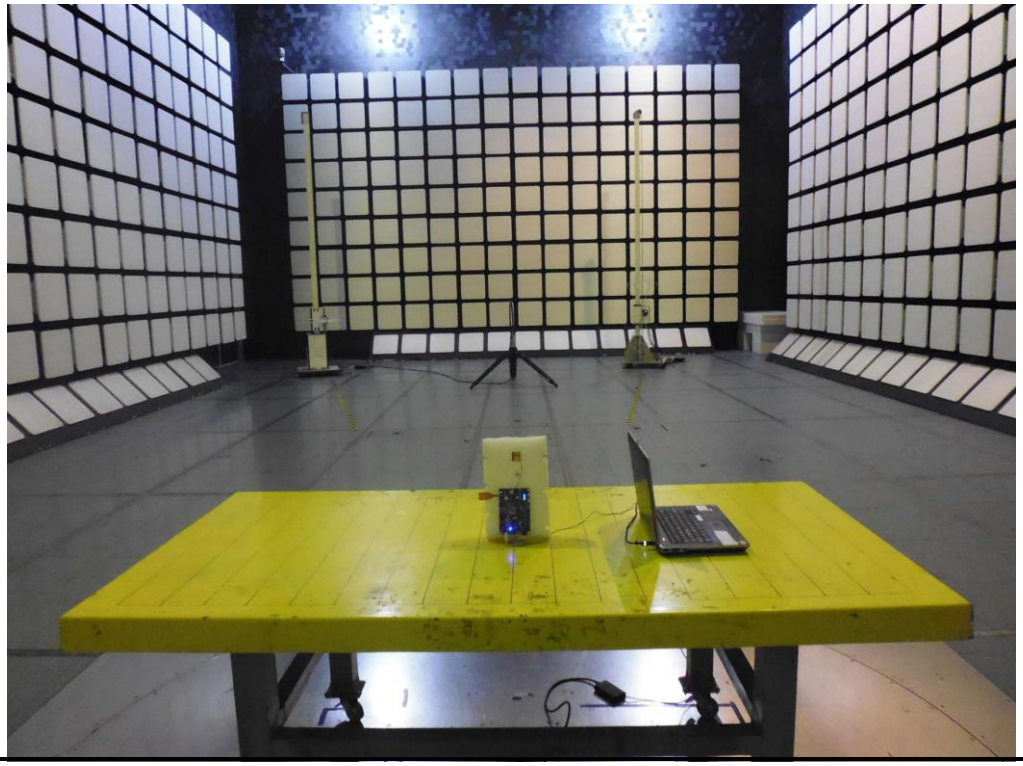
6 Photographs of the Test Configuration

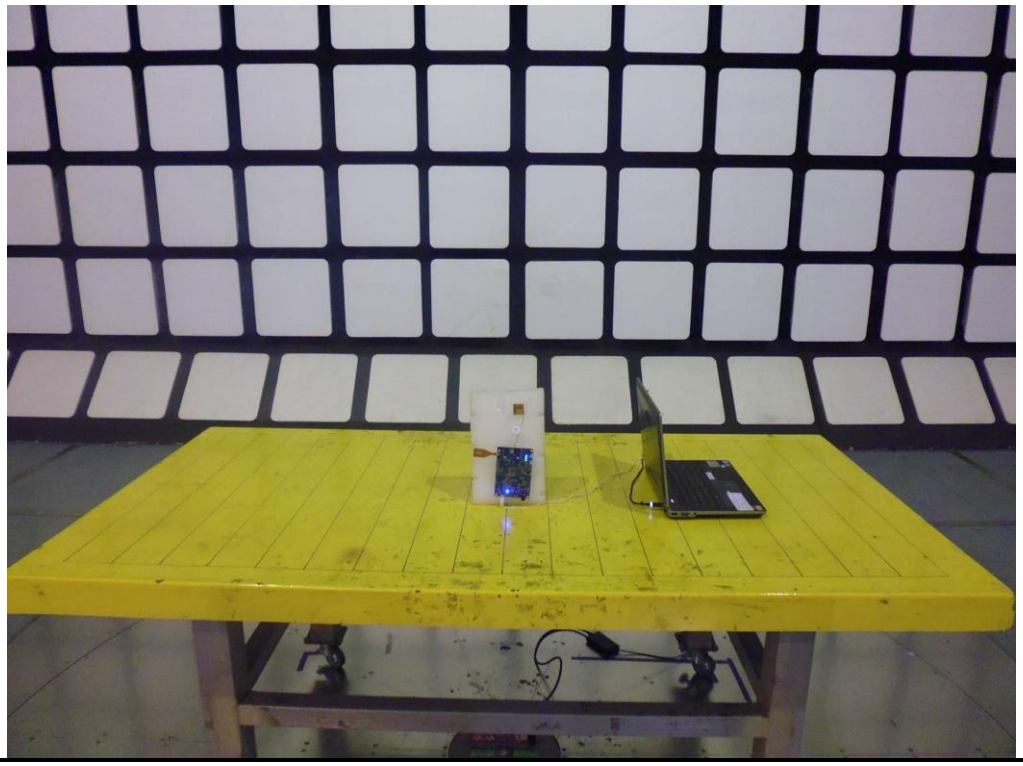
Spurious Emission Test below 30MHz (Test Configuration 1)



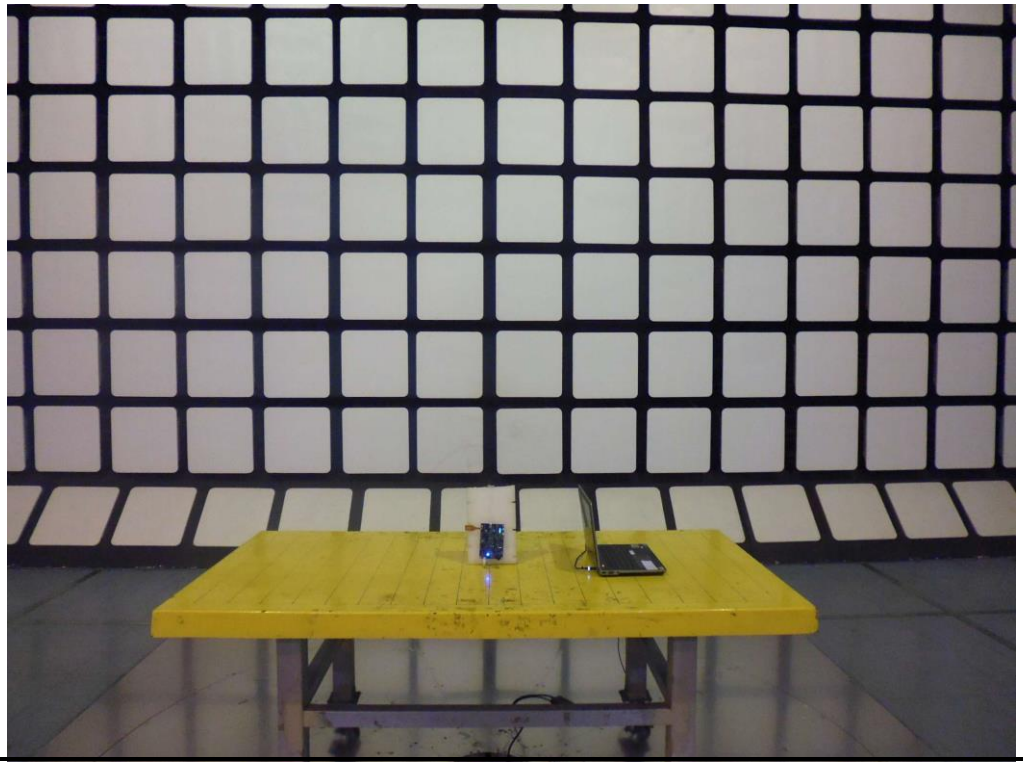


Spurious Emission Test below 30MHz (Test Configuration 2)

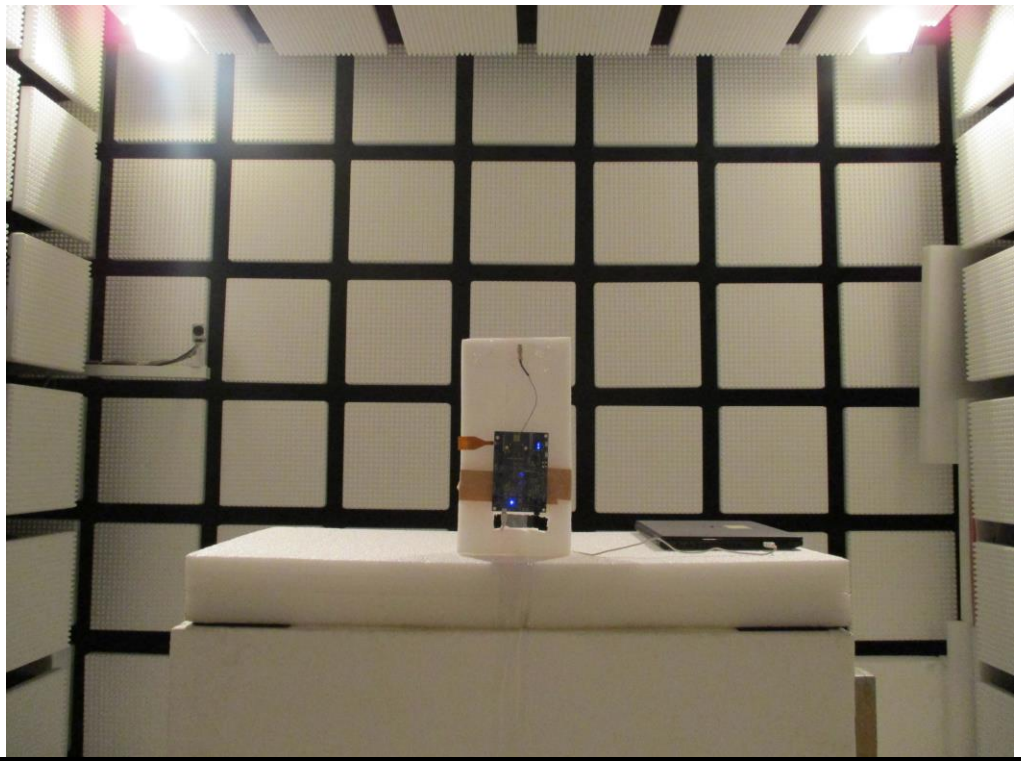




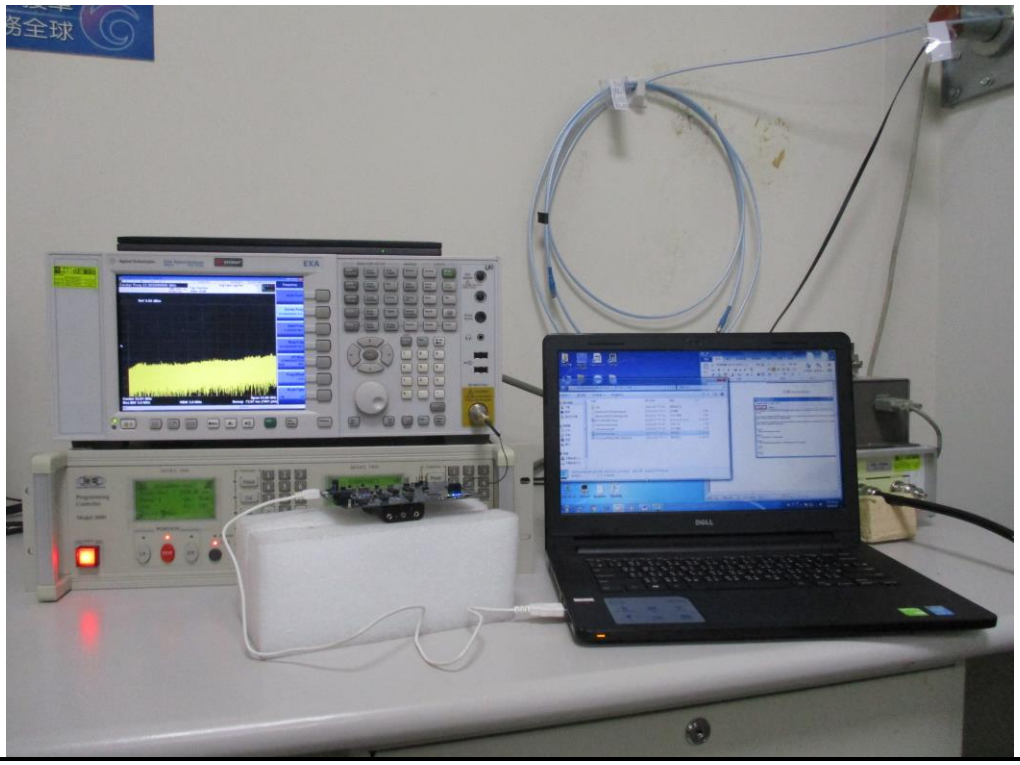
Spurious Emission Test below 30MHz (Test Configuration 3)



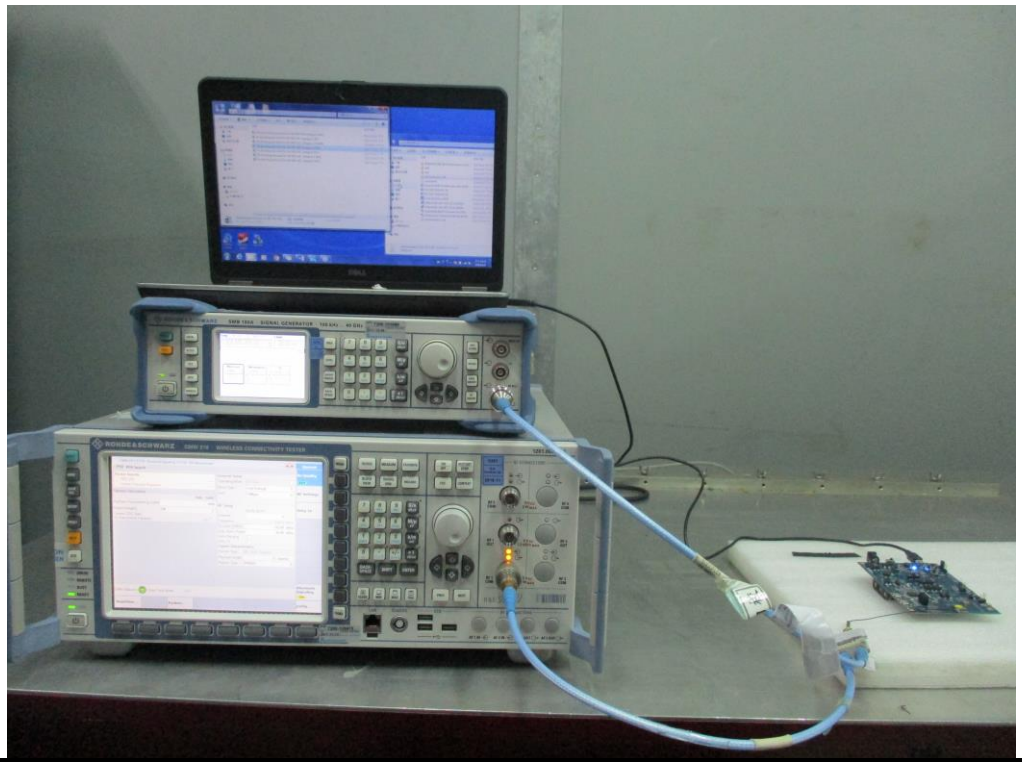
Radiated Spurious Emission Test above 30MHz



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

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Email: ICC_Service@icertifi.com.tw

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