CE Test Report

Equipment	:	**Sterling-LWB5 Module**
Model No.	:	**450-0162, 450-0168, 450-0169** **(Refer to item 1.1.1 for more details)**
Brand Name	:	**Laird**
Applicant	:	**Laird Technologies**
Address	:	**W66N220 Commerce Court, Cedarburg, Wisconsin 53012, USA**
Standard	:	**EN 300 328 V2.1.1 (2016-11)**
Received Date	:	**Jul. 03, 2017**
Tested Date	:	**Aug. 07 ~ Aug. 23, 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

Table of Contents

1 GENERAL DESCRIPTION 5

1.1 Information 5
1.2 Local Support Equipment List 7
1.3 Test Setup Chart 7
1.4 Test Equipment List and Calibration Data 8
1.5 Testing Applied Standards 10
1.6 Measurement Uncertainty 10

2 TEST CONFIGURATION 11

2.1 Testing Condition 11
2.2 The Worst Test Modes and Channel Details 11

3 TRANSMITTER TEST RESULTS 12

3.1 RF Output Power 12
3.2 Power Spectral Density 14
3.3 Occupied Channel Bandwidth 15
3.4 Transmitter Unwanted Emissions in the Out-Of-Band Domain 16
3.5 Transmitter Unwanted Emissions in the Spurious Domain 19

4 RECEIVER TEST RESULTS 33

4.1 Receiver Spurious Emissions 33

5 RECEIVER BLOCKING TEST RESULTS 47

5.1 Receiver Blocking 47

6 PHOTOGRAPHS OF THE TEST CONFIGURATION 51

7 TEST LABORATORY INFORMATION 54

Release Record

Report No.	Version	Description	Issued Date
ER770305AE	Rev. 01	Initial issue	Sep. 14, 2017
ER770305AE	Rev. 02	Revising the model name	Sep. 25, 2017

Summary of Test Results

Ref. Std. Clause	Test Items	Measured	Result
4.3.2.2	RF Output Power	9.75 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
4.3.2.7	Occupied Channel Bandwidth	Meet the requirement of limit.	Pass
4.3.2.8	Transmitter unwanted emissions in the out of band domain	Meet the requirement of limit.	Pass
4.3.2.9	Transmitter unwanted emissions in the spurious domain	Meet the requirement of limit.	Pass
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	450-0162	Sterling-LWB5 Module	SIP Module
	450-0168		U.FL Module
	450-0169		Chip Antenna Module

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	V4.1 LE	2402-2480	0-39 [40]	1 Mbps
Note 1: Bluetooth LE (Low energy) uses GFSK modulation.				

1.1.3 Antenna Details

Ant. No.	Model	Type	Connector	Gain (dBi)	Remarks
1	LSR/001-0009	Dipole	IPEX U.FL	2	---
2	LSR/FlexPIFA 001-0016	PIFA	IPEX U.FL		---
3	LSR/001-0012	Dipole	IPEX U.FL		---
4	CHIP ANTENNA: Johanson P/N: 2450AD14A5500#	Chip	IPEX U.FL	1	---

1.1.4 EUT Operational Condition

Power Supply Type	3.3Vdc from host		
SW Version	6.37.39.77		
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)
37	2402	18	2442
0	2404	19	2444
1	2406	20	2446
2	2408	21	2448
3	2410	22	2450
4	2412	23	2452
5	2414	24	2454
6	2416	25	2456
7	2418	26	2458
8	2420	27	2460
9	2422	28	2462
10	2424	29	2464
38	2426	30	2466
11	2428	31	2468
12	2430	32	2470
13	2432	33	2472
14	2434	34	2474
15	2436	35	2476
16	2438	36	2478
17	2440	39	2480

1.1.7 Test Tool and Duty Cycle

Test Tool	Bluetooth RF Eval Tool		
Duty Cycle and Duty Factor	**Modulation Mode**	**Duty Cycle (%)**	**Duty Factor (dB)**
	GFSK-1Mbps	61.29	2.13

1.1.8 Power Setting

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

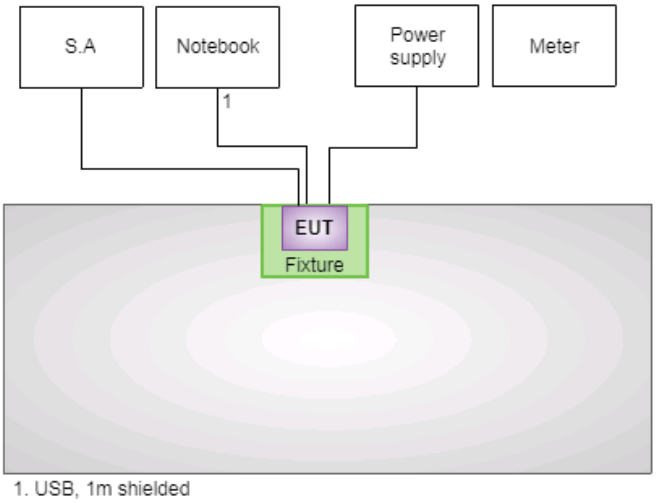
1.2 Local Support Equipment List

Support Equipment List						
No.	**Equipment**	**Brand**	**Model**	**S/N**	**FCC ID**	**Signal cable / Length (m)**
1	Notebook	DELL	Latitude E6430	J5GB4X1	DoC	USB, 1m shielded.
2	DC Power Supply	GWINSTEK	GPC-3060D	EM884797	---	---
3	Fixture	---	---	---	---	---

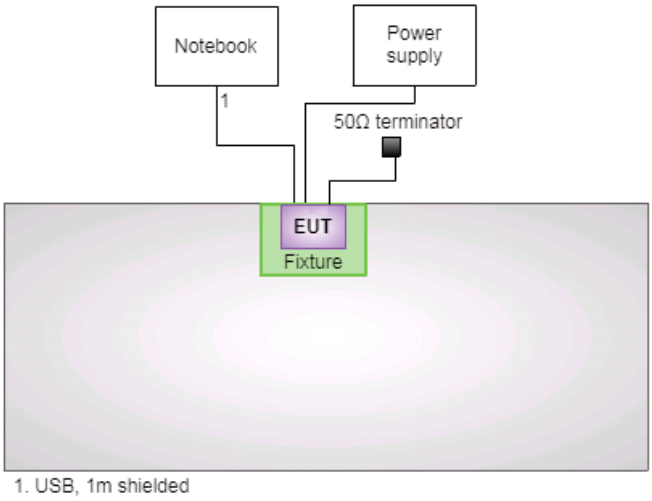
Note: Fixture is provided by applicant.

1.3 Test Setup Chart

Test Setup Diagram (Conducted)



Test Setup Diagram (Radiated)



1.4 Test Equipment List and Calibration Data

Test Item	Radiated Emissions				
Test Site	Fully-anechoic chamber 2 / (05CH02-WS)				
Tested Date	Aug. 07, 2017				
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)				
Tested Date	Aug. 14, 2017				
Instrument	**Manufacturer**	**Model No.**	**Serial No.**	**Calibration Date**	**Calibration Until**
Spectrum Analyzer	ROHDE&SCHWARZ	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
Power Sensor	Agilent	U2021XA	MY53510003	Feb. 06, 2017	Feb. 05, 2018
Power Sensor	Agilent	U2021XA	MY54070003	Feb. 15, 2017	Feb. 14, 2018
Power Sensor	Agilent	U2021XA	MY54060013	Feb. 15, 2017	Feb. 14, 2018
Signal Generator	R&S	SMB100A	175727	Oct. 19, 2016	Oct. 18, 2017
DC POWER SOURCE	GW INSTEK	GPC-6030D	EM892433	Oct. 20, 2016	Oct. 19, 2017
Combiner(1X2)	woken	0120A02201801O	DOM2AEW1A23	Dec. 15, 2016	Dec. 14, 2017
Combiner(1X4)	woken	0120A04056002D	111204	Dec. 15, 2016	Dec. 14, 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)				
Tested Date	Aug. 23, 2017				
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.					

1.5 Testing Applied Standards

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

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

Test Item	Test Site	Ambient Condition	Tested By
RF Conducted	TH01-WS	25°C / 63%	Jack Li
Radiated Emission	05CH02-WS	24°C / 65%	Ryan Lee
Receiver Blocking	05CH01-WS	23°C / 63%	Jack Li

2.2 The Worst Test Modes and Channel Details

Test item	Modulation Mode	Test Frequency (MHz)	Data Rate	Test Configuration
RF Output Power	GFSK	2402 / 2440 / 2480	1 Mbps	1, 2
Power Spectral Density				
Transmitter unwanted emissions in the out of band domain	GFSK	2402 / 2480	1 Mbps	1, 2
Transmitter Spurious Emissions Occupied Channel Bandwidth	GFSK	2402 / 2480	1 Mbps	2
Receiver Spurious Emissions				
Receiver Blocking	GFSK	2402 / 2480	1 Mbps	2

NOTE:

1. The test configurations are listed as follows:
   Configuration 1 : Antenna Gain 1dBi
   Configuration 2 : Antenna Gain 2dB**i**
2. 50Ω terminators is connected to antenna port of EUT for radiated emission measurement.

3 Transmitter Test Results

3.1 RF Output Power

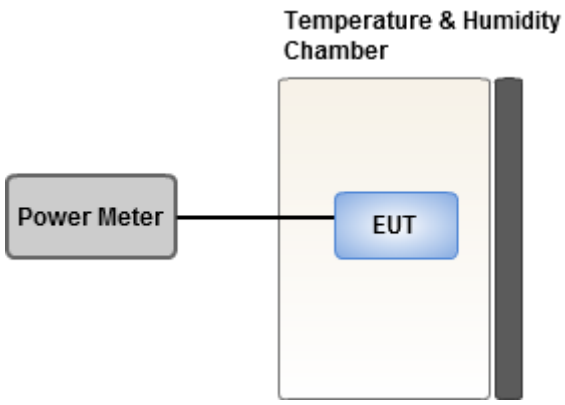
3.1.1 Limit of RF Output Power

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

Configuration 1 : Antenna Gain 1dBi

RF Output Power (dBm)				
Condition	**Freq. (MHz)**	**EIRP Power**	**Limit (dBm)**	**Results**
$T_{nom}V_{nom}$	2402	7.33	20	Pass
$T_{min}V_{nom}$	2402	8.75	20	Pass
$T_{max}V_{nom}$	2402	4.02	20	Pass
$T_{nom}V_{nom}$	2440	7.57	20	Pass
$T_{min}V_{nom}$	2440	8.63	20	Pass
$T_{max}V_{nom}$	2440	3.45	20	Pass
$T_{nom}V_{nom}$	2480	6.30	20	Pass
$T_{min}V_{nom}$	2480	7.32	20	Pass
$T_{max}V_{nom}$	2480	2.13	20	Pass

Configuration 2 : Antenna Gain 2dBi

RF Output Power (dBm)				
Condition	**Freq. (MHz)**	**EIRP Power**	**Limit (dBm)**	**Results**
$T_{nom}V_{nom}$	2402	8.33	20	Pass
$T_{min}V_{nom}$	2402	**9.75**	20	Pass
$T_{max}V_{nom}$	2402	5.02	20	Pass
$T_{nom}V_{nom}$	2440	8.57	20	Pass
$T_{min}V_{nom}$	2440	9.63	20	Pass
$T_{max}V_{nom}$	2440	4.45	20	Pass
$T_{nom}V_{nom}$	2480	7.30	20	Pass
$T_{min}V_{nom}$	2480	8.32	20	Pass
$T_{max}V_{nom}$	2480	3.13	20	Pass

3.2 Power Spectral Density

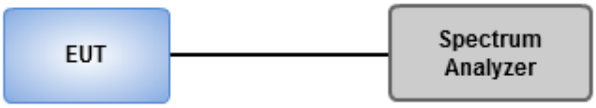
3.2.1 Limit of Power Spectral Density

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

Configuration 1 : Antenna Gain 1dBi

Modulation Mode	Freq. (MHz)	Power Density (dBm/1MHz)	Limit (dBm/1MHz)	Results
GFSK-1Mbps	2402	7.30	10	Pass
GFSK-1Mbps	2440	7.49	10	Pass
GFSK-1Mbps	2480	6.70	10	Pass

Configuration 2 : Antenna Gain 2dBi

Modulation Mode	Freq. (MHz)	Power Density (dBm/1MHz)	Limit (dBm/1MHz)	Results
GFSK-1Mbps	2402	8.30	10	Pass
GFSK-1Mbps	2440	8.49	10	Pass
GFSK-1Mbps	2480	7.70	10	Pass

3.3 Occupied Channel Bandwidth

3.3.1 Limit of Occupied Channel Bandwidth

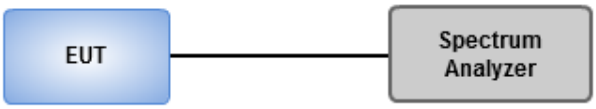
The Occupied Channel Bandwidth shall fall completely within 2.4~2.4835 GHz.

In addition, for non-adaptive equipment using wide band modulations other than FHSS and with e.i.r.p greater than 10 dBm, the occupied channel bandwidth shall be less than 20 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

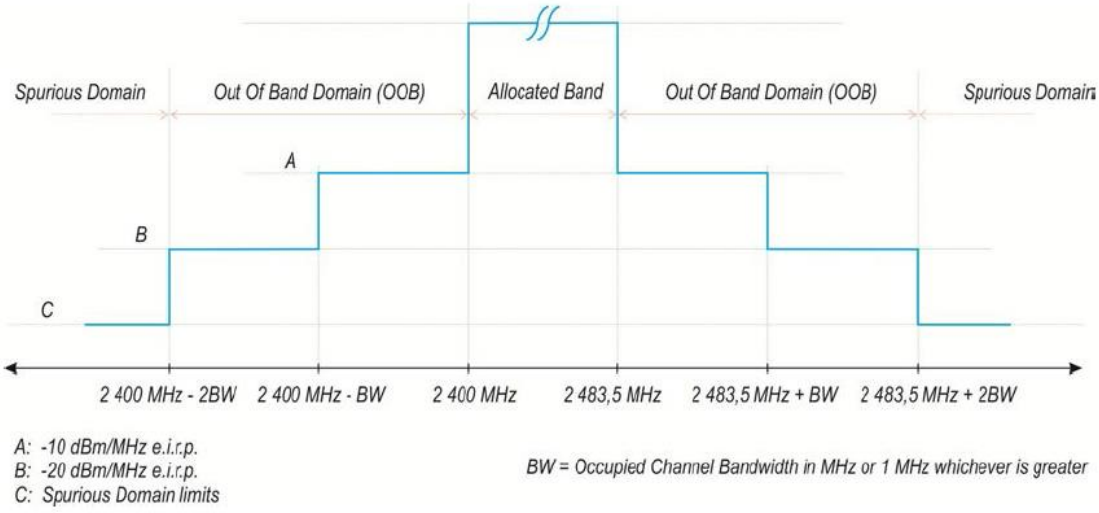


3.3.4 Test Result of Occupied Channel Bandwidth

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-1Mbps	2402	1.06	2401.47	2402.54	2400.0
GFSK-1Mbps	2480	1.06	2479.46	2480.52	2483.5

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

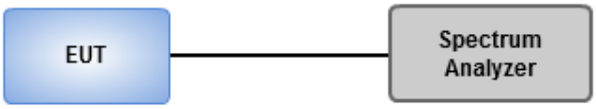
3.4.1 Limit of Transmitter Unwanted Emissions in the Out-Of-Band Domain



3.4.2 Test Procedures

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

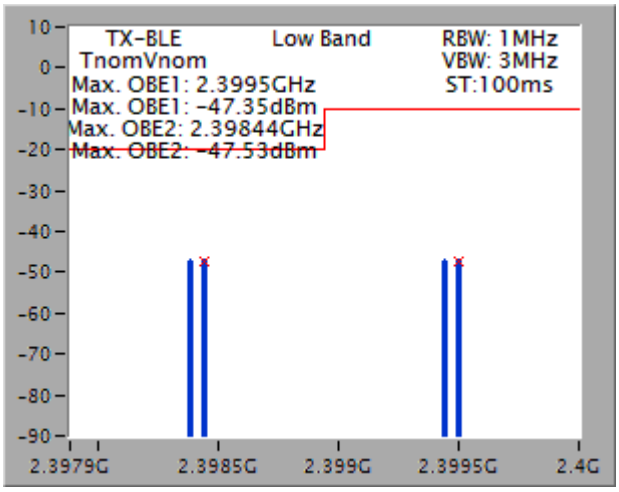
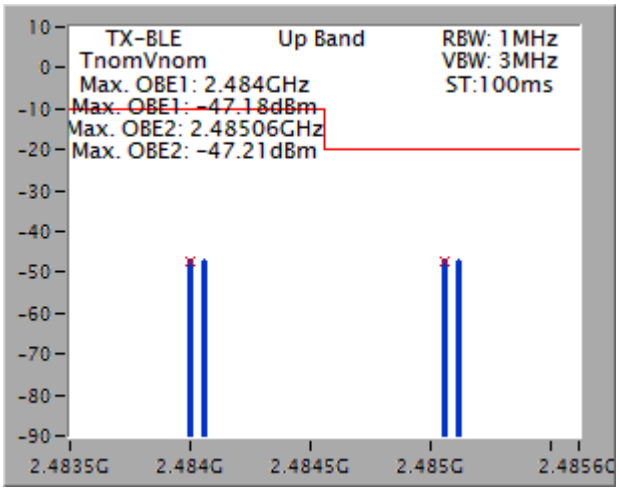
3.4.3 Test Setup



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

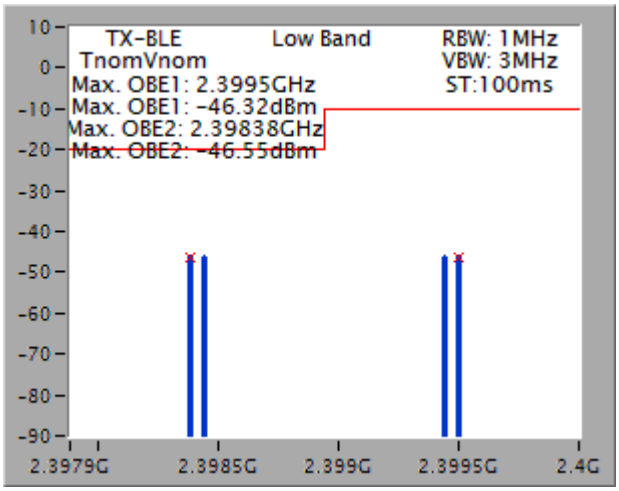
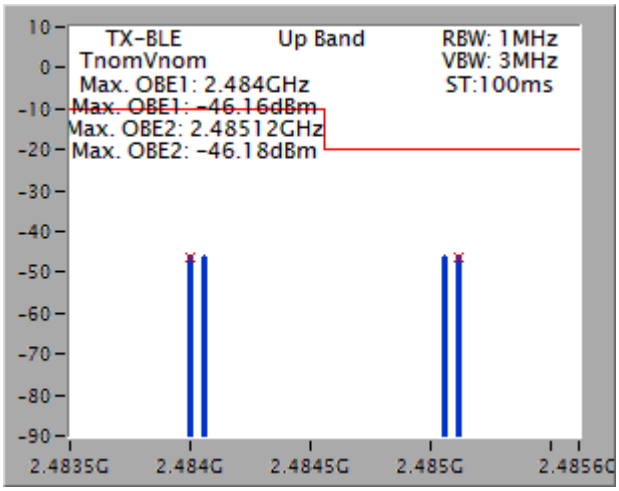
Configuration 1 : Antenna Gain 1dBi

Condition	Modulation Mode	Freq. (MHz)	OOB Freq. (MHz)	OOB Emissions (dBm)	Limit (dBm)
TnomVnom	GFSK-1Mbps	2402	2399.50	-47.35	-10
TnomVnom	GFSK-1Mbps	2402	2398.44	-47.53	-20
TnomVnom	GFSK-1Mbps	2480	2484.00	-47.18	-10
TnomVnom	GFSK-1Mbps	2480	2485.06	-47.21	-20

Low Band	Up Band
	

Configuration 2 : Antenna Gain 2dBi

Condition	Modulation Mode	Freq. (MHz)	OOB Freq. (MHz)	OOB Emissions (dBm)	Limit (dBm)
TnomVnom	GFSK-1Mbps	2402	2399.50	-46.32	-10
TnomVnom	GFSK-1Mbps	2402	2398.38	-46.55	-20
TnomVnom	GFSK-1Mbps	2480	2484.00	-46.16	-10
TnomVnom	GFSK-1Mbps	2480	2485.12	-46.18	-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

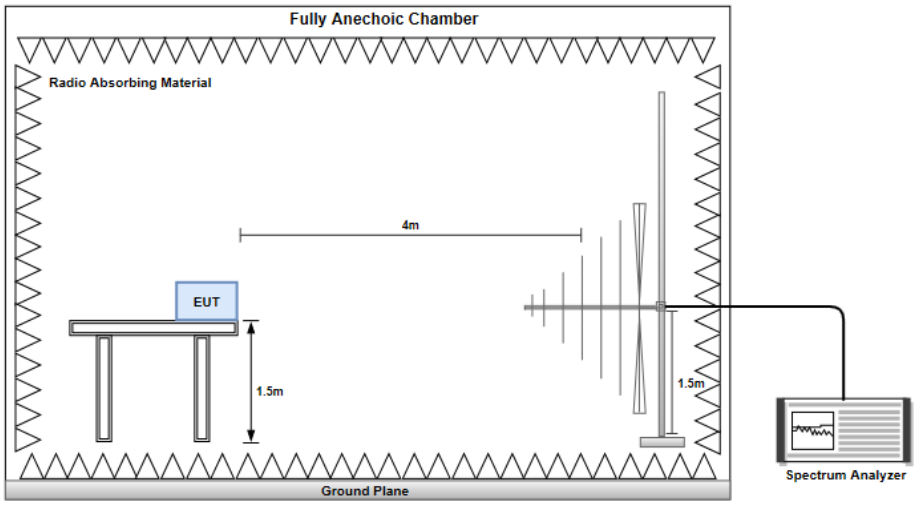
Frequency Range (MHz)	Maximum power (dBm)	Bandwidth (kHz)
30 to 47	-36	100
47 to 74	-54	100
74 to 87,5	-36	100
87,5 to 118	-54	100
118 to 174	-36	100
174 to 230	-54	100
230 to 470	-36	100
470 to 862	-54	100
862 to 1000	-36	100
1000 to 12750	-30	1000

3.5.2 Test Procedures

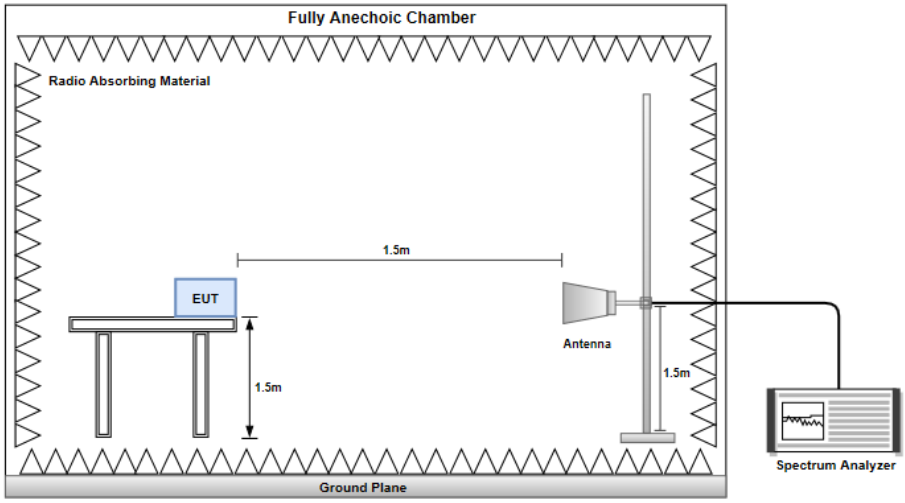
Reference to clause 5.4.9.2 of ETSI EN 300 328 V2.1.1 (2016-11).

3.5.3 Test Setup

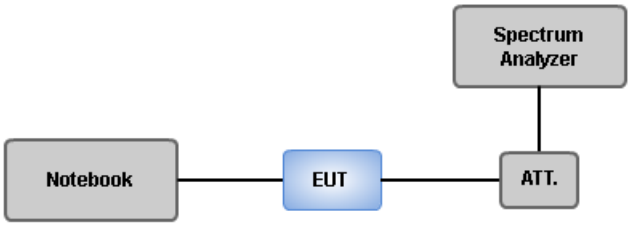
Below 1GHz



Above 1 GHz

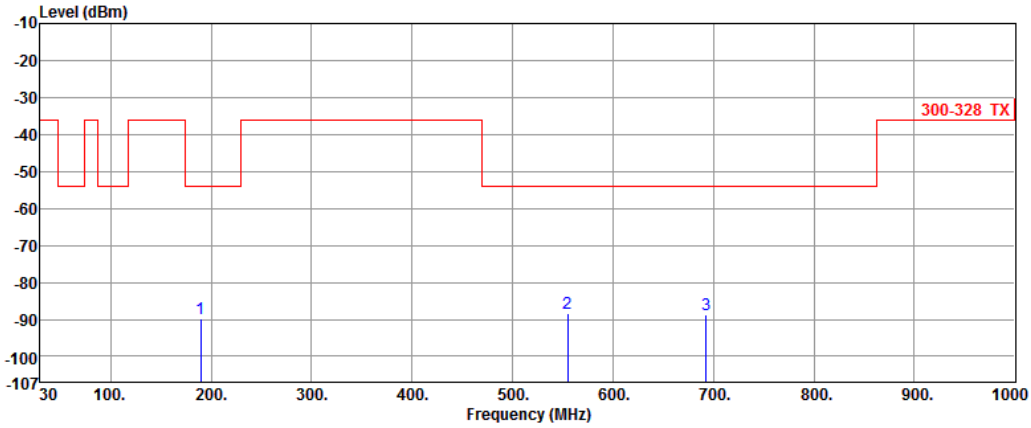


Conducted Emission



3.5.4 Transmitter Conducted Unwanted Emissions (Below 1GHz)

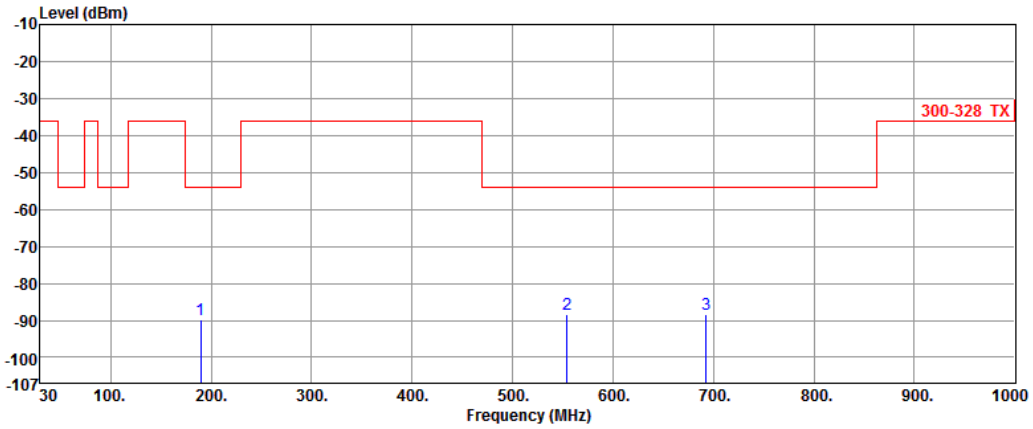
Modulation	GFSK	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	189.54	-89.65	-54.00	-35.65	0.00	-89.65
2	554.58	-88.45	-54.00	-34.45	0.00	-88.45
3	692.88	-88.58	-54.00	-34.58	0.00	-88.58

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

Modulation	GFSK	Test Freq. (MHz)	2480

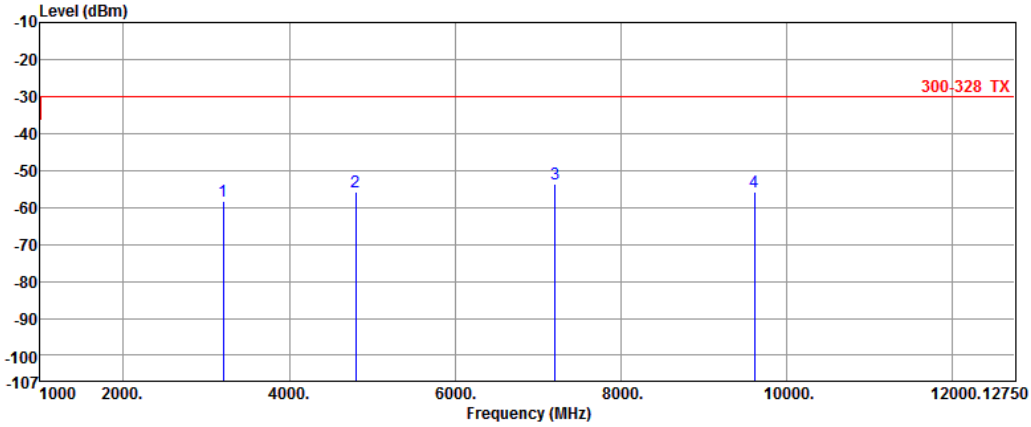


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	189.54	-89.65	-54.00	-35.65	0.00	-89.65
2	554.54	-88.47	-54.00	-34.47	0.00	-88.47
3	692.55	-88.47	-54.00	-34.47	0.00	-88.47

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

3.5.5 Transmitter Conducted Unwanted Emissions (Above 1GHz)

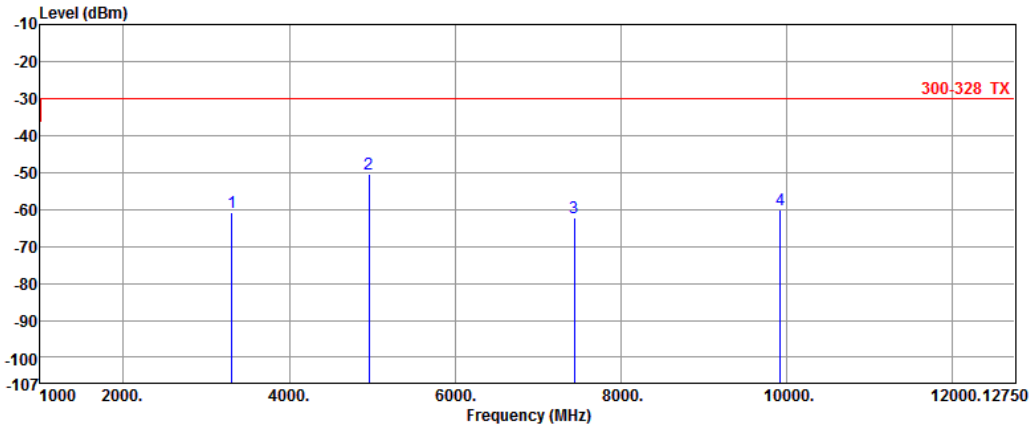
Modulation	GFSK	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	3202.48	-58.36	-30.00	-28.36	0.00	-58.36
2	4804.32	-55.94	-30.00	-25.94	0.00	-55.94
3	7205.38	-53.61	-30.00	-23.61	0.00	-53.61
4	9609.02	-55.80	-30.00	-25.80	0.00	-55.80

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

Modulation	GFSK	Test Freq. (MHz)	2480

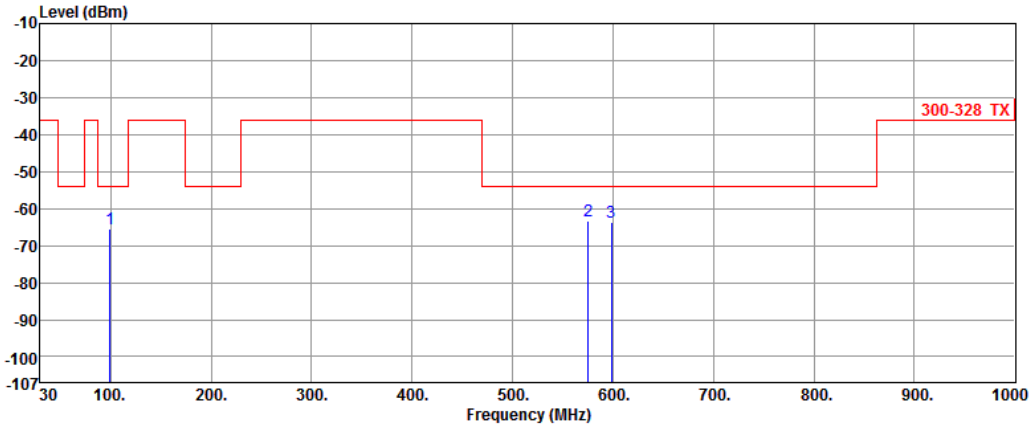


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	3306.89	-60.77	-30.00	-30.77	0.00	-60.77
2	4960.38	-50.45	-30.00	-20.45	0.00	-50.45
3	7438.81	-62.30	-30.00	-32.30	0.00	-62.30
4	9920.76	-60.03	-30.00	-30.03	0.00	-60.03

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

3.5.6 Transmitter Radiated Unwanted Emissions (Below 1GHz)

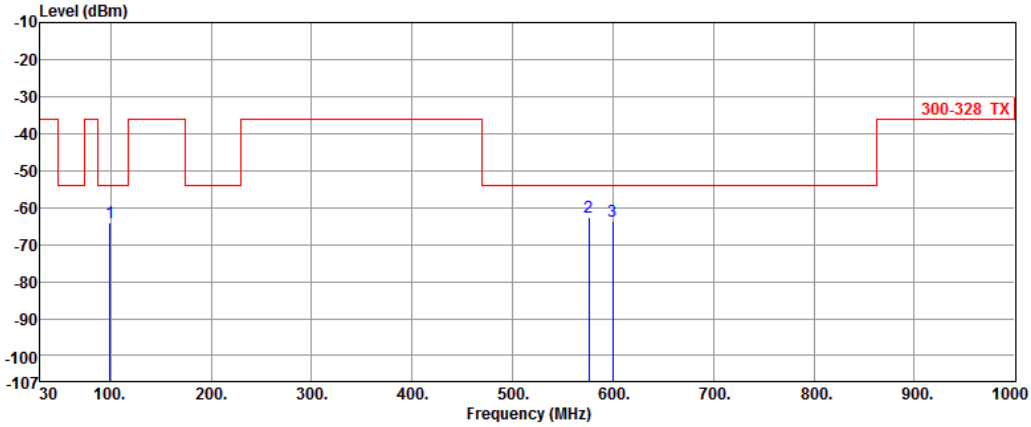
Modulation	GFSK	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	99.15	-65.65	-54.00	-11.65	-6.06	-59.59
2	575.45	-63.46	-54.00	-9.46	5.49	-68.95
3	598.65	-63.65	-54.00	-9.65	6.75	-70.40

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

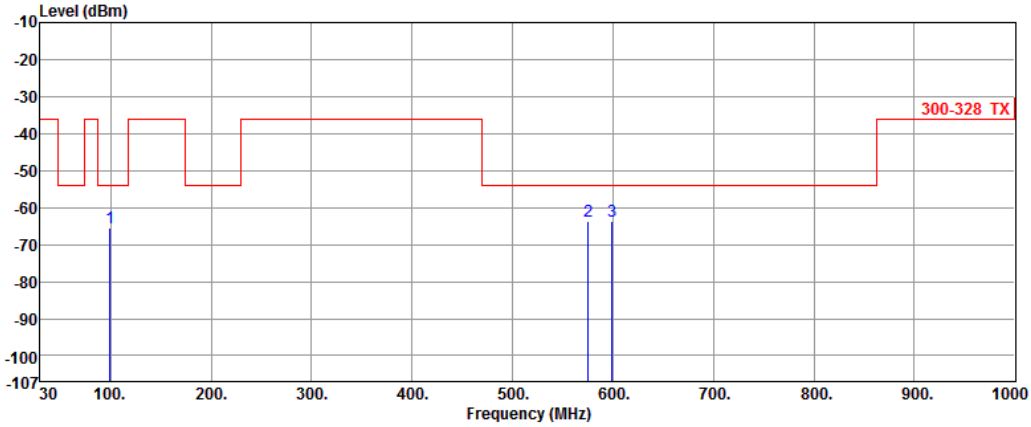
Modulation	GFSK	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	99.54	-64.13	-54.00	-10.13	-4.15	-59.98
2	575.84	-62.46	-54.00	-8.46	6.52	-68.98
3	599.87	-63.65	-54.00	-9.65	7.13	-70.78

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

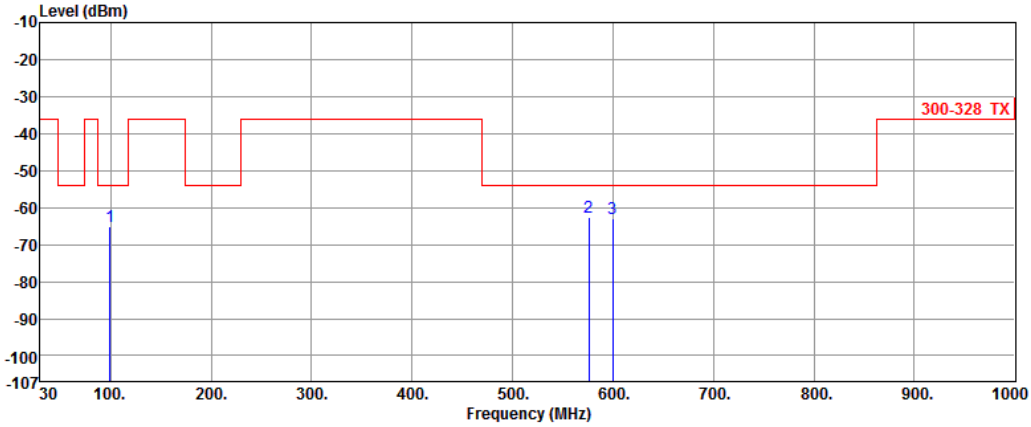
Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	99.54	-65.54	-54.00	-11.54	-6.01	-59.53
2	575.65	-63.57	-54.00	-9.57	5.50	-69.07
3	598.84	-63.55	-54.00	-9.55	6.75	-70.30

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

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		

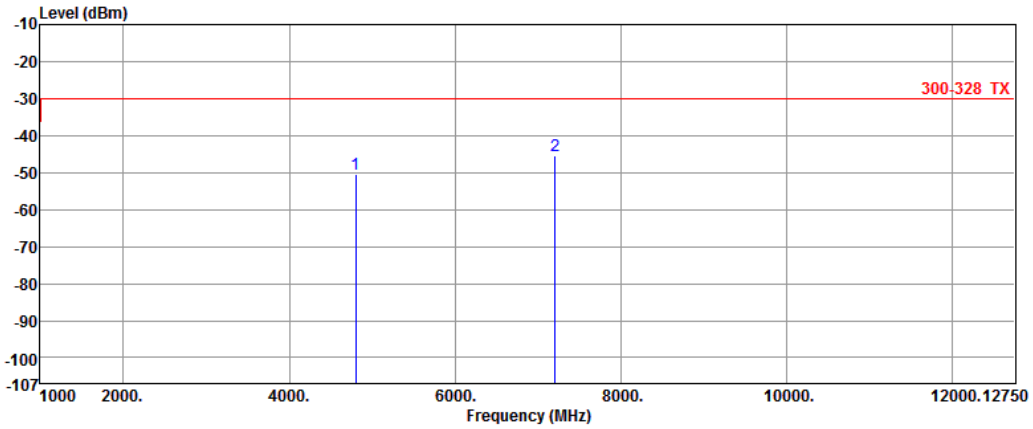


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	99.45	-64.99	-54.00	-10.99	-4.16	-60.83
2	575.74	-62.46	-54.00	-8.46	6.51	-68.97
3	599.78	-63.15	-54.00	-9.15	7.13	-70.28

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 (Above 1GHz)

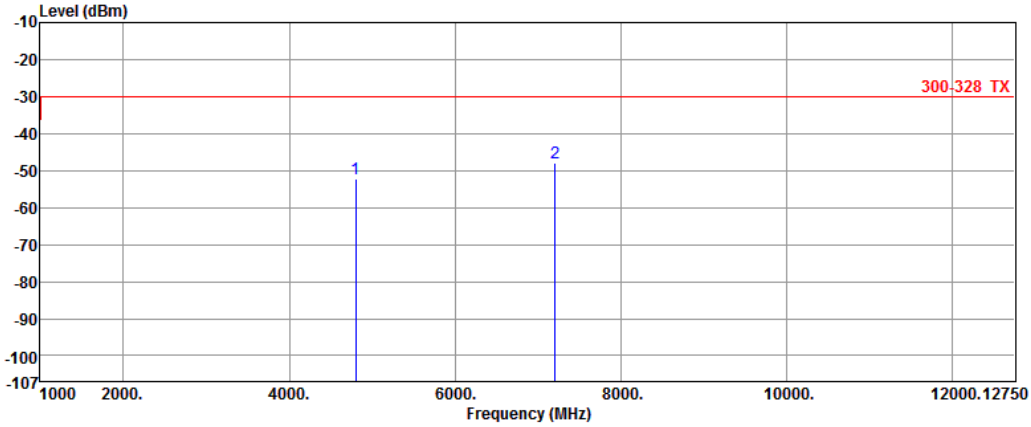
Modulation	GFSK	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4804.50	-50.48	-30.00	-20.48	11.64	-62.12
2	7205.22	-45.45	-30.00	-15.45	17.38	-62.83

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

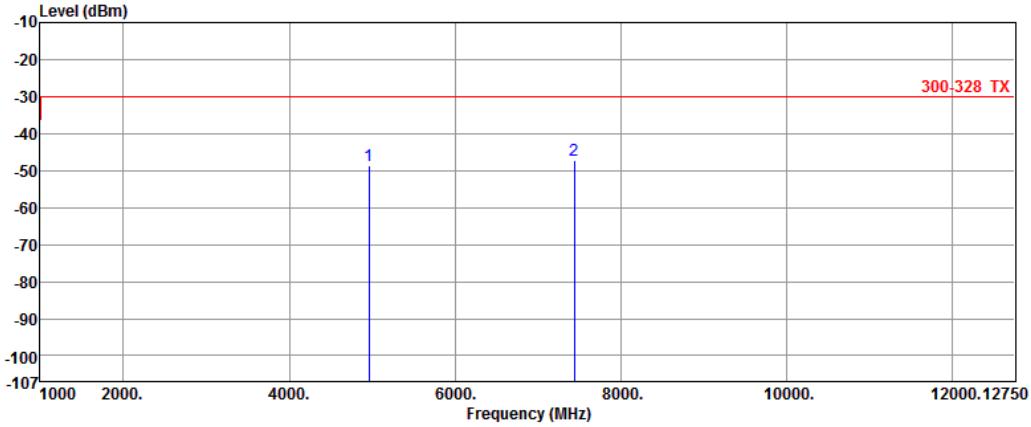
Modulation	GFSK	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4804.17	-52.40	-30.00	-22.40	11.89	-64.29
2	7206.50	-48.04	-30.00	-18.04	17.17	-65.21

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

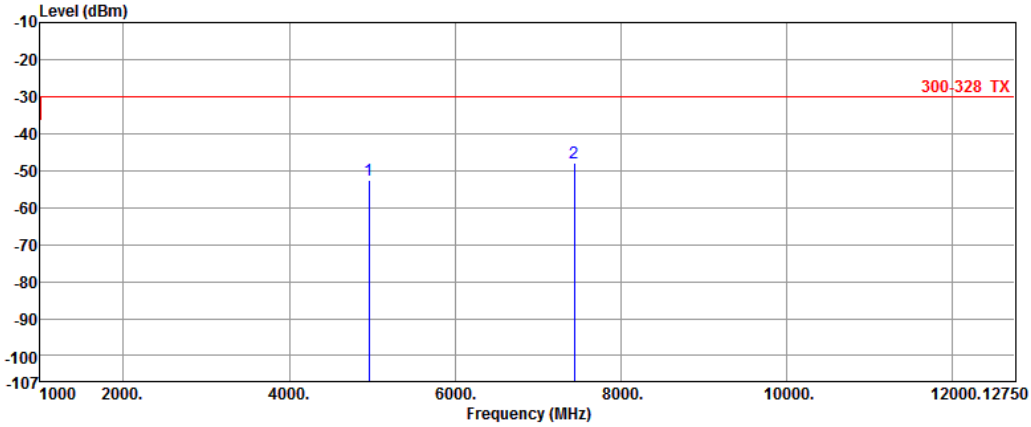
Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4959.85	-48.53	-30.00	-18.53	12.23	-60.76
2	7438.81	-47.29	-30.00	-17.29	17.00	-64.29

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

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4960.07	-52.76	-30.00	-22.76	11.66	-64.42
2	7439.70	-47.88	-30.00	-17.88	17.71	-65.59

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

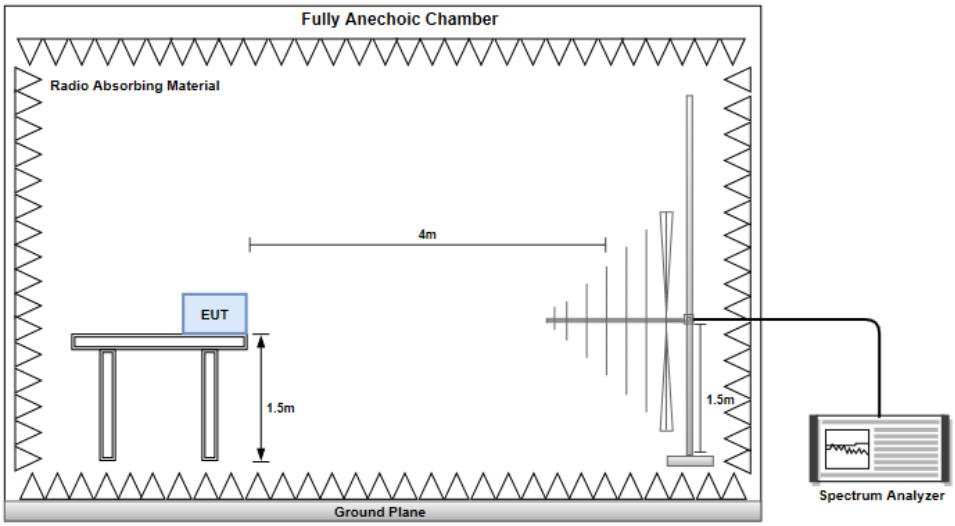
Frequency Range	Maximum power (dBm)	Measurement bandwidth (kHz)
30 MHz to 1 GHz	-57	100
Above 1 GHz to 12,75 GHz	-47	1000

4.1.2 Test Procedures

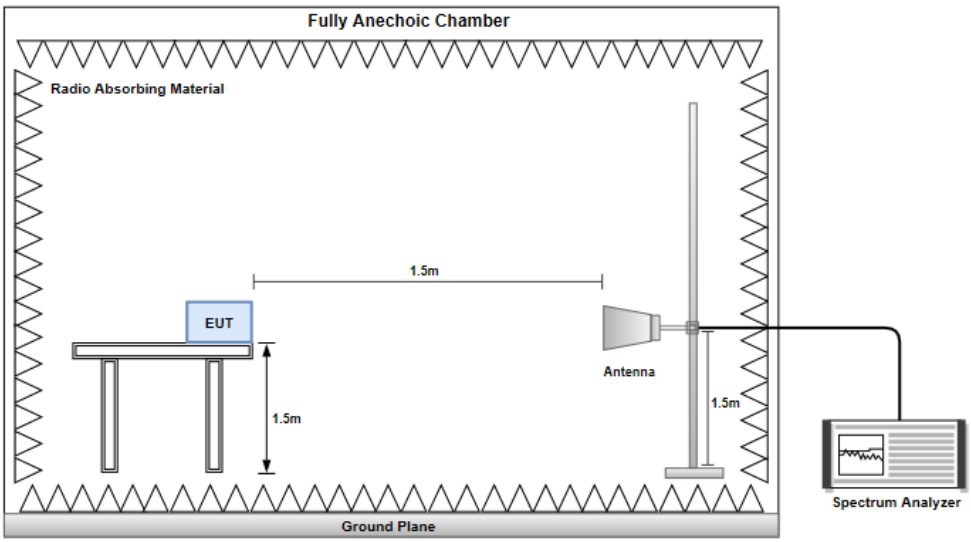
Reference to clause 5.4.10.2 of ETSI EN 300 328 V2.1.1 (2016-11).

4.1.3 Test Setup

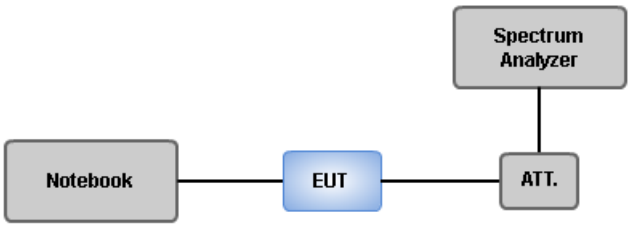
Below 1GHz



Above 1 GHz

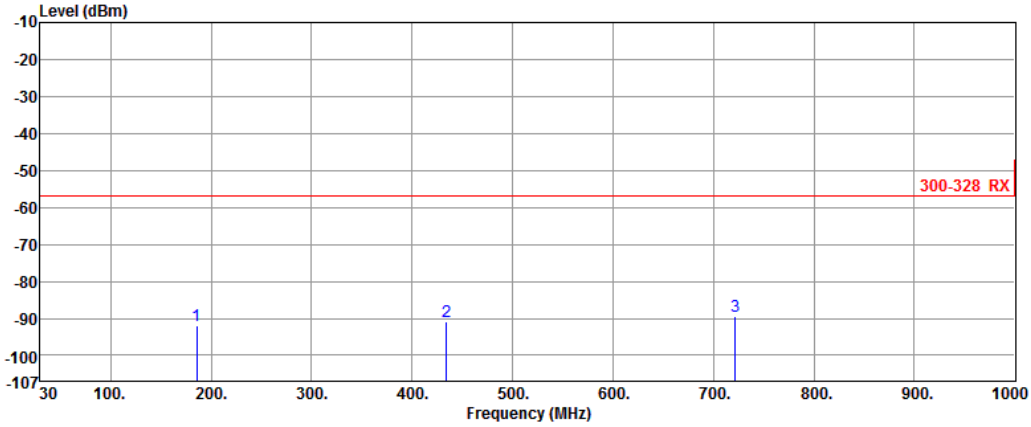


Conducted Emission



4.1.4 Receiver Conducted Unwanted Emissions (Below 1GHz)

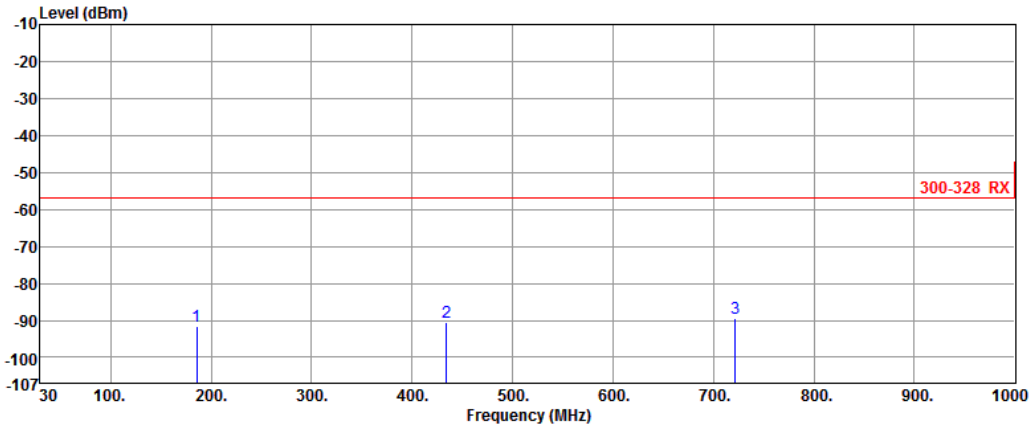
Modulation	GFSK	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	185.54	-91.85	-57.00	-34.85	0.00	-91.85
2	434.52	-90.99	-57.00	-33.99	0.00	-90.99
3	721.54	-89.45	-57.00	-32.45	0.00	-89.45

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

Modulation	GFSK	Test Freq. (MHz)	2480

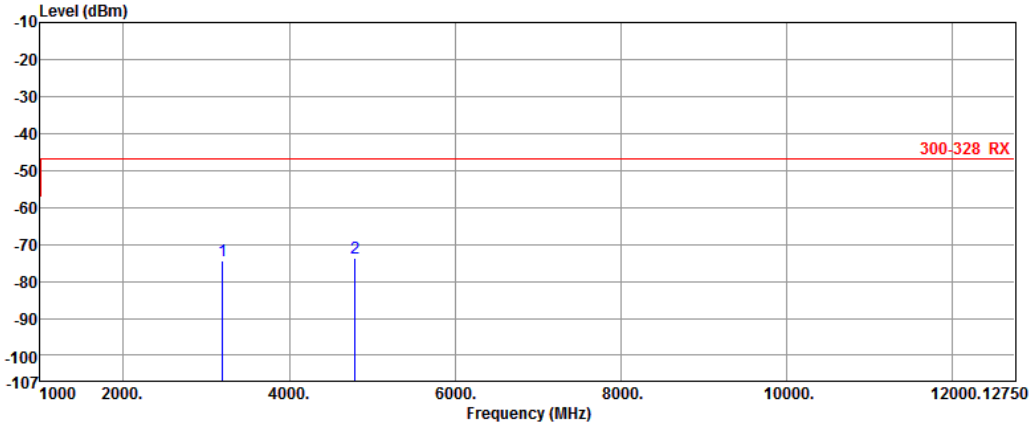


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	185.47	-91.65	-57.00	-34.65	0.00	-91.65
2	434.45	-90.64	-57.00	-33.64	0.00	-90.64
3	721.54	-89.54	-57.00	-32.54	0.00	-89.54

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

4.1.5 Receiver Conducted Unwanted Emissions (Above 1GHz)

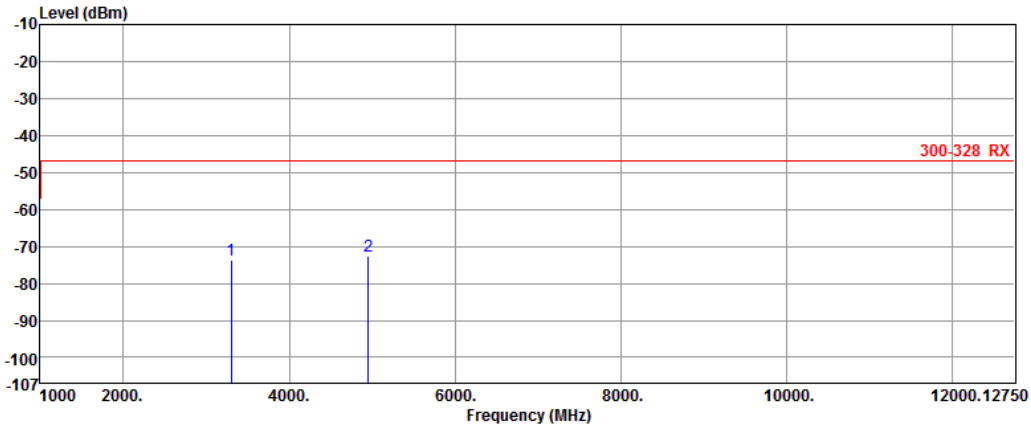
Modulation	GFSK	Test Freq. (MHz)	2402



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	3195.93	-74.39	-47.00	-27.39	0.00	-74.39
2	4793.56	-73.66	-47.00	-26.66	0.00	-73.66

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

Modulation	GFSK	Test Freq. (MHz)	2480

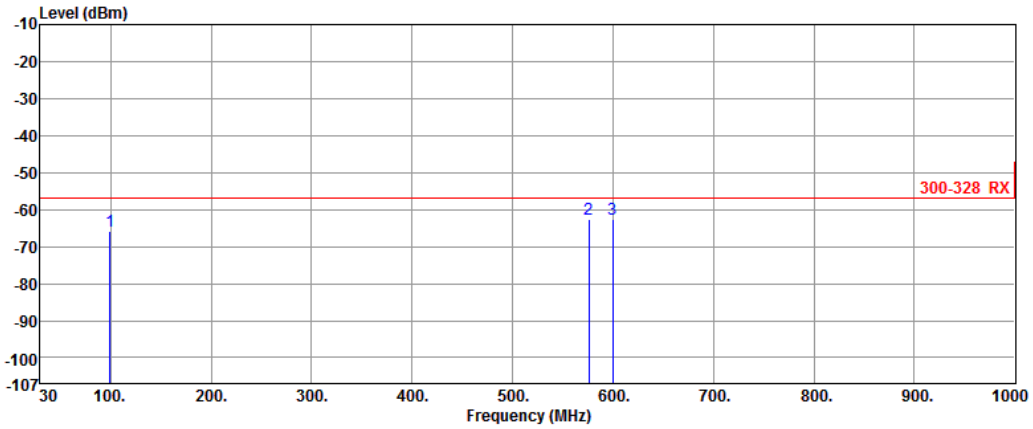


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	3300.18	-73.76	-47.00	-26.76	0.00	-73.76
2	4950.03	-72.79	-47.00	-25.79	0.00	-72.79

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

4.1.6 Receiver Radiated Unwanted Emissions (Below 1GHz)

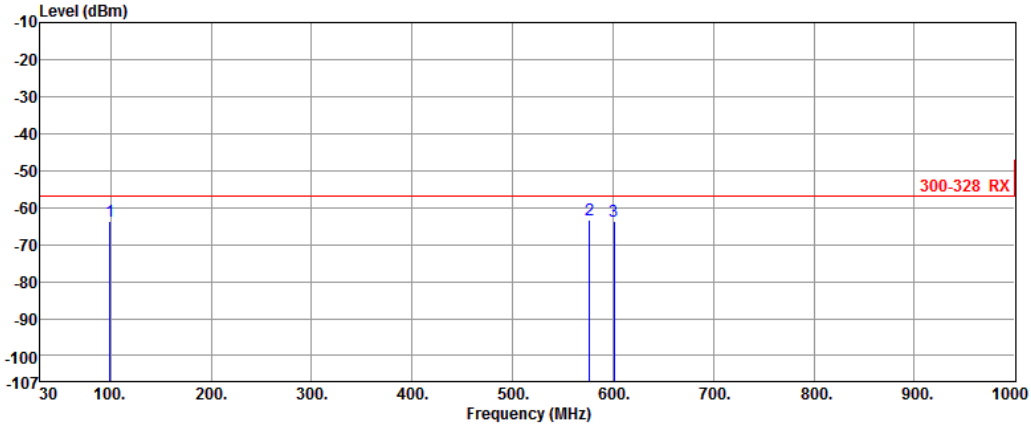
Modulation	GFSK	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	99.49	-65.68	-57.00	-8.68	-6.01	-59.67
2	576.16	-62.64	-57.00	-5.64	5.54	-68.18
3	599.47	-62.46	-57.00	-5.46	6.78	-69.24

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

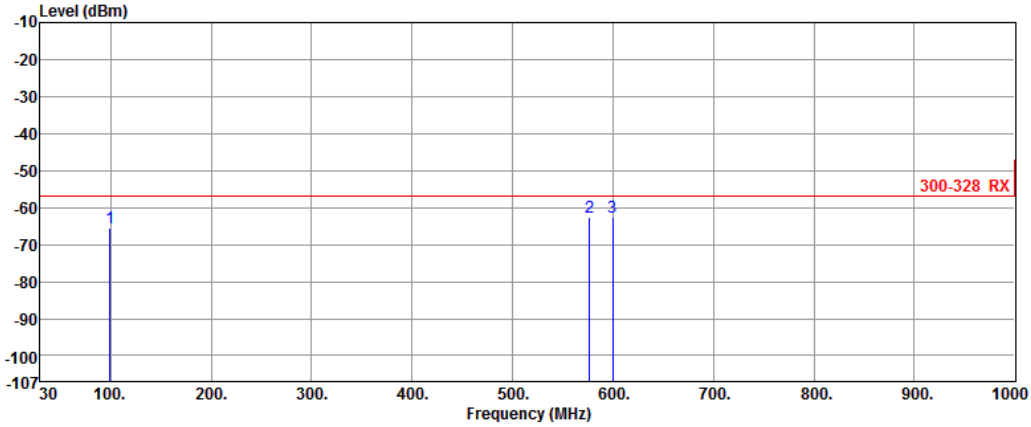
Modulation	GFSK	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	99.45	-63.66	-57.00	-6.66	-4.17	-59.49
2	576.65	-63.46	-57.00	-6.46	6.56	-70.02
3	600.98	-63.65	-57.00	-6.65	7.21	-70.86

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

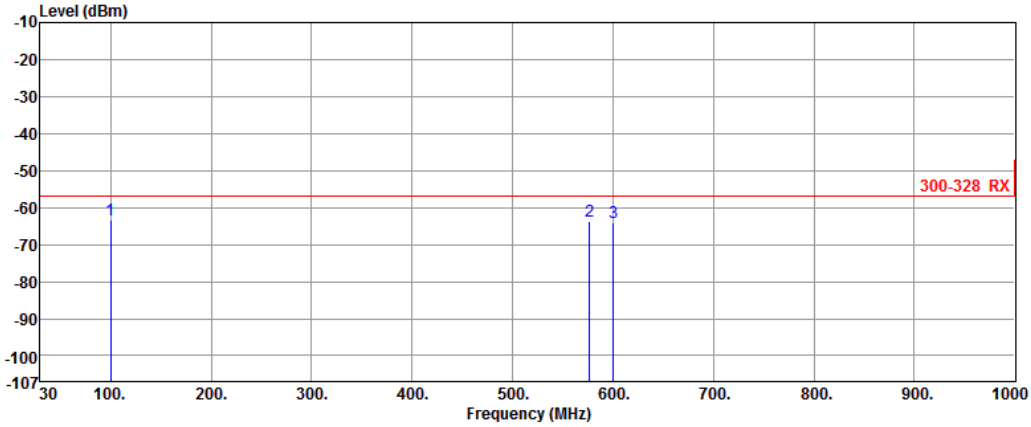
Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	99.32	-65.66	-57.00	-8.66	-6.04	-59.62
2	576.55	-62.47	-57.00	-5.47	5.57	-68.04
3	599.56	-62.66	-57.00	-5.66	6.78	-69.44

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

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		

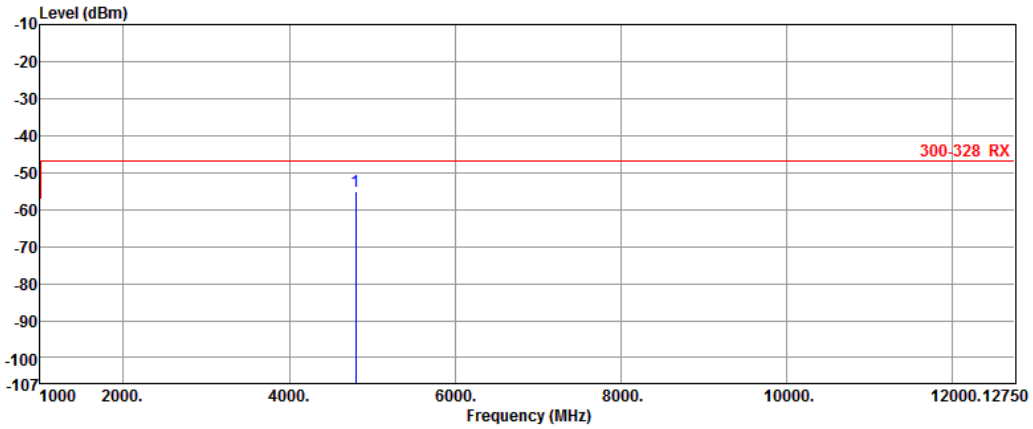


	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	99.87	-63.35	-57.00	-6.35	-4.11	-59.24
2	576.64	-63.83	-57.00	-6.83	6.56	-70.39
3	600.63	-63.95	-57.00	-6.95	7.18	-71.13

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 (Above 1GHz)

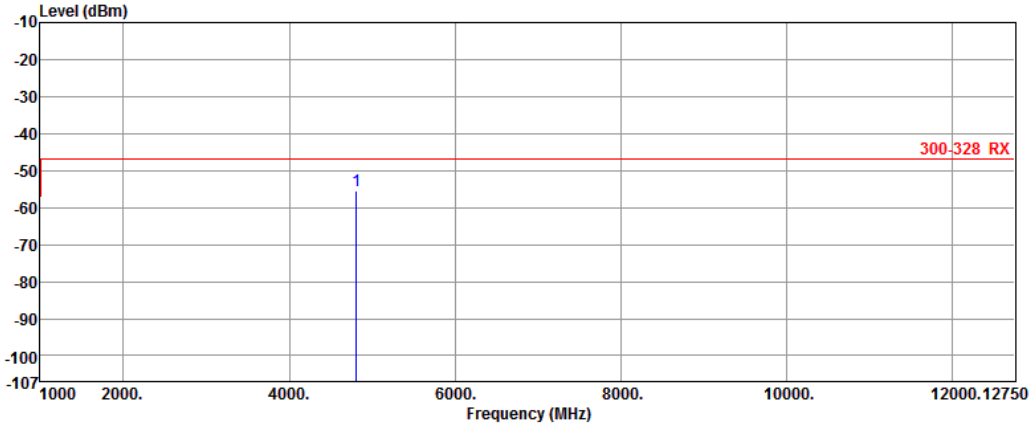
Modulation	GFSK	**Test Freq. (MHz)**	2402
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4806.02	-54.93	-47.00	-7.93	11.64	-66.57

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

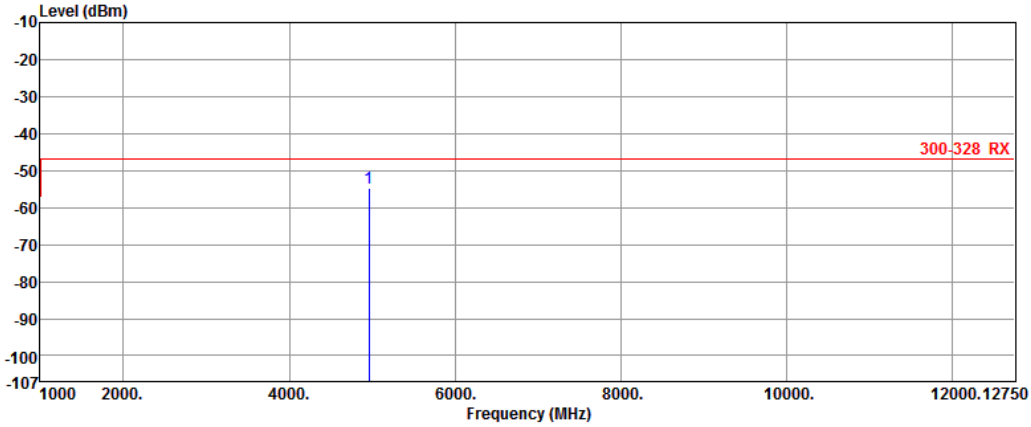
Modulation	GFSK	Test Freq. (MHz)	2402
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4806.36	-55.54	-47.00	-8.54	11.88	-67.42

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

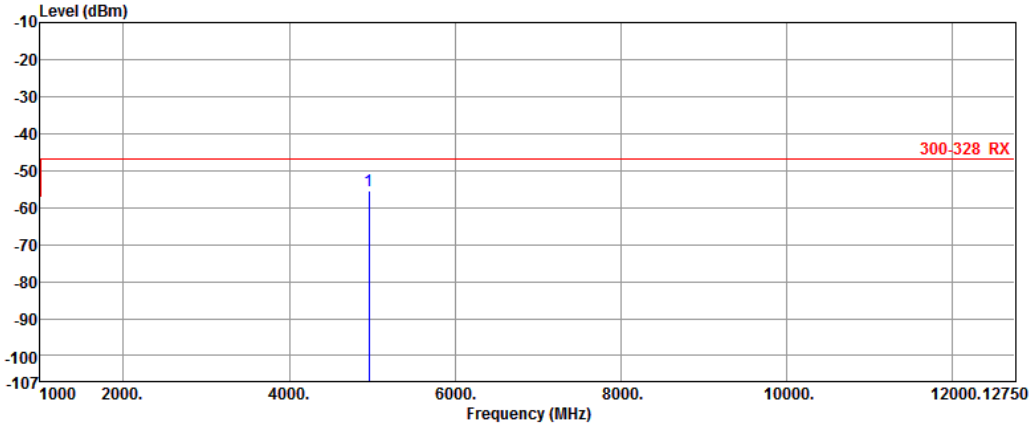
Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Horizontal		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4960.03	-54.61	-47.00	-7.61	12.23	-66.84

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

Modulation	GFSK	Test Freq. (MHz)	2480
Polarization	Vertical		



	Freq.	Measured value	Limit	Margin	Factor	Reading
	MHz	dBm	dBm	dB	dB	dBm
1	4959.80	-55.46	-47.00	-8.46	11.66	-67.12

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.			

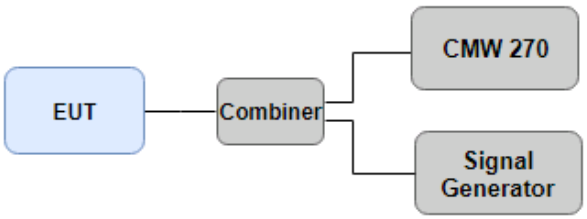
Receiver Blocking Parameters for Receiver Category 2 Equipment Limit			
Wanted Signal Mean Power from Companion Device (dBm)	**Blocking Signal Frequency (MHz)**	**Blocking Signal Power (dBm) (see Note 2)**	**Type of Blocking Signal**
P_{min} + 6 dB	2 380 2 503,5	-57	CW
P_{min} + 6 dB	2 300 2 583,5	-47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

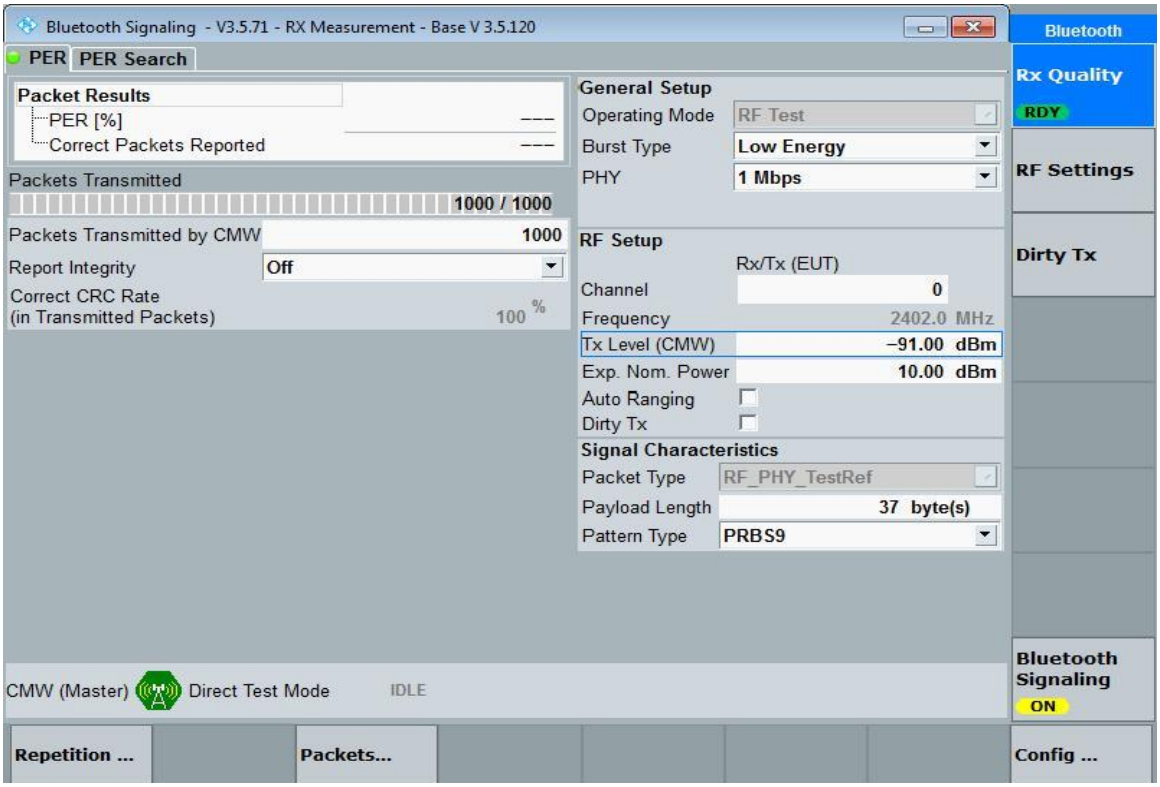
Reference to clause 5.4.11.2 of ETSI EN 300 328 V2.1.1 (2016-11).

5.1.3 Test Setup



5.1.4 Test Result of Receiver Blocking

2402 MHz



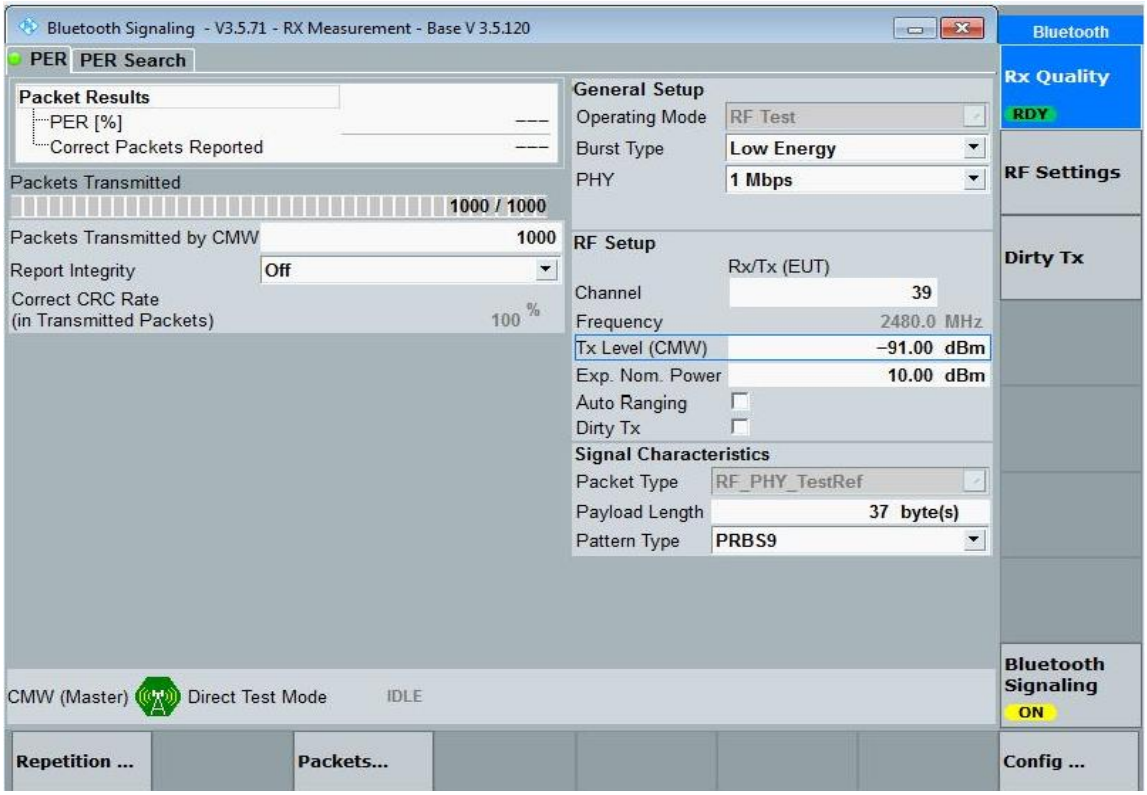
LE receiver test started
LE test ended. Packets Rxd: 921

Packet Sent Numbers	1000
Packet Received Numbers	921
PER(%)	7.9

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

Sensitivity Level	-91		**dBm**
Want Signal Mean Power form Companion Device (dBm)	**Blocking Signal Frequency (MHz)**	**Blocking Signal Power (dBm)**	**Test Result**
-85	2380.0	-55	Pass
-85	2503.5		Pass
-85	2300.0	-45	Pass
-85	2583.5		Pass

2480 MHz



LE receiver test started
LE test ended. Packets Rxd: 937

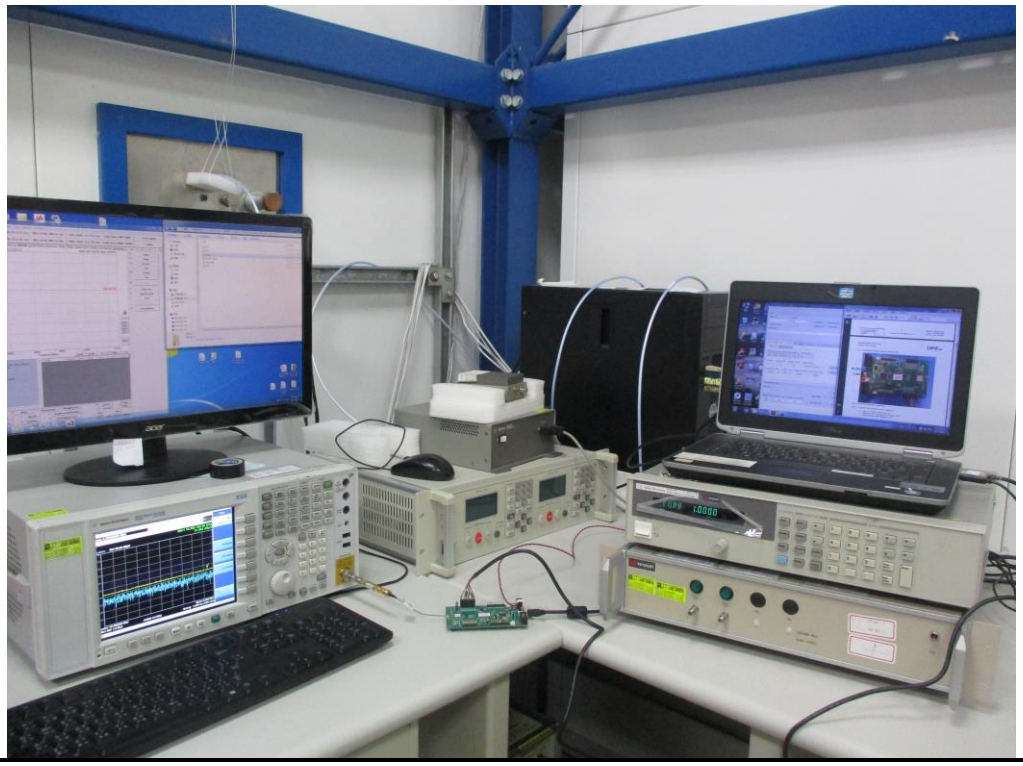
Packet Sent Numbers	1000
Packet Received Numbers	937
PER(%)	6.3

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

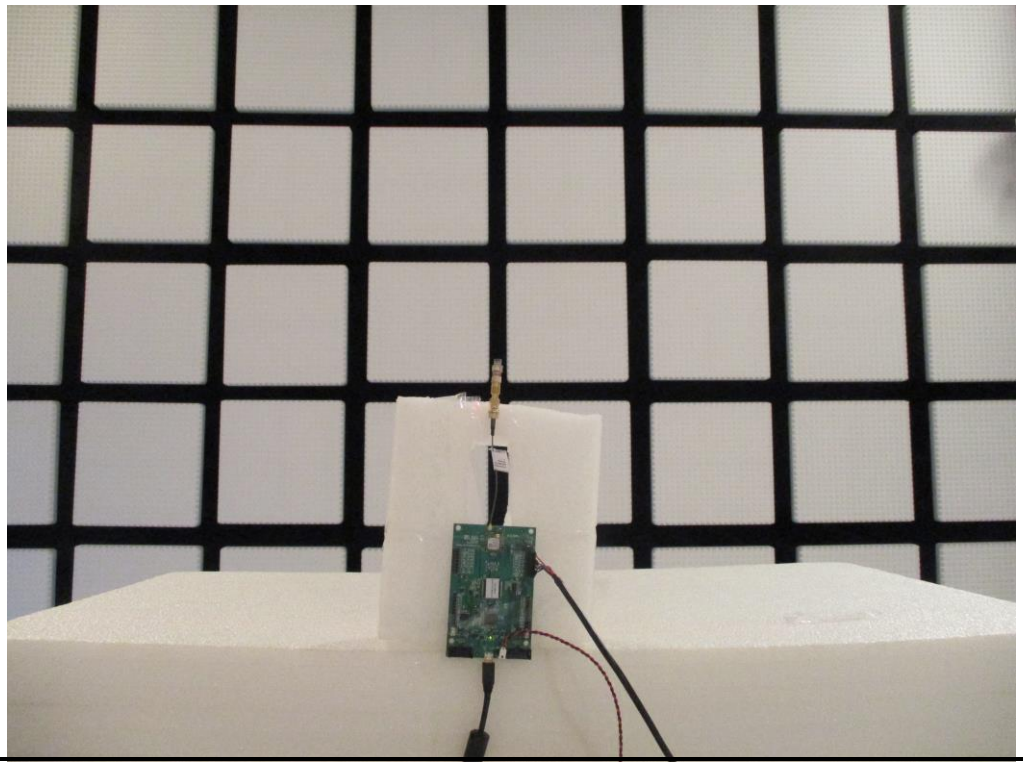
Sensitivity Level	-91		**dBm**
Want Signal Mean Power form Companion Device (dBm)	**Blocking Signal Frequency (MHz)**	**Blocking Signal Power (dBm)**	**Test Result**
-85	2380.0	-55	Pass
-85	2503.5		Pass
-85	2300.0	-45	Pass
-85	2583.5		Pass

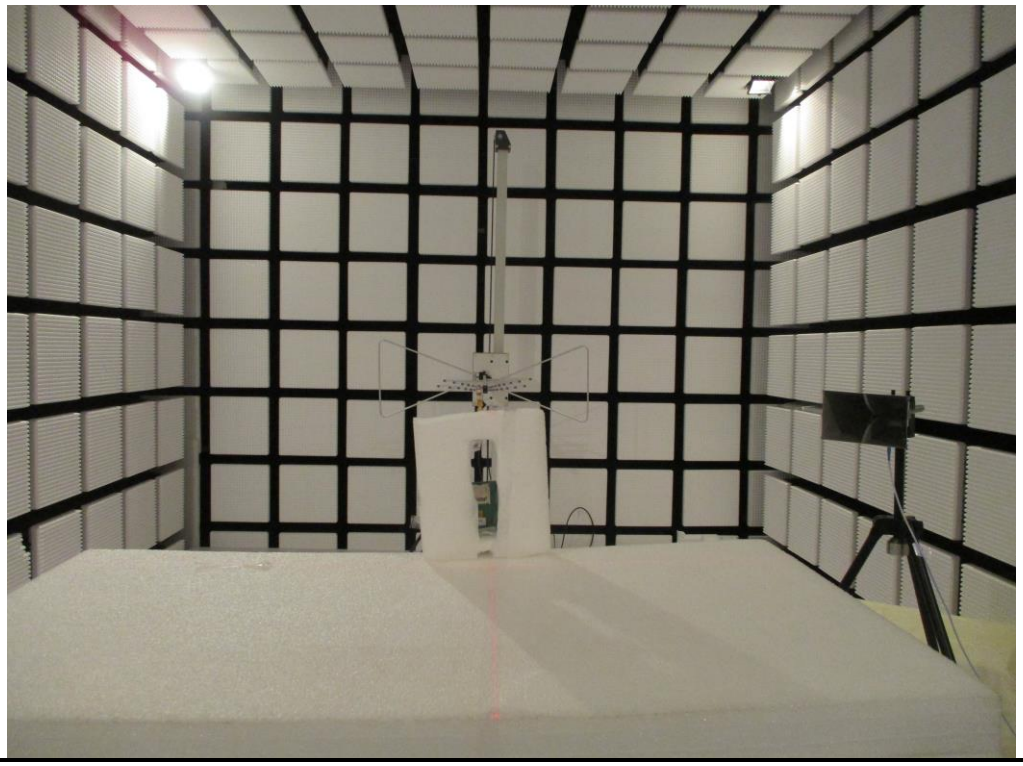
6 Photographs of the Test Configuration

Conducted Spurious Emission Test



Radiated 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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