RF Test Report

Report No.: AGC08501171201EE11

PRODUCT DESIGNATION	:	Open-Source Sensor Beacon
BRAND NAME	:	Ruuvi
MODEL NAME	:	RuuviTag
MANUFACTURER	:	Ruuvi Innovations Ltd.
DATE OF ISSUE	:	Dec. 22, 2017
STANDARD(S)	:	EN 300 328 V2.1.1 (2016-11)
REPORT VERSION	:	V1.0

Attestation of ***G***lobal ***C***ompliance (Shenzhen) Co., Ltd

CAUTION:
This report shall not be reproduced except in full without the written permission of the test laboratory and shall not be quoted out of context.

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Dec. 22, 2017	Valid	Initial release

TABLE OF CONTENTS

TABLE OF CONTENTS 3
1. TEST RESULT CERTIFICATION 4
2. TECHNICAL INFORMATION 5
2.1 EUT DESCRIPTION 5
2.2 SUPPORT EQUIPMENT 6
2.3 DESCRIPTION OF TEST MODES 6
3. DETAILS OF TEST 8
3.1 IDENTIFICATION OF THE RESPONSIBLE TESTING LOCATION 8
3.2 LIST OF TEST EQUIPMENTS 8
3.3 ENVIRONMENTAL CONDITIONS 9
3.4 MEASUREMENT UNCERTAINTY 9
4. ETSI EN 300 328 REQUIREMENTS 10
4.1 RF OUTPUT POWER 10
4.2 POWER SPECTRAL DENSITY 13
4.3 DUTY CYCLE, TX-SEQUENCE, TX-GAP 16
4.4 MEDIUM UTILISATION (MU) FACTOR 17
4.5 ADAPTIVITY (CHANNEL ACCESS MECHANISM) 18
4.6 OCCUPIED CHANNEL BANDWIDTH 19
4.7 TRANSMITTER UNWANTED EMISSIONS IN THE OUT OF BAND DOMAIN 21
4.8 TRANSMITTER SPURIOUS EMISSIONS 26
4.9 RECEIVER SPURIOUS EMISSIONS 39
4.10 RECEIVER BLOCKING 50
APPENDIX A 52
PHOTOGRAPHS OF THE TEST SETUP 52
APPENDIX B 52
PHOTOGRAPHS OF THE EUT 52

1. TEST RESULT CERTIFICATION

Manufacturer	Ruuvi Innovations Ltd.
Address	c/o Solventia Rauhankatu 20B20, 06100 Porvoo, Finland
Factory	Ruuvi Innovations Ltd.
Address	c/o Solventia Rauhankatu 20B20, 06100 Porvoo, Finland
Product Designation	Open-Source Sensor Beacon
Brand Name	Ruuvi
Test Model	RuuviTag
Date of test	Dec. 15, 2017 to Dec. 20, 2017

We (AGC), Attestation of Global Compliance (Shenzhen) Co., Ltd has tested the product mentioned above in compliance with the requirements set forth in the European Standard ETSI EN 300 328 V2.1.1. The results of testing in this report apply to the product/system which was tested only. Other similar equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties. The test results of this report relate only to the tested sample identified in this report.

Tested By Henry Zhang

Henry Zhang(Zhang Zhuorui) Dec. 20, 2017

Reviewed By cool cheng

Cool Cheng(Cheng Mengguo) Dec. 22, 2017

Approved By Forrest Lei

Forrest Lei(Lei Yonggang) Dec. 22, 2017
Authorized Officer

2. TECHNICAL INFORMATION

2.1 EUT DESCRIPTION

Bluetooth Version	V4.2
Modulation	GFSK
Receiver Category	Category 2
Hardware Version	B6
Software Version	V1.0
Adaptive / non-adaptive equipment	Adaptive Equipment
The number of Hopping Frequencies	40
The maximum RF Output Power (e.i.r.p.)	2.51dBm
The different transmit operating modes	Operating mode 1: Single Antenna Equipment Equipment with only 1 antenna
Operating Frequency Range(s)	2402MHz~2480MHz
Type of Equipment	Stand-alone
Antenna designation	PCB Antenna
Antenna gain	0dBi
Nominal voltages	DC 3V by battery
The extreme operating conditions	Recommended temperature range: -20°C~55°C

Note:

1. The above information was declared by the applicant.
2. The equipment submitted are representative production models.
3. The EUT provides Bluetooth wireless interface operating at 2.4G ISM band (2402MHz-2480MHz).
4. Only the Bluetooth was tested according the standard requirement.
5. The EUT is an adaptive equipment and hand-portable station according to ETSI EN 300 328 V2.1.1.
6. Please refer to Appendix Ⅰ for the photographs of the EUT. For more details, please refer to the User's manual of the EUT.
7. The EUT didn't support BR/EDR.

2.2 SUPPORT EQUIPMENT

Item	Equipment	Mfr/Brand	Model/Type No.	Remark
1	PC	Acer	ms2392	A.E

2.3 DESCRIPTION OF TEST MODES

NO.	TEST MODE DESCRIPTION
1	Low channel TX
2	Middle channel TX
3	High channel TX
4	Low channel (RX Mode)
5	Middle channel (RX Mode)
6	High channel (RX Mode)

Note:

1. All modes have been tested and the worst mode test data recording in the test report, if no any other data.

A) OBJECTIVE

Perform Radio Spectrum tests for CE Marking according to the provisions of article 3.2 of the RED Directive

B) TEST STANDARDS AND RESULTS

2. The EUT has been tested according to ETSI EN 300 328 V2.1.1 (2016-11).

ETSI EN 300 328 V2.1.1 (2016-11)	Wideband transmission systems ;Data transmission equipment operating in the 2,4 GHz ISM band and using wide band modulation techniques; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU

TEST ITEMS AND THE RESULTS ARE AS BELOW:

№	Basic Standard	Test Type	The worst case operational mode	Result
1	ETSI EN 300 328 4.3.2.2	RF Output Power	Mode 1/2/3	Pass
2	ETSI EN 300 328 4.3.2.3	Power Spectral Density	Mode 1/2/3	Pass
3	ETSI EN 300 328 4.3.2.4	Duty Cycle, Tx-sequence, Tx-gap	N/A	N/A
4	ETSI EN 300 328 4.3.2.5	Medium Utilisation (MU) factor	N/A	N/A
5	ETSI EN 300 328 4.3.2.6	Adaptivity (adaptive equipment using modulations other than FHSS)	N/A	N/A
6	ETSI EN 300 328 4.3.2.7	Occupied Channel Bandwidth	Mode 1/3	Pass
7	ETSI EN 300 328 4.3.2.8	Transmitter unwanted emissions in the out-of-band domain	Mode 1/3	Pass
8	ETSI EN 300 328 4.3.2.9	Transmitter unwanted emissions in the spurious domain	Mode 1/3	Pass
9	ETSI EN 300 328 4.3.2.10	Receiver spurious emissions	Mode 4/6	Pass
10	ETSI EN 300 328 4.3.2.11	Receiver Blocking	Mode 4/6	Pass
11	ETSI EN 300 328 4.3.2.12	Geo-location capability	N/A	N/A

Note:

1. N/A means it's not applicable to this item.
2. Owing to the maximum declared RF Output power (e.i.r.p.) less than 10 dBm, so the item 3, 4, 5 are not applicable.

3 DETAILS OF TEST

3.1 IDENTIFICATION OF THE RESPONSIBLE TESTING LOCATION

Company Name:	Attestation of Global Compliance (Shenzhen) Co., Ltd.
Address:	2/F., Building 2, No.1-No.4, Chaxi Sanwei Technical Industrial Park, Gushu, Xixiang, Bao'an District, Shenzhen, Guangdong, China

3.2 LIST OF TEST EQUIPMENTS

Description	Manufacturer	Model No.	S/N	Calibration Date	Calibration Due.
Signal Analyzer	AGILENT	N9020A	MY49100060	Nov.09, 2017	Nov.08,2018
Signal Generator	AGILENT	N5182A	MY50140530	Oct.16, 2017	Oct.15, 2018
Signal Generator	AGILENT	E8257D	MY45141029	Oct.16, 2017	Oct.15, 2018
USB Wideband Power Sensor	AGILENT	U2021XA	MY54110007	Oct.16, 2017	Oct.15, 2018
USB Wideband Power Sensor	AGILENT	U2021XA	MY54110009	Oct.16, 2017	Oct.15, 2018
USB Wideband Power Sensor	AGILENT	U2021XA	MY54110014	Oct.16, 2017	Oct.15, 2018
USB Wideband Power Sensor	AGILENT	U2021XA	MY54110012	Oct.16, 2017	Oct.15, 2018
USB Simultaneous Sampling Multifunction DAQ	AGILENT	U2531A	MY5211038	Oct.16, 2017	Oct.15, 2018
2.4 GHz Filter	MICRO-TRONICS	BRM50702	017	Mar.01, 2017	Feb.28, 2018
Spectrum Analyzer	AGILENT	E4440A	US41421290	July 13, 2017	July 12, 2018
Wideband Frequency Antenna	SCHWARZBECK	VULB9168	VULB9168-494	Mar.12, 2017	Mar.11, 2018
Horn Antenna	EM	EM-AH-10180	67	Mar.01, 2017	Feb.28, 2018
Amplifier	EM	EM30180	060552	Mar.01, 2017	Feb.28, 2018
Bluetooth Tester	R&S	CMW270	1201.0002K75-100528-Tu WIRELESSCONN.TESTER	Oct.10, 2017	Oct.09, 2018
Signal generator	R&S	SMBV100A	ST113247Z	Oct.10, 2017	Oct.09, 2018
Attenuator	WARIORS	W13	11324	N/A	N/A
Power spliter	Mini-Circuits	ZFRSC-183-S	3122	N/A	N/A

3.3 ENVIRONMENTAL CONDITIONS

During the measurement the environmental conditions were within the listed ranges:

- Normal Temperature: 15-35ºC
- Extreme Temperature: -20-55ºC
- Humidity: 30-60 %
- Atmospheric pressure: 86-106 kPa

3.4 MEASUREMENT UNCERTAINTY

The uncertainty is calculated using the methods suggested in the “Guide to the Expression of Uncertainty in Measurement” (GUM) published by ISO.

- Uncertainty of Radio Frequency, Uc=±1 x 10^{-5}
- Uncertainty of total RF power, conducted, Uc = ±1.5dB
- Uncertainty of RF power density, conducted, Uc = ±3dB
- Uncertainty of spurious emissions, conducted, Uc = ±3dB
- Uncertainty of all emissions, radiated, Uc = ±6dB
- Uncertainty of Temperature: ±1° C
- Uncertainty of Humidity: ±5 %
- Uncertainty of DC and low frequency voltages: ±3 %

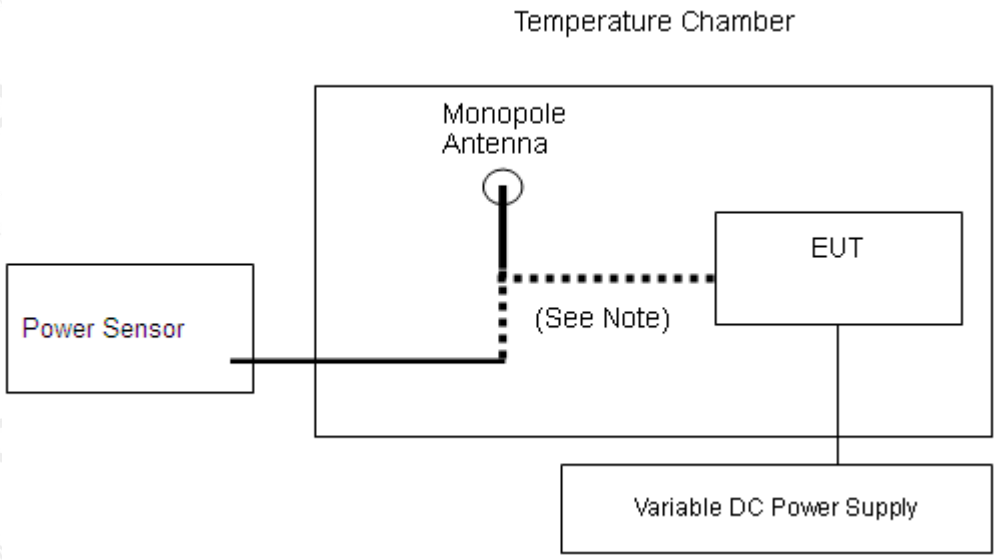
4. ETSI EN 300 328 REQUIREMENTS

4.1 RF OUTPUT POWER

EN 300 328 Clause 4.3.2.2

For adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be 20 dBm.
The maximum RF output power for non-adaptive equipment shall be declared by the supplier and shall not exceed 20 dBm. See clause 5.4.1 m). For non-adaptive equipment using wide band modulations other than FHSS, the maximum RF output power shall be equal to or less than the value declared by the supplier.
This limit shall apply for any combination of power level and intended antenna assembly.

Test Configuration



Remarks:
EUT was direct connected to test equipment through coupling device.

TEST PROCEDURE

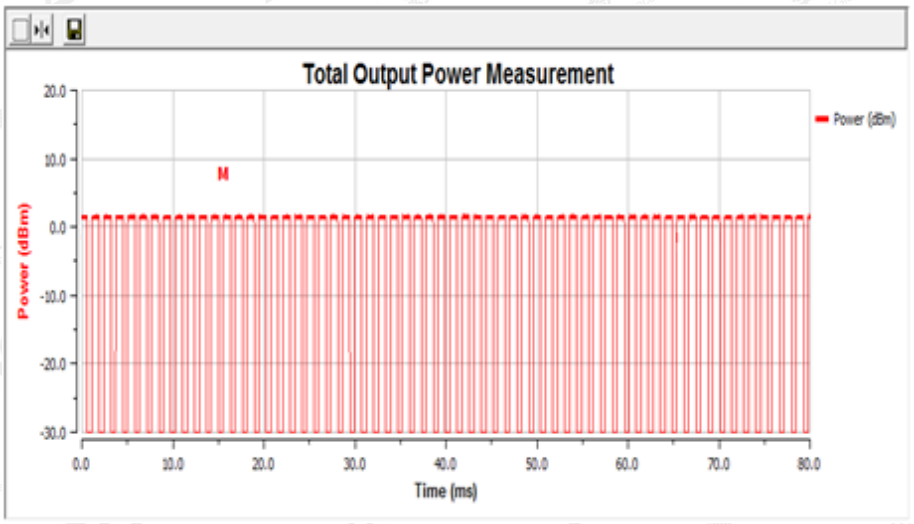
1. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.3 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.4.2 for the measurement method.

TEST RESULTS

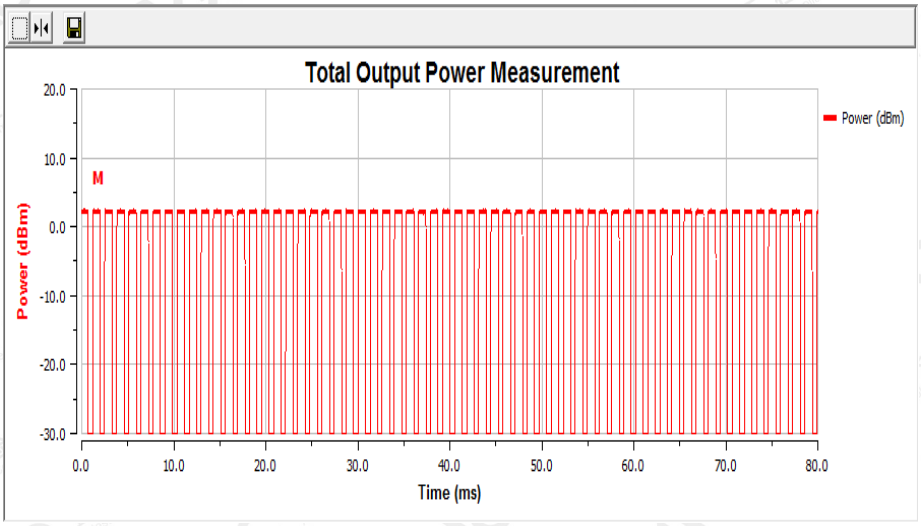
Temperature:	25°C	Tested by:	Henry
Humidity:	55 % RH	Detector:	RMS
Number of Burst		= 10	
Measurement Time		= 45.53ms	

TEST CONDITIONS	GFSK MODULATION RF OUTPUT POWER (dBm)		
	Temp (25)°C	Temp (-20)°C	Temp (55)°C
Result	DC 3V	DC 3V	DC 3V
Low Channel TX	1.42	1.37	1.36
Middle Channel TX	2.51	2.50	2.45
High Channel TX	1.89	1.87	1.86
Limit	20dBm		

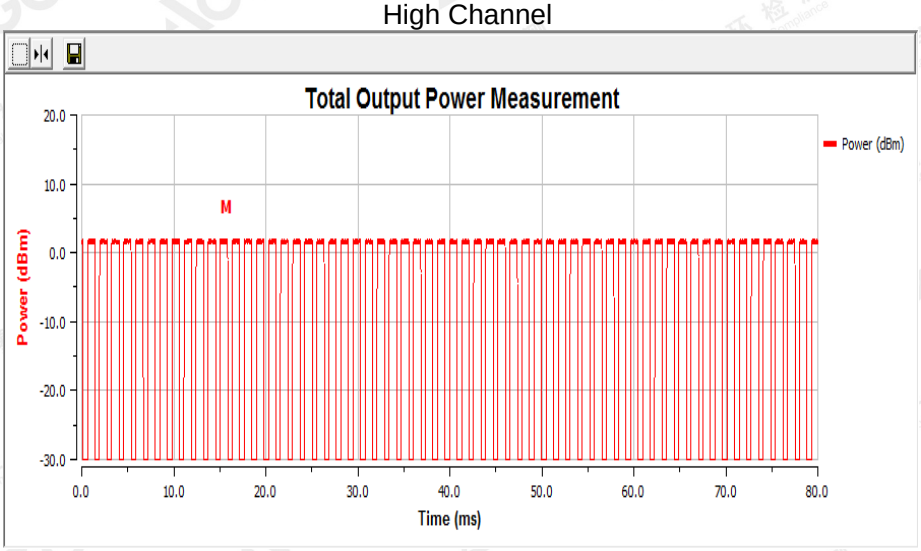
Low Channel



Middle Channel



High Channel



Note: Result=Reading+ Ant. Gain
The diagrams are for normal temperature.

Conclusion: PASS

4.2. POWER SPECTRAL DENSITY

EN 300 328 Clause 4.3.2.3

For wide band modulations other than the FHSS, The maximum E.I.R.P Power density is limited to 10mW Per MHz

TEST PROCEDURE

1. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.3for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.4.3 for the measurement method.

3 The equipment setting as following

Start Frequency: 2 400 MHz

- Stop Frequency: 2 483,5 MHz
- Resolution BW: 10 kHz
- Video BW: 30 kHz
- Sweep Points: >8350

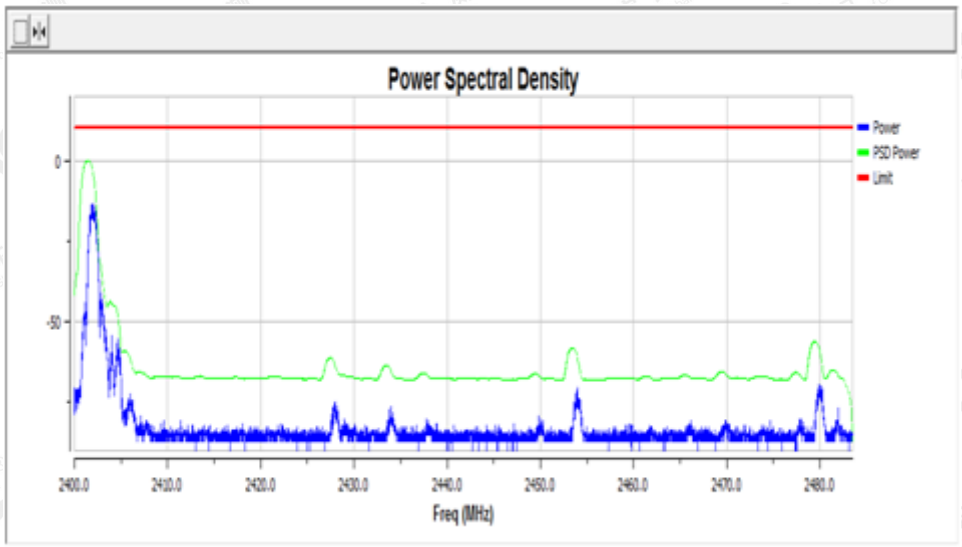
Detector: RMS

- Trace Mode: Max Hold
- Sweep time: Auto

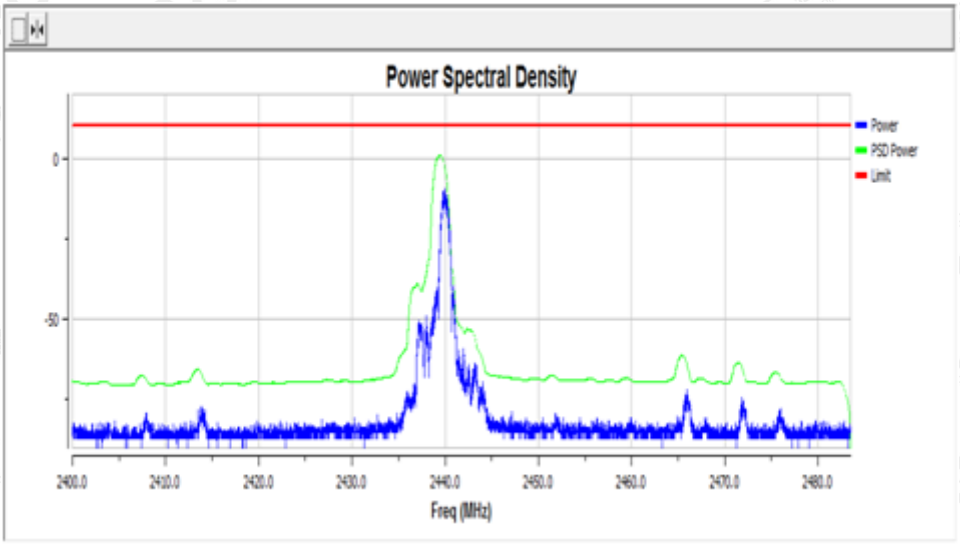
TEST RESULTS

PEAK POWER DENSITY			
Channel Tested	**Power Density (dBm/MHz)**	**Test Limit (dBm/MHz)**	**Pass / Fail**
Low Channel TX	1.15	10	Pass
Middle Channel TX	1.98	10	Pass
High Channel TX	1.66	10	Pass

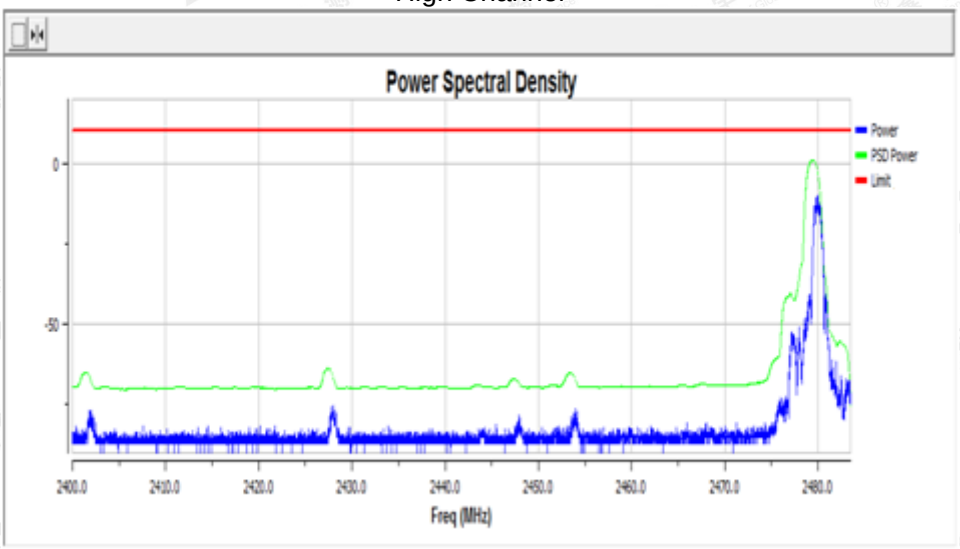
Low Channel



Middle Channel



High Channel

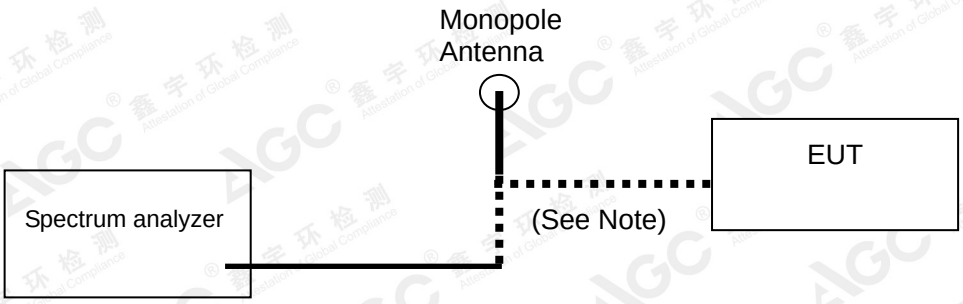


4.3. DUTY CYCLE, TX-SEQUENCE, TX-GAP

ETSI EN 300 328 SUBCLAUSE 4.3.2.4

The Duty Cycle shall be equal to or less than the maximum value declared by the supplier.
The maximum Tx-sequence Time and the minimum Tx-gap Time shall be according to the formula below:
Maximum Tx-Sequence Time = Minimum Tx-gap Time = M
where M is in the range of 3,5 ms to 10 ms.

TEST CONFIGURATION



TEST PROCEDURE

1. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.3 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.3.2.2.1.3 the measurement method.

TEST RESULT

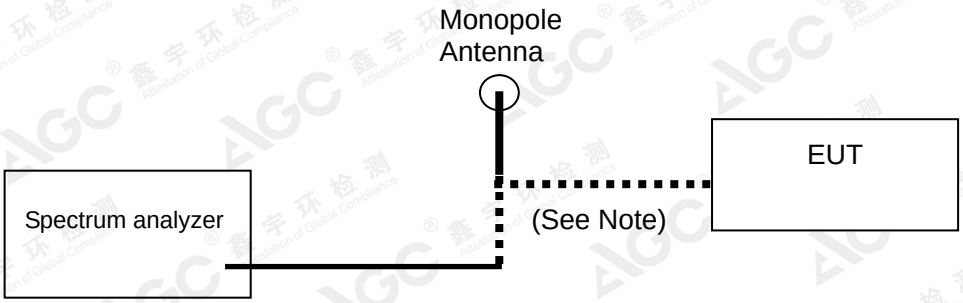
N/A

4.4. MEDIUM UTILISATION (MU) FACTOR

ETSI EN 300 328 SUBCLAUSE 4.3.2.5

The Medium Utilisation (MU) factor is a measure to quantify the amount of resources (Power and Time) used by non-adaptive equipment. The Medium Utilisation factor is defined by the formula:
MU = (P/100 mW) × DC
where: MU is Medium Utilisation factor in %.
P is the RF output power as defined in clause 4.3.1.1.1 expressed in mW.
DC is the Duty Cycle as defined in clause 4.3.1.2.1 expressed in %.
NOTE: The equipment may have dynamic behaviour with regard to duty cycle and corresponding power level.

TEST CONFIGURATION



TEST PROCEDURE

1. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.3 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.4.2 the measurement method.

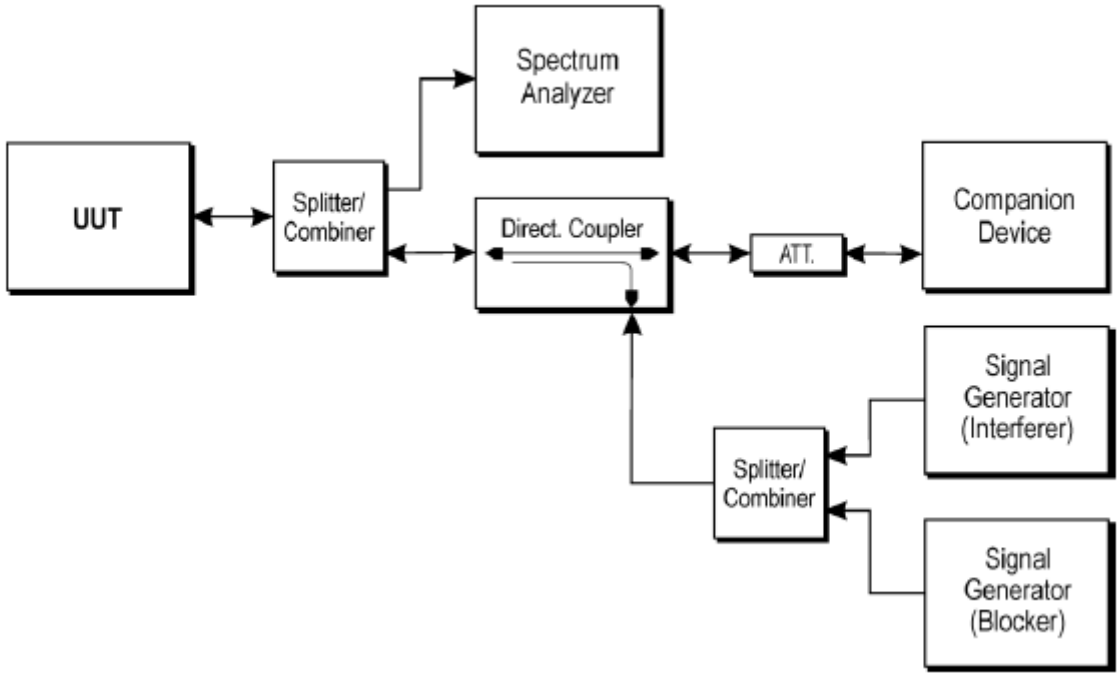
TEST RESULT
N/A

4.5. ADAPTIVITY (CHANNEL ACCESS MECHANISM)

ETSI EN 300 328 SUBCLAUSE 4.3.2.6

This requirement does not apply to non-adaptive equipment or adaptive equipment operating in a non-adaptive mode providing the equipment complies with the requirements and/or restrictions applicable to non-adaptive equipment.
In addition, this requirement does not apply for equipment with a maximum declared RF Output power level of less than 10 dBm e.i.r.p. or for equipment when operating in a mode where the RF Output power is less than 10 dBm e.i.r.p.
Adaptive equipment using modulations other than FHSS is allowed to operate in a non-adaptive mode providing it complies with the requirements applicable to non-adaptive equipment.
An adaptive equipment using modulations other than FHSS is equipment that uses a mechanism by which it can adapt to its environment by identifying other transmissions present within its Occupied Channel Bandwidth.
Adaptive equipment using modulations other than FHSS shall implement either of the Detect and Avoid mechanisms provided in clauses 4.3.2.5.1 or 4.3.2.5.2.
Adaptive systems are allowed to switch dynamically between different adaptive modes.

TEST CONFIGURATION



TEST PROCEDURE

1. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.3 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.4.6 for the measurement method.

.

TEST RESULT

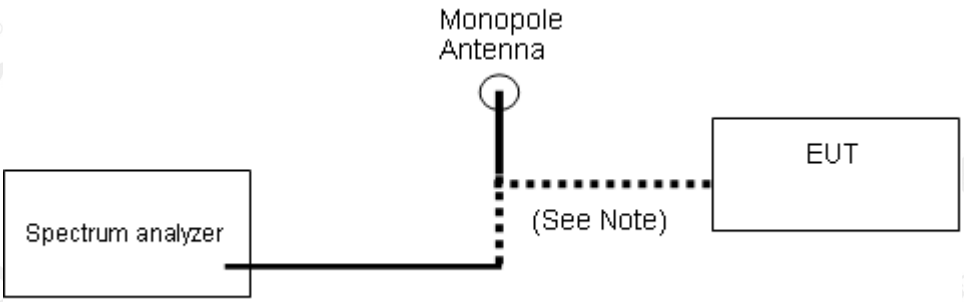
N/A

4.6. OCCUPIED CHANNEL BANDWIDTH

ETSI EN 300328 SUBCLAUSE 4.3.2.7

The Occupied Channel Bandwidth shall fall completely within the band given in clause 1.
In addition, for non-adaptive systems 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.

CONFIGURATION



TEST PROCEDURE

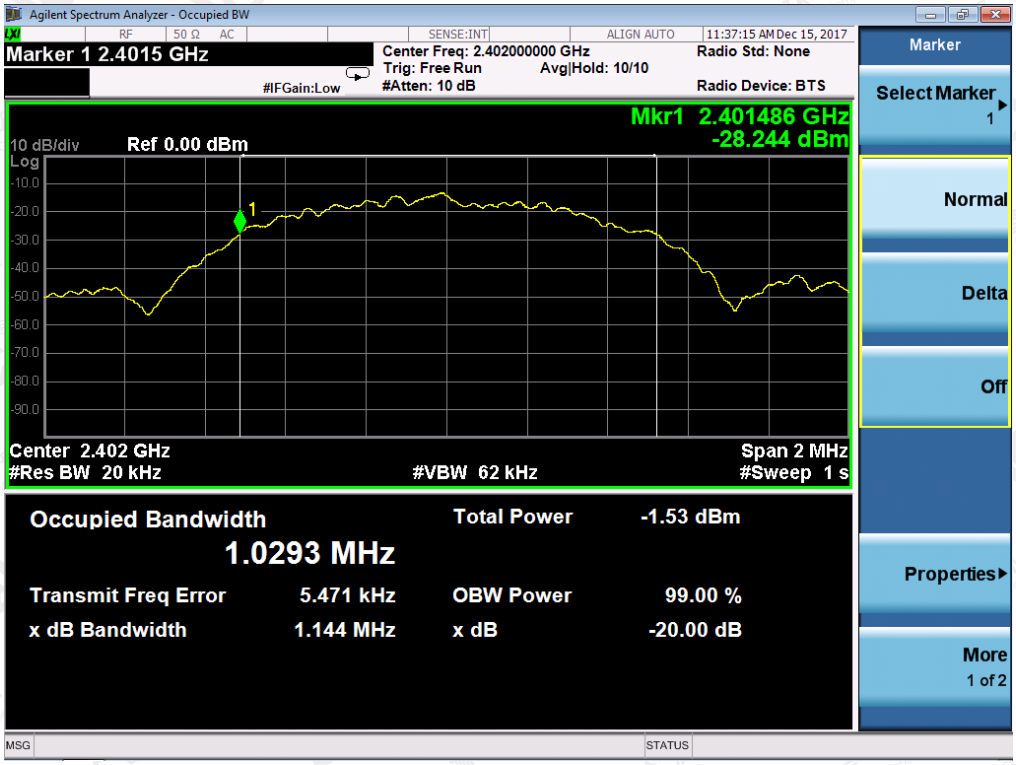
1. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.3for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.4.7 the measurement method.
3. The Test equipment information as following
   Centre frequency: 2402MHz,2480MHz
   Resolution bandwidth: 20kHz
   Video bandwidth: 62kHz
   Detector mode :RMs
   Trace mode :Max Hold

TEST RESULT

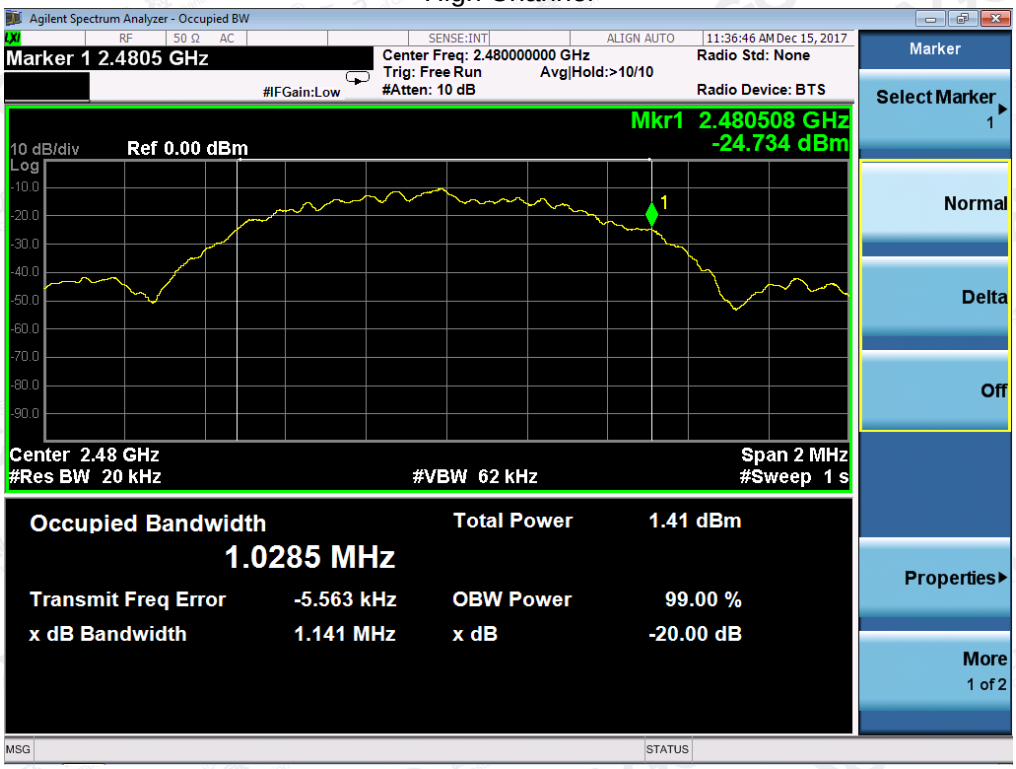
TEST ITEM	OCCUPIED CHANNEL BANDWIDTH
TEST MODE	GFSK MODULATION

MEASUREMENT RESULT		
Test Data (MHz)		**Result**
Low Channel	1.029	PASS
High Channel	1.029	PASS

Low Channel



High Channel



Conclusion: PASS

4.7. TRANSMITTER UNWANTED EMISSIONS IN THE OUT OF BAND DOMAIN

ETSI EN300328 SUBCLAUSE 4.3.2.8

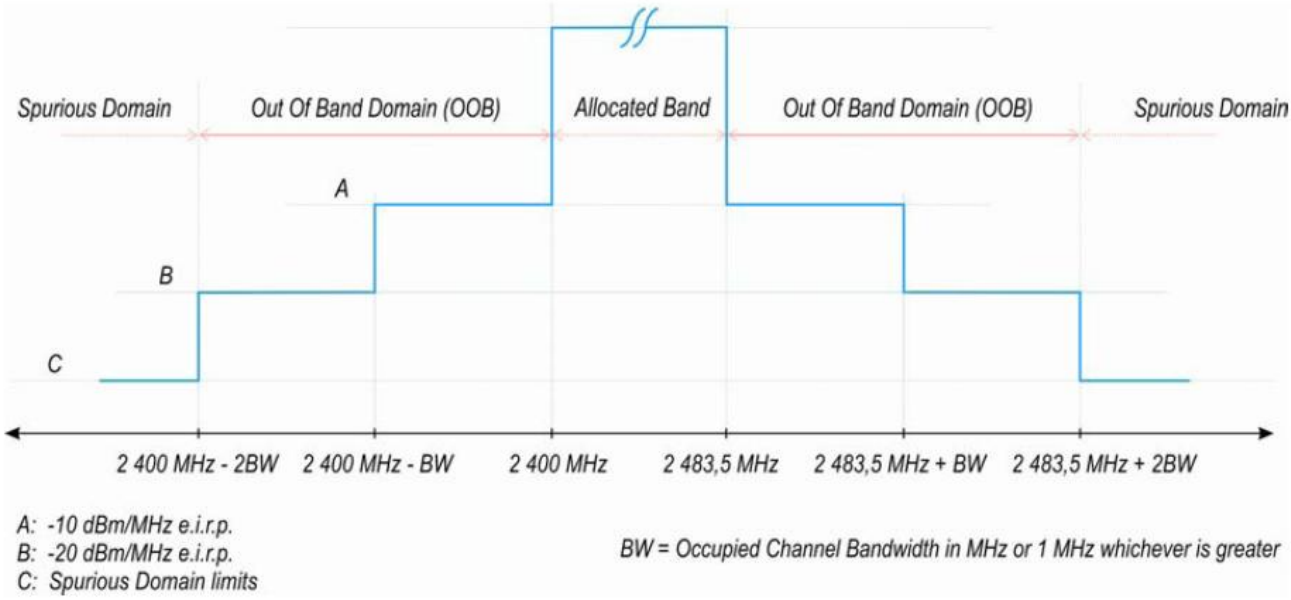
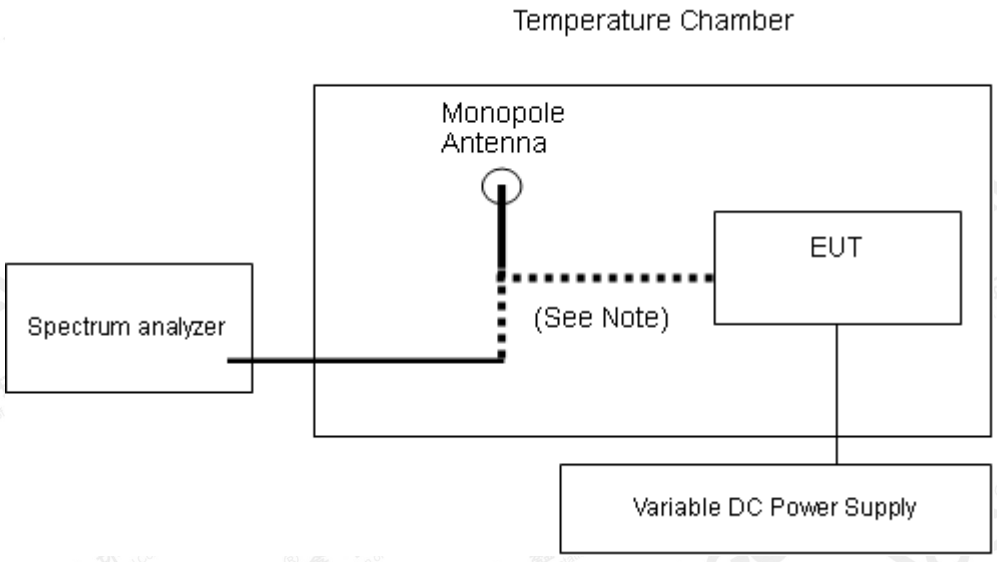
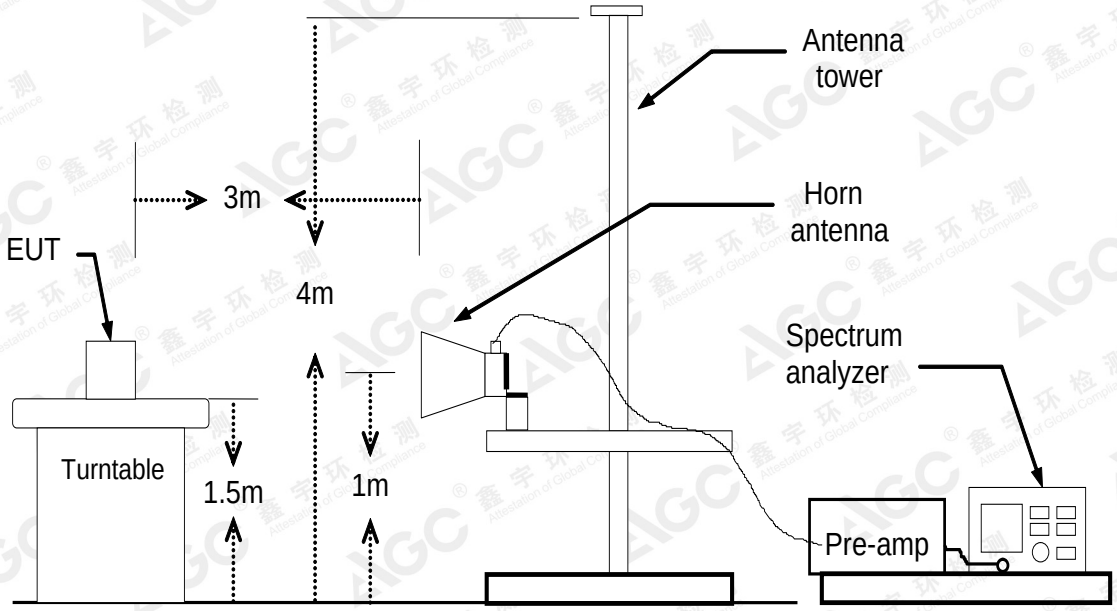


Figure 1: Transmit mask

TEST CONFIGURATION



For have temporary antenna connector product



For have no temporary antenna product

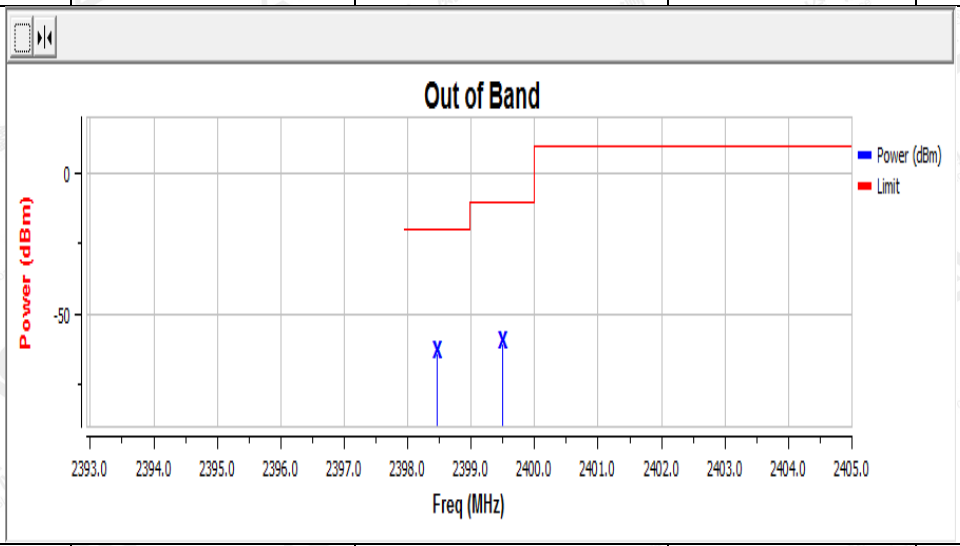
TEST PROCEDURE

1. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.3 for the test conditions.
2. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.4.8 the measurement method.

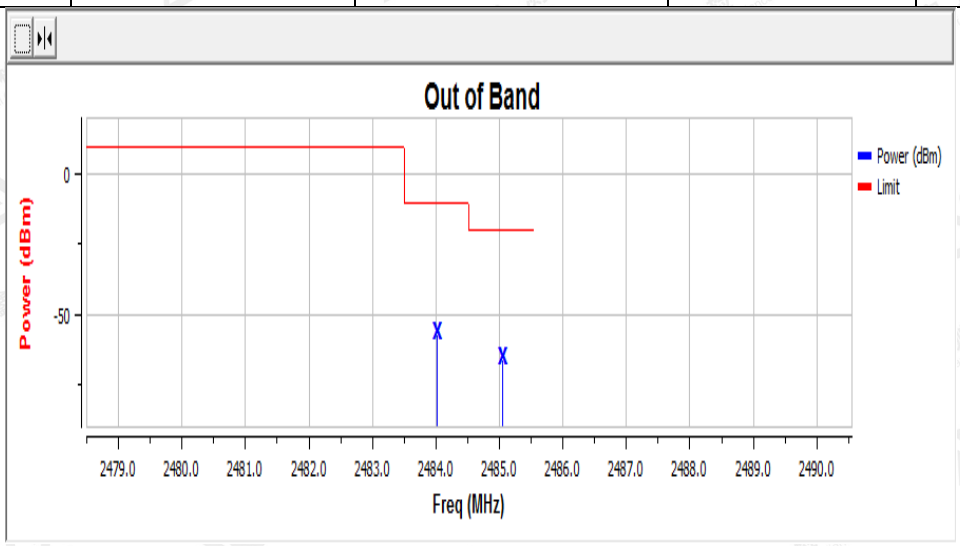
TEST RESULT

NORMAL TEMPERATURE NORMAL VOLTAGE

Channel	Antenna	Freq(MHz)	Level	Limit
CH Low-2402	Antenna 1	2399.5	-61.27	-10
CH Low-2402	Antenna 1	2398.472	-64.71	-20

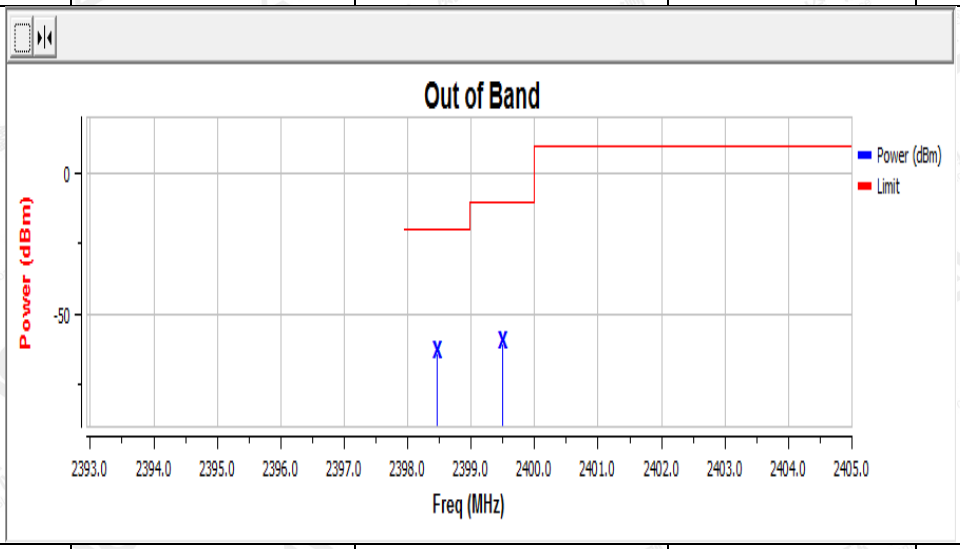


Channel	Antenna	Freq(MHz)	Level	Limit
CH High-2480	Antenna 1	2484.026	-57.89	-10
CH High-2480	Antenna 1	2485.052	-66.8	-20

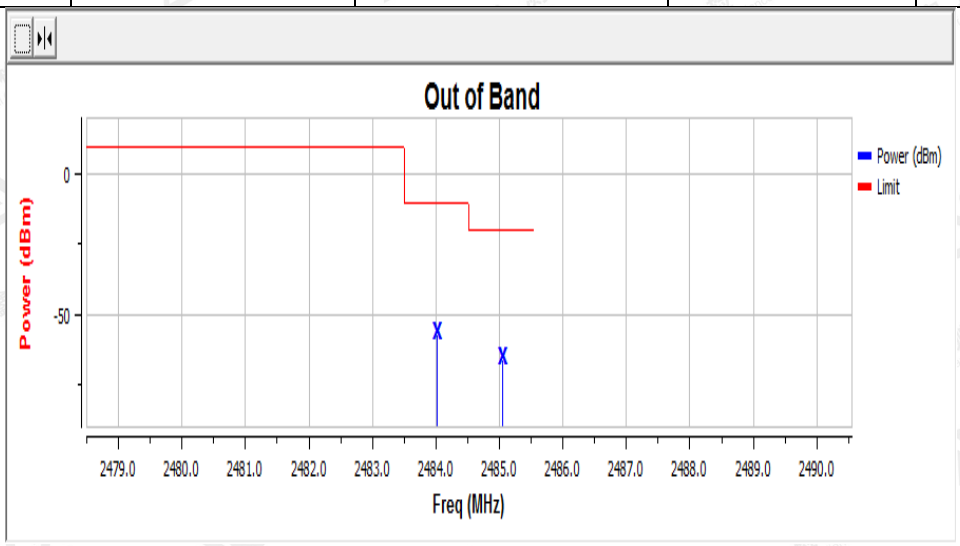


LOW TEMPERATURE NORMAL VOLTAGE

Channel	Antenna	Freq(MHz)	Level	Limit
CH Low-2402	Antenna 1	2399.5	-61.32	-10
CH Low-2402	Antenna 1	2398.472	-64.68	-20

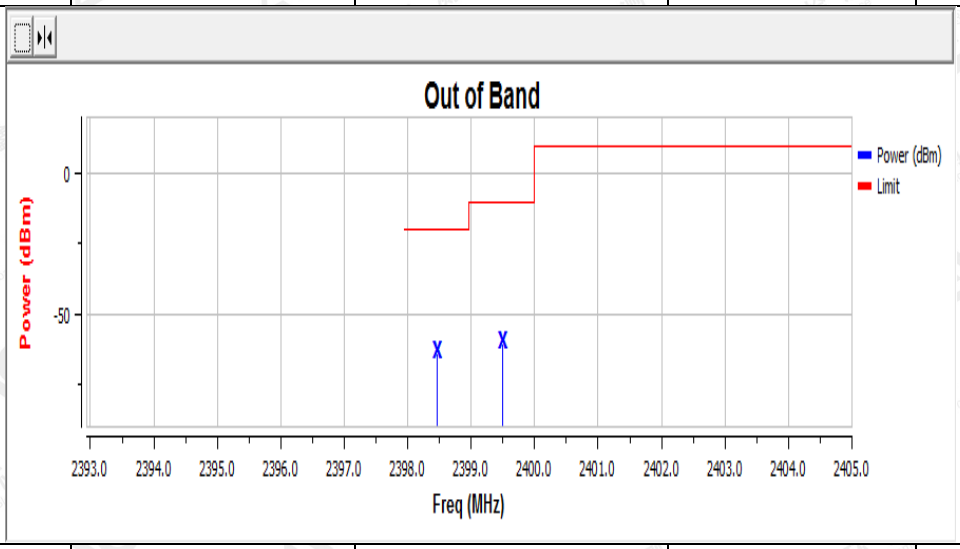


Channel	Antenna	Freq(MHz)	Level	Limit
CH High-2480	Antenna 1	2484.026	-57.88	-10
CH High-2480	Antenna 1	2485.052	-66.82	-20

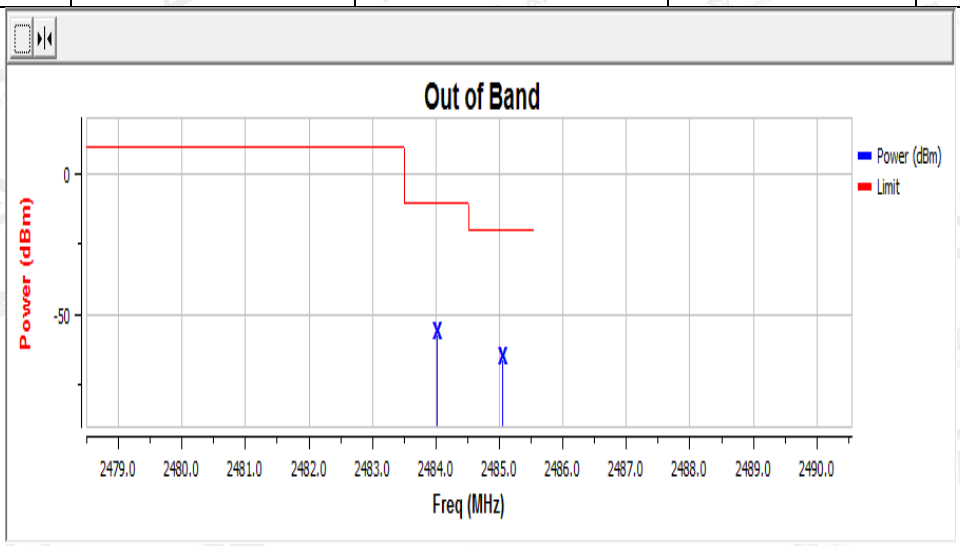


HIGH TEMPERATURE NORMAL VOLTAGE

Channel	Antenna	Freq(MHz)	Level	Limit
CH Low-2402	Antenna 1	2399.5	-61.33	-10
CH Low-2402	Antenna 1	2398.471	-64.68	-20



Channel	Antenna	Freq(MHz)	Level	Limit
CH High-2480	Antenna 1	2484.026	-57.85	-10
CH High-2480	Antenna 1	2485.052	-66.78	-20



Note: The worst modulation used during test is GFSK.
Conclusion: PASS

4.8. TRANSMITTER SPURIOUS EMISSIONS

ETSI EN300328 SUBCLAUSE 4.3.2.9

Spurious emissions are emissions outside the frequency range(s) of the equipment as defined in Clause 4.3.1.9.

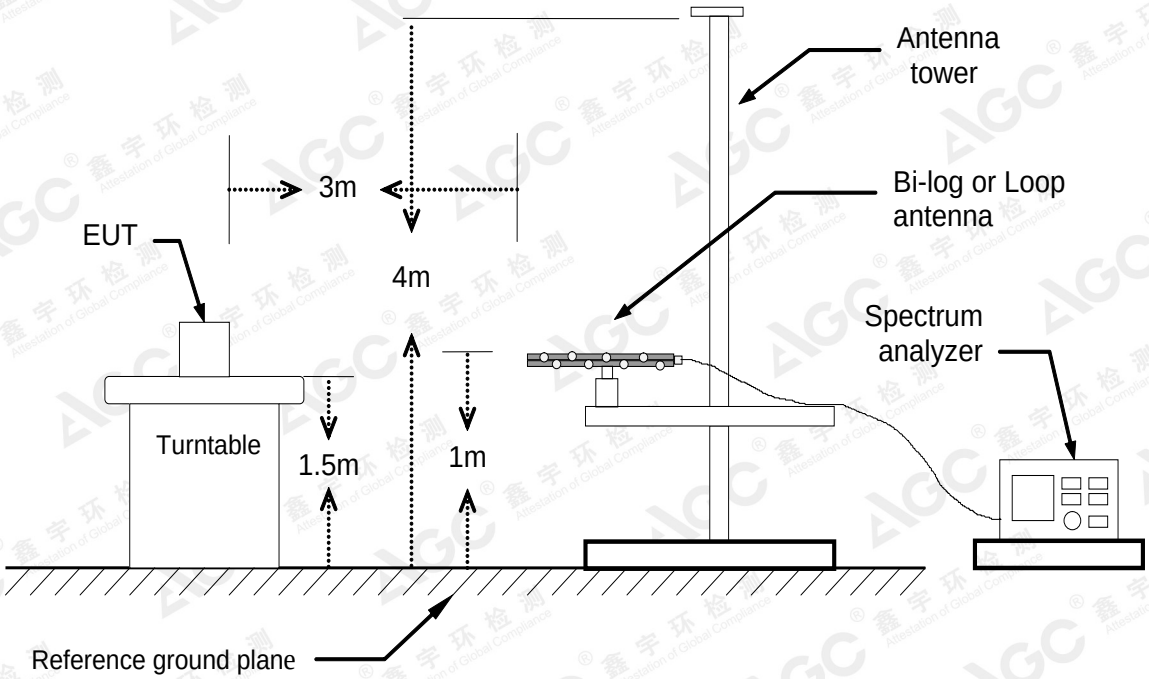
Transmitter unwanted emissions in the spurious domain are emissions outside the allocated band and outside the out-of-band domain as indicated in figure 1 when the equipment is in Transmit mode.

The spurious emissions of the transmitter shall not exceed the values in tables in the indicated bands:

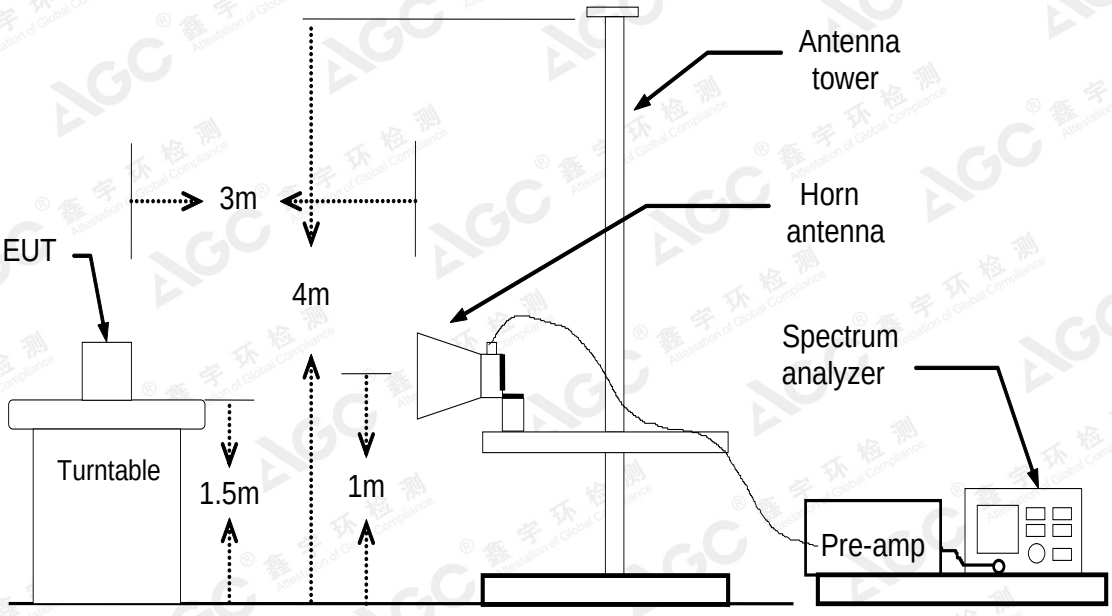
Frequency Range	Maximum Power e.r.p(<=1GHz)/e.i.r.p(>1GHz)	Bandwidth
30MHz to 47MHz	-36dBm	100kHz
47MHz to 74MHz	-54dBm	100kHz
74MHz to 87.5MHz	-36dBm	100kHz
87.5MHz to 118MHz	-54dBm	100kHz
118MHz to 174MHz	-36dBm	100kHz
174 MHz to 230MHz	-54dBm	100kHz
230 MHz to 470MHz	-36dBm	100kHz
470 MHz to 862MHz	-54dBm	100kHz
862 MHz to 1GHz	-36dBm	100kHz
1 GHz to 12.75GHz	-30dBm	1MHz

Test Configuration

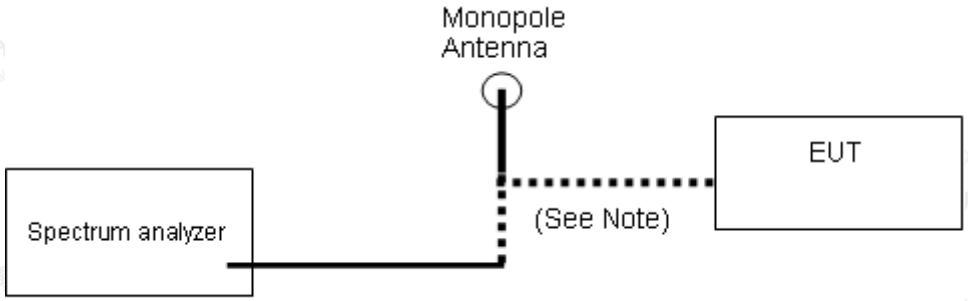
Below 1GHz



Above 1GHz



Radiated Method



Conducted Method

TEST PROCEDURE

1. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.3 for the conducted method.
2. Please refer to ETSI EN 300 328 (V2.1.1) clause 5.4.9 for the radiated method.

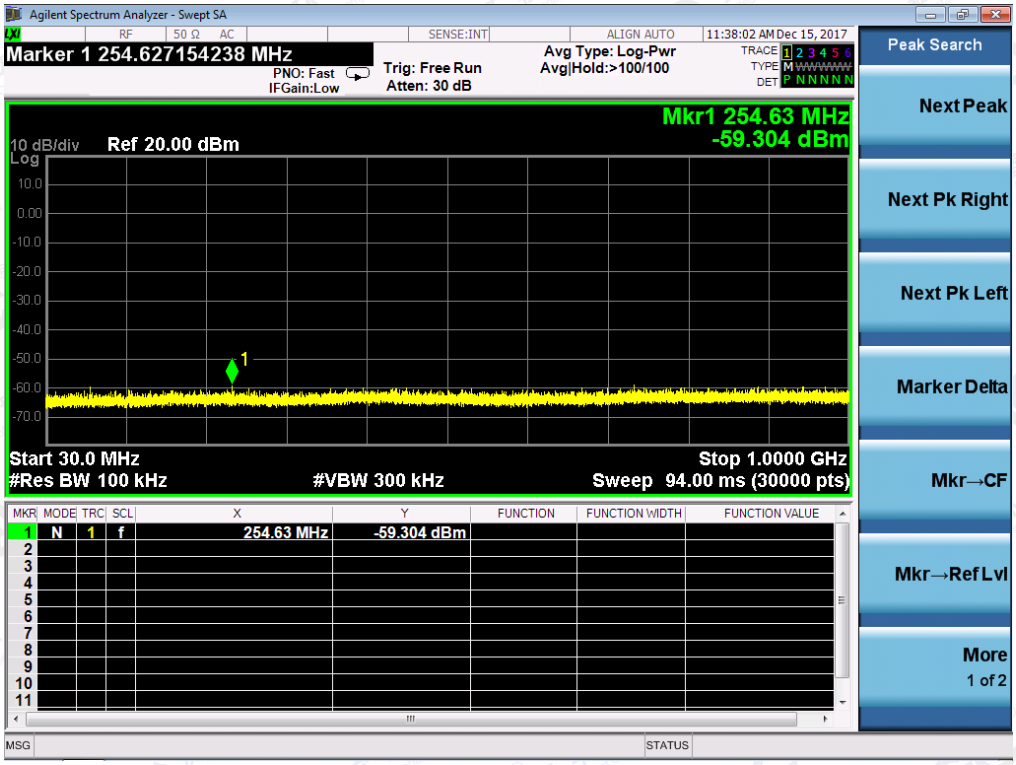
TEST SETTING

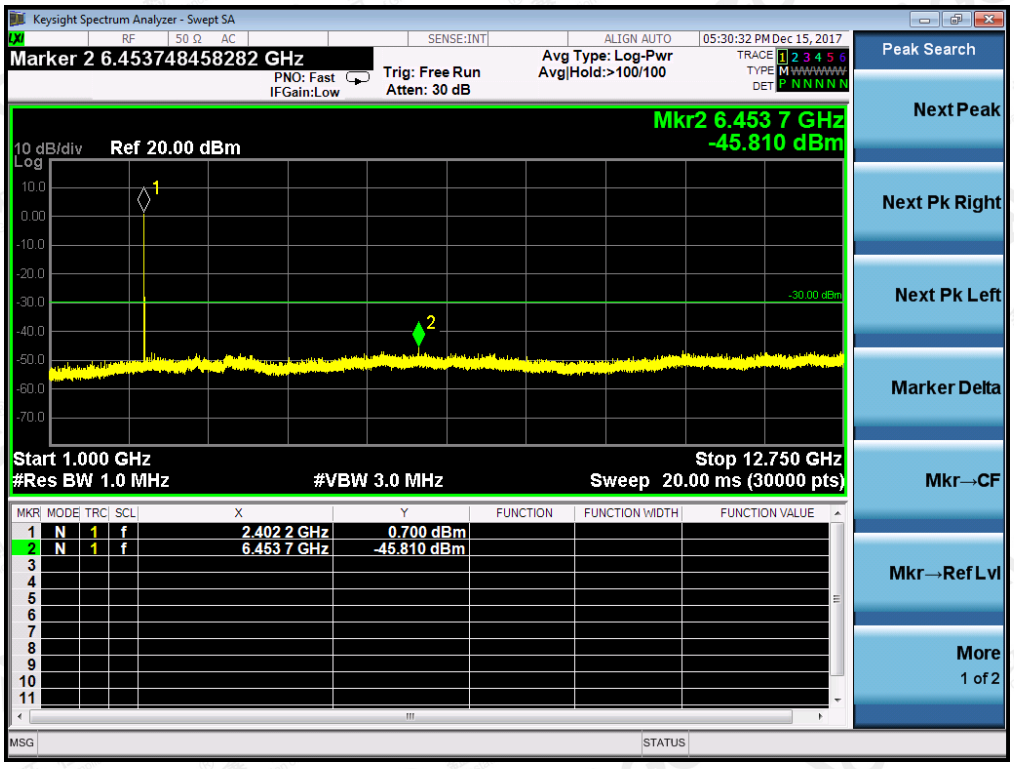
The emissions over the range 30 MHz to 1 000 MHz shall be identified.
Spectrum analyzer settings:
• Resolution bandwidth: 100 kHz
• Video bandwidth: 300 kHz
• Detector mode: Peak
• Trace Mode: Max Hold
• Sweep Points: ≥ 9 970

The emissions over the range 1 GHz to 12.75 GHz shall be identified.
Spectrum analyzer settings:
• Resolution bandwidth: 1 MHz
• Video bandwidth: 3 MHz
• Detector mode: Peak
• Trace Mode: Max Hold
• Sweep Points: Sweep time [µs] / (1 µs) with a maximum of 30 000

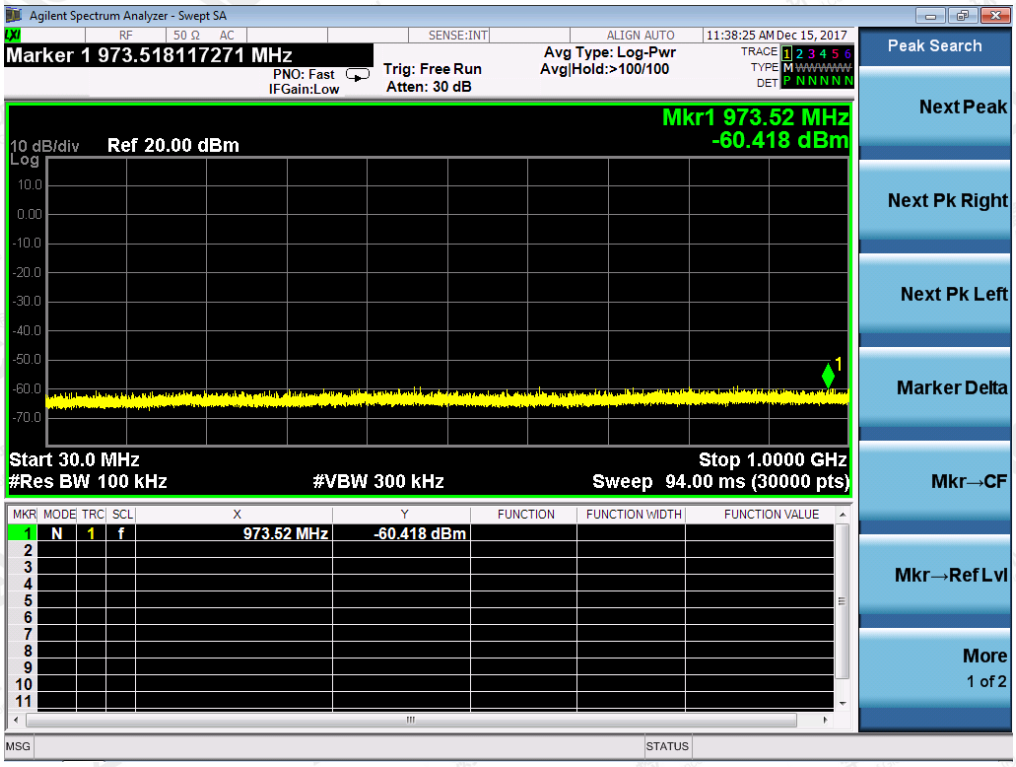
TEST RESULTS

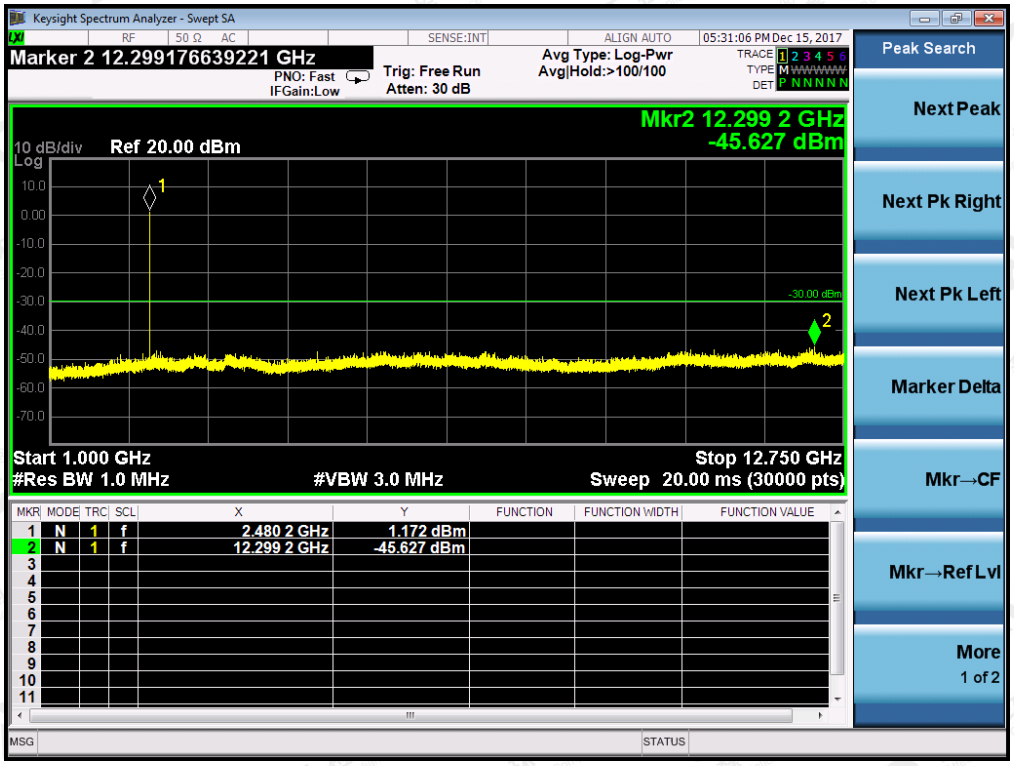
CONDUCTED RESULTS: (Low channel)





(High channel)

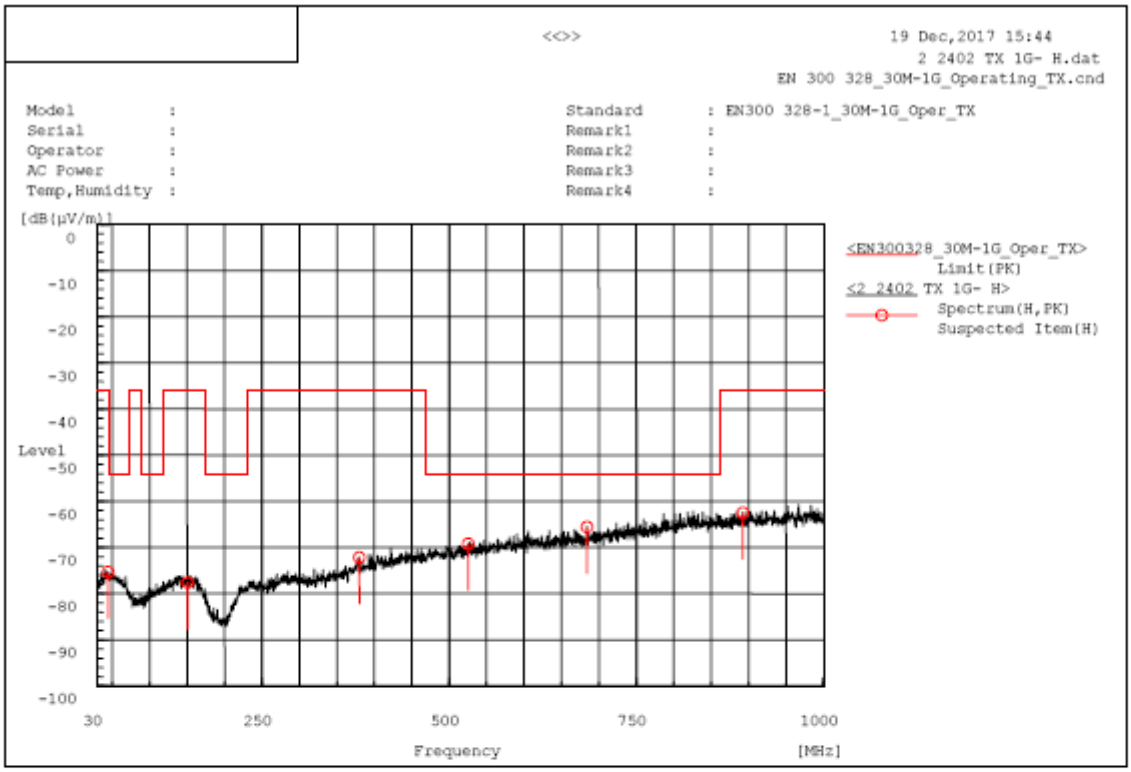




Conclusion: PASS

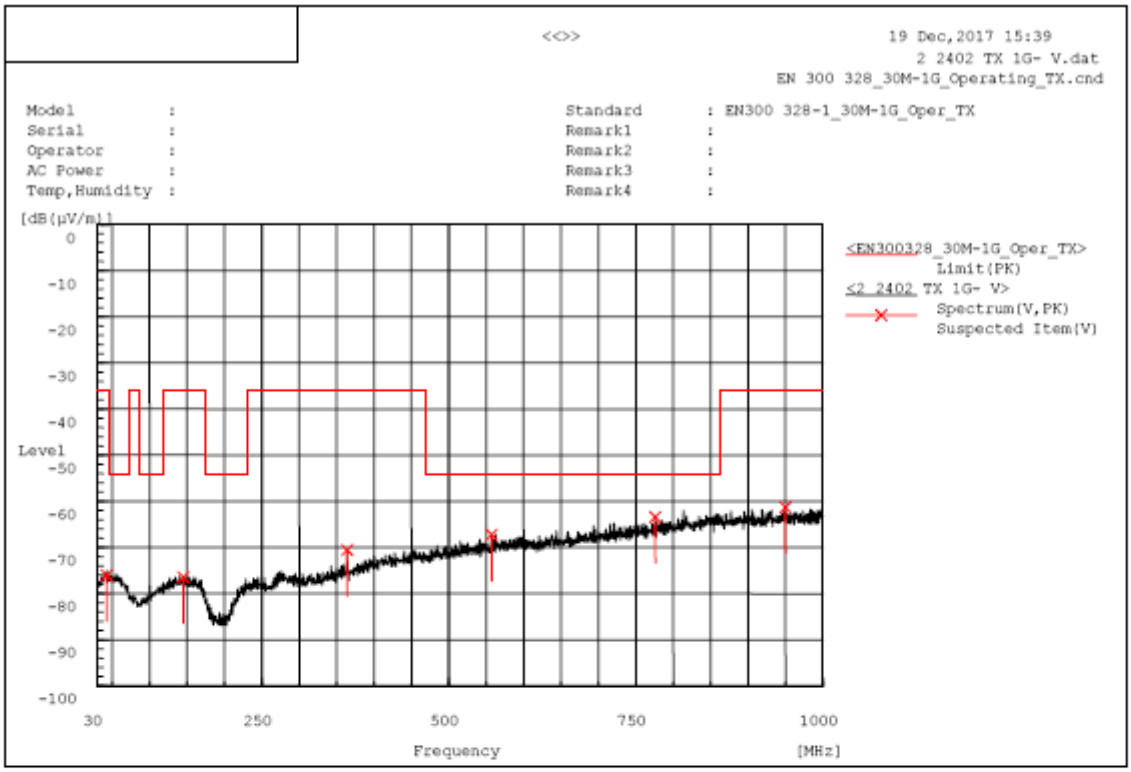
TEST RESULTS FOR RADIATED METHOD

Low Channel: Transmitter Spurious Emission below 1GHz (30MHz-1GHz)



A. Suspected List:

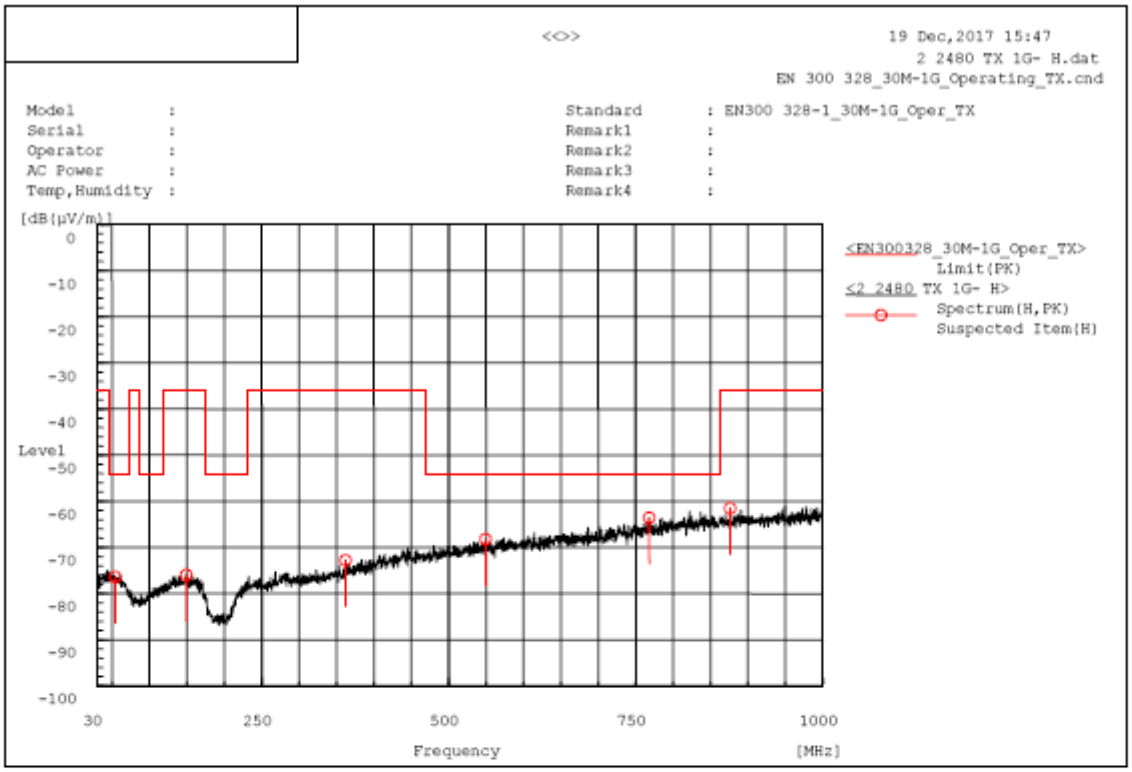
Frequency MHz	Polarization	Reading dBm	Factor dB (1/m)	Level dBm	Limit dBm PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
44.550	H	5.5	-80.8	-75.3	-36.0	39.3	Pass	200.0	177.7
150.765	H	3.8	-81.4	-77.6	-36.0	41.6	Pass	100.0	233.9
380.170	H	5.9	-78.0	-72.1	-36.0	36.1	Pass	100.0	125.3
525.670	H	5.3	-74.5	-69.2	-54.0	15.2	Pass	200.0	106.3
684.265	H	6.4	-71.9	-65.5	-54.0	11.5	Pass	100.0	161.1
892.330	H	5.4	-67.9	-62.5	-36.0	26.5	Pass	100.0	268.1



A. Suspected List:

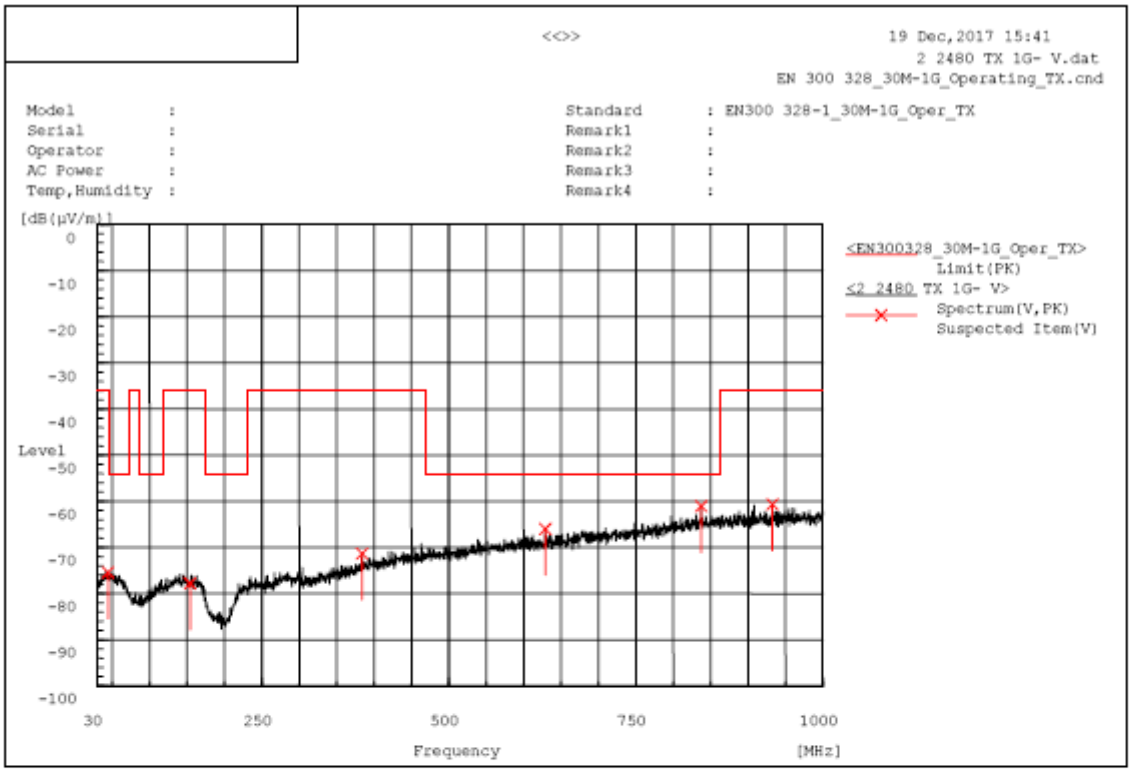
Frequency MHz	Polarization	Reading dBm	Factor dB (1/m)	Level dBm	Limit dBm PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
42.610	V	4.8	-80.8	-76.0	-36.0	40.0	Pass	200.0	305.7
145.430	V	5.0	-81.4	-76.4	-36.0	40.4	Pass	100.0	72.5
364.165	V	8.2	-78.8	-70.6	-36.0	34.6	Pass	100.0	325.7
557.195	V	6.7	-73.9	-67.2	-54.0	13.2	Pass	100.0	325.7
775.930	V	6.4	-69.8	-63.4	-54.0	9.4	Pass	200.0	196.6
950.045	V	6.1	-67.4	-61.3	-36.0	25.3	Pass	200.0	50.4

High Channel: Transmitter Spurious Emission below 1GHz (30MHz-1GHz)



A. Suspected List:

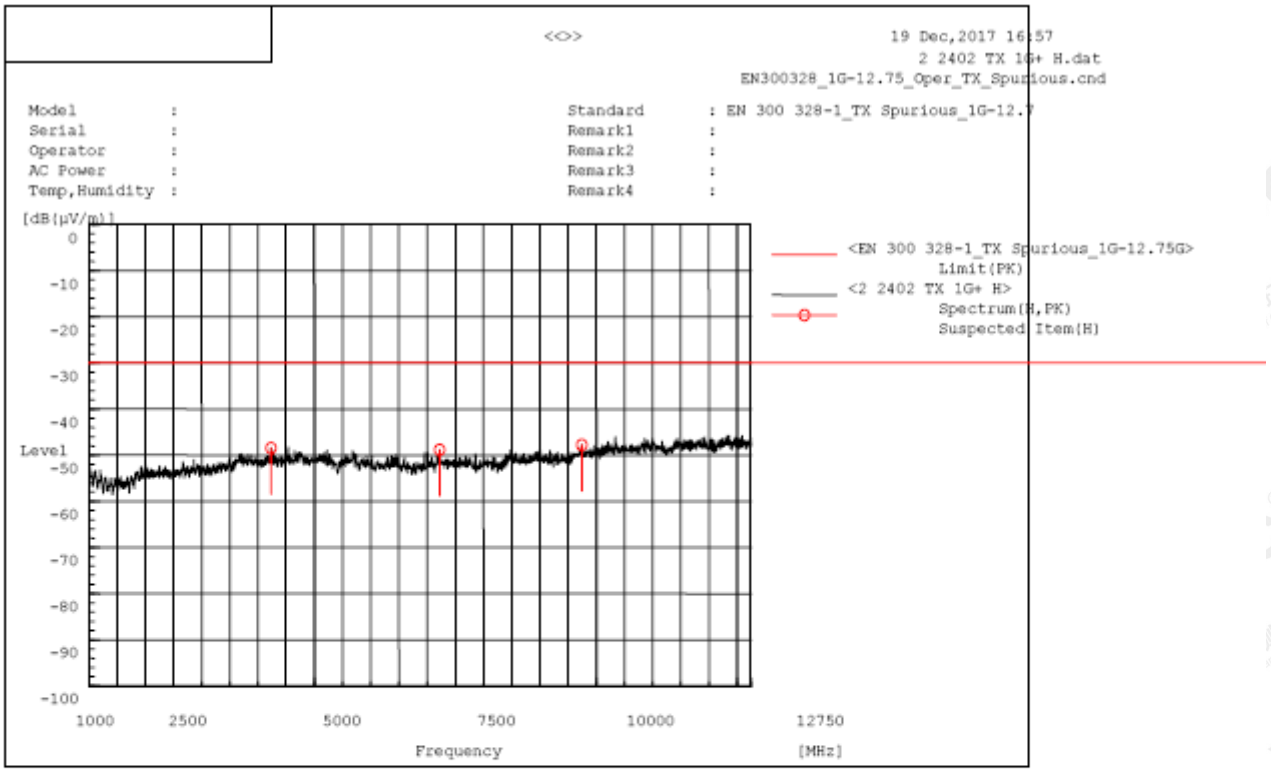
Frequency MHz	Polarization	Reading dBm	Factor dB (1/m)	Level dBm	Limit dBm PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
54.250	H	5.0	-81.4	-76.4	-54.0	22.4	Pass	100.0	287.0
149.310	H	5.4	-81.4	-76.0	-36.0	40.0	Pass	200.0	264.9
362.225	H	6.1	-78.9	-72.8	-36.0	36.8	Pass	200.0	264.9
549.435	H	5.8	-74.0	-68.2	-54.0	14.2	Pass	100.0	71.6
768.170	H	6.5	-70.0	-63.5	-54.0	9.5	Pass	100.0	357.8
876.325	H	6.6	-68.1	-61.5	-36.0	25.5	Pass	100.0	143.5



A. Suspected List:

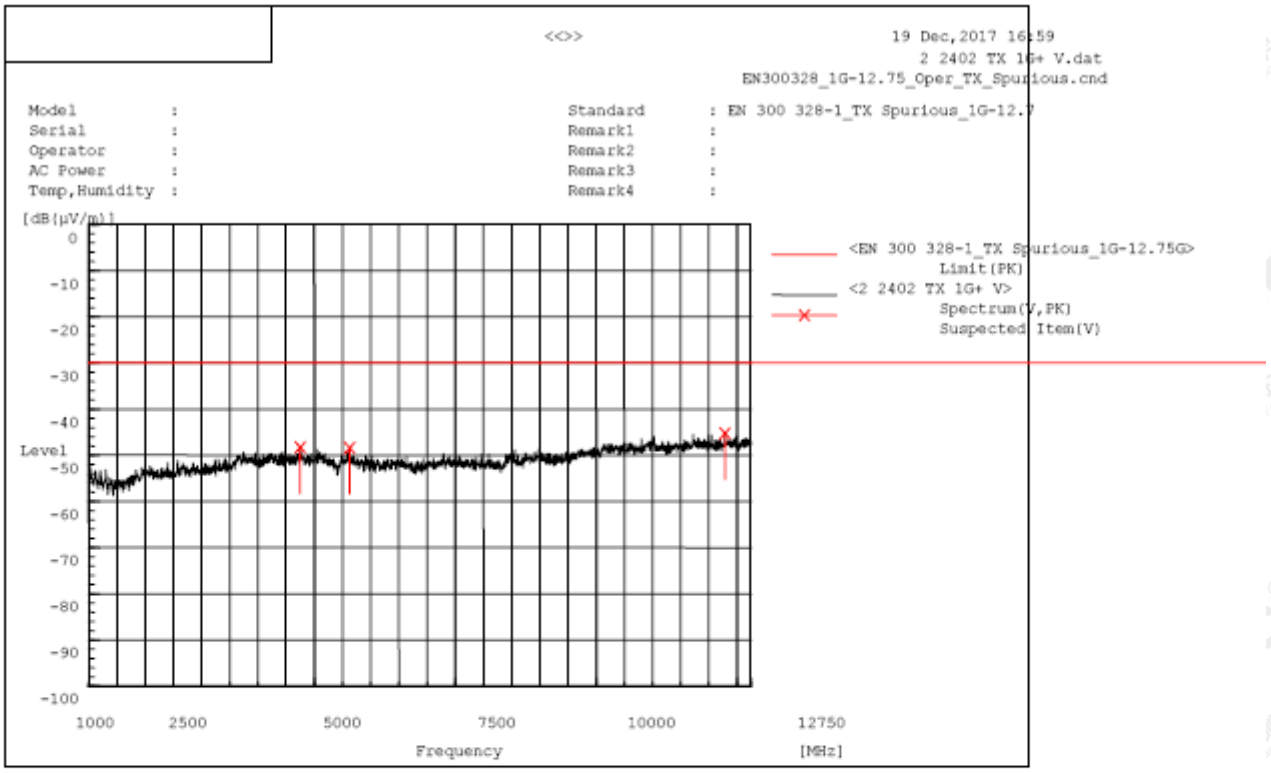
Frequency MHz	Polarization	Reading dBm	Factor dB (1/m)	Level dBm	Limit dBm PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
44.550	V	5.4	-80.8	-75.4	-36.0	39.4	Pass	100.0	338.7
154.160	V	3.6	-81.4	-77.8	-36.0	41.8	Pass	100.0	229.4
384.050	V	6.6	-77.9	-71.3	-36.0	35.3	Pass	100.0	84.5
628.975	V	6.6	-72.6	-66.0	-54.0	12.0	Pass	100.0	120.3
837.525	V	7.5	-68.6	-61.1	-54.0	7.1	Pass	100.0	84.5
932.585	V	6.8	-67.5	-60.7	-36.0	24.7	Pass	100.0	156.7

Low Channel: Transmitter Spurious Emission above 1GHz (1GHz-12.75GHz)



A. Suspected List:

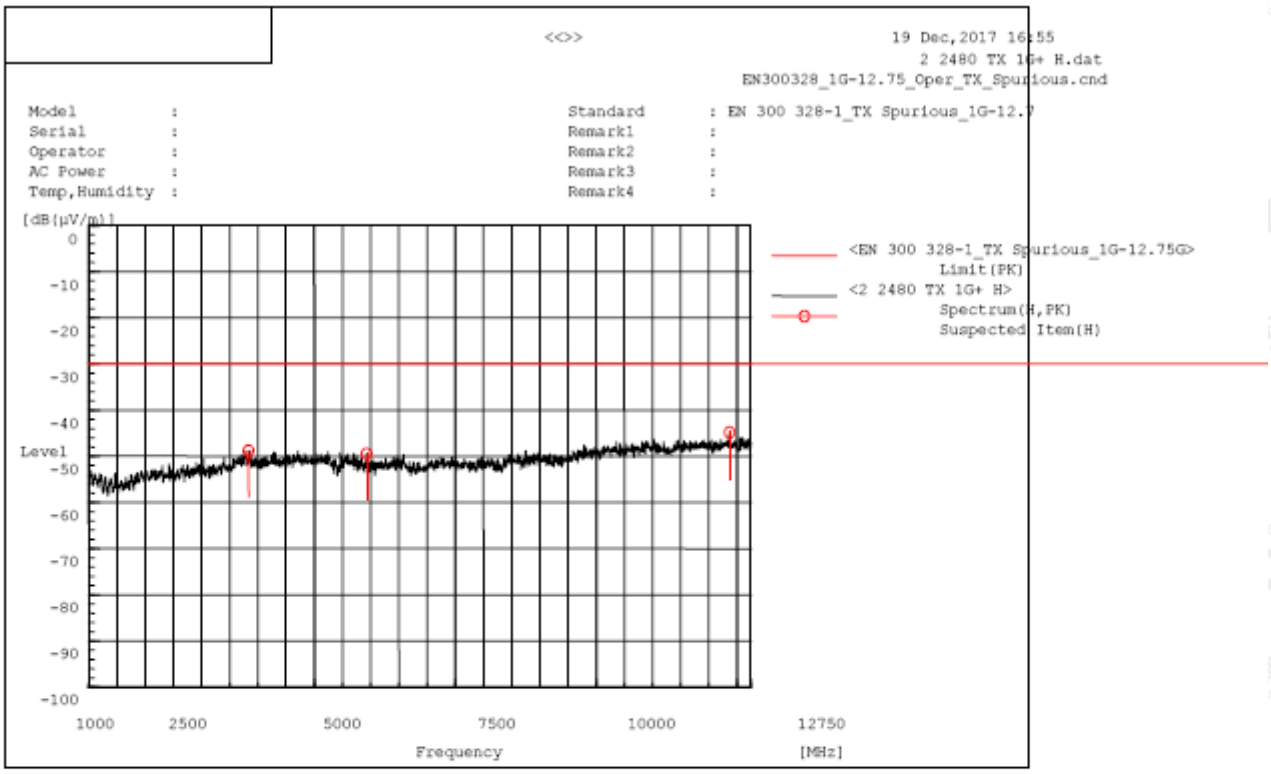
Frequency MHz	Polarization	Reading dB(uV)	Factor dB (1/m)	Level dB(uV/m) PK	Limit dB(uV/m) PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
4232.867	H	41.2	-89.6	-48.5	-30.0	18.5	Pass	150.0	288.6
7224.738	H	36.5	-85.3	-48.8	-30.0	18.8	Pass	200.0	289.5
9746.373	H	33.9	-81.6	-47.8	-30.0	17.8	Pass	200.0	289.5



A. Suspected List:

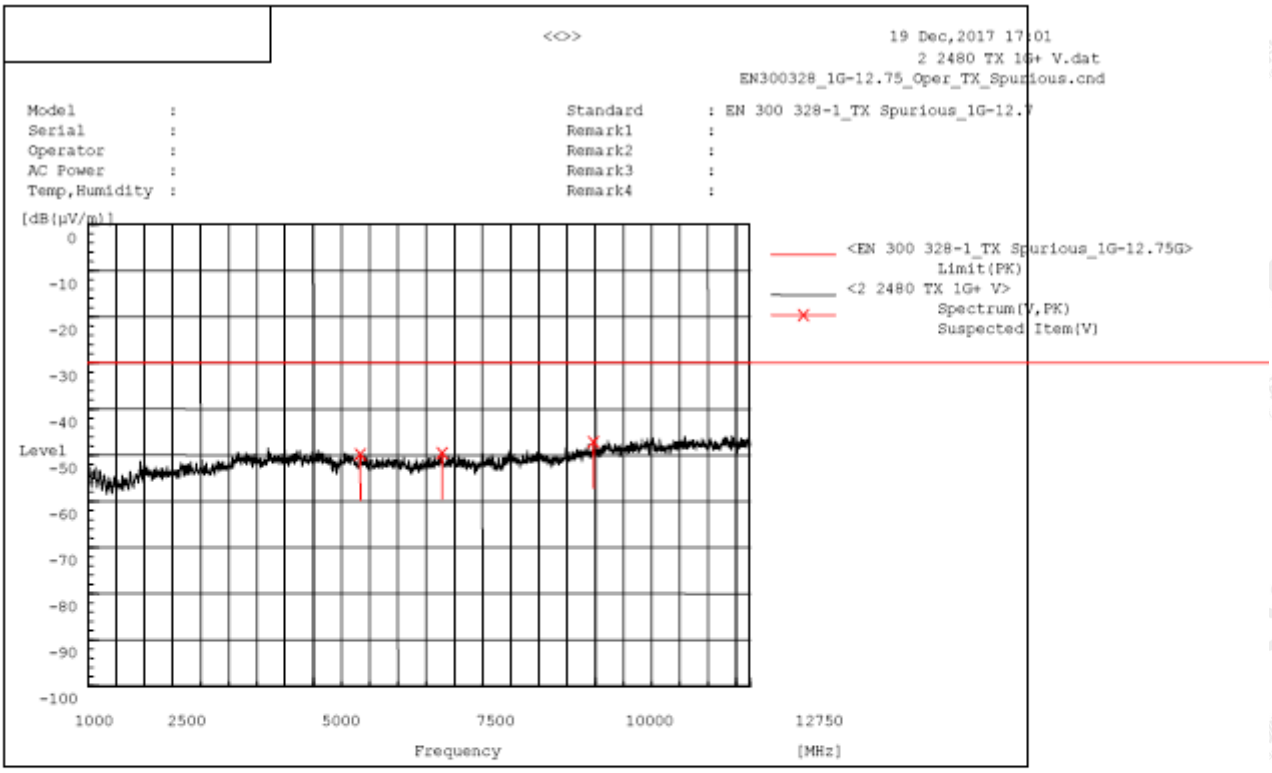
Frequency MHz	Polarization	Reading dB(uV)	Factor dB (1/m)	Level dB(uV/m) PK	Limit dB(uV/m) PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
4750.125	V	40.4	-88.7	-48.3	-30.0	18.3	Pass	150.0	252.2
5625.938	V	38.6	-87.0	-48.4	-30.0	18.4	Pass	150.0	66.7
12285.643	V	32.3	-77.5	-45.2	-30.0	15.2	Pass	150.0	288.6

High Channel: Transmitter Spurious Emission above 1GHz (1GHz-12.75GHz)



A. Suspected List:

Frequency MHz	Polarization	Reading dB(uV)	Factor dB (1/m)	Level dB(uV/m) PK	Limit dB(uV/m) PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
3833.167	H	41.7	-90.5	-48.8	-30.0	18.8	Pass	150.0	287.3
5925.713	H	37.2	-86.7	-49.5	-30.0	19.5	Pass	150.0	28.2
12367.934	H	32.7	-77.5	-44.8	-30.0	14.8	Pass	200.0	214.2



A. Suspected List:

Frequency MHz	Polarization	Reading dB(uV)	Factor dB (1/m)	Level dB(uV/m) PK	Limit dB(uV/m) PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
5831.666	V	37.0	-86.8	-49.8	-30.0	19.8	Pass	100.0	214.0
7283.517	V	35.7	-85.2	-49.5	-30.0	19.5	Pass	150.0	212.9
9969.735	V	33.9	-81.0	-47.1	-30.0	17.1	Pass	200.0	175.5

Conclusion: PASS

4.9. RECEIVER SPURIOUS EMISSIONS

ETSI EN300328 SUBCLAUSE 4.3.2.10

Receiver spurious emissions are emissions at any frequency when the equipment is in receive mode. The spurious emissions of the receiver shall not exceed the values given in table 13.

Table 13: Spurious emission limits for receivers

Frequency range	Maximum power	Bandwidth
30 MHz to 1 GHz	-57 dBm	100 kHz
1 GHz to 12,75 GHz	-47 dBm	1 MHz

TEST CONFIGURATION

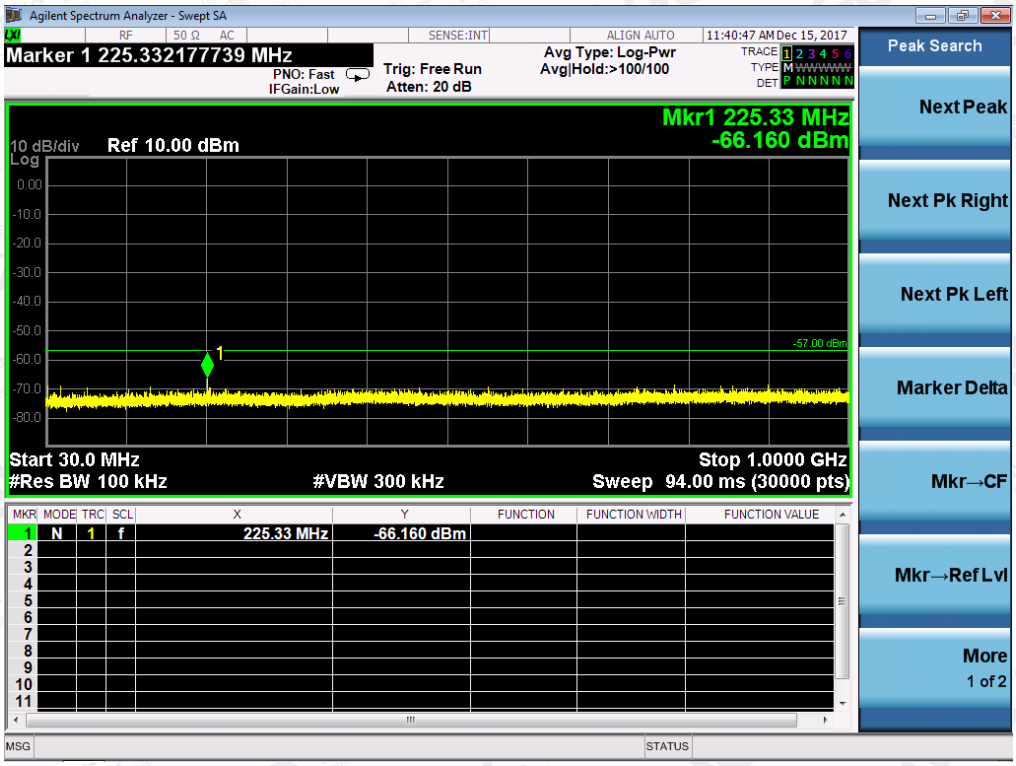
Radiated Spurious Emissions: Same as section 4.8 in this test report

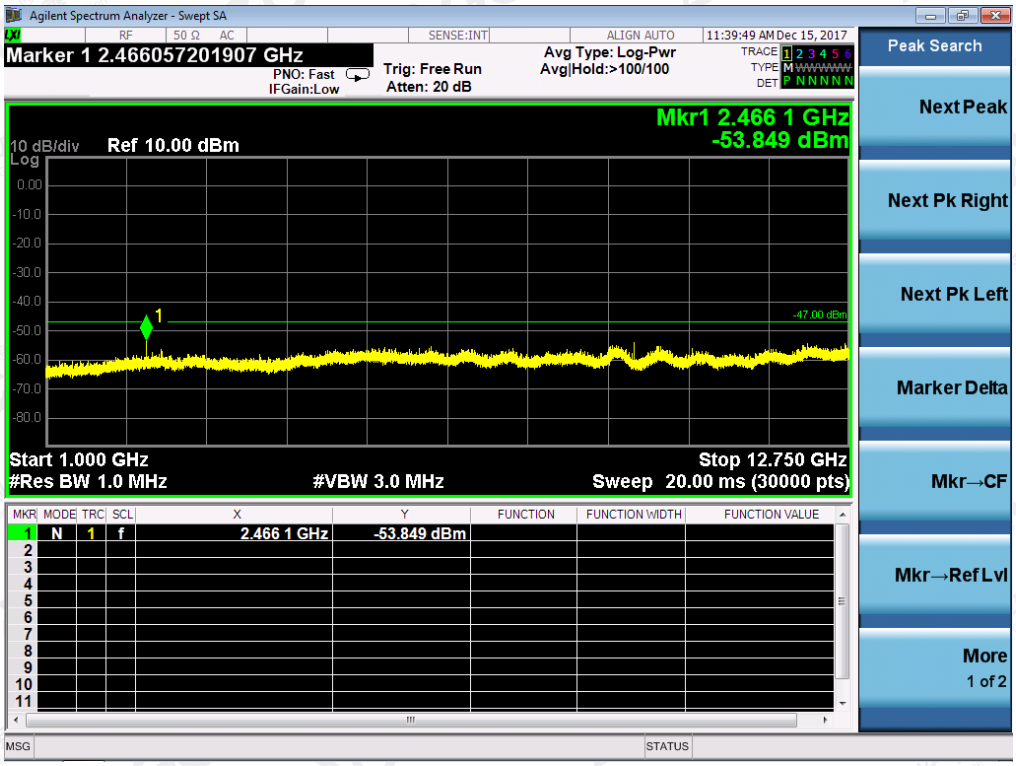
TEST PROCEDURE

1. Please refer to ETSI EN 300 328 clause 5.3 for the test conditions.
2. Please refer to ETSI EN 300 328 clause 5.4.10for the measurement methods.

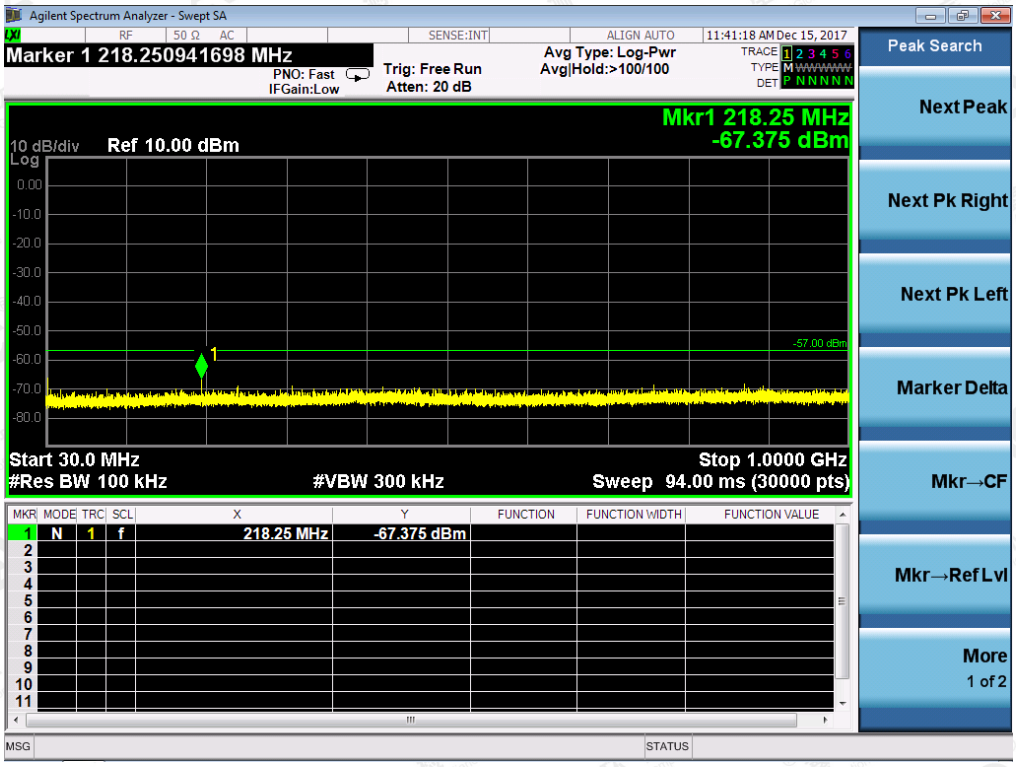
TEST RESULTS FOR CONDUCTED METHOD

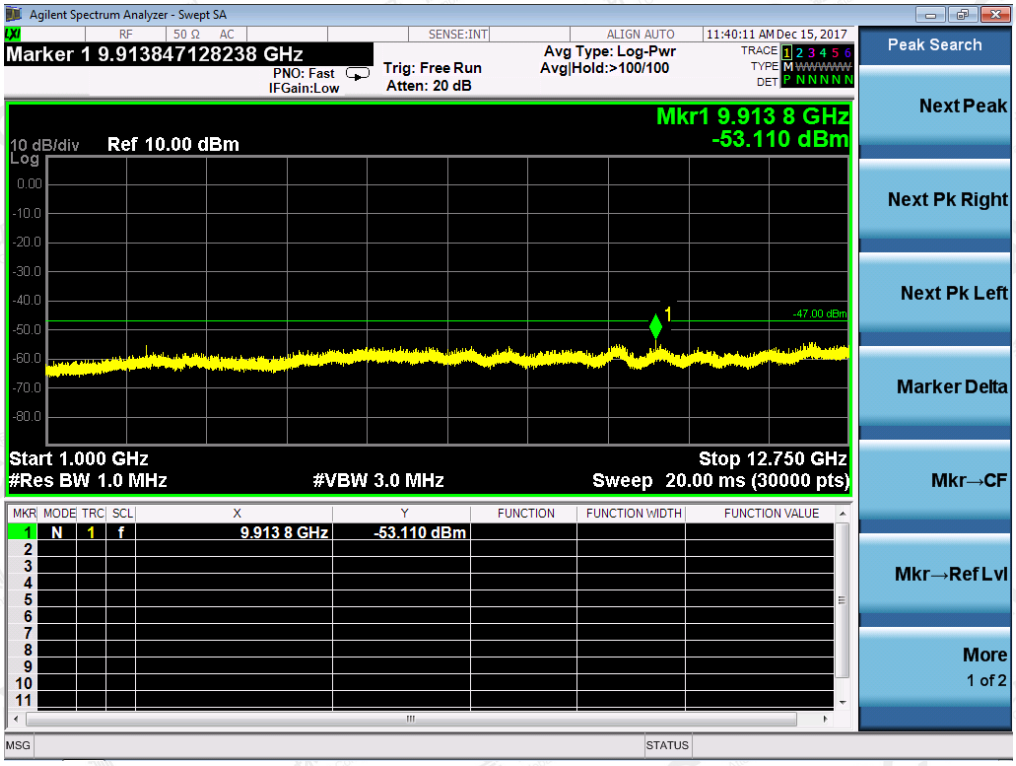
RECEIVER MODE (Low channel)





RECEIVER MODE (High channel)

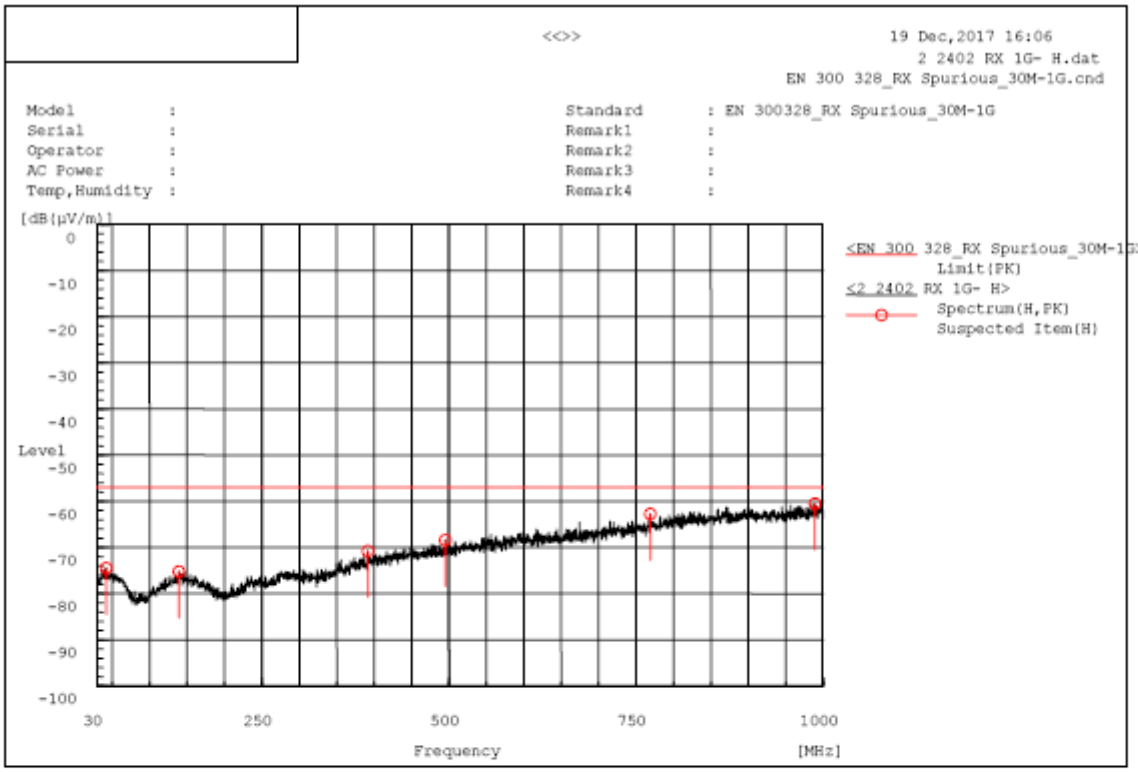




Conclusion: PASS

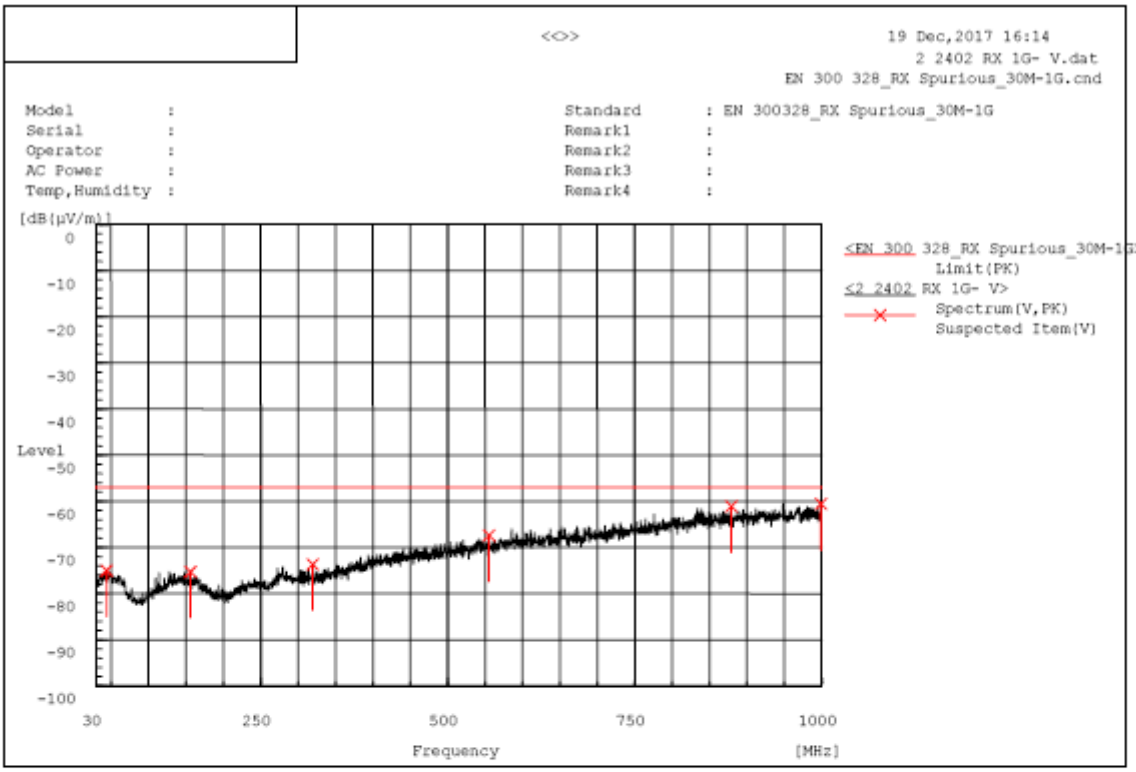
TEST RESULTS FOR RADIATED METHOD

Low Channel: Receiver Spurious Emission below 1GHz (30MHz-1GHz)



A. Suspected List:

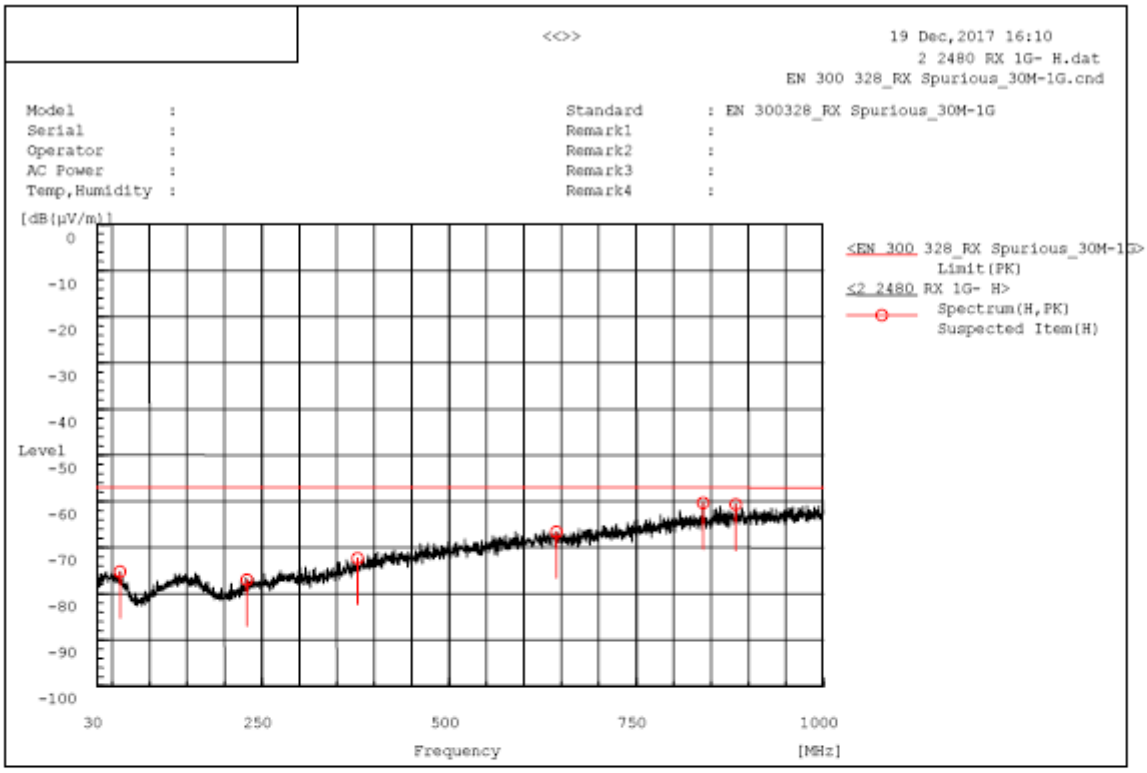
Frequency MHz	Polarization	Reading dB(uV)	Factor dB (1/m)	Level dB(uV/m) PK	Limit dB(uV/m) PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
42.125	H	6.0	-80.5	-74.5	-57.0	17.5	Pass	200.0	223.7
139.125	H	5.7	-80.9	-75.2	-57.0	18.2	Pass	200.0	265.1
391.810	H	6.0	-76.8	-70.8	-57.0	13.8	Pass	100.0	179.0
495.115	H	6.0	-74.4	-68.4	-57.0	11.4	Pass	200.0	152.8
769.140	H	6.4	-69.1	-62.7	-57.0	5.7	Pass	200.0	82.0
989.330	H	5.6	-66.1	-60.5	-57.0	3.5	Pass	200.0	265.1



A. Suspected List:

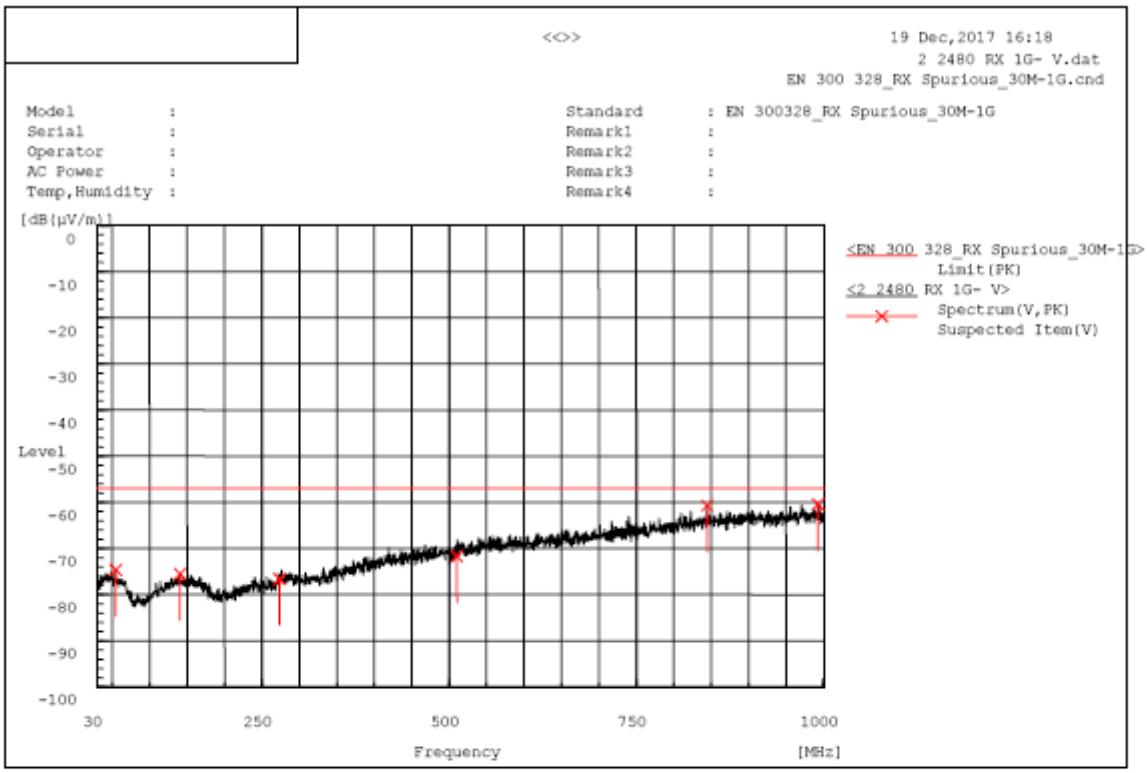
Frequency MHz	Polarization	Reading dB(uV)	Factor dB (1/m)	Level dB(uV/m) PK	Limit dB(uV/m) PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
44.065	V	5.5	-80.5	-75.0	-57.0	18.0	Pass	100.0	3.3
156.100	V	5.6	-80.9	-75.3	-57.0	18.3	Pass	100.0	287.9
319.545	V	6.3	-79.9	-73.6	-57.0	16.6	Pass	200.0	93.4
555.255	V	5.7	-73.1	-67.4	-57.0	10.4	Pass	100.0	251.5
879.235	V	6.0	-67.1	-61.1	-57.0	4.1	Pass	100.0	287.9
999.030	V	5.5	-66.0	-60.5	-57.0	3.5	Pass	200.0	93.4

High Channel: Receiver Spurious Emission below 1GHz (30MHz-1GHz)



A. Suspected List:

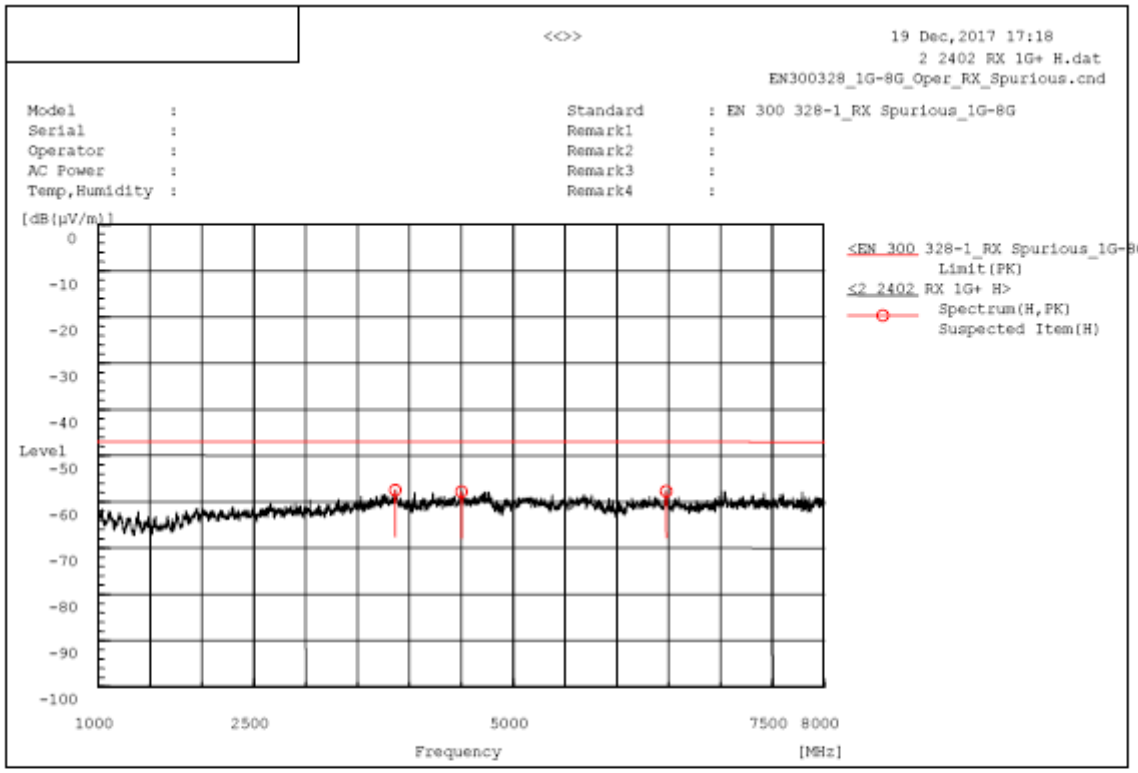
Frequency MHz	Polarization	Reading dB(uV)	Factor dB (1/m)	Level dB(uV/m) PK	Limit dB(uV/m) PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
60.555	H	6.4	-81.6	-75.2	-57.0	18.2	Pass	100.0	289.5
229.820	H	4.9	-81.8	-76.9	-57.0	19.9	Pass	200.0	94.1
377.745	H	5.2	-77.5	-72.3	-57.0	15.3	Pass	100.0	146.5
643.525	H	5.0	-71.6	-66.6	-57.0	9.6	Pass	100.0	289.5
839.465	H	7.4	-67.7	-60.3	-57.0	3.3	Pass	100.0	355.8
883.115	H	6.4	-67.0	-60.6	-57.0	3.6	Pass	200.0	59.1



A. Suspected List:

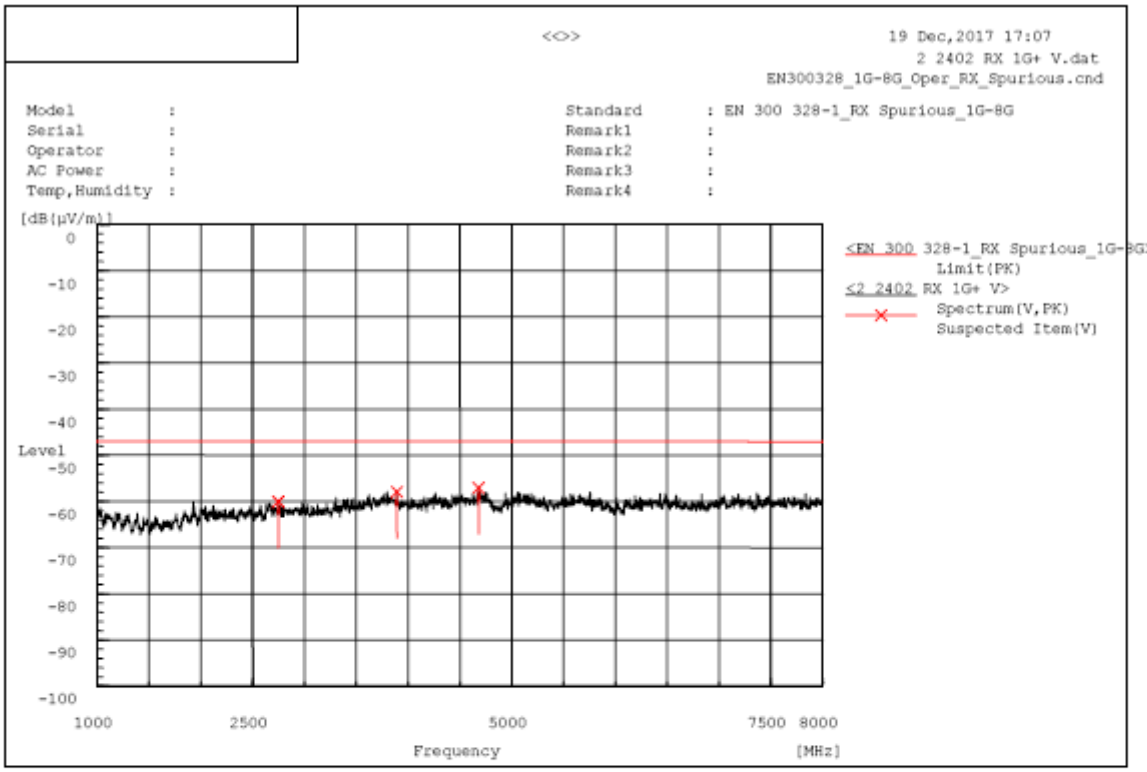
Frequency MHz	Polarization	Reading dB(uV)	Factor dB (1/m)	Level dB(uV/m) PK	Limit dB(uV/m) PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
54.735	V	6.5	-81.1	-74.6	-57.0	17.6	Pass	200.0	20.9
140.580	V	5.4	-80.9	-75.5	-57.0	18.5	Pass	200.0	92.3
273.470	V	3.6	-80.2	-76.6	-57.0	19.6	Pass	200.0	92.3
510.635	V	2.4	-74.1	-71.7	-57.0	14.7	Pass	100.0	178.2
844.800	V	7.0	-67.7	-60.7	-57.0	3.7	Pass	100.0	288.1
992.725	V	5.7	-66.1	-60.4	-57.0	3.4	Pass	100.0	215.1

Low Channel: Receiver Spurious Emission above 1GHz (1GHz-12.75GHz)



A. Suspected List:

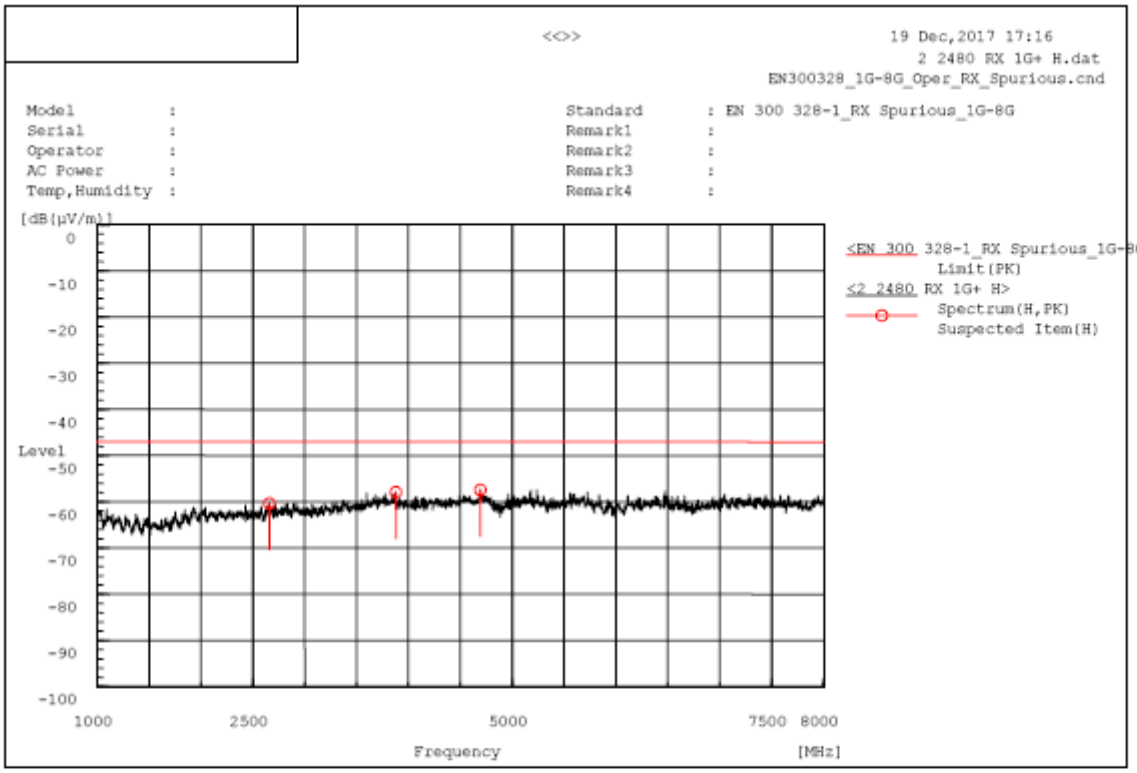
Frequency MHz	Polarization	Reading dBm	Factor dB (1/m)	Level dBm	Limit dBm PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
3864.432	H	32.9	-90.4	-57.5	-47.0	10.5	Pass	150.0	71.4
4501.751	H	31.3	-89.1	-57.8	-47.0	10.8	Pass	200.0	321.3
6476.739	H	28.5	-86.2	-57.7	-47.0	10.7	Pass	100.0	71.4



A. Suspected List:

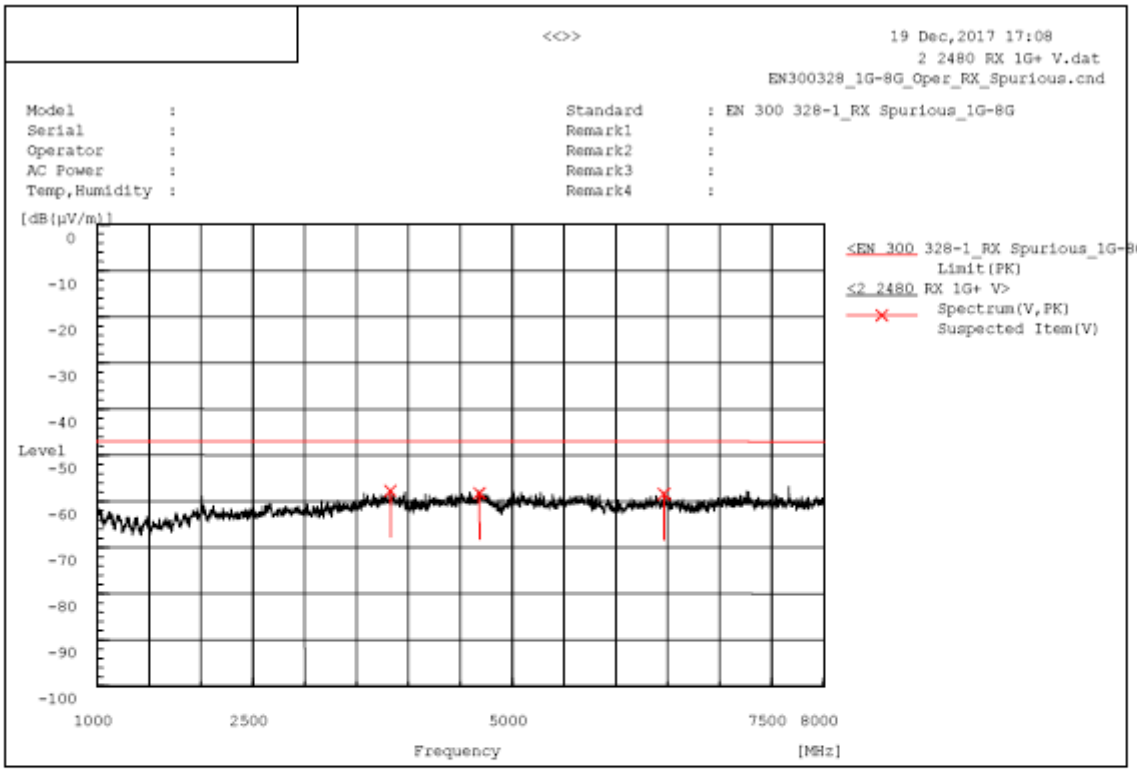
Frequency MHz	Polarization	Reading dBm	Factor dB (1/m)	Level dBm	Limit dBm PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
2747.374	V	34.1	-94.1	-60.0	-47.0	13.0	Pass	150.0	144.9
3892.446	V	32.5	-90.4	-58.0	-47.0	11.0	Pass	200.0	291.2
4680.340	V	31.7	-88.8	-57.1	-47.0	10.1	Pass	150.0	71.9

High Channel: Receiver Spurious Emission above 1GHz (1GHz-12.75GHz)



A. Suspected List:

Frequency MHz	Polarization	Reading dBm	Factor dB (1/m)	Level dBm	Limit dBm PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
2659.830	H	33.9	-94.3	-60.4	-47.0	13.4	Pass	200.0	108.0
3878.439	H	32.5	-90.4	-57.9	-47.0	10.9	Pass	200.0	292.6
4694.347	H	31.4	-88.8	-57.4	-47.0	10.4	Pass	150.0	72.4



A. Suspected List:

Frequency MHz	Polarization	Reading dBm	Factor dB (1/m)	Level dBm	Limit dBm PK	Margin dB PK	Pass/Fail	Height cm	Angle deg
3825.913	V	32.8	-90.5	-57.7	-47.0	10.7	Pass	100.0	72.2
4683.842	V	30.6	-88.8	-58.2	-47.0	11.2	Pass	150.0	11.6
6462.732	V	28.0	-86.3	-58.3	-47.0	11.3	Pass	100.0	72.2

Conclusion: PASS

Note: 8GHz to 12.75GHz at least have 20dB margin. No recording in the test report.

4.10. RECEIVER BLOCKING

ETSI EN300328 SUBCLAUSE 4.3.2.11

This requirement applies to all receiver categories as defined in clause 4.2.3.
Performance Criteria
The minimum performance criterion shall be a PER less than or equal to 10 %. The manufacturer may declare alternative performance criteria as long as that is appropriate for the intended use of the equipment (see clause 5.4.1.t)).
Receiver Category 1
Table 14 contains the Receiver Blocking parameters for Receiver Category 1 equipment.

Table 14: Receiver Blocking parameters for Receiver Category 1 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 6 dB	2 380 2 503,5	-53	CW
P_{min} + 6 dB	2 300 2 330 2 360	-47	CW
P_{min} + 6 dB	2 523,5 2 553,5 2 583,5 2 613,5 2 643,5 2 673,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

Receiver Category 2
Table 15 contains the Receiver Blocking parameters for Receiver Category 2 equipment.

Table 15: Receiver Blocking parameters receiver category 2 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 6 dB	2 380 2 503,5	-57	CW
P_{min} + 6 dB	2 300 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

Receiver Category 3
Table 16 contains the Receiver Blocking parameters for Receiver Category 3 equipment.

Table 16: Receiver Blocking parameters receiver category 3 equipment

Wanted signal mean power from companion device (dBm)	Blocking signal frequency (MHz)	Blocking signal power (dBm) (see note 2)	Type of blocking signal
P_{min} + 12 dB	2 380 2 503,5	-57	CW
P_{min} + 12 dB	2 300 2 583,5	-47	CW
NOTE 1: P_{min} is the minimum level of the wanted signal (in dBm) required to meet the minimum performance criteria as defined in clause 4.3.2.11.3 in the absence of any blocking signal. NOTE 2: The levels specified are levels in front of the UUT antenna. In case of conducted measurements, the levels have to be corrected by the actual antenna assembly gain.			

TEST PROCEDURE

1. Please refer to ETSI EN 300 328 clause 5.4.11.1 for the test conditions.
2. Please refer to ETSI EN 300 328 clause 5.4.11.2 for the measurement methods.

TEST RESULTS: (Low channel, Direct Test Mode, Receiver Category 2)

Wanted signal mean power from companion device(dBm)	Blocking Signal Frequency(MHz)	Blocking Signal Power(dBm)	Type of blocking signal	Limit PER	Performance PER	Result
Pmin (-83)+6	2380	-57	CW	10%	0.03%	Pass
Pmin (-83)+6	2503.5	-57	CW	10%	0.18%	
Pmin (-83)+6	2300	-47	CW	10%	0.22%	Pass
Pmin (-83)+6	2583.5	-47	CW	10%	0.16%	

(High channel, Direct Test Mode, Receiver Category 2)

Wanted signal mean power from companion device(dBm)	Blocking Signal Frequency(MHz)	Blocking Signal Power(dBm)	Type of blocking signal	Limit PER	Performance PER	Result
Pmin (-83)+6	2380	-57	CW	10%	0.18%	Pass
Pmin (-83)+6	2503.5	-57	CW	10%	0.15%	
Pmin (-83)+6	2300	-47	CW	10%	0.14%	Pass
Pmin (-83)+6	2583.5	-47	CW	10%	0.17%	

APPENDIX A

PHOTOGRAPHS OF THE TEST SETUP

Refer to Attached file (APPENDIX I).

APPENDIX B

PHOTOGRAPHS OF THE EUT

Refer to Attached file (APPENDIX I).

----END OF REPORT----