RF TEST REPORT

Report No.:	SET2018-11896
Product Name:	Smart Antenna
FCC ID:	2ACRAHX-TS103
Model No. :	HX-TS103
Applicant:	HARXON CORPORATION
Address:	6/F, Block B, D3 Building, TCL International E City, No. 1001 Zhongshanyuan Road, Nanshan District, Shenzhen，518055，PRC
Dates of Testing:	09/10/2018 — 09/21/2018
Issued by:	CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd.
Lab Location:	Building 28/29, East of Shigu, Xili Industrial Zone, Xili Road, Nanshan District, Shenzhen, Guangdong, China
	Tel: 86 755 26627338 **Fax:** 86 755 26627238

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Test Report

Product Name.....:	Smart Antenna
Brand Name.....:	HARXON
Trade Name.....:	HARXON
Applicant.....:	HARXON CORPORATION
Applicant Address.....:	6/F, Block B, D3 Building, TCL International E City, No. 1001 Zhongshanyuan Road, Nanshan District, Shenzhen，518055，PRC
Manufacturer .....:	HARXON CORPORATION
Manufacturer Address .....:	6/F, Block B, D3 Building, TCL International E City, No. 1001 Zhongshanyuan Road, Nanshan District, Shenzhen，518055，PRC
Test Standards.....:	47 CFR Part 15 Subpart C 2017：Radio Frequency Devices ANSI C63.10:2013：American National Standard for Testing Unlicensed Wireless Devices
Test Result.....:	PASS
Tested by .....:	2018.09.21 Shallwe Yang, Test Engineer
Reviewed by .....:	2018.09.21 Zhu Qi, Senior Engineer
Approved by .....:	2018.09.21 Smart Li, Manager

TABLE OF CONTENTS

Change History		
Issue	Date	Reason for change
1.0	2018.09.21	First edition

1. General Information

1.1. EUT Description

EUT Type	Smart Antenna
Hardware Version	V1R0
Software Version	BOOT:V001.01.02 APP:V003.01.05
Frequency Range	410.125MHz-469.125MHz The frequency block is 410MHz to 470MHz
Channel Space	25KHz
Modulation Type	GMSK/4FSK
Power Supply	DC 9~30V
Antenna Type	External antenna
Antenna Gain	4dBi

Note 1: For a more detailed description, please refer to Specification or User's Manual supplied by the applicant and/or manufacturer.

Note 2:The lowest channel 410.125MHz, middle channel 440.125MHz and highest channel 469.125MHz were selected to test .

1.2. Test Standards and Results

The objective of the report is to perform testing according to 47 CFR Part 90 Subpart I for the EUT FCC ID Certification:

1.47 CFR Part 2, 90(I)

2. ANSI/TIA/EIA-603-D-2010

Test detailed items/section required by FCC rules and results are as below:

No.	Section in CFR 47	Description	Result
1	15.203	Antenna Requirement	PASS
2	90.205	Power and antenna height limits	PASS
3	90.209	Occupied Bandwidth	PASS
4	90.210	Emission Mask	PASS
5	90.213	Frequency Stability	PASS
6	90.214	Transmitter Frequency Behavior	PASS
7	2.1051; 90.210(h)	Transmitter Conducted Spurious Emission	PASS
8	2.1053; 90.210(h)	Transmitter Radiated Spurious Emission	PASS
9	15.111(a)	Receiver Conducted Spurious Emission	PASS
10	15.109;15.111(a)	Receiver Radiated Spurious Emission	PASS

Remark：

All test items were verified and recorded according to the standards and without any deviation during the test.

1.3. Facilities and Accreditations

1.3.1. Facilities

FCC-Registration No.: CN5031

CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd. EMC Laboratory has been registered and fully described in a report filed with the FCC (Federal Communications Commission). The acceptance letter from the FCC is maintained in our files. Designation Number: CN5031, valid time is until December 31, 2018.

ISED Registration: 11185A-1

CCIC Southern Electronic Product Testing (Shenzhen) Co., Ltd. EMC Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for the performance of radiated measurements with Registration No. 11185A-1 on Aug. 04, 2016, valid time is until Aug. 03, 2019.

NVLAP Lab Code: 201008-0

CCIC-SET is a third party testing organization accredited by NVLAP according to ISO/IEC 17025. The accreditation certificate number is 201008-0.

1.3.2. Test Environment Conditions

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

Temperature (°C):	15°C - 35°C
Relative Humidity (%):	30% -60%
Atmospheric Pressure (kPa):	86KPa-106KPa

2. 47 CFR Part 90 Requirements

2.1. Power and antenna height limits

2.1.1. Limit of Peak Output Power

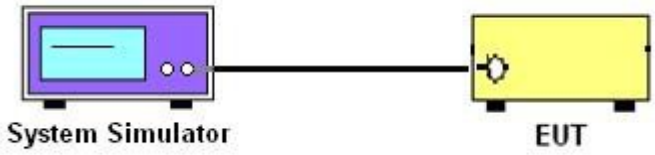
According to FCC section 90.205, The maximum allowable station effective radiated power (ERP) is dependent upon the station's antenna HAAT and required service area and will be authorized in accordance with table 2

	Service area radius (km)									
	3	8	13	16	24	32	40	48	64	80
Maximum ERP (w)	2	100	2500	2500	2500	2500	2500	2500	2500	2500
Up to reference HAAT (m)	15	15	15	27	63	125	250	410	950	2700

2.1.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.1.3. Test Setup



2.1.4. Test Procedures

1. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.

2. Set to the maximum power setting and enable the EUT transmit continuously.

3. Measure the conducted output power and record the results in the test report.

2.1.5. Test Result

Rated Power	Modulation Type	Frequency (MHz)	Measured Output Peak Power	Antenna Gain (dBd)	ERP (dBm)	ERP (W)	Limit (W)
1W	GMSK	410.125	28.87	4	32.87	1.936	2.0
		440.125	28.21		32.21	1.663	2.0
		469.125	28.96		32.96	1.977	2.0
	4FSK	410.125	28.84		32.24	1.675	2.0
		440.125	28.44		32.44	1.754	2.0
		469.125	28.93		32.93	1.963	2.0

2.2. Occupied Bandwidth

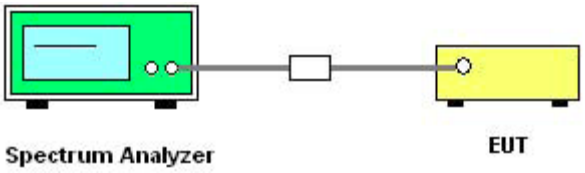
2.2.1. Limit of occupied Bandwidth

Operations using equipment designed to operate with a 12.5 kHz channel bandwidth will be authorized a 11.25 kHz bandwidth

2.2.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.2.3. Test Setup



2.2.4. Test Procedures

1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

2. Set to the maximum power setting and enable the EUT transmit continuously.

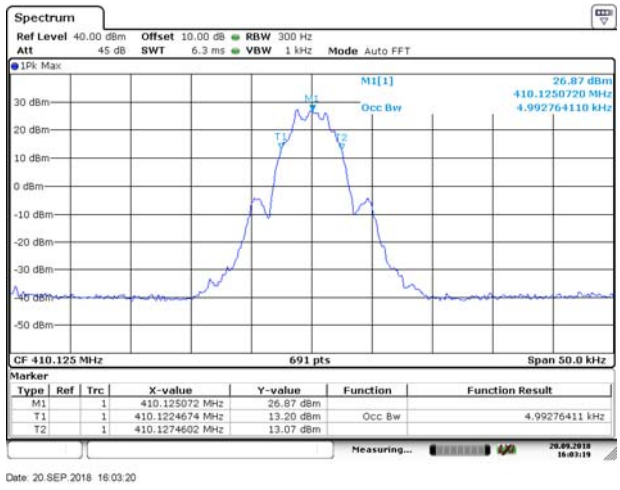
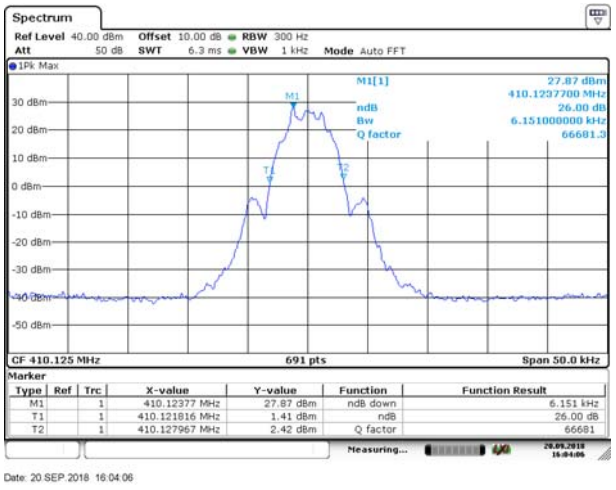
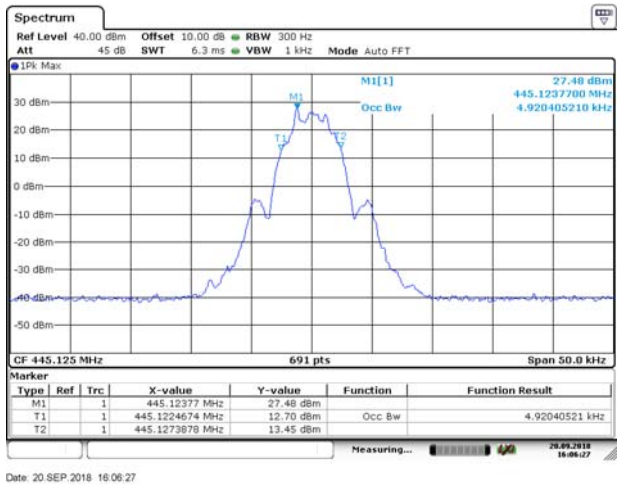
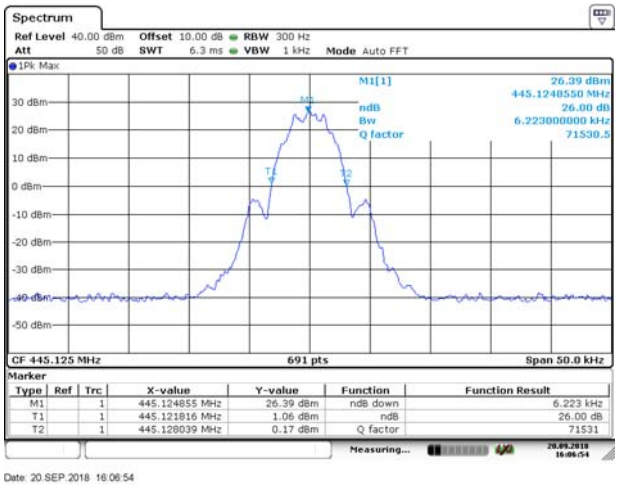
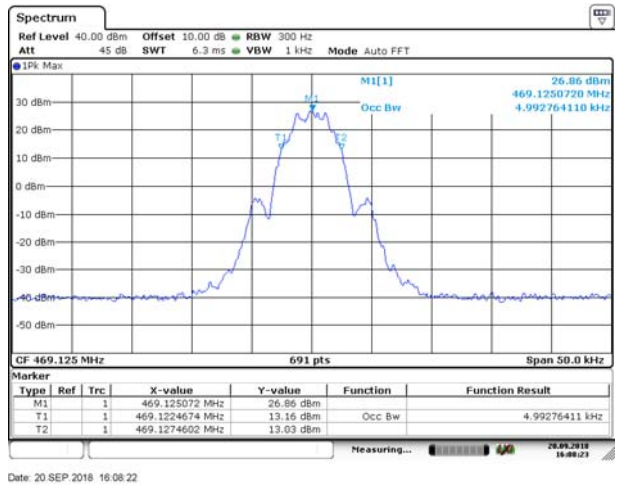
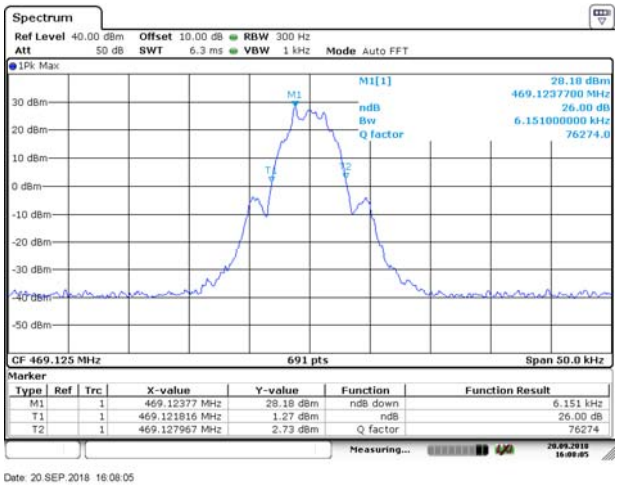
3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 300Hz. Set the Video bandwidth (VBW) = 1 KHz. Span=50KHz, Detector=peak; Sweep time=AUTO; Set 99% Occupied Bandwidth and 26dB Occupied Bandwidth

4. Measure and record the results in the test report.

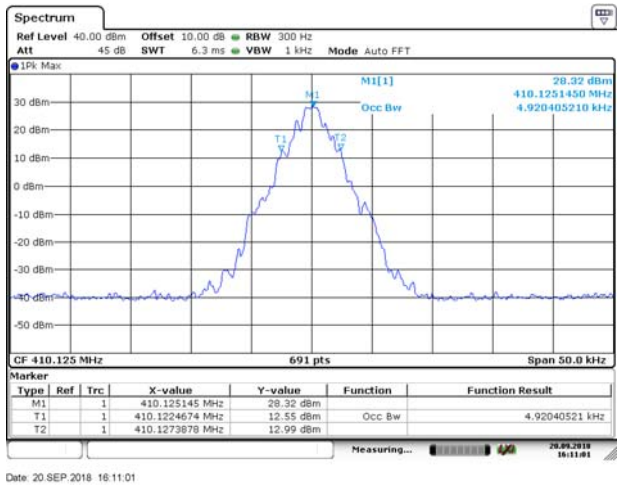
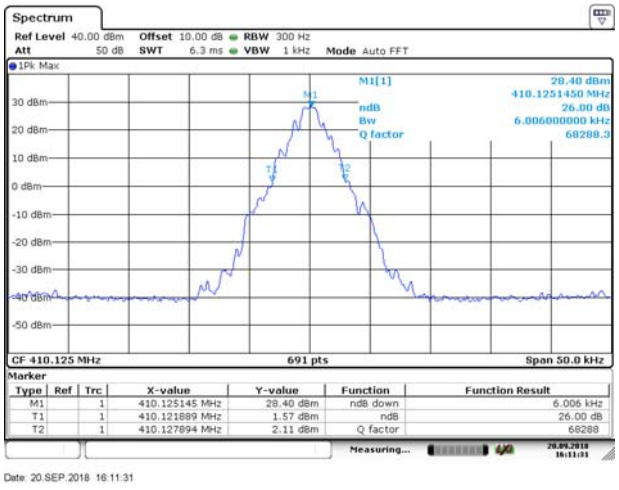
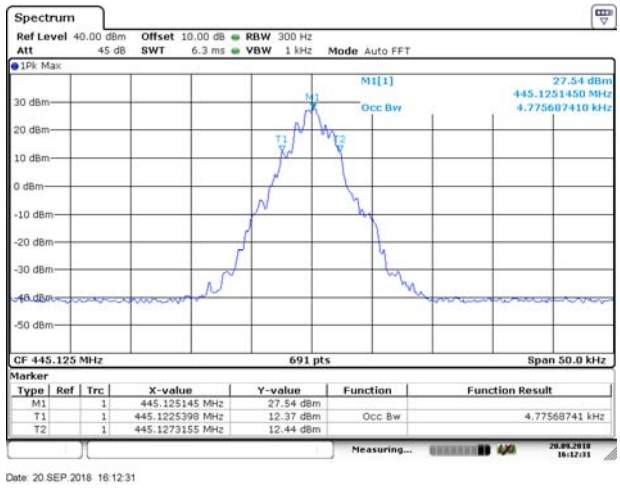
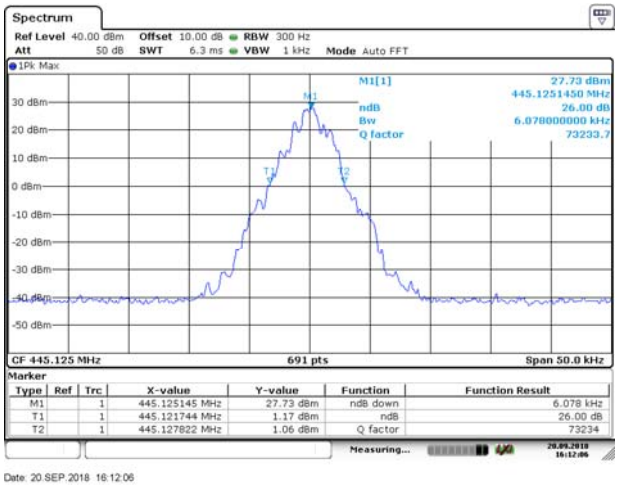
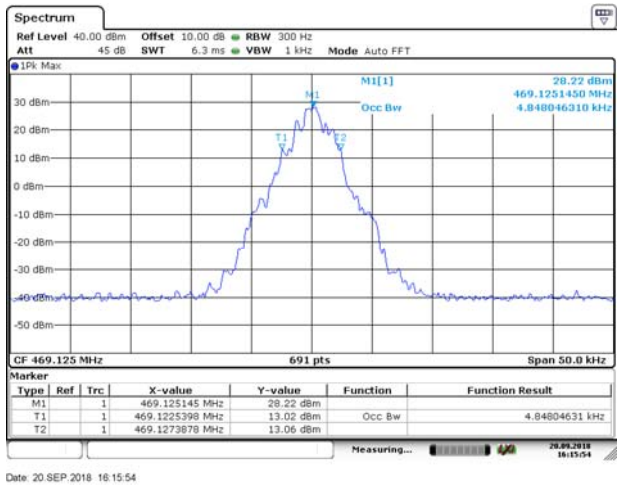
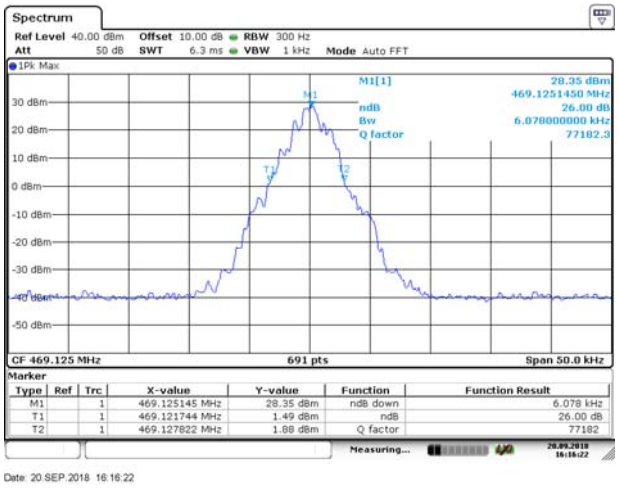
2.2.5. Test Results

Modulation Type	Frequency (MHz)	99% Bandwidth (KHz)	-26 dB Bandwidth (KHz)	Limits(kHz)	Result
GMSK	410.125	4.99	6.15	≤11.25	PASS
	440.125	4.92	6.22	≤11.25	PASS
	469.125	4.99	6.15	≤11.25	PASS
4FSK	410.125	4.92	6.01	≤11.25	PASS
	440.125	4.78	6.08	≤11.25	PASS
	469.125	4.85	6.08	≤11.25	PASS

GMSK:

410.125MHz 99%OBW	410.125MHz 26dB Bandwidth
	
440.125MHz 99%OBW	440.125MHz 26dB Bandwidth
	
469.125MHz 99%OBW	469.125MHz 26dB Bandwidth
	

4FSK:

410.125MHz 99%OBW	410.125MHz 26dB Bandwidth
	
440.125MHz 99%OBW	440.125MHz 26dB Bandwidth
	
469.125MHz 99%OBW	469.125MHz 26dB Bandwidth
	

2.3. Emission Mask

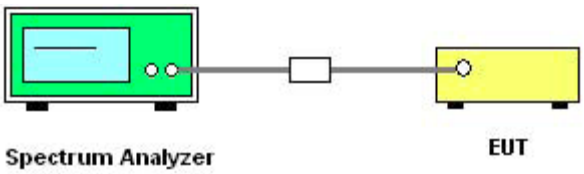
2.3.1. Limit of Emission Mask

According to §90.210(d)
Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:
(1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB.
(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(f_d−2.88 kHz) dB.
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

2.3.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.3.3. Test Setup



2.3.4. Test Procedure

1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator.

   The path loss was compensated to the results for each measurement.

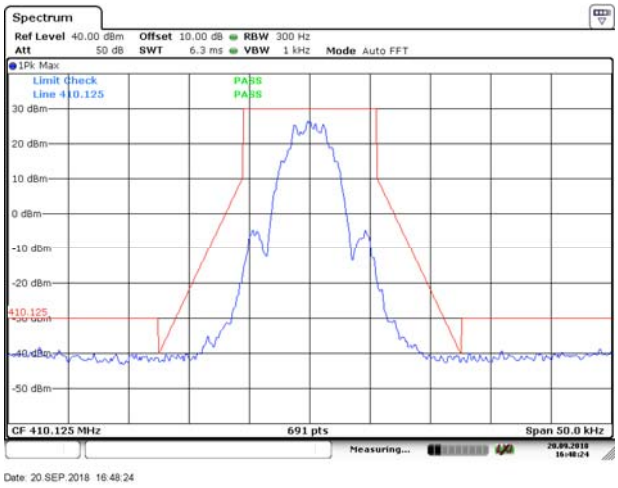
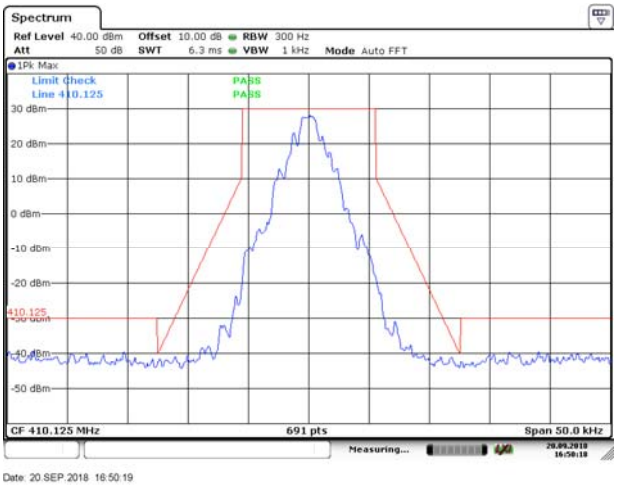
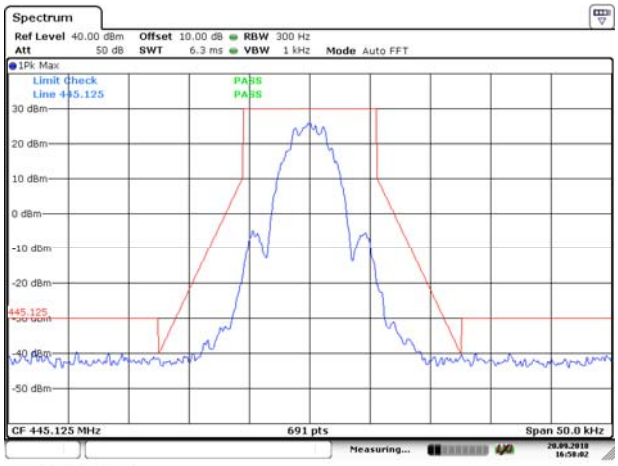
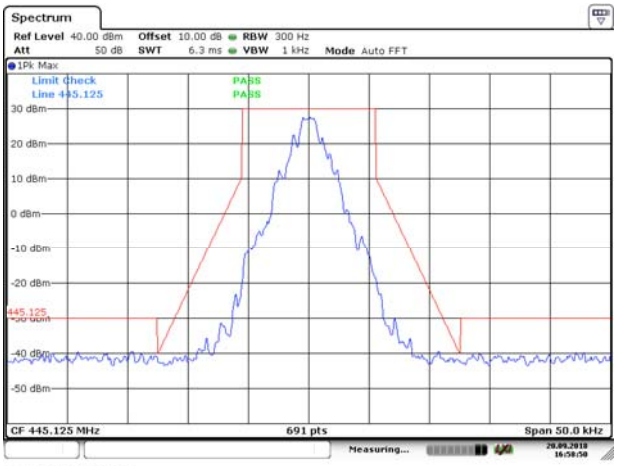
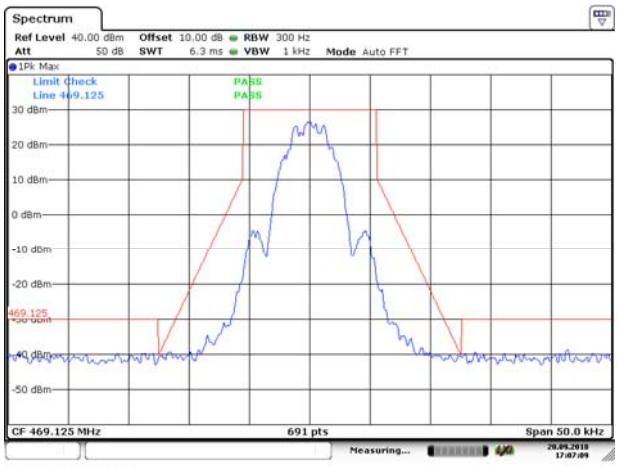
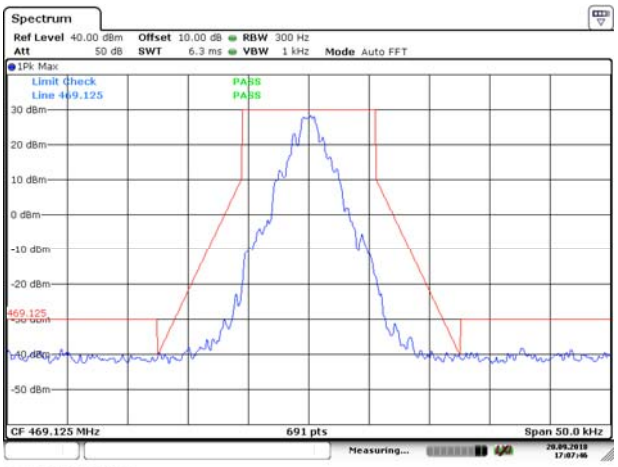
2. Set to the maximum power setting and enable the EUT transmit continuously.

3. Set the EUT into the maximum power emission state :

4. according §90.210(d)(1)(2)(3)(4) to set Emission mask limit

4. Measure and record the results in the test report.

2.3.5. Test Results of Conducted Band Edges

410.125MHz GMSK	410.125MHz 4FSK
	
440.125MHz GMSK	440.125MHz 4FSK
	
469.125MHz GMSK	469.125MHz 4FSK
	

2.4. Frequency Stability

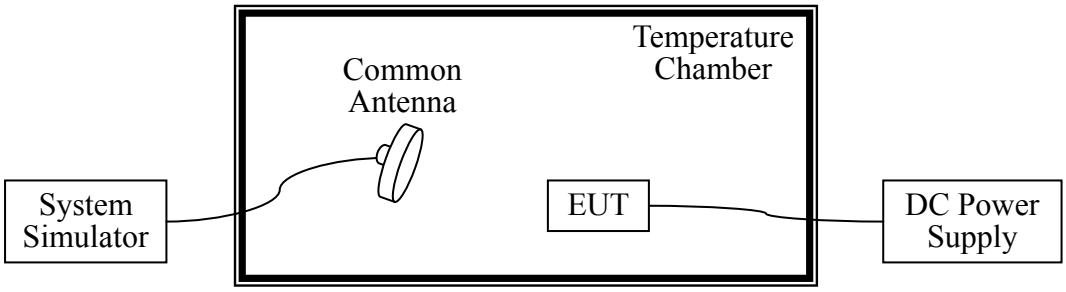
2.4.1. Limit of Frequency Stability

According to FCC section 90.213, In the 421–512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm

2.4.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.4.3. Test Setup



2.4.4. Test Procedures

1. The EUT was set up in the thermal chamber and connected with the system simulator.
2. After temperature stabilization for approximately 20 minutes, the lower, the middle and the highest frequency for was measured by the RF Communication Test Set and recorded, For Frequency stability Vs. Voltage the EUT was connected to a DC power supply and the voltage was adjusted in the required ranges

2.4.5. Test Results

DC Voltage (V)	Frequency （MHz）	Temperature (℃)	Frequency error（Hz）	Measure (ppm)	Limit (ppm)	Result
20	410.125	-30	643	1.57	2.5	Pass
		-20	765	**1.87**		Pass
		-10	598	1.46		Pass
		0	705	1.72		Pass
		10	659	1.61		Pass
		20	741	1.81		Pass
		30	669	1.63		Pass
		40	578	1.41		Pass
		50	396	0.97		Pass
20	440.125	-30	665	1.51		Pass
		-20	487	1.11		Pass
		-10	385	0.87		Pass
		0	605	1.37		Pass
		10	582	1.32		Pass
		20	580	1.32		Pass
		30	405	0.92		Pass
		40	521	1.18		Pass
		50	385	0.87		Pass
20	469.125	-30	258	0.55		Pass
		-20	147	0.31		Pass
		-10	459	0.98		Pass
		0	378	0.81		Pass
		10	296	0.63		Pass
		20	-220	0.47		Pass
		30	524	1.12		Pass
		40	498	1.06		Pass
		50	295	0.63		Pass
9	410.125	20	451	1.10		Pass
30		20	365	0.89		Pass
9	440.125	20	158	0.36		Pass
30		20	295	0.67		Pass
9	469.125	20	288	0.61		Pass
30		20	265	0.56		Pass

2.5. Transmitter Frequency Behavior

2.5.1. Limit of Transmitter Frequency Behavior

According to FCC section 90.214:
Transmitters designed to operate in the 150-174 MHz and 421-512 MHz frequency bands must maintain transient frequencies within the maximum frequency difference limits during the time intervals indicated:

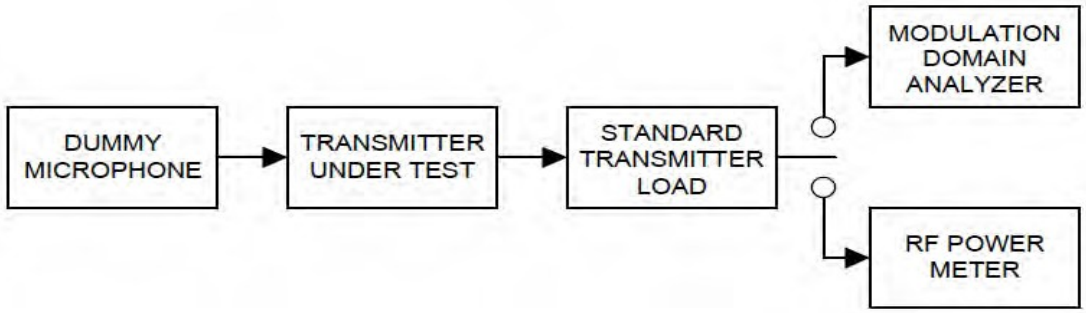
Time intervals1 2	Maximum frequency difference3	All equipment	
		150 to 174 MHz	421 to 512 MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 kHz Channels			
t1[4]	±25.0 kHz	5.0 ms	10.0 ms
t2	±12.5 kHz	20.0 ms	25.0 ms
t3[4]	±25.0 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 kHz Channels			
t1[4]	±12.5 kHz	5.0 ms	10.0 ms
t2	±6.25 kHz	20.0 ms	25.0 ms
t3[4]	±12.5 kHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 kHz Channels			
t1[4]	±6.25 kHz	5.0 ms	10.0 ms
t2	±3.125 kHz	20.0 ms	25.0 ms
t3[4]	±6.25 kHz	5.0 ms	10.0 ms

1_{on} is the instant when a 1 kHz test signal is completely suppressed, including any capture time due to phasing.
t_1 is the time period immediately following ton.
t_2 is the time period immediately following t1.
t_3 is the time period from the instant when the transmitter is turned off until toff.
t_{off} is the instant when the 1 kHz test signal starts to rise.
[2] During the time from the end of t2 to the beginning of t3, the frequency difference must not exceed the limits specified in §90.213.
[3] Difference between the actual transmitter frequency and the assigned transmitter frequency.
[4] If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

2.5.2. Measuring Instruments

The measuring equipment is listed in the section 3 of this test report.

2.5.3. Test Setup

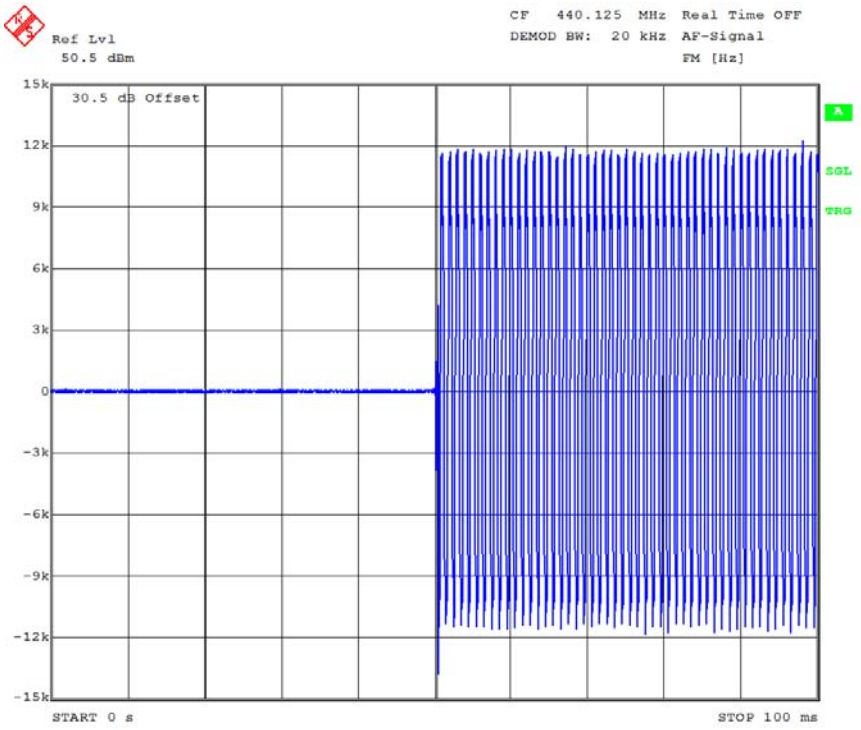


2.5.4. Test Procedures

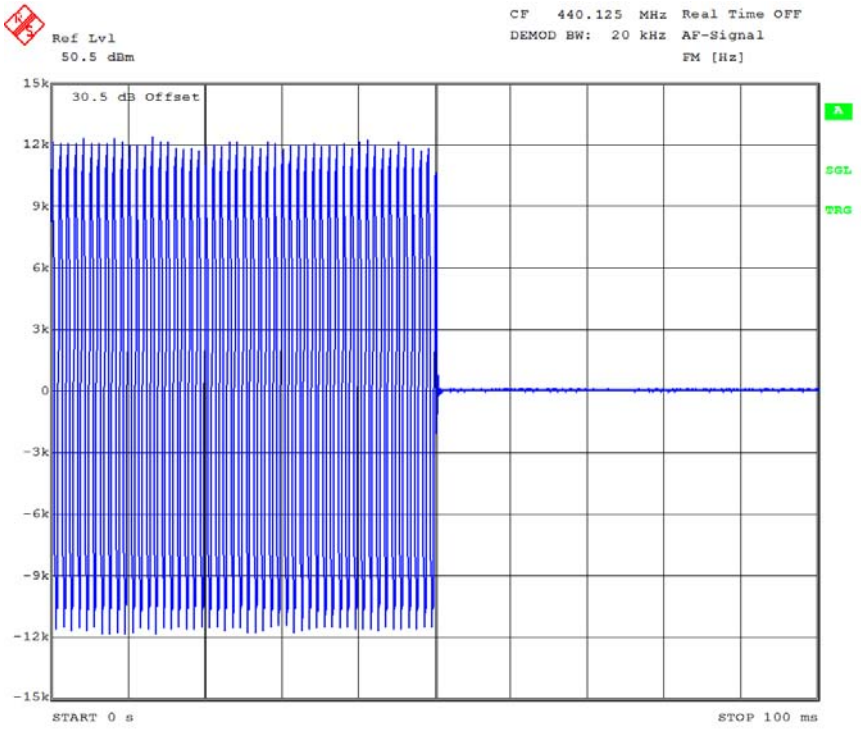
a) Connect the equipment as illustrated.
b) Connect the output of the standard transmitter load to the RF power meter. Supply sufficient attenuation via the RF attenuator to provide a level that is approximately 40 dB below the maximum allowable input to the modulation domain analyzer.
c) Unkey the transmitter.
d) Disconnect the RF power meter and connect the modulation domain analyzer in its place. Set the envelope trigger of the modulation domain analyzer to the minimum level that will trigger when the transmitter is keyed.
e) Reduce the attenuation of the RF attenuator so that the input to the to the modulation domain analyzer is increased by 30 dB when the transmitter is keyed.
f) Set the modulation domain analyzer to trigger on the rising edge of the waveform in order to capture a single-shot turn-on of the transmitter signal.
g) Adjust the display of the modulation domain analyzer for proper viewing of the transmitter transient behavior. Set the time base reference to the left for observing the transmitter turn-on transient.
h) Key the transmitter.
i) Observe the stored display of the modulation domain analyzer. The signal trace shall be maintained within the allowable limits during the periods t1 and t2, and shall also remain within limits following t2.
j) Adjust the modulation domain analyzer to trigger on the falling edge of the transmitter waveform in order to capture a single-shot turn-off transient of the transmitter signal.
k) Adjust the display of the modulation domain analyzer for proper viewing of the transmitter transient behavior. Set the time base reference to the right for observing the transmitter turn-off transient.
l) Unkey the transmitter.
m) Observe the stored display of the modulation domain analyzer. The signal trace shall be maintained within the allowable limits during the period t3.
Note: Provide worst-case of middle channel data here

2.5.5. Test Results

Frequency (MHz)	Transmitter status	Result
440.125	Off-On	PASS
440.125	On-Off	PASS



Off-On



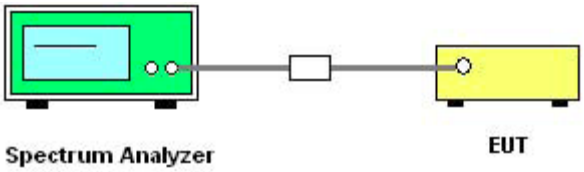
On-Off

2.6. Transmitter Conducted Spurious Emission

2.6.1. Limit of Transmitter Conducted Spurious Emission

According to FCC section 2.1051, The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in §2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.
According to FCC section 90.210, (d) Emission Mask D—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:
(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation. Radiated spurious emissions in dB = 50 + 10 log10 (power out in Watts)or an equivalent absolute level of -20 dBm (10 μW)

2.6.2. Test Setup



2.6.3. Test Procedures

1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

2. Set to the maximum power setting and enable the EUT transmit continuously.

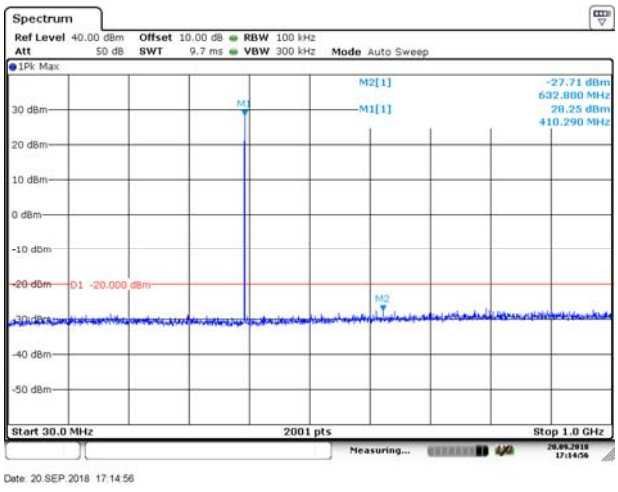
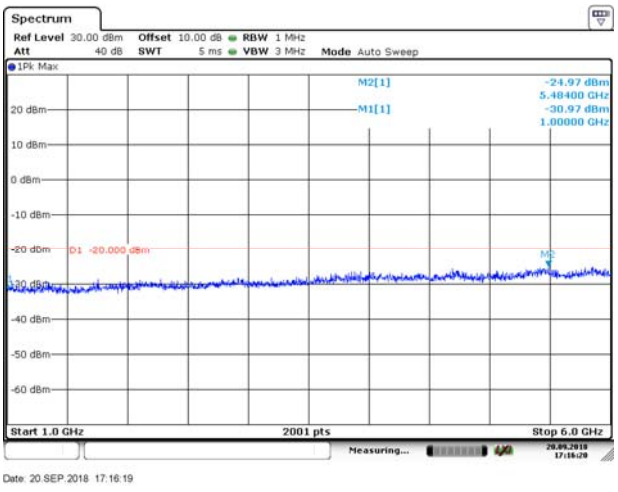
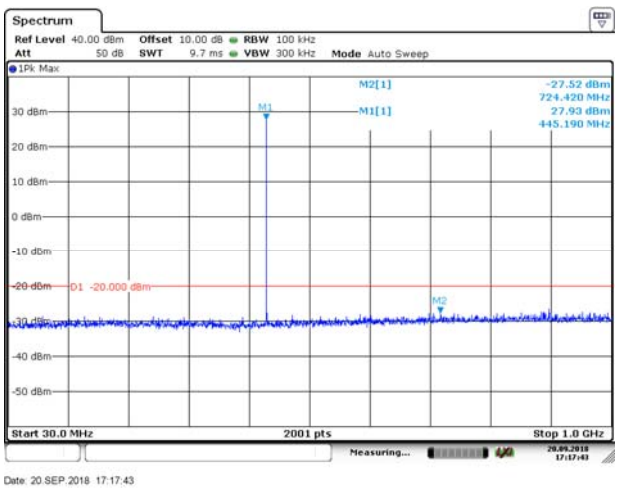
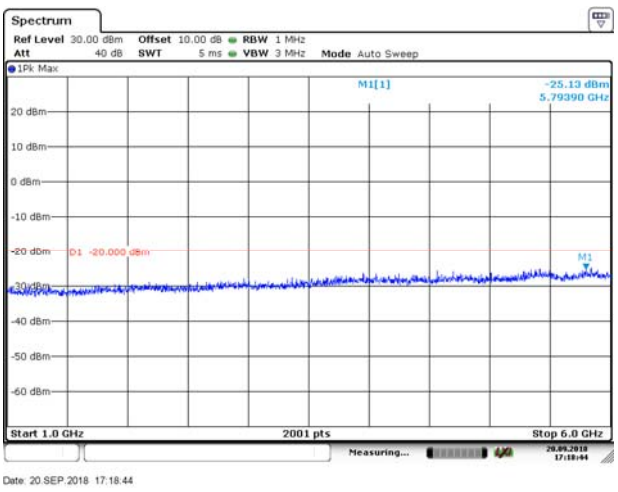
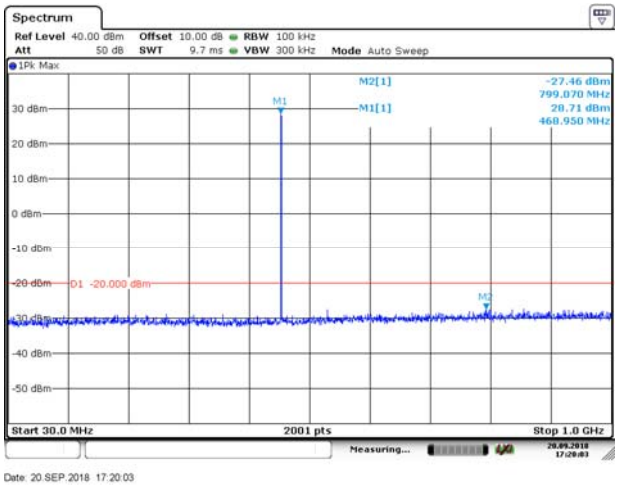
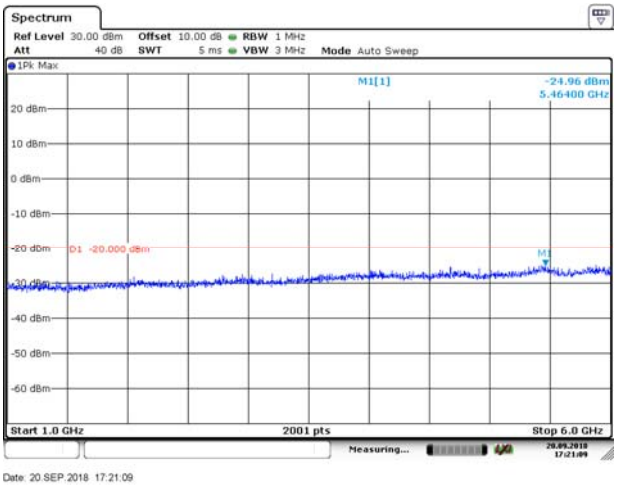
3. Set the EUT into the maximum power emission state :

4. Measure and record the results in the test report.

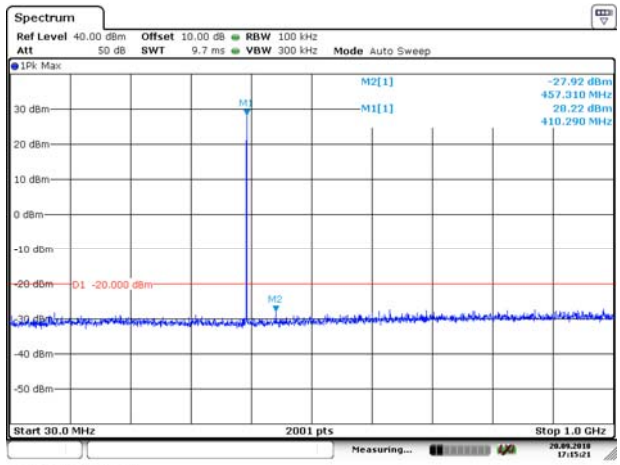
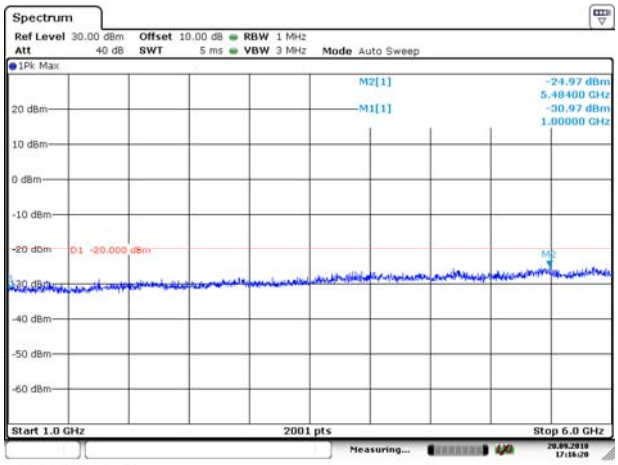
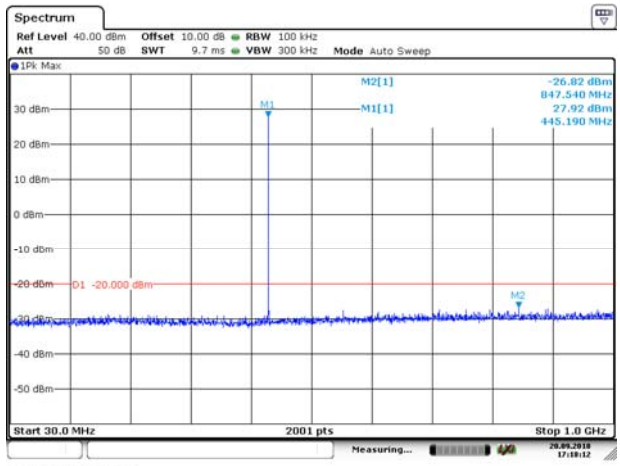
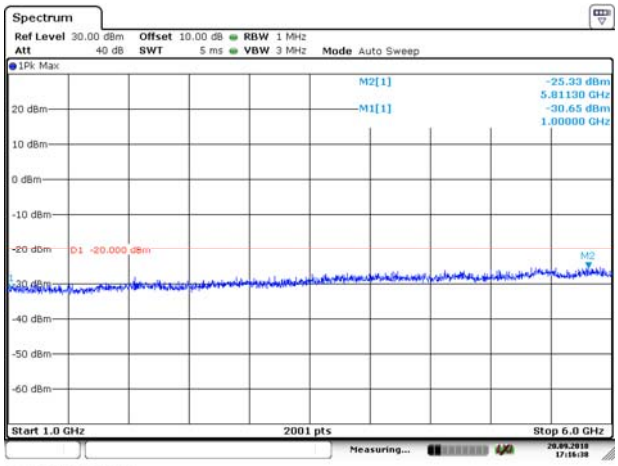
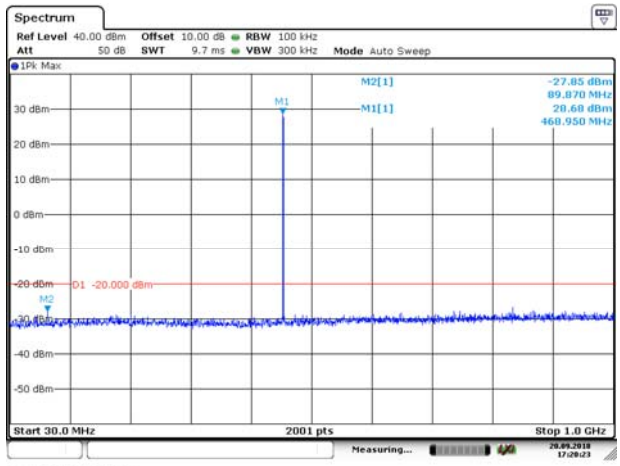
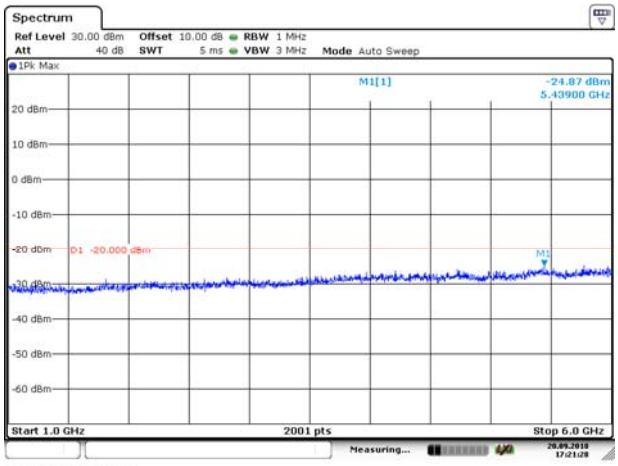
5. For measurements at frequencies below 1 GHz, the spectrum analyzer resolution bandwidth was set to 100kHz. For measurements at frequencies above 1 GHz, the spectrum analyzer resolution bandwidth was set to 1 MHz. Average detector is used for these measurements.

2.6.4. Test Results

GMSK

410.125MHz, 30M-1GHz	410.125MHz, 1GHz-6GHz
	
440.125MHz, 30M-1GHz	440.125MHz, 1GHz-6GHz
	
469.125MHz, 30M-1GHz	469.125MHz, 1GHz-6GHz
	

4FSK

410.125MHz, 30M-1GHz	410.125MHz, 1GHz-6GHz
	
440.125MHz, 30M-1GHz	440.125MHz, 1GHz-6GHz
	
469.125MHz, 30M-1GHz	469.125MHz, 1GHz-6GHz
	

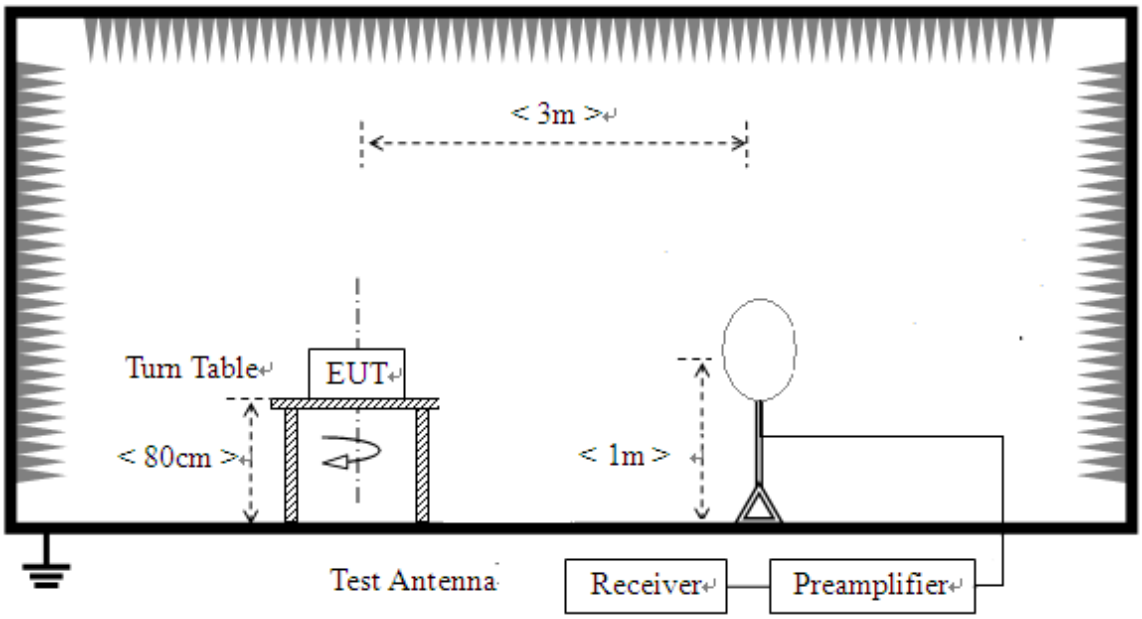
2.7. Transmitter Radiated Spurious Emission

2.7.1. Limit of Transmitter Radiated Spurious Emission

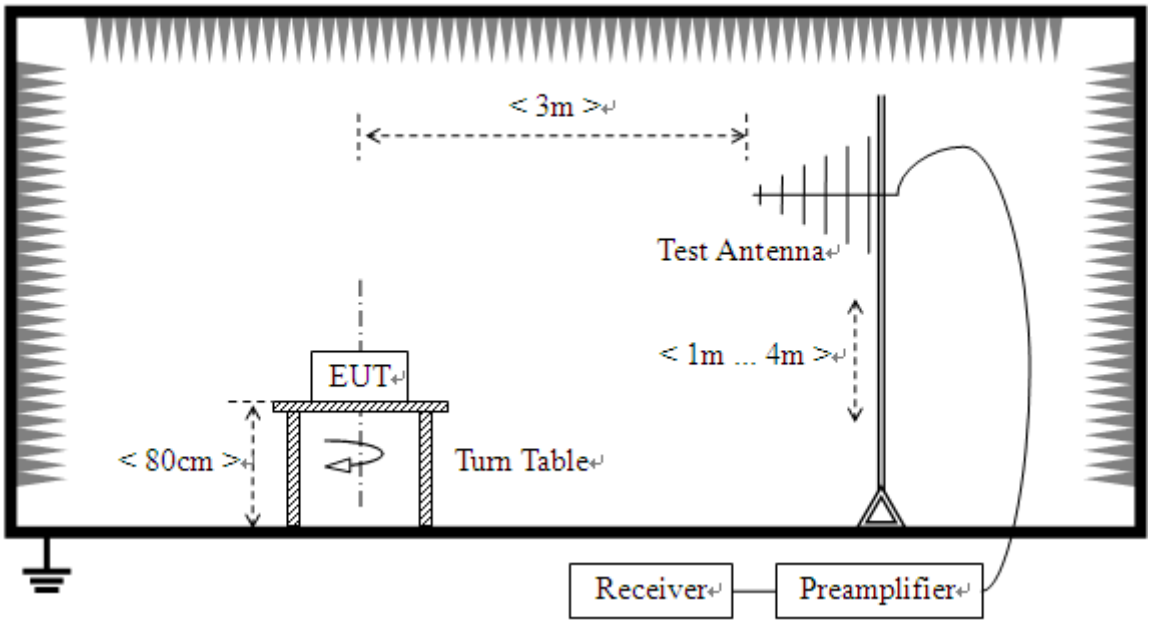
According to FCC section 2.1051 & 90.210,
(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of §2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half wave dipole antennas.
(b) The measurements specified in paragraph (a) of this section shall be made for the following equipment:
(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.
(2) All equipment operating on frequencies higher than 25 MHz.
(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.
(4) Other types of equipment as required, when deemed necessary by the Commission. On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.
Radiated spurious emissions in dB = 50 + 10 log10 (power out in Watts)or an equivalent absolute level of -20 dBm (10 μW)

2.7.2. Test Setup

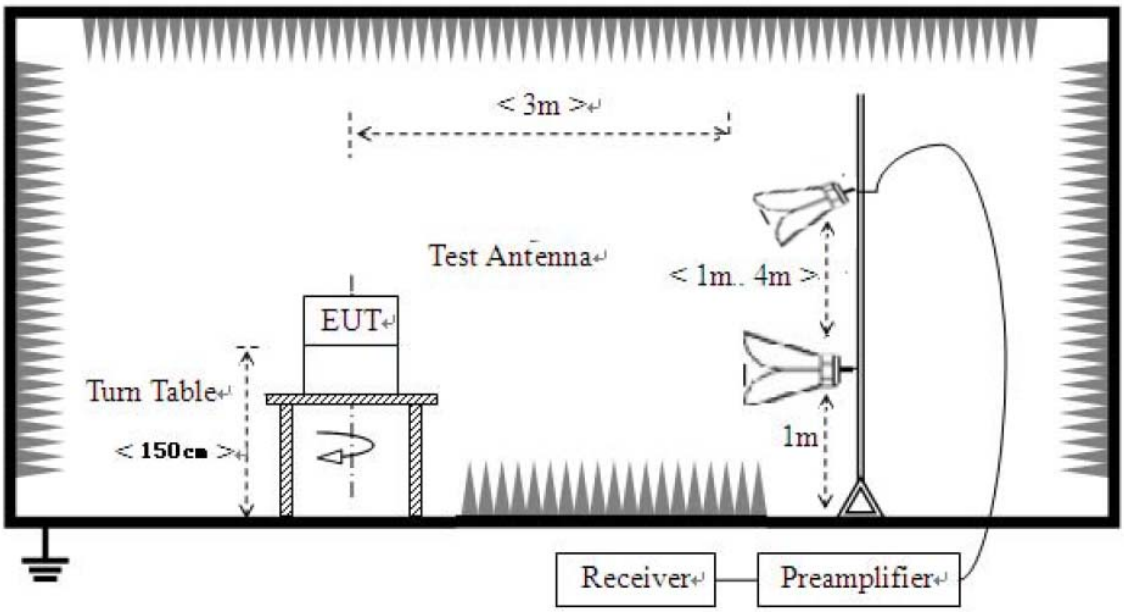
For radiated emissions from 9 KHz to 30 MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



2.7.3. Test Procedures

1. The EUT was placed on the top of a rotating table 0.8m for below 1GHz/1.5m for above 1GHz above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. Height of receiving antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported.
   Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

7. For the radiated emission test above 1GHz:

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

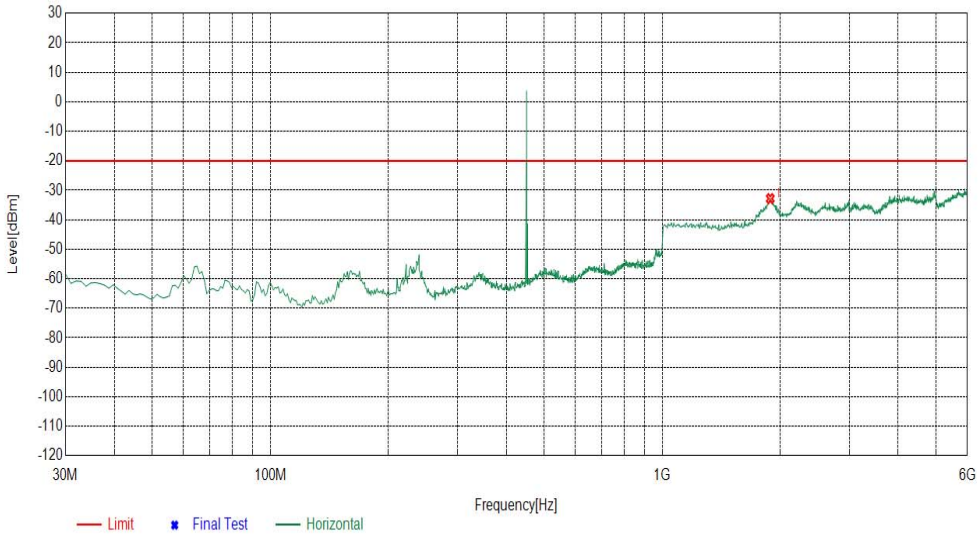
NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. All radiated emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

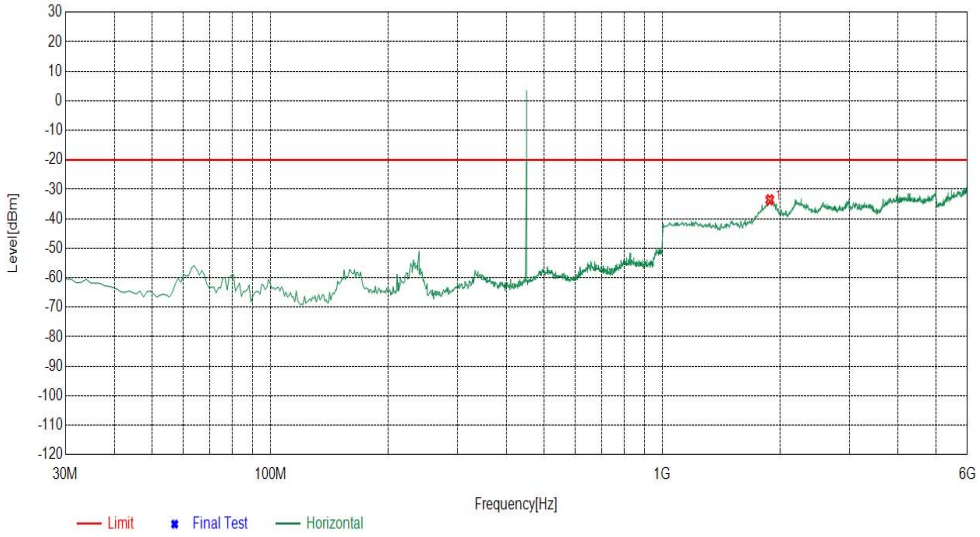
For 1GHz to 25 GHz

GMSK:

410.125MHz TX

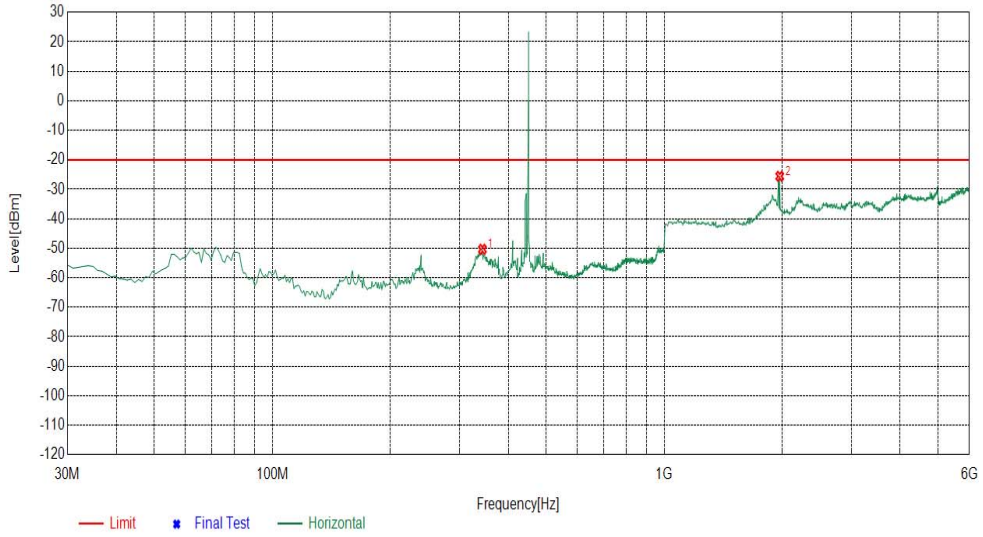


NO.	Freq. [MHz]	Reading [dBm]	Emission Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Polarity
1	1885.8859	-80.94	-32.83	-20.00	12.83	48.11	Horizontal

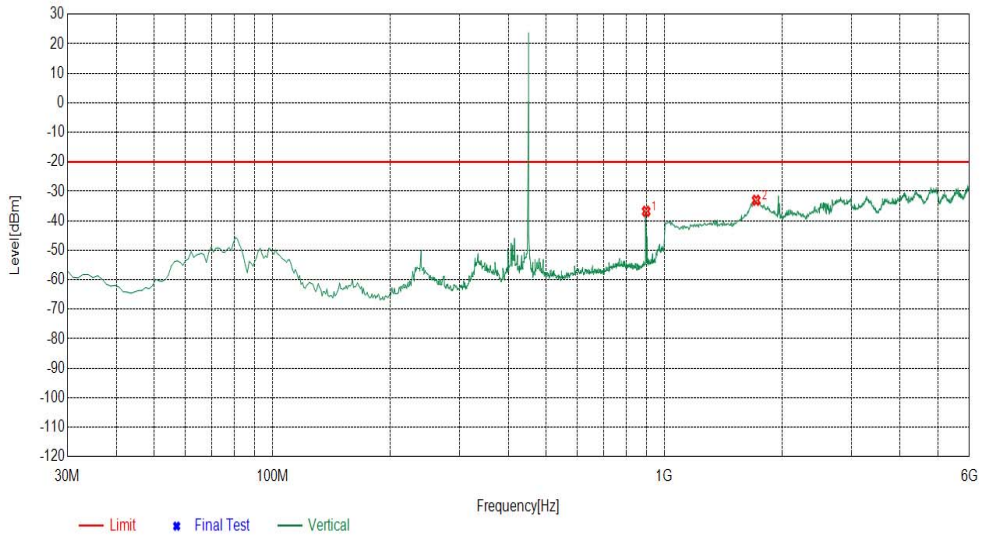


NO.	Freq. [MHz]	Reading [dBm]	Emission Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Polarity
1	1880.8809	-81.51	-33.57	-20.00	13.57	47.94	Vertical

440.125MHz TX

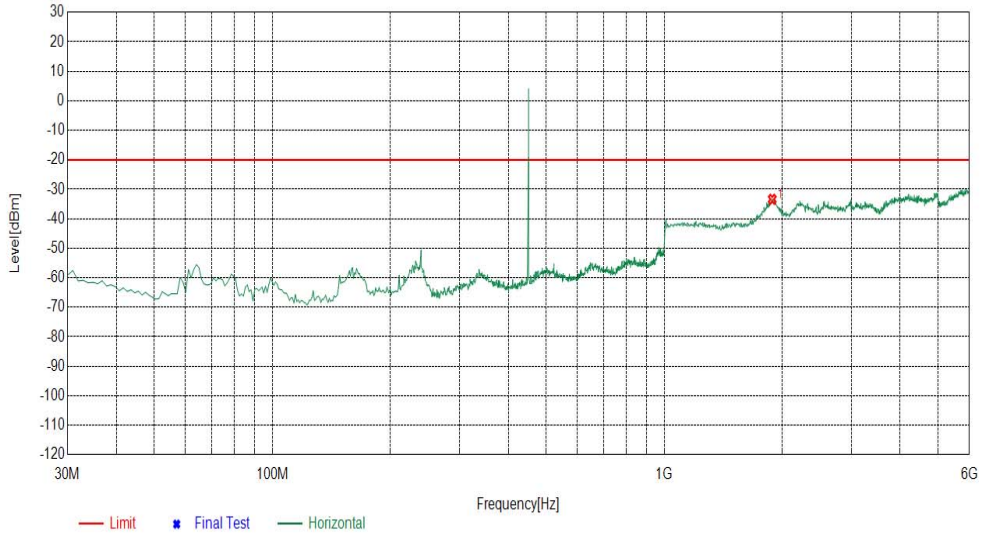


NO.	Freq. [MHz]	Reading [dBm]	Emission Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Polarity
1	343.623	-75.27	-50.33	-20.00	30.33	24.94	Horizontal
2	1970.97	-70.76	-25.58	-20.00	5.58	45.18	Horizontal

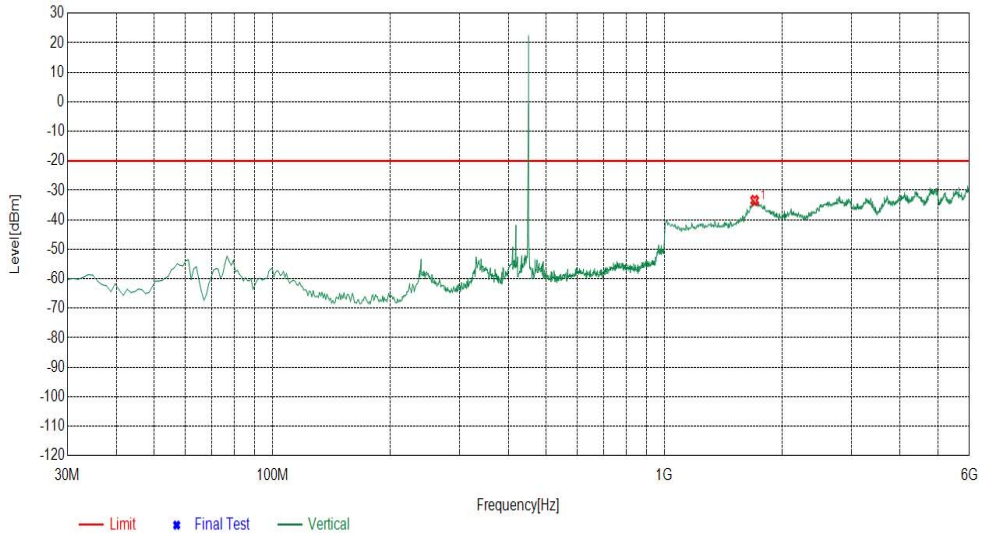


NO.	Freq. [MHz]	Reading [dBm]	Emission Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Polarity
1	899.019	-67.73	-36.80	-20.00	16.80	30.93	Vertical
2	1715.71	-81.09	-33.06	-20.00	13.06	48.03	Vertical

469.125MHz TX



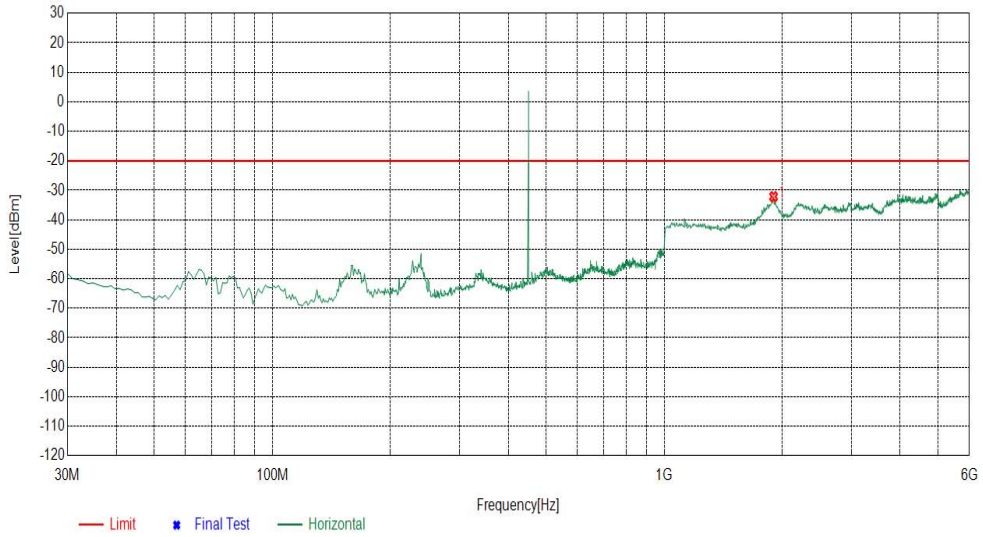
NO.	Freq. [MHz]	Reading [dBm]	Emission Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Polarity
1	1885.88	-81.49	-33.38	-20.00	13.38	48.11	Horizontal



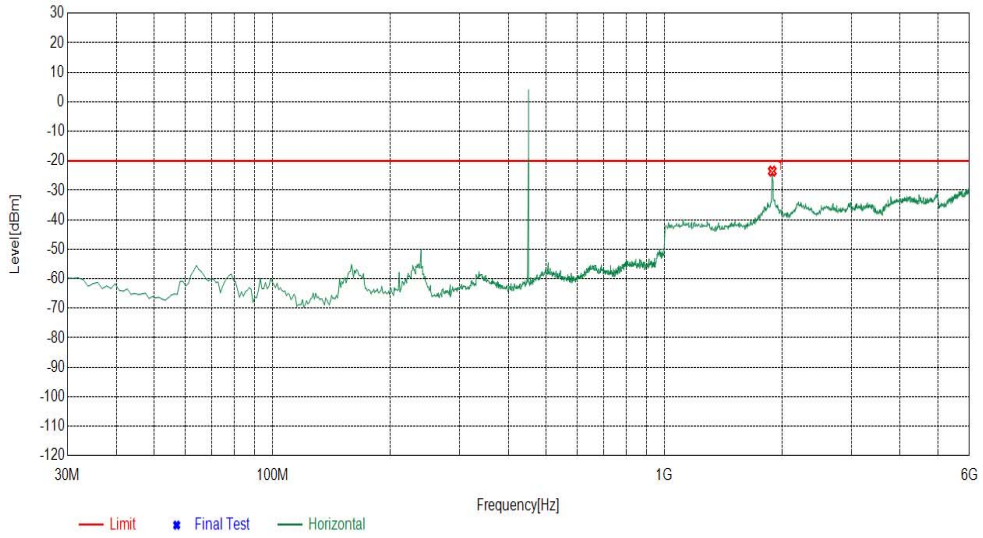
NO.	Freq. [MHz]	Reading [dBm]	Emission Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Polarity
1	1700.70	-81.78	-33.43	-20.00	13.43	48.35	Vertical

4FSK:

410.125MHz TX

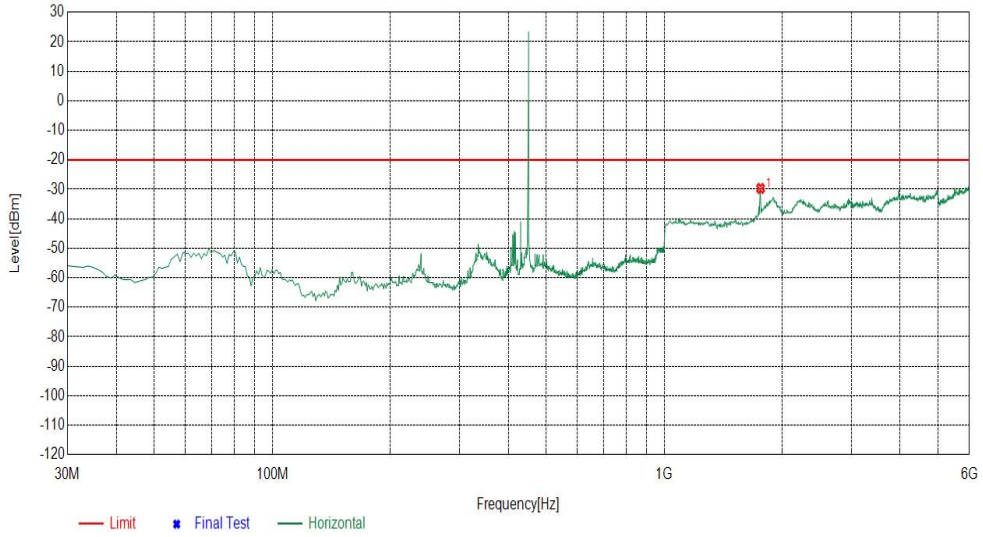


NO.	Freq. [MHz]	Reading [dBm]	Emission Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Polarity
1	1900.90	-80.72	-32.16	-20.00	12.16	48.56	Horizontal

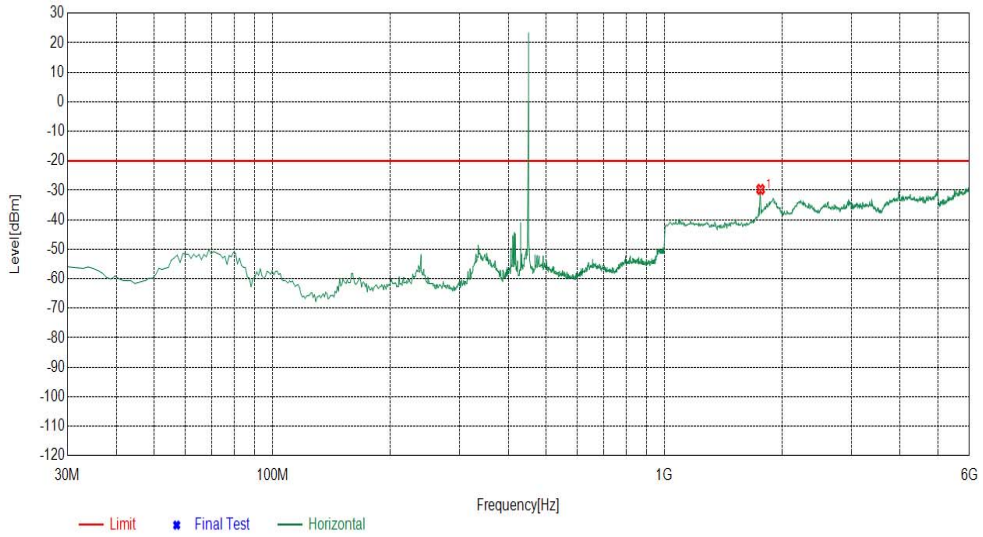


NO.	Freq. [MHz]	Reading [dBm]	Emission Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Polarity
1	1885.88	-71.62	-23.51	-20.00	3.51	48.11	Vertical

440.125MHz TX

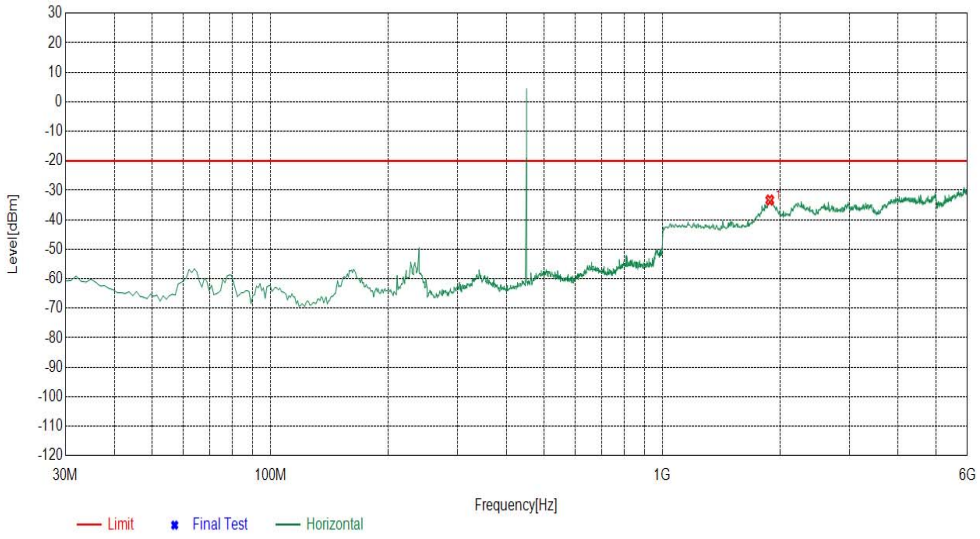


NO.	Freq. [MHz]	Reading [dBm]	Emission Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Polarity
1	1760.76	-73.36	-29.71	-20.00	9.71	43.65	Horizontal

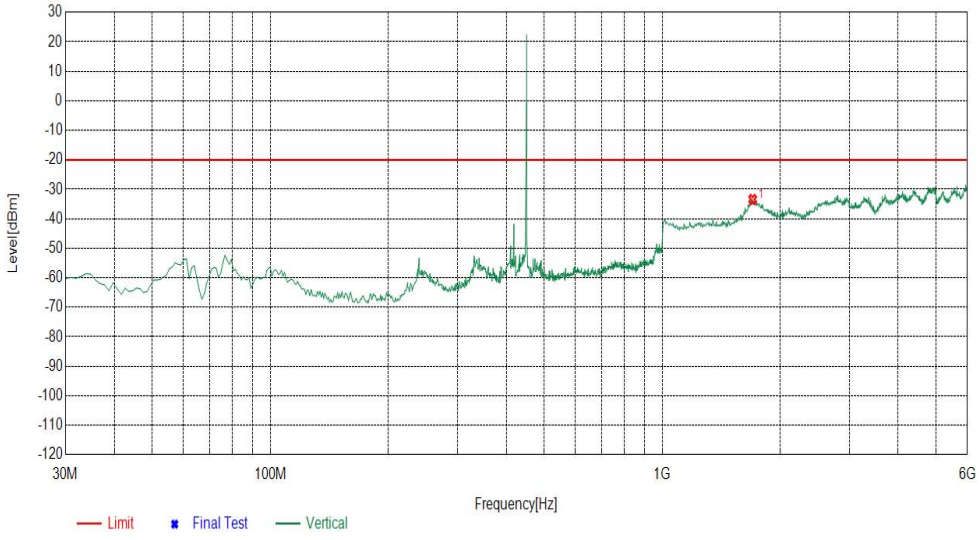


NO.	Freq. [MHz]	Reading [dBm]	Emission Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Polarity
1	1760.76	-73.36	-29.71	-20.00	9.71	43.65	Vertical

469.125MHz TX



NO.	Freq. [MHz]	Reading [dBm]	Emission Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Polarity
1	1880.88	-81.26	-33.32	-20.00	13.32	47.94	Horizontal



NO.	Freq. [MHz]	Reading [dBm]	Emission Level [dBm]	Limit [dBm]	Margin [dB]	Factor [dB]	Polarity
1	1700.70	-81.78	-33.43	-20.00	13.43	48.35	Vertical

REMARKS:

1. Emission Level(dBm) = Reading (dBm) + Correction Factor(dB)
2. Correction Factor(dB) = Antenna Factor(dB) + Cable Factor(dB)
   - Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit no need to report.
4. Margin value = Emission Level - Limit value

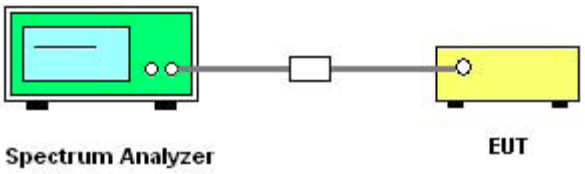
3. Receiver Conducted Spurious Emission

3.1. Antenna power conduction for receivers.

3.1.1. Antenna power conduction limits for receivers

(a) In addition to the radiated emission limits, receivers that operate (tune) in the frequency range 30 to 960 MHz and CB receivers that provide terminals for the connection of an external receiving antenna may be tested to demonstrate compliance with the provisions of §15.109 with the antenna terminals shielded and terminated with a resistive termination equal to the impedance specified for the antenna, provided these receivers also comply with the following: With the receiver antenna terminal connected to a resistive termination equal to the impedance specified or employed for the antenna, the power at the antenna terminal at any frequency within the range of measurements specified in §15.33 shall not exceed 2.0 nanowatts.

3.1.2. Test Setup



3.1.3. Test Procedures

1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.

2. Set to the maximum power setting and enable the EUT transmit continuously.

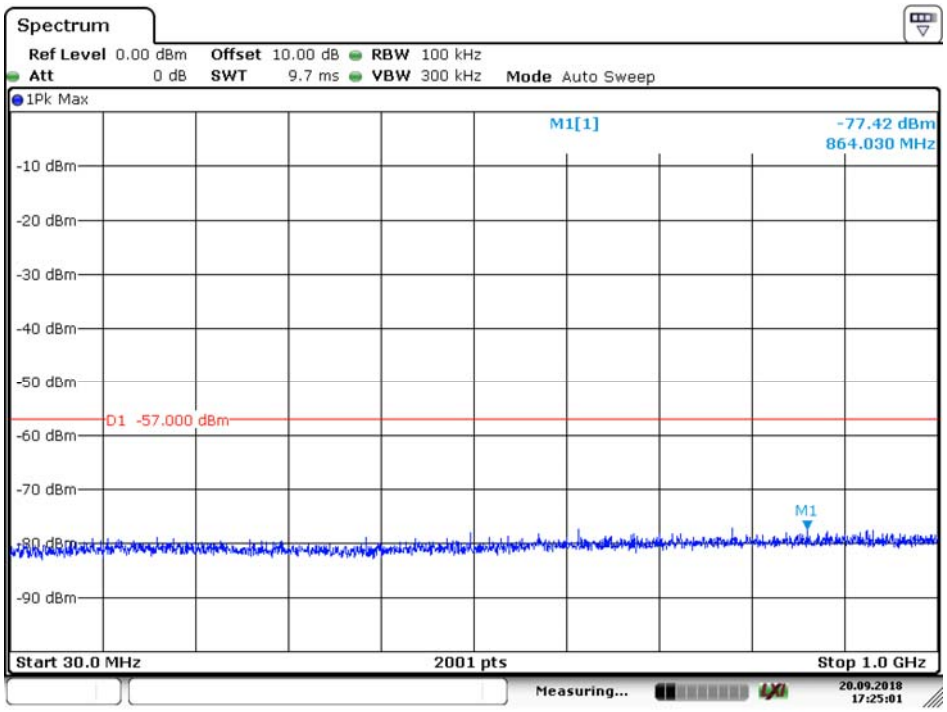
3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100KHz. below 1GHz and 1M above 1GHz, video bandwidth(VBW)=3RBW, Detector=Max Peak.

4. Measure and record the results in the test report.

3.1.4. Test Results

GMSK

410.125MHz (30MHz-6GHz)



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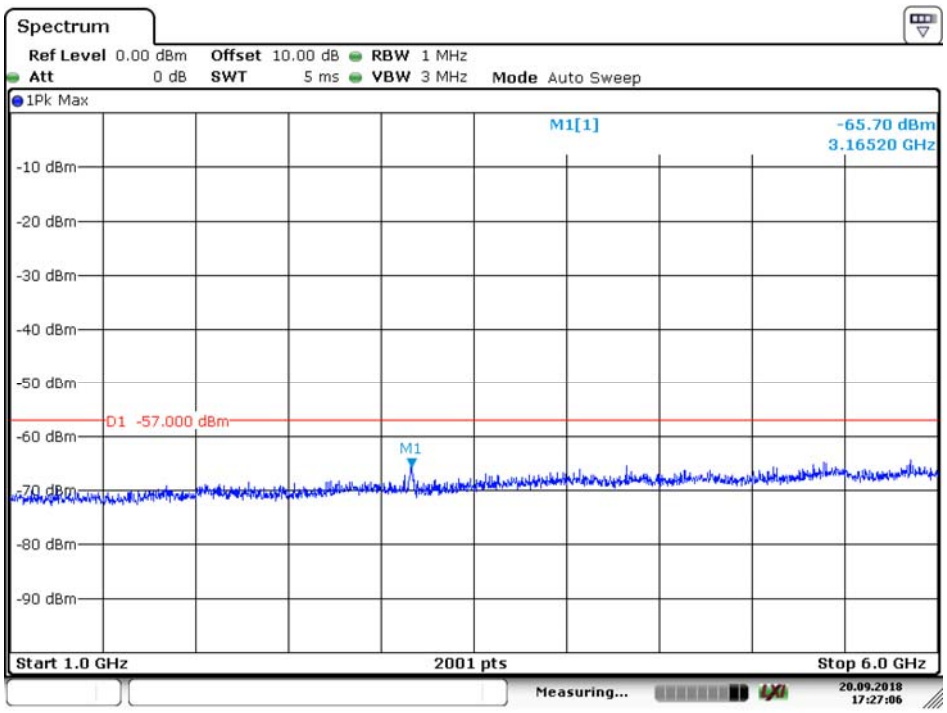
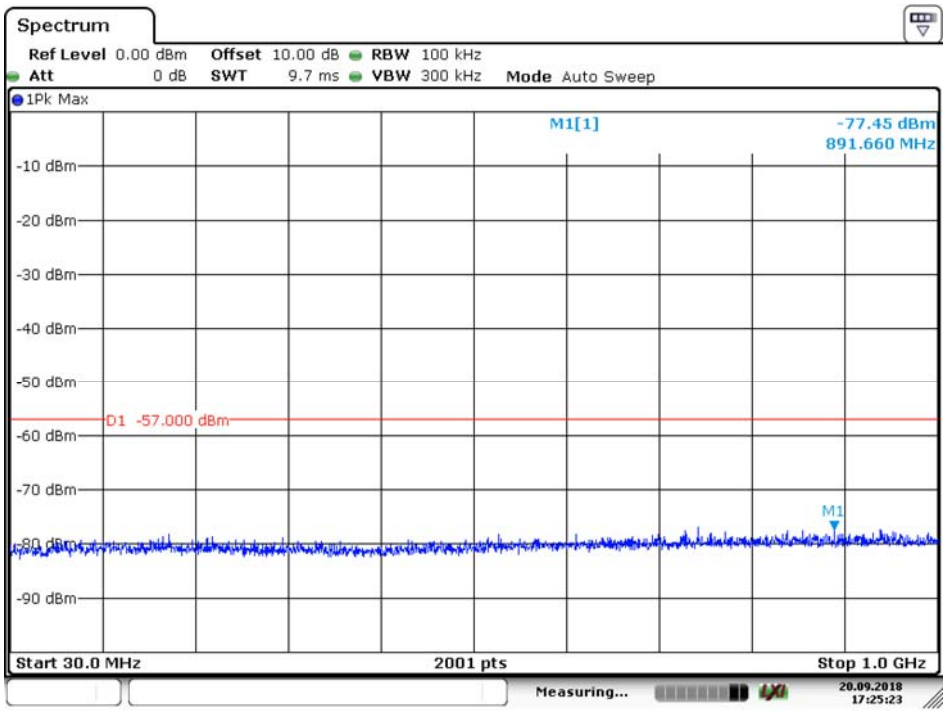


Date: 20.SEP.2018 17:27:05

440.125MHz (30MHz-6GHz)



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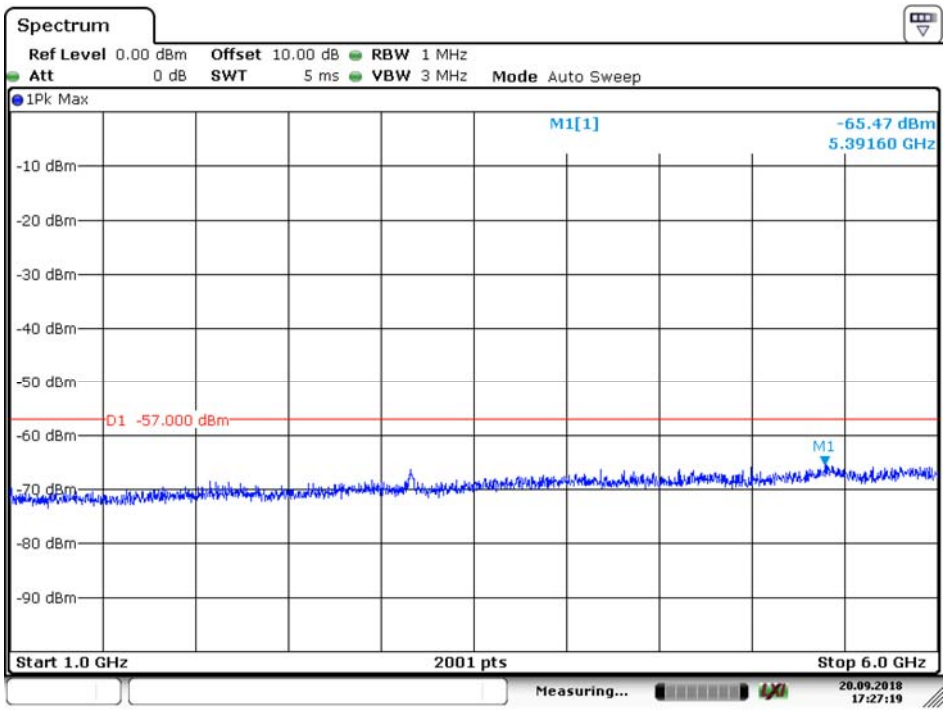

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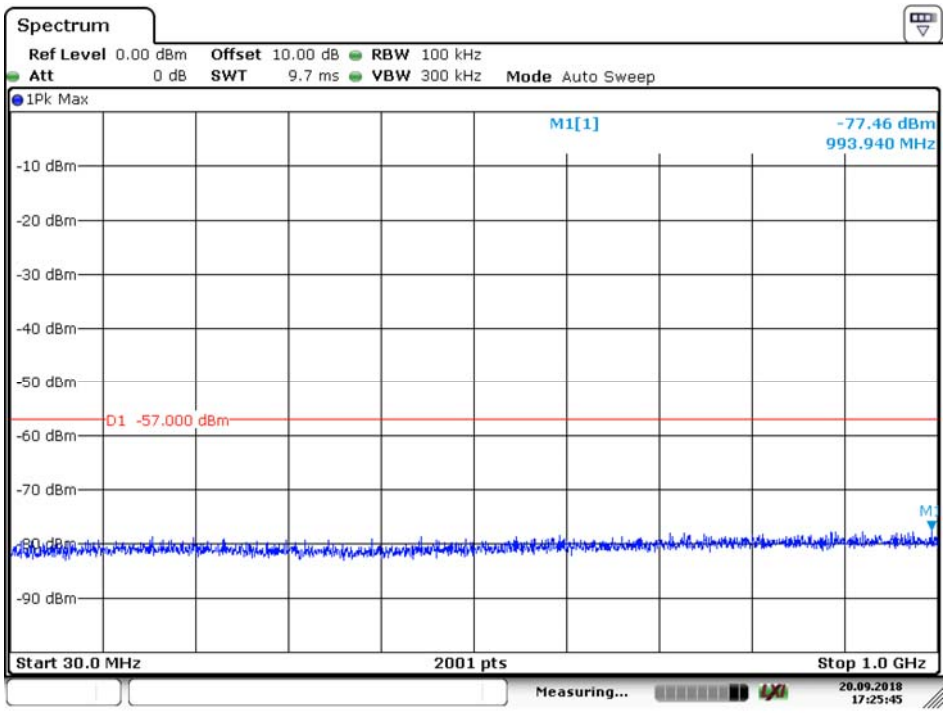
469.125MHz (30MHz-6GHz)



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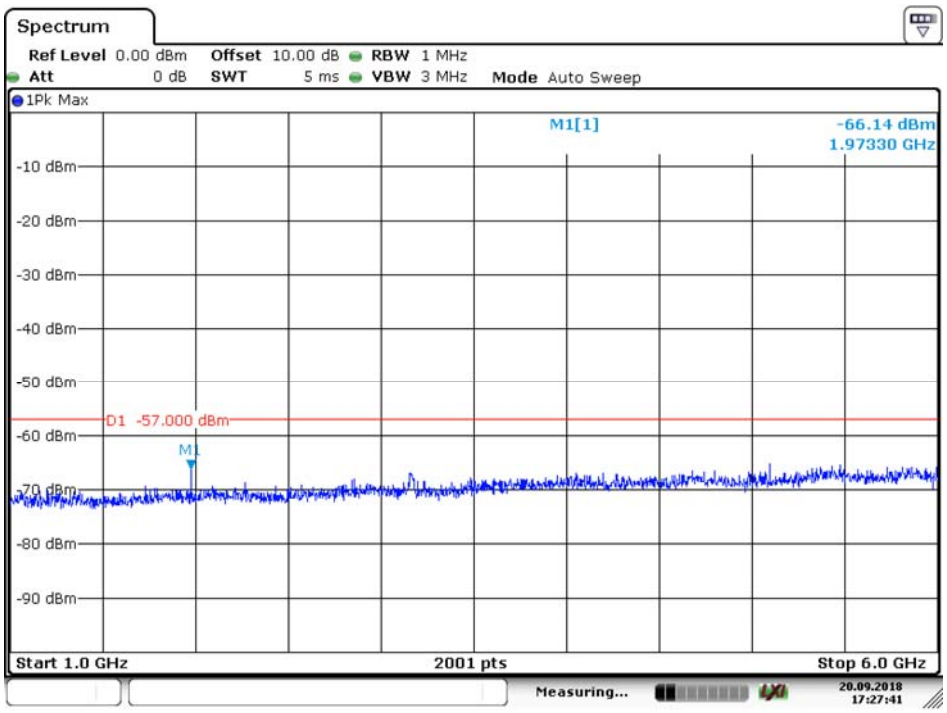

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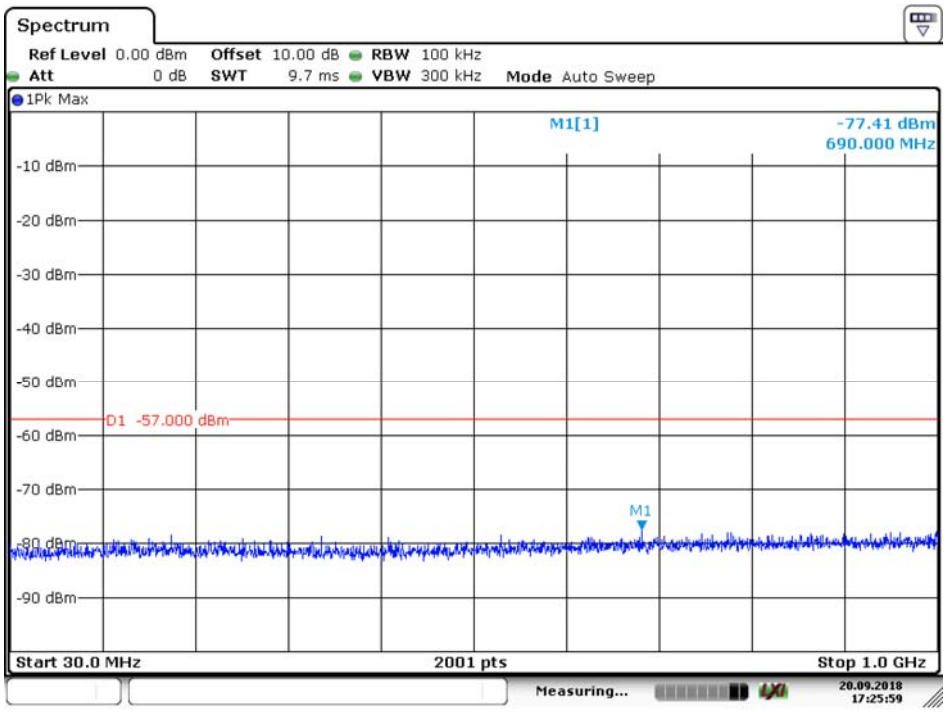
4FSK

410.125MHz (30MHz-6GHz)



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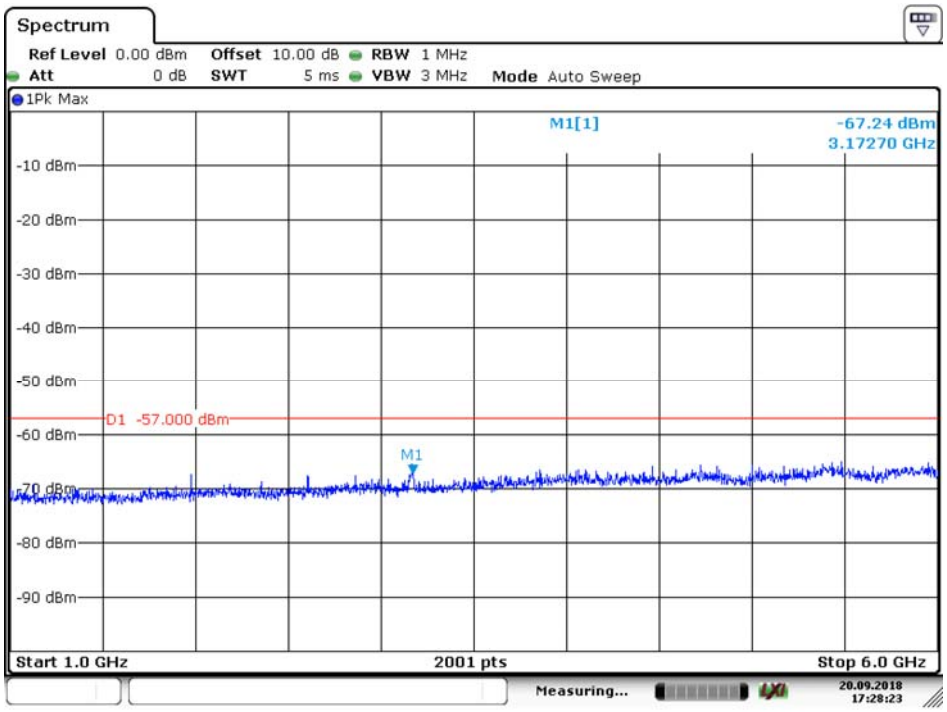
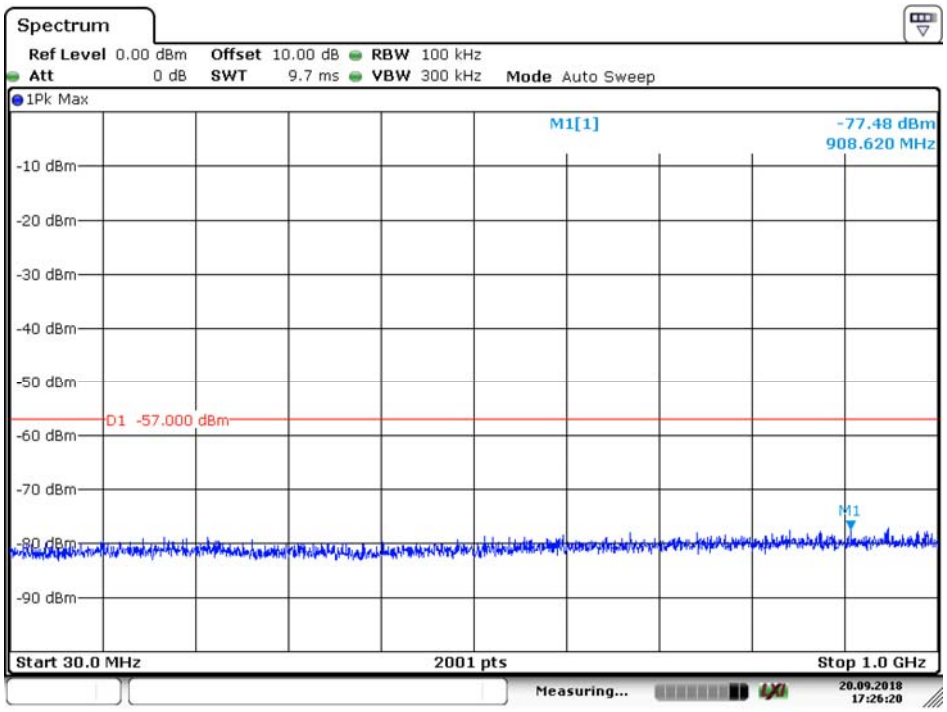
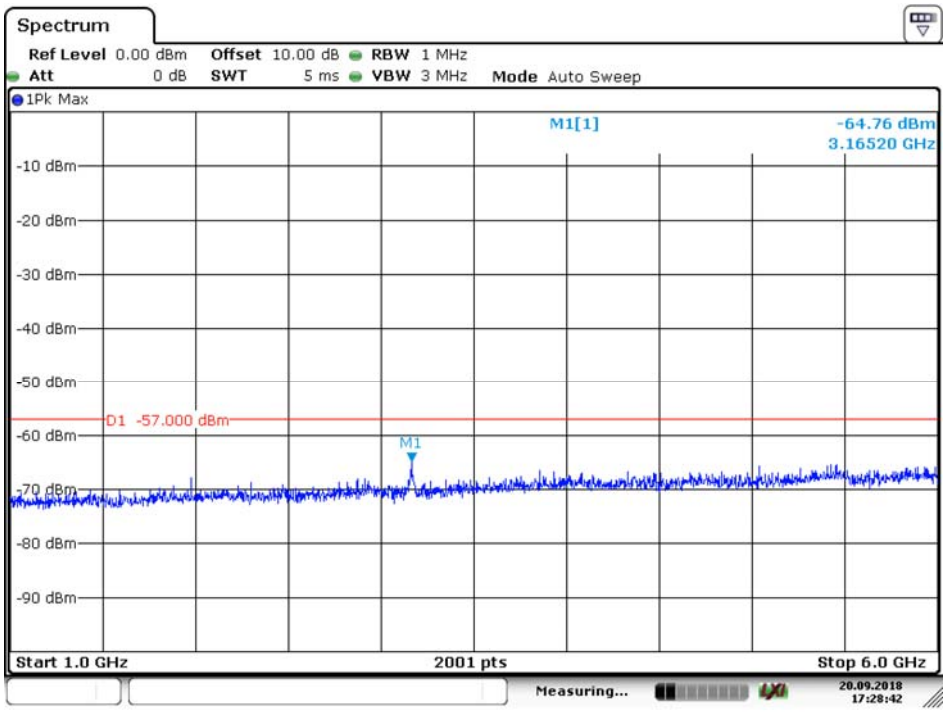


Date: 20.SEP.2018 17:28:23

440.125MHz (30MHz-6GHz)

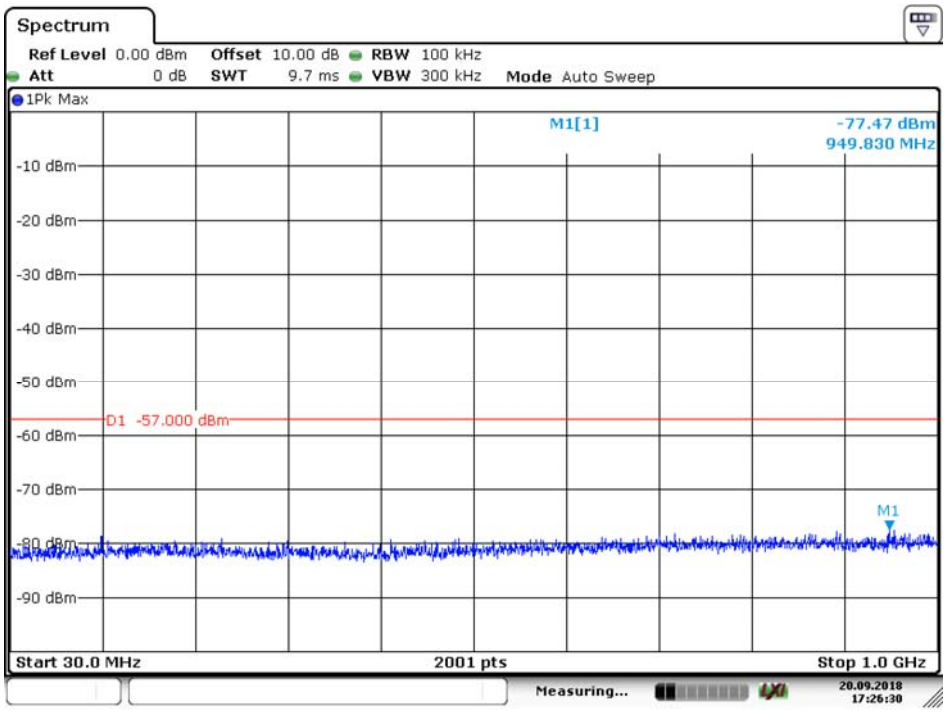


Date: 20.SEP.2018 17:26:21

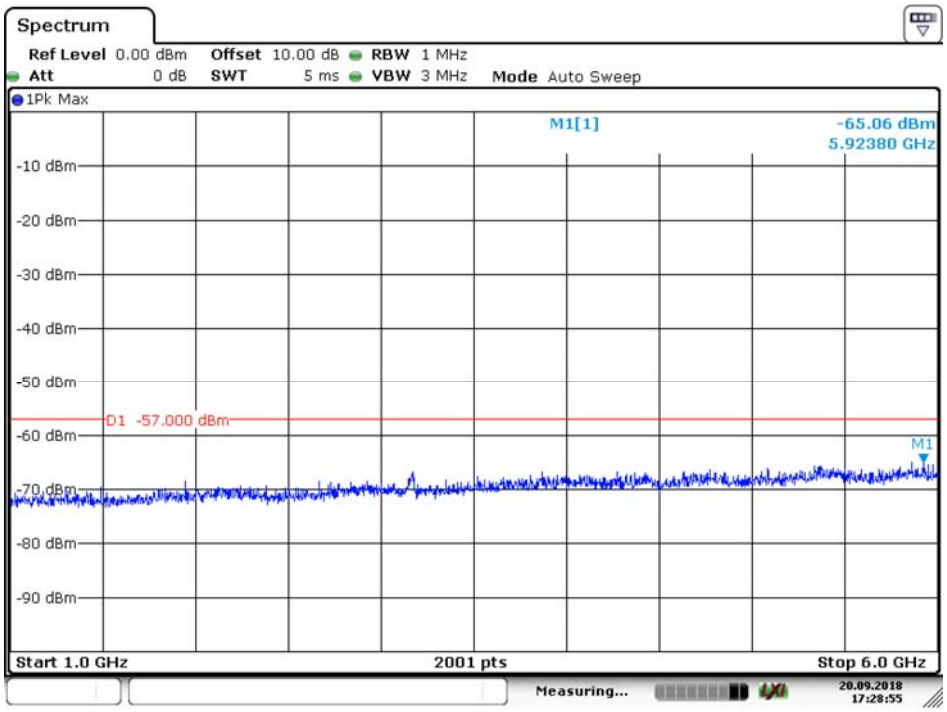


Date: 20.SEP.2018 17:28:42

469.125MHz (30MHz-6GHz)



Date: 20.SEP.2018 17:26:30



Date: 20.SEP.2018 17:28:55

3.2. Receiver Radiated Spurious Emission

3.2.1. Limit of Receiver Radiated Spurious Emission

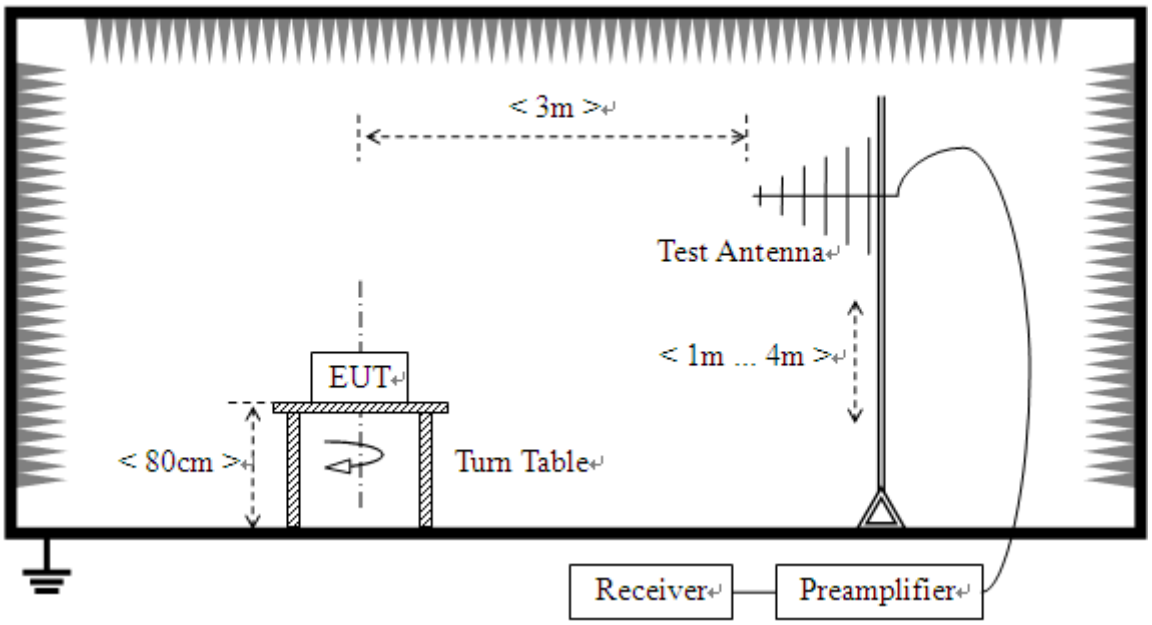
According to FCC Section 15.209

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

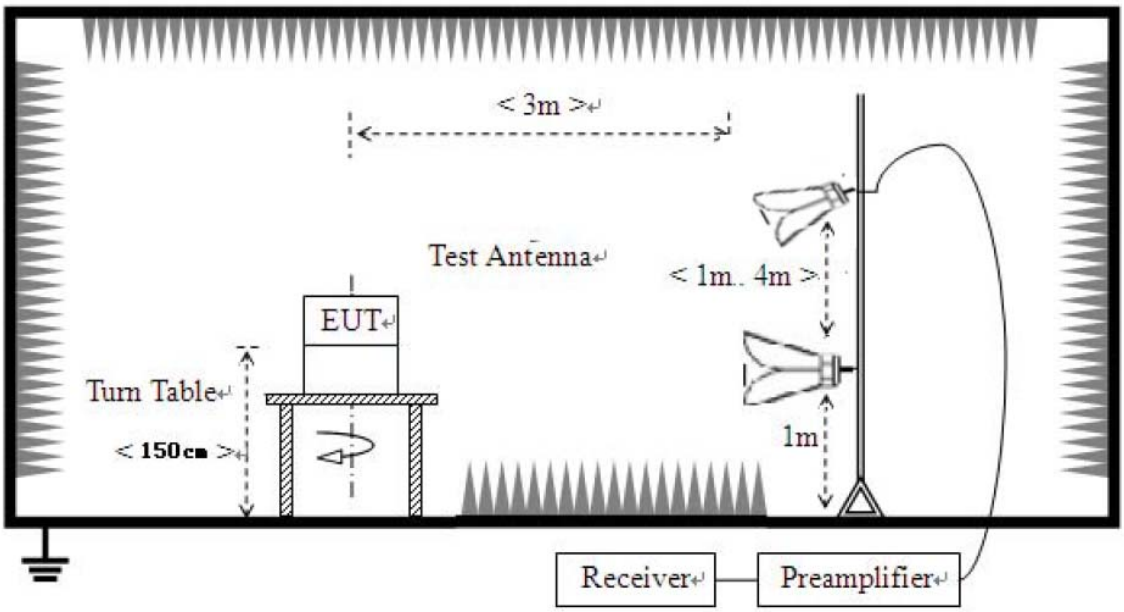
Frequency (MHz)	Field Strength (μV/m)	Measurement Distance (m)
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

3.2.2. Test setup

For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz



3.2.3. Test Procedures

1. The EUT was placed on the top of a rotating table 0.8m for below 1GHz/1.5m for above 1GHz above the ground at a 3 meters semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. Height of receiving antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. If the emission level of the EUT in peak mode was lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported.
   Otherwise the emissions would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

7. For the radiated emission test above 1GHz:

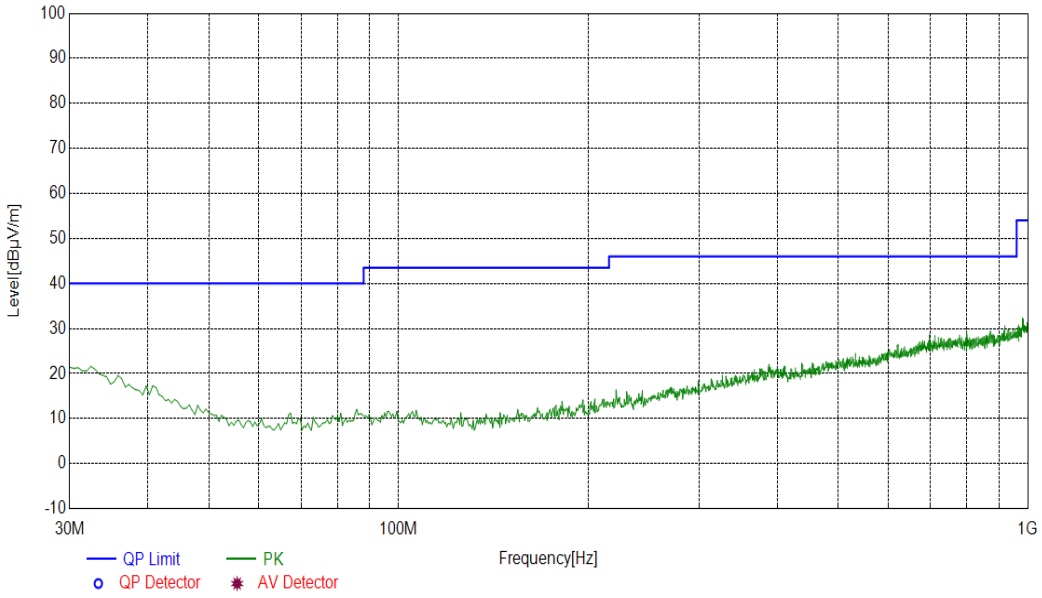
Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.

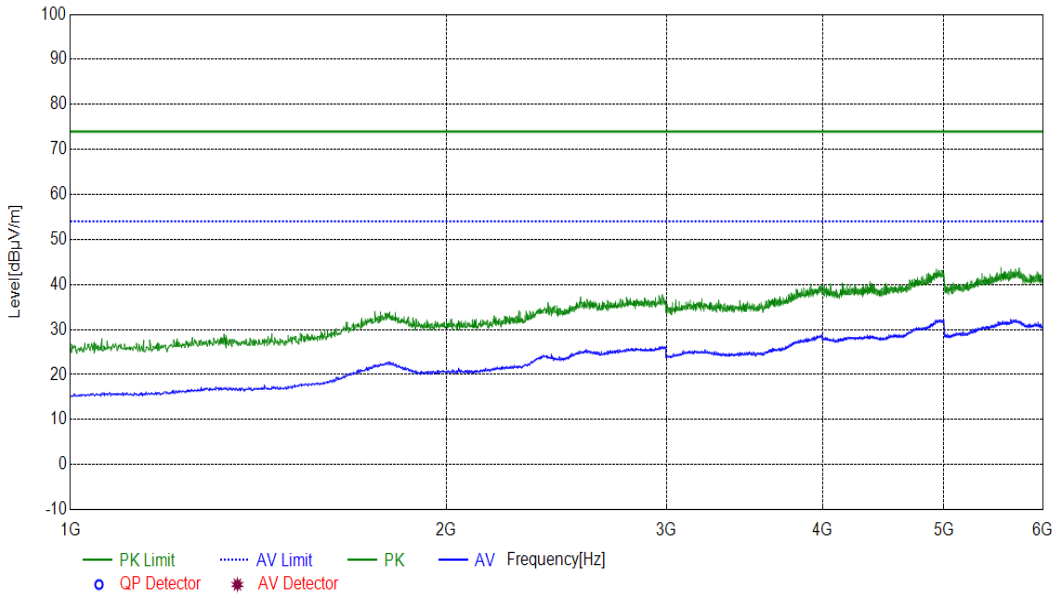
NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and video bandwidth is 3MHz for Peak detection at frequency above 1GHz.
3. The worst channel 410.125MHz reported only.
4. The emission level is more than 20dB below the limit no need to be reported.

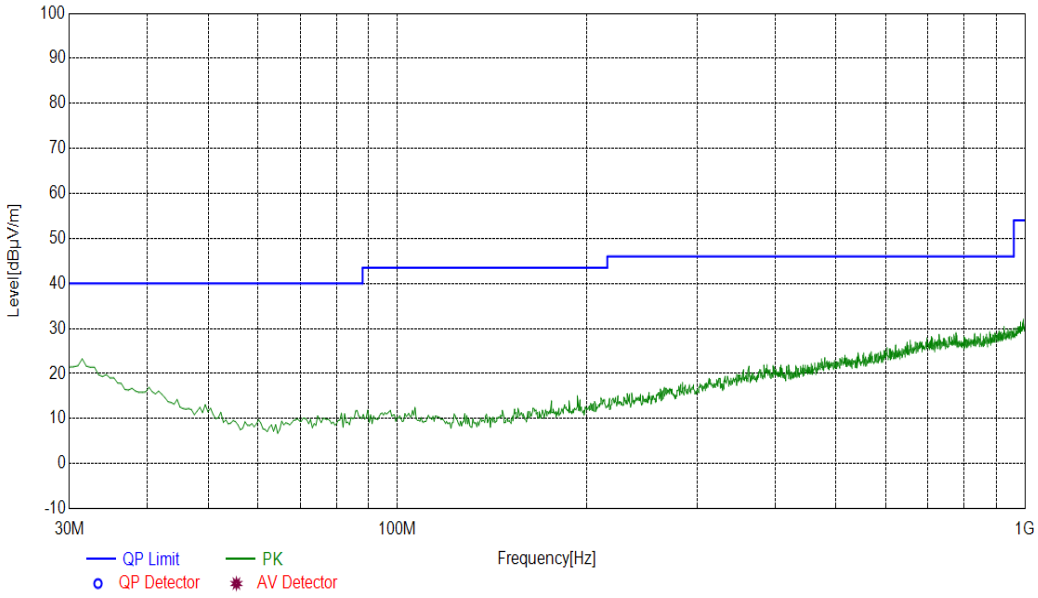
3.2.4. Test Results

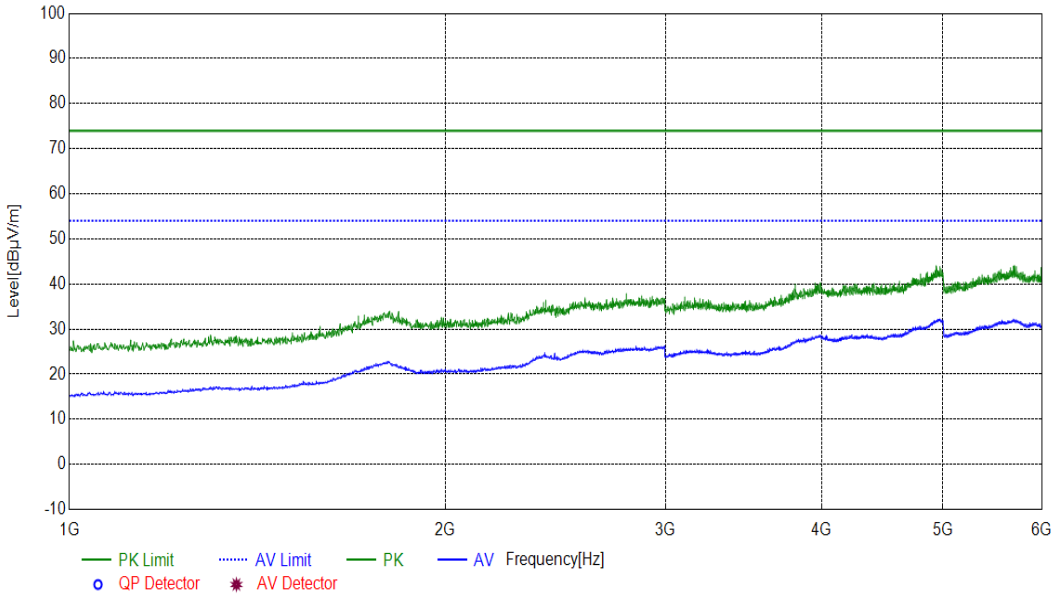
30MHz-6GHz Antenna Horizontal





30MHz-6GHz Antenna Vertical





4. List of measuring equipment

Radiated Emission					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal
1	Ultra-Broadband Antenna	ShwarzBeck	VULB9163	538	11/12/2017
2	EMI TEST RECEIVER	Rohde&Schwarz	ESI 26	100009	11/12/2017
3	EMI TEST Software	Audix	E3	N/A	N/A
4	TURNTABLE	ETS	2088	2149	N/A
5	ANTENNA MAST	ETS	2075	2346	N/A
6	EMI TEST Software	Rohde&Schwarz	ESK1	N/A	N/A
7	HORNANTENNA	ShwarzBeck	9120D	1011	11/12/2017
8	Amplifer	Sonoma	310N	E009-13	11/12/2017
9	JS amplifer	Rohde&Schwarz	JS4-00101800-28-5A	F201504	11/12/2017
10	High pass filter	Compliance Direction systems	BSU-6	34202	11/12/2017
11	HORNANTENNA	ShwarzBeck	9120D	1012	11/12/2017
12	Amplifer	Compliance Direction systems	PAP1-4060	120	11/12/2017
13	Loop Antenna	Rohde&Schwarz	HFH2-Z2	100020	11/12/2017
14	TURNTABLE	MATURO	TT2.0	----	N/A
15	ANTENNA MAST	MATURO	TAM-4.0-P	----	N/A
16	Horn Antenna	SCHWARZBECK	BBHA9170	25841	11/12/2017
17	ULTRA-BROADBAND ANTENNA	Rohde&Schwarz	HL562	100015	11/12/2017

Conducted					
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Last Cal
1	Spectrum Analyzer	Rohde&Schwarz	FSIQ	831929/005	08/30/2018
2	Spectrum Analyzer	Keysight	N9030A	ATO-67098	10/09/2017
3	Power Meter	Anritsu	ML2480B	100798	11/12/2017
4	Power Sensor	Anritsu	MA2411B	100258	11/12/2017

The calibration interval was one year.

END OF REPORT