

**FCC 47 CFR PART 15 SUBPART C &
INDUSTRY CANADA RSS-251****TEST REPORT****For****Automotive Radar****Model: LRR-20****Trade Name: MANDO***Issued to***For FCC:****MANDO corp.****21, Pangyo-ro 255beon-gil, Bundang-gu, Gyeonggi-do, Seongnam-si,
463-400, South Korea****For IC:****MANDO corp.****21, Pangyo-ro 255beon-gil, Bundang-gu, Gyeonggi-do, Seongnam-si,
463-400, Korea (Rep.)***Issued by***Compliance Certification Services Inc.****No.11, Wugong 6th Rd., Wugu Dist.,
New Taipei City 24891, Taiwan. (R.O.C.)****<http://www.ccsrf.com>****service@ccsrf.com****Issued Date: September 21, 2016**

Note: This report shall not be reproduced except in full, without the written approval of Compliance Certification Services Inc. This document may be altered or revised by Compliance Certification Services Inc. personnel only, and shall be noted in the revision section of the document.

Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	September 21, 2016	Initial Issue	ALL	Doris Chu
01	October 18, 2016	1. Added IC standard. 2. Added mixers frequency range. 3. Added 40G-325G uncertainty. 4. Added section 5.4. 5. Added Average Power Density in test procedure. 6. Added remark to description how to convert. 7. Modify test procedure NO.6.	P.4, P.11, P.12, P.21, P.22, P.28	Doris Chu

TABLE OF CONTENTS

1. TEST RESULT CERTIFICATION	4
2. EUT DESCRIPTION.....	6
3. TEST SUMMERY.....	7
4. TEST METHODOLOGY.....	8
4.1 EUT CONFIGURATION	8
4.2 EUT EXERCISE	8
4.3 GENERAL TEST PROCEDURES	8
4.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS	9
4.5 DESCRIPTION OF TEST MODES	10
5. INSTRUMENT CALIBRATION	11
5.1 MEASURING INSTRUMENT CALIBRATION.....	11
5.2 MEASUREMENT EQUIPMENT USED.....	11
5.3 MEASUREMENT UNCERTAINTY	12
6. FACILITIES AND ACCREDITATIONS	13
6.1 FACILITIES	13
6.2 EQUIPMENT	13
7. SETUP OF EQUIPMENT UNDER TEST	14
7.1 SETUP CONFIGURATION OF EUT	14
7.2 SUPPORT EQUIPMENT	14
8. TEST REQUIREMENTS	15
8.1 FREQUENCY BAND	15
8.2 OCCUPIED BANDWIDTH	17
8.3 20DB BANDWIDTH.....	19
8.4 POWER DENSITY	21
8.5 SPURIOUS EMISSIONS.....	24
8.6 FREQUENCY STABILITY	39
APPENDIX I PHOTOGRAPHS OF TEST SETUP.....	41
APPENDIX 1 - PHOTOGRAPHS OF EUT	

1. TEST RESULT CERTIFICATION

Applicant: For FCC:
MANDO corp.
21, Pangyo-ro 255beon-gil, Bundang-gu, Gyeonggi-do,
Seongnam-si, 463-400, South Korea
For IC:
MANDO corp.
21, Pangyo-ro 255beon-gil, Bundang-gu, Gyeonggi-do,
Seongnam-si, 463-400, Korea (Rep.)

Manufacturer: For FCC:
MANDO corp.
21, Pangyo-ro 255beon-gil, Bundang-gu, Gyeonggi-do,
Seongnam-si, 463-400, South Korea
For IC:
MANDO corp.
21, Pangyo-ro 255beon-gil, Bundang-gu, Gyeonggi-do,
Seongnam-si, 463-400, Korea (Rep.)

Equipment Under Test: Automotive Radar

Trade Name: MANDO

Model: LRR-20

Date of Test: September 12 ~ 21, 2016

APPLICABLE STANDARDS	
STANDARD	TEST RESULT
FCC 47 CFR Part 15 Subpart C	No non-compliance noted
IC RSS-251	No non-compliance noted

We hereby certify that:

All test results conform to above mentioned standards.

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10: 2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part15.209, 15.253 and Industry Canada RSS-251.

The test results of this report relate only to the tested sample EUT identified in this report.

Approved by:



Miller Lee
Section Manager
Compliance Certification Services Inc.

Reviewed by:



Zeus Chen
Engineer
Compliance Certification Services Inc.

2. EUT DESCRIPTION

Product	Automotive Radar
Trade Name	MANDO
Model Number	LRR-20
Model Discrepancy	N/A
Received Date	July 11, 2016
Power Supply	12.0-V _{DC} from power supply
Frequency Band	76.0 – 77.0 GHz
Modulation	FMCW
Number of Channel	1 (76.5 GHz)
Antenna Designation	PCB Antenna / Gain: 21.8 dBi
Temperature Range	-20°C to +55 °C

Remark:

1. The sample selected for test was production product and was provided by manufacturer.
2. This submittal(s) (test report) is intended for FCC ID: **2ACDX-LRR-20** filing to comply with Section 15.209 and 15.253 of the FCC Part 15, Subpart C Rules.
3. This submittal(s) (test report) is intended for ISED NO: **11988A-LRR20** filing to comply with IC RSS-251 & RSS-GEN.

3. TEST SUMMERY

Chapter	Test Item	Result
8.1	Frequency band	Pass
8.2	Occupied bandwidth	Pass
8.3	20dB bandwidth	Pass
8.2	Power density	Pass
8.5	Radiated spurious emissions	Pass
8.6	Frequency stability	Pass

4. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10: 2013 , ANSI 63.4 2014 and FCC CFR 47 Part 15.253, 15.209.15.215

The tests documented in this report were performed in accordance with IC RSS-251, IC RSS-Gen and ANSI C63.10:2013, ANSI 63.4 2014

This submittal(s) (test report) is intended for IC Certification with Industry Canada RSS-251.

4.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

4.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.215,15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

The tests documented in this report were performed in accordance with IC RSS-251, IC RSS-Gen, and ANSI C63.10: 2013.

4.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in ANSI C63.10: 2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 1.5 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in ANSI C63.10: 2013.

4.4 FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS

- (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 -	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.52525	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	156.7 - 156.9	3260 - 3267	23.6 - 24.0
12.29 - 12.293	162.0125 - 167.17	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	167.72 - 173.2	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	240 - 285	3600 - 4400	(²)
13.36 - 13.41	322 - 335.4		

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

- (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

4.5 DESCRIPTION OF TEST MODES

The EUT (model: LRR-20) had been tested under operating condition.

Software used to control the EUT for staying in continuous transmitting mode was programmed. The worst case data rate is determined as the data rate with highest output power.

After verification, all tests were carried out with the worst case test modes as shown below except radiated spurious emission below 1GHz and power line conducted emissions below 30MHz, which worst case was in normal link mode only.

The field strength of spurious emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). The worst emission was found in lie-down position (Y axis) and the worst case was recorded.

5. INSTRUMENT CALIBRATION

5.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

5.2 MEASUREMENT EQUIPMENT USED

Equipment Used for Emissions Measurement

Remark: Each piece of equipment is scheduled for calibration once a year and Loop Antenna is scheduled for calibration once three years.

Conducted Emissions Test Site					
Name of Equipment	Manufacturer	Model	Serial Number	Cal Date	Cal Due
Spectrum Analyzer	R&S	FSV 40	101073	08/01/16	07/31/17
Thermostatic/Hrgrosatic Chamber	GWINSTEK	GTC-288MH-CC	TH160402	05/04/16	05/03/17
Harmonic Mixer (50 GHz-75 GHz)	ROHDE&SCHWARZ	FH-PP-75 / FS-Z75	10001 / 100162	04/22/15	04/21/17
Harmonic Mixer (75 GHz-110 GHz)	ROHDE&SCHWARZ	FH-PP-110 / FS-Z110	10003 / 100096	04/24/15	04/23/17
Harmonic Mixer (110 GHz-170GHz)	ROHDE&SCHWARZ	FH-PP-170 / SAM-170	10003 / 20011	04/27/15	04/26/17
Harmonic Mixer (140 GHz-220 GHz)	ROHDE&SCHWARZ	FH-PP-220 / SAM-220	10003 / 20013	04/30/15	04/29/17
Harmonic Mixer (220 GHz-325 GHz)	Radiometer Physics Gmbn	FH-PP-325 / SAM-325	10007 / 20048	05/05/15	05/04/17
Harmonic Mixer (40 GHz-60GHz)	A-INFO / ROHDE&SCHWARZ	LB-19-20-A / FS-Z60	J202020872 / 100142	04/17/15	04/16/17

Fully Chamber Test Site					
Name of Equipment	Manufacturer	Model	Serial Number	Cal Date	Cal Due
Spectrum Analyzer	Agilent	E4446A	US42510252	12/08/15	12/07/16
Loop Ant	COM-POWER	AL-130	121051	02/25/16	02/24/17
Bilog Antenna	Sunol Sciences	JB3	A030105	07/03/16	07/02/17
Pre-Amplifier	EMEC	EM330	60609	06/08/16	06/07/17
Horn Antenna	ETC	MCTD 1209	DRH13M02003	09/02/16	09/01/17
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R
Harmonic Mixer (50 GHz-75 GHz)	ROHDE&SCHWARZ	FH-PP-75 / FS-Z75	10001 / 100162	04/22/15	04/21/17
Harmonic Mixer (75 GHz-110 GHz)	ROHDE&SCHWARZ	FH-PP-110 / FS-Z110	10003 / 100096	04/24/15	04/23/17
Harmonic Mixer (110 GHz-170GHz)	ROHDE&SCHWARZ	FH-PP-170 / SAM-170	10003 / 20011	04/27/15	04/26/17
Harmonic Mixer (140 GHz-220 GHz)	ROHDE&SCHWARZ	FH-PP-220 / SAM-220	10003 / 20013	04/30/15	04/29/17
Harmonic Mixer (220 GHz-325 GHz)	Radiometer Physics Gmbn	FH-PP-325 / SAM-325	10007 / 20048	05/05/15	05/04/17
Harmonic Mixer (40 GHz-60GHz)	A-INFO / ROHDE&SCHWARZ	LB-19-20-A / FS-Z60	J202020872 / 100142	04/17/15	04/16/17

5.3 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	+/- 1.2575
Emission bandwidth, 6dB bandwidth	+/- 1.4003
RF output power, conducted	+/- 1.1372
Power density, conducted	+/- 1.4003
3M Semi Anechoic Chamber / 30M~200M	+/- 4.0138
3M Semi Anechoic Chamber / 200M~1000M	+/- 3.9483
3M Semi Anechoic Chamber / 1G~8G	+/- 2.5975
3M Semi Anechoic Chamber / 8G~18G	+/- 2.6112
3M Semi Anechoic Chamber / 18G~26G	+/- 2.7389
3M Semi Anechoic Chamber / 26G~40G	+/- 2.9683
3M Semi Anechoic Chamber / 40G~60G	+/- 1.8509
3M Semi Anechoic Chamber / 60G~75G	+/- 1.9869
3M Semi Anechoic Chamber / 75G~110G	+/- 2.9651
3M Semi Anechoic Chamber / 110G~170G	+/- 2.7807
3M Semi Anechoic Chamber / 170G~220G	+/- 3.6437
3M Semi Anechoic Chamber / 220G~325G	+/- 4.2982

Remark: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

5.4 TABLE OF ACCREDITATIONS AND LISTINGS

Country	Agency	Scope of Accreditation	Logo
USA	FCC	3M Semi Anechoic Chamber (FCC MRA: TW1039) to perform FCC Part 15 measurements	 FCC MRA: TW1039
Canada	Industry Canada	3M Semi Anechoic Chamber (IC 2324G-1 / IC 2324G-2) to perform	 IC 2324G-1 IC 2324G-2

* No part of this report may be used to claim or imply product endorsement by A2LA or any agency of the US Government.

6. FACILITIES AND ACCREDITATIONS

6.1 FACILITIES

All measurement facilities used to collect the measurement data are located at

☐ No.199, Chunghsen Road, Hsintien City, Taipei Hsien, Taiwan, R.O.C.

Tel: 886-2-2217-0894 / Fax: 886-2-2217-1029

☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City 24891, Taiwan. (R.O.C.)

Tel: 886-2-2299-9720 / Fax: 886-2-2299-9721

☐ No.81-1, Lane 210, Bade 2nd Rd., Lujhu Township, Taoyuan County 33841, TAIWAN, R.O.C.

Tel: 886-3-324-0332 / Fax: 886-3-324-5235

The sites are constructed in conformance with the requirements of ANSI C63.7, ANSI C63.4 and CISPR Publication 22.

6.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

7. SETUP OF EQUIPMENT UNDER TEST

7.1 SETUP CONFIGURATION OF EUT

See test photographs attached in Appendix II for the actual connections between EUT and support equipment.

7.2 SUPPORT EQUIPMENT

No.	Device Type	Brand	Model	Series No.	FCC ID	Data Cable	Power Cord
1.	DC Power Source	GWINST EK	SPS-3610	GPE880163	FCC DoC	1.5m shielding	1.8m non-shielding

Remark:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

8. TEST REQUIREMENTS

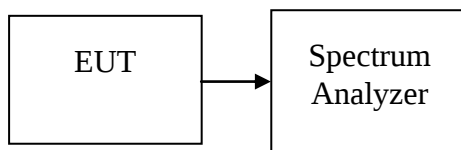
8.1 FREQUENCY BAND

LIMIT

According to FCC 15.253(c), systems using digital modulation techniques may operate in the 76.0 GHz-77 GHz.

According to IC RSS-251(5.1), Field disturbance sensors may operate in the 76.0 GHz -77 GHz band.

Test Configuration



TEST PROCEDURE

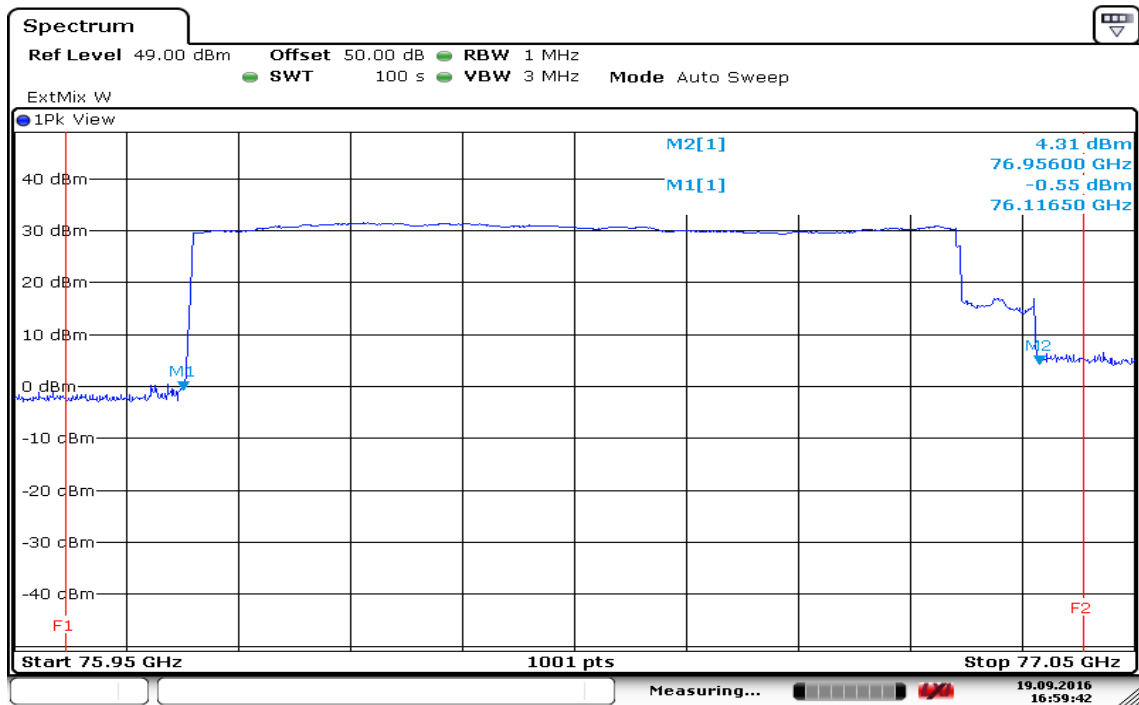
The transmitter output is connected to the spectrum analyzer. Set the RBW=1MHz the emission bandwidth, VBW $\geq 3 \times$ RBW, Detector = Peak, Trace mode = Max hold, Sweep = 100S. Mark point1 and point 2 to Measure the operation frequency range.

TEST RESULTS

No non-compliance noted

Test Data

Test Plot



Date: 19.SEP.2016 16:59:42

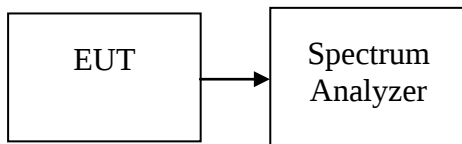
8.2 OCCUPIED BANDWIDTH (99%)

Definition

According to IC RSS-Gen Issue 4,2014 clause 6.6, The emission bandwidth (x dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated x dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

Test Configuration



Test procedure

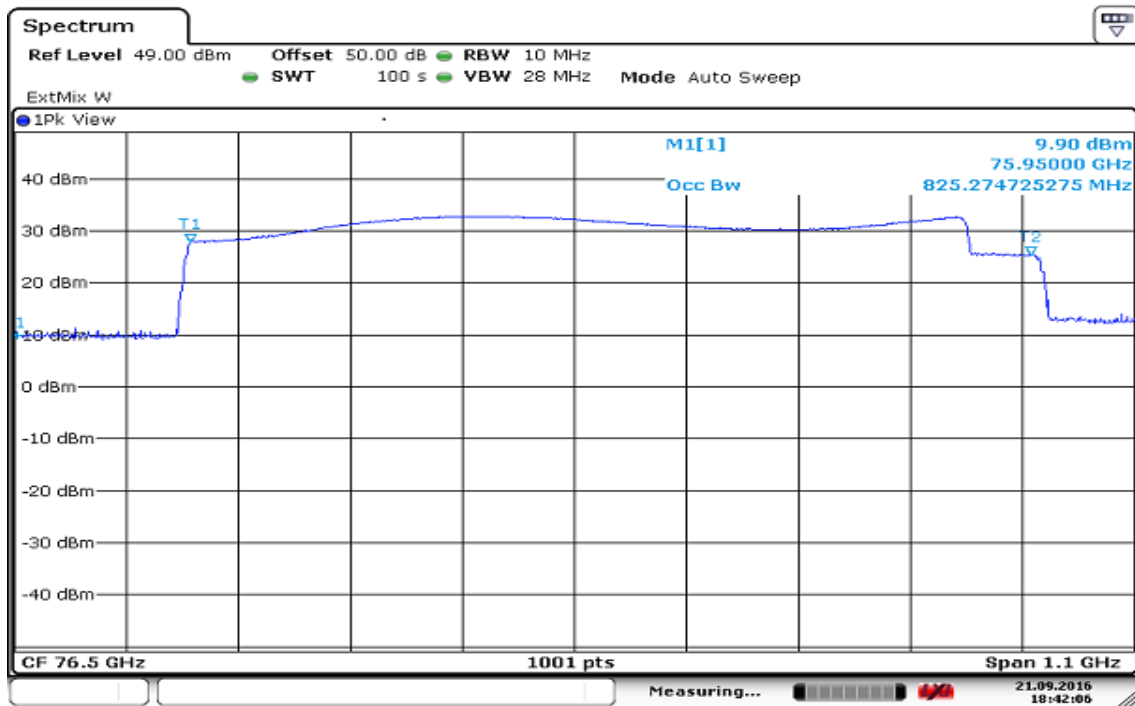
The transmitter output is connected to the spectrum analyzer. Set the RBW=10 MHz the emission bandwidth, VBW $\geq 3 \times$ RBW, Detector = Peak, Trace mode =Max hold, Sweep = 100s. Measure the maximum width of the emission that is constrained by the frequencies associated with the Occupied Bandwidth.

TEST RESULTS

No non-compliance noted

Test Condition	Frequency(GHz)	Occupied Bandwidth 99% (MHz)
Operation mode	76.5	825.27

Test Data



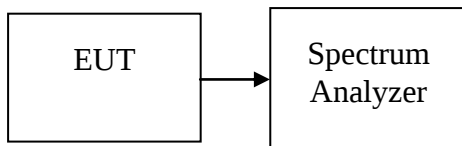
Date: 21.SEP.2016 18:42:06

8.3 20DB BANDWIDTH

Definition

According to FCC Part 15.215 (c) ,Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Test Configuration



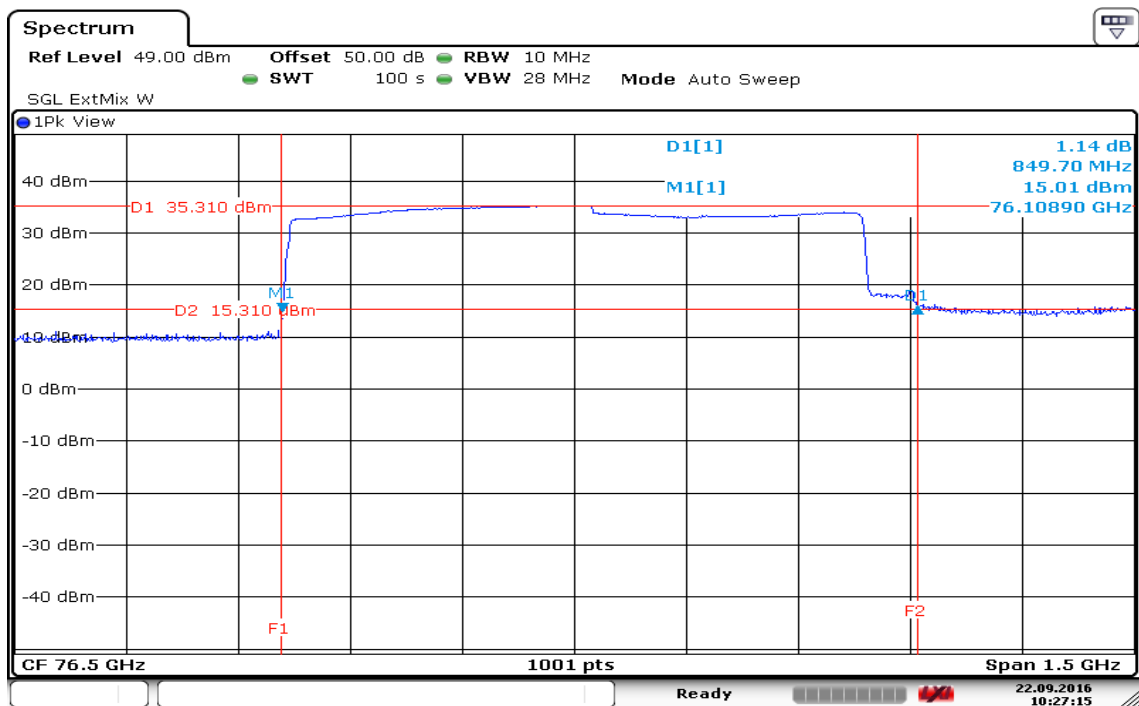
Test procedure

The transmitter output is connected to the spectrum analyzer. Set the RBW=10 MHz the emission bandwidth, VBW $\geq 3 \times$ RBW, Detector = Peak, Trace mode =Max hold, Sweep = 100s. Measure the maximum width of the emission that is constrained by the frequencies associated with the Occupied Bandwidth.

TEST RESULTS

No non-compliance noted

Test Condition	Frequency(GHz)	20 dB bandwidth (MHz)
Operation mode	76.5	849.70

Test Data

Date: 22.SEP.2016 10:27:15

8.4 POWER DENSITY

LIMIT

The power density of the intentional radiator shall not exceed the following:

According to FCC 15.253(d)(1)(2),

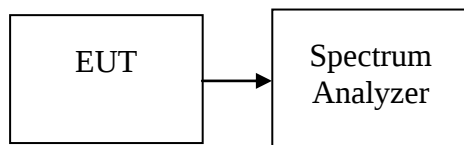
The average power density of any emission within the bands specified in this section shall not exceed $88 \mu\text{W}/\text{cm}^2$ at a distance of 3 meters from the exterior surface of the radiating structure (average EIRP of 50 dBm).

The peak power density of any emission within the band 76-77 GHz shall not exceed $279 \mu\text{W}/\text{cm}^2$ at a distance of 3 meters from the exterior surface of the radiating structure (peak EIRP of 55 dBm).

According to IC RSS-251(5.2.2),

Power Density	Power Density Limit at 3m	Total e.i.r.p.
Average power density	$88 \mu\text{W}/\text{cm}^2$	50 dBm (average)
Peak power density	$279 \mu\text{W}/\text{cm}^2$	55 dBm (peak)

Test Configuration



TEST PROCEDURE

Peak Power Density

The transmitter output is connected to the spectrum analyzer. Set the RBW=1MHz the emission bandwidth, VBW $\geq 3 \times$ RBW, Detector = Peak, Trace mode = Max hold, Sweep = 100S. Use the peak marker function to determine the maximum amplitude level within the RBW

Average Power Density

The transmitter output is connected to the spectrum analyzer. Set the RBW=1MHz the emission bandwidth, VBW $\geq 3 \times$ RBW, Detector = RMS, Trace mode = Max hold, Sweep = 100S. Use the peak marker function to determine the maximum amplitude level within the RBW

TEST RESULTS

No non-compliance noted.

Test Condition	Frequency(GHz)	Peak EIRP(dBm)	AVG EIRP (dBm)
Operation mode	76.5	31.00	15.87

Power

Antenna Gain: 21.8 dBi

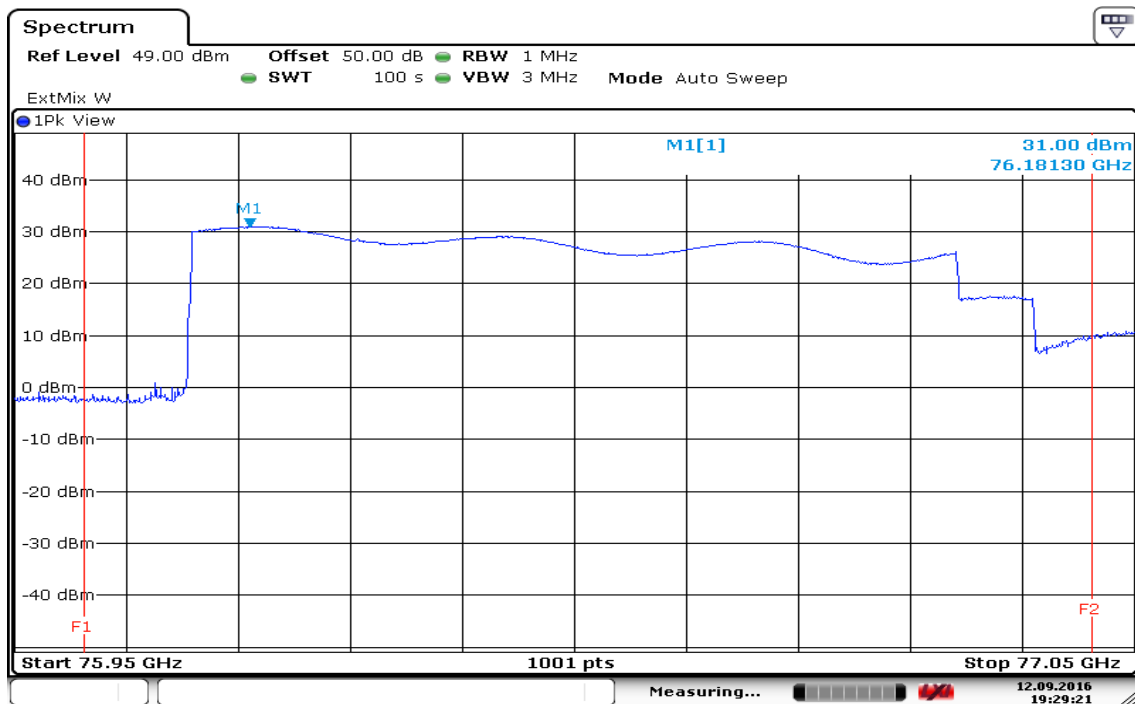
Test Condition	Frequency(GHz)	Conducted Peak Power(dBm)	Conducted AVG Power (dBm)
Operation mode	76.5	9.2	-5.93

Remark:

1. EIRP Power = conducted power (eirp) + antenna gain + cableloss
1. Conducted Power = radiated power (eirp) – antenna gain

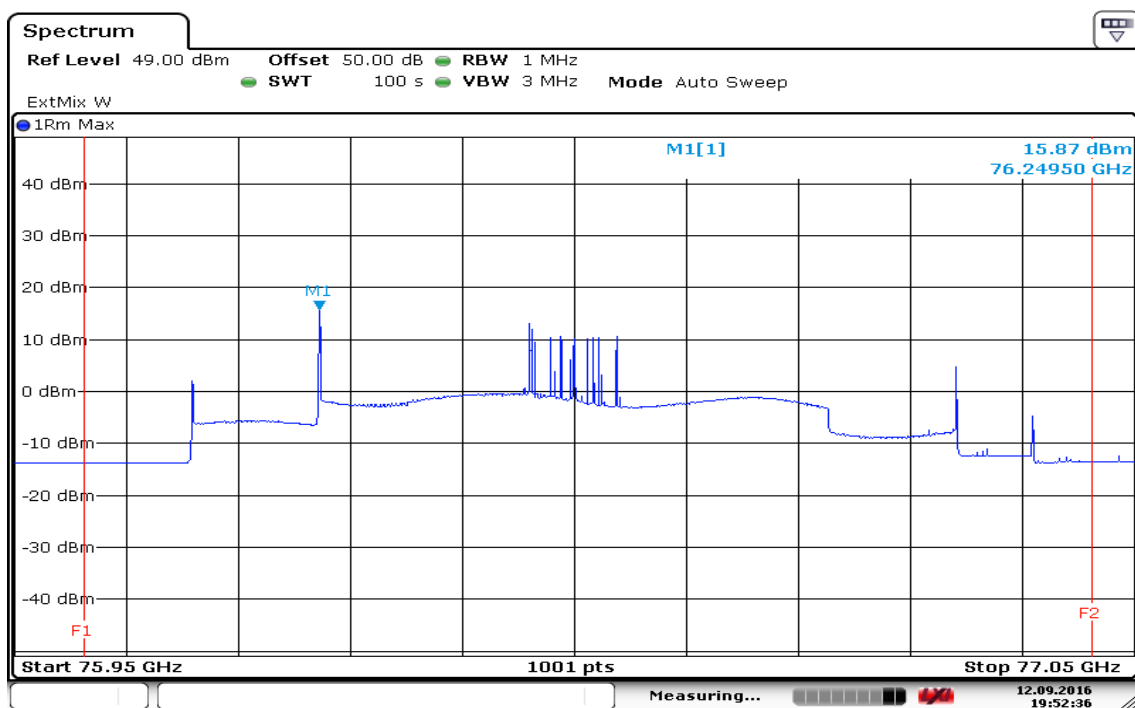
Test Data

Peak Power Density



Date: 12.SEP.2016 19:29:21

Average Power Density



Date: 12.SEP.2016 19:52:36

8.5 SPURIOUS EMISSIONS

8.5.1 Radiated Emissions

LIMIT

1. According to FCC PART 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 ($\mu\text{V/m}$)	Measurement Distance (m)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

2. In the above emission table, the tighter limit applies at the band edges.

Frequency (MHz)	Field Strength ($\mu\text{V/m}$ at 3-meter)	Field Strength (dB $\mu\text{V/m}$ at 3-meter)
0.009 - 0.490	2400/F(kHz) +80	20LOG((2400/F(kHz))+80)
0.490 - 1.705	24000/F(kHz) +40	20LOG((24000/F(kHz))+40)
1.705 – 30.0	30	69.54
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

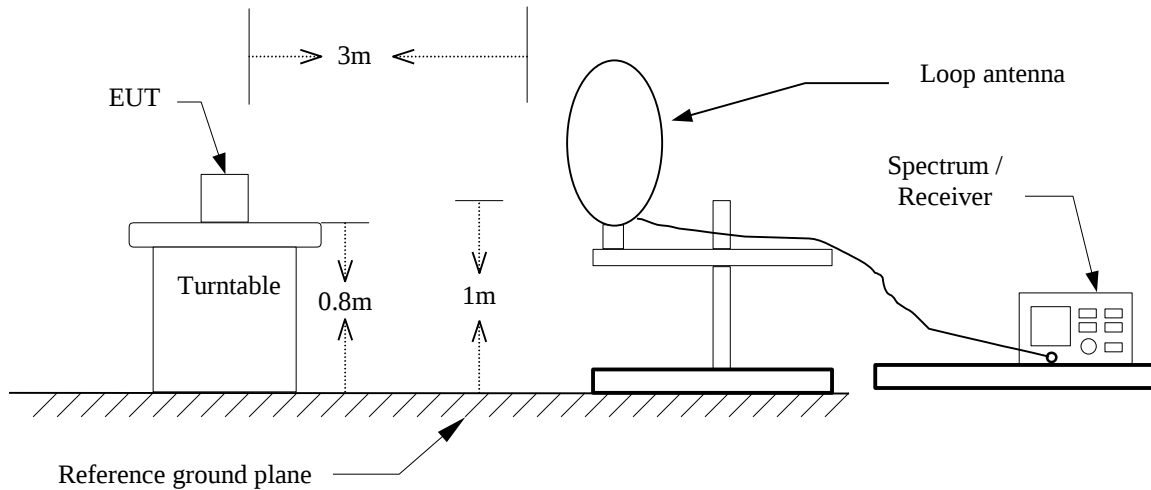
3. According to FCC PART 15.253(2)(ii), For field disturbance sensors operating in the band 76-77 GHz: 600 pW/cm² at a distance of 3 meters from the exterior surface of the radiating structure
4. According to FCC PART 15.253(3), For radiated emissions above 200 GHz from field disturbance sensors operating in the 76-77 GHz band: the power density of any emission shall not exceed 1000 pW/cm² at a distance of 3 meters from the exterior surface of the radiating structure.

5. According to FCC PART 15.253(4) For field disturbance sensors operating in the 76-77 GHz band, the spectrum shall be investigated up to 231 GHz.
6. According to IC RSS-251(5.3),

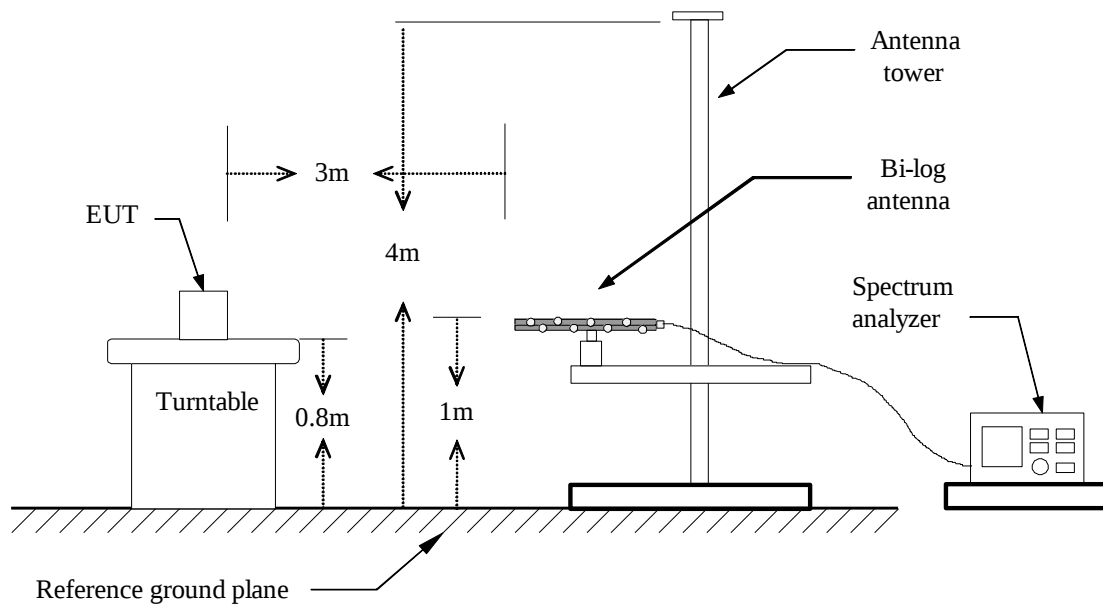
Emission Frequency Range	Parameter Measured	Limit
Below 40 GHz	Field strength	RSS-Gen field strength limits
40-200 GHz (outside the operating band)	Power density at 3 m: Field disturbance sensors in the band 46.7-46.9 GHz	2 pW/cm ²
	Power density at 3 m: Field disturbance sensors in the band 76-77 GHz	600 pW/cm ²
Above 200 GHz	Power density at 3 m: Field disturbance sensors in the band 76-77 GHz	1000 pW/cm ²

Test Configuration

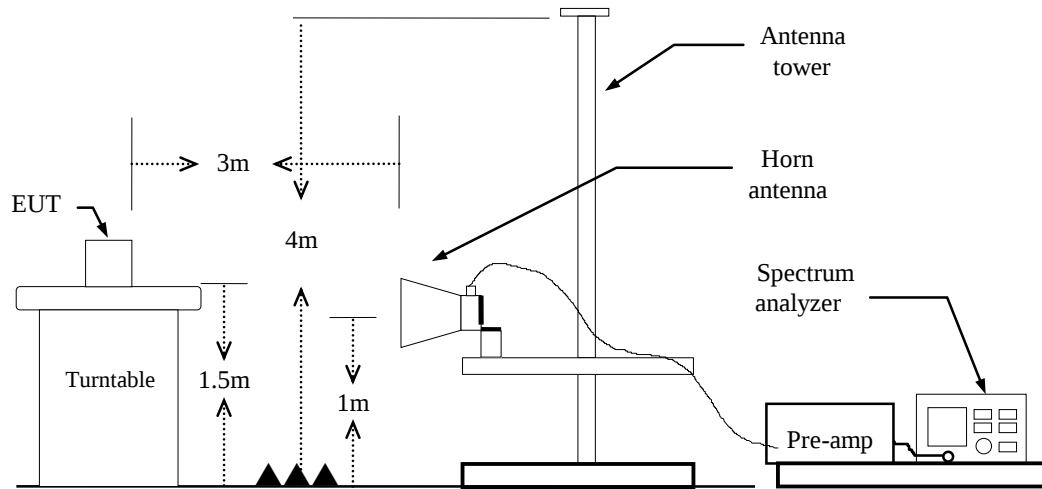
9kHz ~ 30MHz



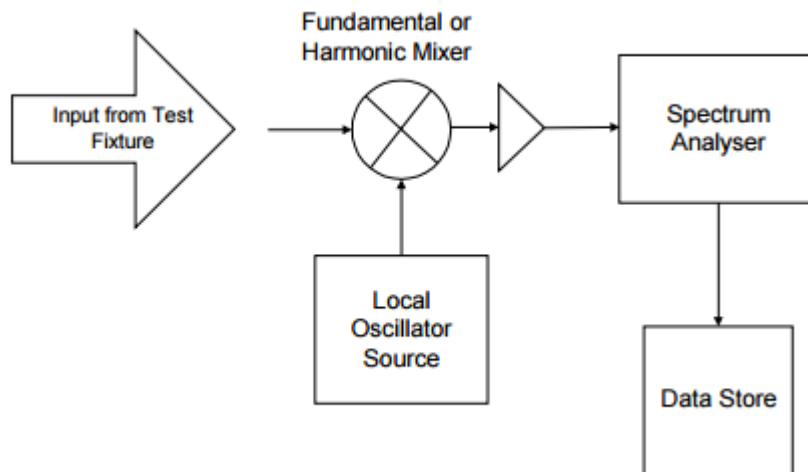
30MHz ~ 1 GHz



Above 1 GHz



Above 40 GHz



TEST PROCEDURE

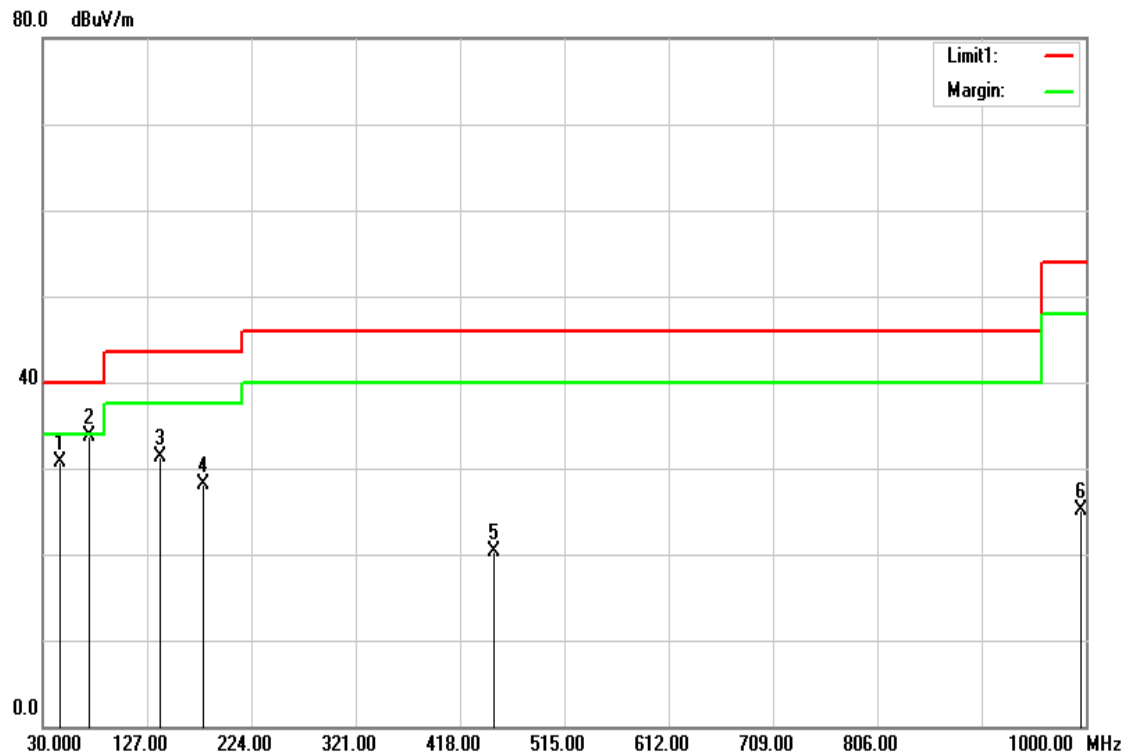
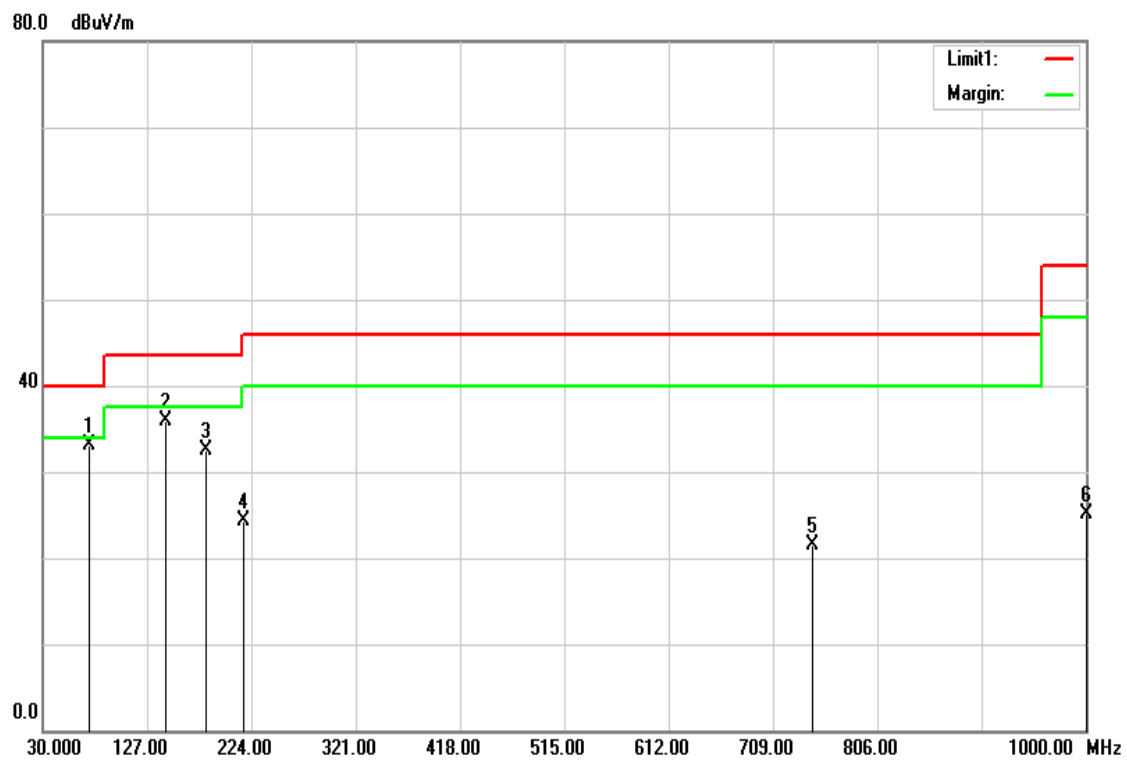
1. The EUT is placed on a turntable, which is 1.5m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:
Below 1GHz:
RBW=100kHz / VBW=300kHz / Sweep=AUTO
Above 1GHz:
(a)PEAK: RBW=1MHz / VBW=3MHz / Sweep=AUTO
(b)AVERAGE: RBW=1MHz,
Above 40GHz:
RBW = 1 MHz, VBW= 3 MHz,
Detector = Peak, Trace mode = max hold, Sweep = AUTO.
7. Repeat above procedures until the measurements for all frequencies are complete.

Below 1 GHz**Operation Mode:** Normal Link**Test Date:** September 19, 2016**Temperature:** 28°C**Tested by:** Zeus Chen**Humidity:** 53% RH**Polarity:** Ver. / Hor.

Frequency (MHz)	Reading (dBUV)	Correction Factor (dB/m)	Result (dBUV/m)	Limit (dBUV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
46.4900	49.68	-19.06	30.62	40.00	-9.38	QP	V
73.6500	54.66	-20.91	33.75	40.00	-6.25	peak	V
139.6100	46.98	-15.77	31.21	43.50	-12.29	peak	V
179.3800	45.51	-17.31	28.20	43.50	-15.30	peak	V
449.0400	30.44	-10.22	20.22	46.00	-25.78	peak	V
995.1500	26.72	-1.66	25.06	54.00	-28.94	peak	V
72.6800	53.87	-20.86	33.01	40.00	-6.99	peak	H
144.4600	51.79	-15.91	35.88	43.50	-7.62	peak	H
182.2900	49.72	-17.14	32.58	43.50	-10.92	peak	H
216.2400	41.03	-16.69	24.34	46.00	-21.66	peak	H
745.8600	26.56	-5.02	21.54	46.00	-24.46	peak	H
1000.0000	26.62	-1.58	25.04	54.00	-28.96	peak	H

Remark:

1. No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).
2. Radiated emissions measured were made with an instrument using peak/quasi-peak detector mode.
3. Quasi-peak test would be performed if the peak result were greater than the quasi-peak limit or as required by the applicant.
4. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with "N/A" remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
5. Margin (dB) = Remark result (dBUV/m) – Quasi-peak limit (dBUV/m).

Polarity : Vertical**Polarity : Horizontal**

Above 1 GHz**Operation Mode:** Test Mode**Test Date:** September 19, 2016**Temperature:** 28°C**Tested by:** Zeus Chen**Humidity:** 53% RH**Polarity:** Ver. / Hor.

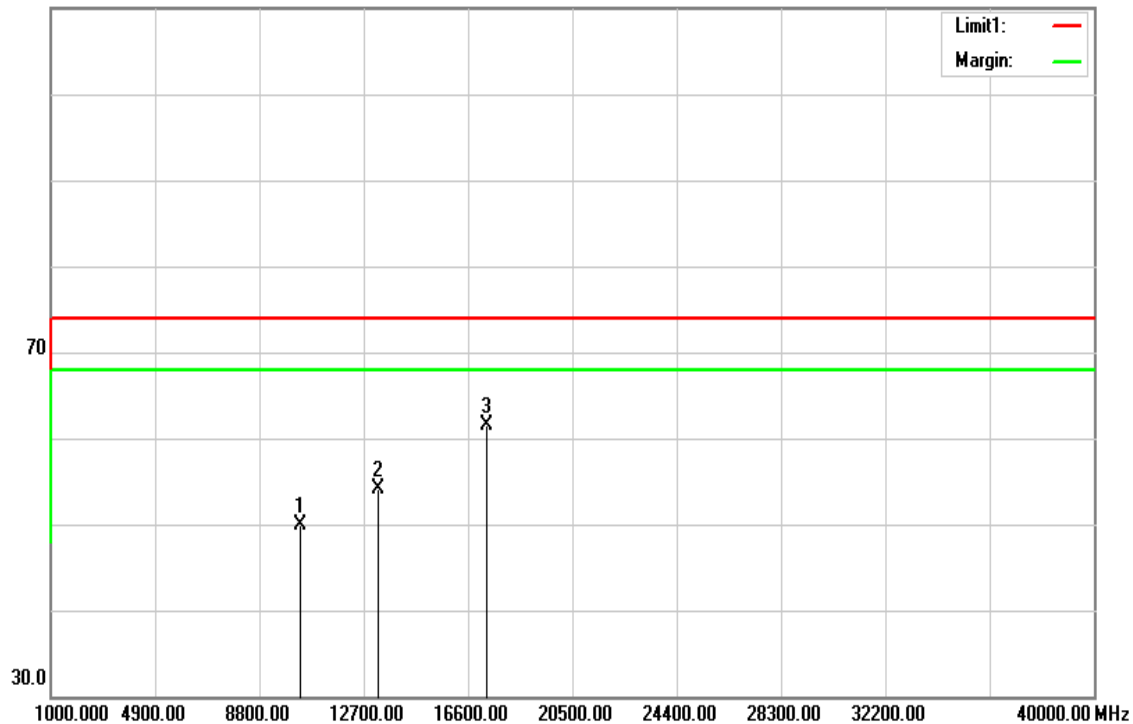
Frequency (MHz)	Reading (dBuV)	Correction (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Ant.Pol. (H/V)
10320.000	49.89	0.00	49.89	74.00	-24.11	peak	V
13240.000	54.14	0.00	54.14	74.00	-19.86	peak	V
17310.000	61.45	0.00	61.45	74.00	-12.55	peak	V
N/A							
10960.000	51.04	0.00	51.04	74.00	-22.96	peak	H
14190.000	55.74	0.00	55.74	74.00	-18.26	peak	H
17350.000	60.96	0.00	60.96	74.00	-13.04	peak	H
N/A							

Remark:

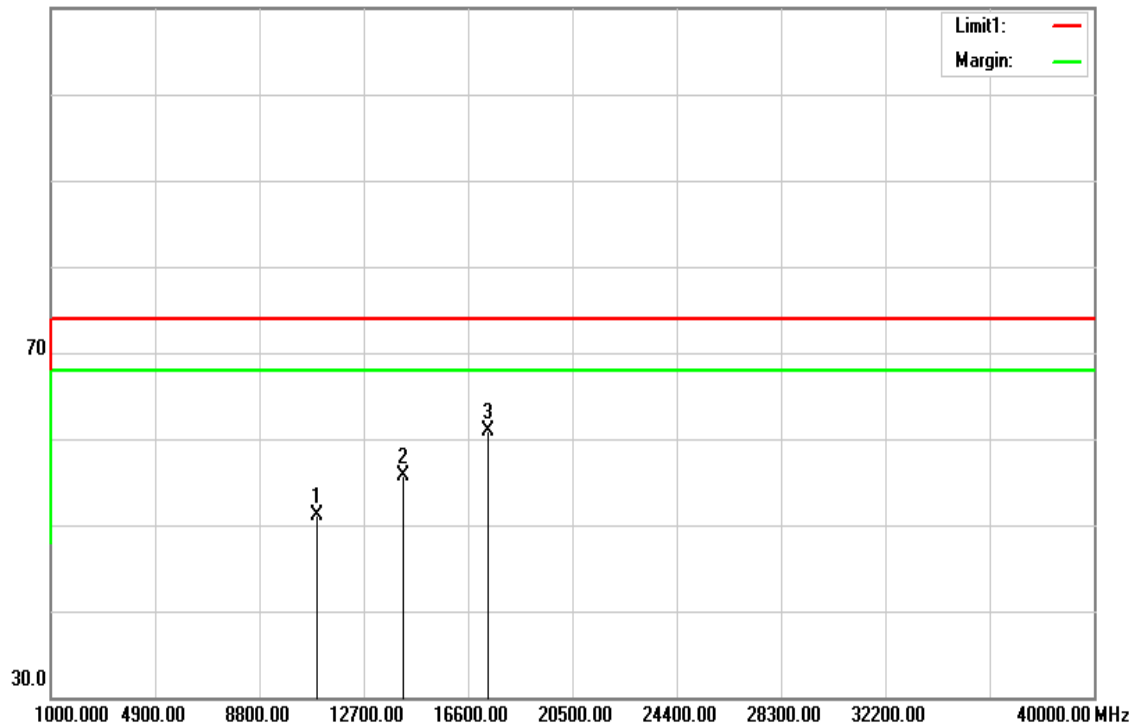
1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Radiated emissions measured in frequency above 1000MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit or as required by the applicant.
4. Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
5. Measurements above show only up to 6 maximum emissions noted, or would be lesser, with " N/A " remark, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.
6. $\text{Margin (dB)} = \text{Remark result (dBuV/m)} - \text{Average limit (dBuV/m)}$.

Polarity : Vertical

110.0 dBuV/m

**Polarity : Horizontal**

110.0 dBuV/m



40G-50G

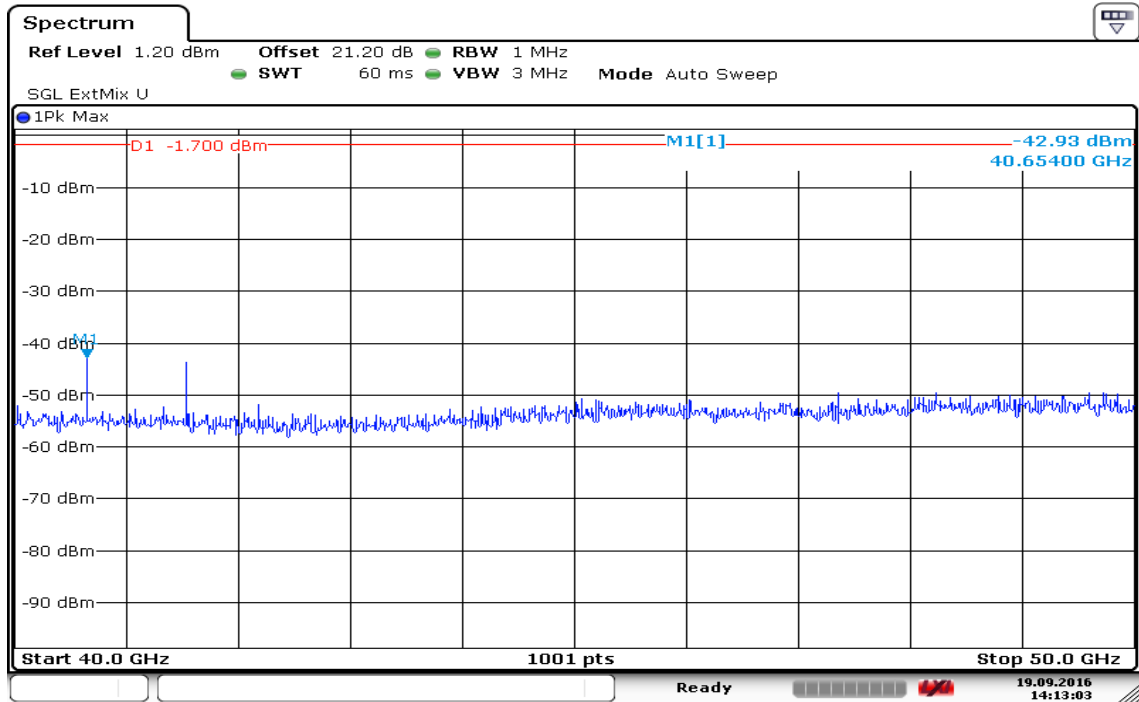
Operation Mode: Test Mode

Test Date: September 19, 2016

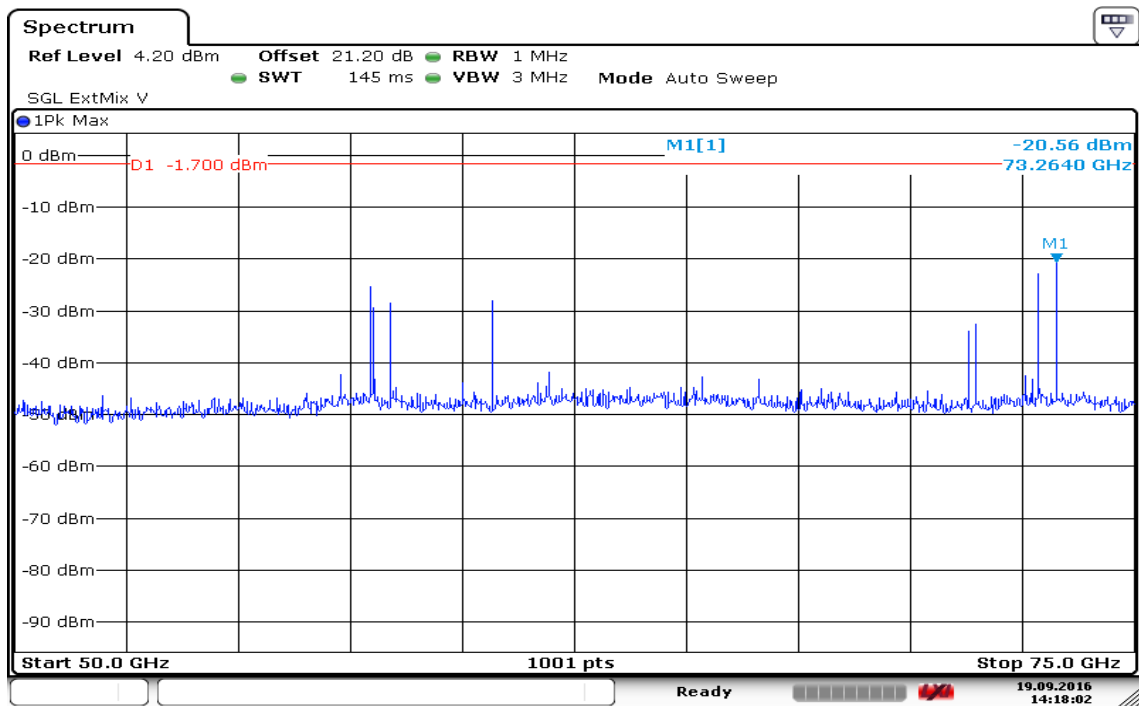
Temperature: 28°C

Tested by: Zeus Chen

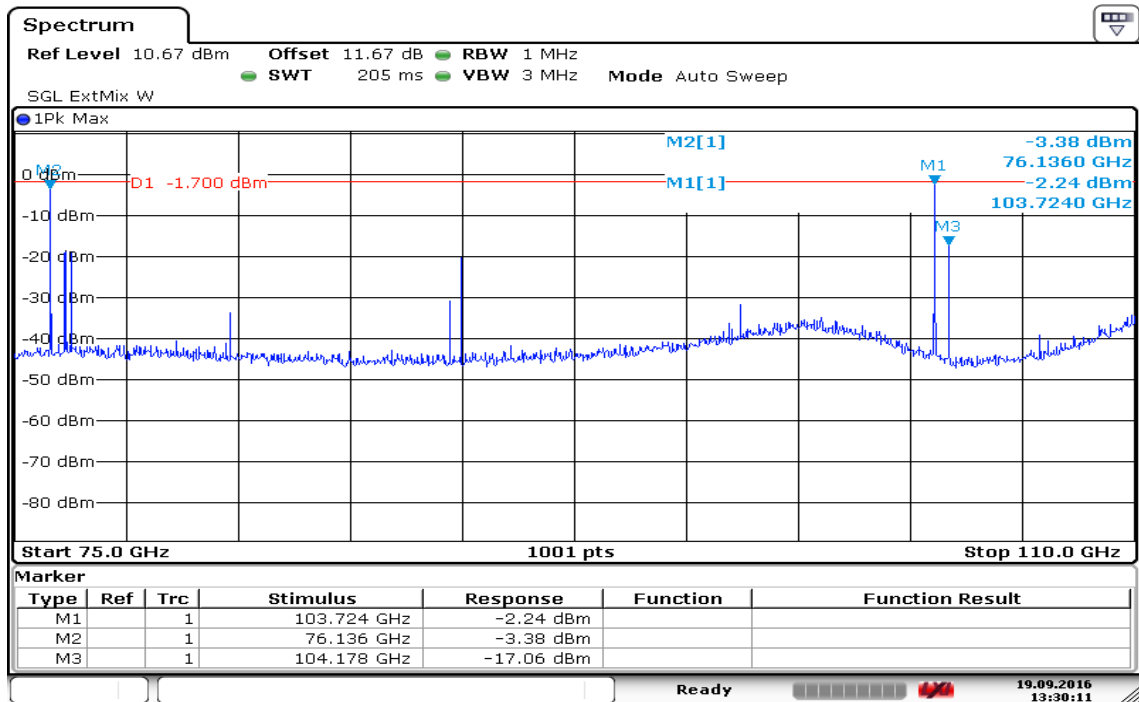
Humidity: 53% RH



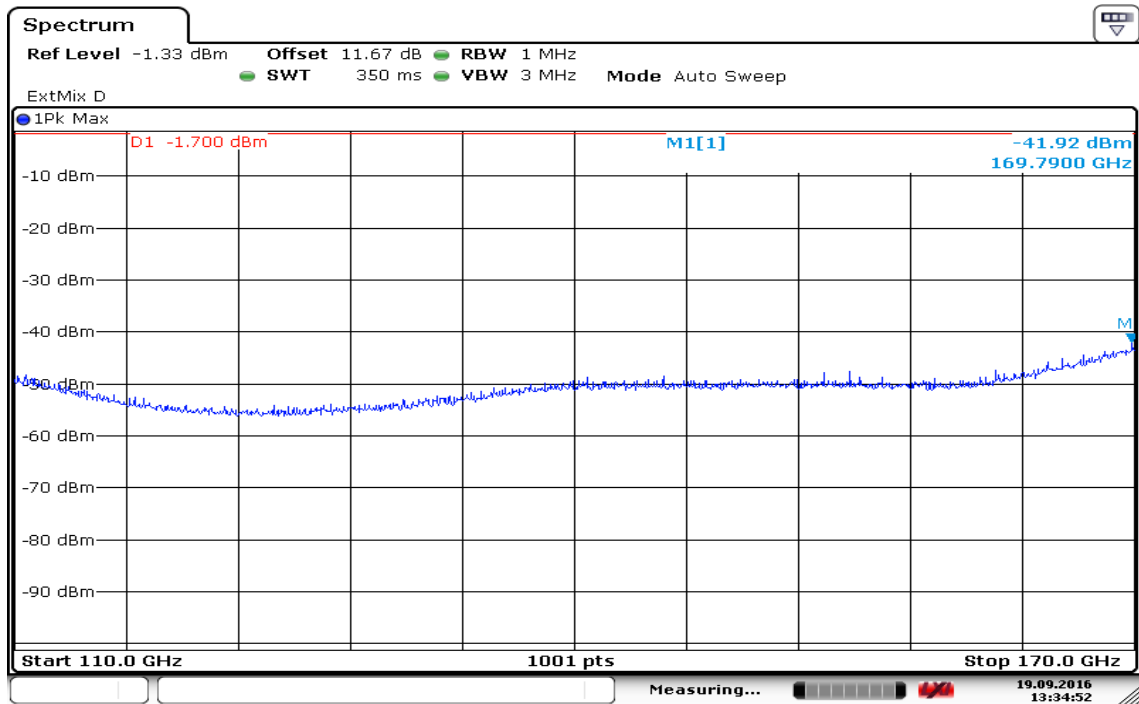
Date: 19.SEP.2016 14:13:02

50G-75G**Operation Mode:** Test Mode**Test Date:** September 19, 2016**Temperature:** 28°C**Tested by:** Zeus Chen**Humidity:** 53% RH

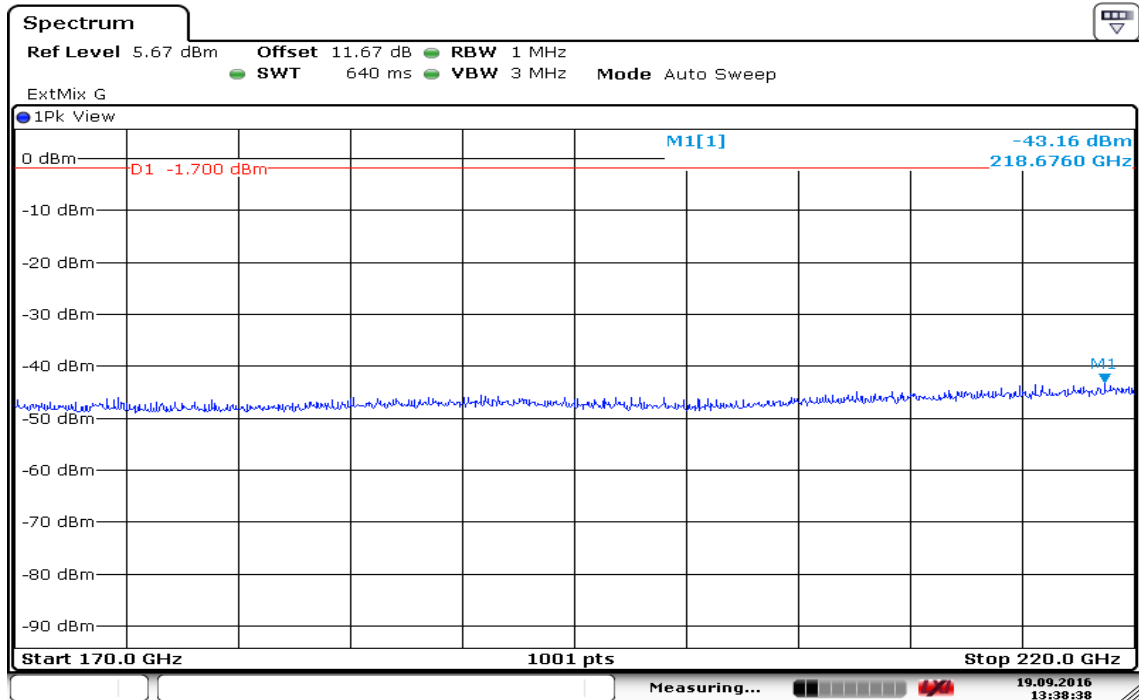
Date: 19.SEP.2016 14:18:01

75G-110G**Operation Mode:** Test Mode**Test Date:** September 19, 2016**Temperature:** 28°C**Tested by:** Zeus Chen**Humidity:** 53% RH

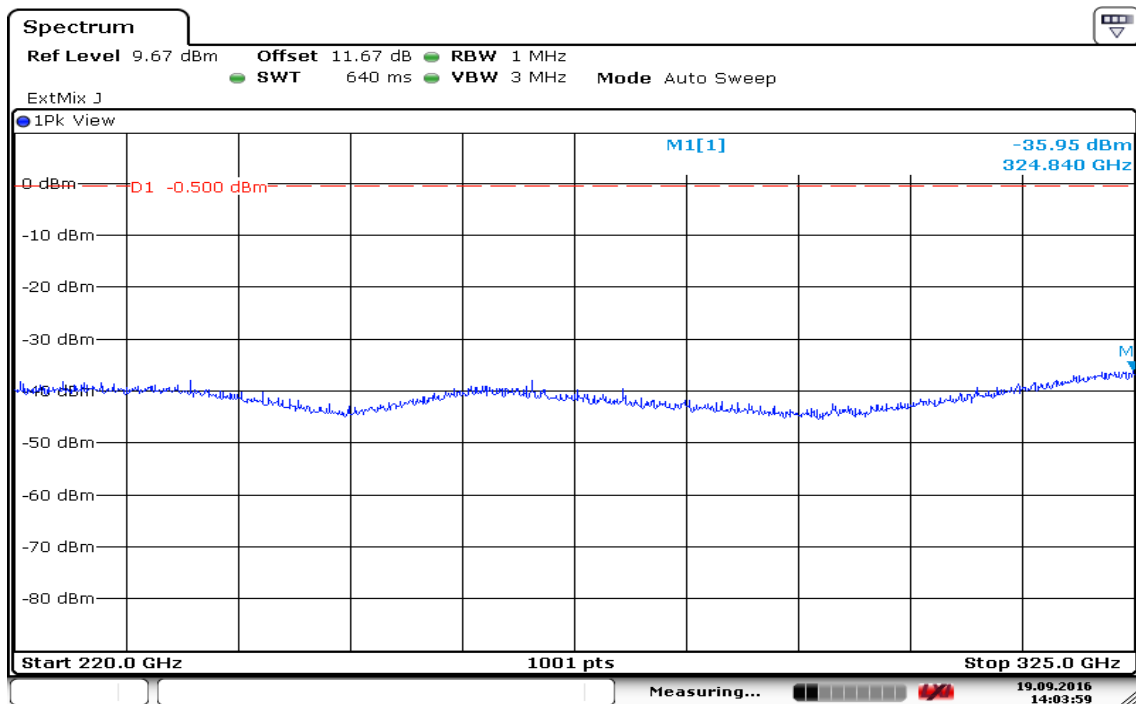
Date: 19.SEP.2016 13:30:11

110G-170G**Operation Mode:** Test Mode**Test Date:** September 19, 2016**Temperature:** 28°C**Tested by:** Zeus Chen**Humidity:** 53% RH

Date: 19.SEP.2016 13:34:53

170G-220G**Operation Mode:** Test Mode**Test Date:** September 19, 2016**Temperature:** 28°C**Tested by:** Zeus Chen**Humidity:** 53% RH

Date: 19.SEP.2016 13:38:39

220G-325G**Operation Mode:** Test Mode**Test Date:** September 19, 2016**Temperature:** 28°C**Tested by:** Zeus Chen**Humidity:** 53% RH

Date: 19.SEP.2016 14:03:58

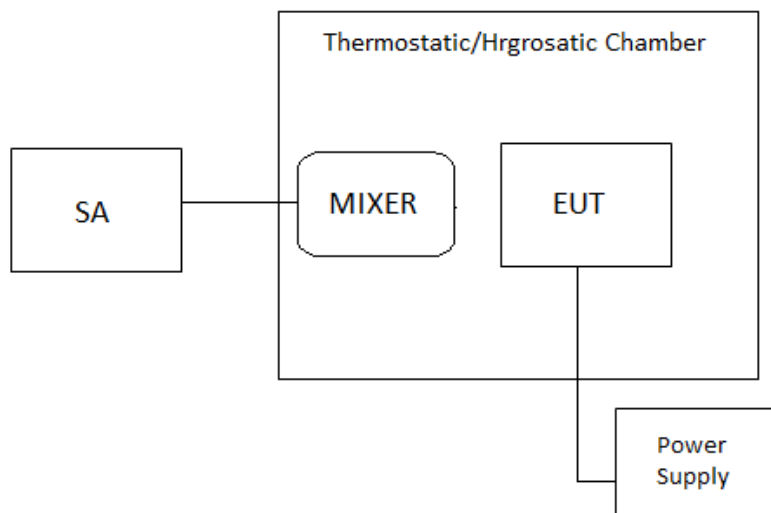
8.6 FREQUENCY STABILITY

LIMIT

According to FCC 15.253(f), Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to $+50$ degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

According to IC RSS-251(5.4) and RSS-Gen(6.1.1), Fundamental emissions shall be contained within the frequency bands specified in this standard during all conditions of operation specified in RSS-Gen. Equipment is presumed to operate over the temperature range -30 to $+50$ degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

Test Configuration



TEST PROCEDURE

The equipment under test was connected to an external AC or DC power supply and input rated voltage. RF output was connected to a frequency counter or spectrum analyzer via feed through attenuators. The EUT was placed inside the temperature chamber. Set the spectrum analyzer RBW low enough to obtain the desired frequency resolution and measure EUT 20°C operating frequency as reference frequency. Turn EUT off and set the chamber temperature to -30°C . After the temperature stabilized for approximately 30 minutes recorded the frequency. Repeat step measure with 10°C increased per stage until the highest temperature of $+50^{\circ}\text{C}$ reached.

TEST RESULTS

No non-compliance noted.

Operating Frequency: 76.5 GHz					
Environment Temperature(°C)	Voltage (V)	Measured Frequency (GHz)	Margin	Limit Range(GHz)	Test Result
50	12	76.5390	0.0390	76-77	Pass
40	12	76.3861	0.1139	76-77	Pass
30	12	76.2767	0.2233	76-77	Pass
20	12	76.2917	0.2083	76-77	Pass
10	12	76.8761	-0.3761	76-77	Pass
0	12	76.1419	0.3581	76-77	Pass
-10	12	76.5674	-0.0674	76-77	Pass
-20	12	76.8652	-0.3652	76-77	Pass
-30	12	76.6019	-0.1019	76-77	Pass

Operating Frequency: 76.5 GHz					
Environment Temperature(°C)	Voltage (V)	Measured Frequency (GHz)	Margin	Limit Range(GHz)	Test Result
20	10.8	76.2932	0.2068	76-77	Pass
	12	76.2917	0.2083	76-77	Pass
	13.2	76.3007	0.1993	76-77	Pass