Test Report

Test Report No.: CQC-IVTS-2024-0429-E1

Product Name	Radar Level Sensor
Model Number	PRL-100
Applicant	Pyxis Lab, Inc
Approval Types	FCC ID: 2BAJ2-PRL IC: 30170-PRL

CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd.

National Quality Inspection and Testing Center for Internet of Vehicles Products

TEST REPORT DECLARATION

Equipment under Test	:	**Radar Level Sensor**
Model /Type	:	PRL-100
Listed Models	:	/
Applicant	:	**Pyxis Lab, Inc**
Address	:	21242 Spell Circle Tomball, TX 77375 USA
Manufacturer	:	**Changzhou Luo Pan Xing Analytical Tech Co, Ltd.**
Address	:	6th Floor, A3 Building, Technology Venture Center,801 Changwu Middle Road, Changzhou, Jiangsu 213164, China

The EUT described above is tested by CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd. to determine the maximum emissions from the EUT. CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd. is assumed full responsibility for the accuracy of the test results.

Project Engineer:	Yankun Wang (Yankun Wang 王炎坤)	Date:	2025-3-24
Checked by:	Haohao Li (Haohao Li 李昊昊)	Date:	2025-3-24
Approved by:	Wenliang (Wenliang Li 李文亮)	Date:	2025.3.24

Contents

1. TEST STANDARDS

The tests were performed according to following standards: The equipment under test (EUT) has been tested at CQC-IVTS's (own or subcontracted) laboratories according to the leading reference documents giving table below:

No	Identify	Document Title	Version/Date
1	47 CFR Part 15.256	Operation of level probing radars within the bands 5.925-7.250 GHz, 24.05-29.00 GHz, and 75-85 GHz.	4/11/2023
2	RSS-211	Level Probing Radar Equipment	Issue 1 / March 2015
3	RSS-Gen	General Requirements for Compliance of Radio Apparatus	Issue 5 / April 2018
4	ANSI C63.4	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz	2014
5	ANSI C63.10	American National Standard for Testing Unlicensed Wireless Devices	2020

2. SUMMARY

2.1. General Remarks

Date of receipt of test sample	:	December 25, 2024
Testing commenced on	:	December 25, 2024
Testing concluded on	:	January 20, 2025

2.2. Product Description*

Product Name:	Radar Level Sensor
Model/Type Reference:	PRL-100
FCC ID:	2BAJ2-PRL
IC:	30170-PRL
HMN:	-/-
PMN:	Radar Level Sensor
HVIN:	PRL-100
FVIN:	-/-
Hardware Version:	V1.0
Software Version:	1.0r75
Frequency Range:	75 – 85 GHz
Number of Channels:	1
Modulation Type:	Frequency Modulation (FMCW)
Antenna:	Integrated patch antenna
Antenna Gain:	Maximum peak value is 28.0 dBi
Power Supply:	DC 3.7V from the battery
IC Classification:	Radar device
Emission Designator:	PXN

*: declared by the applicant

2.3. EUT operation mode

EUT operating mode no	Description of operating modes	Additional information
op. 1	Continuously transmitting and receiving mode	Carrier modulation (normal mode). 75 – 85 GHz, a continuous wave with 100% duty cycle

*: declared by the applicant

2.4. Modifications

No modifications were implemented to meet testing criteria

2.5. Test Item (Equipment Under Test) Description*

Short designation	EUT Name	EUT Description	Serial number	Hardware status	Software status
EUT A	PRL-100	Radar Level Sensor	240001	V1.0	1.0r75

*: declared by the applicant.

2.6. Auxiliary Equipment (AE) Description

AE short designation	EUT Name (if available)	EUT Description	Serial number (if available)	Software (if used)
AE 1	-/-	-/-	-/-	-/-
AE 2	-/-	-/-	-/-	-/-

*: declared by the applicant.

2.7. Test Item Set-ups Description

set. 1	EUT A	EUT operating mode 1
-/-	-/-	-/-

2.8. Test Conditions*

Temperature, [°C]	
T_{nom}	+20
T_{min}	-20
T_{max}	+50

*: declared by the applicant

2.9. Additional Information*

Test items differences	None
Additional application considerations to test a component or sub-assembly	none
The TLPR works with maximum output power < 7dBm with an antenna gain of 23.00 dBi. The maxumum EIRP therefore is 30.00 dBm. The receiver interferer is –49.3 dBm as calculated by the manufacturer.	

*: declared by the manufacturer. CQC-IVTS not reponsible for the accuary.

2.10. Test Location

Location 1

Company:	CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd.
Address:	Building G5, TCL International E City, Xili Street, Nanshan District, Shenzhen, China
Post code:	518112
Contact Person:	Wenliang Li
Telephone:	+86-755-8618 9654
e-Mail:	liwenliang@cqc.com.cn

2.11. Abnormalities from Standard Conditions

None

2.12. Possible verdicts of the results

Test sample meets the requirements	P (PASS) ± the measured value is below the acceptance limit, AL = TL
Test sample does not meet the requirements	F (FAIL) ± the measured value is above the acceptance limit, AL = TL
Test case does not apply to the test sample	N/A (Not applicable)
Test case not performed	N/P (Not performed)

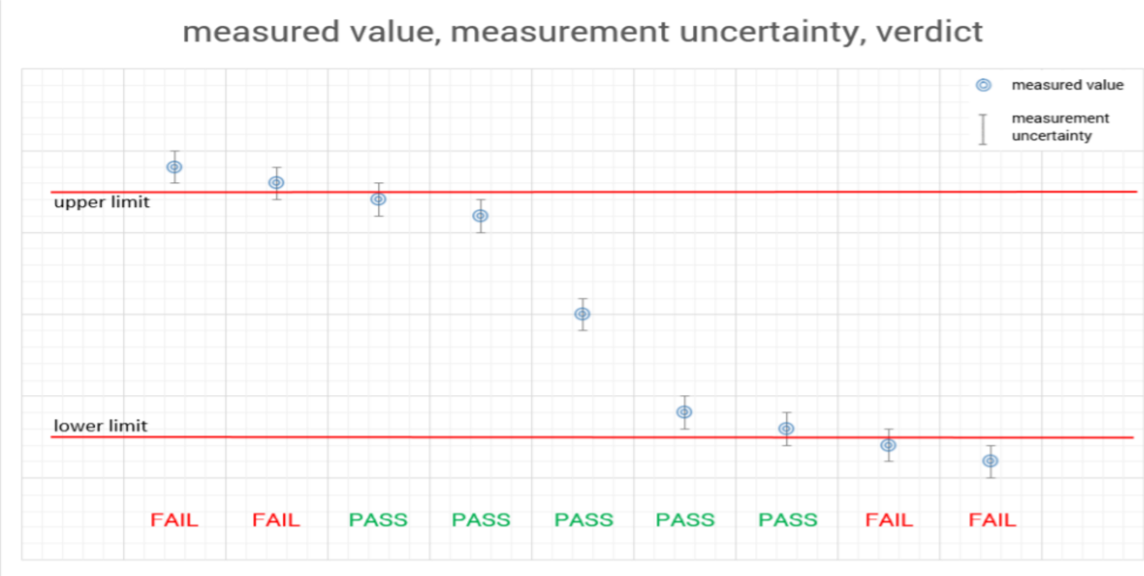
2.13. Formula for Determination of Correction Values (E_c)

$E_C = E_R + AF + C_L + D_F - G_A$ (1)
$M = L_T - E_C$ (2)

E_C = Electrical field ± corrected value
E_R = Receiver reading
M = Margin
L_T = Limit
AF = Antenna factor
C_L = Cable loss
D_F = Distance correction factor (if used)
G_A = Gain of pre-amplifier (if used)
All units are dB-units, positive margin means value is below limit.

2.14. Reporting Statements of Conformity – Decision Rule

Only the measured values related to their corresponding limits will be used to decide whether the equipment under test meets the requirements of the test standards listed. The measurement uncertainty is mentioned in this test report, see chapter 9, but is not taken into account - neither to the limits nor to the measurement results. Measurement results with a smaller margin to the corresponding limits than the measurement uncertainty have a potential risk of more than 5% that the decision might be wrong."



3. TEST ENVIRONMENT

3.1. Address of the test laboratory

CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd.
Building G5, TCL International E City, Xili Street, Nanshan District, Shenzhen, China
CQC-IVTS A2LA Certification Number: 6645.01;
FCC Designation Number: CN1329
ISED test lab CAB identifier: CN0134

3.2. Environmental conditions

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

Normal Temperature:	25°C
Lative Humidity	55 %
Air Pressure	989 hPa

3.3. Test Description

Test Specification Clause	Test Case	Temperature Condition	Power Supply	Pass	Fail	NA	NP	Results
§15.256(g) RSS-211 Clause 5.2b	Fundamental Emissions Limits	Nominal	Nominal	☒	☐	☐	☐	
§15.256(f) RSS-211 Clause 2.4	Fundamental Bandwidth (6dB)	Nominal	Nominal	☒	☐	☐	☐	
§15.215(c) RSS-Gen Clause 6.7	Occupied Bandwidth (99%)	Nominal	Nominal	☒	☐	☐	☐	
§15.256(h) §15.209 RSS-211 Clause 5.1d RSS-Gen Clause 8.9	Unwanted Emissions Limits	Nominal	Nominal	☒	☐	☐	☐	
§15.215(c) RSS-Gen Clause 6.11	Frequency Stability	Nominal Extreme	Nominal Extreme	☒	☐	☐	☐	
§15.207 RSS-Gen Clause 8.8	AC Power-:Line Conducted Emissions Limits	Nominal	Nominal	☐	☐	☒	☐	
§15.256(i) RSS-211 Clause 5.2a	Antenna Beamwidth	Nominal	Nominal	☒	☐	☐	☐	
§15.256(i) RSS-211 Clause 5.2C	Antenna Side Lobe Gain	Nominal	Nominal	☒	☐	☐	☐	
§15.256(i) RSS-Gen Clause 7.1	Emissions From Digital Circuitry	Nominal	Nominal	☒	☐	☐	☐	

Remark:
(1) NA means "Not Applicable"; NP means "Not Performed";
(2) The measurement uncertainty is not included in the test result.

3.4. Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. to TR-100028-01" Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd..quality system acc. to DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CQC Internet of Vehicles Technical Service (Shenzhen) Co., Ltd.:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	30~1000MHz	4.90 dB	(1)
Radiated Emission	1~6GHz	4.20 dB	(1)
Radiated Emission	6~18GHz	4.50 dB	(1)
Radiated Emission	18-40GHz	5.42 dB	(1)
Radiated Emission	Above 40 GHz	5.50 dB	(1)
Conducted Disturbance	0.15~30MHz	3.30 dB	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3.5. Equipments Used during the Test

Radiated Emission						
Item	Test Equipment	Manufacturer	Model No.	Equipment No.	Last Cal.	Cal.Due
1	EMI Test Receiver	R&S	ESW26	103003	2024/06/18	2025/06/17
2	Spectrum Analyzer	R&S	FSW43	10182	2024/05/14	2025/05/13
3	Ultra-Broadband Antenna	Schwarzbeck	VULB9168	1291	2024/08/01	2027/07/31
4	Horn Antenna	ETS-Lindgren	3117	102732	2024/08/01	2027/07/31
5	Amplifier	R&S	SCU01F	100369	2024/05/14	2025/05/13
6	Amplifier	R&S	SCU18F	100868	2024/05/14	2025/05/13
7	Amplifier	R&S	SCU26F	100781	2024/05/14	2025/05/13
8	Horn Antenna	A-INFO	LB-180500H	211008100089	2024/05/14	2025/05/13
9	EMI Test Software	R&S	EMC32	N/A	N/A	N/A
10	TC-RX50	Tonscond	Receive Unit	1544	N/A	N/A
11	TC-RX75	Tonscond	Receive Unit	1545	N/A	N/A
12	TC-RX110	Tonscond	Receive Unit	1546	N/A	N/A
13	TC-RX170	Tonscond	Receive Unit	1547	N/A	N/A
14	TC-RX240	Tonscond	Receive Unit	1548	N/A	N/A
15	TC-RX40	Tonscond	Receive Unit	1543	N/A	N/A
16	Signal Generator	R&S	SMW200A	170436	2024/05/14	2025/05/13
17	Thermal chamber	ESPEC	GFS-800-15	0050-001161	2024/06/18	2025/06/17

4. TEST CONDITIONS AND RESULTS

4.1. Unwanted Emissions Limits

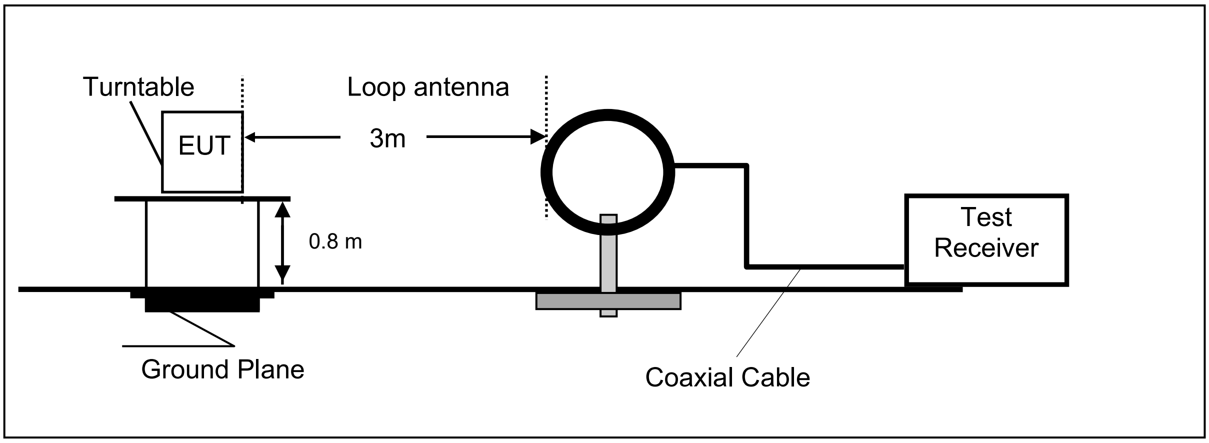
4.1.1. LIMITS

According to § 15.256(h) and RSS-211 Clause 5.1 (d): Unwanted emissions limits: Unwanted emissions from LPR devices shall not exceed the general emission limit in § 15.209 of this chapter and RSS-Gen. The levels of the spurious emissions shall not exceed the level of the fundamental emission.

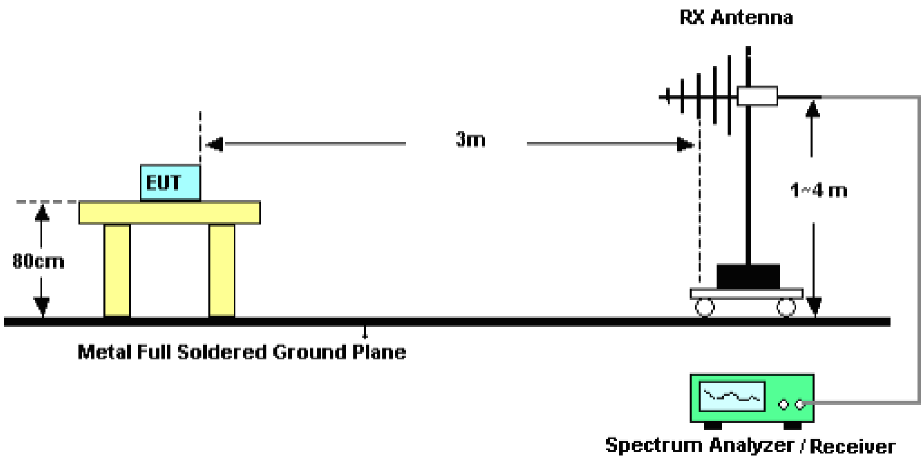
Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

4.1.2. TEST CONFIGURATION

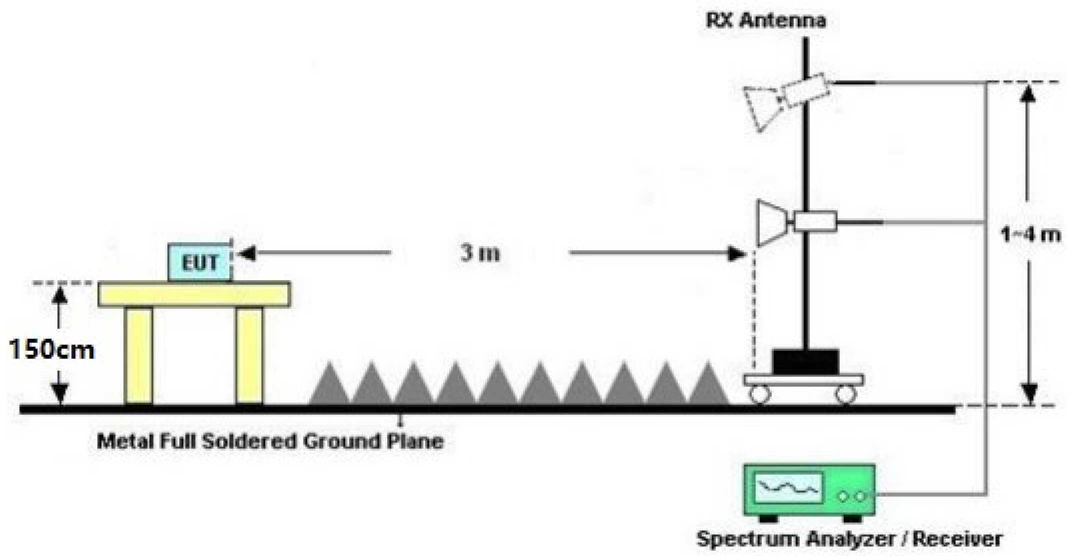
(a) Frequency range 9 KHz – 30MHz



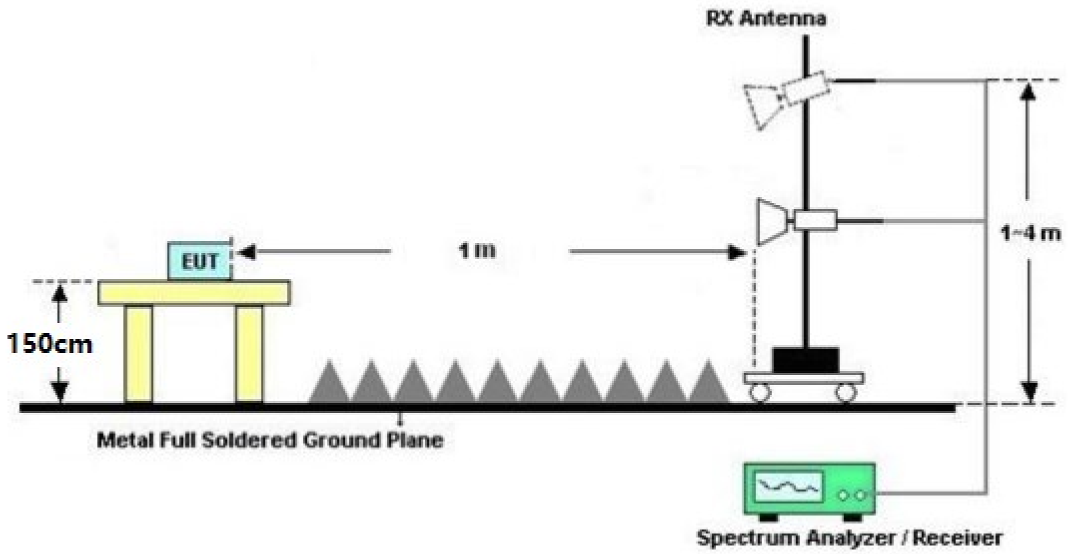
(b) Radiated emission test set-up, frequency range: 30 - 1000MHz



(c) Radiated emission test set-up, frequency range 1GHz – 18 GHz



(d) Radiated emission test set-up, frequency range above 18GHz



4.1.3. TEST PROCEDURE

4.1.3.1 Sequence of testing radiated spurious 9 KHz to 30 MHz

Setup

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer
- If the EUT is a tabletop system, 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turn table.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measuremet distance is 3m (see ANSI C63.4) – see test details.
- EUT is set into operation.

Premeasurement

- The turntable rotates from 0 degree to 360 degree.
- The antenna height is 1.5m.
- Set RBW = 200 Hz / VBW = 1 KHz, sweep time: Auto
- At each turntable position the anzlyer sweeps with position-peak detector to find the maximum of all emissions.

Final measurement

- Identified emissions during the premeaurement are maximized by the software by rotating the turntable from 0 degree to 360 degree.
- The final measurement is done in the position (turntable and elevation) causing the highest emissions with quasi-peak (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, conrrection factor, margin to the limit and limit will be recorded. A plot with the graph of the measurement and the limit is stored.

4.1.3.2 Sequence of testing radiated spurious 30 MHz to 1 GHz

Setup
- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer
- If the EUT is a tabletop system, 0.8 m height is used, which is placed on the ground plance.
- If the EUT is a floor standing device, it is placed directly on the ground plane.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measuremet distance is 3m (see ANSI C63.4) – see test details.
- EUT is set into operation.

Premeasurement
- The turntable rotates from 0 degree to 360 degree.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1m to 4m.
- Set RBW = 120 KHz / VBW = 1 MHz, sweep time: Auto
- At each turntable position the anzlyer sweeps with position-peak detector to find the maximum of all emissions.

Final measurement
- The final neasurement us perormed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable and antenna height between 1 and 4 m.
- The final measurement is done with quasi-peak detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, conrrection factor, margin to the limit and limit will be recorded. A plot with the graph of the measurement and the limit is stored.

4.1.3.3 Sequence of testing radiated spurious 1 GHz to 18 GHz

Setup
- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer
- If the EUT is a tabletop system, 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turntable.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measuremet distance is 3m (see ANSI C63.4) – see test details.
- EUT is set into operation.

Premeasurement
- The turntable rotates from 0 degree to 360 degree.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1m to 4m.
- Set RBW = 1 MHz / VBW = 3 MHz, sweep time: Auto, detector: Peak for Peak, RBW = 1 MHz / VBW = 3 MHz, sweep time: Auto, detector: Average for Average.
- At each turntable position the anzlyer sweeps with position-peak detector to find the maximum of all emissions.

Final measurement
- The final neasurement us perormed for at least six highest peaks according to the requirements of the ANSI C63.4.

- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable and antenna height between 1 and 4 m.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the height emissions with Peak and Average detector (as described in ANSI C 63.4).
- Final levels, frequency, measuring time, bandwidth, turntable position, conrrection factor, margin to the limit and limit will be recorded. A plot with the graph of the measurement and the limit is stored.

4.1.3.4 Sequence of testing radiated spurious above 18 GHz

Setup
- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer
- If the EUT is a tabletop system, 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turntable.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measuremet distance is 1m (see ANSI C63.4) – see test details.
- EUT is set into operation.

Premeasurement
- The turntable rotates from 0 degree to 360 degree.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1m to 4m.
- Set RBW = 1 MHz / VBW = 3 MHz, sweep time: Auto, detector: Peak for Peak, RBW = 1 MHz / VBW = 3 MHz, sweep time: Auto, detector: Average for Average.
- At each turntable position the anzlyer sweeps with position-peak detector to find the maximum of all emissions.

Final measurement
- The final neasurement us perormed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable and antenna height between 1 and 4 m.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the height emissions with Peak and RMS detector (as described in ANSI C 63.4).
- All final levels should consider distance conversion factor as format: Final values (3 m) = Measurement values (1 m) + Distance conversion factor
  Distance conversion factor = 20 x Log_{10} (d/3), where d = measurement distance in m
  - Distance conversion factor = 20 x Log_{10} (1/3) = -10.0 [dB]
- Final levels, frequency, measuring time, bandwidth, turntable position, conrrection factor, margin to the limit and limit will be recorded. A plot with the graph of the measurement and the limit is stored.

4.1.3.5 Sequence of testing radiated spurious above 40 GHz with external mixers

Setup
- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer
- If the EUT is a tabletop system, 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turntable.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measuremet distance is 1m (see ANSI C63.4) – see test details.
- EUT is set into operation.

Premeasurement
- The turntable rotates from 0 degree to 360 degree.
- The antenna with external mixer is polarized vertical and horizontal.
- The antenna height changes from 1m to 4m.
- Set RBW = 1 MHz / VBW = 3 MHz, sweep time: 600s detector: Peak.
- At each turntable position the anzlyer sweeps with position-peak detector to find the maximum of all emissions.

Final measurement

- The final neasurement us perormed for at least six highest peaks according to the requirements of the ANSI C63.4.
- Based on antenna and turntable positions at which the peak values are measured the software maximize the peaks by changing turntable and antenna height between 1 and 4 m.
- The final measurement is done in the position (turntable, EUT-table and antenna polarization) causing the height emissions with Peak and RMS detector (as described in ANSI C 63.4).
- All final levels should consider distance conversion factor as format: Final values (3 m) = Measurement values (1 m) + Distance conversion factor
  Distance conversion factor = 20 x Log_{10} (d/3), where d = measurement distance in m
  - Distance conversion factor = 20 x Log_{10} (1/3) = -10.0 [dB]
- Final levels, frequency, measuring time, bandwidth, turntable position, conrrection factor, margin to the limit and limit will be recorded. A plot with the graph of the measurement and the limit is stored.

4.1.4. FIELD STRENGTH CALCULATION

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS (dBuV/m) = RA (dBuV) + AF (dB/m) + CL (dB) – AG (dB)

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

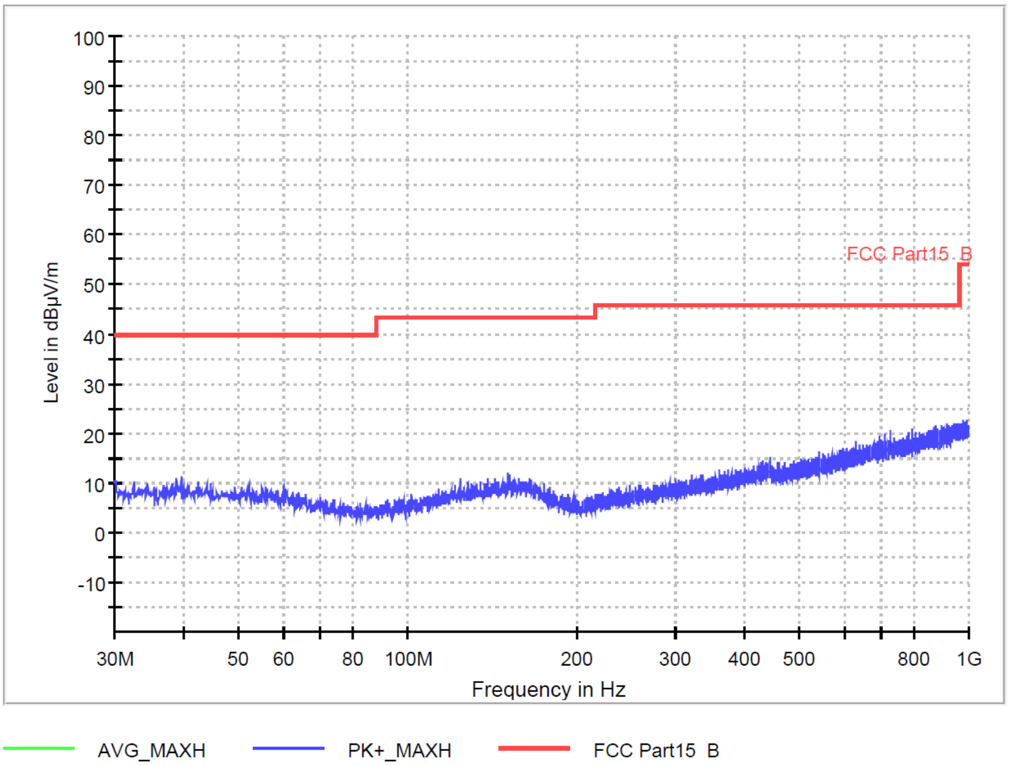
4.1.5. TEST RESULTS

PASS

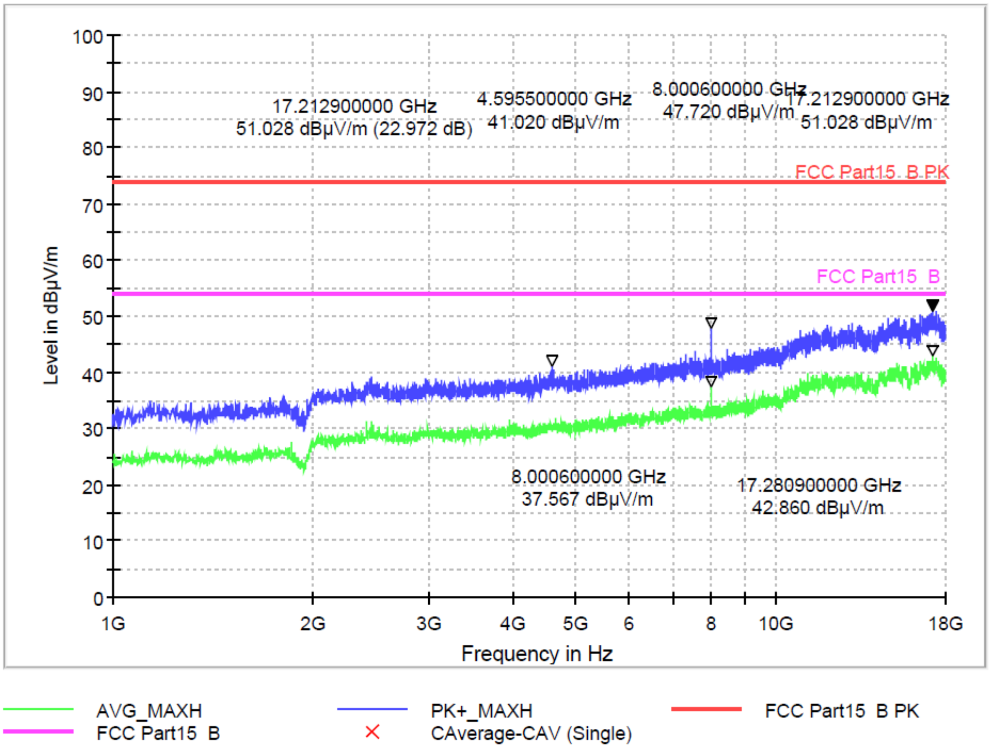
Remark:

1. Not recorded values after pre-test below 30 MHz (9 KHz – 30 MHz), values at least 20 dB below limit.
2. Distance conversion factor offset in test plots.

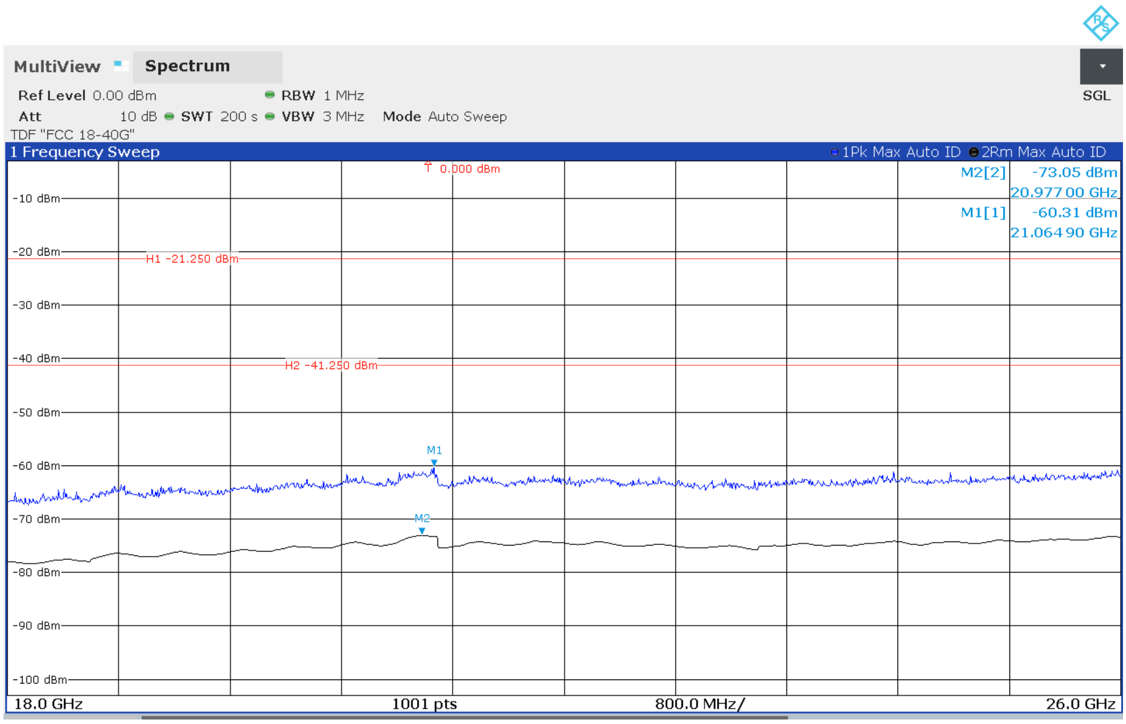
Plots No. 1: 30 MHz to 1 GHz, Horizontal / Vertical Polarization



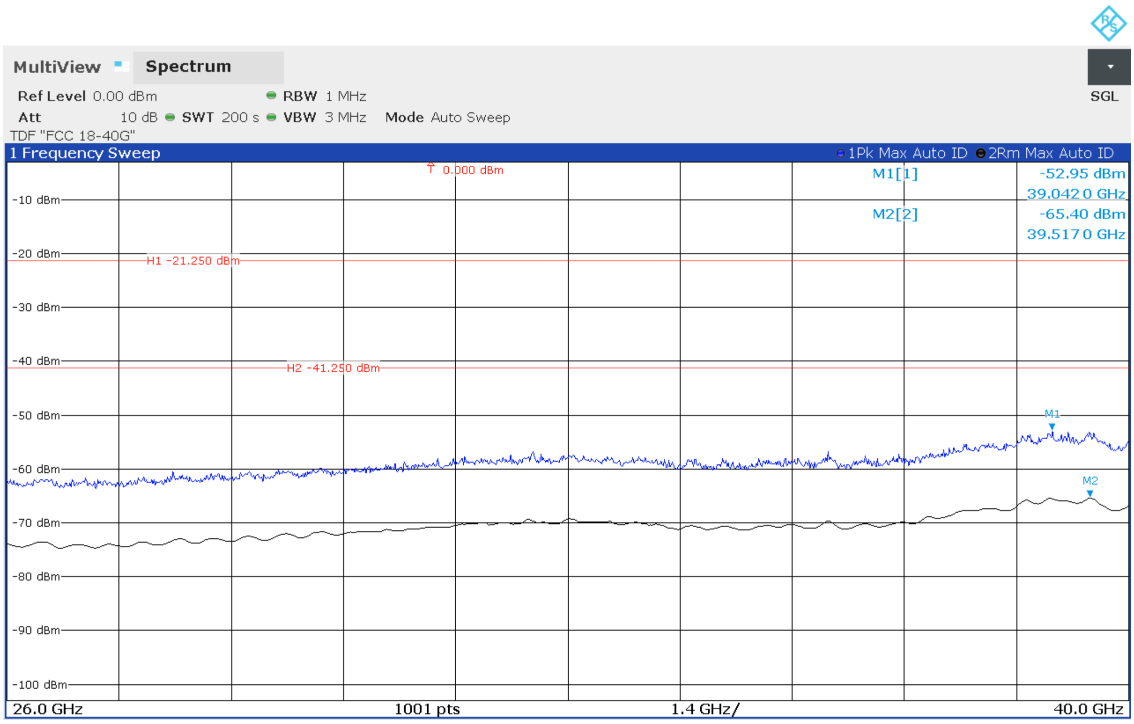
Plots No. 2: 1 GHz to 18 GHz, Horizontal / Vertical Polarization



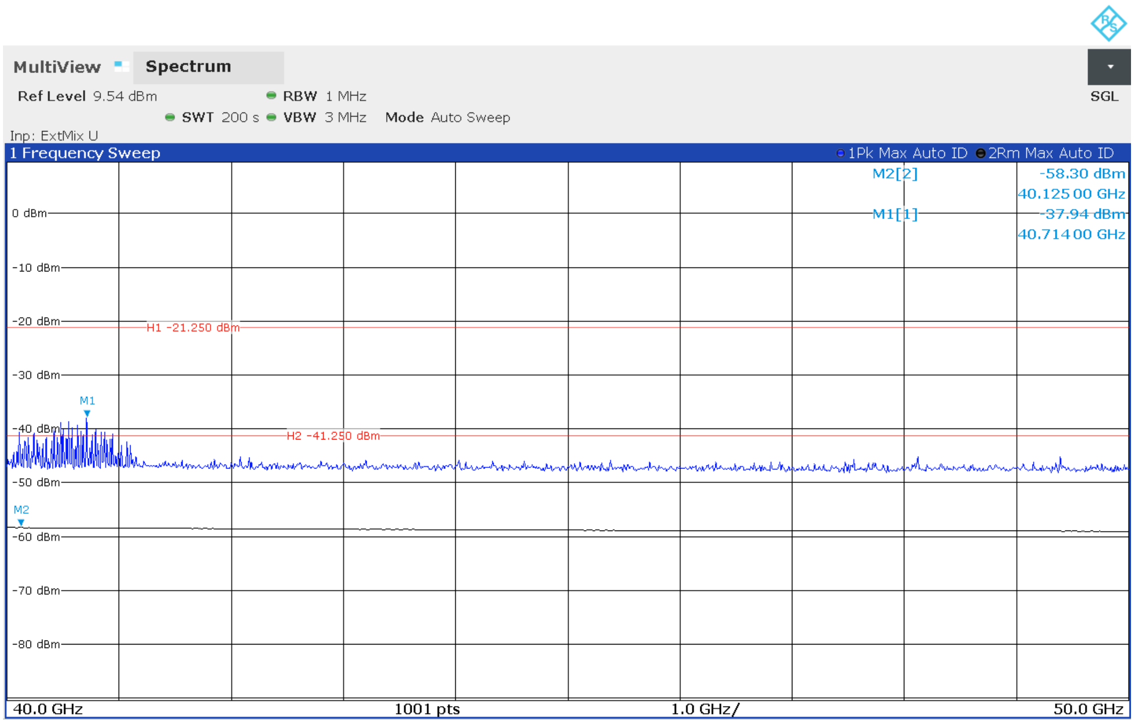
Plots No. 3: 18 GHz to 26 GHz, Horizontal / Vertical Polarization



Plots No. 4: 26 GHz to 40 GHz, Horizontal / Vertical Polarization

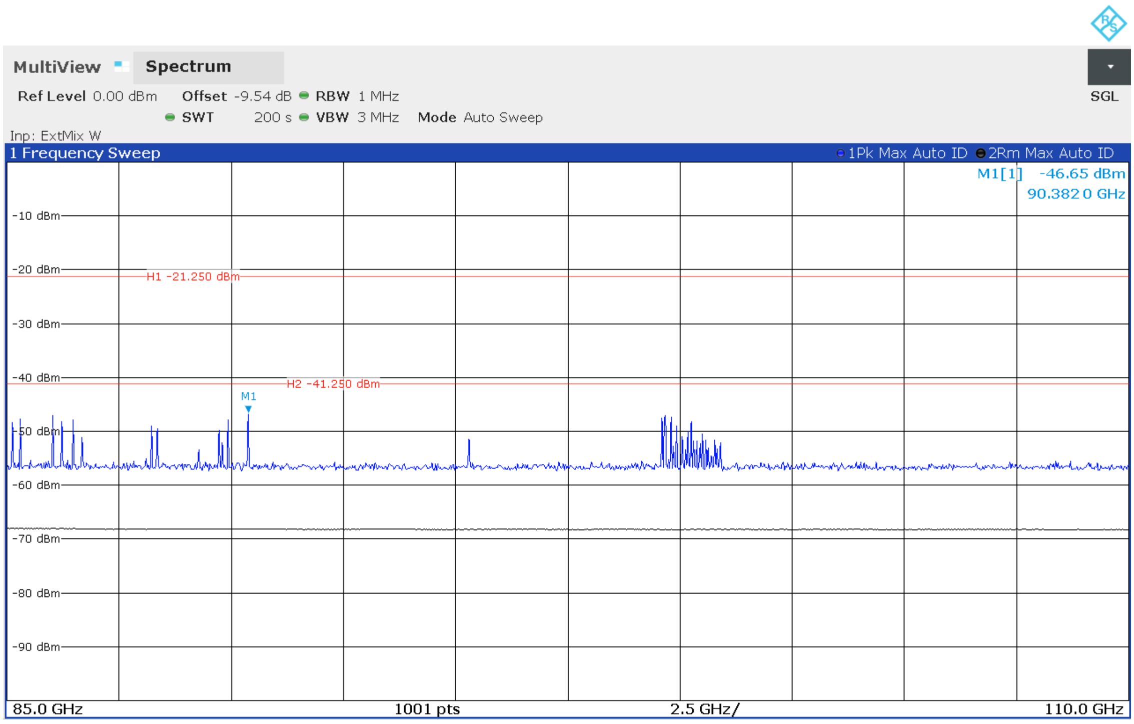


Plots No. 5: 40 GHz to 50 GHz, Horizontal / Vertical Polarization

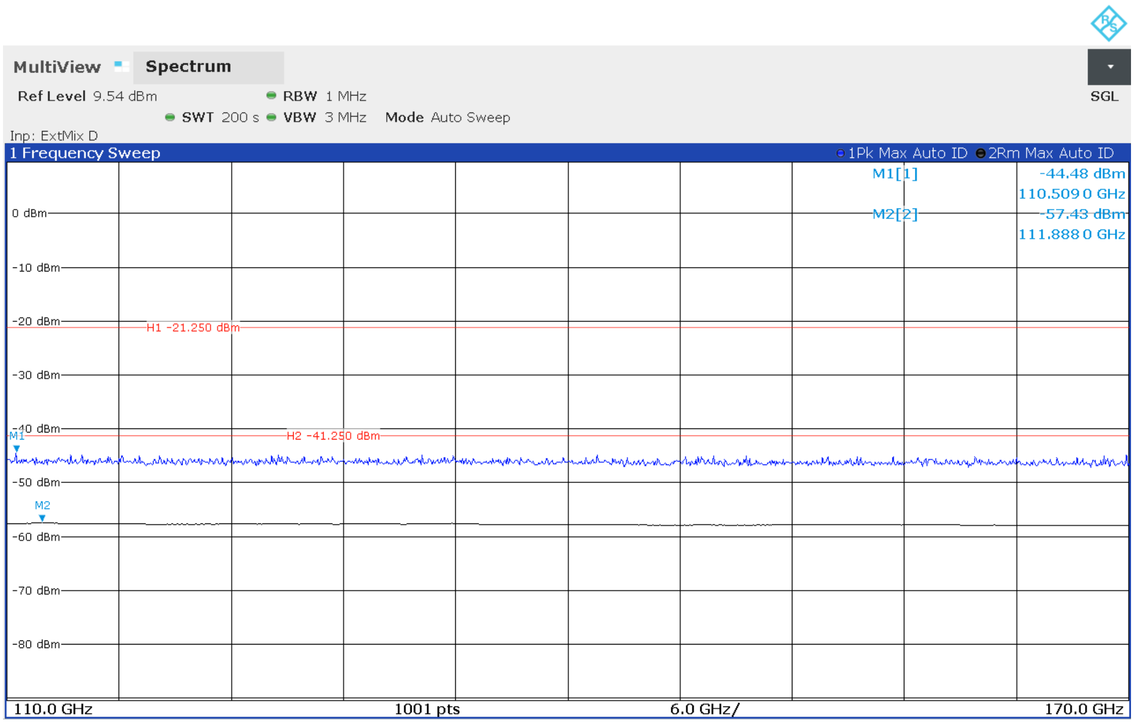


Plots No. 6: 50 GHz to 75 GHz, Horizontal / Vertical Polarization

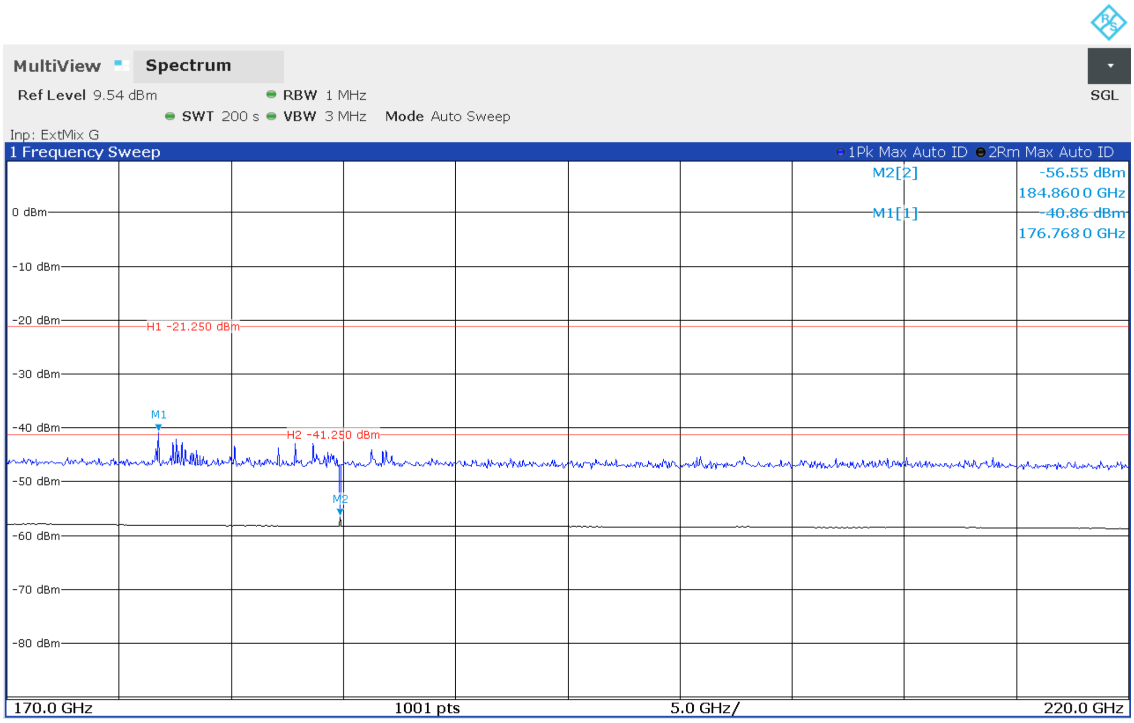
Plots No. 7: 85 GHz to 110 GHz, Horizontal / Vertical Polarization



Plots No. 8: 110 GHz to 170 GHz, Horizontal / Vertical Polarization



Plots No. 9: 170 GHz to 220 GHz, Horizontal / Vertical Polarization



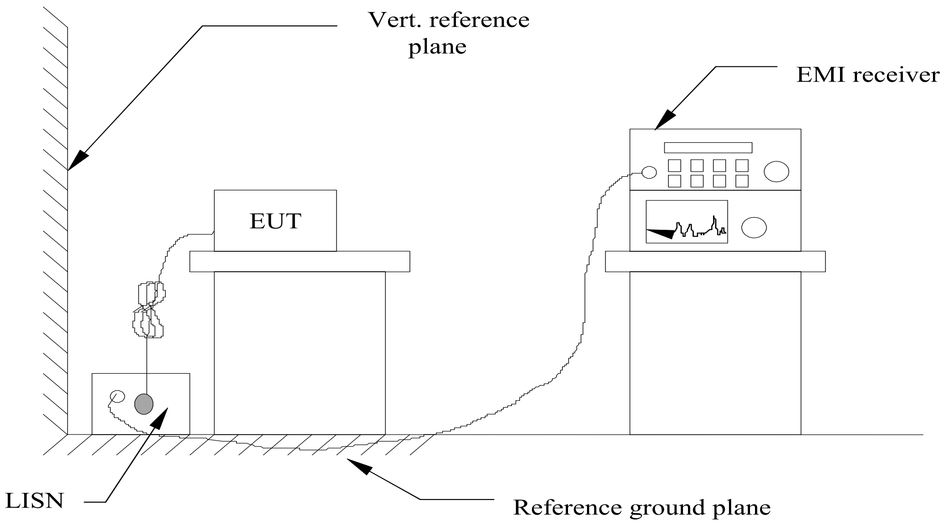
4.2. AC Conducted Emission

4.2.1. LIMITS OF DISTURBANCE

According to RSS Gen 8.8 and § 15.207(a) Line Conducted Emission Limits is as following:

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50
* Decreases with the logarithm of the frequency.		

4.2.2. TEST CONFIGURATION



4.2.3. TEST PROCEDURE

1. The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
2. Support equipment, if needed, was placed as per ANSI C63.10-2013
3. All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
4. The EUT received DC 12V power from adapter, the adapter received AC120V/60Hz and AC 240V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5. All support equipment received AC power from a second LISN, if any.
6. The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50-ohm load; the second scan had Line 1 connected to a 50-ohm load and Line 2 connected to the Analyzer / Receiver.
7. Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8. During the above scans, the emissions were maximized by cable manipulation.

4.2.4. DISTURBANCE CALCULATION

The AC mains conducted disturbance is calculated by adding the 10dB Pulse Limiter and Cable Factor and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

CD (dBuV) = RA (dBuV) + PL (dB) + CL (dB)

Where CD = Conducted Disturbance	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	PL = 10 dB Pulse Limiter Factor

4.2.5. TEST RESULTS

Not Applicable (The device was powered by DC)

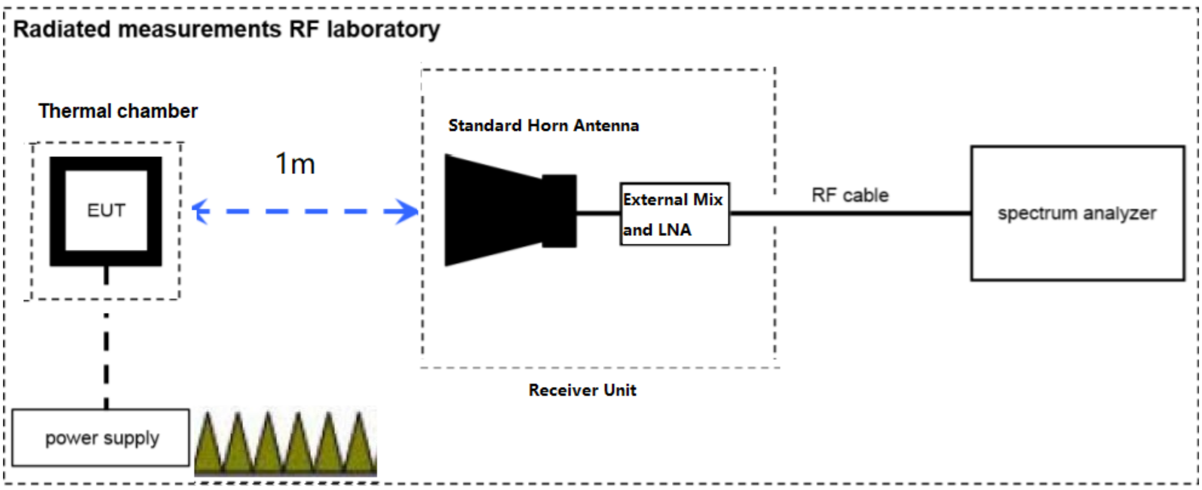
4.3. Frequency Stability and Fundamental Occupied Bandwidth (99% & 10dB Bandwidth)

4.3.1. LIMITS

According to §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. In the case of intentional radiators operating under the provisions of subpart E, the emission bandwidth may span across multiple contiguous frequency bands identified in that subpart. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.
According to RSS-Gen Clause 6.7: The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.
In some cases, the “x dB bandwidth” is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.
For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth)
According to § 15.256 (f) and RSS-211 Clasue 5.1 (a): The fundamental bandwidth of an LPR emission is defined as the width of the signal between two points, one below and one above the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power when measured in an equivalent resolution bandwidths.

(1) The fundamental bandwidth of an LPR emission is defined as the width of the signal between two points, one below and one above the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power when measured in an equivalent resolution bandwidth.
(2) The fundamental bandwidth of an LPR emission is defined as the width of the signal between two points, one below and one above the center frequency, outside of which all emissions are attenuated by at least 10 dB relative to the maximum transmitter output power when measured in an equivalent resolution bandwidth.

4.3.2. TEST CONFIGURATION



4.3.3. TEST PROCEDURE

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer
- If the EUT is a tabletop system, 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turntable.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- Measuremet distance is 1m (see ANSI C63.4) – see test details.
- EUT is set into operation.
- The turntable rotates from 0 degree to 360 degree.
- The antenna with external mixer is polarized vertical and horizontal.
- The antenna height changes from 1m to 4m.
- Setup corresponding Temperature / Voltage. EUT waiting for 10 minutes to stability before start testing.
- Set the resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

4.3.4. TEST RESULTS

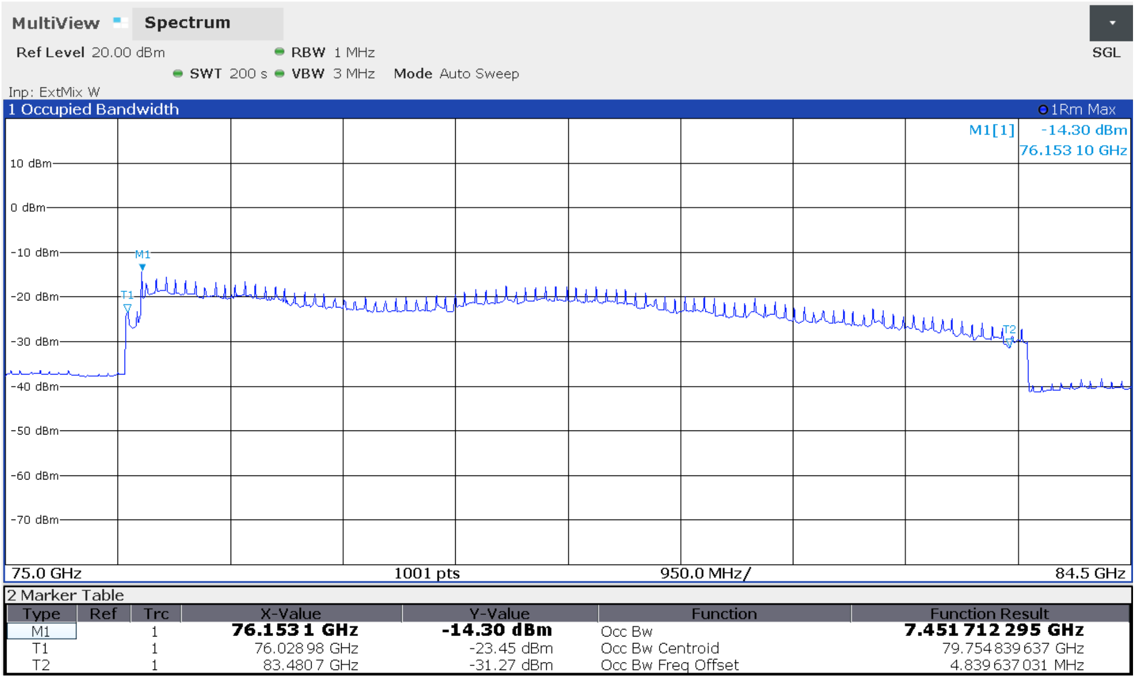
Test Conditions	EUT/Antenna Orientation	Fundamental Occupied Bandwidth (10dB)				Test Results
Temperature (℃)		F_L [GHz]	F_H [GHz]	Occupied Bandwidth [GHz]	Occupied Bandwidth Limit [GHz]	
-20	X/H&V	75.9893	83.5203	7.531	10	PASS
-10	X/H&V	76.0458	83.4638	7.418	10	PASS
0	X/H&V	75.9988	83.5108	7.512	10	PASS
10	X/H&V	76.0208	83.4888	7.468	10	PASS
20	X/H&V	76.0107	83.6221	7.451	10	PASS
30	X/H&V	75.9968	83.5128	7.516	10	PASS
40	X/H&V	75.9893	83.5203	7.531	10	PASS
50	X/H&V	76.0163	83.4933	7.477	10	PASS
20	X/H&V	76.0223	83.4873	7.465	10	PASS
20	X/H&V	76.0043	83.5053	7.501	10	PASS

Remark:
(1) The Fundamental Occupied Bandwidth (10dB) within central: 4.532 GHz / 5 GHz = 90.64% > 80%
(2) Test plots only provide V_{nor}/T_{nor}, modes,

Test Conditions		EUT/Antenna Orientation	99% Occupied Bandwidth				Test Results
Voltage (V)	Temperature (℃)		F_L [GHz]	F_H [GHz]	Occupied Bandwidth [GHz]	Occupied Bandwidth Limit [GHz]	
24.0	20	X/H&V	76.0289	83.4807	7.451	No Limits	PASS

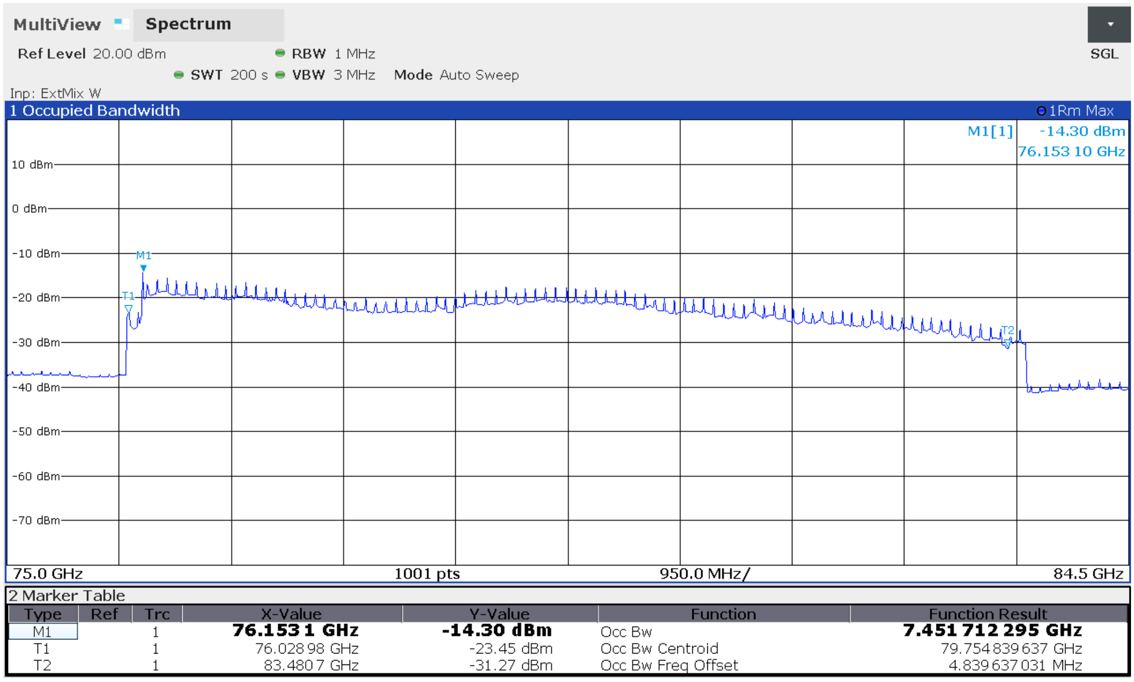
Remark:
(1) 99% occupied bandwidth no limit, only for report use.

Plots No. 11: 10dB Fundamental Occupied Bandwidth, Horizontal / Vertical Polarization_ V_{nor}/T_{nor}



Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**76.153 1 GHz**	**-14.30 dBm**	Occ Bw	**7.451 712 295 GHz**
T1		1	76.028 98 GHz	-23.45 dBm	Occ Bw Centroid	79.754 839 637 GHz
T2		1	83.480 7 GHz	-31.27 dBm	Occ Bw Freq Offset	4.839 637 031 MHz

Plots No. 12: 99% Occupied Bandwidth, Horizontal / Vertical Polarization_ V_{nor}/T_{nor}



Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**76.153 1 GHz**	**-14.30 dBm**	Occ Bw	**7.451 712 295 GHz**
T1		1	76.028 98 GHz	-23.45 dBm	Occ Bw Centroid	79.754 839 637 GHz
T2		1	83.480 7 GHz	-31.27 dBm	Occ Bw Freq Offset	4.839 637 031 MHz

Notes: The 10dB Fundamental and 99% bandwidth of the emission is contained within the frequency band.

4.4. Fundamental Emissions Limits

4.4.1. LIMITS

According to § 15.256 (g) and RSS-211 5.2(b): Fundamental emissions limits:

(1) All emission limits provided in this section are expressed in terms of Equivalent Isotropic Radiated Power (EIRP).

(2) All emission limits provided in this section are expressed in terms of Equivalent Isotropic Radiated Power (EIRP).

  (a) The EIRP in 1 MHz is computed from the maximum power level measured within any 1-MHz bandwidth using a power averaging detector;

  (b) The EIRP in 50 MHz is computed from the maximum power level measured with a peak detector in a 50-MHz bandwidth centered on the frequency at which the maximum average power level is realized and this 50 MHz bandwidth must be contained within the authorized operating bandwidth. For a RBW less than 50 MHz, the peak EIRP limit (in dBm) is reduced by 20 log(RBW/50) dB where RBW is the resolution bandwidth in megahertz. The RBW shall not be lower than 1 MHz or greater than 50 MHz. The video bandwidth of the measurement instrument shall not be less than the RBW. If the RBW is greater than 3 MHz, the application for certification filed shall contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

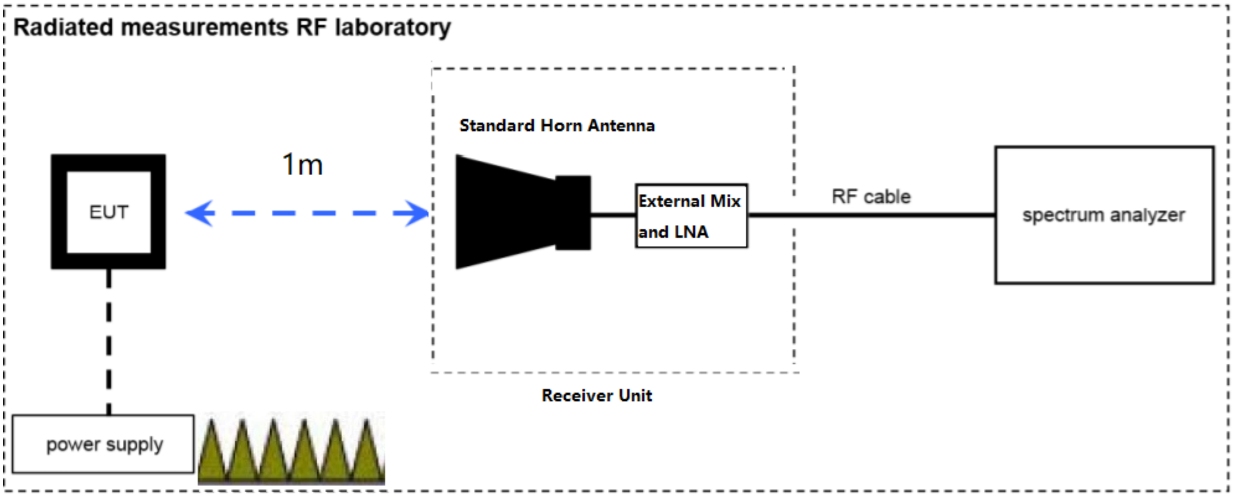
(3) The EIRP in 50 MHz is computed from the maximum power level measured with a peak detector in a 50-MHz bandwidth centered on the frequency at which the maximum average power level is realized and this 50 MHz bandwidth must be contained within the authorized operating bandwidth. For a RBW less than 50 MHz, the peak EIRP limit (in dBm) is reduced by 20 log(RBW/50) dB where RBW is the resolution bandwidth in megahertz. The RBW shall not be lower than 1 MHz or greater than 50 MHz. The video bandwidth of the measurement instrument shall not be less than the RBW. If the RBW is greater than 3 MHz, the application for certification filed shall contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing.

Table 1—LPR EIRP Emission Limits

Frequency band of operation (GHz)	Average emission limit (EIRP in dBm measured in 1MHz)	Peak emission limit (EIRP in dBm measured in 50 MHz)
5.925 – 7.250	-33	7
24.05 – 29.00	-14	26
75 – 85	-3	34

Notes: 1. The minimum bandwidth at the -10 dB point is 50 MHz.
2. All emission limits defined herein are based on boresight measurements (i.e., measurements performed within the main beam of an LPR antenna).

4.4.2. TEST CONFIGURATION



4.4.3. TEST PROCEDURE

- The equipment is set up to simulate normal operation mode as described in the user manual or defined by the manufacturer
- If the EUT is a tabletop system, 1.5 m height is used.
- If the EUT is a floor standing device, it is placed directly on the turntable.
- Auxiliary equipment and cables are positioned to simulate normal operation conditions as described in ANSI C63.4.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.

- Measuremet distance is 1m (see ANSI C63.4) – see test details.
- EUT is set into operation.
- The turntable rotates from 0 degree to 360 degree.
- The antenna with external mixer is polarized vertical and horizontal.
- The antenna height changes from 1m to 4m.
- Set the resolution bandwidth RBW=3MHz/VBW=50MHz, Sweep Time=800s, Dector: Peak / RBW=1MHz/VBW=3MHz, Sweep Time=200s, Dector: RMS.

4.4.4. TEST RESULTS

Test Conditions	EUT/Antenna Orientation	Fundamental Emissions						Test Results
		Peak E.I.R.P in 8MHz [dBm]	RBW Factor (dB)	Peak E.I.R.P in 50MHz [dBm]	Peak E.I.R.P in 50MHz Limit [dBm]	Average E.I.R.P in 1MHz [dBm]	Average E.I.R.P in 1MHz Limit [dBm]	
T_{nom} / V_{nom}	X/H&V	0.17	24.437	24.607	34.00	-37.90	-3.00	PASS

Remark:

(1) RBW Factor = 20 log (50 MHz / 3 MHz) = 24.437 dB

(2) There are two difference aspects which will affect the peak-to-average ratio resp.RMS values at all:
 - Duty cycle of the device
 - Frequency domain mitigation / dwell time due to FMCW-modulation

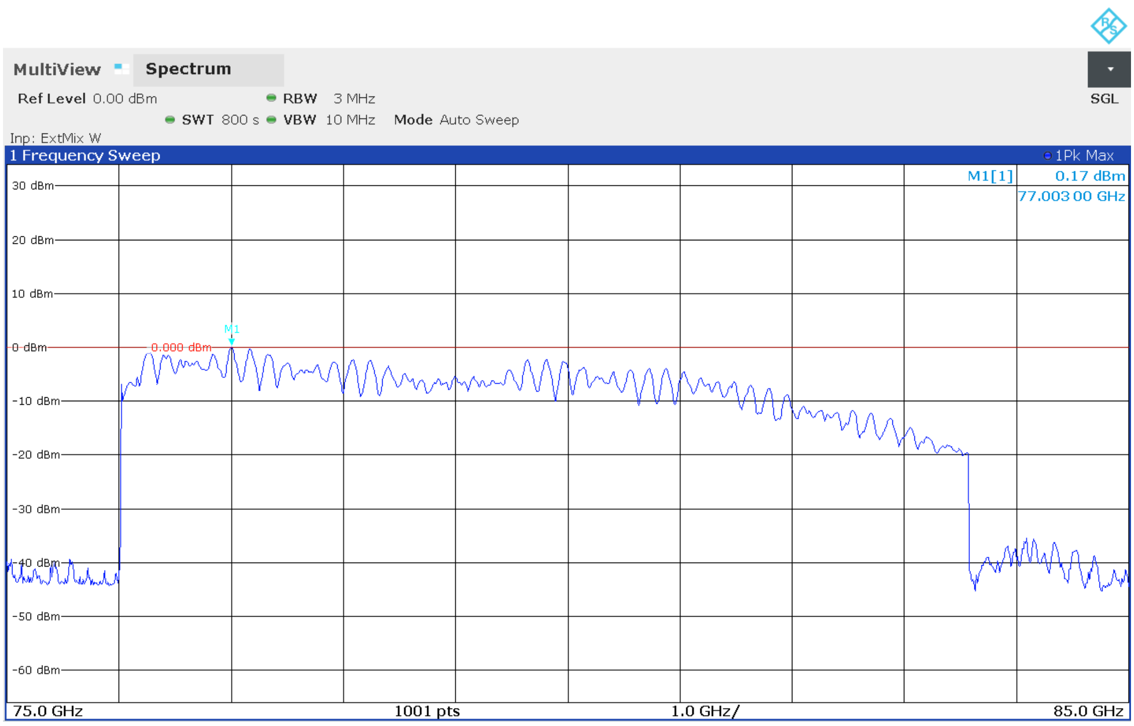
The EUT uses FMCW with a negative or positive ramp over a bandwidth of 8 GHz.
This will lead to:

Mode	Operation Bandwidth (△F) [GHz]	Dwell time (TD)* [µs/MHz]	Averaging Factor (AF)** [dB]
Normal	7.451	0.1226	-49.115

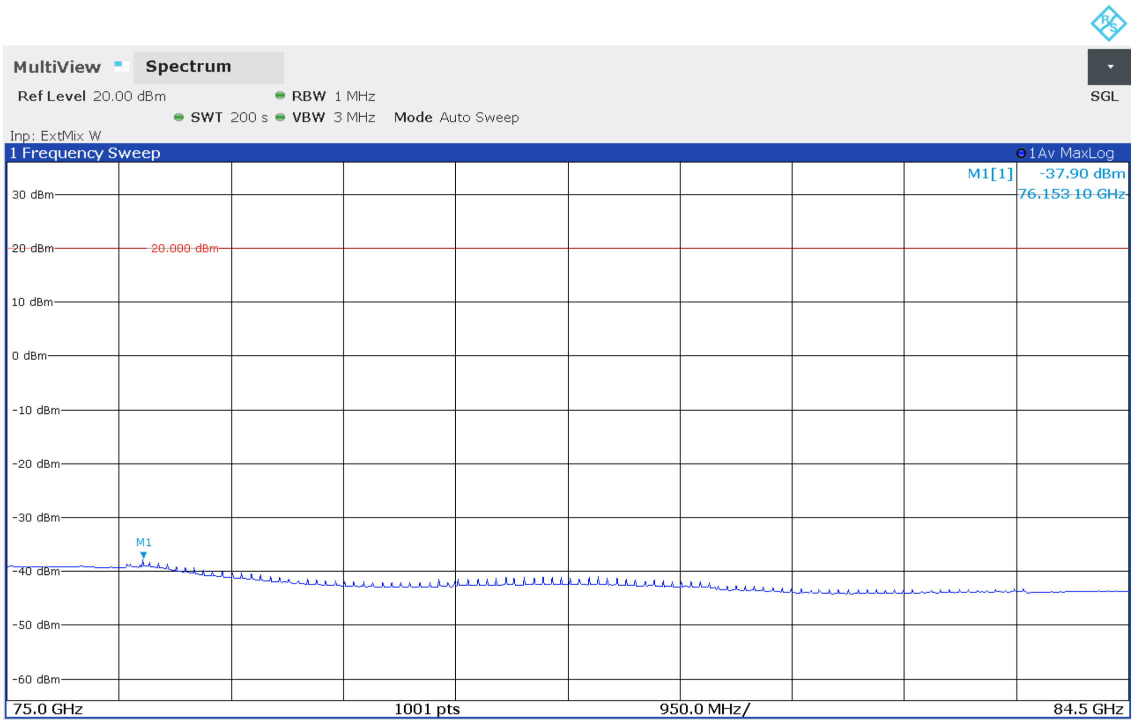
*dwell time = TD = T_s/△F; or declaraed by customer
**average factor AF = 10 log (T_D / cycle time)

Mode	Equivalent Isotropic Radiated Power (EIRP).	
	Peak Power	Average Power
Normal	24.607 dBm	-37.90 dBm

Plots No. 12: Peak E.I.R.P / RBW = 3MHz, Horizontal / Vertical Polarization



Plots No. 13: Average E.I.R.P / RBW = 1 MHz, Horizontal / Vertical Polarization



4.5. Emissions from Digital Circuitry

4.5.1. LIMITS

According to § 15.256 (k): Emissions from digital circuitry used to enable the operation of the transmitter may comply with the limits in § 15.209 of this chapter provided it can be clearly demonstrated that those emissions are due solely to emissions from digital circuitry contained within the transmitter and the emissions are not intended to be radiated from the transmitter's antenna. Emissions from associated digital devices, as defined in § 15.3(k) of this part, e.g., emissions from digital circuitry used to control additional functions or capabilities other than the operation of the transmitter, are subject to the limits contained in subpart B, part 15 of this chapter. Emissions from these digital circuits shall not be employed in determining the −10 dB bandwidth of the fundamental emission or the frequency at which the highest emission level occurs.

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

4.5.2. TEST CONFIGURATION

See 4.1.2 Test Configuration of Unwanted Emissions Limits according to § 15.256 (h) / RSS-211 Clause 5.1 (d)

4.5.3. TEST PROCEDURE

See 4.1.3 Test Procedure of Unwanted Emissions Limits according to § 15.256 (h) / RSS-211 Clause 5.1 (d)

4.5.4. TEST RESULTS

See 4.1.4 Test Results of Unwanted Emissions Limits according to § 15.256 (h) / RSS-211 Clause 5.1 (d)

4.6. Antenna Beamwidth and Antenna Side Lobe Gain

4.6.1. REQUIREMENT

According to § 15.256(j) and RSS-211 Clause 5.2 (c): LPR devices operating under the provisions of this section must limit the side lobe antenna gain relative to the main beam gain for off-axis angles from the main beam of greater than 60 degrees to the levels provided in Table 2.

Table 2—Antenna Side Lobe Gain Limits

Frequency Range (GHz)	Antenna side lobe gain limit relative to main beam gain (dB)
5.925 – 7.250	-22
24.05 – 29.00	-27
75 – 85	-38

The standard ETSI EN 302 729 contains measurement techniques for the LPR “boresight-axis” method.

According to § 15.256(i) Antenna beamwidth.

(a) LPR devices operating under the provisions of this section within the 5.925–7.250 GHz and 24.05–29.00 GHz bands must use an antenna with a −3 dB beamwidth no greater than 12 degrees.

(b) LPR devices operating under the provisions of this section within the 75–85 GHz band must use an antenna with a −3 dB beamwidth no greater than 8 degrees.

4.6.2. TEST RESULTS

Antennas	Maximum Gain		Maximum 3dB Beam Width		Maximum Side Lobe Level > 60℃		Results
	Data	Limits	Data	Limits	Data	Limits	
Eched Antennas	25.7 dBi	No Limits	(7.9°)	≤ 8 (°)	-39.4 dBc	≤ -38 dBc	PASS*

Remark

(1) See Antenna information provided by manfacturer

(2) Antenna information provided by manfacturer, CQC-IVTS not responsible for results accuary.

5. Test Set-up Photos of the EUT

Please refer to independent test set-up photos of the EUT

6. External and Internal Photos of the EUT

External Photos

Please refer to independent external photos

Internal Photos

Please refer to independent external photos

Revision History

Revision	Issue Date	Revisions	Revised By
1.0	2025-03-24	Original Issue	Wenliang Li

********************** **End of Report** ********************

DECLARATION

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.
If you have any questions on this report, please contact us within 15 days after issue this report.

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