FCC 47 CFR PART 15 SUBPART C
ISED RSS-210 ISSUE 10
ISED RSS-GEN ISSUE 5

CERTIFICATION TEST REPORT

FOR

V-Band Radar

MODEL NUMBER: SBV-01

FCC ID: 2ANOS-SBV01
IC: 27966-SBV01

REPORT NUMBER: R13747609-E1

ISSUE DATE: 2022-01-19

Prepared for
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CERT #0751.06

Revision History

Rev.	Issue Date	Revisions	Revised By
V1	2021-12-14	Initial Issue	Henry Lindbo
V2	2022-01-12	Revised 1-40GHz RSE Data	Henry Lindbo
V3	2022-01-13	Added 99% Bandwidth Section	Henry Lindbo
V4	2022-01-19	Added Additional Frequency Stability Data	Henry Lindbo

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Inxpect S.p.a.
Via Serpente, 91
BS 25131 Italy

EUT DESCRIPTION: V-Band Radar

MODEL: SBV-01

SERIAL NUMBER: ZZ864

DATE TESTED: 2021-09-10 to 2022-01-19

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Complies
ISED RSS-210 Issue 10 Annex J	Complies
ISED RSS-GEN Issue 5	Complies

UL LLC tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.

This document may not be altered or revised in any way unless done so by UL LLC and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL LLC will constitute fraud and shall nullify the document.

Approved & Released For
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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2013, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 5, and RSS-210 Issue 10.

This report contains data provided by the applicant which can impact the validity of results. UL LLC is only responsible for the validity of results after the integration of the data provided by the customer.

3. FACILITIES AND ACCREDITATION

UL LLC is accredited by A2LA, Cert. No. 751.06, for all testing performed within the scope of this report. Testing was performed at the locations noted below.

	Address	ISED CABID	ISED Company Number	FCC Registration
☐	12 Laboratory Drive Research Triangle Park, NC 27709, U.S.A.	US0067	2180C	825374
☒	2800 Perimeter Dr., Suite B, Morrisville, NC 27560, U.S.A.	US0067	27265	825374

4. DECISION RULES AND MEASUREMENT UNCERTAINTY

4.1. METROLOGICAL TRACEABILITY

All test and measuring equipment utilized to perform the tests documented in this report are calibrated on a regular basis, with a maximum time between calibrations of one year or the manufacturers' recommendation, whichever is less, and where applicable is traceable to recognized national standards.

4.2. DECISION RULES

The Decision Rule is based on Simple Acceptance in accordance with ISO Guide 98-4:2012 Clause 8.2. (Measurement uncertainty is not taken into account when stating conformity with a specified requirement.)

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus.

PARAMETER	U_{Lab}
Conducted Disturbance, 0.15 to 30 MHz	2.8 dB
Radiated Disturbance, 30 to 1000 MHz	6.0 dB
Radiated Emissions, 1-6 GHz	4.7 dB
Radiated Emissions, 6-18 GHz	4.7 dB
Radiated Emissions,18-26 GHz	4.5 dB
Radiated Emissions, 26-40 GHz	5.3 dB
Radiated Emissions, 40-200GHz	2.9 dB
Occupied Channel Bandwidth	± 0.39 dB
Time	± 0.02 %

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. MANUFACTURER'S DESCRIPTION OF EUT

The EUT is a radar sensor, operating in the 57-71 GHz band using FMCW modulation. One mode of operation is available.

The EUT does not have any external phase locking inputs for beam forming.

5.2. OUTPUT POWER

The antenna is integral thus radiated measurements are made. The EIRP was measured at the worst-case condition, thus the EIRP measurement conditions correspond to the maximum EUT antenna gain.

The highest peak radiated output power is -3.22 dBm EIRP.

The highest peak conducted output power is -13.22 dBm.

The highest average radiated output power is -9.09 dBm EIRP.

5.3. MANUFACTURER'S DESCRIPTION OF AVAILABLE ANTENNAS

The EUT utilizes an integral antenna with a gain of 10.0 dBi.

6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Support Equipment List				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
Power Supply	Circuit Specialists	CSI3005X5	76021	NA
ISC-BO1 Controller	Inxpect S.p.A	ISC-BO1	ZZ684	NA

I/O CABLES

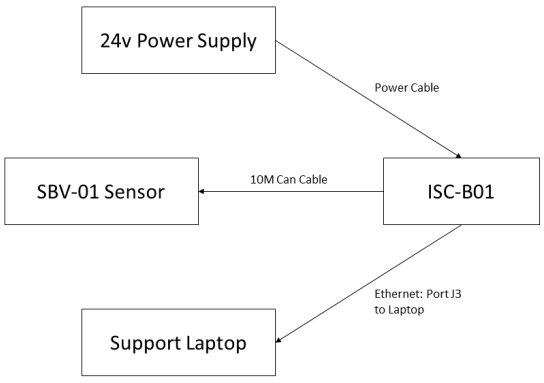
I/O Cable List						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length (m)**	**Remarks**
1	NA	NA	M12	CAN	10	CAN cable for powering EUT
2	NA	NA	Bare Wire	Power Cable	1	Screwed directly into Power Supply to power EUT

TEST SETUP

The EUT was powered by the ISC-BO1 controller (via a 10m CAN cable) which was in turn powered by a variable power supply set to 24v. Upon power up the EUT automatically begins continuous Tx modulated operation.

The equipment under test was transmitting while connected to its integral antenna.

SETUP DIAGRAM



TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Test Equipment Used - mmWave Test Equipment (Morrisville – mmWave 1)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	40-50 GHz				
206209	Standard Gain Horn, 40-50GHz	Custom Microwave Inc.	HO22R	2020-07-27	See note *
205910	Low Noise Amplifier	Eravant	SBL-3335033040-2222-E1	2021-04-15	2022-04-15
207949	Band Pass Filter	Eravant	SWF-4510460-2F2F-B1	2021-05-26	2022-05-26
	50-75 GHz				
206202	Standard Gain Horn, 50-75GHz	Custom Microwave Inc.	HO15R	2020-07-27	See note *
206607	WR15 Downconverter	VDI	WR15.0SAX-F	2021-04-05	2022-04-05
205911	Low Noise Amplifier	Eravant	SBL-5037531850-1515-E1	2021-04-15	2022-04-15
	75-110 GHz				
206222	Standard Gain Horn, 75-110GHz	Custom Microwave Inc.	HO10R	2020-07-27	See note *
207249	WR10 Downconverter	VDI	WR10.0SAX-F	2021-04-19	2022-04-19
205913	Low Noise Amplifier	Eravant	SBL-7531142050-1010-E1	2021-04-15	2022-04-15
	110-170 GHz				
206242	Standard Gain Horn, 110-170GHz	Custom Microwave Inc.	HO6R	2020-07-27	See note *
206555	WR6.5 Downconverter	VDI	WR6.5SAX-F	2021-04-02	2022-04-02
205912	Low Noise Amplifier	Eravant	SBL-1141741860-0606-E1	2021-04-15	2022-04-15
	170-260 GHz				
206244	Standard Gain Horn, 170-260GHz	Custom Microwave Inc.	HO4R	2020-07-27	See note *
206556	WR6.5 Downconverter	VDI	WR4.3SAX-F	2021-04-02	2022-04-02
	Receiver & Software				
206459	Spectrum Analyzer	Rohde & Schwarz	FSW50	2021-03-15	2022-03-15

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
mmWave	mmWave Software	UL	V2021.4.30		
	Additional Equipment used				
207161	Signal Generator	Rohde and Schwarz	SMA100B	2021-04-06	2022-04-06
207216	Power Meter	Rohde and Schwarz	NRX	2021-04-13	2022-04-13
207176	Thermal Power Sensor	Rohde and Schwarz	NRP75WG	2021-03-13	2022-03-13
206568	Isolator, 50-75GHz	Mi-Wave	115V/385	NA	NA
206569	Diode Detector, 50-75GHz	Mi-Wave	950V/385	NA	NA
s/n 181474341	Environmental Meter	Fisher Scientific	15-077-963	2020-08-06	2021-08-06
208201	350 MHz High Definition Oscilloscope	Teledyne Lecroy	HDO6034A	2021-05-27	2022-05-27
s/n 05-01-401	200 MHz Low-Noise Voltage Amplifier	Femto	HVA-200M-40-B	NA	NA
T116 80814	Microwave Detector	Agilent Technologies	8474C	NA	NA
206203	Standard Gain Horn, 50-75GHz	Custom Microwave Inc.	HO15R	2020-07-27	See note *
OS0043	400MHz Oscilloscope	Tektronix	TDS 380	2021-08-18	2022-08-18
981142	800MHz-4.2GHz Amplifier	Amplifier Research	10S1G4	2021-11-22	2022-11-22

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - South Chamber)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	18-40 GHz				
AT0061	Horn Antenna, 26-40GHz	ARA	MWH-2640/B	2021-11-04	2022-11-04
	Gain-Loss Chains				
S-SAC04	Gain-loss string: 18-40GHz	Various	Various	2021-07-09	2022-07-09
	Receiver & Software				
SA0020	Spectrum Analyzer	Agilent	E4446A	2021-05-25	2022-05-25
SOFTEMI	EMI Software	UL	Version 9.5 (18 Oct 2021)		
	Additional Equipment used				

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
s/n 200037635	Environmental Meter	Fisher Scientific	06-662-4	2020-01-22	2022-01-22
PWR002	Switching Mode Power Supply	BK Precision	1687B (s/n 7611-3202-1010)	NA	NA

Test Equipment Used - Radiated Disturbance Emissions Test Equipment (Morrisville - North Chamber)

Equip. ID	Description	Manufacturer/Brand	Model Number	Last Cal.	Next Cal.
	0.009-30MHz				
AT0079	Active Loop Antenna	ETS-Lindgren	6502	2021-08-19	2022-08-19
	30-1000 MHz				
AT0066	Hybrid Broadband Antenna	Sunol Sciences Corp.	JB1	2021-02-19	2022-02-19
	1-18 GHz				
AT0078	Double-Ridged Waveguide Horn Antenna, 1 to 18 GHz	ETS Lindgren	3117	2020-11-19	2021-11-19
	18-40 GHz				
AT0063	Horn Antenna, 18-26.5GHz	ARA	MWH-1826/B	2020-10-30	2021-10-30
AT0061	Horn Antenna, 26-40GHz	ARA	MWH-2640/B	2020-10-30	2021-10-30
	Gain-Loss Chains				
N-SAC01	Gain-loss string: 0.009-30MHz	Various	Various	2021-07-20	2022-07-20
N-SAC02	Gain-loss string: 25-1000MHz	Various	Various	2021-07-20	2022-07-20
N-SAC03	Gain-loss string: 1-18GHz	Various	Various	2021-07-20	2022-07-20
N-SAC04	Gain-loss string: 18-40GHz	Various	Various	2021-07-20	2022-07-20
	Receiver & Software				
197954	Spectrum Analyzer	Rohde & Schwarz	ESW44	2021-03-30	2022-03-30
SA0020	Spectrum Analyzer	Agilent	E4446A	2021-05-25	2022-05-25
SOFTEMI	EMI Software	UL	Version 9.5 (24 Jun 2021)		
	Additional Equipment used				
s/n 200037635	Environmental Meter	Fisher Scientific	06-662-4	2020-01-21	2022-01-21

Test Equipment Used - Wireless Conducted Measurement Equipment

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
	Conducted Room 1				
207726	Temp/Humid Chamber	Thermotron	SM-32-8200	2021-01-04	2022-01-04
76023 (EC0225)	Temp/Humid Chamber	Cincinnati Sub-Zero	ZPH-8-3.5-SCT/AC	2021-05-27	2022-05-27
76022	DC Regulated Power Supply	CircuitSpecialists.Com	CSI3005X5	NA	NA
	Additional Equipment used				
206202	Standard Gain Horn, 50-75GHz	Custom Microwave Inc.	HO15R	2020-07-27	See note *
206607	WR15 Downconverter	VDI	WR15.0SAX-F	2021-04-05	2022-04-05
206459	Spectrum Analyzer	Rohde & Schwarz	FSW50	2021-03-15	2022-03-15
207161	Signal Generator	Rohde and Schwarz	SMA100B	2021-04-06	2022-04-06

*- All horn antennas at and above the 33-50 GHz band are standard gain horns. In accordance with ANSI C63.10 clause 4.4.3 (a) Standard gain horns need not be periodically recalibrated, unless damage or deterioration is suspected or known to have occurred. If a standard gain horn is not periodically recalibrated, then its critical dimensions (see IEEE Std 1309-2005) shall be verified and documented on an annual basis.

UL measures the critical dimensions on an annual basis and checks for damage and deterioration before each test.

All equipment was within calibration during the time of test.

7. SUMMARY TABLE

FCC Part Section	IC Part Section	Test Description	Test Limit	Test Condition	Test Result
15.255 (e) (1)	RSS-210 J.4 (c) RSS-GEN 6.7	Occupied Bandwidth	N/A	Radiated	Compliant
15.255 (c) (3)	RSS-210 J.2.1 (b)	Equivalent Isotropic Radiated Power (EIRP)	+10 dBm (Peak Radiated) -10dBm (Peak Conducted) N/A (Average Radiated)	Radiated	Compliant
15.255 (c) (3), (e)	RSS-210 J.4 (b), J.4 (a)	Conducted Power	500 mW (Peak)	Radiated	Compliant
15.255 (d) (2)	RSS-210 J.3 (b)	Spurious Emissions < 40GHz	See FCC 15.209	Radiated	Compliant
15.255 (d) (3)	RSS-210 J.3 (c)	Spurious Emissions 40 – 200GHz	90 pW/cm^2	Radiated	Compliant
15.255 (f)	RSS-210 J.6	Frequency Stability	Within Band	Radiated	Compliant
15.255 (h)	RSS-210 J.7	Group installation	No Beam Forming / Phase Locking	Radiated	Compliant

8. APPLICABLE LIMITS AND TEST RESULTS

8.1. FAR-FIELD DISTANCE AND MEASUREMENT DISTANCE

The measurement distance is in the far field per formula $2D^2/\lambda$ where D is the largest dimension of the antenna.

For fundamental / band edge emissions, the largest far-field distance of either the EUT antenna or measurement antenna shall be used. In this case, the measurement antenna has the largest far-field distance. For above 18 GHz spurious emissions, the far-field distance shall be based on the measurement antenna. The EUT is manipulated through all orthogonal planes representative of its typical use to achieve the highest EIRP reading on the receive spectrum analyzer.

Frequency Range (GHz)	Wavelength (m)	Rx Antenna Diagonal dim. (m)	Far Field Distance (m)	Measurement Distance Used (m)
40-50	0.0060	0.069	1.61	3.00
50-75	0.0040	0.046	1.05	3.00
75-110	0.0027	0.031	0.70	3.00
110-170	0.0018	0.02	0.46	0.50
170-200	0.0012	0.013	0.31	0.50

Radiated spurious emissions limits above 40 GHz are based on a 3-meter measurement distance. As such, testing from 40-110 GHz was performed at 3-meters. Above 110 GHz, testing was performed at a 0.5-meter distance and the data was corrected, accordingly, to the 3-meter limit.

In-band testing was performed at a 3-meter distance, which was still in the far-field based on the maximum EUT / measurement antenna dimension.

Radiated power levels are investigated while the receive antenna was rotated through all angles to determine the worst-case polarization/positioning. The worse-case orientation of the EUT was with the front fact facing the RX antenna, which was polarized vertically. Refer to test setup photos exhibit for details.

8.2. DUTY CYCLE

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

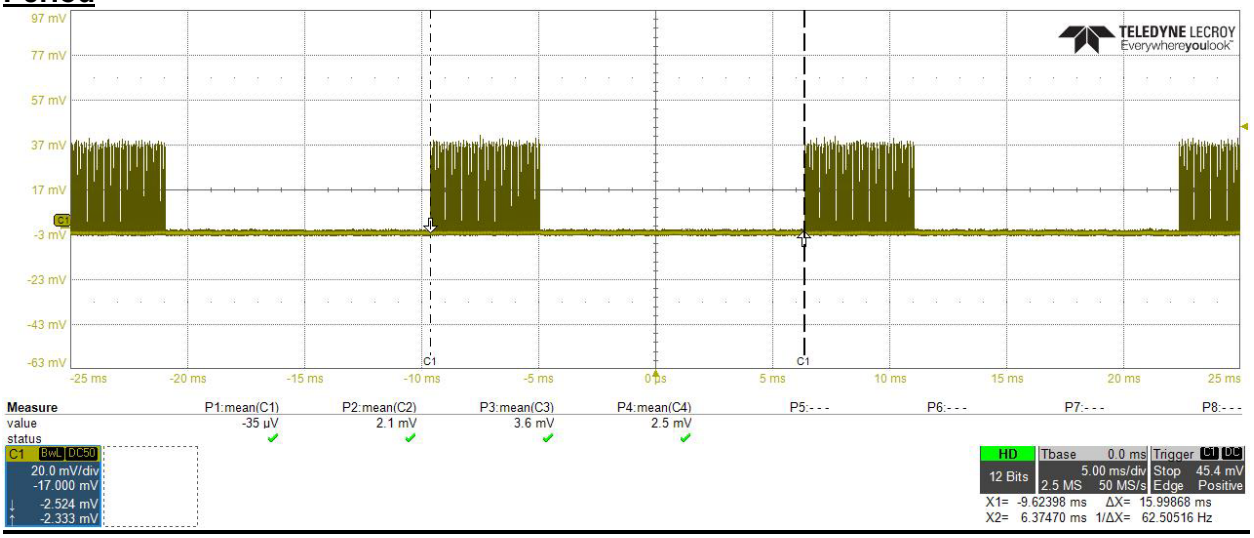
The fundamental is measured using a Standard Gain Horn Antenna, Low Noise Amplifier and a Diode Detector connected to an Oscilloscope. Pulse widths, burst lengths, and periods are measured, then the duty cycle is calculated.

RESULTS

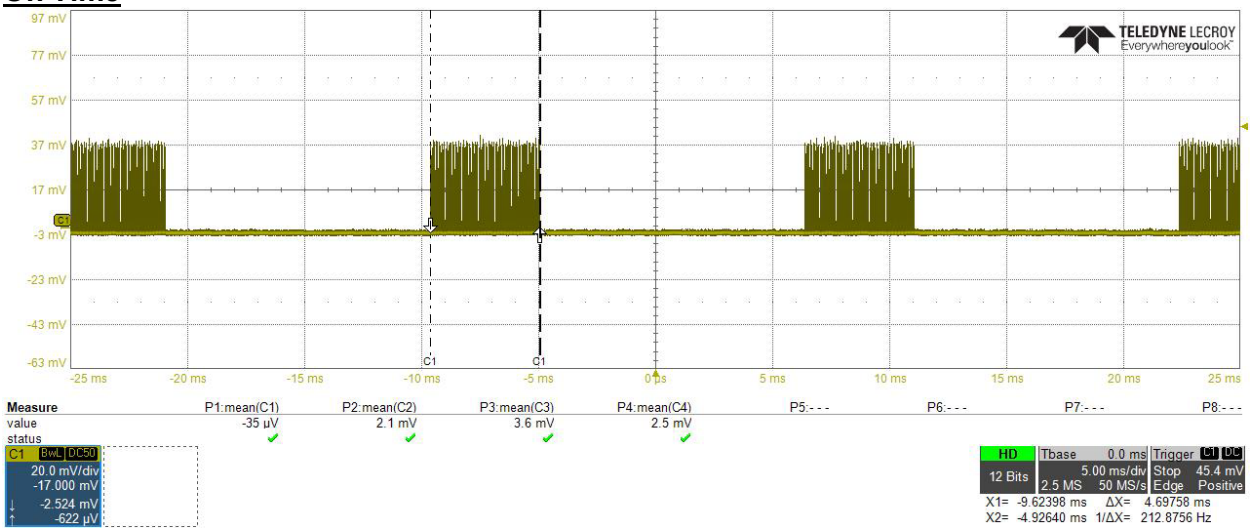
Duty cycle linear = on time / period
Duty cycle % = Duty cycle linear * 100

On Time (ms)	Period (ms)	Duty Cycle (linear)	Duty Cycle (%)
4.69758	15.99868	0.2936	29.36%

Period



On Time



8.3. OCCUPIED BANDWIDTH

APPLICABLE RULE

§15.255 (e) (1) For the purposes of this paragraph (e)(1), emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g. for frequency hopping devices).

§RSS-210 J.4 (c) For the purpose of this standard, emission bandwidth is defined as the instantaneous frequency range occupied by a steady radiated signal with modulation, outside which the radiated power spectral density shall be 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth. The centre frequency must be stationary during the measurement interval, even if not stationary during normal operation.

§RSS-GEN 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.

LIMIT

None; for reporting purposes only.

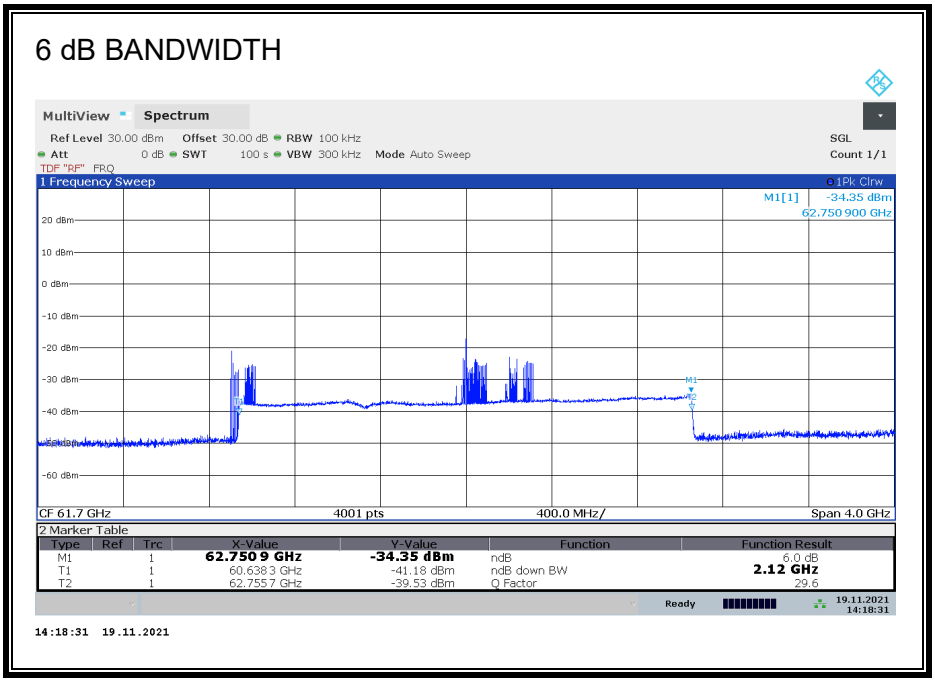
TEST PROCEDURE

ANSI C63.10-2013 Clause 9.3

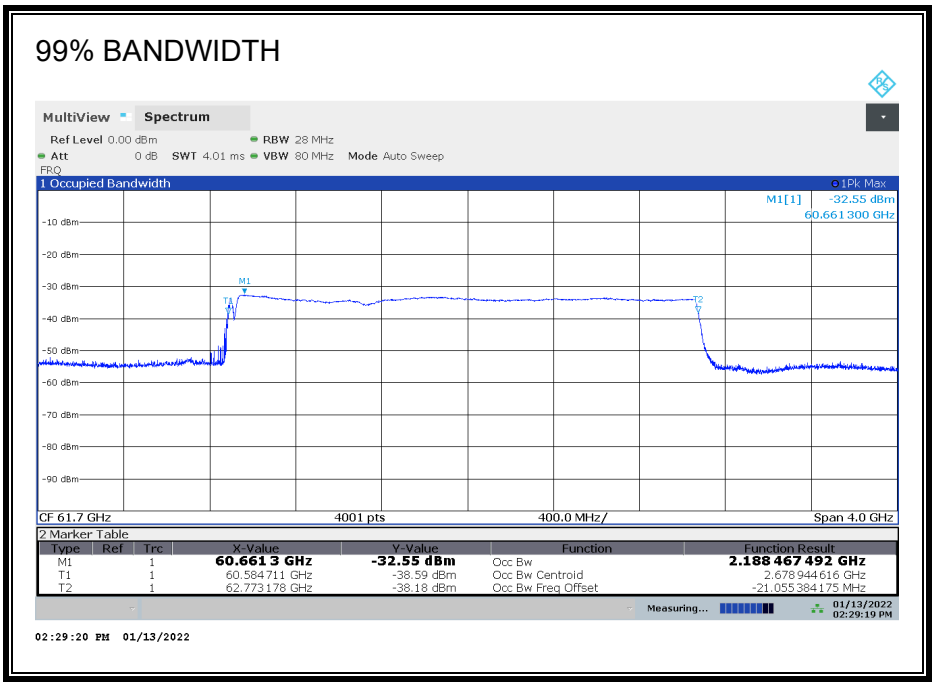
RESULTS

Frequency (GHz)	6 dB (MHz)	99% (MHz)
61.7	2120.00	2188.47

6 dB BANDWIDTH



99% BANDWIDTH



8.4. EIRP

LIMIT

§15.255 (c) Within the 57-71 GHz band, emission levels shall not exceed the following equivalent isotropically radiated power (EIRP):

(3) For fixed field disturbance sensors other than those operating under the provisions of paragraph (c)(2) of this section, and short-range devices for interactive motion sensing, the peak transmitter conducted output power shall not exceed −10 dBm and the peak EIRP level shall not exceed 10 dBm.

§RSS-210 J.2.1 (b) For fixed field disturbance sensors other than those operating under the provisions of (a) above and for interactive motion sensors, the peak transmitter output power shall not exceed -10 dBm, and the peak e.i.r.p. shall not exceed 10 dBm.

TEST PROCEDURE

ANSI C63.10-2013 Clause 9.11

The measured power level is converted to EIRP using ANSI C63.10 Eqs. (19) and (22:

$$E = 126.8 - 20\log(\lambda) + P - G \quad (19)$$

where

E is the field strength of the emission at the measurement distance, in dBµV/m
P is the power measured at the output of the test antenna, in dBm
λ is the wavelength of the emission under investigation [$300/f_{MHz}$], in m
G is the gain of the test antenna, in dBi

NOTE—The measured power P includes all applicable instrument correction factors up to the connection to the test antenna.

$$\mathrm{EIRP} = E_{\mathrm{Meas}} + 20\log(d_{\mathrm{Meas}}) - 104.7 \quad (22)$$

where

EIRP is the equivalent isotropically radiated power, in dBm
E_{Meas} is the field strength of the emission at the measurement distance, in dBµV/m
d_{Meas} is the measurement distance, in m

NOTE—Because this equation yields the identical result whether the field strength is extrapolated using the default 20 dB/decade of distance extrapolation factor, or the field strength is not extrapolated for distance, this equation can generally be applied directly (with no further correction) to determine EIRP. In some cases, a different distance correction factor may be required; see 9.1.

FAR FIELD BOUNDARY CALCULATIONS

The far-field boundary is given in ANSI C63.10 Clause 9.1 as:

$R_{far\ field} = (2 * L^2) / \lambda$

where:

L = Largest Antenna Dimension, including the reflector, in meters
λ = wavelength in meters

Frequency (GHz)	L (m)	Lambda (m)	R (Far Field) (m)
61.7	0.050	0.0049	1.03

PEAK EIRP RESULTS

Frequency (GHz)	Lambda λ (m)	Meas Distance (m)	Meas Peak Power (dBm)	Rx Ant Gain (dBi)	LNA Gain (dB)	Field Strength (dBuV/m)	Peak EIRP (dBm)	Peak EIRP Limit (dBm)	Limit Margin (dB)
61.7	0.00486	2	-36.10	23.2	18.3	95.46	-3.22	10	-13.22

AVERAGE EIRP RESULTS

For RF exposure purposes, Average EIRP was measured in accordance with ANSI C63.10-2013 Clause 9.11

Frequency (GHz)	Lambda λ (m)	Meas Distance (m)	Meas Average Power (dBm)	Rx Ant Gain (dBi)	LNA Gain (dB)	Field Strength (dBuV/m)	Average EIRP (dBm)
61.7	0.00486	2	-41.98	23.2	18.3	89.59	-9.09

8.5. PEAK CONDUCTED POWER

LIMIT

The peak conducted power limit is -10 dBm, based on the lowest of the following:

§15.255 (c) (3) For fixed field disturbance sensors other than those operating under the provisions of paragraph (c)(2) of this section, and short-range devices for interactive motion sensing, the peak transmitter conducted output power shall not exceed −10 dBm and the peak EIRP level shall not exceed 10 dBm.

§15.255 (e) Except as specified paragraph (e)(1) of this section, the peak transmitter conducted output power shall not exceed 500 mW. Depending on the gain of the antenna, it may be necessary to operate the intentional radiator using a lower peak transmitter output power in order to comply with the EIRP limits specified in paragraph (b) of this section.

(1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter conducted output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g., for frequency hopping devices).

(2) Peak transmitter conducted output power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-71 GHz band and that has a video bandwidth of at least 10 MHz.

(3) For purposes of demonstrating compliance with this paragraph, corrections to the transmitter conducted output power may be made due to the antenna and circuit loss.

§RSS-210 J.2.1 (b) For fixed field disturbance sensors other than those operating under the provisions of (a) above and for interactive motion sensors, the peak transmitter output power shall not exceed -10 dBm, and the peak e.i.r.p. shall not exceed 10 dBm.

§RSS-210 J.4 (a) For devices with an emission bandwidth greater than or equal to 100 MHz, the peak transmitter output power shall not exceed 500 mW. For devices with an emission bandwidth less than 100 MHz, the peak transmitter output power shall be less than the product of 500 mW and their emission bandwidth divided by 100 MHz

(b) For the purposes of demonstrating compliance with this RSS, corrections to the transmitter output power may be made to compensate for antenna and circuit loss.

PROCEDURE

The EUT antenna gain is subtracted from the Peak EIRP.

RESULTS

Frequency (GHz)	Peak EIRP (dBm)	EUT Antenna Gain (dBi)	Peak Power (dBm)	Conducted Limit (dBm)	Limit Margin (dB)
61.7	-3.22	10	-13.22	-10.0	-3.22

8.6. SPURIOUS EMISSIONS

LIMITS

§15.255 (d) Limits on spurious emissions:

(1) The power density of any emissions outside the 57-71 GHz band shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

§RSS-210 J.3 The power of any emissions outside the band 57-71 GHz shall consist solely of spurious emissions and shall not exceed:

(a) the fundamental emission levels

(b) the general field strength limits specified in RSS-Gen for emissions below 40 GHz

(c) 90 pW/cm2 at a distance of 3 m for emissions between 40 GHz and 200 GHz

PROCEDURE FOR 30 MHz TO 40 GHz

ANSI C63.10-2013 Clause 9.13

The EUT is placed on a non-conducting table 80 cm above the ground plane for measurement below 1 GHz; 1.5 m above the ground plane for measurement above 1GHz. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.26 and set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements in the 30-1000MHz range. Peak detection is used unless otherwise noted as quasi-peak or average.

For pre-scans above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements.

For final measurements above 1 GHz the resolution bandwidth is set to 1 MHz; the video bandwidth is set to 3 MHz for peak measurements; as applicable for linear voltage averaging measurements.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned

from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.

PROCEDURE FOR 40 TO 200 GHz

ANSI C63.10-2013 Clause 9.12

External harmonic mixers are utilized.

The measurement distance is in the far field per formula $2D^2/\lambda$ where D is the larger dimension of the antenna.

Frequency Range (GHz)	Wavelength (m)	Rx Antenna Diagonal dim. (m)	Far Field Distance (m)	Measurement Distance Used (m)
40-50	0.0060	0.069	1.61	3.00
50-75	0.0040	0.046	1.05	3.00
75-110	0.0027	0.031	0.70	3.00
110-170	0.0018	0.02	0.46	0.50
170-200	0.0012	0.013	0.31	0.50

Radiated spurious emissions limits above 40 GHz are based on a 3-meter measurement distance. As such, testing from 40-170GHz was performed at 3-meters. Above 170GHz, testing was performed at a 0.5-meter distance and the data was corrected, accordingly, to the 3-meter limit.

The antenna is scanned around the entire perimeter surface of the EUT, in both horizontal and vertical polarizations.

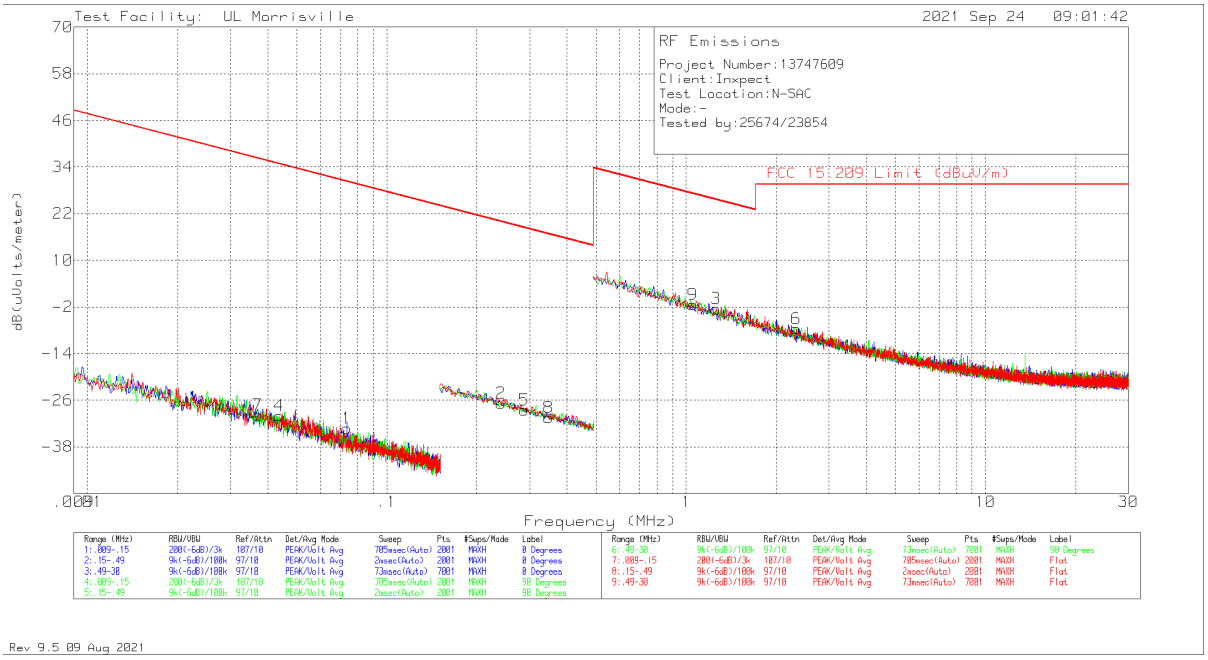
A final test is made at any frequencies at which emissions are found. During this final scan, the antenna is kept no further from the EUT than the maximum distance calculated for each mixer band that yields a minimum system noise floor at least 6 dB below the spurious emissions limit.

The power is measured, the EIRP is calculated, then the extrapolated power density at a 3 meter distance is calculated.

The 90 pW/cm^2 limit was converted to dBm by the following equation:

$10 * \log(\ 90\ [\ pW/cm^2\ ] * 100^2 * 10^{-12} * 4pi * (3m)^2\ * 1000\ ) = -9.92$ dBm

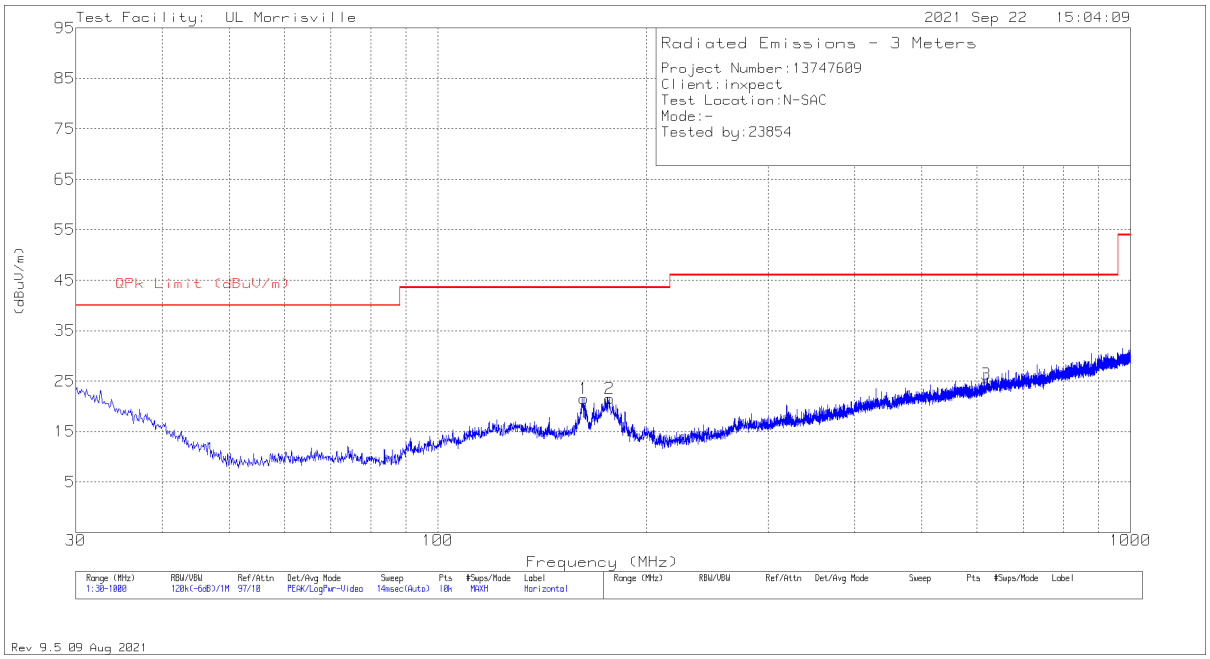
TX AND RX SPURIOUS EMISSION 9kHz TO 30 MHz



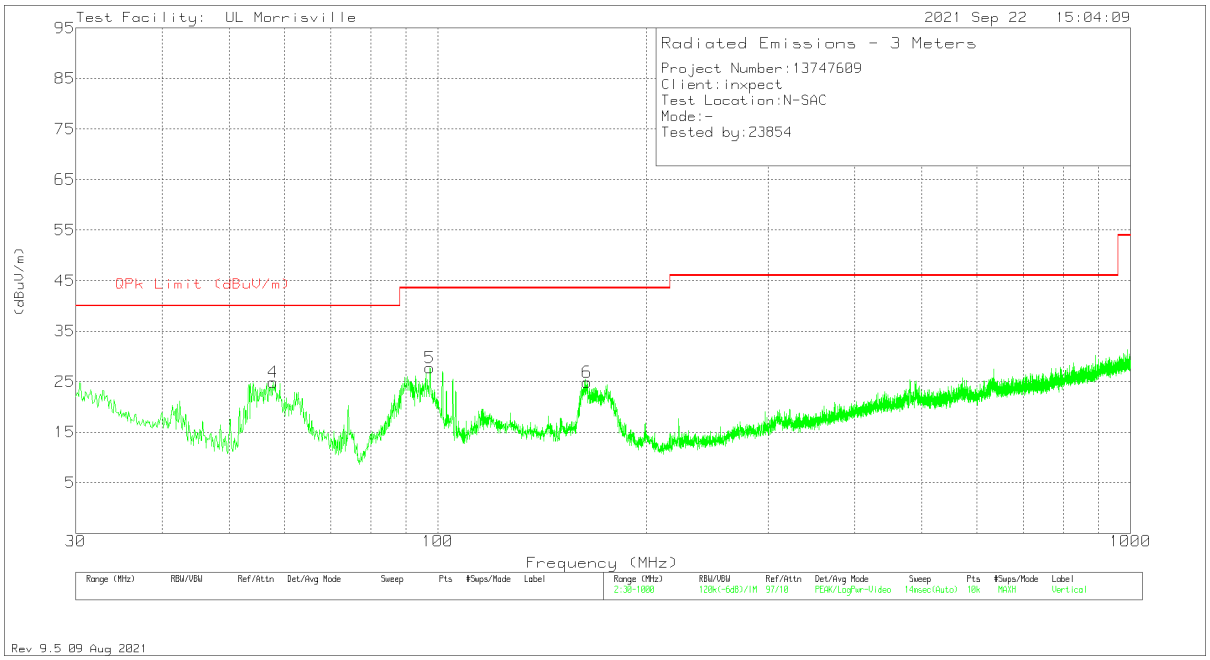
Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0079 (dB/m)	Cbl (dB)	Dist. Corr. Factor (dB)	Corrected Reading dB(uVolts/meter)	FCC 15.209 Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Loop Angle
7	.03705	37.34	Pk	12.8	.1	-80	-29.76	36.23	-65.99	0-360	404	Flat
4	.04372	37.59	Pk	12.3	.1	-80	-30.01	34.79	-64.8	0-360	404	90 degs
1	.07361	35.35	Pk	11.4	.1	-80	-33.15	30.27	-63.42	0-360	404	0 degs
2	.24044	41.94	Pk	11.2	.1	-80	-26.76	19.98	-46.74	0-360	404	0 degs
5	.2877	40.16	Pk	11.2	.1	-80	-28.54	18.43	-46.97	0-360	404	90 degs
8	.34763	38.18	Pk	11.2	.1	-80	-30.52	16.78	-47.3	0-360	404	Flat
9	1.05073	27.1	Pk	11.3	.2	-40	-1.4	27.17	-28.57	0-360	404	Flat
3	1.25731	26.02	Pk	11.3	.2	-40	-2.48	25.62	-28.1	0-360	404	0 degs
6	2.33661	20.67	Pk	11.4	.3	-40	-7.63	29.54	-37.17	0-360	404	90 degs

Pk - Peak detector

TX AND RX SPURIOUS EMISSION 30 TO 1000 MHz (HORIZONTAL PLOT)



TX AND RX SPURIOUS EMISSION 30 TO 1000 MHz (VERTICAL PLOT)

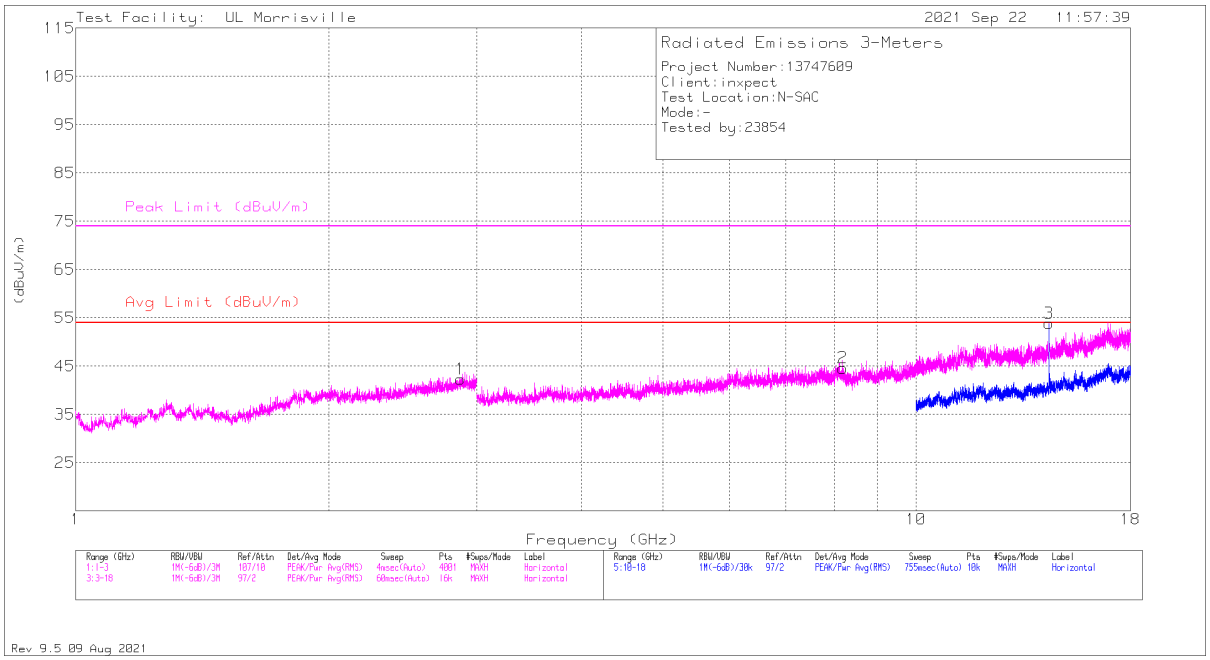


Marker	Frequency (MHz)	Meter Reading (dBuV)	Det	AT0066 (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	57.839	42.53	Pk	13.3	-30.9	24.93	40	-15.07	0-360	100	V
5	97.415	42.53	Pk	15.7	-30.5	27.73	43.52	-15.79	0-360	100	V
1	162.502	33.25	Pk	18	-29.7	21.55	43.52	-21.97	0-360	200	H
6	164.345	36.72	Pk	17.9	-29.7	24.92	43.52	-18.6	0-360	100	V
2	176.858	33.78	Pk	17.5	-29.7	21.58	43.52	-21.94	0-360	100	H
3	619.275	25.42	Pk	25.5	-26.5	24.42	46.02	-21.6	0-360	200	H

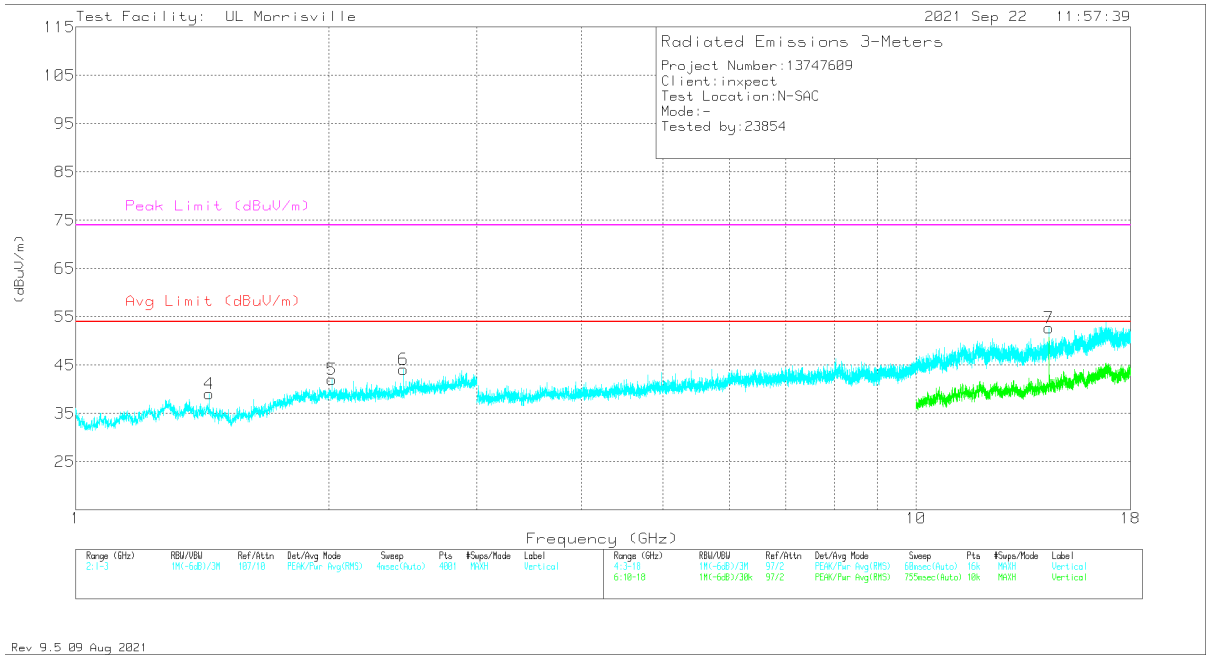
Pk - Peak detector

TX AND RX SPURIOUS EMISSIONS 1 TO 40 GHz VERTICAL AND HORIZONTAL DATA

1 – 18 GHz HORIZONTAL



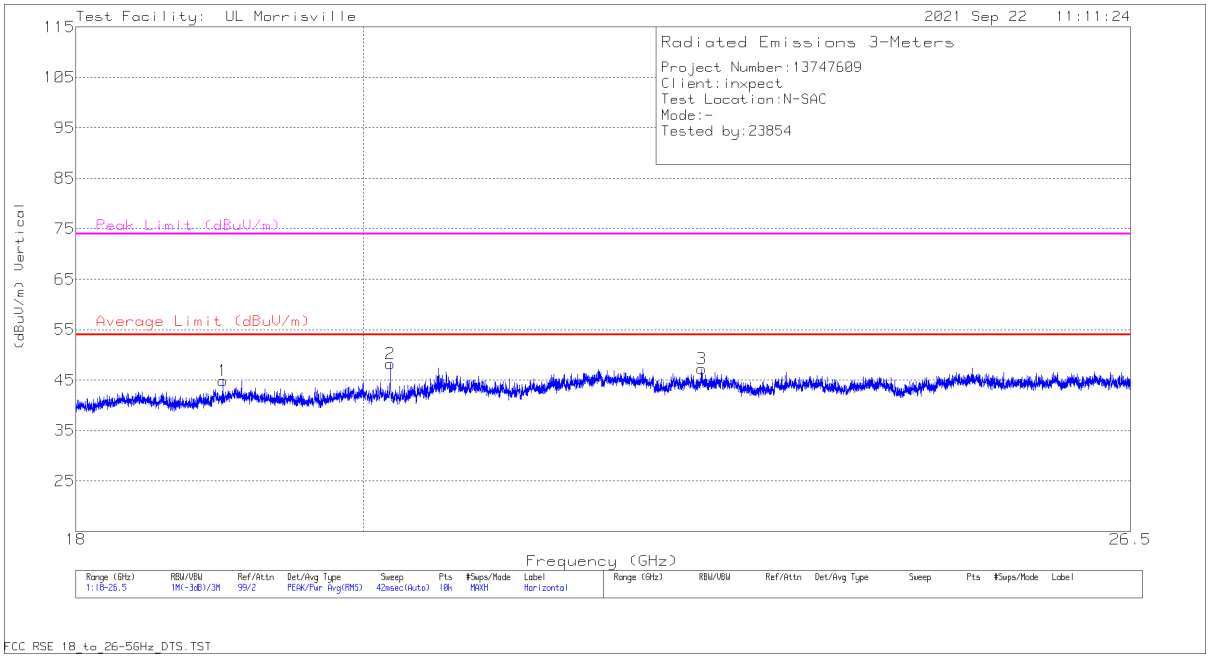
1 – 18 GHz VERTICAL



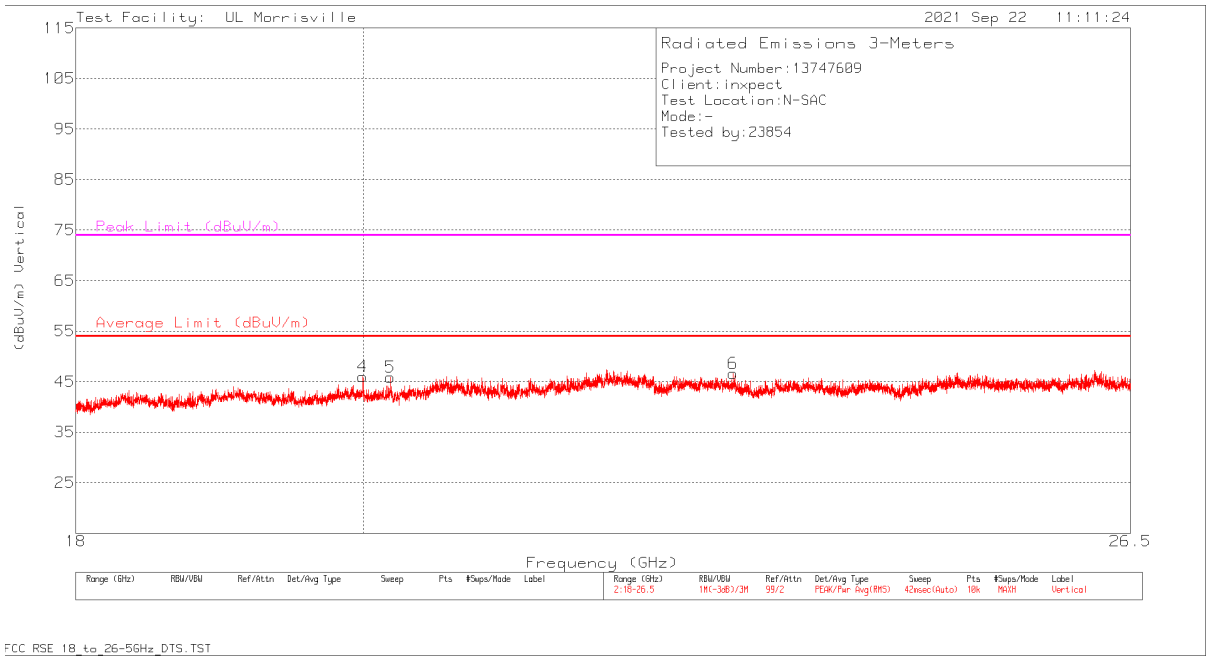
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0078 (db/m)	Amp/Cbl/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 2.868	33.57	Pk	32.5	-23.8	42.27	54	-11.73	74	-31.73	0-360	199	H
4	* 1.4415	35.62	Pk	28.7	-25.3	39.02	54	-14.98	74	-34.98	0-360	101	V
5	2.018	34.84	Pk	31.7	-24.5	42.04	54	-11.96	74	-31.96	0-360	200	V
6	2.4545	36.59	Pk	32.3	-24.7	44.19	54	-9.81	74	-29.81	0-360	200	V
2	* 8.18906	37.4	Pk	35.9	-28.7	44.6	54	-9.4	74	-29.4	0-360	101	H
3	14.4	41.34	Pk	39.3	-26.7	53.94	54	-0.06	74	-20.06	0-360	199	H
7	14.4	40.08	Pk	39.3	-26.7	52.68	54	-1.32	74	-21.32	0-360	200	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector

18 – 26.5 GHz HORIZONTAL



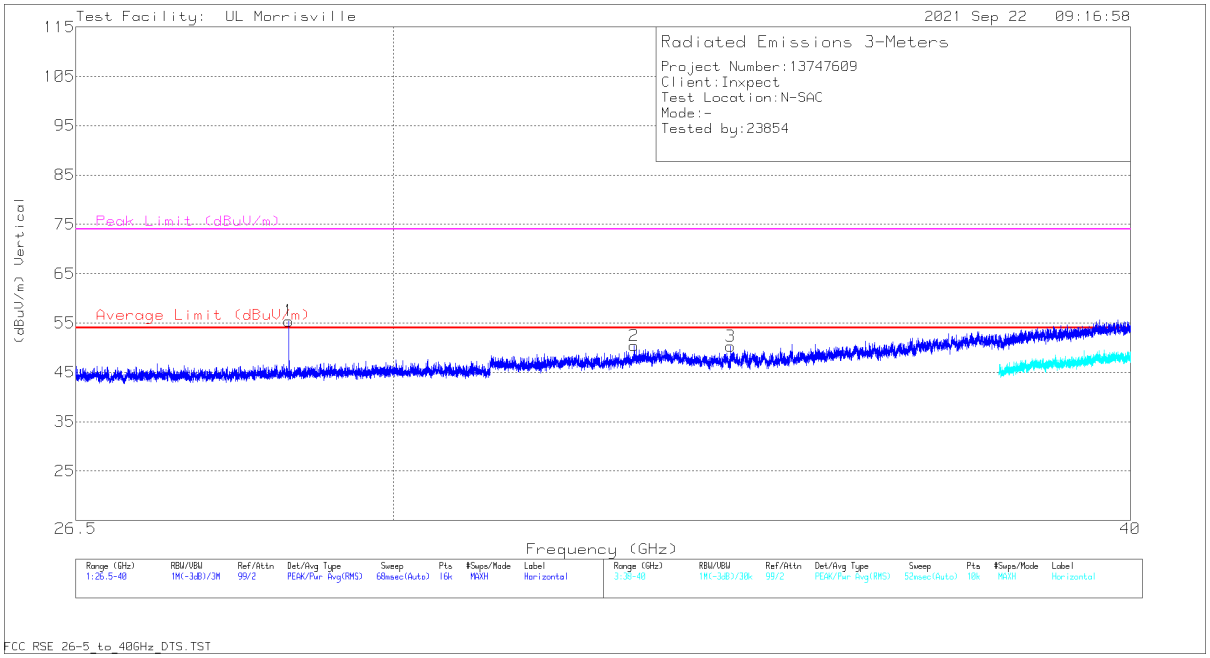
18 – 26.5 GHz VERTICAL



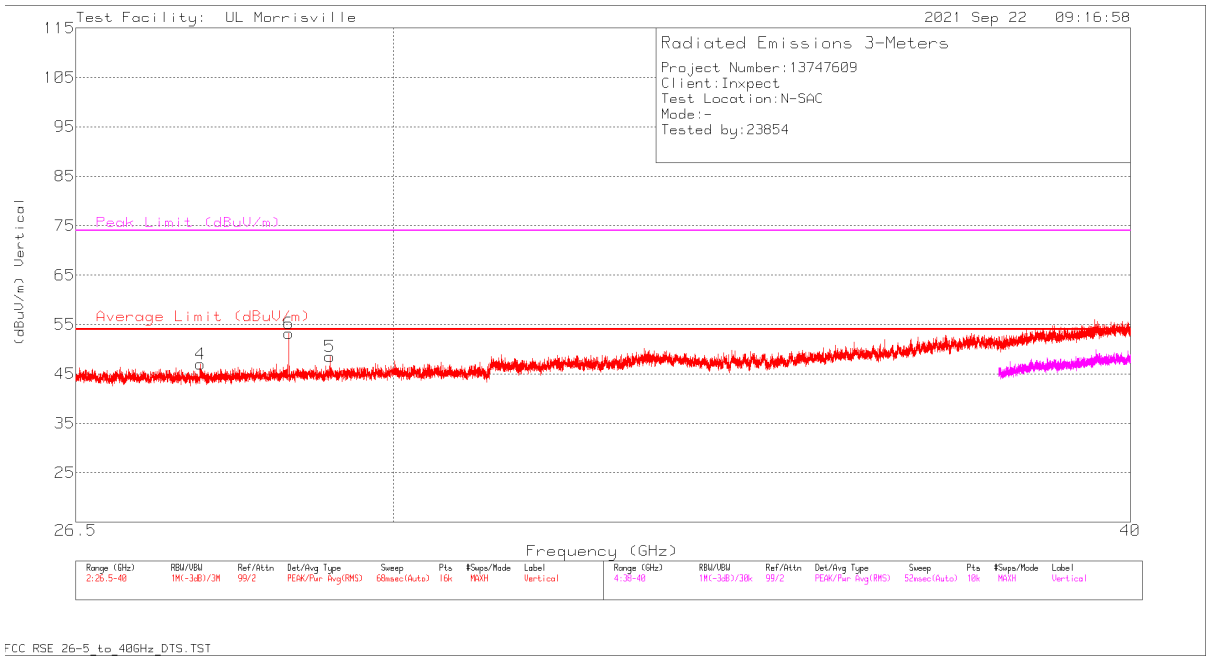
Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0063 AF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	* 18.9995	50.72	Pk	33.4	-39.2	44.92	54	-9.08	74	-29.08	0-360	299	H
2	* 20.19958	53.02	Pk	33.8	-38.6	48.22	54	-5.78	74	-25.78	0-360	149	H
3	* 22.64564	50.25	Pk	36	-39	47.25	54	-6.75	74	-26.75	0-360	101	H
4	* 19.999	51.58	Pk	33.7	-39.3	45.98	54	-8.02	74	-28.02	0-360	101	V
5	* 20.19958	50.71	Pk	33.8	-38.6	45.91	54	-8.09	74	-28.09	0-360	201	V
6	* 22.90741	50.43	Pk	35.3	-39.1	46.63	54	-7.37	74	-27.37	0-360	150	V

* - indicates frequency in CFR47 Pt 15 / IC RSS-Restricted Band
Pk - Peak detector

26.5 – 40 GHz HORIZONTAL



26.5 – 40 GHz VERTICAL

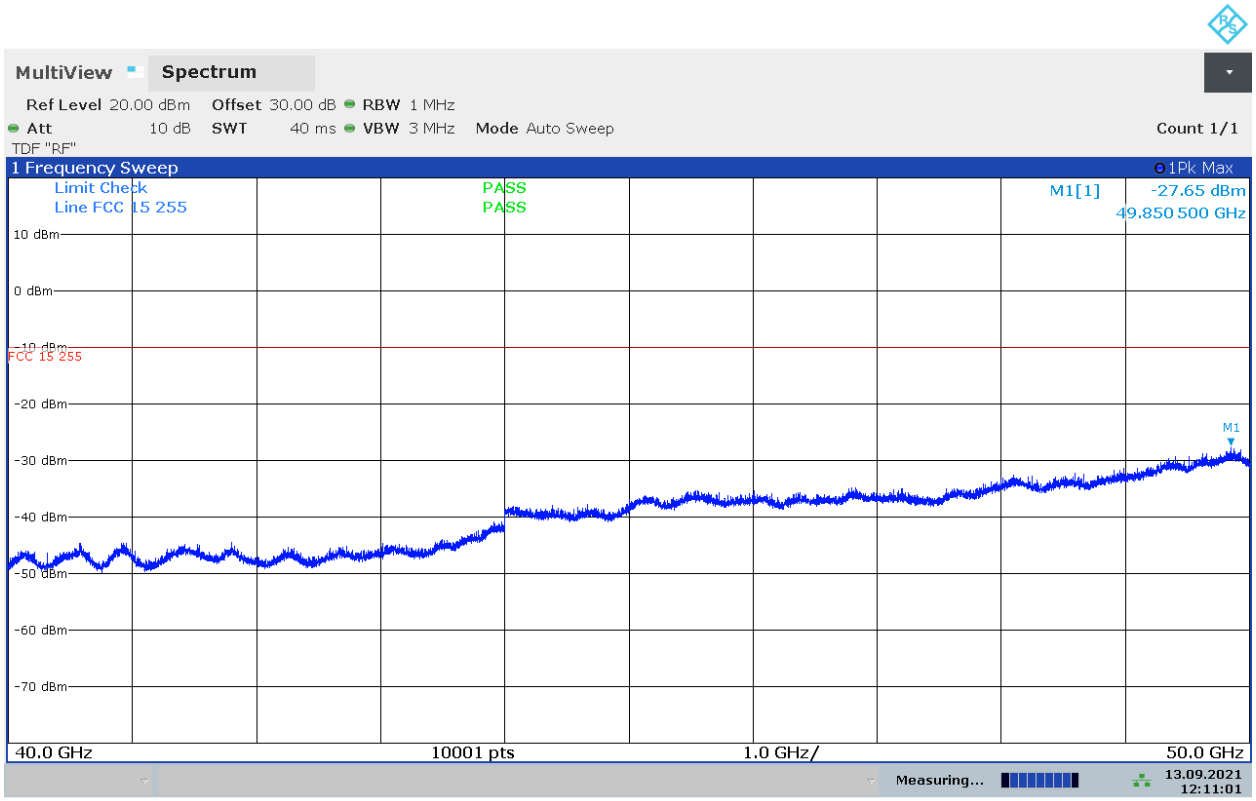


Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AT0061 AF (dB/m)	Amp/Cbl (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	27.82376	47.84	Pk	35.9	-36.8	46.94	54	-7.06	74	-27.06	0-360	101	V
1	28.7975	42.14	Pk	36.2	-36.9	41.44	-	-	74	-32.56	40	153	H
	28.79996	52.29	Av	36.2	-37.1	51.39	54	-2.61	-	-	40	153	H
6	28.79987	54.35	Pk	36.2	-37.1	53.45	-	-	74	-20.55	21	157	V
	28.79995	52.56	Av	36.2	-37.1	51.66	54	-2.34	-	-	21	157	V
5	29.26311	49.35	Pk	36.2	-37	48.55	54	-5.45	74	-25.45	0-360	101	V
2	32.95681	49.4	Pk	37.4	-36.4	50.4	54	-3.6	74	-23.6	0-360	150	H
3	34.22151	49.8	Pk	37.3	-36.8	50.3	54	-3.7	74	-23.7	0-360	199	H

Pk - Peak detector
Av - Average detector

TX AND RX SPURIOUS EMISSIONS 40 TO 200 GHz

40 – 50 GHz HORIZONTAL



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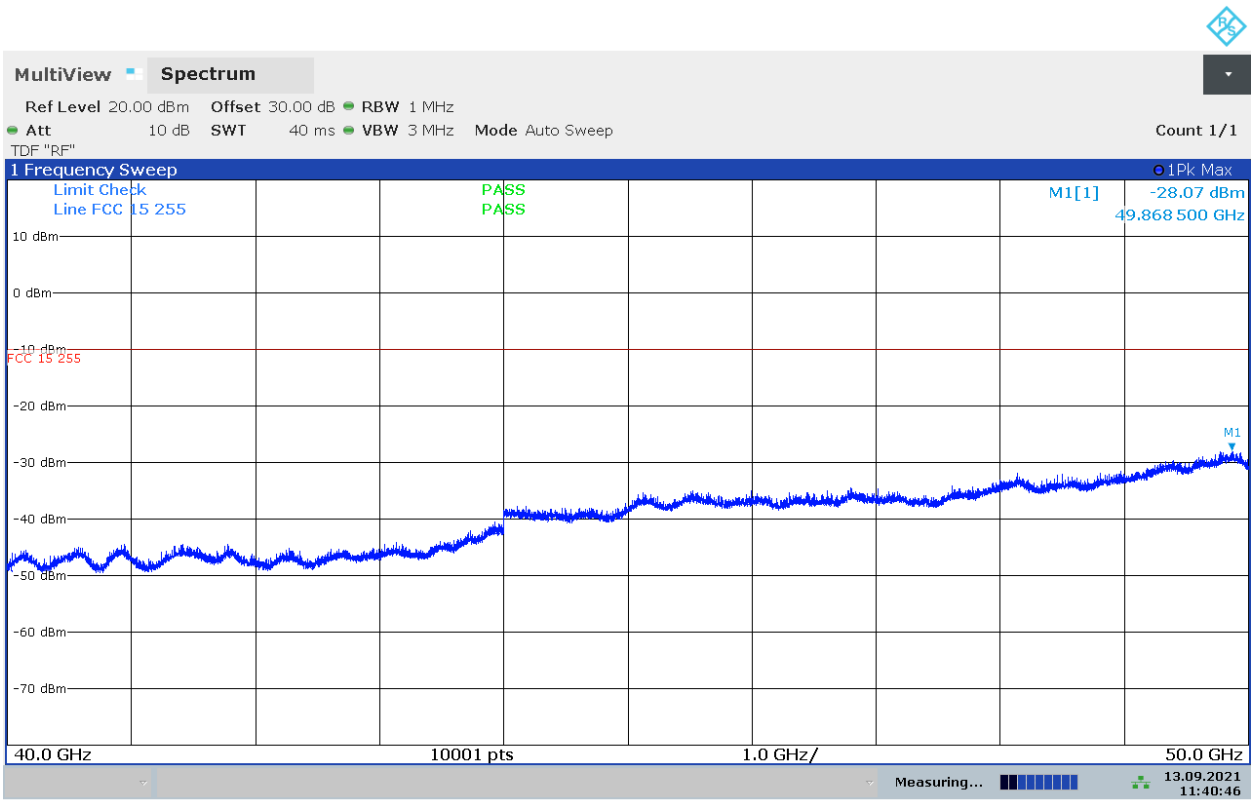
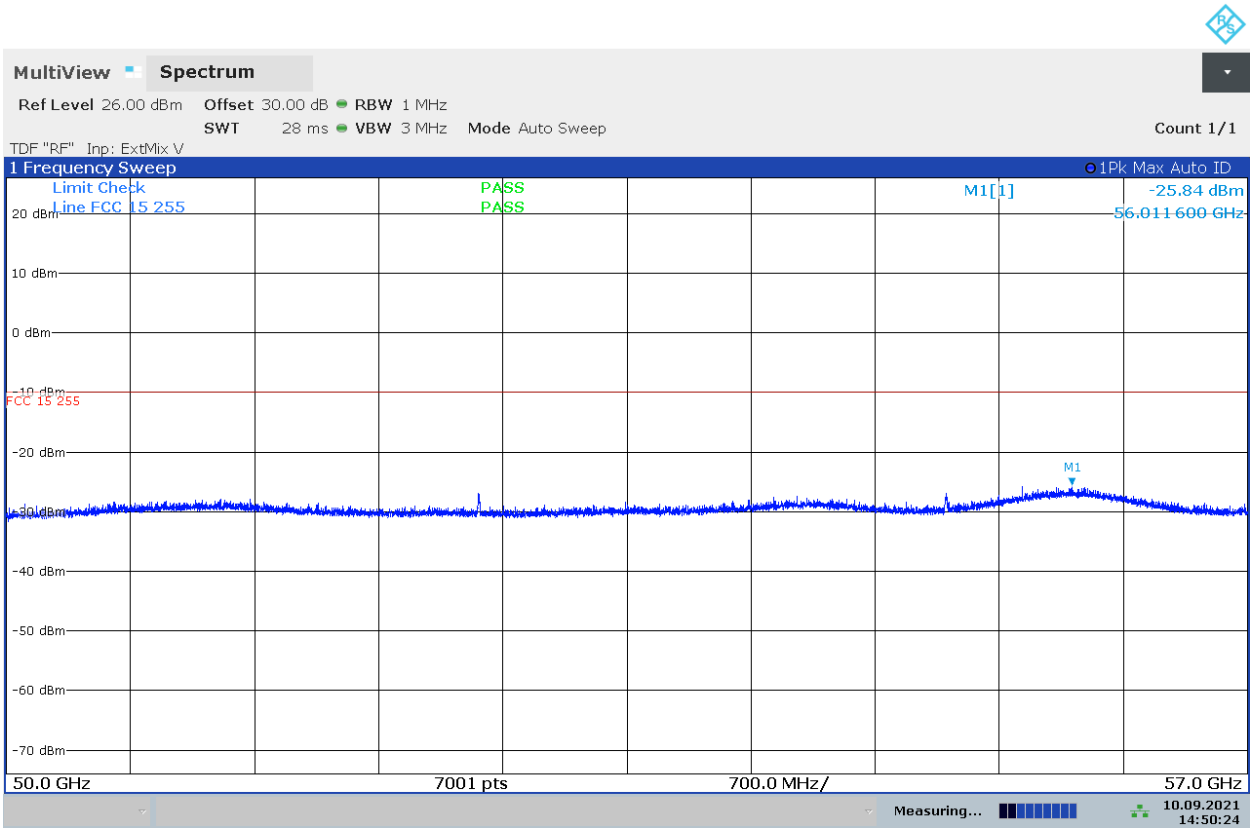
40 – 50 GHz VERTICAL

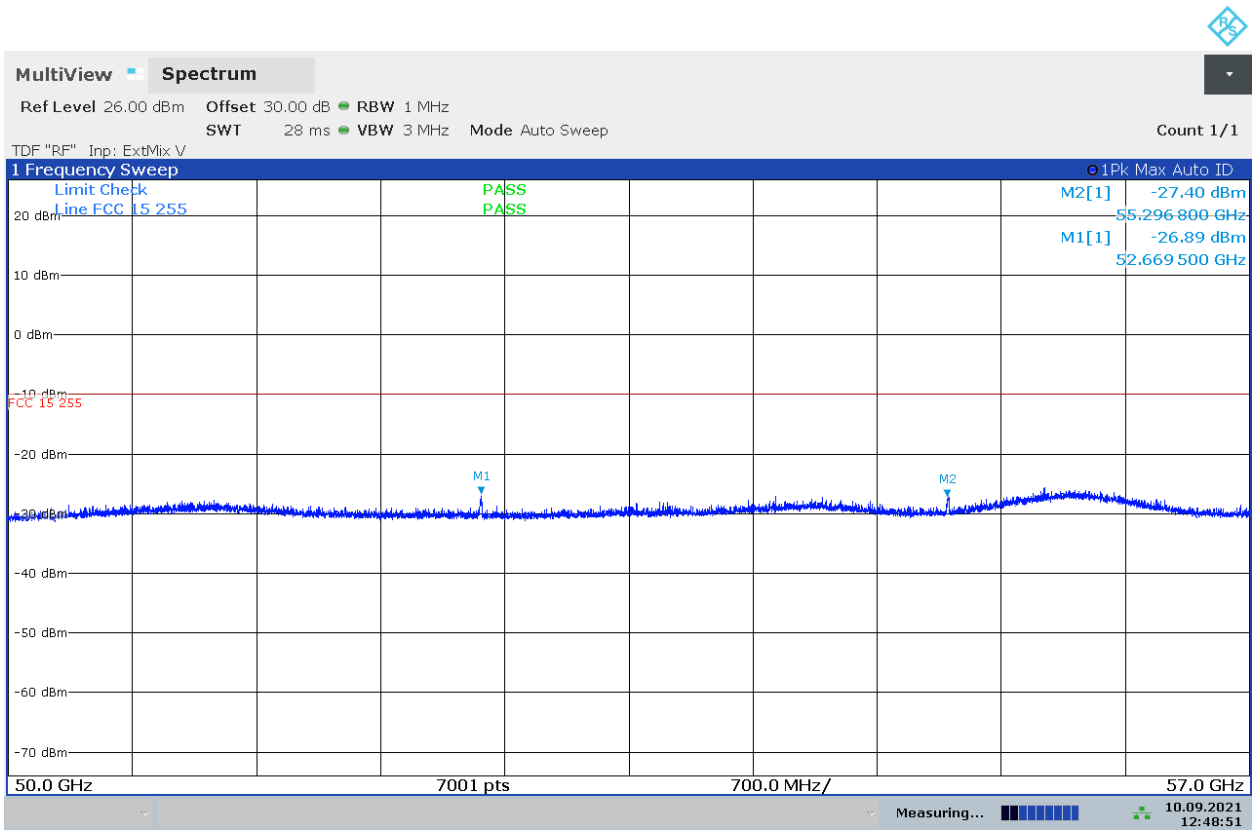


11:40:46 13.09.2021

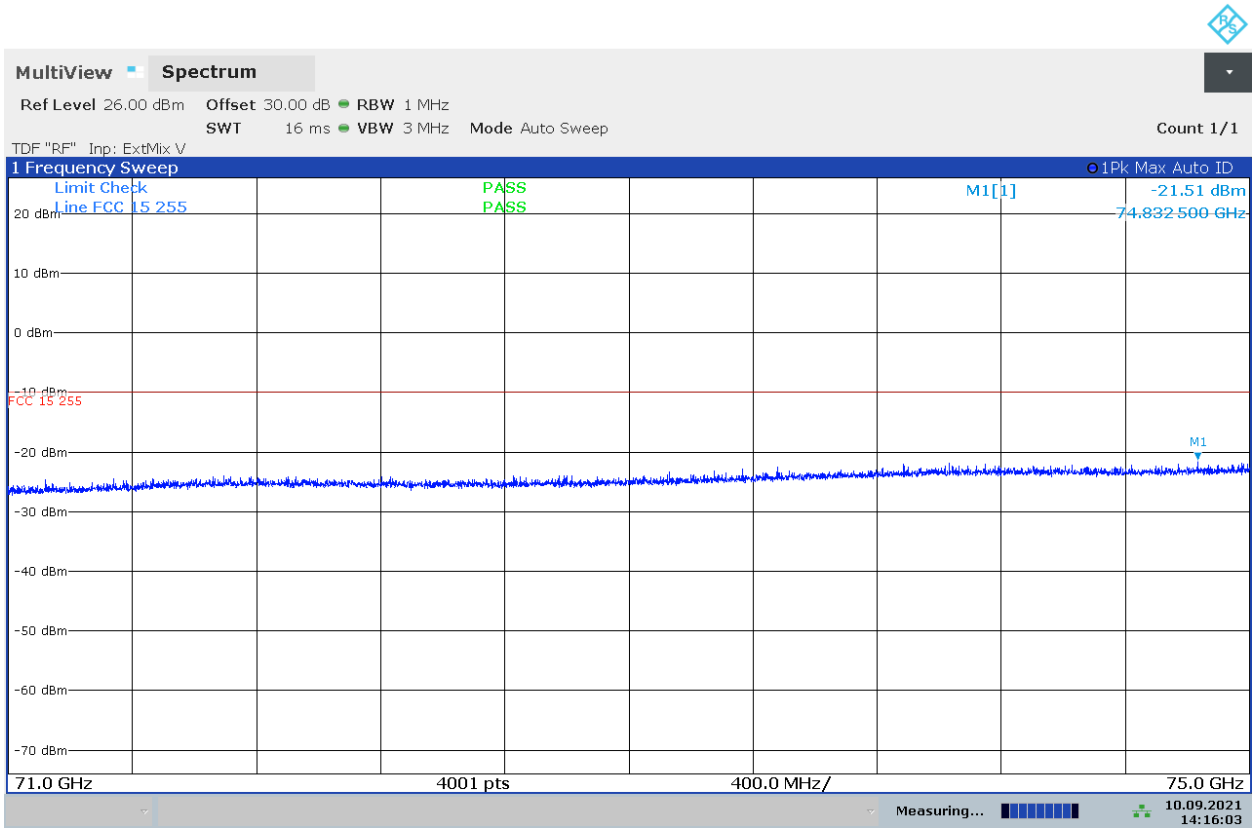
50 – 57 GHz HORIZONTAL



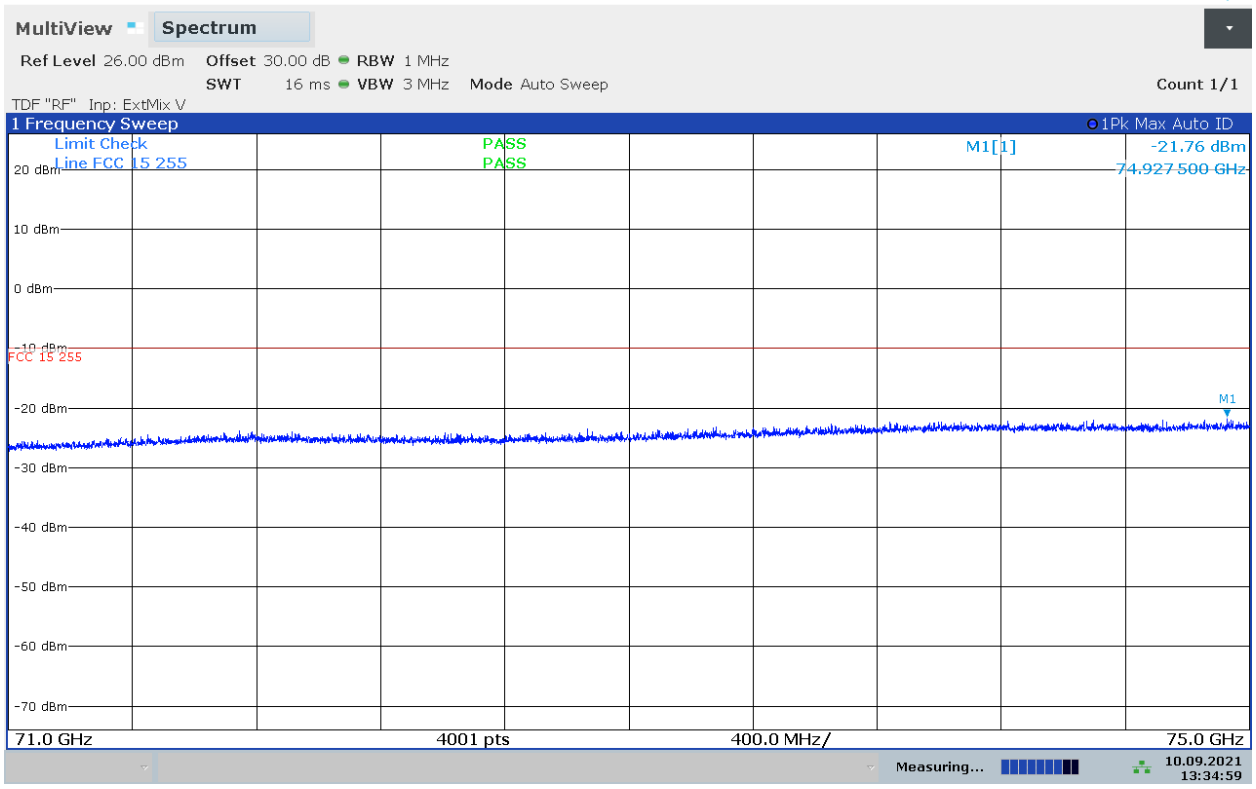
50 – 57 GHz VERTICAL



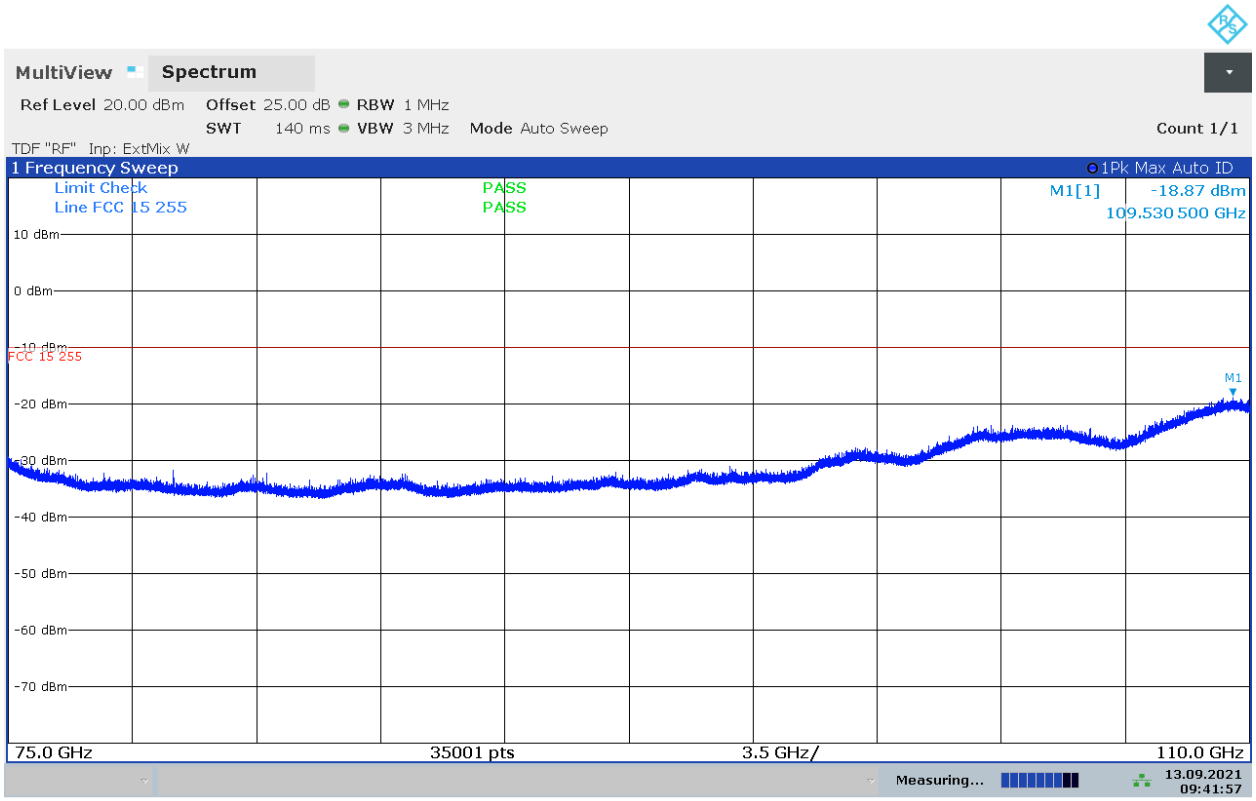
71 – 75 GHz HORIZONTAL



71 – 75 GHz VERTICAL

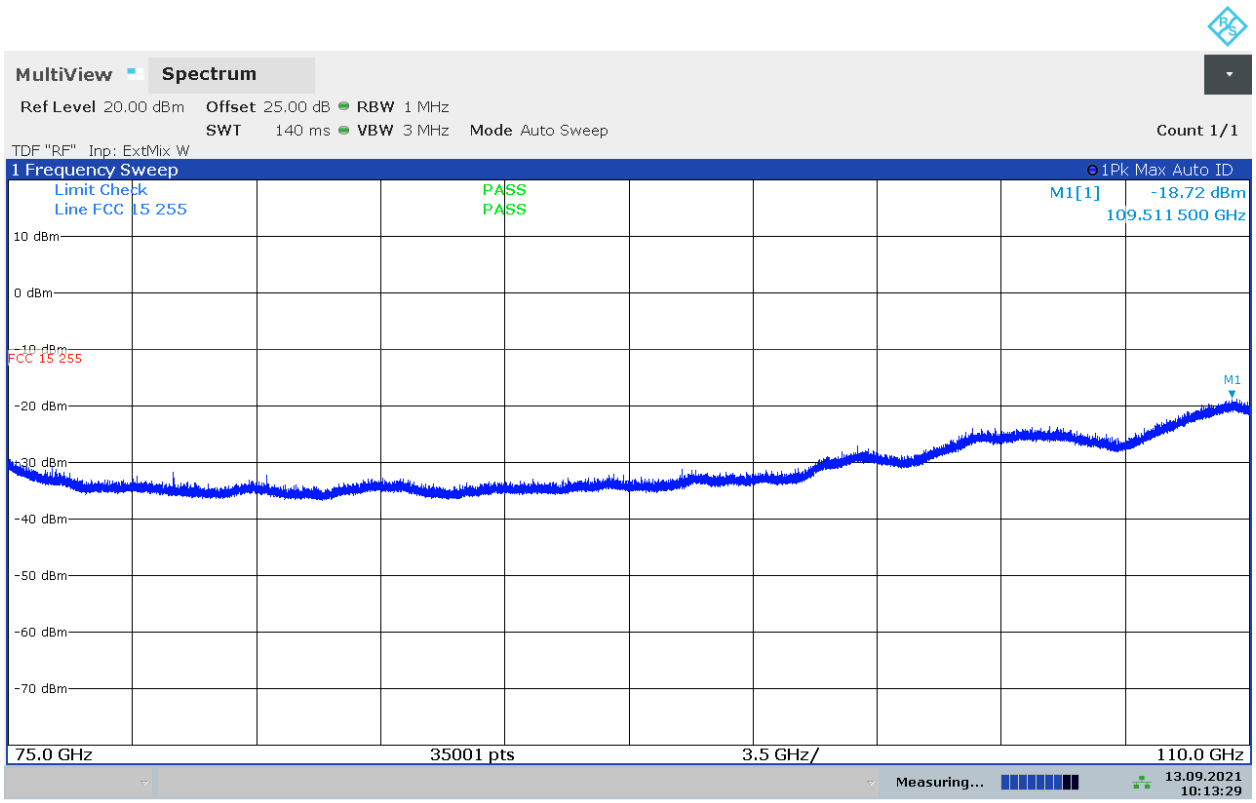


75 – 110 GHz HORIZONTAL



09:41:57 13.09.2021

75 – 110 GHz VERTICAL



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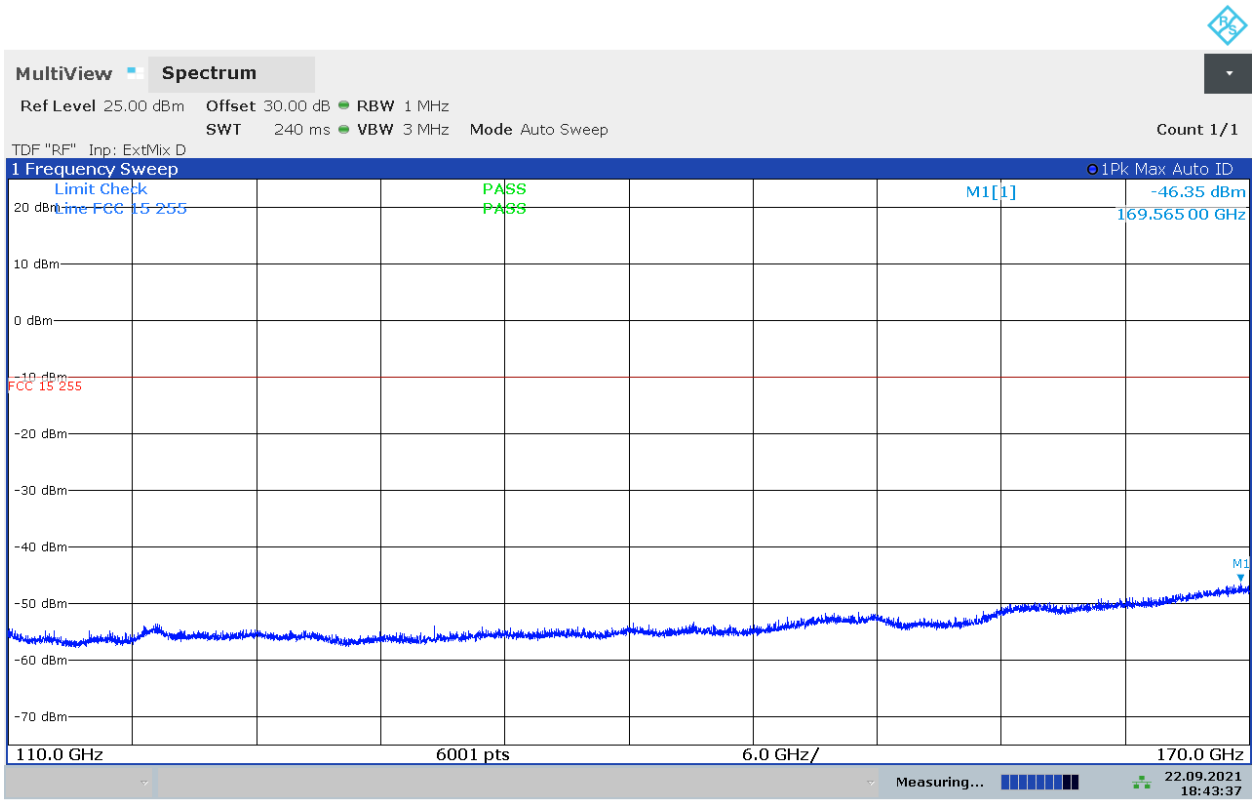
110 – 170 GHz HORIZONTAL



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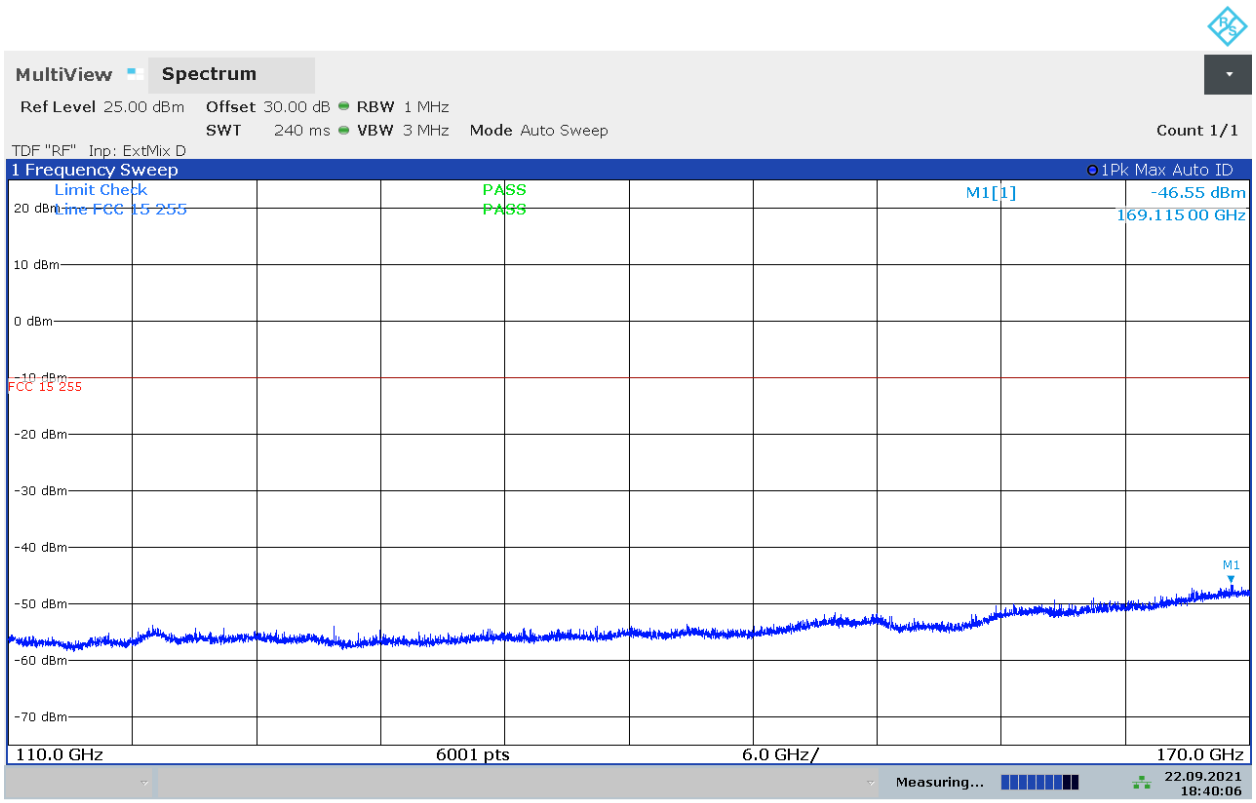
110 – 170 GHz VERTICAL



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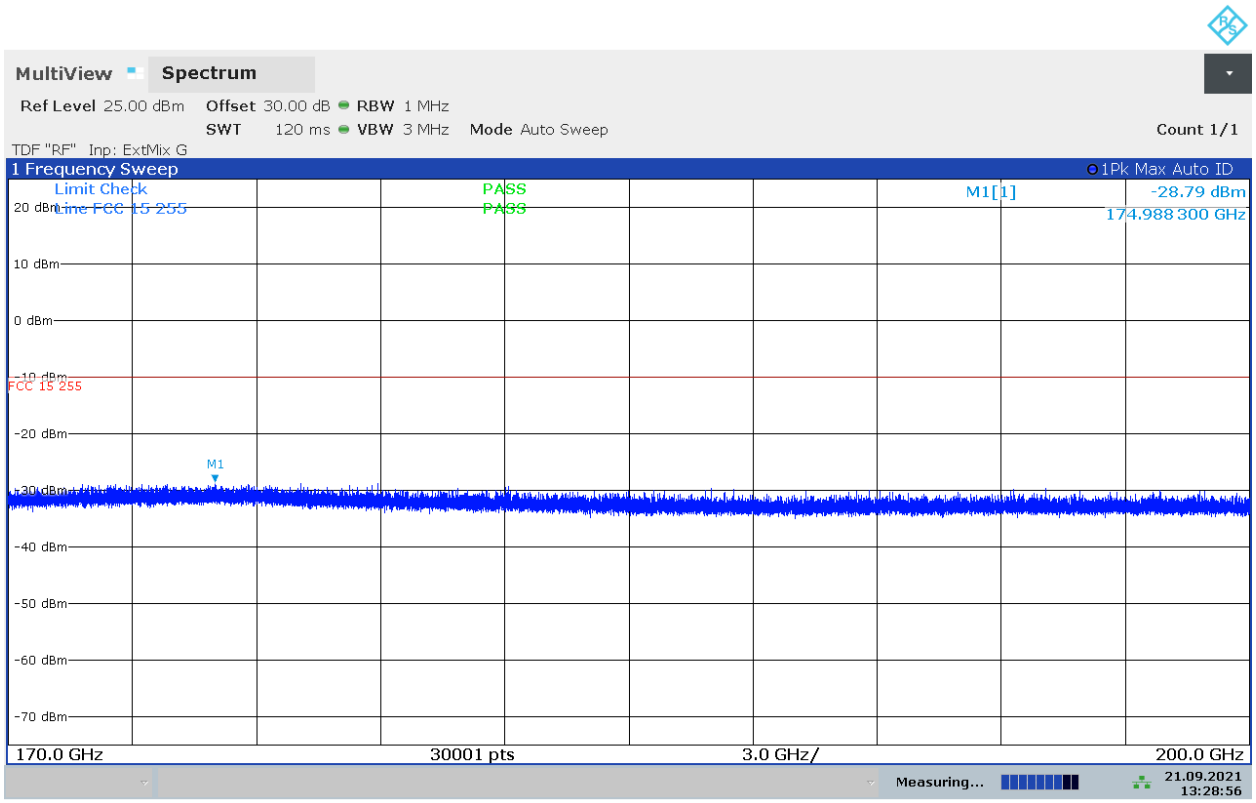
170– 200 GHz HORIZONTAL



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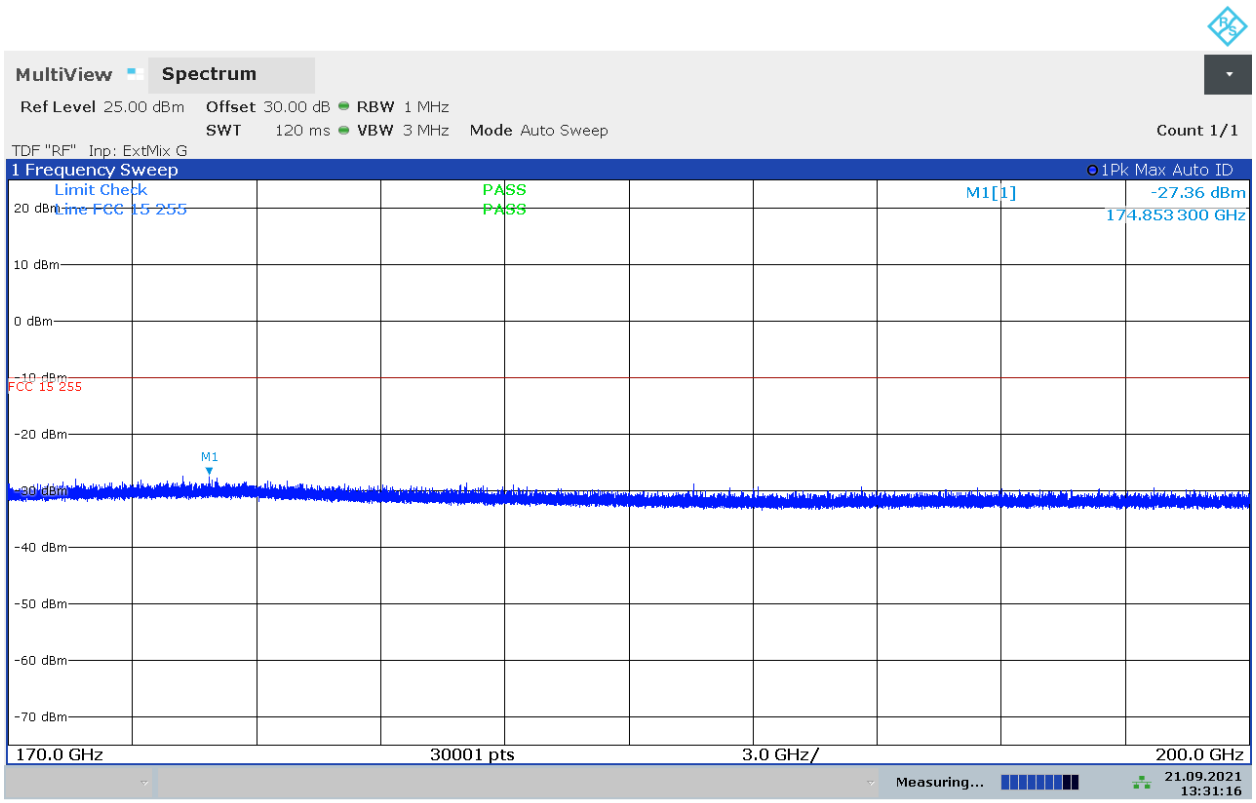
170 – 200 GHz VERTICAL



13:31:17 21.09.2021

8.7. RECEIVER SPURIOUS EMISSIONS

LIMITS

As the device is a transceiver there are no separate spurious limits for the receiver portion. All emissions were measured with the transmitters and receivers operating simultaneously. The receiver spurious performance is documented by the transmit spurious results above.

8.8. FREQUENCY STABILITY

LIMIT

§15.255 (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.

TEST PROCEDURE

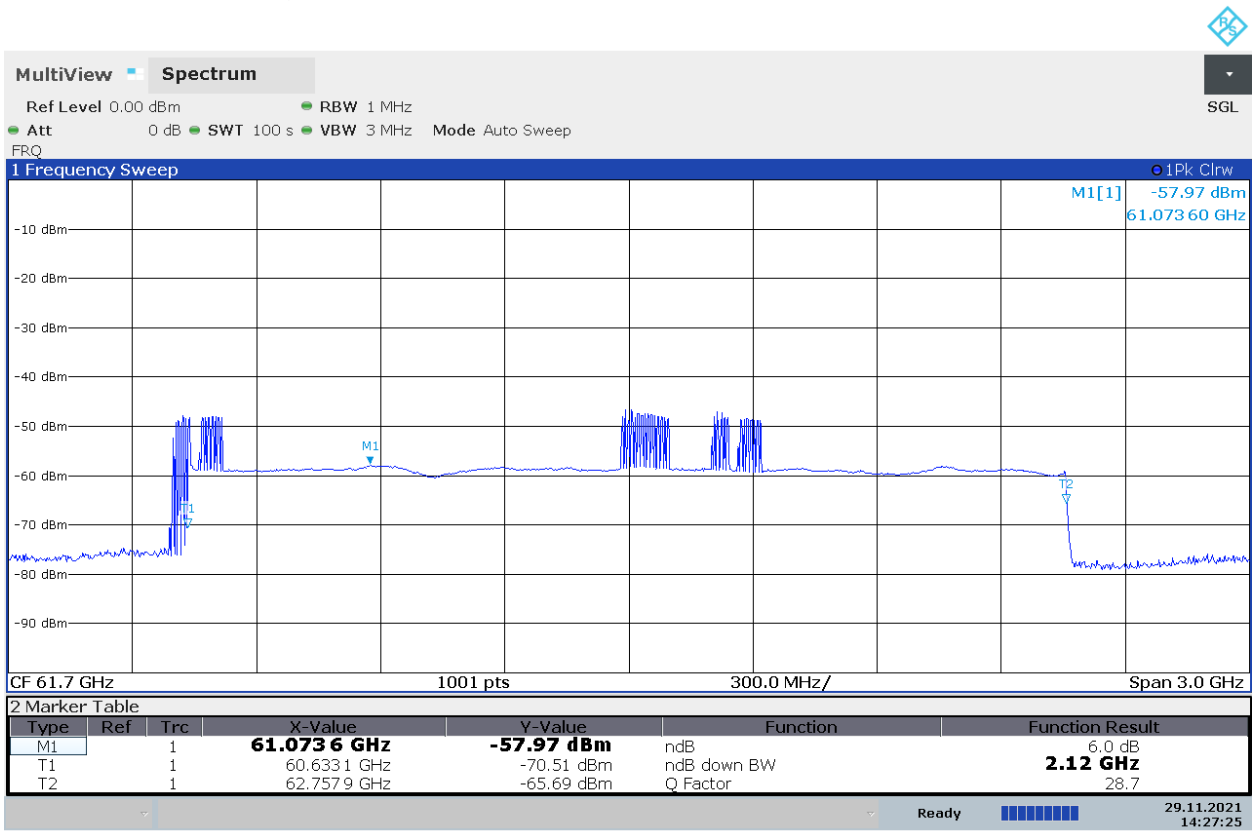
ANSI C63.10-2013 Clause 9.14

The radio module is placed in an environmental chamber, with power furnished by an adjustable source. The carrier frequency is counted at each condition and compared with the reference condition.

RESULTS

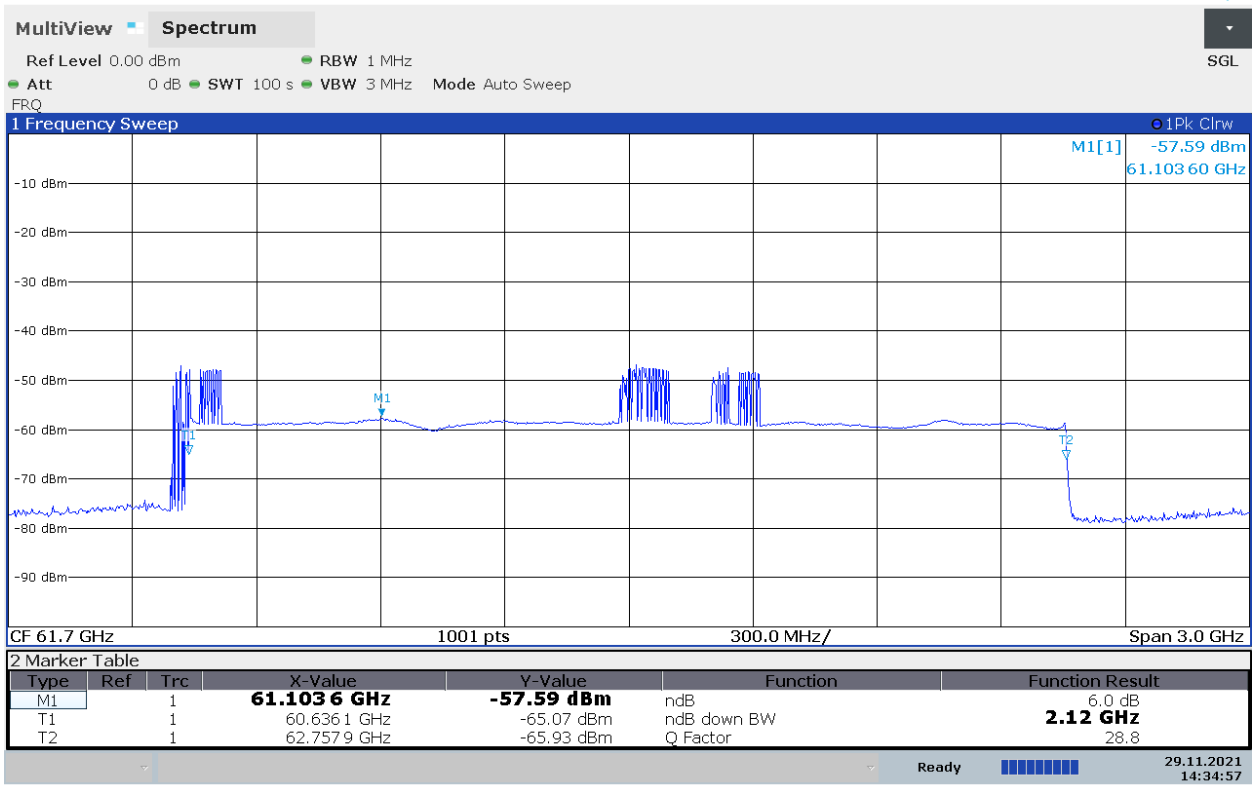
Input Voltage (v)	Temperature (deg C)	6dB Bandwidth (GHz)	F Low (GHz)	F Low Limit (GHz)	F High (GHz)	F High Limit (GHz)
20.4	-20	2.12	60.6361	57.0	62.7579	71.0
24	-20	2.12	60.7579	57.0	62.7579	71.0
27.6	-20	2.12	60.6361	57.0	62.7579	71.0
24	-10	2.12	60.6331	57.0	62.7579	71.0
24	0	2.13	60.6301	57.0	62.7579	71.0
24	+10	2.13	60.6301	57.0	62.7579	71.0
20.4	+20	2.12	60.6301	57.0	62.7549	71.0
24	+20	2.13	60.6301	57.0	62.7579	71.0
27.6	+20	2.12	60.6361	57.0	62.7579	71.0
24	+30	2.12	60.8861	57.0	62.7579	71.0
24	+40	2.12	60.6331	57.0	62.7549	71.0
20.4	+50	2.12	60.6301	57.0	62.7549	71.0
24	+50	2.12	60.6361	57.0	62.7549	71.0
27.6	+50	2.12	60.6331	57.0	62.7000	71.0

NOMINAL VOLTAGE, TEMPERATURE -20C



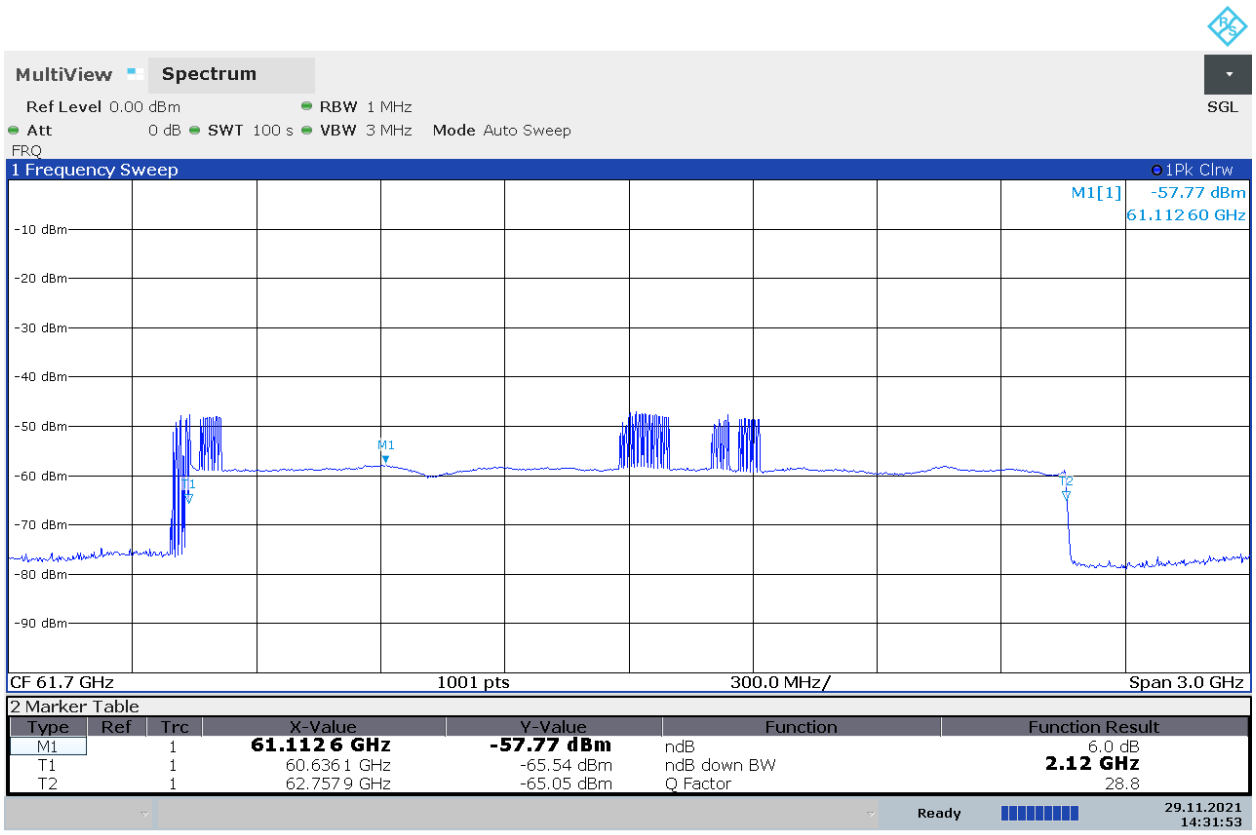
14:27:26 29.11.2021

HIGH VOLTAGE, TEMPERATURE -20C



14:34:57 29.11.2021

LOW VOLTAGE, TEMPERATURE -20C



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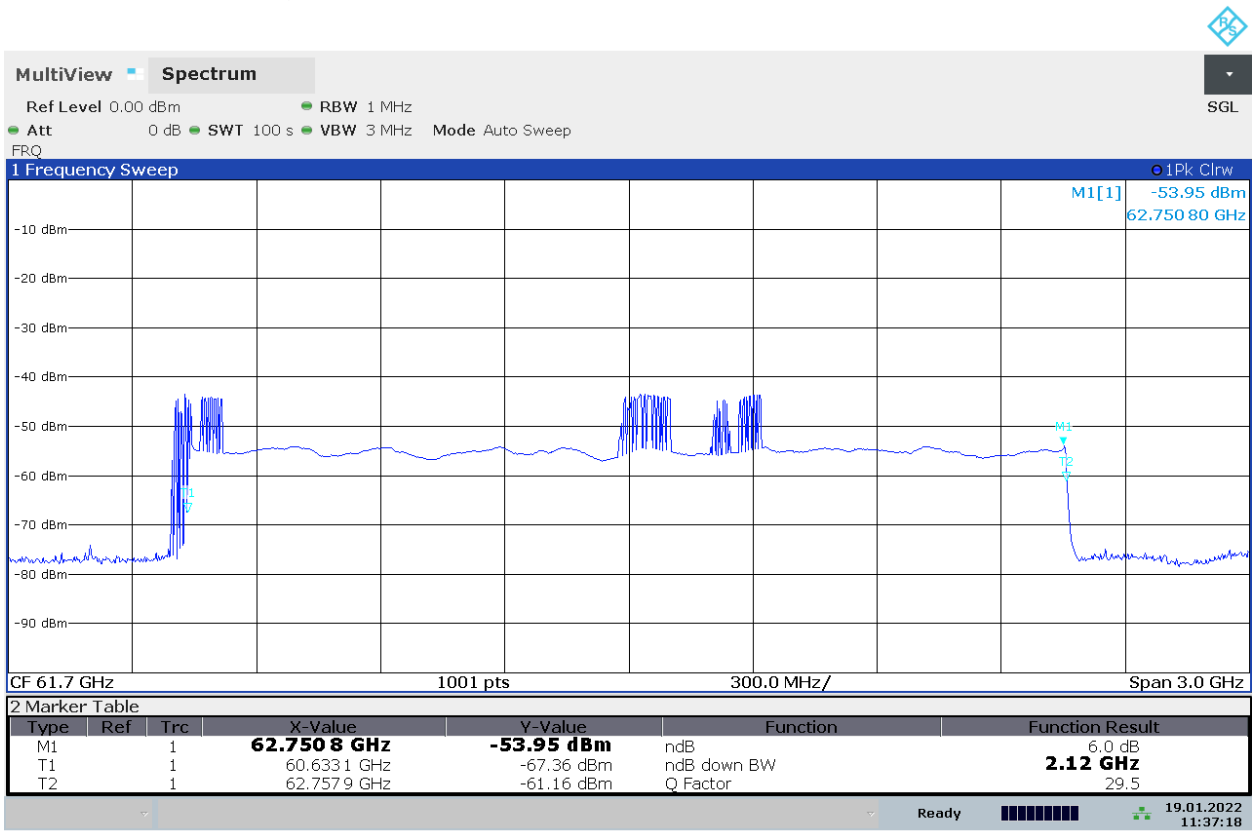
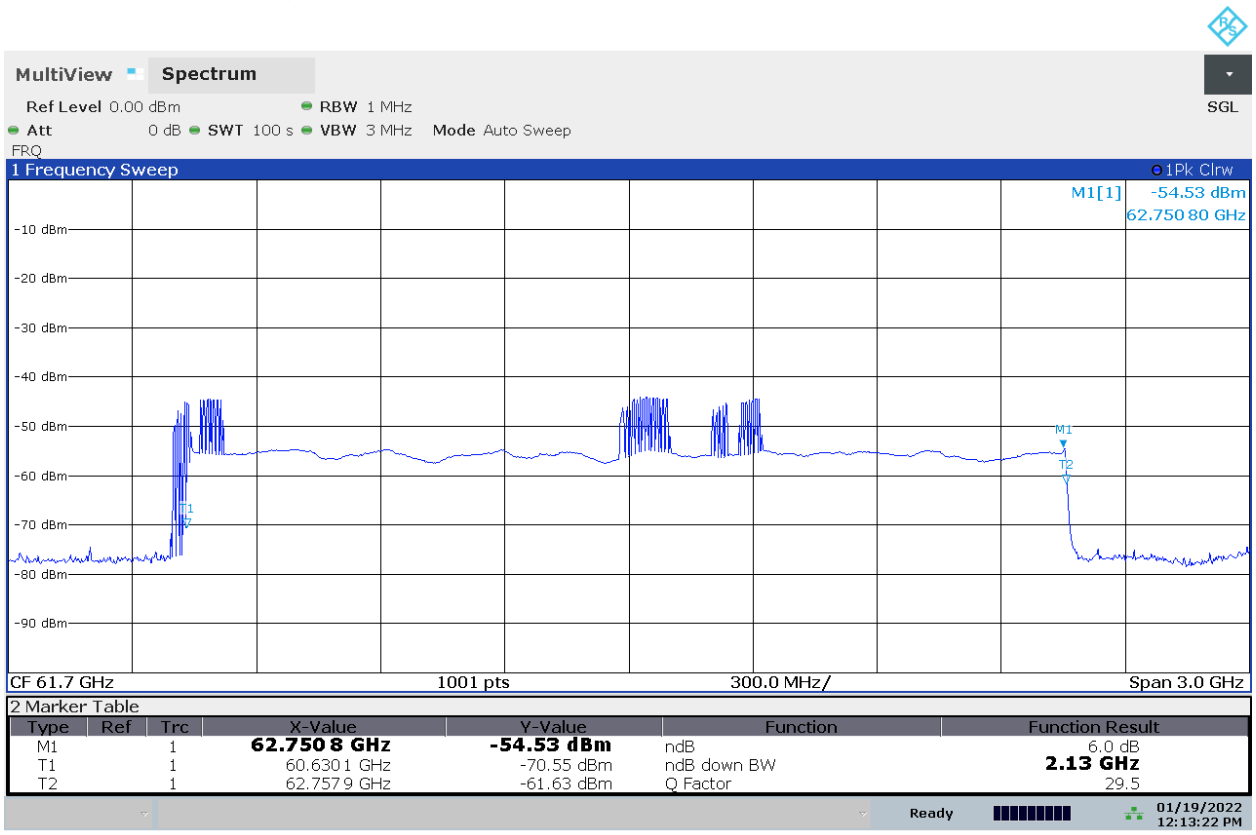
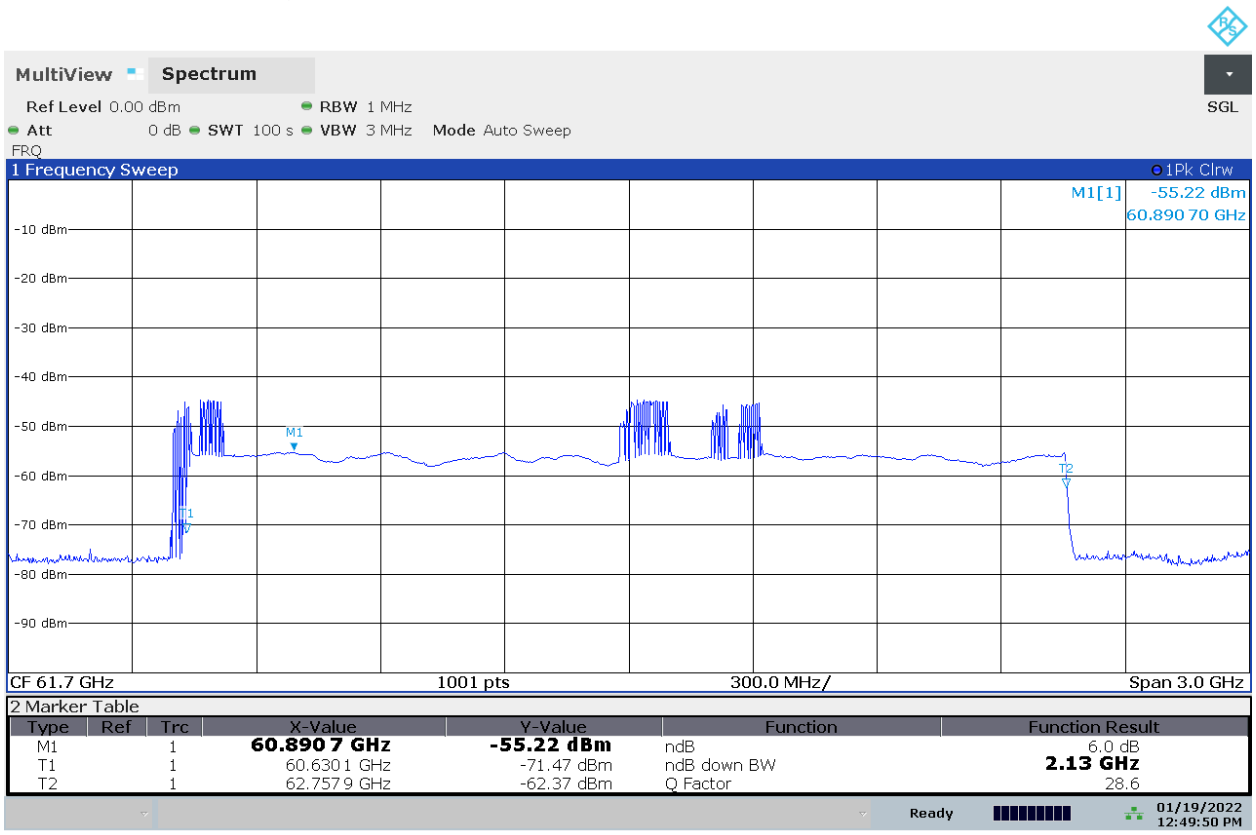


NOMINAL VOLTAGE, TEMPERATURE 0C



12:13:23 PM 01/19/2022

NOMINAL VOLTAGE, TEMPERATURE +10C



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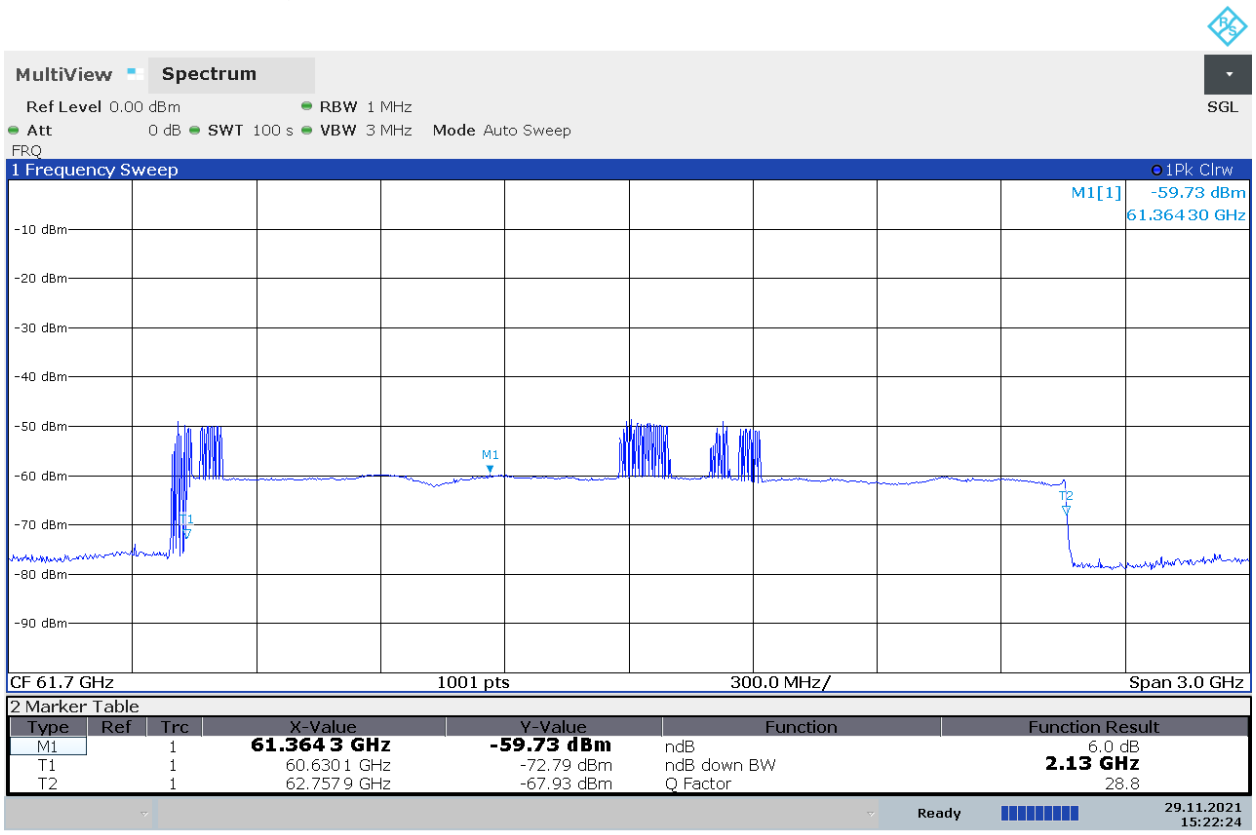
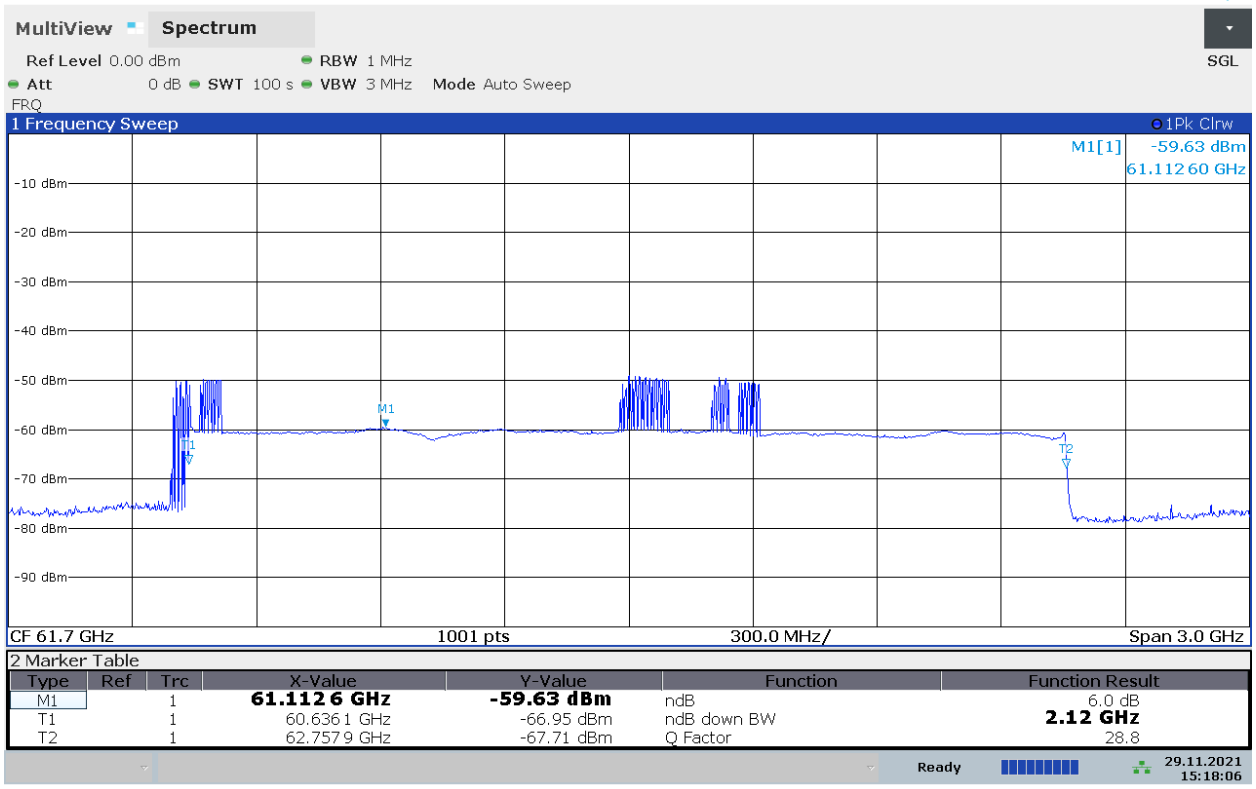
NOMINAL VOLTAGE, TEMERATURE +20C



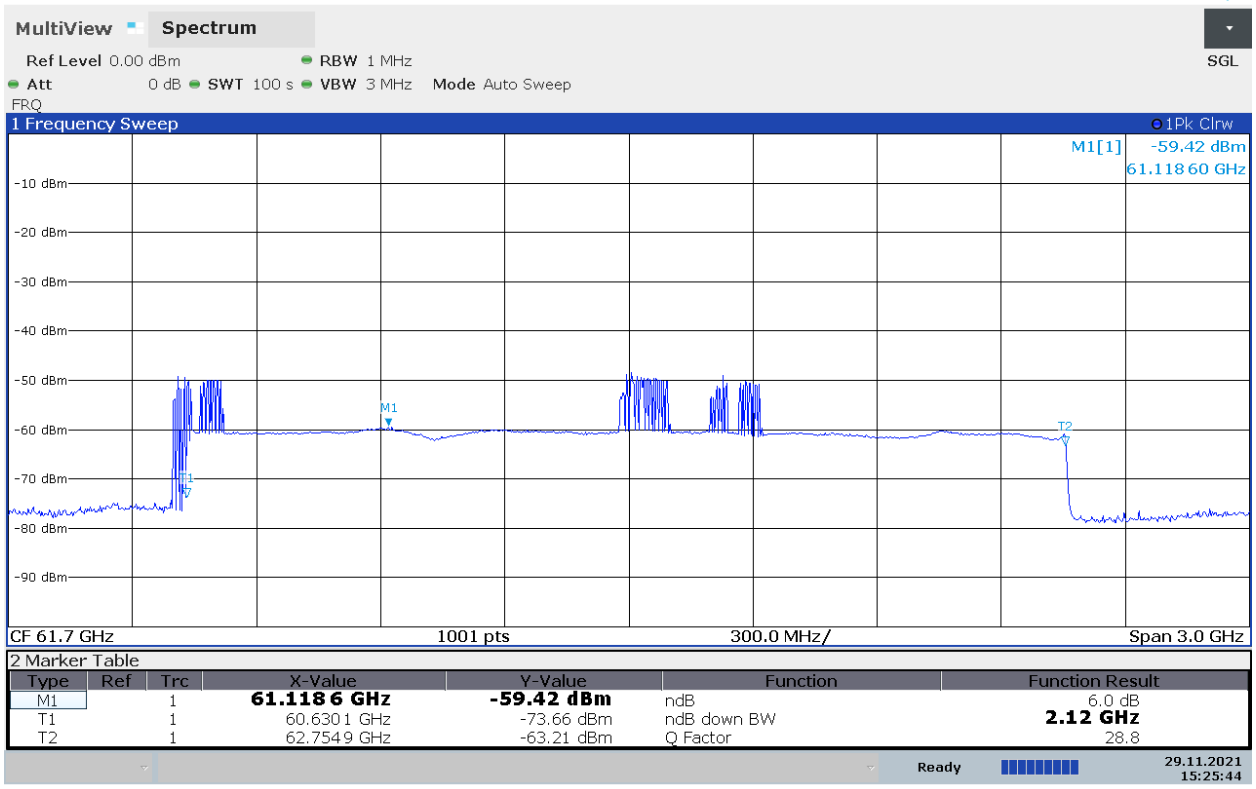
15:22:25 29.11.2021

HIGH VOLTAGE, TEMPERATURE +20C



15:18:06 29.11.2021

LOW VOLTAGE, TEMPERATURE +20C

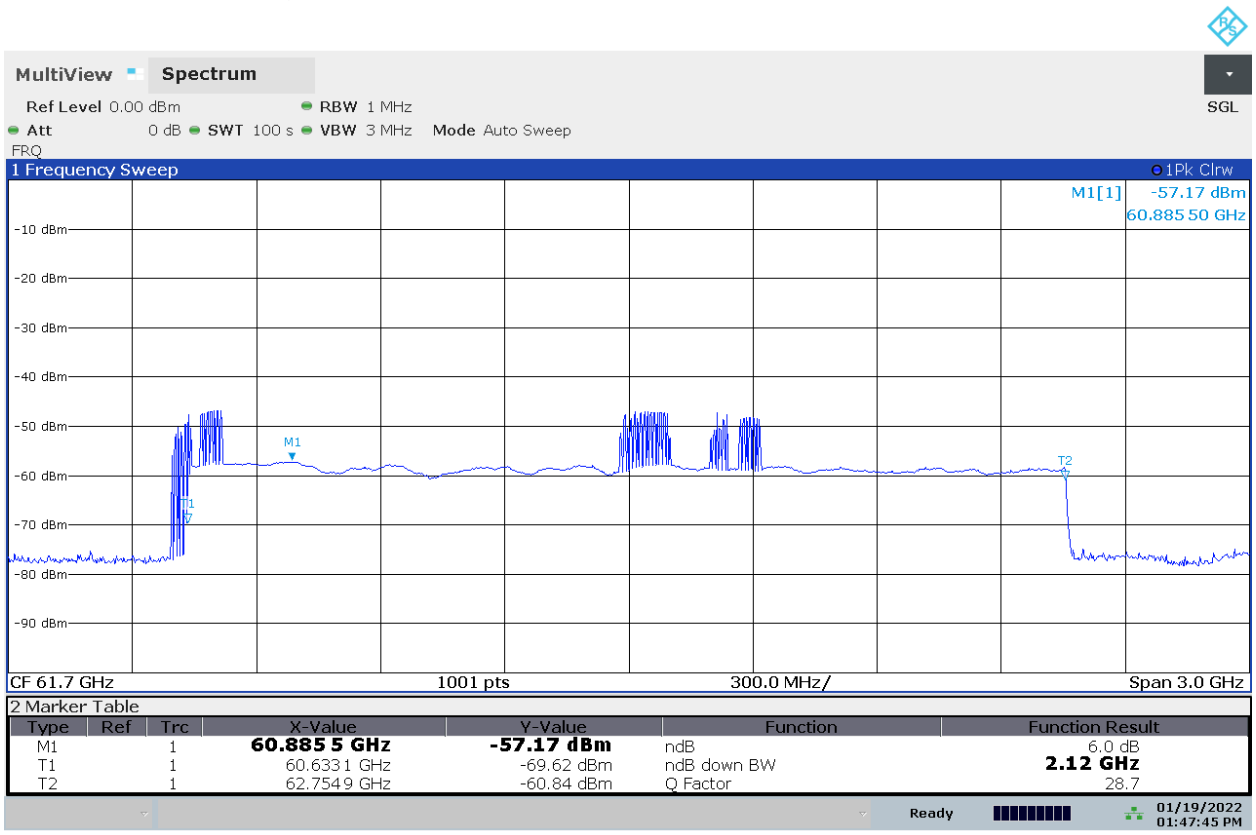


15:25:44 29.11.2021

NOMINAL VOLTAGE, TEMPERATURE +30C

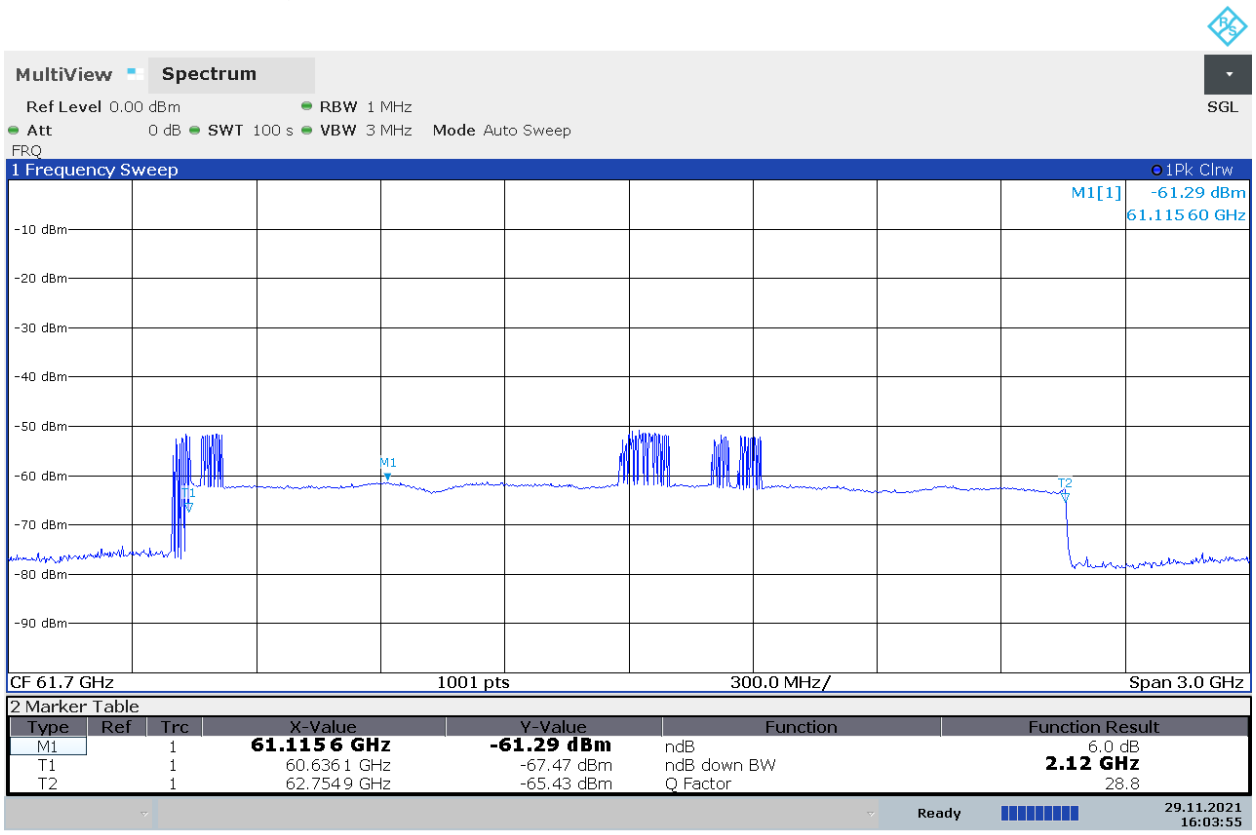
01:19:10 PM 01/19/2022

NOMINAL VOLTAGE, TEMPERATURE +40C



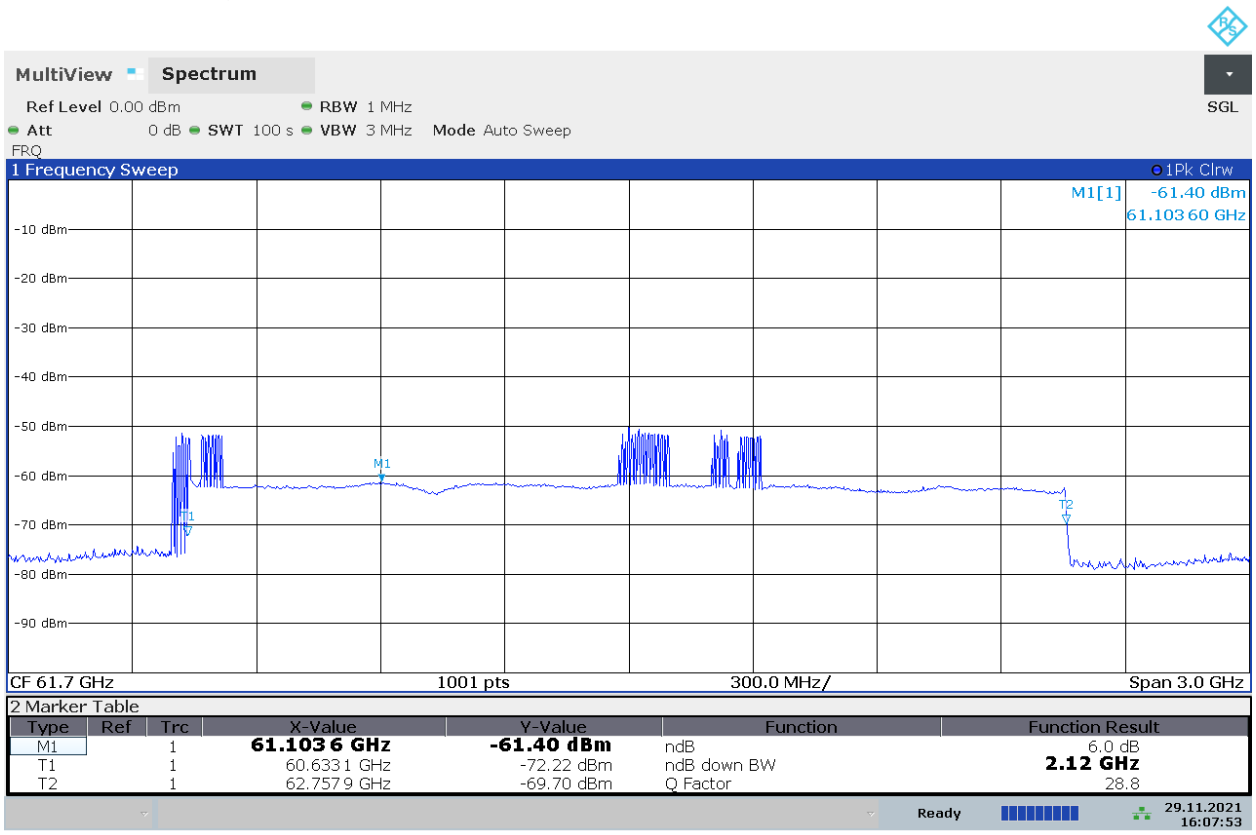
01:47:45 PM 01/19/2022

NOMINAL VOLTAGE, TEMPERATURE +50C



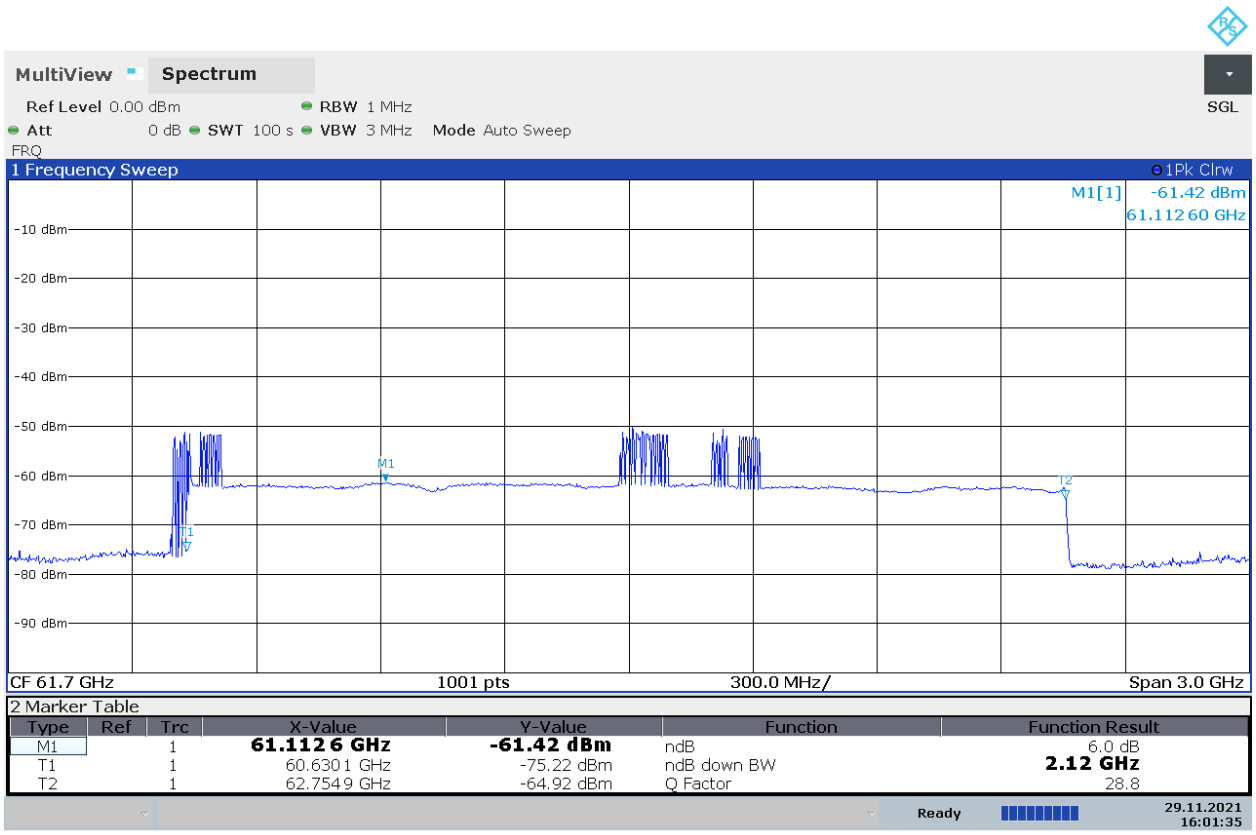
16:03:55 29.11.2021

HIGH VOLTAGE, TEMPERATURE +50C



16:07:54 29.11.2021

LOW VOLTAGE, TEMPERATURE +50C



16:01:36 29.11.2021

8.9. GROUP INSTALLATION

LIMIT

§15.255 (h) Any transmitter that has received the necessary FCC equipment authorization under the rules of this chapter may be mounted in a group installation for simultaneous operation with one or more other transmitter(s) that have received the necessary FCC equipment authorization, without any additional equipment authorization. However, no transmitter operating under the provisions of this section may be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

§RSS 210 J.7 Any transmitter that is certified under this RSS may be mounted in a group installation for simultaneous operation with one or more certified transmitters, without any additional equipment authorization. However, no transmitter operating under the provisions of this section shall be equipped with external phase-locking inputs that permit beam-forming arrays to be realized.

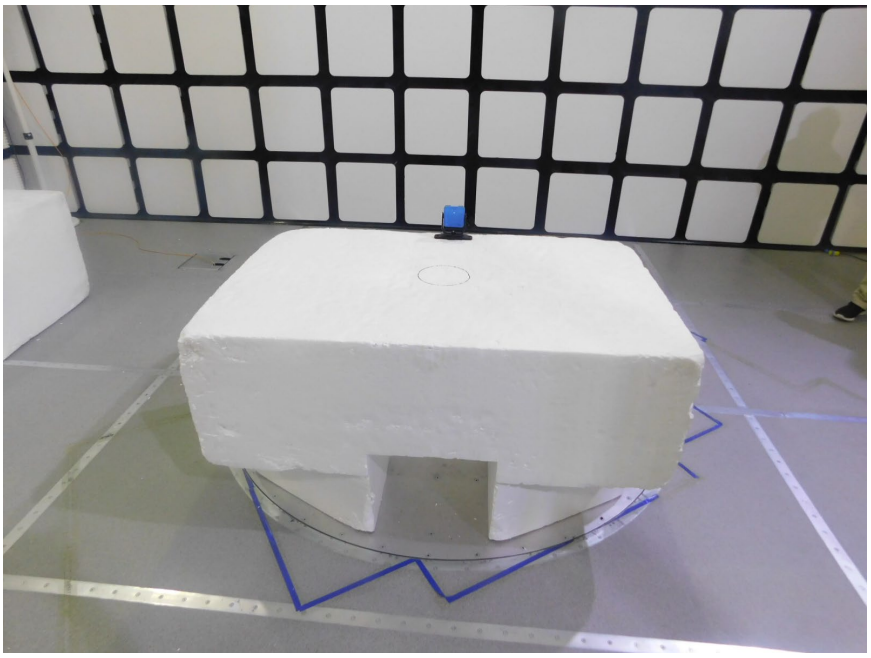
RESULTS

The EUT does not have any external phase locking inputs for beam forming.

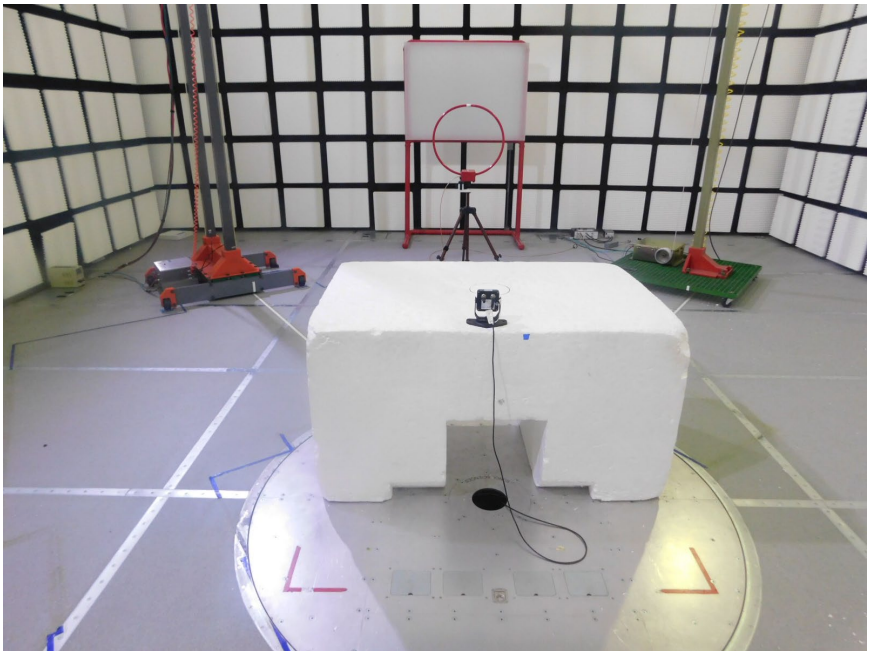
9. SETUP PHOTOS

RADIATED MEASUREMENT SETUP (9kHz – 30MHz)

FRONT VIEW

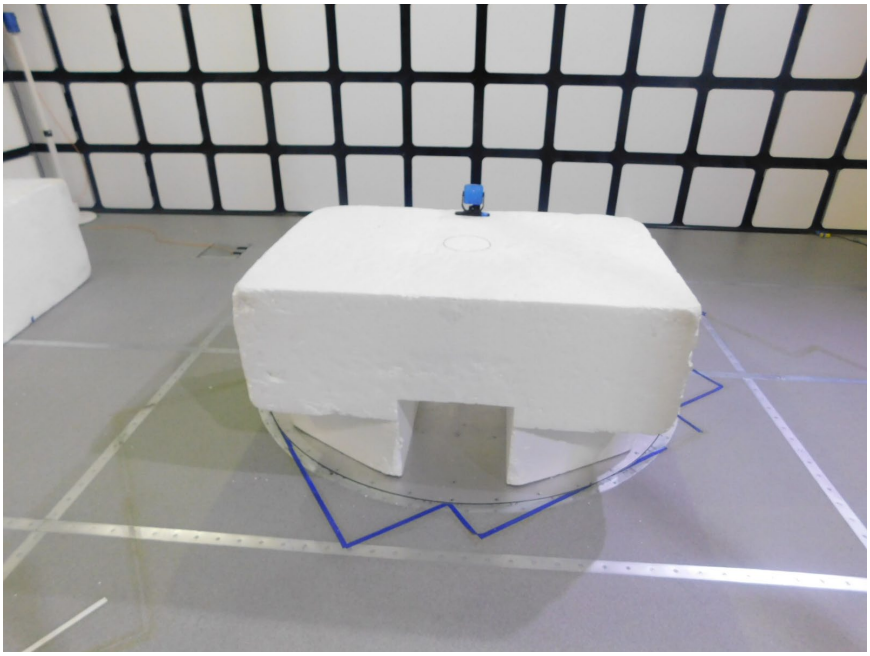


BACK VIEW

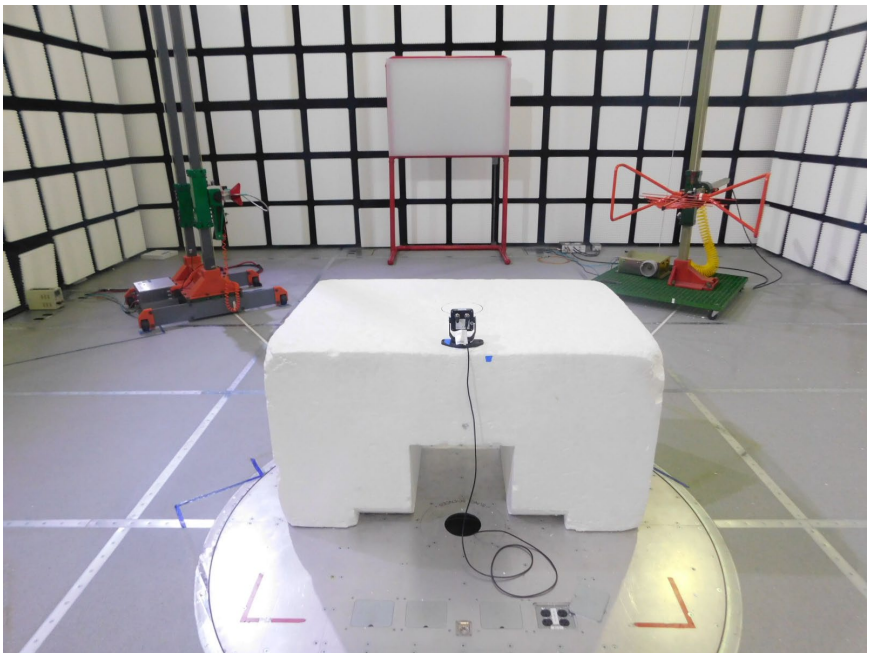


RADIATED MEASUREMENT SETUP (30MHz – 1000MHz)

FRONT VIEW



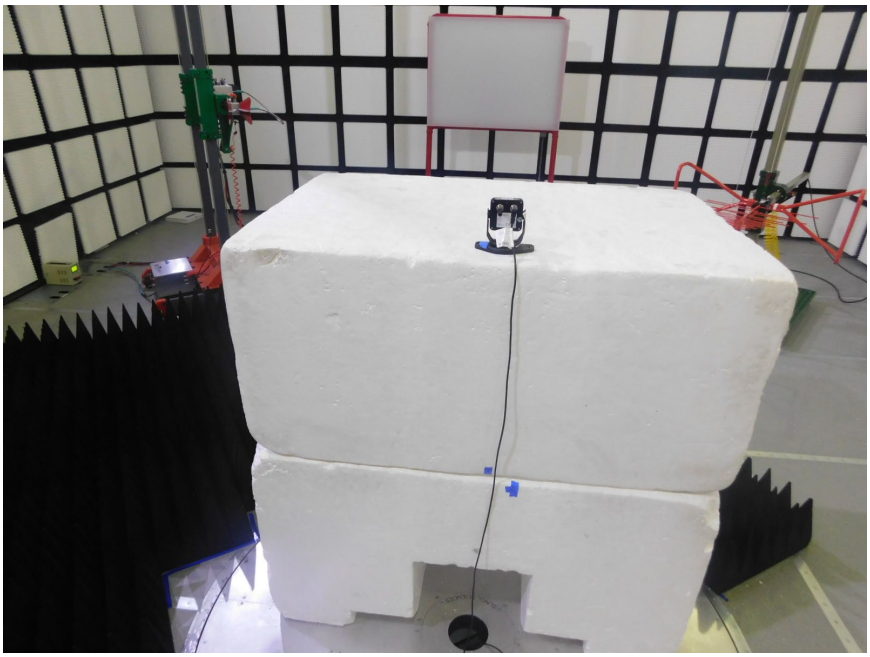
BACK VIEW



RADIATED MEASUREMENT SETUP (1GHz – 18GHz)

FRONT VIEW

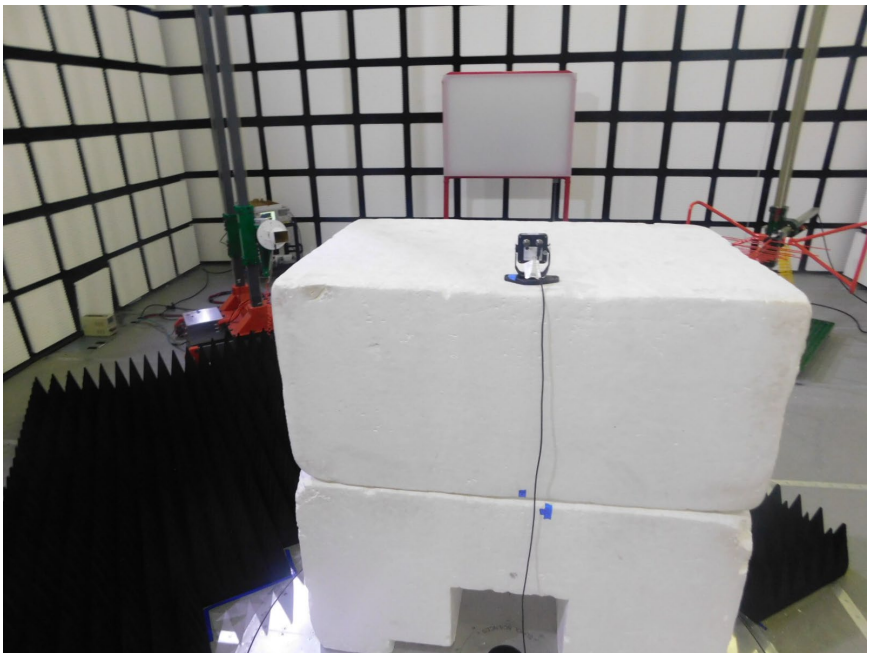
BACK VIEW



RADIATED MEASUREMENT SETUP (18GHz – 26.5GHz)

FRONT VIEW

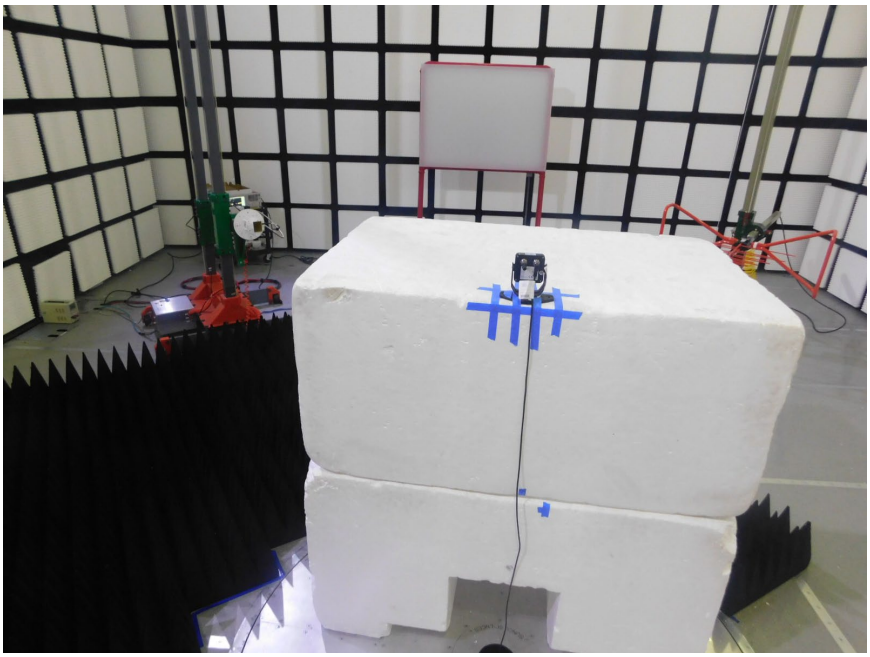
BACK VIEW



RADIATED MEASUREMENT SETUP (26.5GHz – 40GHz)

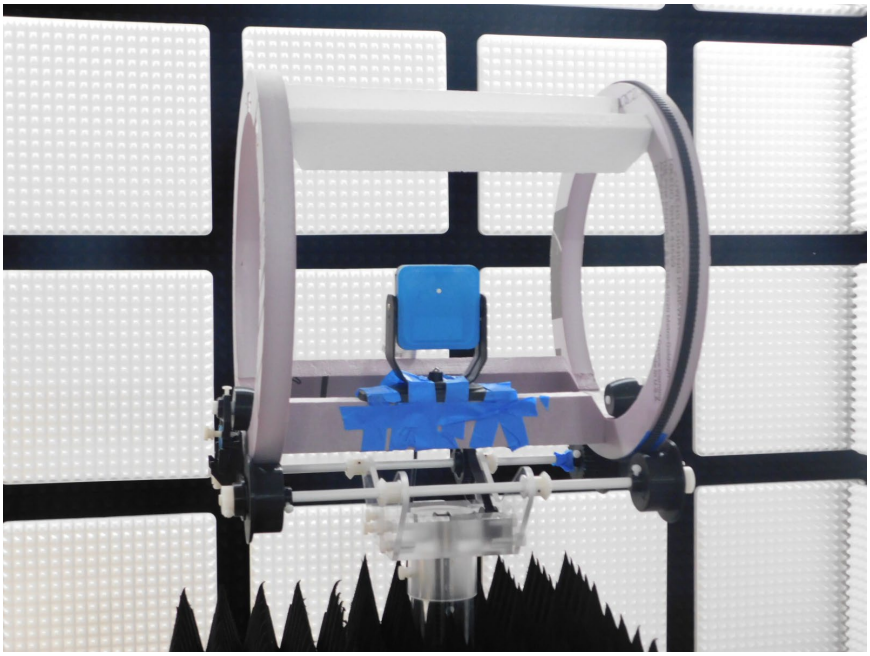
FRONT VIEW

BACK VIEW

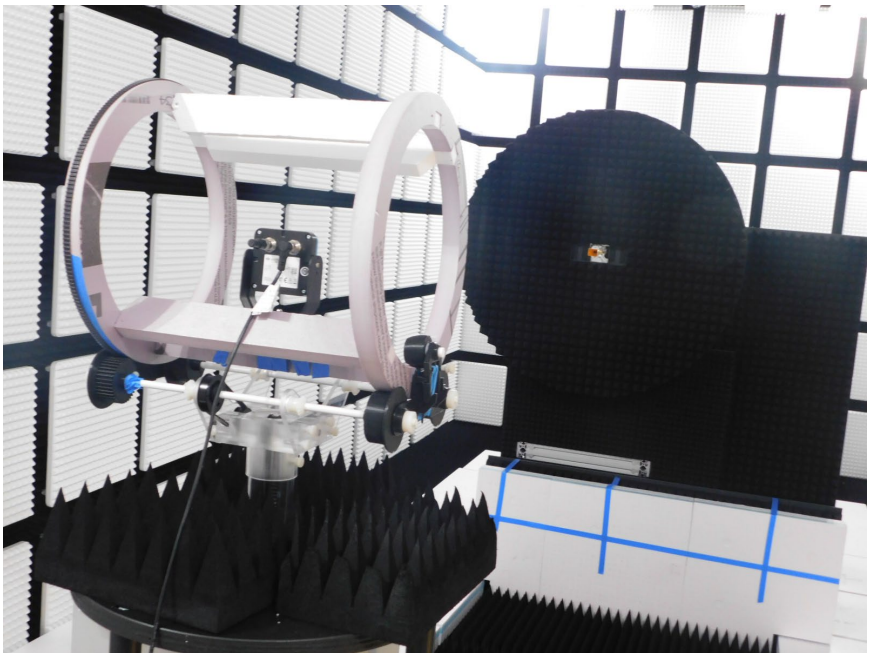


RADIATED MEASUREMENT SETUP (>40GHz)

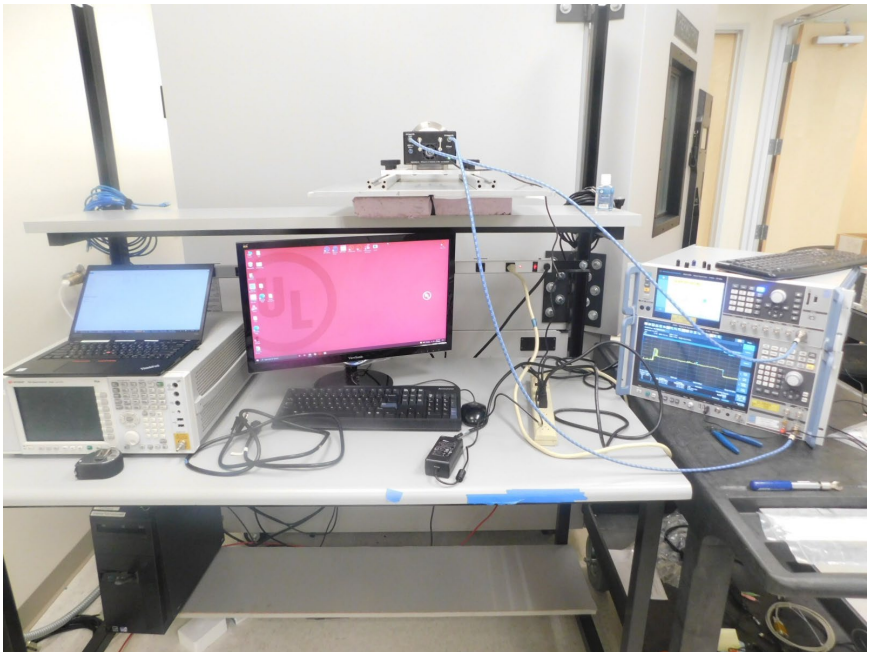
FRONT VIEW



BACK VIEW



TEMPERATURE CHAMBER MEASUREMENT SETUP



END OF TEST REPORT