Radio Test Report

Dense Air Ltd

STC-v11-Node-n48

AAA

47 CFR Part 15.255 Effective Date 1st October 2021
DXX: Part 15 Low Power Communication Device Transmitter
Test Date: 17th July 2023 to 14th August 2023
Report Number: 07-14220-1-23 Issue 01

The testing was carried out by RN Electronics Ltd, an independent test house, at their test facility located at:

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This laboratory is accredited in accordance with the recognised International Standard ISO/IEC 17025. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer joint ISO-ILAC-IAF communiqué dated April 2017).

Arnolds Court, Arnolds Farm Lane, Mountnessing, Brentwood Essex, CM13 1UT

Certificate of Test 14220-1

The equipment noted below has been partially tested by R.N. Electronics Limited and, where appropriate, conforms to the relevant subpart of 47 CFR Part 15C. This is a certificate of test only and should not be confused with an equipment authorisation. Other standards may also apply.

Equipment:	STC-v11-Node-n48
Model Number:	AAA
Unique Serial Number:	AAAD32500106
Applicant:	Dense Air Ltd Atlas House, Globe Business Park, Parkway, Third Avenue Marlow, Buckinghamshire SL7 1EY
Proposed FCC ID	2BBSF-SC11-AAA
Full measurement results are detailed in Report Number:	07-14220-1-23 Issue 01
Test Standards:	47 CFR Part 15.255 Effective Date 1st October 2021 DXX: Part 15 Low Power Communication Device Transmitter

NOTE:
Certain tests were not performed based upon applicant's declarations. Certain other requirements are subject to applicant's declaration only and have not been tested/verified. For details refer to section 3 of this report. This report pertains to the 60 GHz functionality of the device, for 5G NR functionality please refer to report 09-14220-3-23 Issue 01.

DEVIATIONS:
No deviations have been applied.

This certificate relates only to the unit tested as identified by a unique serial number and in the condition at the time it was tested. It does not relate to any other similar equipment and performance of the product before or after the test cannot be guaranteed. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of unit not meeting the intentions of the standard or the requirements of the Federal Regulations, particularly under different conditions to those during testing. Any compliance statements are made reliant on (a) the application of the product and use of the assigned band being acceptable to the FCC and (b) the modes of operation as instructed to us by the Customer based on their specific knowledge of the application and functionality of the EUT. Statements of compliance, where measurements were made, do not include the measurement uncertainty. The measurement uncertainty, where stated, is the expanded uncertainty based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Date of Test: 17th July 2023 to 14th August 2023

Test Engineer:
Graham Blake

Graham Blake
Digitally signed by: Graham Blake
DN: CN = Graham Blake email = graham.blake@rnelectronics.com C = AD O = RN Electronics OU = Engineer
Date: 2023.10.20 16:02:17 Z

Approved By:
Radio Manager

Digitally signed by: Daniel Sims
DN: CN = Daniel Sims C = GB O = RN Electronics Ltd
Date: 2023.10.20 14:59:34 Z

Customer
Representative:

DocuSigned by:
Peter Warburg 08-11-2023
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1 Contents

2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	Dense Air Ltd Atlas House Globe Business Park Parkway, Third Avenue Marlow Buckinghamshire SL7 1EY	
Manufacturer of EUT	Dense Air Ltd	
Full Name of EUT	STC-v11-Node-n48	
Model Number of EUT	AAA	
Serial Number of EUT	AAAD32500106	
Date Received	26th June 2023	
Date of Test:	17th July 2023 to 21st July 2023	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Issued	17th October 2023	
Main Function	The unit is a 5G Base Station with integrated optical networking and 60GHz mmWave radio.	
Information Specification	Height	770 mm
	Width	400 mm
	Depth	<770 mm
	Weight	<20.2 kg
	Voltage	+45VDC Nominal
	Current	<5A

2.2 Configurations for testing

General Parameters	
EUT Normal use position	Pole mounted
Choice of model(s) for type tests	Sample
Antenna details	mmWave Phased Array Antenna 23dBi Gain
Antenna port	No
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	70.2 GHz
Lowest Signal generated in EUT	9 KHz
Hardware Version (HVIN)	V1.1
Software Version	5G Radio - SR19.00 60GHz mmWave Radio - Rel 0.16
Firmware Version (FVIN)	Particle - 509
Type of Equipment	Outdoor 5G Small Cell Base Station
Technology Type	Multi-Gigabit/s Radio (IEEE 802.11ad)
Geo-location (yes/no)	No
TX Parameters	
Alignment range – transmitter	57-71 GHz band
EUT Declared Modulation Parameters	π/2-DBPSK (MCS0, π/2-BPSK (MCS1-5), π/2-QPSK (MCS6-9), π/2-16QAM (MCS10-12)
EUT Declared Power level	10W EIRP per radio module
EUT Declared Signal Bandwidths	Full band - 2.16 GHz
EUT Declared Channel Spacing's	2.16 GHz
EUT Declared Duty Cycle	99%
Unmodulated carrier available?	Yes
Declared frequency stability	±2ppm
RX Parameters	
Alignment range – receiver	57-71 GHz band
EUT Declared RX Signal Bandwidth	2.16 GHz
FCC Parameters	
FCC Transmitter Class	DXX: Part 15 Low Power Communication Device Transmitter

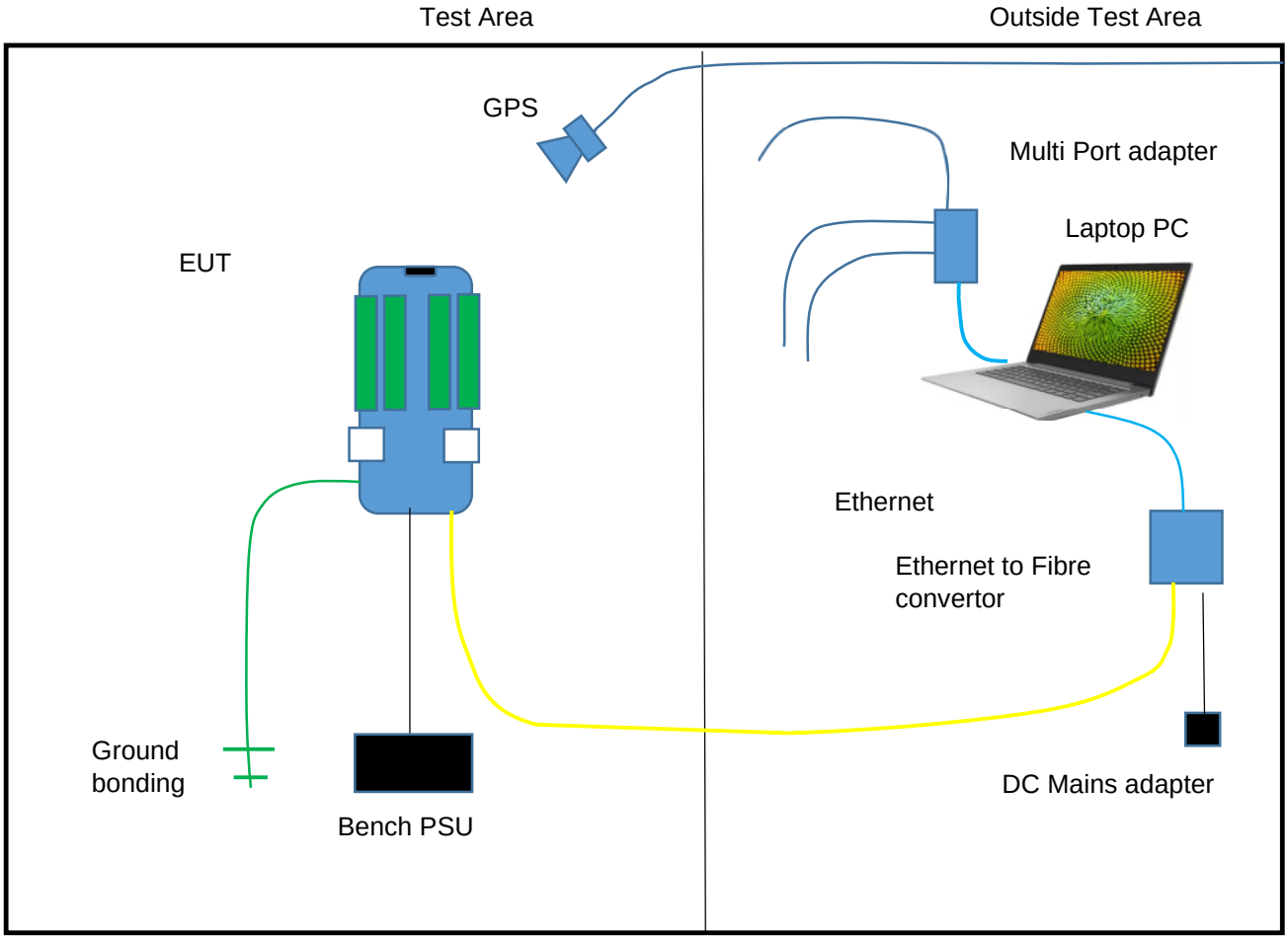
2.3 Functional description

The streetCell v1.1 is a 5G Small Cell Base Station with a switchable antenna designed to allow 5G radio coverage optimisation in each deployment, the streetCell v1.1 also supports multiple back haul options including fixed optical or 60GHz mmWave radio to the core network directly or via another streetCell v1.1 unit.

2.4 Modes of operation

Mode Reference	Description	Used for testing
TX1	Transmitting continuously at 58.32 GHz with system modulation	Yes
TX2	Transmitting continuously at 60.48 GHz with system modulation	No
TX3	Transmitting continuously at 62.64 GHz with system modulation	No
TX4	Transmitting continuously at 64.8 GHz with system modulation	Yes
TX5	Transmitting continuously at 66.96 GHz with system modulation	No
TX6	Transmitting continuously at 69.12 GHz with system modulation	Yes
TX7	Transmitting continuously at 58.32 GHz without modulation (CW)	Yes
TX8	Transmitting continuously at 60.48 GHz without modulation (CW)	No
TX9	Transmitting continuously at 62.64 GHz without modulation (CW)	No
TX10	Transmitting continuously at 64.8 GHz without modulation (CW)	Yes
TX11	Transmitting continuously at 66.96 GHz without modulation (CW)	No
TX12	Transmitting continuously at 69.12 GHz without modulation (CW)	Yes
TX13	Transmitting continuously at 58.32 GHz with system modulation & 5g radio transmitting at max power in ID config 1 with QPSK modulation.	Yes
TX14	Transmitting continuously at 60.48 GHz with system modulation & 5g radio transmitting at max power in ID config 1 with QPSK modulation.	No
TX15	Transmitting continuously at 62.64 GHz with system modulation & 5g radio transmitting at max power in ID config 1 with QPSK modulation.	No
TX16	Transmitting continuously at 64.8 GHz with system modulation & 5g radio transmitting at max power in ID config 1 with QPSK modulation.	Yes
TX17	Transmitting continuously at 66.96 GHz with system modulation & 5g radio transmitting at max power in ID config 1 with QPSK modulation.	No
TX18	Transmitting continuously at 69.12 GHz with system modulation & 5g radio transmitting at max power in ID config 1 with QPSK modulation.	Yes

2.5 Emissions configuration



The unit was powered from a bench power supply connected to a 120 V / 60 Hz supply. The power supply was set to 45 VDC. In end-user operation the EUT is normally mounted to a metal pole, to replicate this in the test chamber a grounding braid was connected to the EUT metal enclosure and this was bonded to the ground plane floor of the chamber. The unit was configured using a laptop PC and terminal software to allow permanent transmit modes of the 60 GHz function of the device on both of the EUT's 60 GHz radios with individual beam settings also settable. Terminal software was used to configure the 60GHz radio.
The EUT incorporates a 5G cellular radio which can operate at the same time as the 60GHz radio. During radiated emissions tests the EUT was assessed with both 60 GHz radios operating on the same channel and with the 5G radio active but with its antennae disconnected and terminated. The EUT's 5G radio antennae were then reconnected to allow it to be assessed for intermodulation products. The 5G radio was configured using the laptop PC running specialised engineering software (Qualcomm QRCT). The PC was removed from the test area prior to test.

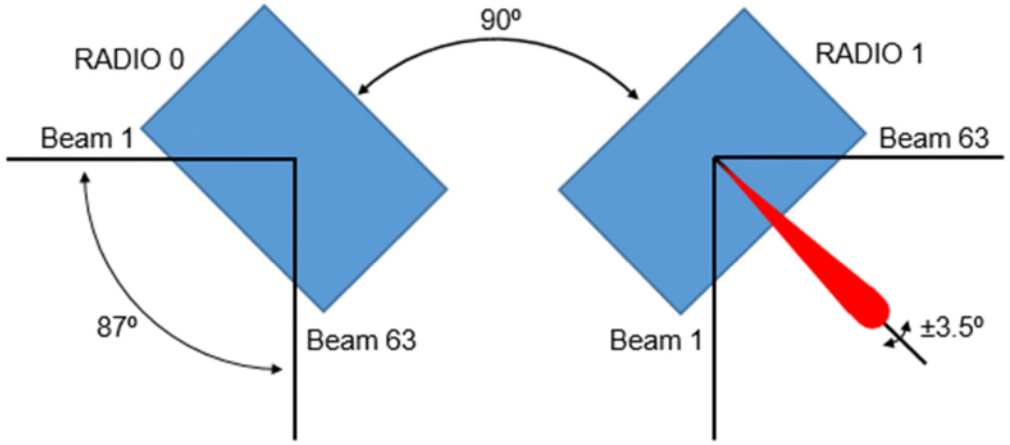
To establish the 'worst-case' modulation scheme a pre-test was performed where all modulations were assessed in turn (MCS0 to MCS12). For final test modulation scheme MCS1 was used as this was found to be worst-case.

The 60GHz radio was assessed at the maximum power setting (as per factory calibration) using the following channels:
Low = 58.32 GHz, 2.16GHz BW
Mid = 64.8 GHz, 2.16GHz BW
High = 69.12 GHz, 2.16GHz BW

Measured duty cycles for the schemes were as follows:-

MCS0 98.52 %
MCS1 97.83 %
MCS2 99.13 %
MCS3 98.55 %
MCS4 98.92 %
MCS5 98.83 %
MCS6 98.56 %
MCS7 98.21 %
MCS8 97.86 %
MCS9 97.92 %
MCS10 97.46 %
MCS11 96.85 %
MCS12 96.27 %

Each 60 GHz radio has its own steerable (azimuth only) antenna array with settings between 1 and 63 resulting in a steering range of approximately 87º. The two radios are aligned at 90º to each other. The -3 dB beam width of the antenna is approximately ±3.5º



EUT viewed from above

To assess the possibility of any beam overlap when both radios are transmitting on the same channel the EIRP was measured for any combination of RADIO 0 beam settings of 59-63 with RADIO 1 beam settings of 1-5. The following results were obtained: -

Measured EIRP (dBm)	RADIO 0 (beam setting)				
RADIO 1 (beam setting)	63	62	61	60	59
1	32.2	32.1	32.1	32.1	32.2
2	32.7	32.8	32.9	32.9	32.8
3	33.2	33.2	33.2	33.2	33.2
4	33.7	33.7	33.7	33.7	33.7
5	33.8	33.9	33.9	33.9	33.9

All of the above results are more than 3dB lower than the maximums recorded for a single beam setting on a single radio, which indicates no beam overlap occurs between the two 60GHz radios.

For Intermodulation testing between 60GHz and the 5G radio the maximum power setting of 5G NR was left at the default maximum power setting (33 dBm conducted) using the following channels:
Low = 3570 MHz, 20MHz BW, QPSK Modulation
Mid = 3625 MHz, 20MHz BW, QPSK Modulation
High = 3680 MHz, 20MHz BW, QPSK Modulation

For AC Conducted emissions, the EUT was tested in conjunction with an ‘off the self’ DC power supply provided by the applicant. This was powered using a 120V 60Hz power source. The EUT was tested with both the 60GHz and the 5G radio both transmitting simultaneously on mid channels.

2.5.1 Signal leads

Port Name	Cable Type	Connected
DC Input	2-Core	Yes
Grounding point	Copper braid	Yes
Point-of-presence	Full Duplex Fibre	Yes
Daisy chain 1	Full Duplex Fibre	No
Daisy chain 2	Full Duplex Fibre	No
Debug Ethernet	CAT-5	No*
Debug Serial	USB to RJ45	No*
Debug USB	USB-A Connector	No*

*Declared as Engineering / Factory use only

3 Summary of test results

The 60GHz mmWave radios in the STC-v11-Node-n48, AAA were tested for compliance to the following standard(s) :

47 CFR Part 15.255 Effective Date 1st October 2021
DXX: Part 15 Low Power Communication Device Transmitter

Any compliance statements are made reliant on (a) the application of the product and use of the assigned band being acceptable to the FCC and (b) the modes of operation as instructed to us by the Customer based on their specific knowledge of the application and functionality of the EUT. Whilst every effort is made to assure quality of testing, type tests are not exhaustive and although no non-conformances may be found, this doesn't exclude the possibility of equipment not meeting the intentions of the standard or the essential requirements of the directive, particularly under different conditions to those during testing. Statements of compliance, where measurements were made, do not include the measurement uncertainty. The measurement uncertainty, where stated, is the expanded uncertainty based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Title	References	Results
Transmitter Tests		
1. AC power line conducted emissions	47 CFR Part 15C Part 15.207	PASSED
2. Radiated emissions 9 - 150 kHz	47 CFR Part 15C Part 15.209	PASSED
3. Radiated emissions 150 kHz - 30 MHz	47 CFR Part 15C Part 15.209	PASSED
4. Radiated emissions 30 MHz -1 GHz	47 CFR Part 15C Part 15.255(d)(2)	PASSED
5. Radiated emissions 1 - 40 GHz	47 CFR Part 15C Part 15.255(d)(2)/(3)/(4)	PASSED
6. Radiated emissions 40 - 200 GHz	47 CFR Part 15C Part 15.255(d)(2)/(3)/(4)	PASSED[1]
7. Peak & Average EIRP	47 CFR Part 15C Part 15.255(c)(1)(i)/(ii)	PASSED
8. Peak Conducted Power	47 CFR Part 15C Part 15.255(c)(3)/(4)	PASSED[2]
9. Frequency stability	47 CFR Part 15C Part 15.255(f)	PASSED
10. 6dB Occupied bandwidth	47 CFR Part 15C Part 15.255(e)1	PASSED

[1] Spectrum investigated started at a frequency of 9 kHz up to a frequency of 200GHz. The highest signal generated in the equipment is 70.2 GHz.
[2] EUT does not have a conducted RF port, however, calculation has been provided to determine conducted power against the limit from maximum EIRP measured and antenna gain supplied.

4 Specifications

The tests were performed and operated in accordance with R.N. Electronics Ltd procedures and the relevant standards listed below.

4.1 Relevant standards

Ref.	Standard Number	Version	Description
4.1.1	47 CFR Part 15C	2021	Federal Communications Commission PART 15 – RADIO FREQUENCY DEVICES
4.1.2	ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
4.1.3	ANSI C63.4	2014	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
4.1.4	KDB 842590 D01 v01	2019	Federal Communications Commission Office of Engineering and Technology Laboratory Division; Basic certification requirements and measurement procedures for Upper Microwave Flexible Use Service (UMFUS) devices

4.2 Deviations

No deviations were applied.

4.3 Tests at extremes of temperature & voltage

The following test conditions were used to simulate testing at nominal or extremes.

Temperature Test Conditions		Voltage Test Conditions	
T nominal	20 °C	V nominal	45V DC
T minimum	-30 °C	V minimum	40.5V DC
T maximum	50 °C	V maximum	49.5V DC

Extremes of voltage are based upon manufacturer's declaration of nominal ±10 %.
Extremes of temperature are based upon manufacturer's declaration and rule part 15.255.
The ambient test conditions of humidity and pressure in the laboratory were as specified in each specific test section within this report

4.4 Test fixtures

In order to measure RF parameters at temperature extremes, the EUT was tested in a temperature-controlled chamber as follows:
Tests were performed radiated. To allow the fundamental transmission to pass through the temperature-controlled chamber, a Styrofoam door was used.

5 Tests, methods and results

5.1 AC power line conducted emissions

5.1.1 Test methods

Test Requirements:	47 CFR Part 15C Part 15.207 [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.2 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.207 [Reference 4.1.1 of this report]

5.1.2 Configuration of EUT

The EUT was placed on a wooden table 0.8m above the ground plane and connected an off the shelf power supply. The power supply was connected to a LISN via a 1m mains cable.

Details of the Peripheral and Ancillary Equipment connected for this test are listed in section 10.

During an initial scan there was no discernible difference between channels / modulation schemes and therefore for final test the EUT was operated in TX16 mode.

5.1.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment listed in the 'Test Equipment' Section. Measurements were made on the live and neutral conductors using both average and quasi-peak detection.

At least 6 signals within 20dB and/or all signals within 10dB of the limit were investigated.

Tests were performed in Test Site F.

5.1.4 Test equipment

E150, E035, ZSW1, E412, E411, TMS938

See Section 9 for more details

5.1.5 Test results

Temperature of test environment	20°C
Humidity of test environment	50%
Pressure of test environment	101kPa

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS0
Mid channel	64.8 GHz +5G NR channel 3625 MHz

Plot refs
14220-1 Cond 1 AC Live 150 kHz - 30 MHz Average
14220-1 Cond 1 AC Live 150 kHz - 30 MHz Quasi-Peak
14220-1 Cond 1 AC Neutral 150 kHz - 30 MHz Average
14220-1 Cond 1 AC Neutral 150 kHz - 30 MHz Quasi-Peak

Table of signals measured for Cond 1 AC Live 150 kHz - 30 MHz

Signal No.	Freq (MHz)	Peak Amp (dBuV)	QP Amp (dBuV)	QP -Lim (dB)	AV Amp (dBuV)	AV -Lim (dB)
1	0.677	43.2	41.2	-14.8	36.8	-9.2
2	0.773	40.6	39.3	-16.7	37.5	-8.5
3	0.884	40.8	38.7	-17.3	32.3	-13.7
4	0.952	41.8	40.2	-15.8	33.5	-12.5
5	1.021	42.1	39.3	-16.7	32.0	-14.0
6	1.088	42.5	40.4	-15.6	33.1	-12.9
7	1.160	44.2	41.8	-14.2	36.7	-9.3
8	1.217	40.7	36.8	-19.2	27.2	-18.8
9	4.253	41.3	40.3	-15.7	38.7	-7.3
10	4.446	42.2	41.3	-14.7	39.4	-6.6
11	4.639	42.1	41.0	-15.0	39.0	-7.0
12	4.736	41.3	40.6	-15.4	39.7	-6.3
13	4.833	40.8	39.7	-16.3	37.8	-8.2
14	4.929	43.1	42.4	-13.6	41.5	-4.5
15	5.606	44.7	44.2	-15.8	43.4	-6.6
16	5.799	44.8	44.2	-15.8	43.5	-6.5
17	6.089	44.6	43.8	-16.2	42.4	-7.6
18	6.282	45.2	44.7	-15.3	43.7	-6.3
19	6.476	44.5	44.1	-15.9	43.2	-6.8
20	6.959	44.2	43.6	-16.4	42.6	-7.4
21	10.245	46.6	45.0	-15.0	43.1	-6.9
22	10.438	47.7	46.5	-13.5	44.9	-5.1
23	10.632	48.3	47.1	-12.9	45.4	-4.6
24	10.632	48.9	47.5	-12.5	45.8	-4.2
25	10.728	47.2	45.4	-14.6	43.1	-6.9
26	10.825	49.3	46.9	-13.1	44.6	-5.4
27	10.921	49.3	48.1	-11.9	46.0	-4.0
28	11.018	47.6	46.0	-14.0	42.2	-7.8
29	11.115	50.8	49.5	-10.5	47.3	-2.7
30	11.211	48.2	45.7	-14.3	41.9	-8.1
31	11.308	51.2	49.8	-10.2	47.4	-2.6
32	11.405	49.9	48.2	-11.8	45.4	-4.6
33	11.501	50.7	48.8	-11.2	45.8	-4.2
34	11.598	52.4	50.9	-9.1	47.5	-2.5
35	11.694	49.7	47.1	-12.9	42.3	-7.7
36	11.791	52.8	51.5	-8.5	47.7	-2.3
37	11.888	48.9	46.9	-13.1	41.5	-8.5
38	11.984	51.5	50.0	-10.0	45.6	-4.4
39	12.081	49.7	47.9	-12.1	43.0	-7.0
40	12.178	47.8	46.1	-13.9	41.1	-8.9
41	15.270	40.8	40.0	-20.0	38.8	-11.2
42	15.753	41.9	41.2	-18.8	40.0	-10.0
43	15.947	41.8	41.1	-18.9	40.1	-9.9
44	16.237	41.1	40.2	-19.8	38.9	-11.1
45	16.430	42.0	41.3	-18.7	39.8	-10.2
46	16.623	41.3	40.4	-19.6	38.9	-11.1
47	16.913	42.2	40.8	-19.2	39.0	-11.0
48	17.106	41.3	40.4	-19.6	38.8	-11.2
49	17.397	40.4	39.3	-20.7	37.7	-12.3
50	17.590	40.3	39.5	-20.5	37.7	-12.3
51	18.073	40.4	39.5	-20.5	37.9	-12.1

52	18.556	40.5	39.9	-20.1	38.4	-11.6

Table of signals measured for Cond 1 AC Neutral 150 kHz - 30 MHz

Signal No.	Freq (MHz)	Peak Amp (dBuV)	QP Amp (dBuV)	QP -Lim (dB)	AV Amp (dBuV)	AV -Lim (dB)
1	0.677	43.2	41.1	-14.9	36.7	-9.3
2	0.870	41.8	40.1	-15.9	37.6	-8.4
3	0.870	41.7	39.7	-16.3	37.3	-8.7
4	0.948	41.3	38.6	-17.4	29.7	-16.3
5	1.022	41.7	38.7	-17.3	31.7	-14.3
6	1.063	43.2	41.4	-14.6	38.8	-7.2
7	1.159	43.7	41.7	-14.3	36.5	-9.5
8	1.353	42.3	39.3	-16.7	35.9	-10.1
9	1.546	42.0	40.2	-15.8	37.9	-8.1
10	1.740	41.8	40.2	-15.8	38.3	-7.7
11	4.446	41.2	40.3	-15.7	38.5	-7.5
12	4.639	41.3	40.4	-15.6	38.7	-7.3
13	4.736	40.9	40.0	-16.0	39.1	-6.9
14	4.929	42.5	41.8	-14.2	40.8	-5.2
15	5.606	44.6	44.0	-16.0	43.3	-6.7
16	5.799	44.9	44.4	-15.6	43.5	-6.5
17	6.089	44.5	44.1	-15.9	42.9	-7.1
18	6.283	45.7	45.1	-14.9	44.3	-5.7
19	6.476	45.0	44.4	-15.6	43.6	-6.4
20	6.959	44.7	44.3	-15.7	43.3	-6.7
21	10.632	48.3	47.0	-13.0	45.3	-4.7
22	10.826	48.7	47.0	-13.0	44.7	-5.3
23	10.922	49.9	48.3	-11.7	46.3	-3.7
24	11.019	48.6	46.5	-13.5	42.6	-7.4
25	11.116	50.3	49.2	-10.8	47.2	-2.8
26	11.212	48.6	46.0	-14.0	42.7	-7.3
27	11.405	50.7	49.0	-11.0	46.1	-3.9
28	11.405	50.7	49.0	-11.0	46.1	-3.9
29	11.502	50.3	48.7	-11.3	45.4	-4.6
30	11.502	50.9	48.6	-11.4	45.5	-4.5
31	11.599	52.6	50.9	-9.1	47.7	-2.3
32	11.696	50.1	47.3	-12.7	42.4	-7.6
33	11.792	52.9	51.3	-8.7	47.4	-2.6
34	11.889	49.9	46.8	-13.2	41.6	-8.4
35	11.985	51.0	49.7	-10.3	45.1	-4.9
36	12.179	47.9	46.1	-13.9	41.5	-8.5
37	12.276	48.5	47.1	-12.9	43.4	-6.6
38	12.759	47.2	45.8	-14.2	40.6	-9.4
39	12.952	48.7	47.3	-12.7	42.0	-8.0
40	13.146	47.7	46.4	-13.6	41.1	-8.9
41	15.272	44.4	43.8	-16.2	42.4	-7.6
42	15.466	44.4	43.6	-16.4	42.4	-7.6
43	15.562	43.5	42.6	-17.4	40.9	-9.1
44	15.755	45.6	44.9	-15.1	43.6	-6.4
45	15.949	46.0	45.4	-14.6	44.3	-5.7
46	16.142	44.5	43.9	-16.1	43.0	-7.0
47	16.238	44.7	43.8	-16.2	42.2	-7.8
48	16.432	46.2	45.3	-14.7	43.9	-6.1
49	16.625	45.6	45.0	-15.0	43.7	-6.3

50	16.915	45.9	45.1	-14.9	42.9	-7.1
51	17.108	46.0	45.0	-15.0	43.6	-6.4
52	17.302	44.4	43.8	-16.2	42.2	-7.8
53	17.592	44.3	43.6	-16.4	42.2	-7.8
54	18.269	43.7	42.9	-17.1	41.2	-8.8
55	18.752	44.1	43.6	-16.4	42.3	-7.7
56	19.235	44.5	43.9	-16.1	42.6	-7.4
57	19.429	43.9	43.4	-16.6	42.3	-7.7
58	19.719	43.7	43.2	-16.8	41.4	-8.6
59	19.912	44.4	43.8	-16.2	42.5	-7.5
60	20.395	45.2	43.8	-16.2	41.4	-8.6

No discernible difference was noted in emissions between channels (exploratory measurements); therefore the final measurements are presented for TX mid channel mode only.

Peak detector “Max held” Analyser plots against the Quasi-Peak / Average limit line(s) can be found in Section 6 of this report./ Only results within 20dB of limits have been reported.

LIMITS:
15.207: as given in the above tables / drawn on the respective plots.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
UE71 150kHz to 30MHz ±3.4dB

5.2 Radiated emissions 9 - 150 kHz

5.2.1 Test methods

Test Requirements:	47 CFR Part 15C Part 15.209 [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.4 & 6.6 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.209/15.255(d)(2) [Reference 4.1.1 of this report]

5.2.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was assessed in its normal use position. Radiated Emissions testing was performed whilst powered from a bench power supply. During the initial scan, no discernible difference in emissions could be observed when operating on different channels or modulation schemes. The EUT was assessed with both 60 GHz radios operating on the same channel and with the 5G radio active but with its antennae disconnected and terminated. The EUTs 5G radio antennae were then reconnected to allow it to be assessed for intermodulation products. The EUT was operated in TX1, 4, 6, 13, 16, 18 modes for full test.

5.2.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. Measurements were made in a semi-anechoic chamber (pre-scan) with any final measurements required performed on an OATS without a ground plane. The antenna was placed 1m above the ground. The equipment was rotated 360 degrees to record the worst case emissions. At least 6 signals within 20dB and all signals within 10dB of the limit were investigated. Tests were performed using Test Site M.

5.2.4 Test equipment

TMS81, ZSW1, E624, E411

See Section 9 for more details

5.2.5 Test results

Temperature of test environment	20°C
Humidity of test environment	60%
Pressure of test environment	101kPa

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1
Mid channel	64.8 GHz (Radio 0 & Radio 1)

Plot refs
14220-1 Rad 1 9k-150kHz Para
14220-1 Rad 1 9k-150kHz Perp

Peak detector “Max held” Analyser plots against the Quasi-Peak / Average limit line(s) can be found in Section 6 of this report.

LIMITS:
15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.
The general limits of 15.209 are as drawn on the respective plots.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
9kHz - 30MHz ±3.9dB

5.3 Radiated emissions 150 kHz - 30 MHz

5.3.1 Test methods

Test Requirements:	47 CFR Part 15C Part 15.209 [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.4 & 6.6 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.209/15.255(d)(2) [Reference 4.1.1 of this report]

5.3.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was assessed in its normal use position. Radiated Emissions testing was performed whilst powered from a bench power supply. During the initial scan, no discernible difference in emissions could be observed when operating on different channels or modulation schemes. The EUT was assessed with both 60 GHz radios operating on the same channel and with the 5G radio active but with its antennae disconnected and terminated. The EUTs 5G radio antennae were then reconnected to allow it to be assessed for intermodulation products. The EUT was operated in TX1, 4, 6, 13, 16, 18 modes for full test.

5.3.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. Measurements were made in a semi-anechoic chamber (pre-scan) with any final measurements required performed on an OATS without a ground plane. The antenna was placed 1m above the ground. The equipment was rotated 360 degrees to record the worst case emissions. At least 6 signals within 20dB and all signals within 10dB of the limit were investigated. Tests were performed using Test Site M.

5.3.4 Test equipment

TMS81, ZSW1, E624, E411

See Section 9 for more details

5.3.5 Test results

Temperature of test environment	20°C
Humidity of test environment	60%
Pressure of test environment	101kPa

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1
64.8 MHz channel	64.8 GHz (Radio 0 & Radio 1)

Plot refs
14220-1 Rad 1 150 kHz - 30 MHzHz Para
14220-1 Rad 1 150 kHz - 30 MHzHz Perp

Peak detector “Max held” Analyser plots against the Quasi-Peak / Average limit line(s) can be found in Section 6 of this report.

LIMITS:
15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.
The general limits of 15.209 are as drawn on the respective plots.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
9kHz - 30MHz ±3.9dB

5.4 Radiated emissions 30 MHz -1 GHz

5.4.1 Test methods

Test Requirements:	47 CFR Part 15C Part 15.255(d)(2) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.3 & 6.5 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.255(d)(2) [Reference 4.1.1 of this report]

5.4.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was assessed in its normal use position. Radiated Emissions testing was performed whilst powered from a bench power supply. During the initial scan, no discernible difference in emissions could be observed when operating on different channels or modulation schemes. The EUT was assessed with both 60 GHz radios operating on the same channel and with the 5G radio active but with its antennae disconnected and terminated. The EUTs 5G radio antennae were then reconnected to allow it to be assessed for intermodulation products. The EUT was operated in TX4 mode for full test. The EUT was operated in TX1, 4, 6, 13, 16, 18 modes for full test.

5.4.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment listed below.
Measurements were made on a site listed with the FCC. The equipment was rotated 360 degrees and the antenna scanned 1 – 4 metres in both horizontal and vertical polarisations to record the worst case emissions.
At least 6 signals within 20dB and all signals within 10dB of the limit were investigated.
Tests were performed using Test Site M.

5.4.4 Test equipment

LPE364, E743, NSA-M, ZSW1, E624, E411

See Section 9 for more details

5.4.5 Test results

Temperature of test environment	20°C
Humidity of test environment	60%
Pressure of test environment	101kPa

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1
Mid channel	64.8 GHz

Plot refs
14220-1 Rad 1 VHF Horiz
14220-1 Rad 1 VHF Vert
14220-1 Rad 1 UHF Horiz
14220-1 Rad 1 UHF Vert

Table of signals measured for Rad 1 Horizontal Sig List

Signal No.	Freq (MHz)	Peak Amp (dBuV/m)	QP Amp (dBuV/m)	QP -Lim (dB)
1	367.187	37.5	34.0	-12.0
2	375.000	34.0	30.8	-15.2
3	476.562	38.2	35.2	-10.8
4	625.000	41.7	39.7	-6.3
5	750.000	42.3	40.1	-5.9
6	874.999	41.0	38.5	-7.5

Table of signals measured for Rad 1 Vertical Sig List

Signal No.	Freq (MHz)	Peak Amp (dBuV/m)	QP Amp (dBuV/m)	QP -Lim (dB)
1	30.446	30.4	24.0	-16.0
2	41.274	34.7	31.4	-8.6
3	93.472	32.7	29.0	-14.5
4	375.000	34.0	30.7	-15.3
5	476.566	36.5	32.3	-13.7
6	563.181	32.0	26.1	-19.9
7	578.125	37.1	33.5	-12.5
8	625.000	41.0	37.8	-8.2
9	750.000	39.4	35.9	-10.1

Peak detector “Max held” Analyser plots against the Quasi-Peak / Average limit line(s) can be found in Section 6 of this report.

LIMITS:
15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.
The general limits of 15.209 are as drawn on the respective plots.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
30MHz - 1000MHz ±6.1dB

5.5 Radiated emissions 1 - 40 GHz

5.5.1 Test methods

Test Requirements:	47 CFR Part 15C Part 15.255(d)(2)/(3)/(4) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.3 & 6.6 & 9.8 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.255(d)(2)/(3)/(4) [Reference 4.1.1 of this report]

5.5.2 Configuration of EUT

The EUT was placed on a 1.5 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was assessed in its normal use position. Radiated Emissions testing was performed whilst powered from a bench power supply. During the initial scan, no discernible difference in emissions could be observed when operating on different channels or modulation schemes. The EUT was assessed with both 60 GHz radios operating on the same channel and with the 5G radio active but with its antennae disconnected and terminated. The EUTs 5G radio antennae were then reconnected to allow it to be assessed for intermodulation products. The EUT was operated in TX1, 4, 6, 13, 16, 18 modes for full test.

5.5.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment listed below.
Measurements were made in a semi-anechoic chamber with appropriate absorbing material for use in this range. Horn antennas were used at heights where the whole of the EUT was contained within the main beam, and emissions maximised. The EUT was rotated through 360 degrees to record the worst case emissions. A measurement distance of 3m was used between the test-range 1 - 6GHz, 1.2m was used in the test range 6 - 18GHz, 0.3m was used in the test range 18 - 40GHz.
At least 6 signals within 20dB and all signals within 10dB of the limit were investigated.
Tests were performed using test Site M.

5.5.4 Test equipment

E136, E296-2, E330, E411, E574, E580, E624, TMS78, TMS79, TMS82

See Section 9 for more details

5.5.5 Test results

Temperature of test environment	20°C
Humidity of test environment	60%
Pressure of test environment	102kPa

Setup Table

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1
Mid channel	64.8 GHz (Radio 0 & Radio 1)

Spurious Frequency (MHz)	Measured Peak Level (dBµV/m)	Difference to Peak Limit (dB)	Measured Average Level (dBµV/m)	Difference to Average Limit (dB)	EUT Polarisation	Antenna Polarisation
6249.998	43.2	-30.8	34.7	-19.3	Normal use position	Vertical
6406.249	44.8	-29.2	37.8	-16.2	Normal use position	Vertical
10312.412	46	-28	34.3	-19.7	Normal use position	Horizontal
10312.498	49.9	-24.1	43.3	-10.7	Normal use position	Vertical

Plots
14156-1 Rad 1 1-2GHz Horiz
14156-1 Rad 1 1-2GHz Vert
14156-1 Rad 1 2-2.7GHz Horiz
14156-1 Rad 1 2-2.7GHz Vert
14156-1 Rad 1 2.7-5GHz Horiz 5g on
14156-1 Rad 1 2.7-5GHz Vert 5g on
14156-1 Rad 1 2.7-5GHz Horiz 5g off
14156-1 Rad 1 2.7-5GHz Vert 5g off
14156-1 Rad 1 5-6GHz Horiz
14156-1 Rad 1 5-6GHz Vert
14156-1 Rad 1 6upto10GHz Horiz
14156-1 Rad 1 6upto10GHz Vert
14156-1 Rad 1 10upto12_5GHz Horiz
14156-1 Rad 1 10upto12_5GHz Vert
14156-1 Rad 1 12.5 - 15 GHz Horiz
14156-1 Rad 1 12.5 - 15 GHz Vert
14156-1 Rad 1 15 - 18 GHz Horiz
14156-1 Rad 1 15 - 18 GHz Vert
14156-1 Rad 1 18 - 22 GHz Horiz
14156-1 Rad 1 18 - 22 GHz Vert
14156-1 Rad 1 22 - 26 GHz Horiz
14156-1 Rad 1 22 - 26 GHz Vert
14156-1 Rad 1 26 - 26.5 GHz Horiz
14156-1 Rad 1 26 - 26.5 GHz Vert
14156-1 Rad 1 26.5 - 30 GHz Horiz
14156-1 Rad 1 26.5 - 30 GHz Vert
14156-1 Rad 1 30 - 34 GHz Horiz
14156-1 Rad 1 30 - 34 GHz Vert
14156-1 Rad 1 34 - 38 GHz Horiz
14156-1 Rad 1 34 - 38 GHz Vert
14156-1 Rad 1 38 - 40 GHz Horiz
14156-1 Rad 1 38 - 40 GHz Vert

Peak detector “Max held” Analyser plots against the Average limit line can be found in Section 6 of this report.

Note: Whilst Low, Mid and High channels were tested, plots are for illustrative purposes only and only Mid channel plots are shown in this report.

LIMITS:
15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.
The general limits of 15.209 are as drawn on the respective plots.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
1 – 18 GHz ±3.5dB, 18 – 26.5 GHz ±3.9dB, 26.5 – 40 GHz ±3.9dB

5.6 Radiated emissions 40 - 200 GHz

5.6.1 Test methods

Test Requirements:	47 CFR Part 15C Part 15.255(d)(2)/(3)/(4) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.3 & 6.6 & 9.8 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.255(d)(2)/(3)/(4) [Reference 4.1.1 of this report]

5.6.2 Configuration of EUT

The EUT was placed on a 1.5 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was assessed in its normal use position. Radiated Emissions testing was performed whilst powered from a bench power supply. During the initial scan, no discernible difference in emissions could be observed when operating on different channels or modulation schemes. The EUT was assessed with both 60 GHz radios operating on the same channel and with the 5G radio active but with its antennae disconnected and terminated. The EUTs 5G radio antennae were then reconnected to allow it to be assessed for any intermodulation products. The EUT was operated in TX1, 4, 6, 13, 16, 18 modes for full test.

5.6.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment listed below. Measurements were made in a semi-anechoic chamber with appropriate absorbing material for use in this range. Horn antennas were used at heights where the EUT was contained within the main beam and emissions maximised, or where this was not possible due to the size of the EUT versus antenna beamwidth, height and lateral scanning of the EUT to maximise emissions was performed. The EUT was rotated through 360 degrees to record any worst case emissions. A measurement distance of 0.3m was used in the test range 40 - 75GHz, 0.1m was used in the test range 75-110GHz and 0.1/0.03m was used in the test range 110-200 GHz. At least 6 signals within 20dB and all signals within 10dB of the limit were investigated.
Tests were performed using test Site M and A.

5.6.4 Test equipment

E296-4, E296-5, E412, E485, E487, E503, E520, E580, E638, E718, E719, E720, E755, E760, E771, E941, F015, F190, F191, F352, F400

See Section 9 for more details

5.6.5 Test results

Temperature of test environment	20°C
Humidity of test environment	60%
Pressure of test environment	102kPa

Setup Table

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1
Mid channel	58.32 GHz

Spurious Frequency (MHz)	Measured Peak Level (dBµV/m)	Difference to Peak Limit (dB)	Measured Average Level (dBµV/m)	Difference to Average Limit (dB)	EUT Polarisation	Antenna Polarisation
No emissions were observed within 20dB of the limit						

Plots
14156-1 Rad 1 40 – 44 GHz Horiz
14156-1 Rad 1 40 – 44 GHz Vert
14156-1 Rad 1 44 – 48 GHz Horiz
14156-1 Rad 1 44 – 48 GHz Vert
14156-1 Rad 1 48 – 52 GHz Horiz
14156-1 Rad 1 48 – 52 GHz Vert
14156-1 Rad 1 52 – 56 GHz Horiz
14156-1 Rad 1 52 – 56 GHz Vert
14156-1 Rad 1 56 – 60 GHz Horiz
14156-1 Rad 1 56 – 60 GHz Vert
14156-1 Rad 1 60 – 65 GHz Horiz Radio off
14156-1 Rad 1 60 – 65 GHz Vert Radio off
14156-1 Rad 1 60 – 65 GHz Horiz Radio on
14156-1 Rad 1 60 – 65 GHz Vert Radio on
14156-1 Rad 1 65 – 70 GHz Horiz Radio off
14156-1 Rad 1 65 – 70 GHz Vert Radio off
14156-1 Rad 1 65 – 70 GHz Horiz Radio on
14156-1 Rad 1 65 – 70 GHz Vert Radio on
14156-1 Rad 1 70 – 75 GHz Horiz
14156-1 Rad 1 70 – 75 GHz Vert
14156-1 Rad 1 75 – 80 GHz Horiz
14156-1 Rad 1 75 – 80 GHz Vert
14156-1 Rad 1 80 – 85 GHz Horiz
14156-1 Rad 1 80 – 85 GHz Vert
14156-1 Rad 1 85 – 90 GHz Horiz
14156-1 Rad 1 85 – 90 GHz Vert
14156-1 Rad 1 90 – 95 GHz Horiz
14156-1 Rad 1 90 – 95 GHz Vert
14156-1 Rad 1 95 – 100 GHz Horiz
14156-1 Rad 1 95 – 100 GHz Vert
14156-1 Rad 1 100 – 105 GHz Horiz
14156-1 Rad 1 100 – 105 GHz Vert
14156-1 Rad 1 105 – 110 GHz Horiz
14156-1 Rad 1 105 – 110 GHz Vert
14156-1 Rad 1 110 – 120 GHz Horiz
14156-1 Rad 1 110 – 120 GHz Vert
14156-1 Rad 1 120 – 130 GHz Horiz
14156-1 Rad 1 120 – 130 GHz Vert
14156-1 Rad 1 130 – 140 GHz Horiz
14156-1 Rad 1 130 – 140 GHz Vert
14156-1 Rad 1 140 – 150 GHz Horiz
14156-1 Rad 1 140 – 150 GHz Vert
14156-1 Rad 1 150 – 160 GHz Horiz
14156-1 Rad 1 150 – 160 GHz Vert
14156-1 Rad 1 160 – 170 GHz Horiz
14156-1 Rad 1 160 – 170 GHz Vert
14156-1 Rad 1 170 – 180 GHz Horiz
14156-1 Rad 1 170 – 180 GHz Vert
14156-1 Rad 1 180 – 190 GHz Horiz
14156-1 Rad 1 180 – 190 GHz Vert
14156-1 Rad 1 190 – 200 GHz Horiz
14156-1 Rad 1 190 – 200 GHz Vert

Peak detector “Max held” Analyser plots against the Average limit line can be found in Section 6 of this report.

Note: Whilst Low, Mid and High channels were tested, plots are for illustrative purposes only and only Mid channel plots are shown in this report.

LIMITS:
15.255 (d)(3) between 40 GHz and 200 GHz the level of the emissions shall not exceed 90pW/cm2 at a distance of 3m (85.3 dBuV/m @3m). The limits are as drawn on the respective plots.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows: 1 – 18 GHz ±3.5dB, 18 – 26.5 GHz ±3.9dB, 26.5 – 60 GHz ±3.9dB, 60 – 110 GHz ±4.4dB, 110 – 200 GHz ±5.9dB

5.7 Peak & Average EIRP

5.7.1 Test methods

Test Requirements:	47 CFR Part 15C Part 15.255(c)(1)(i)/(ii) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 9.10 & 9.11 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.255(c)(1)(i)/(ii) [Reference 4.1.1 of this report]

5.7.2 Configuration of EUT

The EUT was placed on a 1.5 metres high turntable. Measurements were performed at a distance of 60 centimetres. The EUT's antenna was positioned and aligned with the measuring antenna. In a pre-test it was determined that Radio 1 had the highest EIRP and therefore this radio was used for all other tests. All modulation schemes were assessed on low, middle and high channels using the beam setting that provided the highest EIRP. EIRP testing was performed whilst powered using a bench power supply.

The EUT was operated in TX1, TX4 and TX6 modes.

5.7.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment listed below.

Measurements were made in a semi-anechoic chamber with appropriate absorbing material for use in this range. A Horn antenna was used to align with and measure the radiated power from the EUT. A wideband RF detector was used with a digital oscilloscope to measure the Peak and Average power. Voltage measured from the detector was recorded and then substitution performed to determine actual EUT power level in dBm. A measurement distance of 0.6m was used.

Tests were performed using test Site A.

5.7.4 Test equipment

E755, E658, F024 F136, E781, E908, E920, F305, F356, E503, H078, F042, E994, F045, E768, F379, E602, E433.

See Section 9 for more details

5.7.5 Test results

Temperature of test environment	20°C
Humidity of test environment	60%
Pressure of test environment	101kPa

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1 (Worst Case)
Low channel	58.32 GHz (Radio 0)

Chan Freq (GHz)	Meas distance (m)	Max beam/array setting
58.32	0.6	29
Mod scheme/rate	**Pk EIRP result (dBm)**	**RMS EIRP result (dBm)**
MCS0	38.65	38.52
MCS1	38.71	38.55
MCS2	38.71	38.49
MCS3	38.71	38.45
MCS4	38.71	38.45
MCS5	38.71	38.45
MCS6	38.71	38.27
MCS7	38.71	38.34

MCS8	38.71	38.35
MCS9	38.71	38.35
MCS10	38.51	38.03
MCS11	38.51	38.00
MCS12	38.51	38.01

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1 (Worst Case)
Mid channel	64.8 GHz (Radio 0)

Chan Freq (GHz)	Meas distance (m)	Max beam/array setting
64.8	0.6	23
Mod scheme/rate	Pk EIRP result (dBm)	RMS EIRP result (dBm)
MCS0	38.5	38.38
MCS1	38.5	38.41
MCS2	38.5	38.36
MCS3	38.5	38.38
MCS4	38.5	38.36
MCS5	38.5	38.29
MCS6	38.5	38.38
MCS7	38.33	38.40
MCS8	38.33	38.41
MCS9	38.33	38.41
MCS10	38.33	38.01
MCS11	38.5	38.04
MCS12	38.5	38.06

Note: The following command was applied to lower to power for this channel “bwt_vendor -d wlP1p32s0f0 fwopt link 0xa1c 0x000401eo”

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1 (Worst Case)
High channel	69.12 GHz (Radio 0)

Chan Freq (GHz)	Meas distance (m)	Max beam/array setting
69.12	0.6	19
Mod scheme/rate	Pk EIRP result (dBm)	RMS EIRP result (dBm)
MCS0	38.63	38.37
MCS1	38.63	38.55
MCS2	38.63	38.37
MCS3	38.63	38.39
MCS4	38.63	38.38
MCS5	38.63	38.38
MCS6	38.63	38.11
MCS7	38.63	38.18
MCS8	38.63	38.14
MCS9	38.69	38.14
MCS10	38.69	38.16
MCS11	38.69	37.99
MCS12	38.69	38.02

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1 (Worst Case)
Low channel	58.32 GHz (Radio 1)

Chan Freq (GHz)	Meas distance (m)	Max beam/array setting
58.32	0.6	29
Mod scheme/rate	Pk EIRP result (dBm)	RMS EIRP result (dBm)
MCS0	38.49	37.95
MCS1	38.49	37.97
MCS2	38.49	37.84
MCS3	38.49	37.87
MCS4	38.49	37.92
MCS5	38.49	37.83
MCS6	38.49	37.32
MCS7	38.49	37.33
MCS8	37.78	37.32
MCS9	38.49	37.28
MCS10	37.78	37.15
MCS11	37.78	37.11
MCS12	37.78	37.18

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1 (Worst Case)
Mid channel	64.8 GHz (Radio 1)

Chan Freq (GHz)	Meas distance (m)	Max beam/array setting
64.8	0.6	40
Mod scheme/rate	Pk EIRP result (dBm)	RMS EIRP result (dBm)
MCS0	38.59	38.41
MCS1	38.59	38.47
MCS2	38.59	38.45
MCS3	38.59	38.41
MCS4	38.59	38.40
MCS5	38.45	38.20
MCS6	38.45	38.21
MCS7	38.45	38.23
MCS8	38.59	38.24
MCS9	38.59	38.24
MCS10	38.59	38.00
MCS11	38.59	38.03
MCS12	38.59	38.05

Note: The following command was applied to lower to power for this channel “bwt_vendor -d wlP1p32s0f1 fwopt link 0xa1c 0x000401C4”

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1 (Worst Case)
High channel	69.12 GHz (Radio 1)

Chan Freq (GHz)	Meas distance (m)	Max beam/array setting
69.12	0.6	19
Mod scheme/rate	Pk EIRP result (dBm)	RMS EIRP result (dBm)
MCS0	38.61	38.64
MCS1	38.71	38.67
MCS2	38.71	38.61
MCS3	38.71	38.64
MCS4	38.71	38.62
MCS5	38.67	38.62
MCS6	38.71	38.64
MCS7	38.71	38.65
MCS8	38.71	38.67
MCS9	38.71	38.66
MCS10	38.51	38.28
MCS11	38.51	38.21
MCS12	38.51	38.24

Example of EIRP calculation from measured dBuV/m at 0.6m. using ANSI C63.10:2013 equation 22:

Using 147.81 dBuV/m average @0.6m as highest measured E field (radio 1 top channel):

(22): EIRP = E_{Meas} + 20log(d_{Meas}) -104.7, = 147.81+(-4.44)-104.7 = +38.67 dBm.

LIMITS:
15.255 (c)(1)(i) the average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 4.6 dB

5.8 Peak Conducted Power

5.8.1 Test methods

Test Requirements:	47 CFR Part 15C Part 15.255(c)(3)/(4) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 9.10 & 9.11 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.255(c)(3)/(4) [Reference 4.1.1 of this report]

5.8.2 Configuration of EUT

The results from the EIRP tests in section 5.7 above were used.

5.8.3 Test procedure

A calculation was performed in accordance with ANSI C63.10:2013 clause 9.7. Equation 27 using the following formula:

$$P_{COND} = EIRP_{LINEAR} / G_{EUT}$$

Where:

P_{COND} is conducted power in Watts.

$EIRP_{LINEAR}$ is equivalent isotropically radiated power in Watts

G_{EUT} is numeric gain of EUT radiating element (Antenna)

The Peak EIRP measurement was in dBm and this measurement was then converted to Watts.

Measurements were made in a chamber in site A.

5.8.4 Test equipment

Not required.

See Section 9 for more details

5.8.5 Test results

Temperature of test environment	20°C
Humidity of test environment	50%
Pressure of test environment	101kPa

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1
Low channel	58.32 GHz (Radio 0)
Mid channel	64.8 GHz (Radio 0)
High channel	69.12 GHz (Radio 0)

Test conditions	Low channel	Mid channel	High channel
Peak EIRP measured (dBm)	38.71	38.5	38.69
Beam setting for maximum	29	14	19
Declared antenna gain (dBi)	23	23	23
Pk conducted power (dBm)	15.71	15.5	15.69
Peak conducted power result (mW)	37.24	35.48	37.07
Limit (mW)	500	500	500

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Test conditions	Low channel	Mid channel	High channel
Peak EIRP measured (dBm)	38.49	38.59	38.71
Beam setting for maximum	29	40	19
Declared antenna gain (dBi)	23	23	23
Pk conducted power (dBm)	15.49	15.59	15.71
Peak conducted power result (mW)	35.4	36.22	37.24
Limit (mW)	500	500	500

LIMITS:
15.255 (e)(1) Peak transmitter conducted output power shall not exceed 500mW (+27dBm).

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 1.0 dB

5.9 Frequency stability

5.9.1 Test methods

Test Requirements:	47 CFR Part 15C Part 15.255(f) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.8 / 9.14 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.255(f) [Reference 4.1.1 of this report]

5.9.2 Configuration of EUT

The EUT was placed in a temperature-controlled chamber and the measurements were performed radiated. A Styrofoam door was fitted to the temperature-controlled chamber which allowed the fundamental transmission to pass through the door aperture but kept the chamber sealed. The EUT was configured to generate a CW tone which had an offset from the centre frequency of 99.687 MHz. A single test frequency was used during tests. The EUT was operated in TX7, TX10 and TX12 modes for this test.

5.9.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment listed below.
Temperature stability was achieved at each test temperature level before taking measurements.
A Frequency count was made on the CW signal using a spectrum analyser connected to an external GPS 10MHz reference. The EUT had a 99.687 MHz offset from channel frequency centre in this mode, which was accounted for and added into the analyser before making measurements.

Tests were performed using Test Site J.

5.9.4 Test equipment

C036, E503, E602, E755, E781, E908, E920, E994, L264, TMS57

See Section 9 for more details

5.9.5 Test results

Temperature of test environment	20°C
Humidity of test environment	60%
Pressure of test environment	101kPa

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Test conditions		Frequency (MHz) Low channel	Frequency (MHz) Mid channel	Frequency (MHz) High channel
-30°C	Volts Nominal (45)	58320.112758	64800.125721	69119.865466
-20°C	Volts Nominal (45)	58320.084557	64800.095949	69119.893994
-10°C	Volts Nominal (45)	58320.039377	64800.036828	69119.958293
0°C	Volts Nominal (45)	58320.005675	64800.005359	69119.993353
10°C	Volts Nominal (45)	58320.016130	64800.021551	69119.981176
20°C	Volts Minimum (40.5)	58320.044020	64800.049702	69119.950388
	Volts Nominal (45)	58320.045004	64800.048251	69119.952797
	Volts Maximum (49.5)	58320.044904	64800.048928	69119.948562
30°C	Volts Nominal (45)	58320.069375	64800.079859	69119.913458
40°C	Volts Nominal (45)	58320.062954	64800.064674	69119.954199
50°C	Volts Nominal (45)	58320.088590	64800.097447	69119.896711
Max Frequency Error per chan (Hz)		+112758	+125721	-134534
Max Frequency Error observed (MHz)		0.112758	0.125721	-0.134534

Maximum variation observed was +112.7 kHz / -134.5 kHz.

LIMITS:
15.255 (f) Fundamental emissions must be contained within the frequency band specified during all conditions of operation.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 0.7 ppm

5.10 6dB Occupied bandwidth

5.10.1 Test methods

Test Requirements:	47 CFR Part 15C Part 15.255(e)1 [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.9 / 9.10 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.255(f) [Reference 4.1.1 of this report]

5.10.2 Configuration of EUT

The EUT was placed on a 1.5 metres high turntable. The front edge of the EUT was positioned facing the antenna. The EUT was measured at a distance of 60 centimetres. The EUT was operated in TX1, TX4 and TX6 modes.

5.10.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment listed below. A 100 kHz RBW, 3x VBW, auto sweep time and max hold settings were used for the 6 dB bandwidth. All schemes were assessed. Tests were performed using test Site A.

5.10.4 Test equipment

E755, E602, E920, H078, E503, E908, E781, F042

See Section 9 for more details

5.10.5 Test results

Temperature of test environment	20°C
Humidity of test environment	60%
Pressure of test environment	101kPa

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS0
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.307	1.403	1.197
Plot of 6dB and 99% Bandwidth (GHz)	14156-1 Radio 1 Low Channel MCS0	14156-1 Radio 1 Mid Channel MCS0	14156-1 Radio 1 High Channel MCS0
99% Bandwidth (GHz)	1.8544	1.8344	1.8193
Frequency Error (MHz)	30.411	31.765	-28.633
Operating frequency (GHz)	58.32	64.8	69.12
6dB BW FLOW Worst case (GHz)	57.696911	64.130265	68.492867
6dB BW FHIGH Worst case (GHz)	59.003911	65.533265	69.689867

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.323	1.478	1.396
Plot of 6dB and 99% Bandwidth (GHz)	14156-1 Radio 1 Low Channel MCS1	14156-1 Radio 1 Mid Channel MCS1	14156-1 Radio 1 High Channel MCS1
99% Bandwidth (GHz)	1.8764	1.8582	1.8495
Frequency Error (MHz)	10.957	7.554	-3.7203
Operating frequency (GHz)	58.32	64.8	69.12
6dB BW FLOW Worst case (GHz)	57.669457	64.068554	68.4182797
6dB BW FHIGH Worst case (GHz)	58.992457	65.546554	69.8142797

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS2
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.293	1.43	1.289
Plot of 6dB and 99% Bandwidth (GHz)	14156-1 Radio 1 Low Channel MCS2	14156-1 Radio 1 Mid Channel MCS2	14156-1 Radio 1 High Channel MCS2
99% Bandwidth (GHz)	1.8763	1.8587	1.8509
Frequency Error (MHz)	10.657	8.3722	-2.3691
Operating frequency (GHz)	58.32	64.8	69.12
6dB BW FLOW Worst case (GHz)	57.684157	64.0933722	68.4731309
6dB BW FHIGH Worst case (GHz)	58.977157	65.5233722	69.7621309

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS3
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.362	1.275	1.31
Plot of 6dB and 99% Bandwidth (GHz)	14156-1 Radio 1 Low Channel MCS3	14156-1 Radio 1 Mid Channel MCS3	14156-1 Radio 1 High Channel MCS3
99% Bandwidth (GHz)	1.8785	1.8567	1.8522
Frequency Error (MHz)	10.63	10.449	-2.0261
Operating frequency (GHz)	58.32	64.8	69.12
6dB BW FLOW Worst case (GHz)	57.64963	64.172949	68.4629739
6dB BW FHIGH Worst case (GHz)	59.01163	65.447949	69.7729739

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS4
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.375	1.506	1.413
Plot of 6dB and 99% Bandwidth (GHz)	14156-1 Radio 1 Low Channel MCS4	14156-1 Radio 1 Mid Channel MCS4	14156-1 Radio 1 High Channel MCS4
99% Bandwidth (GHz)	1.8776	1.8596	1.8509
Frequency Error (MHz)	10.261	8.6069	-2.8971
Operating frequency (GHz)	58.32	64.8	69.12
6dB BW FLOW Worst case (GHz)	57.642761	64.0556069	68.4106029
6dB BW FHIGH Worst case (GHz)	59.017761	65.5616069	69.8236029

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.52	1.441	1.32
Plot of 6dB and 99% Bandwidth (GHz)	14156-1 Radio 1 Low Channel MCS5	14156-1 Radio 1 Mid Channel MCS5	14156-1 Radio 1 High Channel MCS5
99% Bandwidth (GHz)	1.8784	1.8576	1.8478
Frequency Error (MHz)	10.958	9.2298	-1.5167
Operating frequency (GHz)	58.32	64.8	69.12
6dB BW FLOW Worst case (GHz)	57.570958	64.0887298	68.4584833
6dB BW FHIGH Worst case (GHz)	59.090958	65.5297298	69.7784833

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS6
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.441	1.475	1.447
Plot of 6dB and 99% Bandwidth (GHz)	14156-1 Radio 1 Low Channel MCS6	14156-1 Radio 1 Mid Channel MCS6	14156-1 Radio 1 High Channel MCS6
99% Bandwidth (GHz)	1.9053	1.9123	1.8973
Frequency Error (MHz)	10.605	6.4797	-2.033
Operating frequency (GHz)	58.32	64.8	69.12
6dB BW FLOW Worst case (GHz)	57.610105	64.0689797	68.394467
6dB BW FHIGH Worst case (GHz)	59.051105	65.5439797	69.841467

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS7
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.568	1.434	1.248
Plot of 6dB and 99% Bandwidth (GHz)	14156-1 Radio 1 Low Channel MCS7	14156-1 Radio 1 Mid Channel MCS7	14156-1 Radio 1 High Channel MCS7
99% Bandwidth (GHz)	1.9045	1.9128	1.8944
Frequency Error (MHz)	13.691	6.168	-1.9646
Operating frequency (GHz)	58.32	64.8	69.12
6dB BW FLOW Worst case (GHz)	57.549691	64.089168	68.4940354
6dB BW FHIGH Worst case (GHz)	59.117691	65.523168	69.7420354

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS8
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.54	1.516	1.293
Plot of 6dB and 99% Bandwidth (GHz)	14156-1 Radio 1 Low Channel MCS8	14156-1 Radio 1 Mid Channel MCS8	14156-1 Radio 1 High Channel MCS8
99% Bandwidth (GHz)	1.9034	1.9111	1.8924
Frequency Error (MHz)	12.655	6.8835	-2.447
Operating frequency (GHz)	58.32	64.8	69.12
6dB BW FLOW Worst case (GHz)	57.562655	64.0488835	68.471053
6dB BW FHIGH Worst case (GHz)	59.102655	65.5648835	69.764053

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS9
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.365	1.591	1.286
Plot of 6dB and 99% Bandwidth (GHz)	14156-1 Radio 1 Low Channel MCS9	14156-1 Radio 1 Mid Channel MCS9	14156-1 Radio 1 High Channel MCS9
99% Bandwidth (GHz)	1.9045	1.9168	1.8942
Frequency Error (MHz)	11.908	6.1002	-1.8924
Operating frequency (GHz)	58.32	64.8	69.12
6dB BW FLOW Worst case (GHz)	57.649408	64.0106002	68.4751076
6dB BW FHIGH Worst case (GHz)	59.014408	65.6016002	69.7611076

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS10
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.516	1.393	1.244
Plot of 6dB and 99% Bandwidth (GHz)	14156-1 Radio 1 Low Channel MCS10	14156-1 Radio 1 Mid Channel MCS10	14156-1 Radio 1 High Channel MCS10
99% Bandwidth (GHz)	1.9044	1.9206	1.8992
Frequency Error (MHz)	12.009	6.8018	-2.6449
Operating frequency (GHz)	58.32	64.8	69.12
6dB BW FLOW Worst case (GHz)	57.574009	64.1103018	68.4953551
6dB BW FHIGH Worst case (GHz)	59.090009	65.5033018	69.7393551

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS11
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.31	1.502	1.42
Plot of 6dB and 99% Bandwidth (GHz)	14156-1 Radio 1 Low Channel MCS11	14156-1 Radio 1 Mid Channel MCS11	14156-1 Radio 1 High Channel MCS11
99% Bandwidth (GHz)	1.9065	1.9171	1.899
Frequency Error (MHz)	11.69	5.0984	-1.5549
Operating frequency (GHz)	58.32	64.8	69.12
6dB BW FLOW Worst case (GHz)	57.67669	64.0540984	68.4084451
6dB BW FHIGH Worst case (GHz)	58.98669	65.5560984	69.8284451

Band	57-71 GHz
Power Level	40 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS12
Low channel	58.32 GHz (Radio 1)
Mid channel	64.8 GHz (Radio 1)
High channel	69.12 GHz (Radio 1)

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.362	1.451	1.437
Plot of 6dB and 99% Bandwidth (GHz)	14156-1 Radio 1 Low Channel MCS12	14156-1 Radio 1 Mid Channel MCS12	14156-1 Radio 1 High Channel MCS12
99% Bandwidth (GHz)	1.9106	1.9183	1.8992
Frequency Error (MHz)	12.734	5.9862	-2.5526
Operating frequency (GHz)	58.32	64.8	69.12
6dB BW FLOW Worst case (GHz)	57.651734	64.0804862	68.3989474
6dB BW FHIGH Worst case (GHz)	59.013734	65.5314862	69.8359474

Note: Tests performed on Radio 1 as worst-case 60GHz radio in the device from power tests.

Analyser plots for the 6dB bandwidth can be found in Section 6 of this report.

Applying frequency stability results from Section 5.9 of +112.7 kHz / -134.5 kHz to the above results for FLOW and FHIGH shows that all emissions remain within the 57-71 GHz band.

LIMITS:
15.255 (f) Fundamental emissions must be contained within the frequency band specified during all conditions of operation.

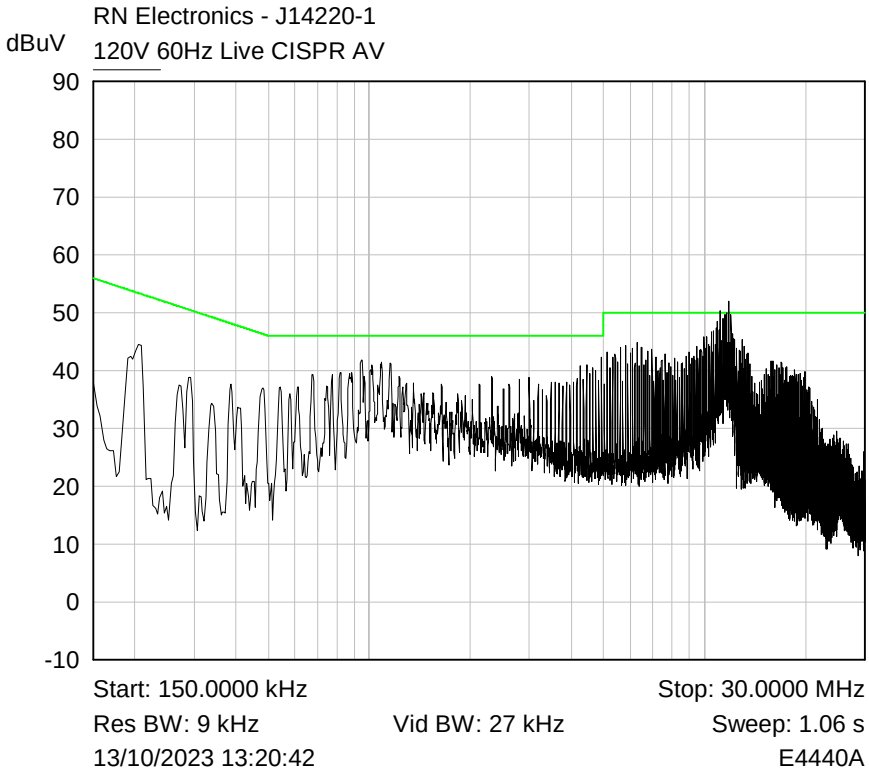
These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 1.9 %

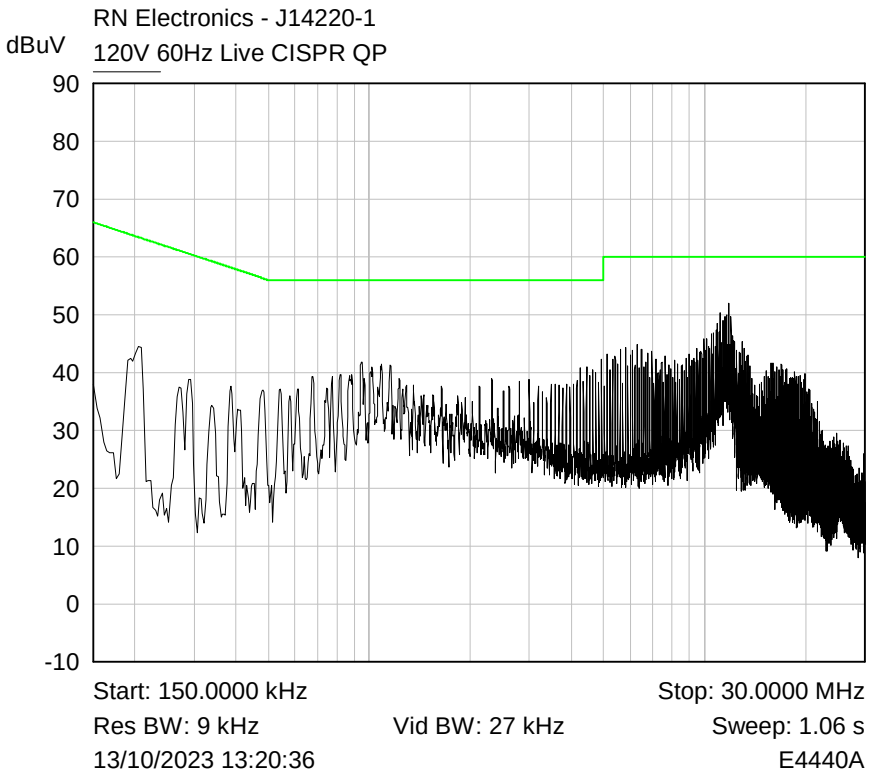
6 Plots/Graphical results

6.1 AC power line conducted emissions

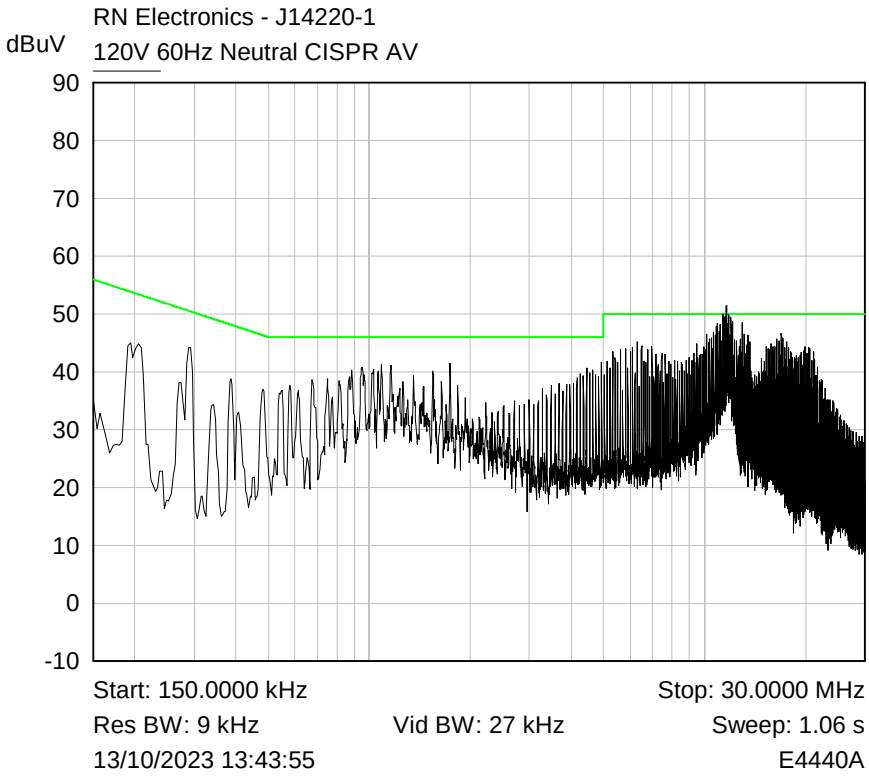
RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS5, Channel 64.8 GHz +5G NR channel 3625MHz



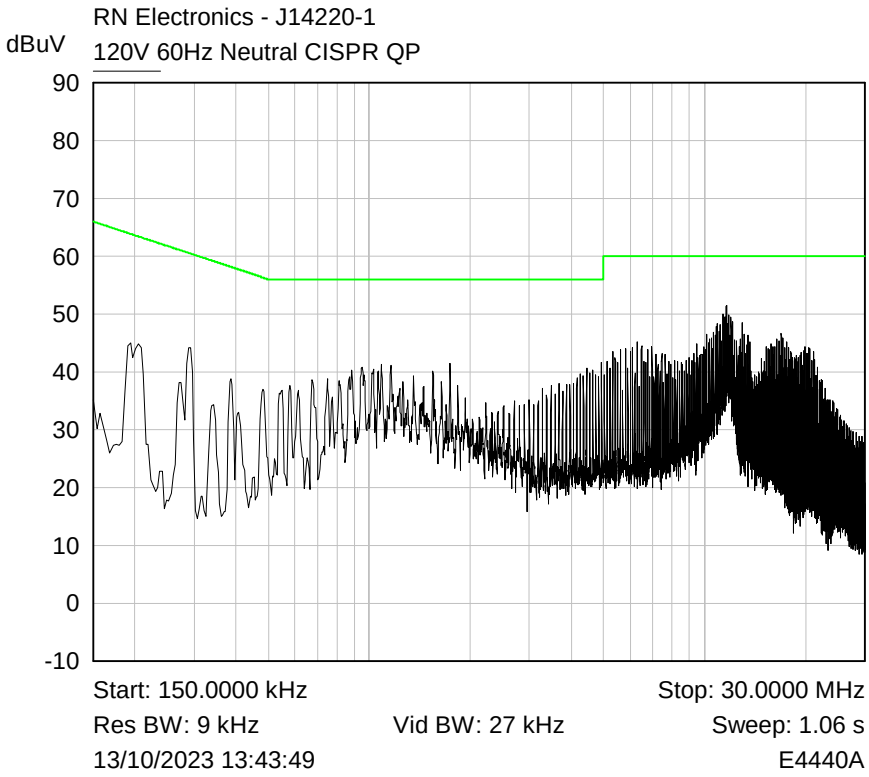
Plot of Live 150 kHz - 30 MHz Average



Plot of Live 150 kHz - 30 MHz Quasi-Peak



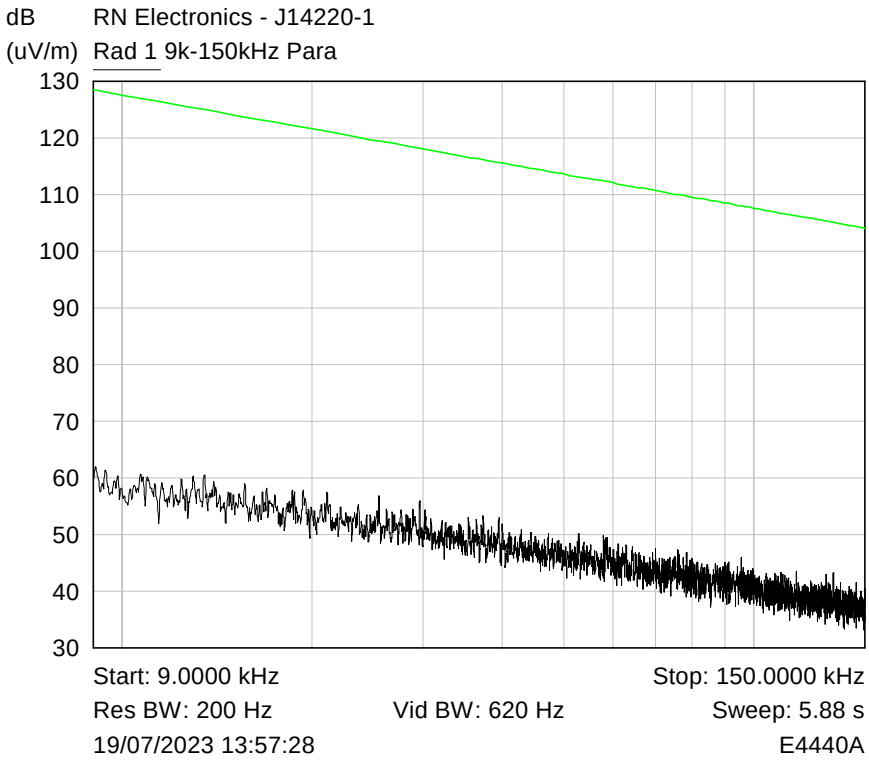
Plot of Neutral 150 kHz - 30 MHz Average



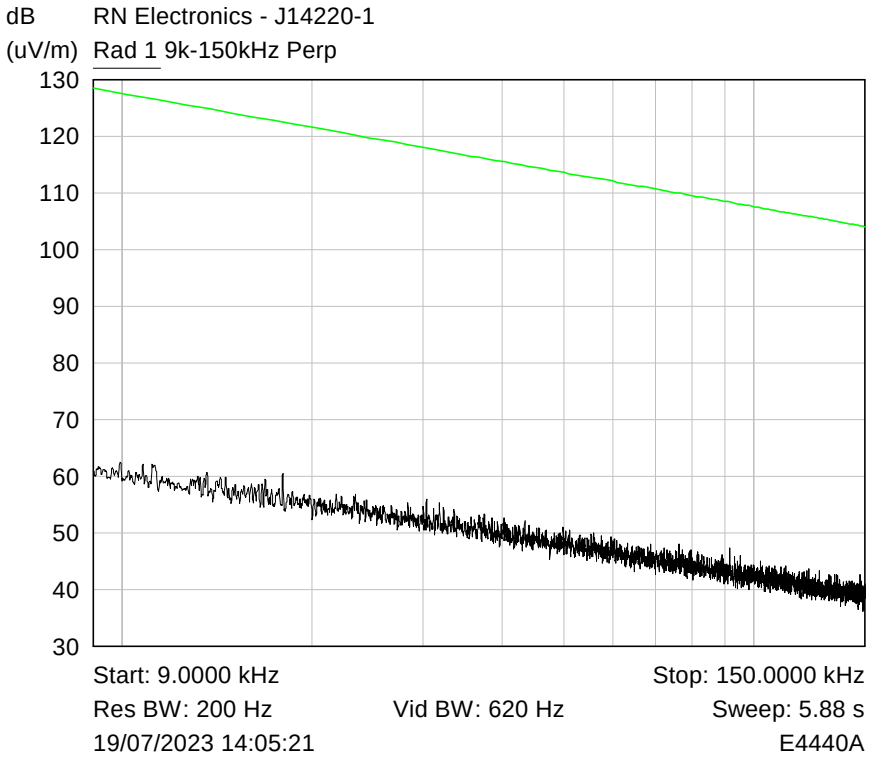
Plot of Neutral 150 kHz - 30 MHz Quasi-Peak

6.2 Radiated emissions 9 - 150 kHz

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS1, Channel 58.32 GHz



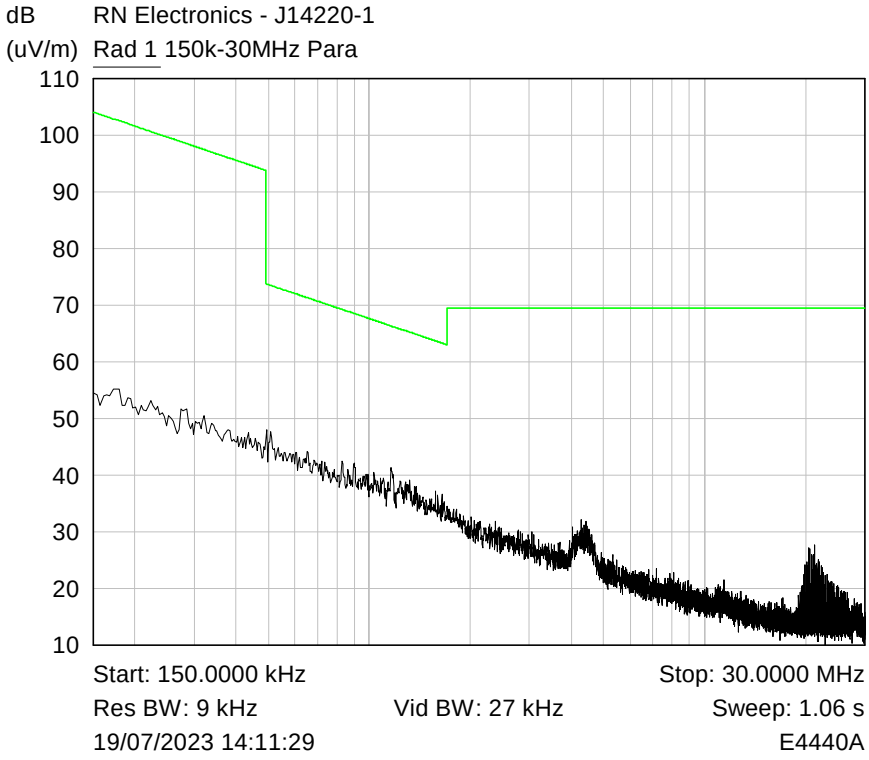
Plot of 9k-150kHz Parallel



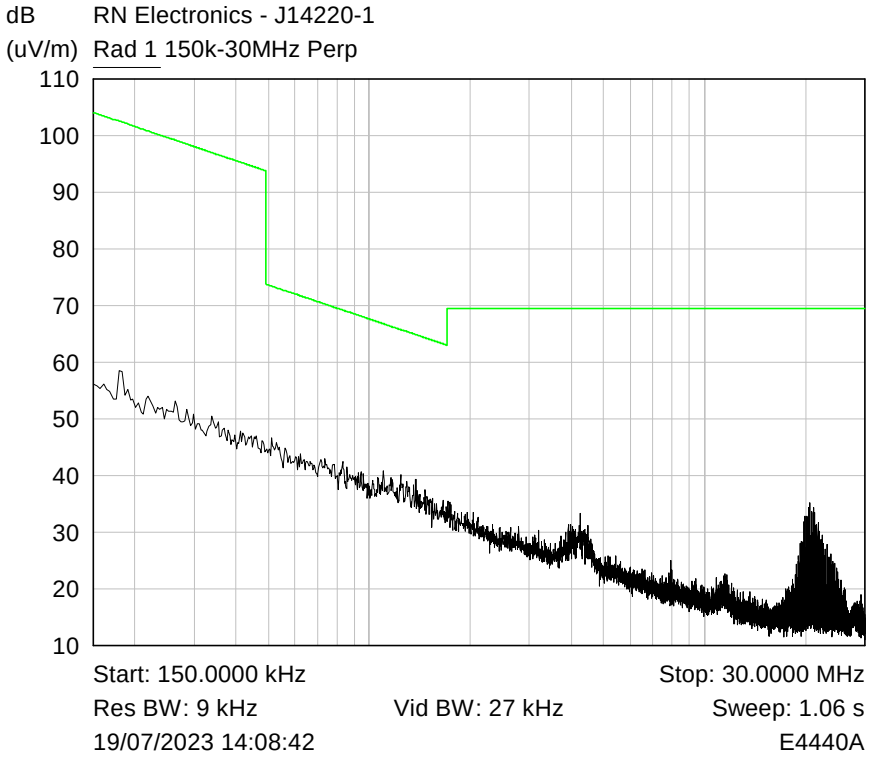
Plot of 9k-150kHz Perpendicular

6.3 Radiated emissions 150 kHz - 30 MHz

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS1, Channel 58.32 GHz



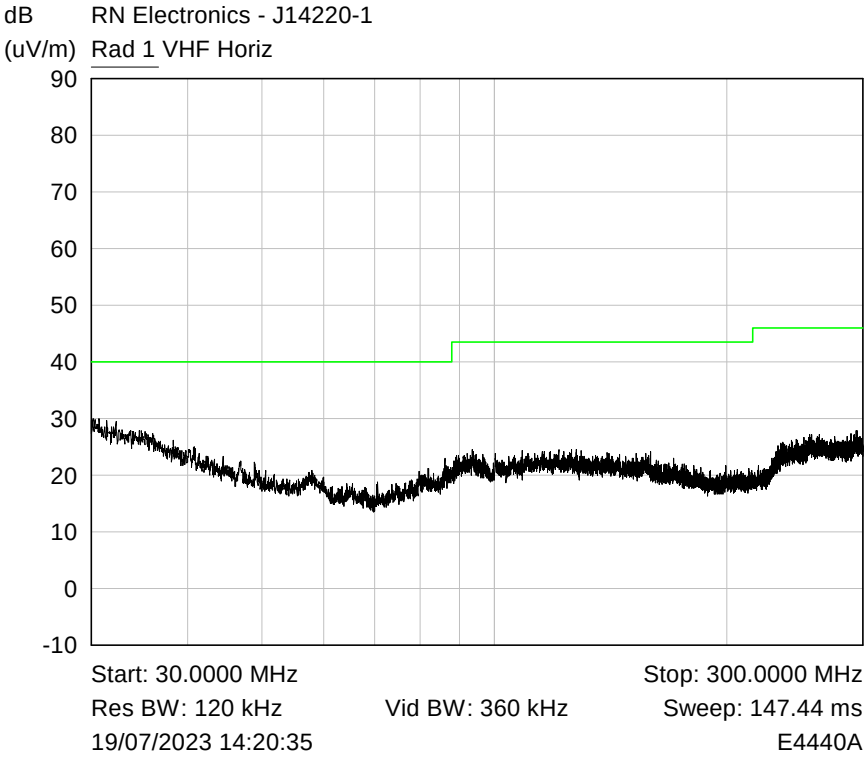
Plot of 150kHz-30MHz Parallel



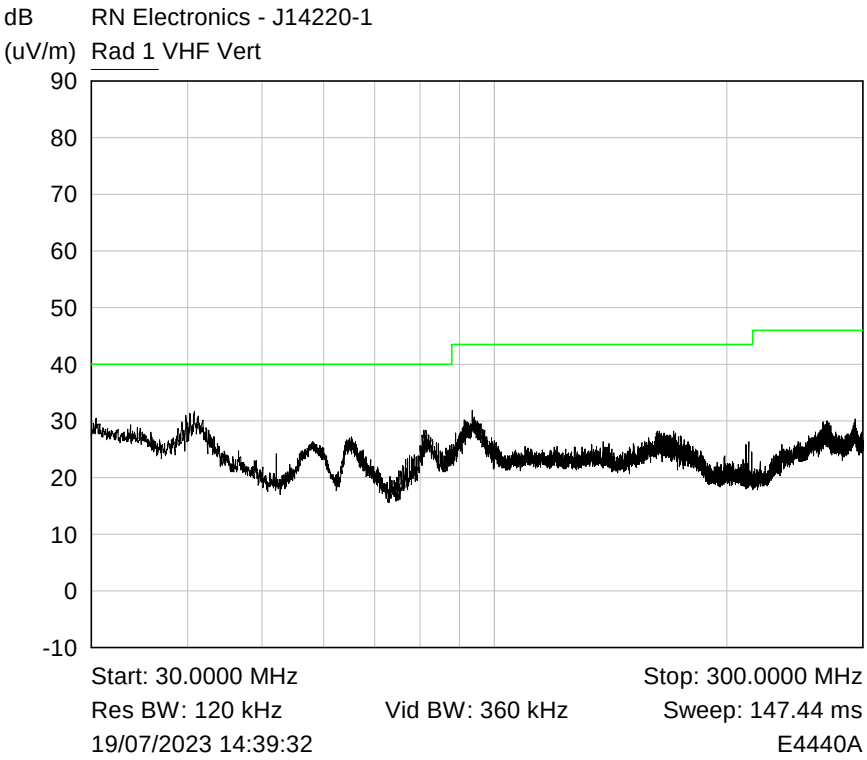
Plot of 150kHz-30MHz Perpendicular

6.4 Radiated emissions 30 MHz -1 GHz

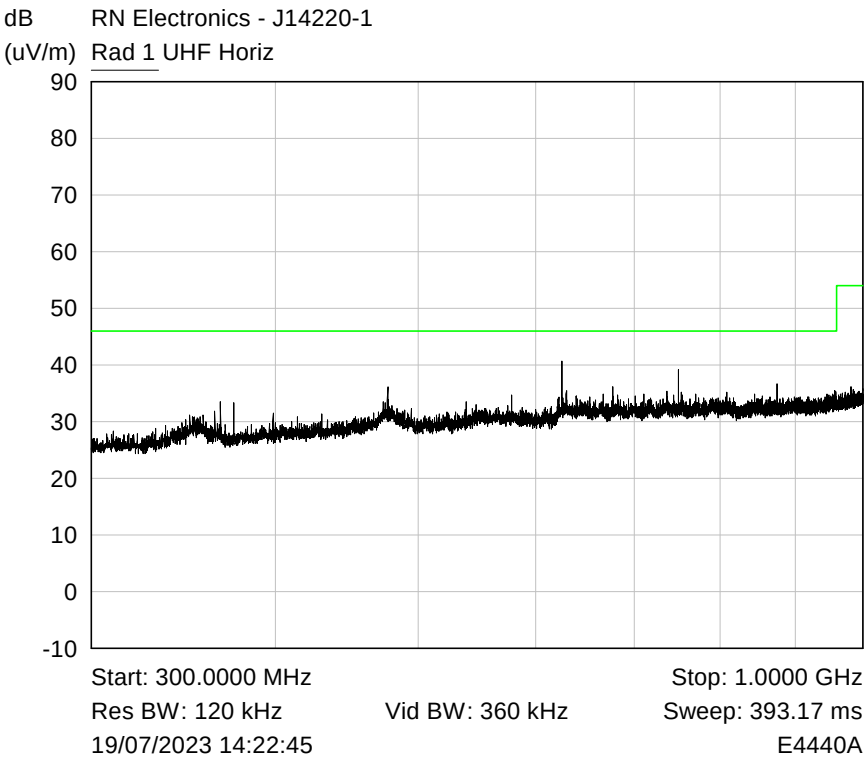
RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS1, Channel 58.32 GHz



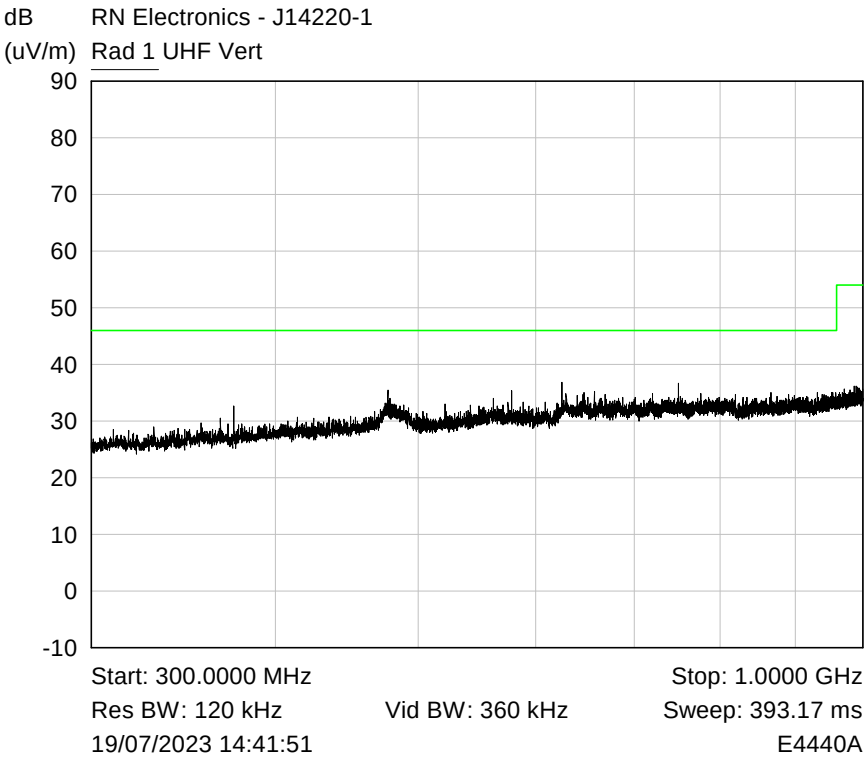
Plot of Peak emissions for VHF Horizontal against the QP limit line.



Plot of Peak emissions for VHF Vertical against the QP limit line.



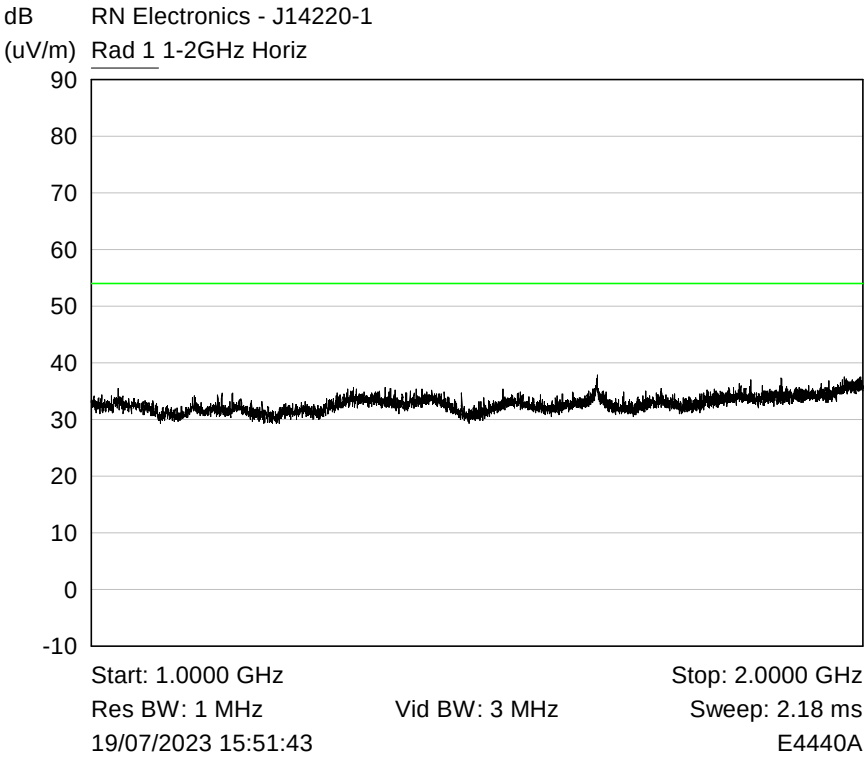
Plot of Peak emissions for UHF Horizontal against the QP limit line.

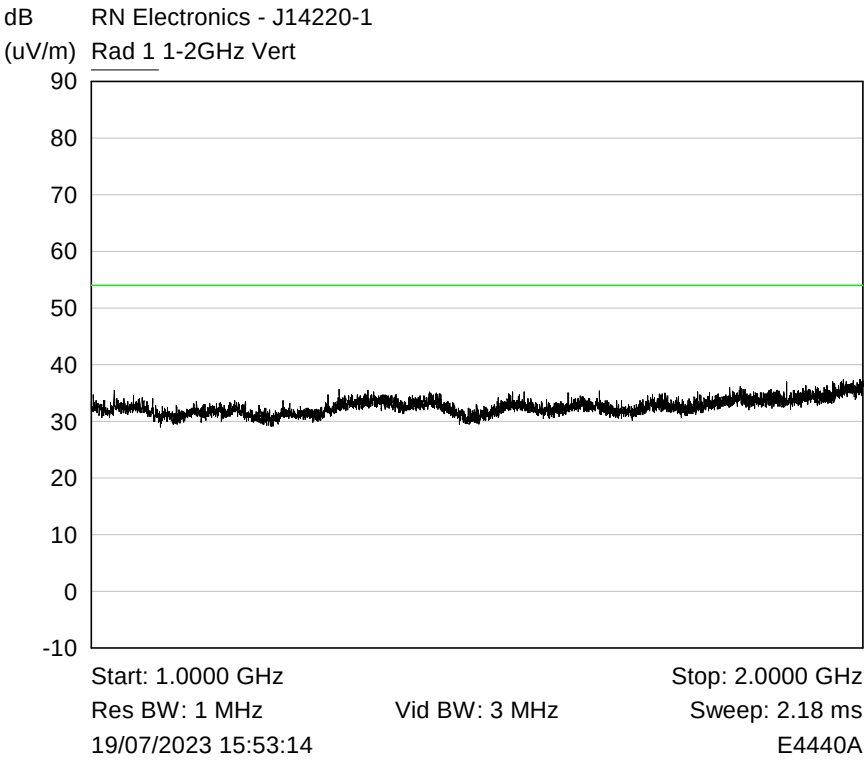


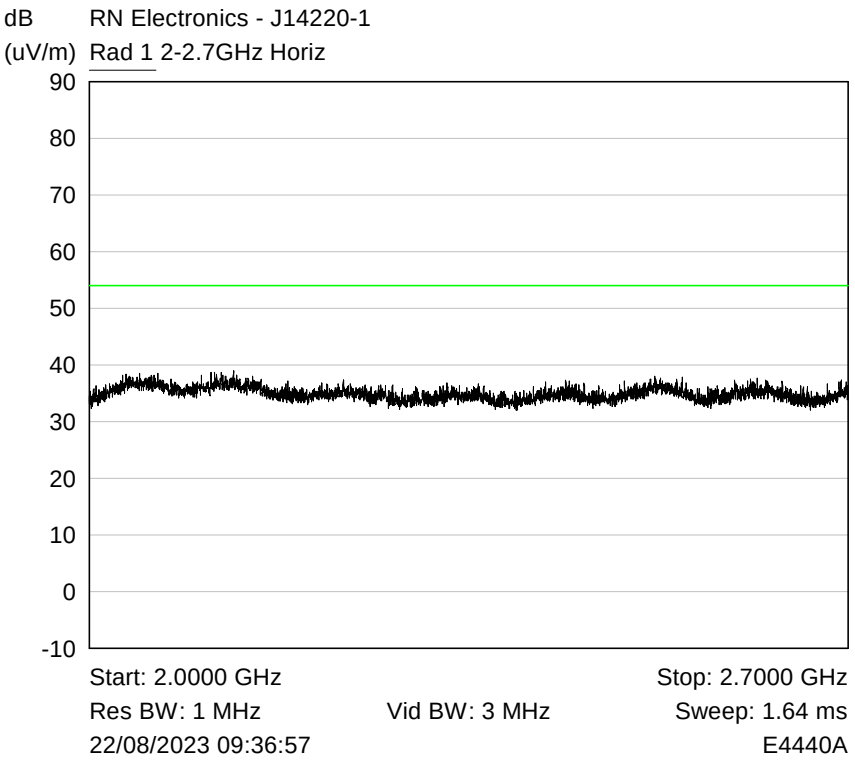
Plot of Peak emissions for UHF Vertical against the QP limit line.

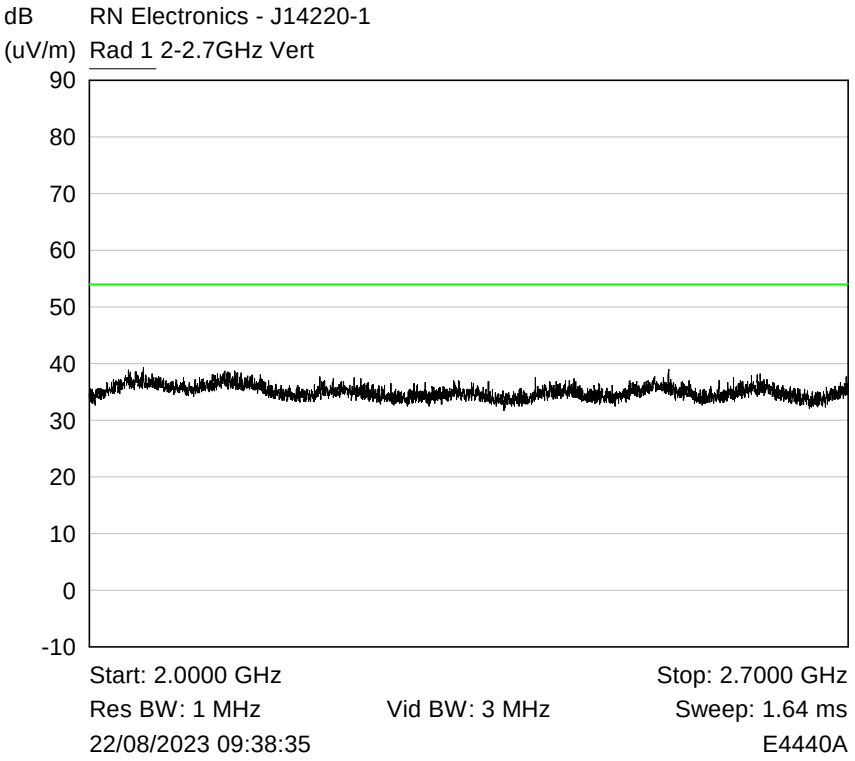
6.5 Radiated emissions 1 - 40 GHz

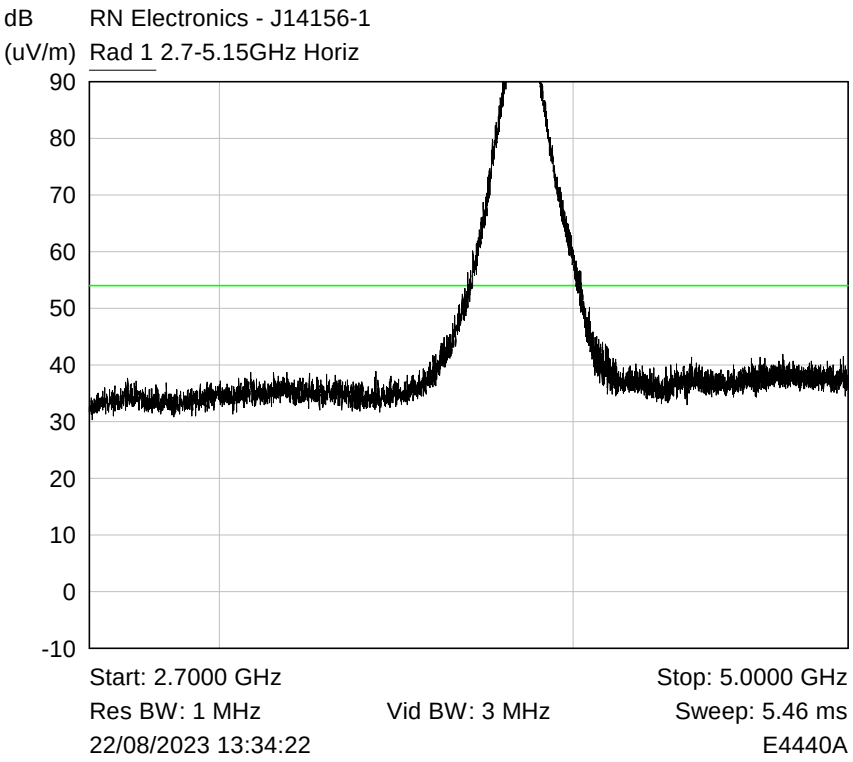
RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS1, Channel 64.8 GHz



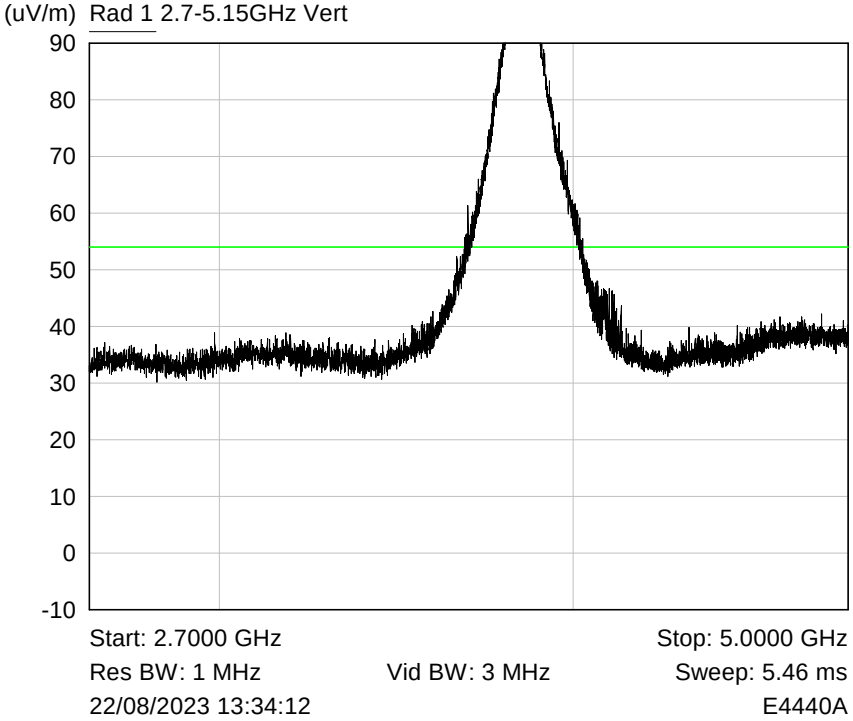




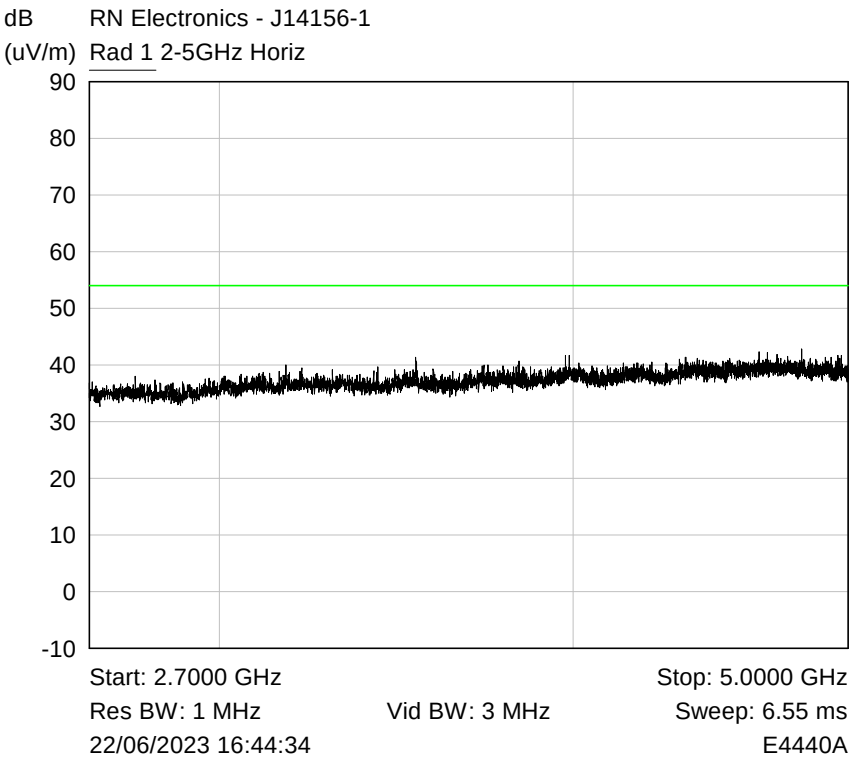




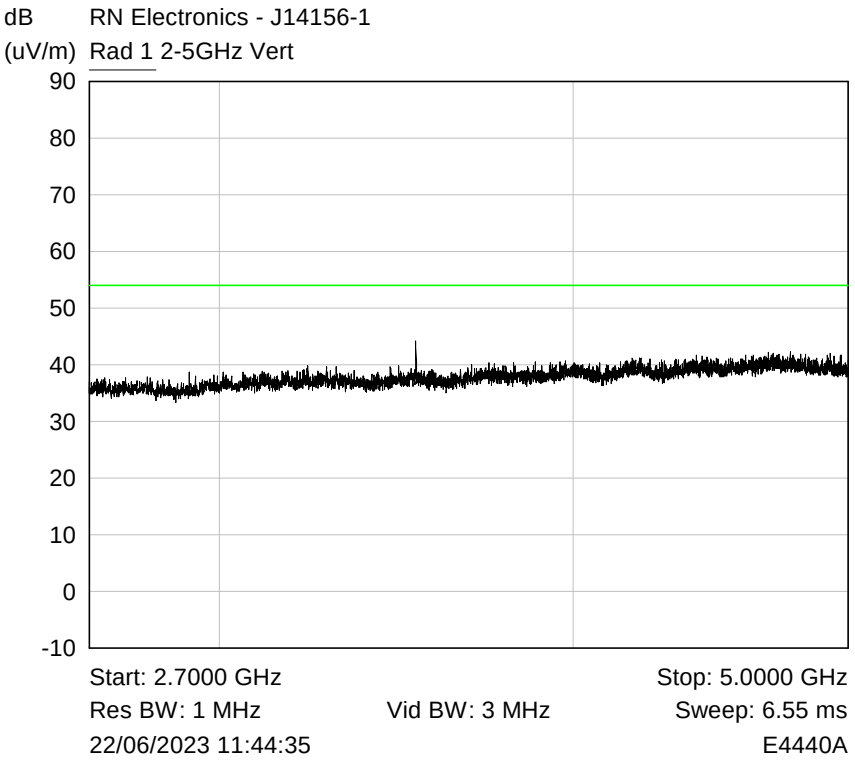
Note: This plot shows the 5G intentional transmission turned on



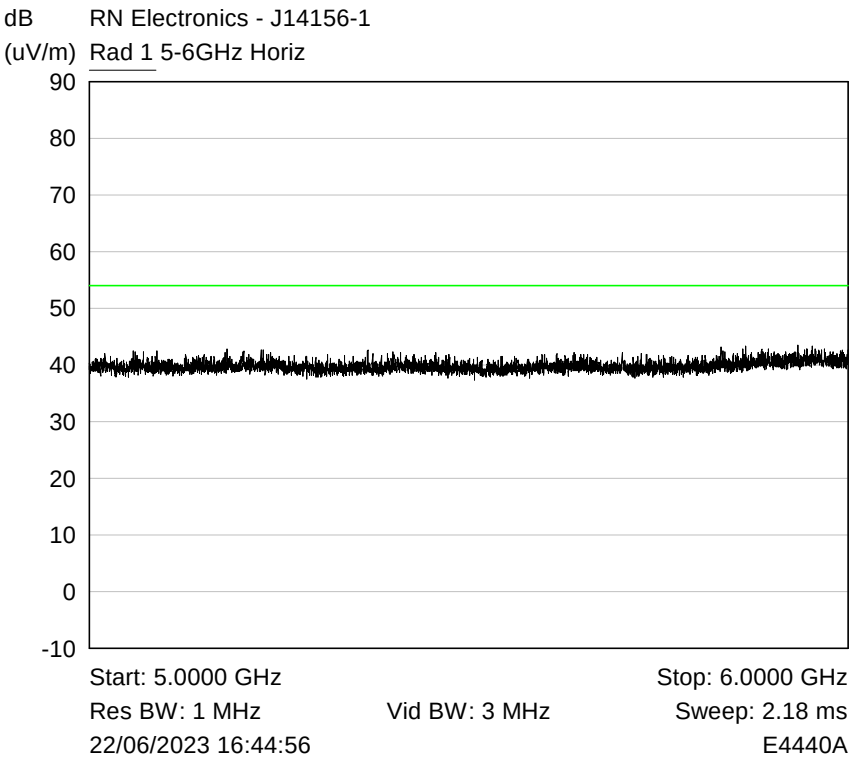
Note: This plot shows the 5G intentional transmission turned on

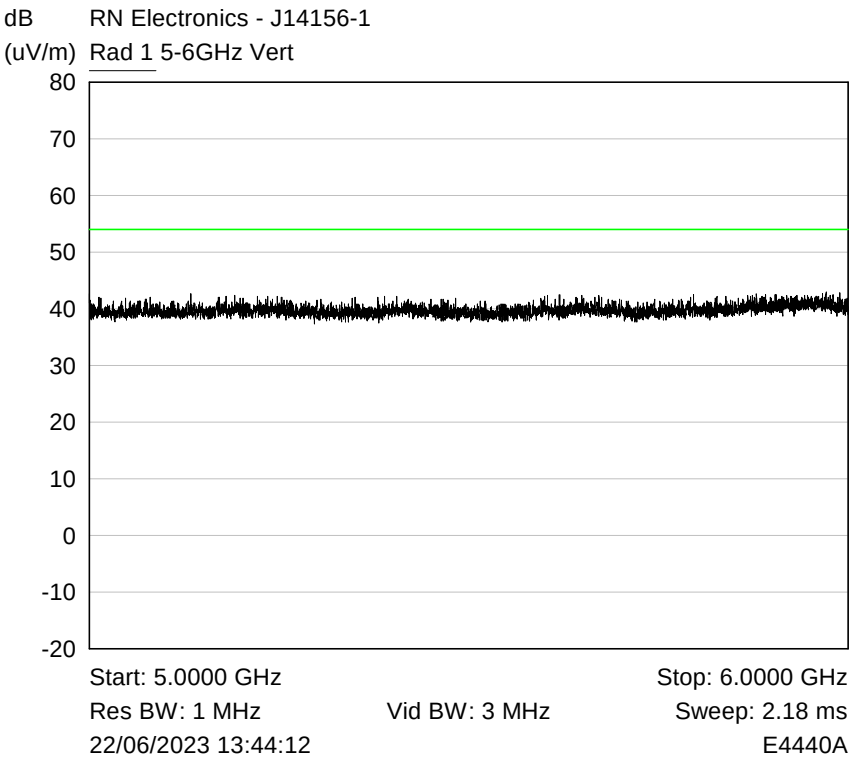


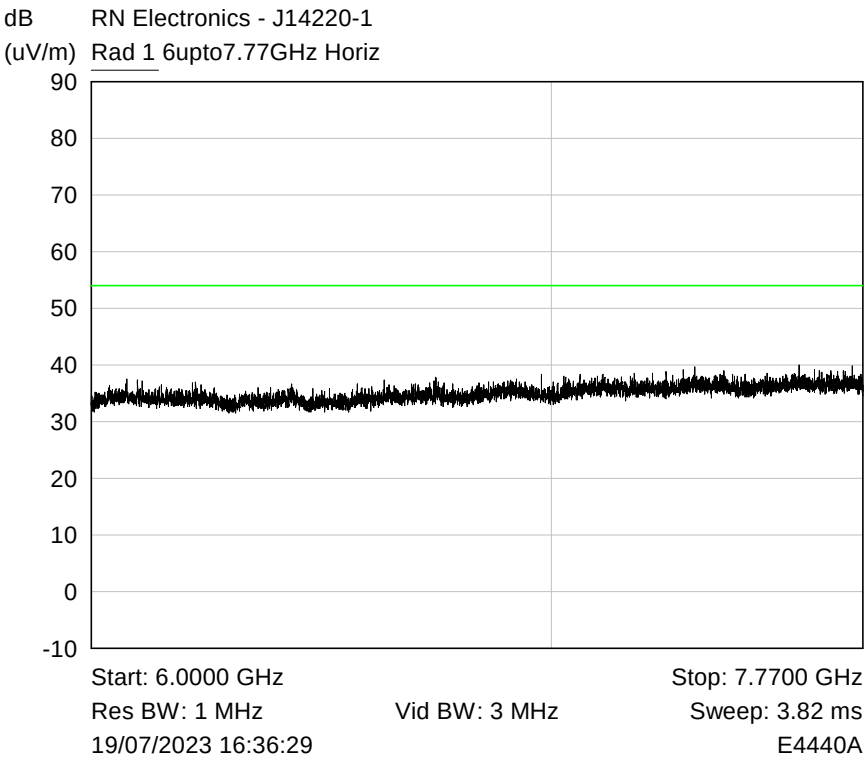
Note: This plot shows the 5G intentional transmission turned off

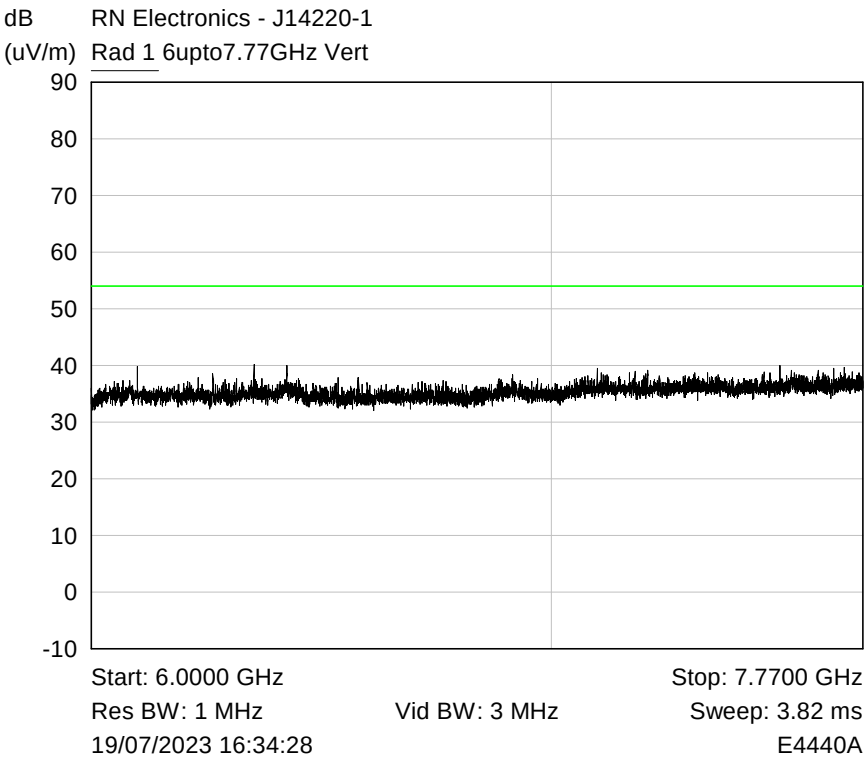


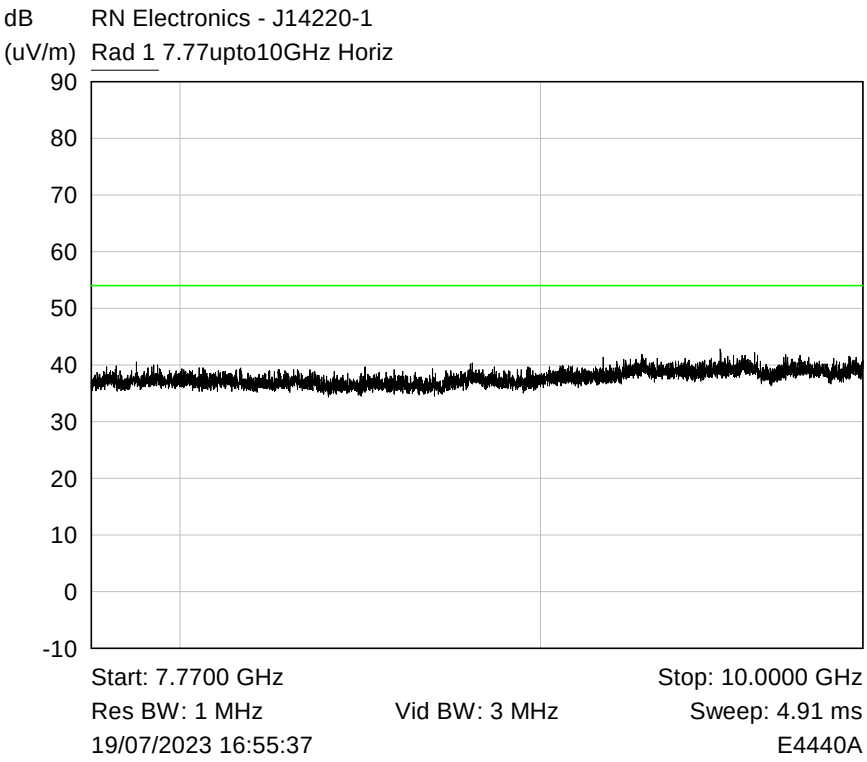
Note: This plot shows the 5G intentional transmission turned off

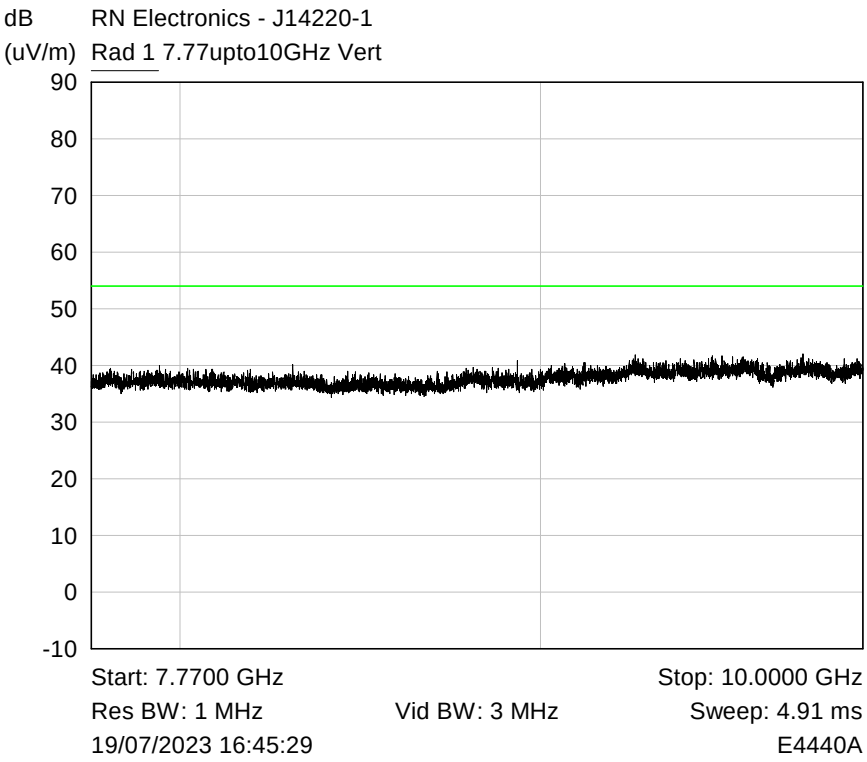


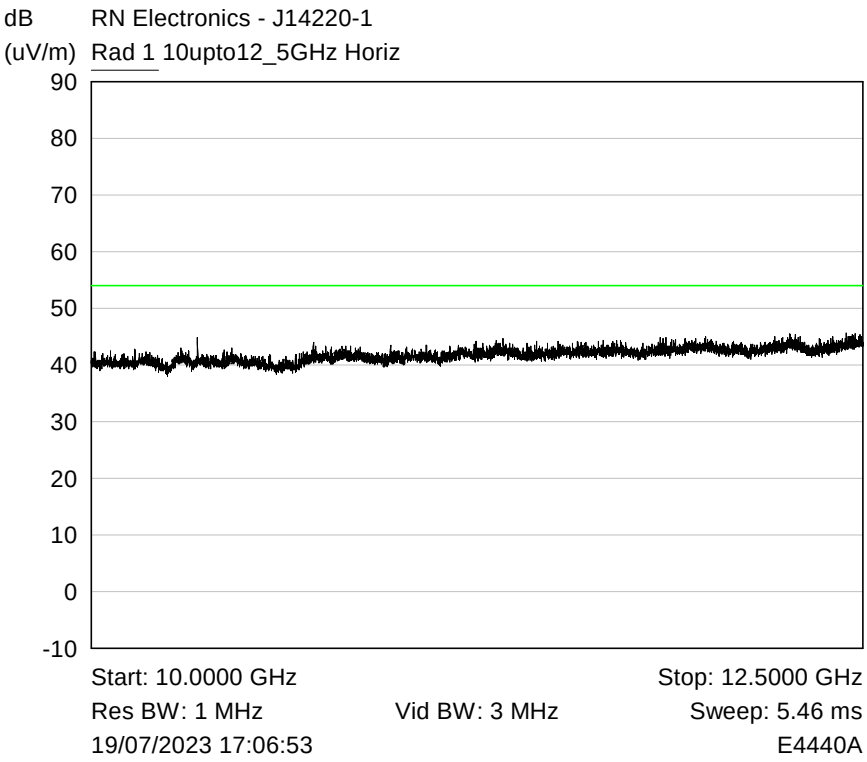


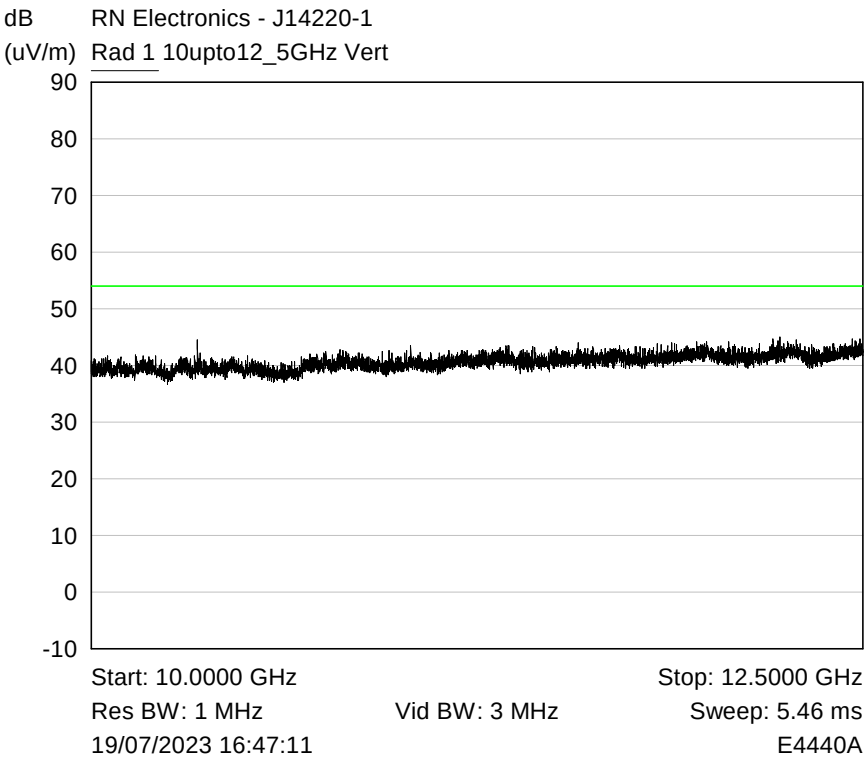


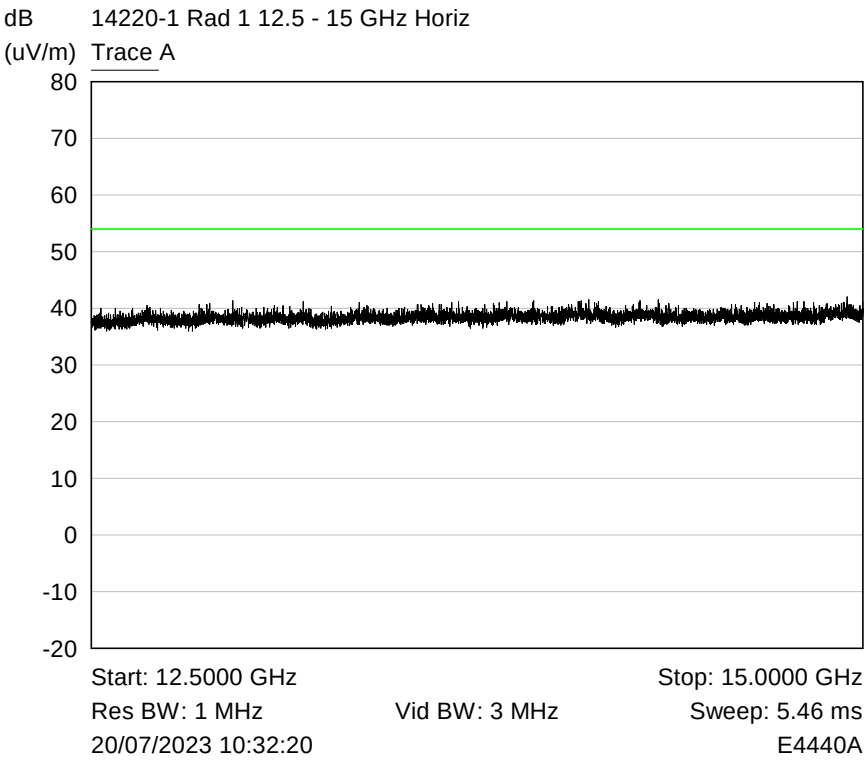


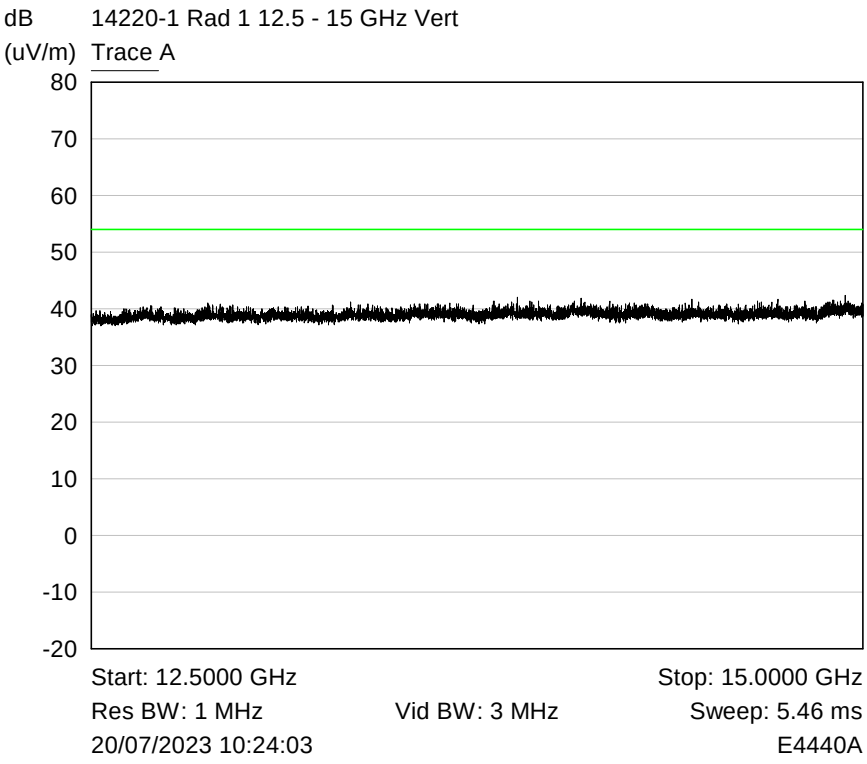


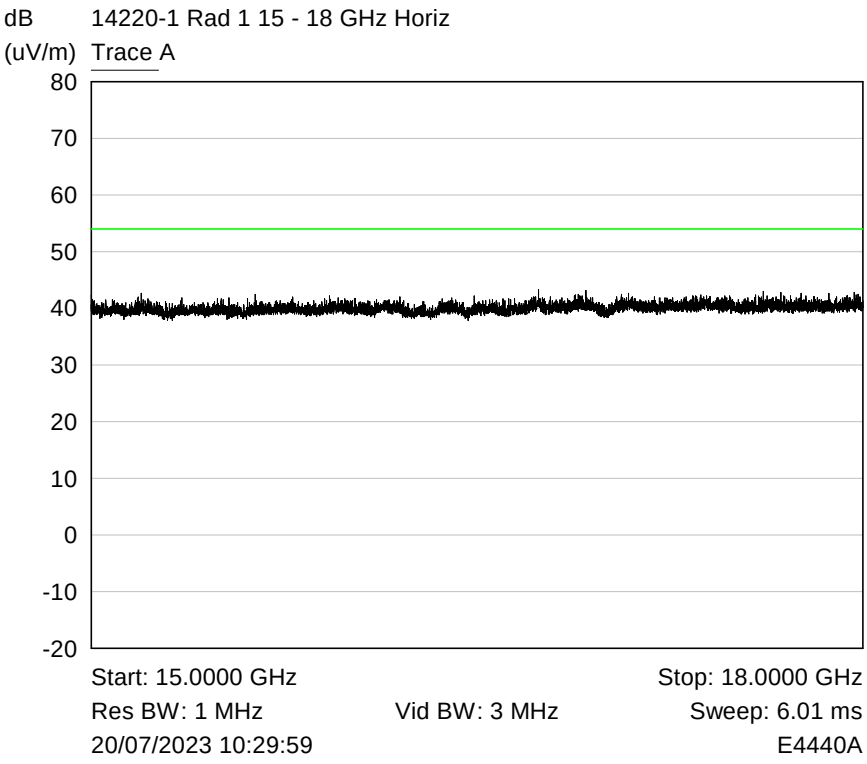


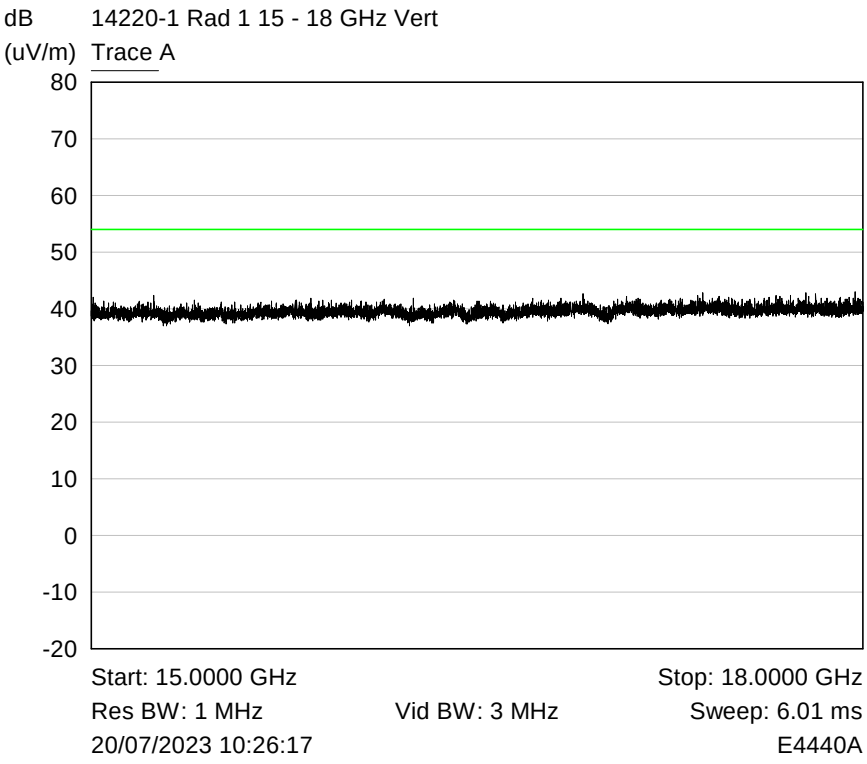


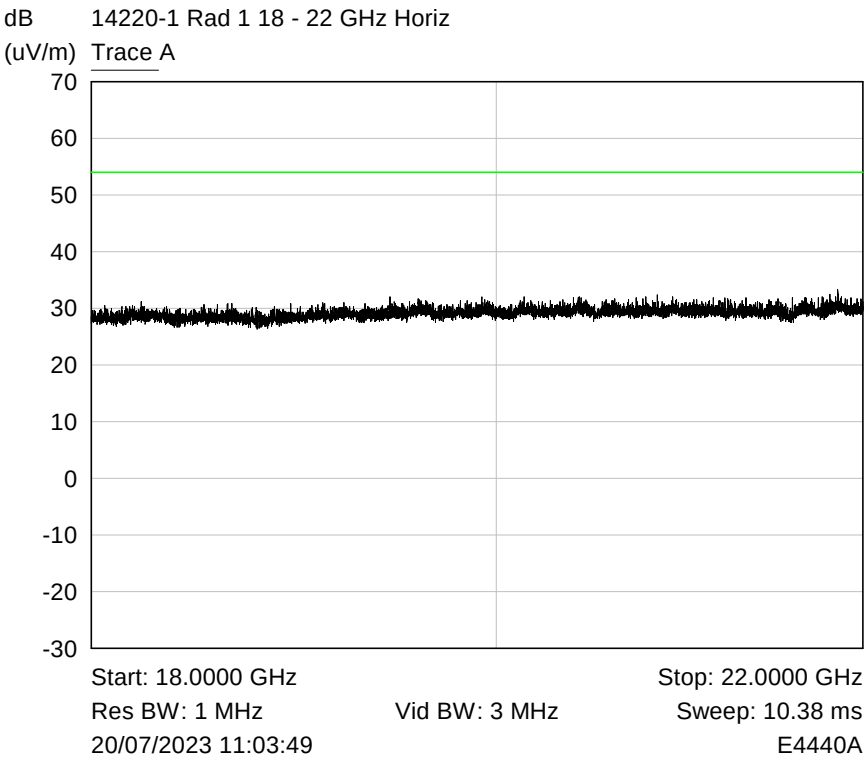


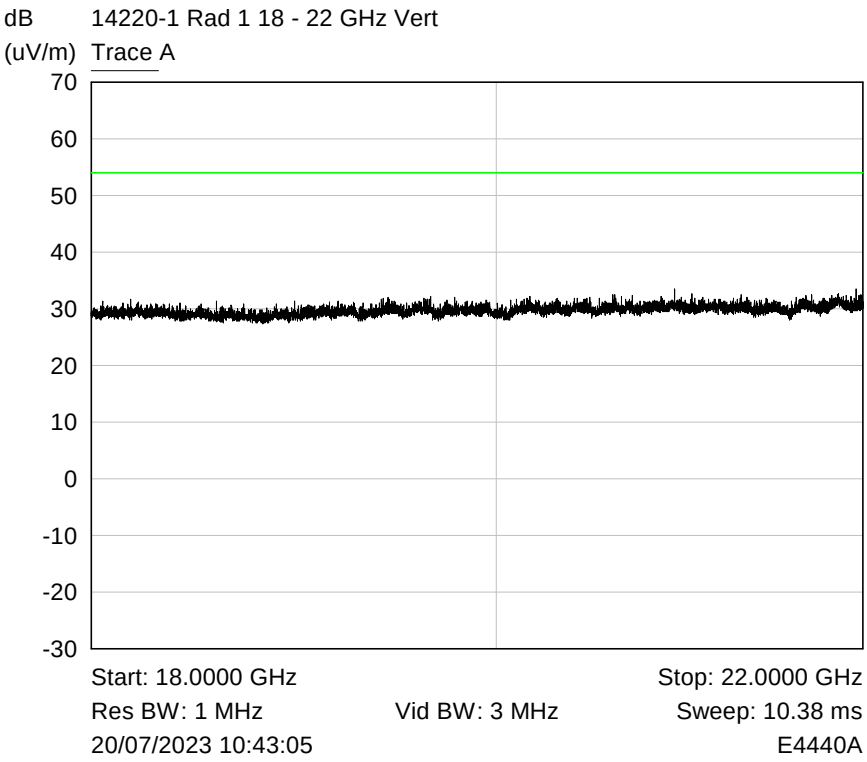


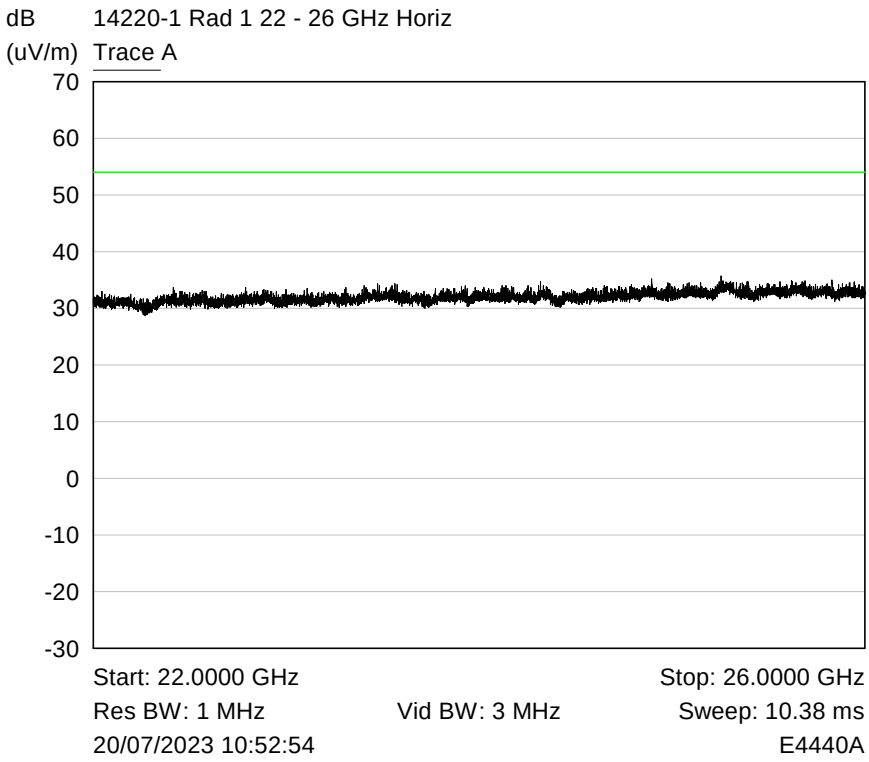


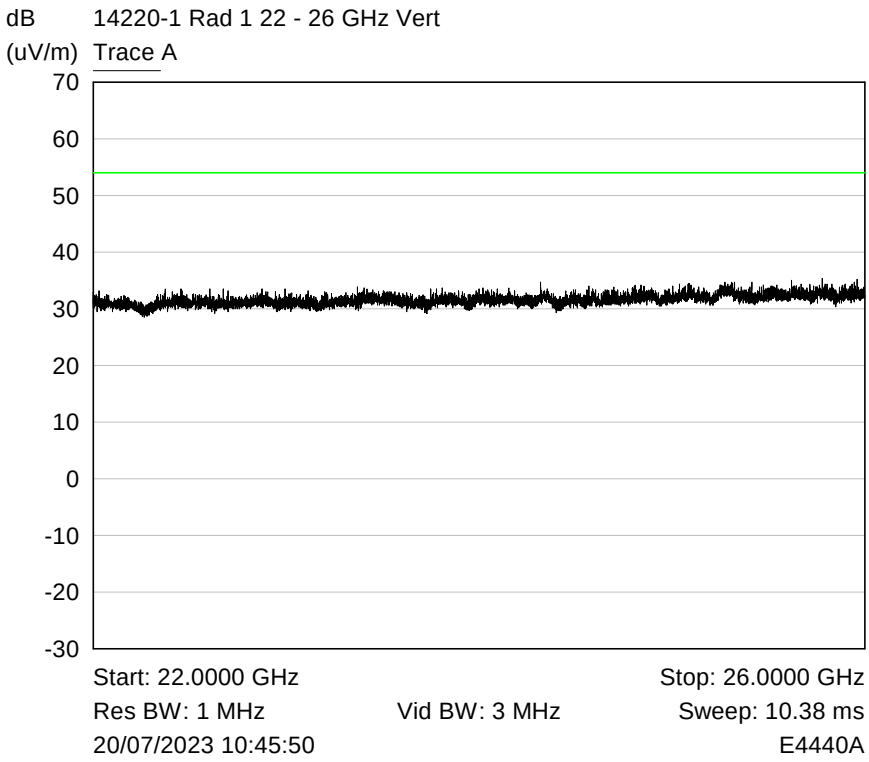


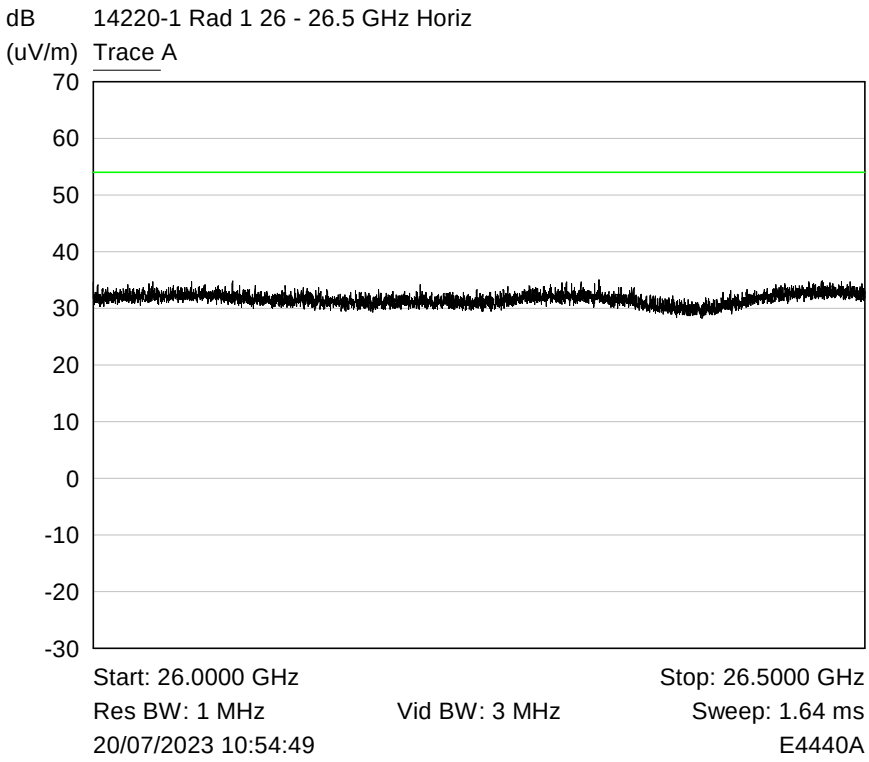


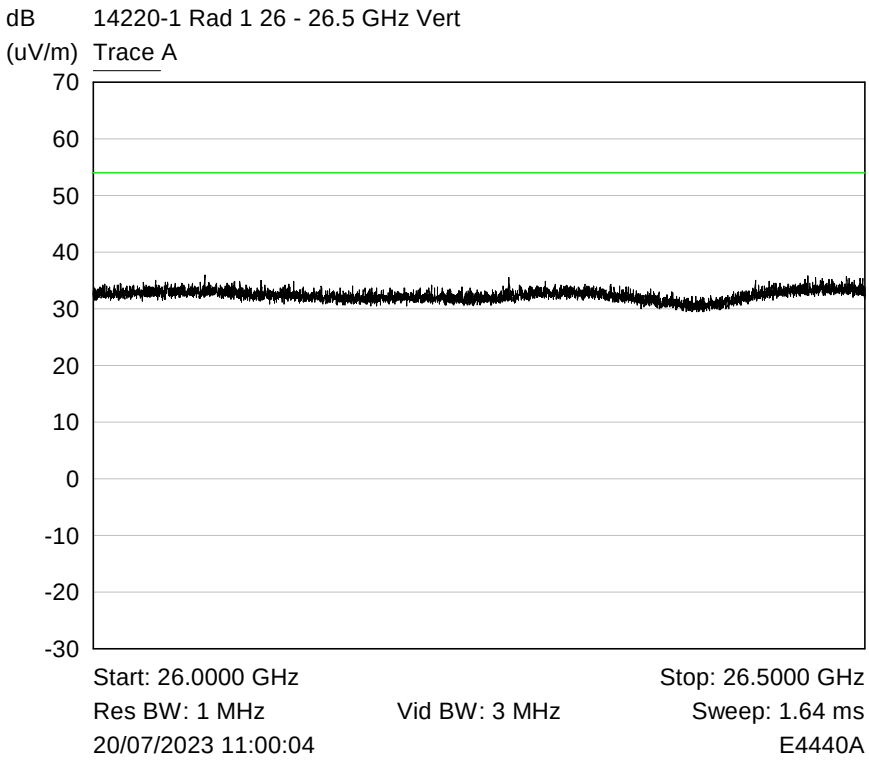


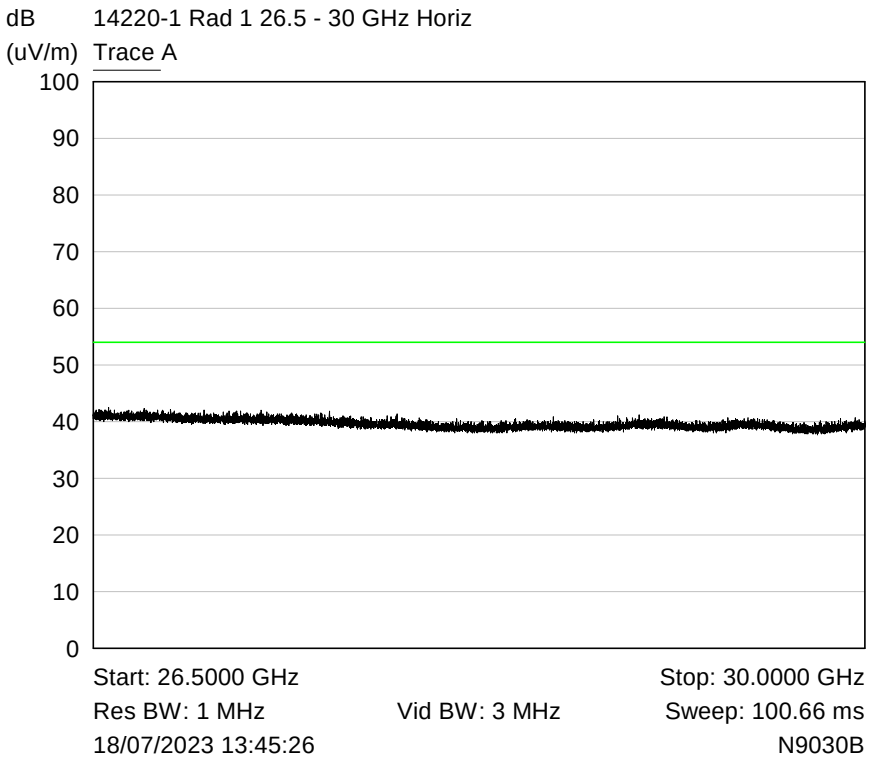


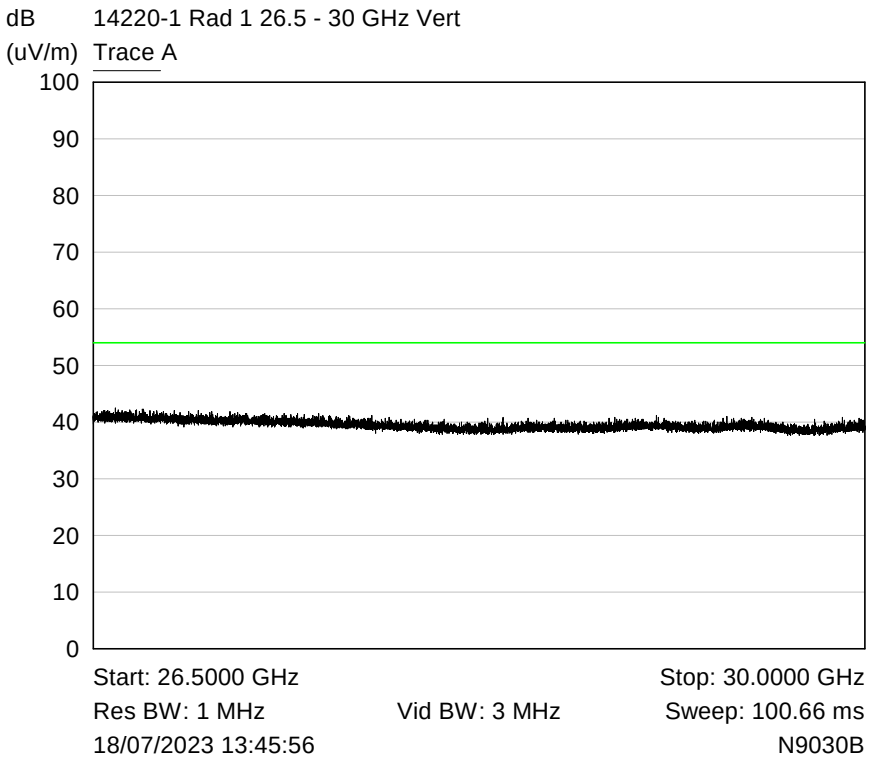


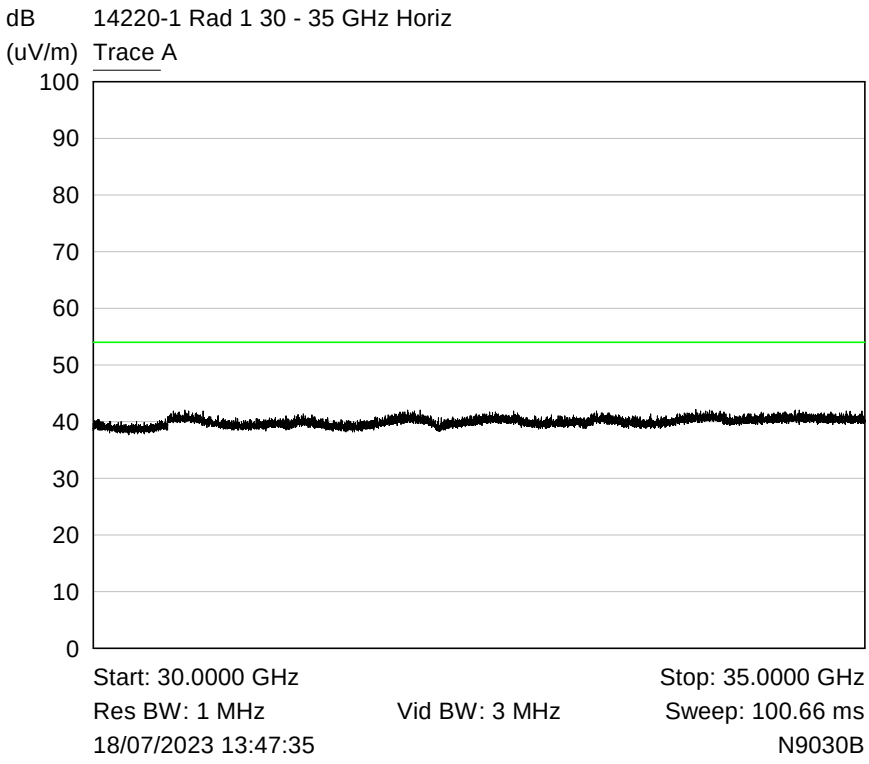


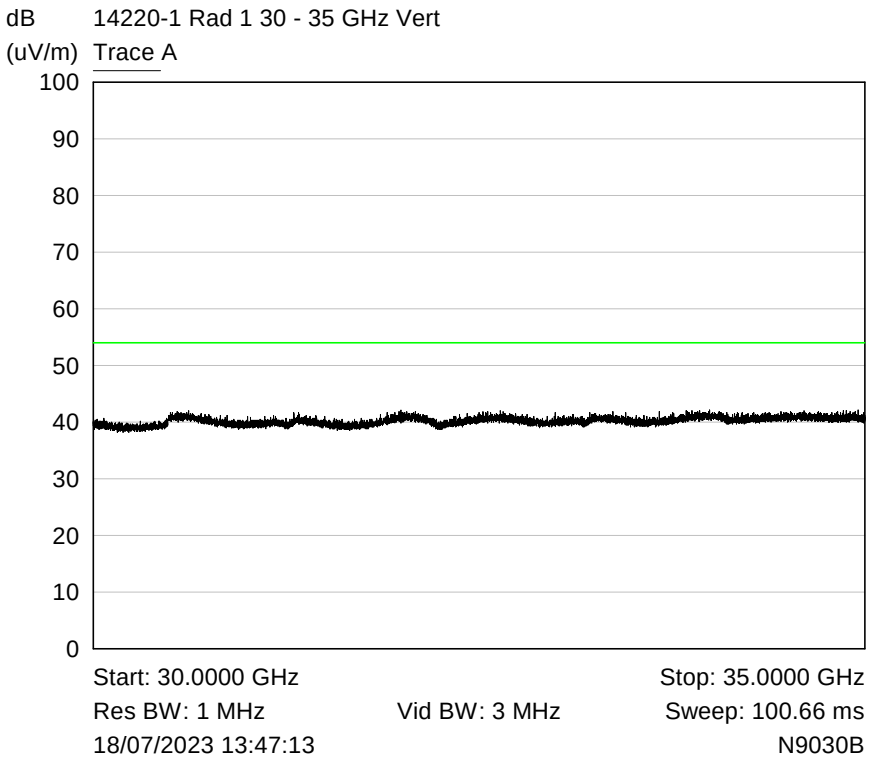


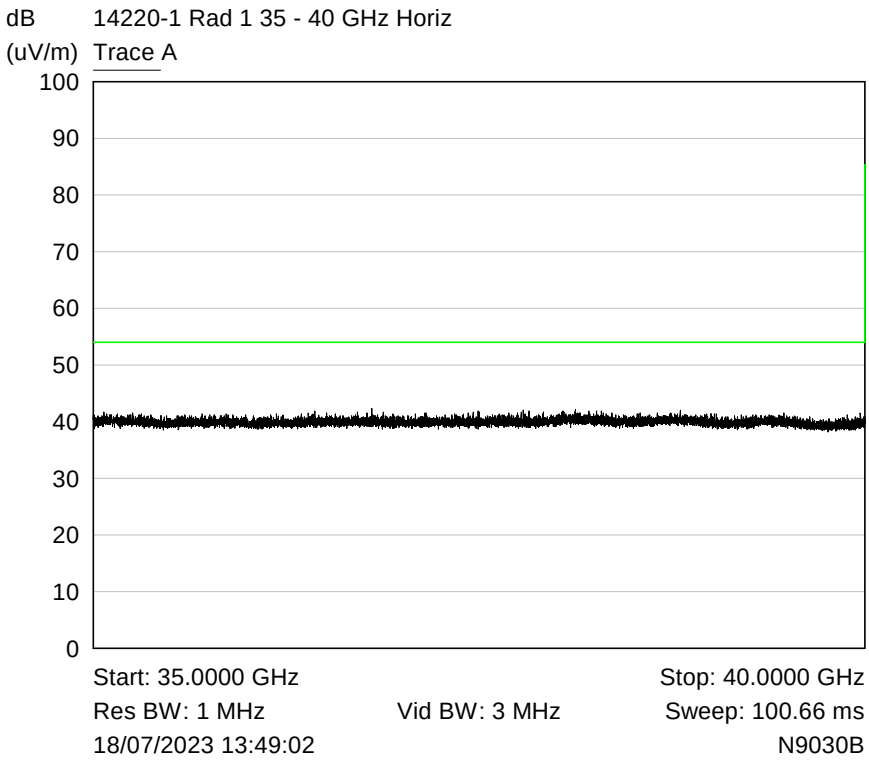


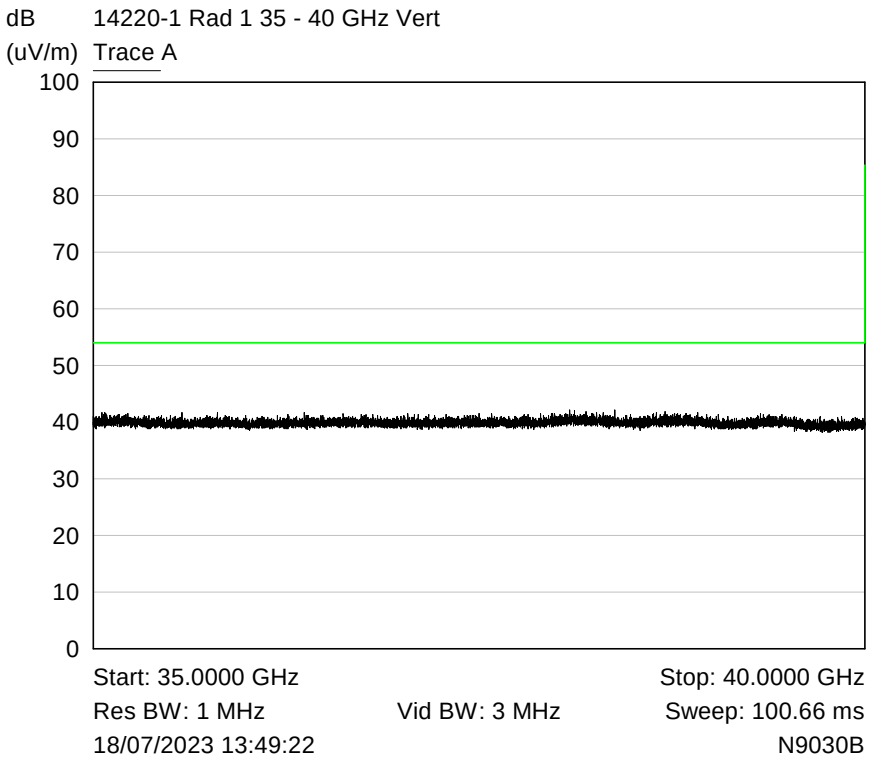






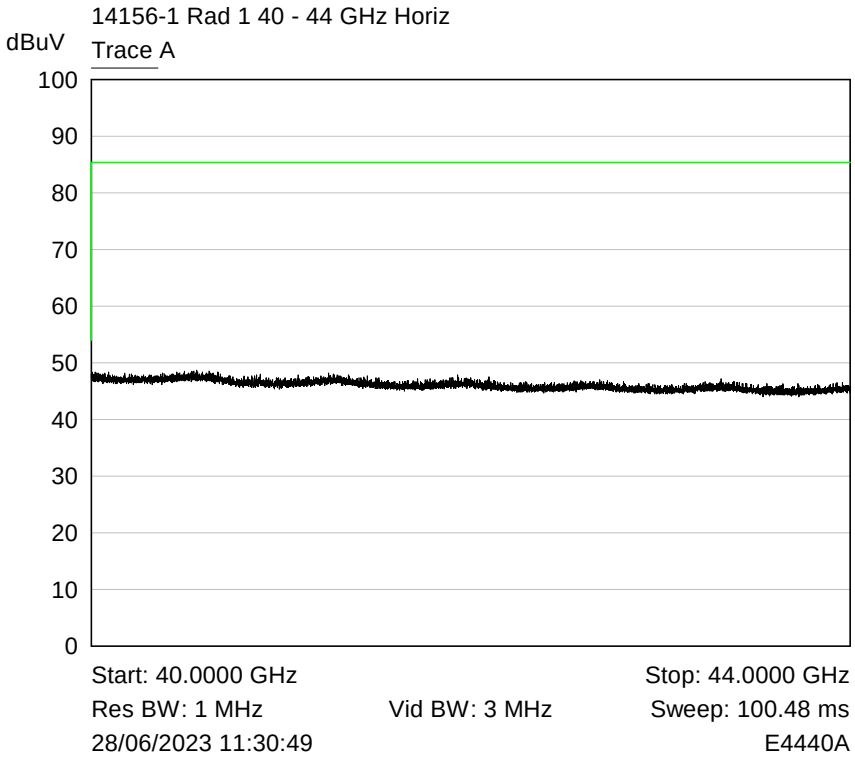


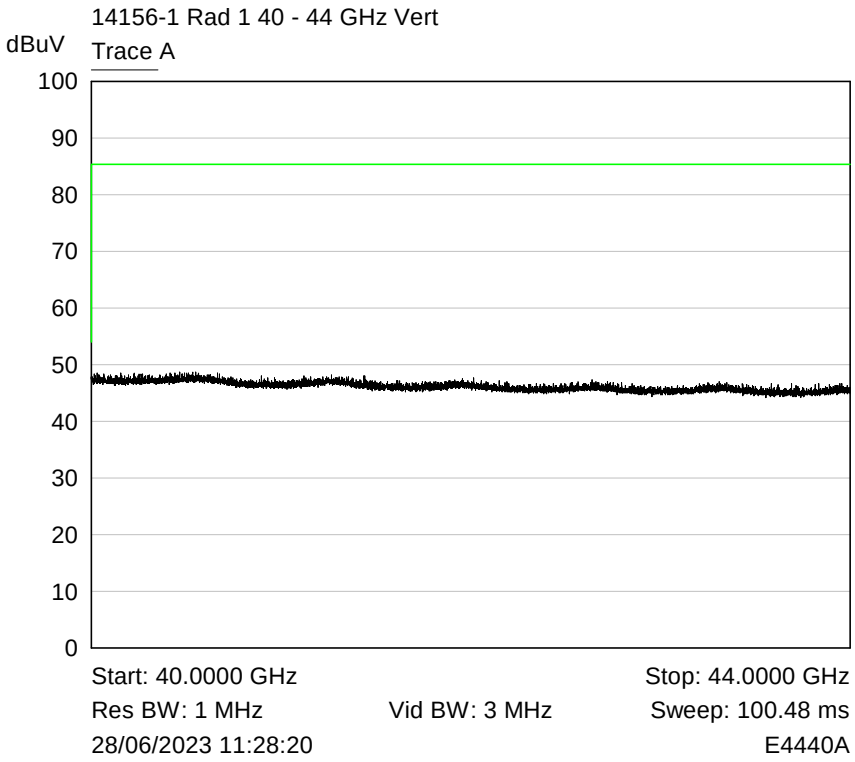


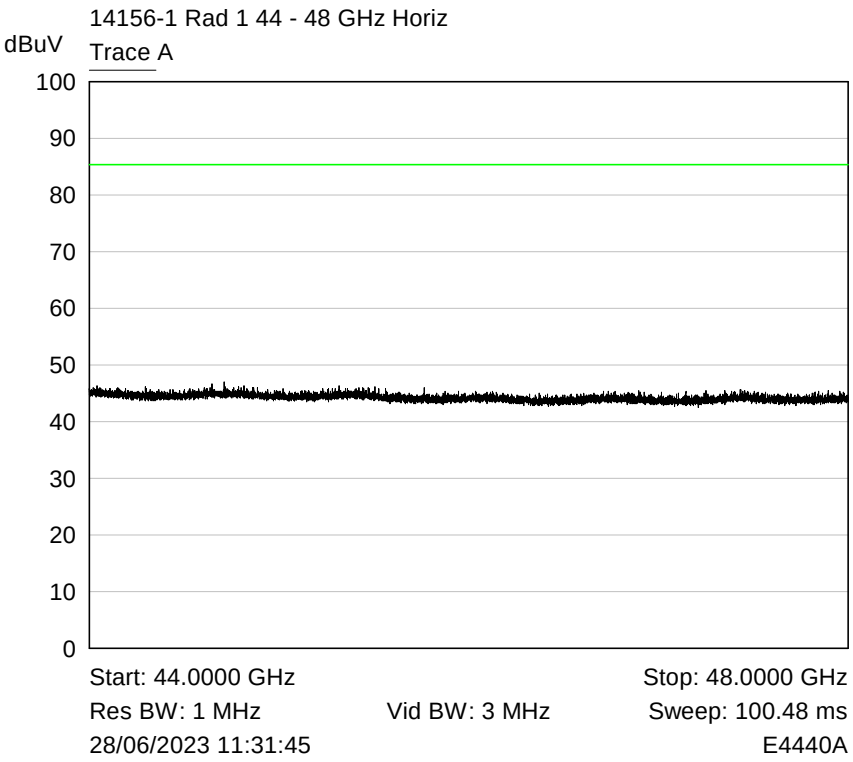


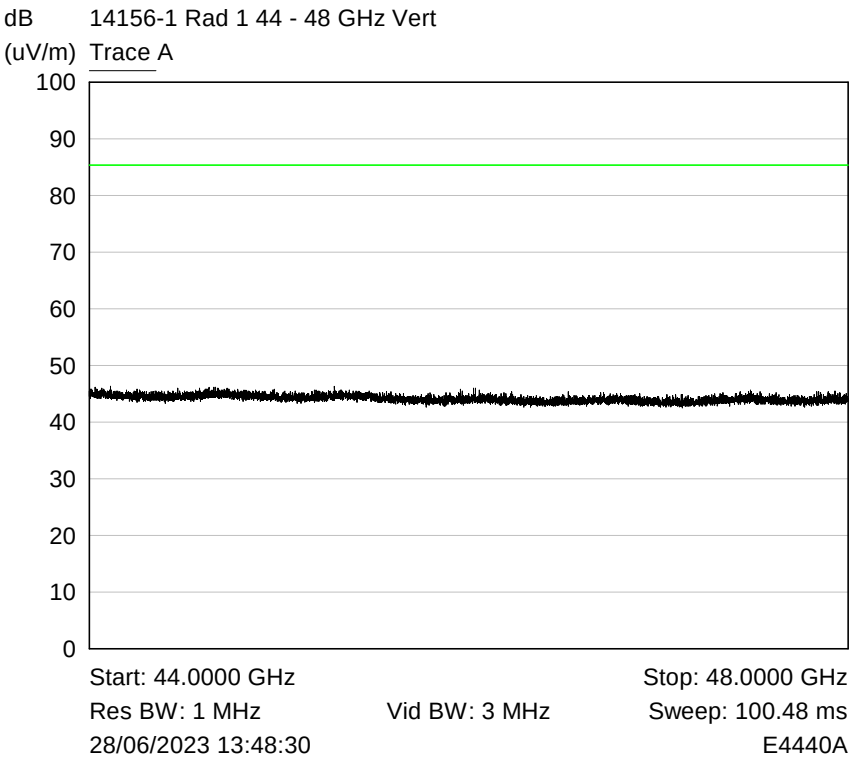
6.5 Radiated emissions 40 – 200 GHz

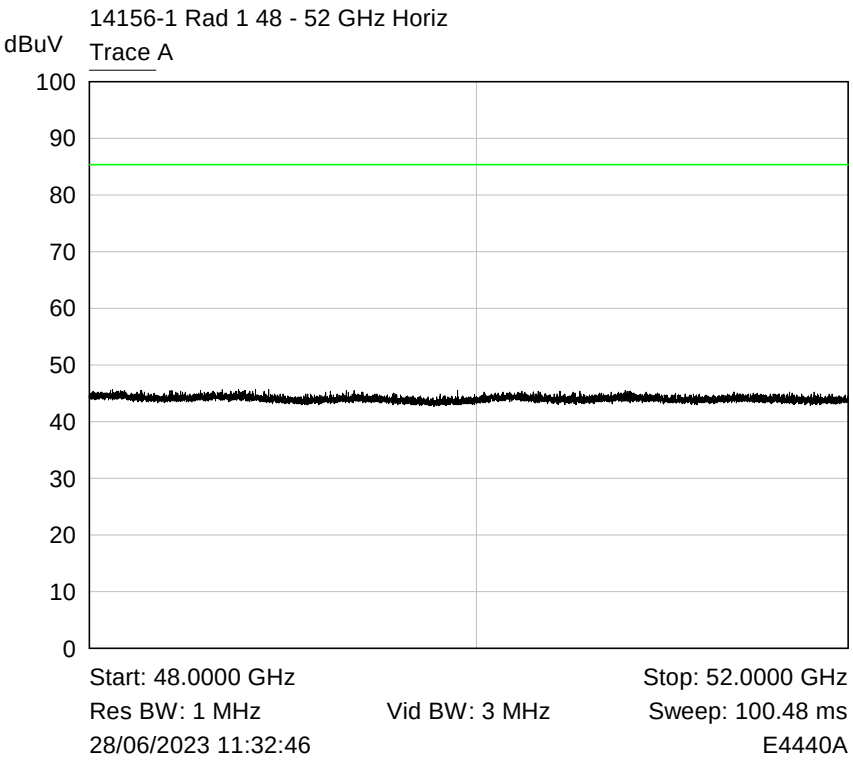
RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS1, Channel 64.8 GHz

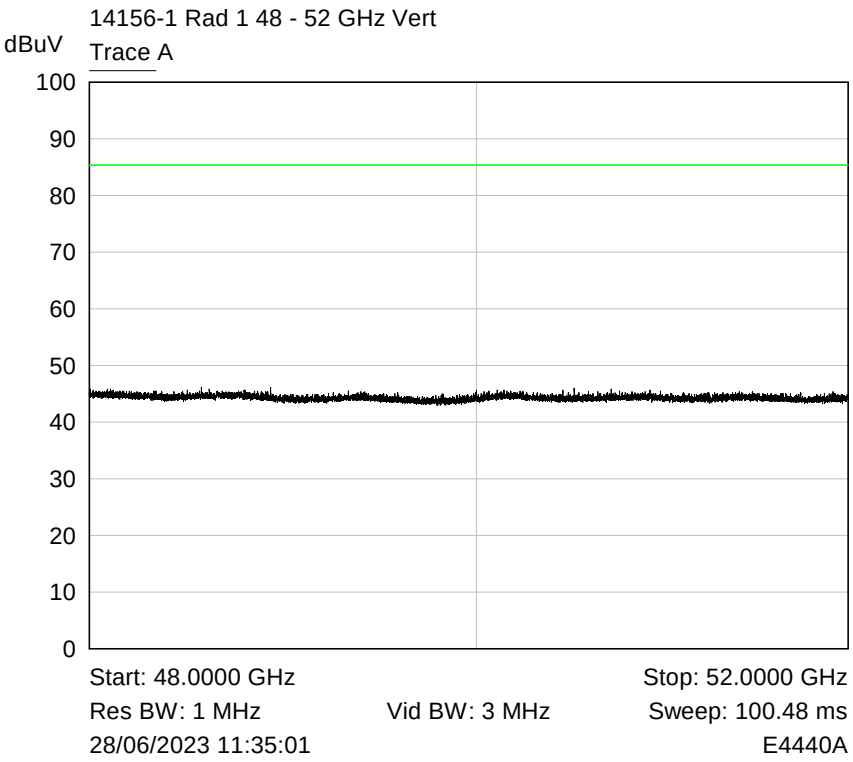


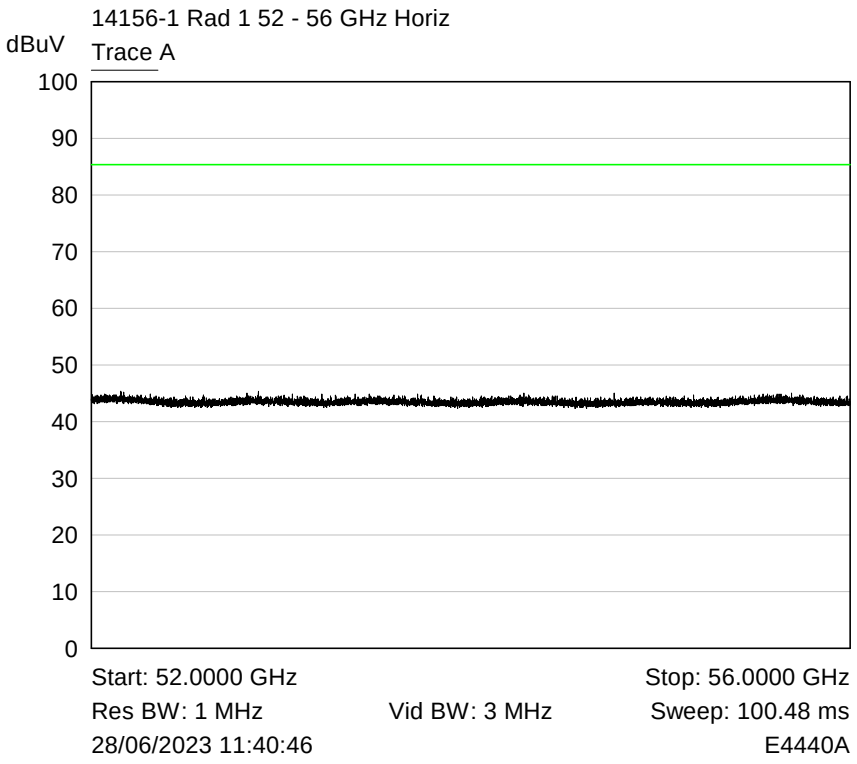


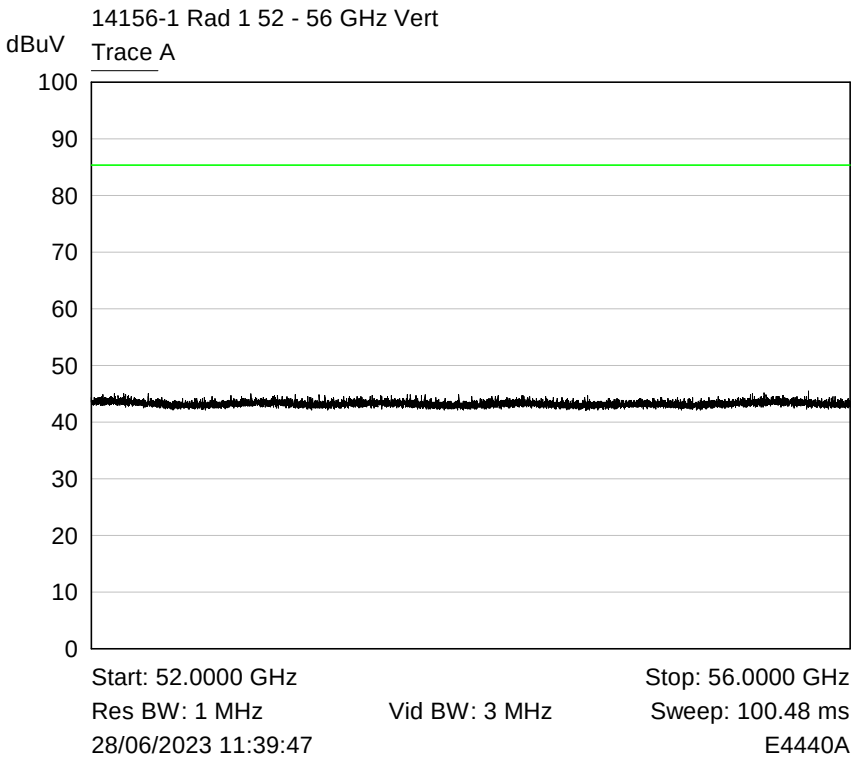


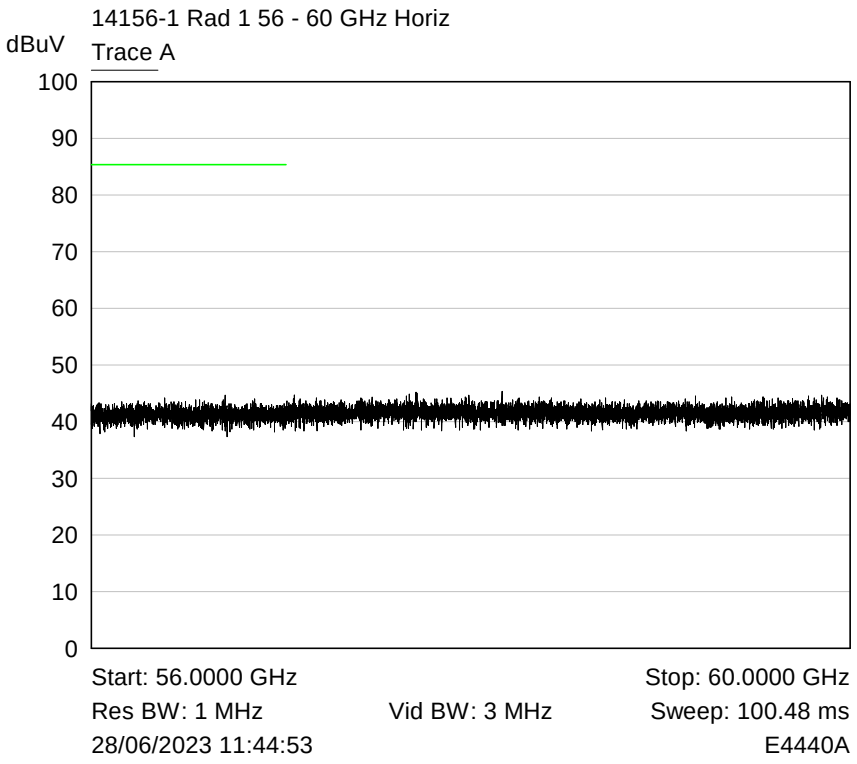


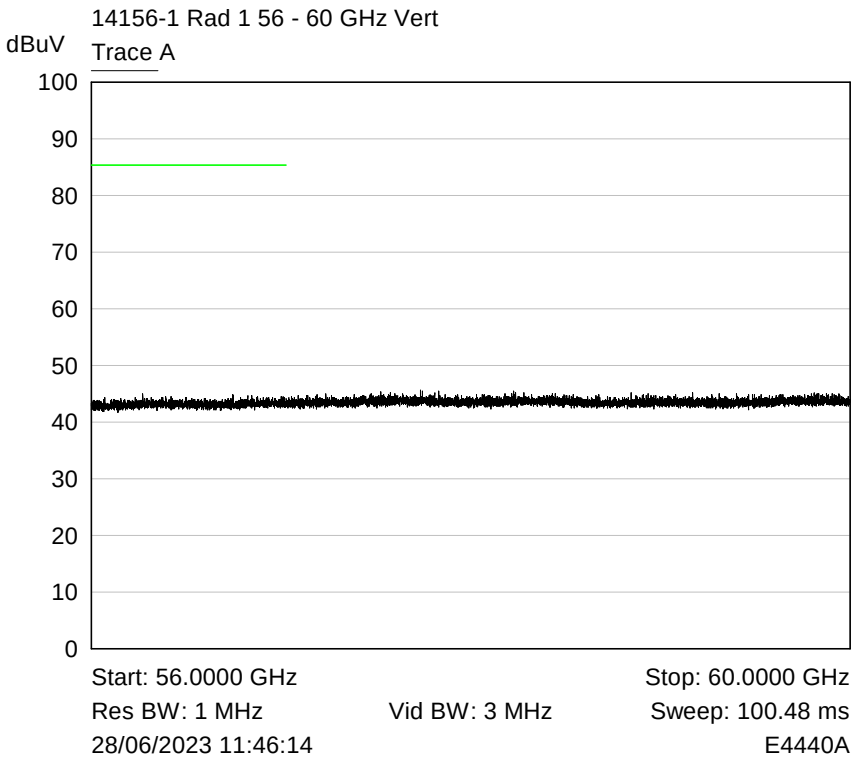


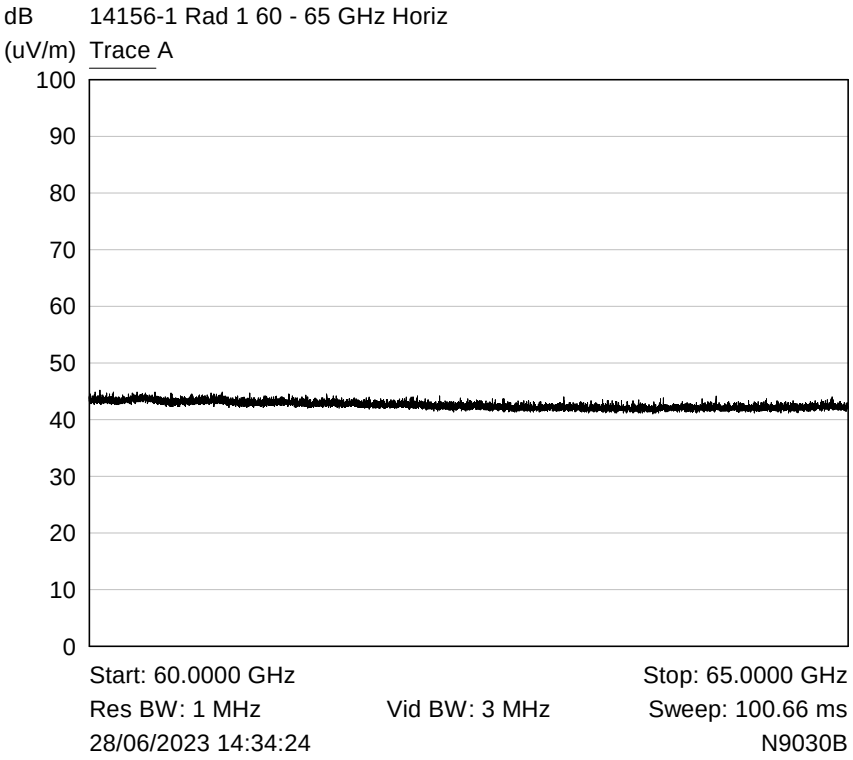




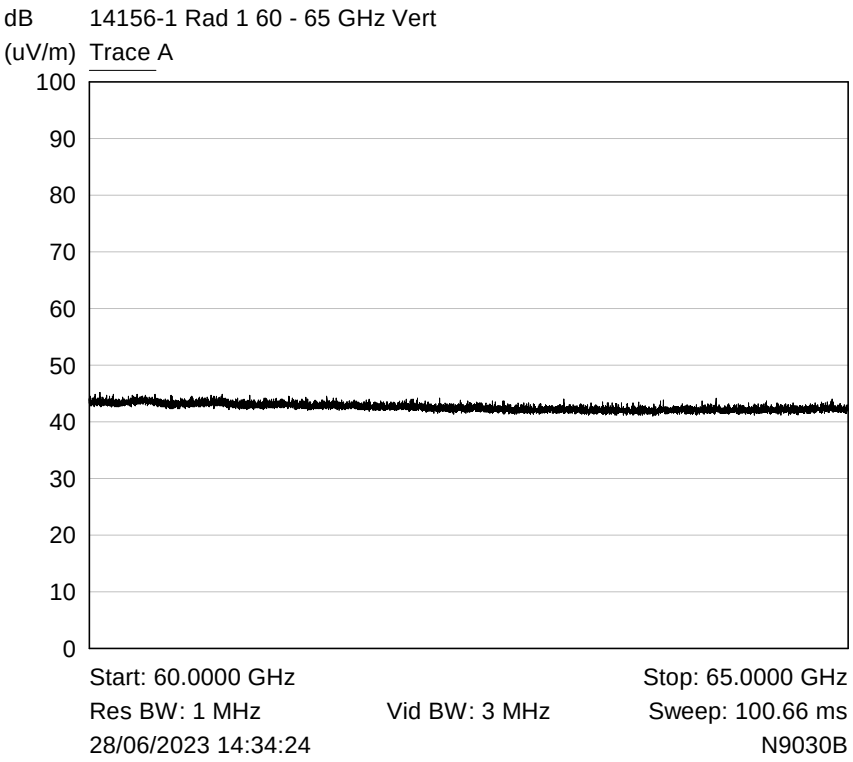




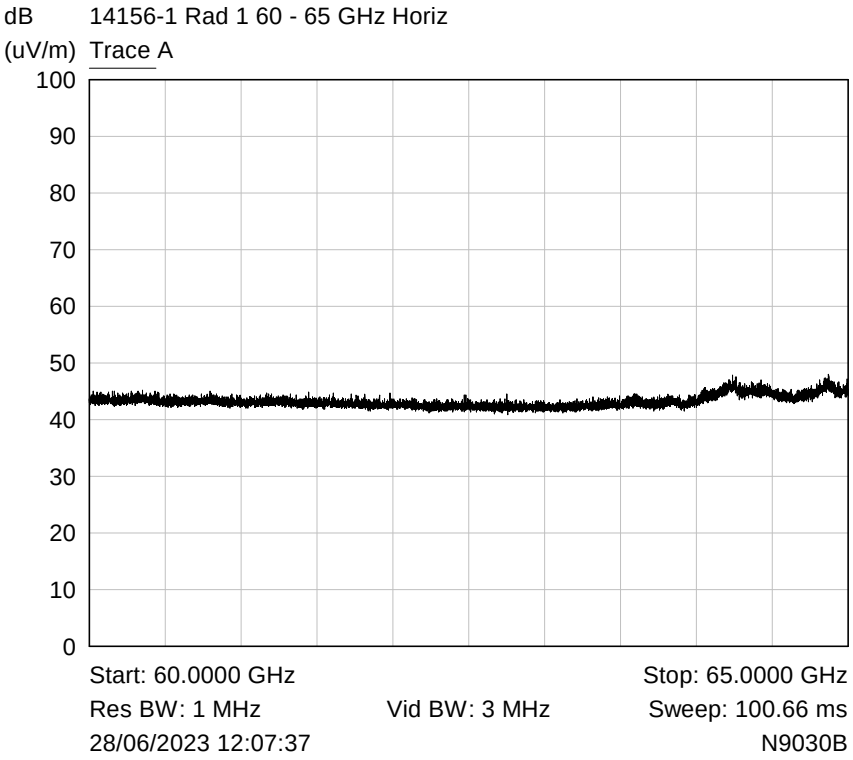




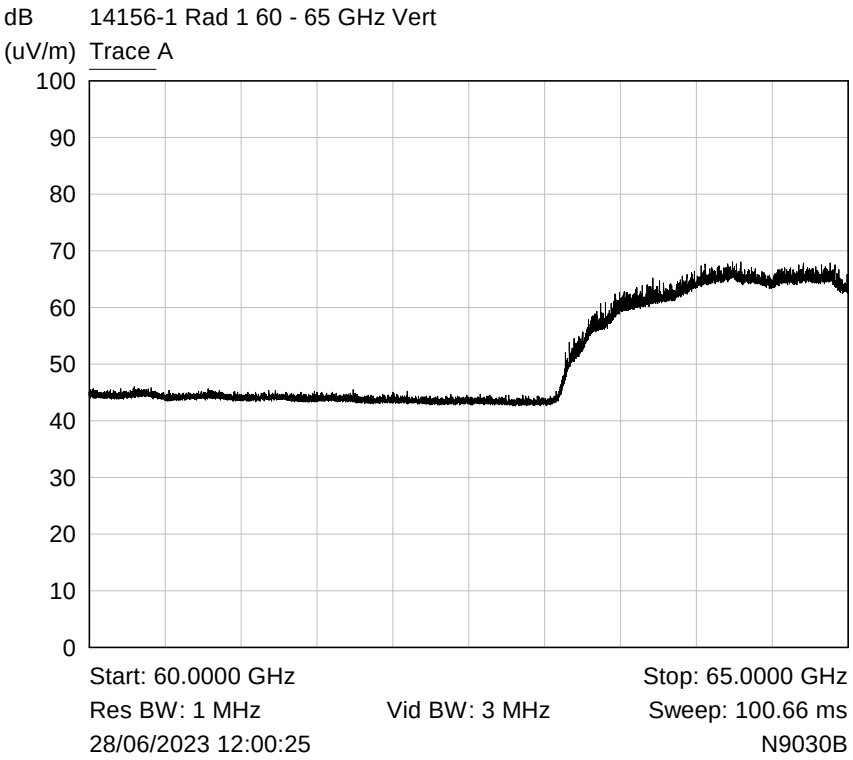
Note: This plot shows the 60GHz intentional transmission turned off



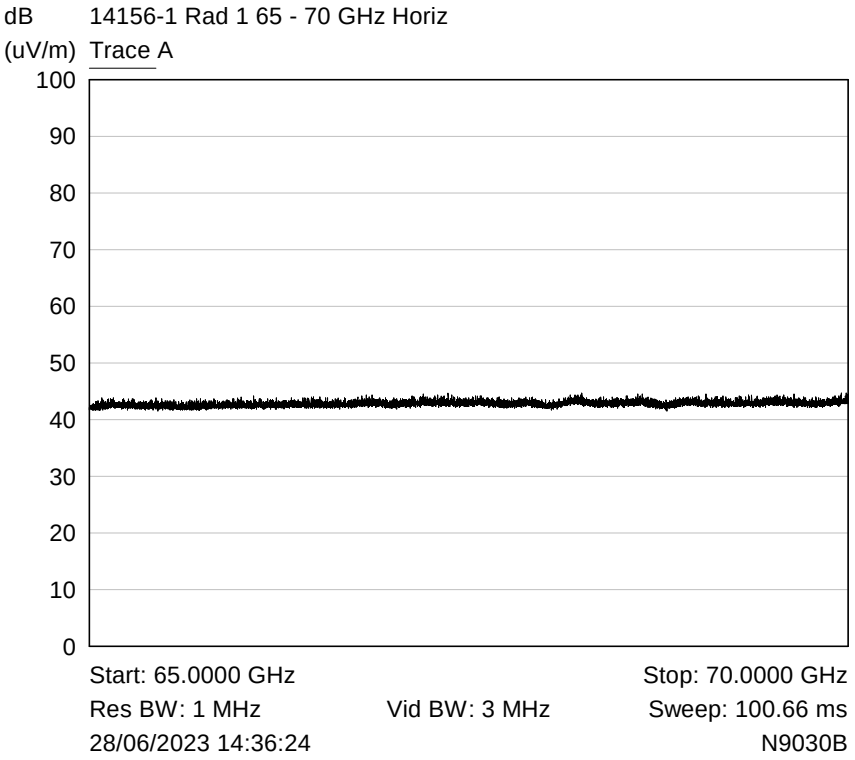
Note: This plot shows the 60GHz intentional transmission turned off



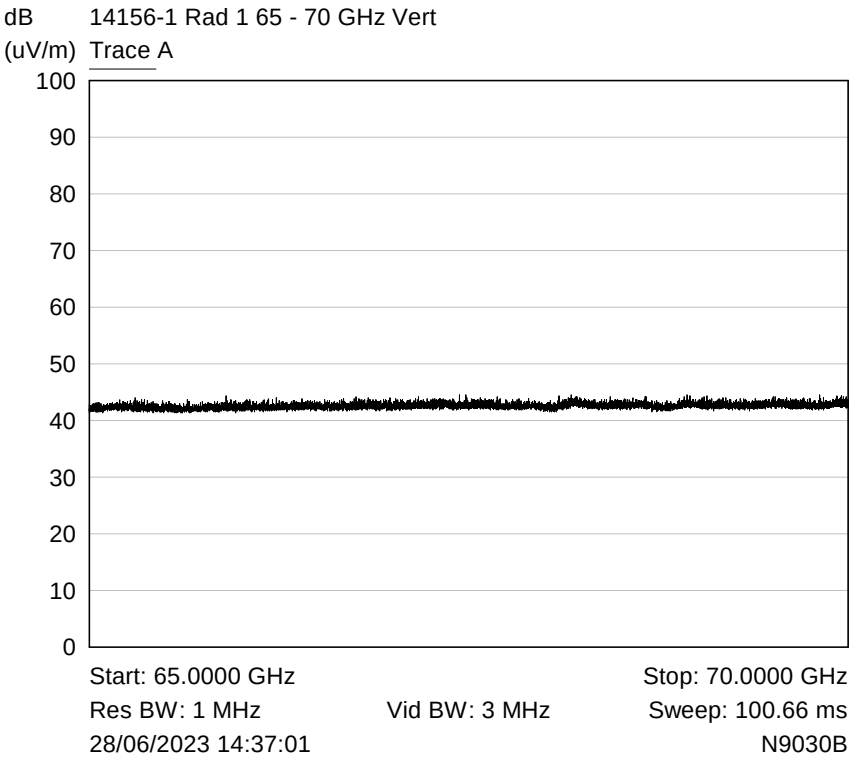
Note: This plot shows the 60GHz intentional transmission turned on



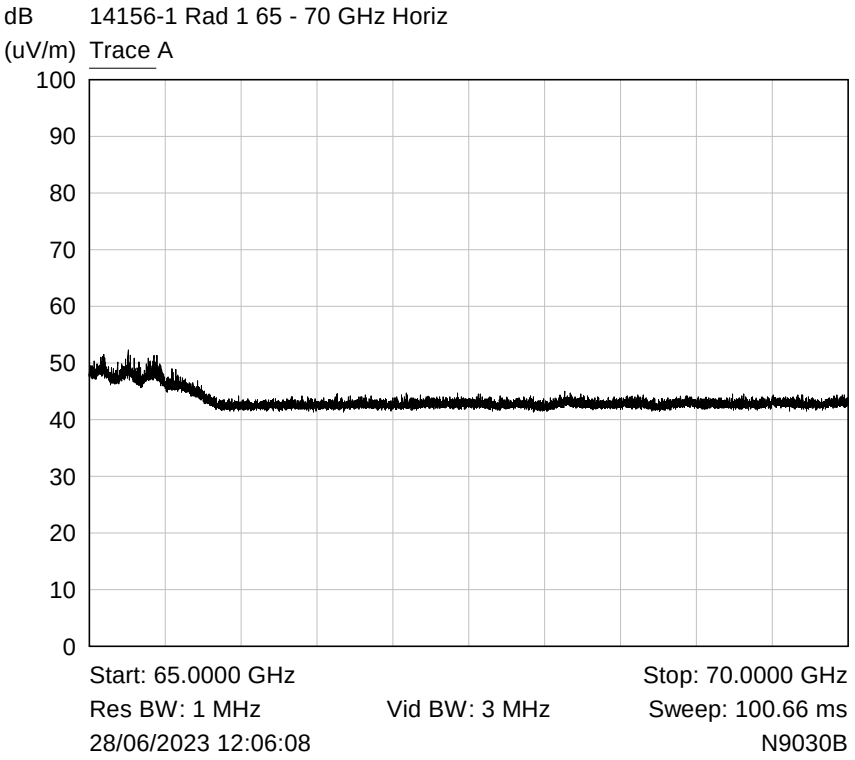
Note: This plot shows the 60GHz intentional transmission turned on



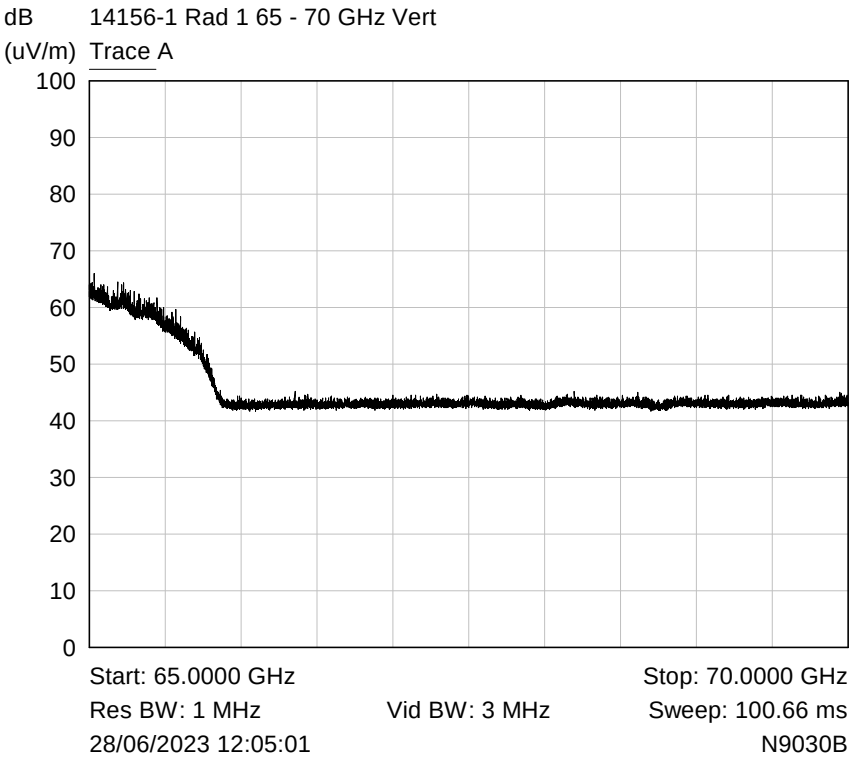
Note: This plot shows the 60GHz intentional transmission turned off



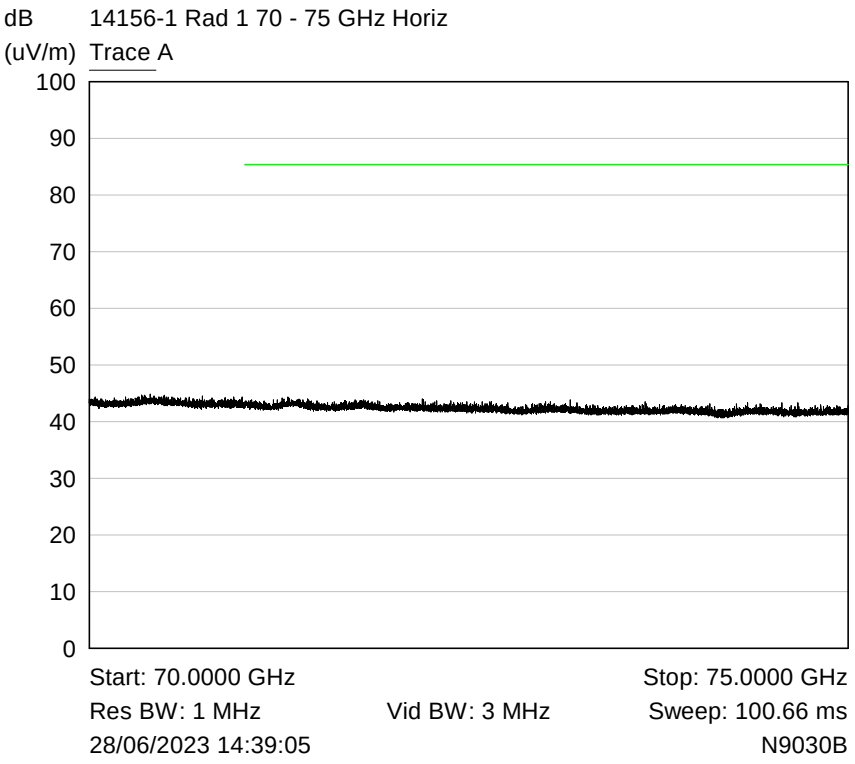
Note: This plot shows the 60GHz intentional transmission turned off

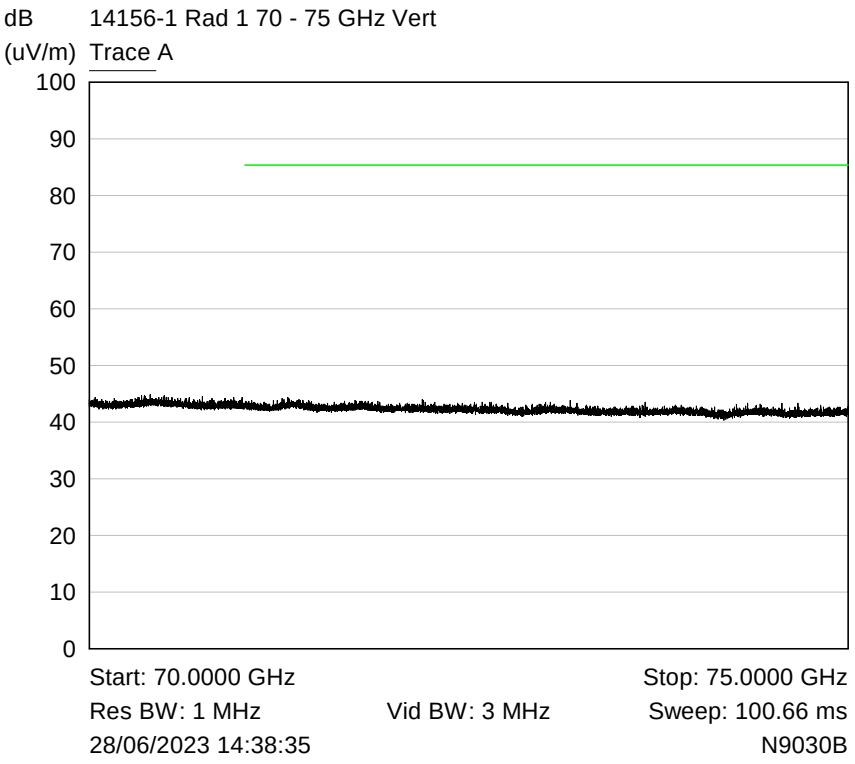


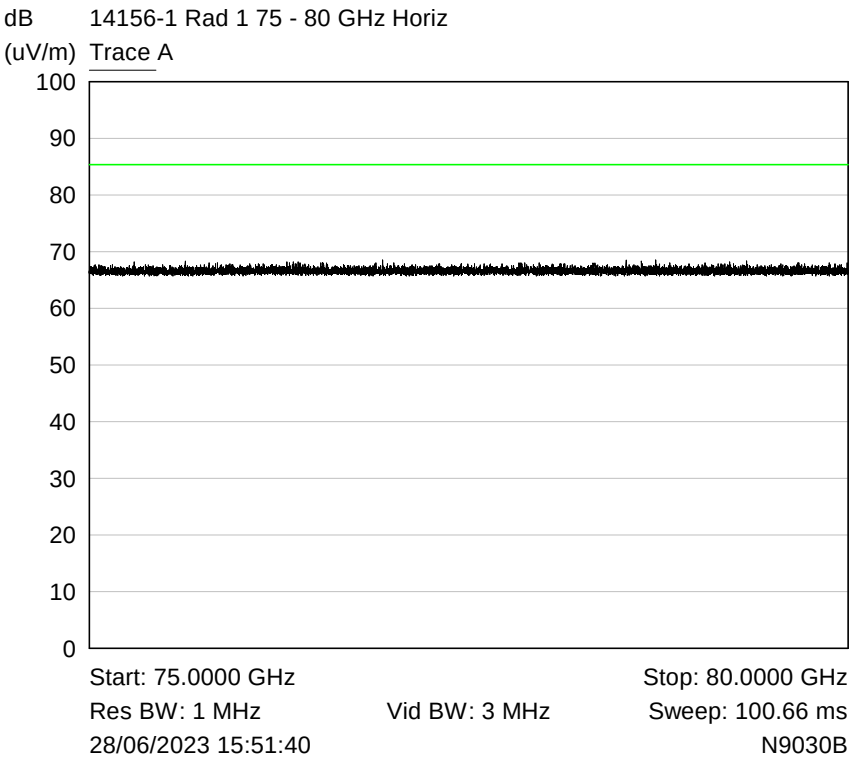
Note: This plot shows the 60GHz intentional transmission turned on

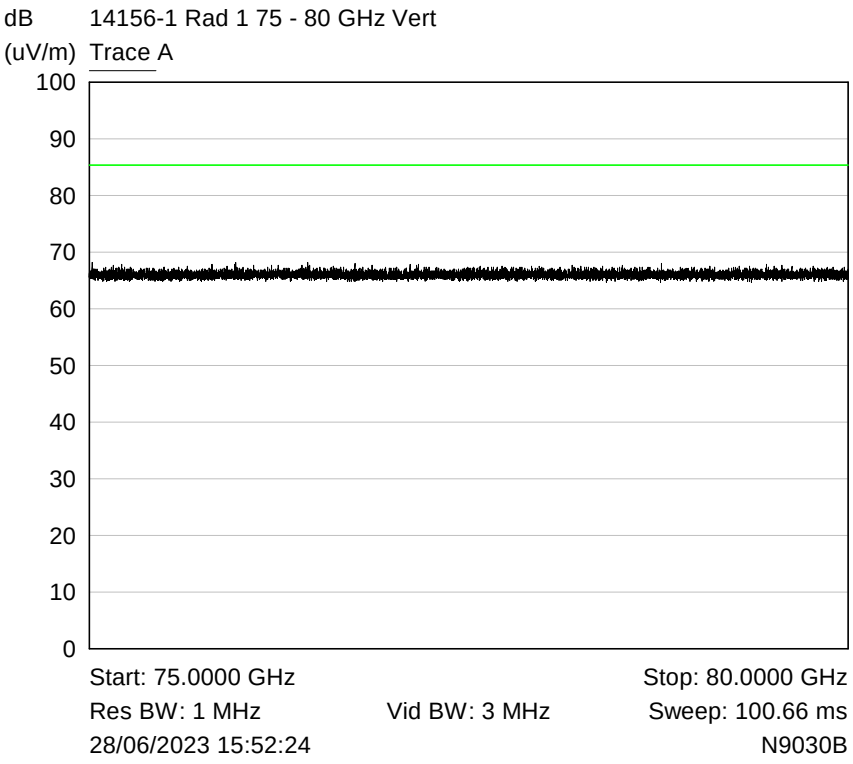


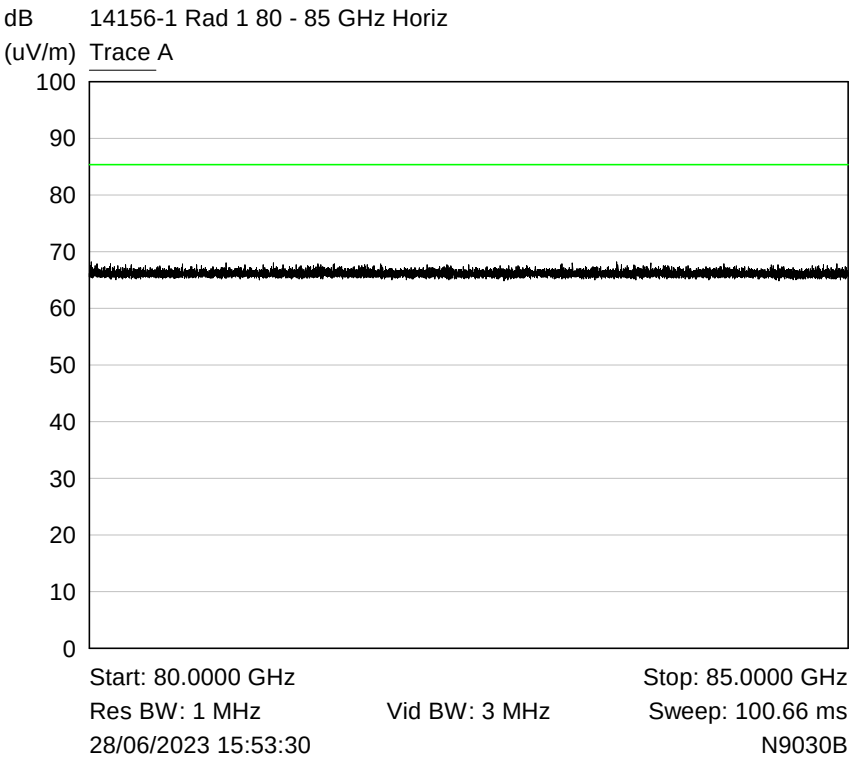
Note: This plot shows the 60GHz intentional transmission turned on

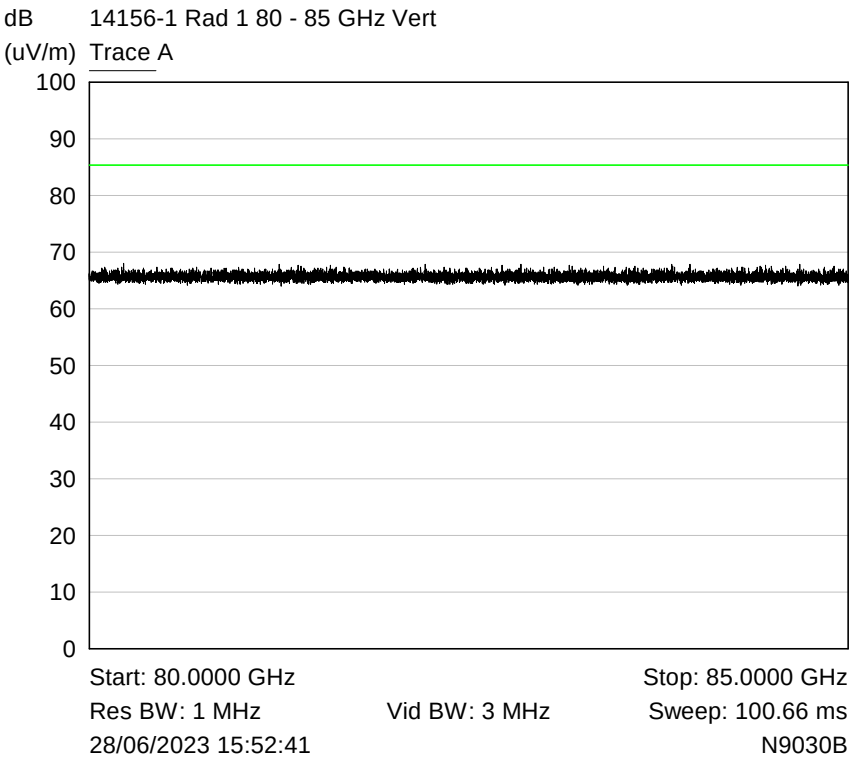


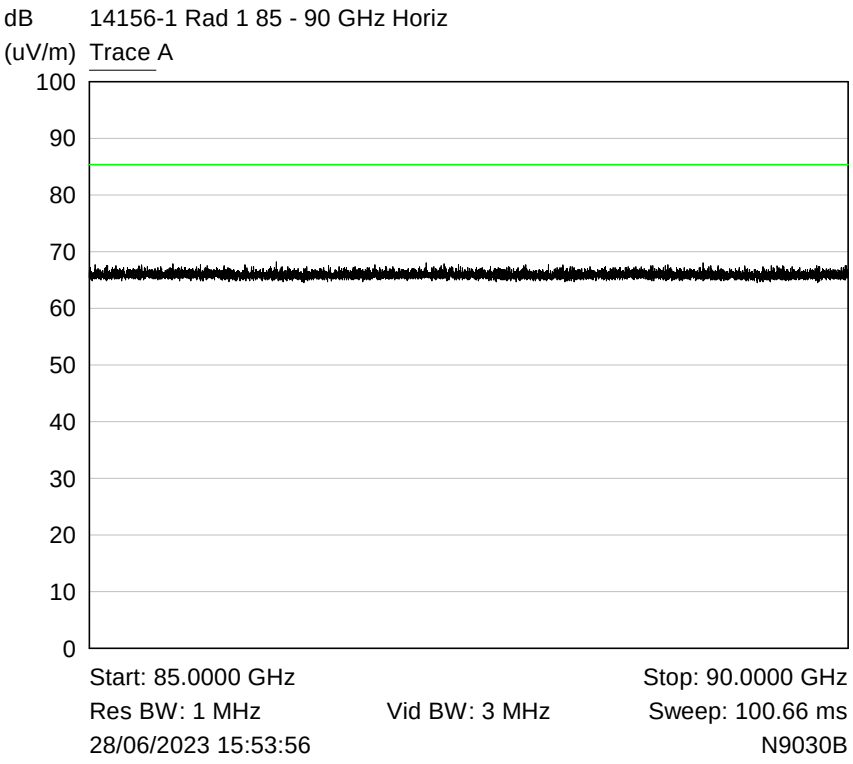


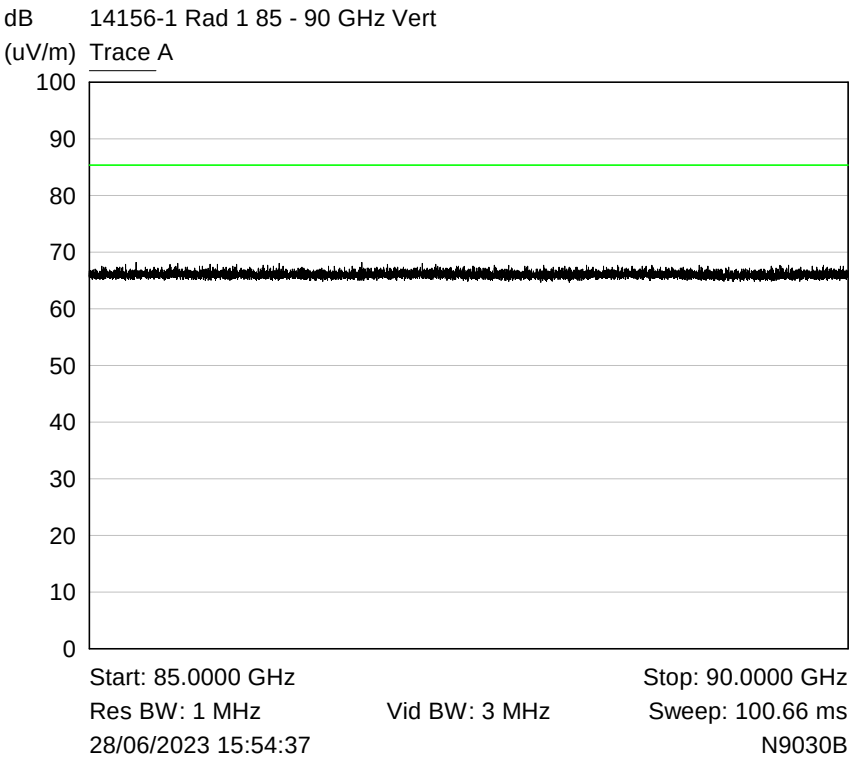


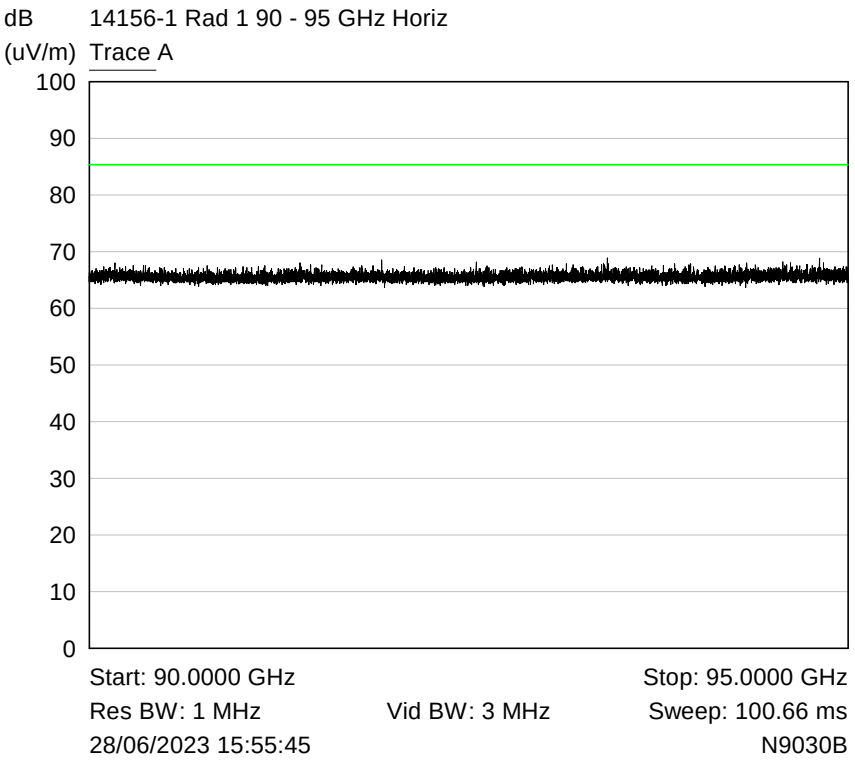


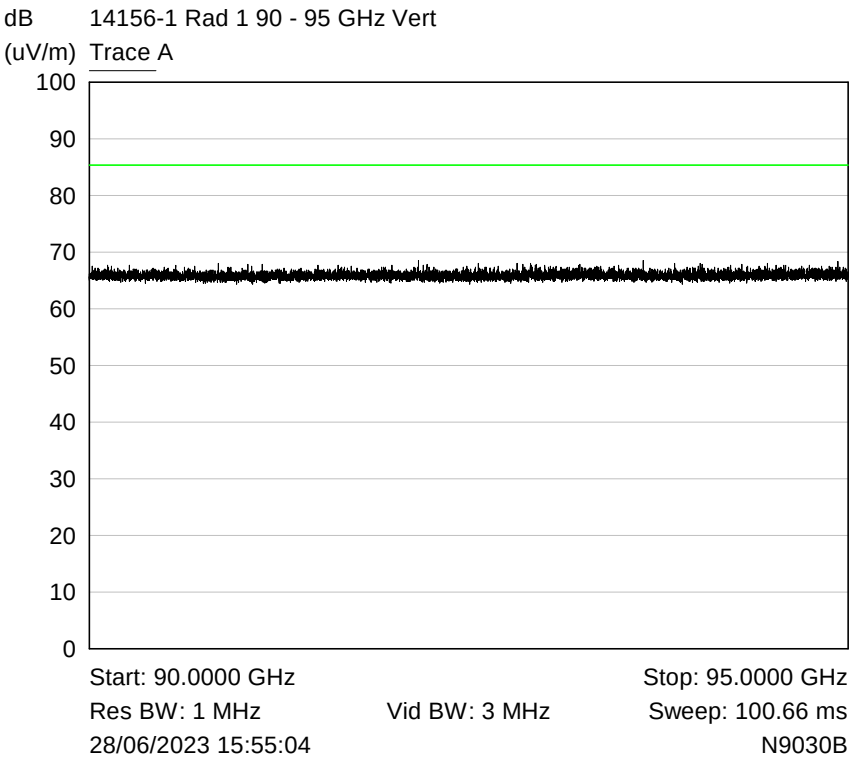


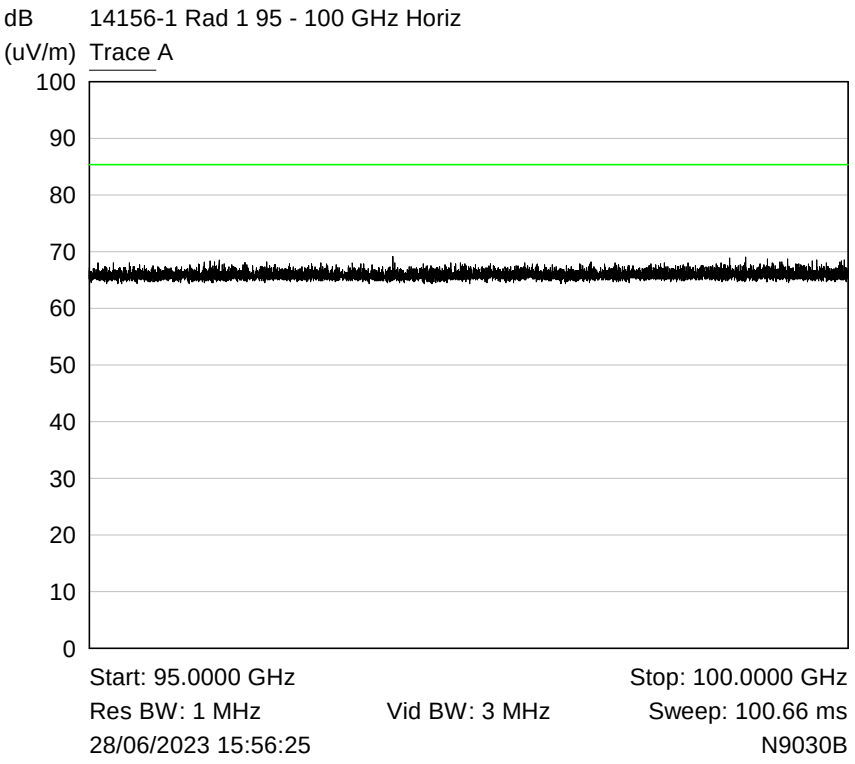


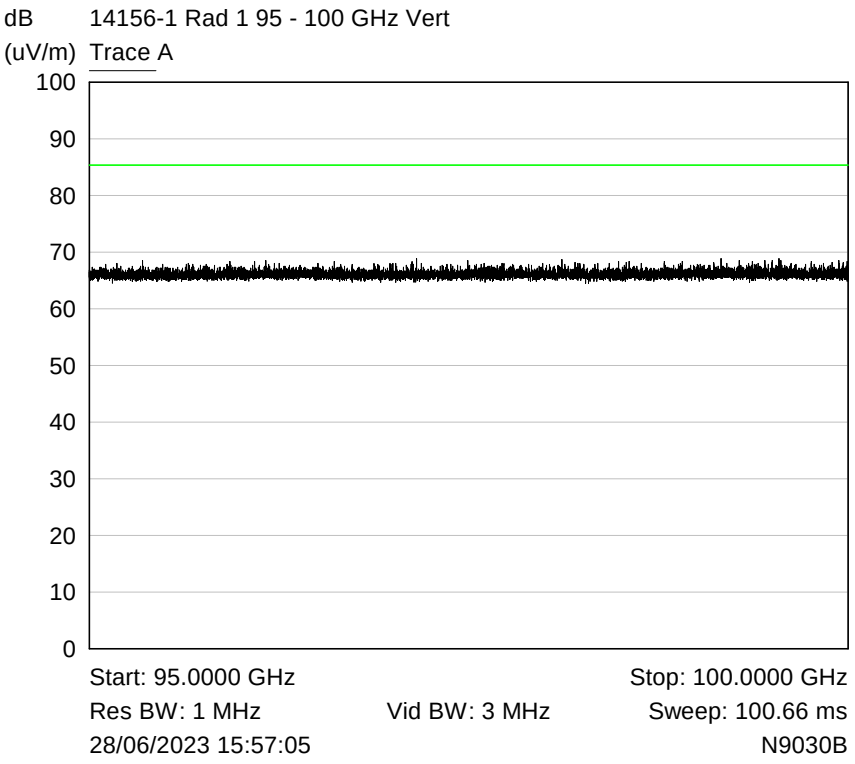


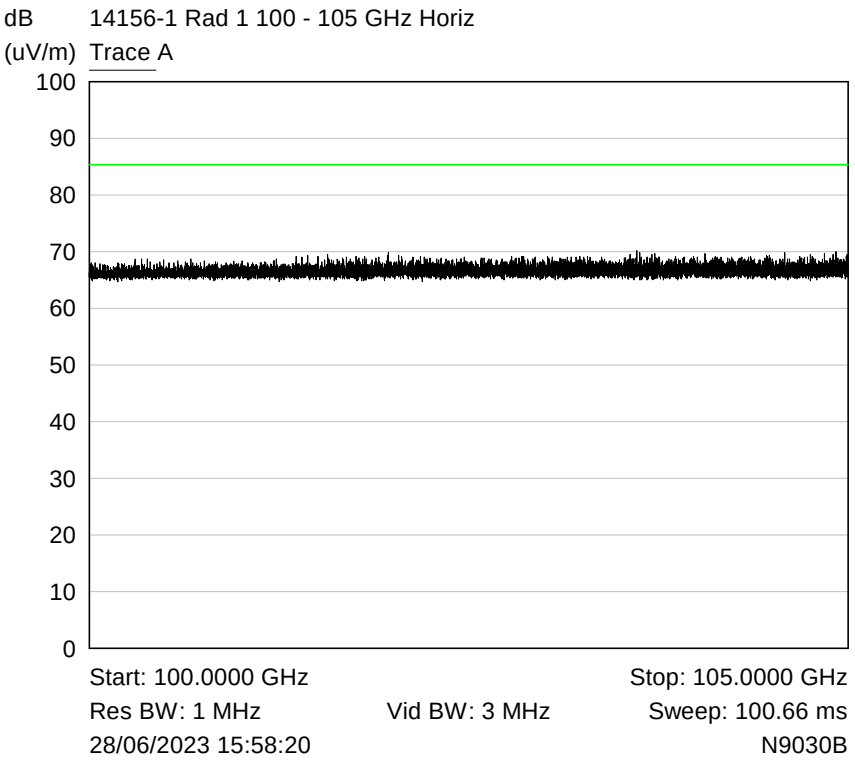


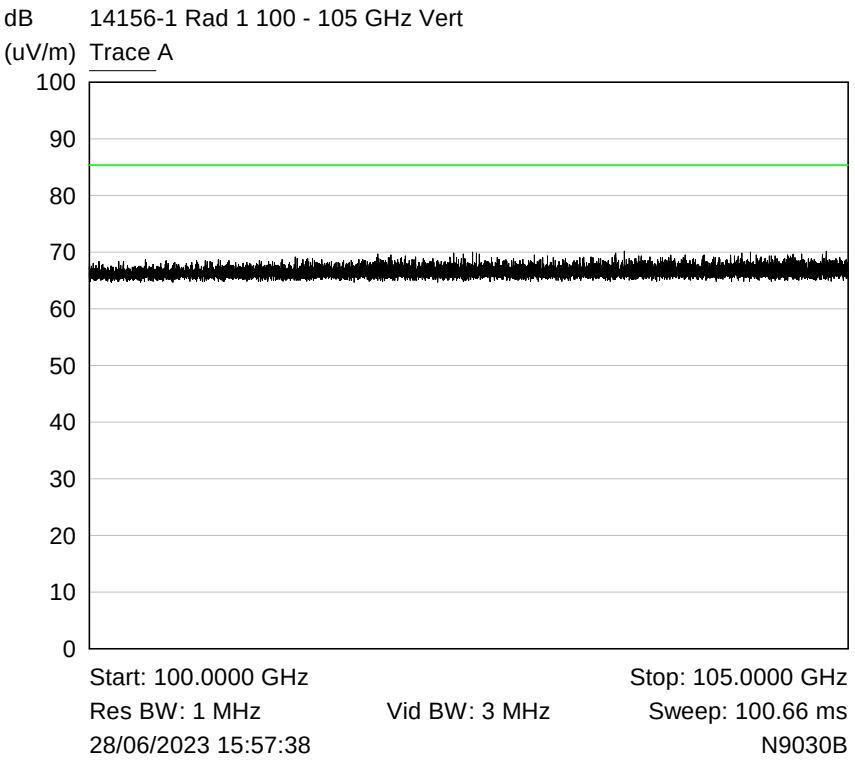


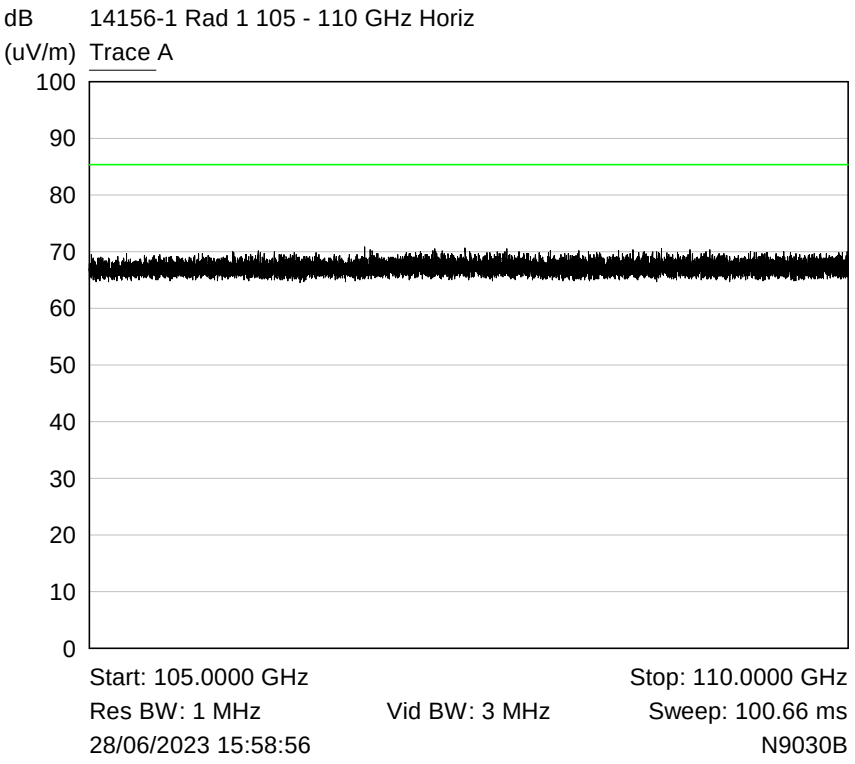


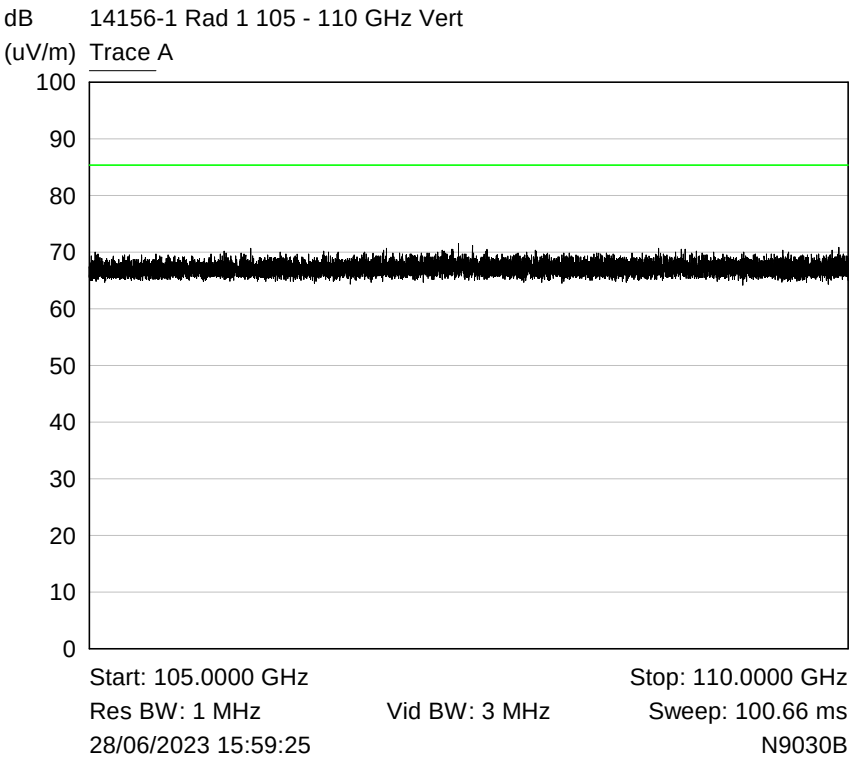


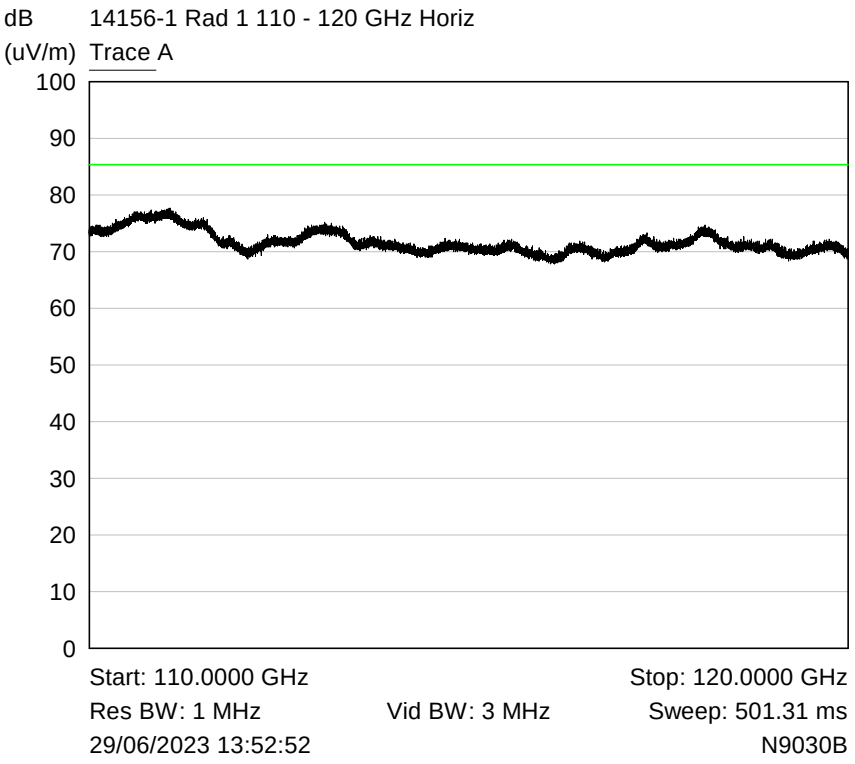


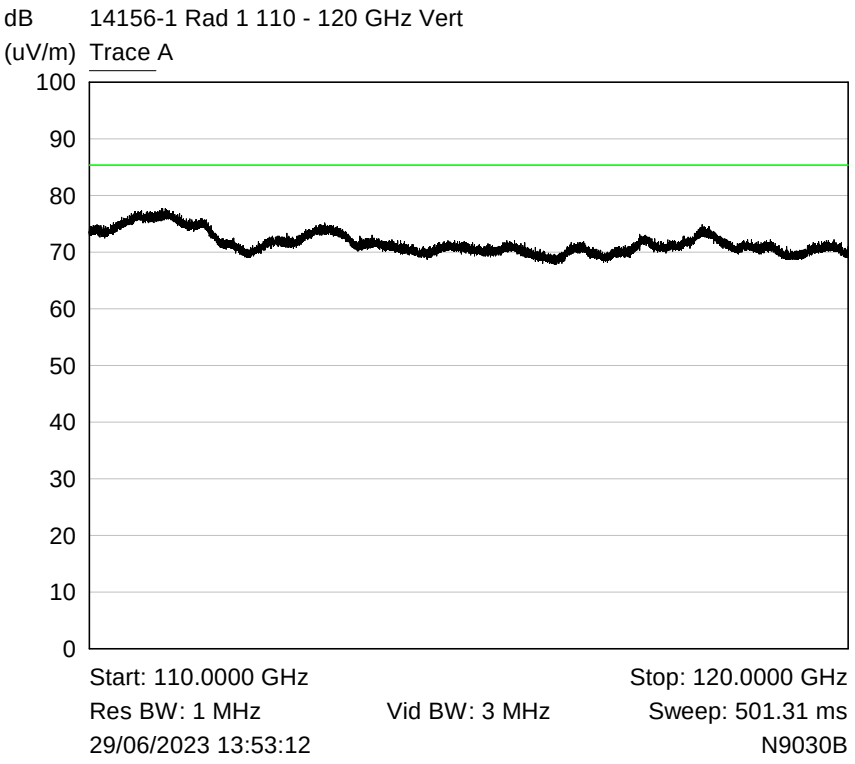


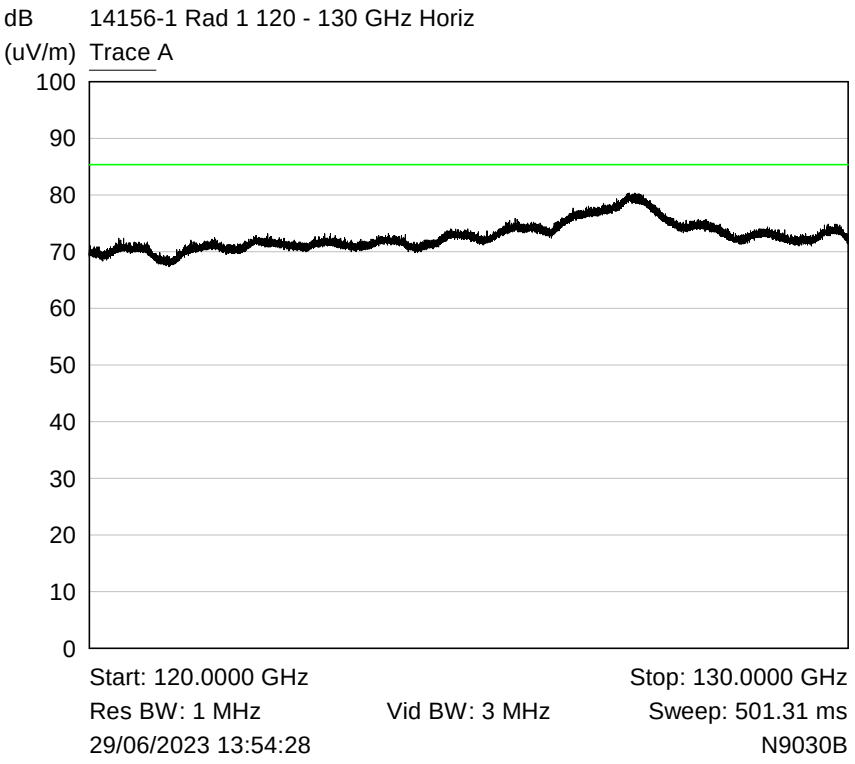


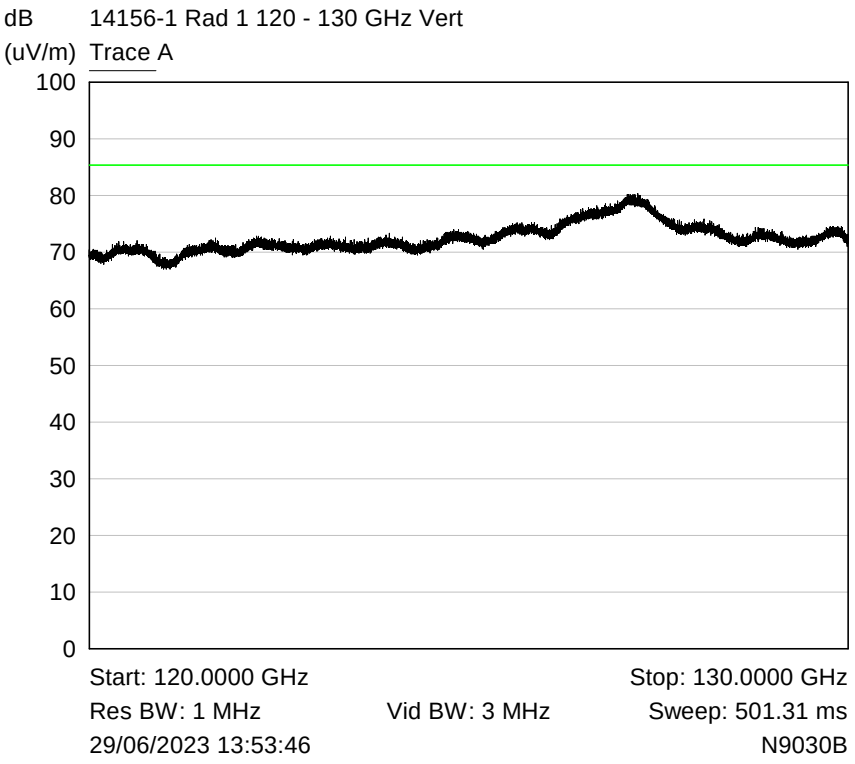


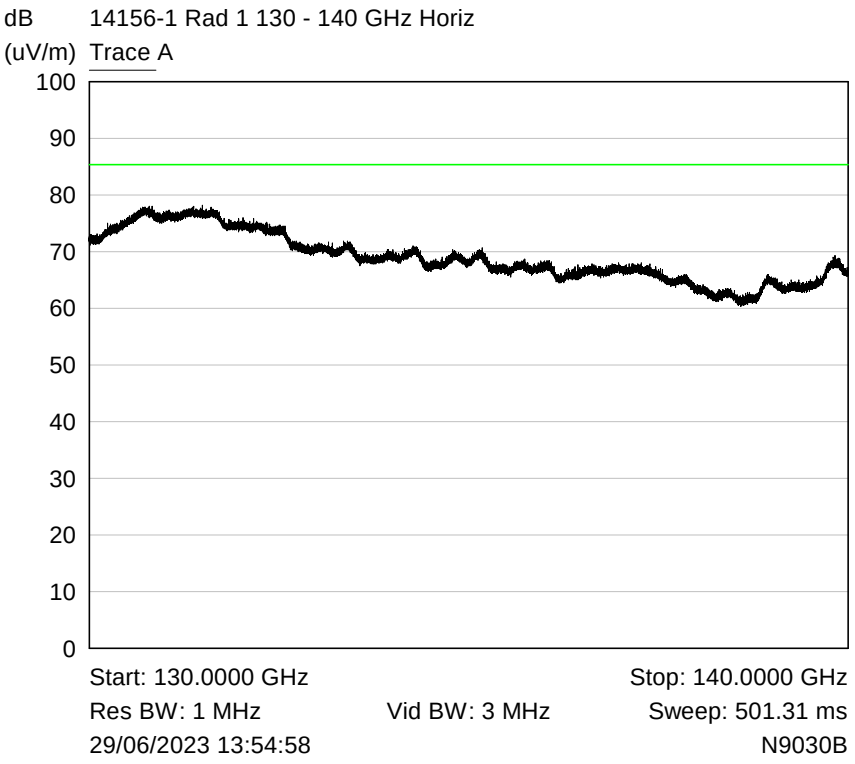


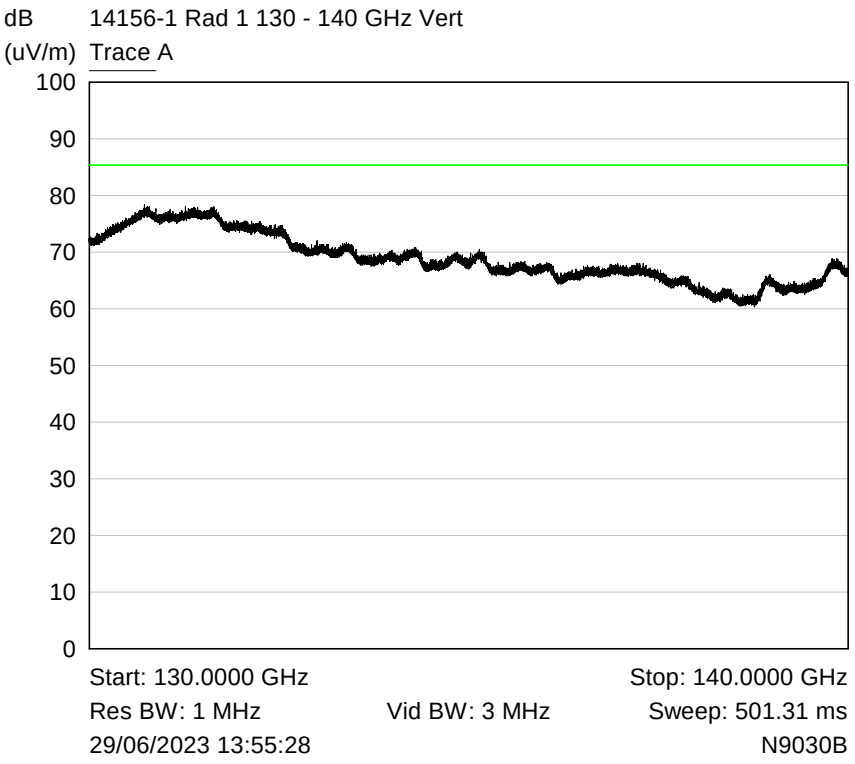


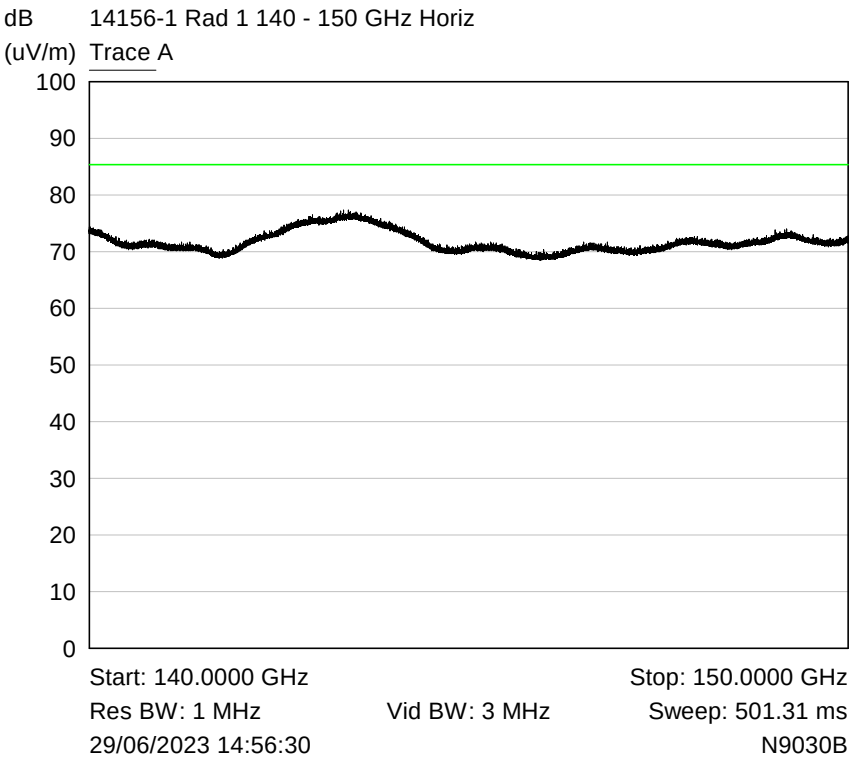


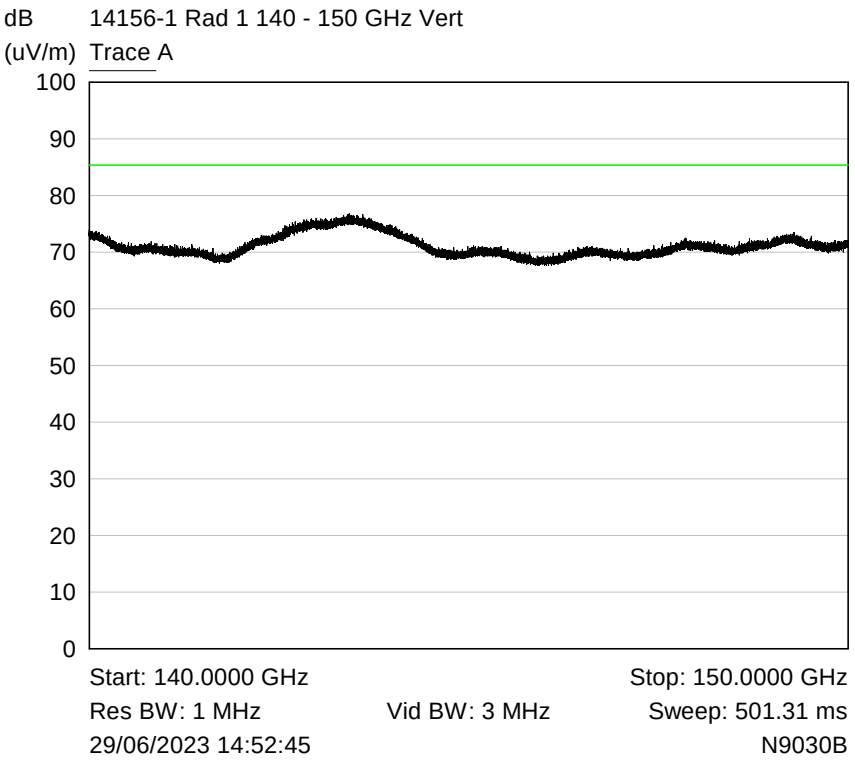


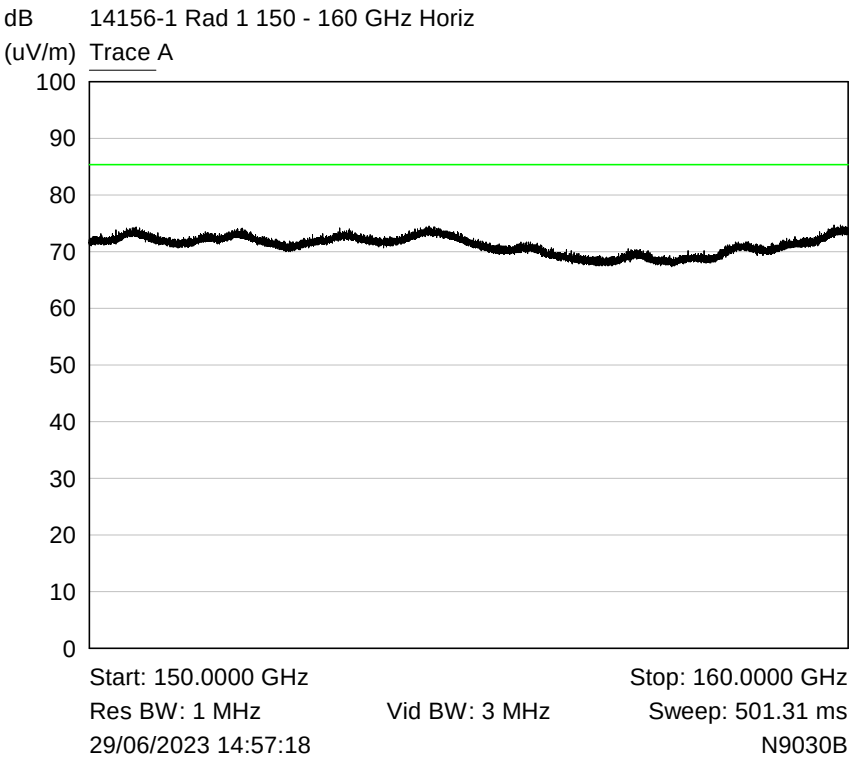


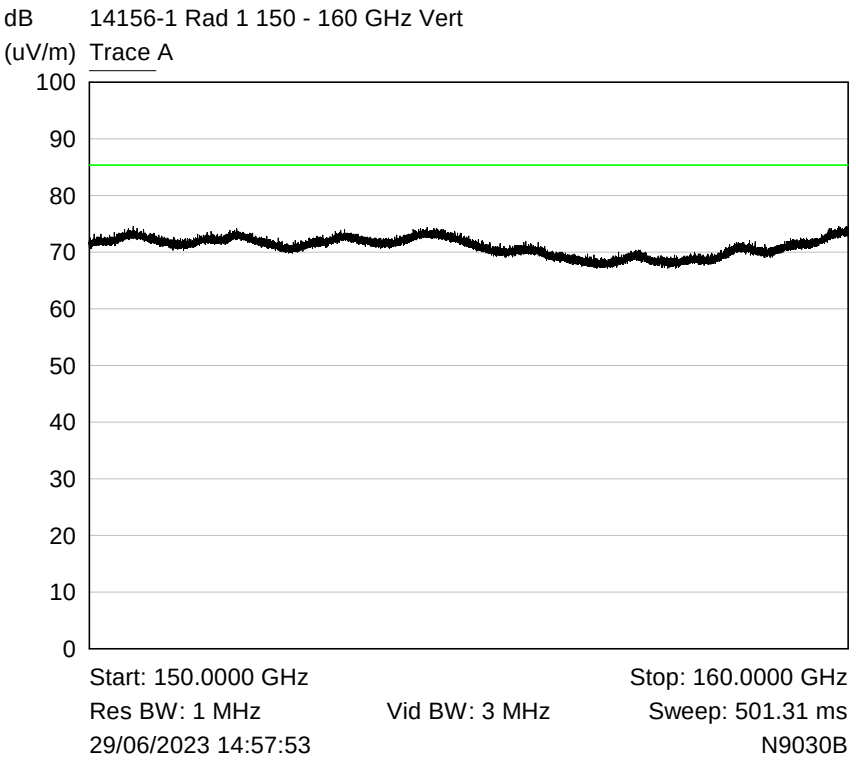


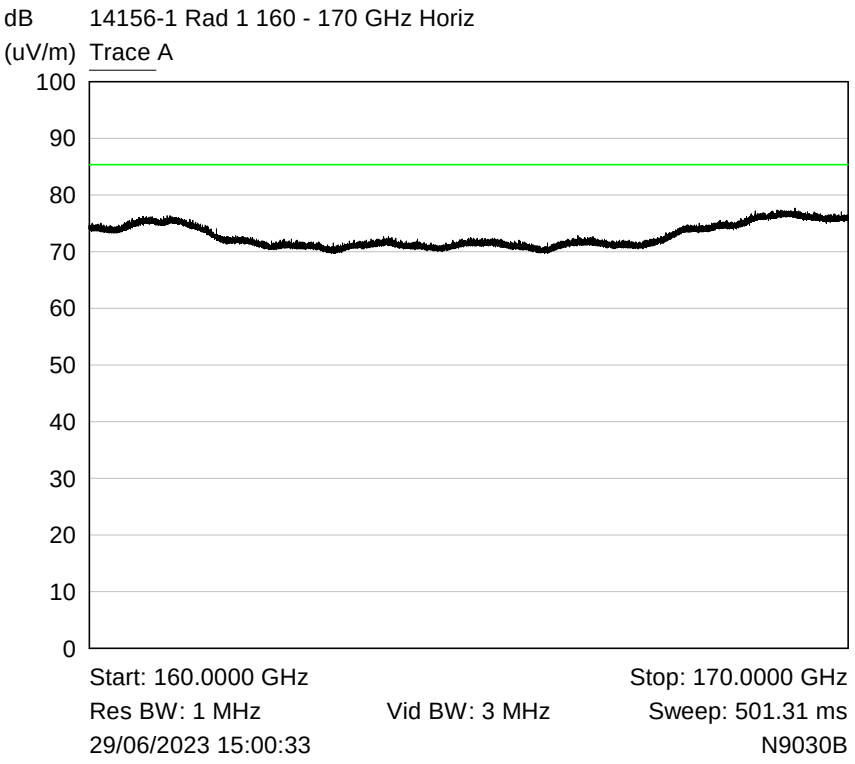


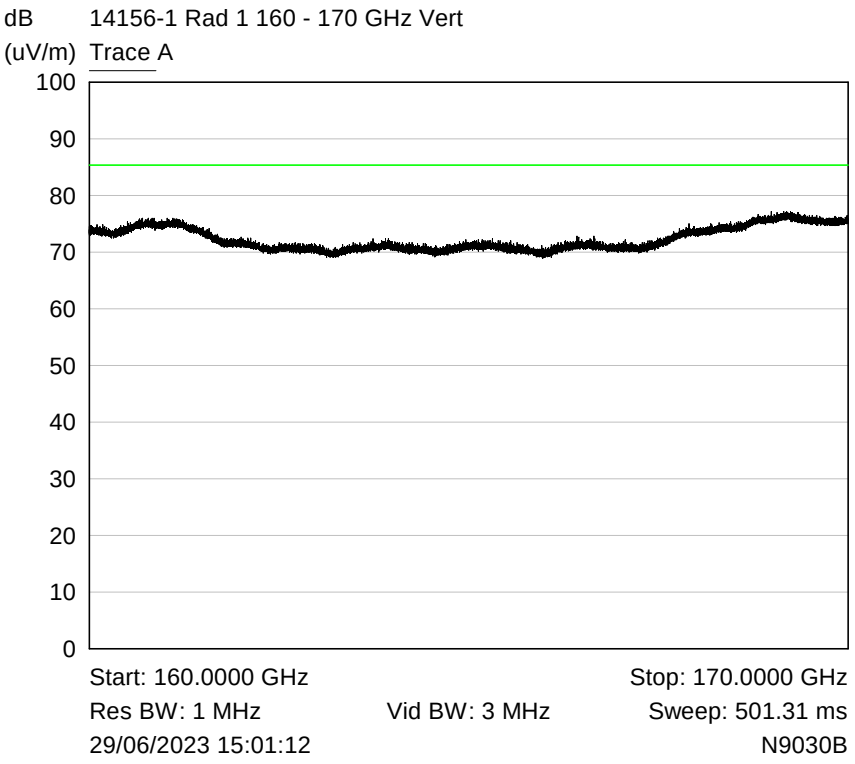


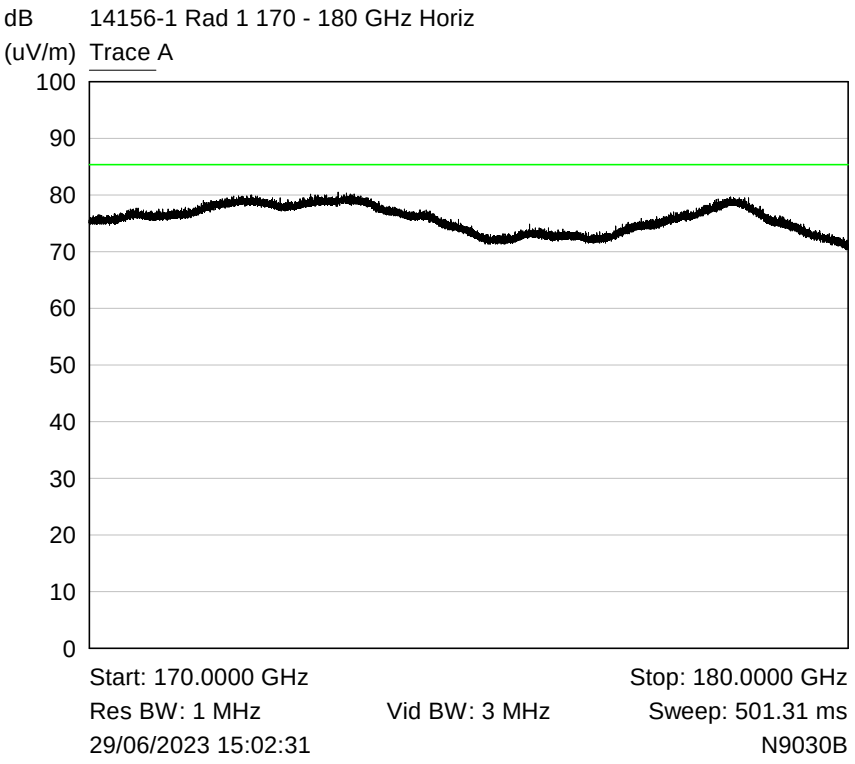


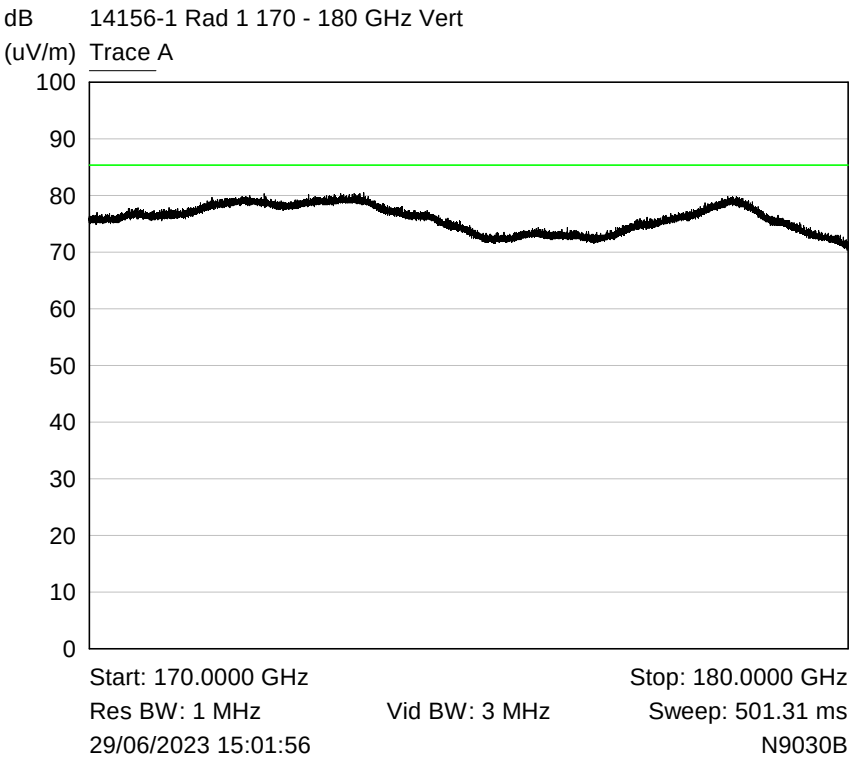


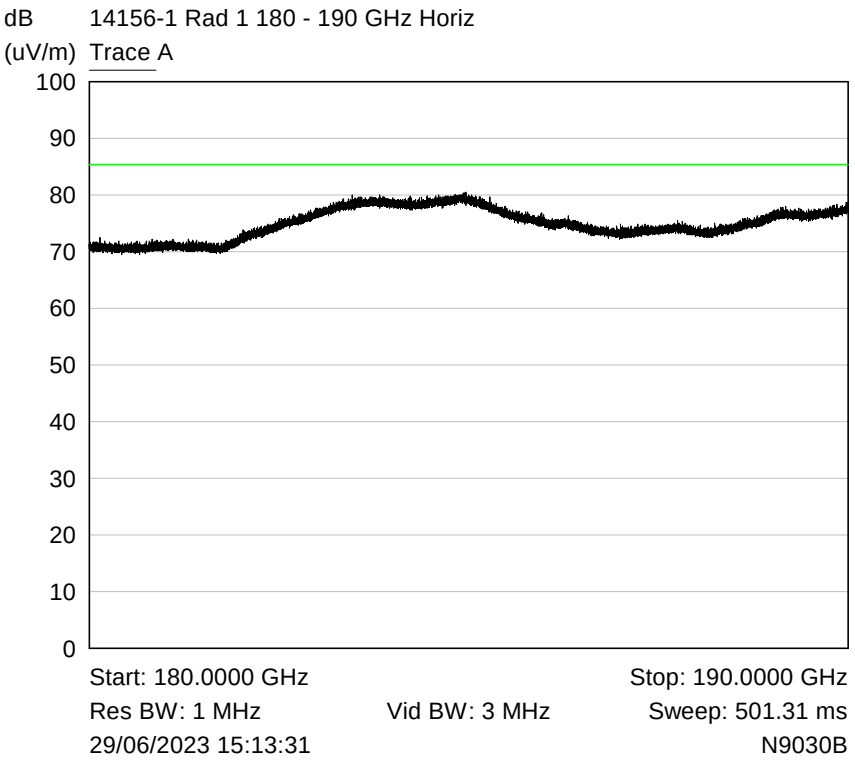


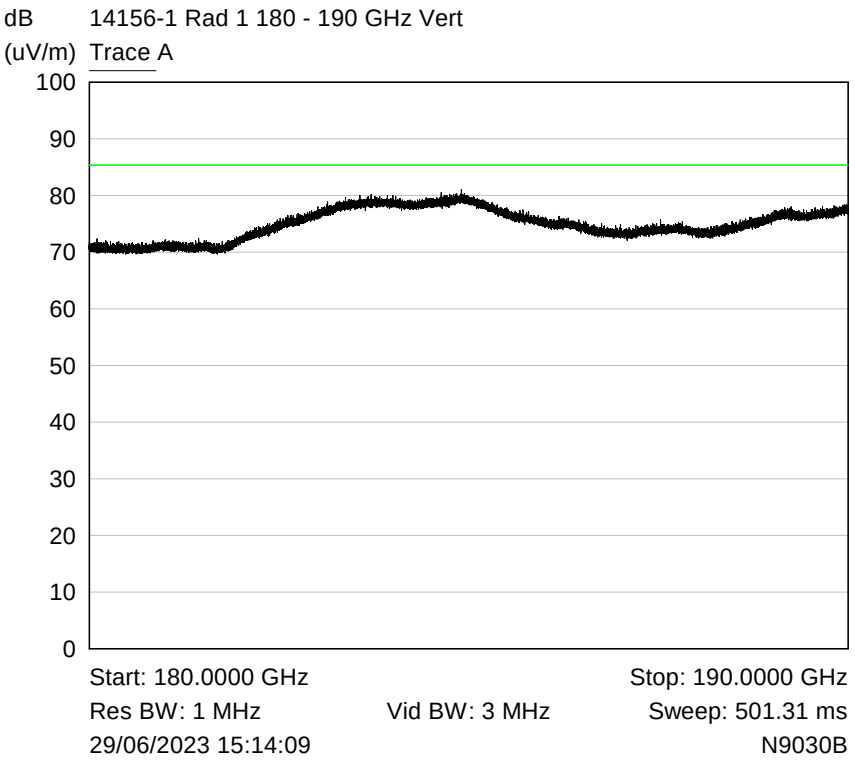


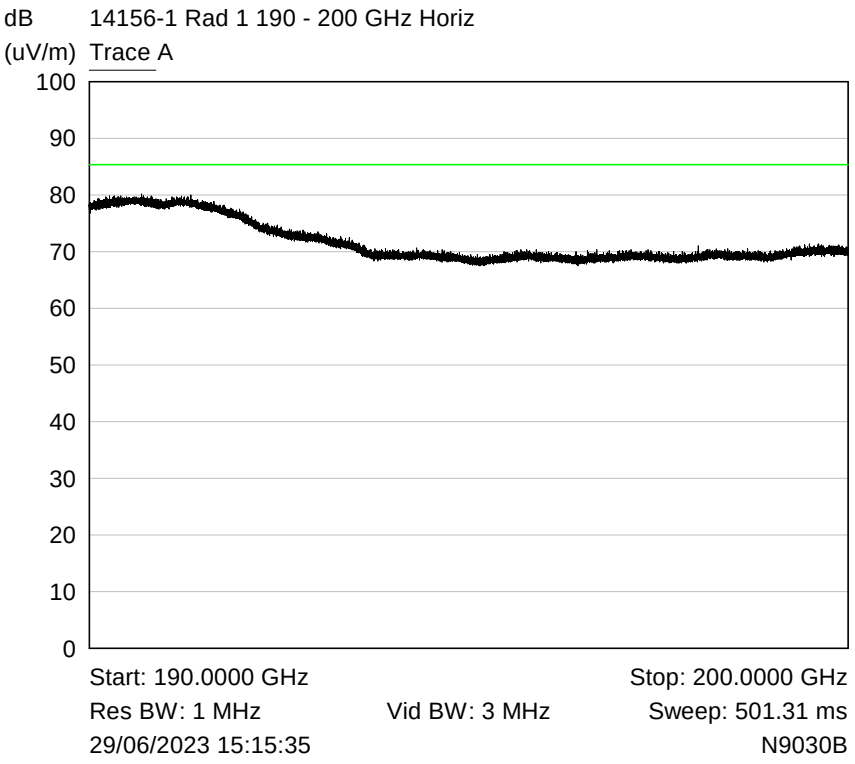


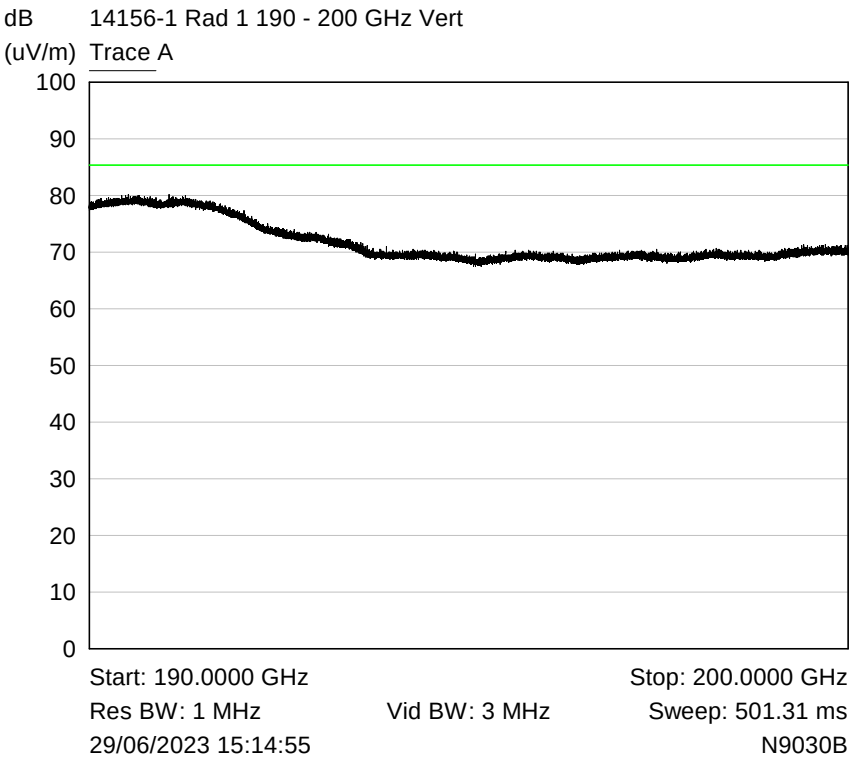










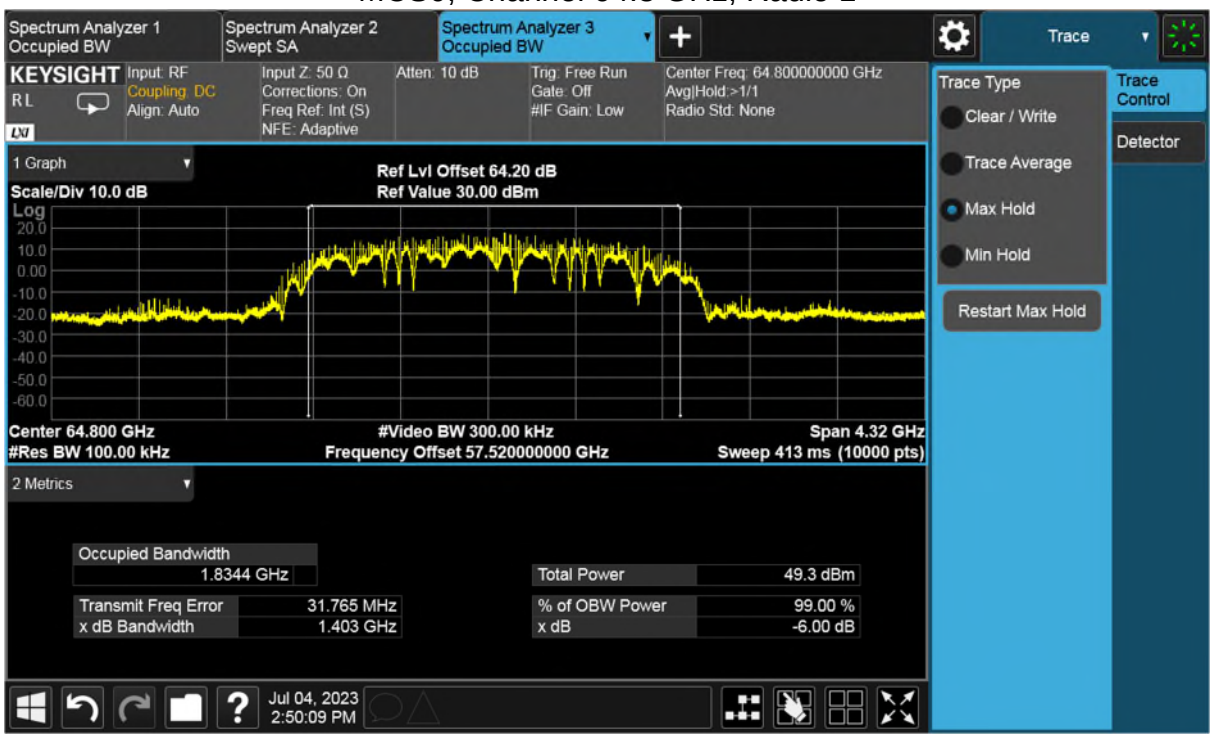


6.7 6dB Occupied bandwidth

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS0, Channel 58.32 GHz, Radio 1

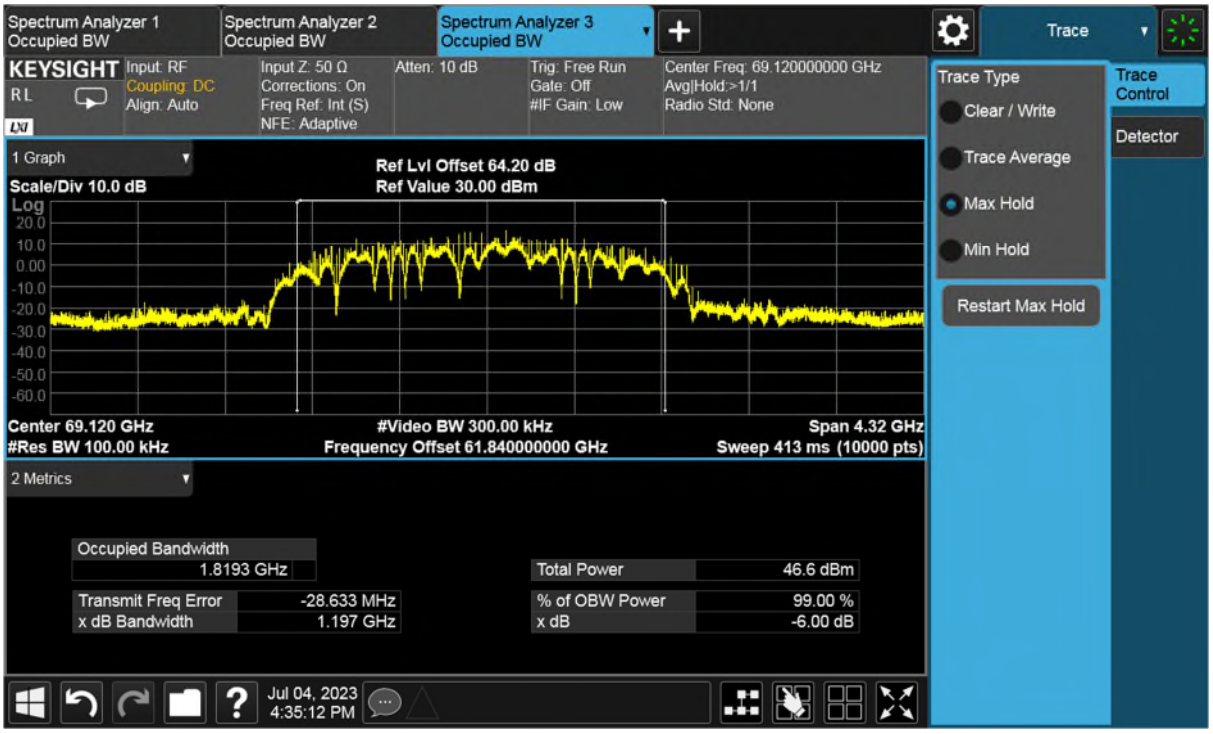
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS0, Channel 64.8 GHz, Radio 1



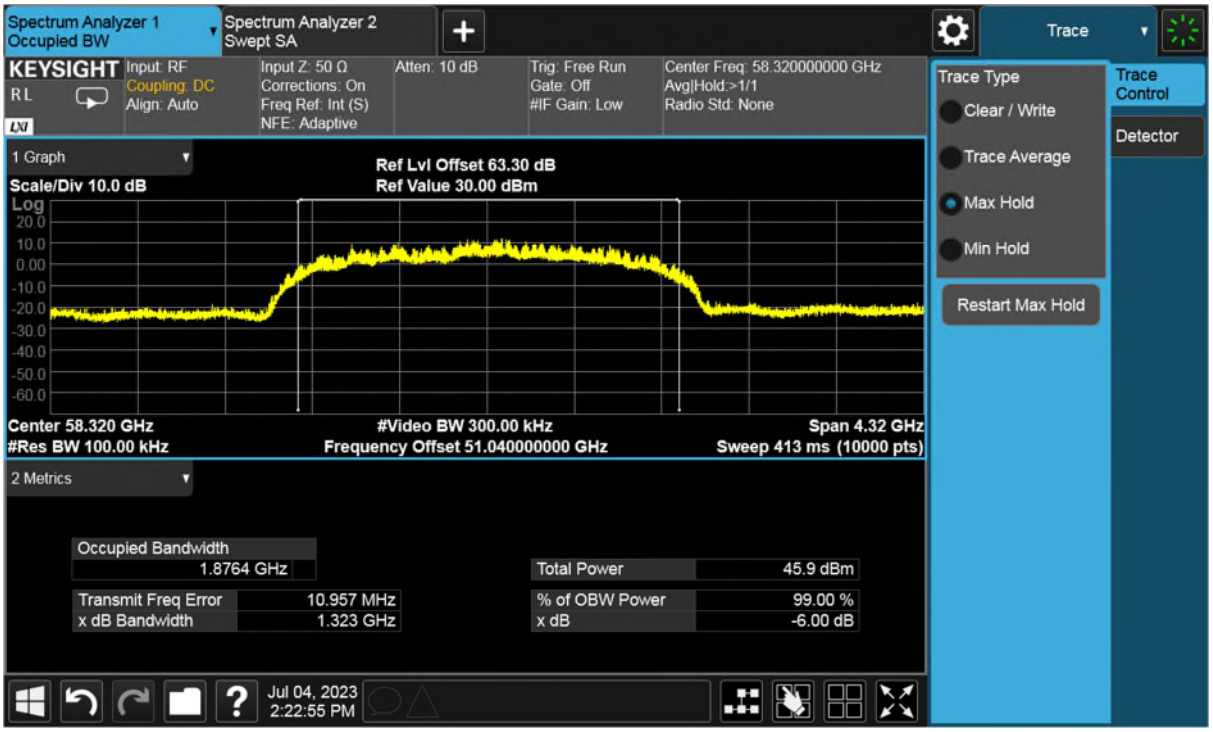
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS0, Channel 69.12 GHz, Radio 1



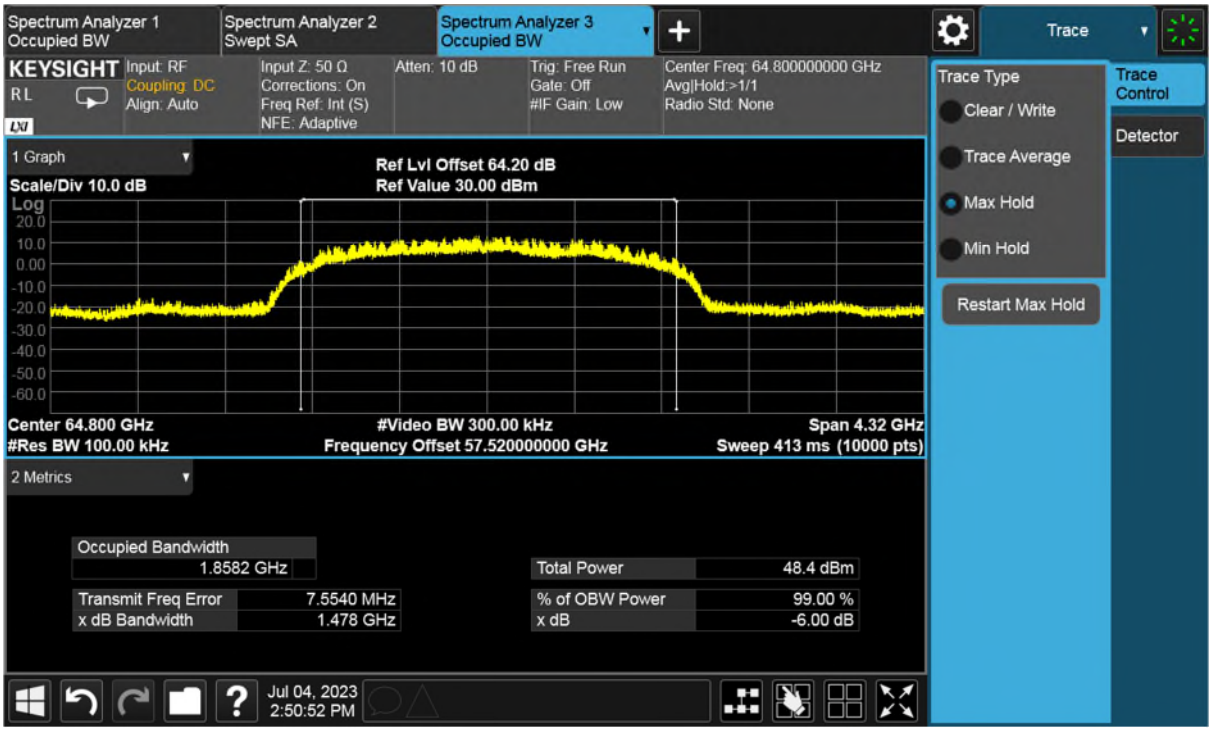
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS1, Channel 58.32 GHz, Radio 1



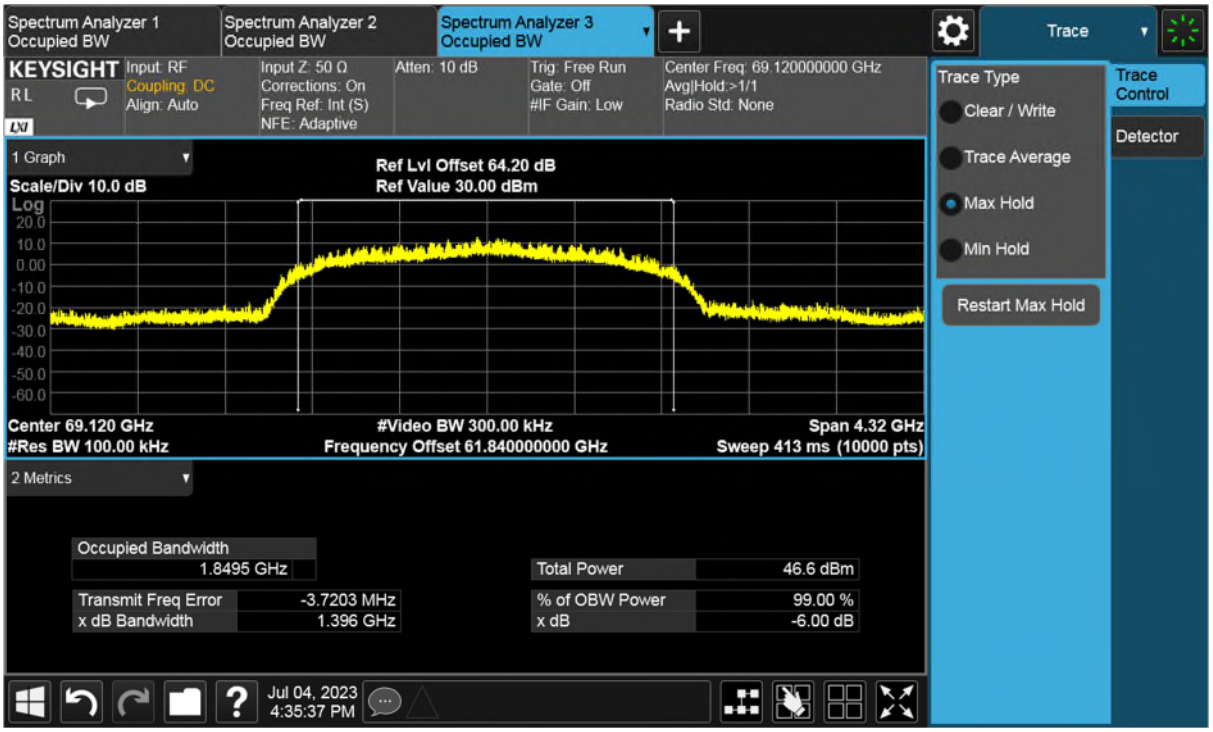
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS1, Channel 64.8 GHz, Radio 1



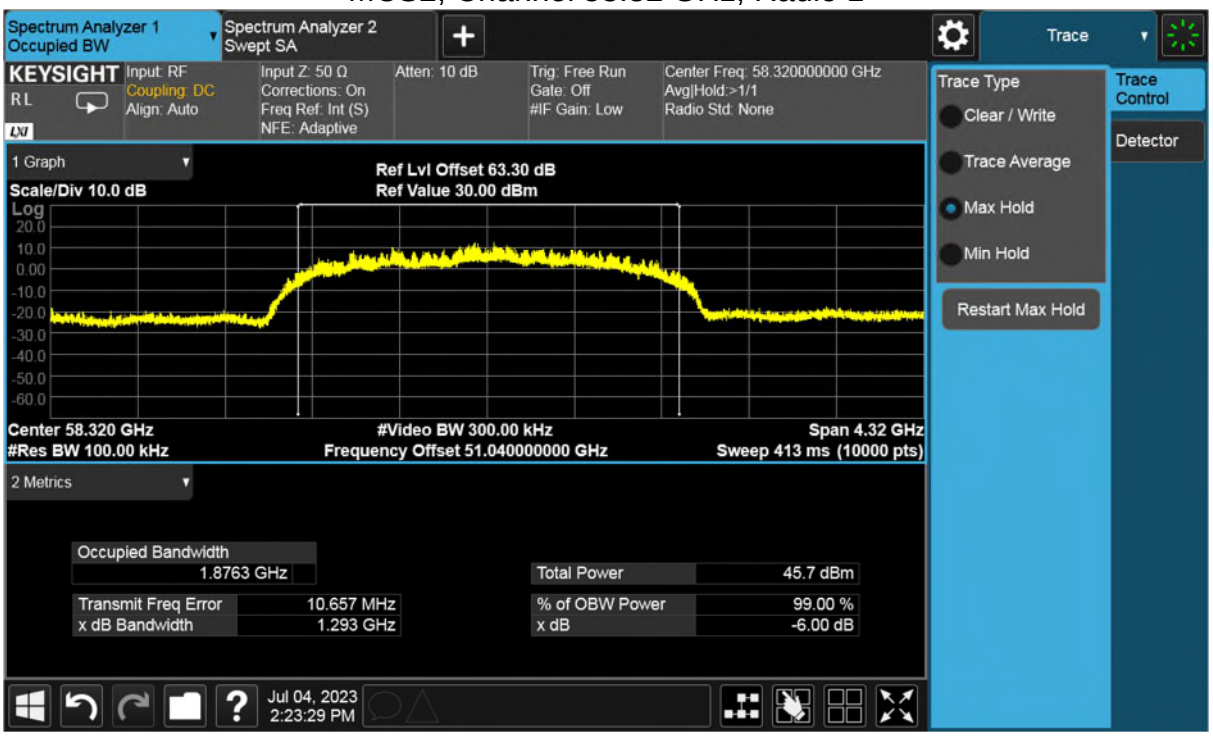
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS1, Channel 69.12 GHz, Radio 1



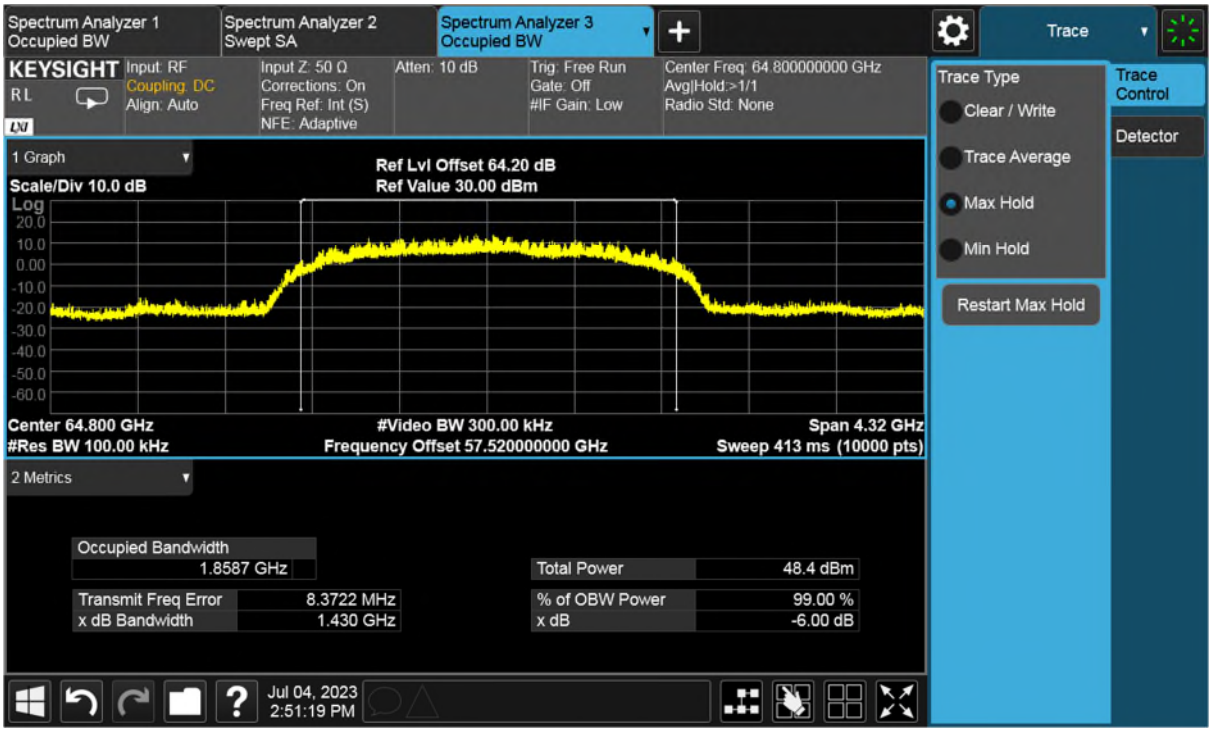
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS2, Channel 58.32 GHz, Radio 1



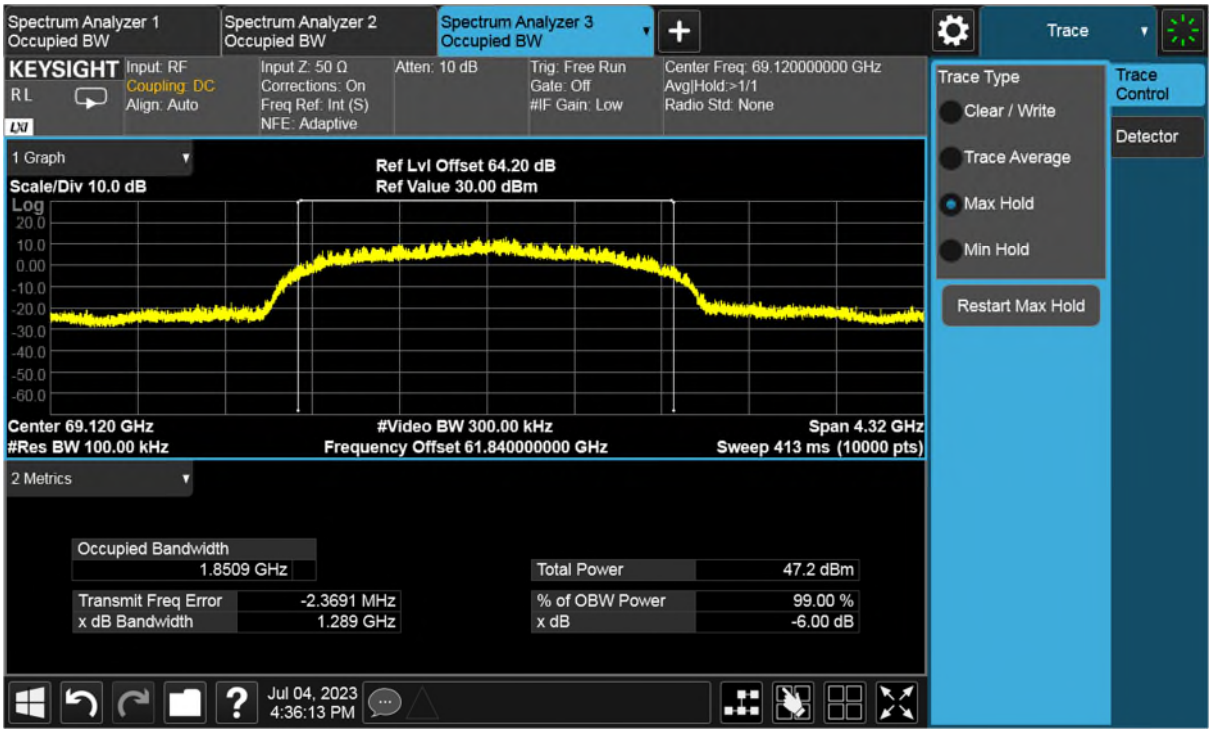
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS2, Channel 64.8 GHz, Radio 1



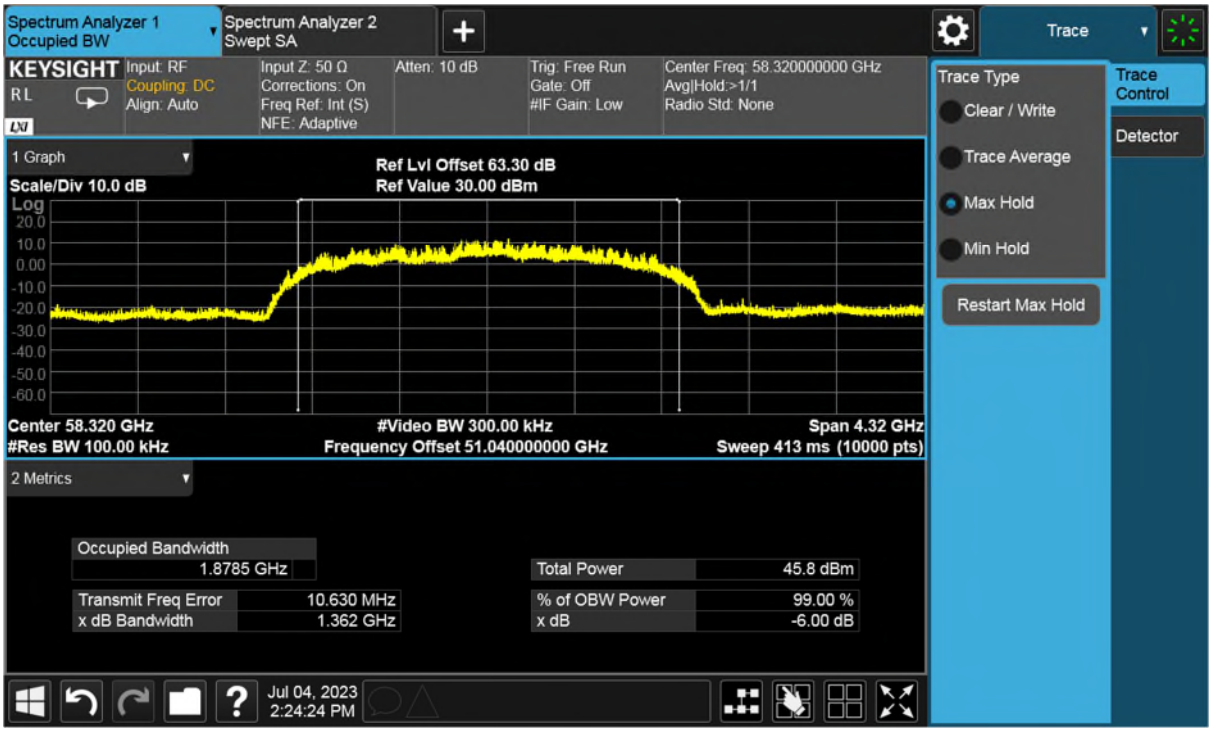
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS2, Channel 69.12 GHz, Radio 1



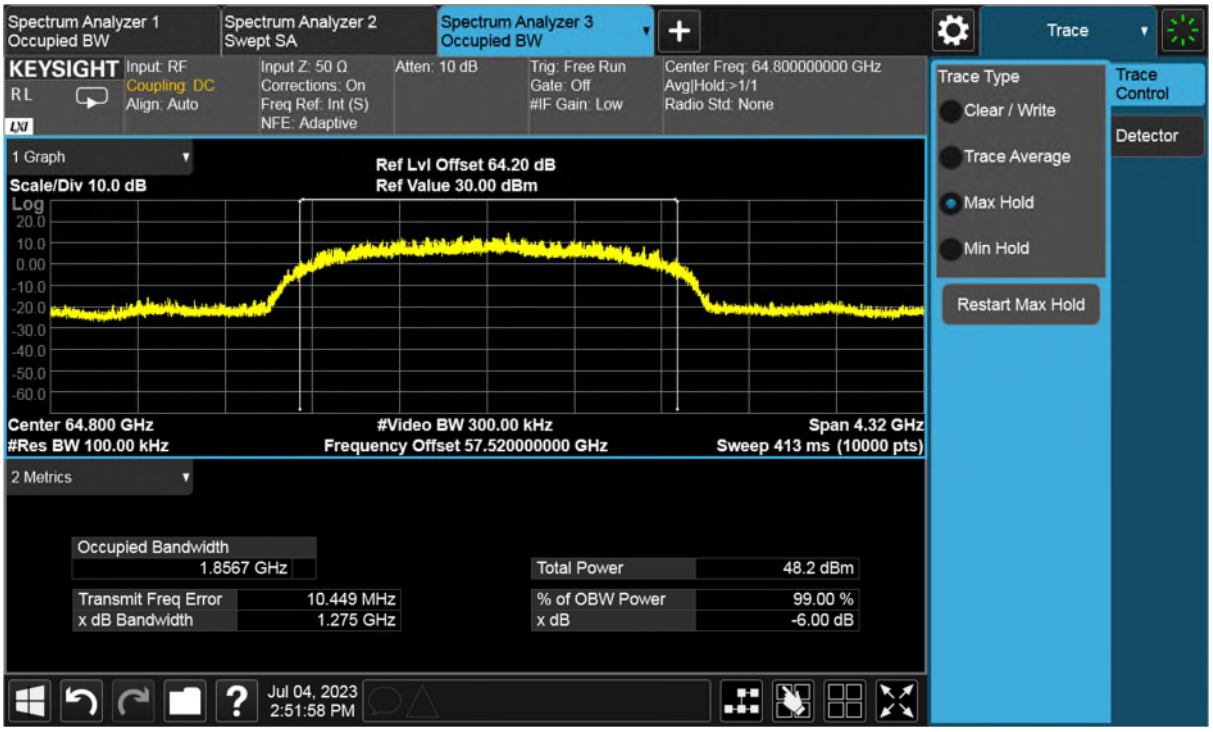
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS3, Channel 58.32 GHz, Radio 1



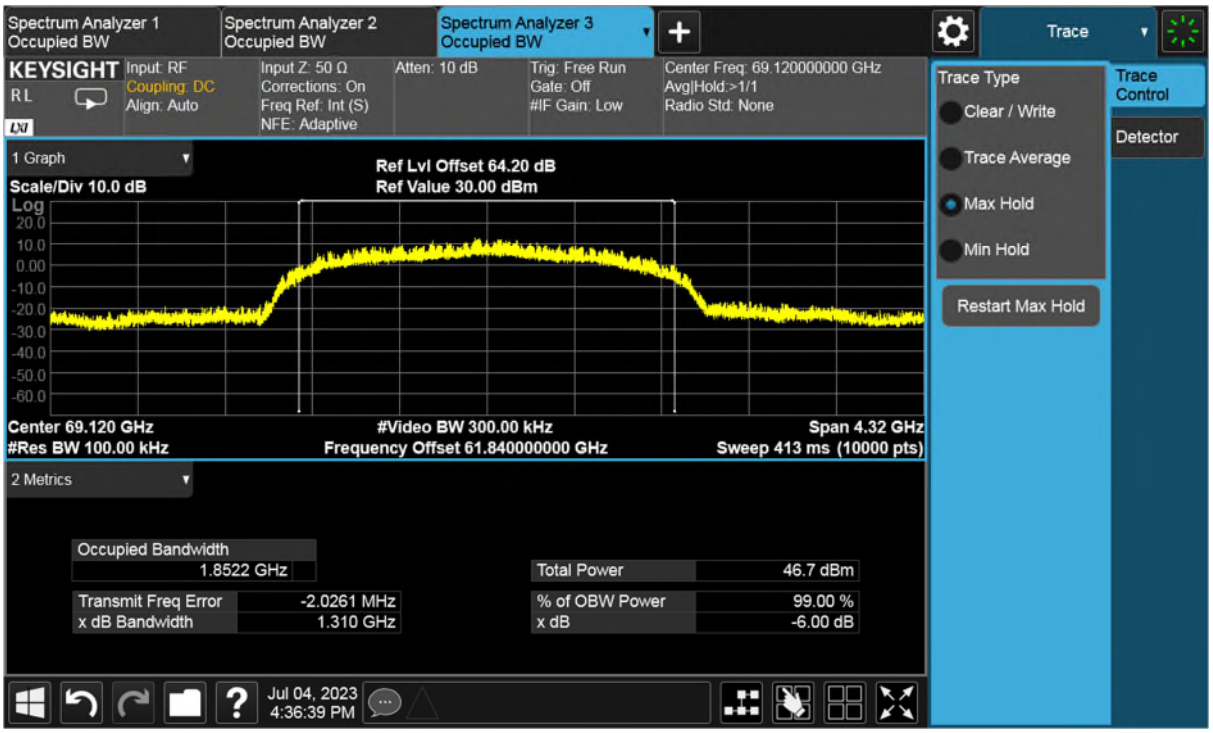
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS3, Channel 64.8 GHz, Radio 1



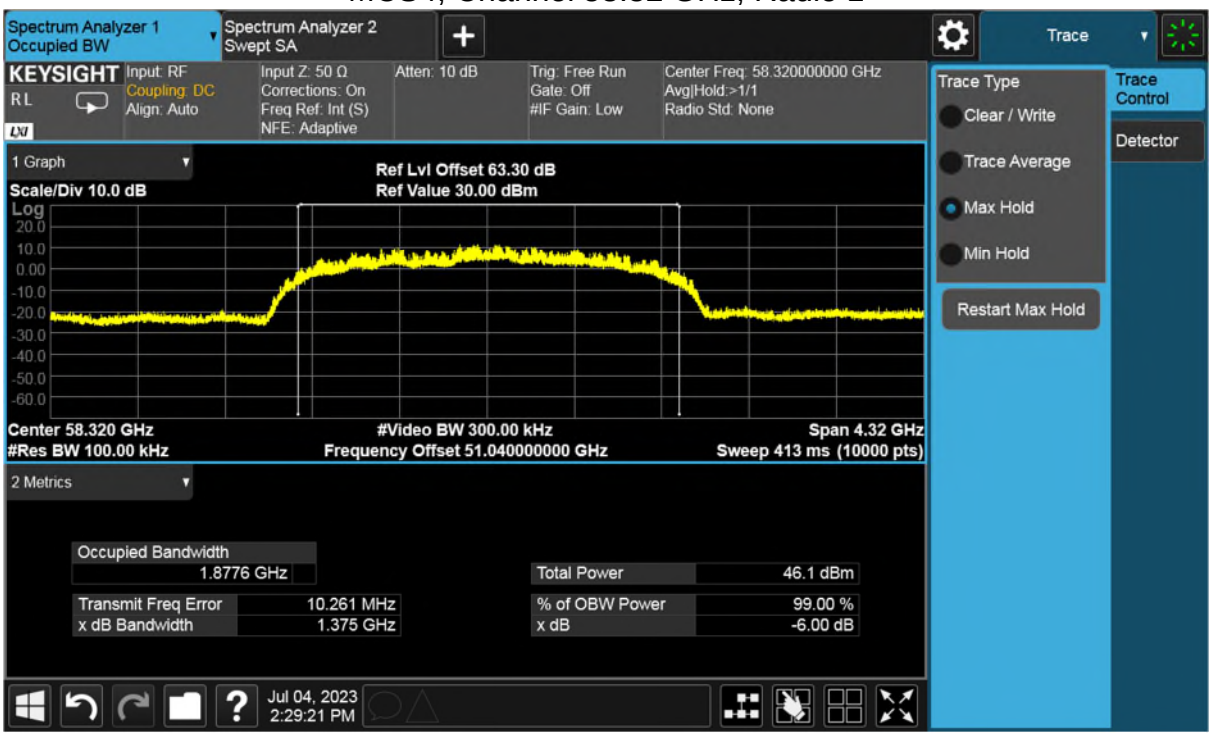
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS3, Channel 69.12 GHz, Radio 1



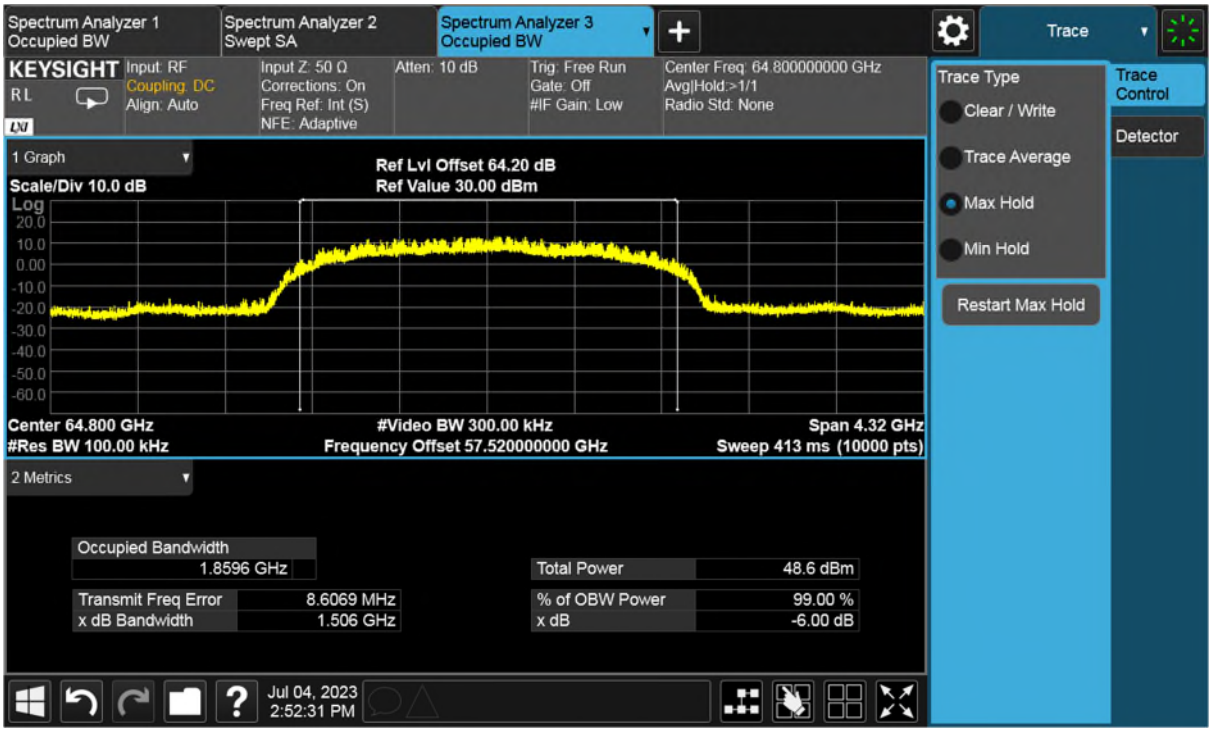
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS4, Channel 58.32 GHz, Radio 1



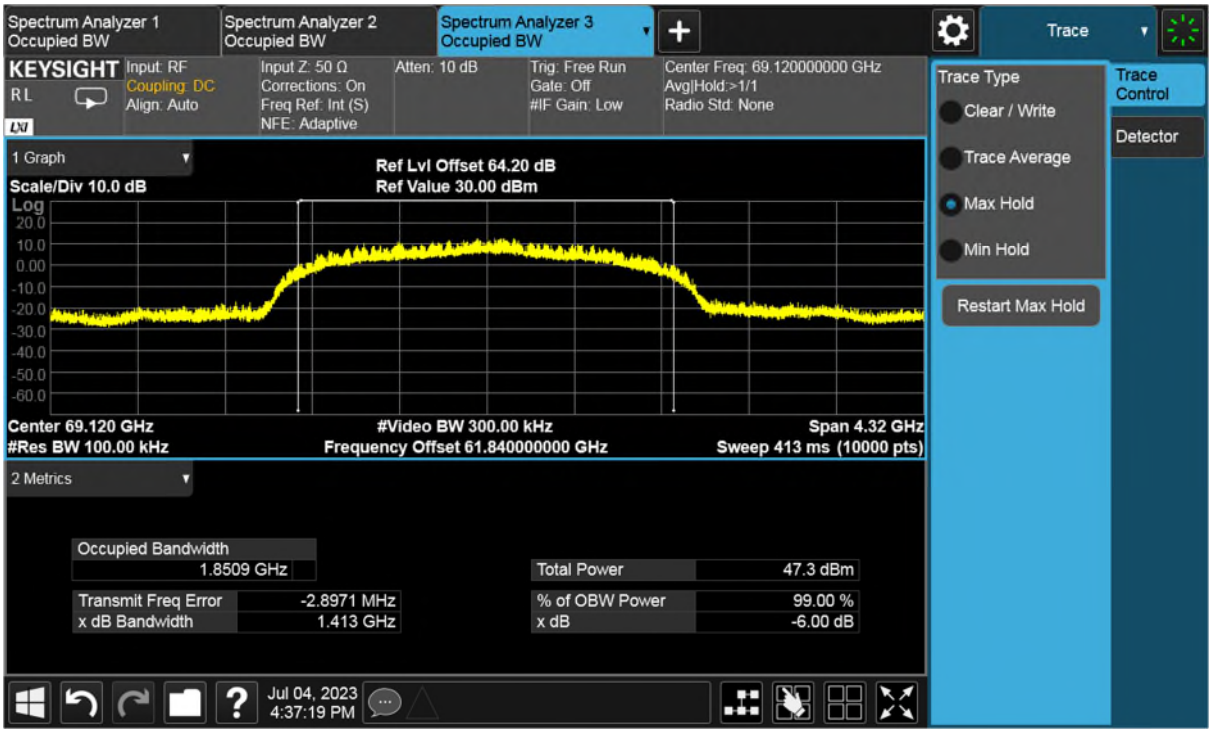
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS4, Channel 64.8 GHz, Radio 1



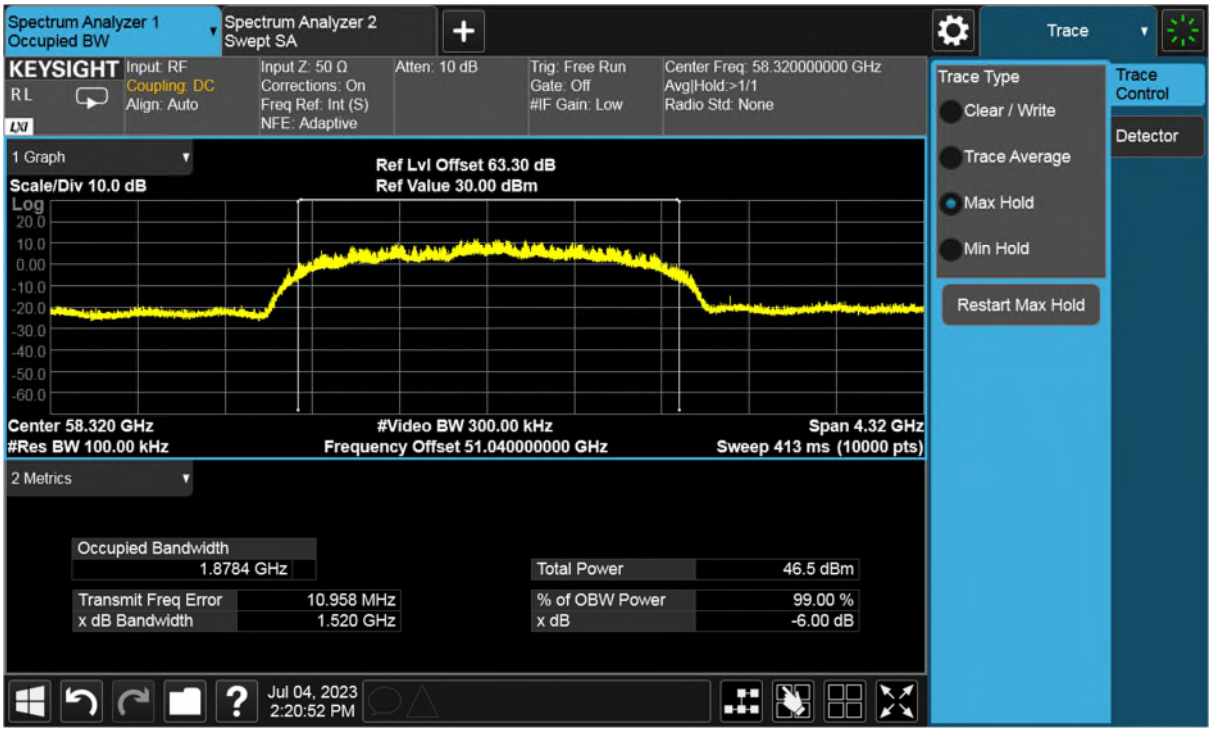
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS4, Channel 69.12 GHz, Radio 1



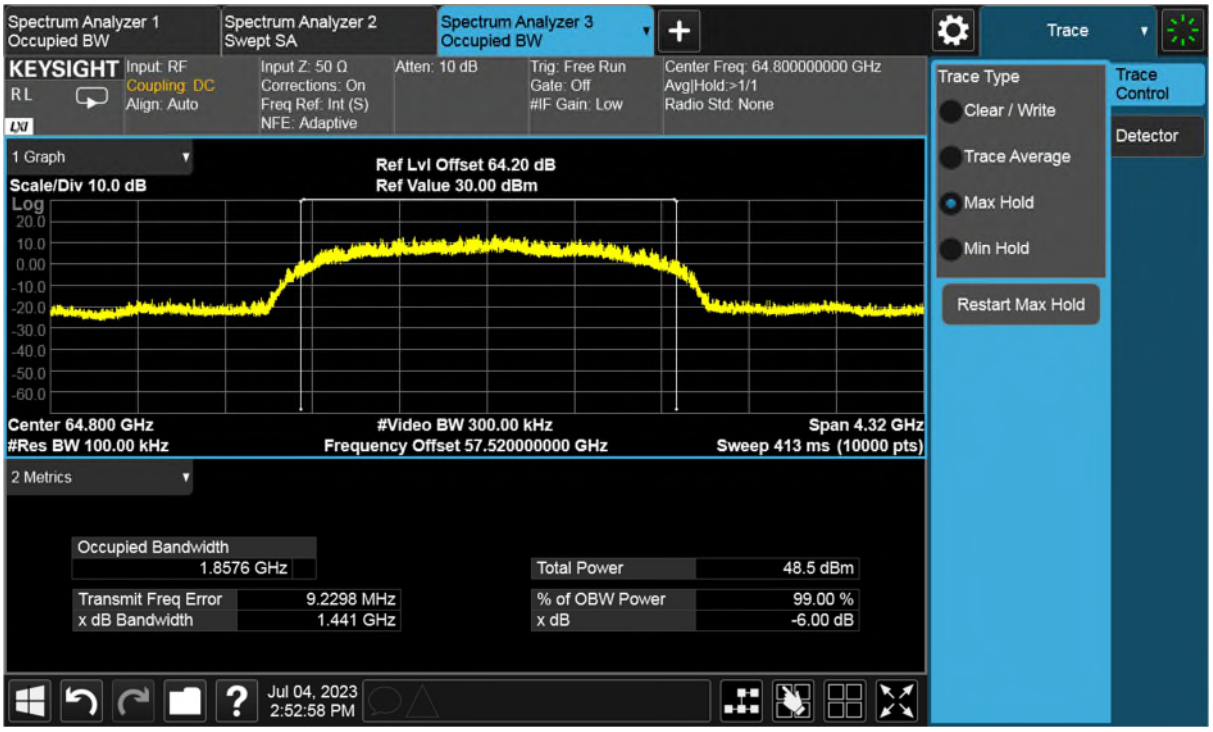
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS5, Channel 58.32 GHz, Radio 1



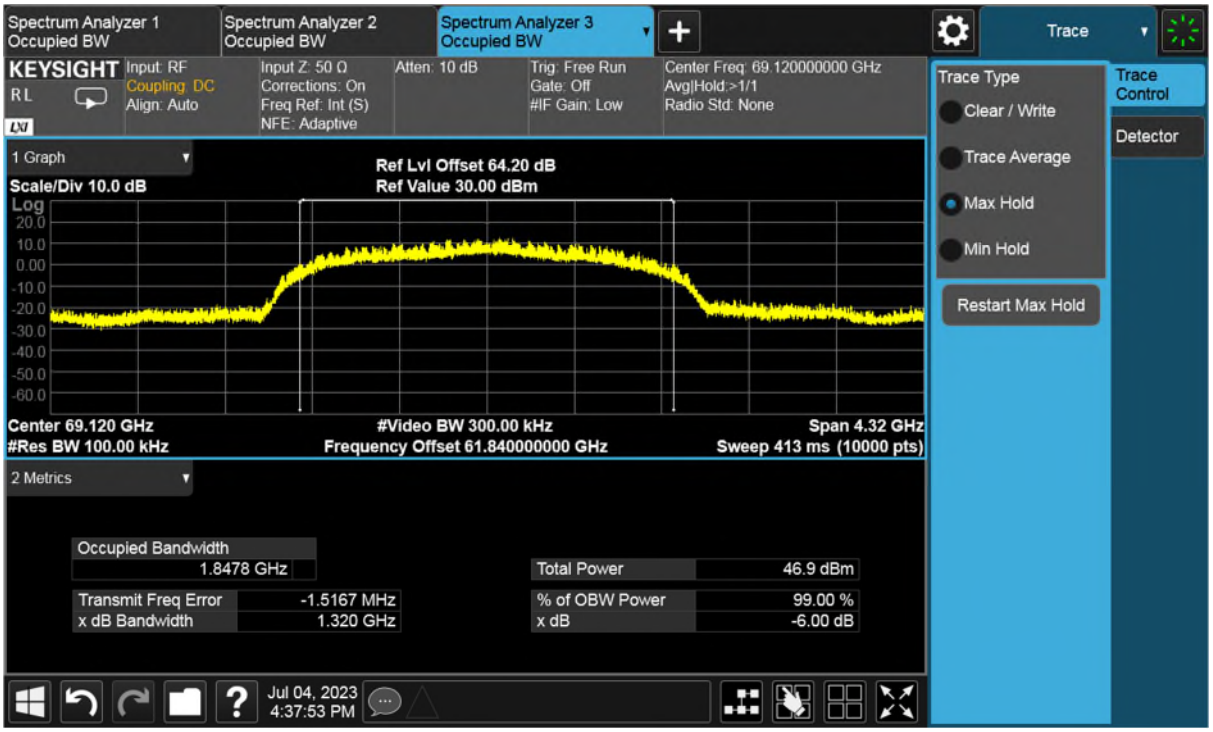
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS5, Channel 64.8 GHz, Radio 1



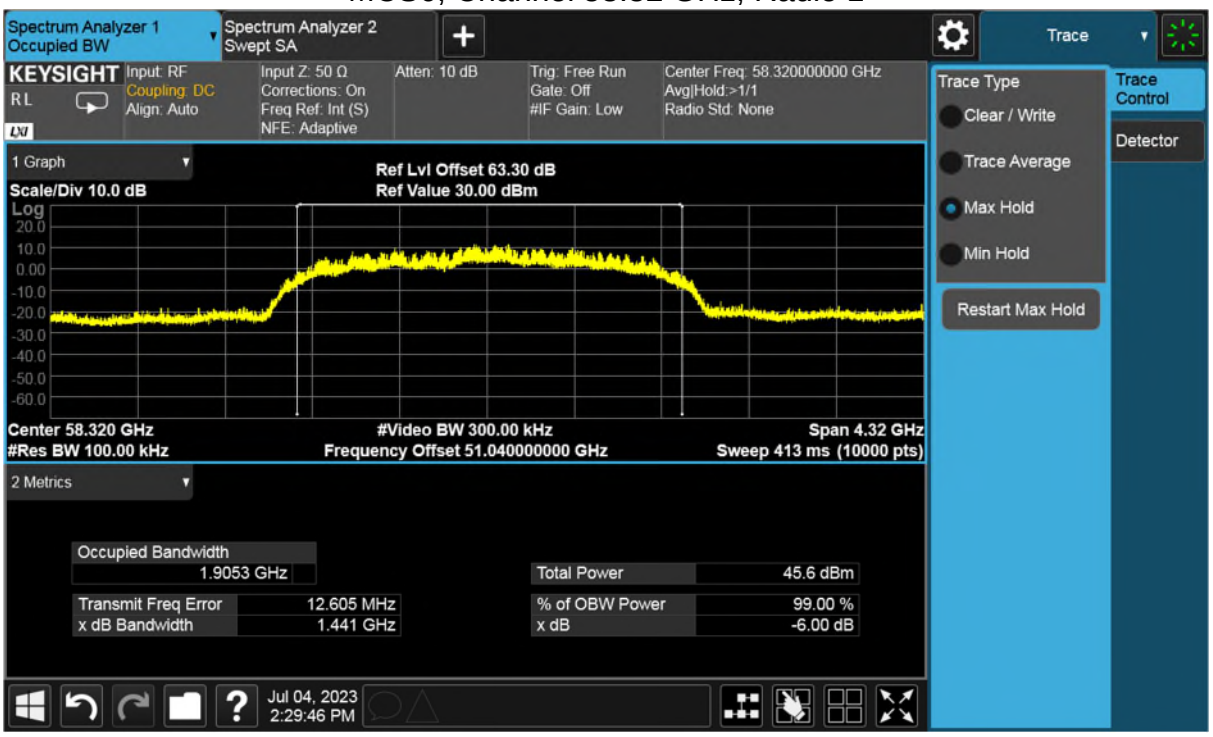
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS5, Channel 69.12 GHz, Radio 1



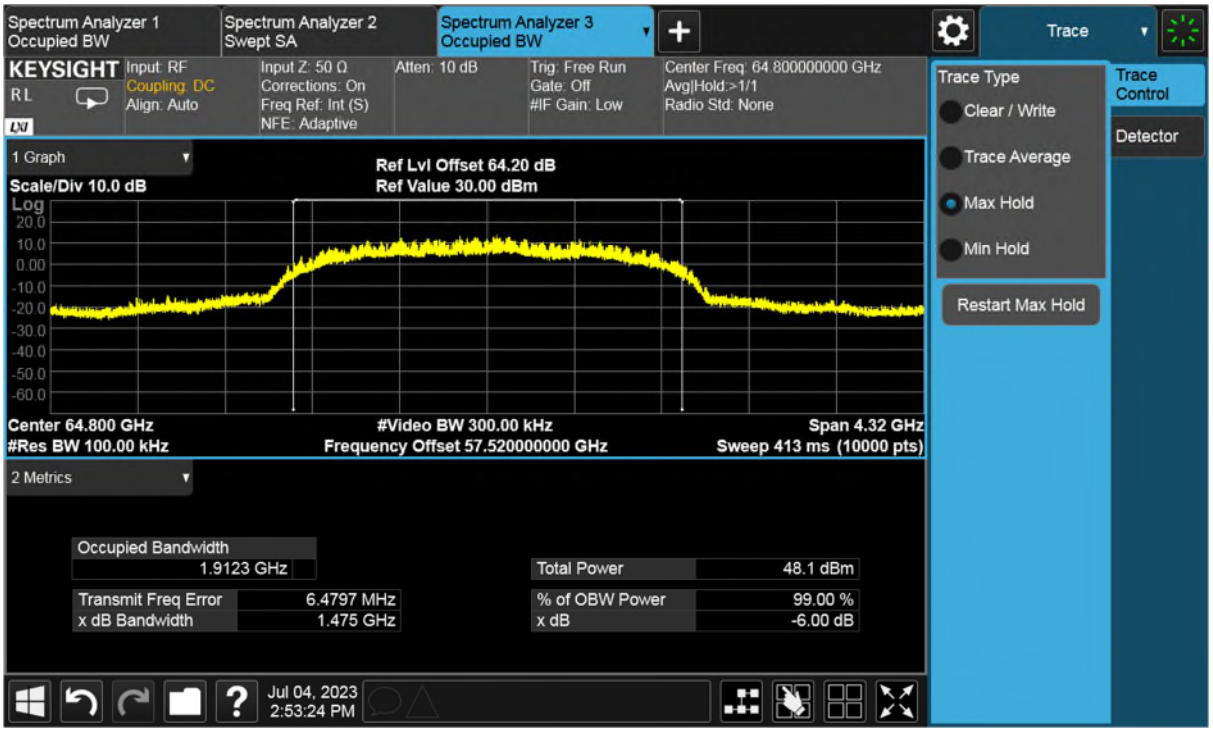
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS6, Channel 58.32 GHz, Radio 1



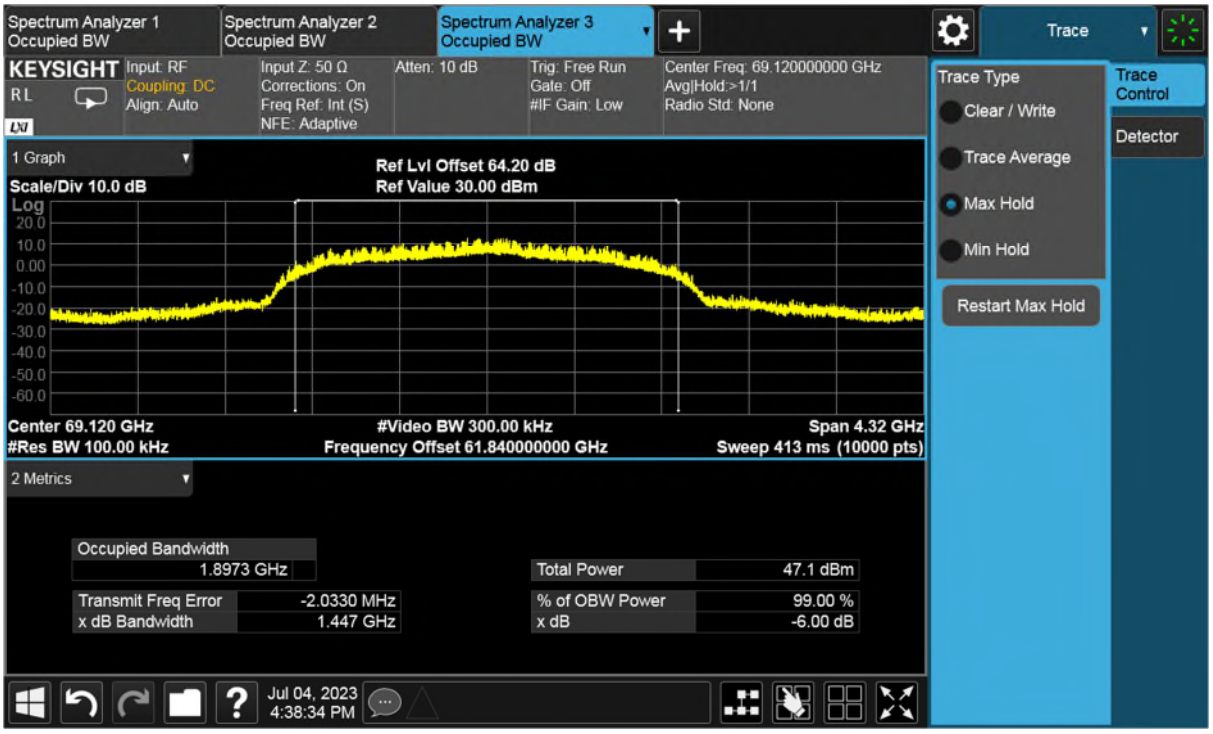
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS6, Channel 64.8 GHz, Radio 1



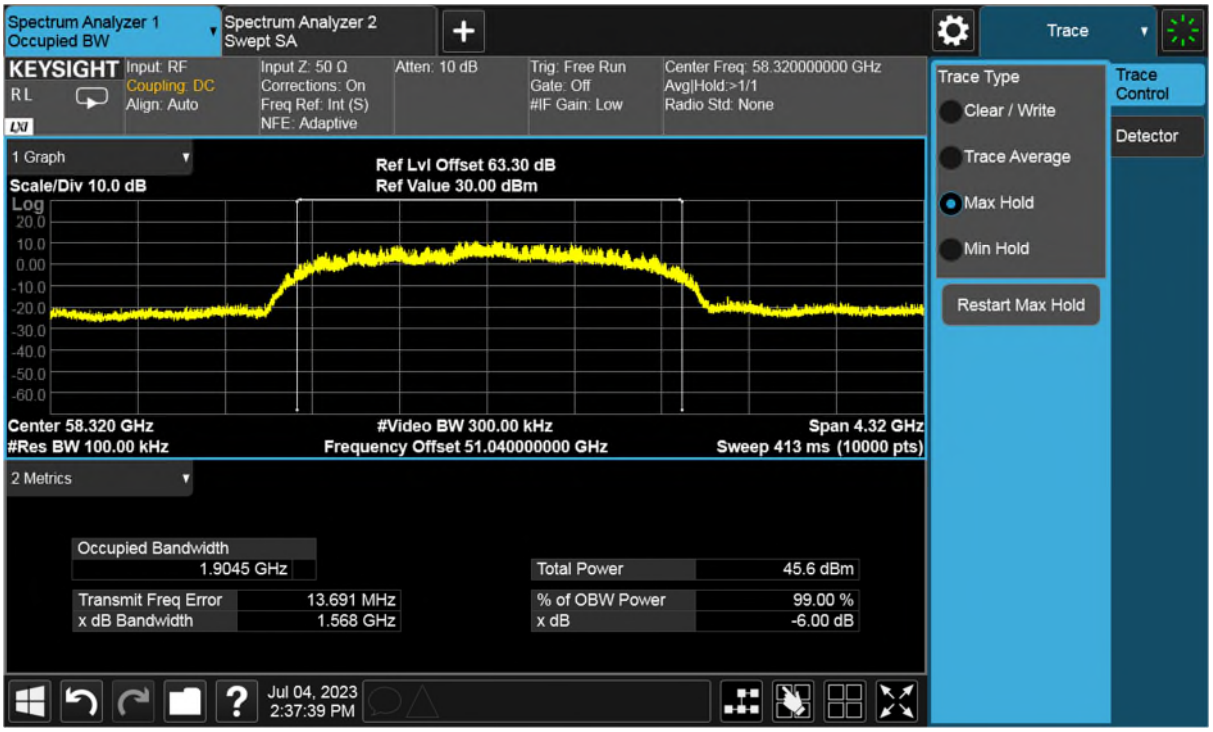
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS6, Channel 69.12 GHz, Radio 1



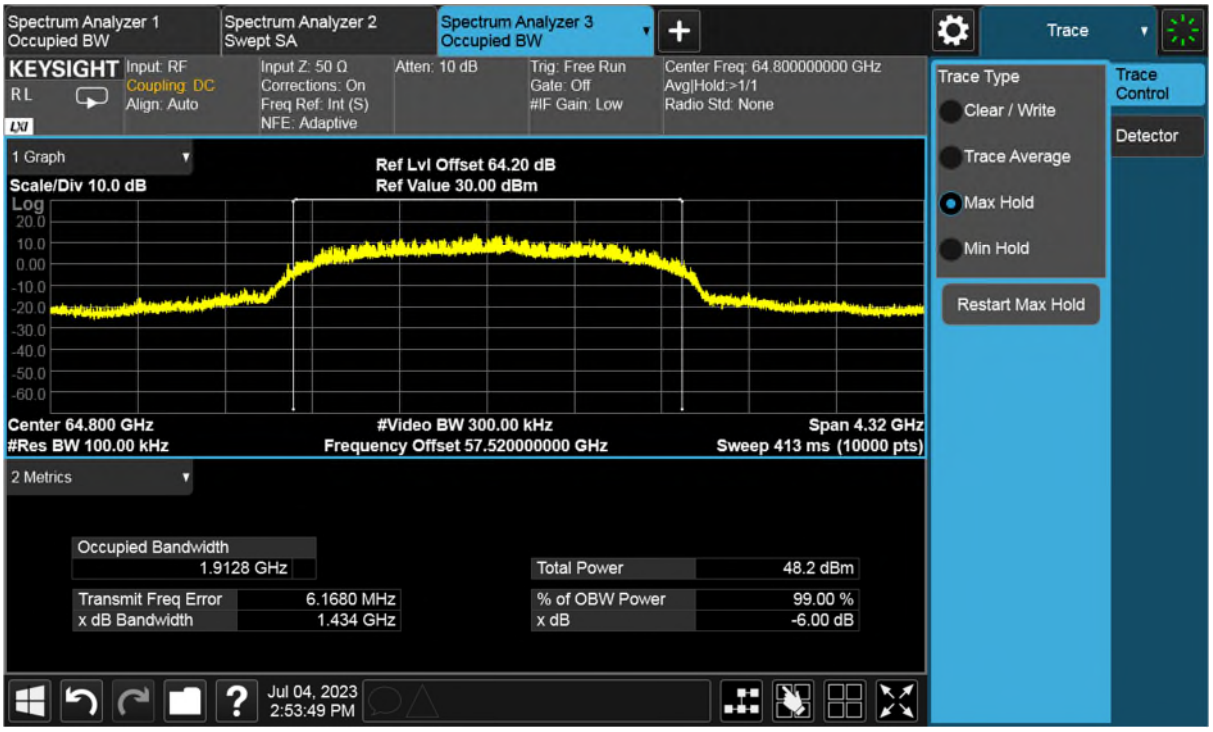
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS7, Channel 58.32 GHz, Radio 1



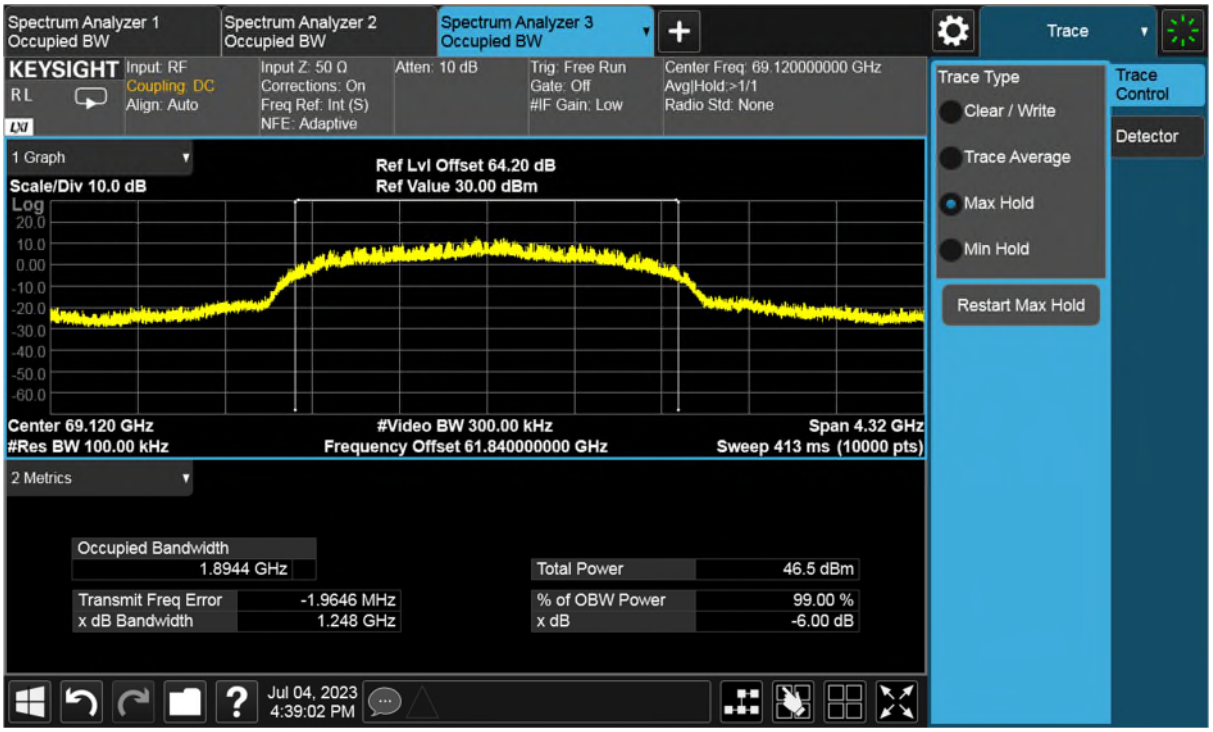
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS7, Channel 64.8 GHz, Radio 1



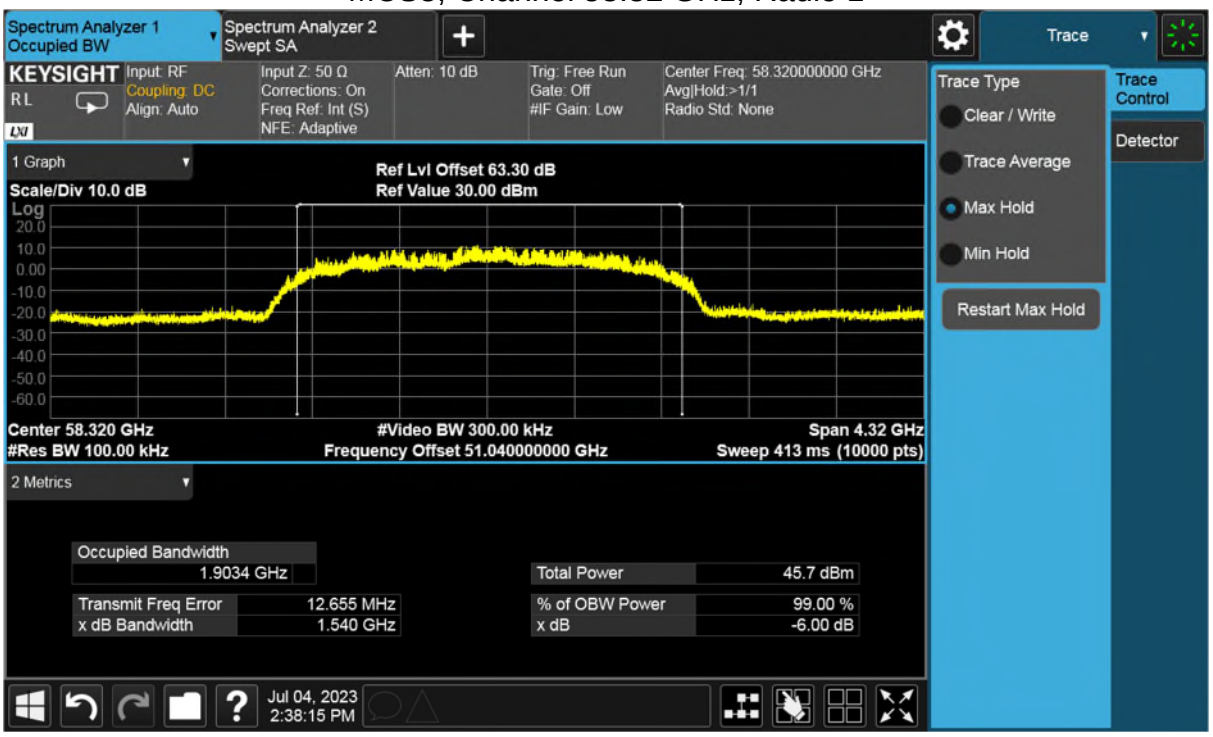
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS7, Channel 69.12 GHz, Radio 1



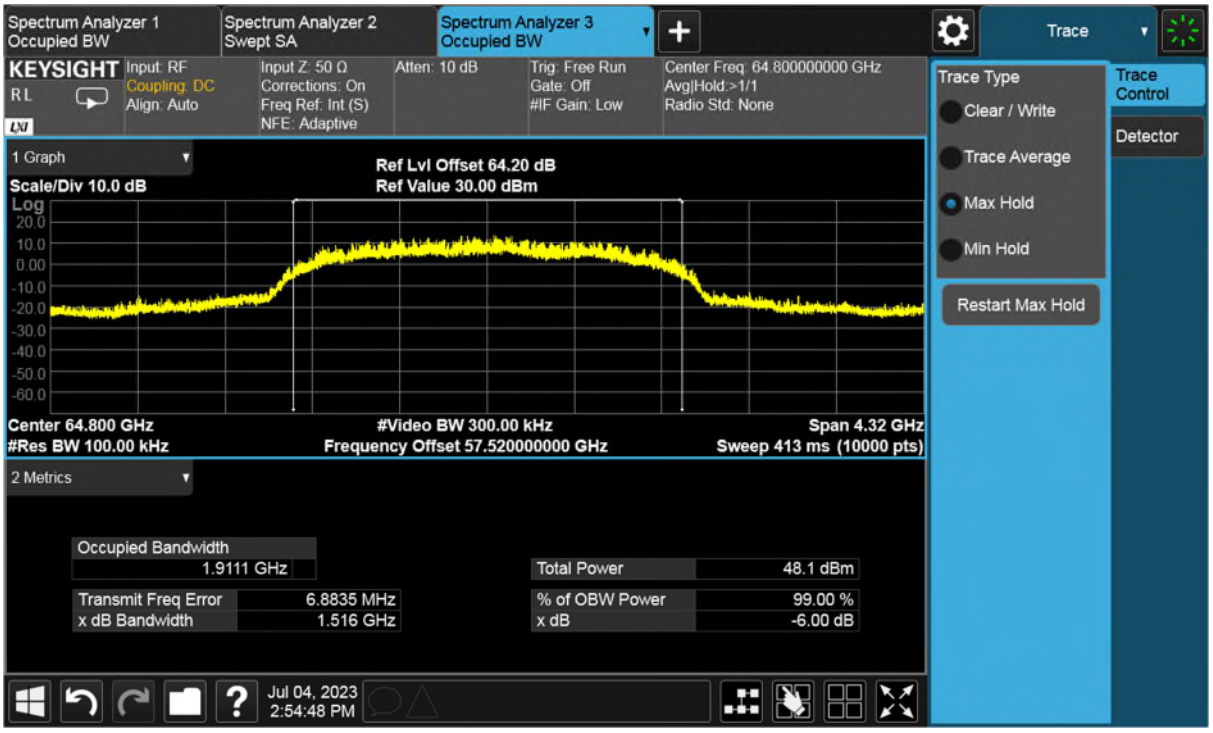
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS8, Channel 58.32 GHz, Radio 1



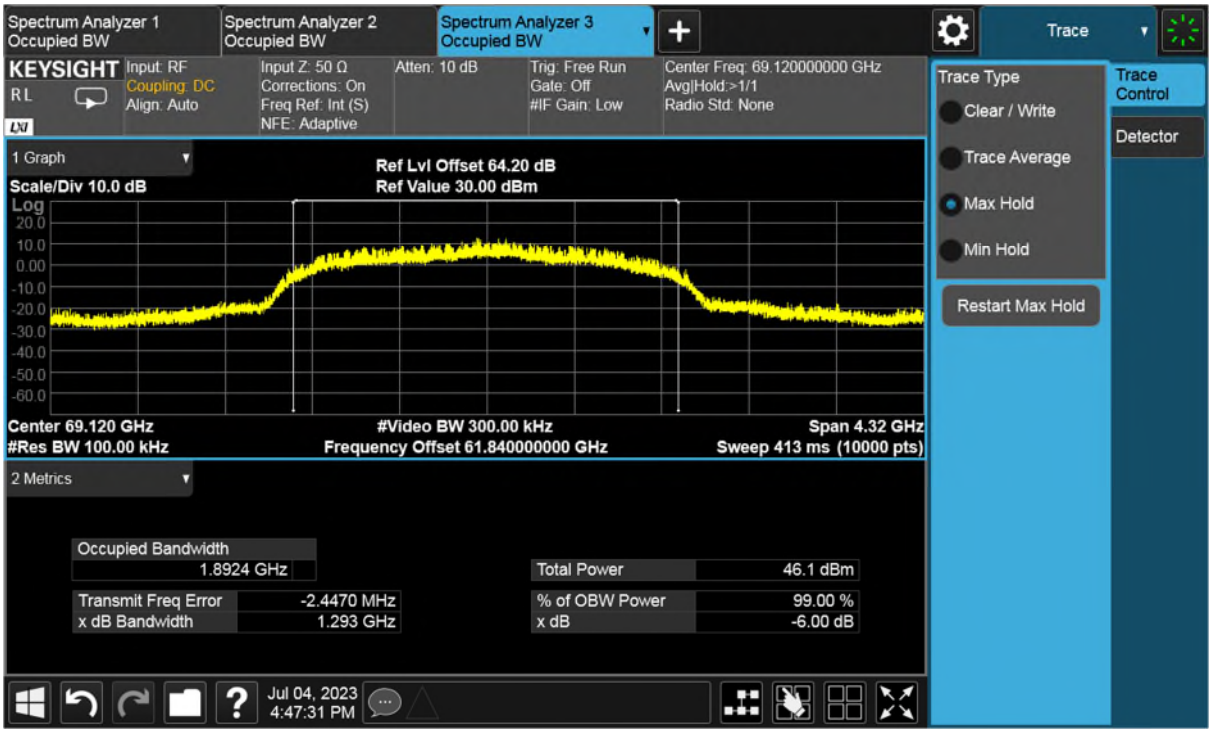
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS8, Channel 64.8 GHz, Radio 1



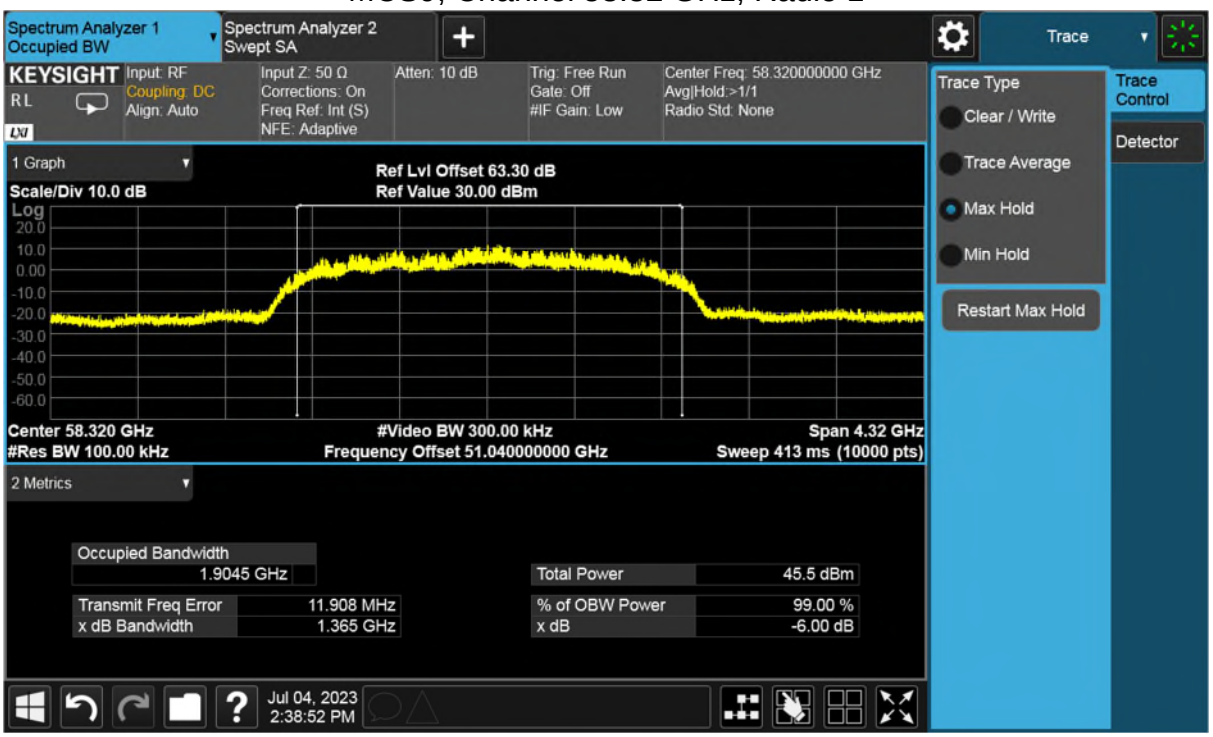
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS8, Channel 69.12 GHz, Radio 1



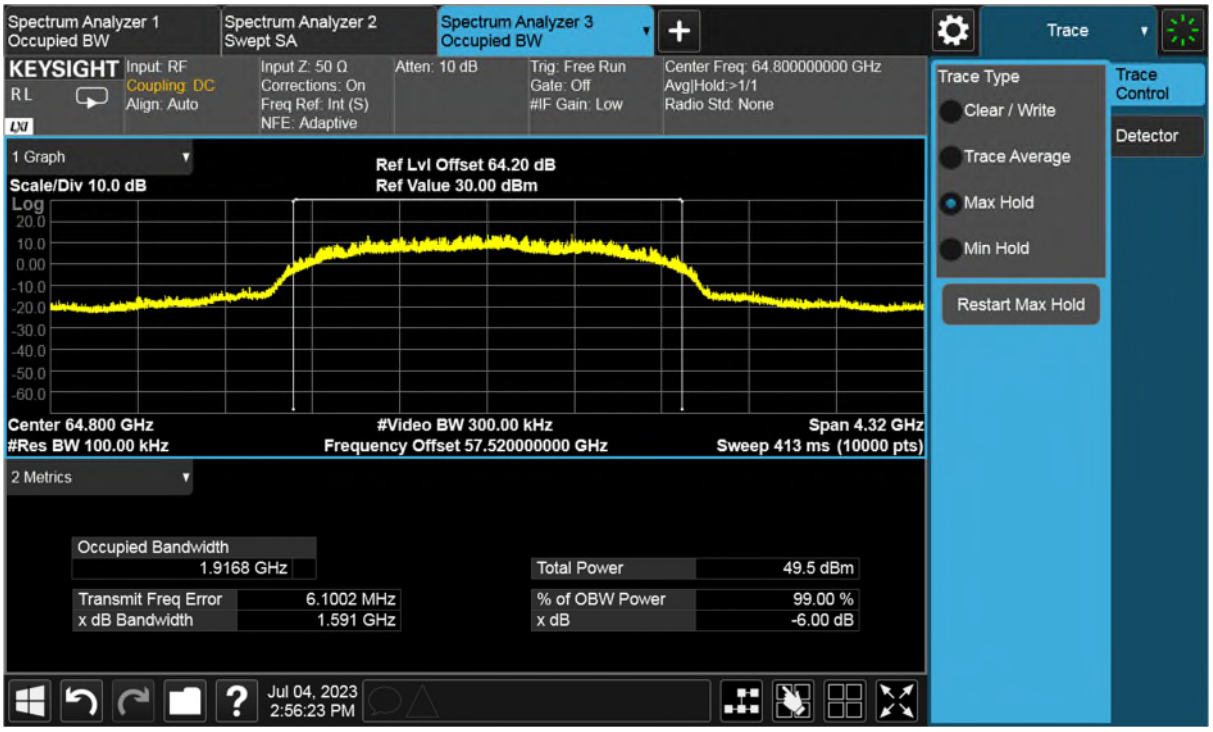
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS9, Channel 58.32 GHz, Radio 1



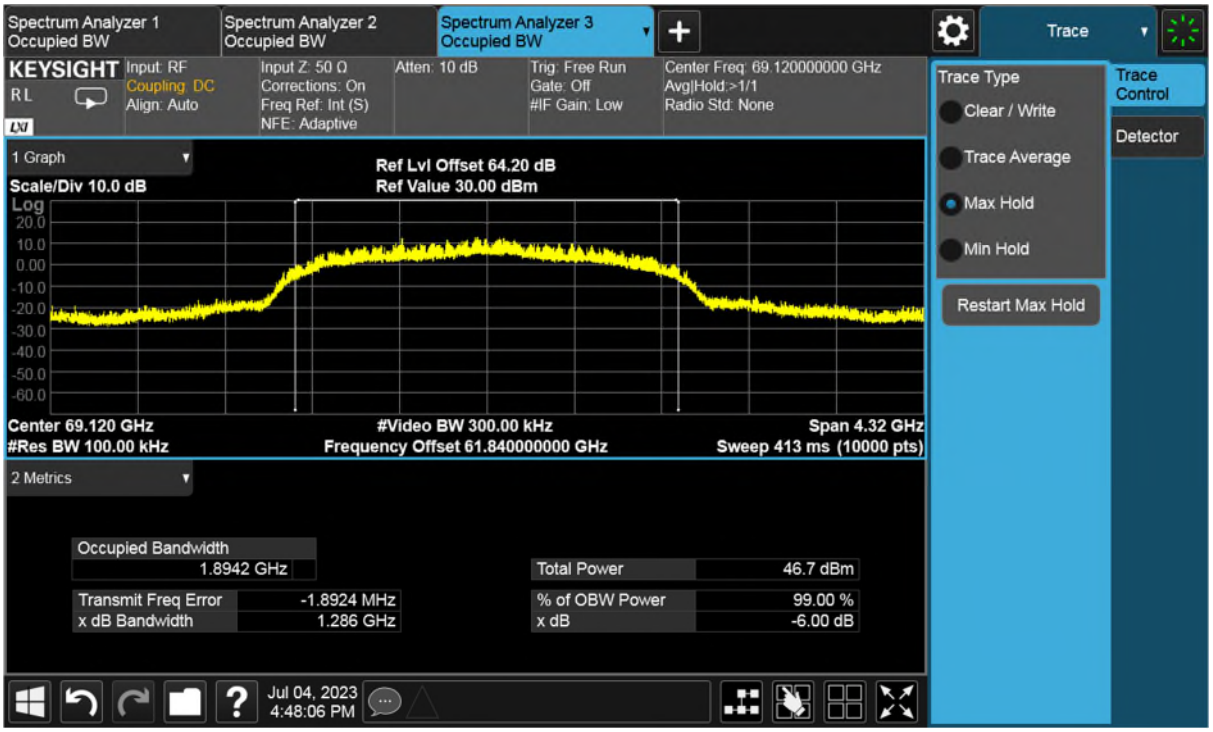
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS9, Channel 64.8 GHz, Radio 1



Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS9, Channel 69.12 GHz, Radio 1

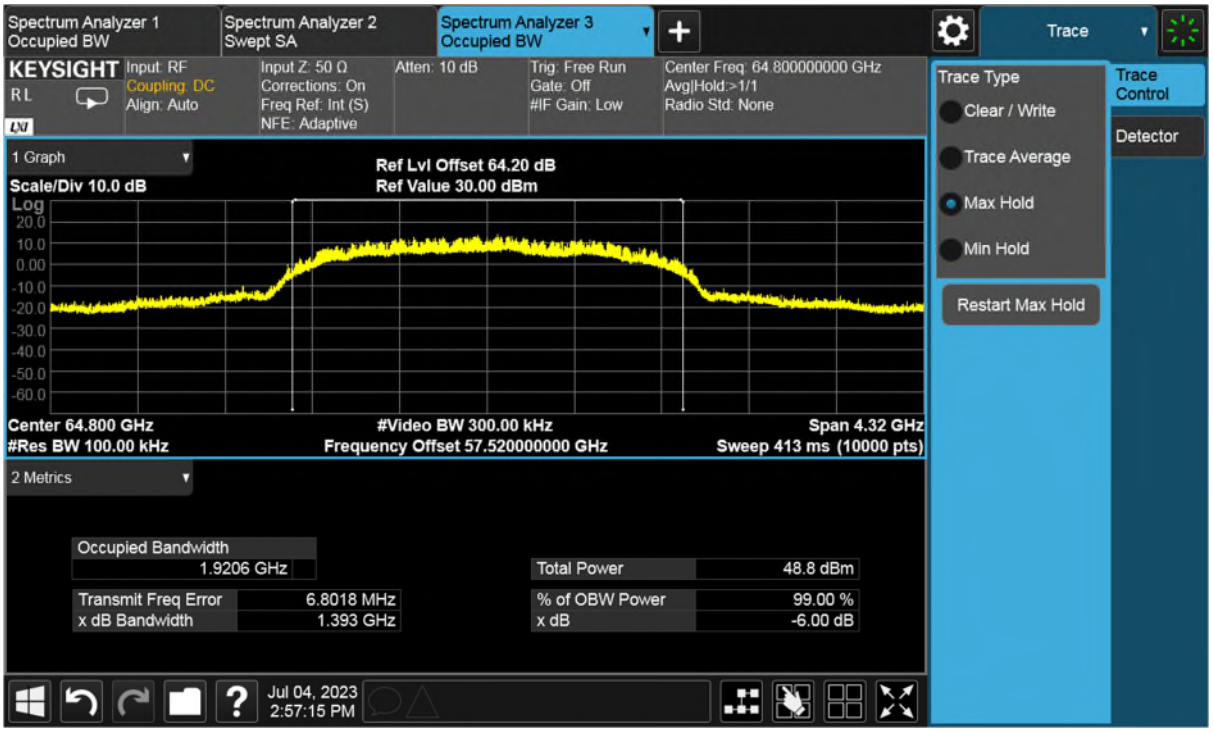


Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS10, Channel 58.32 GHz, Radio 1

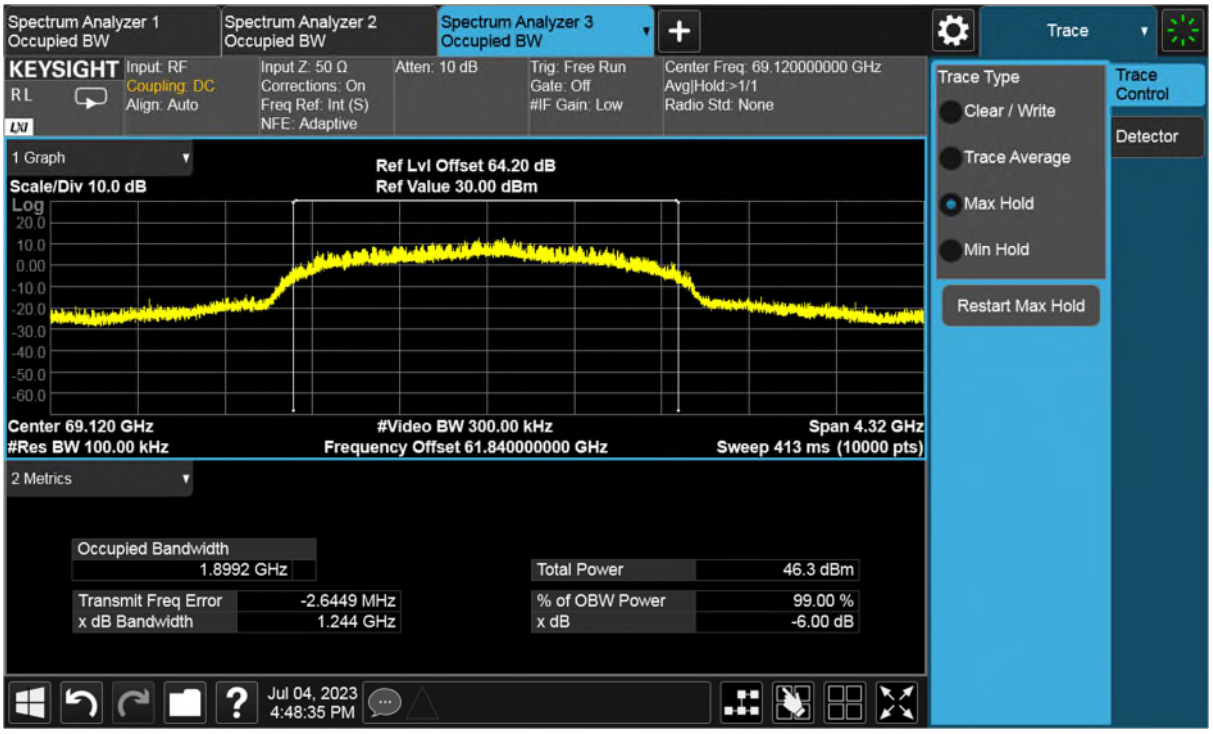
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS10, Channel 64.8 GHz, Radio 1



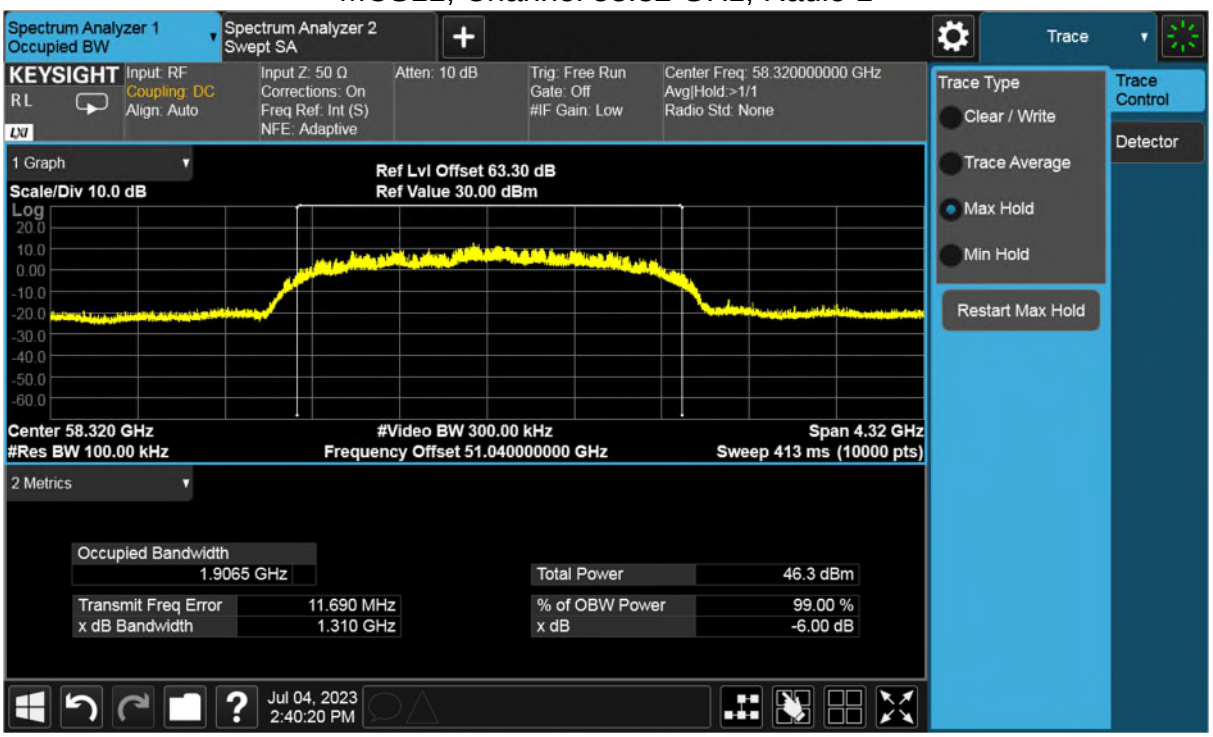
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS10, Channel 69.12 GHz, Radio 1



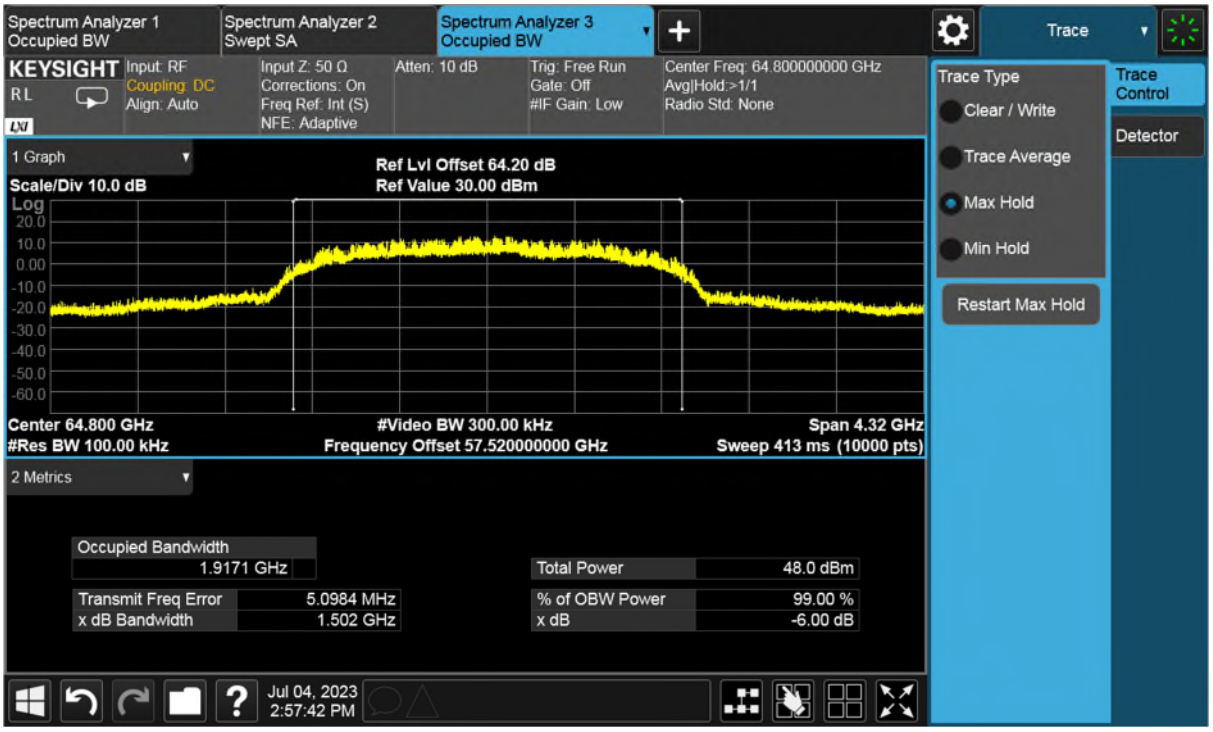
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS11, Channel 58.32 GHz, Radio 1



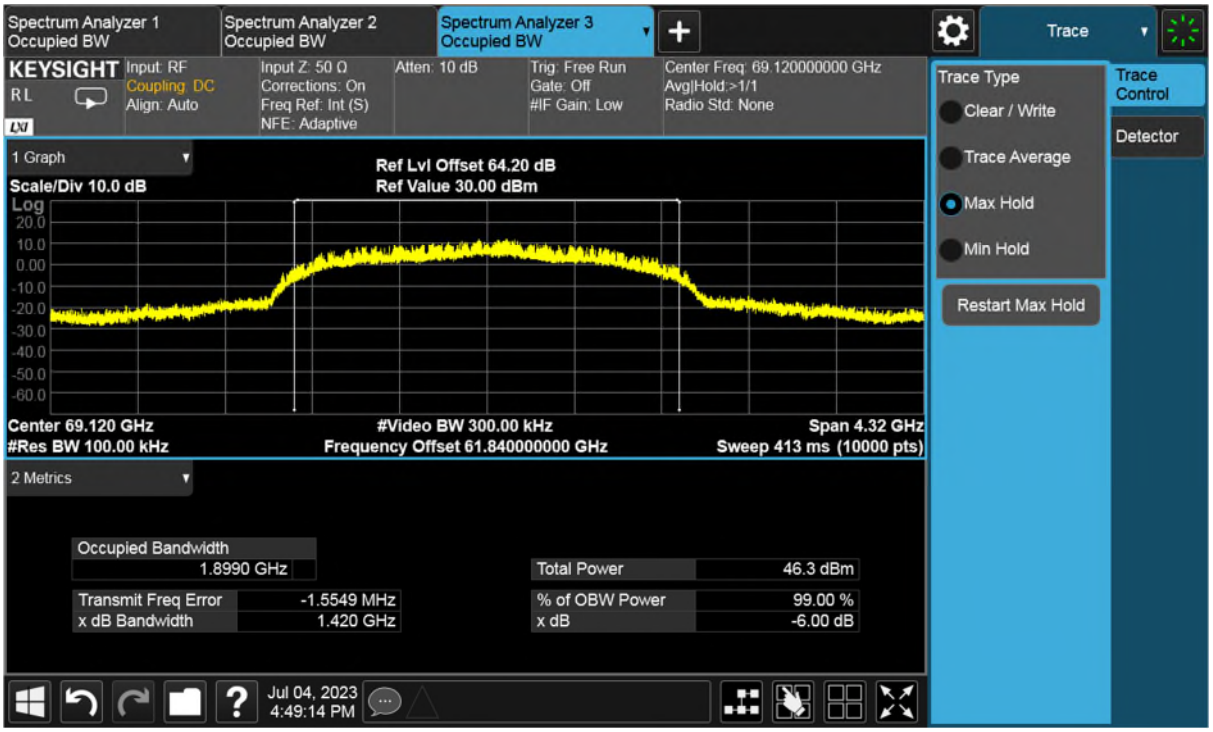
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS11, Channel 64.8 GHz, Radio 1



Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS11, Channel 69.12 GHz, Radio 1

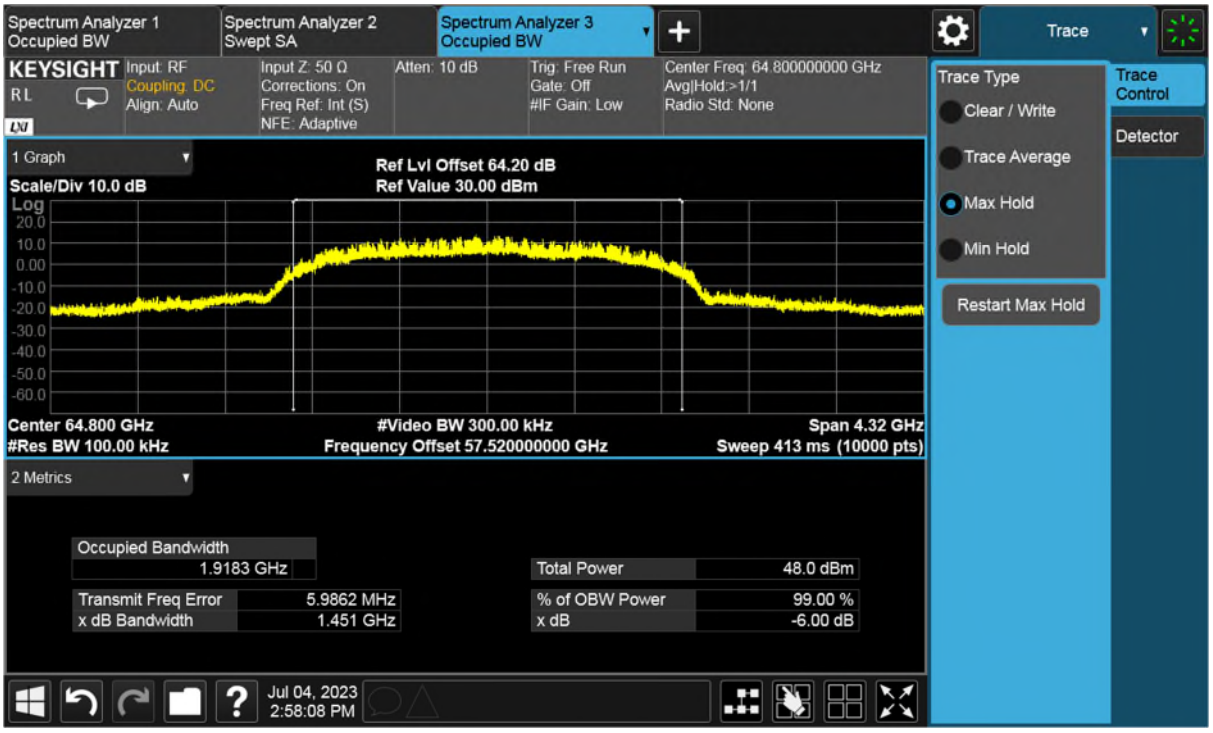


Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS12, Channel 58.32 GHz, Radio 1

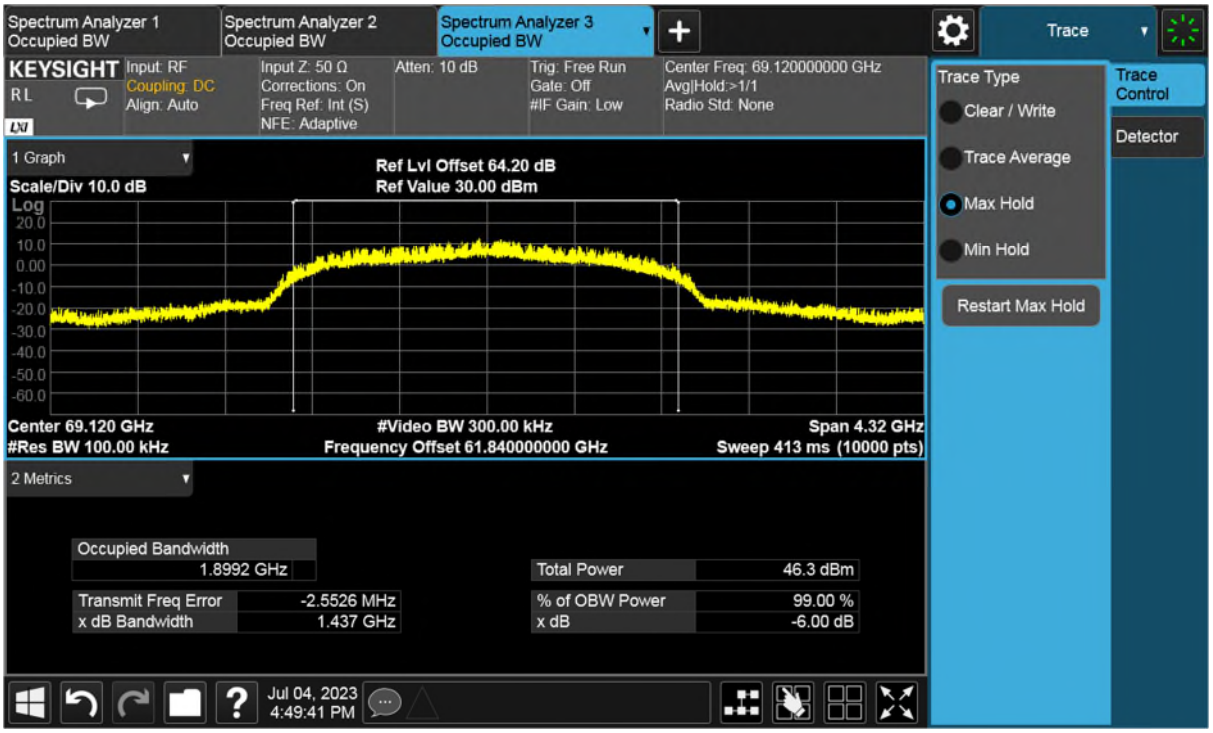
Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS12, Channel 64.8 GHz, Radio 1



Plot of 6dB Bandwidth (GHz)

RF Parameters: Band 57-71 GHz, Power 40 dBm, Channel Spacing 2.16 GHz, Modulation MCS12, Channel 69.12 GHz, Radio 1



Plot of 6dB Bandwidth (GHz)

7 Explanatory Notes

7.1 Explanation of Table of Signals Measured

Measurements are made as required by the standard. These measurements are made and recorded using detectors, either peak, quasi peak or average dependant on the test. A table of results has been given following the relevant plots. This table looks similar to the one illustrated below dependant on the measurements required by the test: -

Signal No.	Freq (MHz)	Peak Amp (dBuV)	Pk – Lim 1 (dB)	QP Amp (dBuV)	QP - Lim1 (dB)	Av Amp (dBuV)	Av - Lim1 (dB)
1	12345	54.9	-10.5	48	-12.6	37.6	-14.4

Column One - Labelled Signal No. is an incremental number that the receiver has given to each signal that has been measured.

Column Two - Labelled Freq (MHz) is the approximate frequency of the signal received.

Column Three - Labelled Peak Amp (dBμV) is the level of received signal that was measured in dB above 1μV using the peak detector.

Column Four - Labelled Pk - Lim1 (dB) is the difference in level from the peak signal given to the active limit line. If this column appears in the table the peak detector measurement is required by the standard for this test. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.

Column Five - Labelled QP Amp (dBμV) is the level of received signal that was measured in dB above 1μV using the quasi-peak detector.

Column Six - Labelled QP - Lim1 (dB) is the difference in level from the quasi-peak signal given to the active limit line. If this column appears in the table the quasi-peak detector measurement is required by the standard for this test. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.

Column Seven - Labelled Av Amp (dBμV) is the level of received signal that was measured in dB above 1μV using the average detector.

Column Eight - Labelled Av - Lim1 (dB) is the difference in level from the average signal given to the active limit line. If this column appears in the table the average detector measurement is required by the standard for this test. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.

Only signals highlighted in red are deemed to exceed the limit of the detector required.

7.2 Explanation of limit line calculations for radiated measurements

The limits given in the test standard are normally expressed as absolute values (e.g. in μV/m at a specified distance), whereas the measured values are expressed as peak, quasi peak or average values in dBμV/m referenced to the measuring instrument inputs. RN Electronics calibrate the test set-up to account for any path losses, antenna gains, etc. so that the value read at the receiver relates directly to the absolute value required, except that it is expressed in dB relative to one microVolt and may need to take account of any alternative measuring distance used. Examples:

(a) limit of 500 μV/m equates to 20.log (500) = 54 dB μV/m.

(b) limit of 300 μV/m at 10m equates to 20.log (300 . 10/3) = 60 dB μV/m at 3m

(c) limit of 30 µV/m at 30m, but below 30MHz, equates to 20.log(30) + 40.log(30/3) = 69.5 dBµV/m at 3m, as extrapolation factor below 30MHz is 40dB/decade per 15.31(f)(2).

The measurement receiver used for emissions testing, performs the field strength (FS) calculations automatically. The receiver combines the signal amplitude (RA), Antenna Factor (AF) and Cable Loss (CL) factors for the frequency to be measured.

Example calculation: - FS = RA + AF + CL.

Receiver amplitude (RA)	Antenna factor (3m) (AF)	Cable loss (CL)	Field strength result (3m) (FS)
20dBuV	25 dB	3 dB	48dBuV/m

Additional calculation examples per ANSI C63.10 clause 9.4 – 9.6 equations 21, 22, 25 & 26:

Equation 21: $E_{Linear} = 10^{((E_{log}-120)/20)}$

And therefore equation 21 transposed is: $E_{Log} = 20xLog(E_{Linear}) +120$

Where:
E_{Linear} is the field strength of the emission in V/m
E_{Log} is the field strength of the emissions in dBµV/m

Equation 22: $EIRP = E_{Meas} + 20log(d_{Meas})$ -104.7

Where:
EIRP is 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 metres

Equation 25: $PD = EIRP_{Linear} / 4\pi d^2$

And therefore equation 25 transposed is: $EIRP_{Linear} = PD \times 4\pi d^2$

Where:
PD is the power density at distance specified by the limit, in W/m^2
$EIRP_{Linear}$ is the equivalent isotropically radiated power in Watts
d is the distance at which the power density limit is specified in metres

Equation 26: $PD = E^2_{Speclimit} / 377$

And therefore equation 26 transposed is: $E_{Spec\ limit} = \sqrt{(PD \times 377)}$

Where:
PD is the power density at distance specified by the limit, in W/m^2
$E_{spec\ limit}$ is the field strength at the distance specified by the limit in V/m

Example:

Radiated spurious emissions limit at 3metres of 90pW/cm$^{2.}$

90pW/cm^2 x 100^2 = 0.9 µW/m^2 = (EIRP Linear)

Equation 25 transposed: 0.9 x 10^{-6} x 4 x π x 3^2 = 0.0001017876 W

And
Equation 26 transposed: $E_{Spec\ limit}$ = √(0.9x10^{-6} x 377) = 0.01842 V/m.

And
Equation 21 transposed: E_{Log} = 20Log(0.01842) +120 = 85.3dBµV/m @ 3m.

8 Photographs

No photos included in report due to requested confidentiality under FCC certification.

8.1 Radiated emission diagrams

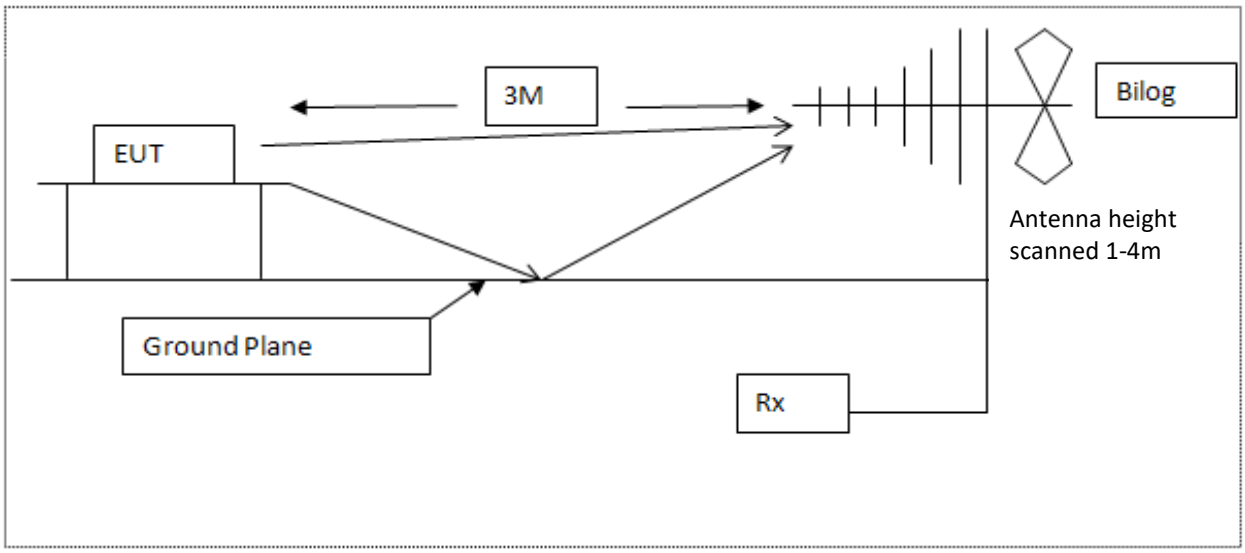


Diagram of the radiated emissions test setup 30 - 1000 MHz

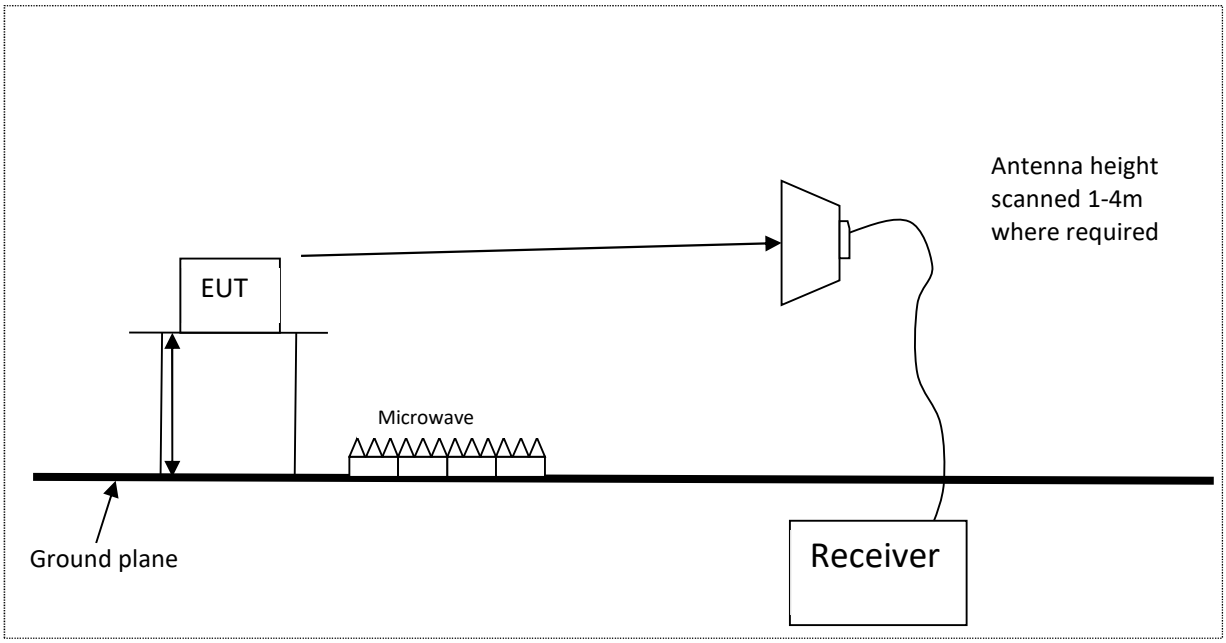


Diagram of the radiated emissions test setup above 1GHz

9 Test equipment calibration list

The following is a list of the test equipment used by R.N. Electronics Ltd to test the unit detailed within this report. In line with our procedures, the equipment was within calibration for the period during which testing was carried out.

RN No.	Model No.	Description	Manufacturer	Calibration date	Cal period
C036	909A	Termination 18GHz 50Ω opt 012	Agilent Technologies	21-Feb-2023	12 months
E035	11947A	Transient Limiter 9kHz – 200MHz	Hewlett Packard	16-Dec-2023	12 months
E136	3105	Horn Antenna 1 - 12.5 GHz	EMCO	#02-Apr-2023	12 months
E150	MN2050	LISN 13A	Chase	03-May-2023	12 months
E296-2	11970A	Harmonic Mixer 26.5-40GHz	Hewlett Packard	#27-Jun-2022	12 months
E296-4	11970U	Harmonic Mixer 40-60GHz	Hewlett Packard	#08-Jul-2021	24 months
E296-5	11970V	Harmonic Mixer 50-75GHz	Hewlett Packard	#08-Jul-2021	24 months
E330	2224-20	Horn Antenna 26.5-40GHz	Flann (FMI)	17-Apr-2023	12 months
E411	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	#07-Jul-2022	12 months
E412	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	21-Jun-2022	24 months
E433	MG3693A	Signal Generator 2 GHz - 30 GHz	Anritsu	03-Oct-2022	12 months
E485	11974-60028	Preselector PSU	Agilent Technologies	27-Feb-2023	12 months
E487	11974U	Preselect Mixer 40 - 60GHz	Agilent Technologies	26-Jan-2023	24 months
E503	2524-20	Horn Antenna 50-75GHz	Flann (FMI)	17-Apr-2023	12 months
E520	MD4A	Diplexor IF DC-2.5GHz, LO 5-20GHz	Pacific Millimeter Products	15-Mar-2023	12 months
E574	15093-SF50	Transition	Flann (FMI)		12 months
E580	24240	Horn Std Gain 40GHz - 60 GHz	Flann (FMI)	17-Apr-2023	12 months
E602	MG3692A	Signal Generator 10 MHz - 20 GHz	Anritsu	02-Mar-2023	12 months
E624	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	06-Jul-2022	24 months
E638	11974VE01	Preselected Mixer 50 - 80GHz	Agilent Technologies	10-Jan-2023	24 months
E658	E4418B	Power Meter EPM series	Agilent Technologies	20-Sep-2022	12 months
E718	-	Horn Std Gain 75-110GHz	-	17-Apr-2023	12 months
E719	-	Horn Std Gain 90-140GHz	-	17-Apr-2023	12 months
E720	28240	Horn Std Gain 90-140 GHz	Flann (FMI)	17-Apr-2023	12 months
E743	2017 4/2dB	Attenuator 4/2dB 30-1000MHz	RN Electronics	15-Mar-2023	12 months
E755	N9030B	PXA Signal Analyser 3 Hz to 50 GHz	Keysight Technologies	03-Aug-2022	12 months
E760	M05HWDX	Mixer 140-220GHz	OML Inc	06-Dec-2021	24 months
E768	FBI-15_R0000	Isolator 50 to 75GHz	Millitech	22-Jul-2022	24 months
E771	861G/387	Horn Std Gain 140-220GHz WR5	Alpha Industries Inc	17-Apr-2023	12 months
E781	MX4-15-F	Multiplier 50 - 75GHz X4 WR15	MMWave Group (Quantum)	23-Jan-2023	24 months
E908	00365-60004	Isolator 50-75GHz WR15	Hewlett Packard	22-Jul-2022	24 months
E920	FTL 6541	Mixer 60 - 90GHz	Farran Technology	27-Jan-2023	12 months
E941	M08HWDX	Mixer 90-140GHz	OML Inc	06-Dec-2021	24 months
E994	B220H	DC Block 10MHz to 18GHz	ATM Inc	27-Jan-2023	12 months
F015	11974A	Preselect Mixer 26.5 - 40GHz	Hewlett Packard	06-Feb-2023	12 months
F024	V8486A	Power Sensor 50-75GHz	Hewlett Packard	06-Dec-2022	24 months
F042	45324H-1110	Directional Coupler 10dB WR15	Hughes	20-Apr-2022	24 months
F045	2511	Attenuator 50-75GHz Rotary	Flann (FMI)	05-Jan-2023	24 months
F136	DSO5034A	Oscilloscope 300MHz 4CH	Agilent Technologies	03-Oct-2022	12 months
F190	UFA210A	Cable Light blue 92cm(36") SMA m to SMA m	Micro-Coax Utiflex	18-Apr-2023	6 months

F191	UFA210A	Cable Light blue 92cm(36") SMA m to SMA m	Micro-Coax Utiflex	18-Apr-2023	6 months
F305	DET-15-RPFA0	Detector WR15	Millitech	06-Feb-2023	12 months
F352	V00LOIF	Cable 3ft Blue SMA to SMA	OML Inc	#14-Jun-2023	12 months
F356	SLP-10.7+	Filter Low Pass 11 MHz	Mini-Circuits	03-Apr-2023	12 months
H078	V530	Waveguide switch 50-75GHz	-	#23-May-2022	12 months
L264	DT75	Digital Thermometer	Instrotech Ltd	20-Dec-2021	24 months
LPE364	CBL6112A	Antenna BiLog 30MHz - 2GHz	Chase Electronics Ltd	28-Mar-2022	24 months
NSA-M	NSA - M	NSA - Site M	RN Electronics	29-Nov-2021	36 months
TMS57	PM2534	Digital Multimeter	Philips	13-Apr-2022	12 months
TMS78	3160-08	Horn Std Gain 12.4 - 18 GHz	ETS Systems	30-Sep-2022	12 months
TMS79	3160-09	Horn Std Gain 18 - 26.5 GHz	ETS Systems	25-May-2022	12 months
TMS81	6502	Antenna Active Loop	EMCO	22-Jul-2021	24 months
TMS82	8449B	Pre-Amplifier 1GHz - 26.5GHz	Agilent Technologies	16-Dec-2022	12 months
TMS938	NSG1007	AC Power Source 3kVA	Schaffner	31-Aug-2022	24 months
ZSW1	V2.5.2	Measurement Software Suite	RN Electronics	N/A	N/A

Equipment was within calibration dates for tests and has been re-calibrated since/during date of tests.

10 Auxiliary and peripheral equipment

10.1 Customer supplied equipment

Item No.	Model No.	Description	Manufacturer	Serial No.
1	CPX200D	DC Power Supply	TTi	558035

10.2 RN Electronics supplied equipment

RN No.	Model No.	Description	Manufacturer	Serial No
I218	ZYW	Laptop	Acer	NXV9WEK0014380846B7600

11 Condition of the equipment tested

In order for the EUT to produce the results shown within this report the following modifications, if any, were implemented.

11.1 Modifications before test

No modifications were made before test by RN Electronics Ltd.

11.2 Modifications during test

The following modifications were applied to the EUT in order to comply with the Peak and Average EIRP test limits:

1) Radio 0 middle channel: The following command was applied to lower to power for this channel “bwt_vendor -d wlP1p32s0f0 fwopt link 0xa1c 0x000401cc”.
2) Radio 0 high channel: The following command was applied to lower the power for this channel “bwt_vendor -d wlP1p32s0f0 fwopt link 0xa1c 0x000601dc”.
3) Radio 1 Low channel: The following command was applied to lower to power for this channel “bwt_vendor -d wlP1p32s0f1 fwopt link 0xa1c 0x000010e4”.
4) Radio 1 Middle channel: The following command was applied to lower to power for this channel “bwt_vendor -d wlP1p32s0f1 fwopt link 0xa1c 0x000401dc.
5) Radio 1 high channel: The following command was applied to lower to power for this channel “bwt_vendor -d wlP1p32s0f1 fwopt link 0xa1c 0x000601e8.

12 Description of test sites

Site A Radio Laboratory and Anechoic Chamber

Site B Semi-Anechoic Chamber and Control Room
FCC Registration No. 293246, ISED Registration No. 5612A-4

Site C Transient Laboratory

Site D Screened Room (Conducted Immunity)

Site E Screened Room (Control Room for Site D)

Site F Screened Room (Conducted Emissions)

Site G Screened Room (Control Room for Site H)

Site H 3m Semi-Anechoic Chamber (indoor OATS)
FCC Registration No. 293246, ISED Registration No. 5612A-2, VCCI Registration No. 4065

Site J Transient Laboratory

Site K Screened Room (Control Room for Site M)

Site M 3m Semi-Anechoic Chamber (indoor OATS)
FCC Registration No. 293246, ISED Registration No. 5612A-3

Site N Radio Laboratory

Site Q Fully-Anechoic Chamber

Site OATS 3m and 10m Open Area Test Site
FCC Registration No. 293246, ISED Registration No. 5612A-1

Site R Screened Room (Conducted Immunity)

Site S Safety Laboratory

Site T Transient Laboratory

RN Electronics CAB identifier as issued by Innovation, Science and Economic Development Canada is UK0002
RN Electronics CAB identifier as issued by FCC is UK2015

13 Abbreviations and units

%	Percent
λ	Wavelength
µA/m	microAmps per metre
µV	microVolts
µW	microWatts
AC	Alternating Current
ACK	ACKnowledgement
ACP	Adjacent Channel Power
AFA	Adaptive Frequency Agility
ALSE	Absorber Lined Screened Enclosure
AM	Amplitude Modulation
Amb	Ambient
ANSI	American National Standards Institute
ATPC	Automatic Transmit Power Control
AVG	Average
AWGN	Additive White Gaussian Noise
BER	Bit Error Rate
BPSK	Binary Phase Shift Keying
BT	BlueTooth
BLE	BlueTooth Low Energy
BW	Bandwidth
ºC	Degrees Celsius
C/I	Carrier / Interferer
CAC	Channel Availability Check
CCA	Clear Channel Assessment
CEPT	European Conference of Postal and Telecommunications Administrations
CFR	Code of Federal Regulations
CISPR	Comité International Spécial des Perturbations Radioélectriques
cm	centimetre
COFDM	Coherent OFDM
COT	Channel Occupancy Time
CS	Channel Spacing
CW	Continuous Wave
DAA	Detect And Avoid
dB	deciBels
dBµA/m	deciBels relative to 1µA/m
dBµV	deciBels relative to 1µV
dBµV/m	deciBels relative to 1µV/m
dBc	deciBels relative to Carrier
dBd	deciBels relative to dipole gain
dBi	deciBels relative to isotropic gain
dBm	deciBels relative to 1mW
dBr	deciBels relative to a maximum value
dBW	deciBels relative to 1W
DC	Direct Current
DFS	Dynamic Frequency Selection
DMO	Dynamic Modulation Order
DSSS	Direct Sequence Spread Spectrum
DTA	Digital Transmission Analyser
EIRP	Equivalent Isotropic Radiated Power
emf	electromotive force
ERC	European Radiocommunications Committee
ERP	Effective Radiated Power
ETSI	European Telecommunications Standards Institute
EU	European Union
EUT	Equipment Under Test
FCC	Federal Communications Commission
FER	Frame Error Rate
FHSS	Frequency Hopping Spread Spectrum
FM	Frequency Modulation
FSK	Frequency Shift Keying
FSS	Fixed Satellite Service
g	Grams
GHz	GigaHertz
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
Hz	Hertz
IEEE	Institute of Electrical and Electronics Engineers
IF	Intermediate Frequency
ISED	Innovation Science and Economic Development
ITU	International Telecommunications Union
KDB	Knowledge DataBase

kg	kilogram	pW	picoWatts
kHz	kiloHertz	QAM	Quadrature Amplitude Modulation
kPa	Kilopascal	QP	Quasi Peak
LBT	Listen Before Talk	QPSK	Quadrature Phase Shift Keying
LISN	Line Impedance Stabilisation Network	RBW	Resoution Band Width
LNA	Low Noise Amplifier	RED	Radio Equipment Directive
LNB	Low Noise Block	R&TTE	Radio and Telecommunication Terminal Equipment
LO	Local Oscillator	Ref	Reference
m	metre	RF	Radio Frequency
mA	milliAmps	RFC	Remote Frequency Control
max	maximum	RFID	Radio Frequency IDentification
Mbit/s	MegaBits per second	RLAN	Radio Local Area Network
MCS	Modulation and Coding Scheme	RMS	Root Mean Square
MHz	MegaHertz	RNSS	Radio Navigation Satellite Service
mic	Microphone	RSL	Received Signal Level
MIMO	Multiple Input, Multiple Output	RSSI	Received Signal Strength Indicator
min	minimum	RTP	Room Temperature and Pressure
mm	millimetres	RTPC	Remote Transmit Power Control
ms	milliseconds	Rx	Receiver
mW	milliWatts	s	Seconds
NA	Not Applicable	SINAD	Signal to Noise And Distortion
NFC	Near Field Communications	SRD	Short Range Device
nom	Nominal	Tx	Transmitter
nW	nanoWatt	UKAS	United Kingdom Accreditation Service
OATS	Open Area Test Site	UKCA	United Kingdom Conformity Assessed
OBW	Occupied Band Width	UKRER	United Kingdom Radio Equipment Regulations
OCW	Occupied Channel Width	UHF	Ultra High Frequency
OFDM	Orthogonal Frequency Division Multiplexing	U-NII	Unlicensed National Information Infrastructure
OOB	Out Of Band	USB	Universal Serial Bus
ppm	Parts per million	UWB	Ultra Wide Band
PER	Packet Error Rate	V	Volts
PK	Peak	V/m	Volts per metre
PMR	Private Mobile Radio	VBW	Video Band Width
PRBS	Pseudo Random Bit Sequence	VHF	Very High Frequency
PRF	Pulse Repitition Frequency	VSAT	Very Small Aperture Terminal
PSD	Power Spectral Density	W	Watts
PSU	Power Supply Unit		

====== END OF TEST REPORT ======