



A part of



Radio Test Report

Cambium Networks Ltd

60 GHz cnWave V2000

Model: V2000

47 CFR Part 15.255 Effective Date 1st October 2020

DXX: Part 15 Low Power Communication Device Transmitter

Test Date: 8th June 2022 to 24th June 2022

Report Number: 06-13438-1-22 Issue 01

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Certificate of Test 13438-1

The equipment noted below has been fully 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:	60 GHz cnWave V2000
Model Number:	V2000
Unique Serial Number:	V5YD001DCFQJ
Applicant:	Cambium Networks Ltd Unit B2, Linhay Business Park, Eastern Road Ashburton, Devon TQ13 7UP
Proposed FCC ID	QWP-60V2000
Full measurement results are detailed in Report Number:	06-13438-1-22 Issue 01
Test Standards:	47 CFR Part 15.255 Effective Date 1st October 2020 DXX: Part 15 Low Power Communication Device Transmitter

NOTE:

With reference to the Rule part detailed, Certain tests were not performed based upon applicant's declarations. For details refer to section 3 of this report.

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: 8th June 2022 to 24th June 2022

Test Engineer:

Approved By:
Radio Manager

Customer

Representative:



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2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	Cambium Networks Ltd Unit B2 Linhay Business Park Eastern Road Ashburton Devon TQ13 7UP	
Manufacturer of EUT	Cambium Networks Ltd	
Full Name of EUT (PMN)	60 GHz cnWave V2000	
Model Number of EUT	V2000	
Serial Number of EUT	V5YD001DCFQJ	
Date Received	7th June 2022	
Date of Test:	8th June 2022 to 24th June 2022	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Issued	3 rd August 2022	
Main Function	60 GHz Point to Multipoint Client Node, Point to Point Node, MESH	
Information Specification	Height	250 mm
	Width	167 mm
	Depth	170 mm
	Weight	1.75 kg
	Voltage	42.5 - 57 VDC (Provided by PoE mains adapter)
	Current	1.38 Amps
EUT Supplied PSU (PoE)	Manufacturer	Cambium Networks
	Model number	P060U04 (C000000L141A)
	Serial number	13-20120000-00038
	Input voltage	100 – 240 VAC 50/60 Hz
	Input current	1.7 Amp
	Output	56 VDC 1.07 Amps

2.2 Configurations for testing

General Parameters	
EUT Normal use position	Pole Mounted
Choice of model(s) for type tests	Engineering Sample
Antenna details	RF tile antenna with beam-steering with a gain of 22.5 dBi. RF tile is then focused using a duel reflector with an additional gain for 12 dBi. Total combined antenna gain of 34.5 dBi. Beam steering of +/- 20 Degrees azimuth, +/- 8 Degrees elevation. The RF tile antenna array is integral to the SWL-QD46 module.
Antenna port	No
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	64.8 GHz
Lowest Signal generated in EUT	34.8 MHz
Hardware Version (HVIN)	V2000
Firmware Version (FVIN)	CANOPY 21.1
Type of Equipment	60 GHz Point to multipoint client node, point to point node, MESH
Technology Type	IEEE 802.11ay
Geo-location (yes/no)	Yes
TX Parameters	
Alignment range – transmitter	57 to 66 GHz
EUT Declared Modulation Parameters	$\pi/2$ -DBPSK (MCS0), $\pi/2$ -BPSK (MCS2 to MCS5), $\pi/2$ -QPSK (MCS6 to MCS9) and $\pi/2$ -16QAM (MCS10 to MCS13)
EUT Declared Power level	49 dBm
EUT Declared Signal Bandwidths	2.16 GHz and 4.32 GHz (channel bonding)
EUT Declared Channel Spacing's	2.16 GHz and 4.32 GHz
EUT Declared Duty Cycle	50%
Unmodulated carrier available?	Yes
Declared frequency stability	Not declared
RX Parameters	
Alignment range – receiver	57 to 66 GHz
EUT Declared RX Signal Bandwidth	2.16 GHz and 4.32 GHz
FCC Parameters	
FCC Transmitter Class	DXX: Part 15 Low Power Communication Device Transmitter

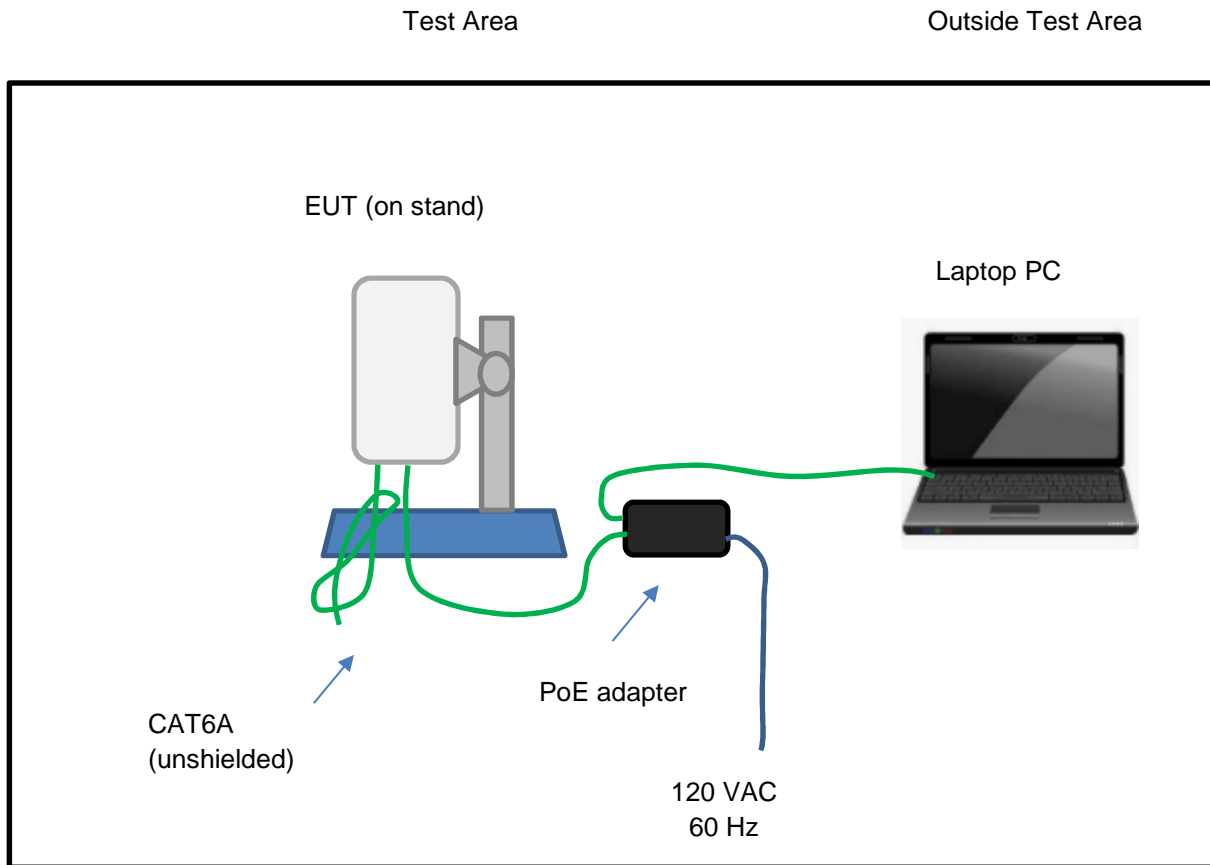
2.3 Functional description

The equipment under test (EUT) is a 60 GHz data node operating in the 57 – 71 GHz frequency band. The EUT support 2.16 GHz and 4.32 GHz channel bandwidths. 4.32 GHz channels are created by bonding two adjacent 2.16 GHz channels together. The EUT is PoE powered via the supplied mains to PoE adapter. The EUT has an integrated tile antenna which employs beam-steering. The tile antenna is further focused using a dual reflector. The EUT has two PoE ports 1 x PoE in and 1 x PoE out. The EUT supports modulation schemes MCS0 and MCS2 to MCS12 (2.16 GHz channels) and MCS0 and MCS2 to MCS13 (4.32 GHz channels).

2.4 Modes of operation

Mode Reference	Description	Used for testing
CH1	Transmitting continuously at 58.32 GHz with modulation, 2.16 GHz channel bandwidth.	Yes
CH3	Transmitting continuously at 62.64 GHz with modulation, 2.16 GHz channel bandwidth.	Yes
CH4	Transmitting continuously at 64.8 GHz with modulation, 2.16 GHz channel bandwidth.	Yes
CH9	Transmitting continuously at 59.4 GHz with modulation, 4.32 GHz channel bandwidth.	Yes
CH10	Transmitting continuously at 61.56 GHz with modulation, 4.32 GHz channel bandwidth.	Yes
CH11	Transmitting continuously at 63.72 GHz with modulation, 4.32 GHz channel bandwidth.	Yes
CH1 (CW)	Transmitting continuously at 58.32 GHz without modulation (CW)	Yes
CH3 (CW)	Transmitting continuously at 62.64 GHz without modulation (CW)	Yes
CH4 (CW)	Transmitting continuously at 64.8 GHz without modulation (CW)	Yes
CH9 (CW)	Transmitting continuously at 59.4 GHz without modulation (CW)	Yes
CH10 (CW)	Transmitting continuously at 61.56 GHz without modulation (CW)	Yes
CH11 (CW)	Transmitting continuously at 63.72 GHz without modulation (CW)	Yes

2.5 Emissions configuration



The unit was powered from the supplied PoE adapter which was connected to a 120 V AC mains source. The EUT was connected to a laptop PC via the PoE adapter. The EUT's AUX Ethernet port was populated with a 1 meter Ethernet cable and the excess length was bundled. The unit was configured using a laptop PC running specialised engineering software (Qualcomm QRCT) to allow permanent transmit modes of the 60 GHz radio to be set. Using the software it was possible to configure the channel, RF power, modulation scheme, local oscillator level (LO_GC) and individual antenna beam (sector) settings. The EUT was configured in accordance with the applicant's instructions.

The following modulation schemes were assessed during testing:

(2.16 GHz Channels) MCS0, MCS2, MCS3, MCS4, MCS5, MCS6, MCS7, MCS8, MCS9, MCS10, MCS11, MCS12

(4.32 GHz Channels) MCS0, MCS2, MCS3, MCS4, MCS5, MCS6, MCS7, MCS8, MCS9, MCS10, MCS11, MCS12, MCS13

Note: MCS1 was declared as not used by the applicant.

The settings used for full test were:

Channel	Frequency	Channel bandwidth	TPC Power Setting	LO_GC Setting	Sector Setting found for max eirp
1	58.32 GHz	2.16 GHz	+4	3	32
3	62.64 GHz	2.16 GHz	2.9 / +4 (see note)	3	32
4	64.8 GHz	2.16 GHz	+4	3	37
9	59.4 GHz	4.32 GHz	+4	3	32
10	62.56 GHz	4.32 GHz	+4	3	32
11	63.72 GHz	4.32 GHz	+4	3	37

Note: (Channel 3 only) TPC Power set to 2.9 for MCS0 and MCS2 to MCS10, all other modulation schemes were set to +4 dBm setting.

Measured duty cycles for the schemes were as follows:-
All mod schemes >99.9 %

Software used to configure EUT:
Qualcomm Radio Control Tool, Version 4.0.00203.0
DM TOOLS Version 3.9.0.3
Teraterm Version 4.106

For Radiated spurious emissions tests the Dual reflector was left in place as worst case for emissions, For all other tests the dual reflector was removed in order to allow closer measuring distances to be realised, all results were then referenced back to include the 12dBi dual reflector gain.

2.5.1 Signal leads

Port Name	Cable Type	Connected
Ethernet Main	Cat 6A (unscreened)	Yes
Ethernet Aux	Cat 6A (unscreened)	Yes

3 Summary of test results

The 60 GHz cnWave V2000, Model: V2000 was tested for compliance to the following standard(s) :

47 CFR Part 15.255 Effective Date 1st October 2020
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	NOT APPLICABLE ¹
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 ²
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 ³
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 Lowest frequency generated within the unit is declared as 25 MHz.

² Spectrum investigated started at a frequency of 150 kHz up to a frequency of 200GHz. The highest signal generated in the equipment is 66 GHz.

³ 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.

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	2020	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	120V DC
T minimum	-20 °C	V minimum	102V DC
T maximum	50 °C	V maximum	138V DC

Extremes of voltage are based on nominal +/-15%.

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 rubber bung was removed from the side-access aperture prior to test.

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 the PoE adapter 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 the initial scan, no discernible difference in emissions could be observed when operating on different channels or modulation schemes. For final test the EUT was operated in CH3 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, E624, E411

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	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Mid channel	62.64 GHz

Plot refs	
13438-1 Cond 1 AC Live 150k-30M Average	
13438-1 Cond 1 AC Live 150k-30M Quasi-Peak	
13438-1 Cond 1 AC Neutral 150k-30M Average	
13438-1 Cond 1 AC Neutral 150k-30M 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	0.157	56.0	49.7	-15.9	30.7	-24.9
2	0.169	53.8	48.2	-16.8	28.8	-26.2
3	0.237	47.9	41.0	-21.2	23.6	-28.6
4	0.324	41.4	36.0	-23.6	20.9	-28.7
5	0.340	40.5	34.6	-24.6	16.6	-32.6
6	0.366	40.1	34.0	-24.6	20.8	-27.8
7	0.412	42.9	37.8	-19.8	30.2	-17.4
8	0.421	42.5	39.0	-18.4	30.9	-16.5
9	0.492	36.8	30.2	-25.9	17.3	-28.8
10	0.509	35.5	30.1	-25.9	18.5	-27.5
11	0.569	37.0	30.1	-25.9	21.5	-24.5

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	0.153	54.7	48.7	-17.1	29.3	-26.5
2	0.162	53.7	47.5	-17.9	29.0	-26.4
3	0.188	50.2	43.5	-20.6	23.5	-30.6
4	0.194	51.2	44.1	-19.8	24.0	-29.9
5	0.215	48.3	42.1	-20.9	22.0	-31.0
6	0.215	48.2	42.2	-20.8	22.1	-30.9
7	0.234	46.2	39.8	-22.5	19.3	-33.0
8	0.267	44.3	38.3	-22.9	23.1	-28.1
9	0.288	42.5	36.4	-24.2	24.2	-26.4
10	0.310	42.3	35.3	-24.7	23.6	-26.4
11	0.354	38.7	31.3	-27.6	18.2	-30.7

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

LIMITS:

15.207: 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:

150kHz to 30MHz ±3.6dB

5.2 Radiated emissions 9 - 150 kHz

NOT APPLICABLE: Lowest frequency generated within the unit is declared as 25 MHz.

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 examined in normal use position. Radiated Emissions testing was performed whilst the PoE adapter was powered from 120 VAC. During the initial scan, no discernible difference in emissions could be observed when operating on different channels or modulation schemes. The EUT was operated in CH3 mode 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 50%
 Pressure of test environment 102kPa

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Mid channel	62.64 GHz

Plot refs
13438-1 Rad 1 150k-30MHz Para
13438-1 Rad 1 150k-30MHz Perp

Peak detector "Max held" Analyser plots against the Quasi-Peak / Average limit line(s) can be found in Section 6 of this report. No emissions were observed within 20dB of limits.

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 examined in normal use position. Radiated Emissions testing was performed whilst the PoE adapter was powered from 120 VAC. During the initial scan, no discernible difference in emissions could be observed when operating on different channels or modulation schemes. The EUT was operated in CH3 mode 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 H.

5.4.4 Test equipment

E534, E535, E660, E744, NSA-H, ZSW1

See Section 9 for more details

5.4.5 Test results

Temperature of test environment 20°C
 Humidity of test environment 50%
 Pressure of test environment 102kPa

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Mid channel	62.64 GHz

Plot refs	
13438-1 Rad 2 VHF Horiz	
13438-1 Rad 2 VHF Vert	
13438-1 Rad 2 UHF Horiz	
13438-1 Rad 2 UHF Vert	

Table of signals measured for Rad 2 Horizontal Sig List

Signal No.	Freq (MHz)	Peak Amp (dBuV/m)	QP Amp (dBuV/m)	QP -Lim (dB)
1	99.127	24.6	17.2	-26.3
2	137.147	27.4	20.6	-22.9
3	137.147	26.4	19.2	-24.3
4	138.334	26.4	19.4	-24.1
5	180.000	26.3	20.8	-22.7
6	874.992	42.8	40.8	-5.2

Table of signals measured for Rad 2 Vertical Sig List

Signal No.	Freq (MHz)	Peak Amp (dBuV/m)	QP Amp (dBuV/m)	QP -Lim (dB)
1	30.089	40.3	34.0	-6.0
2	45.280	35.5	28.8	-11.2
3	54.918	33.5	28.5	-11.5
4	62.450	34.8	29.6	-10.4
5	72.379	40.9	36.0	-4.0
6	72.380	40.8	36.2	-3.8
7	137.237	38.5	33.8	-9.7
8	874.992	41.7	39.3	-6.7

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

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:

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 examined in its normal use position. Radiated Emissions testing was performed whilst powered from the manufacturers PoE adapter. The EUT was operated in CH1, CH3, CH4, CH9, CH10 and CH11 modes.

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 H and M.

5.5.4 Test equipment

E136, E296-2, E330, E411, E412, E485, E534, E535, E642, F015, LPE261, LPE333, TMS78, TMS79, TMS82

See Section 9 for more details

5.5.5 Test results

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

Setup Table

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Low 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
7289.99	44.2	-29.8	36.0	-18.0	Normal use position	Vertical
7289.99	46.8	-27.2	41.1	-12.9	Normal use position	Horizontal
14298	47.3	-26.7	37.1	-16.9	Normal use position	Vertical
14298	45.6	-28.4	35.5	-18.5	Normal use position	Horizontal

Setup Table

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Mid channel	62.64 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
7829.989	48.5	-25.5	43.8	-10.2	Normal use position	Vertical
7829.989	53.2	-20.8	50.8	-3.2	Normal use position	Horizontal

Plots
13438-1 Rad 1 1-2GHz Horiz
13438-1 Rad 1 1-2GHz Vert
13438-1 Rad 1 2-5GHz Horiz
13438-1 Rad 1 2-5GHz Vert
13438-1 Rad 1 5-6GHz Horiz
13438-1 Rad 1 5-6GHz Vert
13438-1 Rad 2 6upto10GHz Horiz
13438-1 Rad 2 6upto10GHz Vert
13438-1 Rad 2 10upto12_5GHz Horiz
13438-1 Rad 2 10upto12_5GHz Vert
13438-1 Rad 1 12.5-15GHz Horiz
13438-1 Rad 1 12.5-15GHz Vert
13438-1 Rad 1 15-18GHz Horiz
13438-1 Rad 1 15-18GHz Vert
13438-1 Rad 1 18-22GHz Horiz
13438-1 Rad 1 18-22GHz Vert
13438-1 Rad 1 22-25GHz Horiz
13438-1 Rad 1 22-25GHz Vert
13438-1 Rad 1 25-26.5GHz Horiz
13438-1 Rad 1 25-26.5GHz Vert
J13438-1 Radiated Emissions 26.5 - 30 GHz Horiz
J13438-1 Radiated Emissions 26.5 - 30 GHz Vert
J13438-1 Radiated Emissions 30 - 35 GHz Horiz
J13438-1 Radiated Emissions 30 - 35 GHz Vert
J13438-1 Radiated Emissions 35 - 40 GHz Horiz
J13438-1 Radiated Emissions 35 - 40 GHz Vert

Setup Table

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
High channel	64.8 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
8099.989	46.3	-27.7	38.8	-15.2	Normal use position	Vertical
8099.989	52.6	-21.4	50.0	-4.0	Normal use position	Horizontal

Setup Table

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS5
Low channel	59.4 GHz (Bonded)

Spurious Frequency (MHz)	Measured Peak Level (dB μ V/m)	Difference to Peak Limit (dB)	Measured Average Level (dB μ V/m)	Difference to Average Limit (dB)	EUT Polarisation	Antenna Polarisation
7424.99	48.9	-25.1	44.7	-9.3	Normal use position	Vertical
7424.99	52.3	-21.7	49.5	-4.5	Normal use position	Horizontal

Setup Table

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS5
Mid channel	61.56 GHz (Bonded)

Spurious Frequency (MHz)	Measured Peak Level (dB μ V/m)	Difference to Peak Limit (dB)	Measured Average Level (dB μ V/m)	Difference to Average Limit (dB)	EUT Polarisation	Antenna Polarisation
7694.99	44.7	-29.3	36.2	-17.8	Normal use position	Vertical
7694.99	47.5	-26.5	42.5	-11.5	Normal use position	Horizontal

Setup Table

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS5
High channel	63.72 GHz (Bonded)

Spurious Frequency (MHz)	Measured Peak Level (dB μ V/m)	Difference to Peak Limit (dB)	Measured Average Level (dB μ V/m)	Difference to Average Limit (dB)	EUT Polarisation	Antenna Polarisation
7964.989	48.3	-25.7	43.6	-10.4	Normal use position	Vertical
7964.989	50.1	-23.9	46.3	-7.7	Normal use position	Horizontal

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. No discernible difference in emissions was observed between modulation schemes, therefore MCS5 was used for full tests.

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 ± 3.5 dB, 18 – 26.5 GHz ± 3.9 dB, 26.5 – 40 GHz ± 3.9 dB

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 distances stated in the procedure. The EUT was examined in its normal use position Radiated Emissions testing was performed whilst powered from the manufacturers PoE adapter.

The EUT was operated in CH1, CH3, CH4, CH9, CH10 and CH11 modes.

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 H and A.

5.6.4 Test equipment

E296-4, E411, E412, E485, E487, E503, E534, E535, E580, E638, E642, E718, E721, E760, E771, E941, F015, F091, H070,

See Section 9 for more details

5.6.5 Test results

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

Setup Table

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Low 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
115760	68.2	-17.1	63.6	-21.7	Normal use position	Vertical
117520	74.2	-11.1	71.7	-13.6	Normal use position	Vertical

Setup Table

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Mid channel	62.64 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
124400	68.6	-16.7	63.5	-21.8	Normal use position	Vertical
126160	69.3	-16.0	65.0	-20.3	Normal use position	Vertical

Plots
J13438-1 Radiated Emissions 40 – 45 GHz Horiz
J13438-1 Radiated Emissions 40 – 45 GHz Vert
J13438-1 Radiated Emissions 45 – 50 GHz Horiz
J13438-1 Radiated Emissions 45 – 50 GHz Vert
J13438-1 Radiated Emissions 50 – 55 GHz Horiz
J13438-1 Radiated Emissions 50 – 55 GHz Vert
J13438-1 Radiated Emissions 55 – 60 GHz Horiz
J13438-1 Radiated Emissions 55 – 60 GHz Vert
J13438-1 Radiated Emissions 60 – 64 GHz Horiz
J13438-1 Radiated Emissions 60 – 64 GHz Vert
J13438-1 Radiated Emissions 64 – 68 GHz Horiz
J13438-1 Radiated Emissions 64 – 68 GHz Vert
J13438-1 Radiated Emissions 68 – 72 GHz Horiz
J13438-1 Radiated Emissions 68 – 72 GHz Vert
J13438-1 Radiated Emissions 72 – 75 GHz Horiz
J13438-1 Radiated Emissions 72 – 75 GHz Vert
J13438-1 Radiated Emissions 75 – 85 GHz Horiz
J13438-1 Radiated Emissions 75 – 85 GHz Vert
J13438-1 Radiated Emissions 85 – 95 GHz Horiz
J13438-1 Radiated Emissions 85 – 95 GHz Vert
J13438-1 Radiated Emissions 95 – 105 GHz Horiz
J13438-1 Radiated Emissions 95 – 105 GHz Vert
J13438-1 Radiated Emissions 105 – 110 GHz Horiz
J13438-1 Radiated Emissions 105 – 110 GHz Vert
J13438-1 Radiated Emissions 110 – 120 GHz Horiz
J13438-1 Radiated Emissions 110 – 120 GHz Vert
J13438-1 Radiated Emissions 120 – 130 GHz Horiz
J13438-1 Radiated Emissions 120 – 130 GHz Vert
J13438-1 Radiated Emissions 130 – 140 GHz Horiz
J13438-1 Radiated Emissions 130 – 140 GHz Vert
J13438-1 Radiated Emissions 140 – 150 GHz Horiz
J13438-1 Radiated Emissions 140 – 150 GHz Vert
J13438-1 Radiated Emissions 150 – 160 GHz Horiz
J13438-1 Radiated Emissions 150 – 160 GHz Vert
J13438-1 Radiated Emissions 170 – 180 GHz Horiz
J13438-1 Radiated Emissions 170 – 180 GHz Vert
J13438-1 Radiated Emissions 180 – 190 GHz Horiz
J13438-1 Radiated Emissions 180 – 190 GHz Vert
J13438-1 Radiated Emissions 190 – 200 GHz Horiz
J13438-1 Radiated Emissions 190 – 200 GHz Vert

Setup Table

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
High channel	64.8 GHz

Spurious Frequency (MHz)	Measured Peak Level (dB μ V/m)	Difference to Peak Limit (dB)	Measured Average Level (dB μ V/m)	Difference to Average Limit (dB)	EUT Polarisation	Antenna Polarisation
128720	66.3	-19.0	60.4	-24.9	Normal use position	Vertical
130480	65.5	-19.8	58.3	-27.3	Normal use position	Vertical

Setup Table

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS5
Low channel	59.4 GHz (Bonded)

Spurious Frequency (MHz)	Measured Peak Level (dB μ V/m)	Difference to Peak Limit (dB)	Measured Average Level (dB μ V/m)	Difference to Average Limit (dB)	EUT Polarisation	Antenna Polarisation
117040	70.5	-14.8	67.8	-17.5	Normal use position	Vertical
120560	64.3	-21.0	58.1	-27.2	Normal use position	Vertical

Setup Table

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS5
Mid channel	61.56 GHz (Bonded)

Spurious Frequency (MHz)	Measured Peak Level (dB μ V/m)	Difference to Peak Limit (dB)	Measured Average Level (dB μ V/m)	Difference to Average Limit (dB)	EUT Polarisation	Antenna Polarisation
121360	64.0	-21.3	56.2	-29.1	Normal use position	Vertical
124880	67.2	-18.1	62.0	-23.3	Normal use position	Vertical

Setup Table

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS5
High channel	63.72 GHz (Bonded)

Spurious Frequency (MHz)	Measured Peak Level (dB μ V/m)	Difference to Peak Limit (dB)	Measured Average Level (dB μ V/m)	Difference to Average Limit (dB)	EUT Polarisation	Antenna Polarisation
125680	66.3	-19.0	61.4	-23.9	Normal use position	Vertical
129200	65.5	-19.8	57.7	-27.6	Normal use position	Vertical

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. MCS5 modulation scheme was used as worst case/highest EIRP found.

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 dB μ V/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:
40 – 60 GHz \pm 3.9dB, 60 – 110 GHz \pm 4.4dB, 110 – 200 GHz \pm 5.9dB

5.7 Peak & Average EIRP

5.7.1 Test methods

Test Requirements:	47 CFR Part 15C Part 15.255(e)(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(e) (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. To avoid making measurements in the near-field, the EUT's antenna reflector was removed prior to test. This allowed measurements to be performed at a distance of 30 centimetres. The EUT antenna was positioned and aligned with the measuring antenna. During the initial scan all modulation schemes were assessed on the 2.16GHz BW Mid channel and the 4.32 GHz BW Mid channel settings, as they provided highest EIRP. Modulation scheme MCS5 was found to be the worst case mode of operation along with the stated beams for maximum EIRP across all channels, therefore MCS5 and the beam settings stated below were used for full test. The EUT was operated in CH1, CH3, CH4, CH9, CH10 and CH11 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 0.3m was used. The measurement was adjusted by 12 dB to account for the declared antenna reflector gain omitted from the test configuration.

Tests were performed using test Site A.

5.7.4 Test equipment

E433, E602, E658, E755, F024, F045, F136, F306, F357, F379, H078

See Section 9 for more details

5.7.5 Test results

Temperature of test environment	20°C
Humidity of test environment	50%
Pressure of test environment	102kPa

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Low channel	58.32 GHz

Chan Freq (GHz)	Meas distance (m)	Max beam/array setting
58.32	0.3	32
Mod scheme/rate	Pk EIRP result (dBm)	RMS EIRP result (dBm)
MCS5	48.40	47.72
Limit Margin (dB)	-3.6	-1.28

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	ALL
Mid channel	62.64 GHz

Chan Freq (GHz)	Meas distance (m)	Max beam/array setting
62.64	0.3	32
Mod scheme/rate	Pk EIRP result (dBm)	RMS EIRP result (dBm)
MCS0	48.23	48.09
MCS2	48.42	48.02
MCS3	48.44	47.96
MCS4	48.37	48.02
MCS5	48.98	48.56
MCS6	48.67	47.76
MCS7	48.73	47.71
MCS8	48.60	48.36
MCS9	48.67	47.73
MCS10	44.32	43.32
MCS11	45.10	44.44
MCS12	44.71	43.94
Worst case (MCS5) Limit Margin (dB)	-3.02	-0.44

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
High channel	64.8 GHz

Chan Freq (GHz)	Meas distance (m)	Max beam/array setting
64.8	0.3	37
Mod scheme/rate	Pk EIRP result (dBm)	RMS EIRP result (dBm)
MCS5	48.60	48.14
Limit Margin (dB)	-3.4	-0.86

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS5
Low channel	59.4 GHz (Bonded)

Chan Freq (GHz)	Meas distance (m)	Max beam/array setting
59.4	0.3	32
Mod scheme/rate	Pk EIRP result (dBm)	RMS EIRP result (dBm)
MCS5	48.82	48.41
Limit Margin (dB)	-3.18	-0.59

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	ALL
Mid channel	61.56 GHz (Bonded)

Chan Freq (GHz)	Meas distance (m)	Max beam/array setting
61.56	0.3	32
Mod scheme/rate	Pk EIRP result (dBm)	RMS EIRP result (dBm)
MCS0	48.41	47.86
MCS1	48.57	47.85
MCS2	49.06	48.93
MCS3	49.14	48.86
MCS4	49.09	48.90
MCS5	49.11	48.93
MCS6	49.10	48.31
MCS7	49.14	48.72
MCS8	49.16	48.71
MCS9	49.15	48.66
MCS10	49.09	48.71
MCS11	49.11	48.68
MCS12	43.87	43.22
MCS13	44.54	43.86
Worst case (MCS5) Limit Margin (dB)	-2.89	-0.07

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS5
High channel	63.72 GHz (Bonded)

Chan Freq (GHz)	Meas distance (m)	Max beam/array setting
63.72	0.3	37
Mod scheme/rate	Pk EIRP result (dBm)	RMS EIRP result (dBm)
MCS5	48.49	48.19
Limit Margin (dB)	-3.51	-0.81

LIMITS:

15.255 (c)(i) the average power of any emission shall not exceed 40 dBm and the peak power of any emission shall not exceed 43 dBm or (ii) for fixed point-to-point transmitters located outdoors, the average power of any emission shall not exceed 82 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi. The peak power of any emission shall not exceed 85 dBm, and shall be reduced by 2 dB for every dB that the antenna gain is less than 51 dBi.

The declared total antenna gain used within the EUT is 34.5 dBi and therefore the Average and Peak power limits are 49 dBm and 52 dBm respectively.

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(e)(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(e)(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 performed with the EUT's tile-antenna in place, but without the EUT's dual reflector fitted (please refer to section 5.7). This measurement was then adjusted to subtract the declared gain of the tile-antenna. This measurement was then converted to Watts.

5.8.4 Test equipment

E433, E602, E658, E755, F024, F045, F136, F306, F357, F379, H078,

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

Note: results shown for worst case scheme only

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

	Low channel	Mid channel	High channel
Sector / Array / Beam setting	32	32	37
TPC Setting (dB)	4.0	2.9	4.0
Pk EIRP result (measured without reflector in dBm)	36.4	36.98	36.6
Pk conducted power result dBm (with 22.5 dBi tile-antenna gain subtracted)	13.9	14.48	14.1
Peak Conducted power (Watts)	0.0245	0.0281	0.0257

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS5
Low channel	59.4 GHz (Bonded)
Mid channel	61.56 GHz (Bonded)
High channel	63.72 GHz (Bonded)

	Low channel	Mid channel	High channel
Sector / Array / Beam setting	32	32	37
TPC Setting (dB)	4.0	2.9	4.0
Pk EIRP result (dBm)	36.82	37.11	36.49
Pk conducted power result dBm(with 22.5 dBi tile-antenna gain subtracted)	14.32	14.61	13.99
Peak Conducted power (Watts)	0.027	0.0289	0.0251

LIMITS:

15.255 (e) the peak transmitter conducted output power shall not exceed 500 mW.

The declared total antenna gain used within the EUT is 34.5 dBi made up of 12dBi dual reflector gain and 22.5 dBi antenna array gain.

These results show that the EUT has PASSED this test.

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, To allow the EUT's fundamental transmission to pass through the chamber a rubber bung was removed from the side-access aperture prior to test. The EUT was operated in CH1 (CW), CH3 (CW), CH4 (CW), CH9 (CW), CH10 (CW) and CH11 (CW) 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 using a counter function of a spectrum analyser. Tests were performed using Test Site J.

5.9.4 Test equipment

E433, E717, E755, E781, E920, L264, N495, S032, S036

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	102kPa

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	CW
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

Test conditions		Frequency Error (MHz)	Frequency Error (MHz)	Frequency Error (MHz)
		Low channel	Mid channel	High channel
-20°C	Volts Nominal (120)	58320.084737	62640.089473	64800.091175
-10°C	Volts Nominal (120)	58320.075501	62640.080719	64800.083656
0°C	Volts Nominal (120)	58320.080555	62640.086143	64800.088802
10°C	Volts Nominal (120)	58320.077216	62640.160331	64800.085084
20°C	Volts Minimum (102)	58320.084000	62640.090837	64800.094101
	Volts Nominal (120)	58320.084521	62640.090910	64800.095664
	Volts Maximum (138)	58320.084544	62640.091125	64800.094017
30°C	Volts Nominal (120)	58320.084926	62640.091312	64800.094579
40°C	Volts Nominal (120)	58320.079741	62640.085633	64800.088556
50°C	Volts Nominal (120)	58320.082261	62640.087661	64800.088968
Max Frequency Error per chan (Hz)		+84926 / -0	+160331 / -0	+95664 / -0
Max Frequency Error observed (MHz)		0.084926	0.160331	0.095664

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	CW
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Test conditions		Frequency Error (MHz) Low channel	Frequency Error (MHz) Mid channel	Frequency Error (MHz) High channel
-30°C	Volts Nominal (120)	n/a	n/a	n/a
-20°C	Volts Nominal (120)	59400.086152	61560.088655	63720.090618
-10°C	Volts Nominal (120)	59400.076674	61560.079182	63720.081815
0°C	Volts Nominal (120)	59400.081952	61560.084727	63720.087333
10°C	Volts Nominal (120)	59400.079199	61560.080580	63720.083549
20°C	Volts Minimum (102)	59400.086337	61560.089824	63720.093511
	Volts Nominal (120)	59400.086183	61560.089547	63720.093311
	Volts Maximum (138)	59400.086410	61560.090741	63720.093233
30°C	Volts Nominal (120)	59400.086765	61560.089981	63720.093042
40°C	Volts Nominal (120)	59400.081040	61560.083941	63720.086844
50°C	Volts Nominal (120)	59400.081442	61559.915646	63720.087141
Max Frequency Error per chan (Hz)		+86765 / -0	+90741 / -84354	+93511 / -0
Max Frequency Error observed (MHz)		0.086765	0.090741	0.093511

Maximum variation observed was +160.3 / - 84.3 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 CH1, CH3, CH4, CH9, CH10 and CH11 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

E433, E717, E755, E920

See Section 9 for more details

5.10.5 Test results

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

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS0
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.367	1.448	1.018
Plot reference	13438-1 Low Channel 2.16 GHz, mcs0	13438-1 Mid Channel 2.16 GHz, mcs0	13438-1 High Channel 2.16 GHz, mcs0
99% Bandwidth (GHz)	2.0704	2.0719	2.8336
Frequency Error (MHz) (include sign)	4.3811	46.976	454.34
Operating frequency (GHz)	58.32	62.64	64.8
6dB BW FLOW Worst case (GHz)	57.6408811	61.962976	64.74534
6dB BW FHIGH Worst case (GHz)	59.0078811	63.410976	65.76334

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS2
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.533	1.643	1.712
Plot reference	13438-1 Low Channel 2.16 GHz, mcs2	13438-1 Mid Channel 2.16 GHz, mcs2	13438-1 High Channel 2.16 GHz, mcs2
99% Bandwidth (GHz)	2.0495	2.1119	2.8629
Frequency Error (MHz) (include sign)	1.3845	47.465	451.76
Operating frequency (GHz)	58.32	62.64	64.8
6dB BW FLOW Worst case (GHz)	57.5548845	61.865965	64.39576
6dB BW FHIGH Worst case (GHz)	59.0878845	63.508965	66.10776

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS3
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.533	1.561	1.658
Plot reference	13438-1 Low Channel 2.16 GHz, mcs3	13438-1 Mid Channel 2.16 GHz, mcs3	13438-1 High Channel 2.16 GHz, mcs3
99% Bandwidth (GHz)	2.0523	2.1236	2.8544
Frequency Error (MHz) (include sign)	2.0983	48.521	450.27
Operating frequency (GHz)	58.32	62.64	64.8
6dB BW FLOW Worst case (GHz)	57.5555983	61.908021	64.42127
6dB BW FHIGH Worst case (GHz)	59.0885983	63.469021	66.07927

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS4
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.65	1.557	1.76
Plot reference	13438-1 Low Channel 2.16 GHz, mcs4	13438-1 Mid Channel 2.16 GHz, mcs4	13438-1 High Channel 2.16 GHz, mcs4
99% Bandwidth (GHz)	2.0419	2.1161	2.8322
Frequency Error (MHz) (include sign)	-0.343	49.151	442.28
Operating frequency (GHz)	58.32	62.64	64.8
6dB BW FLOW Worst case (GHz)	57.494657	61.910651	64.36228
6dB BW FHIGH Worst case (GHz)	59.144657	63.467651	66.12228

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.496	1.585	1.699
Plot reference	13438-1 Low Channel 2.16 GHz, mcs5	13438-1 Mid Channel 2.16 GHz, mcs5	13438-1 High Channel 2.16 GHz, mcs5
99% Bandwidth (GHz)	2.0486	2.1067	2.8514
Frequency Error (MHz) (include sign)	2.226	45.317	450.3
Operating frequency (GHz)	58.32	62.64	64.8
6dB BW FLOW Worst case (GHz)	57.574226	61.892817	64.4008
6dB BW FHIGH Worst case (GHz)	59.070226	63.477817	66.0998

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS6
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.482	1.616	1.629
Plot reference	13438-1 Low Channel 2.16 GHz, mcs6	13438-1 Mid Channel 2.16 GHz, mcs6	13438-1 High Channel 2.16 GHz, mcs6
99% Bandwidth (GHz)	2.325	2.5628	2.9504
Frequency Error (MHz) (include sign)	-145.29	178.01	438.13
Operating frequency (GHz)	58.32	62.64	64.8
6dB BW FLOW Worst case (GHz)	57.43371	62.01001	64.42363
6dB BW FHIGH Worst case (GHz)	58.91571	63.62601	66.05263

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS7
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.599	1.616	1.694
Plot reference	13438-1 Low Channel 2.16 GHz, mcs7	13438-1 Mid Channel 2.16 GHz, mcs7	13438-1 High Channel 2.16 GHz, mcs7
99% Bandwidth (GHz)	2.3359	2.574	2.971
Frequency Error (MHz) (include sign)	-143.17	180.46	440.1
Operating frequency (GHz)	58.32	62.64	64.8
6dB BW FLOW Worst case (GHz)	57.37733	62.01246	64.3931
6dB BW FHIGH Worst case (GHz)	58.97633	63.62846	66.0871

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS8
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.313	1.608	1.568
Plot reference	13438-1 Low Channel 2.16 GHz, mcs8	13438-1 Mid Channel 2.16 GHz, mcs8	13438-1 High Channel 2.16 GHz, mcs8
99% Bandwidth (GHz)	2.3182	2.5466	2.9107
Frequency Error (MHz) (include sign)	-147.15	171.7	431.92
Operating frequency (GHz)	58.32	62.64	64.8
6dB BW FLOW Worst case (GHz)	57.51635	62.0077	64.44792
6dB BW FHIGH Worst case (GHz)	58.82935	63.6157	66.01592

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS9
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.433	1.571	1.717
Plot reference	13438-1 Low Channel 2.16 GHz, mcs9	13438-1 Mid Channel 2.16 GHz, mcs9	13438-1 High Channel 2.16 GHz, mcs9
99% Bandwidth (GHz)	2.3076	2.5502	2.9371
Frequency Error (MHz) (include sign)	-141.29	175.21	440.02
Operating frequency (GHz)	58.32	62.64	64.8
6dB BW FLOW Worst case (GHz)	57.46221	62.02971	64.38152
6dB BW FHIGH Worst case (GHz)	58.89521	63.60071	66.09852

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS10
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.372	1.585	1.605
Plot reference	13438-1 Low Channel 2.16 GHz, mcs10	13438-1 Mid Channel 2.16 GHz, mcs10	13438-1 High Channel 2.16 GHz, mcs10
99% Bandwidth (GHz)	2.221	2.0172	2.9049
Frequency Error (MHz) (include sign)	-112.16	28.237	484.58
Operating frequency (GHz)	58.32	62.64	64.8
6dB BW FLOW Worst case (GHz)	57.52184	61.875737	64.48208
6dB BW FHIGH Worst case (GHz)	58.89384	63.460737	66.08708

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS11
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.527	1.57	1.672
Plot reference	13438-1 Low Channel 2.16 GHz, mcs11	13438-1 Mid Channel 2.16 GHz, mcs11	13438-1 High Channel 2.16 GHz, mcs11
99% Bandwidth (GHz)	2.213	2.0097	2.9095
Frequency Error (MHz) (include sign)	-109.89	28.643	482.18
Operating frequency (GHz)	58.32	62.64	64.8
6dB BW FLOW Worst case (GHz)	57.44661	61.883643	64.44618
6dB BW FHIGH Worst case (GHz)	58.97361	63.453643	66.11818

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS12
Low channel	58.32 GHz
Mid channel	62.64 GHz
High channel	64.8 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	1.357	1.564	1.66
Plot reference	13438-1 Low Channel 2.16 GHz, mcs12	13438-1 Mid Channel 2.16 GHz, mcs12	13438-1 High Channel 2.16 GHz, mcs12
99% Bandwidth (GHz)	2.3124	2.0017	2.8519
Frequency Error (MHz) (include sign)	-124.8	27.093	465.51
Operating frequency (GHz)	58.32	62.64	64.8
6dB BW FLOW Worst case (GHz)	57.5167	61.885093	64.43551
6dB BW FHIGH Worst case (GHz)	58.8737	63.449093	66.09551

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS0
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	3.481	3.487	2.948
Plot reference	13438-1 Low Channel 4.32 GHz, mcs0	13438-1 Mid Channel 4.32 GHz, mcs0	13438-1 High Channel 4.32 GHz, mcs0
99% Bandwidth (GHz)	6.8838	6.5585	5.8696
Frequency Error (MHz) (include sign)	-354.84	-7.7734	803.7
Operating frequency (GHz)	59.4	61.56	63.72
6dB BW FLOW Worst case (GHz)	57.30466	59.8087266	63.0497
6dB BW FHIGH Worst case (GHz)	60.78566	63.2957266	65.9977

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS2
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	3.266	3.538	2.748
Plot reference	13438-1 Low Channel 4.32 GHz, mcs2	13438-1 Mid Channel 4.32 GHz, mcs2	13438-1 High Channel 4.32 GHz, mcs2
99% Bandwidth (GHz)	4.8016	4.1369	4.736
Frequency Error (MHz) (include sign)	-479.34	111.65	488.55
Operating frequency (GHz)	59.4	61.56	63.72
6dB BW FLOW Worst case (GHz)	57.28766	59.90265	62.83455
6dB BW FHIGH Worst case (GHz)	60.55366	63.44065	65.58255

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS3
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	3.29	3.487	2.799
Plot reference	13438-1 Low Channel 4.32 GHz, mcs3	13438-1 Mid Channel 4.32 GHz, mcs3	13438-1 High Channel 4.32 GHz, mcs3
99% Bandwidth (GHz)	5.2081	4.1551	4.8385
Frequency Error (MHz) (include sign)	-563.14	114.47	532.62
Operating frequency (GHz)	59.4	61.56	63.72
6dB BW FLOW Worst case (GHz)	57.19186	59.93097	62.85312
6dB BW FHIGH Worst case (GHz)	60.48186	63.41797	65.65212

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS4
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	3.321	3.531	2.819
Plot reference	13438-1 Low Channel 4.32 GHz, mcs4	13438-1 Mid Channel 4.32 GHz, mcs4	13438-1 High Channel 4.32 GHz, mcs4
99% Bandwidth (GHz)	4.6627	4.0507	4.7778
Frequency Error (MHz) (include sign)	-427.89	74.805	506.79
Operating frequency (GHz)	59.4	61.56	63.72
6dB BW FLOW Worst case (GHz)	57.31161	59.869305	62.81729
6dB BW FHIGH Worst case (GHz)	60.63261	63.400305	65.63629

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS5
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	3.173	3.531	2.755
Plot reference	13438-1 Low Channel 4.32 GHz, mcs5	13438-1 Mid Channel 4.32 GHz, mcs5	13438-1 High Channel 4.32 GHz, mcs5
99% Bandwidth (GHz)	4.3132	4.1124	4.8581
Frequency Error (MHz) (include sign)	-281.09	100.29	549.17
Operating frequency (GHz)	59.4	61.56	63.72
6dB BW FLOW Worst case (GHz)	57.53241	59.89479	62.89167
6dB BW FHIGH Worst case (GHz)	60.70541	63.42579	65.64667

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS6
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	3.56	3.535	2.903
Plot reference	13438-1 Low Channel 4.32 GHz, mcs6	13438-1 Mid Channel 4.32 GHz, mcs6	13438-1 High Channel 4.32 GHz, mcs6
99% Bandwidth (GHz)	6.9471	5.3349	5.3014
Frequency Error (MHz) (include sign)	-3.137	179.9	718.23
Operating frequency (GHz)	59.4	61.56	63.72
6dB BW FLOW Worst case (GHz)	57.616683	59.9724	62.98673
6dB BW FHIGH Worst case (GHz)	61.176863	63.5074	65.88973

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS7
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	2.784	3.521	2.64
Plot reference	13438-1 Low Channel 4.32 GHz, mcs7	13438-1 Mid Channel 4.32 GHz, mcs7	13438-1 High Channel 4.32 GHz, mcs7
99% Bandwidth (GHz)	4.7688	4.3355	4.2461
Frequency Error (MHz) (include sign)	-484.83	70.234	248.04
Operating frequency (GHz)	59.4	61.56	63.72
6dB BW FLOW Worst case (GHz)	57.52317	59.869734	62.64804
6dB BW FHIGH Worst case (GHz)	60.30717	63.390734	65.28804

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS8
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	2.843	3.521	2.603
Plot reference	13438-1 Low Channel 4.32 GHz, mcs8	13438-1 Mid Channel 4.32 GHz, mcs8	13438-1 High Channel 4.32 GHz, mcs8
99% Bandwidth (GHz)	4.767	4.3075	4.978
Frequency Error (MHz) (include sign)	-483.53	55.871	560.64
Operating frequency (GHz)	59.4	61.56	63.72
6dB BW FLOW Worst case (GHz)	57.49497	59.855371	62.97914
6dB BW FHIGH Worst case (GHz)	60.33797	63.376371	65.58214

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS9
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	3.097	3.375	3.091
Plot reference	13438-1 Low Channel 4.32 GHz, mcs9	13438-1 Mid Channel 4.32 GHz, mcs9	13438-1 High Channel 4.32 GHz, mcs9
99% Bandwidth (GHz)	4.6429	4.2828	4.7286
Frequency Error (MHz) (include sign)	-445.05	37.877	455.85
Operating frequency (GHz)	59.4	61.56	63.72
6dB BW FLOW Worst case (GHz)	57.40645	59.910377	62.63035
6dB BW FHIGH Worst case (GHz)	60.50345	63.285377	65.72135

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS10
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	3.039	3.355	3.292
Plot reference	13438-1 Low Channel 4.32 GHz, mcs10	13438-1 Mid Channel 4.32 GHz, mcs10	13438-1 High Channel 4.32 GHz, mcs10
99% Bandwidth (GHz)	4.7332	4.295	4.9267
Frequency Error (MHz) (include sign)	-477.11	49.494	540.74
Operating frequency (GHz)	59.4	61.56	63.72
6dB BW FLOW Worst case (GHz)	57.40339	59.931994	62.61474
6dB BW FHIGH Worst case (GHz)	60.44239	63.286994	65.90674

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS11
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	3.215	3.213	2.69
Plot reference	13438-1 Low Channel 4.32 GHz, mcs11	13438-1 Mid Channel 4.32 GHz, mcs11	13438-1 High Channel 4.32 GHz, mcs11
99% Bandwidth (GHz)	4.7205	4.2914	4.8741
Frequency Error (MHz) (include sign)	-463.21	49.303	512.28
Operating frequency (GHz)	59.4	61.56	63.72
6dB BW FLOW Worst case (GHz)	57.32929	60.002803	62.88728
6dB BW FHIGH Worst case (GHz)	60.54429	63.215803	65.57728

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS12
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	2.844	3.479	3.521
Plot reference	13438-1 Low Channel 4.32 GHz, mcs12	13438-1 Mid Channel 4.32 GHz, mcs12	13438-1 High Channel 4.32 GHz, mcs12
99% Bandwidth (GHz)	3.9857	3.982	4.541
Frequency Error (MHz) (include sign)	-63.077	39.145	386.73
Operating frequency (GHz)	59.4	61.56	63.72
6dB BW FLOW Worst case (GHz)	57.914923	59.859645	62.34623
6dB BW FHIGH Worst case (GHz)	60.758923	63.338645	65.86723

Band	57-71 GHz
Power Level	49 dBm
Channel Spacing	4.32 GHz
Mod Scheme	MCS13
Low channel	59.4 GHz
Mid channel	61.56 GHz
High channel	63.72 GHz

Parameter	Low channel	Mid channel	High channel
6dB Bandwidth (GHz)	3.14	3.198	2.901
Plot reference	13438-1 Low Channel 4.32 GHz, mcs13	13438-1 Mid Channel 4.32 GHz, mcs13	13438-1 High Channel 4.32 GHz, mcs13
99% Bandwidth (GHz)	4.0452	4.0197	4.6027
Frequency Error (MHz) (include sign)	-125.66	50.139	415.84
Operating frequency (GHz)	59.4	61.56	63.72
6dB BW FLOW Worst case (GHz)	57.70434	60.011139	62.68534
6dB BW FHIGH Worst case (GHz)	60.84434	63.209139	65.58634

Analyser plots for the 6dB bandwidth can be found in Section 6 of this report. Using the Maximum variation result observed of +160.3 / - 84.3 kHz, from results in section 5.9.5 frequency stability, all fundamental emissions are within the operational frequency band.

LIMITS:

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

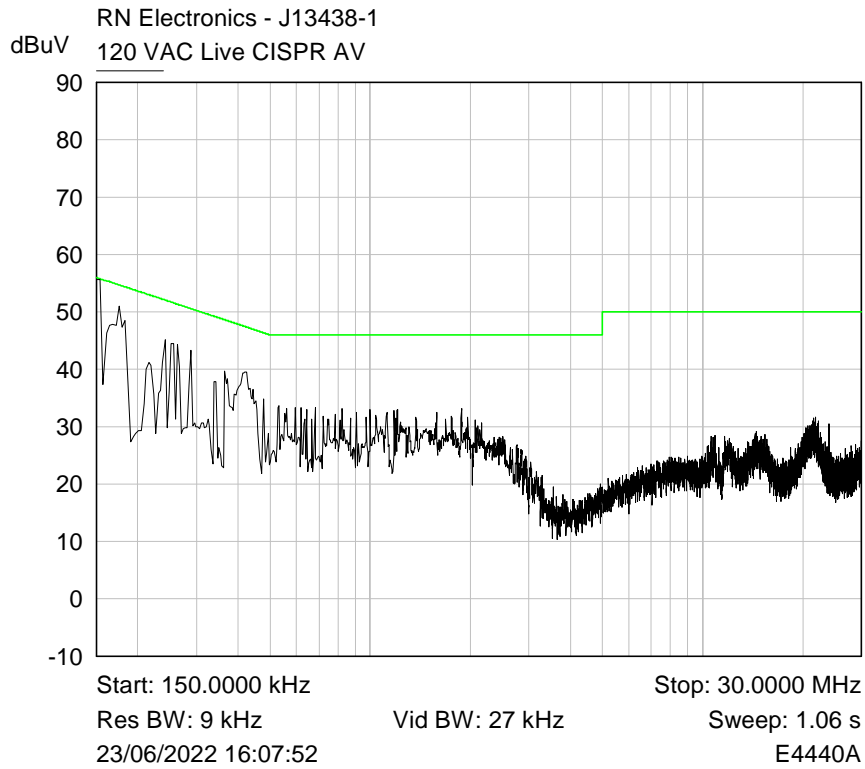
These results show that the EUT has PASSED this test.

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

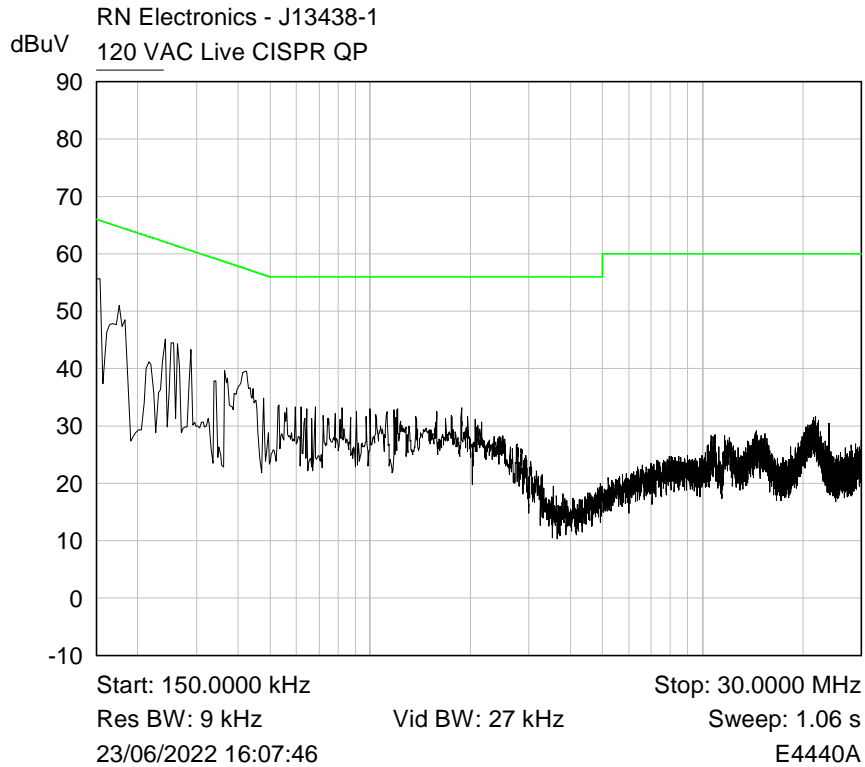
6 Plots/Graphical results

6.1 AC power line conducted emissions

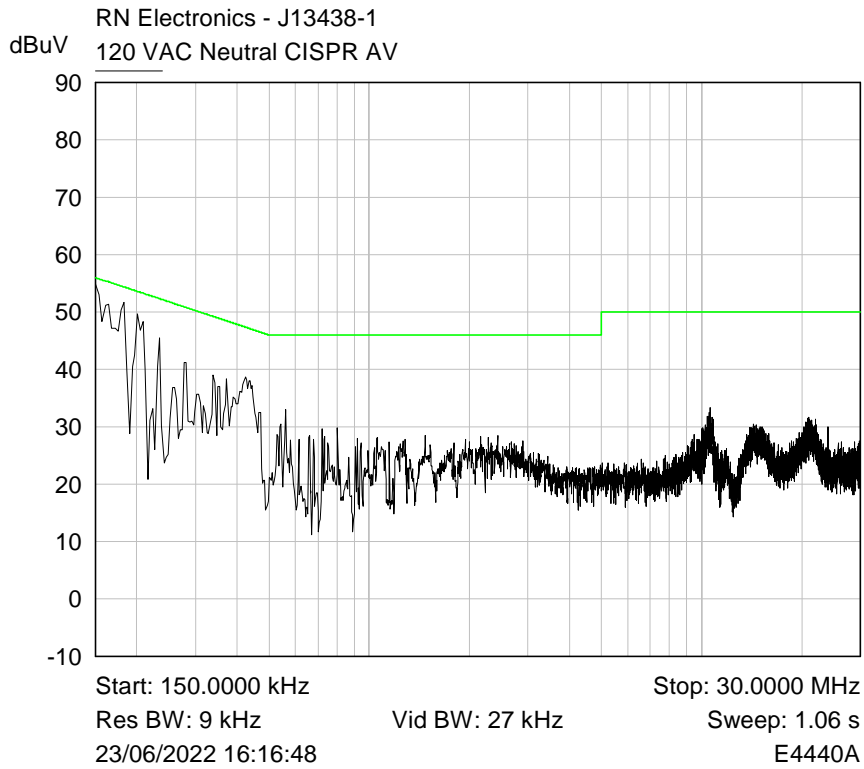
RF Parameters: Band 57-71 GHz, Power 49 dBm, Channel Spacing 2.16 GHz, Modulation MCS5, Channel 58.32 GHz



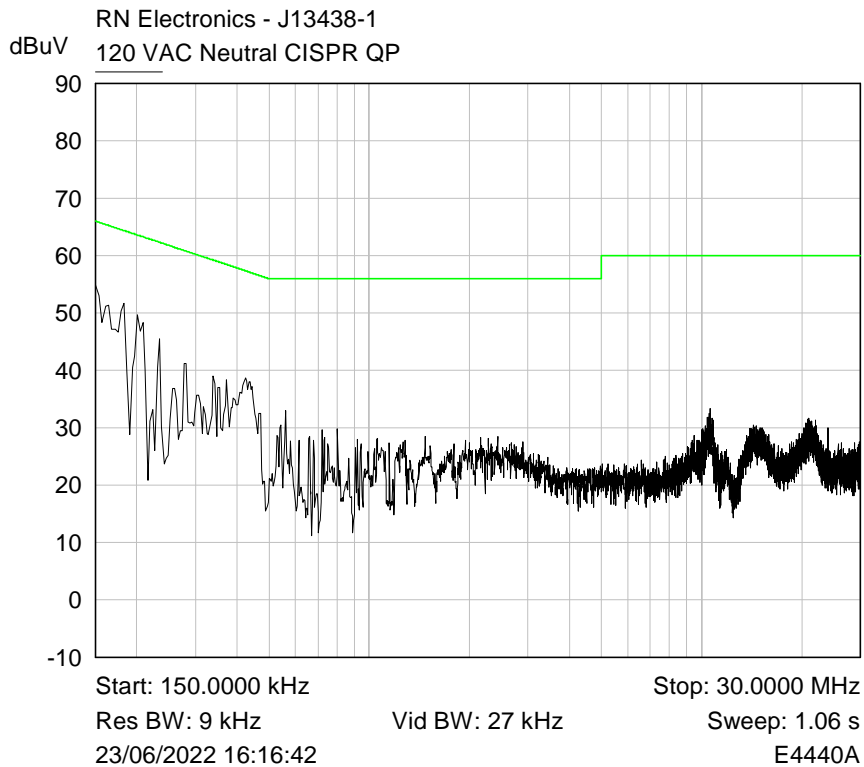
Plot of Live150k-30M Average



Plot of Live150k-30M Quasi-Peak



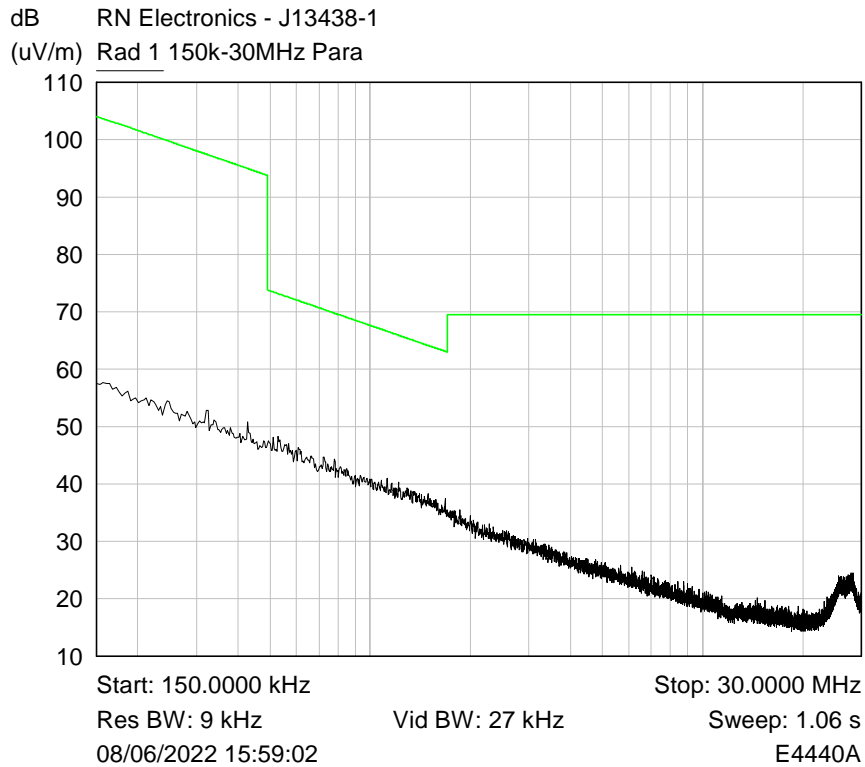
Plot of Neutral150k-30M Average



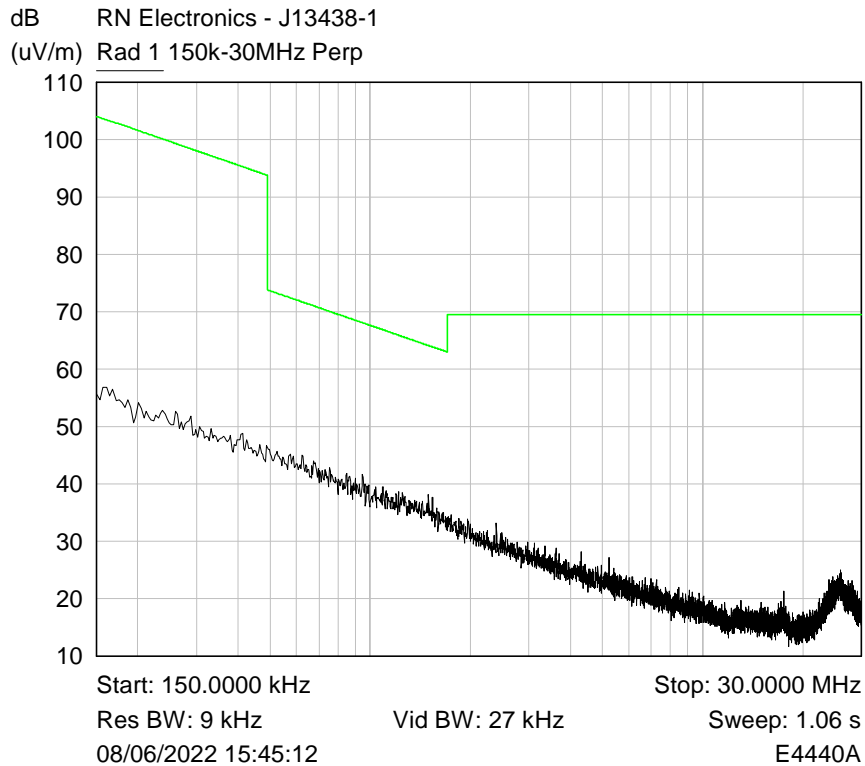
Plot of Neutral150k-30M Quasi-Peak

6.2 Radiated emissions 150 kHz – 30 MHz

RF Parameters: Band 57-71 GHz, Power 49 dBm, Channel Spacing 2.16 GHz, Modulation MCS5, Channel 62.64 GHz



Plot of 150kHz-30MHz Parallel

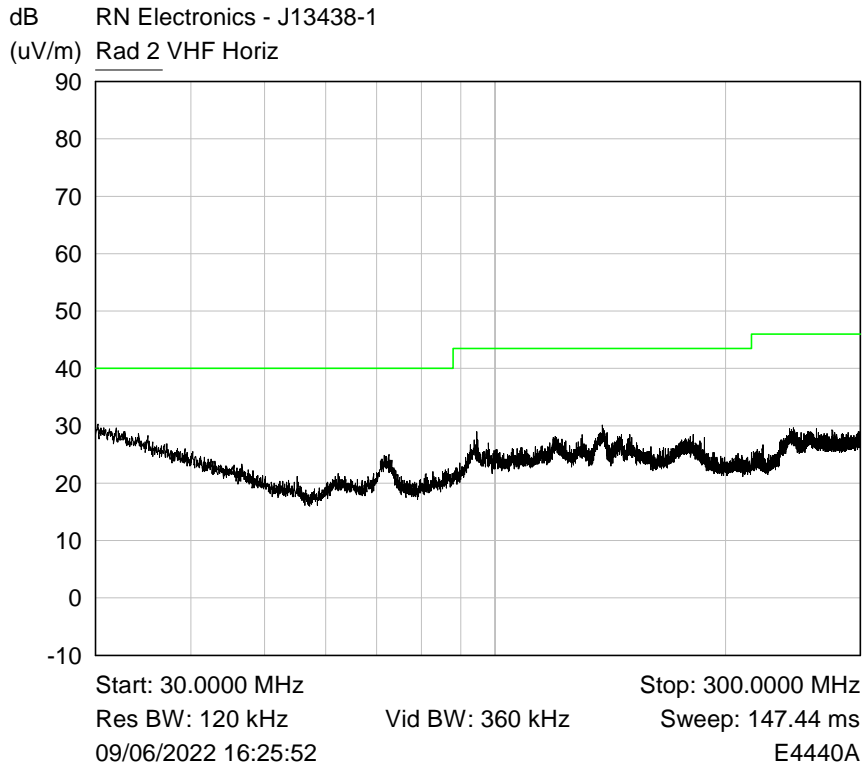


Plot of 150kHz-30MHz Perpendicular

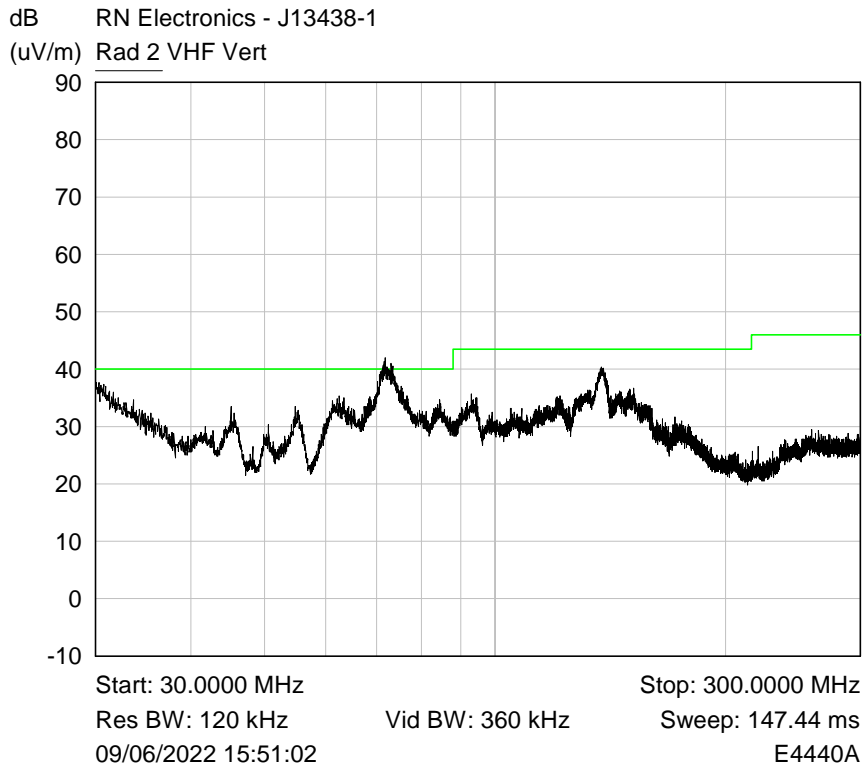
6.3 Radiated emissions 30 MHz -1 GHz

Note: Whilst Low, Mid and High channels have been measured, only middle channel plots are shown to minimise report size.

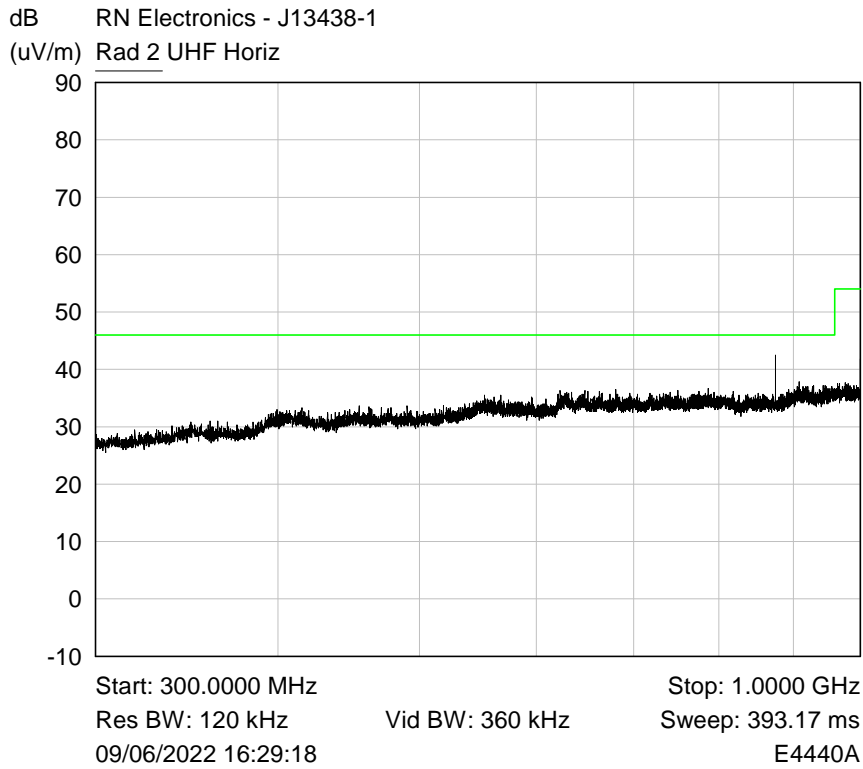
RF Parameters: Band 57-71 GHz, Power 49 dBm, Channel Spacing 2.16 GHz, Modulation MCS5, Channel 62.64 GHz



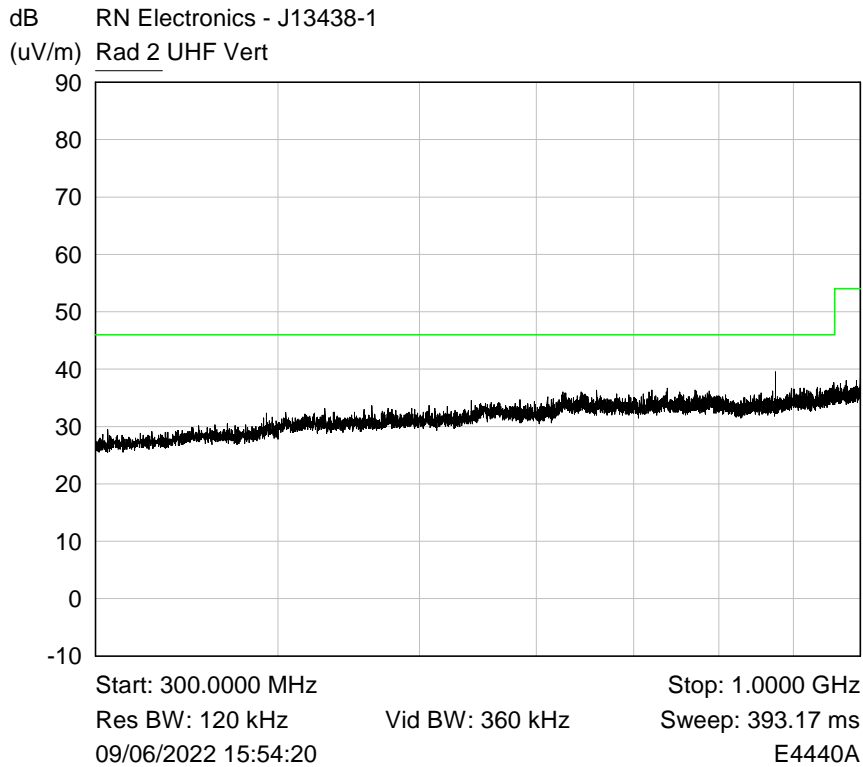
Plot of Peak emissions for VHF Horizontal against the QP limit line.



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



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

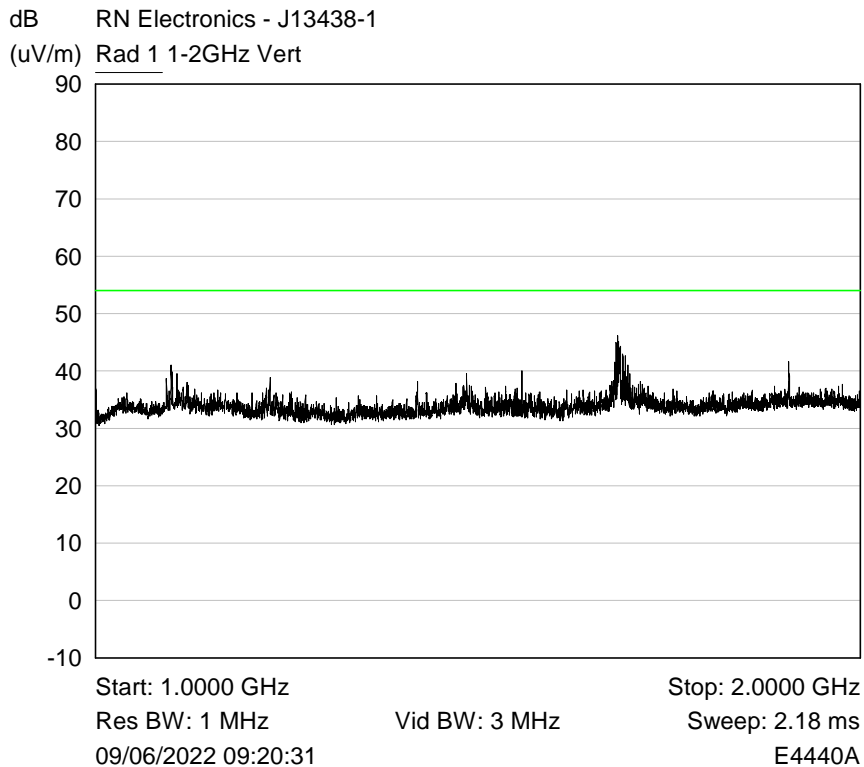
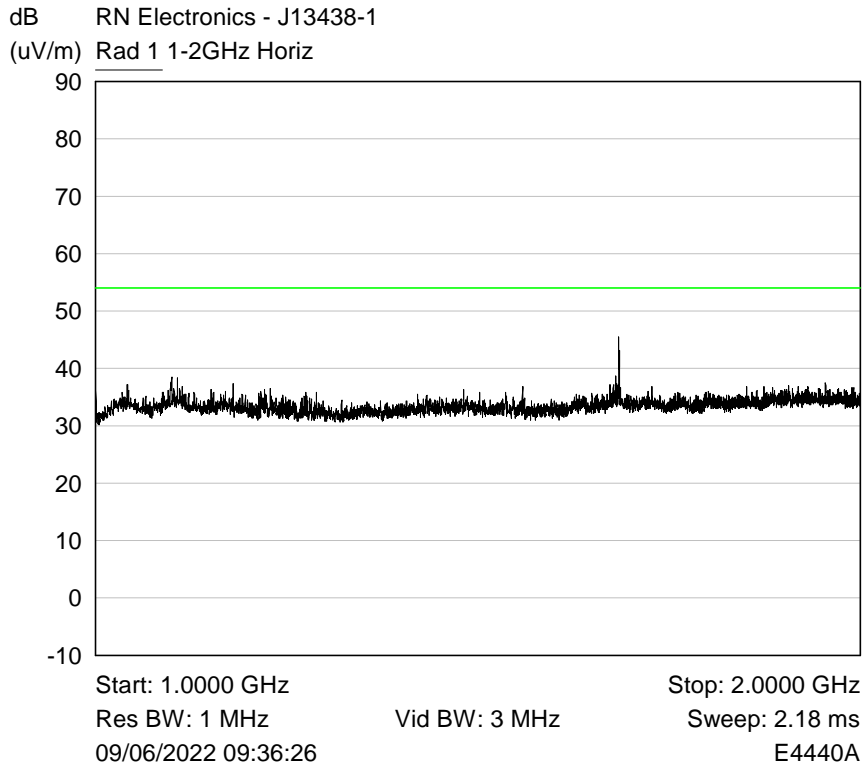


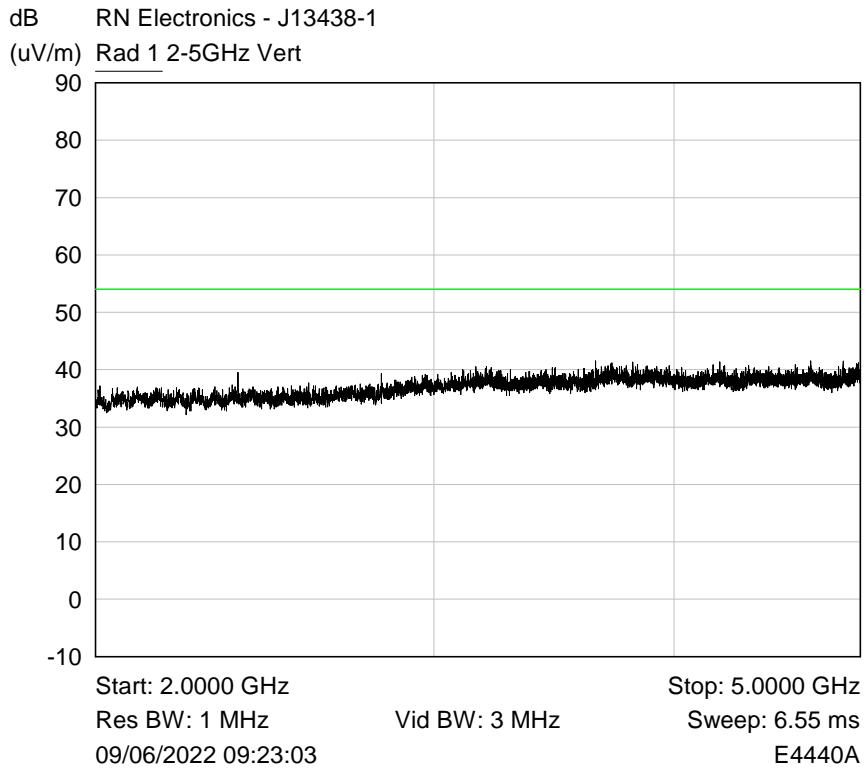
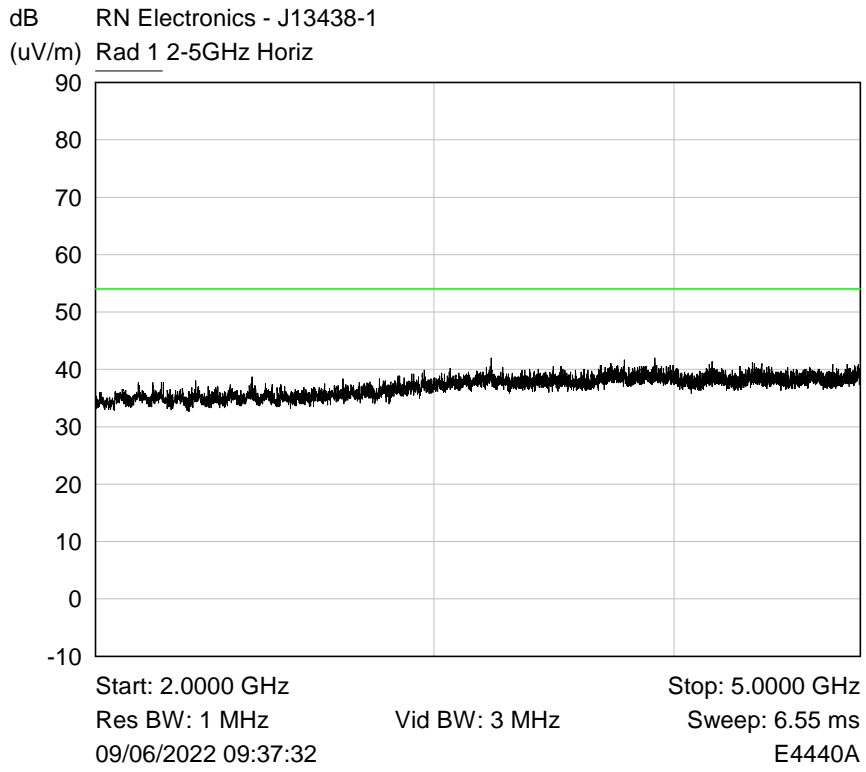
Plot of Peak emissions for UHF Vertical against the QP limit line.

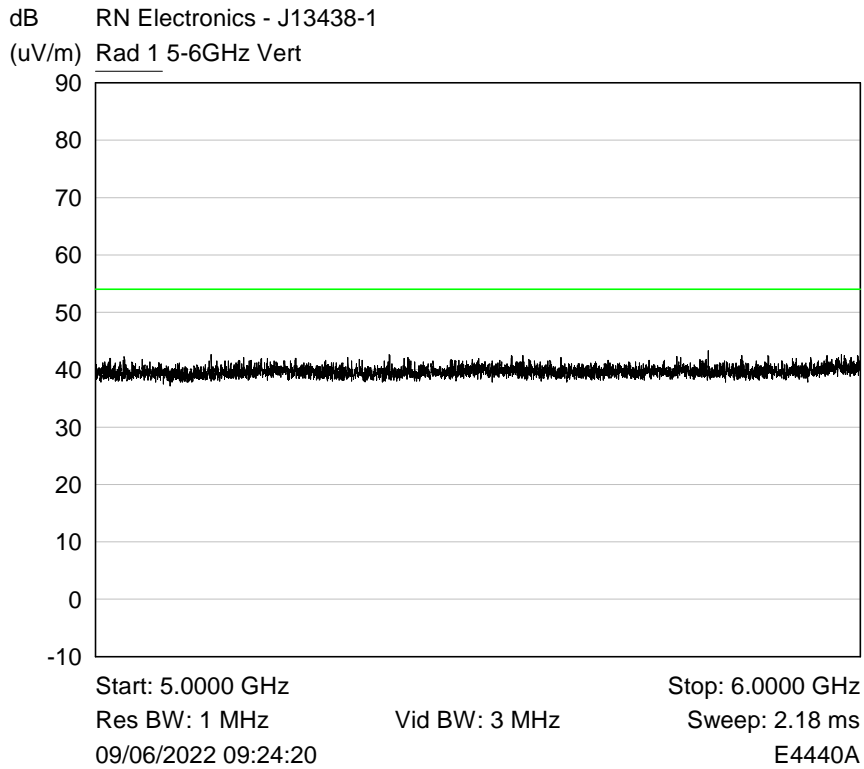
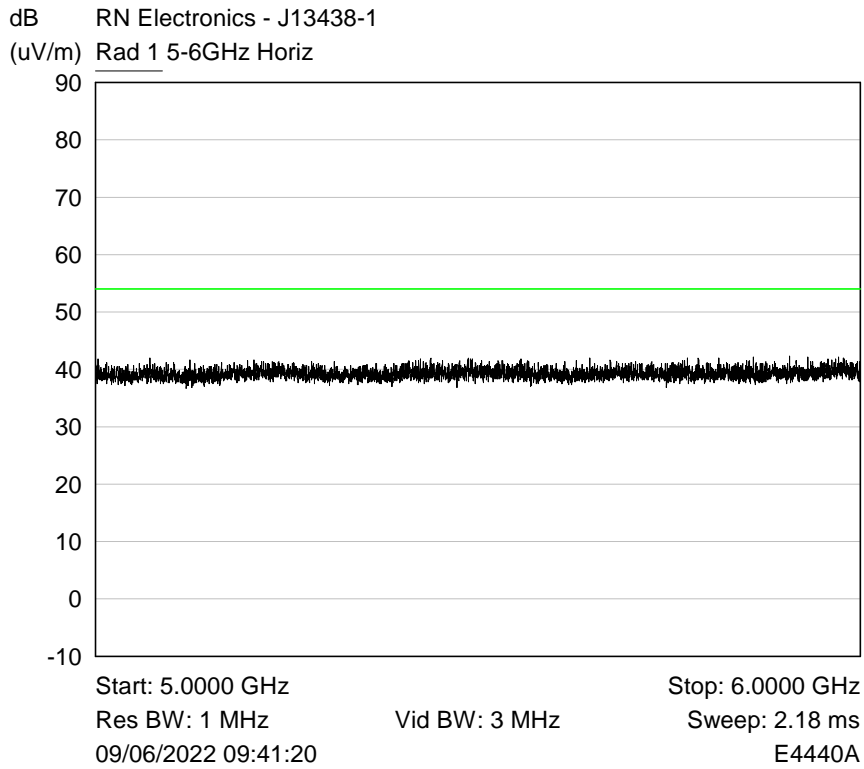
6.4 Radiated emissions 1 – 40 GHz

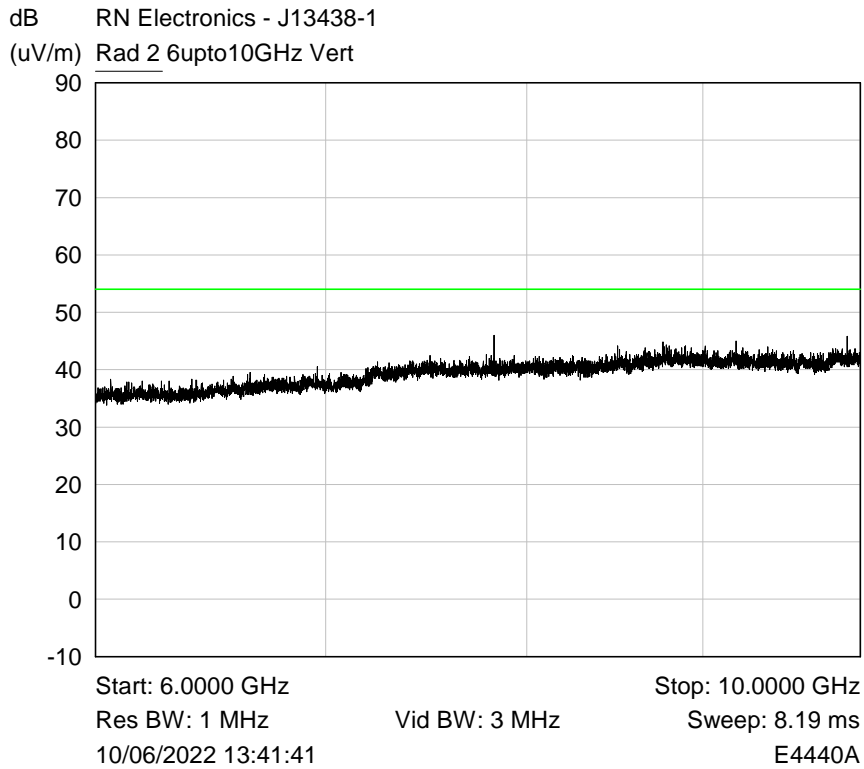
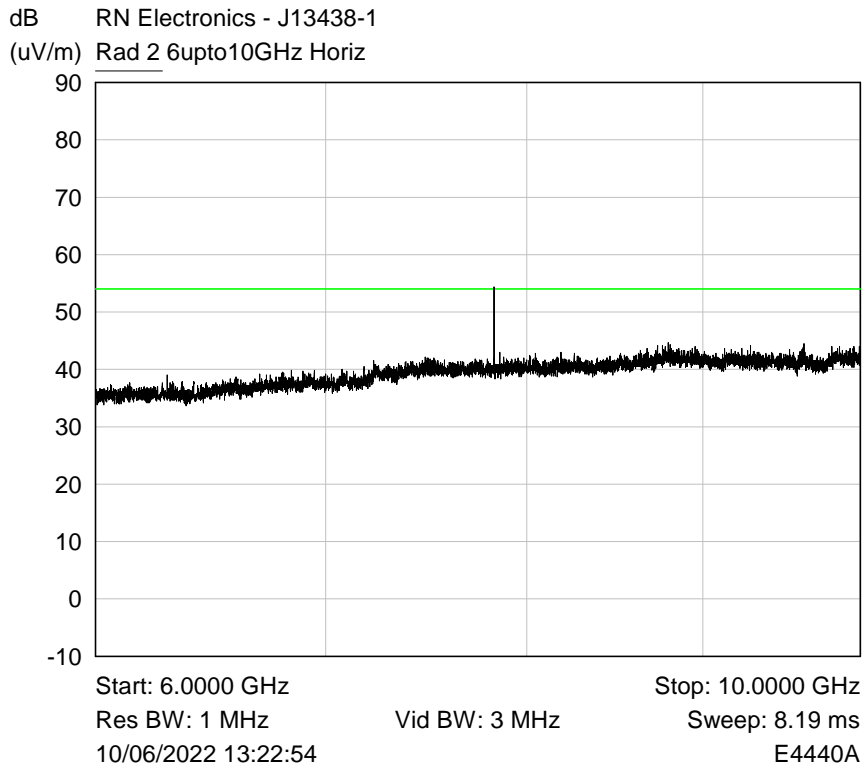
Note: Whilst Low, Mid and High channels have been measured, only middle channel plots are shown to minimise report size.

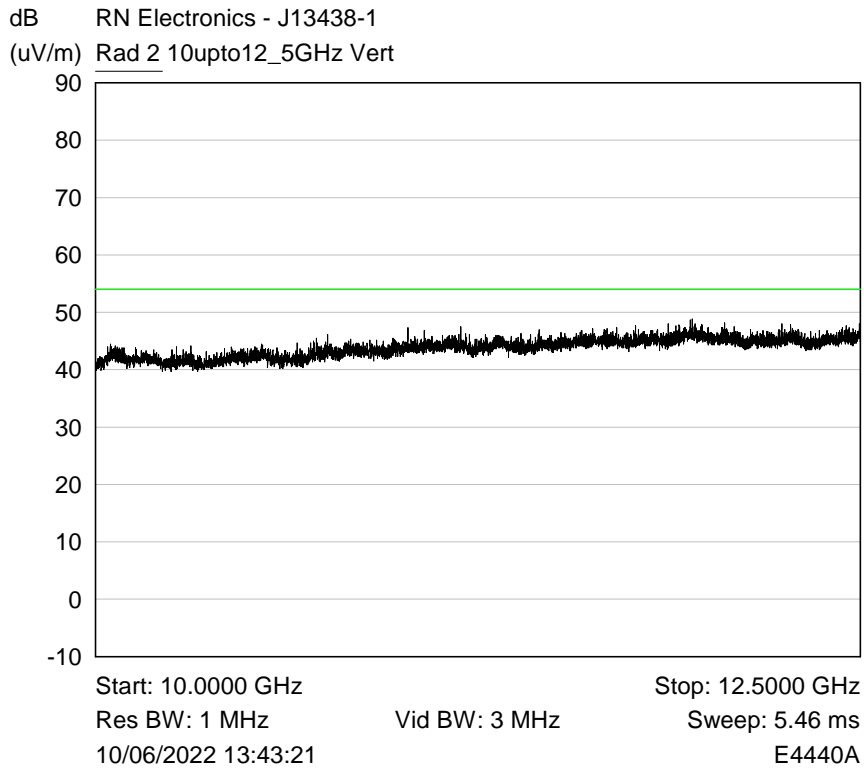
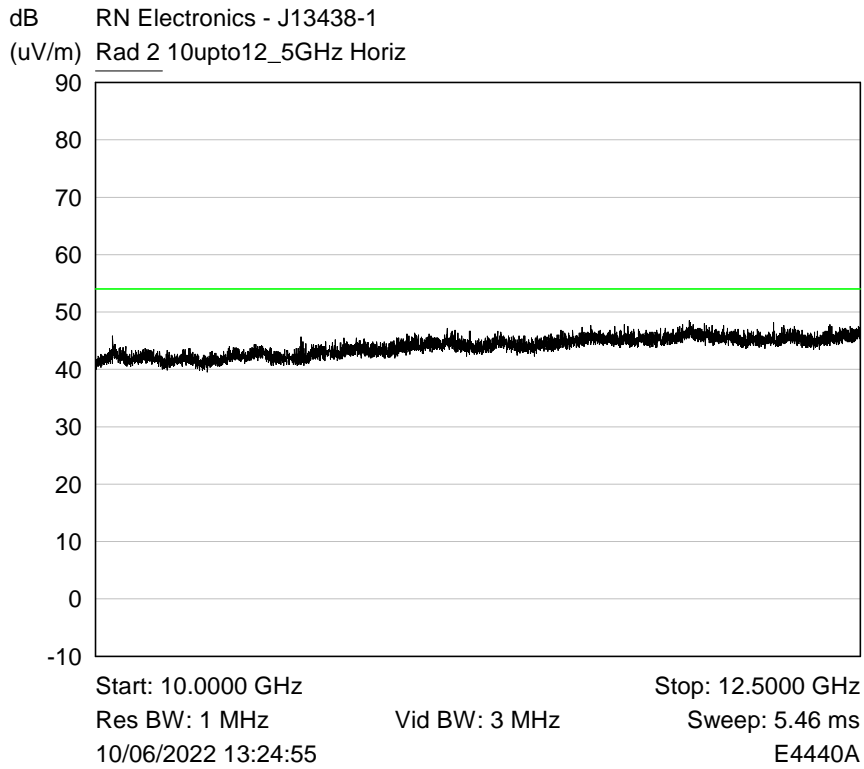
RF Parameters: Band 57-71 GHz, Power 49 dBm, Channel Spacing 2.16 GHz, Modulation MCS5, Channel 62.64 GHz

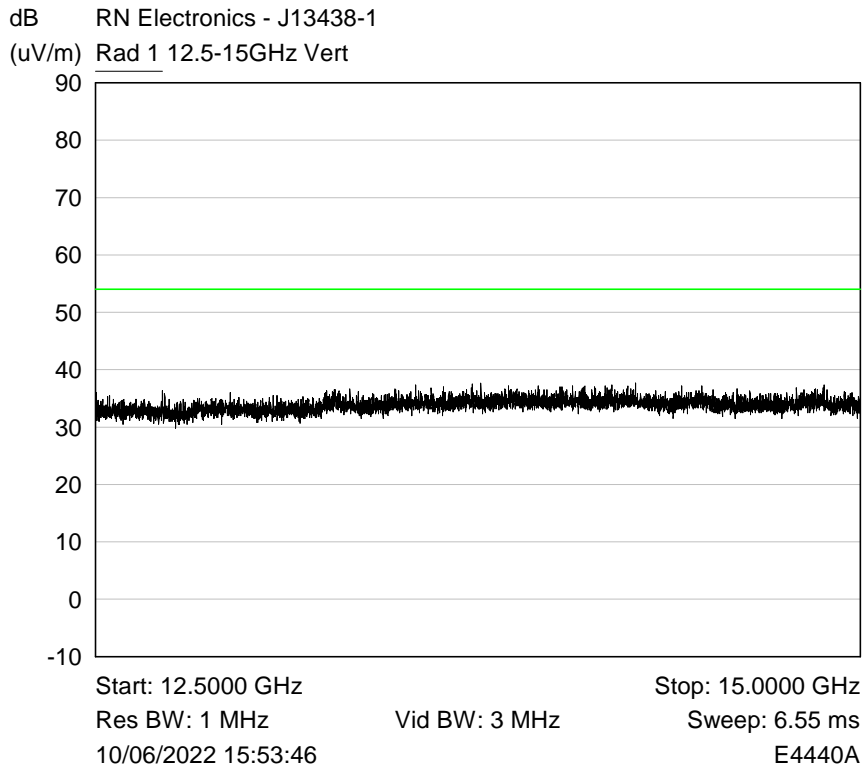
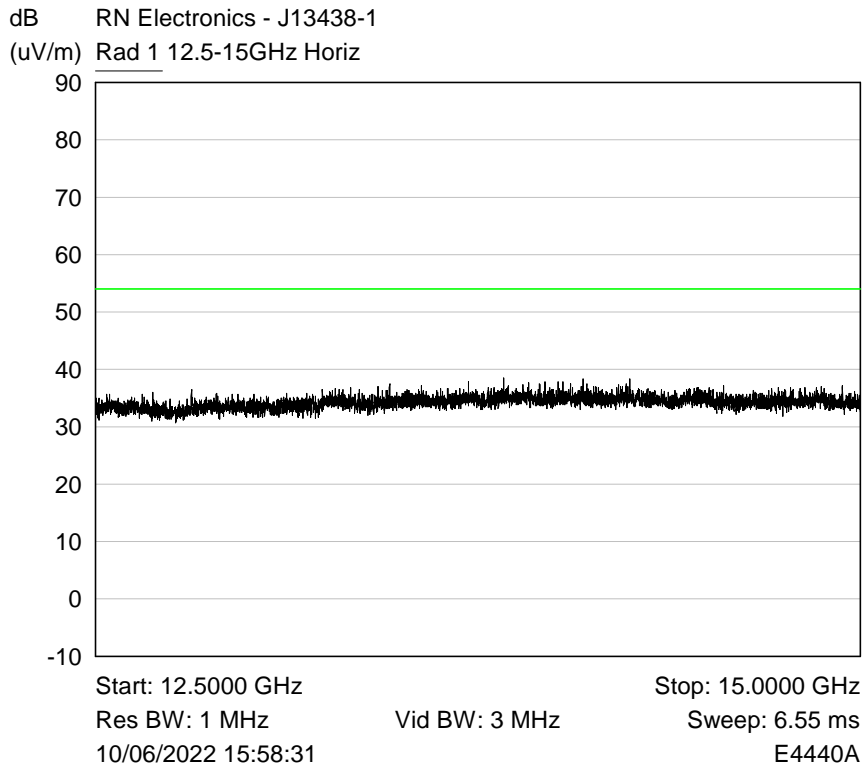


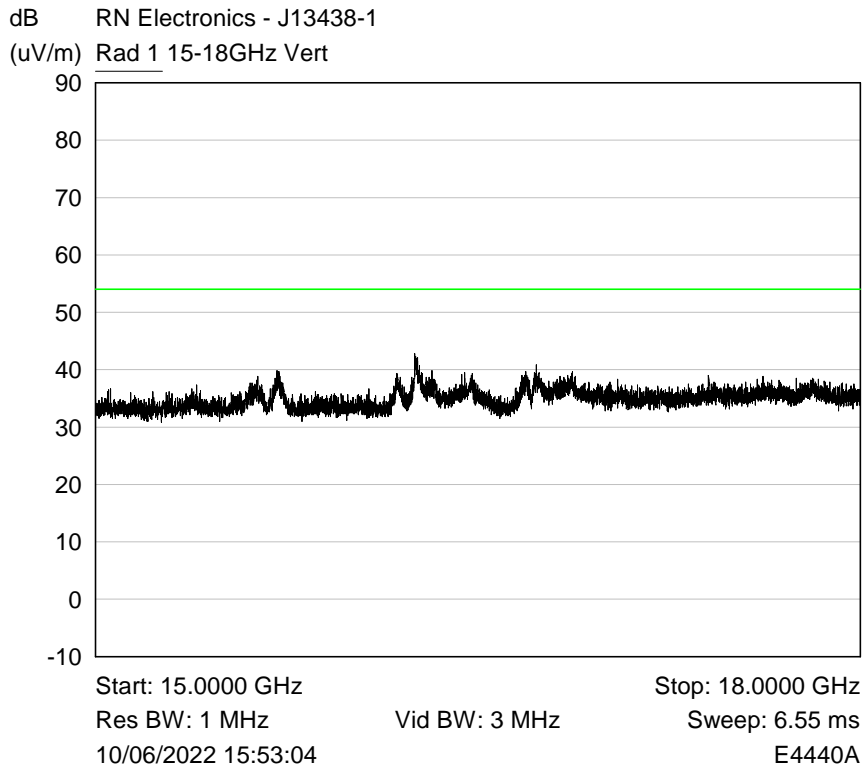
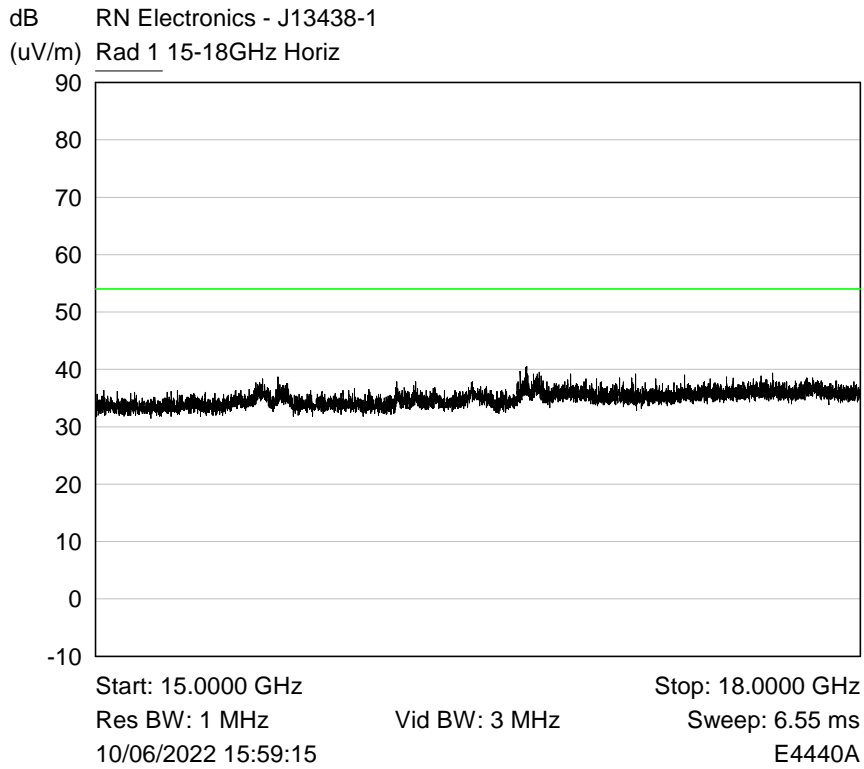


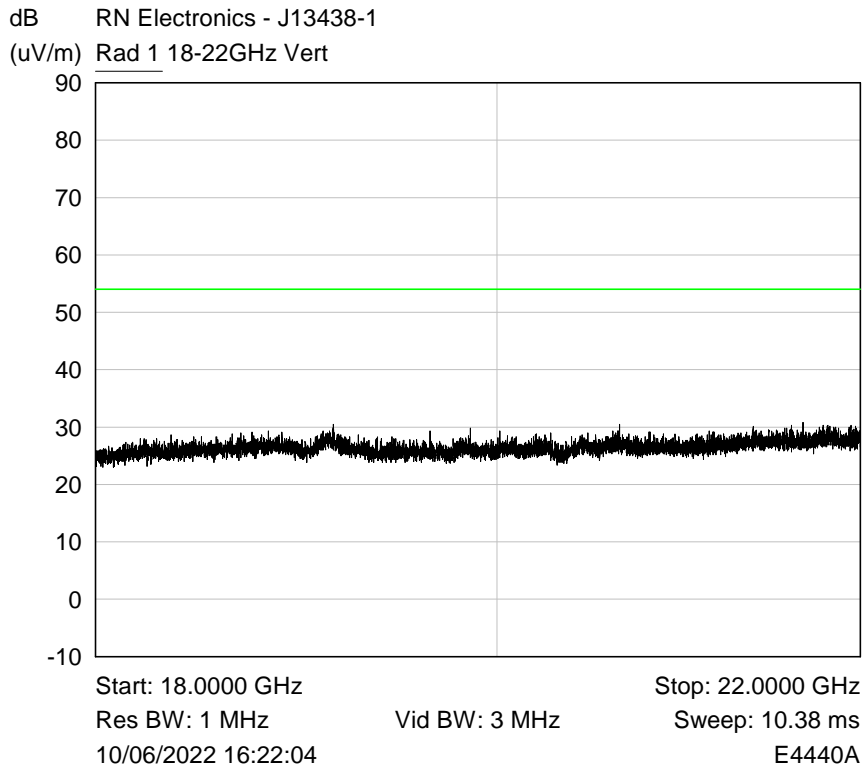
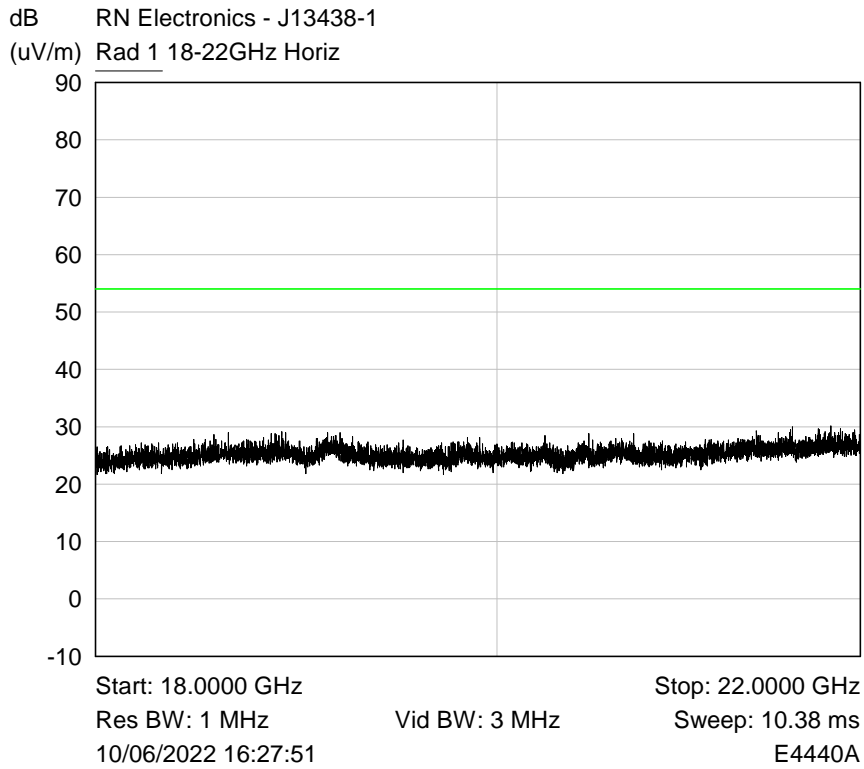


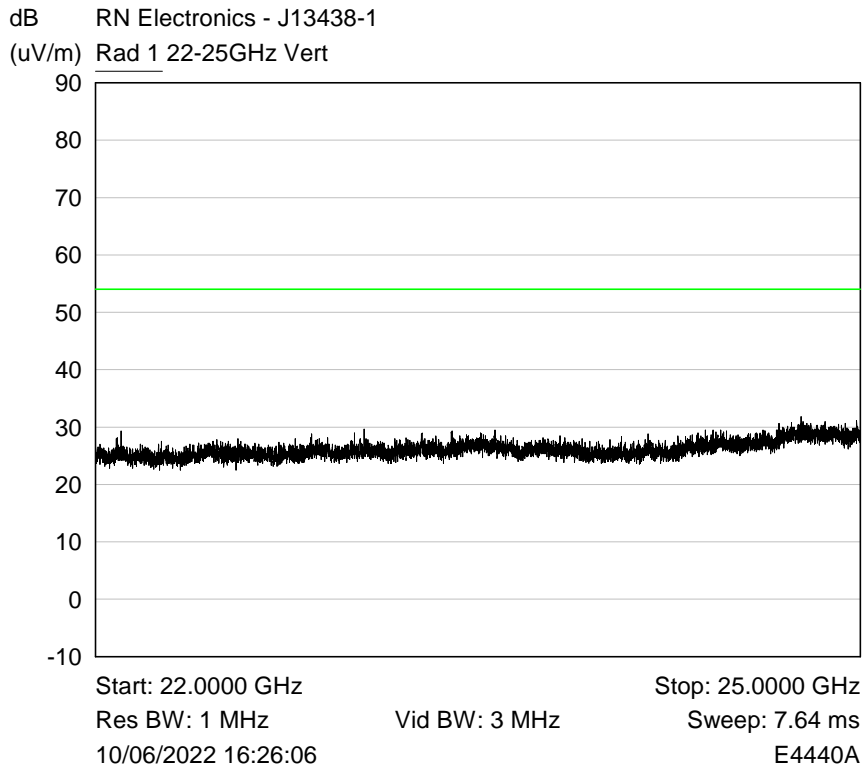
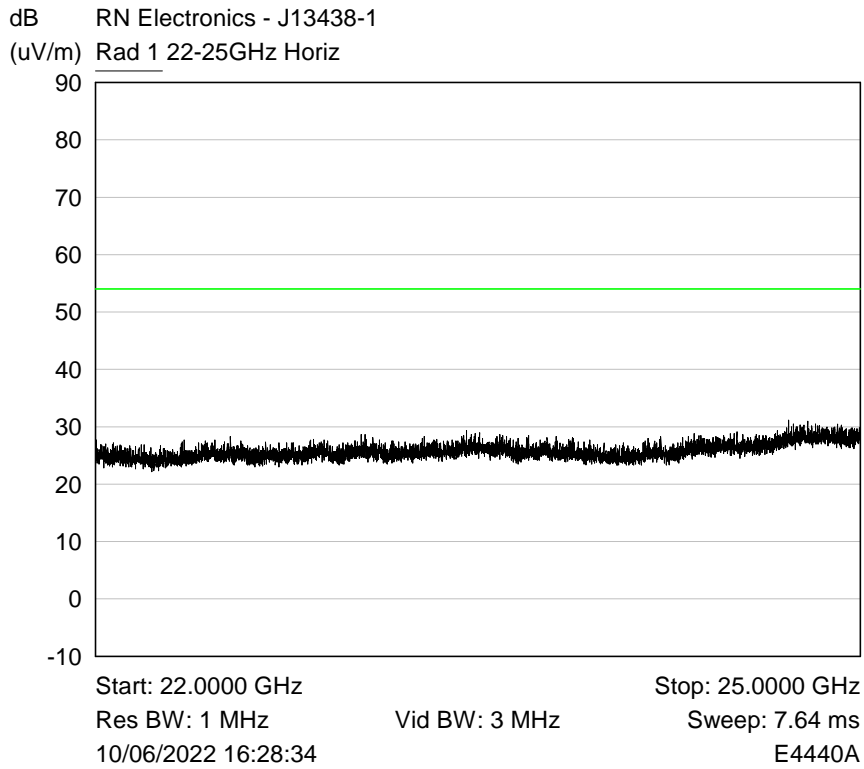


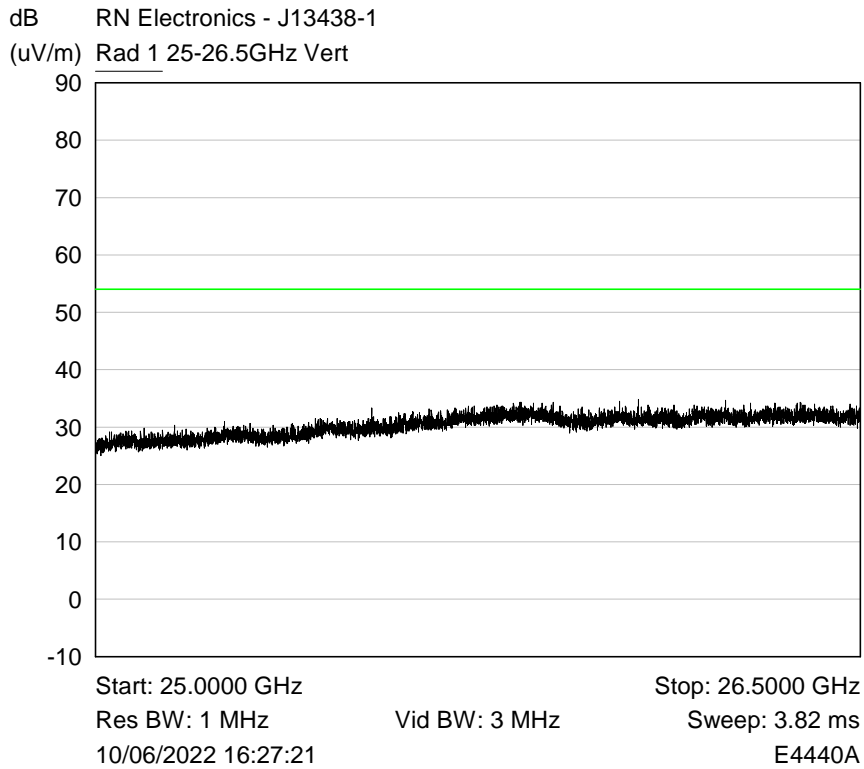
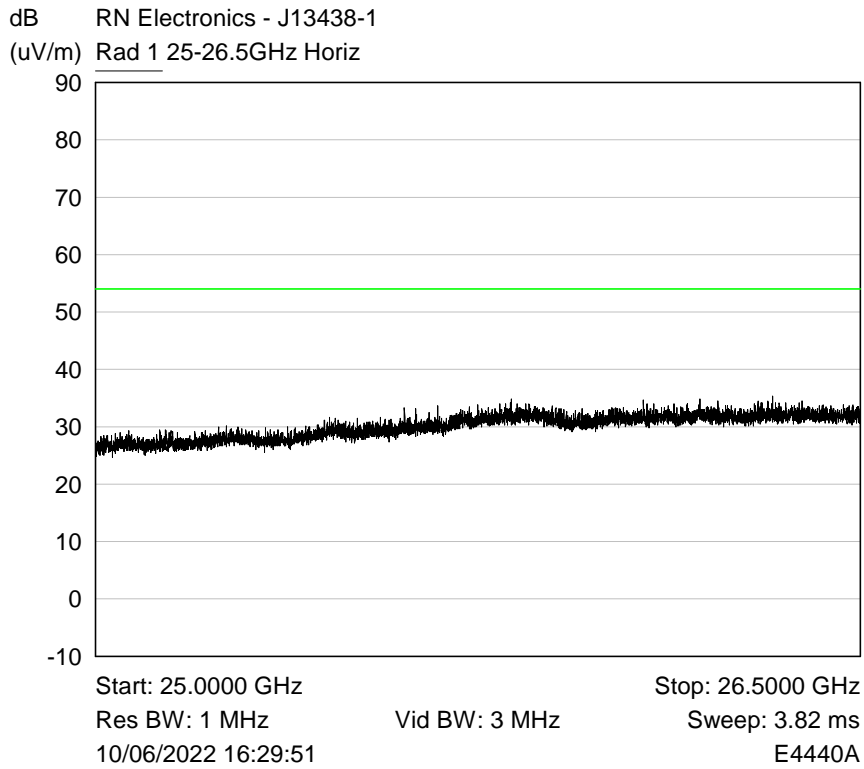


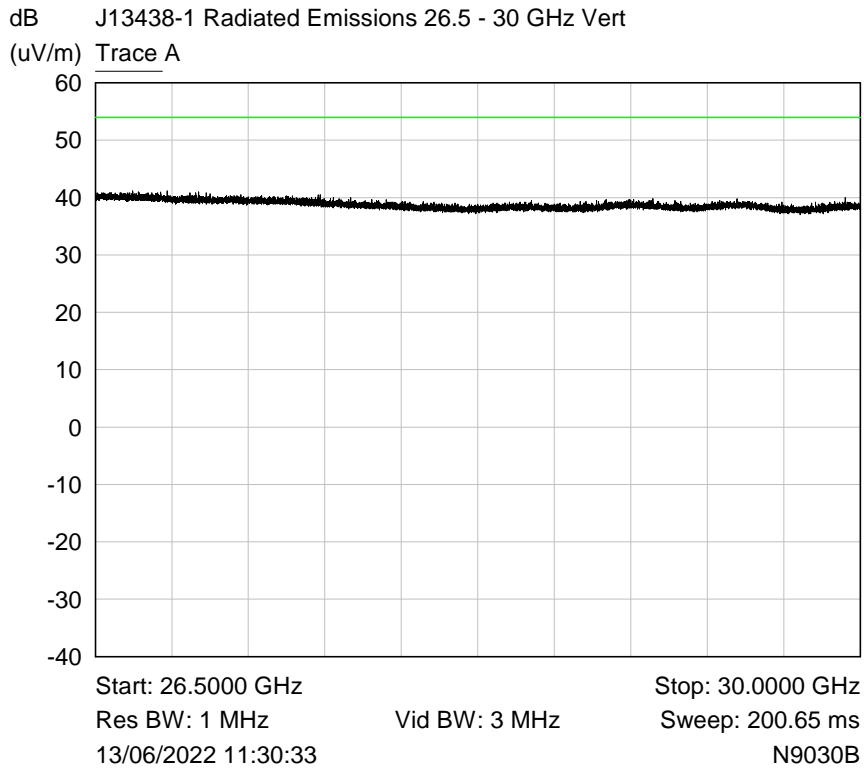
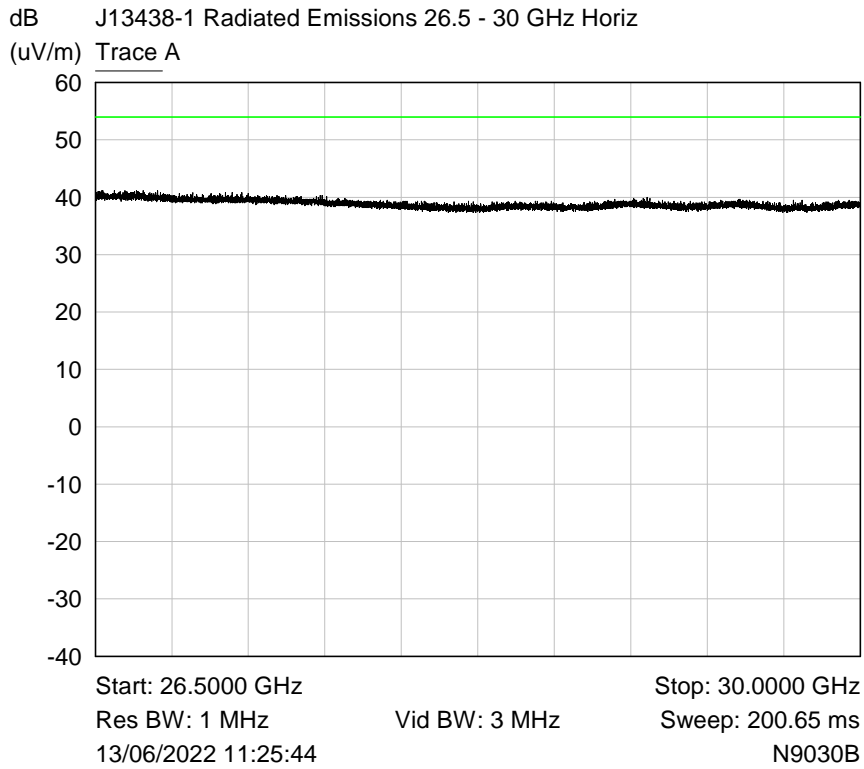


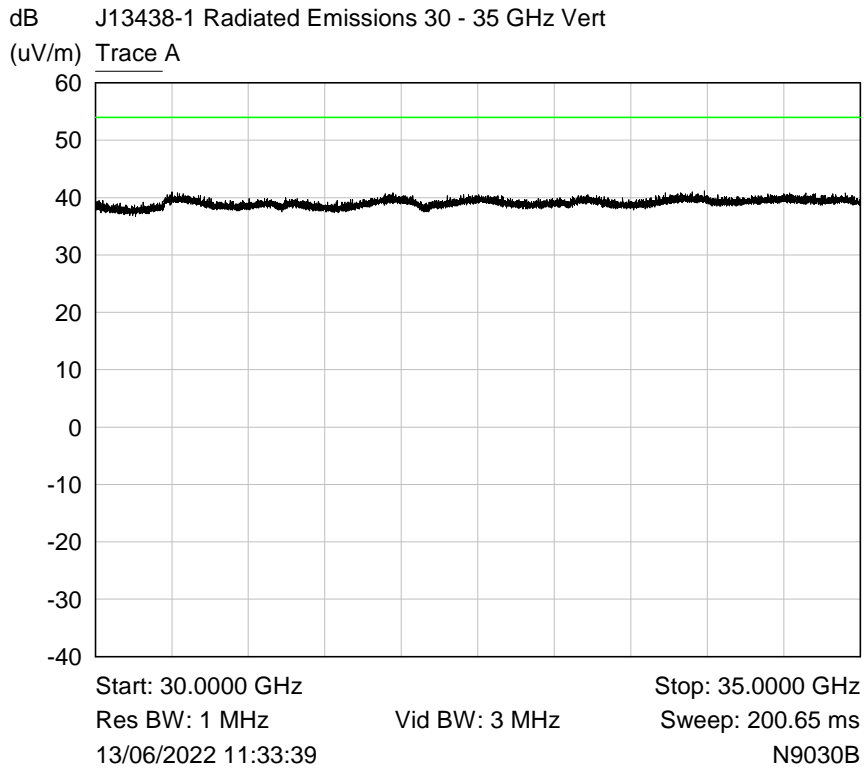
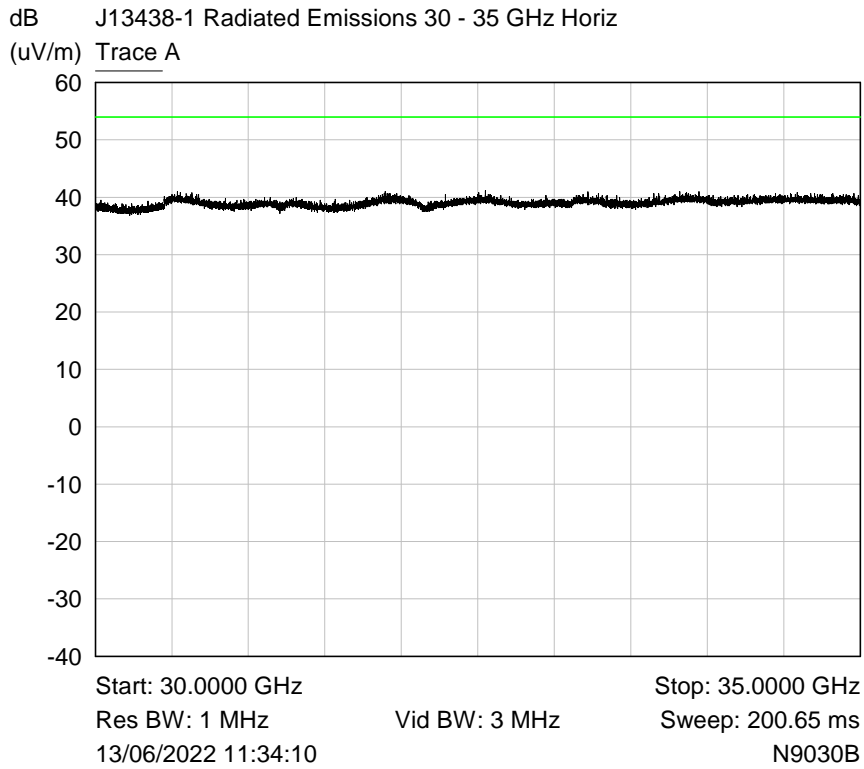


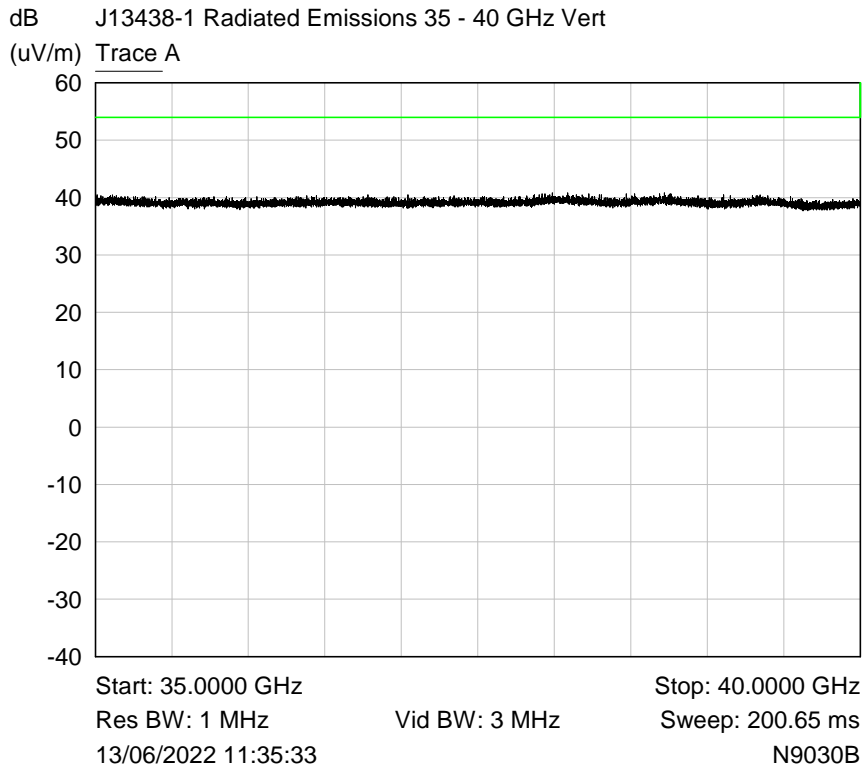
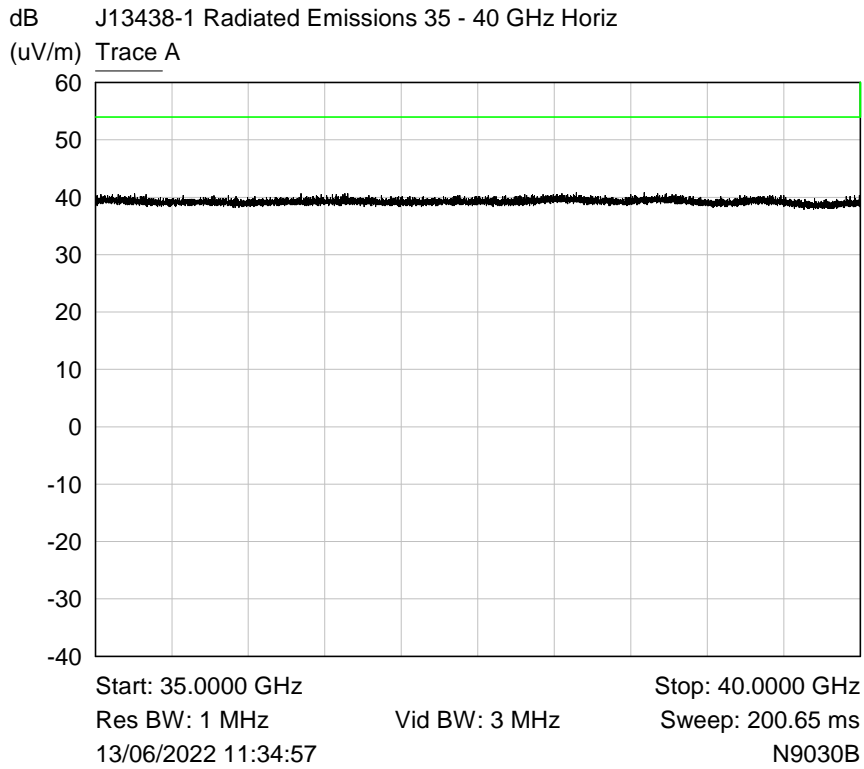








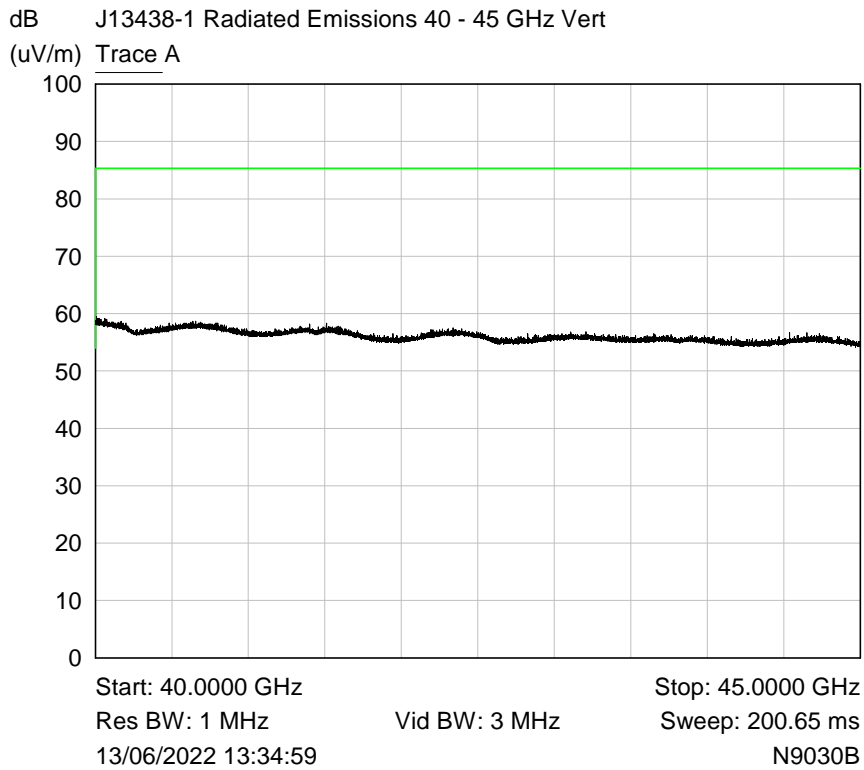
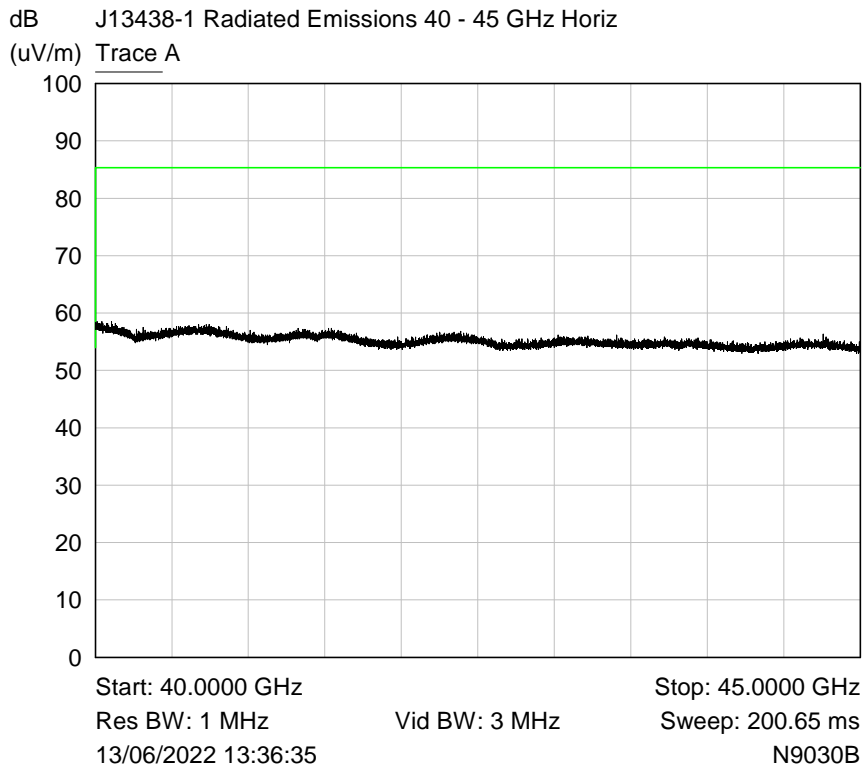




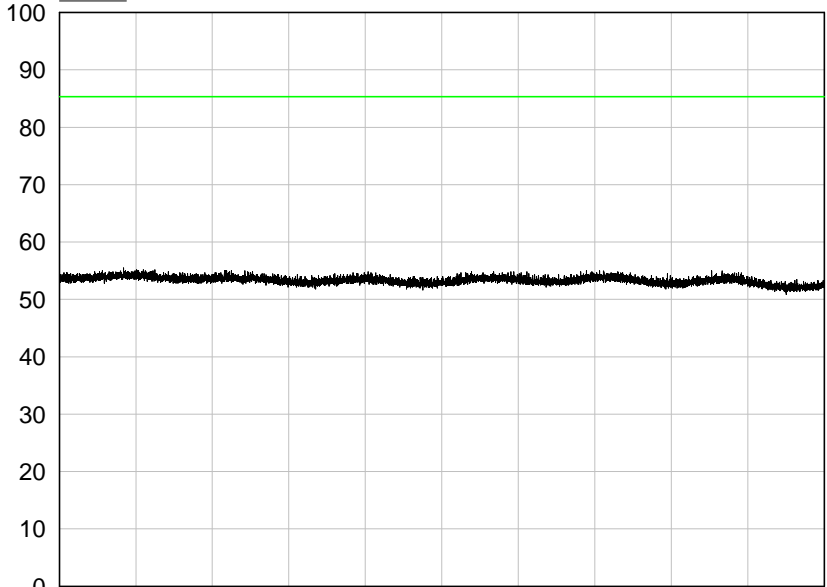
6.5 Radiated emissions 40 – 200 GHz

Note: Whilst Low, Mid and High channels have been measured, only middle channel plots are shown to minimise report size.

RF Parameters: Band 57-71 GHz, Power 49 dBm, Channel Spacing 2.16 GHz, Modulation MCS5, Channel 62.64 GHz

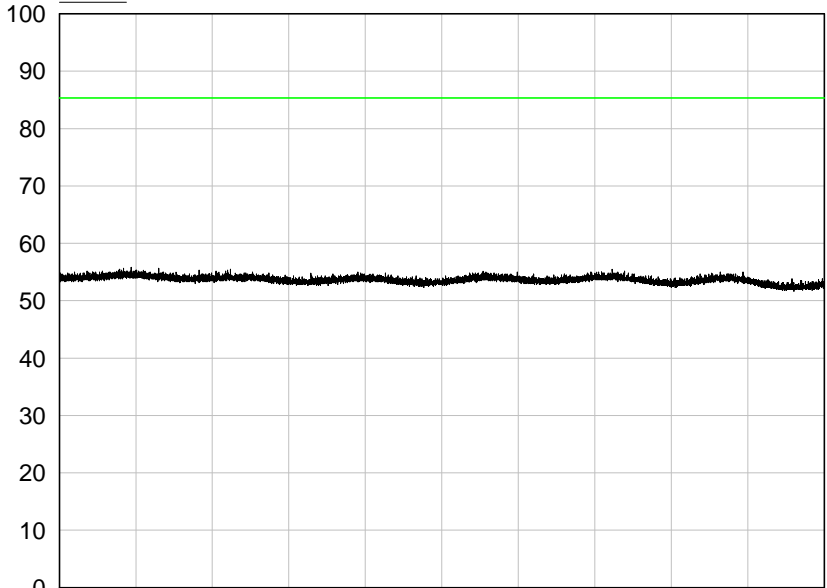


dB J13438-1 Radiated Emissions 45 - 50 GHz Horiz
(uV/m) Trace A



Start: 45.0000 GHz Stop: 50.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 200.65 ms
13/06/2022 13:37:01 N9030B

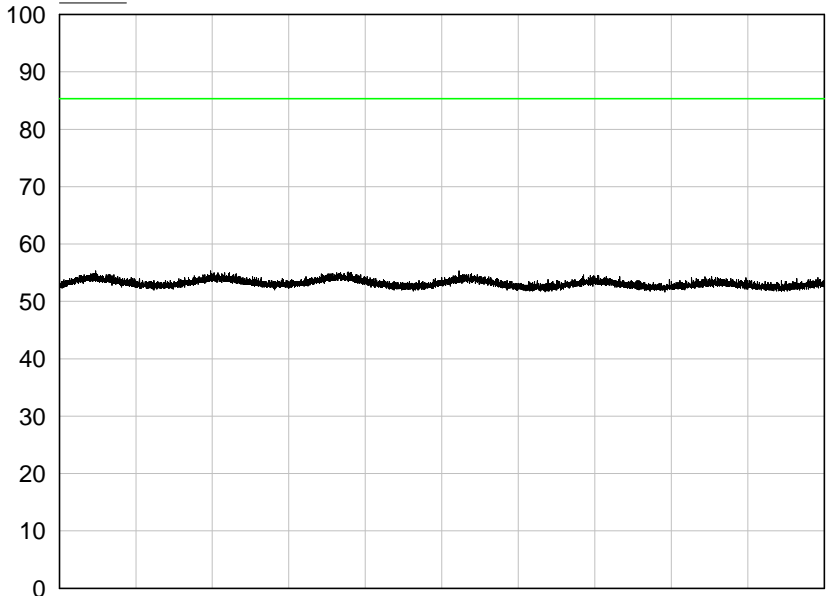
dB J13438-1 Radiated Emissions 45 - 50 GHz Vert
(uV/m) Trace A



Start: 45.0000 GHz Stop: 50.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 200.65 ms
13/06/2022 13:37:53 N9030B

dB J13438-1 Radiated Emissions 50 - 55 GHz Horiz

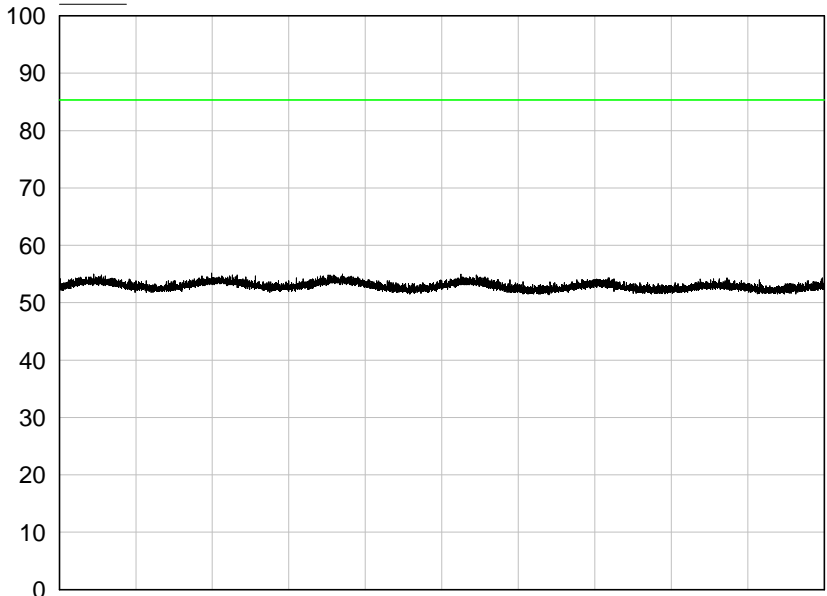
(uV/m) Trace A



Start: 50.0000 GHz Stop: 55.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 200.65 ms
13/06/2022 13:39:18 N9030B

dB J13438-1 Radiated Emissions 50 - 55 GHz Vert

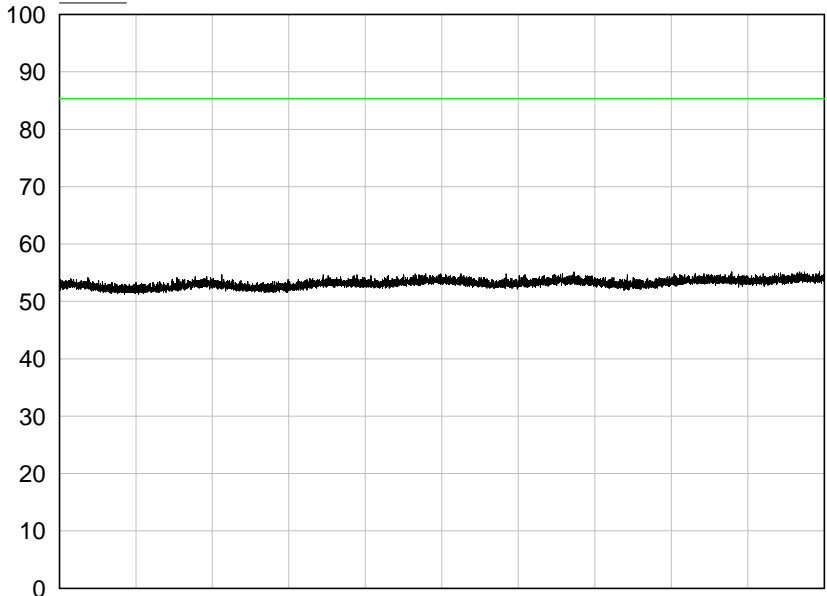
(uV/m) Trace A



Start: 50.0000 GHz Stop: 55.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 200.65 ms
13/06/2022 13:38:32 N9030B

dB J13438-1 Radiated Emissions 55 - 60 GHz Horiz

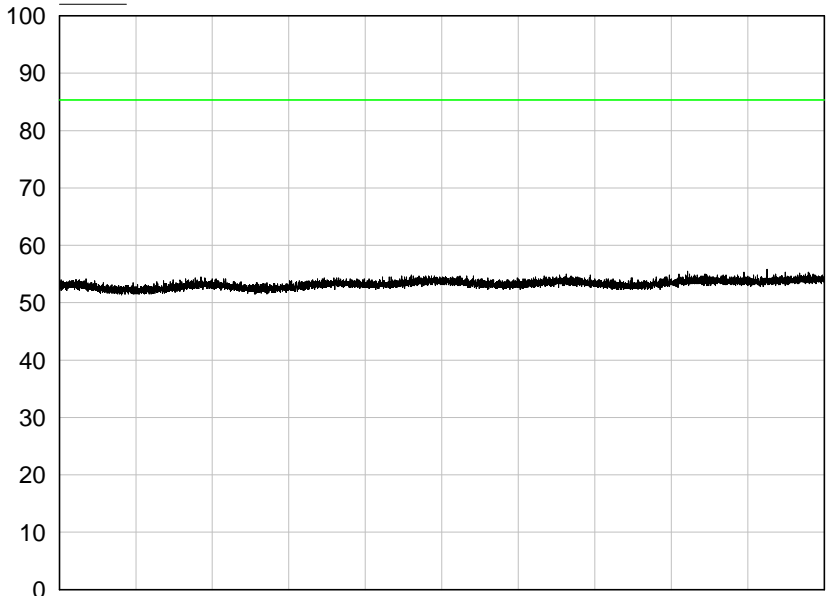
(uV/m) Trace A



Start: 55.0000 GHz Stop: 60.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 200.65 ms
13/06/2022 13:57:19 N9030B

dB J13438-1 Radiated Emissions 55 - 60 GHz Vert

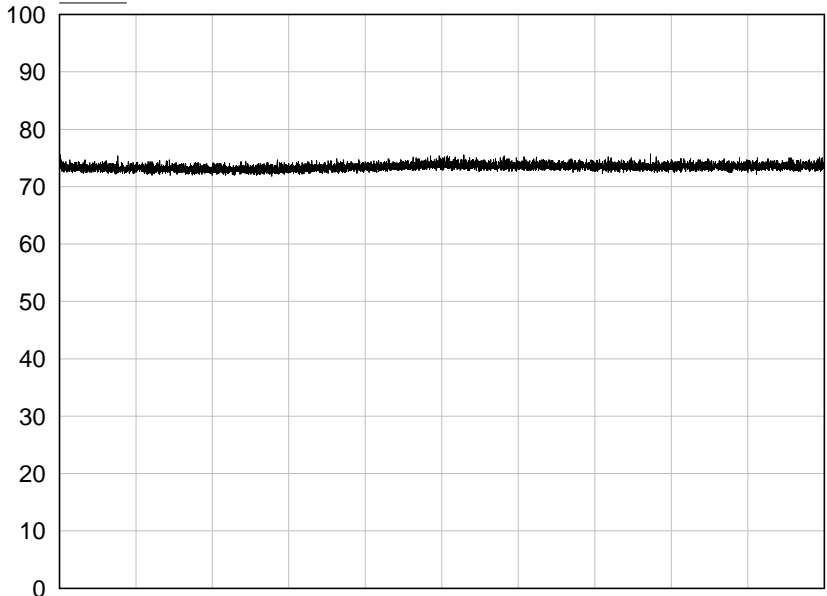
(uV/m) Trace A



Start: 55.0000 GHz Stop: 60.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 200.65 ms
13/06/2022 13:57:55 N9030B

dB J13438-1 Radiated Emissions 60 - 64 GHz Horiz

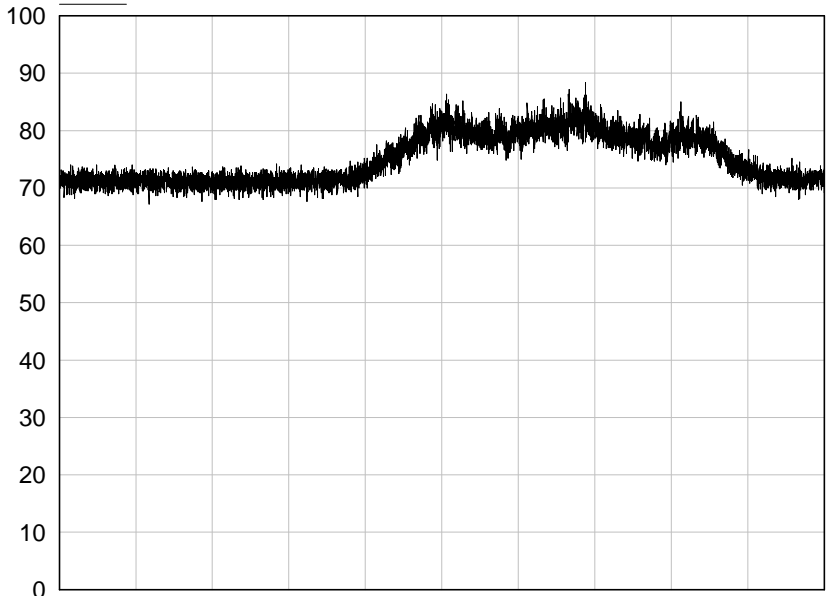
(uV/m) Trace A



Start: 60.0000 GHz Stop: 64.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 100.48 ms
13/06/2022 15:46:30 E4440A

dB J13438-1 Radiated Emissions 60 - 64 GHz Vert

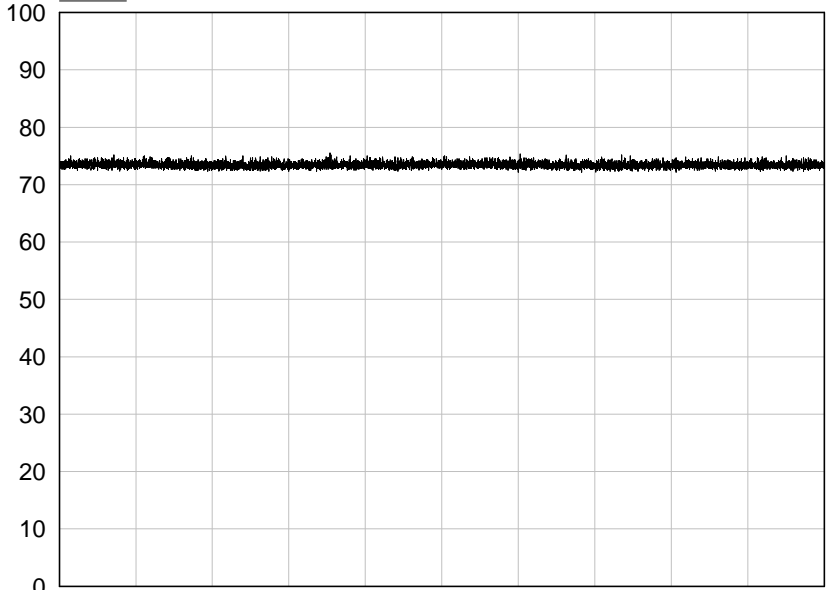
(uV/m) Trace A



Start: 60.0000 GHz Stop: 64.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 100.48 ms
13/06/2022 15:38:49 E4440A

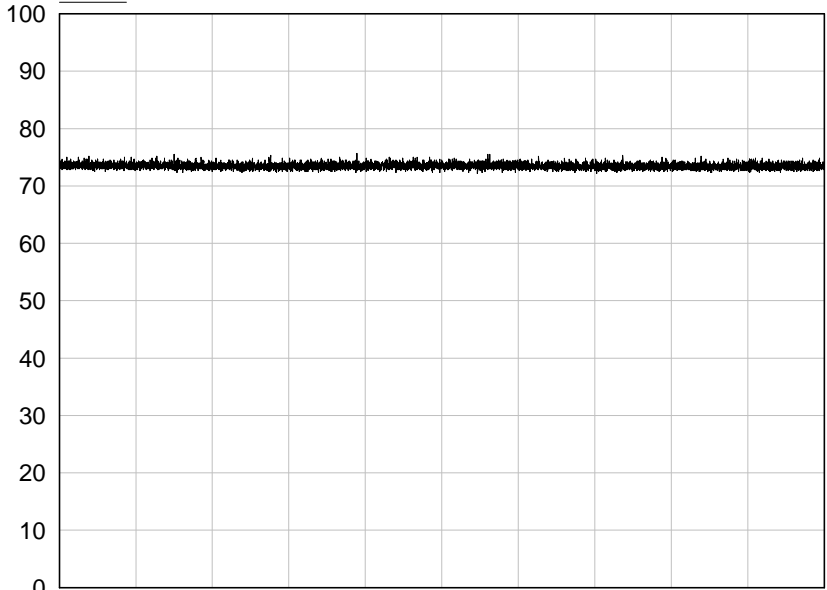
Plot shows the fundamental transmission at 62.64 GHz

dB J13438-1 Radiated Emissions 64 - 68 GHz Horiz
(uV/m) Trace A

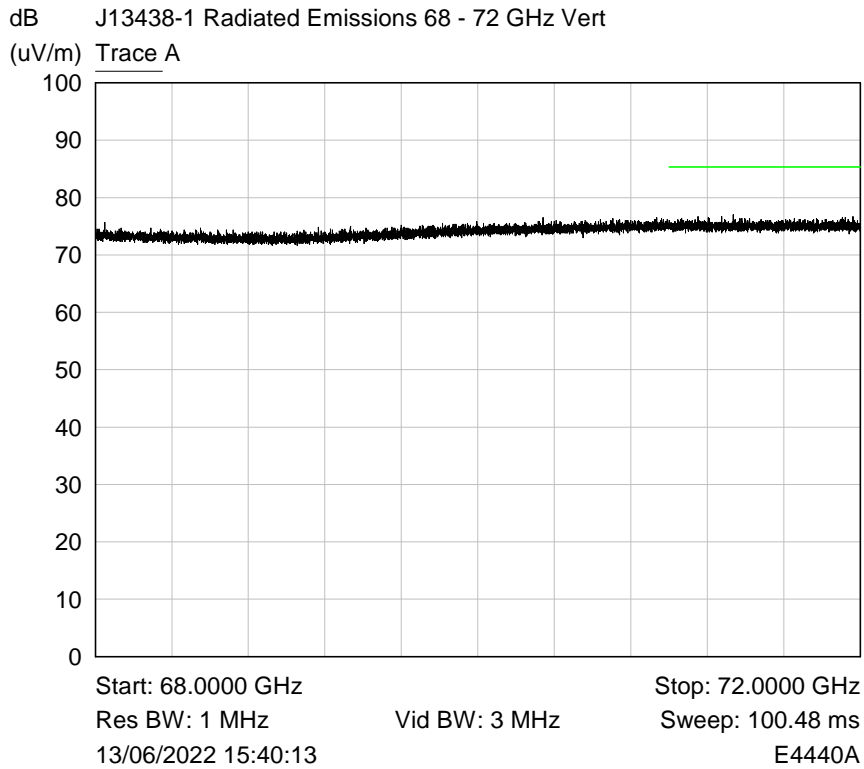
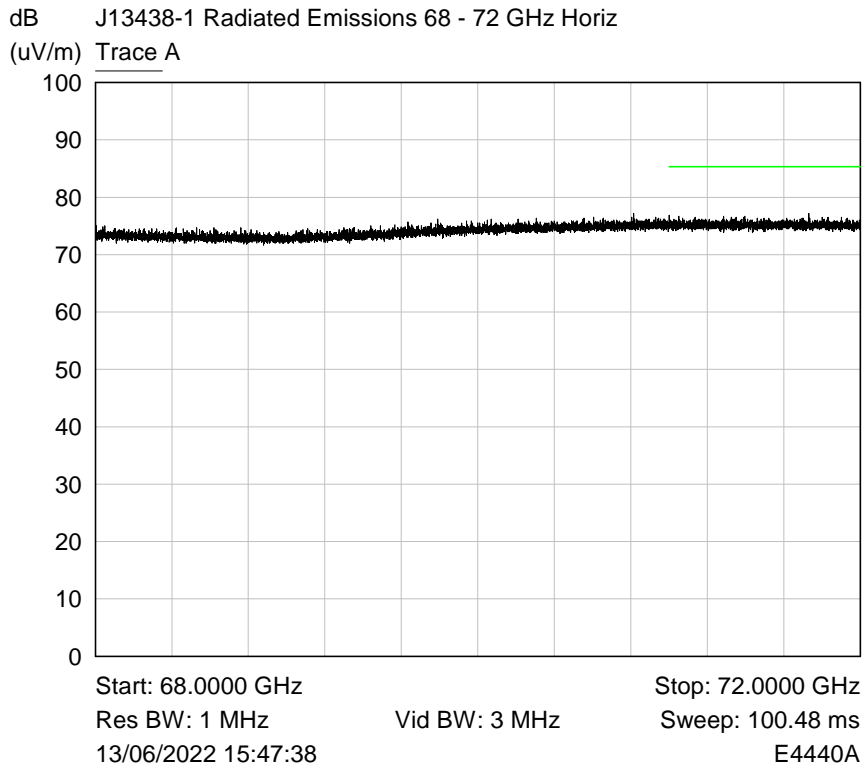


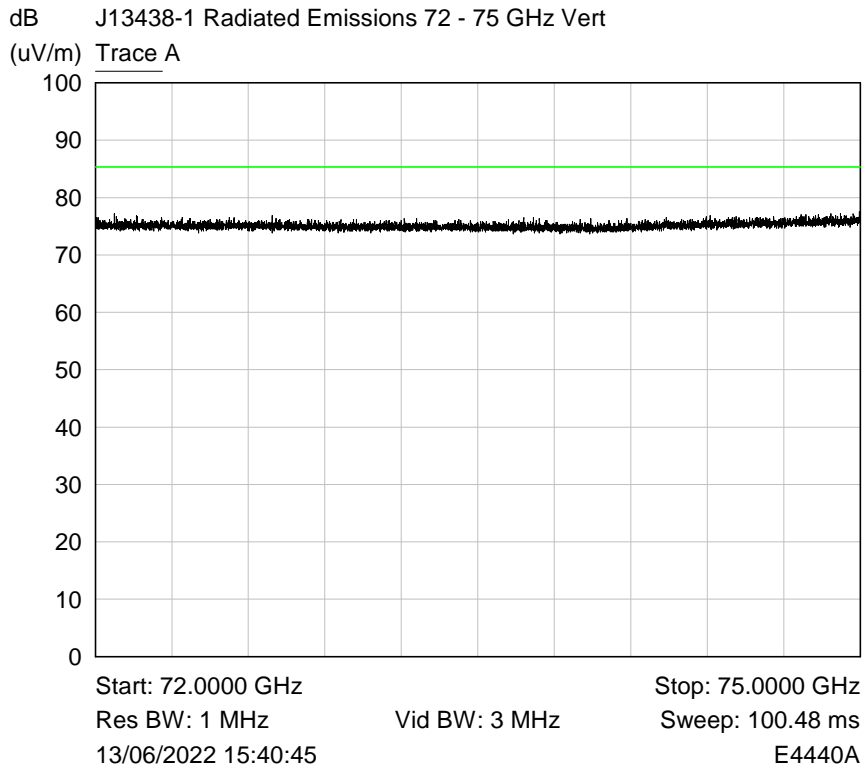
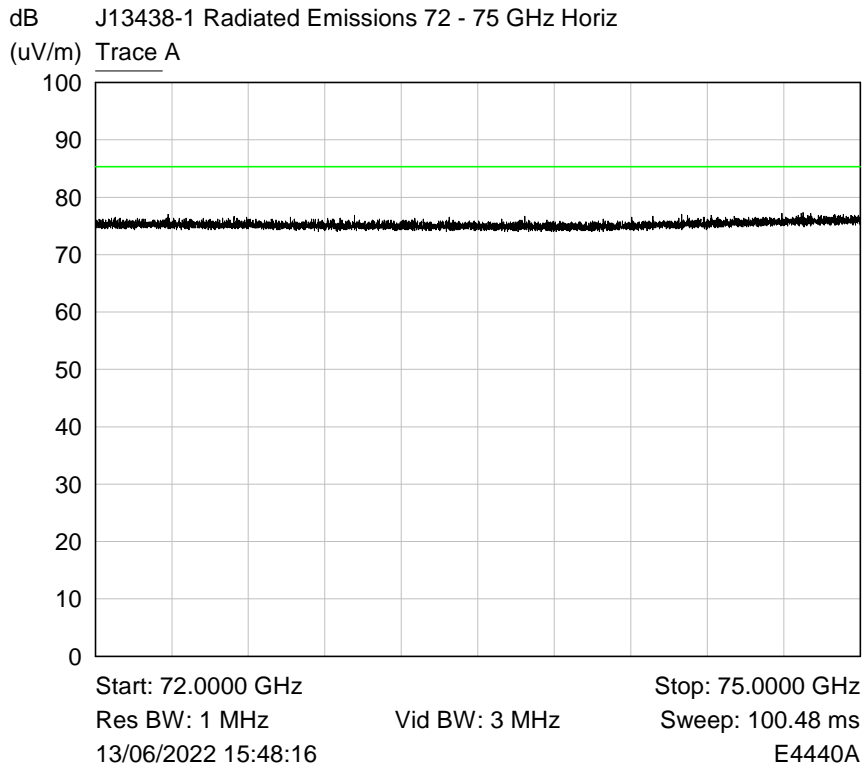
Start: 64.0000 GHz Stop: 68.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 100.48 ms
13/06/2022 15:47:10 E4440A

dB J13438-1 Radiated Emissions 64 - 68 GHz Vert
(uV/m) Trace A

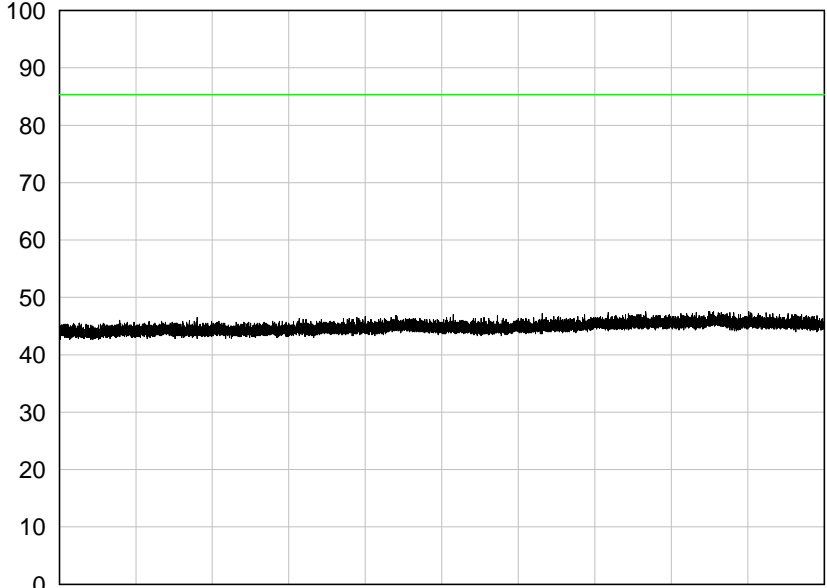


Start: 64.0000 GHz Stop: 68.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 100.48 ms
13/06/2022 15:39:42 E4440A



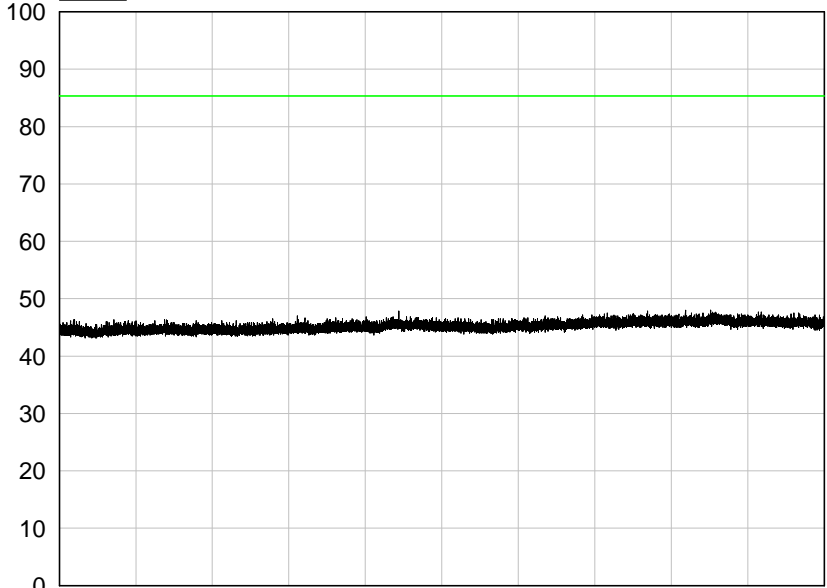


dB J13438-1 Radiated Emissions 75 - 85 GHz Horiz
(uV/m) Trace A



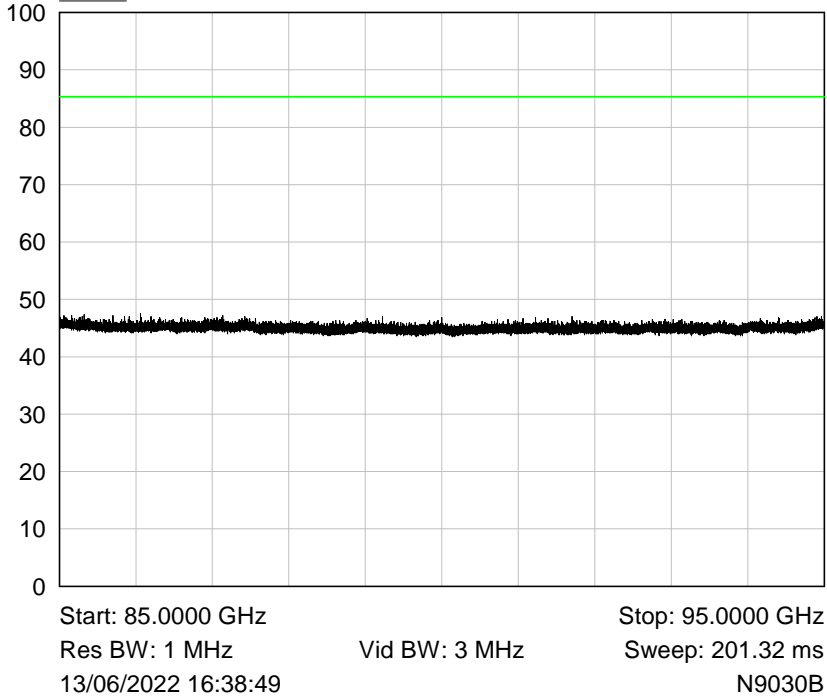
Start: 75.0000 GHz Stop: 85.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 201.32 ms
13/06/2022 16:32:03 N9030B

dB J13438-1 Radiated Emissions 75 - 85 GHz Vert
(uV/m) Trace A

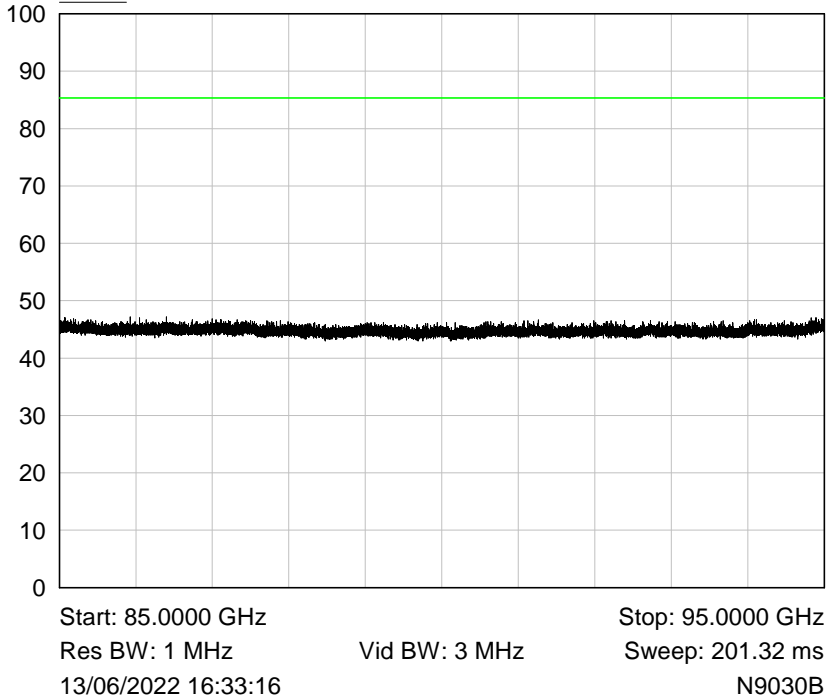


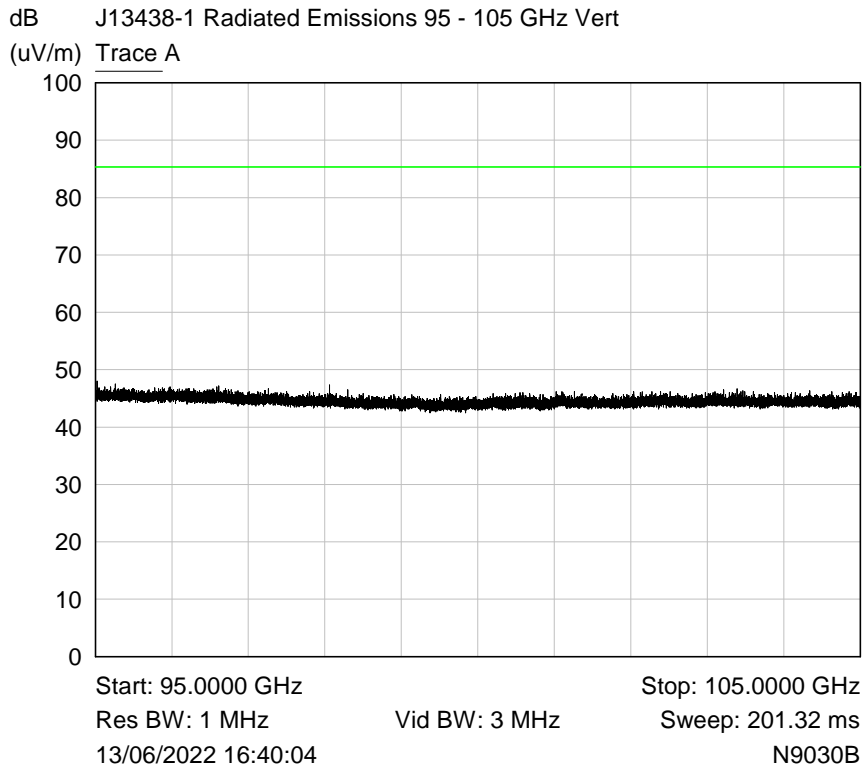
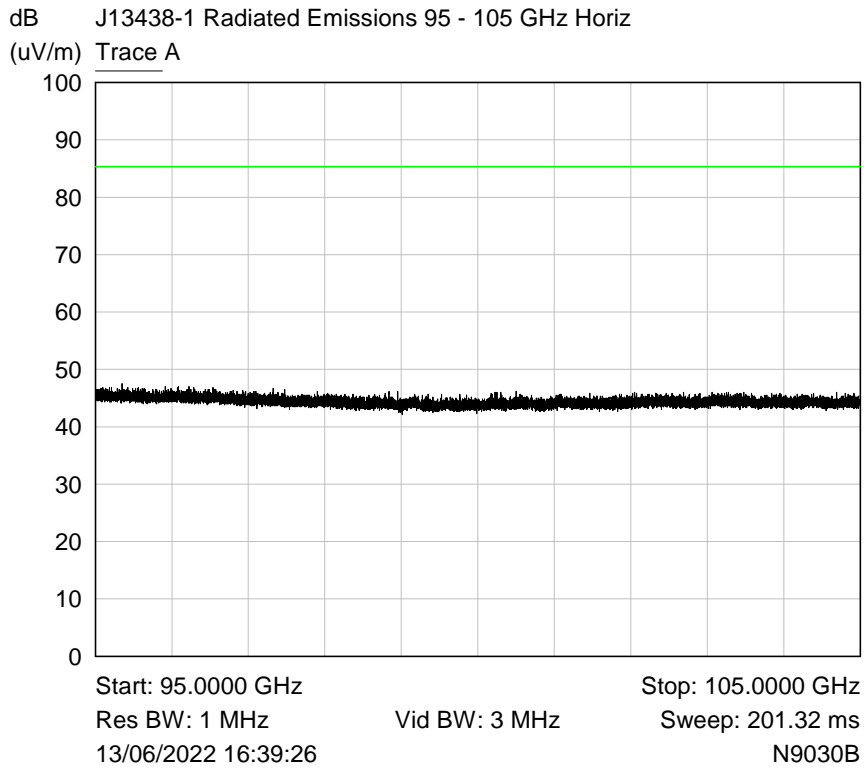
Start: 75.0000 GHz Stop: 85.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 201.32 ms
13/06/2022 16:32:42 N9030B

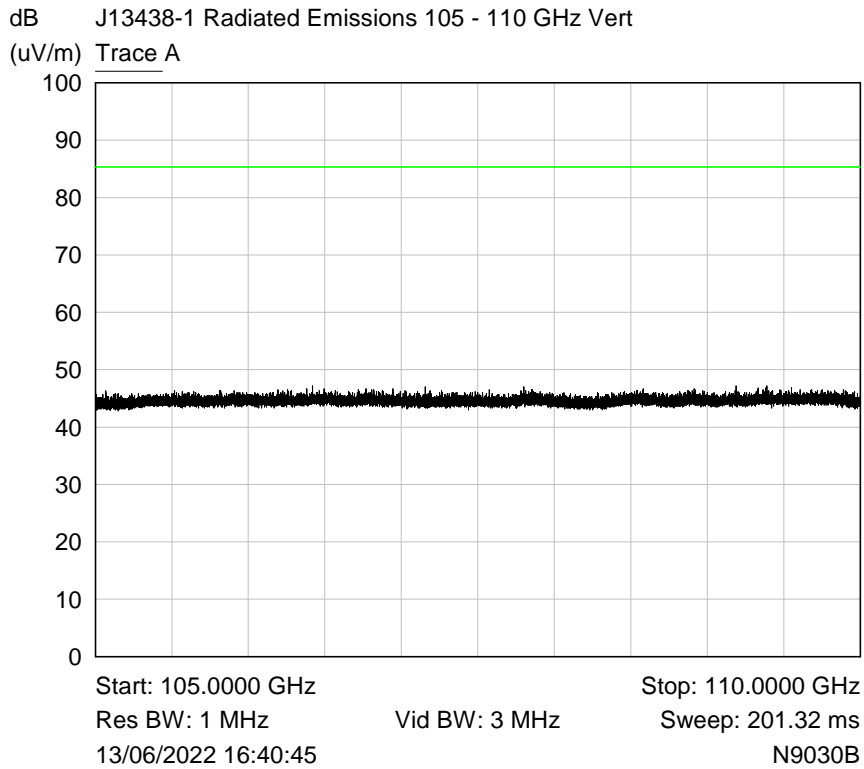
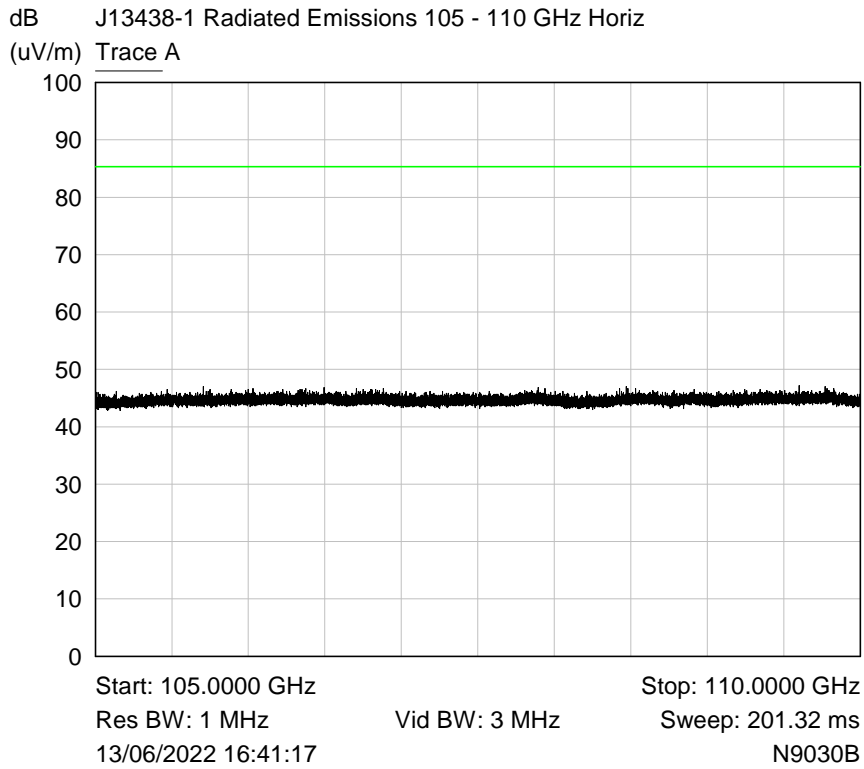
dB J13438-1 Radiated Emissions 85 - 95 GHz Horiz
(uV/m) Trace A

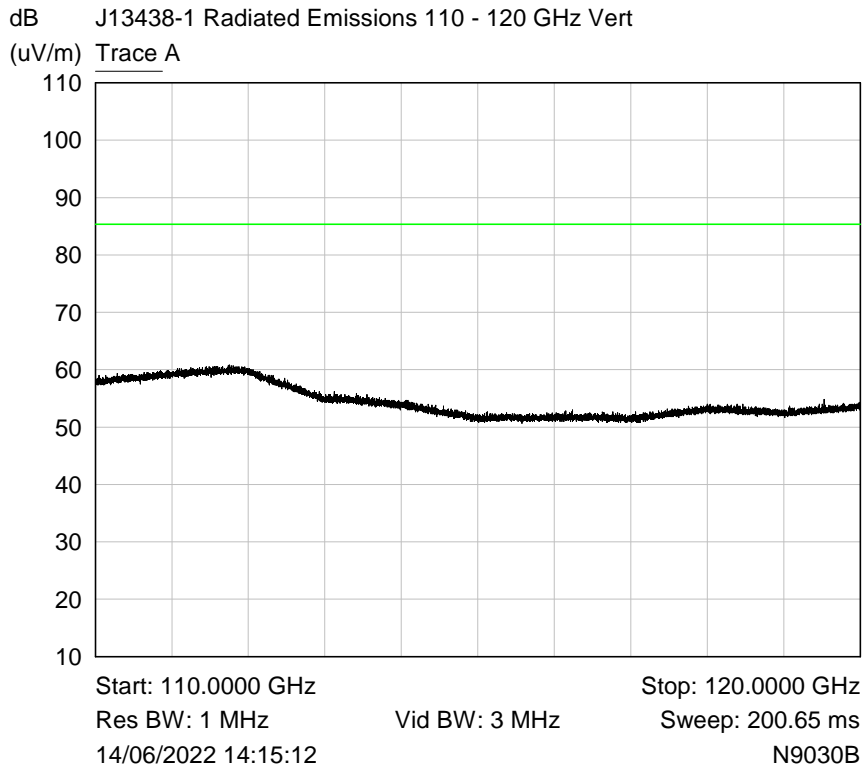
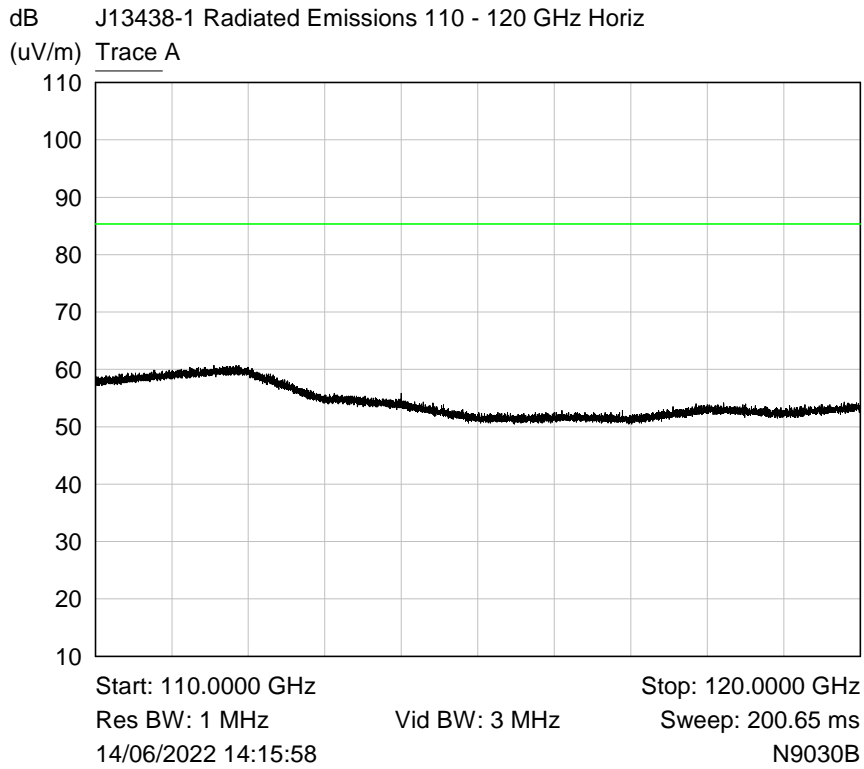


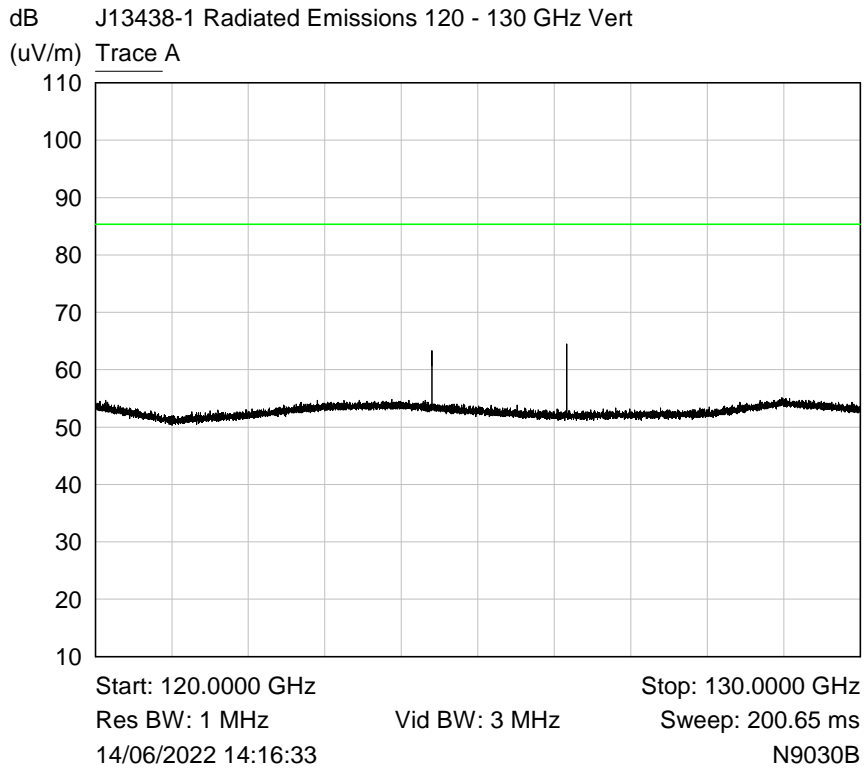
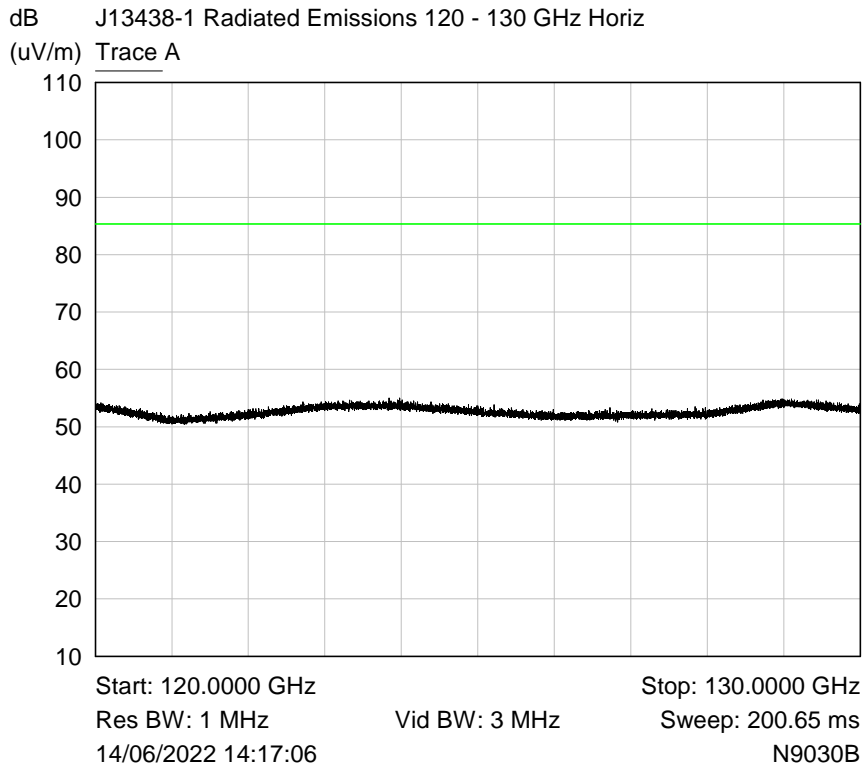
dB J13438-1 Radiated Emissions 85 - 95 GHz Vert
(uV/m) Trace A

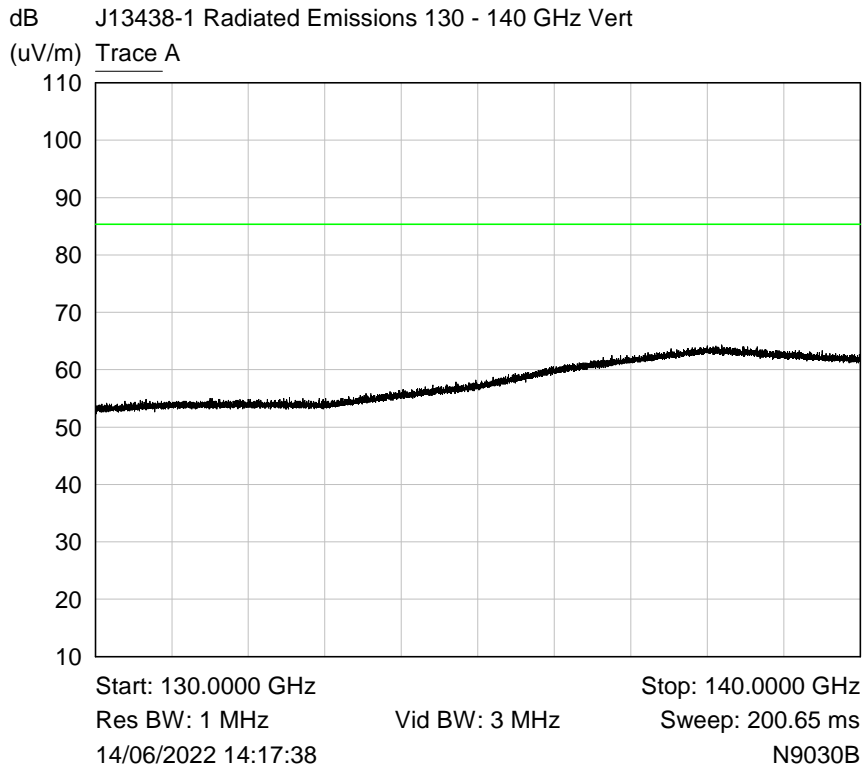
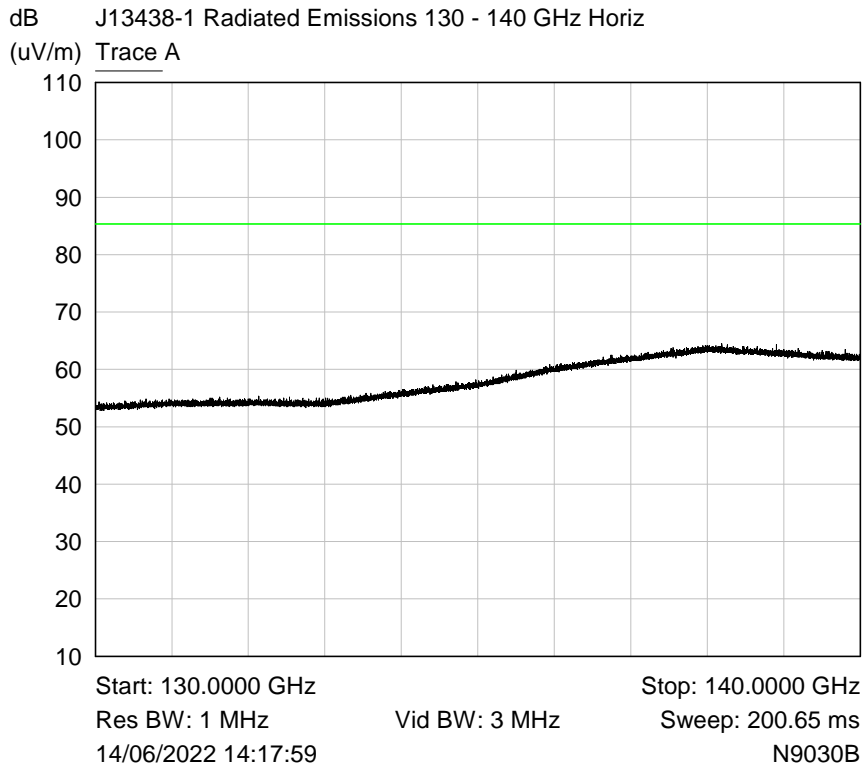


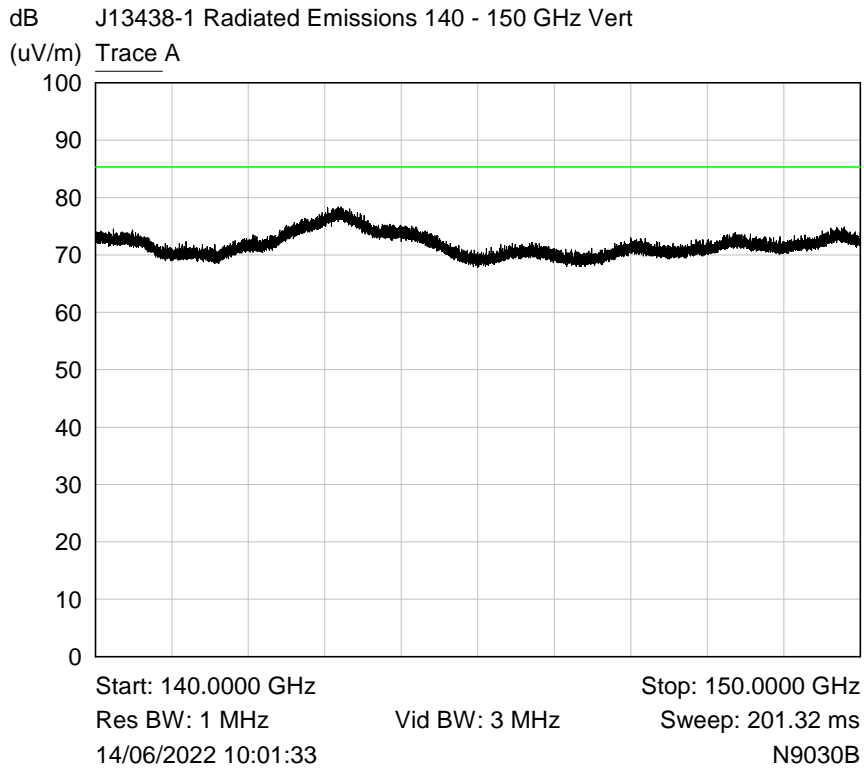
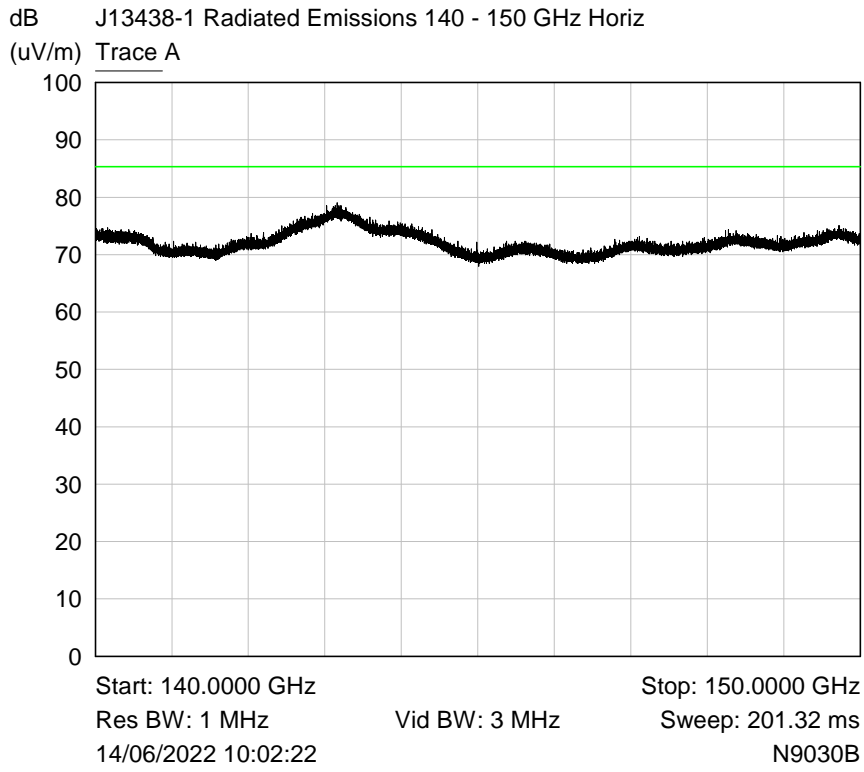


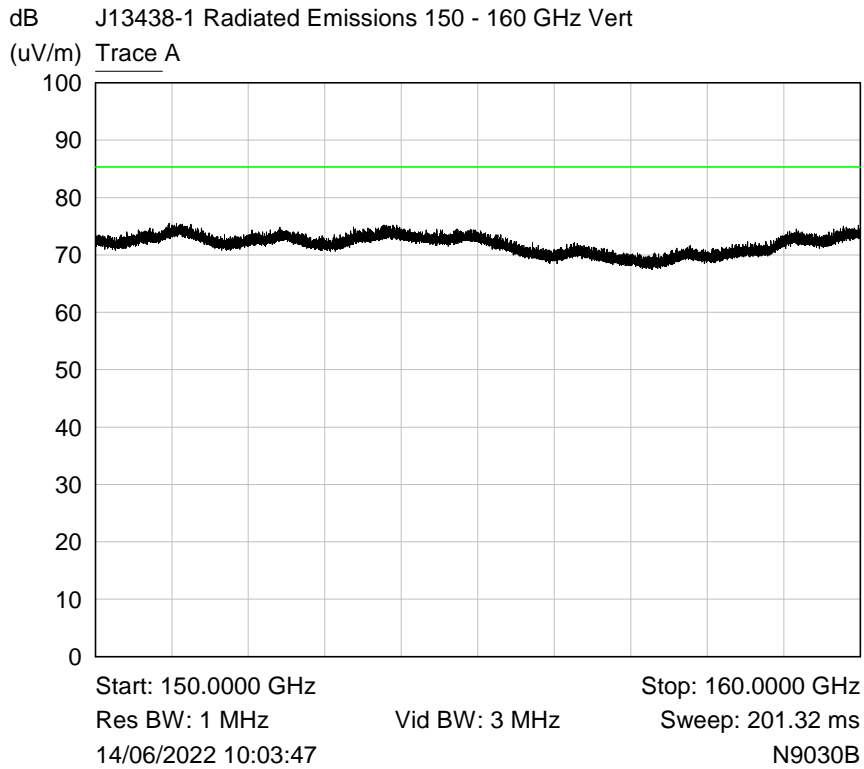
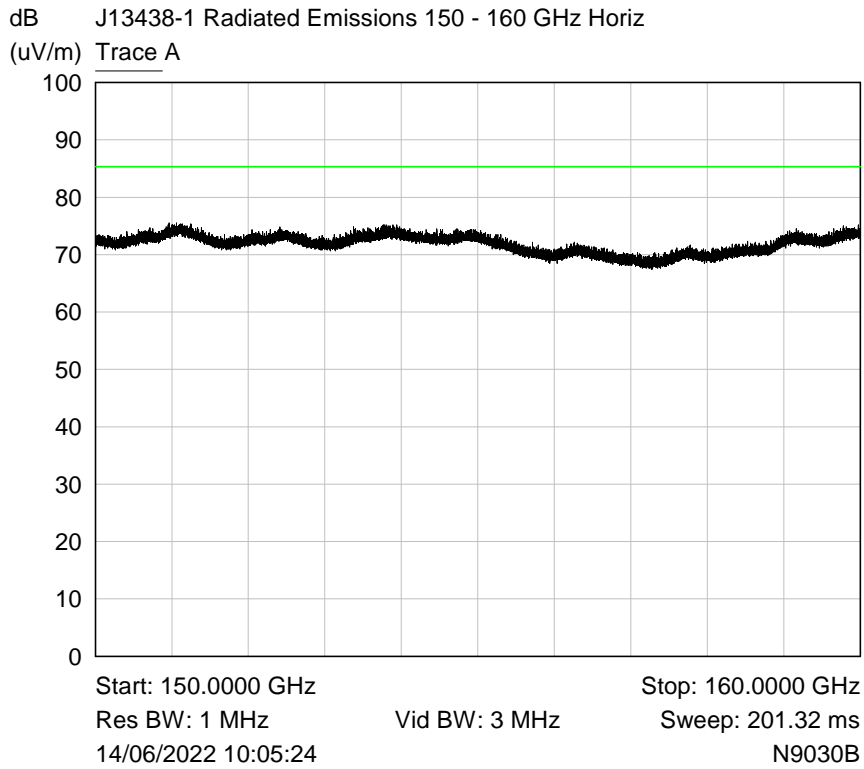






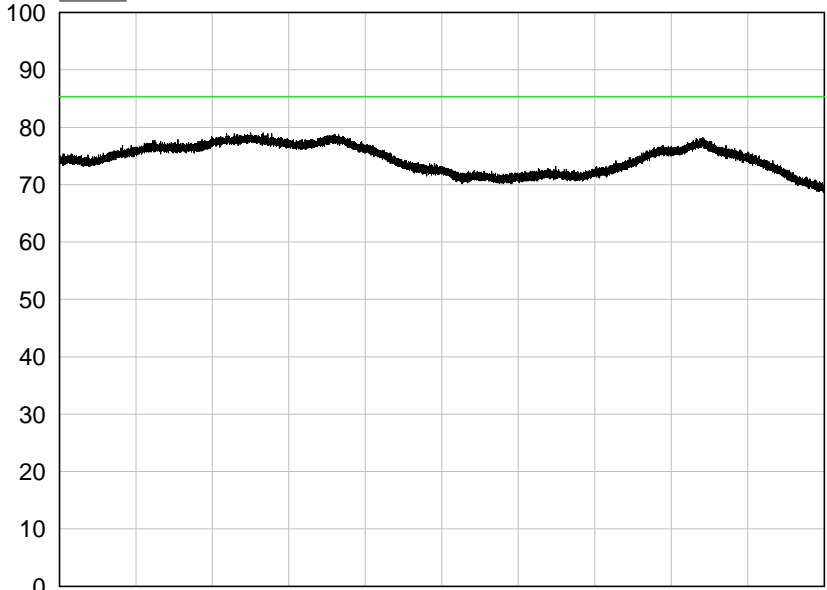






dB J13438-1 Radiated Emissions 170 - 180 GHz Horiz

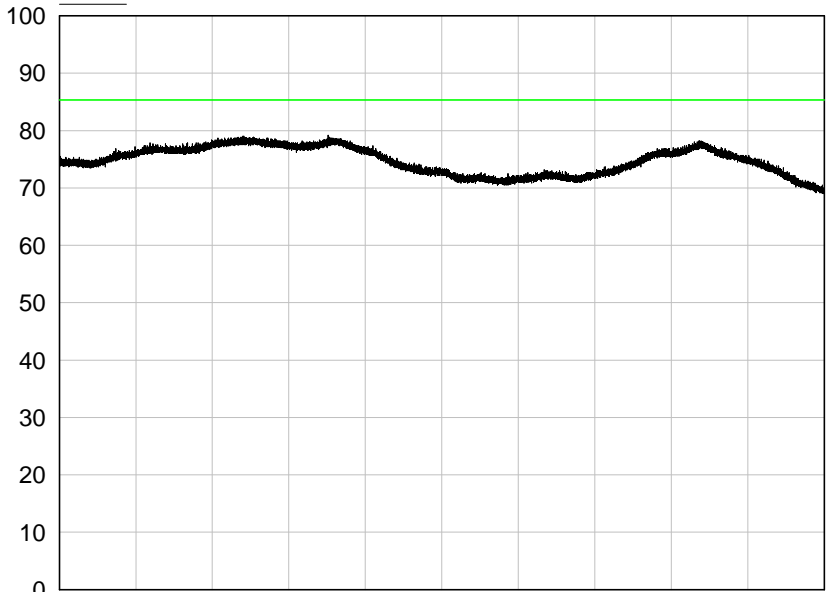
(uV/m) Trace A



Start: 170.0000 GHz Stop: 180.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 1.00 s
14/06/2022 10:10:57 N9030B

dB J13438-1 Radiated Emissions 170 - 180 GHz Vert

(uV/m) Trace A



Start: 170.0000 GHz Stop: 180.0000 GHz
Res BW: 1 MHz Vid BW: 3 MHz Sweep: 1.00 s
14/06/2022 10:11:53 N9030B

