Radio Test Report

Cambridge Communication Systems Ltd

Metnet 60G CPE

G60UC030088

47 CFR Part 15.255 Effective Date 1st October 2018
DXX: Part 15 Low Power Communication Device Transmitter

Test Date: 6th August 2019 to 3rd October 2019
Report Number: 08-11428-2-19 Issue 02
Supersedes Report Number: 08-11428-2-19 Issue 01

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Certificate of Test 11428-2

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:	Metnet 60G CPE
Model Number:	G60UC030088
Unique Serial Number:	348
Applicant:	Cambridge Communication Systems Ltd Victory House, Chivers Way Histon, Cambridge CB24 9ZR
Full measurement results are detailed in Report Number:	08-11428-2-19 Issue 02
Test Standards:	47 CFR Part 15.255 Effective Date 1st October 2018 DXX: Part 15 Low Power communication device transmitter

NOTE:
Certain tests were not performed based upon manufacturer's declarations. Certain other requirements are subject to manufacturer declaration only and have not been tested/verified. For details refer to section 3 of this report. This report pertains to 60GHz operation only and not Wi-Fi operation, however, the unit's Wi-Fi transmitter was in operation for all tests within 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:	6th August 2019 to 3rd October 2019
Test Engineer:	Ian Rose Digitally signed by: Ian Rose DN: CN = Ian Rose email = ian@RNElectronics.com C = GB O = RN Electronics Ltd Date: 2019.10.17 13:51:25 Z
Approved By: Radio Approvals Manager	Digitally signed by: Daniel Sims DN: CN = Daniel Sims C = GB O = RN Electronics Ltd Date: 2019.10.17 13:47:12 Z
Customer Representative:	

2360

0 Revision History

Issue Number	Revision History	Page Reference(s)
01	First Issue	-
02	Report issued date updated Conducted power test result added to summary, and note modified accordingly. Added conducted power calculation to section 5.8	5 9 24

1 Contents

2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	Cambridge Communication Systems Ltd Victory House Chivers Way Histon Cambridge CB24 9ZR	
Manufacturer of EUT	Cambridge Communication Systems Ltd	
Full Name of EUT	Metnet 60G CPE	
Model Number of EUT	G60UC030088 (Grey case version)	
Serial Number of EUT	348	
Date Received	4th July 2019	
Date of Test:	6th August 2019 to 3rd October 2019	
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 2019	
Main Function	60 GHz mmwave backhaul.	
Information Specification	Height	251 mm
	Width	121 mm
	Depth	55 mm
	Weight	1.7 kg
	Voltage	37-57 V DC
	Current	1 A max
EUT Supplied PSU	Manufacturer	Phihong
	Model number	POE60U-1BT
	Serial number	P173900049A1
	Input voltage	100-240 V AC
	Input current	1.5 A
	Output	2 x 56 V DC @ 0.535 A

Note: Applicant declares the only difference between the model G60UC030088 (Grey case version) tested within this report & the model G60UC030000 (Black case version) is the colour of the enclosure/casing.

2.2 Configurations for testing

General Parameters	
EUT Normal use position	Mounted on a lamppost
Choice of model(s) for type tests	Prototype sample
Antenna details	20 dBi phased array beamforming
Antenna port	No
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	64.8 GHz
Lowest Signal generated in EUT	25 MHz
Hardware Version	Metnet 60G CPE V1
Software Version	Metnet_node_archimedes_version-0-3-1-c8
Firmware Version	Not applicable
Type of Equipment	mmWave point to multipoint
Technology Type	802.11 ad
Geo-location (yes/no)	Yes
TX Parameters	
Alignment range – transmitter	57-66 GHz

EUT Declared Modulation Parameters	BPSK, QPSK, 16QAM
EUT Declared Power level	+38 dBm EiRP ±2 dBm
EUT Declared Signal Bandwidths	2.16 GHz
EUT Declared Channel Spacing's	2.16 GHz
EUT Declared Duty Cycle	Not declared
Unmodulated carrier available?	Yes
Declared frequency stability	+/-2.5 ppm/20 years
RX Parameters	
Alignment range – receiver	57-66 GHz
EUT Declared RX Signal Bandwidth	2.16 GHz
Receiver Signal Level (RSL)	Not declared
Method of Monitoring Receiver BER	PER
FCC Parameters	
FCC Transmitter Class	DXX: Part 15 Low Power Communication Device Transmitter

2.3 Functional description

The product is a self-organising transceiver capable of sustaining point to multipoint link with peer node to provide wireless backhaul for access equipment such as cellular base stations. The product is designed to be mounted on street furniture such as lamp posts or residential houses. Equipment contains a single 60-GHz transceiver connected to a steerable multi element antenna array. The equipment also contains a GPS receiver and a 2.4GHz Wi-Fi transceiver module.

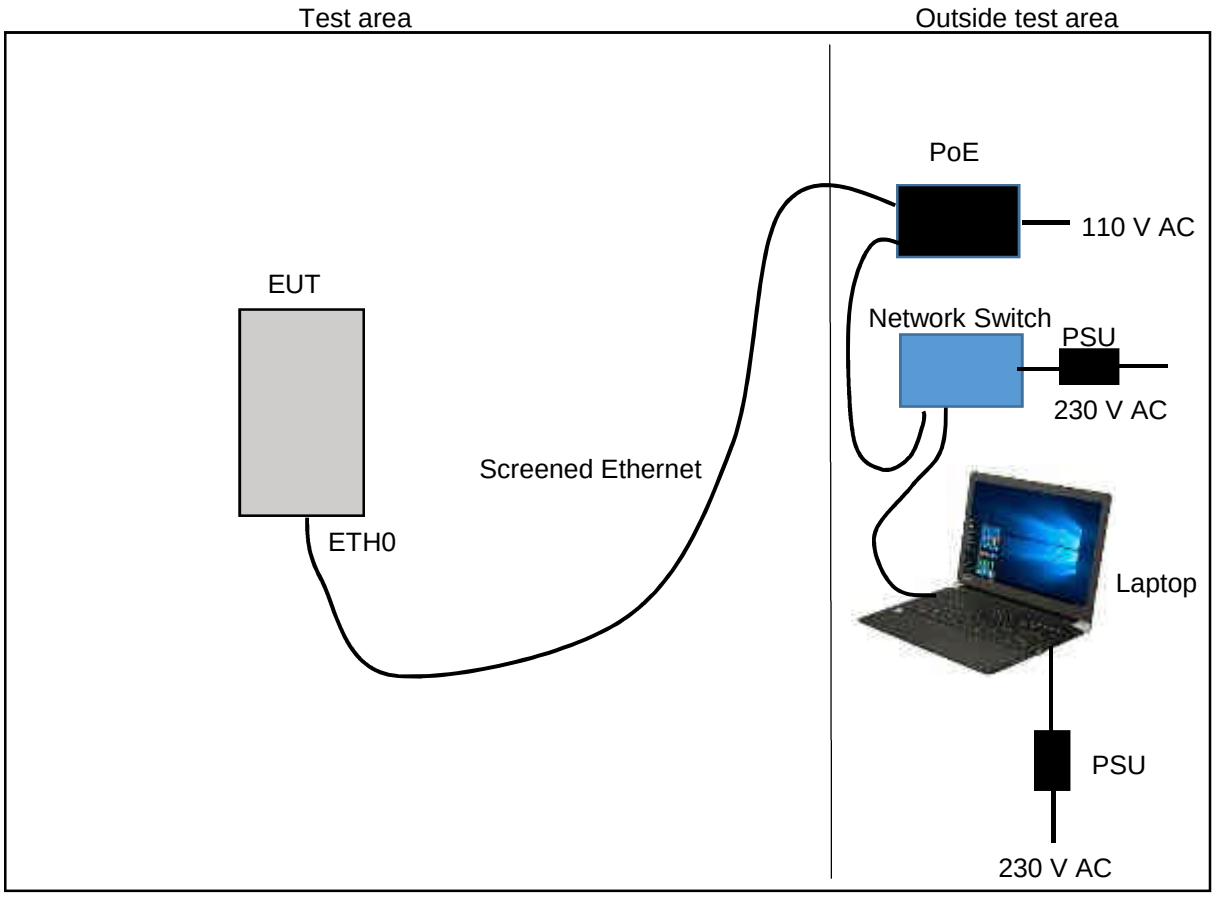
2.4 Modes of operation

Mode Reference	Description	Used for testing
TX1	58.32 GHz 38 dBm MCS1	Yes
TX2	58.32 GHz 38 dBm MCS2	Yes
TX3	58.32 GHz 38 dBm MCS3	Yes
TX4	58.32 GHz 38 dBm MCS4	Yes
TX5	58.32 GHz 38 dBm MCS5	Yes
TX6	58.32 GHz 38 dBm MCS6	Yes
TX7	58.32 GHz 38 dBm MCS7	Yes
TX8	58.32 GHz 38 dBm MCS8	Yes
TX9	58.32 GHz 38 dBm MCS9	Yes
TX10	58.32 GHz 38 dBm MCS10	Yes
TX11	58.32 GHz 38 dBm MCS11	Yes
TX12	58.32 GHz 38 dBm MCS12	Yes
TX13	60.48 GHz 38 dBm MCS1	Yes
TX14	60.48 GHz 38 dBm MCS2	Yes
TX15	60.48 GHz 38 dBm MCS3	Yes
TX16	60.48 GHz 38 dBm MCS4	Yes
TX17	60.48 GHz 38 dBm MCS5	Yes
TX18	60.48 GHz 38 dBm MCS6	Yes
TX19	60.48 GHz 38 dBm MCS7	Yes
TX20	60.48 GHz 38 dBm MCS8	Yes
TX21	60.48 GHz 38 dBm MCS9	Yes
TX22	60.48 GHz 38 dBm MCS10	Yes
TX23	60.48 GHz 38 dBm MCS11	Yes
TX24	60.48 GHz 38 dBm MCS12	Yes
TX25	62.64 GHz 38 dBm MCS1	Yes
TX26	62.64 GHz 38 dBm MCS2	Yes
TX27	62.64 GHz 38 dBm MCS3	Yes
TX28	62.64 GHz 38 dBm MCS4	Yes
TX29	62.64 GHz 38 dBm MCS5	Yes

TX30	62.64 GHz 38 dBm MCS6	Yes
TX31	62.64 GHz 38 dBm MCS7	Yes
TX32	62.64 GHz 38 dBm MCS8	Yes
TX33	62.64 GHz 38 dBm MCS9	Yes
TX34	62.64 GHz 38 dBm MCS10	Yes
TX35	62.64 GHz 38 dBm MCS11	Yes
TX36	62.64 GHz 38 dBm MCS12	Yes
TX37	64.8 GHz 38 dBm MCS1	Yes
TX38	64.8 GHz 38 dBm MCS2	Yes
TX39	64.8 GHz 38 dBm MCS3	Yes
TX40	64.8 GHz 38 dBm MCS4	Yes
TX41	64.8 GHz 38 dBm MCS5	Yes
TX42	64.8 GHz 38 dBm MCS6	Yes
TX43	64.8 GHz 38 dBm MCS7	Yes
TX44	64.8 GHz 38 dBm MCS8	Yes
TX45	64.8 GHz 38 dBm MCS9	Yes
TX46	64.8 GHz 38 dBm MCS10	Yes
TX47	64.8 GHz 38 dBm MCS11	Yes
TX48	64.8 GHz 38 dBm MCS12	Yes
TX49	58.32 GHz CW (99.687 MHz tone)	Yes
TX50	60.42 GHz CW (99.687 MHz tone)	Yes
TX51	62.64 GHz CW (99.687 MHz tone)	Yes
TX52	64.8 GHz CW (99.687 MHz tone)	Yes

Note: The EUT’s pre-approved Wi-Fi module (FCC ID:2AHMR-ESP12S) was transmitting on 2437MHz during all test modes above.

2.5 Emissions configuration



The unit was powered from the supplied Power over Ethernet adapter which was powered from 110 V AC mains. The unit was configured with engineering menus via a terminal program to allow permanent transmit modes of the device on the channels and modulation schemes as stated within section 2.4 of this report. The radio allows circular beam steering as defined in ANSI C63.10 section 13. The beam value is settable between 0 and 64, with 0 being omnidirectional and 1 to 63 being a sector angle. RN Electronics performed initial investigations in 0.5° steps through a 360° EUT rotation for all beam settings. The -3 dB beamwidth was found to be approximately ±4° and is steerable over roughly 95° It was found that the antenna beamwidth increased slightly on antenna beams at each end of the antenna arrays.

The transmit mode was declared as 250 µs off time with on times varying from 300 µs for MCS0 to 7.5 µs for MCS12 with modulation and the power settings for each channel were as stated below:-

Channel 1 = 58.32 GHz, power level +38 dBm (all modulation schemes)
Channel 2 = 60.48 GHz, power level +38 dBm (all modulation schemes)
Channel 3 = 62.64 GHz, power level +38 dBm (all modulation schemes)
Channel 4 = 64.8 GHz, power level +38 dBm (all modulation schemes)

Modulation schemes available were DBPSK (MCS0), BPSK (MCS1 to MCS5), QPSK (MCS6 to MCS9) and 16QAM (MCS10 to MCS12).

In addition, the 2.4 GHz Wi-Fi module was transmitting on 2437 MHz at a power setting of 84 (set by Applicant) during all tests.

2.5.1 Signal leads

Port Name	Cable Type	Connected
EXT0/Power	Ethernet shielded	Yes

3 Summary of test results

The Metnet 60G CPE was tested for compliance to the following standard(s) :

47 CFR Part 15.255 Effective Date 1st October 2018
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 above 1 GHz	47 CFR Part 15C Part 15.255(d)(2)/(3)/(4)	PASSED[3]
6. Frequency stability	47 CFR Part 15C Part 15.255(f)	PASSED
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. 6dB Occupied bandwidth	47 CFR Part 15C Part 15.215	PASSED

[1] Lowest frequency generated within the unit is declared as 25MHz
[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.
[3] Spectrum investigated started at a frequency of 150 kHz up to a frequency of 200GHz. The highest channel/ signal generated in the equipment is 64.8GHz.

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	2018	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

4.2 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	110VAC
T minimum	-20 °C	V minimum	93.5VAC
T maximum	50 °C	V maximum	126.5VAC

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

Extremes of temperature are based upon manufacturer's declaration.
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:

A test fixture was used for testing.

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 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 mode TX36.

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, E856

See Section 9 for more details

5.1.5 Test results

Temperature of test environment	22°C
Humidity of test environment	60%
Pressure of test environment	102kPa

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS12
Single channel	62.64 GHz

Plot refs
11428-2 Cond 1 AC Live 150k-30M Average
11428-2 Cond 1 AC Live 150k-30M Quasi-Peak
11428-2 Cond 1 AC Neutral 150k-30M Average
11428-2 Cond 1 AC Neutral 150k-30M Quasi-Peak

Table of signals measured for Cond 1 AC Live 150k-30M

Signal No.	Freq (MHz)	Peak Amp (dBuV)	QP Amp (dBuV)	QP -Lim (dB)	AV Amp (dBuV)	AV -Lim (dB)
1	0.161	57.8	52.0	-13.4	21.6	-33.8
2	0.174	56.6	50.0	-14.8	20.6	-34.2
3	0.186	56.6	52.0	-12.2	34.7	-19.5
4	0.221	51.6	45.4	-17.4	16.3	-36.5
5	0.244	50.5	44.1	-17.9	23.3	-28.7
6	0.284	46.5	40.5	-20.2	12.8	-37.9
7	21.062	40.7	39.9	-20.1	39.2	-10.8
8	21.766	42.1	41.3	-18.7	40.5	-9.5
9	22.467	43.4	41.3	-18.7	40.4	-9.6
10	22.816	43.8	38.8	-21.2	37.8	-12.2

Table of signals measured for Cond 1 AC Neutral 150k-30M

Signal No.	Freq (MHz)	Peak Amp (dBuV)	QP Amp (dBuV)	QP -Lim (dB)	AV Amp (dBuV)	AV -Lim (dB)
1	0.163	58.0	51.7	-13.6	21.6	-33.7
2	0.189	57.5	52.3	-11.8	35.6	-18.5
3	0.211	52.6	46.4	-16.8	17.6	-35.6
4	0.228	50.8	44.9	-17.6	16.0	-36.5
5	0.272	48.5	42.2	-18.9	20.6	-30.5
6	0.315	46.1	38.9	-20.9	21.6	-28.2
7	20.341	41.6	40.3	-19.7	39.2	-10.8
8	21.045	43.0	41.3	-18.7	40.6	-9.4
9	21.747	42.8	41.8	-18.2	41.0	-9.0
10	22.450	43.7	42.0	-18.0	41.1	-8.9
11	22.798	41.8	39.6	-20.4	38.6	-11.4
12	23.148	43.4	40.7	-19.3	39.6	-10.4

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 is 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 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.209 [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 antenna was orientated in both Parallel and Perpendicular polarisations. The EUT was examined in normal use position. Radiated Emissions testing was performed whilst powered from 110 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 TX12, TX24, TX36 and TX48 modes

5.3.3 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 (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 and the antenna were rotated 360 degrees to record the worst case emissions. Tests were performed in Test Site M

5.3.4 Test equipment

TMS81, ZSW1, E624, E856, E932

See Section 9 for more details

5.3.5 Test results

Temperature of test environment	18°C
Humidity of test environment	58%
Pressure of test environment	102kPa

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS12
Mid channel 2	62.64 GHz

Plot refs
11428-2 Rad 1 150k-30MHz Para
11428-2 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.

n.b. 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 its normal use position. Radiated Emissions testing was performed whilst powered from 110 V AC. 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 TX12, TX24, TX36 and TX48 modes.

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

E642, E743, E856, LPE364, ZSW1

See Section 9 for more details

5.4.5 Test results

Temperature of test environment 21°C
Humidity of test environment 46%
Pressure of test environment 103kPa

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS12
Mid channel 2	62.64 GHz

Plot refs
11428-2 Rad 1 VHF Horiz
11428-2 Rad 1 VHF Vert
11428-2 Rad 1 UHF Horiz
11428-2 Rad 1 UHF Vert

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	38.596	30.9	27.6	-12.4
2	39.309	30.5	27.1	-12.9
3	42.531	27.0	22.8	-17.2
4	44.001	23.6	17.7	-22.3

5	48.261	23.2	15.1	-24.9
6	50.242	26.9	17.6	-22.4

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)
No emissions were observed				

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

No discernible difference was noted in emissions between channel settings (exploratory measurements), therefore final measurements are presented for channel 62.64 GHz only for these test ranges.

Whilst Low, Mid and High channels were tested, plots are for illustrative purposes only and only channel 62.64 GHz 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 above 1 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 distances listed in 5.5.3. The EUT was examined in its normal use position. Radiated Emissions testing was performed whilst powered from 110 V AC. During the initial scan, worst modulation scheme was seen to be MCS12.

The EUT was operated in TX12, TX24, TX36 and TX48 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. 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 - 75GHz, 0.1m was used in the test range 75-110GHz and 0.03m was used in the test range 110-200 GHz. Pre scans over the EUT in all planes were made to identify any point sources of radiation, prior to any referenced measurements/plots taken.

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

Tests were performed using test Sites A and B.

5.5.4 Test equipment

E289, E296-6, E330, E412, E428, E453, E486-2, E487, E503, E579, E580, E638, E642, E712, E719, E722, E760, E917, E918, E918, E942, TMS78

See Section 9 for more details

5.5.5 Test results

Temperature of test environment	21-22°C
Humidity of test environment	51-63%
Pressure of test environment	100-102kPa

Setup Table

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS12
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
2475	41.2	-32.8	35.4	-18.6	Upright	Vertical
2500	40.3	-33.7	35.4	-18.6	Upright	Horizontal
2500	43.9	-30.1	38.4	-15.6	Upright	Vertical
4874	65.6	-8.4	37.2	-16.8	Side	Horizontal
4874	64.8	-9.2	36.3	-17.7	Flat	Vertical
7311	60.8	-13.2	32.3	-21.7	Side	Horizontal
7311	59.4	-14.6	31.0	-23.0	Side	Vertical

9748	64.2	-9.8	36.2	-17.8	Upright	Horizontal
9748	65.0	-9.0	36.8	-17.2	Side	Vertical
19440	40.2	-33.8	35.4	-18.6	Upright	Vertical
38880	50.4	-23.6	42.0	-12.0	Upright	Vertical

Setup Table

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS12
Mid channel 1	60.48 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
2475	41.2	-32.8	35.4	-18.6	Upright	Vertical
2500	40.3	-33.7	35.4	-18.6	Upright	Horizontal
2500	43.9	-30.1	38.4	-15.6	Upright	Vertical
4874	65.6	-8.4	37.2	-16.8	Side	Horizontal
4874	64.8	-9.2	36.3	-17.7	Flat	Vertical
7311	60.8	-13.2	32.3	-21.7	Side	Horizontal
7311	59.4	-14.6	31.0	-23.0	Side	Vertical
9748	64.2	-9.8	36.2	-17.8	Upright	Horizontal
9748	65.0	-9.0	36.8	-17.2	Side	Vertical
20160	40.0	-34.0	34.2	-19.8	Upright	Vertical

Setup Table

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS12
Mid channel 2	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
2475	41.2	-32.8	35.4	-18.6	Upright	Vertical
2500	40.3	-33.7	35.4	-18.6	Upright	Horizontal
2500	43.9	-30.1	38.4	-15.6	Upright	Vertical
4874	65.6	-8.4	37.2	-16.8	Side	Horizontal
4874	64.8	-9.2	36.3	-17.7	Flat	Vertical
7311	60.8	-13.2	32.3	-21.7	Side	Horizontal
7311	59.4	-14.6	31.0	-23.0	Side	Vertical
9748	64.2	-9.8	36.2	-17.8	Upright	Horizontal
9748	65.0	-9.0	36.8	-17.2	Side	Vertical
20880	48.0	-26.0	45.7	-8.3	Upright	Vertical

Plots
11428-2 62.64 GHz 1-2 GHz horiz
11428-2 62.64 GHz 1-2 GHz vert
11428-2 62.64 GHz 2-2.7 GHz horiz
11428-2 62.64 GHz 2-2.7 GHz vert
11428-2 62.64 GHz 2.7-5 GHz horiz
11428-2 62.64 GHz 2.7-5 GHz vert
11428-2 62.64 GHz 5-6 GHz horiz
11428-2 62.64 GHz 5-6 GHz vert

11428-2 62.64 GHz 6-7.7 GHz horiz
11428-2 62.64 GHz 6-7.7 GHz vert
11428-2 62.64 GHz 7.7-10 GHz horiz
11428-2 62.64 GHz 7.7-10 GHz vert
11428-2 62.64 GHz 10-12.5 GHz horiz
11428-2 62.64 GHz 10-12.5 GHz vert
11428-2 62.64 GHz 12.5-15 GHz
11428-2 62.64 GHz 15-18 GHz
11428-2 62.64 GHz 18-22 GHz
11428-2 62.64 GHz 22-26 GHz
11428-2 62.64 GHz 26.5-30 GHz
11428-2 62.64 GHz 26-26.5 GHz
11428-2 62.64 GHz 30-34 GHz
11428-2 62.64 GHz 34-38 GHz
11428-2 62.64 GHz 38-40 GHz
11428-2 62.64 GHz 40-44 GHz
11428-2 62.64 GHz 44-48 GHz
11428-2 62.64 GHz 48-50 GHz
11428-2 62.64 GHz 50-54 GHz
11428-2 62.64 GHz 54-58 GHz
11428-2 62.64 GHz 70.9-75 GHz
11428-2 62.64 GHz 75-79 GHz
11428-2 62.64 GHz 79-83 GHz
11428-2 62.64 GHz 83-87 GHz
11428-2 62.64 GHz 83-87 GHz
11428-2 62.64 GHz 87-90 GHz
11428-2 62.64 GHz 90-140 GHz
11428-2 62.64 GHz 140-170 GHz
11428-2 62.64 GHz 170-200 GHz

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

Note: Whilst all channels were tested, plots are for illustrative purposes only and only plots for channel 62.64 GHz are shown in this report. Plots above 12.5GHz show combined Vertical and Horizontal measurement polarisations.

Setup Table

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS12
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
2475	41.2	-32.8	35.4	-18.6	Upright	Vertical
2500	40.3	-33.7	35.4	-18.6	Upright	Horizontal
2500	43.9	-30.1	38.4	-15.6	Upright	Vertical
4874	65.6	-8.4	37.2	-16.8	Side	Horizontal
4874	64.8	-9.2	36.3	-17.7	Flat	Vertical
7311	60.8	-13.2	32.3	-21.7	Side	Horizontal
7311	59.4	-14.6	31.0	-23.0	Side	Vertical
9748	64.2	-9.8	36.2	-17.8	Upright	Horizontal
9748	65.0	-9.0	36.8	-17.2	Side	Vertical
21600	46.0	-28.0	44.2	-9.8	Upright	Vertical

LIMITS:
15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.
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. This is equivalent to 85.1dBuV/m @ a distance of 3m. Calculations are based on ANSI C63.10 clauses 9.4 – 9.7.

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 – 60 GHz ±3.9dB, 60 – 110 GHz ±4.4dB, 110 – 200 GHz ±5.9dB

5.6 Frequency stability

5.6.1 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]

5.6.2 Configuration of EUT

The EUT was placed in a temperature controlled chamber. The EUT's emissions were observed by means of a test fixture. The EUT was operated in TX49, TX50, TX51 and TX52 modes for this test.

5.6.3 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, adjusted for the tone offset (99.687MHz).

Tests were performed using Test Site A.

5.6.4 Test equipment

E296-5, E412, E434, E503, E555, E917, E918, TMS38, TMS57, TMS80

See Section 9 for more details

5.6.5 Test results

Temperature of test environment 18°C
Humidity of test environment 68%
Pressure of test environment 102kPa

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	CW (99.687 MHz tone)
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

Test conditions		Frequency Error (MHz) Low channel	Frequency Error (MHz) Mid channel 1	Frequency Error (MHz) Mid channel 2	Frequency Error (MHz) High channel
-20°C	Volts Nominal (110)	58319.803582	60479.796347	62639.789085	64799.781812
-10°C	Volts Nominal (110)	58319.805015	60479.797804	62639.790664	64799.783484
0°C	Volts Nominal (110)	58319.807658	60479.800525	62639.793397	64799.786305
10°C	Volts Nominal (110)	58319.809539	60479.802407	62639.795304	64799.788237
20°C	Volts Minimum (93.5)	58319.809457	60479.802208	62639.795193	64799.788176
	Volts Nominal (110)	58319.809435	60479.802236	62639.795189	64799.788113
	Volts Maximum (126.5)	58319.809496	60479.802254	62639.795152	64799.788164
30°C	Volts Nominal	58319.814329	60479.807334	62639.800333	64799.793074

	(110)				
40°C	Volts Nominal (110)	58319.815149	60479.808357	62639.801600	64799.794794
50°C	Volts Nominal (110)	58319.815722	60479.808738	62639.801839	64799.795019
Max Frequency Error per chan (Hz)		+184278 / -196418	+191262 / -203653	+198161 / -210915	+204981 / -218188
Max Frequency Error observed (MHz)		-0.196418	-0.203653	-0.210915	-0.218188

Results shown above have been corrected for the offset tone of 99.687 MHz.

Maximum variation observed was -0.218188 MHz. Refer to 6dB BW test results for BW of signal contained within the band 57-66GHz.

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

5.7 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. The EUT antenna was positioned and aligned with the measuring antenna. The EUT was measured at a distance of 25 centimetres. EIRP testing was performed whilst powered from 110 V AC. During the initial scan, no discernible difference in emissions could be observed when operating using different modulation schemes.
The EUT was operated in TX12, TX24 TX36 and TX48 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. A measurement distance of 25 cm was used to maintain the far field condition at the frequency of interest whilst maintaining enough EUT transmitted signal into the mixer. Substitution was performed to determine results.

Tests were performed using test Site A.

5.7.4 Test equipment

E503, E577, E599, E600, E602, E627, E781, E829, E852, E908

See Section 9 for more details

5.7.5 Test results

Temperature of test environment	22°C
Humidity of test environment	55%
Pressure of test environment	101kPa

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS12
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

Test conditions	Low channel	Mid channel 1	Mid channel 2	High channel
Peak EIRP measured (dBm)	37.93	38.45	36.45	36.25
Beam setting for maximum	26	29	59	11

As the peak EIRP measured does not exceed the average EIRP limit, only peak values are recorded.

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 .

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: ± 5.3 dB.

5.8 Peak Conducted Power

5.8.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.255(e) [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 9.7 [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Part 15.255(e) [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)

5.8.4 Test equipment

Not required

5.8.5 Test results

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS12
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

Test conditions	Low channel	Mid channel 1	Mid channel 2	High channel
Peak EIRP measured (dBm)	37.93	38.45	36.45	36.25
Beam setting for maximum	26	29	59	11
Peak EIRP measured in Watts	6.21	7.00	4.42	4.22
Calculated Peak conducted power (W)	0.0621	0.0700	0.0442	0.00422

Antenna gain is declared as 20dBi (numeric gain is therefore 100)

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

These results show that the EUT has PASSED this test.

5.9 6dB Occupied bandwidth

5.9.1 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 9.3 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.255(e)1 [Reference 4.1.1 of this report]

5.9.2 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 tested whilst connected to the AC power for maximised emissions. The EUT was operated in TX1 to TX48 modes.

5.9.3 Test procedure

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

Tests were performed using test Site A.

5.9.4 Test equipment

E412, E503, E638, E917, E918

See Section 9 for more details

5.9.5 Test results

Temperature of test environment	21°C
Humidity of test environment	63%
Pressure of test environment	102kPa

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS1
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

	Low channel	Mid channel 1	Mid channel 2	High channel
6 dB Bandwidth (GHz) Nominal Temp & Volts	1.6424	1.5369	1.5332	1.6017
Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts	11428-2 58.32GHz mcs1 6dB	11428-2 60.48GHz mcs1 6dB	11428-2 62.64GHz mcs1 6dB	11428-2 64.8GHz mcs1 6dB

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS2
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

	Low channel	Mid channel 1	Mid channel 2	High channel
6 dB Bandwidth (GHz) Nominal Temp & Volts	1.5886	1.5675	1.5026	1.4720
Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts	11428-2 58.32GHz mcs2 6dB	11428-2 60.48GHz mcs2 6dB	11428-2 62.64GHz mcs2 6dB	11428-2 64.8GHz mcs2 6dB

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS3
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

	Low channel	Mid channel 1	Mid channel 2	High channel
6 dB Bandwidth (GHz) Nominal Temp & Volts	1.6054	1.5643	1.4920	1.6123
Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts	11428-2 58.32GHz mcs3 6dB	11428-2 60.48GHz mcs3 6dB	11428-2 62.64GHz mcs3 6dB	11428-2 64.8GHz mcs3 6dB

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS4
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

	Low channel	Mid channel 1	Mid channel 2	High channel
6 dB Bandwidth (GHz) Nominal Temp & Volts	1.6777	1.5922	1.4815	1.6123
Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts	11428-2 58.32GHz mcs4 6dB	11428-2 60.48GHz mcs4 6dB	11428-2 62.64GHz mcs4 6dB	11428-2 64.8GHz mcs4 6dB

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS5
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

	Low channel	Mid channel 1	Mid channel 2	High channel
6 dB Bandwidth (GHz) Nominal Temp & Volts	1.6223	1.5432	1.6292	1.4720
Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts	11428-2 58.32GHz mcs5 6dB	11428-2 60.48GHz mcs5 6dB	11428-2 62.64GHz mcs5 6dB	11428-2 64.8GHz mcs5 6dB

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS6
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

	Low channel	Mid channel 1	Mid channel 2	High channel
6 dB Bandwidth (GHz) Nominal Temp & Volts	1.6640	1.6297	1.6155	1.6017
Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts	11428-2 58.32GHz mcs6 6dB	11428-2 60.48GHz mcs6 6dB	11428-2 62.64GHz mcs6 6dB	11428-2 64.8GHz mcs6 6dB

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS7
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

	Low channel	Mid channel 1	Mid channel 2	High channel
6 dB Bandwidth (GHz) Nominal Temp & Volts	1.6640	1.6128	1.5880	1.6086
Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts	11428-2 58.32GHz mcs7 6dB	11428-2 60.48GHz mcs7 6dB	11428-2 62.64GHz mcs7 6dB	11428-2 64.8GHz mcs7 6dB

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS8
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

	Low channel	Mid channel 1	Mid channel 2	High channel
6 dB Bandwidth (GHz) Nominal Temp & Volts	1.6671	1.5812	1.6360	1.6086
Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts	11428-2 58.32GHz mcs8 6dB	11428-2 60.48GHz mcs8 6dB	11428-2 62.64GHz mcs8 6dB	11428-2 64.8GHz mcs8 6dB

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS9
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

	Low channel	Mid channel 1	Mid channel 2	High channel
6 dB Bandwidth (GHz) Nominal Temp & Volts	1.6228	1.5986	1.4509	1.5812
Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts	11428-2 58.32GHz mcs9 6dB	11428-2 60.48GHz mcs9 6dB	11428-2 62.64GHz mcs9 6dB	11428-2 64.8GHz mcs9 6dB

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS10
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

	Low channel	Mid channel 1	Mid channel 2	High channel
6 dB Bandwidth (GHz) Nominal Temp & Volts	1.6228	1.5812	1.5126	1.5817
Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts	11428-2 58.32GHz mcs10 6dB	11428-2 60.48GHz mcs10 6dB	11428-2 62.64GHz mcs10 6dB	11428-2 64.8GHz mcs10 6dB

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS11
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

	Low channel	Mid channel 1	Mid channel 2	High channel
6 dB Bandwidth (GHz) Nominal Temp & Volts	1.6503	1.6497	1.4989	1.6228
Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts	11428-2 58.32GHz mcs11 6dB	11428-2 60.48GHz mcs11 6dB	11428-2 62.64GHz mcs11 6dB	11428-2 64.8GHz mcs11 6dB

Band	57-66 GHz
Power Level	38 dBm
Channel Spacing	2.16 GHz
Mod Scheme	MCS12
Low channel	58.32 GHz
Mid channel 1	60.48 GHz
Mid channel 2	62.64 GHz
High channel	64.8 GHz

	Low channel	Mid channel 1	Mid channel 2	High channel
6 dB Bandwidth (GHz) Nominal Temp & Volts	1.6228	1.5822	1.4303	1.5817
Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts	11428-2 58.32GHz mcs12 6dB	11428-2 60.48GHz mcs12 6dB	11428-2 62.64GHz mcs12 6dB	11428-2 64.8GHz mcs12 6dB

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

LIMITS:

15.255(e)1 & 15.255(f) The 6dB bandwidth of the emission must be contained within the designated frequency band.

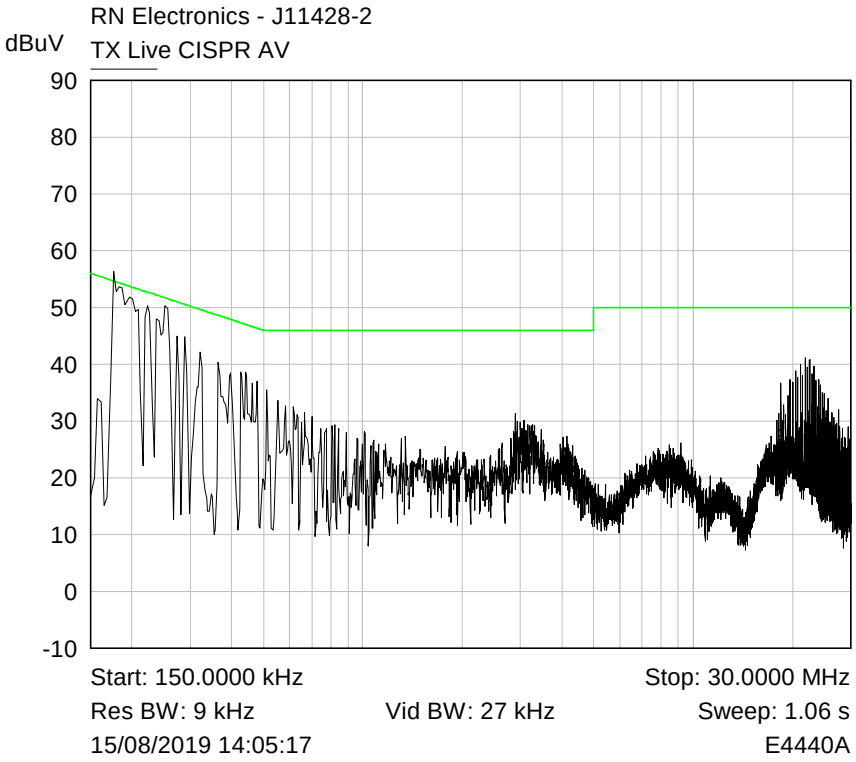
These results show that the EUT has PASSED this test.

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

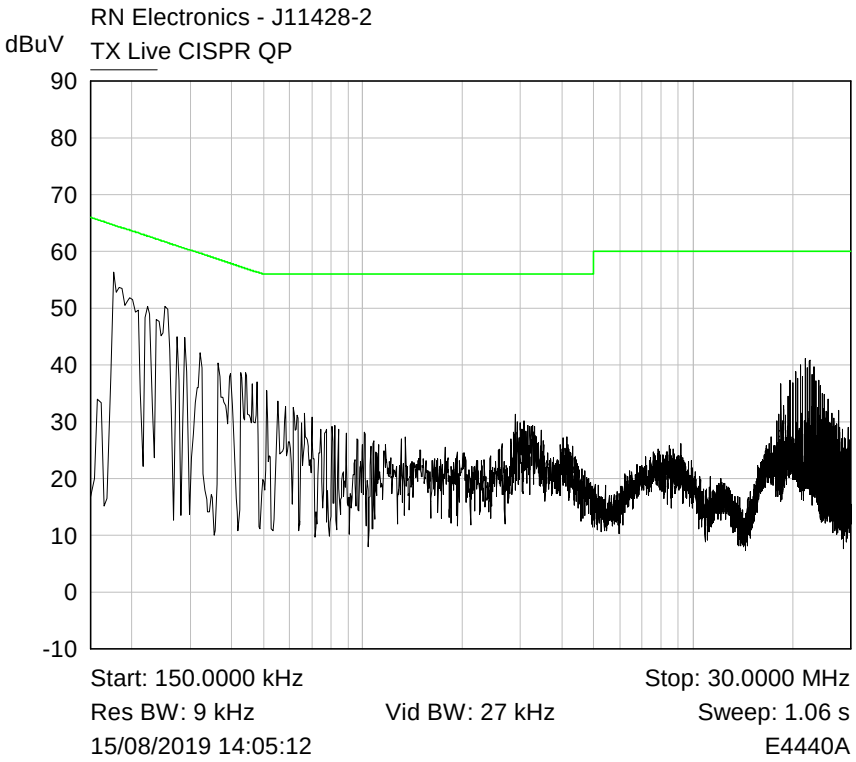
6 Plots/Graphical results

6.1 AC power line conducted emissions

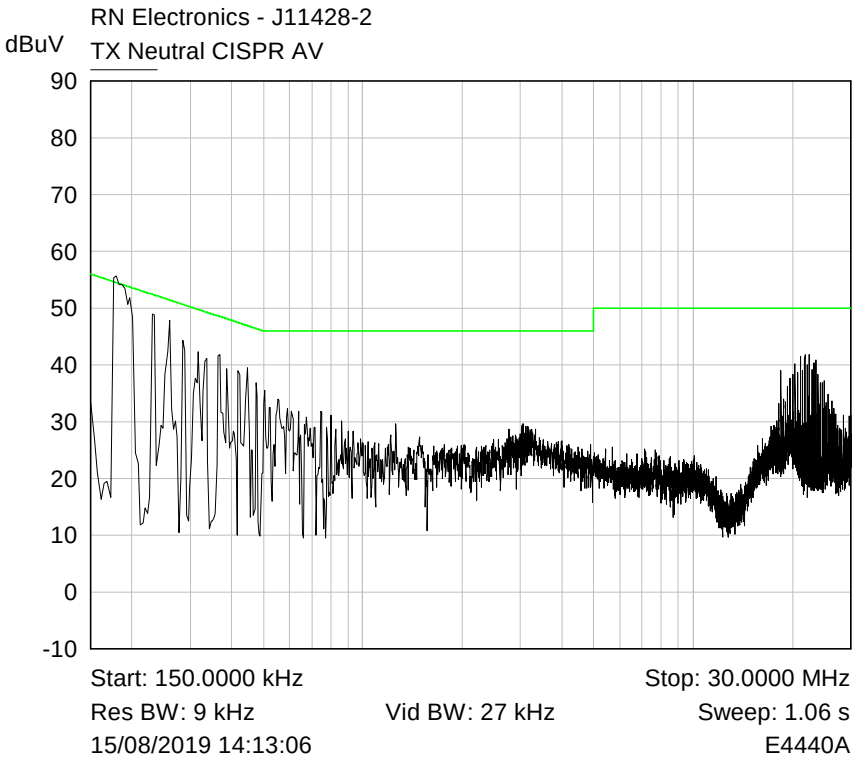
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS12, Channel 62.64 GHz



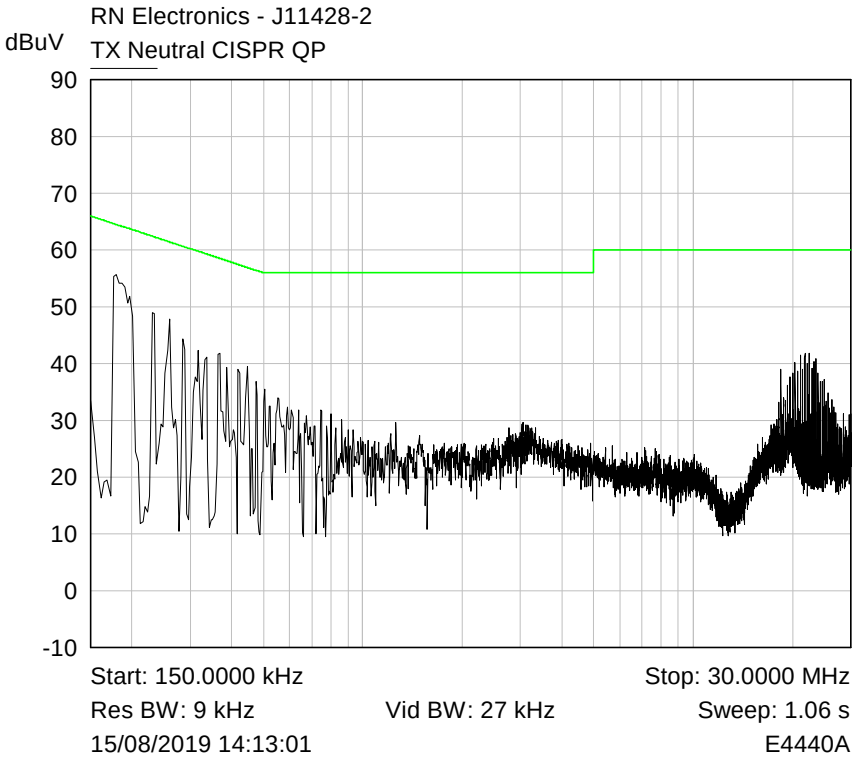
Plot of Live150k-30M Average



Plot of Live150k-30M Quasi-Peak



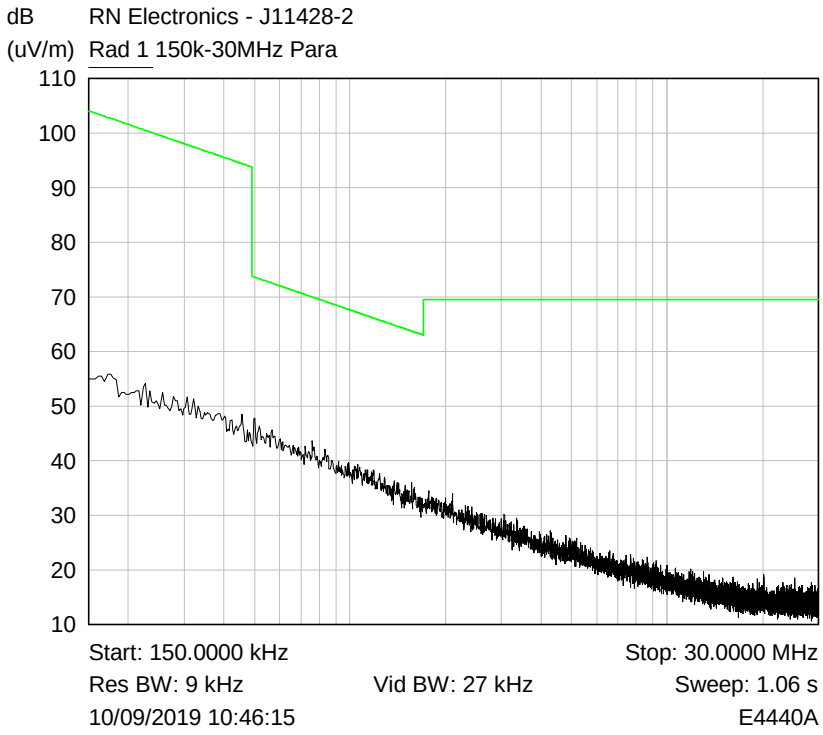
Plot of Neutral150k-30M Average



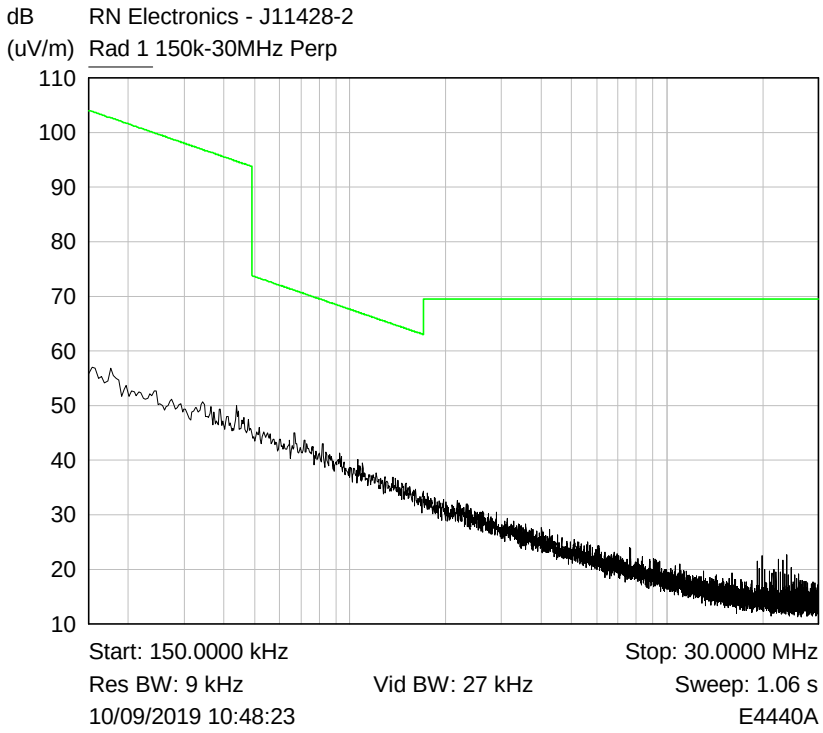
Plot of Neutral150k-30M Quasi-Peak

6.2 Radiated emissions 150k - 30 MHz

RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS12, Channel 62.64 GHz



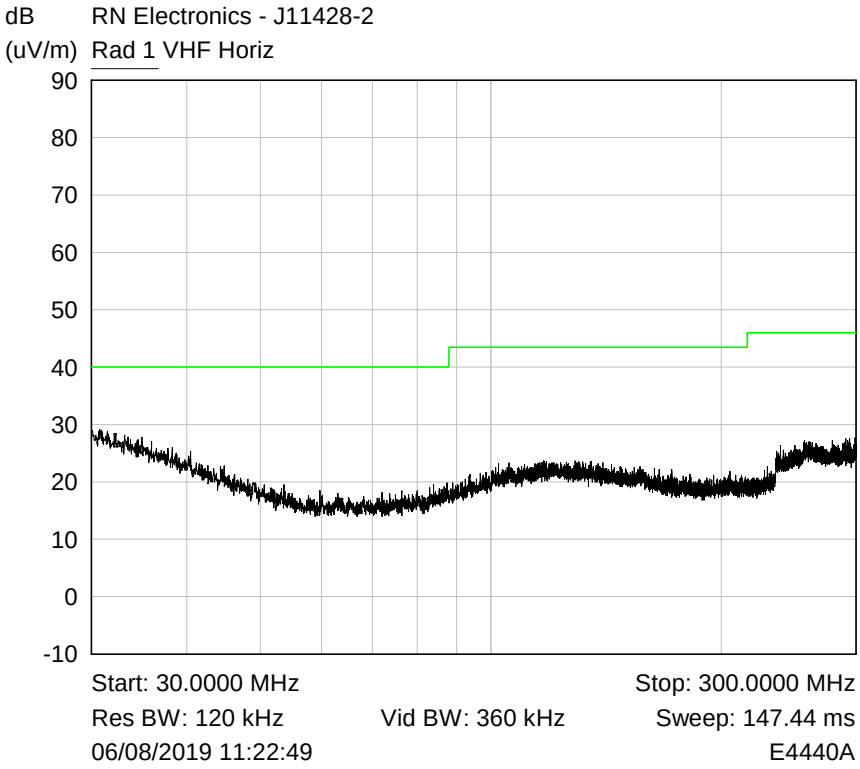
Plot of 150kHz-30MHz Parallel



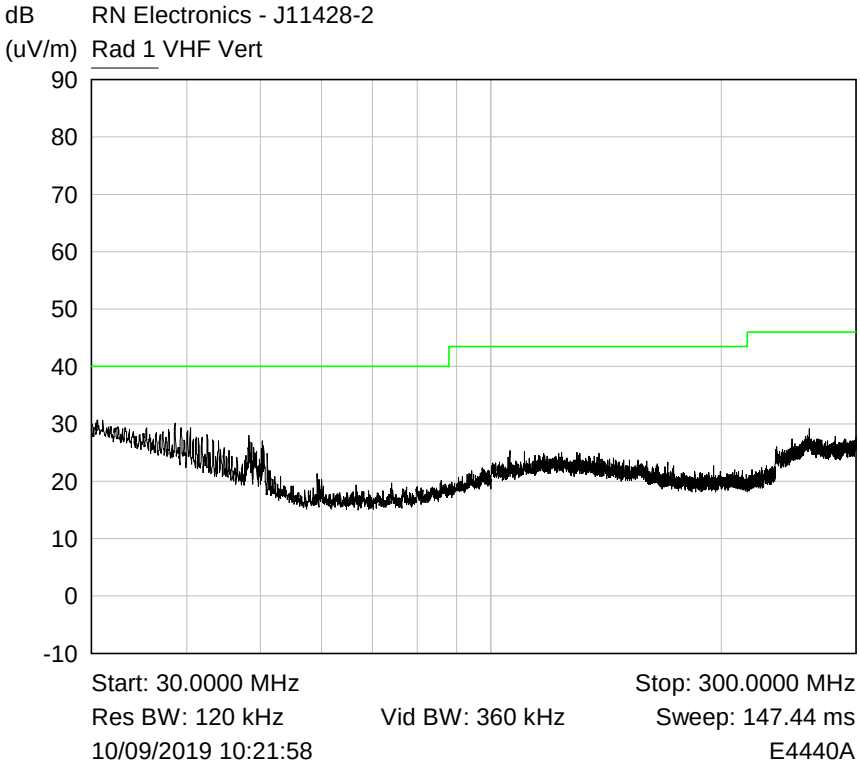
Plot of 150kHz-30MHz Perpendicular

6.3 Radiated emissions 30 MHz - 1 GHz

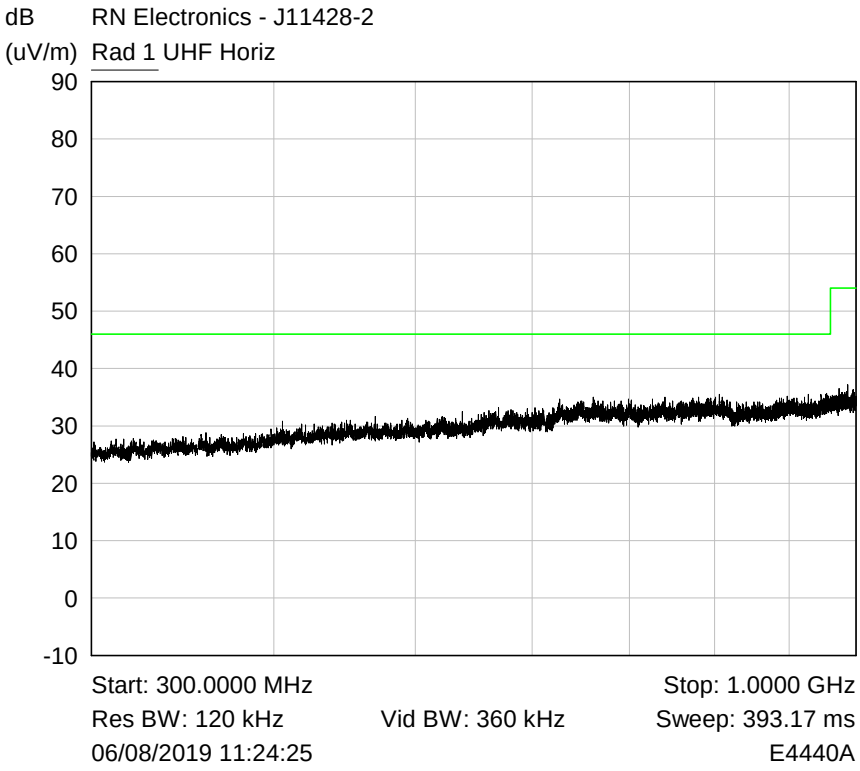
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS12, Channel 62.64 GHz



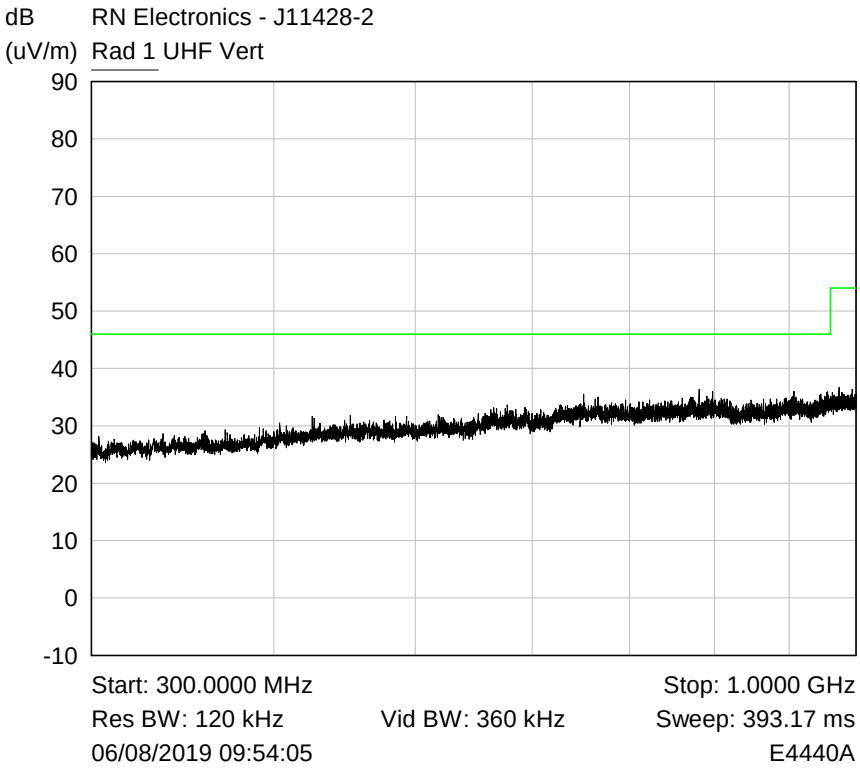
Plot of peak emissions for VHF Horizontal against the QP limit line



Plot of peak emissions for VHF Vertical against the QP limit line



Plot of peak emissions for UHF Horizontal against the QP limit line

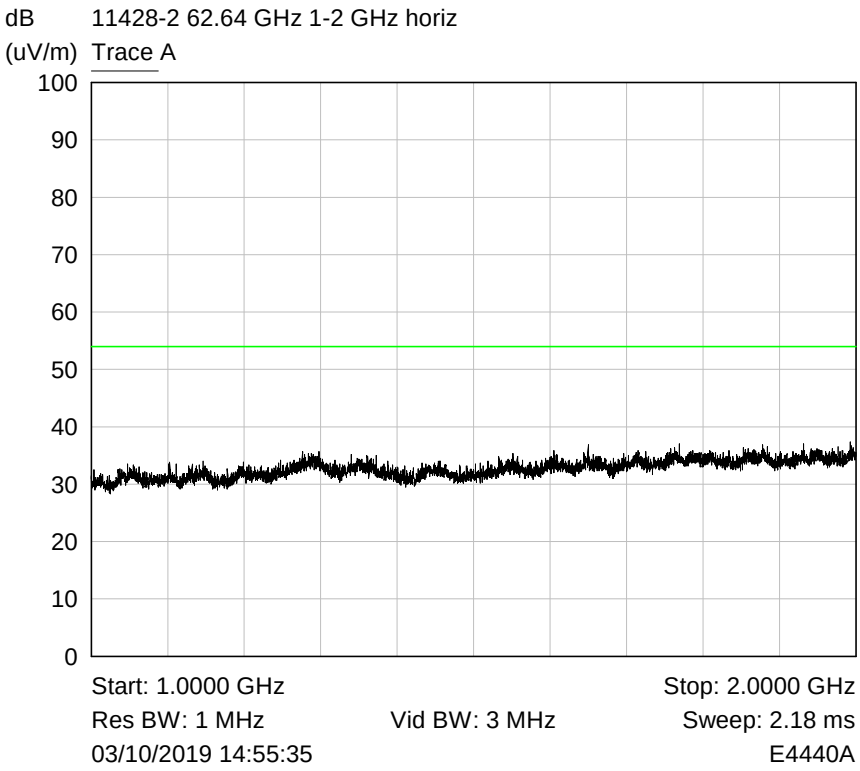


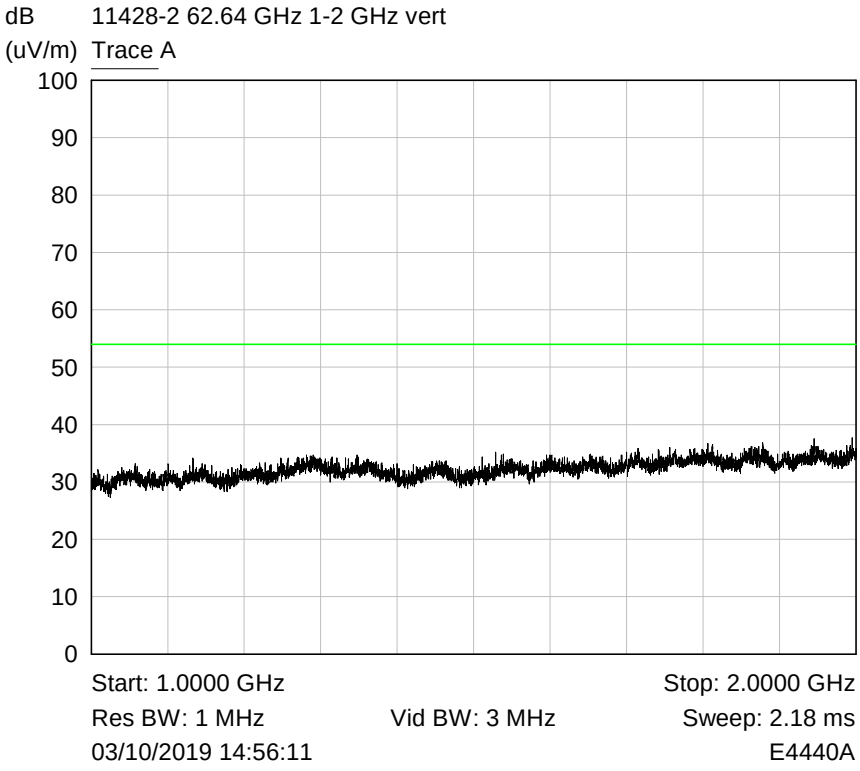
Plot of peak emissions for UHF Vertical against the QP limit line

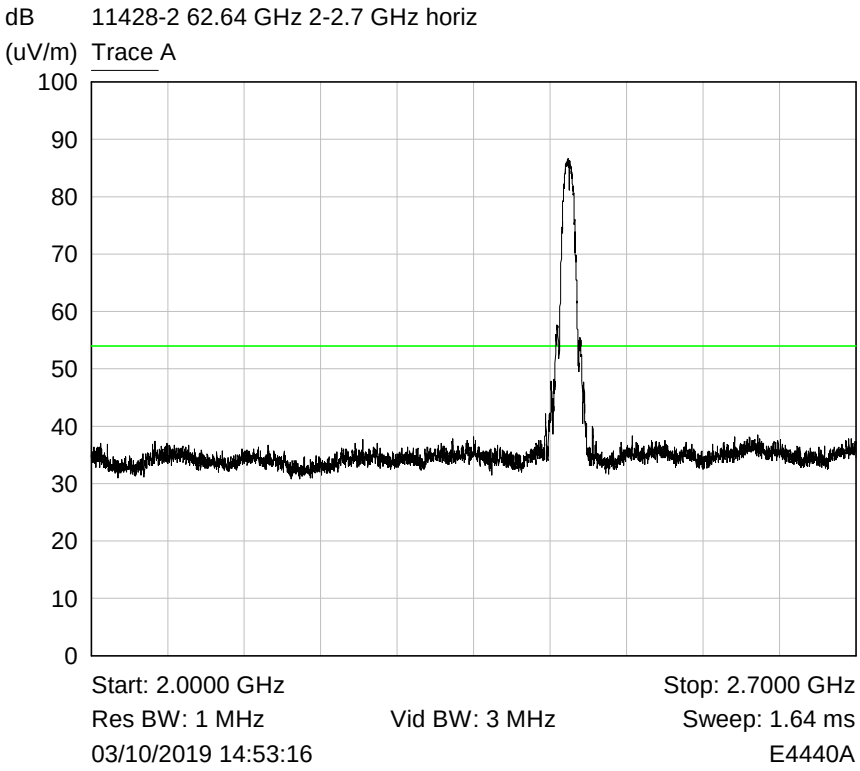
6.4 Radiated emissions above 1 GHz

RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS12, Channel 62.64 GHz

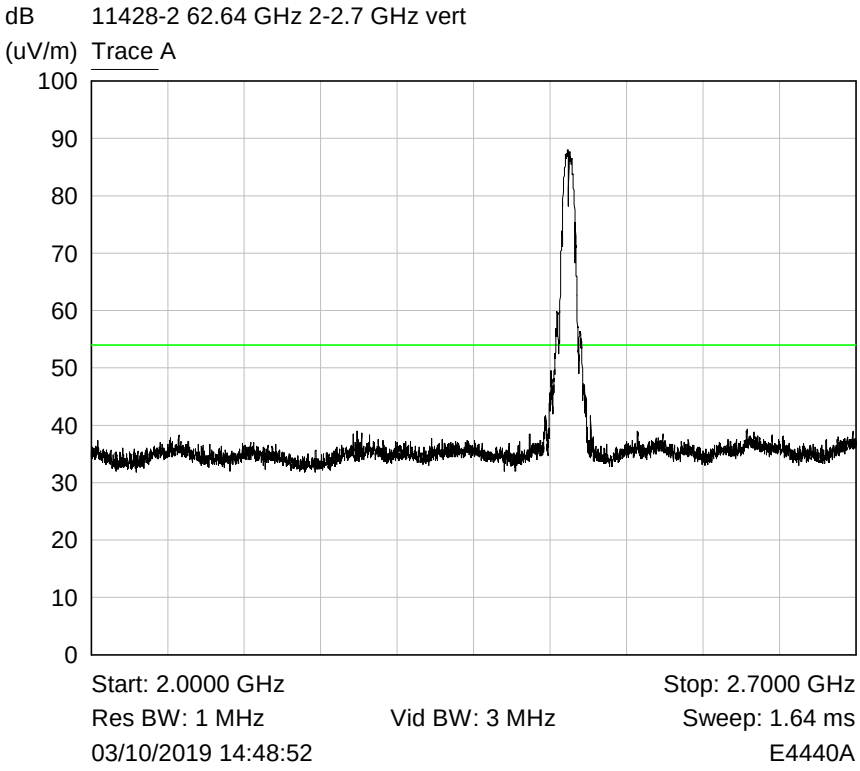
Note: plots shown are peak detector “max held “ plots against the average limit line.



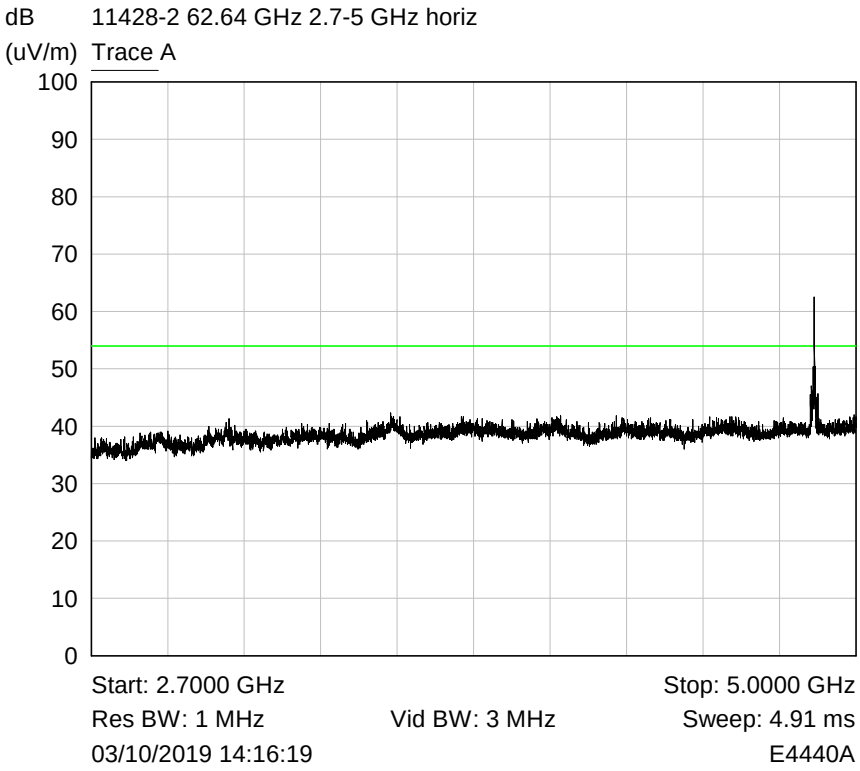


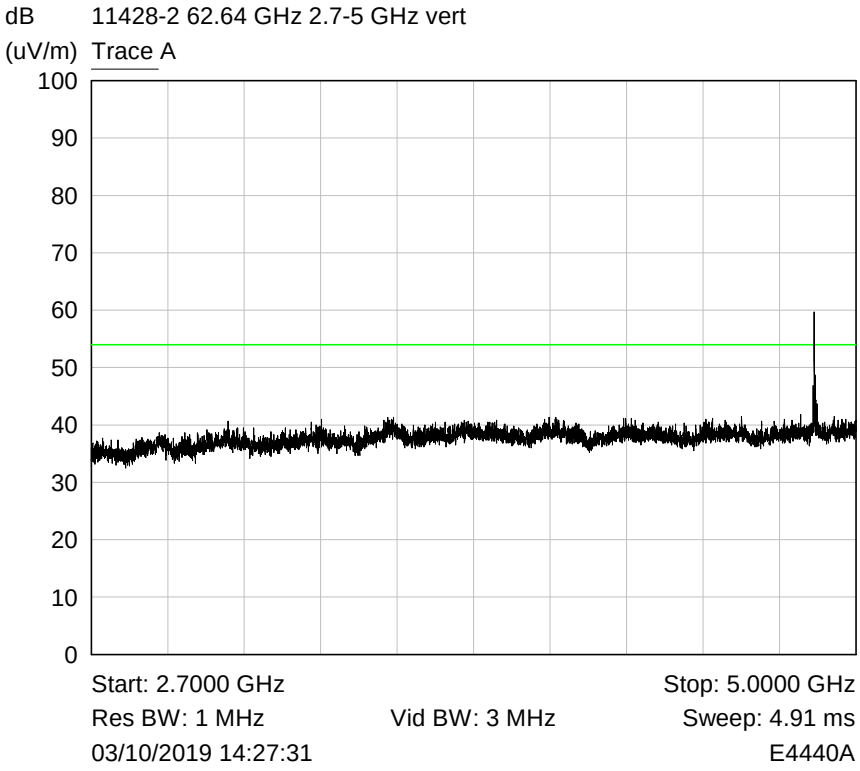


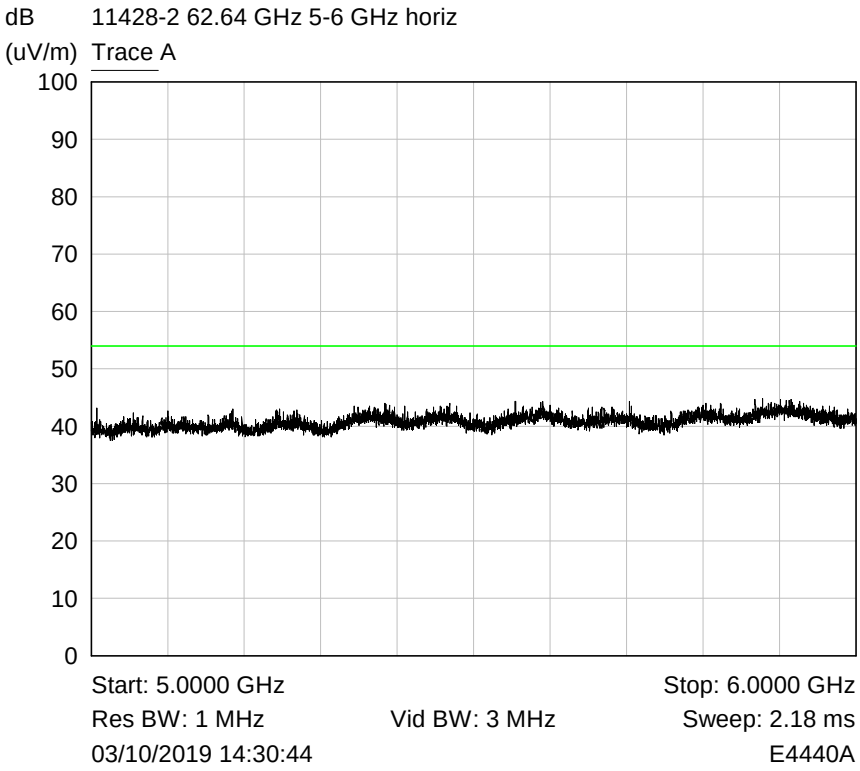
Plot shows intentional WiFi transmission on 2437 MHz.

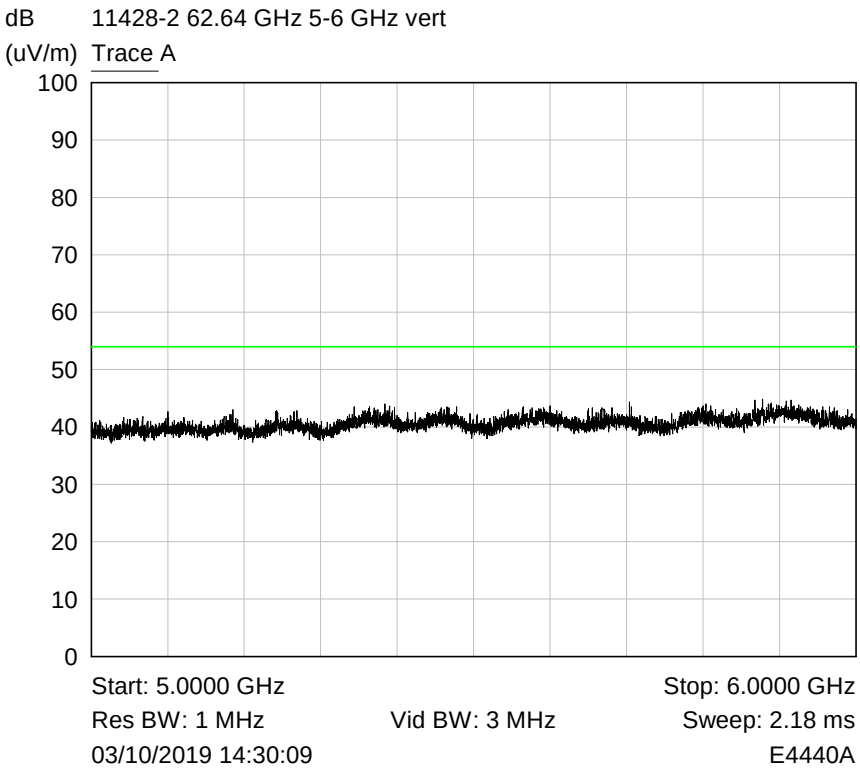


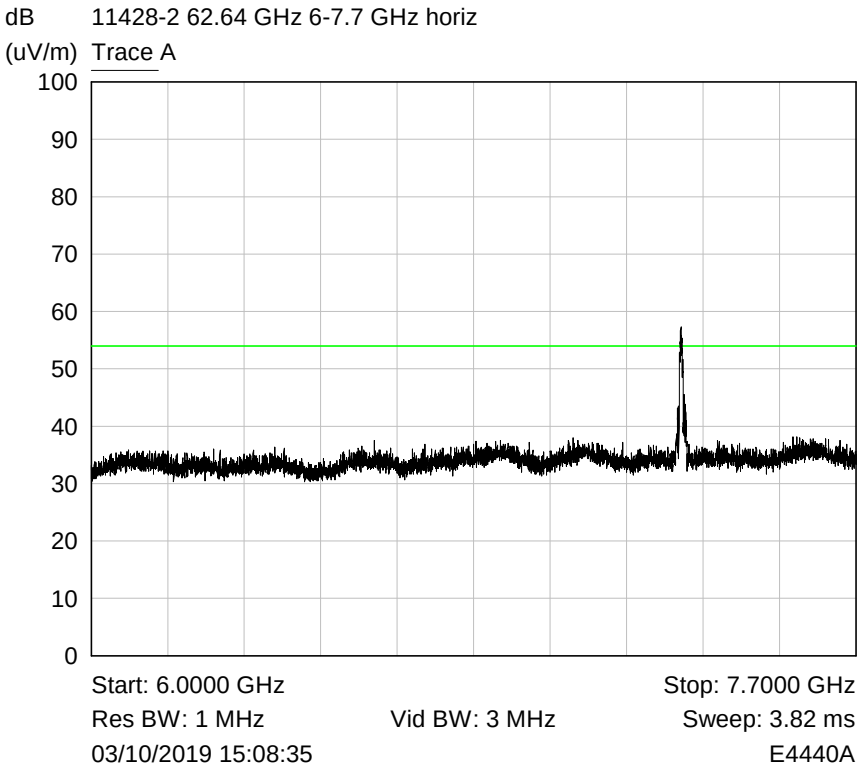
Plot shows intentional WiFi transmission on 2437 MHz.

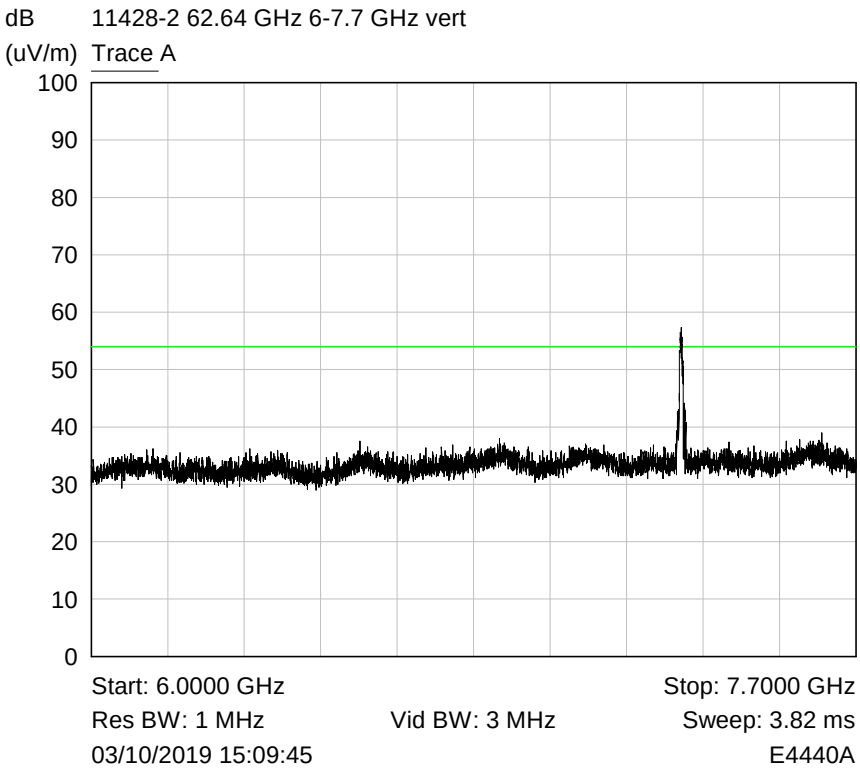


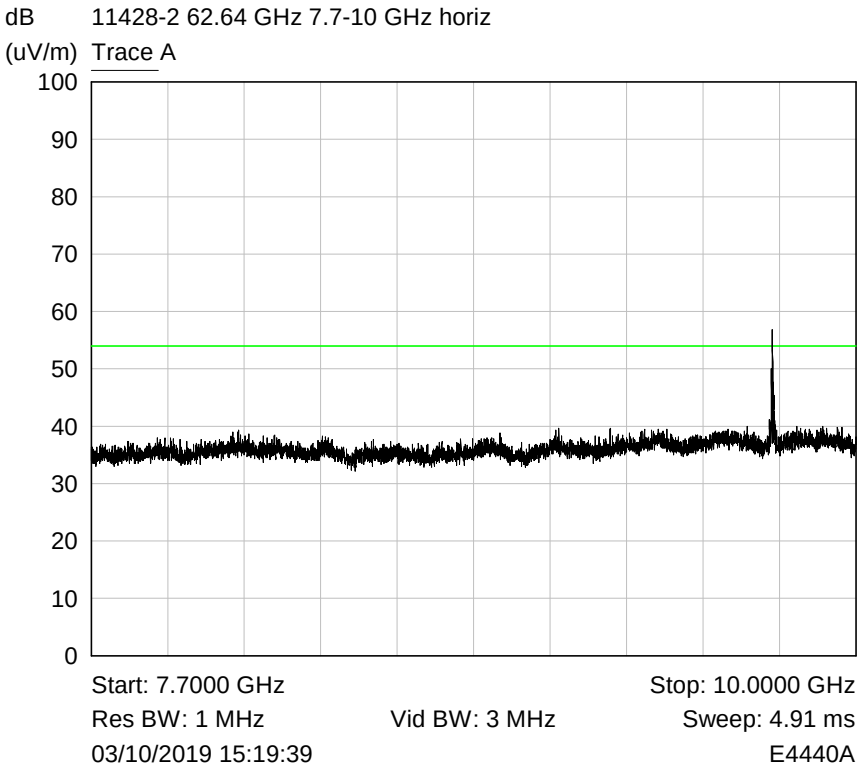


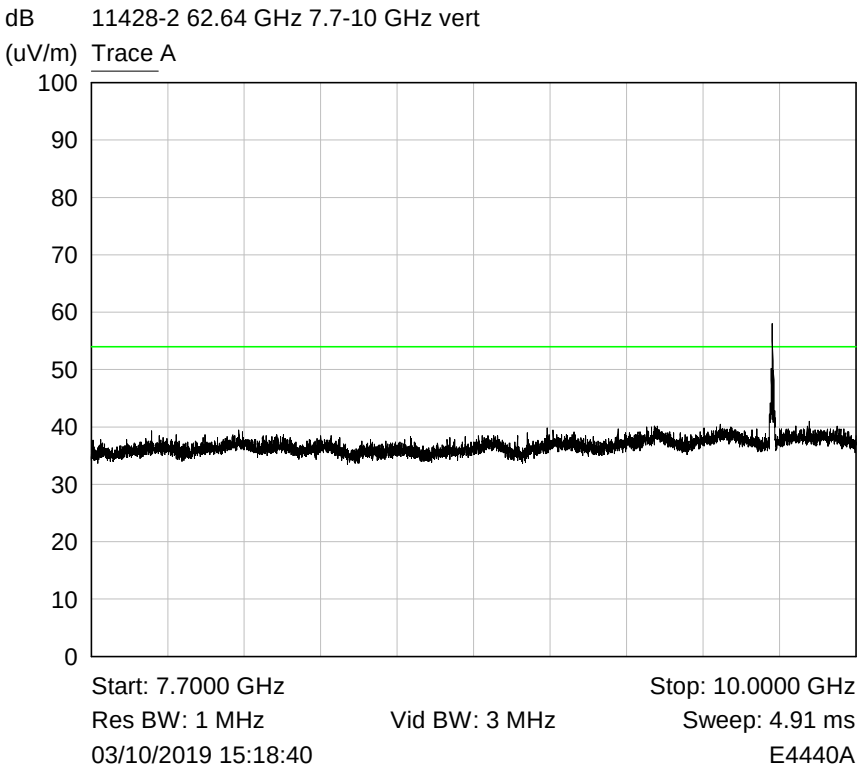


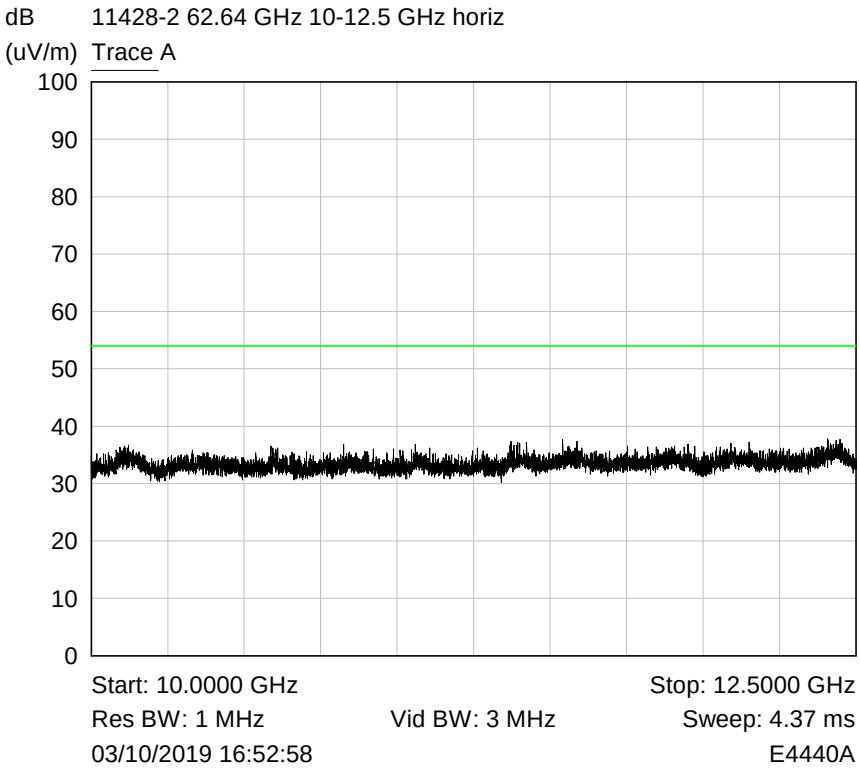


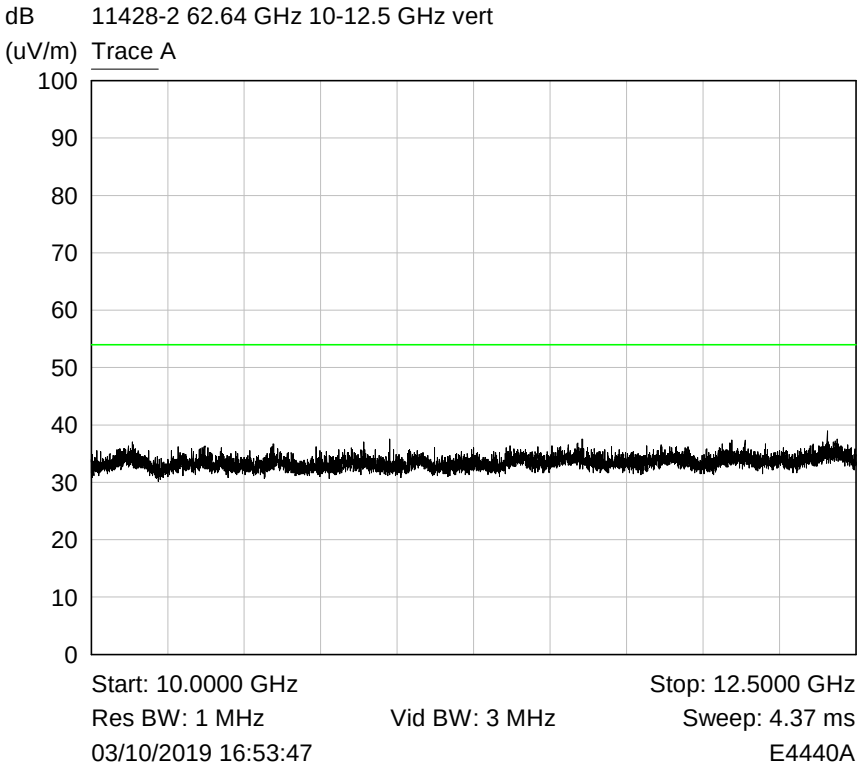


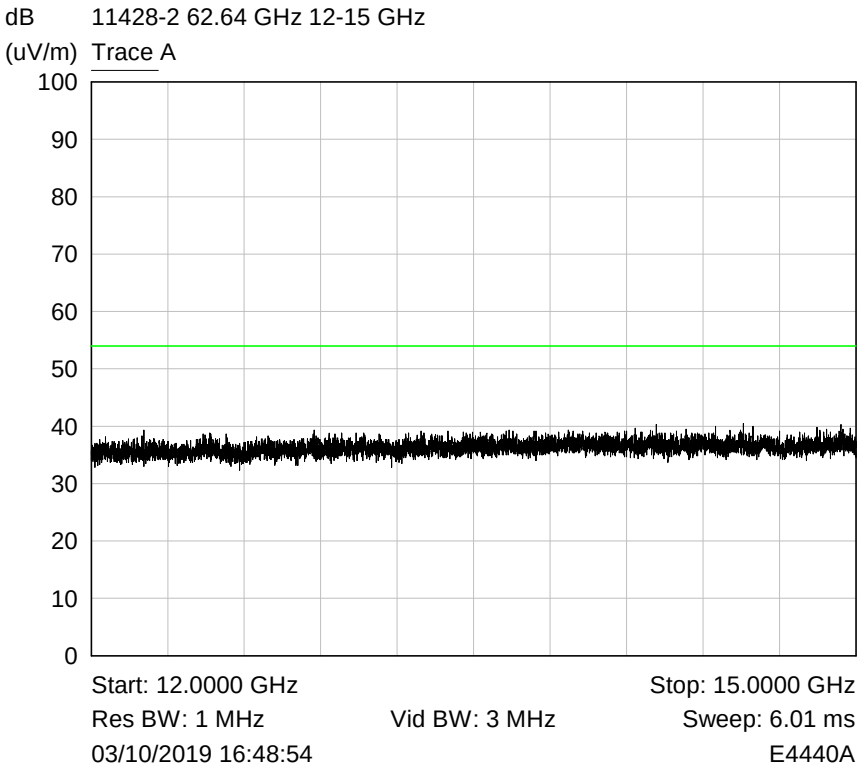


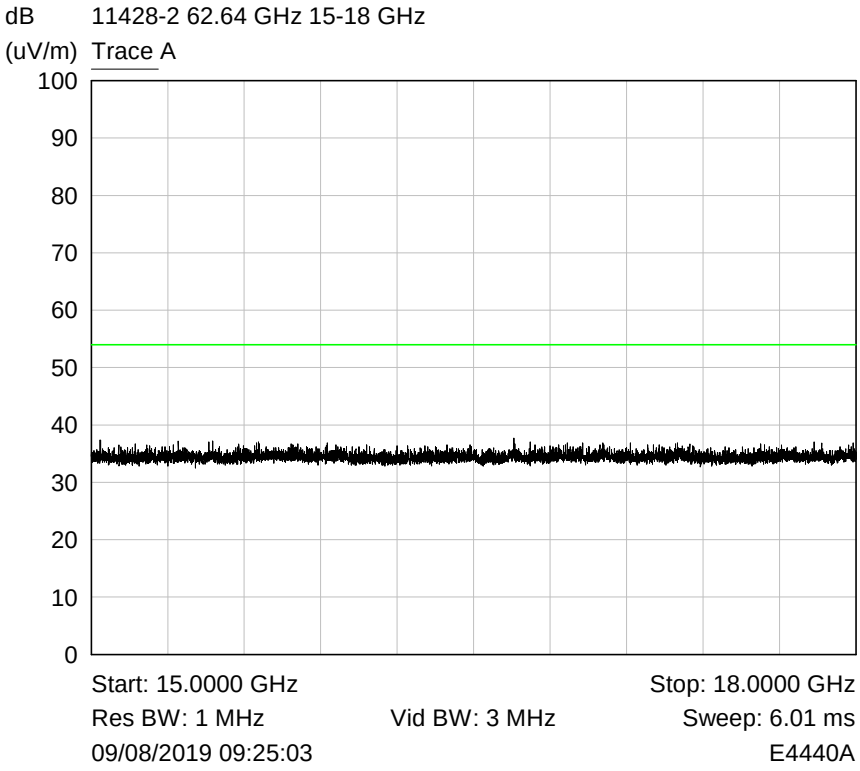


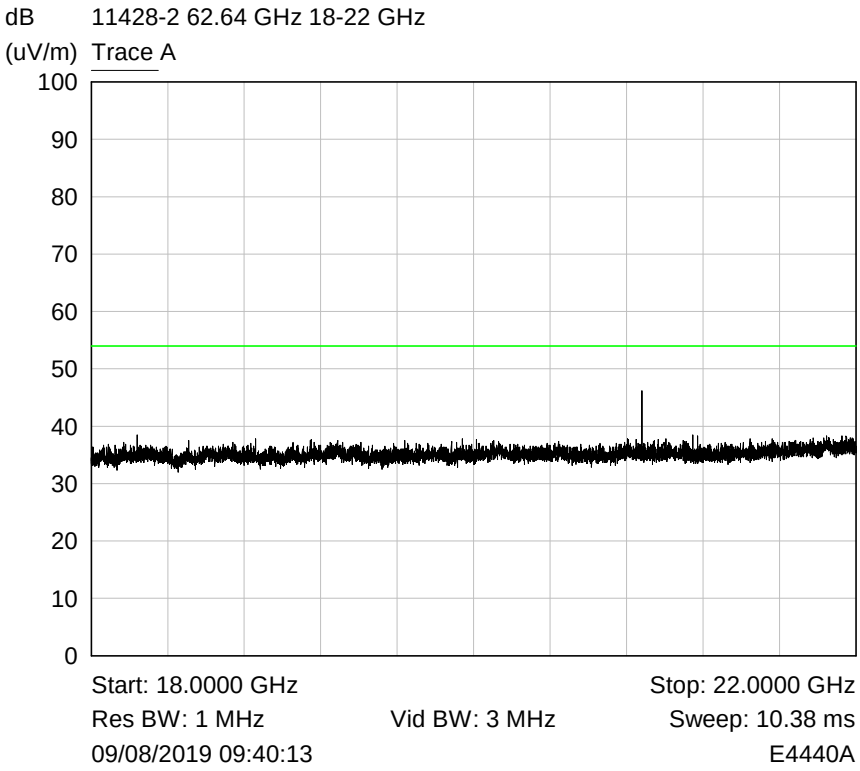


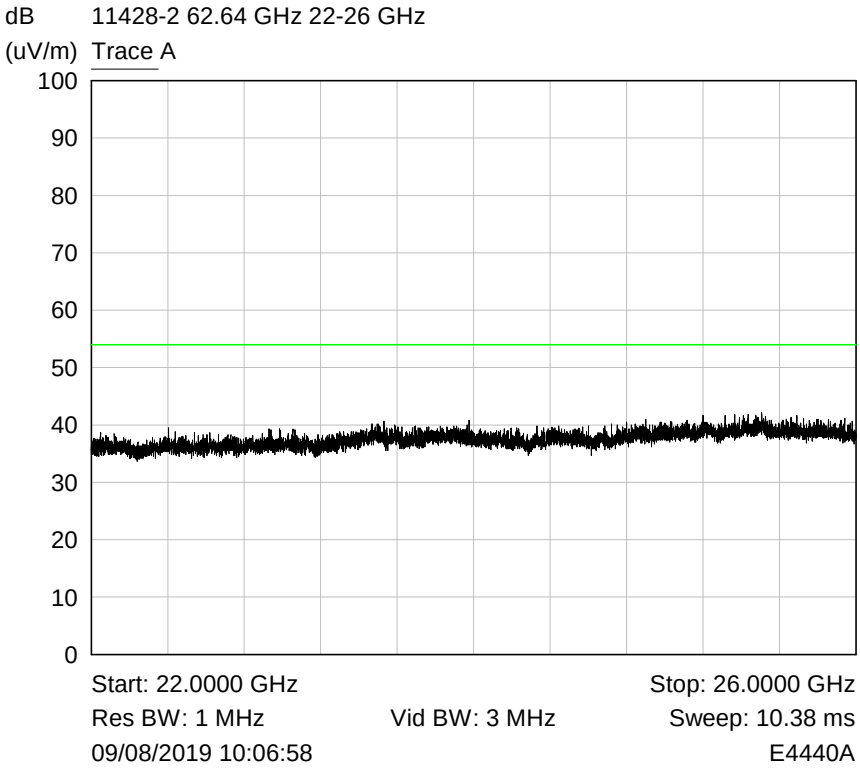


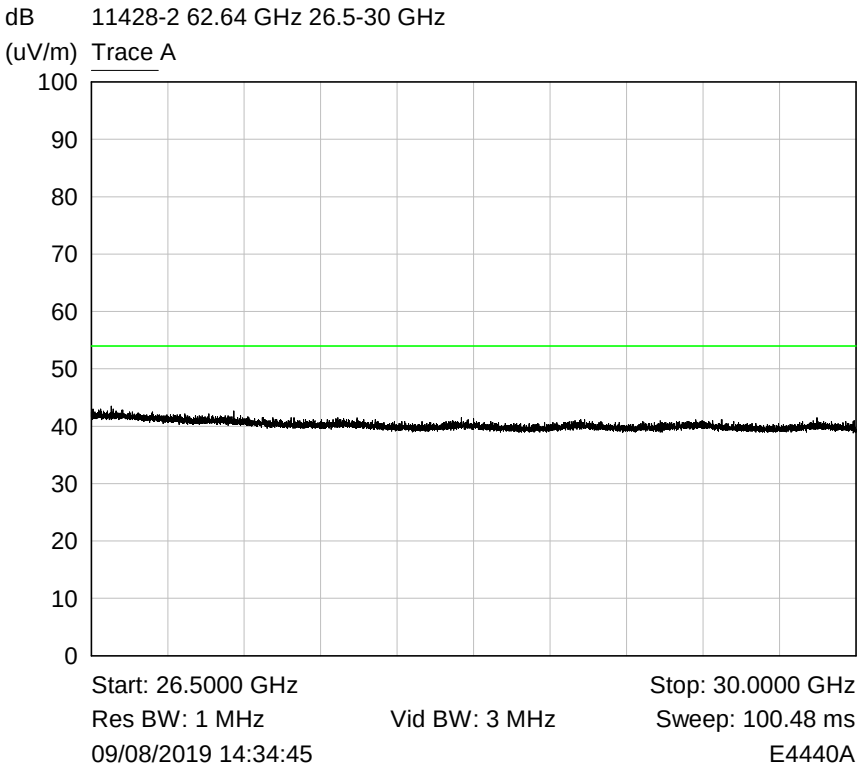


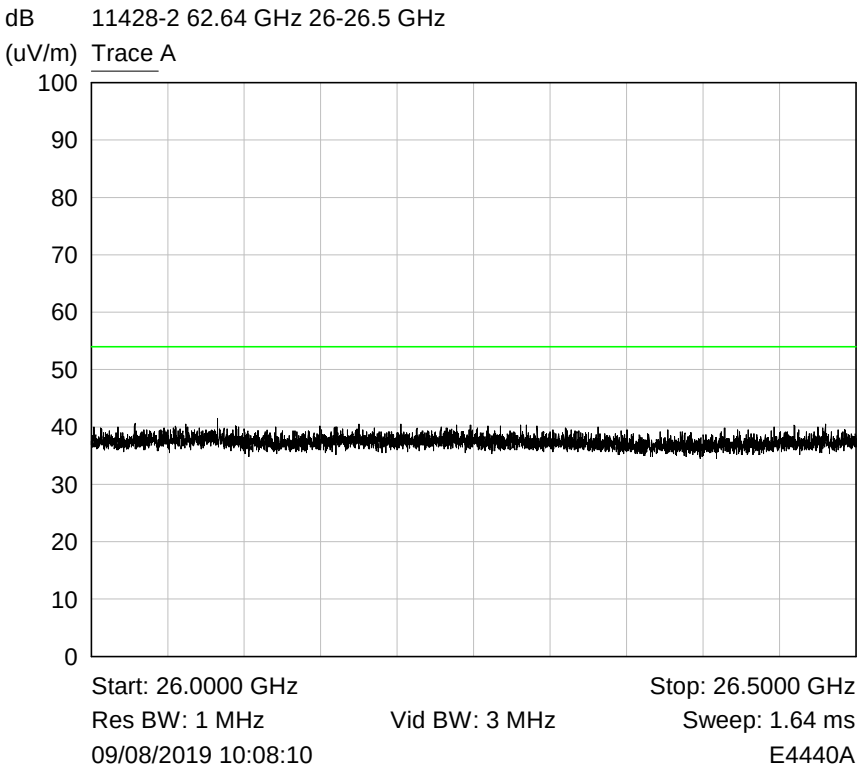


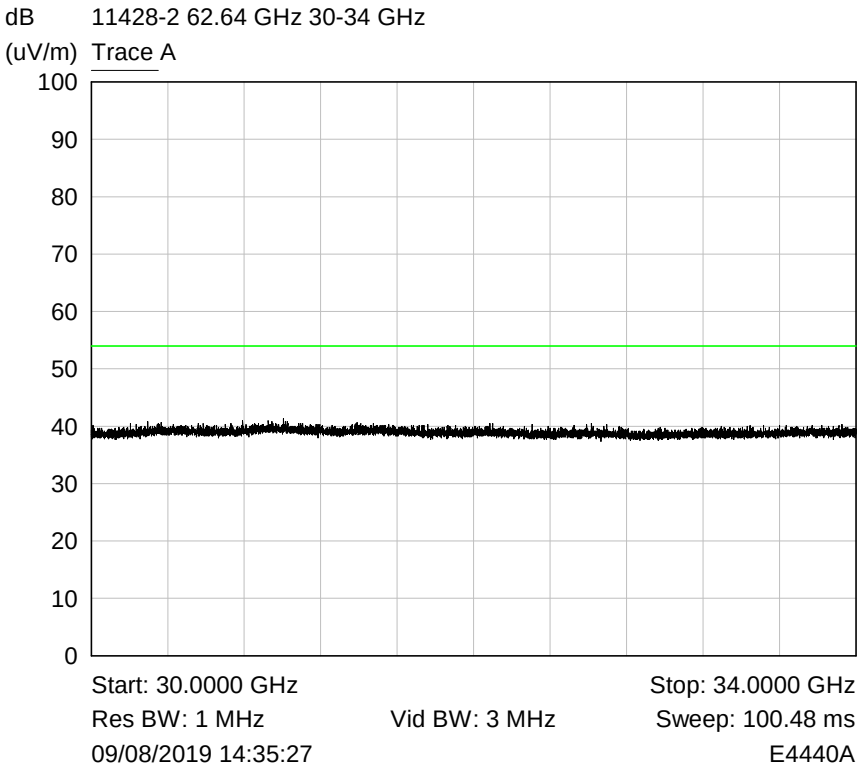


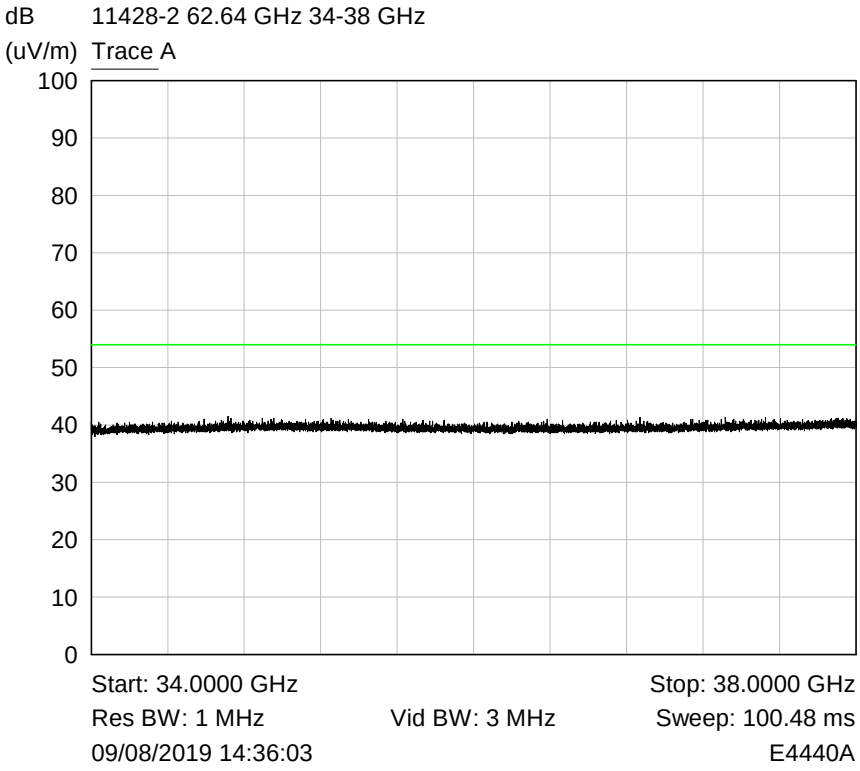


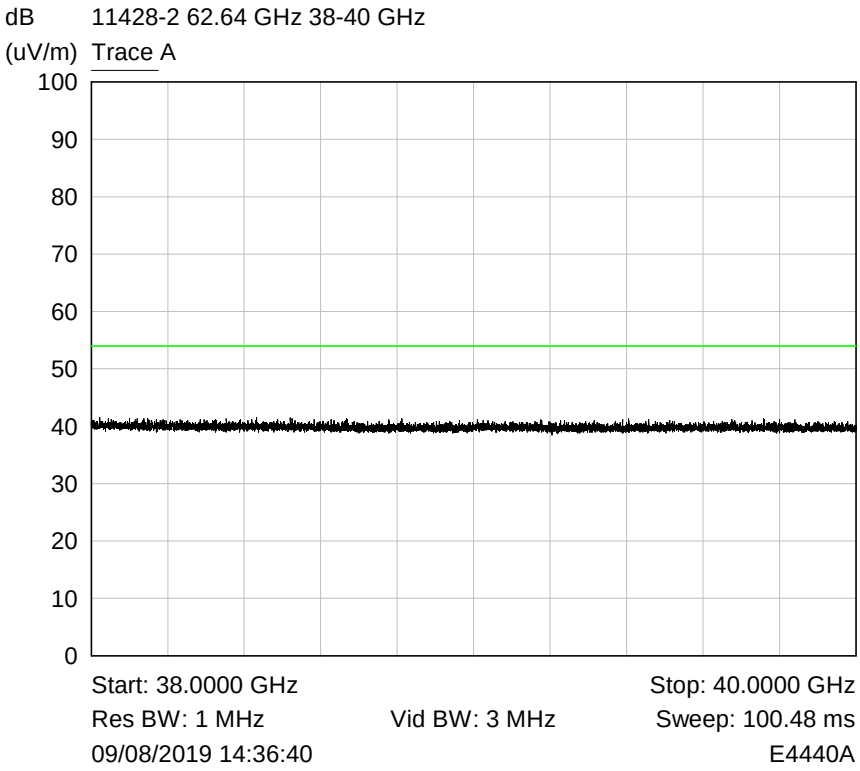


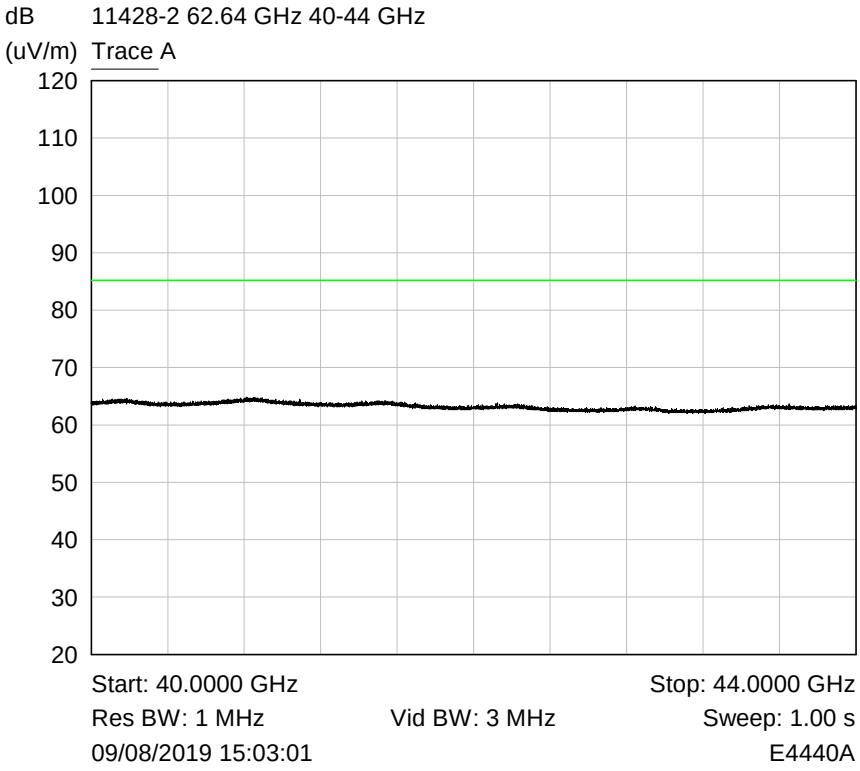


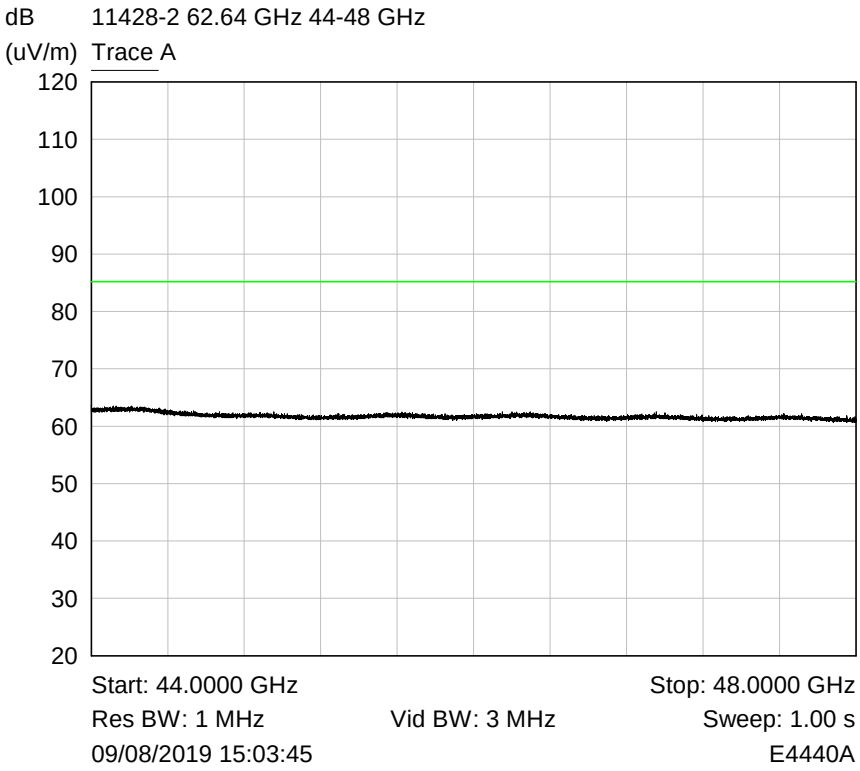


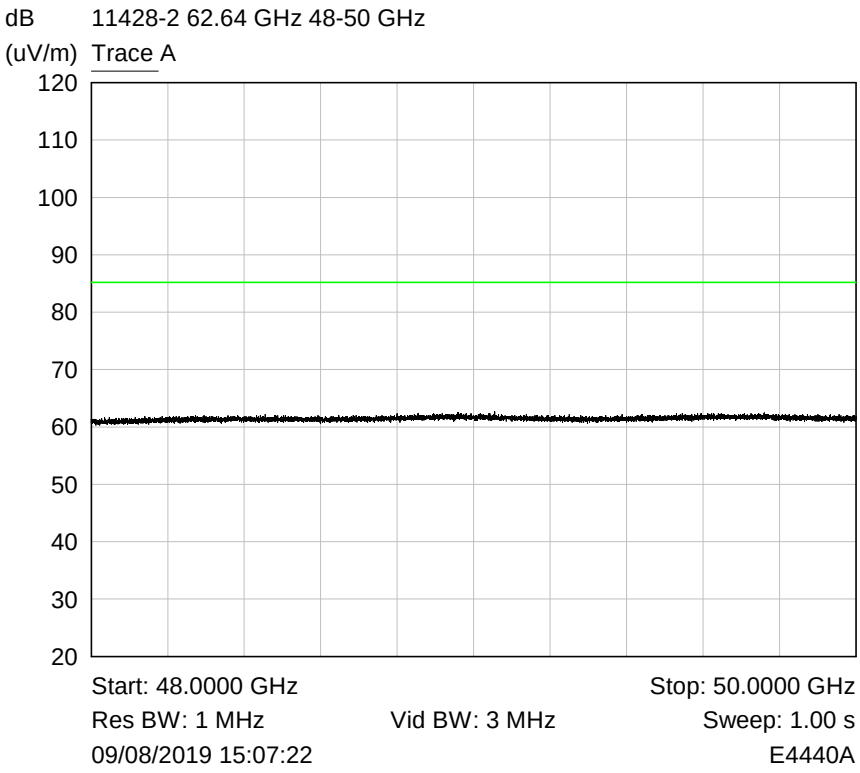


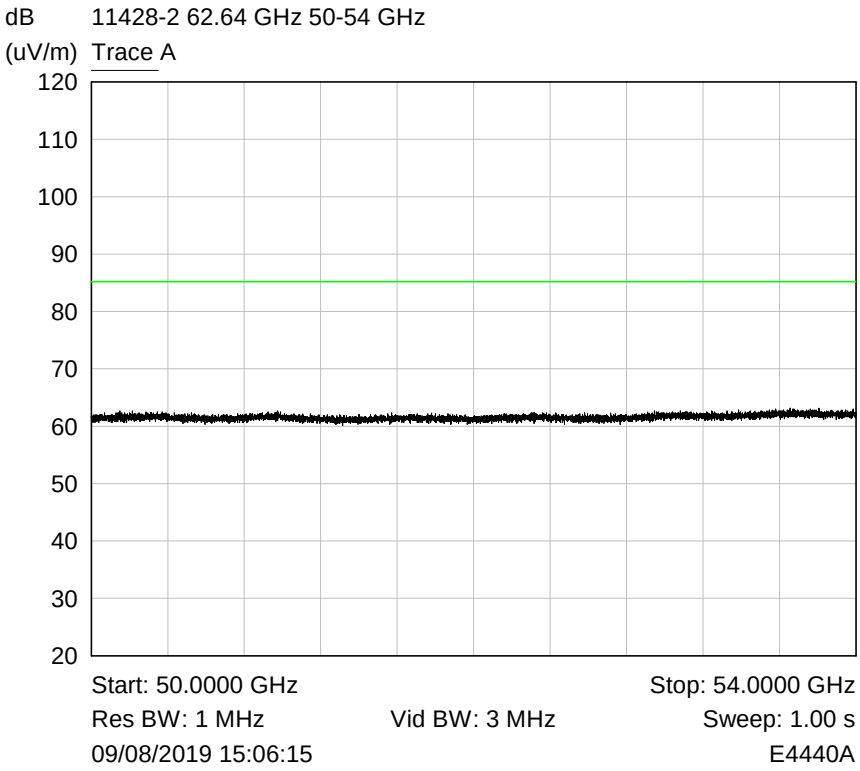


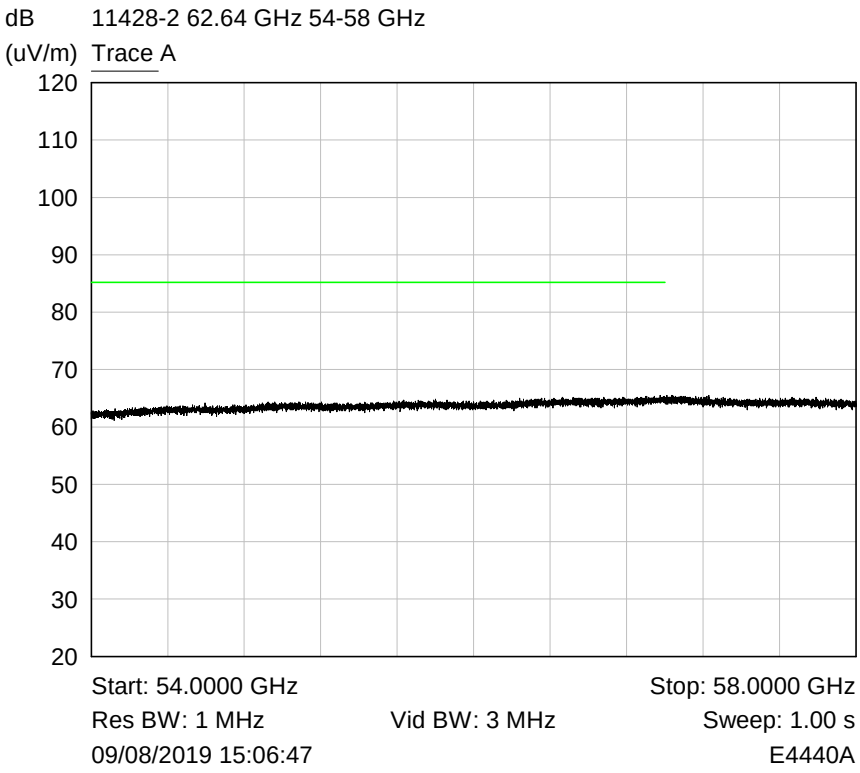


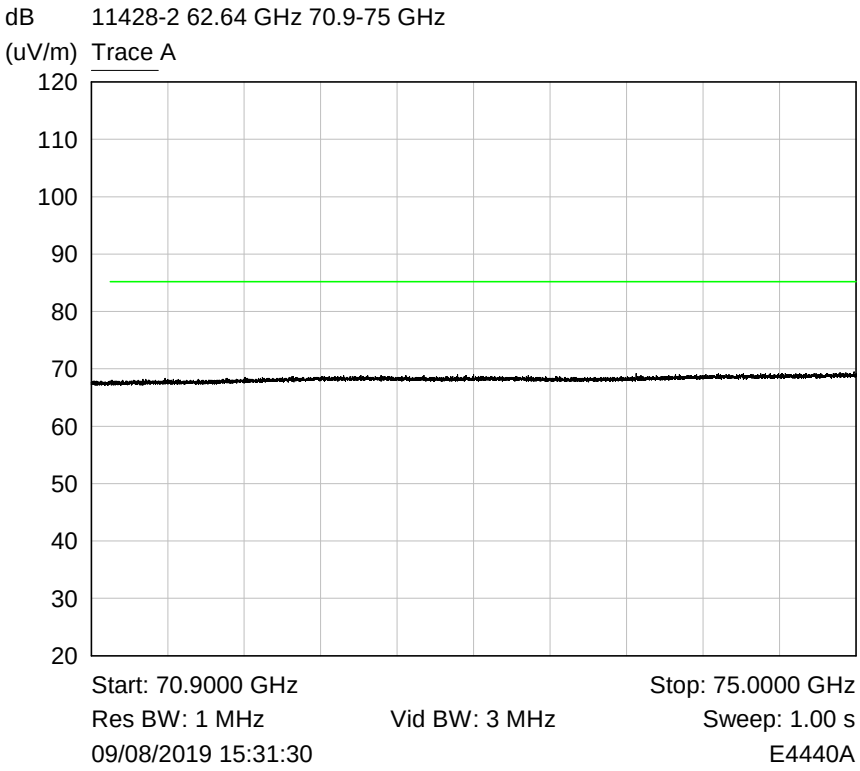


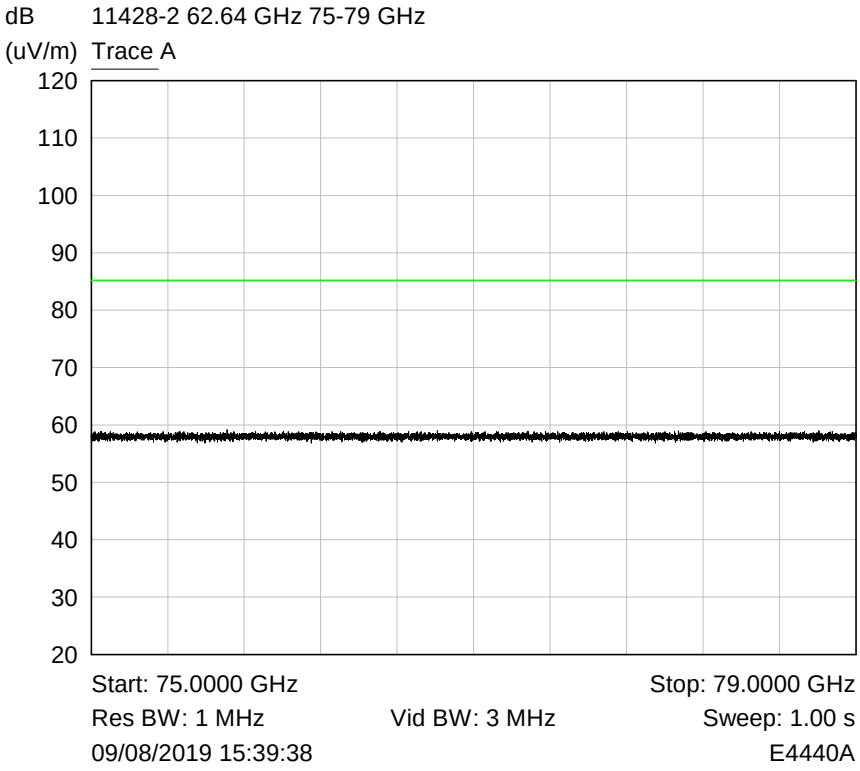


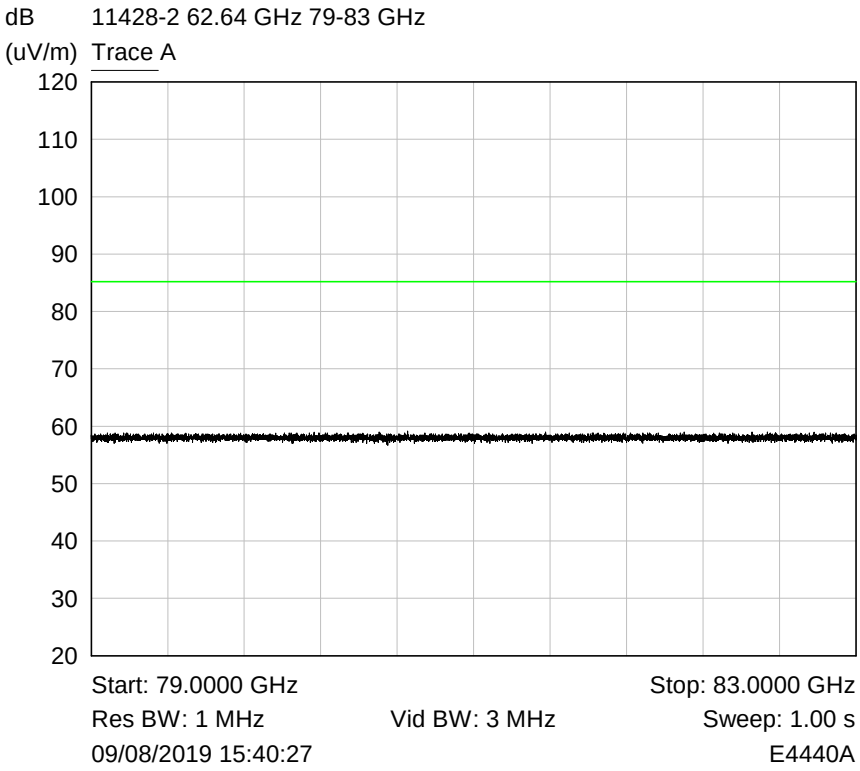


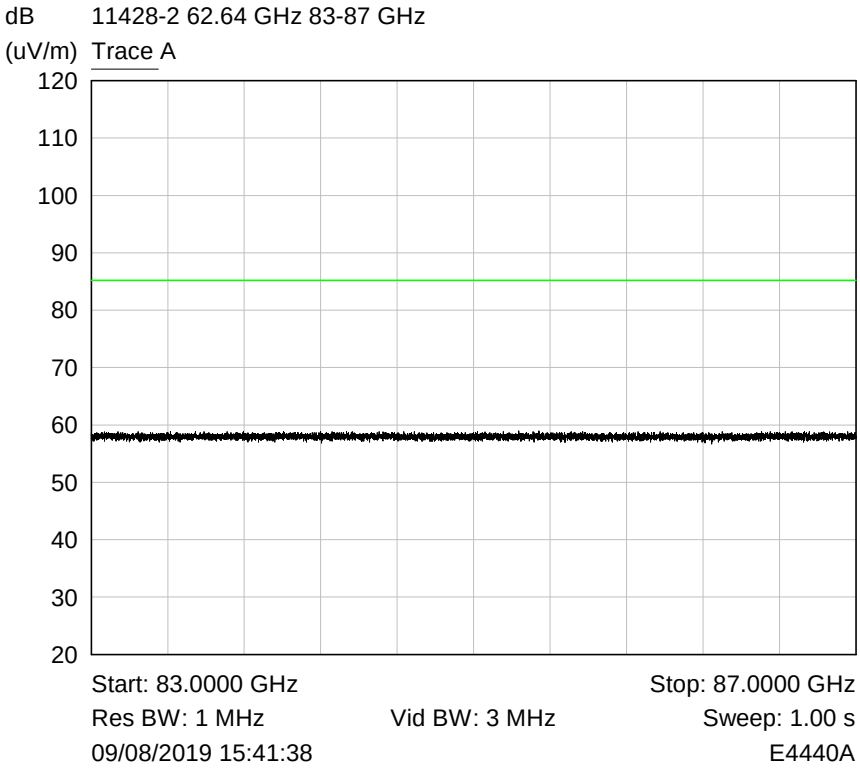


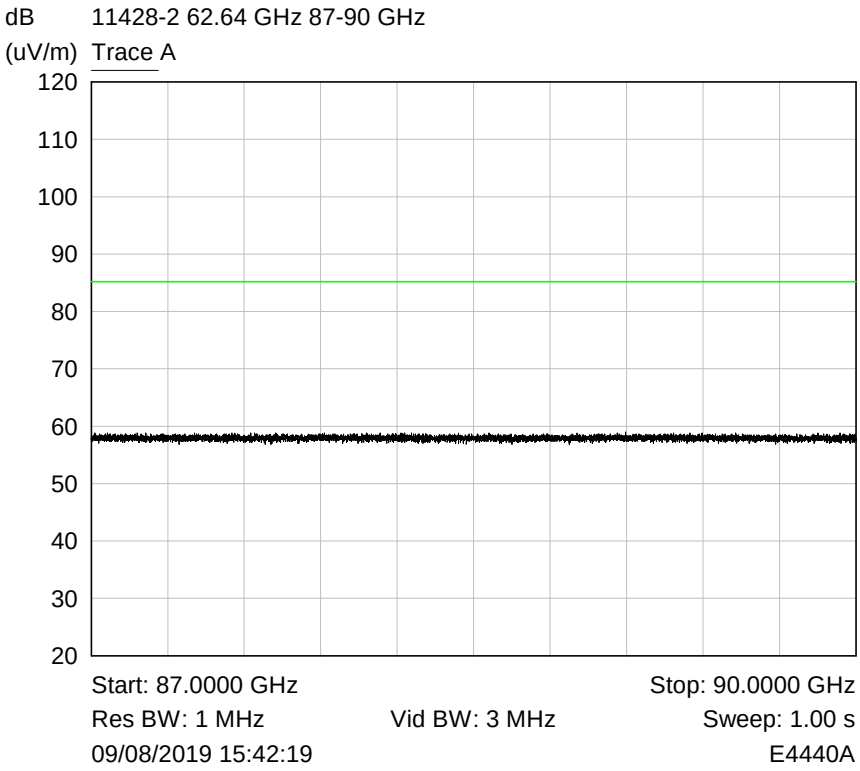


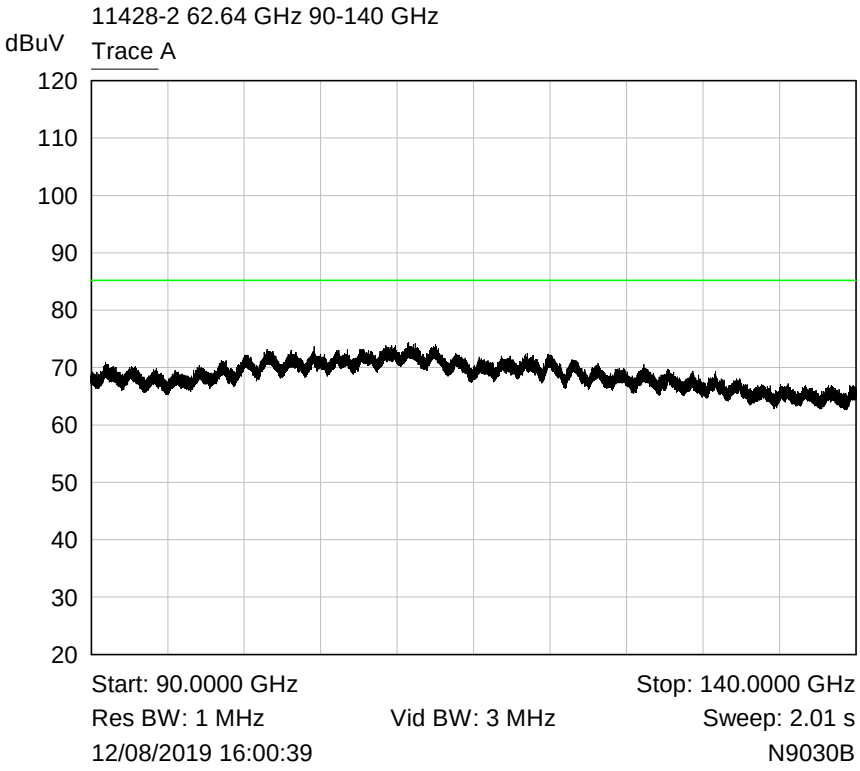


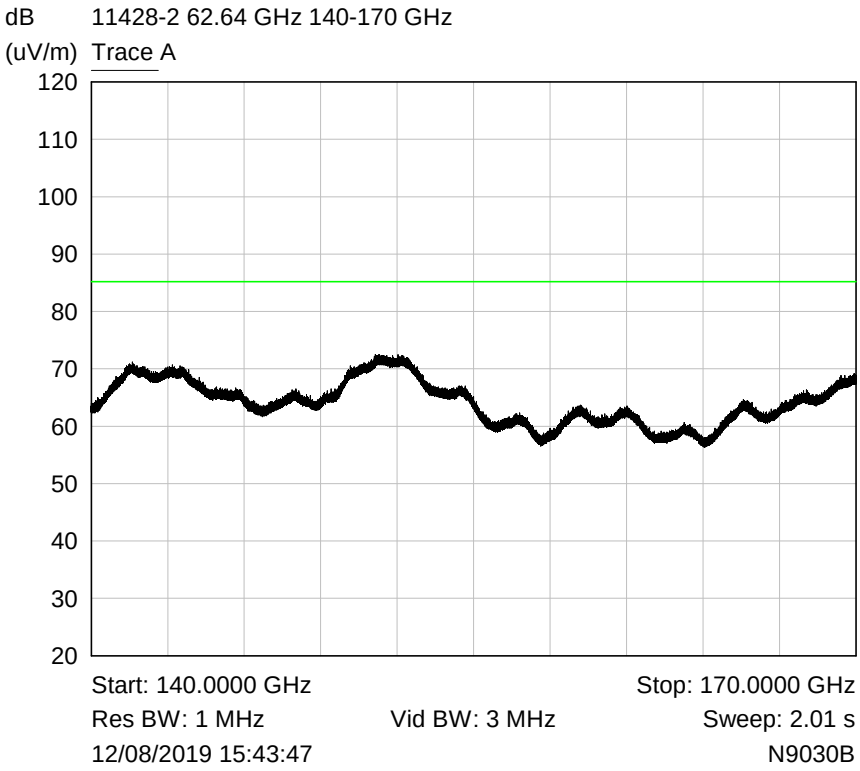


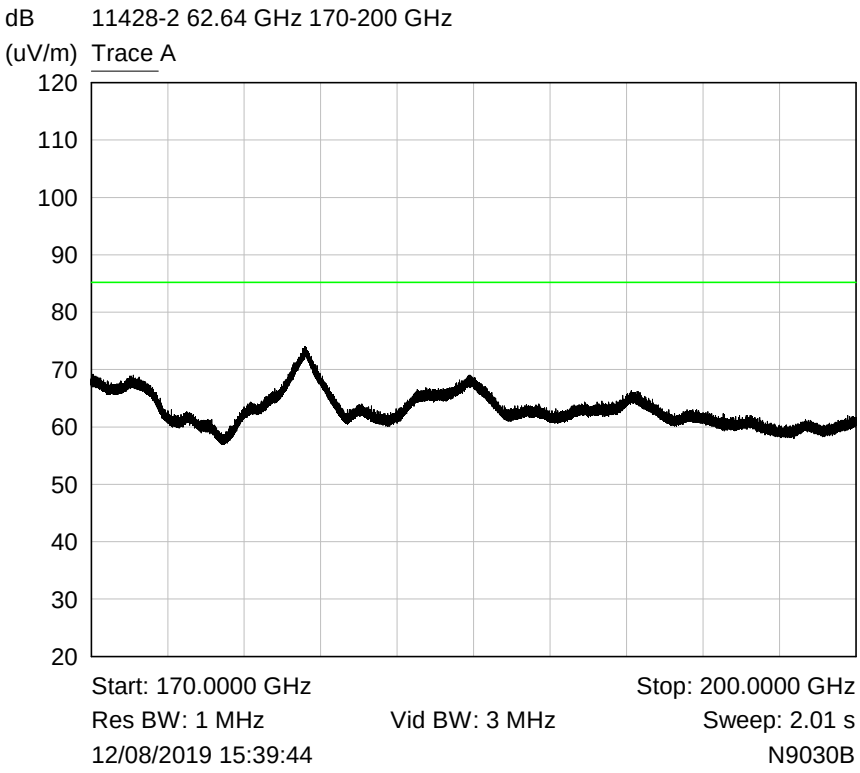






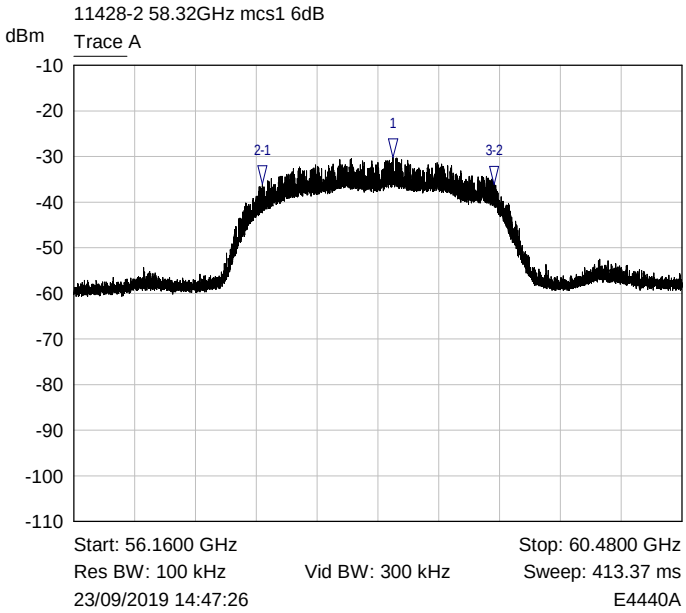






6.5 6dB Occupied bandwidth

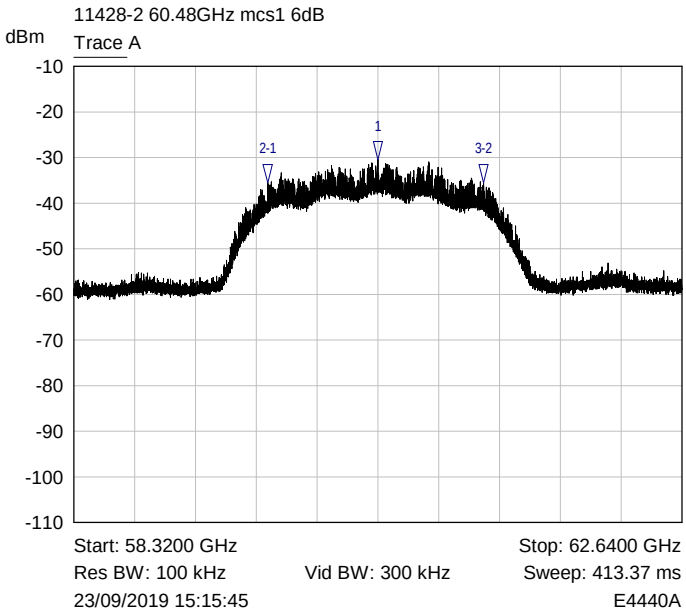
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS1, Channel 58.32 GHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	58.4300 GHz	-30.25 dBm	
2-1 ▽	Trace A	-928.2383 MHz	-5.69 dB	
3-2 ▽	Trace A	1.6434 GHz	-0.20 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

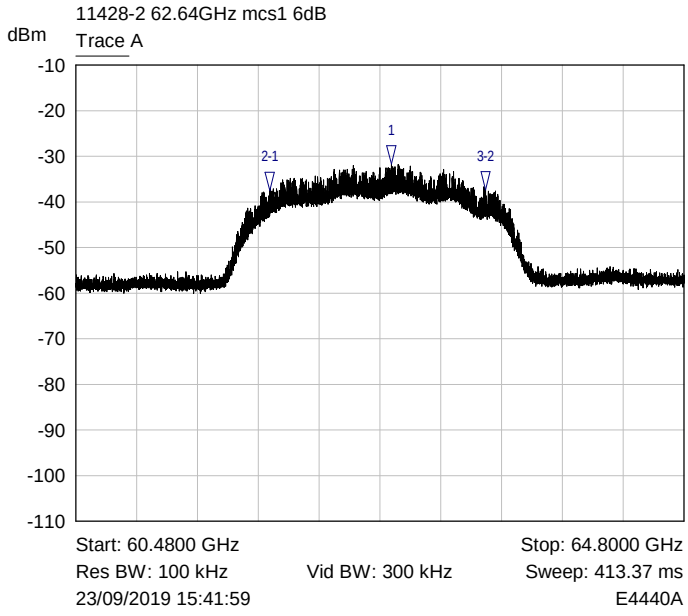
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS1, Channel 60.48 GHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	60.4797 GHz	-30.49 dBm	
2-1 ▽	Trace A	-783.7285 MHz	-4.96 dB	
3-2 ▽	Trace A	1.5369 GHz	-0.09 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

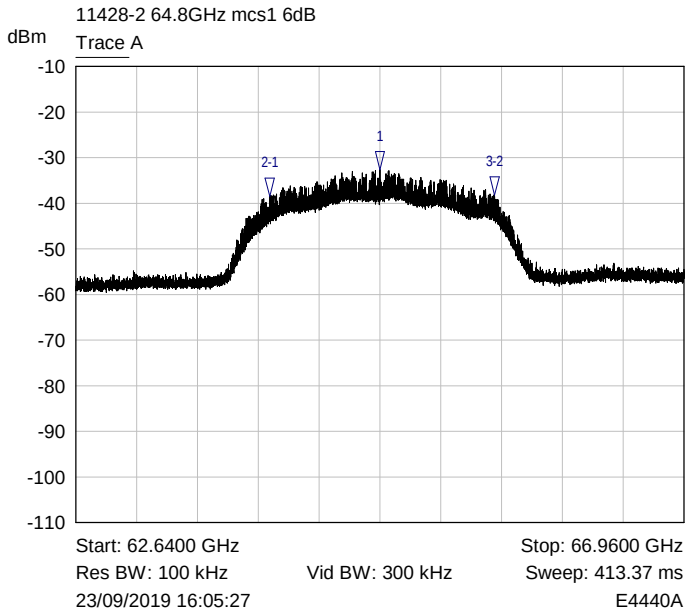
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS1, Channel 62.64 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	62.7220 GHz	-31.63 dBm	
2-1	Trace A	-866.0042 MHz	-5.94 dB	
3-2	Trace A	1.5332 GHz	0.19 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

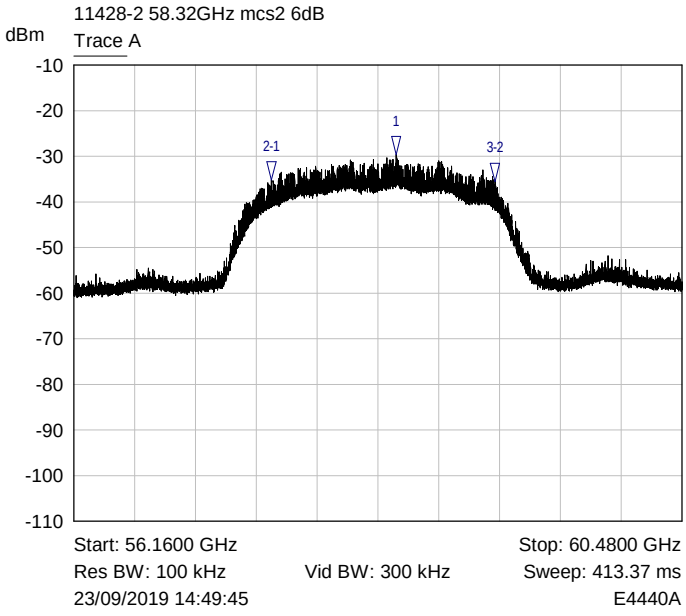
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS1, Channel 64.8 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	64.7997 GHz	-32.62 dBm	
2-1	Trace A	-783.7285 MHz	-5.92 dB	
3-2	Trace A	1.6017 GHz	0.41 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

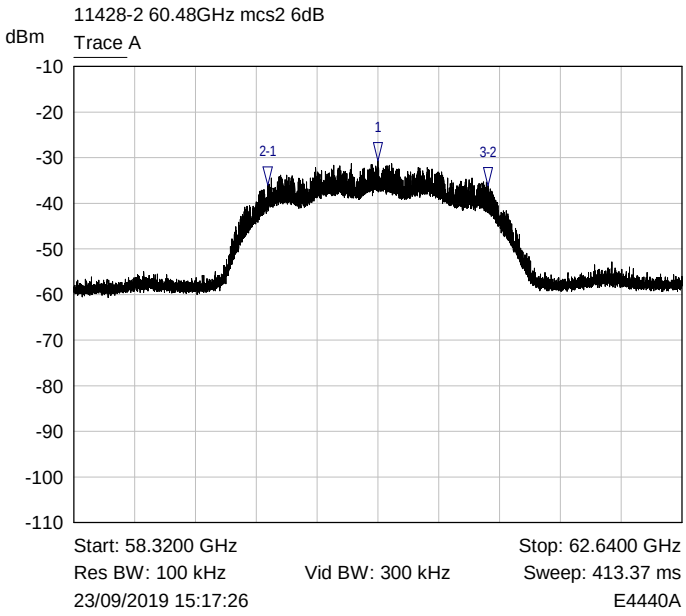
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS2, Channel 58.32 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	58.4505 GHz	-29.59 dBm	
2-1	Trace A	-887.1005 MHz	-5.65 dB	
3-2	Trace A	1.5886 GHz	-0.20 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

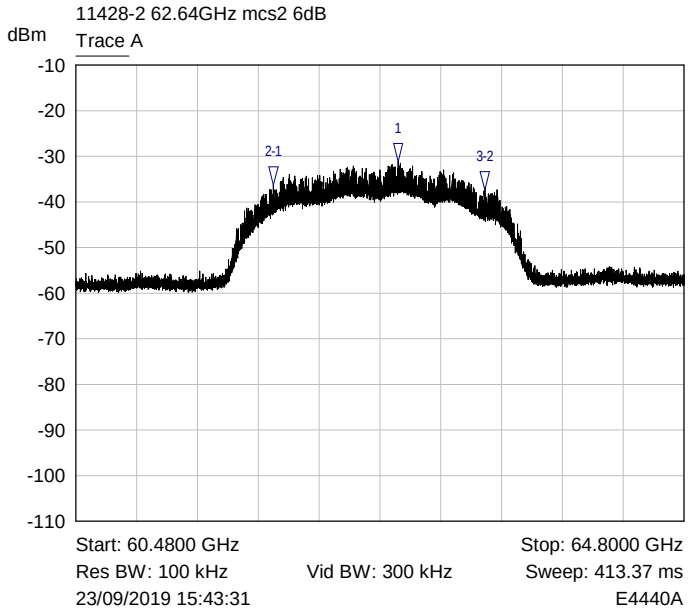
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS2, Channel 60.48 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	60.4797 GHz	-30.74 dBm	
2-1	Trace A	-783.7285 MHz	-5.27 dB	
3-2	Trace A	1.5675 GHz	-0.09 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

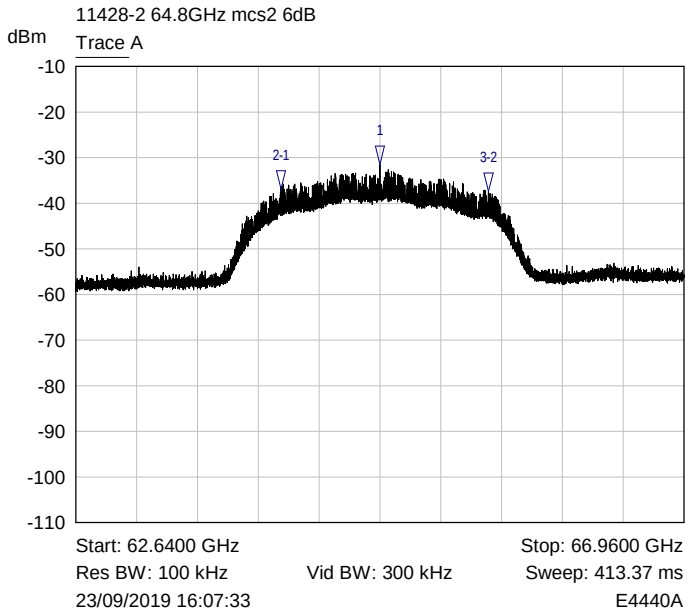
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS2, Channel 62.64 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	62.7705 GHz	-31.17 dBm	
2-1	Trace A	-887.1005 MHz	-5.12 dB	
3-2	Trace A	1.5026 GHz	-1.04 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

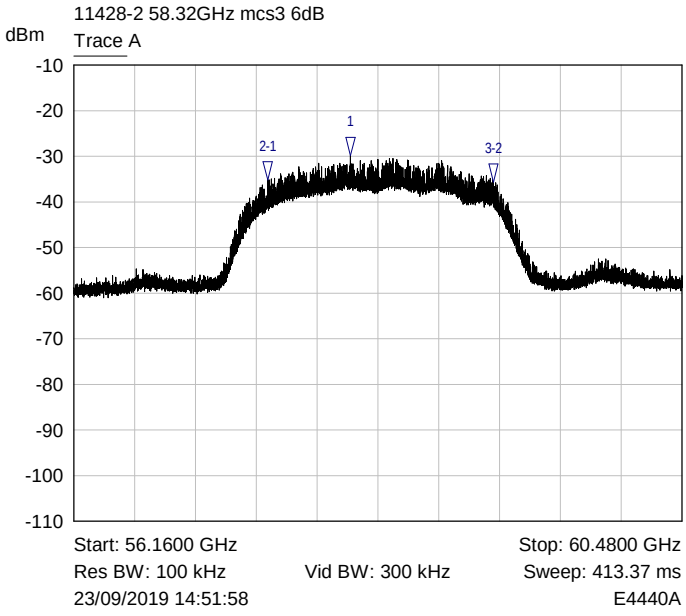
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS2, Channel 64.8 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	64.7997 GHz	-31.46 dBm	
2-1	Trace A	-701.4528 MHz	-5.38 dB	
3-2	Trace A	1.4720 GHz	-0.54 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

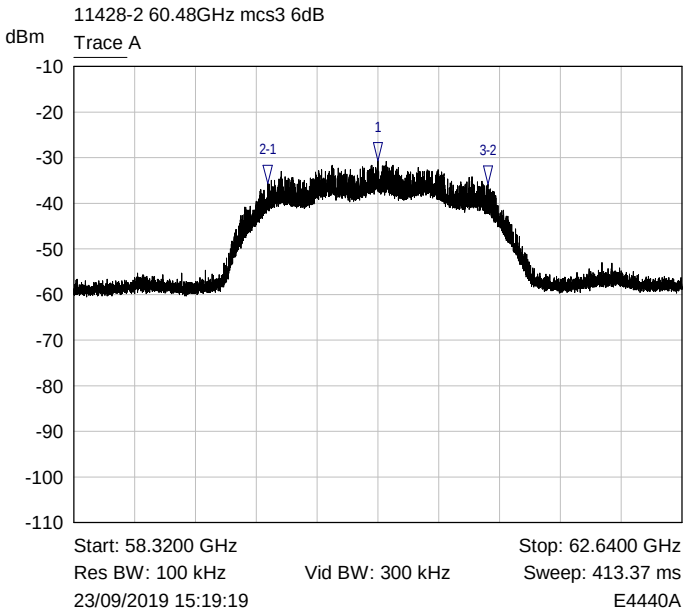
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS3, Channel 58.32 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	58.1241 GHz	-29.86 dBm	
2-1	Trace A	-588.0601 MHz	-5.25 dB	
3-2	Trace A	1.6054 GHz	-0.62 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

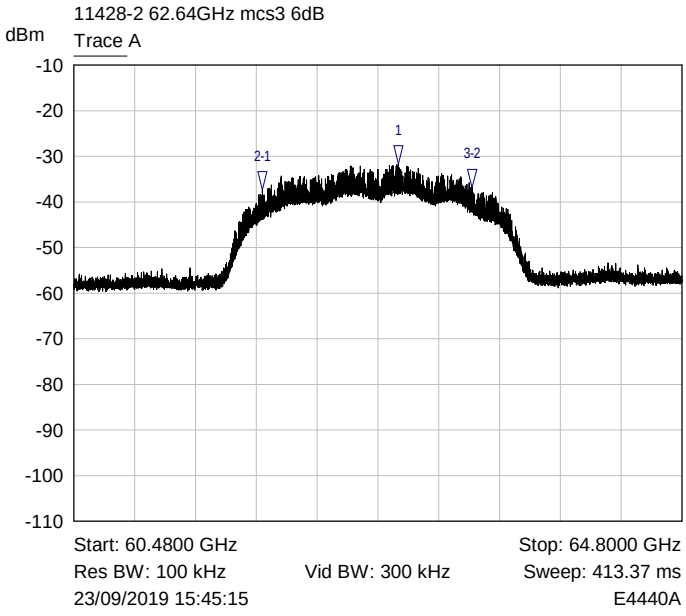
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS3, Channel 60.48 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	60.4797 GHz	-30.63 dBm	
2-1	Trace A	-783.7285 MHz	-4.96 dB	
3-2	Trace A	1.5643 GHz	-0.23 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

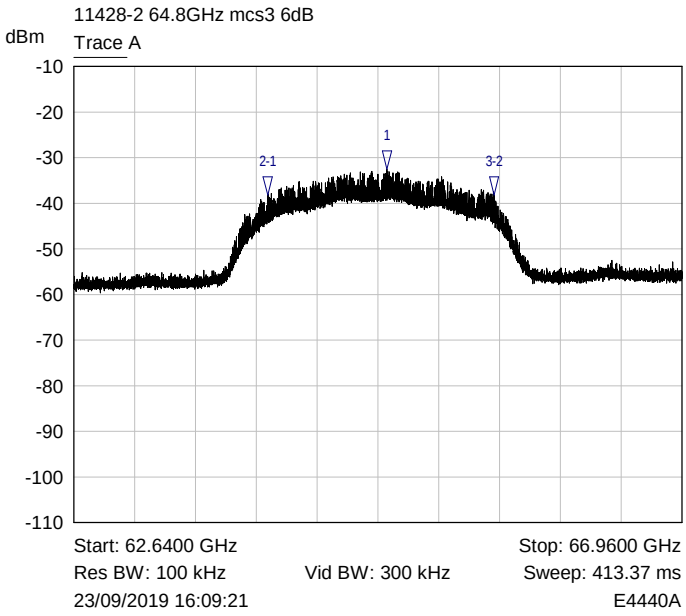
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS3, Channel 62.64 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	62.7842 GHz	-31.60 dBm	
2-1	Trace A	-966.2117 MHz	-5.81 dB	
3-2	Trace A	1.4920 GHz	0.57 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

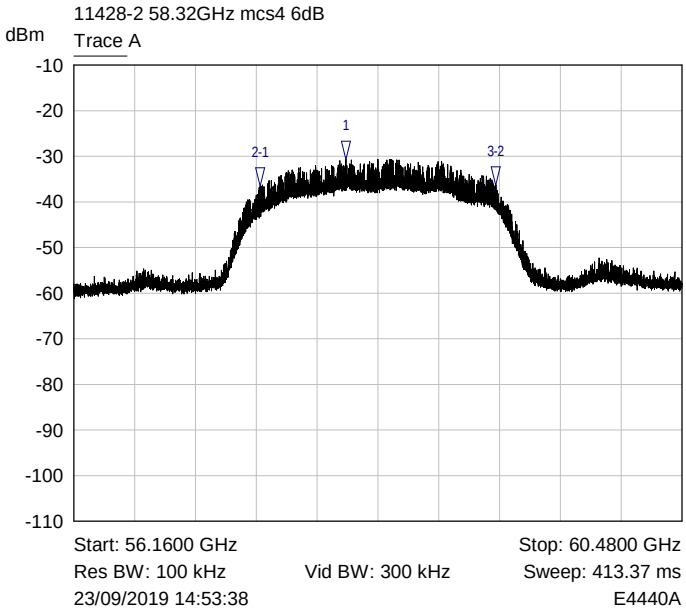
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS3, Channel 64.8 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	64.8651 GHz	-32.51 dBm	
2-1	Trace A	-849.1271 MHz	-5.59 dB	
3-2	Trace A	1.6123 GHz	-0.12 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

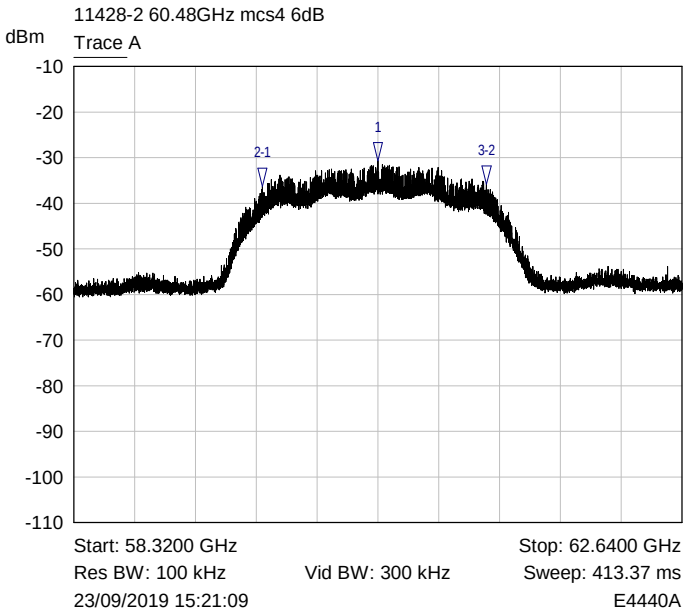
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS4, Channel 58.32 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	58.0930 GHz	-30.64 dBm	
2-1	Trace A	-611.7934 MHz	-5.85 dB	
3-2	Trace A	1.6777 GHz	0.17 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

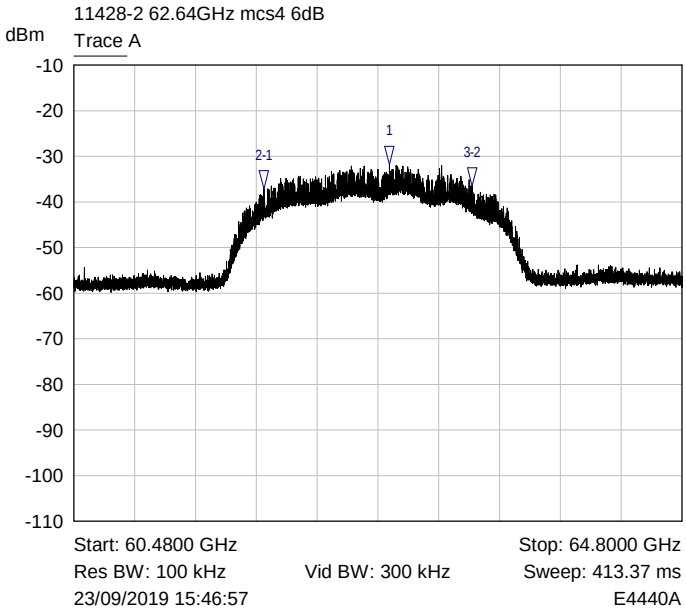
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS4, Channel 60.48 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	60.4797 GHz	-30.61 dBm	
2-1	Trace A	-821.7019 MHz	-5.80 dB	
3-2	Trace A	1.5922 GHz	0.53 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

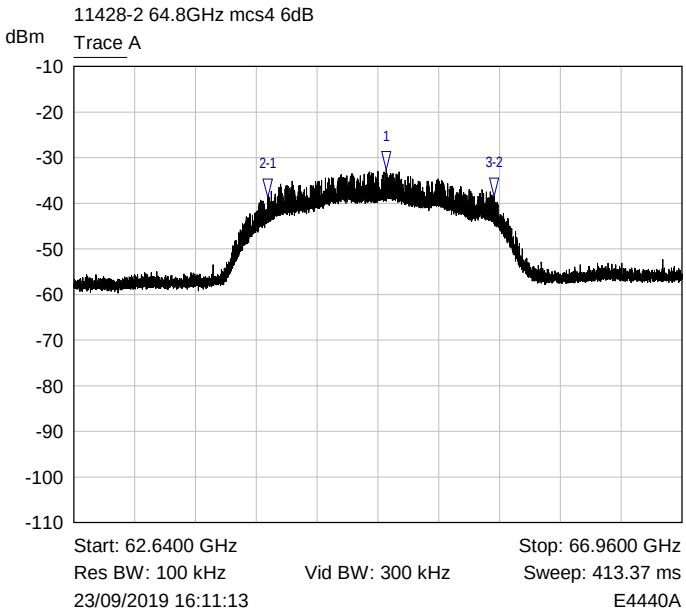
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS4, Channel 62.64 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	62.7225 GHz	-31.91 dBm	
2-1	Trace A	-893.9568 MHz	-5.25 dB	
3-2	Trace A	1.4815 GHz	0.66 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

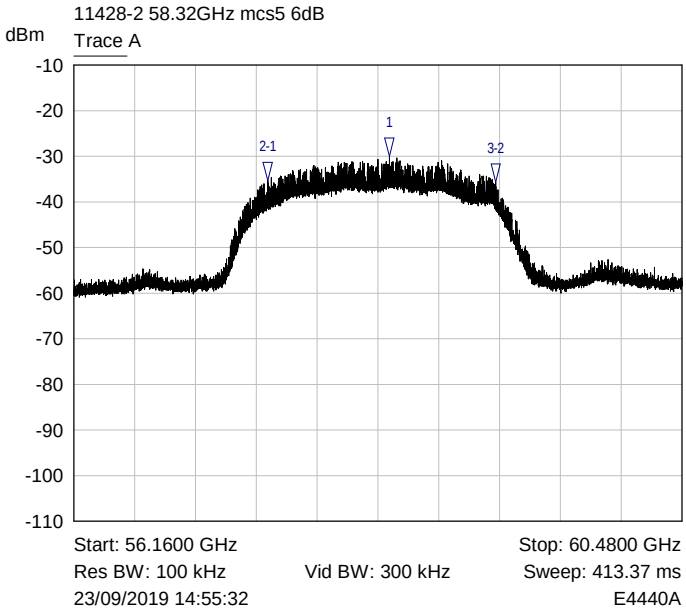
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS4, Channel 64.8 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	64.8614 GHz	-32.75 dBm	
2-1	Trace A	-845.4352 MHz	-5.86 dB	
3-2	Trace A	1.6123 GHz	0.07 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

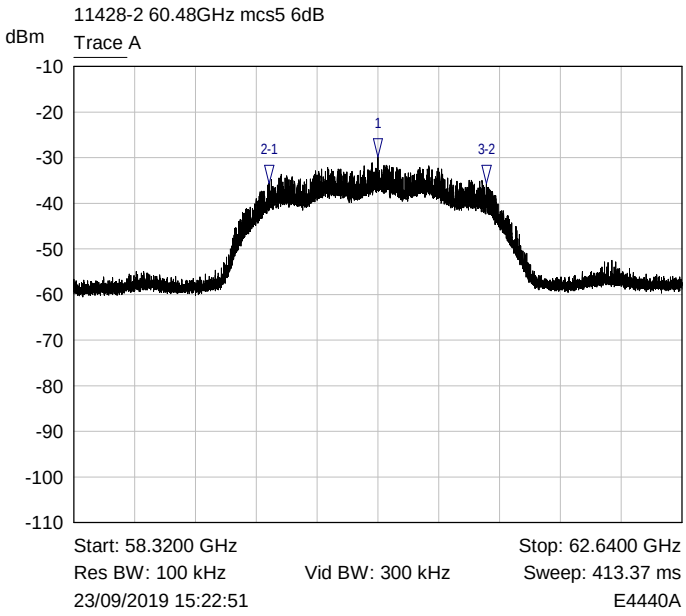
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS5, Channel 58.32 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	58.4020 GHz	-30.02 dBm	
2-1	Trace A	-866.0042 MHz	-5.39 dB	
3-2	Trace A	1.6223 GHz	-0.30 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

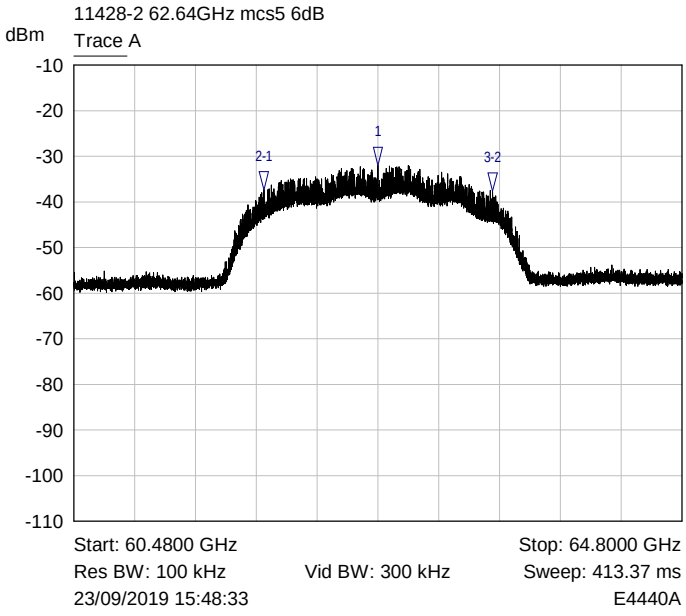
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS5, Channel 60.48 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	60.4797 GHz	-29.90 dBm	
2-1	Trace A	-773.1803 MHz	-5.75 dB	
3-2	Trace A	1.5432 GHz	0.02 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

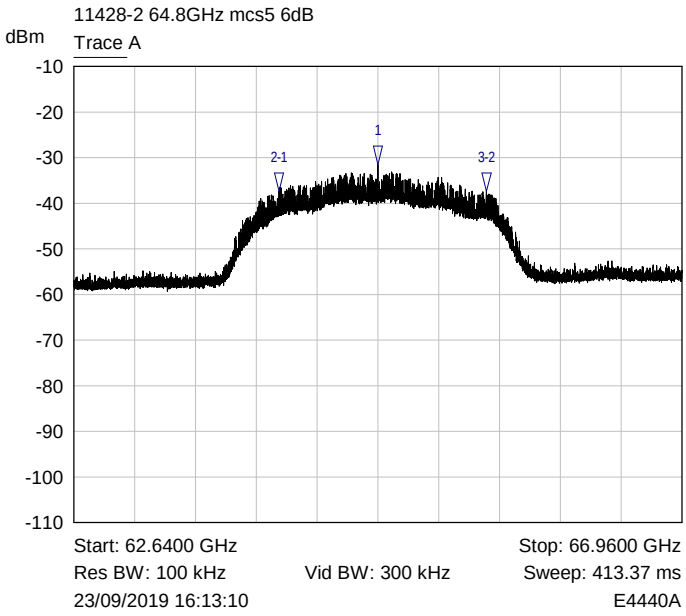
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS5, Channel 62.64 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	62.6397 GHz	-31.97 dBm	
2-1	Trace A	-811.1537 MHz	-5.31 dB	
3-2	Trace A	1.6292 GHz	-0.40 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

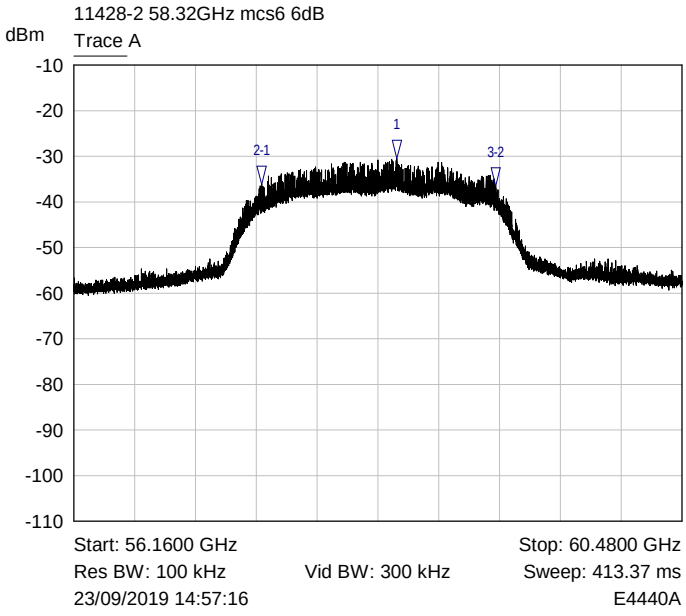
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS5, Channel 64.8 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	64.7997 GHz	-31.42 dBm	
2-1	Trace A	-701.4528 MHz	-5.95 dB	
3-2	Trace A	1.4720 GHz	0.02 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

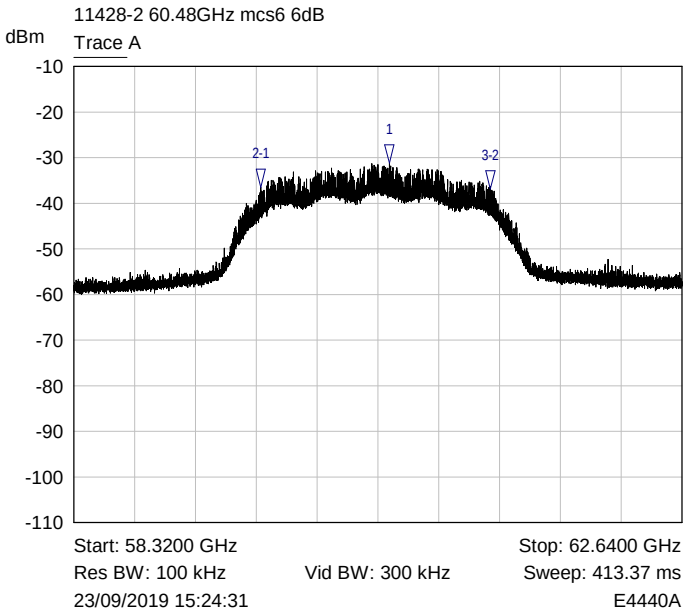
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS6, Channel 58.32 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	58.4574 GHz	-30.46 dBm	
2-1	Trace A	-962.5198 MHz	-5.70 dB	
3-2	Trace A	1.6640 GHz	-0.26 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

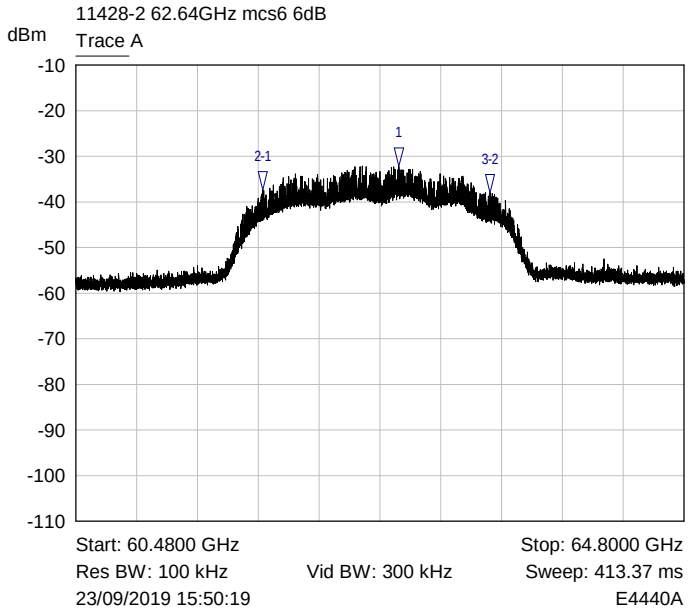
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS6, Channel 60.48 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	60.5620 GHz	-31.09 dBm	
2-1	Trace A	-913.9983 MHz	-5.44 dB	
3-2	Trace A	1.6297 GHz	-0.32 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

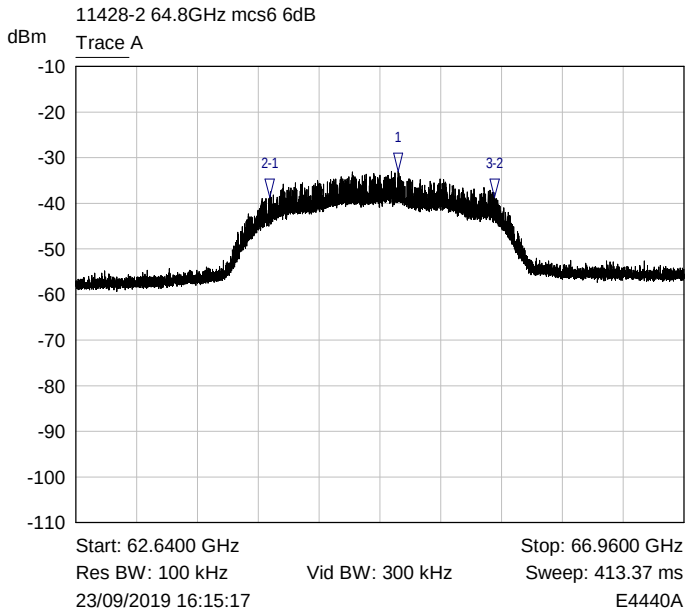
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS6, Channel 62.64 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	62.7774 GHz	-32.20 dBm	
2-1	Trace A	-969.3761 MHz	-5.17 dB	
3-2	Trace A	1.6155 GHz	-0.65 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

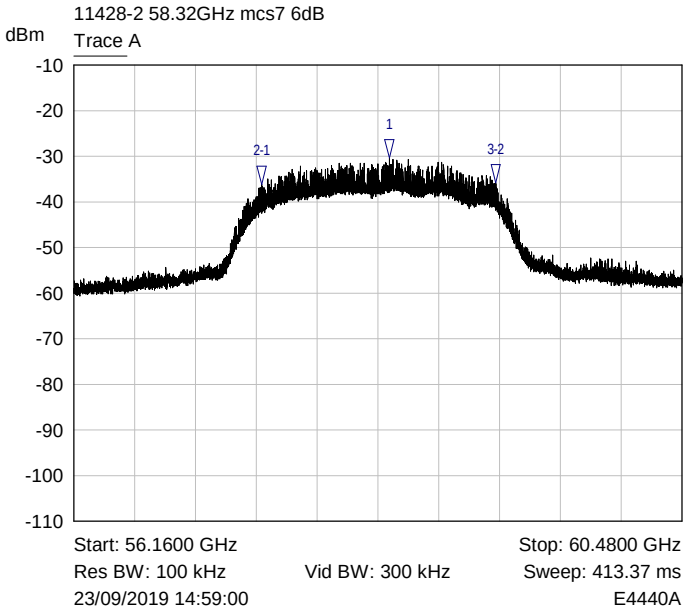
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS6, Channel 64.8 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	64.9305 GHz	-32.97 dBm	
2-1	Trace A	-914.5257 MHz	-5.75 dB	
3-2	Trace A	1.6017 GHz	0.10 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

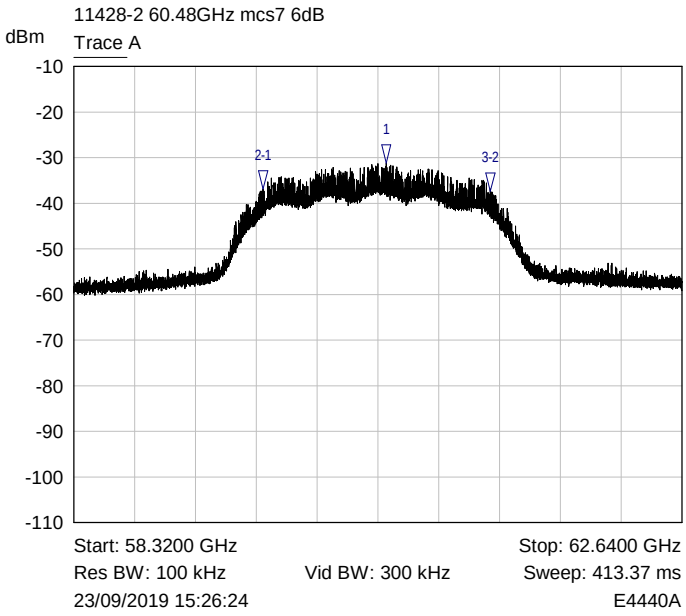
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS7, Channel 58.32 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	58.4020 GHz	-30.38 dBm	
2-1	Trace A	-907.1420 MHz	-5.86 dB	
3-2	Trace A	1.6640 GHz	0.38 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

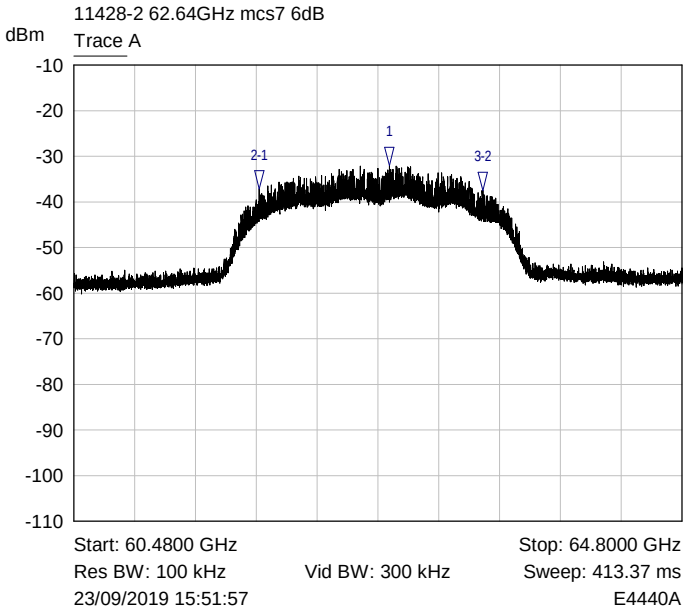
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS7, Channel 60.48 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	60.5414 GHz	-31.09 dBm	
2-1	Trace A	-876.5523 MHz	-5.80 dB	
3-2	Trace A	1.6128 GHz	-0.44 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

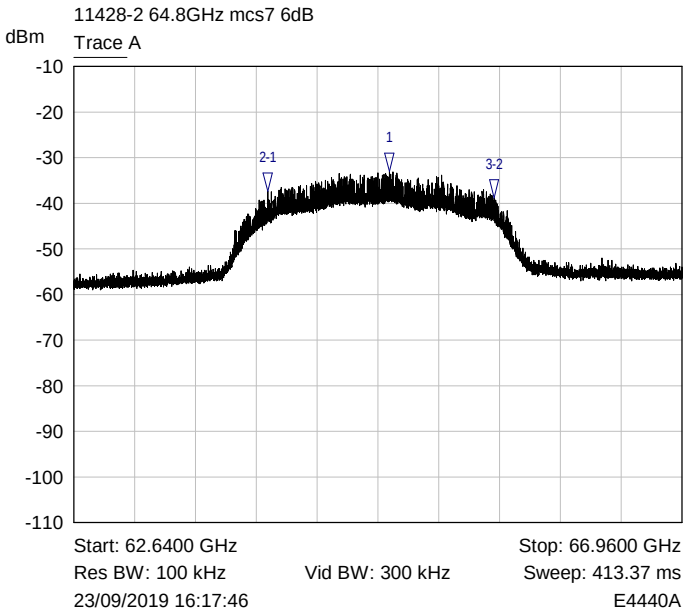
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS7, Channel 62.64 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	62.7225 GHz	-32.07 dBm	
2-1	Trace A	-925.0739 MHz	-5.17 dB	
3-2	Trace A	1.5880 GHz	-0.25 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

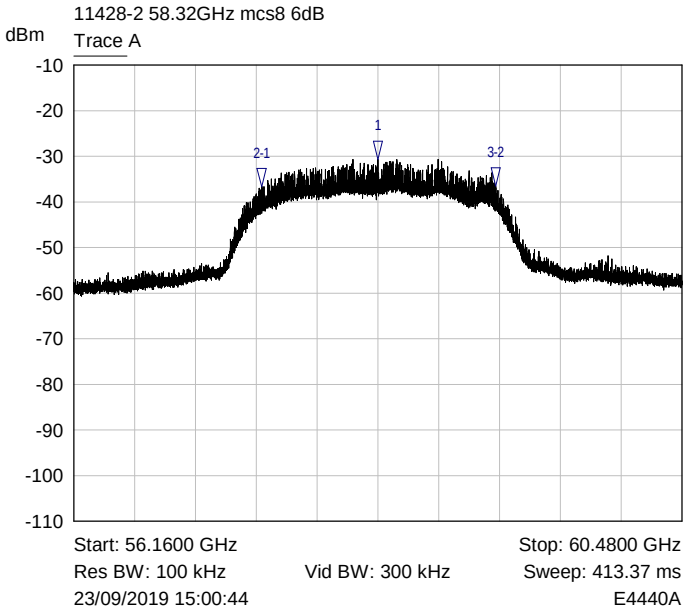
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS7, Channel 64.8 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	64.8820 GHz	-33.07 dBm	
2-1	Trace A	-866.0042 MHz	-4.25 dB	
3-2	Trace A	1.6086 GHz	-1.54 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

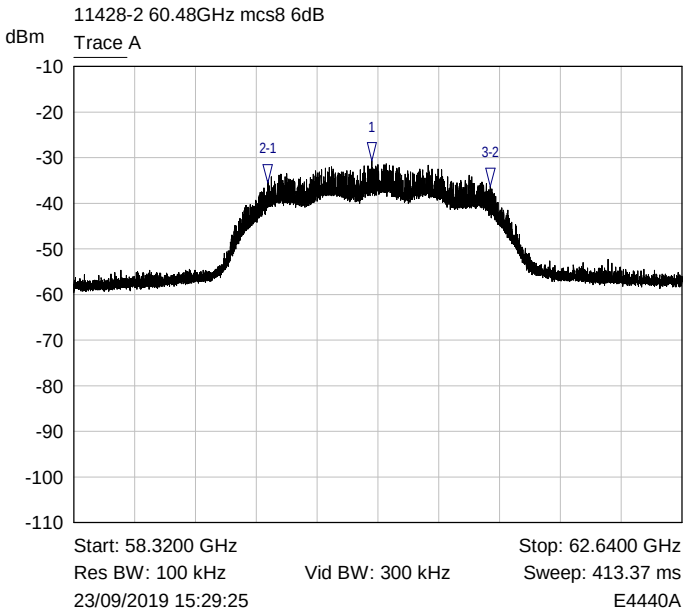
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS8, Channel 58.32 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	58.3197 GHz	-30.59 dBm	
2-1	Trace A	-828.5582 MHz	-6.00 dB	
3-2	Trace A	1.6671 GHz	0.07 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

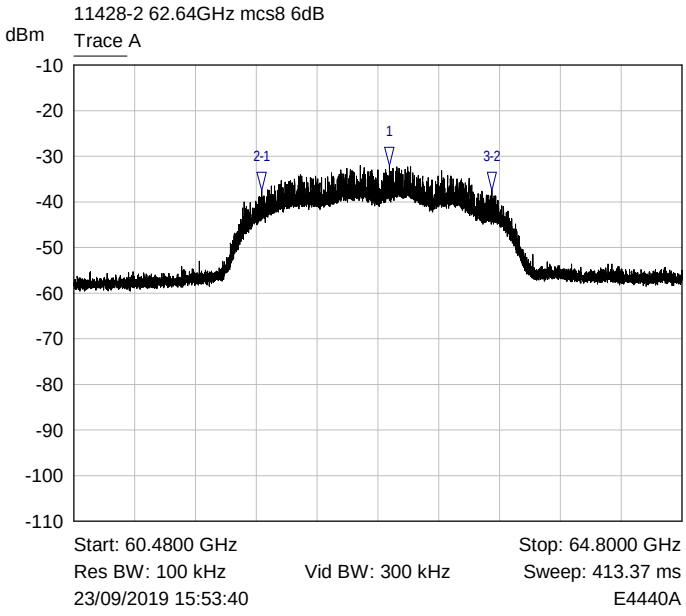
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS8, Channel 60.48 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	60.4386 GHz	-30.58 dBm	
2-1	Trace A	-742.5906 MHz	-4.88 dB	
3-2	Trace A	1.5812 GHz	-0.82 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

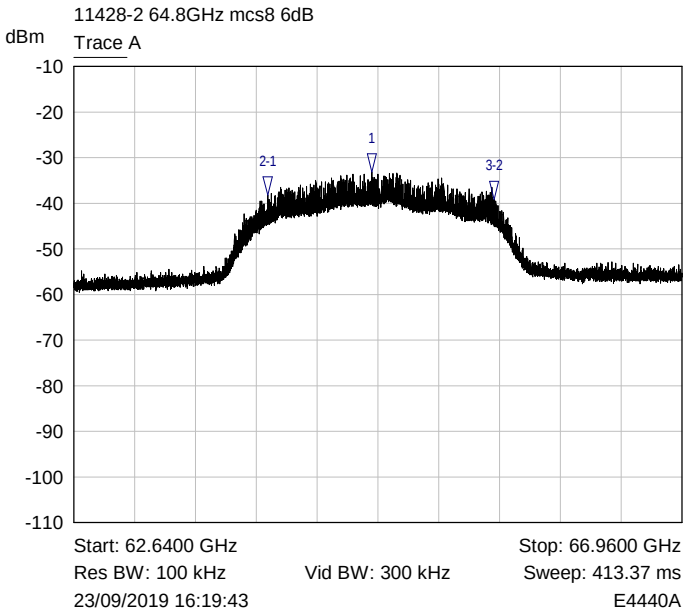
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS8, Channel 62.64 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	62.7220 GHz	-32.05 dBm	
2-1	Trace A	-907.1420 MHz	-5.53 dB	
3-2	Trace A	1.6360 GHz	0.12 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

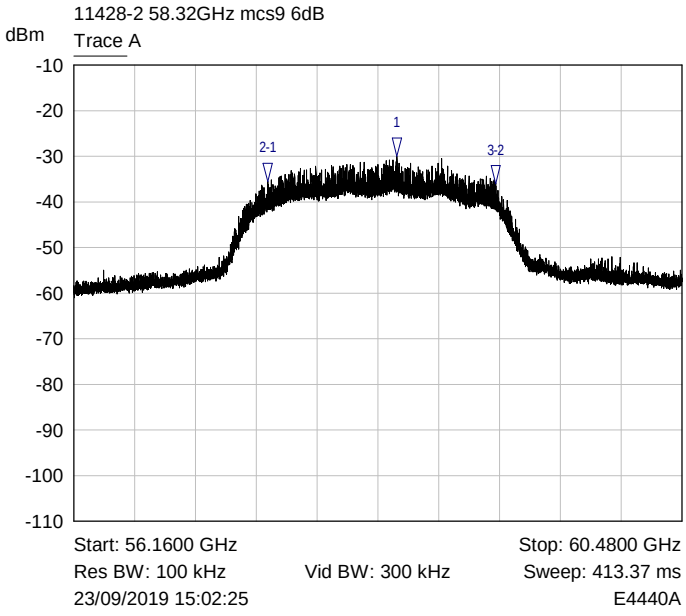
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS8, Channel 64.8 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	64.7586 GHz	-33.23 dBm	
2-1	Trace A	-742.5906 MHz	-4.98 dB	
3-2	Trace A	1.6086 GHz	-1.01 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

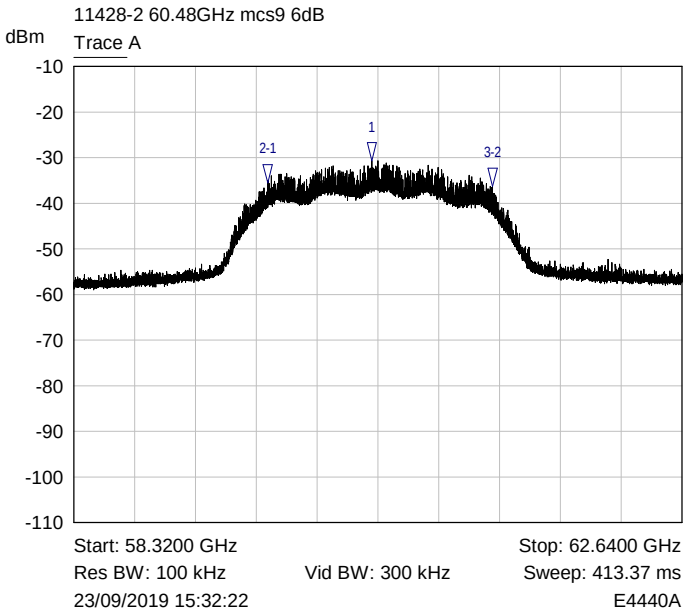
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS9, Channel 58.32 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	58.4574 GHz	-30.07 dBm	
2-1	Trace A	-921.3820 MHz	-5.41 dB	
3-2	Trace A	1.6228 GHz	-0.55 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

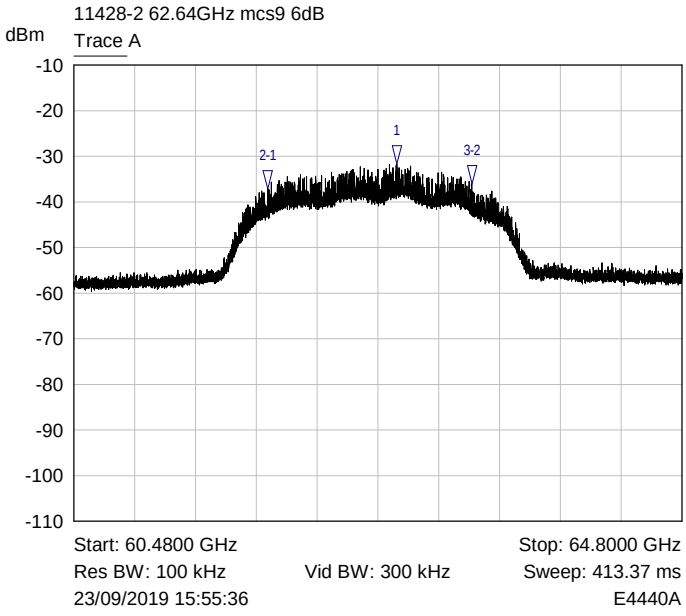
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS9, Channel 60.48 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	60.4386 GHz	-30.58 dBm	
2-1	Trace A	-742.5906 MHz	-4.88 dB	
3-2	Trace A	1.5986 GHz	-0.80 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

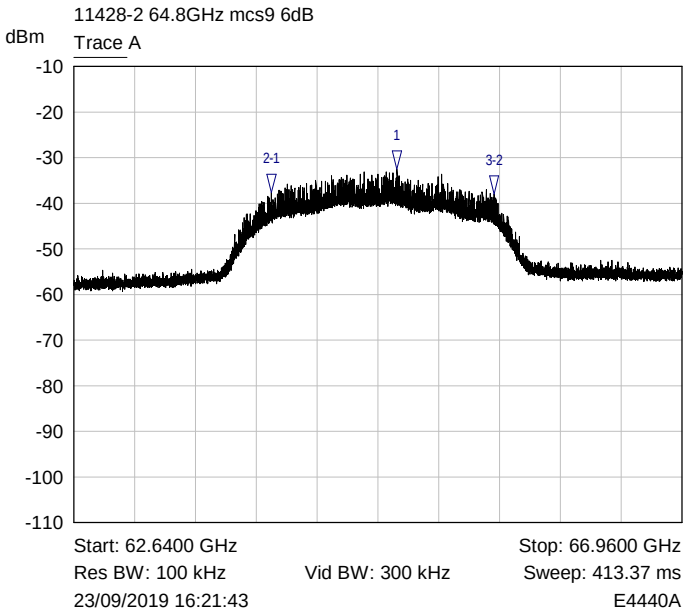
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS9, Channel 62.64 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	62.7774 GHz	-31.61 dBm	
2-1	Trace A	-921.3820 MHz	-5.53 dB	
3-2	Trace A	1.4509 GHz	1.20 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

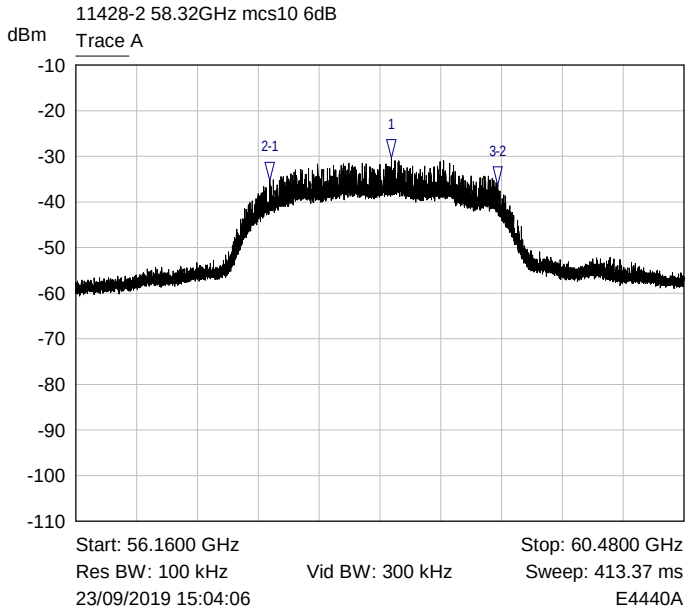
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS9, Channel 64.8 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	64.9374 GHz	-32.42 dBm	
2-1	Trace A	-893.9568 MHz	-5.18 dB	
3-2	Trace A	1.5812 GHz	-0.35 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

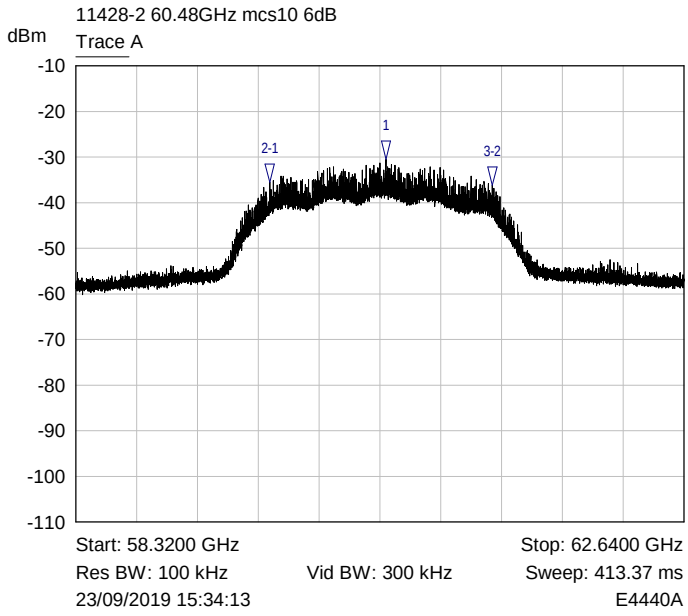
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS10, Channel 58.32 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	58.4020 GHz	-30.34 dBm	
2-1	Trace A	-866.0042 MHz	-4.99 dB	
3-2	Trace A	1.6228 GHz	-1.08 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

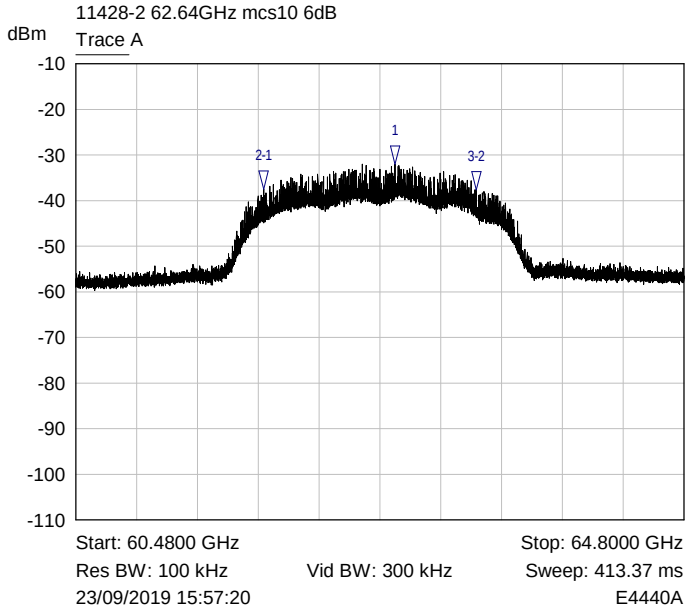
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS10, Channel 60.48 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	60.5209 GHz	-30.55 dBm	
2-1	Trace A	-824.8663 MHz	-5.00 dB	
3-2	Trace A	1.5812 GHz	-0.53 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

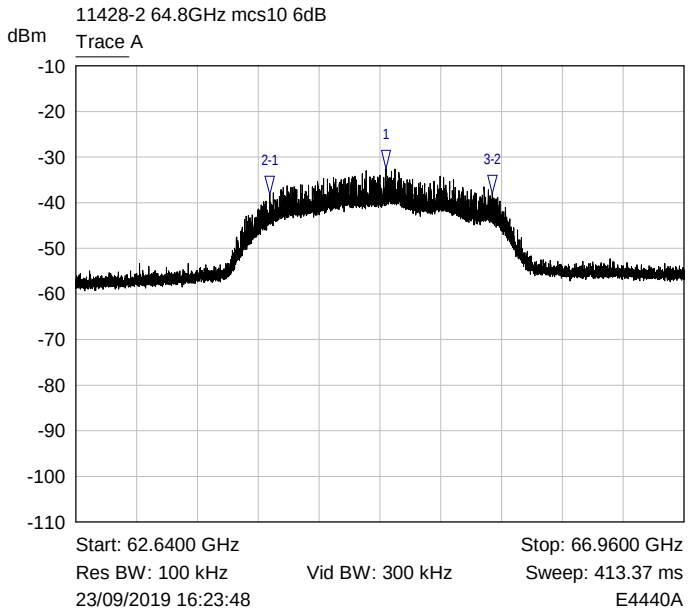
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS10, Channel 62.64 GHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	62.7500 GHz	-31.99 dBm	
2-1 ▽	Trace A	-935.0946 MHz	-5.46 dB	
3-2 ▽	Trace A	1.5126 GHz	-0.22 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

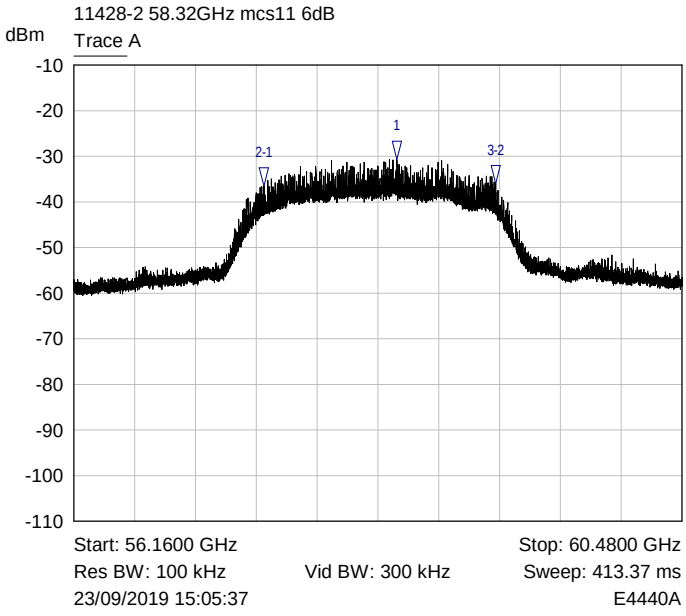
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS10, Channel 64.8 GHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	64.8409 GHz	-32.52 dBm	
2-1 ▽	Trace A	-824.8663 MHz	-5.68 dB	
3-2 ▽	Trace A	1.5817 GHz	0.16 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

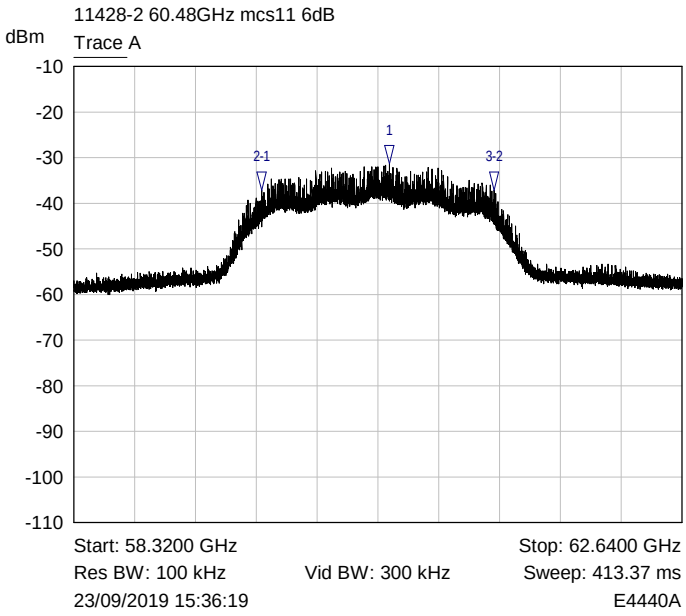
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS11, Channel 58.32 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	58.4574 GHz	-30.61 dBm	
2-1	Trace A	-948.8072 MHz	-5.95 dB	
3-2	Trace A	1.6503 GHz	0.48 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

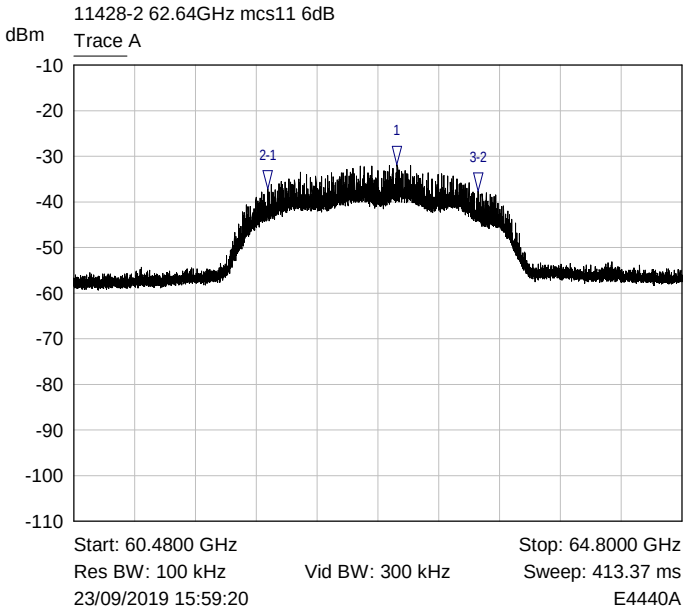
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS11, Channel 60.48 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	60.5620 GHz	-31.39 dBm	
2-1	Trace A	-907.1420 MHz	-5.77 dB	
3-2	Trace A	1.6497 GHz	0.01 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

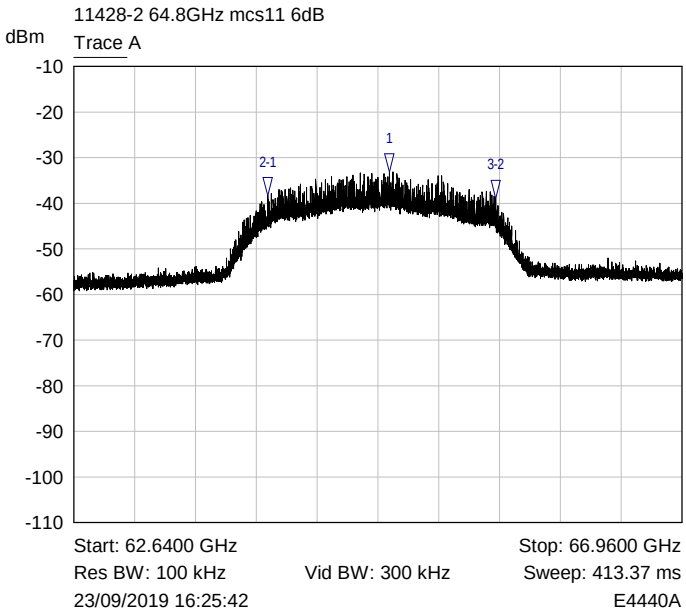
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS11, Channel 62.64 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	62.7774 GHz	-31.77 dBm	
2-1	Trace A	-921.3820 MHz	-5.39 dB	
3-2	Trace A	1.4989 GHz	-0.56 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

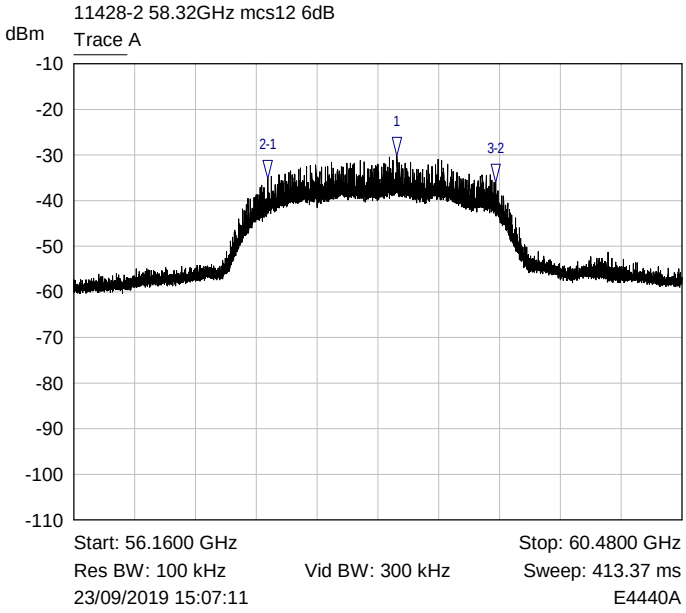
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS11, Channel 64.8 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	64.8825 GHz	-33.15 dBm	
2-1	Trace A	-866.5316 MHz	-5.15 dB	
3-2	Trace A	1.6228 GHz	-0.73 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

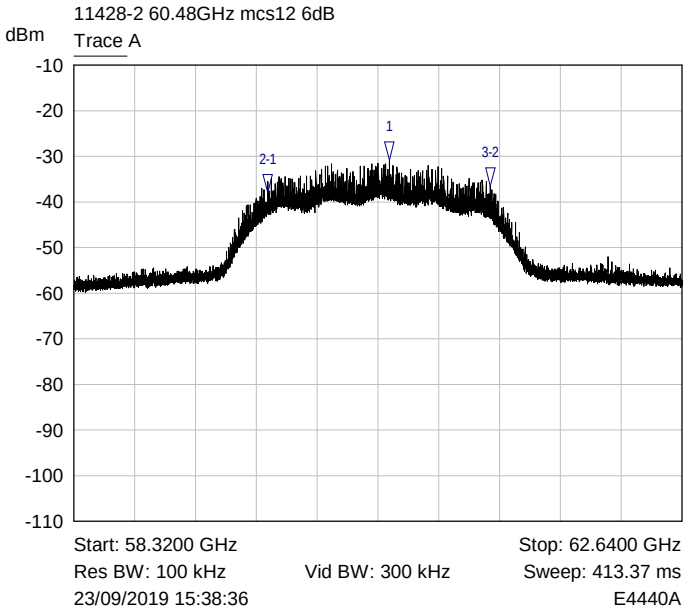
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS12, Channel 58.32 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	58.4574 GHz	-30.24 dBm	
2-1	Trace A	-921.3820 MHz	-4.98 dB	
3-2	Trace A	1.6228 GHz	-0.71 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

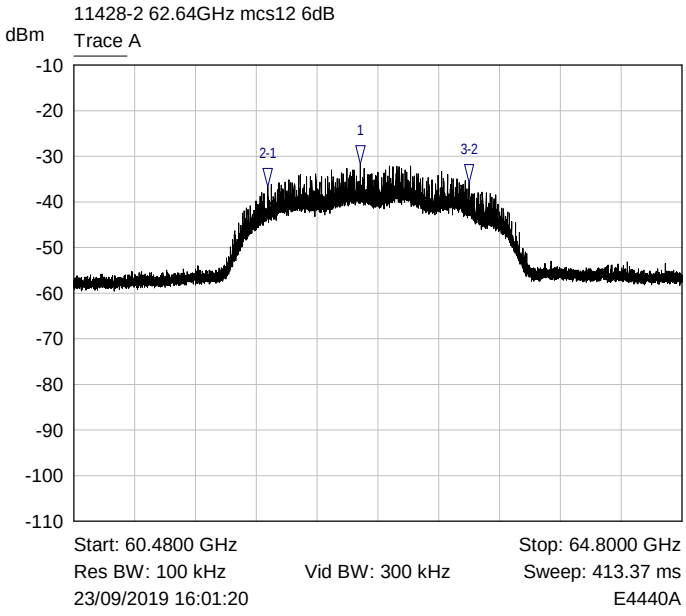
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS12, Channel 60.48 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	60.5620 GHz	-30.82 dBm	
2-1	Trace A	-866.5316 MHz	-7.26 dB	
3-2	Trace A	1.5822 GHz	1.59 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

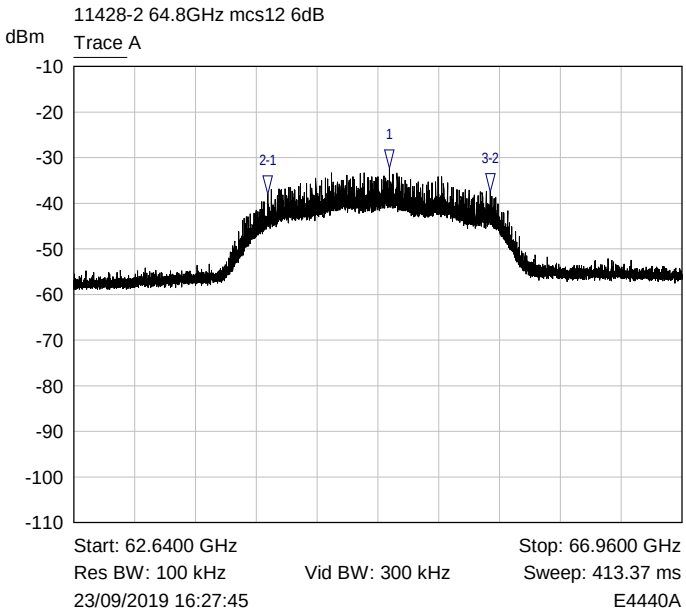
RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS12, Channel 62.64 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	62.5158 GHz	-31.70 dBm	
2-1	Trace A	-659.7876 MHz	-5.02 dB	
3-2	Trace A	1.4303 GHz	0.90 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

RF Parameters: Band 57-66 GHz, Power 38 dBm, Channel Spacing 2.16 GHz, Modulation MCS12, Channel 64.8 GHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	64.8820 GHz	-32.34 dBm	
2-1	Trace A	-866.0042 MHz	-5.64 dB	
3-2	Trace A	1.5817 GHz	0.43 dB	

Plot for 6 dB Bandwidth (GHz) Nominal Temp & Volts

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 $90pW/cm^{2.}$

$90pW/cm^2 \times 100^2 = 0.9\ \mu W/m^2$ = (EIRP Linear)

Equation 25 transposed: $0.9 \times 10^{-6} \times 4 \times \pi \times 3^2 = 0.0001017876$ W

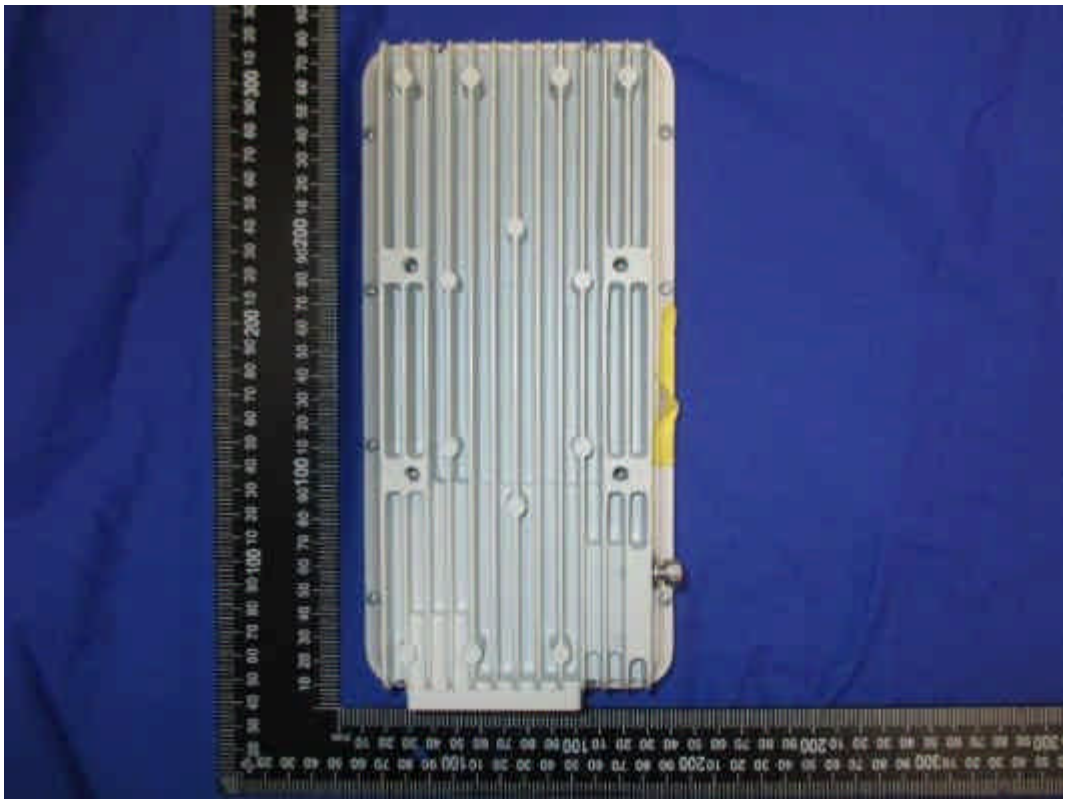
And
Equation 26 transposed: $E_{Spec\ limit} = \sqrt{(0.9x10^{-6} \times 377)} = 0.01842$ V/m.

And
Equation 21 transposed: $E_{Log} = 20Log(0.01842) +120 = 85.3dB\mu V/m$ @ 3m.

8 Photographs

8.1 EUT Front View

8.2 EUT Reverse Angle



8.3 EUT Left side View

8.4 EUT Right side View

8.5 EUT Antenna Port

Note: Photo is blacked out due to confidentiality of internal photos

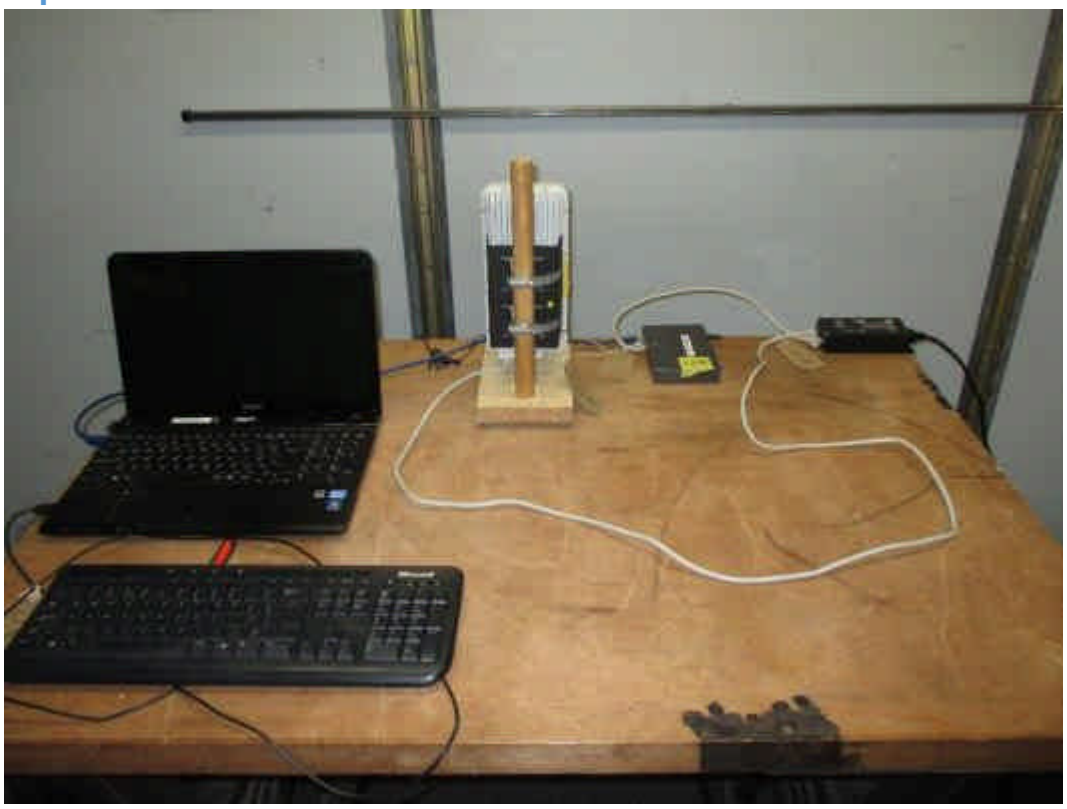
8.6 EUT Display & Controls

8.7 EUT Internal photos

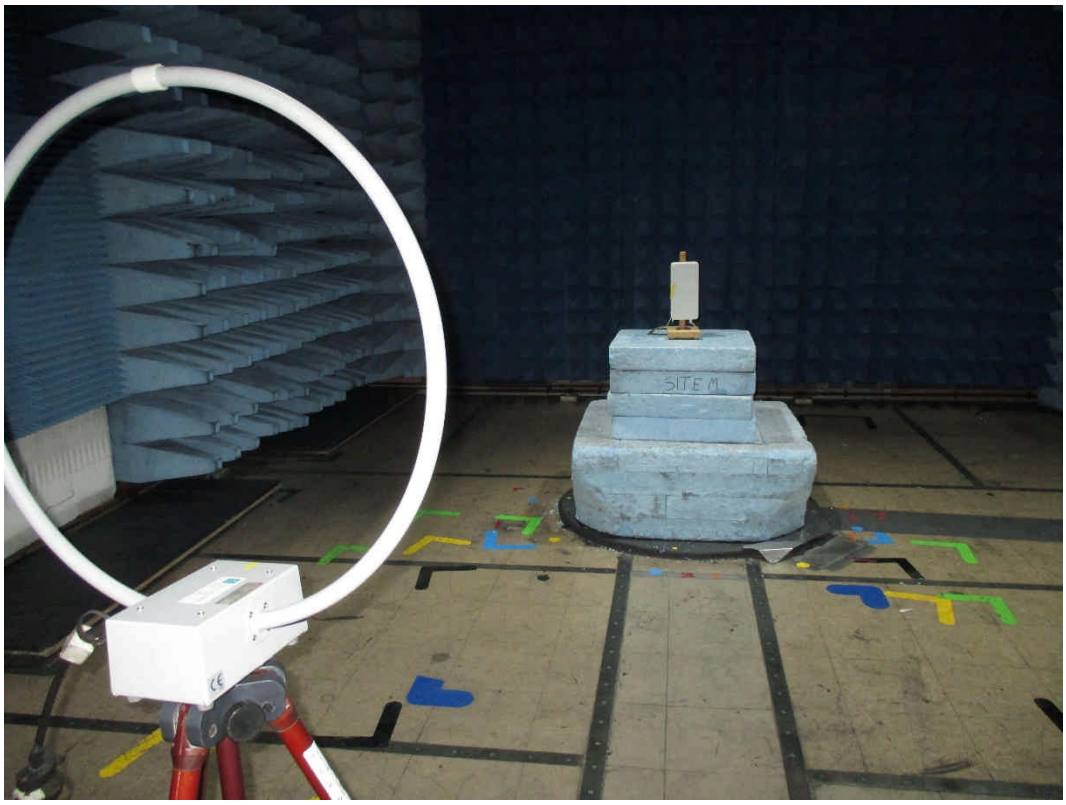
Note: Photos are not included due to confidentiality of internal photos

8.8 EUT ID Label

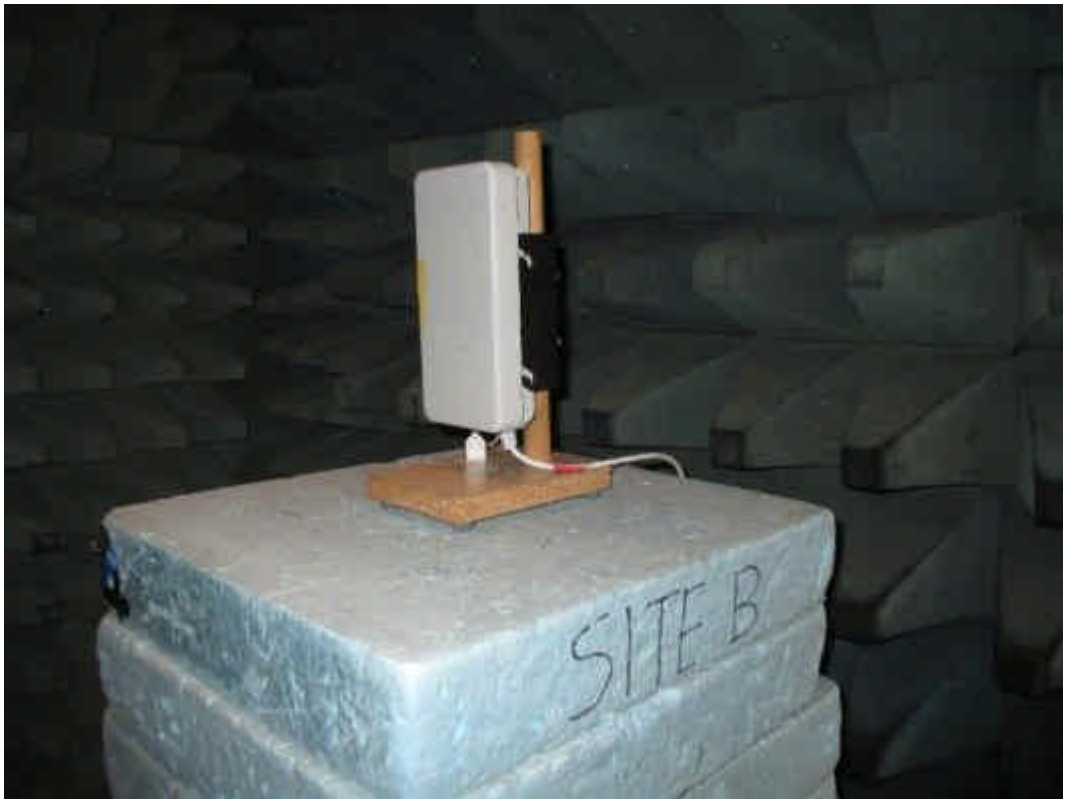
8.9 AC power line conducted emissions



8.10 Radiated emissions 150k – 30 MHz

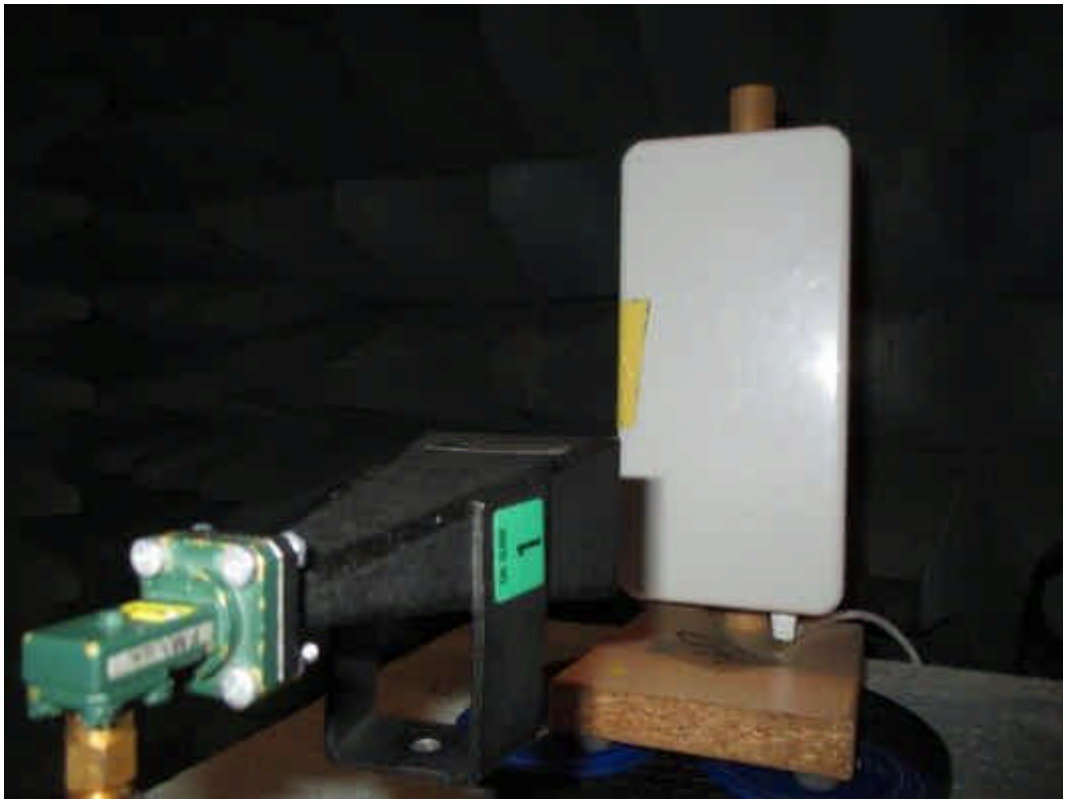


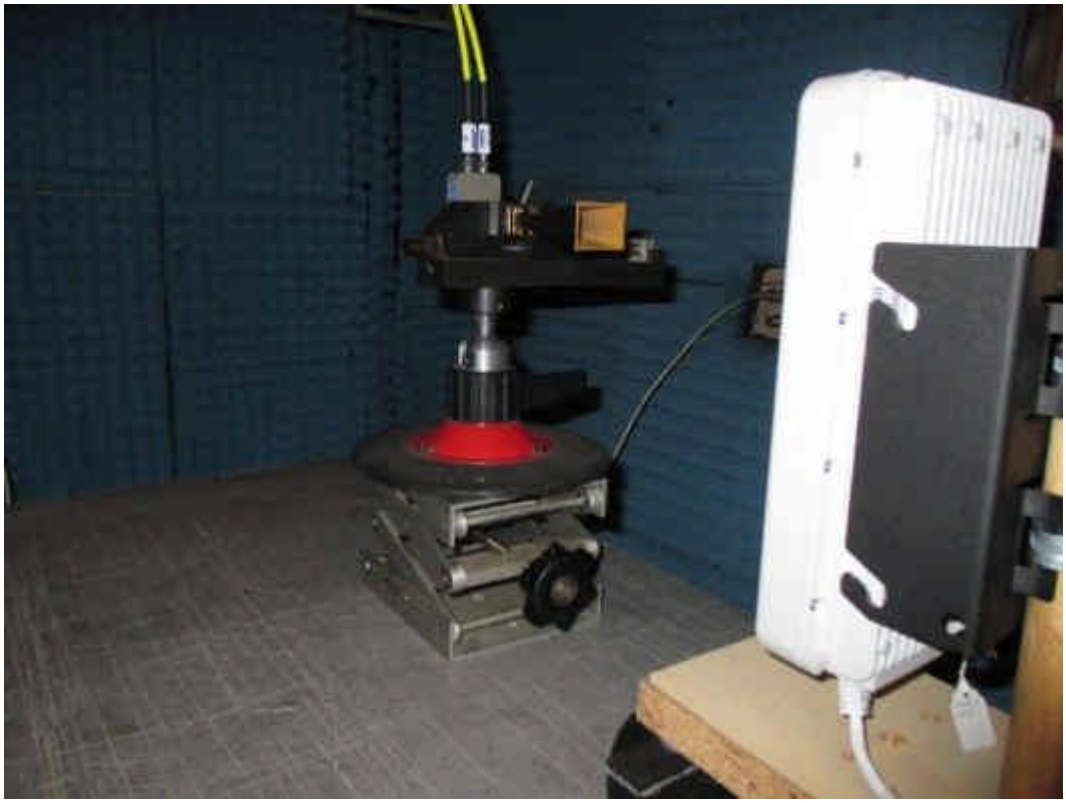
8.11 Radiated emissions 30 MHz -1 GHz

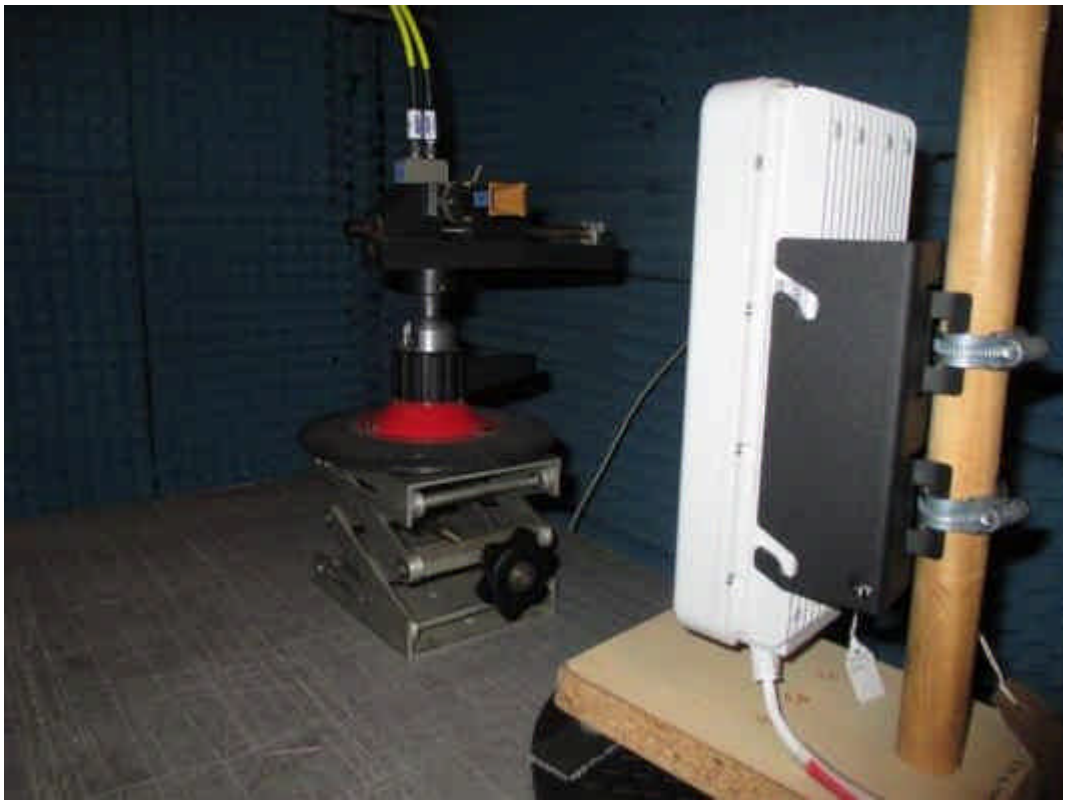


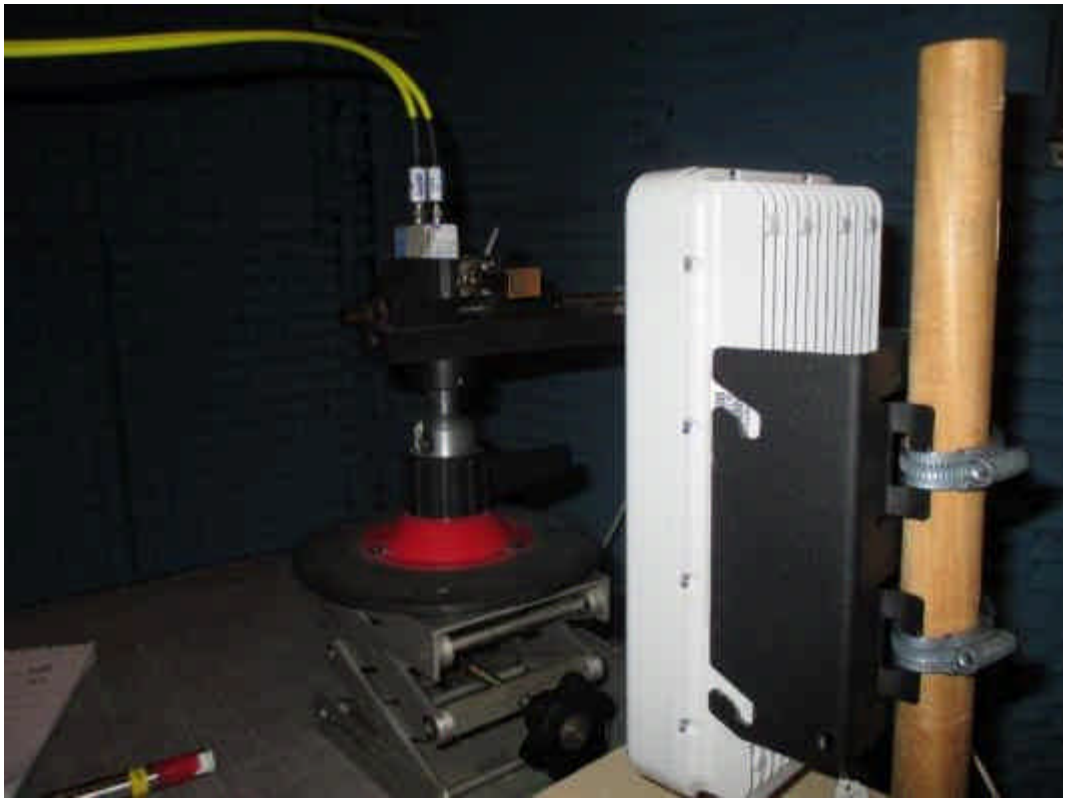
8.12 Radiated emissions above 1 GHz

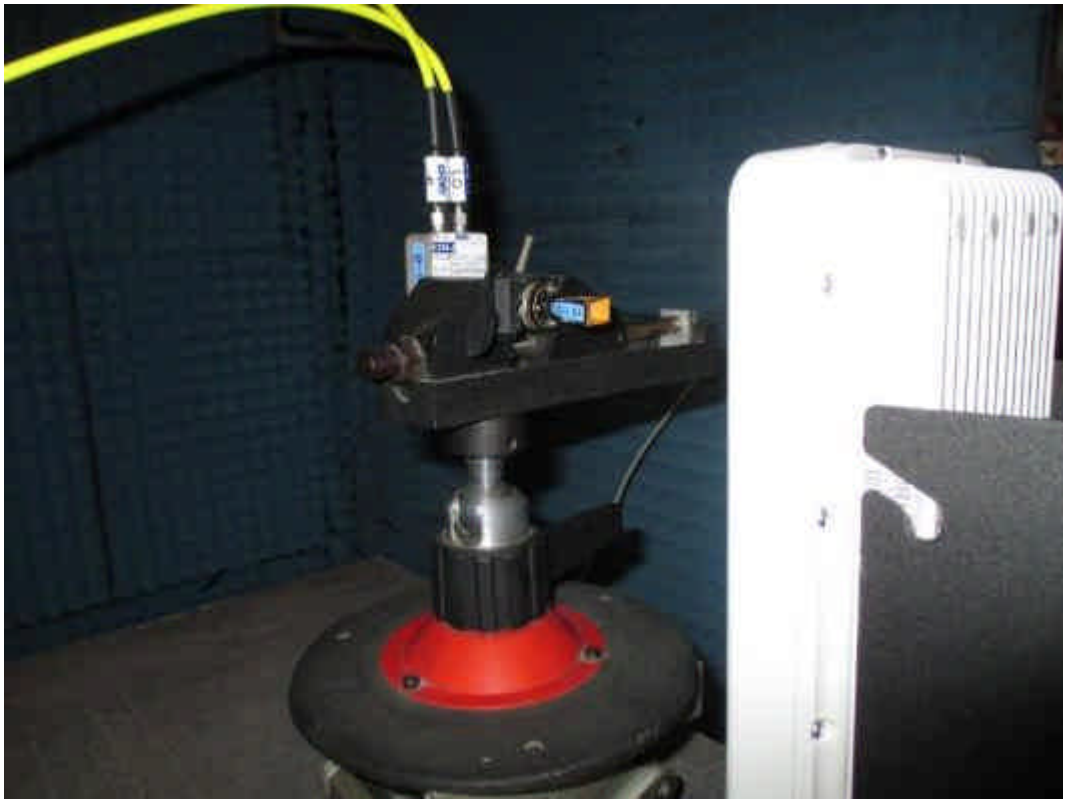

SIDE B











8.13 Radiated emission diagrams

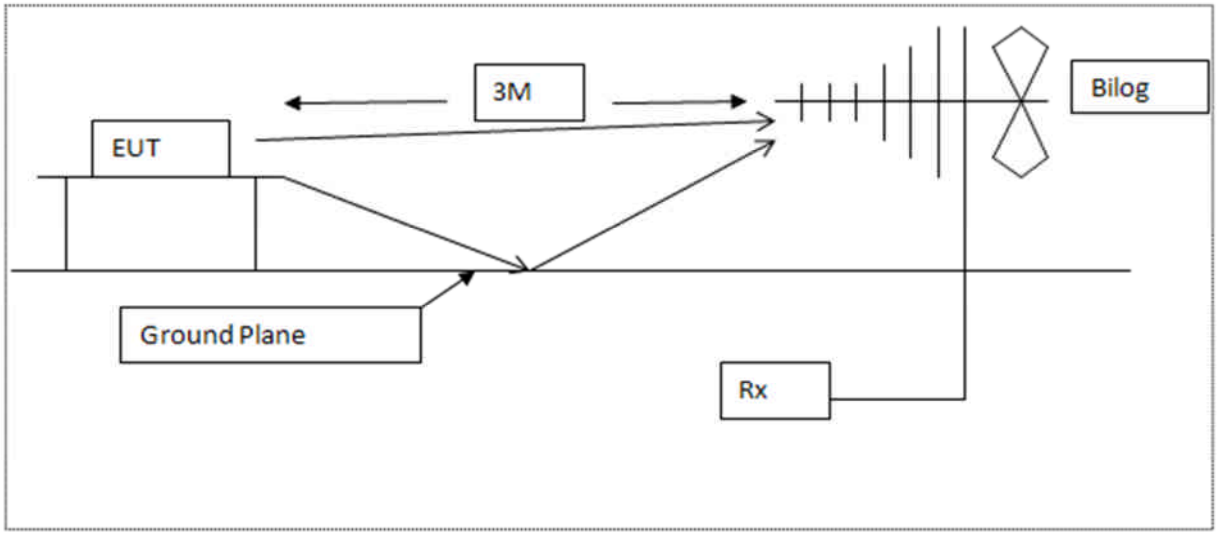


Diagram of the radiated emissions test setup 30 - 1000 MHz

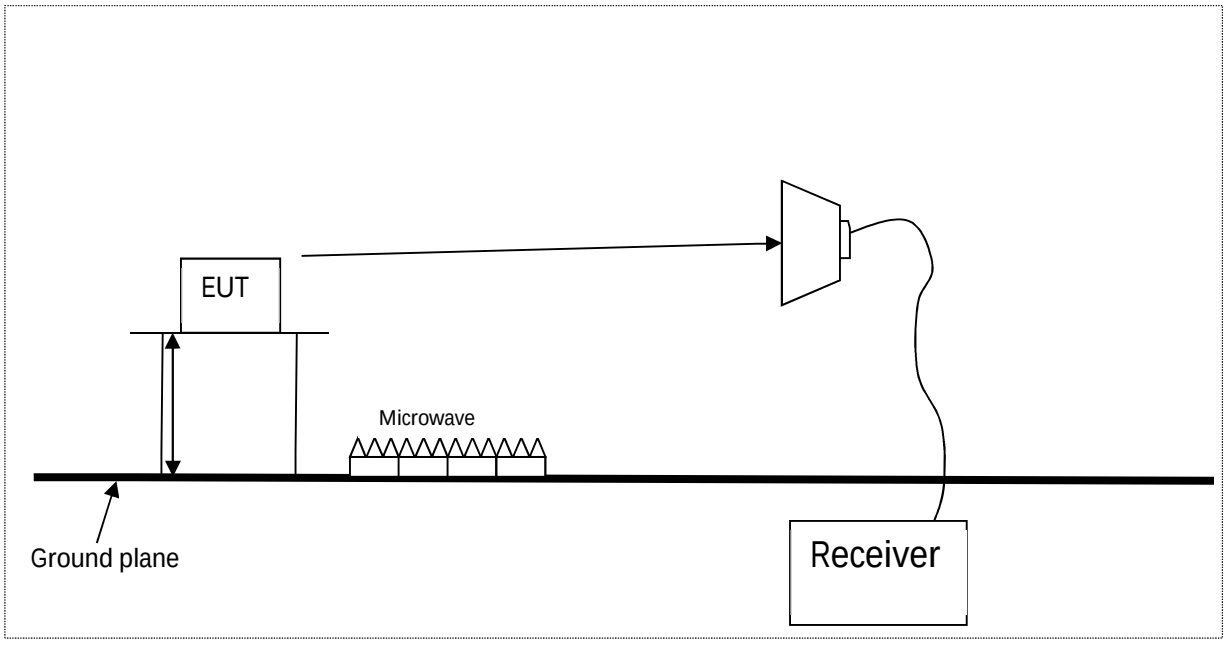


Diagram of the radiated emissions test setup above 1GHz

8.14 AC powerline conducted emission diagram

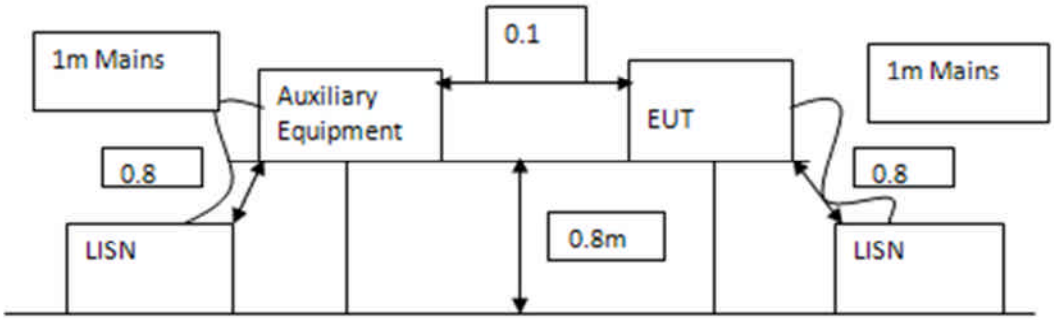


Diagram of the AC conducted emissions test setup

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
E035	11947A	Transient Limiter 9kHz - 200MHz	Hewlett Packard	13-Jun-2019	6 months
E150	MN2050	LISN 13A	Chase	18-Apr-2019	12 months
E289	8449B	Pre-Amplifier 1GHz - 26.5GHz	Hewlett Packard	24-Apr-2019	12 months
E296-5	11970V	Harmonic Mixer 50-75GHz	Hewlett Packard	29-Nov-2017	24 months
E296-6	11970W	Harmonic Mixer 75-110GHz WR10	Hewlett Packard	08-Dec-2017	36 months
E330	2224-20	Horn Antenna 26.5-40GHz	Flann (FMI)	24-Apr-2019	12 months
E412	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	17-Jul-2018	24 months
E428	HF906	Horn Antenna 1-18 GHz	Rohde & Schwarz	27-Apr-2019	12 months
E434	G3RUH	10MHz GPS Disciplined Oscillator	G3RUH - James Miller	07-Jun-2019	3 months
E453	20240-20-AA	Horn Std Gain 17.6 - 26.7GHz	Flann (FMI)	29-May-2019	12 months
E486-2	11974A	Preselect Mixer 26.5 - 40GHz	Hewlett Packard	#18-Sep-2019	12 months
E487	11974U	Preselect Mixer 40 - 60GHz	Agilent Technologies	12-Sep-2018	24 months
E503	2524-20	Horn Antenna 50-75GHz	Flann (FMI)	24-Apr-2019	12 months
E555	CMV 5E-1	Variac 5A	Carroll & Meynell Ltd	N/A	N/A
E577	2511	Attenuator 50-76GHz Rotary	Flann (FMI)	21-Feb-2019	12 months
E579	27240	Horn Std Gain 75GHz - 110GHz	Flann (FMI)	23-Apr-2019	12 months
E580	24240	Horn Std Gain 40GHz - 60GHz	Flann (FMI)	23-Apr-2019	12 months
E599	ML4803A	Power meter	Anritsu	#03-Sep-2019	12 months
E600	MA4002B, MP716A4	50GHz - 75GHz Waveguide Sensor	Anritsu	#03-Sep-2019	12 months
E602	MG3692A	Signal Generator 10MHz - 20GHz	Anritsu	04-Feb-2019	24 months
E624	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	09-Jan-2018	24 months
E627	DSO5052A	Oscilloscope 500MHz 2CH 4GSa/s	Agilent Technologies	21-May-2019	12 months
E638	11974VE01	Preselected Mixer 50 - 80GHz	Agilent Technologies	21-Feb-2019	24 months
E642	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	29-Nov-2017	24 months
E712	WM780F	Mixer 90-140GHz	Tektronix	03-May-2018	24 months
E719	-	Horn Std Gain 90-140GHz	-	25-Jul-2019	12 months
E722	861G/387	Horn Std Gain 140-220GHz	Alpha Industries Inc	25-Jul-2019	12 months
E743	2017 4/2dB	Attenuator 4/2dB 30-1000MHz	RN Electronics	11-Feb-2019	12 months
E760	M05HWDX	Mixer 140-220GHz	OML Inc	25-Jun-2019	12 months
E781	MX4-15-F	Multiplier 50 - 75GHz X4 WR15	MMWave Group (Quantum)	#10-Sep-2019	12 months
E829	47324H-1211	Detector Broadband 50-75GHz	Hughes	#10-Sep-2019	12 months
E852	LPF10	Filter - 10MHz Low Pass	G4HUP	13-Mar-2019	12 months
E856	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	01-May-2019	12 months
E908	00365-60004	Isolator 50-75GHz WR15	Hewlett Packard	10-Jun-2019	12 months
E917	C-SPSP-1801-1M	Cable SMA SMA 1m Yellow	Intelliconnect	01-Apr-2019	12 months
E918	C-SPSP-1801-1M	Cable SMA SMA 1m Yellow	Intelliconnect	01-Apr-2019	12 months
E932	N5181A	Signal Generator 100kHz to 6GHz	Agilent Technologies	05-Jun-2019	12 months
LPE364	CBL6112A	Antenna BiLog 30MHz - 2GHz	Chase Electronics Ltd	21-Mar-2018	24 months
TMS38	VMT04/140	Environmental Oven	Heraeus Votsch	N/A	N/A
TMS57	2534	Digital Multimeter	Philips	20-Mar-2019	24 months
TMS78	3160-08	Horn Std Gain 12.4-18 GHz	ETS Systems	24-Jul-2019	12 months
TMS80	206-3722	Digital Thermometer & K Probe	RS Components Ltd	21-Nov-2018	12 months
TMS81	6502	Antenna Active Loop	EMCO	24-Jun-2019	24 months
ZSW1	V2.3	Measurement Software Suite	RN Electronics	N/A	N/A

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

10 Auxiliary and peripheral equipment

10.1 Customer supplied equipment

Item No.	Model No.	Description	Manufacturer	Serial No.
1	Vaio	Laptop and PSU	Sony	-
2	GS108E	Network switch	Netgear	3UH1465G00791

10.2 RN Electronics supplied equipment

RN No.	Model No.	Description	Manufacturer	Serial No
P272	18V10	PSU 18V 10A	Kingshill	335

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

No modifications were made during test by RN Electronics Ltd.

12 Description of test sites

Site A Radio / Calibration Laboratory and anechoic chamber

Site B Semi-anechoic chamber
FCC Registration No. 293246
IC Registration No. 5612A-4

Site B1 Control Room for Site B

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
IC Registration No. 5612A-2

Site J Screened Room

Site K Screened Room (Control Room for Site M)

Site M 3m Semi-anechoic chamber (indoor OATS)
FCC Registration No. 293246
IC Registration No. 5612A-3

Site Q Fully-anechoic chamber

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

Site R Screened Room (Conducted Immunity)

Site S Safety Laboratory

Site T Transient Laboratory

13 Abbreviations and units

%	Percent	LBT	Listen Before Talk
µA/m	microAmps per metre	LO	Local Oscillator
µV	microVolts	mA	milliAmps
µW	microWatts	max	maximum
AC	Alternating Current	kPa	Kilopascal
ALSE	Absorber Lined Screened Enclosure	Mbit/s	MegaBits per second
AM	Amplitude Modulation	MHz	MegaHertz
Amb	Ambient	mic	Microphone
ATPC	Automatic Transmit Power Control	min	minimum
BER	Bit Error Rate	mm	milliMetres
ºC	Degrees Celsius	ms	milliSeconds
C/I	Carrier / Interferer	mW	milliWatts
CEPT	European Conference of Postal and Telecommunications Administrations	NA	Not Applicable
COFDM	Coherent OFDM	nom	Nominal
CS	Channel Spacing	nW	nanoWatt
CW	Continuous Wave	OATS	Open Area Test Site
dB	deciBels	OFDM	Orthogonal Frequency Division Multiplexing
dBµA/m	deciBels relative to 1µA/m	ppm	Parts per million
dBµV	deciBels relative to 1µV	PRBS	Pseudo Random Bit Sequence
dBc	deciBels relative to Carrier	QAM	Quadrature Amplitude Modulation
dBm	deciBels relative to 1mW	QPSK	Quadrature Phase Shift Keying
DC	Direct Current	R&TTE	Radio and Telecommunication Terminal Equipment
DTA	Digital Transmission Analyser	Ref	Reference
EIRP	Equivalent Isotropic Radiated Power	RF	Radio Frequency
ERP	Effective Radiated Power	RFC	Remote Frequency Control
EU	European Union	RSL	Received Signal Level
EUT	Equipment Under Test	RTP	Room Temperature and Pressure
FM	Frequency Modulation	RTPC	Remote Transmit Power Control
FSK	Frequency Shift Keying	Rx	Receiver
g	Grams	s	Seconds
GHz	GigaHertz	SINAD	Signal to Noise And Distortion
Hz	Hertz	Tx	Transmitter
IF	Intermediate Frequency	V	Volts
kHz	kiloHertz		