Radio Test Report

Scuf Gaming
Scuf Gaming Controller
Scuf HYRE controller

47 CFR Part 15.247 Effective Date 1st October 2017
DSS: Part 15 Spread Spectrum Transmitter
Test Date: 31st October 2017 to 11th January 2018
Report Number: 01-9722-3-18 Issue 03
Supersedes Report Number: 01-9722-3-18 Issue 02

R.N. Electronics Ltd.
Arnolds Court
Arnolds Farm Lane
Mountnessing
Essex
CM13 1UT
U.K.

www.RNelectronics.com

Telephone: +44 (0) 1277 352219
Email: sales@RNelectronics.com

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

Certificate of Test 9722-3

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:	Scuf Gaming Controller
Model Number:	Scuf HYRE Controller
Unique Serial Number:	Radiated #1, conducted 1102
Applicant:	Scuf Gaming Unit 22, Maxet House, Lansdown Ind Est, Gloucester Rd Cheltenham GL51 8PL
Full measurement results are detailed in Report Number:	01-9722-3-18 Issue 03
Test Standards:	47 CFR Part 15.247 Effective Date 1st October 2017 DSS: Part 15 Spread Spectrum 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.

DEVIATIONS:
No deviations were 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:	31st October 2017 to 11th January 2018
Test Engineer:	Ian Rose — Digitally signed by: Ian Rose DN: CN = Ian Rose email = Ian@rnnelectronics.com C = GB O = RN Electronics Date: 2018.03.14 09:10:11 Z
Approved By: Radio Approvals Manager	Digitally signed by: Daniel Sims DN: CN = Daniel Sims C = GB O = RN Electronics Ltd Date: 2018.03.14 09:02:11 Z
Customer Representative:	

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2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	Scuf Gaming Unit 22 Maxet House Lansdown Ind Est, Gloucester Rd Cheltenham GL51 8PL	
Manufacturer of EUT	Scuf Gaming Ltd	
Full Name of EUT	Scuf Gaming Controller	
Model Number of EUT	Scuf HYRE Controller	
Serial Number of EUT	Radiated #1, conducted 1102	
Date Received	17th November 2017	
Date of Test:	31st October 2017 to 11th January 2018	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Issued	12th January 2018	
Main Function	Gaming controller for Sony Play Station.	
Information Specification	Height	65 mm
	Width	170 mm
	Depth	105 mm
	Weight	0.24 kg
	Voltage	4.75-5.25 V dc
	Current	500 mA

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2.2 Configurations for testing

General Parameters	
EUT Normal use position	Handheld
Choice of model(s) for type tests	Prototypes
Antenna details	Inverted F type antenna etched into PCB
Antenna port	Integral antenna
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	2480 MHz
Lowest Signal generated in EUT	12 MHz
Hardware Version	C
Software Version	-
Firmware Version	A
Type of Equipment	Gaming controller
Technology Type	Bluetooth
Geo-location (yes/no)	No
TX Parameters	
Alignment range – transmitter	2400-2483.5 MHz
EUT Declared Modulation Parameters	DH1, DH3, DH5, 2DH1, 2DH3, 2DH5, 3DH1, 3DH3, 3DH5
EUT Declared Power level	+ 4 dBm
EUT Declared Signal Bandwidths	1 MHz
EUT Declared Channel Spacing's	1 MHz
EUT Declared Duty Cycle	Not declared
Unmodulated carrier available?	Yes
Declared frequency stability	20 ppm
RX Parameters	
Alignment range – receiver	2400-2483.5 MHz
Method of Monitoring Receiver BER	Not applicable
FHSS Parameters	FHSS Parameters
Maximum No. Of hop channels declared	79
Minimum No. Of hop channels declared	79

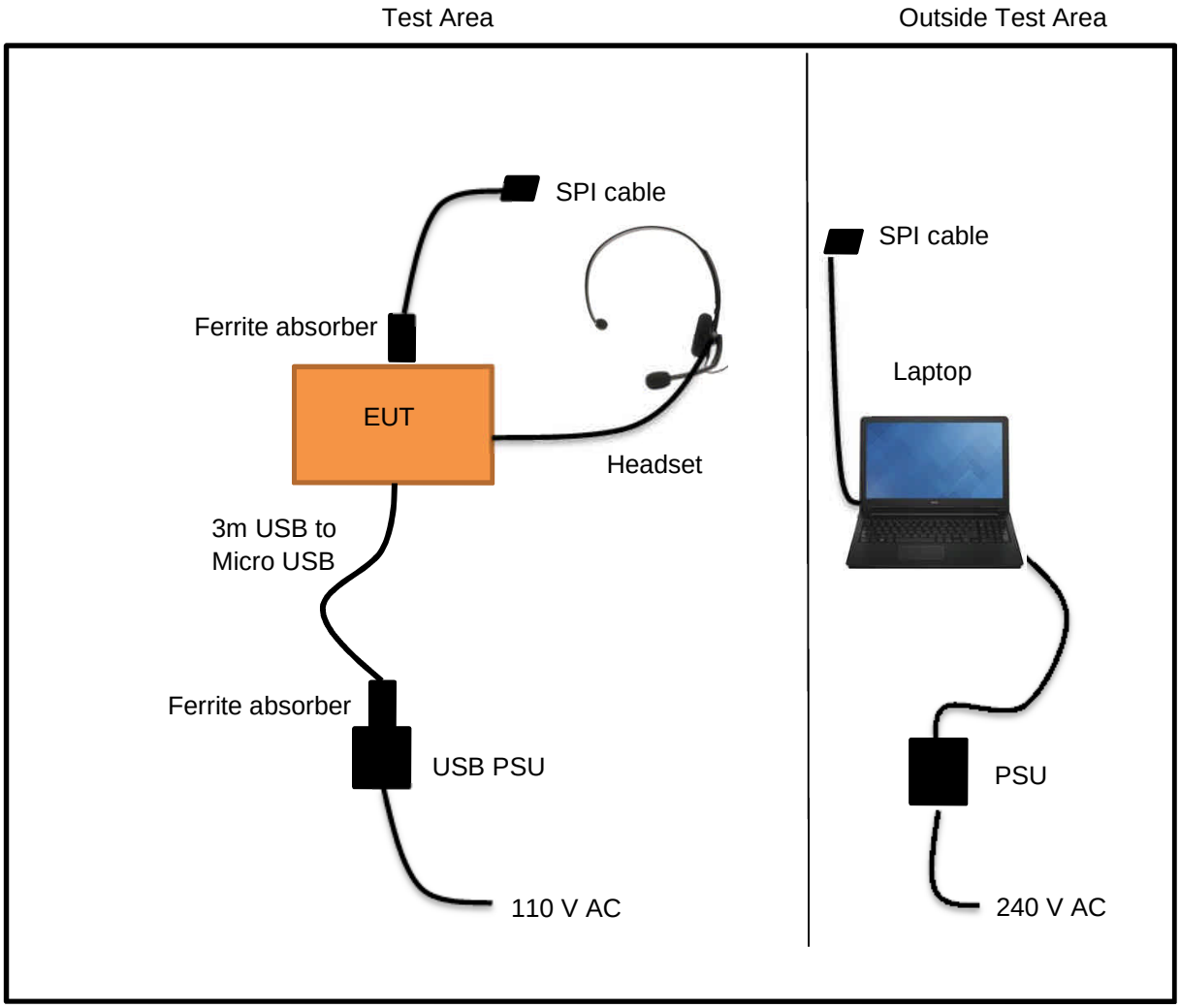
2.3 Functional description

Typical gaming controller with 2 thumb sticks, DPAD, FACE switch, Triggers, Bumpers, Sax Button and 4 Paddles. Can connect and charge via USB port and communicate directly via Bluetooth.

2.4 Modes of operation

Mode Reference	Description	Used for testing
TX1	Low 4 dBm DH1	Yes
TX2	Low 4 dBm 2DH1	Yes
TX3	Low 4 dBm 3DH1	Yes
TX4	Low 4 dBm DH3	Yes
TX5	Low 4 dBm 2DH3	Yes
TX6	Low 4 dBm 3DH3	Yes
TX7	Low 4 dBm DH5	Yes
TX8	Low 4 dBm 2DH5	Yes
TX9	Low 4 dBm 3DH5	Yes
TX10	Mid 4 dBm DH1	Yes
TX11	Mid 4 dBm 2DH1	Yes
TX12	Mid 4 dBm 3DH1	Yes
TX13	Mid 4 dBm DH3	Yes
TX14	Mid 4 dBm 2DH3	Yes
TX15	Mid 4 dBm 3DH3	Yes
TX16	Mid 4 dBm DH5	Yes
TX17	Mid 4 dBm 2DH5	Yes
TX18	Mid 4 dBm 3DH5	Yes
TX19	High 4 dBm DH1	Yes
TX20	High 4 dBm 2DH1	Yes
TX21	High 4 dBm 3DH1	Yes
TX22	High 4 dBm DH3	Yes
TX23	High 4 dBm 2DH3	Yes
TX24	High 4 dBm 3DH3	Yes
TX25	High 4 dBm DH5	Yes
TX26	High 4 dBm 2DH5	Yes
TX27	High 4 dBm 3DH5	Yes
TX28	Hopping 4 dBm DH1	Yes
TX29	Hopping 4 dBm 2DH1	Yes
TX30	Hopping 4 dBm 3DH1	Yes
TX31	Hopping 4 dBm DH3	Yes
TX32	Hopping 4 dBm 2DH3	Yes
TX33	Hopping 4 dBm 3DH3	Yes
TX34	Hopping 4 dBm DH5	Yes
TX35	Hopping 4 dBm 2DH5	Yes
TX36	Hopping 4 dBm 3DH5	Yes

2.5 Emissions configuration



The EUT was powered from an off the shelf AC/DC adapter but with the internal battery installed. Ferrite absorbers were fitted to the temporary serial connections (that allow control of test modes) to prevent emissions from this additional cable from influencing the test results. A ferrite absorber was also fitted on the output of the USB PSU to reduce its own emissions. The EUT was configured in all modes by using the software provided on the laptop via the USB to SPI converter. The laptop was only connected for set up and was removed from the chamber for final measurements. The transmit mode was burst with modulation and the power settings for each channel were as stated below:-

Low Channel (2402 MHz) = level +4 dBm
Mid Channel (2441 MHz) = level +4 dBm
Top Channel (2480 MHz) = level +4 dBm

2.5.1 Signal leads

Port Name	Cable Type	Connected
USB	Micro USB	Yes
Headset	3.5 mm	Yes

3 Summary of test results

The Scuf Gaming Controller, Scuf HYRE Controller was tested for compliance to the following standard(s) :

47 CFR Part 15.247 Effective Date 1st October 2017
DSS: Part 15 Spread Spectrum 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 15.247(d) & 15.209	PASSED
5. Radiated emissions above 1 GHz	47 CFR Part 15C Part 15.247(d) & 15.209	PASSED
6. Effective radiated power field strength	47 CFR Part 15C Part 15.247(d)	PASSED
7. Band Edge Compliance	47 CFR Part 15C Part 15.215 & 15.247(d)	PASSED
8. Occupied bandwidth	47 CFR Part 15C Part 15.215	PASSED
9. Maximum Average conducted output power	47 CFR Part 15C Part 15.247(b3)	NOT APPLICABLE[2]
10. Maximum Peak conducted output power	47 CFR Part 15C Part 15.247(b)(1)	PASSED
11. Maximum Power Spectral Density	47 CFR Part 15C Part 15.247(e)	NOT APPLICABLE[3]
12. Antenna power conducted emissions	47 CFR Part 15C Part 15.247(d)	NOT APPLICABLE[4]
13. Duty cycle	47 CFR Part 15C Part 15.35(c)	NOT APPLICABLE[3]
14. FHSS carrier frequency separation	47 CFR Part 15C Part 15.247(a1)	PASSED
15. Average time of occupancy	47 CFR Part 15C Part 15.247(a)(1)(iii)	PASSED
16. Number of Hop Channels	47 CFR Part 15C Part 15.247(a)(1)(iii)	PASSED

[1] EUT lowest internally generated frequency is 12 MHz.
[2] PK Power measurements performed instead.
[3] EUT uses FHSS technology and is therefore not applicable to this test.
[4] The EUT was tested for radiated emissions with its dedicated antenna in position.

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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	2017	Federal Communications Commission PART 15 – RADIO FREQUENCY DEVICES
4.1.2	ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
4.1.3	ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
4.1.4	DA 00-705	2000	PUBLIC NOTICE Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
4.1.5	KDB 558074 D01 v04	2017	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

4.2 Deviations

No deviations were applied.

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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.

During the initial scan, no difference in emissions could be seen across all modulation schemes and channels (test modes). Therefore full tests were performed in mode TX28.

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

E010, E035, ZSW1, E411, E624, E465

See Section 9 for more details

5.1.5 Test results

Temperature of test environment 18°C
Humidity of test environment 43%
Pressure of test environment 101kPa

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH1
Single channel	Hopping

Plot refs
9722-3 Cond 1 AC Live 150k-30M Average
9722-3 Cond 1 AC Live 150k-30M Quasi-Peak
9722-3 Cond 1 AC Neutral 150k-30M Average
9722-3 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	0.166	53.7	50.7	-14.5	36.6	-18.6
2	0.218	47.0	43.7	-19.2	34.9	-18.0
3	0.275	44.5	43.1	-17.9	34.2	-16.8
4	0.329	43.2	41.7	-17.8	32.9	-16.6

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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	0.195	46.9	40.7	-23.1	15.4	-38.4
2	0.228	45.9	40.0	-22.5	28.1	-24.4
3	0.273	45.5	43.9	-17.1	34.3	-16.7
4	0.300	41.8	38.0	-22.2	21.8	-28.4
5	0.329	44.1	41.9	-17.6	34.1	-15.4
6	0.486	30.9	26.9	-29.3	16.5	-29.7

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

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.

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5.2 Radiated emissions 9 - 150 kHz

NOT APPLICABLE: EUT lowest internally generated frequency is 12 MHz.

.

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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 15.209/15.247(d) [Reference 4.1.1 of this report]

5.3.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was rotated in all three orthogonal planes. Radiated Emissions testing was performed whilst powered using an off the shelf power supply.

Initial tests showed no discernible difference in emissions between modulation schemes/modes. Therefore for full tests the EUT was operated in TX1 mode.

5.3.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. Measurements were made in a semi-anechoic chamber (pre-scan) with final measurements 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.

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

Tests were performed using Test Site M.

5.3.4 Test equipment

TMS81, ZSW1, E411

See Section 9 for more details

5.3.5 Test results

Temperature of test environment	19°C
Humidity of test environment	36%
Pressure of test environment	101kPa

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH1
Low channel	2402 MHz

Plot refs
9722-3 Rad 1 150k-30MHz Para
9722-3 Rad 1 150k-30MHz Perp

No discernible difference was noted in emissions between channel/mode settings (exploratory measurements), therefore final measurements are presented for TX Low channel mode (TX1) only for these test ranges.

No signals were found within 20 dB of limits.

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

LIMITS:

15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.
15.247(d) other emissions, outside the intentional band, must be attenuated by at least 20/30dB from the level

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of the fundamental / meet the general limits of 15.209.
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

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5.4 Radiated emissions 30 MHz -1 GHz

5.4.1 Test methods

Test Requirements:	47 CFR Part 15C Part 15.247(d) & 15.209 [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.5 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.209/15.247(d) [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 rotated in all three orthogonal planes. Radiated Emissions testing was performed whilst powered using an off the shelf power supply.

Initial tests showed no discernible difference in emissions between modulation schemes or modes. Therefore for full tests the EUT was operated in TX10 mode.

5.4.3 Test procedure

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

Tests were performed using Test Site M.

5.4.4 Test equipment

LPE364, E743, NSA1, ZSW1, E411

See Section 9 for more details

5.4.5 Test results

Temperature of test environment	16°C
Humidity of test environment	42%
Pressure of test environment	101kPa

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH1
Mid channel	2441 MHz

Plot refs
9722-3 Rad 1 VHF Horiz
9722-3 Rad 1 VHF Vert
9722-3 Rad 1 UHF Horiz
9722-3 Rad 1 UHF Vert

Table of signals measured for Rad 1 Horizontal Sig List

Signal No.	Freq (MHz)	Peak Amp (dBuV/m)	QP Amp (dBuV/m)	QP Lim (dB)
1	33.168	28.2	22.0	-18.0
2	154.076	23.4	17.0	-26.5
3	195.997	25.7	22.7	-20.8
4	255.990	28.2	23.7	-22.3
5	267.998	29.9	26.1	-19.9

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6	275.940	27.4	21.9	-24.1
7	375.993	35.5	32.2	-13.8
8	718.840	34.5	28.9	-17.1

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	33.815	32.9	26.6	-13.4
2	152.696	23.8	17.6	-25.9
3	195.996	24.9	21.5	-22.0
4	235.456	25.1	18.4	-27.6
5	277.831	26.6	20.0	-26.0
6	340.006	32.6	28.2	-17.8
7	375.994	33.9	30.3	-15.7
8	736.168	35.7	29.3	-16.7

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 TX mid channel mode (TX10) only for these test ranges. Whilst Low, Mid and High channels were tested, plots are for illustrative purposes only and only Mid channel plots are shown in this report.

LIMITS:
15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.
15.247(d) other emissions, outside the intentional band, must be attenuated by at least 20/30dB from the level of the fundamental / meet the general limits of 15.209.
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 15.247(d) & 15.209 [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.6 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.247(d) & 15.209 [Reference 4.1.1 of this report]

5.5.2 Configuration of EUT

The EUT was placed on a 1.5 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was rotated in all three orthogonal planes. Radiated Emissions testing was performed whilst powered using an off the shelf power supply.

Initial tests showed no discernible difference in emissions between modulation schemes. The EUT was operated in TX1, TX10 and TX19 modes.

5.5.3 Test procedure

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

Measurements were made in a semi-anechoic chamber 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 and 0.3m was used in the test range 18 - 25GHz.

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

Tests were performed using Test Sites H, M.

5.5.4 Test equipment

E136, E410, E411, E533, E534, E535, E624, LPE261, LPE333, TMS78, TMS79, TMS82

See Section 9 for more details

5.5.5 Test results

Temperature of test environment	14-16°C
Humidity of test environment	38-45%
Pressure of test environment	101kPa

Setup Table

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH1
Low channel	2402 MHz

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
4804	54.3	-19.7	47.4	-6.6	Upright	Vertical
4804	54.1	-19.9	47.2	-6.8	Upright	Horizontal

Setup Table

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH1
Mid channel	2441 MHz

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
4882	56.2	-17.8	49.1	-4.9	Upright	Vertical
4882	58.2	-15.8	51.5	-2.5	Upright	Horizontal
7323	51.7	-22.3	41.8	-12.2	Upright	Vertical
7323	53.1	-20.9	44.4	-9.6	Upright	Horizontal

Plots
9722-3 Rad 2 1-2GHz Vert
9722-3 Rad 2 1-2GHz Horiz
9722-3 Rad 2 2-5GHz Vert
9722-3 Rad 2 2-5GHz Horiz
9722-3 Rad 2 5-6GHz Vert
9722-3 Rad 2 5-6GHz Horiz
9722-3 Mid 6-9 GHz vert
9722-3 Mid 6-9 GHz horiz
9722-3 Mid 9-12.5 GHz vert
9722-3 Mid 9-12.5 GHz horiz
9722-3 Mid 12.5-15 GHz vert
9722-3 Mid 12.5-15 GHz horiz
9722-3 Mid 15-18 GHz vert
9722-3 Mid 15-18 GHz horiz
9722-3 Mid 18-21 GHz vert
9722-3 Mid 18-21 GHz horiz
9722-3 Mid 21-25 GHz vert
9722-3 Mid 21-25 GHz horiz

Setup Table

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH1
High channel	2480 MHz

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
2375.921	45.6	-28.4	38.4	-15.6	Upright	Vertical
2375.942	45.9	-28.1	38.8	-15.2	Upright	Horizontal
4960	57.1	-16.9	50.8	-3.2	Upright	Vertical
4960	55.4	-18.6	49.1	-4.9	Upright	Horizontal
7440	47.8	-26.2	37.7	-16.3	Upright	Vertical
7440	49.1	-24.9	39.5	-14.5	Upright	Horizontal

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

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

LIMITS:
15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.
15.247(d) other emissions, outside the intentional band, must be attenuated by at least 20/30dB from the level of the fundamental / meet the general limits of 15.209.
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.

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5.6 Effective radiated power field strength

5.6.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.247(d) [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 6.6 [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Part 15.247(d) & 15.209(a) [Reference 4.1.1 of this report]

5.6.2 Configuration of EUT

The EUT was placed on a 1.5 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was rotated in all three orthogonal planes to maximise emissions. Final measurements were taken at 3m. The EUT was operated in TX1 to TX10 and TX19.

5.6.3 Test procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment listed in the 'Test Equipment used' section. The power stated is Peak field strength. Tests were performed in test site H.

5.6.4 Test equipment

E533, E534, E535, LPE261, LPE333

See Section 9 for more details

5.6.5 Test results

Temperature of test environment 13°C
Humidity of test environment 56%
Pressure of test environment 101kPa

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH1
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

	Low channel	Mid channel	High channel
Peak Level (dBµV/m) @3m	90.70	93.90	92.40
Antenna Polarisation	Horiz	Horiz	Horiz
EUT Polarisation	Upright	Flat	Upright

LIMITS:
The maximum output power in all cases is 30dBm/ 1watt.

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:
<± 3.9 dB

5.7 Band Edge Compliance

5.7.1 Test methods

Test Requirements:	47 CFR Part 15C Part 15.215 & 15.247(d) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.10 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Part 15.209(a) & 15.247(d) [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 front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres.

The EUT was operated in TX1 to TX36 modes.

5.7.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. The emission from the EUT was maximised before taking the plots. Tests were performed in both hopping and non-hopping modes. Only Peak measurements were made as the peak emissions complied with the average limit.

Tests were performed using Test Site H.

5.7.4 Test equipment

E533, E534, E535, LPE261, LPE333

See Section 9 for more details

5.7.5 Test results

Temperature of test environment	14°C
Humidity of test environment	56%
Pressure of test environment	101kPa

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH1
Low channel	2402 MHz
Mid channel 1	2480 MHz
Mid channel 2	Low hopping MHz
High channel	High hopping MHz

Restricted Band Edge	Low channel	High channel	Low channel	High channel
Peak Level (dBµV/m)	43.8	41.8	48.7	49.6
Peak Plot reference	9722-3 Low rest DH1 pk	9722-3 Upper rest DH1 pk	9722-3 Low rest DH1 pk hopp	9722-3 Upp rest DH1 pk hopp
Average Level (dBµV/m)	N/A	N/A	N/A	N/A
Average Plot reference	N/A	N/A	N/A	N/A

Authorised Band Edge	Low channel	High channel	Low channel	High channel
Authorised Band Edge Plot reference	9722-3 Low auth DH1 pk	9722-3 Upper auth DH1 pk	9722-3 Low auth DH1 pk hopp	9722-3 Upp auth DH1 pk hopp

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	2DH1
Low channel	2402 MHz
Mid channel 1	2480 MHz
Mid channel 2	Low hopping MHz
High channel	High hopping MHz

Restricted Band Edge	Low channel	High channel	Low channel	High channel
Peak Level (dBµV/m)	43.2	41.3	48.1	48.0
Peak Plot reference	9722-3 Low rest 2DH1 pk	9722-3 Upper rest 2DH1 pk	9722-3 Low rest 2DH1 pk hopp	9722-3 Upp rest 2DH1 pk hopp
Average Level (dBµV/m)	N/A	N/A	N/A	N/A
Average Plot reference	N/A	N/A	N/A	N/A

Authorised Band Edge	Low channel	High channel	Low channel	High channel
Authorised Band Edge Plot reference	9722-3 Low auth 2DH1 pk	9722-3 Upper auth 2DH1 pk	9722-3 Low auth 2DH1 pk hopp	9722-3 Upp auth 2DH1 pk hopp

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	3DH1
Low channel	2402 MHz
Mid channel 1	2480 MHz
Mid channel 2	Low hopping MHz
High channel	High hopping MHz

Restricted Band Edge	Low channel	High channel	Low channel	High channel
Peak Level (dBµV/m)	43.5	41.3	48.2	48.3
Peak Plot reference	9722-3 Low rest 3DH1 pk	9722-3 Upper rest 3DH1 pk	9722-3 Low rest 3DH1 pk hopp	9722-3 Upp rest 3DH1 pk hopp
Average Level (dBµV/m)	N/A	N/A	N/A	N/A
Average Plot reference	N/A	N/A	N/A	N/A

Authorised Band Edge	Low channel	High channel	Low channel	High channel
Authorised Band Edge Plot reference	9722-3 Low auth 3DH1 pk	9722-3 Upper auth 3DH1 pk	9722-3 Low auth 3DH1 pk hopp	9722-3 Upp auth 3DH1 pk hopp

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH3
Low channel	2402 MHz
Mid channel 1	2480 MHz
Mid channel 2	Low hopping MHz
High channel	High hopping MHz

Restricted Band Edge	Low channel	High channel	Low channel	High channel
Peak Level (dBµV/m)	43.9	41.2	48.0	49.2
Peak Plot reference	9722-3 Low rest DH3 pk	9722-3 Upper rest DH3 pk	9722-3 Low rest DH3 pk hopp	9722-3 Upp rest DH3 pk hopp
Average Level (dBµV/m)	N/A	N/A	N/A	N/A
Average Plot reference	N/A	N/A	N/A	N/A

Authorised Band Edge	Low channel	High channel	Low channel	High channel
Authorised Band Edge Plot reference	9722-3 Low auth DH3 pk	9722-3 Upper auth DH3 pk	9722-3 Low auth DH3 pk hopp	9722-3 Upp auth DH3 pk hopp

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	2DH3
Low channel	2402 MHz
Mid channel 1	2480 MHz
Mid channel 2	Low hopping MHz
High channel	High hopping MHz

Restricted Band Edge	Low channel	High channel	Low channel	High channel
Peak Level (dBµV/m)	44.5	40.7	48.4	48.2
Peak Plot reference	9722-3 Low rest 2DH3 pk	9722-3 Upper rest 2DH3 pk	9722-3 Low rest 2DH3 pk hopp	9722-3 Upp rest 2DH3 pk hopp
Average Level (dBµV/m)	N/A	N/A	N/A	N/A
Average Plot reference	N/A	N/A	N/A	N/A

Authorised Band Edge	Low channel	High channel	Low channel	High channel
Authorised Band Edge Plot reference	9722-3 Low auth 2DH3 pk	9722-3 Upper auth 2DH3 pk	9722-3 Low auth 2DH3 pk hopp	9722-3 Upp auth 2DH3 pk hopp

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	3DH3
Low channel	2402 MHz
Mid channel 1	2480 MHz
Mid channel 2	Low hopping MHz
High channel	High hopping MHz

Restricted Band Edge	Low channel	High channel	Low channel	High channel
Peak Level (dBµV/m)	43.2	40.6	47.5	48.1
Peak Plot reference	9722-3 Low rest 3DH3 pk	9722-3 Upper rest 3DH3 pk	9722-3 Low rest 3DH3 pk hopp	9722-3 Upp rest 3DH3 pk hopp
Average Level (dBµV/m)	N/A	N/A	N/A	N/A
Average Plot reference	N/A	N/A	N/A	N/A

Authorised Band Edge	Low channel	High channel	Low channel	High channel
Authorised Band Edge Plot reference	9722-3 Low auth 3DH3 pk	9722-3 Upper auth 3DH3 pk	9722-3 Low auth 3DH3 pk hopp	9722-3 Upp auth 3DH3 pk hopp

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH5
Low channel	2402 MHz
Mid channel 1	2480 MHz
Mid channel 2	Low hopping MHz
High channel	High hopping MHz

Restricted Band Edge	Low channel	High channel	Low channel	High channel
Peak Level (dBµV/m)	43.1	41.5	48.1	49.2
Peak Plot reference	9722-3 Low rest DH5 pk	9722-3 Upper rest DH5 pk	9722-3 Low rest DH5 pk hopp	9722-3 Upp rest DH5 pk hopp
Average Level (dBµV/m)	N/A	N/A	N/A	N/A
Average Plot reference	N/A	N/A	N/A	N/A

Authorised Band Edge	Low channel	High channel	Low channel	High channel
Authorised Band Edge Plot reference	9722-3 Low auth DH5 pk	9722-3 Upper auth DH5 pk	9722-3 Low auth DH5 pk hopp	9722-3 Upp auth DH5 pk hopp

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Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	2DH5
Low channel	2402 MHz
Mid channel 1	2480 MHz
Mid channel 2	Low hopping MHz
High channel	High hopping MHz

Restricted Band Edge	Low channel	High channel	Low channel	High channel
Peak Level (dBµV/m)	43.1	40.9	47.5	48.1
Peak Plot reference	9722-3 Low rest 2DH5 pk	9722-3 Upper rest 2DH5 pk	9722-3 Low rest 2DH5 pk hopp	9722-3 Upp rest 2DH5 pk hopp
Average Level (dBµV/m)	N/A	N/A	N/A	N/A
Average Plot reference	N/A	N/A	N/A	N/A

Authorised Band Edge	Low channel	High channel	Low channel	High channel
Authorised Band Edge Plot reference	9722-3 Low auth 2DH5 pk	9722-3 Upper auth 2DH5 pk	9722-3 Low auth 2DH5 pk hopp	9722-3 Upp auth 2DH5 pk hopp

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	3DH5
Low channel	2402 MHz
Mid channel 1	2480 MHz
Mid channel 2	Low hopping MHz
High channel	High hopping MHz

Restricted Band Edge	Low channel	High channel	Low channel	High channel
Peak Level (dBµV/m)	43.2	40.6	48.2	48.2
Peak Plot reference	9722-3 Low rest 3DH5 pk	9722-3 Upper rest 3DH5 pk	9722-3 Low rest 3DH5 pk hopp	9722-3 Upp rest 3DH5 pk hopp
Average Level (dBµV/m)	N/A	N/A	N/A	N/A
Average Plot reference	N/A	N/A	N/A	N/A

Authorised Band Edge	Low channel	High channel	Low channel	High channel
Authorised Band Edge Plot reference	9722-3 Low auth 3DH5 pk	9722-3 Upper auth 3DH5 pk	9722-3 Low auth 3DH5 pk hopp	9722-3 Upp auth 3DH5 pk hopp

Analyser plots for the Band Edge Compliance can be found in Section 6 of this report. These show the 20/30dBc requirement of 15.247(d) are met at the band edges of 2400 and 2483.5 MHz. Restricted band edge plots are also shown in section 6. Restricted bands are 2310-2390 MHz and 2483.5-2500 MHz. Additional results are referenced in section 5.5 and associated plots in section 6 for radiated emissions above 1GHz.

The tables list the field strengths observed in the adjacent restricted bands, which are required to meet the

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tighter 15.209 limits.

Note: Peak measurements comply with the average limits and as such, Average measurements have not been performed.

LIMITS:
AV = 54dBuV/m at band edges
PK = 74dBuV/m at band edges

The restricted band edges closest to the EUT frequency of 2400-2483.5MHz are 2390 & 2483.5MHz.

Further wider span plots have been taken to show the fact that there are no spurious emissions above the restricted limits of 15.209.

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:
<±3.9dB

5.8 Occupied bandwidth

5.8.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.247(a)(1)/(iii) [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 6.9 [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Part 15.215(c) [Reference 4.1.1 of this report]

5.8.2 Configuration of EUT

The EUT was measured on a bench using a spectrum analyser connected to the temporary RF port. The EUT was operated in TX1 to TX27 modes.

5.8.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. A 30kHz RBW, 3x VBW, auto sweep time and max hold settings were used for the 20 dB bandwidth.

Tests were performed using Test Site M.

5.8.4 Test equipment

E410, E411, E624, LPE261, LPE333

See Section 9 for more details

5.8.5 Test results

Temperature of test environment 18°C
Humidity of test environment 46%
Pressure of test environment 101kPa

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH1
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

	Low channel	Mid channel	High channel
20 dB Bandwidth (MHz) Nominal Temp & Volts	0.863249	0.867145	0.860044
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts	9722-3 Low DH1	9722-3 Mid DH1	9722-3 High DH1

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	2DH1
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

	Low channel	Mid channel	High channel
20 dB Bandwidth (MHz) Nominal Temp & Volts	1.25	1.179	1.176
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts	9722-3 Low 2DH1	9722-3 Mid 2DH1	9722-3 High 2DH1

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	3DH1
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

	Low channel	Mid channel	High channel
20 dB Bandwidth (MHz) Nominal Temp & Volts	1.186	1.184	1.184
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts	9722-3 Low 3DH1	9722-3 Mid 3DH1	9722-3 High 3DH1

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH3
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

	Low channel	Mid channel	High channel
20 dB Bandwidth (MHz) Nominal Temp & Volts	0.868414	0.862067	0.856819
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts	9722-3 Low DH3	9722-3 Mid DH3	9722-3 High DH3

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	2DH3
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

	Low channel	Mid channel	High channel
20 dB Bandwidth (MHz) Nominal Temp & Volts	1.251	1.265	1.178
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts	9722-3 Low 2DH3	9722-3 Mid 2DH3	9722-3 High 2DH3

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	3DH3
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

	Low channel	Mid channel	High channel
20 dB Bandwidth (MHz) Nominal Temp & Volts	1.187	1.185	1.184
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts	9722-3 Low 3DH3	9722-3 Mid 3DH3	9722-3 High 3DH3

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH5
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

	Low channel	Mid channel	High channel
20 dB Bandwidth (MHz) Nominal Temp & Volts	0.862771	0.861491	0.860069
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts	9722-3 Low DH5	9722-3 Mid DH5	9722-3 High DH5

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	2DH5
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

	Low channel	Mid channel	High channel
20 dB Bandwidth (MHz) Nominal Temp & Volts	1.254	1.171	1.181
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts	9722-3 Low 2DH5	9722-3 Mid 2DH5	9722-3 High 2DH5

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	3DH5
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

	Low channel	Mid channel	High channel
20 dB Bandwidth (MHz) Nominal Temp & Volts	1.186	1.184	1.18
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts	9722-3 Low 3DH5	9722-3 Mid 3DH5	9722-3 High 3DH5

Analyser plots for the 20 dB bandwidth can be found in Section 6 of this report.

LIMITS:
15.215(c) The 20dB 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 %

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5.9 Maximum Average conducted output power

NOT APPLICABLE: PK Power measurement performed instead.

5.10 Maximum Peak conducted output power

5.10.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.247(b)(1) [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Part 15.247(b)(1) [Reference 4.1.1 of this report]

5.10.2 Configuration of EUT

The EUT was measured on a bench using a power meter connected to the temporary RF port.
The EUT was set to each mode and test signal in turn (see section 2.4) and highest power levels recorded.
The EUT was operated in TX1 to TX27 modes for this test.

5.10.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.
Power meter reading stated is maximum power observed using a peak power head.
Measurements were made on a test bench in site A.

5.10.4 Test equipment

E611

See Section 9 for more details

5.10.5 Test results

Temperature of test environment 18°C
Humidity of test environment 32%
Pressure of test environment 102kPa

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH1
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

Test conditions		Peak Power (dBm)		
Temperature 20 Deg C	5 Volts	Low channel (dBm)	Mid channel (dBm)	High channel (dBm)
Maximum TX Power observed (dBm)		-3.50	-1.90	-1.70
Variation in TX Power observed (dB)		-33.50	-31.90	-31.70

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH3
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

Test conditions		Peak Power (dBm)		
Temperature 20 Deg C	5 Volts	Low channel (dBm)	Peak Power (dBm)	Peak Power (dBm)
Maximum TX Power observed (dBm)		-3.40	-1.80	-1.60
Variation in TX Power observed (dB)		-33.40	-31.80	-31.60

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH5
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

Test conditions		Peak Power (dBm)		
Temperature 20 Deg C	5 Volts	Low channel (dBm)	Mid channel (dBm)	High channel (dBm)
Maximum TX Power observed (dBm)		-3.40	-1.80	-1.60
Variation in TX Power observed (dB)		-33.40	-31.80	-31.60

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	2DH1
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

Test conditions		Peak Power (dBm)		
Temperature 20 Deg C	5 Volts	Low channel (dBm)	Mid channel (dBm)	High channel (dBm)
Maximum TX Power observed (dBm)		-4.40	-2.30	-2.10
Variation in TX Power observed (dB)		-34.40	-32.30	-32.10

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	2DH3
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

Test conditions		Peak Power (dBm)		
Temperature 20 Deg C	5 Volts	Low channel (dBm)	Mid channel (dBm)	High channel (dBm)
Maximum TX Power observed (dBm)		-4.50	-2.40	-2.20
Variation in TX Power observed (dB)		-34.50	-32.40	-32.20

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	2DH5
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

Test conditions		Peak Power (dBm)		
Temperature 20 Deg C	5 Volts	Low channel (dBm)	Mid channel (dBm)	High channel (dBm)
Maximum TX Power observed (dBm)		-4.50	-2.50	-2.20
Variation in TX Power observed (dB)		-34.50	-32.50	-32.20

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	3DH1
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

Test conditions		Peak Power (dBm)		
Temperature 20 Deg C	5 Volts	Low channel (dBm)	Mid channel (dBm)	High channel (dBm)
Maximum TX Power observed (dBm)		-4.40	-2.30	-2.10
Variation in TX Power observed (dB)		-34.40	-32.30	-32.10

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	3DH3
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

Test conditions		Peak Power (dBm)		
Temperature 20 Deg C	5 Volts	Low channel (dBm)	Mid channel (dBm)	High channel (dBm)
Maximum TX Power observed (dBm)		-4.50	-2.40	-2.20
Variation in TX Power observed (dB)		-34.50	-32.40	-32.20

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	3DH5
Low channel	2402 MHz
Mid channel	2441 MHz
High channel	2480 MHz

Test conditions		Peak Power (dBm)		
Temperature 20 Deg C	5 Volts	Low channel (dBm)	Mid channel (dBm)	High channel (dBm)
Maximum TX Power observed (dBm)		-4.50	-2.40	-2.20
Variation in TX Power observed (dB)		-34.50	-32.40	-32.20

LIMITS:
15.247(b)(1) For FHSS operating 2400-2483.5 MHz employing at least 75 channels 1 Watt.

These results show that the EUT has PASSED this test.

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

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5.11 Maximum Power Spectral Density

NOT APPLICABLE: EUT uses FHSS technology and is therefore not applicable to this test.

5.12 Antenna power conducted emissions

NOT APPLICABLE: The EUT was tested for radiated emissions with its dedicated antenna in position.

5.13 Duty cycle

NOT APPLICABLE: EUT uses FHSS technology and is therefore not applicable to this test.

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5.14 FHSS carrier frequency separation

5.14.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.247(a1) [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 7.8 [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Part 15.247(a1) [Reference 4.1.1 of this report]

5.14.2 Configuration of EUT

The EUT was tested on the bench and ambient conditions were monitored. The EUT was operated in mode TX28.

5.14.3 Test procedure

Tests were made using the measuring equipment listed in the 'Test Equipment' Section. With the EUT hopping, a span was set on the spectrum analyser to show two adjacent channel peaks. The analyser was set to Peak detector and a max held trace, the trace was allowed enough sweeps to stabilise.

Tests were performed in test site A.

5.14.4 Test equipment

E412, E461

See Section 9 for more details

5.14.5 Test results

Temperature of test environment 19°C
Humidity of test environment 55%
Pressure of test environment 102kPa

Band	2400-2483.5 MHz
Power Level	2.5 mW
Channel Spacing	1 MHz
Mod Scheme	DH1
Single channel	Hopping

	Single channel
Separation (kHz)	998.1687
Plot of Separation (kHz)	9722-3 Carrier frequency separation

Analyser plots for the carrier separation can be found in Section 6 of this report.

LIMITS:
FHSS shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the -20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W.

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 %

5.15 Average time of occupancy

5.15.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.247(a)(1)(iii) [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 7.8 [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Part 15.247(a)(1)(i)(iii) [Reference 4.1.1 of this report]

5.15.2 Configuration of EUT

The EUT was measured on a bench using a spectrum analyser connected to the temporary RF port. Ambient conditions were monitored. The EUT was operated in TX30 and TX33 and TX36 modes for this test.

5.15.3 Test procedure

Tests were made using the measuring equipment listed in the 'Test Equipment' Section. With the EUT hopping, a suitable sweep time was set on the spectrum analyser in zero span mode centred on a hopping channel. Both the TX time period and the repetition time were measured and plotted for comparison to the limits.

Tests were performed in test site A.

5.15.4 Test equipment

E547, E755

See Section 9 for more details

5.15.5 Test results

Temperature of test environment 19°C
Humidity of test environment 30%
Pressure of test environment 101kPa

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	3DH1
Single channel	Hopping

Measured Dwell time/pulse width (ms)	0.414
Period time (s)	31.6
Instances of pulse within period time	328
Average time of occupancy (ms)	135.792
Measured Dwell time/pulse width (ms)	9722-3 3DH1 max burst length
Period time (s)	9722-3 2427 MHz 3DH1 accumulated TX time

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	3DH3
Single channel	Hopping

Measured Dwell time/pulse width (ms)	1.664
Period time (s)	31.6
Instances of pulse within period time	167
Average time of occupancy (ms)	277.888
Measured Dwell time/pulse width (ms)	9722-3 3DH3 max burst length
Period time (s)	9722-3 2427 MHz 3DH3 accumulated TX time

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	3DH5
Single channel	Hopping

Measured Dwell time/pulse width (ms)	2.916
Period time (s)	31.6
Instances of pulse within period time	108
Average time of occupancy (ms)	314.928
Measured Dwell time/pulse width (ms)	9722-3 3DH5 max burst length
Period time (s)	9722-3 2427 MHz 3DH5 accumulated TX time

Note: Only worst case scheme (longest TX time) tested.

Analyser plots showing pulse width and period /repetition can be found in Section 6 of this report.

LIMITS:

FHSS operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used.

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:
2.57 ms

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5.16 Number of Hop Channels

5.16.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.247(a)(1)(iii) [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 7.8 [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Part 15.247(a)(1)(iii) [Reference 4.1.1 of this report]

5.16.2 Configuration of EUT

The EUT was measured on a bench using a spectrum analyser connected to the temporary RF port. Ambient conditions were monitored. The EUT was operated in mode TX28 for this test.

5.16.3 Test procedure

Tests were made using the measuring equipment noted in the 'Test Equipment' Section at Site A. With the EUT hopping, a suitable span was set on the spectrum analyser to show clearly over a range of plots the number of channels being used by the EUT. The analyser was set to Peak detector and max held and the trace was allowed to stabilise for each plot.

5.16.4 Test equipment

E412, E461

See Section 9 for more details

5.16.5 Test results

Temperature of test environment	20°C
Humidity of test environment	55%
Pressure of test environment	102kPa

Band	2400-2483.5 MHz
Power Level	4 dBm
Channel Spacing	1 MHz
Mod Scheme	DH1
Single channel	Hopping

No of hopping Channels	79
Minimum No. Required number by specification	15
Plot of Hopping Channels 1-24	9722-3 Hopping channels 2400-2425 MHz
Plot of Hopping Channels 24-49	9722-3 Hopping channels 2425-2450 MHz
Plot of Hopping Channels 49-74	9722-3 Hopping channels 2450-2475 MHz
Plot of Hopping Channels 74-79	9722-3 Hopping channels 2475-2500 MHz

Analyser plots showing the number of hopping channels can be found in Section 6 of this report.

LIMITS:
FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used. FHSs operating in the band 5725-5850 MHz shall use at least 75 hopping channels.

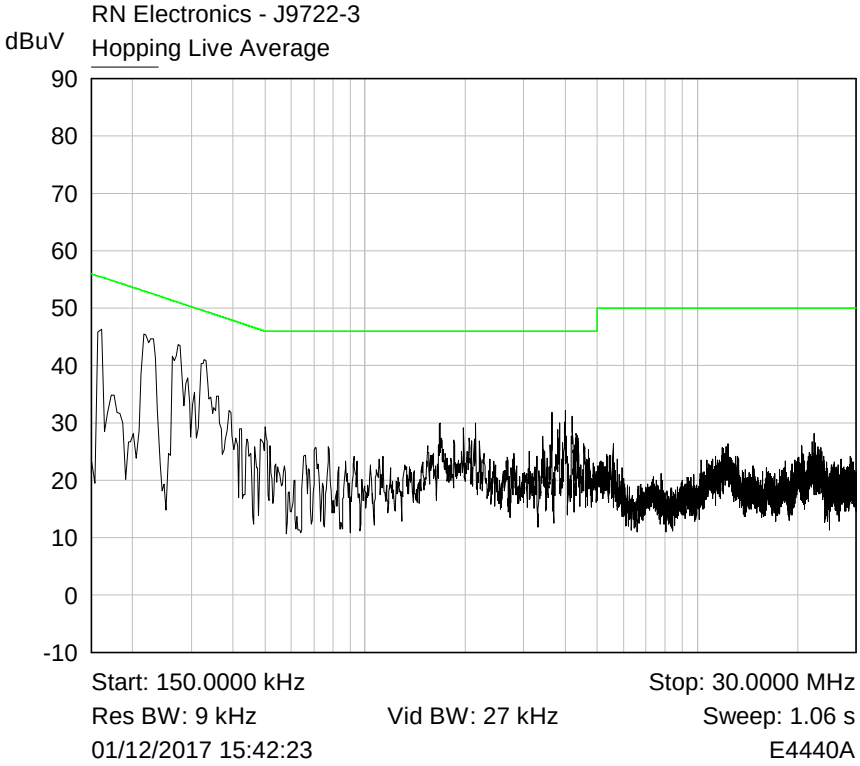
These results show that the EUT has PASSED this test.

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

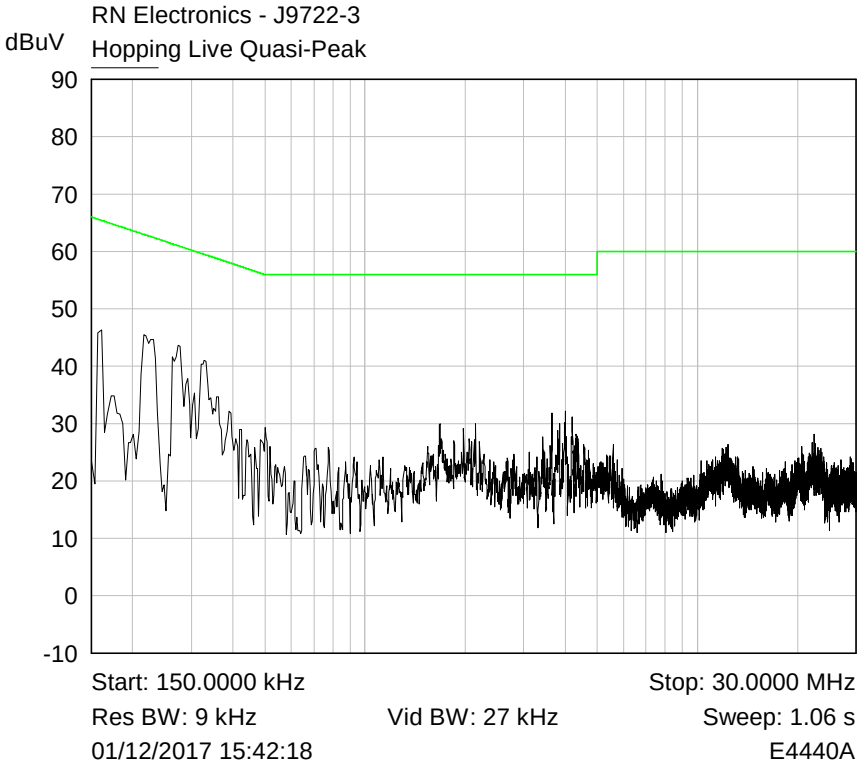
6 Plots/Graphical results

6.1 AC power line conducted emissions

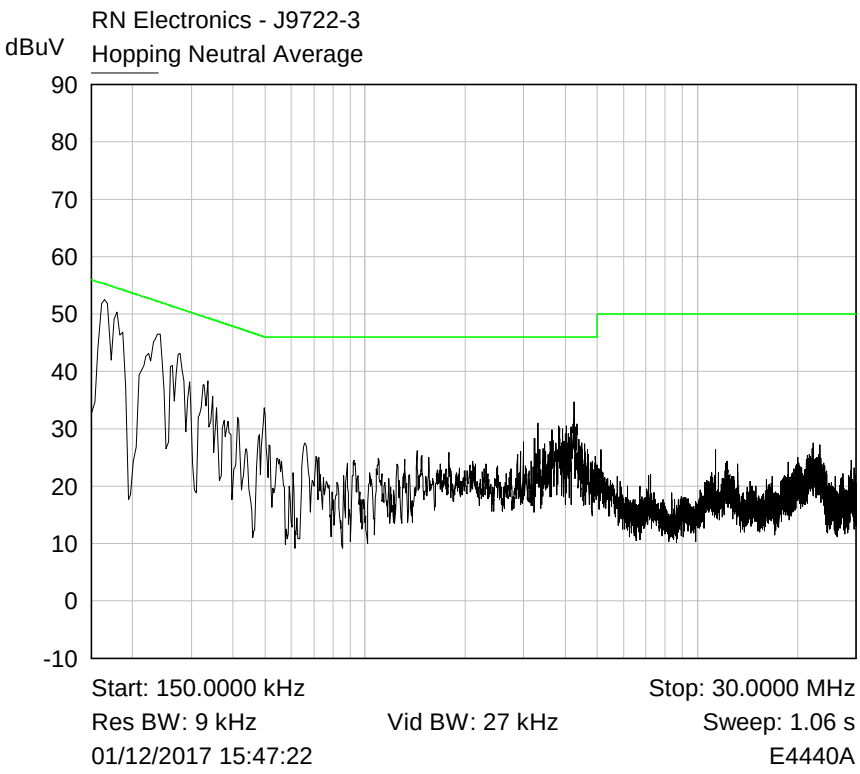
RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH1, Channel Hopping



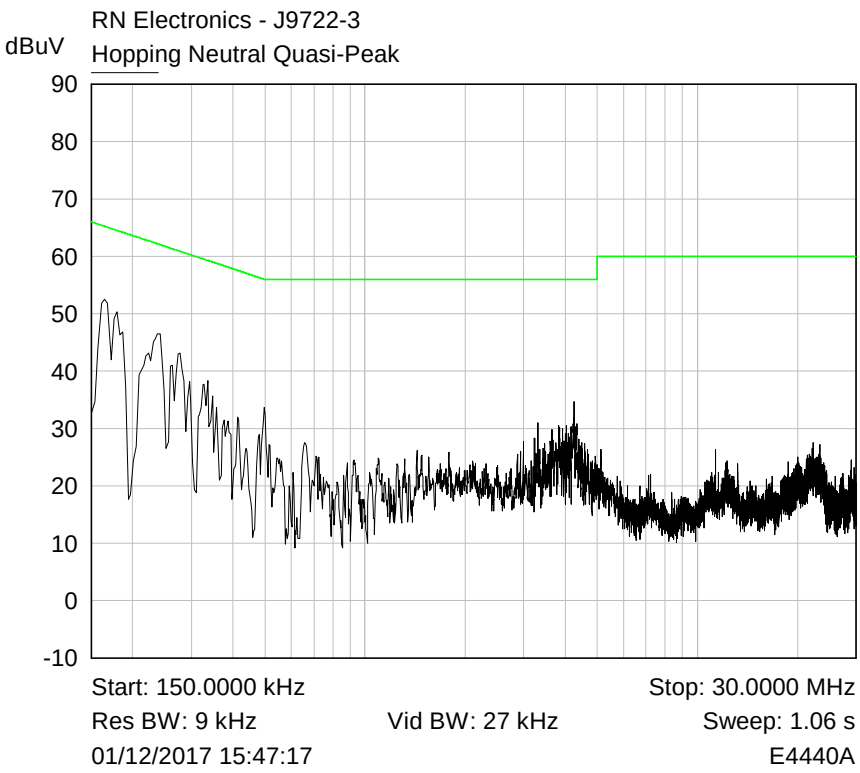
Plot of Live150k-30M Average



Plot of Live150k-30M Quasi-Peak



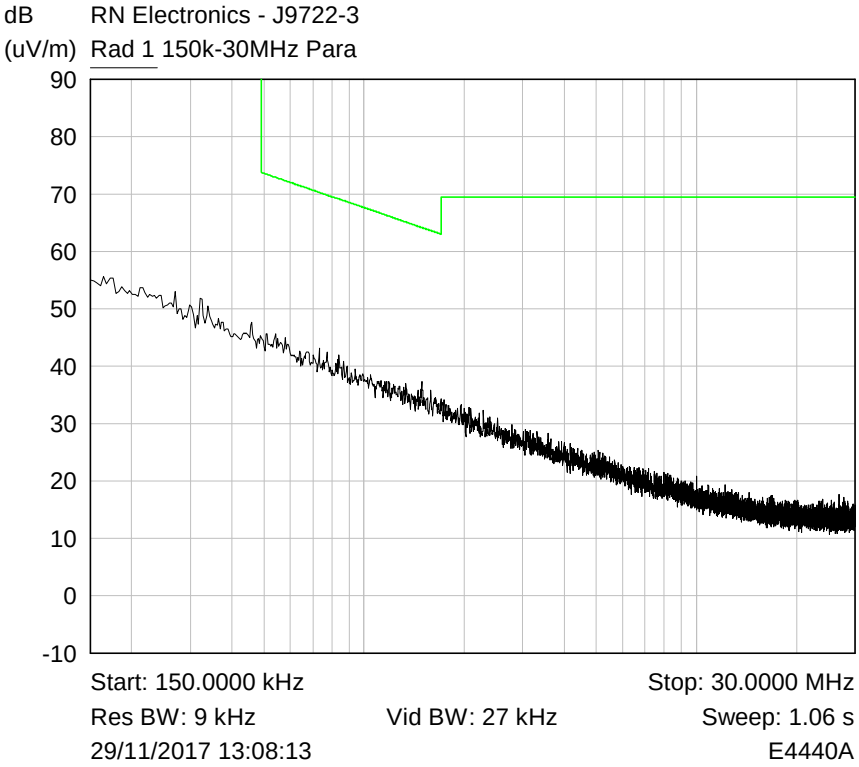
Plot of Neutral150k-30M Average



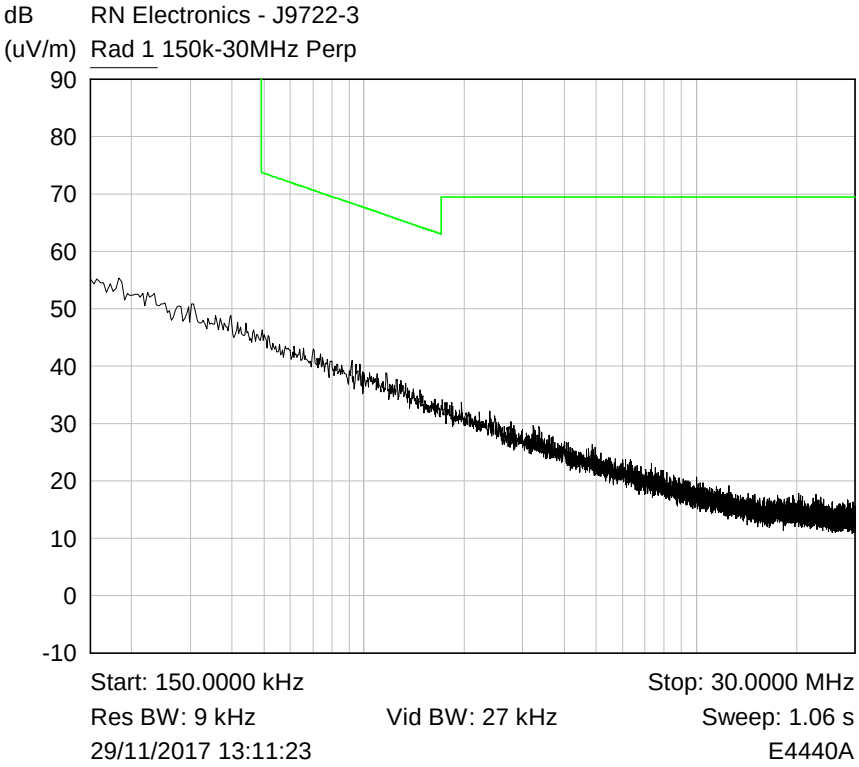
Plot of Neutral150k-30M Quasi-Peak

6.2 Radiated emissions 150 kHz - 30 MHz

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH1, Channel 2402 MHz



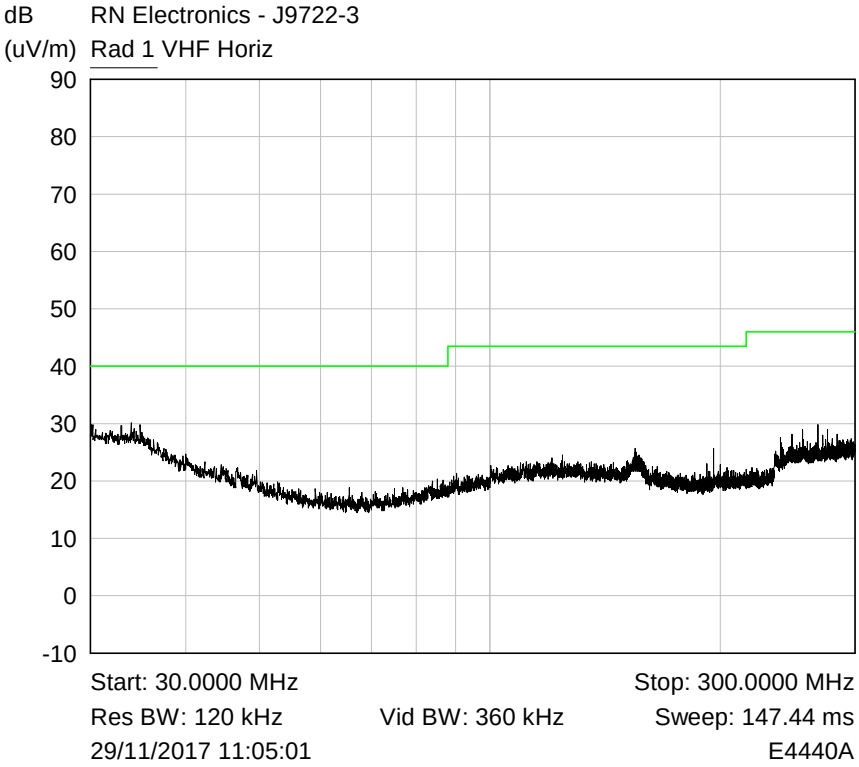
Plot of 150kHz-30MHz Parallel



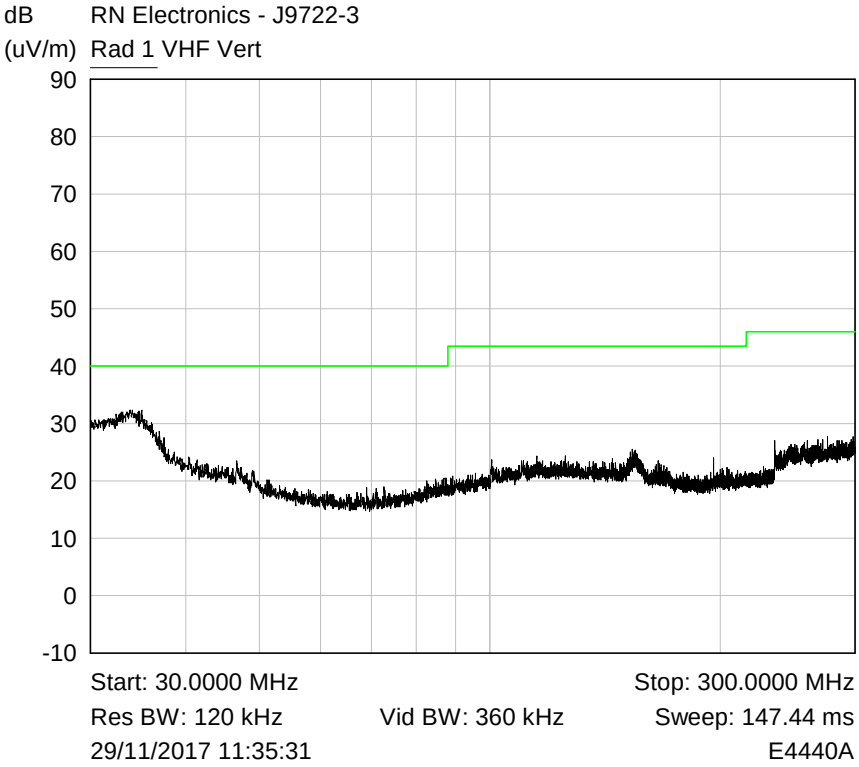
Plot of 150kHz-30MHz Perpendicular

6.3 Radiated emissions 30 MHz -1 GHz

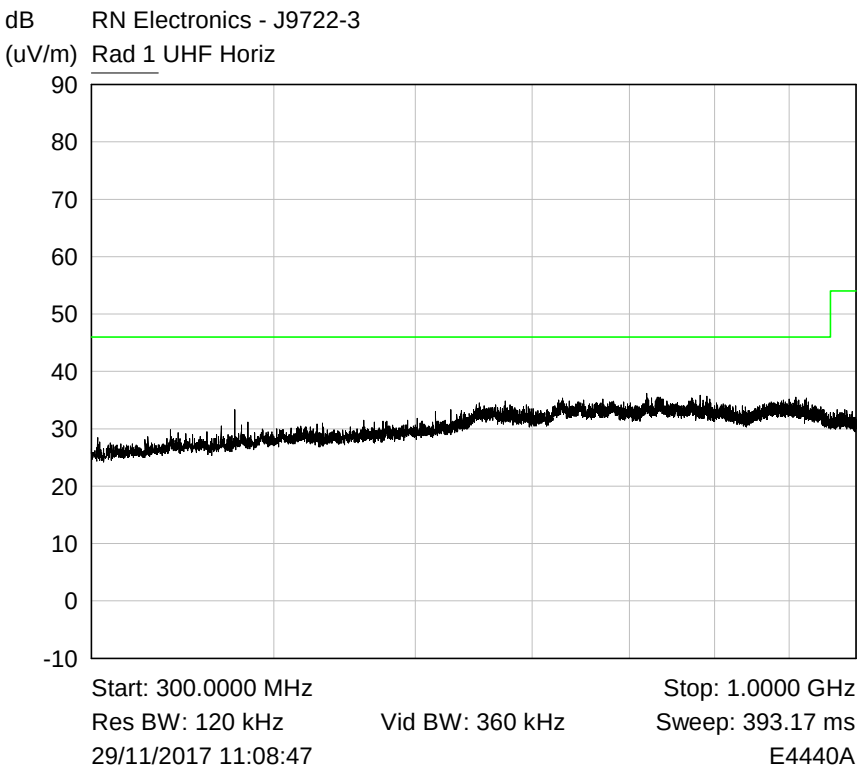
RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH1, Channel 2402 MHz



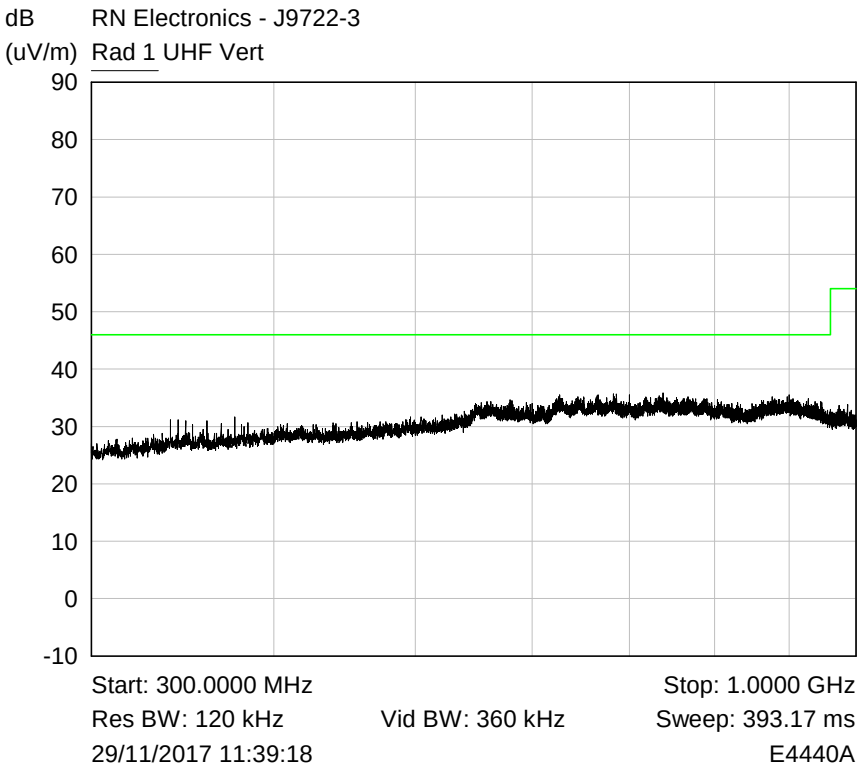
Plot of Peak emissions for VHF Horizontal against the QP limit line.



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



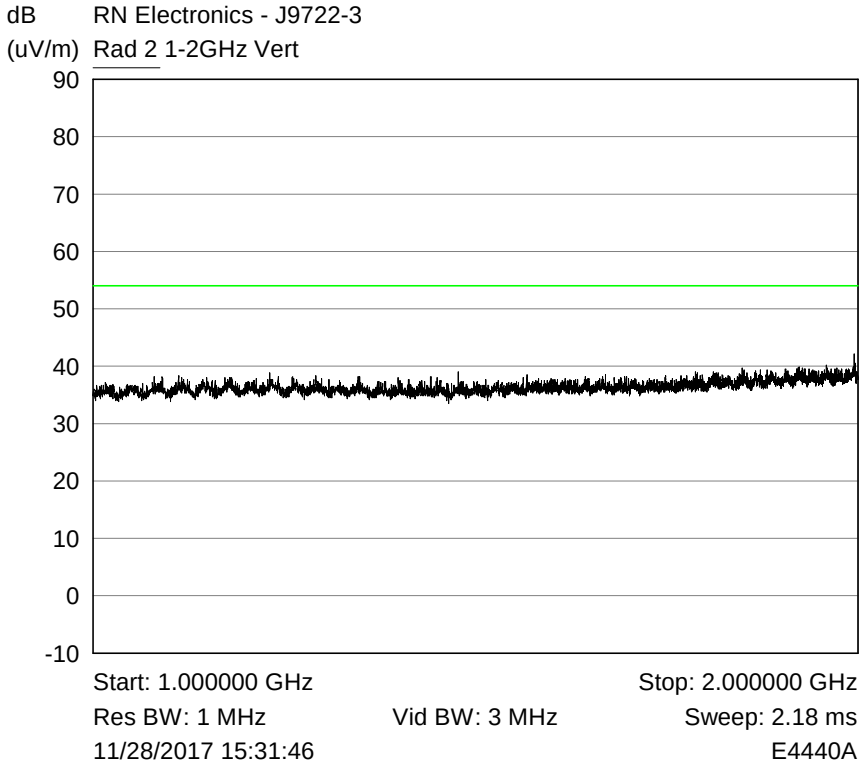
Plot of Peak emissions for UHF Horizontal against the QP limit line.

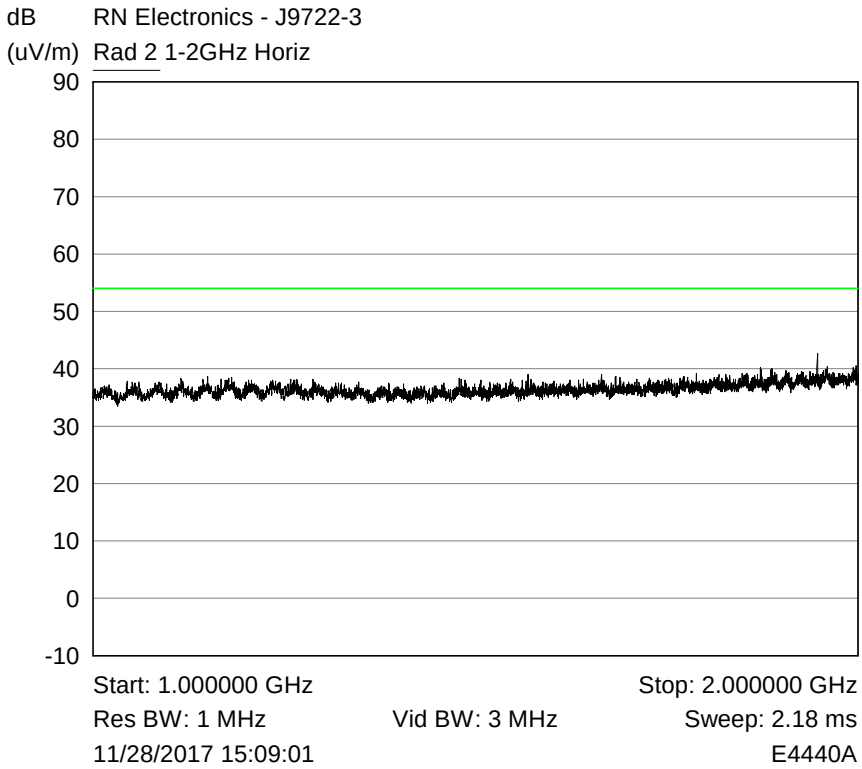


Plot of Peak emissions for UHF Vertical against the QP limit line.

6.4 Radiated emissions above 1 GHz

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH1, Channel 2441 MHz





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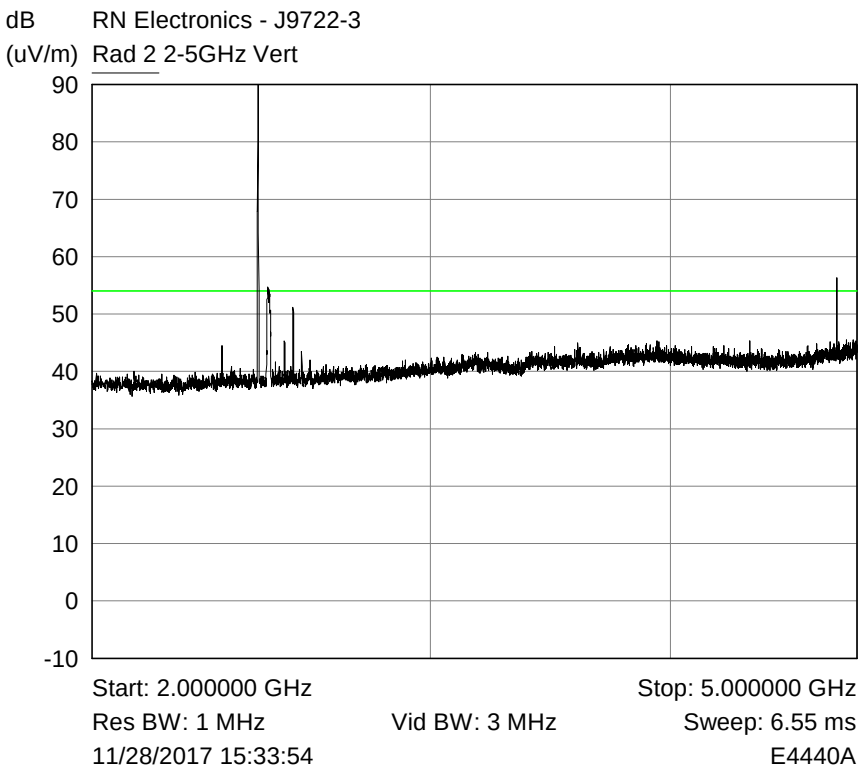
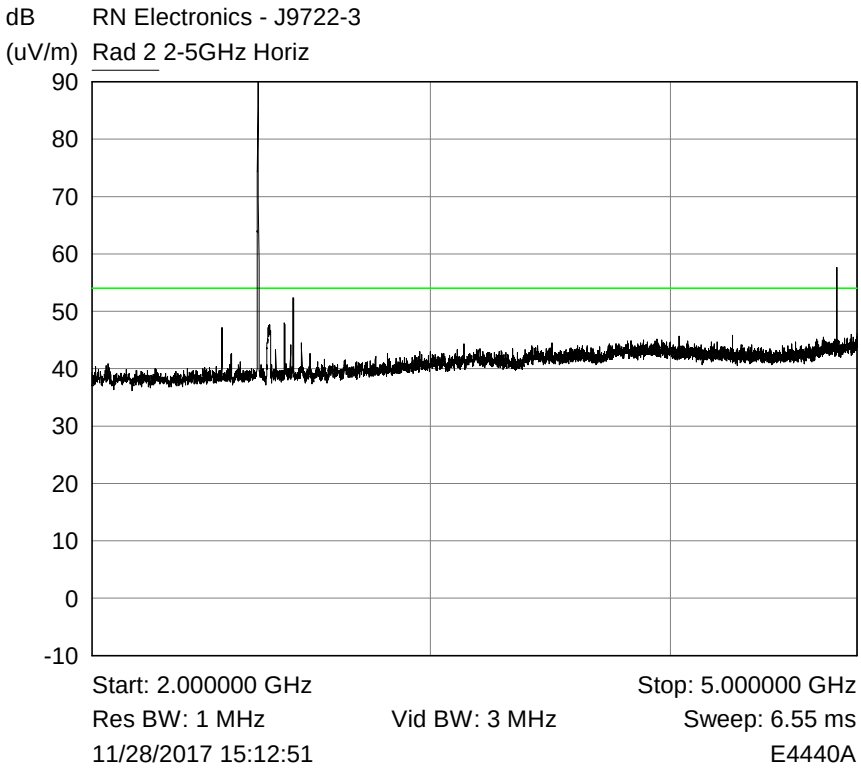
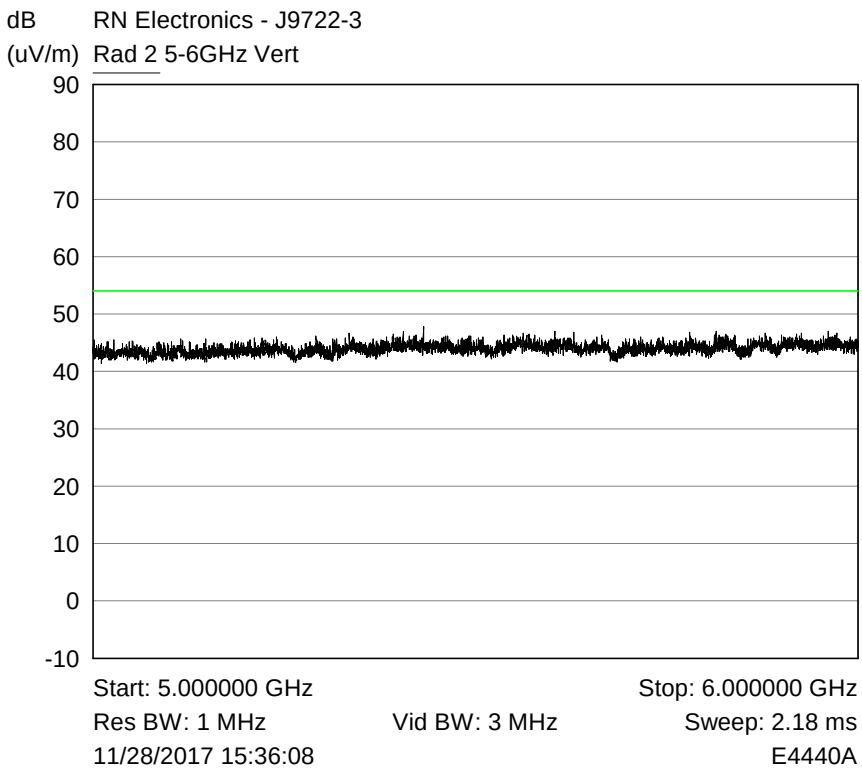
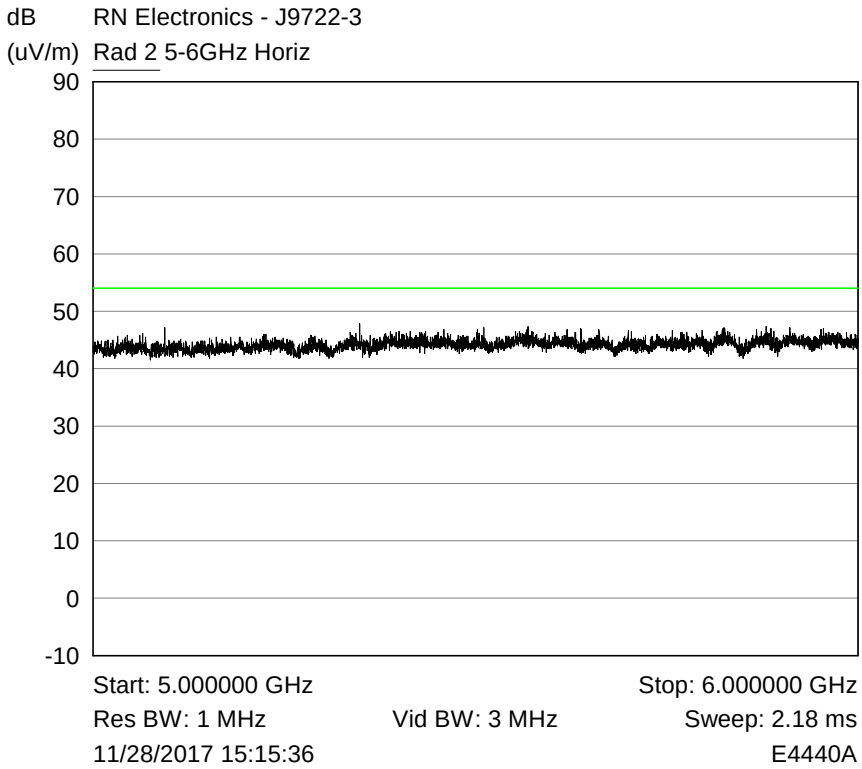
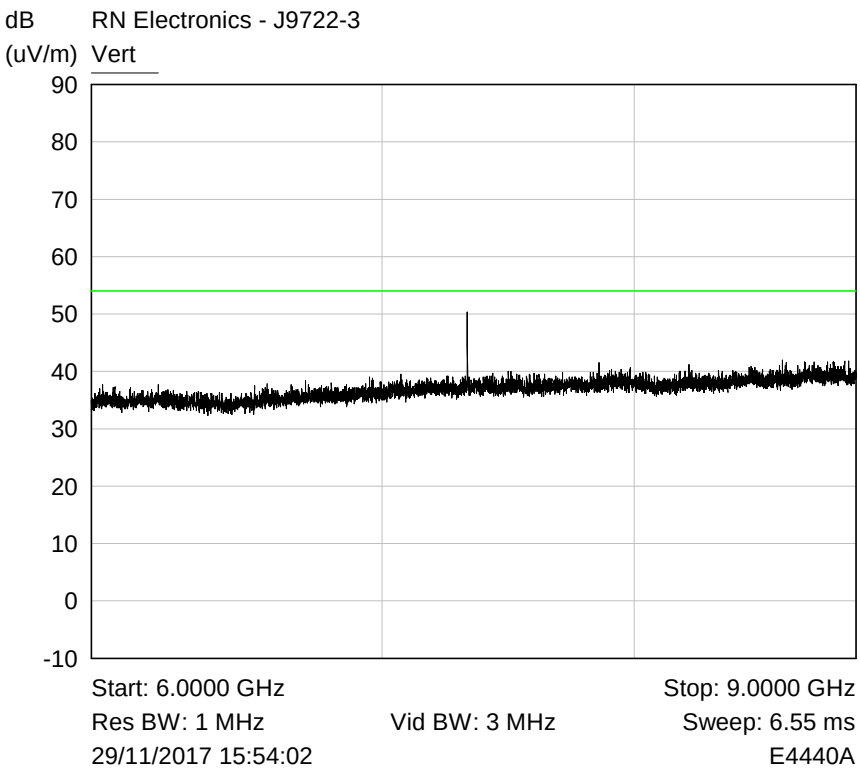


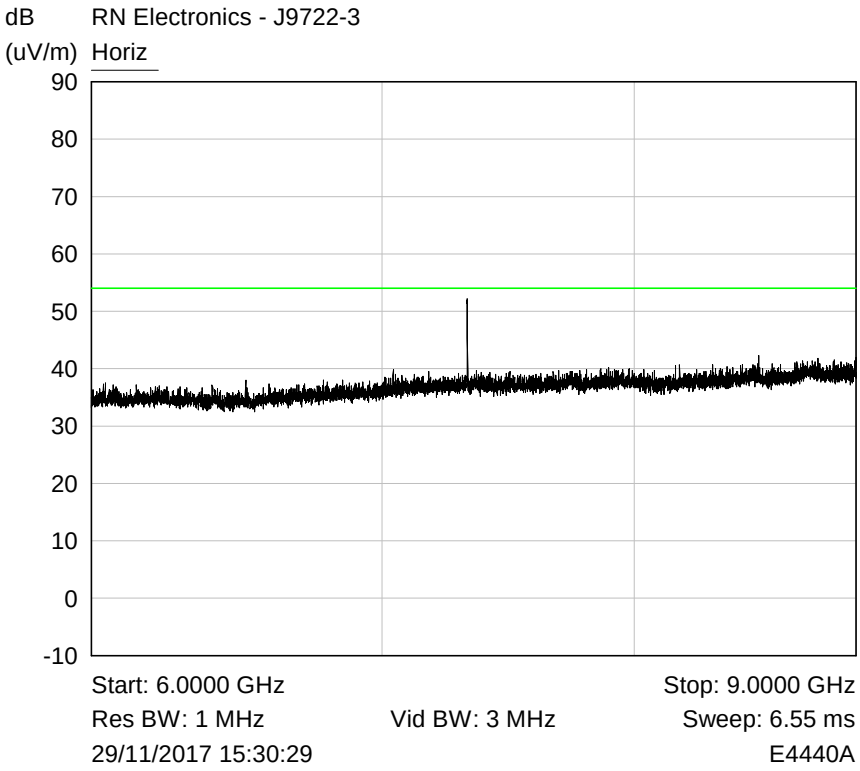


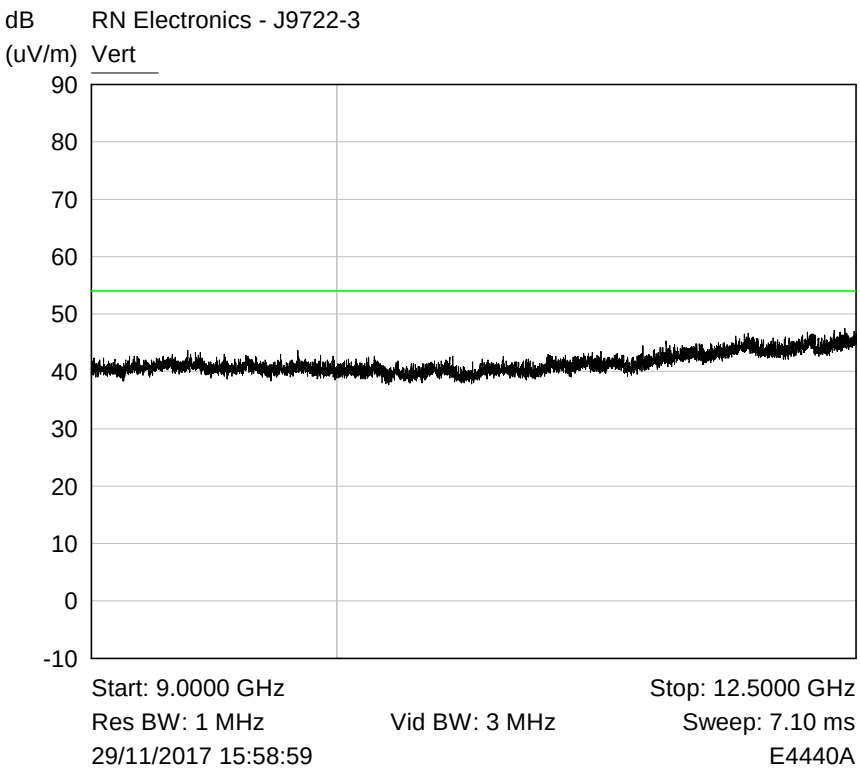
ALL RIGHTS RESERVED

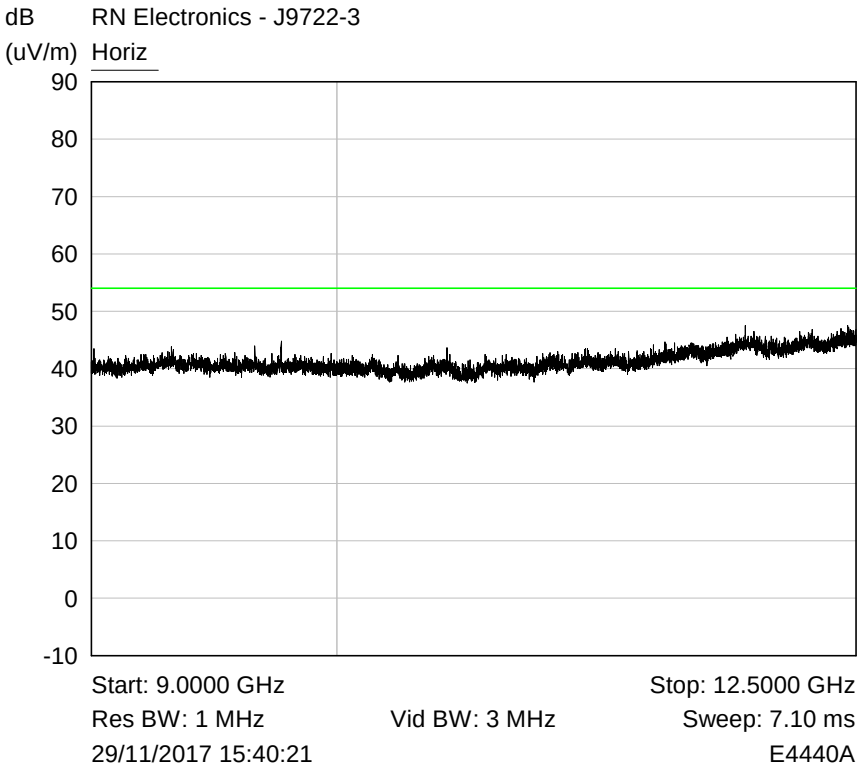


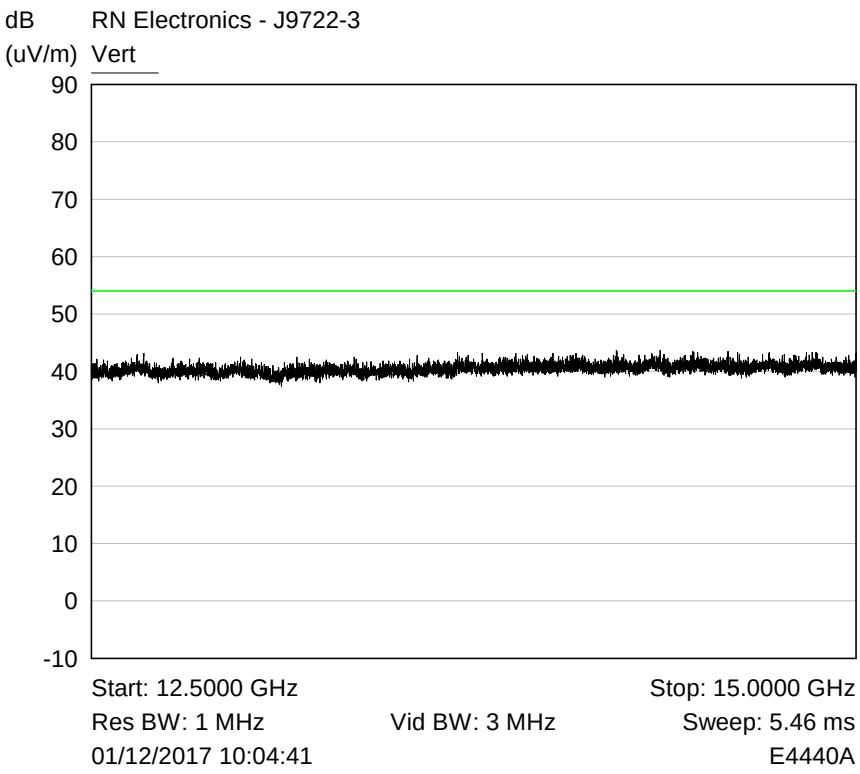


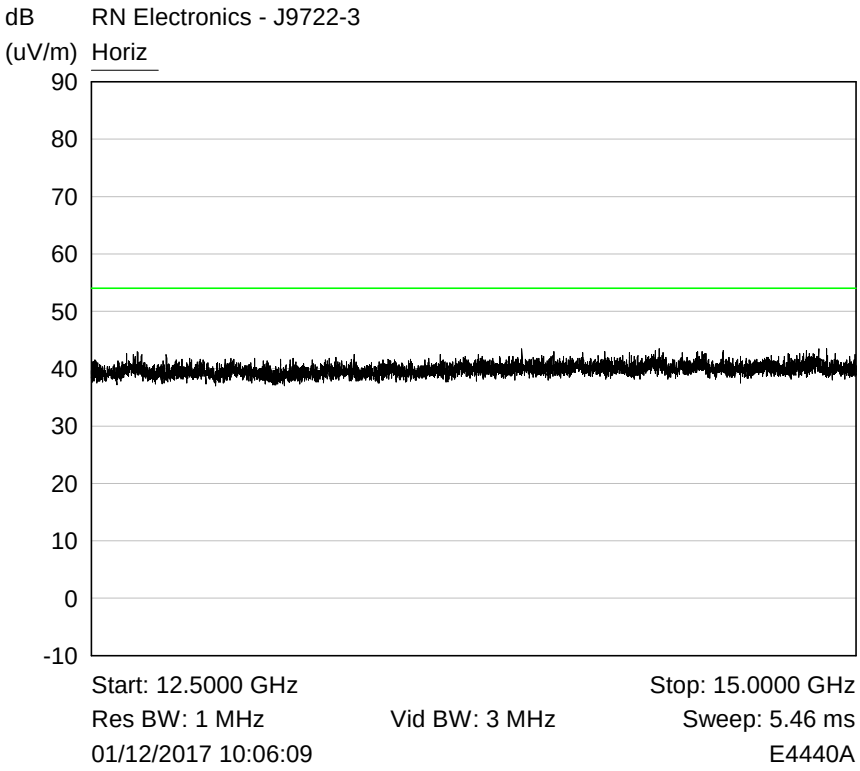

dB
(uV/m)
RN Electronics - J9722-3
Vert
90
80
70
60
50
40
30
20
10
0
-10
Start: 6.0000 GHz
Stop: 9.0000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 6.55 ms
29/11/2017 15:54:02
E4440A

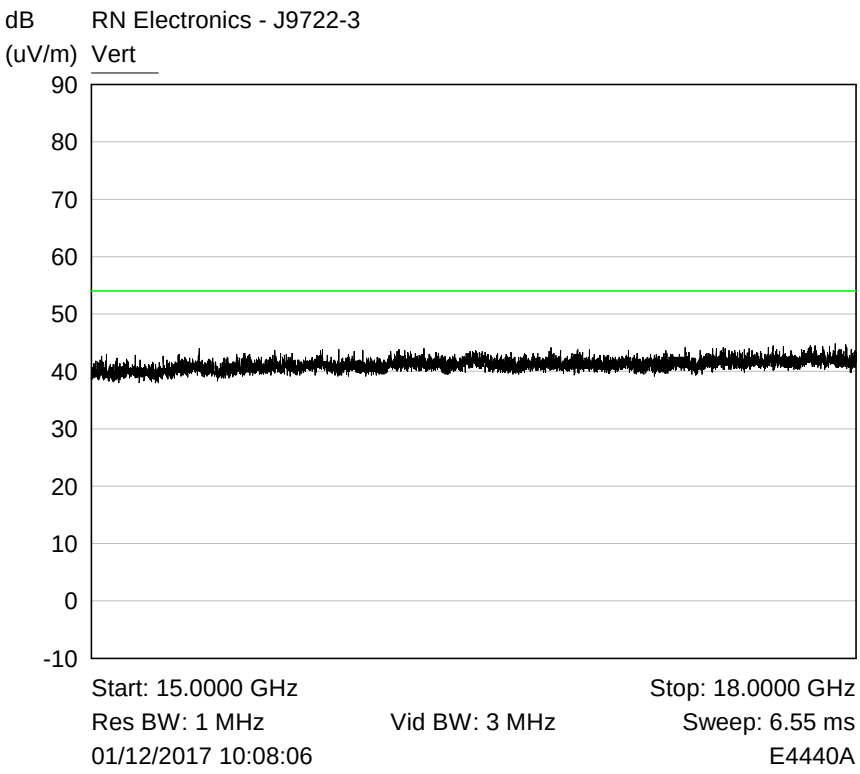

dB
(uV/m)
RN Electronics - J9722-3
Horiz
90
80
70
60
50
40
30
20
10
0
-10
Start: 6.0000 GHz
Stop: 9.0000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 6.55 ms
29/11/2017 15:30:29
E4440A

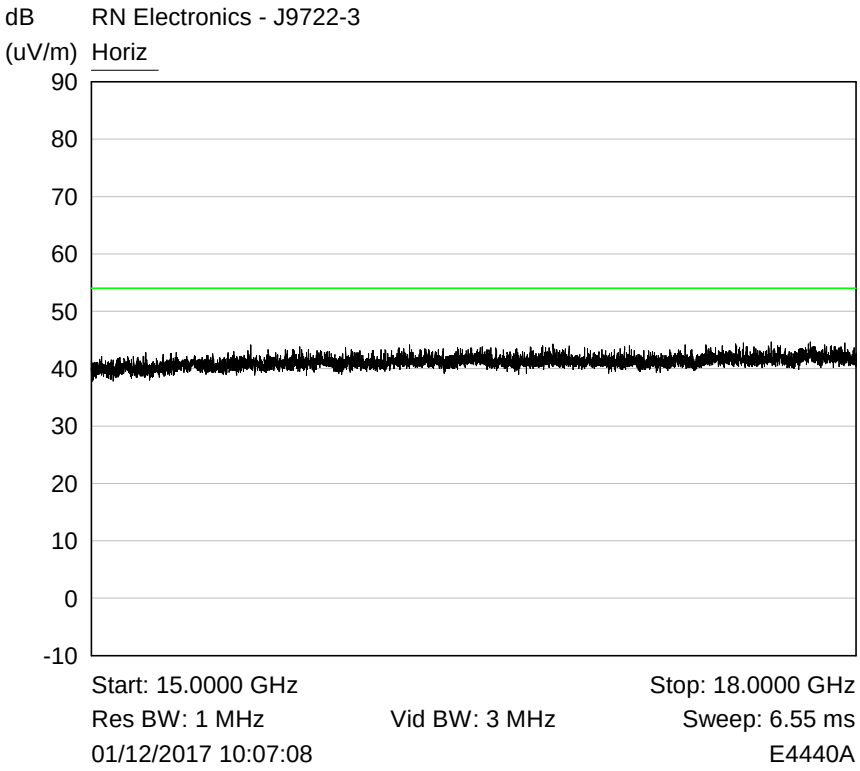

dB
(uV/m)
RN Electronics - J9722-3
Vert
90
80
70
60
50
40
30
20
10
0
-10
Start: 9.0000 GHz
Stop: 12.5000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 7.10 ms
29/11/2017 15:58:59
E4440A

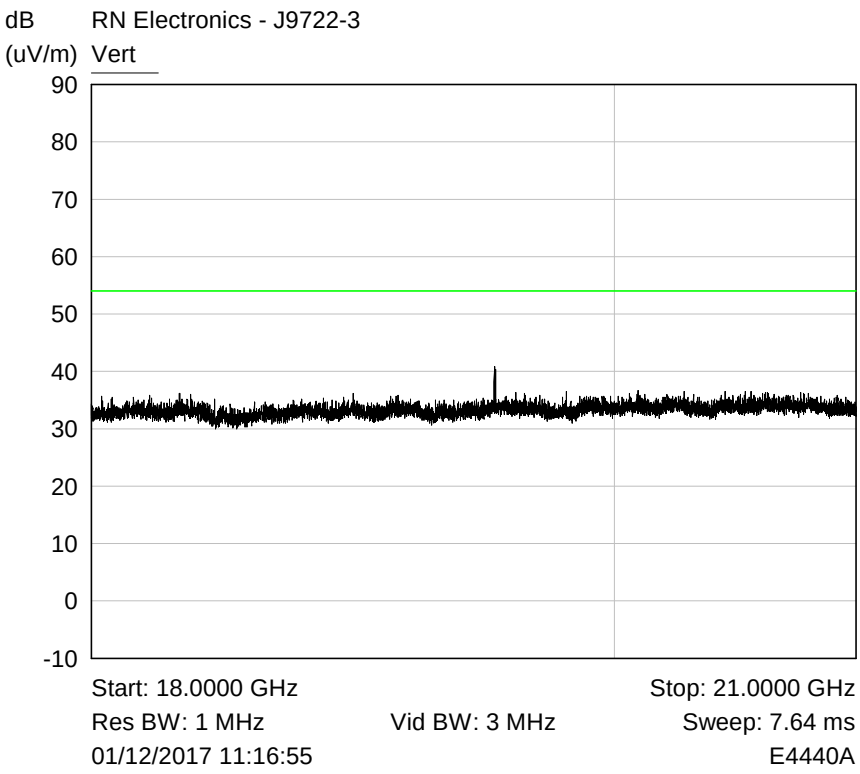

dB
(uV/m)
RN Electronics - J9722-3
Horiz
90
80
70
60
50
40
30
20
10
0
-10
Start: 9.0000 GHz
Stop: 12.5000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 7.10 ms
29/11/2017 15:40:21
E4440A

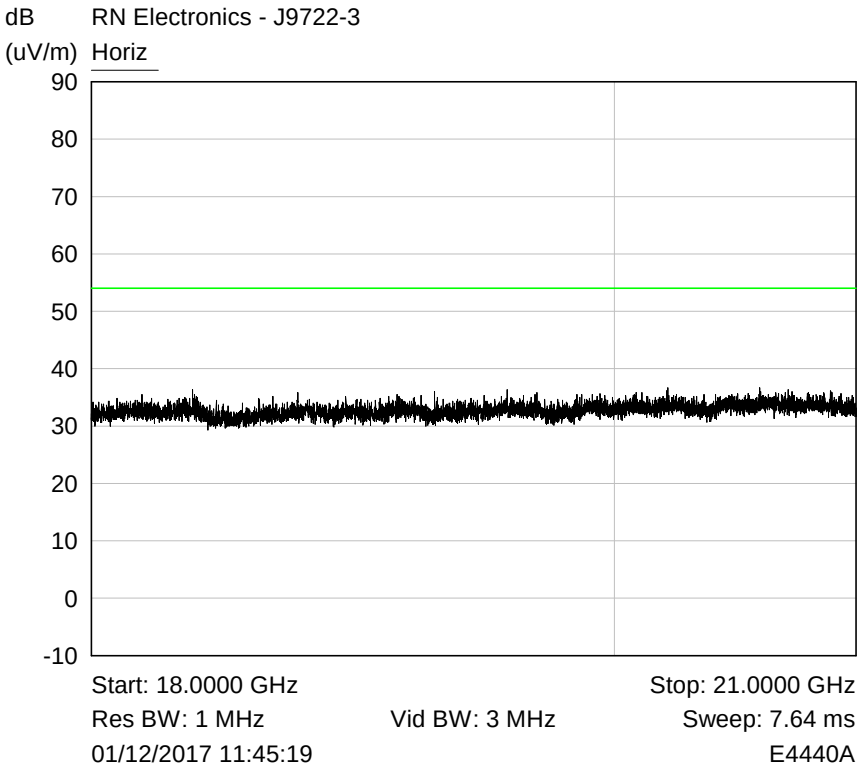

dB
(uV/m)
RN Electronics - J9722-3
Vert
90
80
70
60
50
40
30
20
10
0
-10
Start: 12.5000 GHz
Stop: 15.0000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 5.46 ms
01/12/2017 10:04:41
E4440A

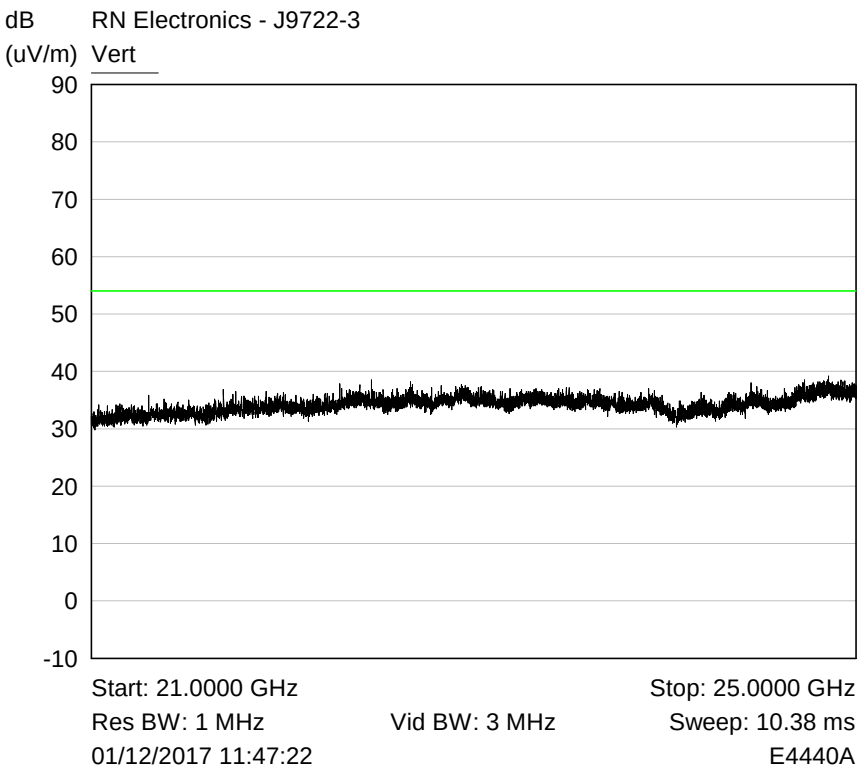

dB
(uV/m)
RN Electronics - J9722-3
Horiz
90
80
70
60
50
40
30
20
10
0
-10
Start: 12.5000 GHz
Stop: 15.0000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 5.46 ms
01/12/2017 10:06:09
E4440A

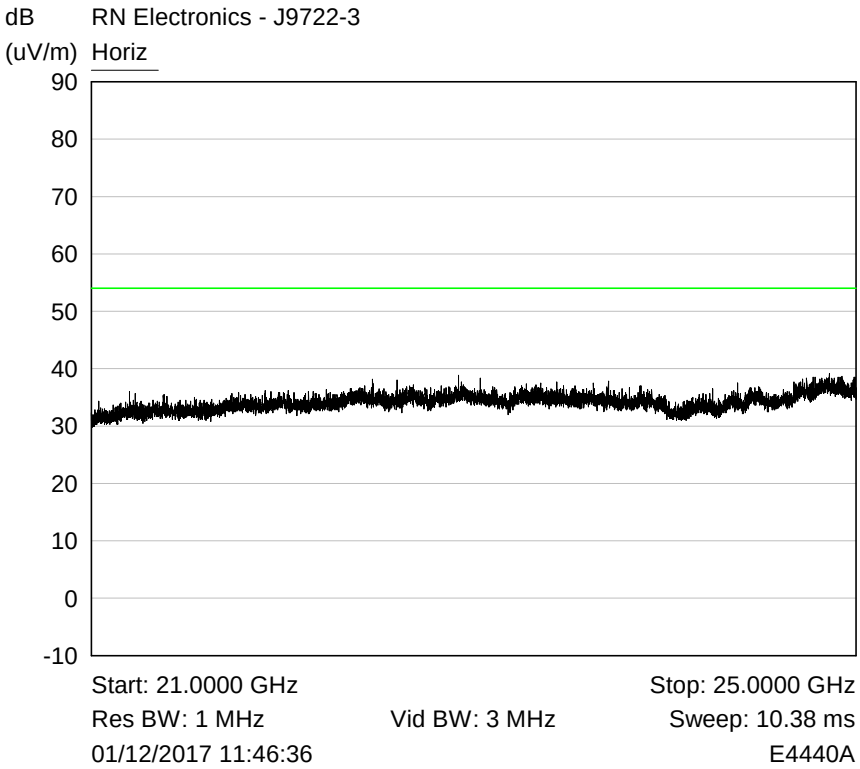

dB
(uV/m)
RN Electronics - J9722-3
Vert
90
80
70
60
50
40
30
20
10
0
-10
Start: 15.0000 GHz
Stop: 18.0000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 6.55 ms
01/12/2017 10:08:06
E4440A


dB
(uV/m)
RN Electronics - J9722-3
Horiz
90
80
70
60
50
40
30
20
10
0
-10
Start: 15.0000 GHz
Stop: 18.0000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 6.55 ms
01/12/2017 10:07:08
E4440A


dB
(uV/m)
RN Electronics - J9722-3
Vert
90
80
70
60
50
40
30
20
10
0
-10
Start: 18.0000 GHz
Stop: 21.0000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 7.64 ms
01/12/2017 11:16:55
E4440A

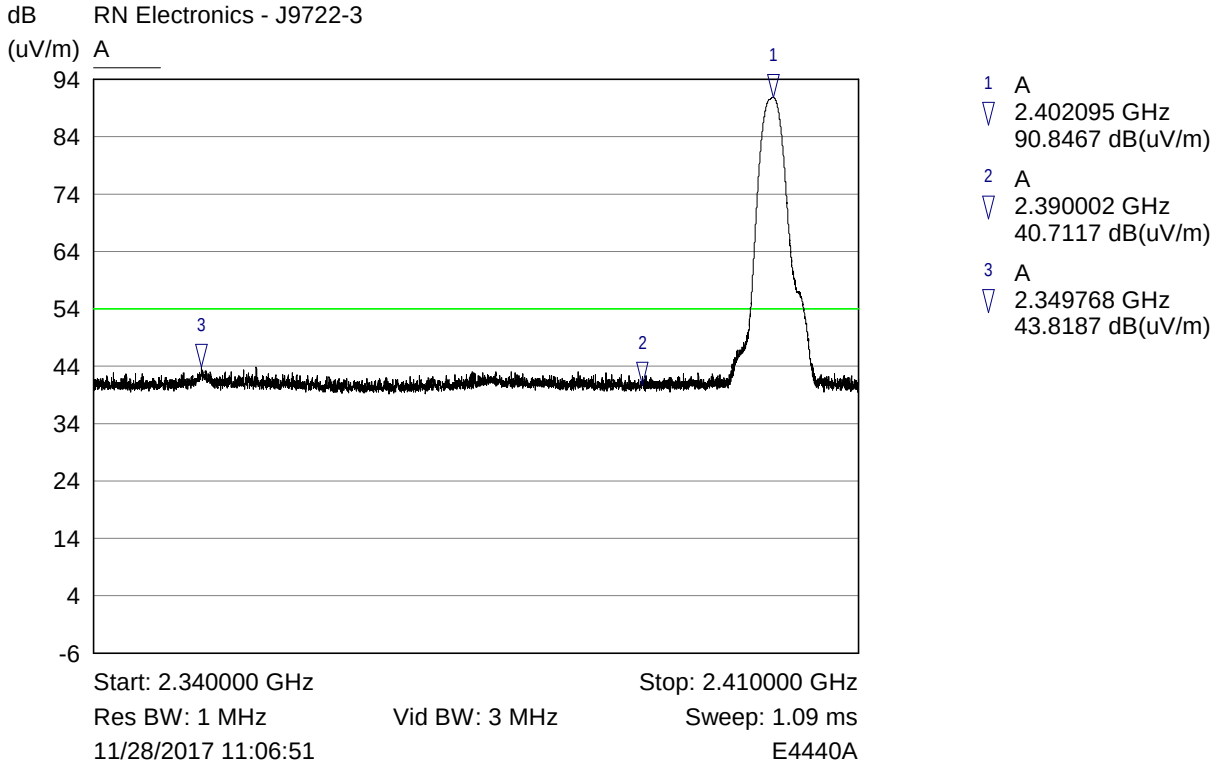

dB
(uV/m)
RN Electronics - J9722-3
Horiz
90
80
70
60
50
40
30
20
10
0
-10
Start: 18.0000 GHz
Stop: 21.0000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 7.64 ms
01/12/2017 11:45:19
E4440A


dB
(uV/m)
RN Electronics - J9722-3
Vert
90
80
70
60
50
40
30
20
10
0
-10
Start: 21.0000 GHz
Stop: 25.0000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 10.38 ms
01/12/2017 11:47:22
E4440A

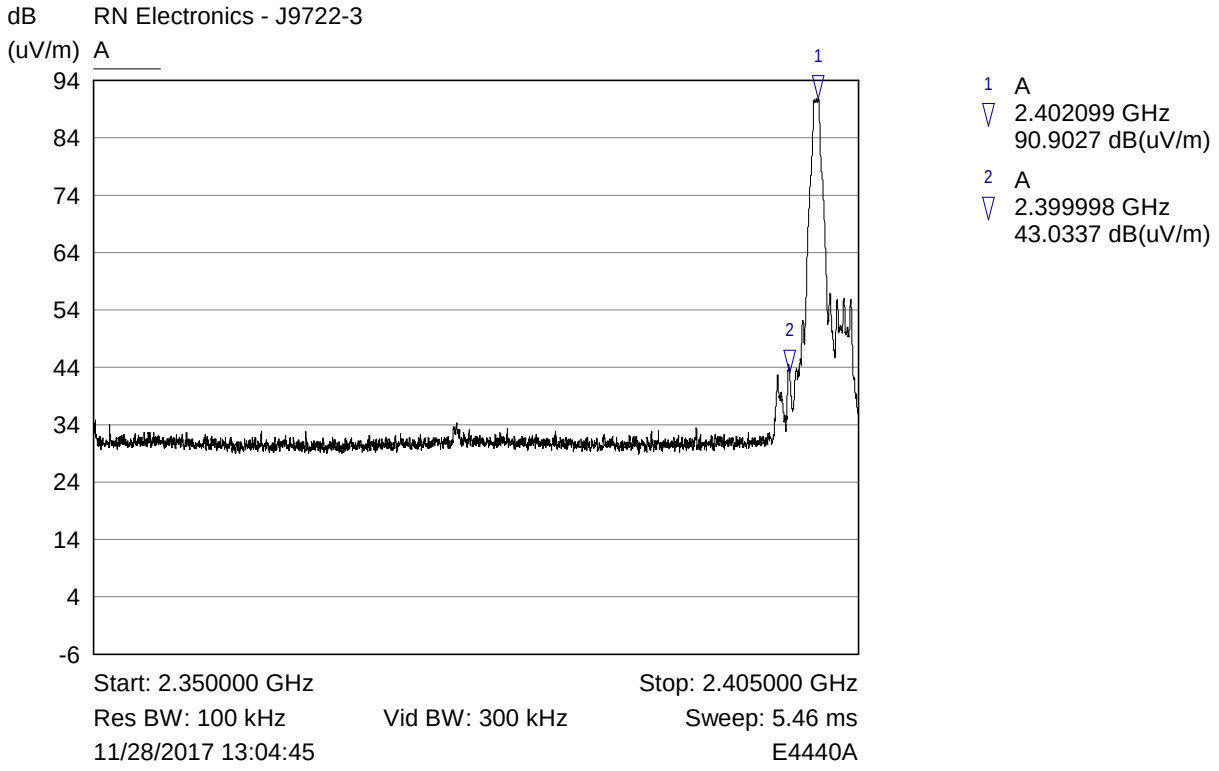

dB
(uV/m)
RN Electronics - J9722-3
Horiz
90
80
70
60
50
40
30
20
10
0
-10
Start: 21.0000 GHz
Stop: 25.0000 GHz
Res BW: 1 MHz
Vid BW: 3 MHz
Sweep: 10.38 ms
01/12/2017 11:46:36
E4440A

6.5 Band Edge Compliance

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH1, Channel 2402 MHz

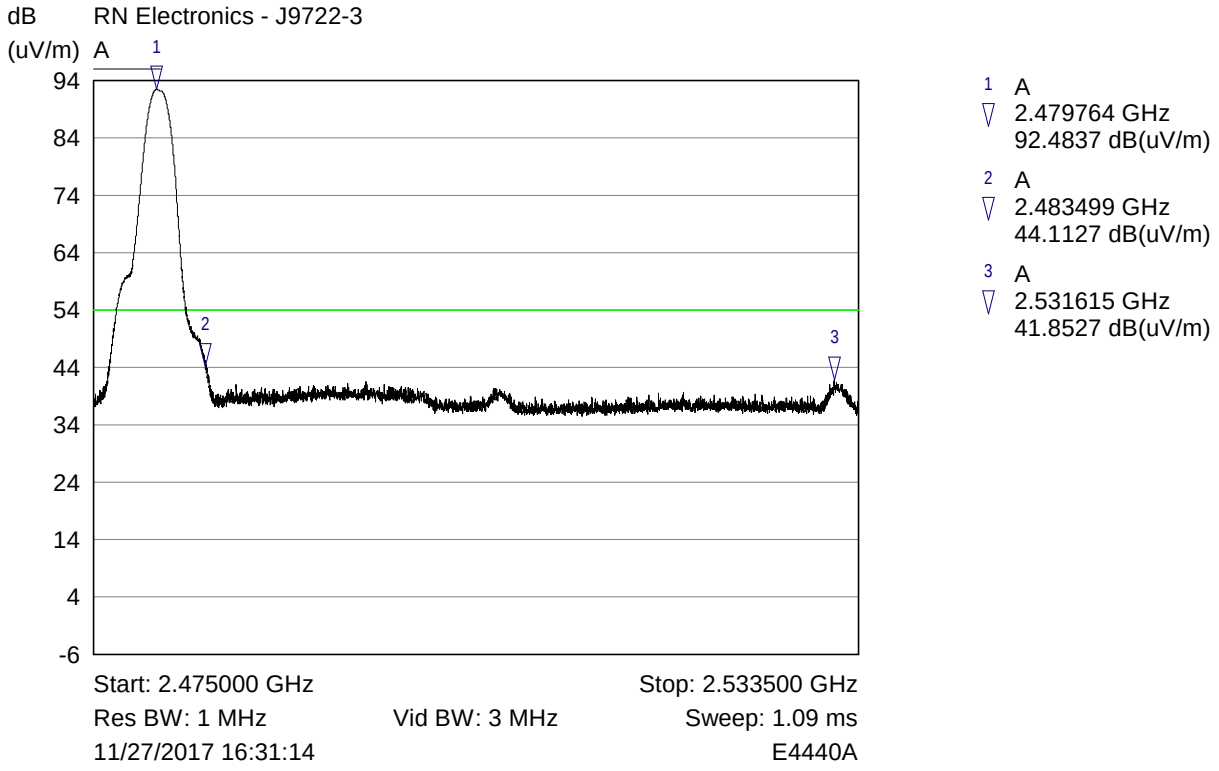


Restricted band edge Peak Plot

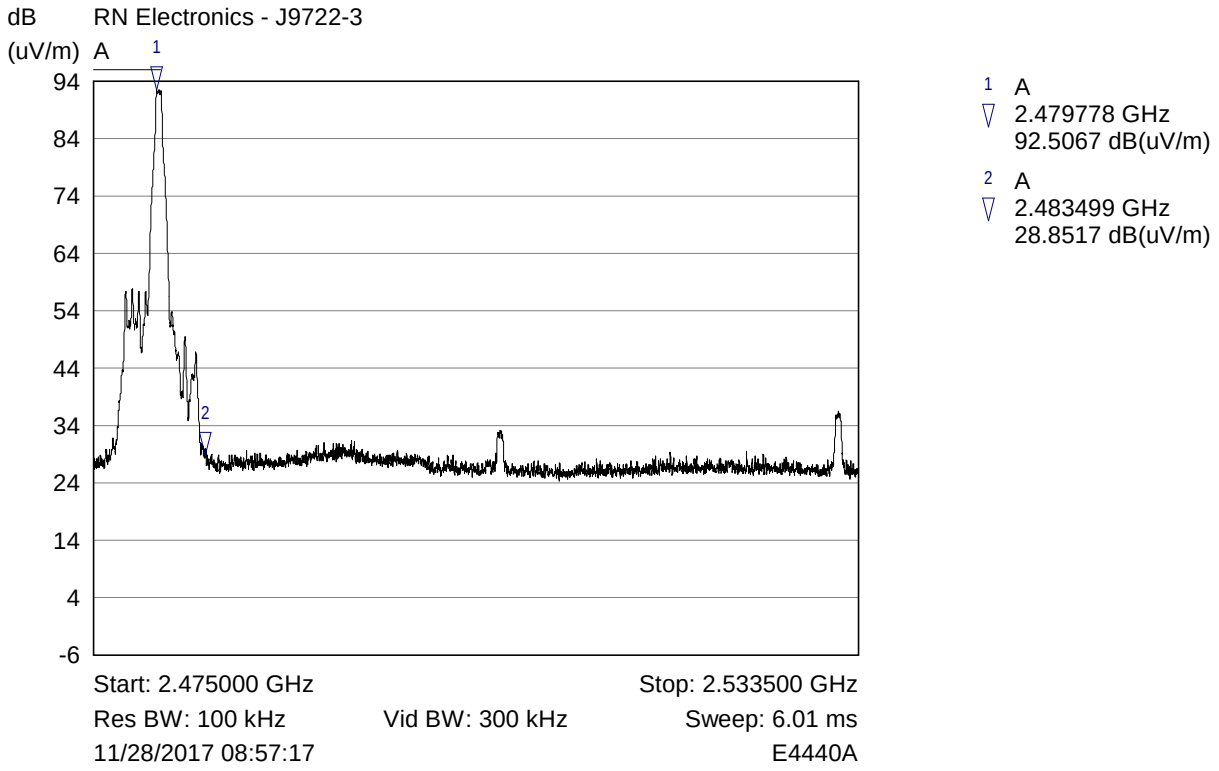


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH1, Channel 2480 MHz

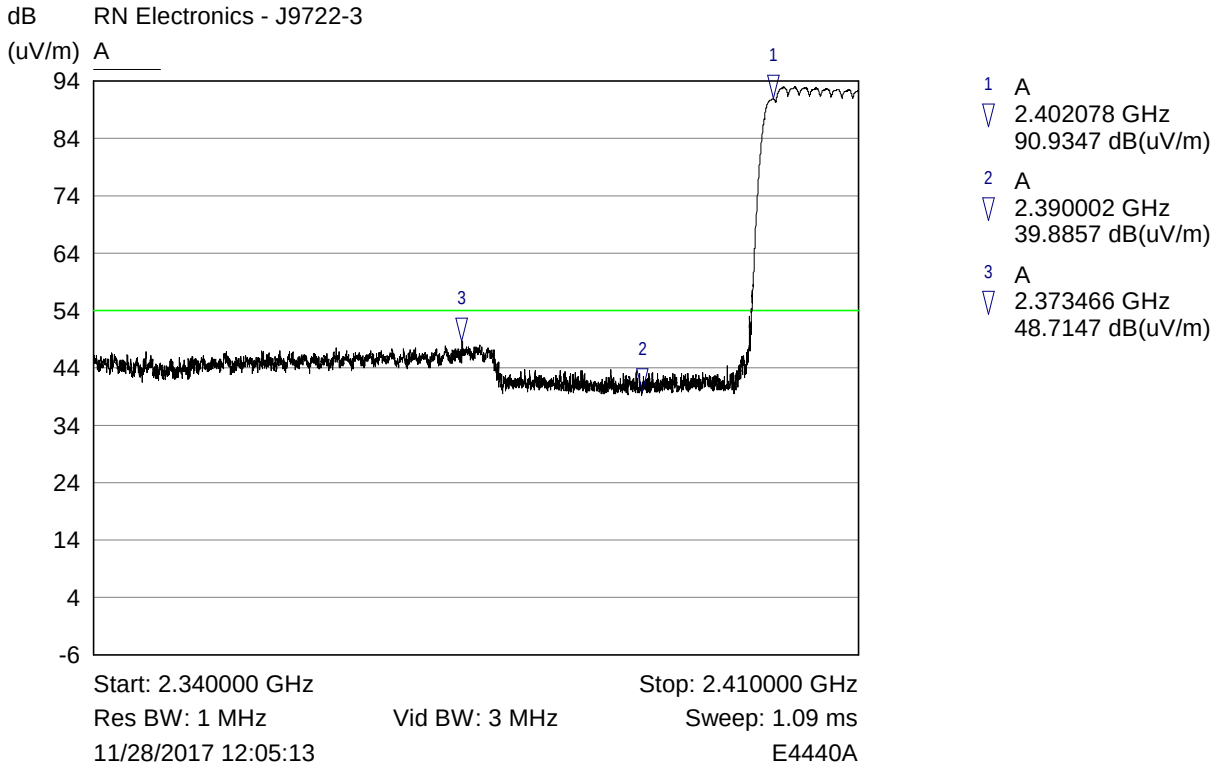


Restricted band edge Peak Plot

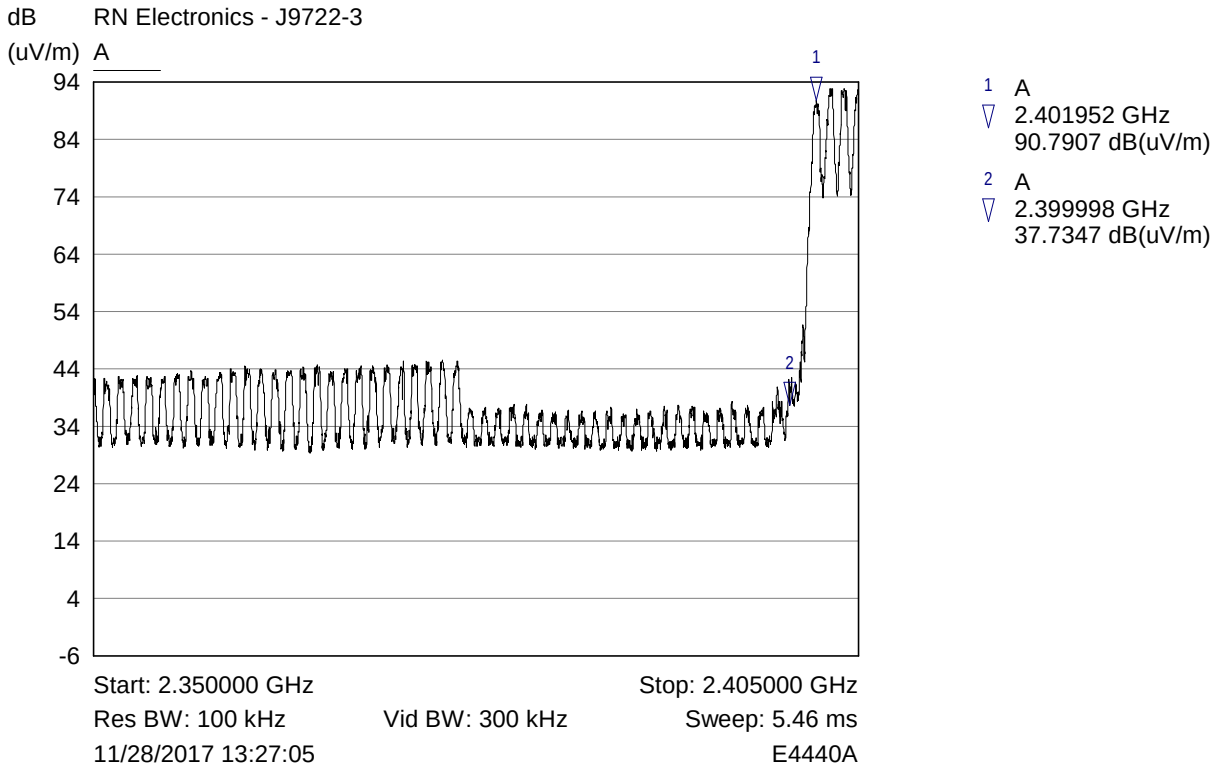


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH1, Channel Low hopping

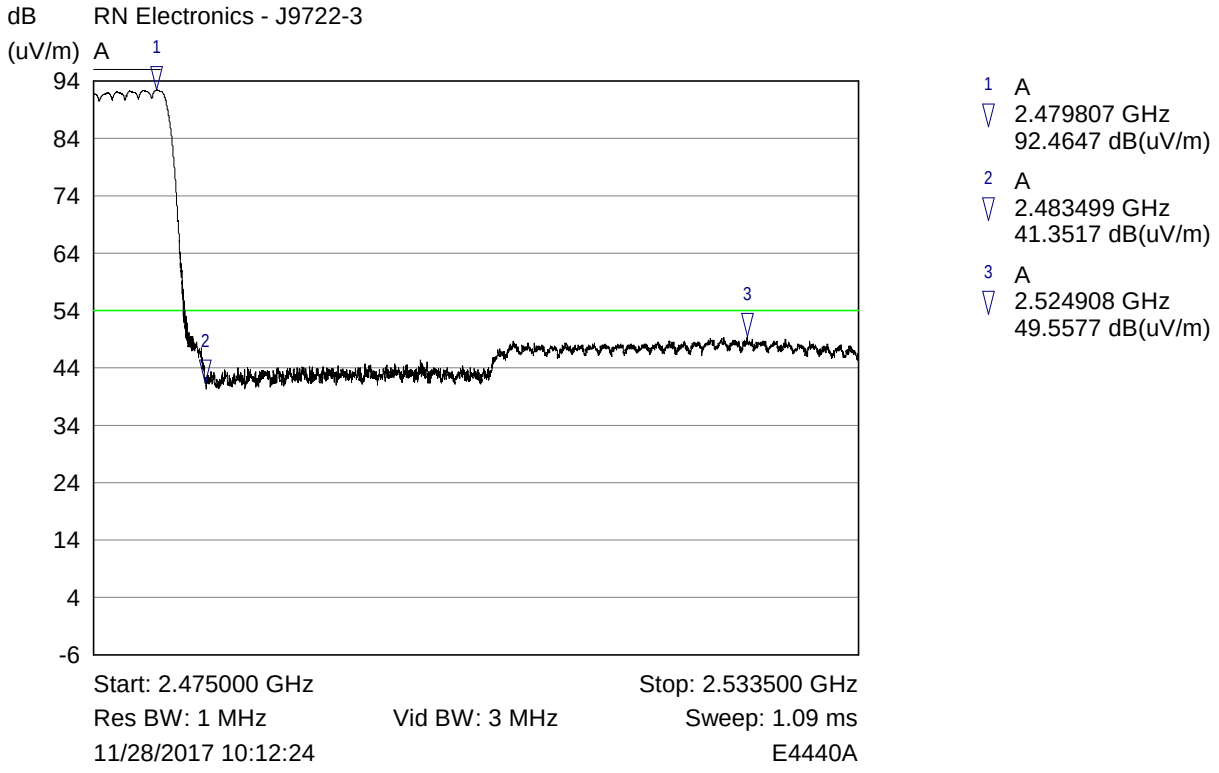


Restricted band edge Peak Plot

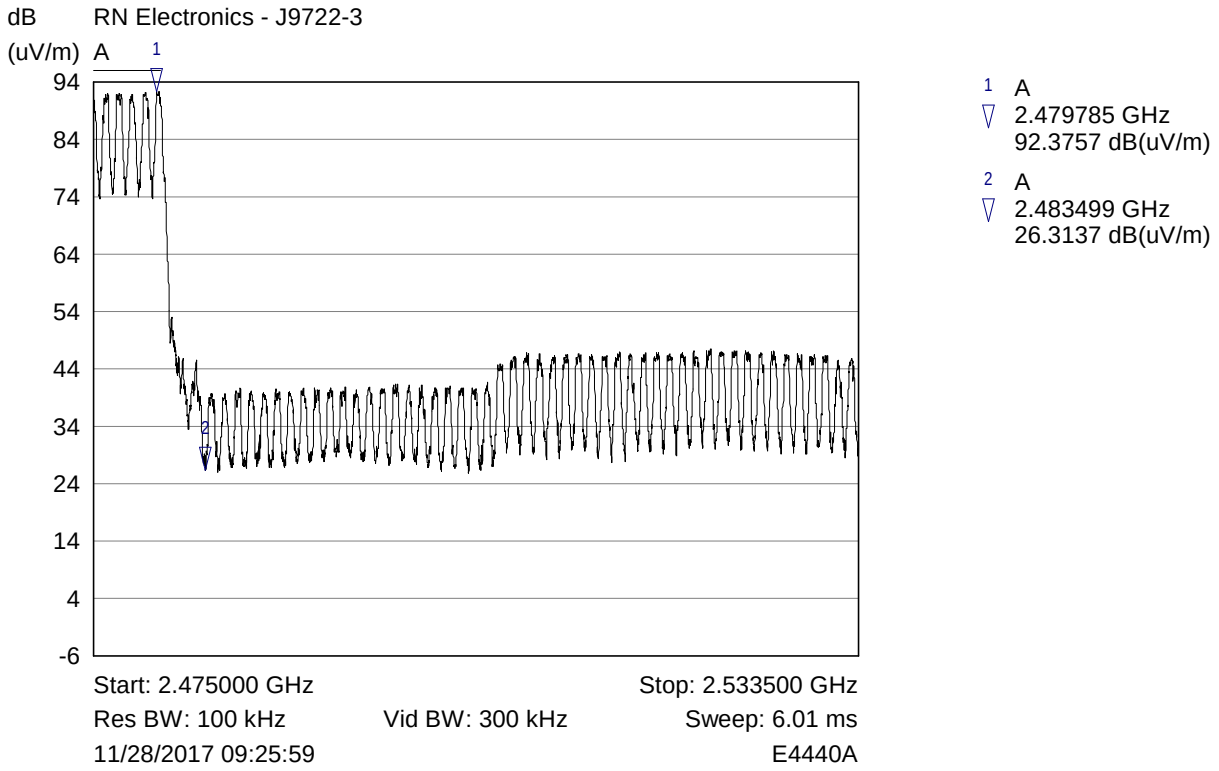


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH1, Channel High hopping

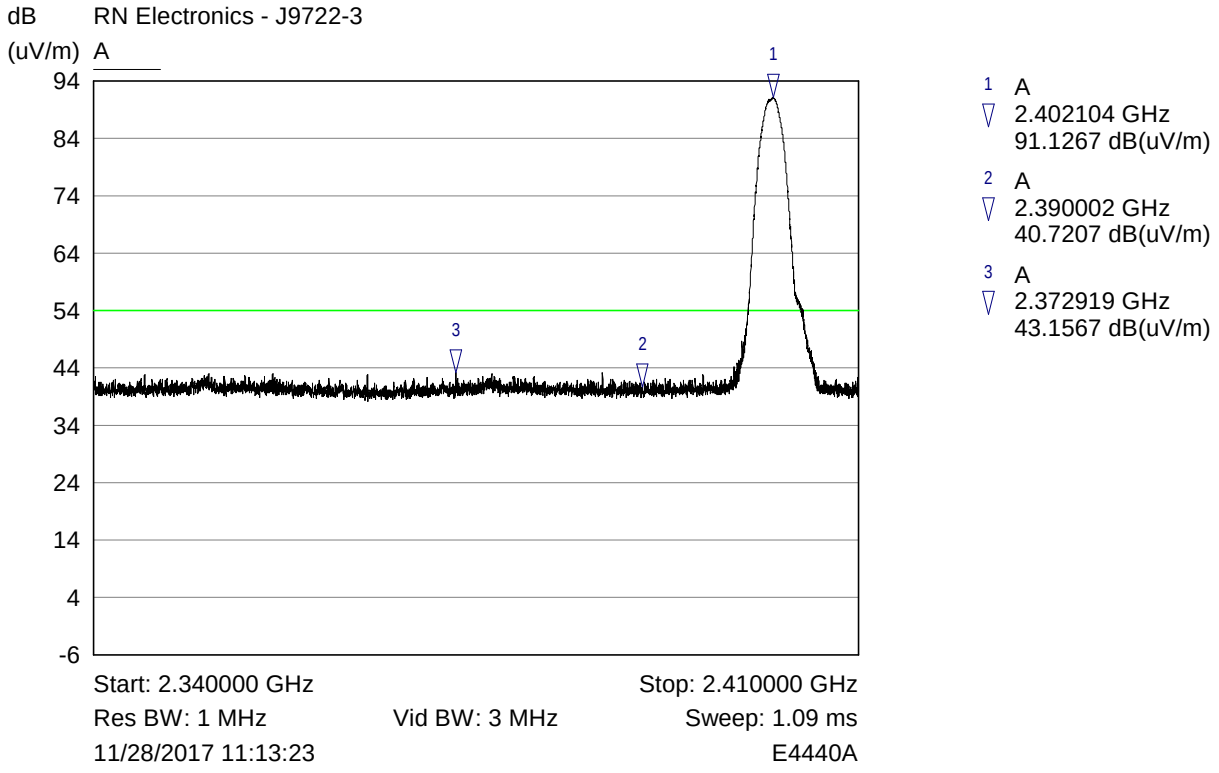


Restricted band edge Peak Plot

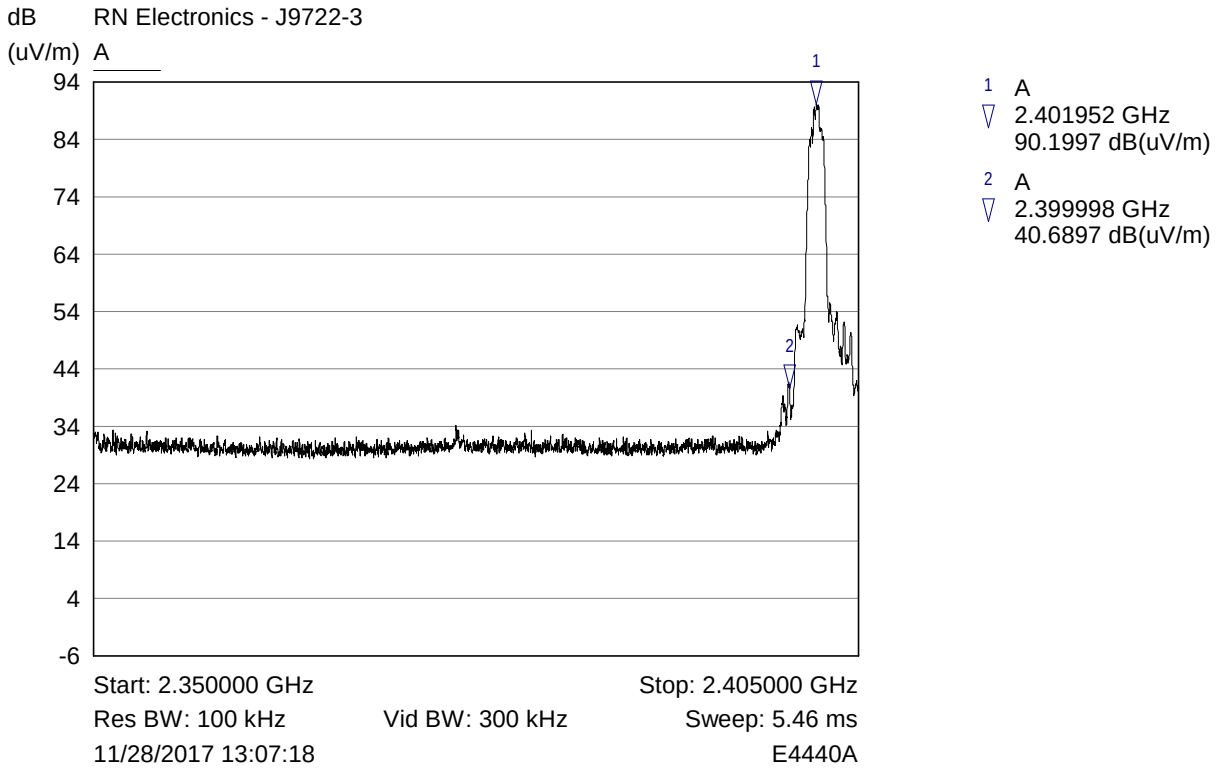


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH1, Channel 2402 MHz

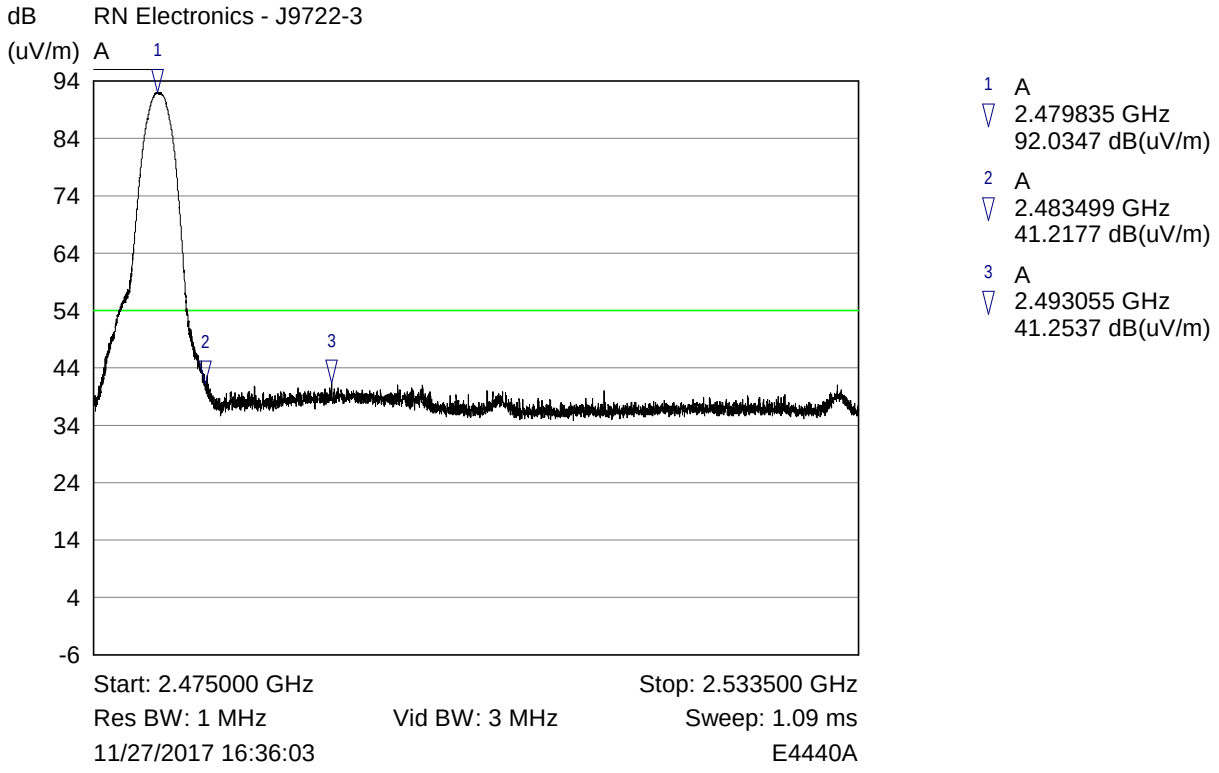


Restricted band edge Peak Plot

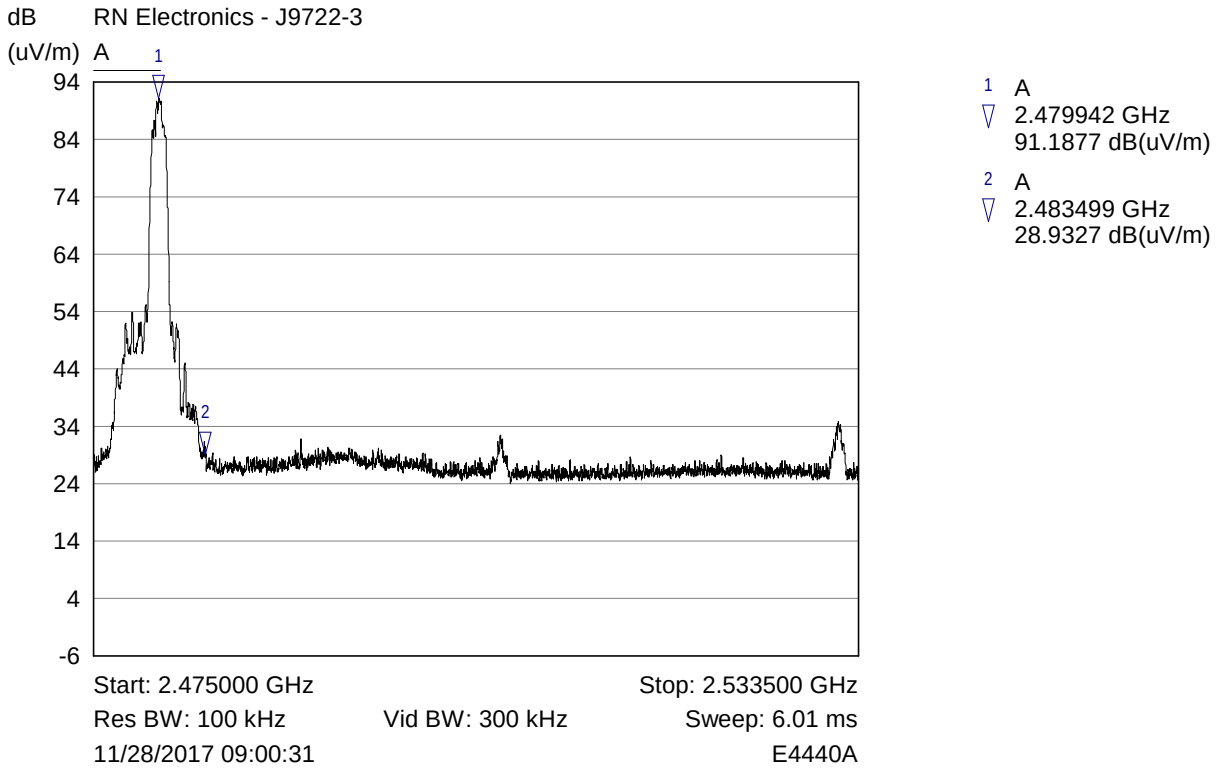


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH1, Channel 2480 MHz

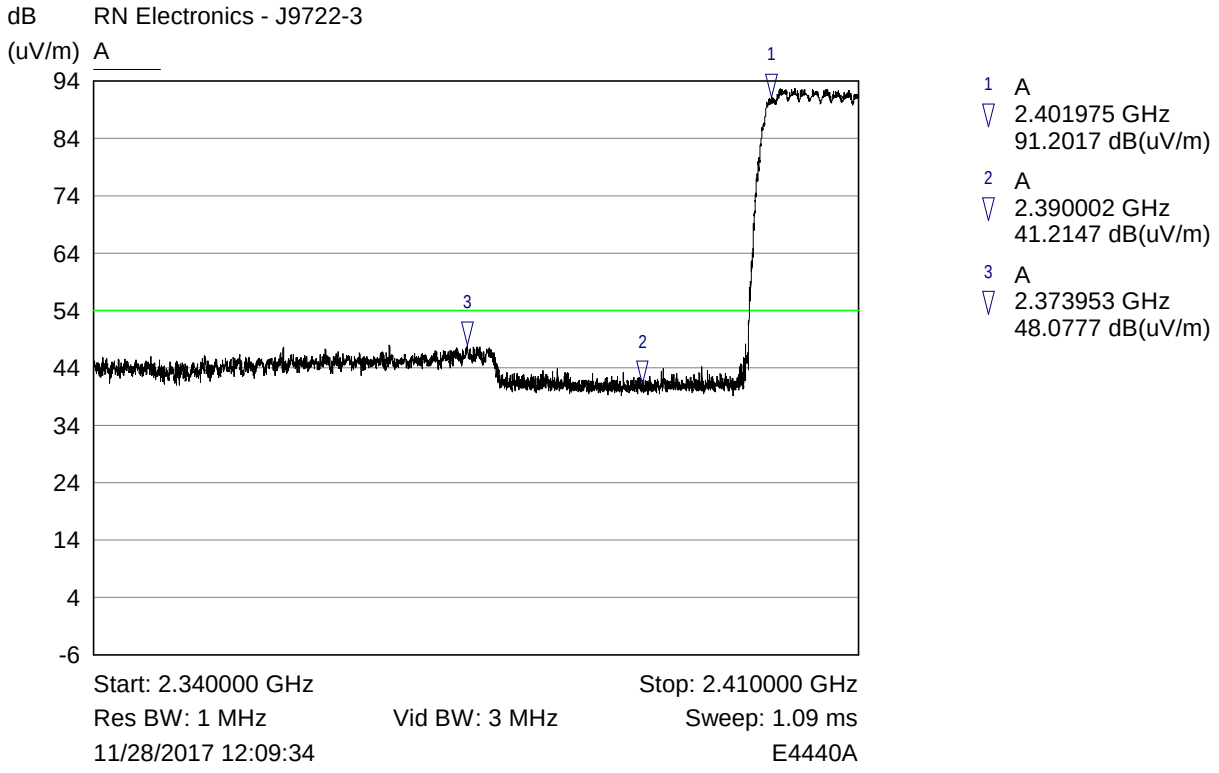


Restricted band edge Peak Plot

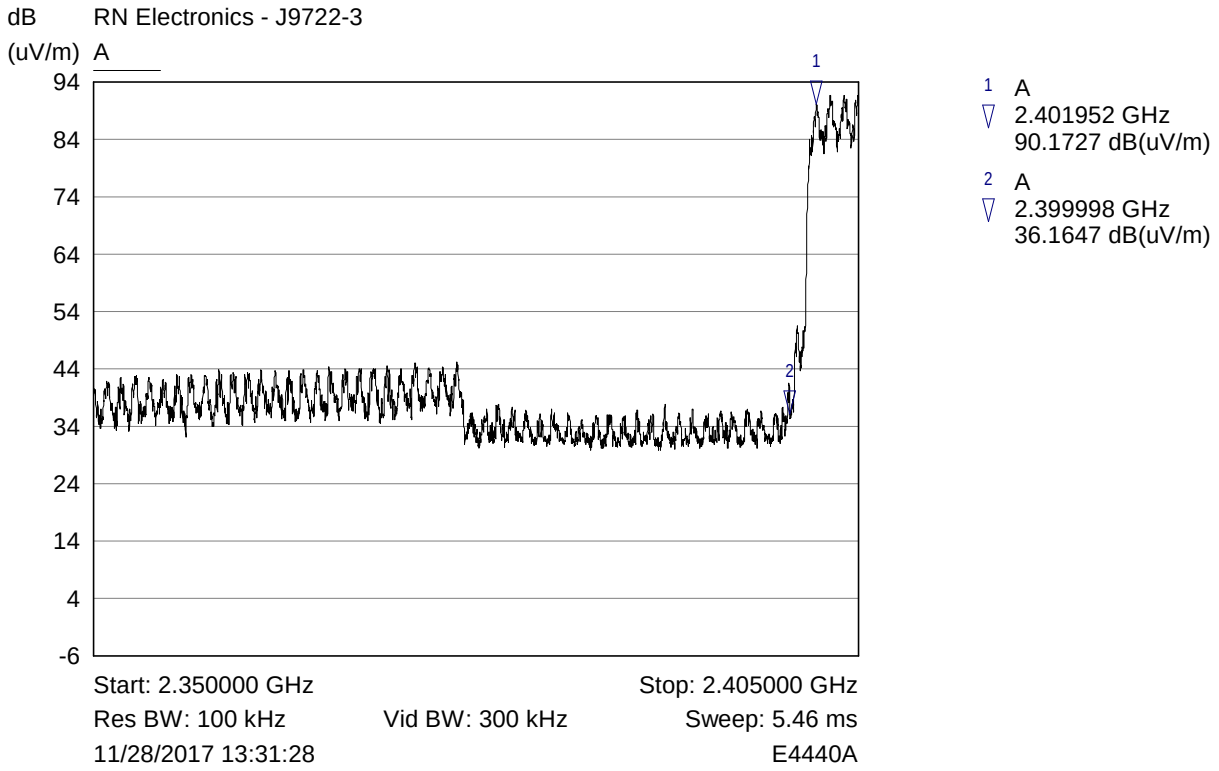


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH1, Channel Low hopping

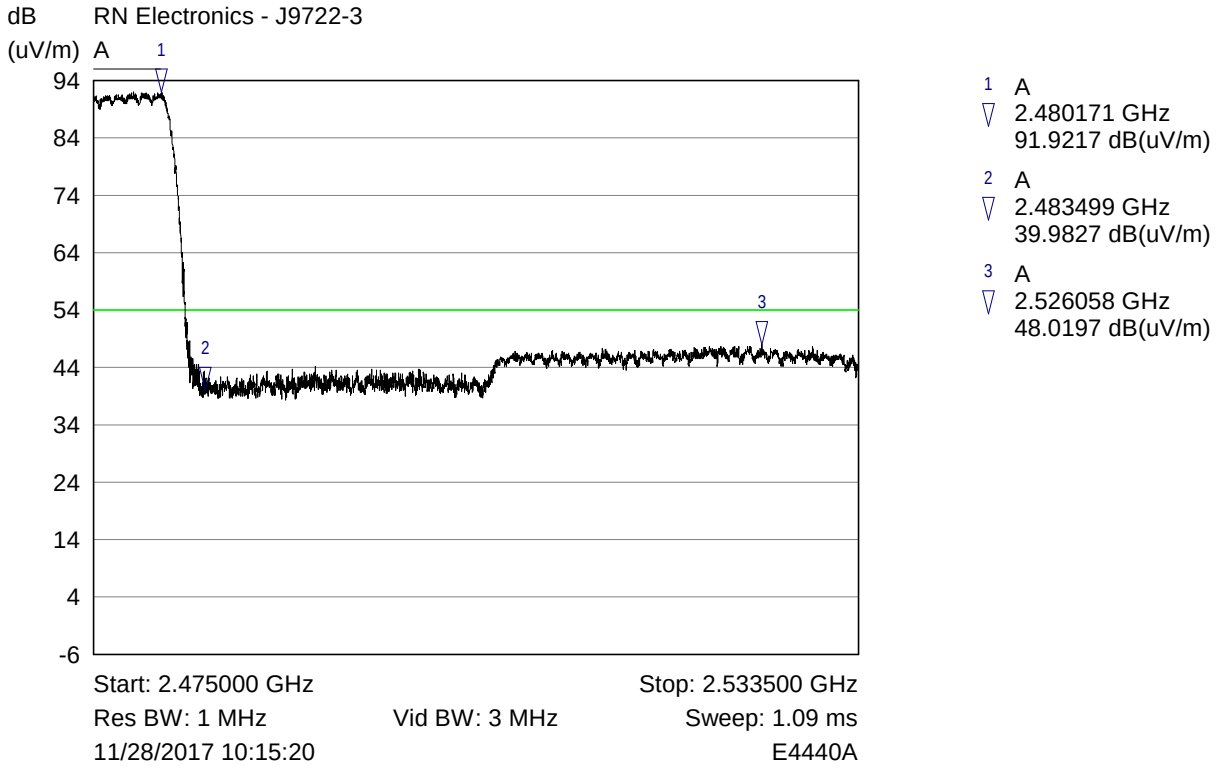


Restricted band edge Peak Plot

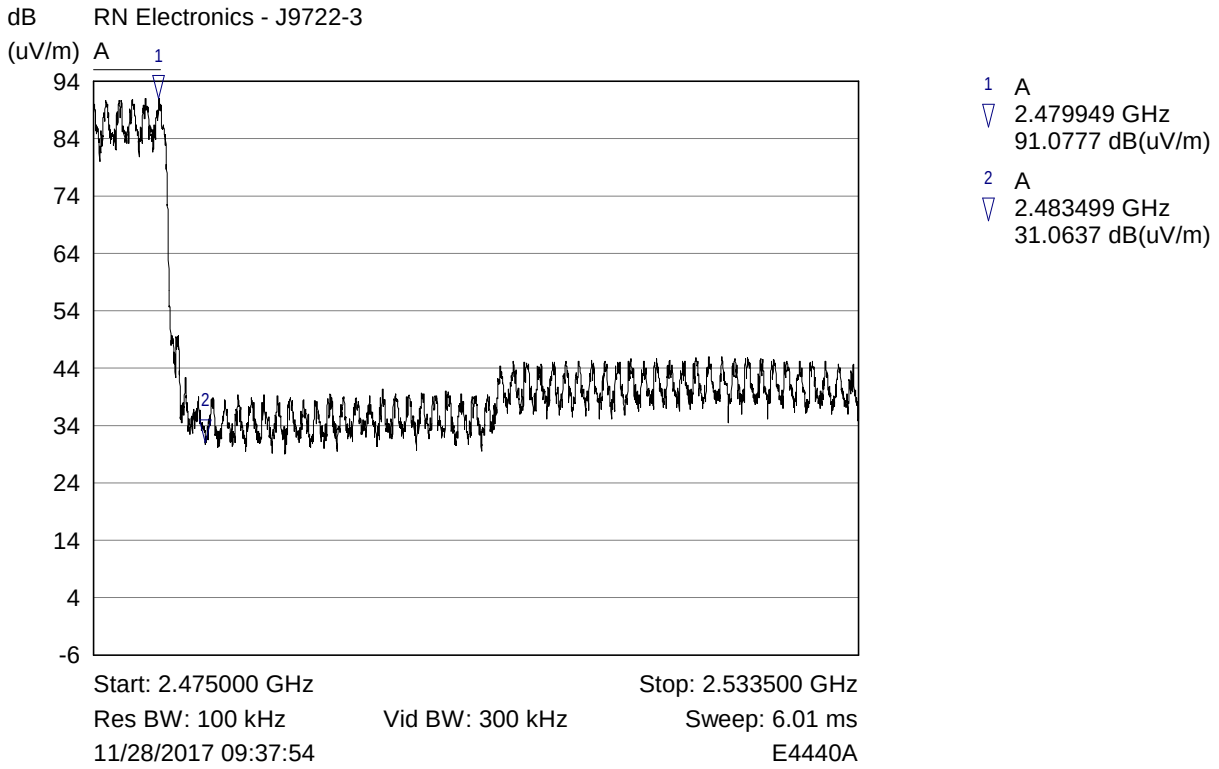


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH1, Channel High hopping

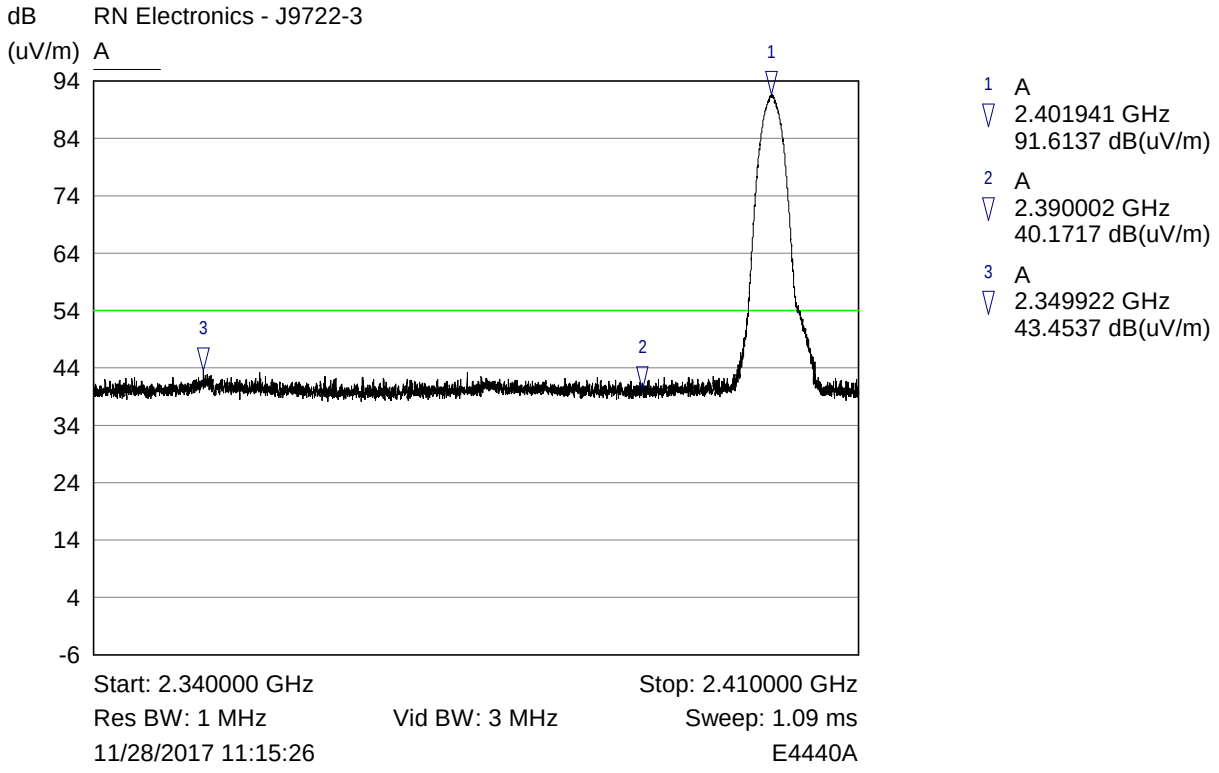


Restricted band edge Peak Plot

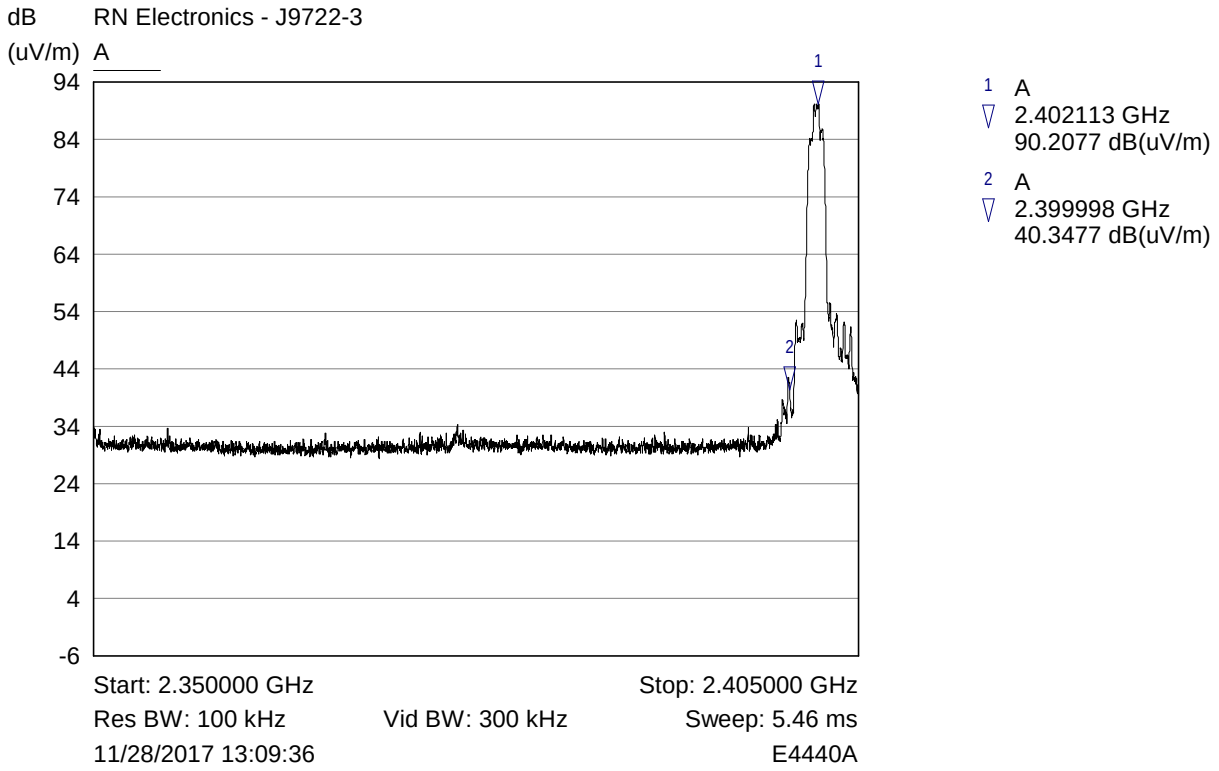


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH1, Channel 2402 MHz

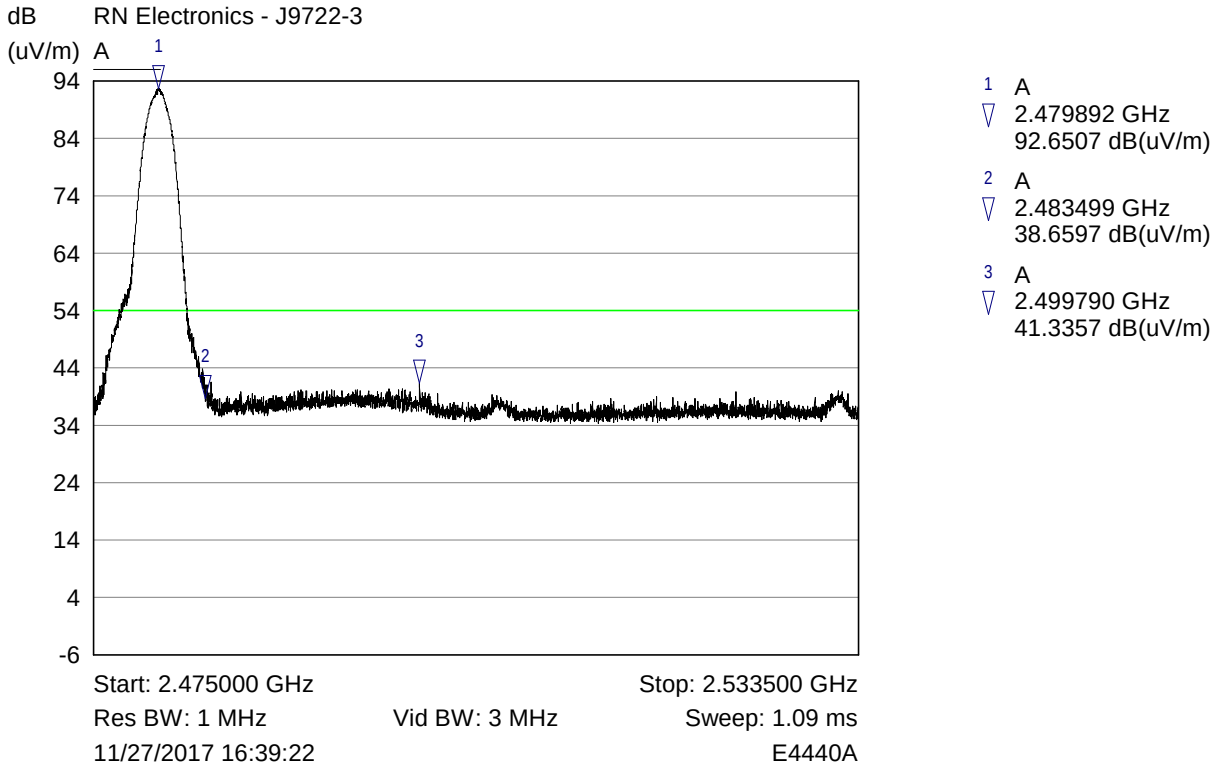


Restricted band edge Peak Plot

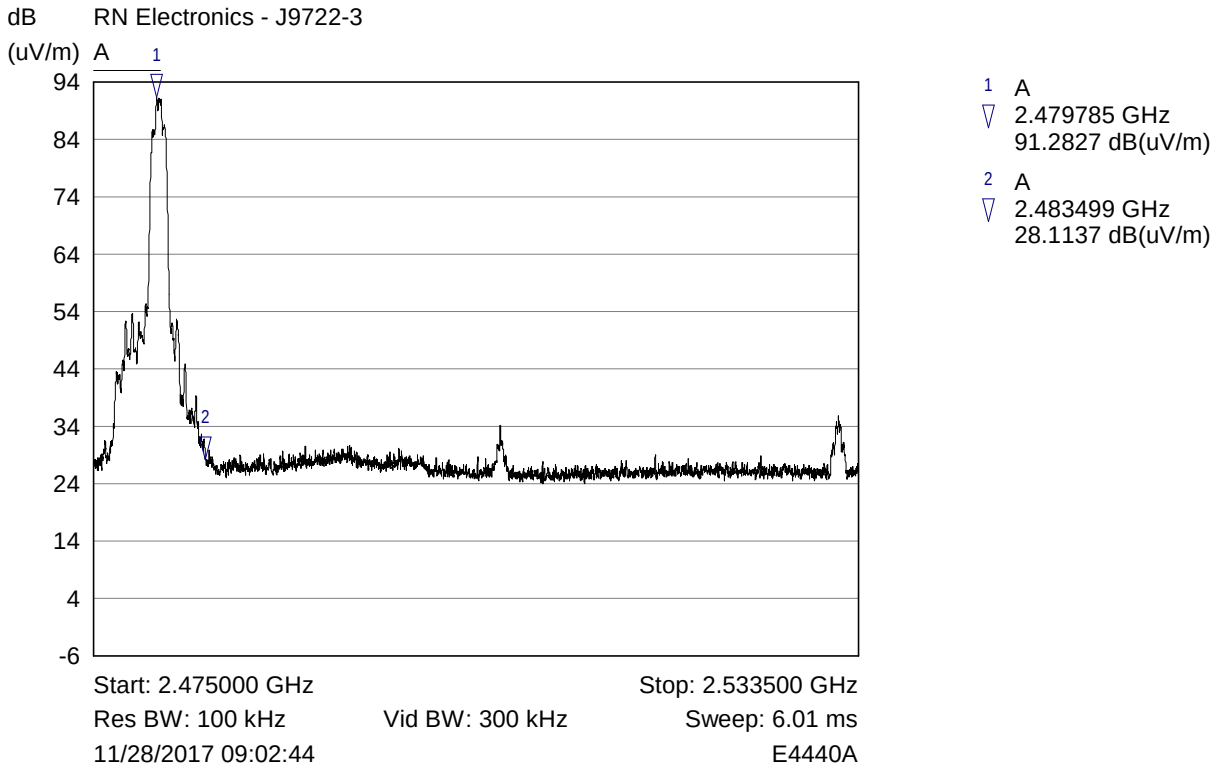


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH1, Channel 2480 MHz

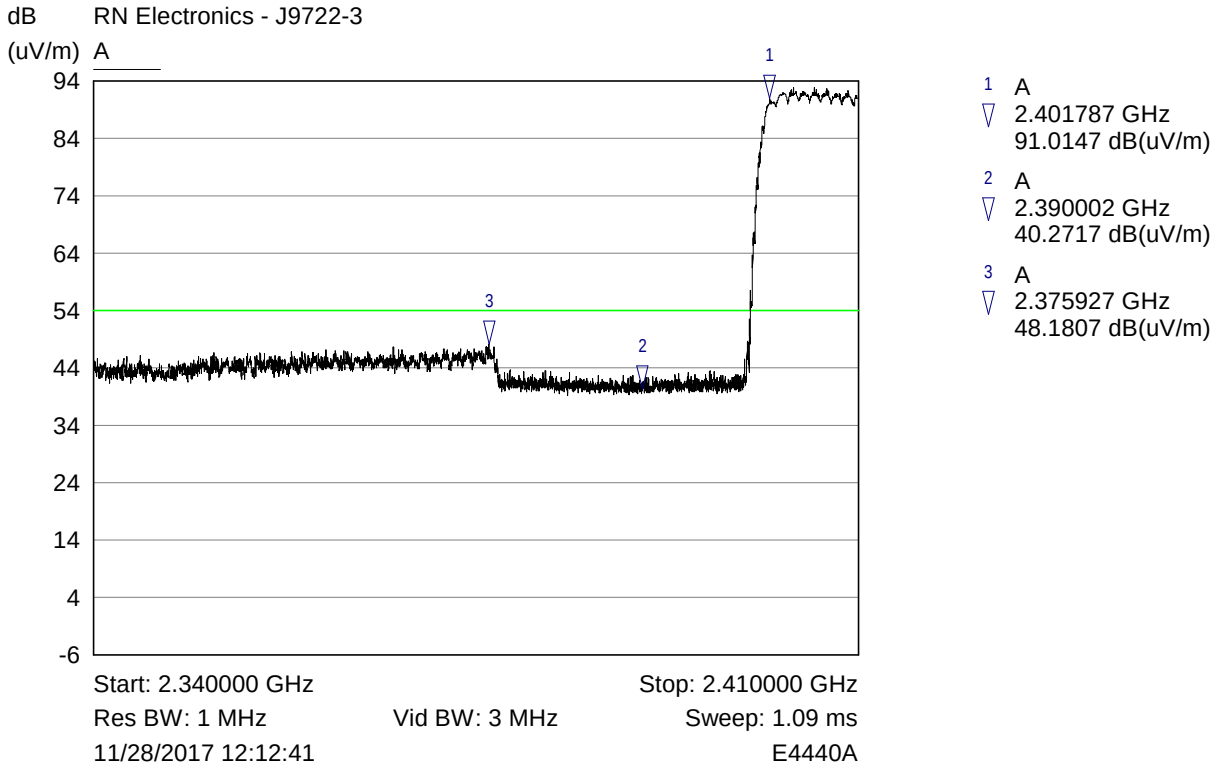


Restricted band edge Peak Plot

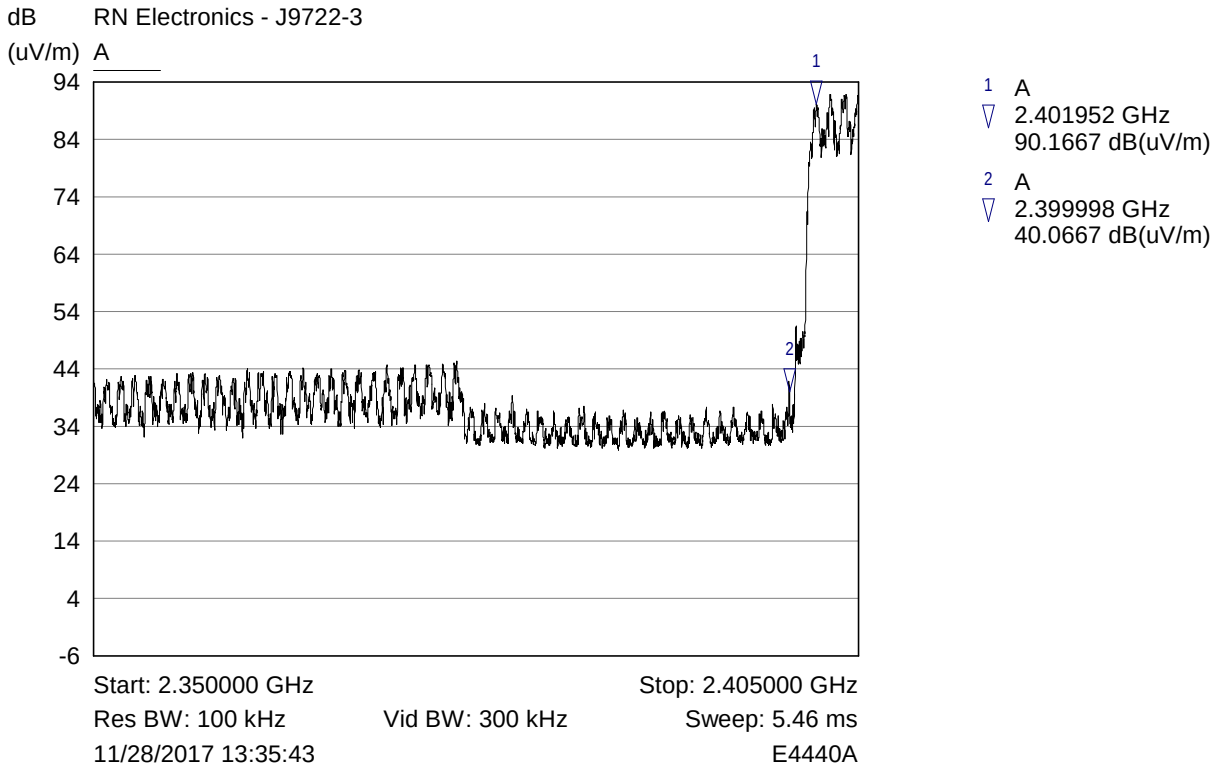


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH1, Channel Low hopping

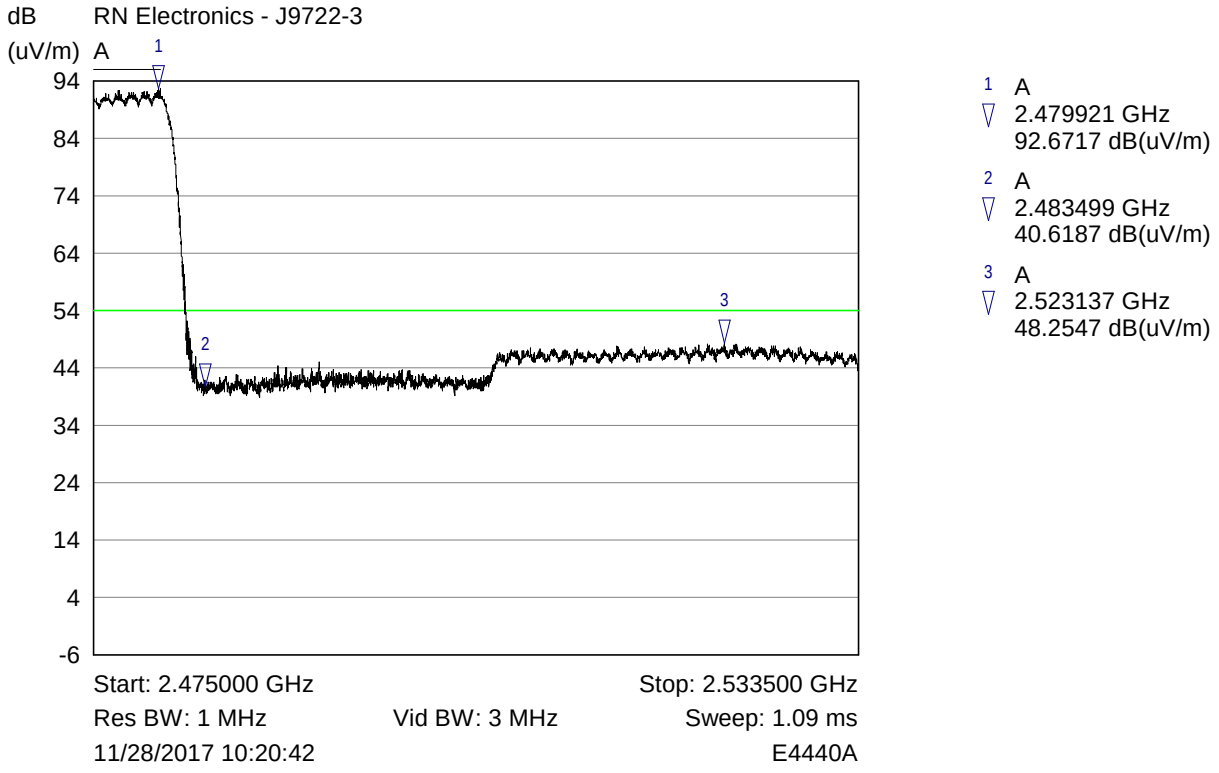


Restricted band edge Peak Plot

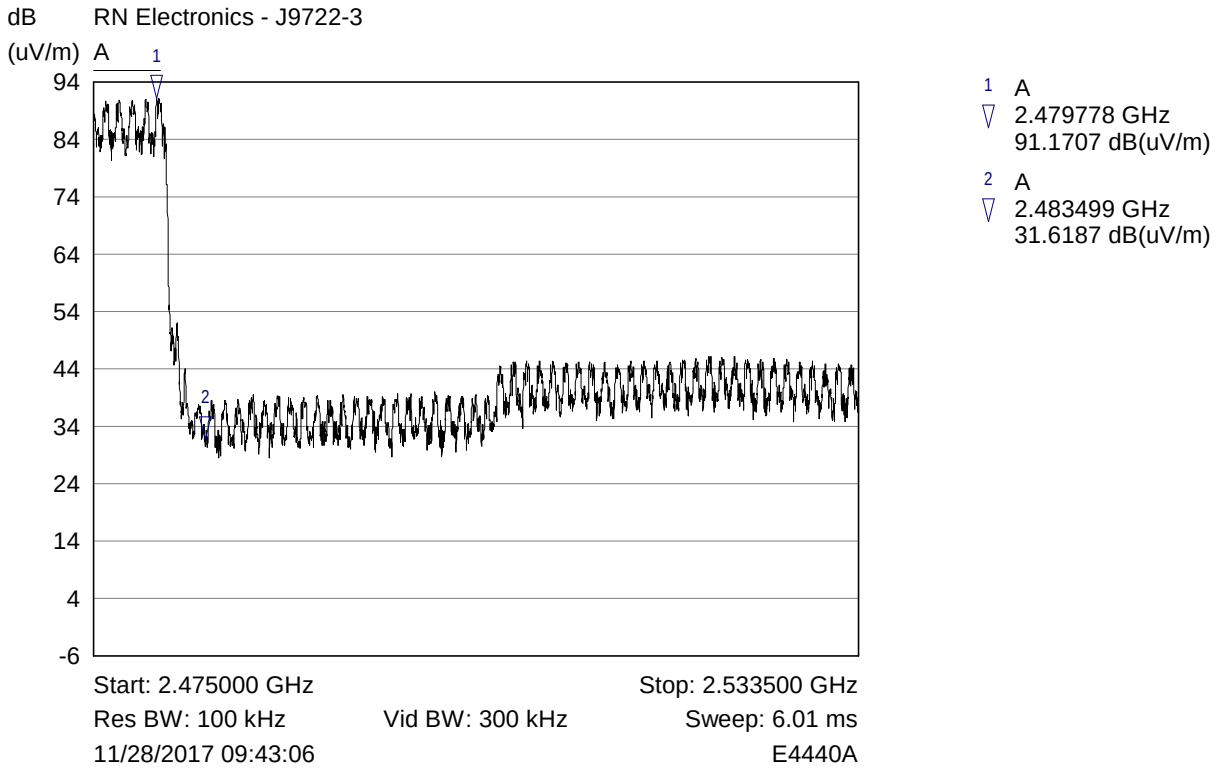


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH1, Channel High hopping

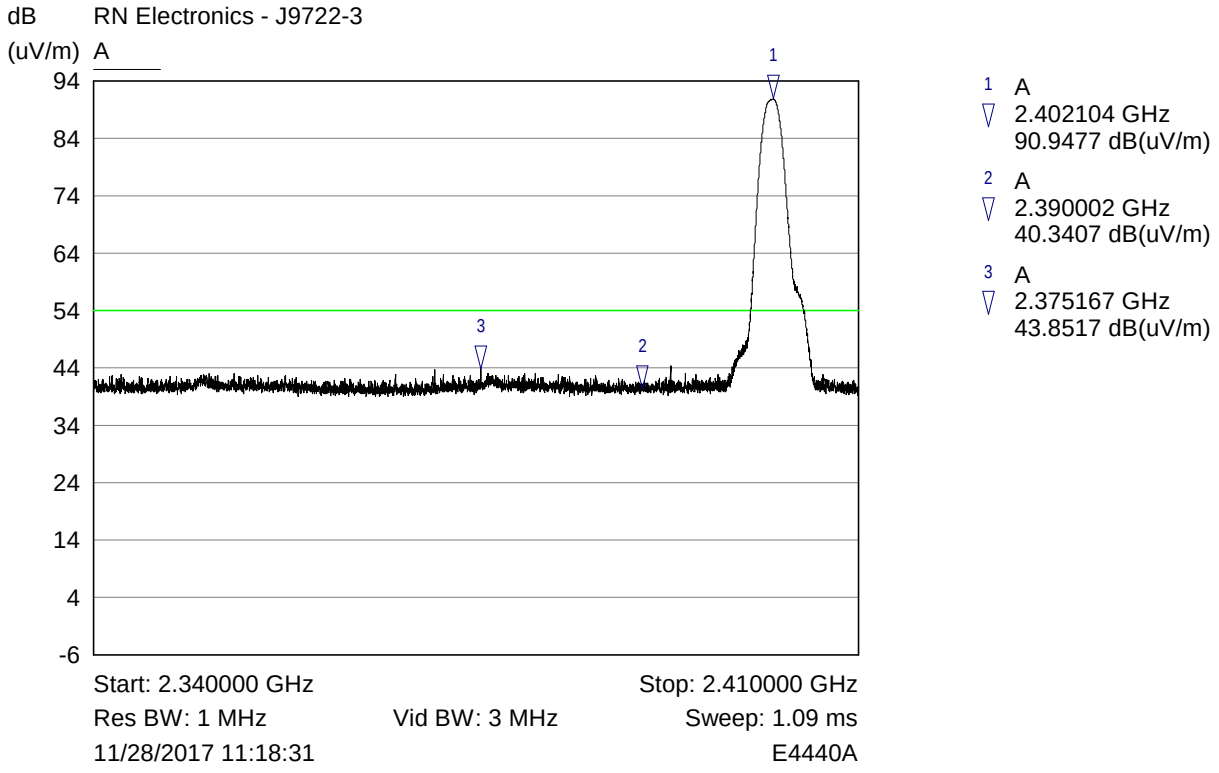


Restricted band edge Peak Plot

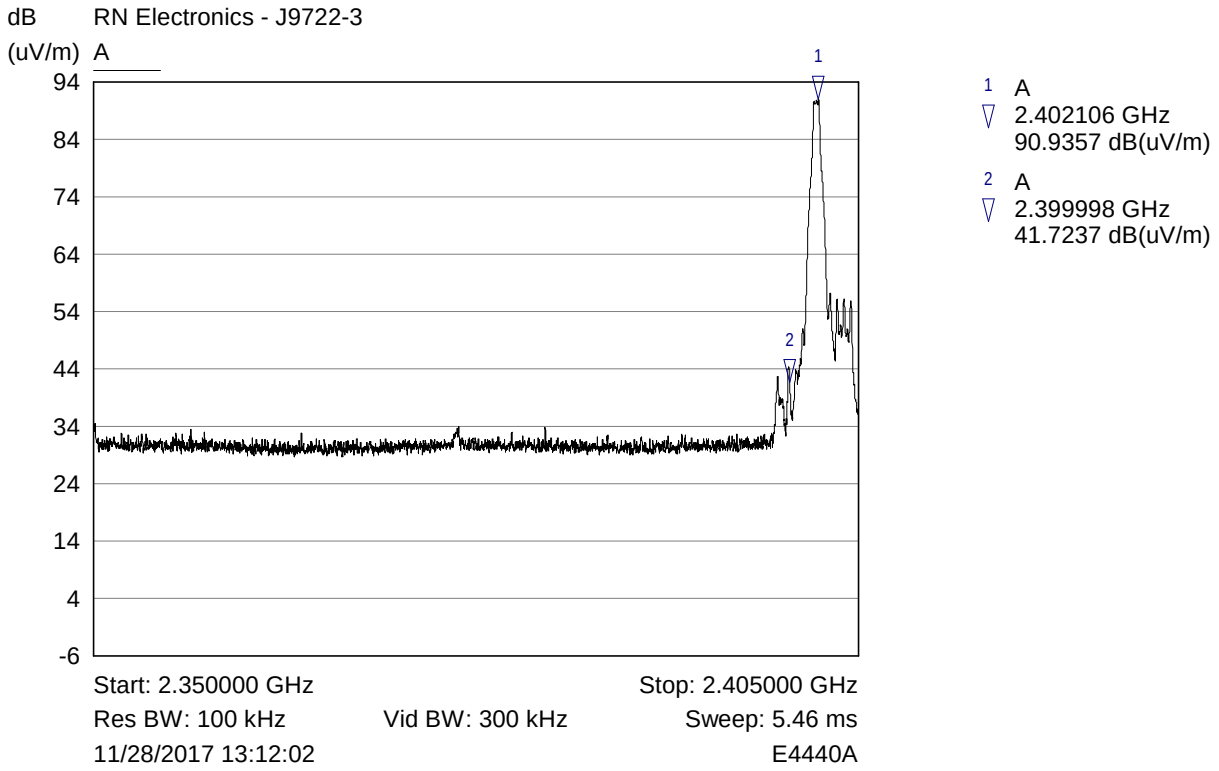


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH3, Channel 2402 MHz

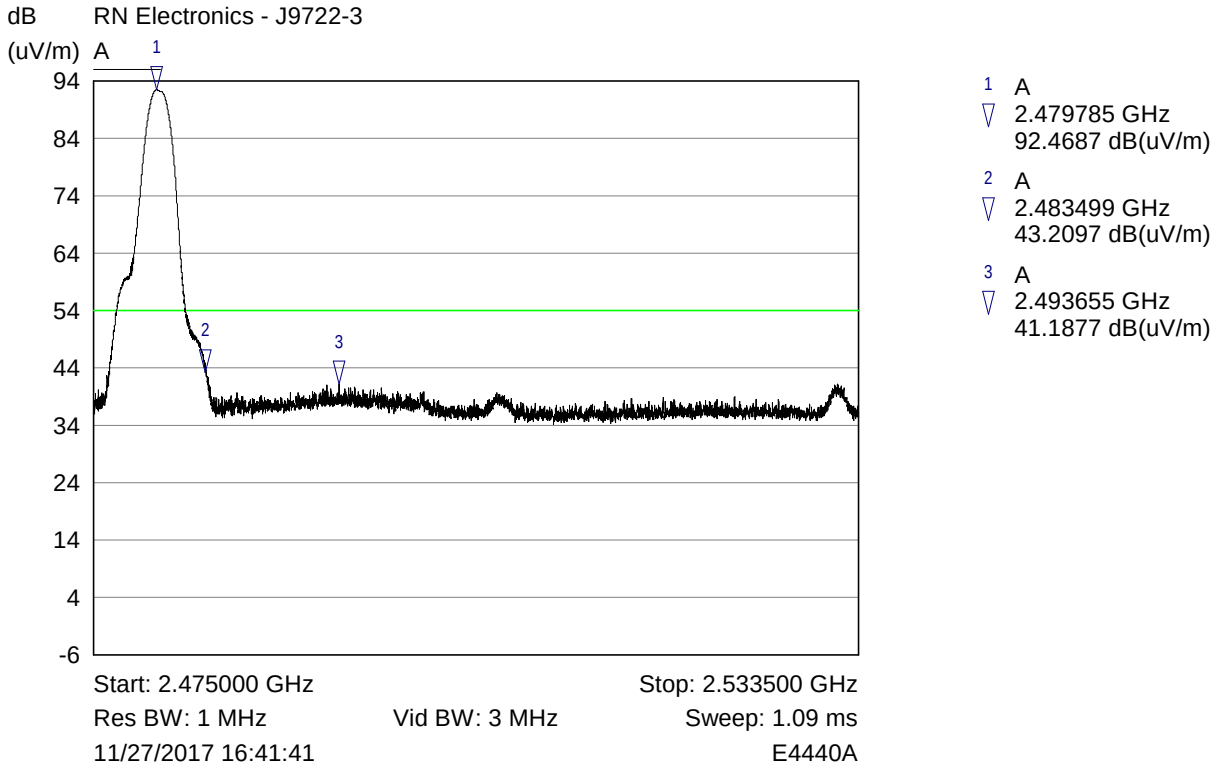


Restricted band edge Peak Plot

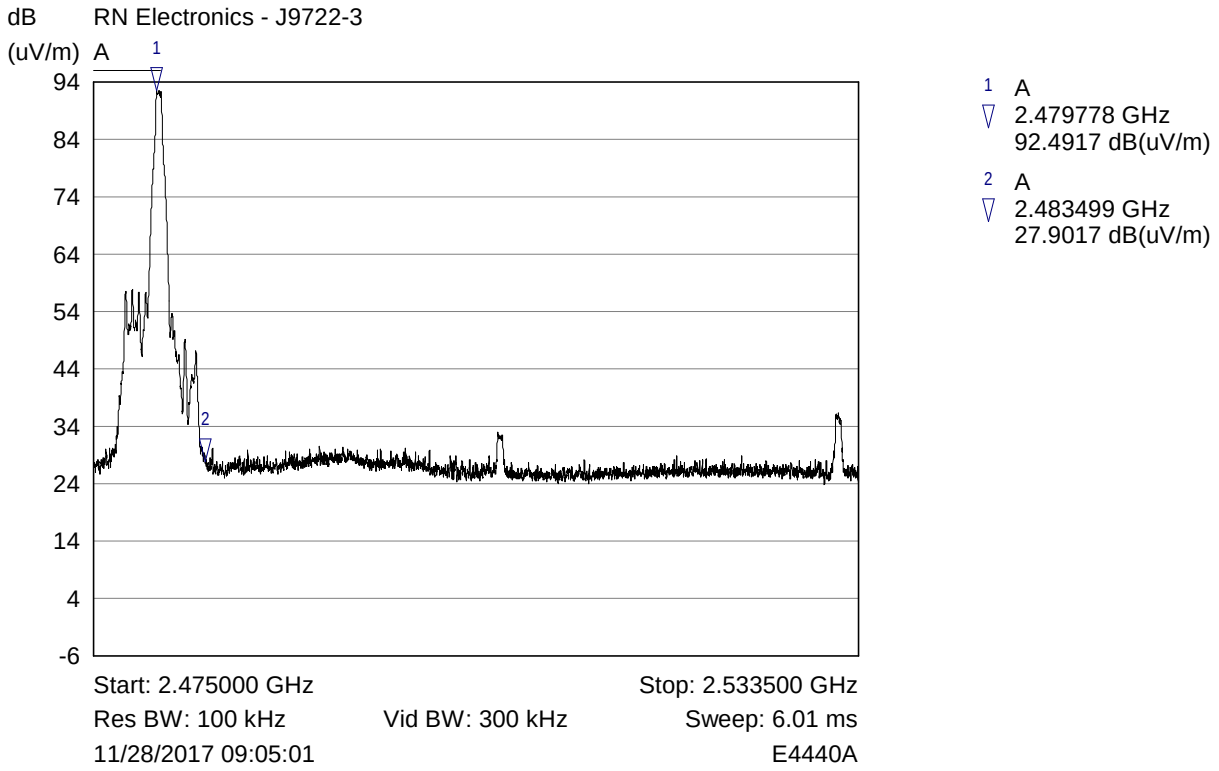


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH3, Channel 2480 MHz

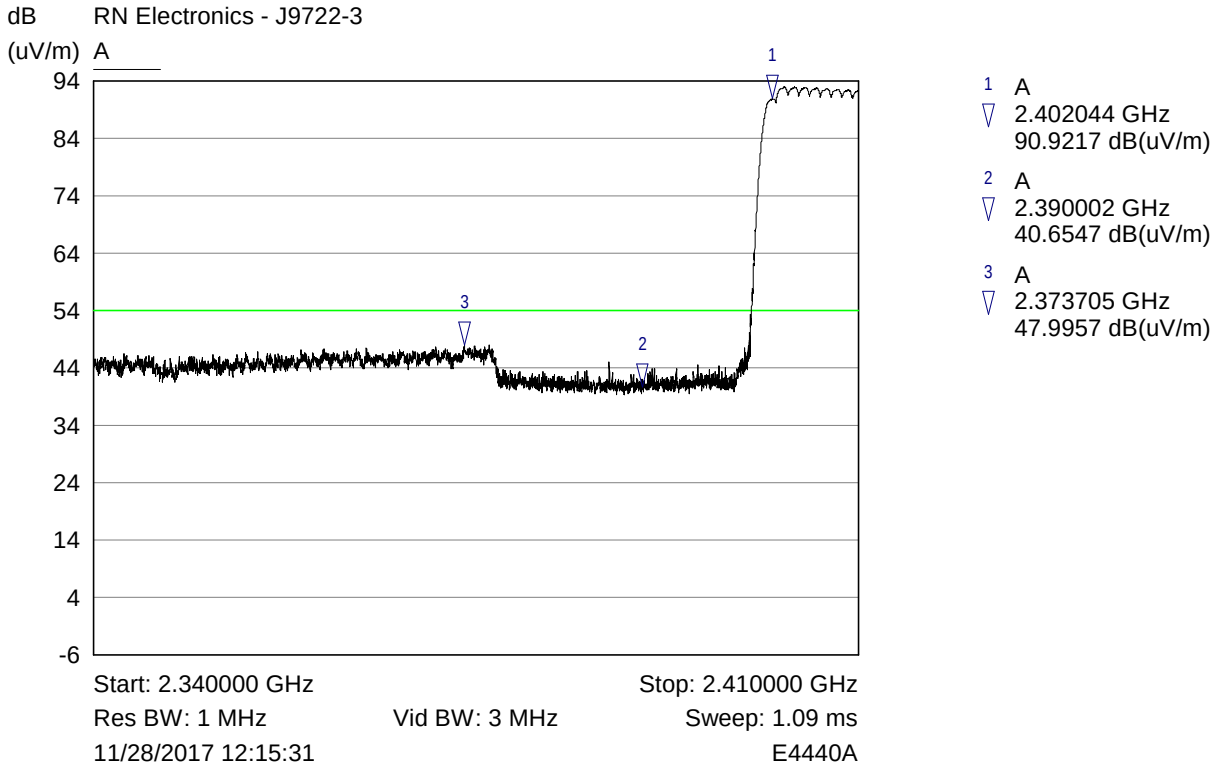


Restricted band edge Peak Plot

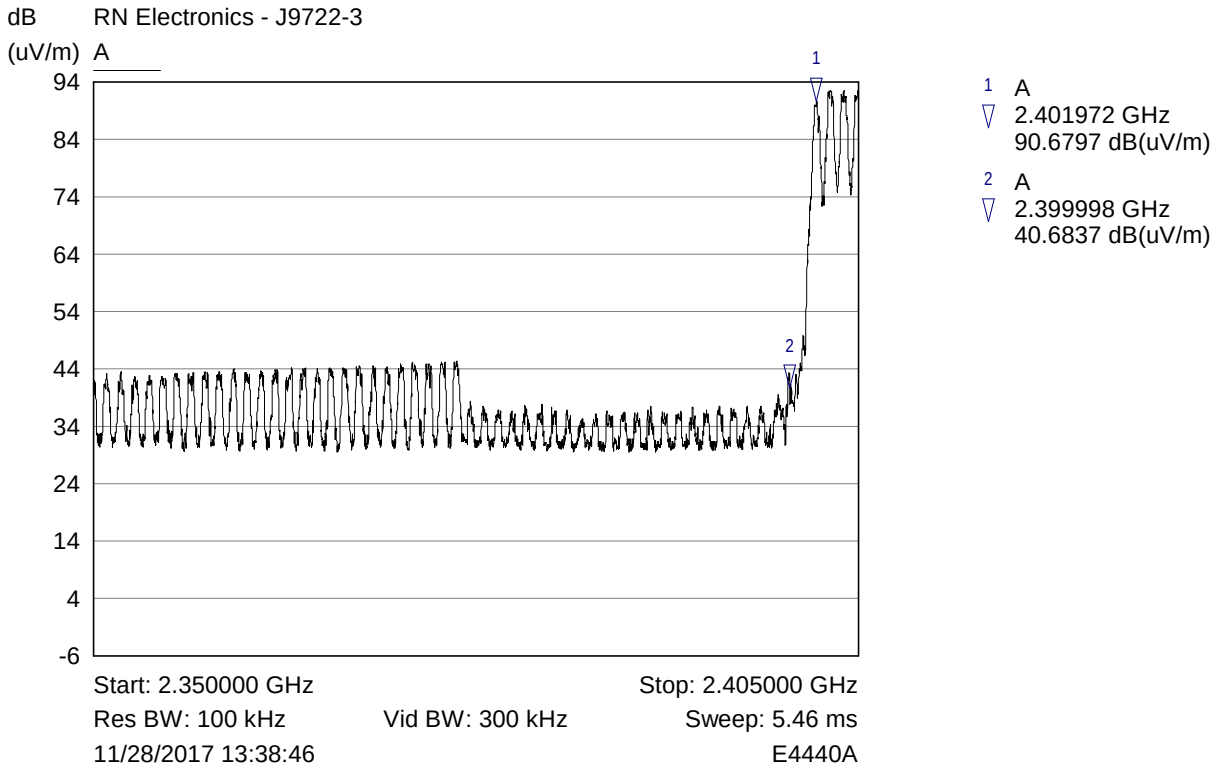


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH3, Channel Low hopping

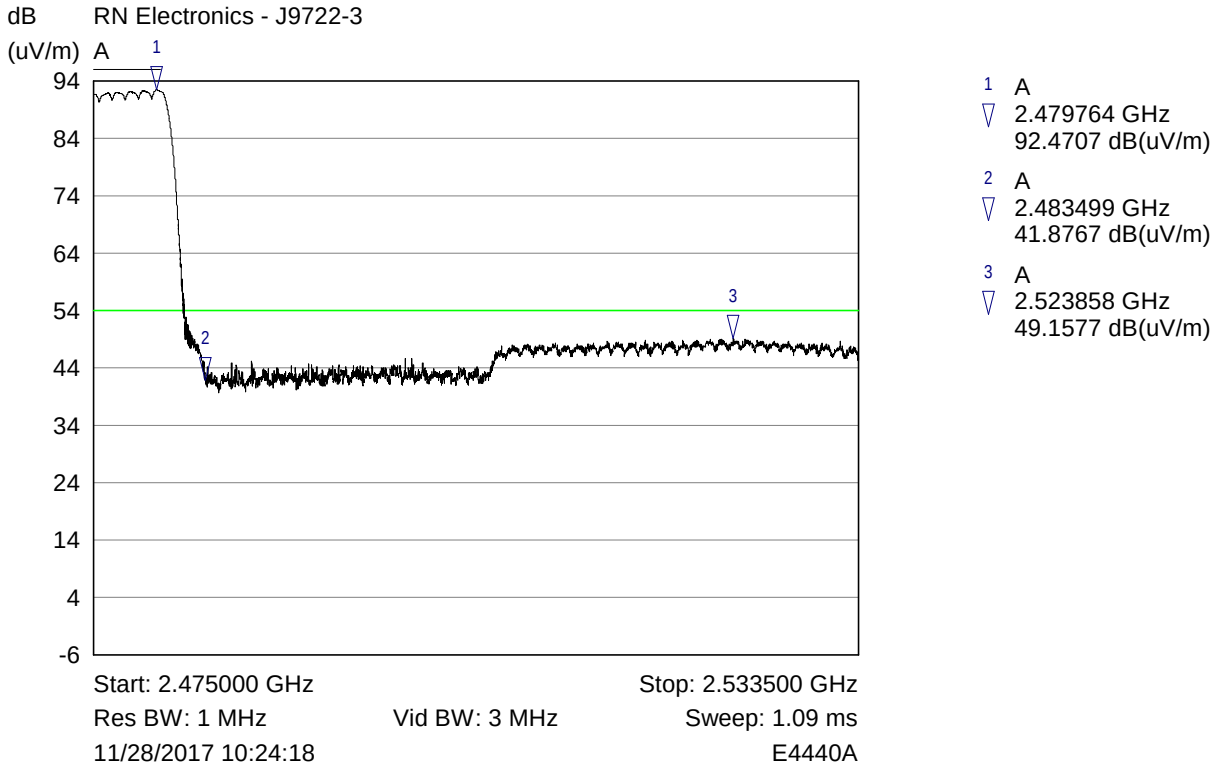


Restricted band edge Peak Plot

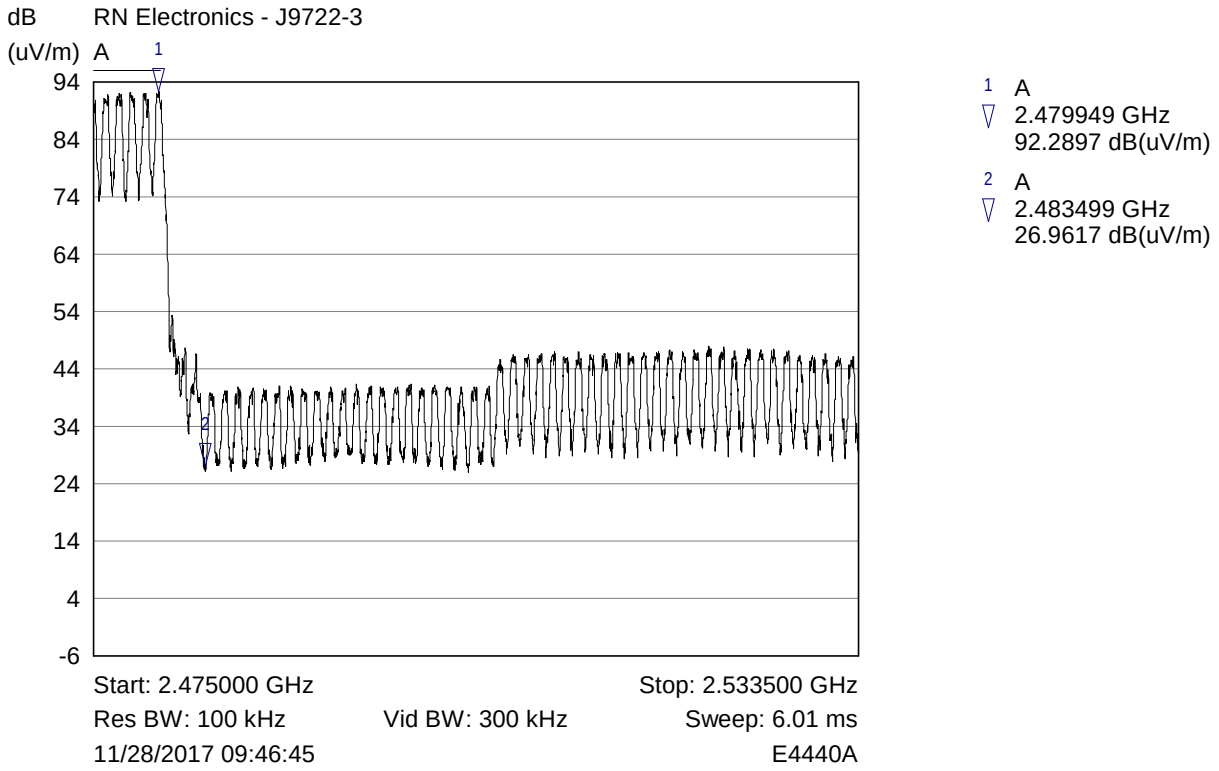


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH3, Channel High hopping

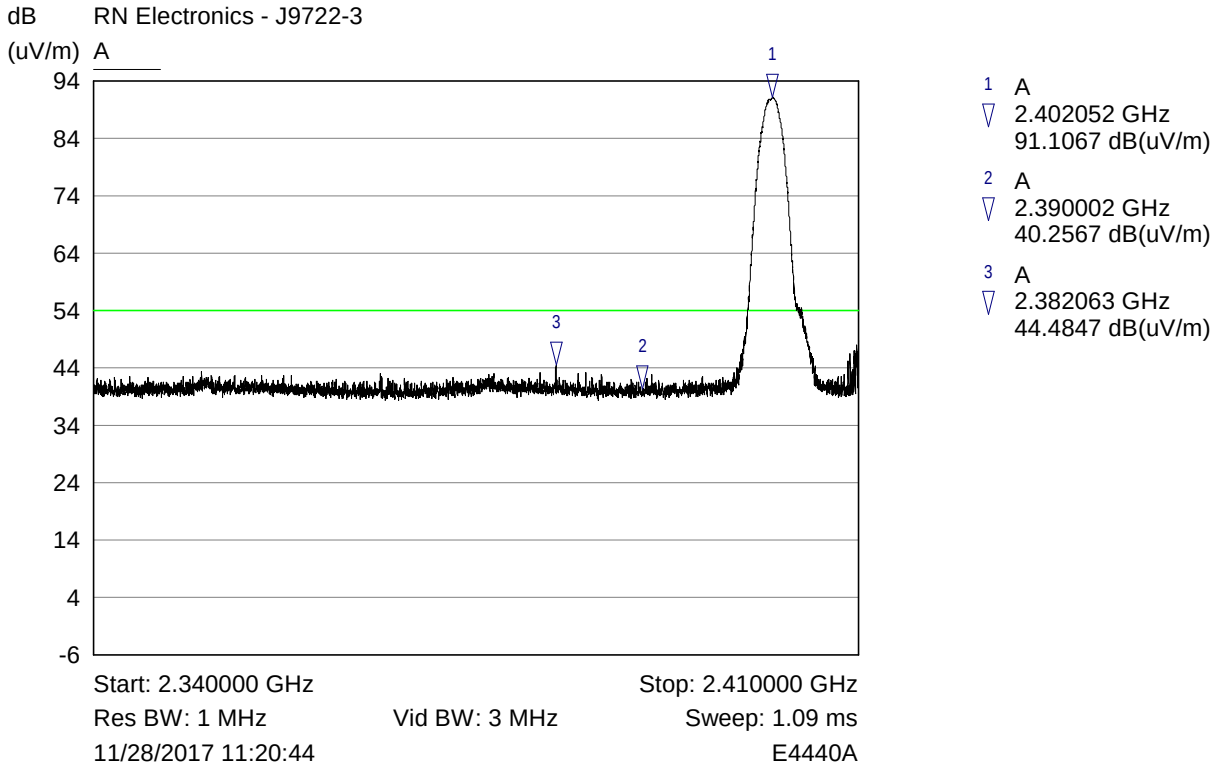


Restricted band edge Peak Plot

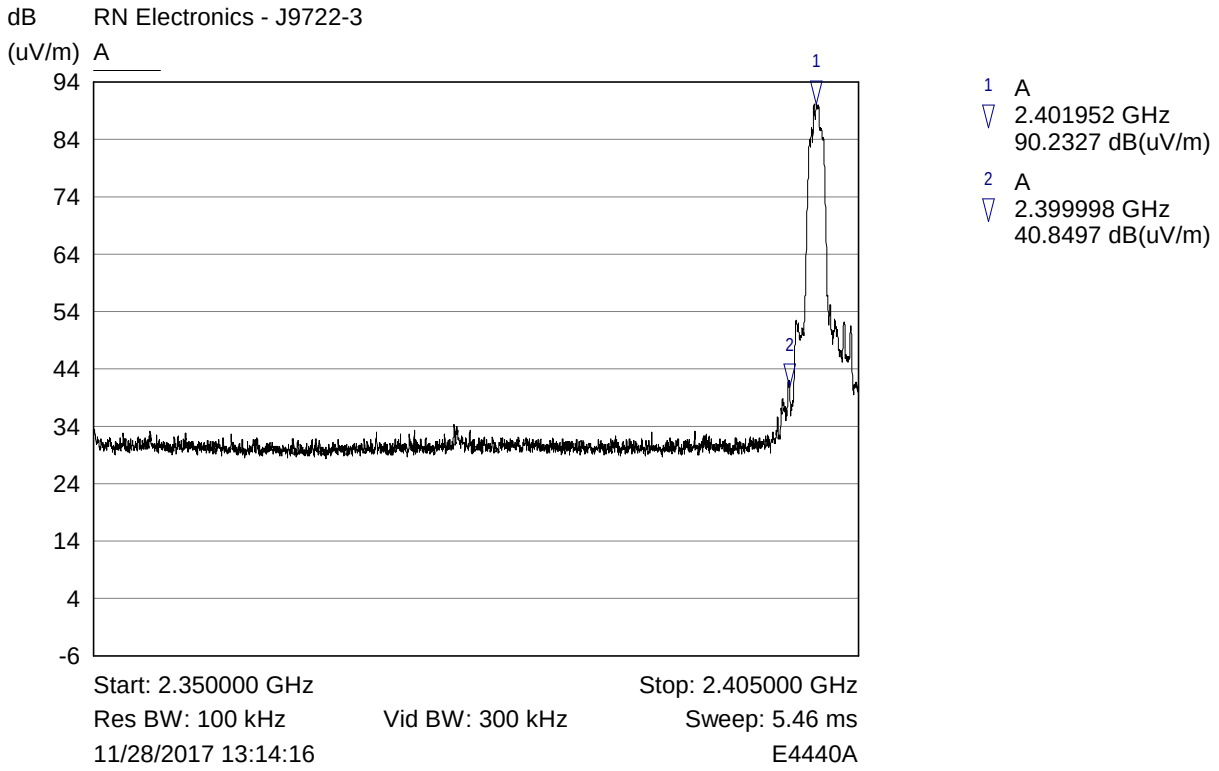


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH3, Channel 2402 MHz

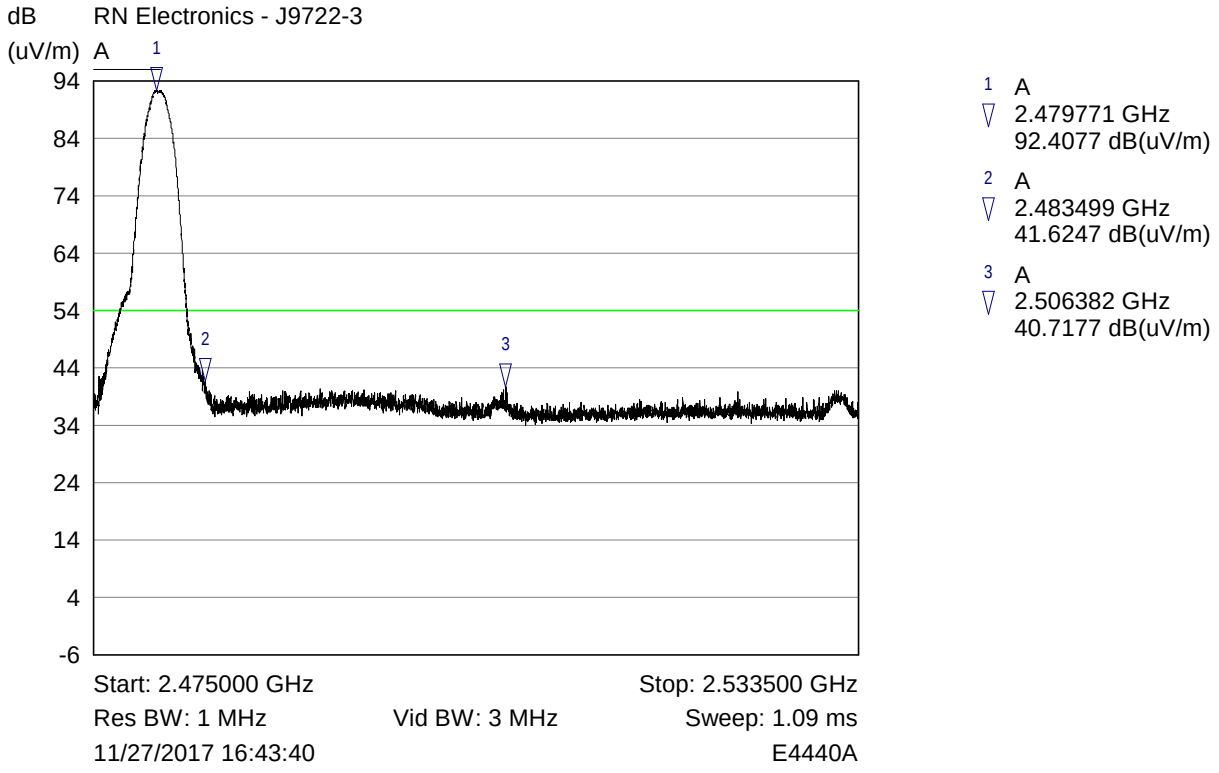


Restricted band edge Peak Plot

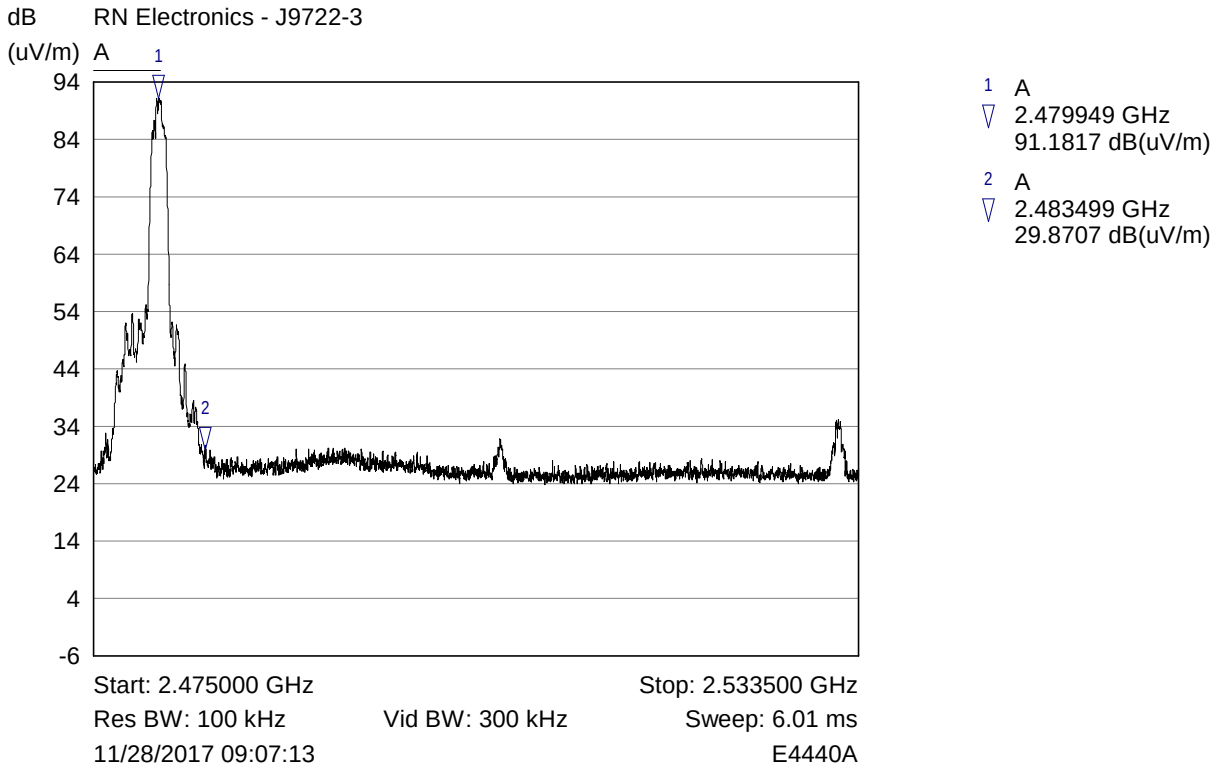


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH3, Channel 2480 MHz

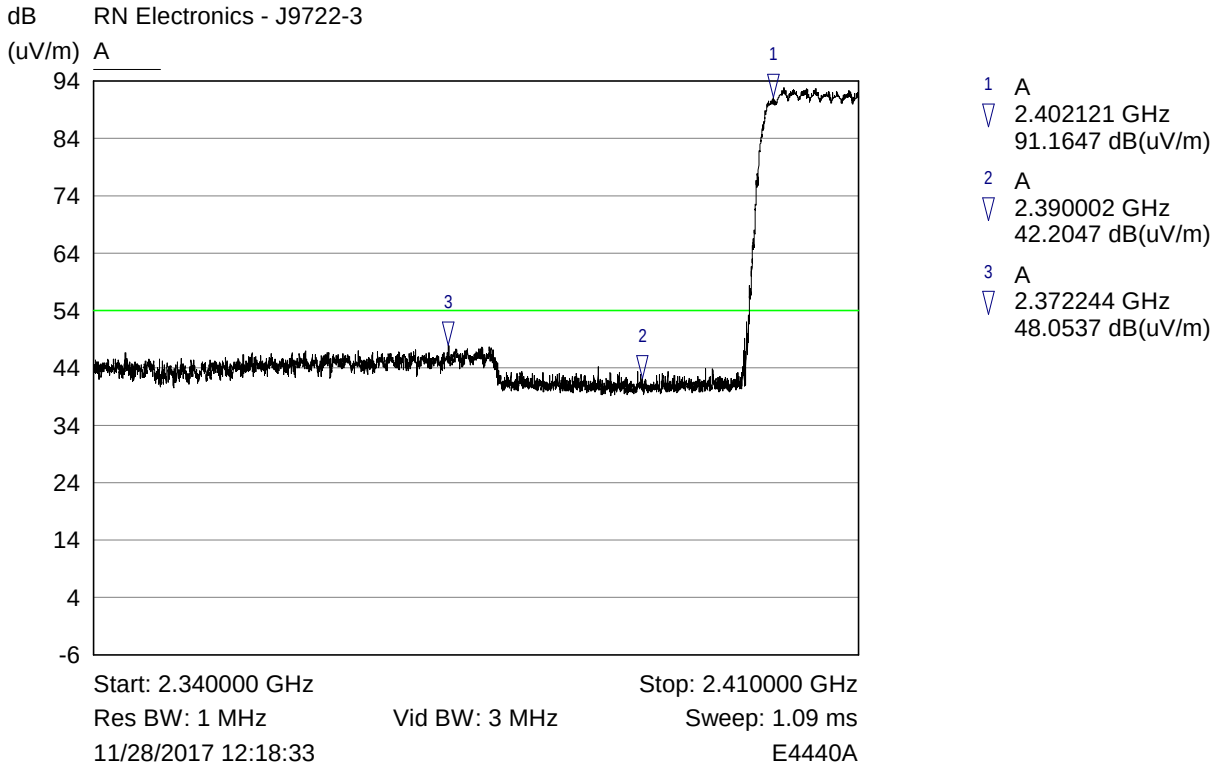


Restricted band edge Peak Plot

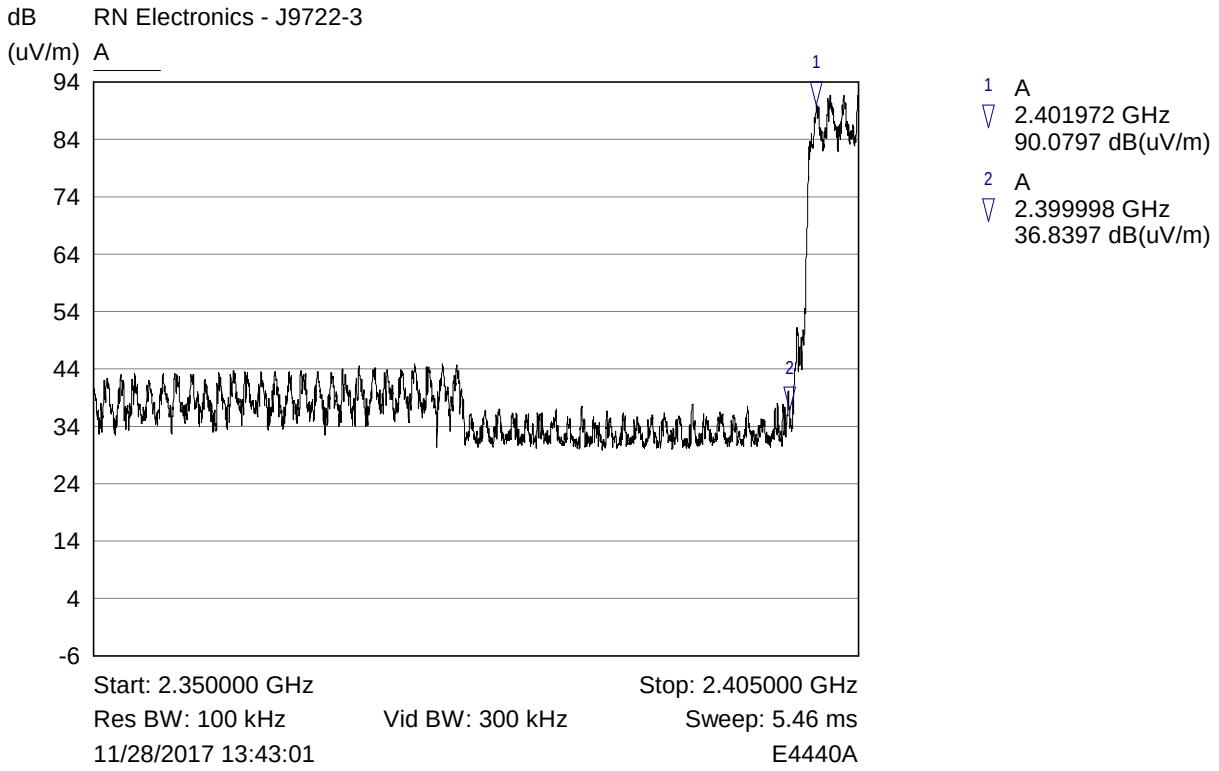


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH3, Channel Low hopping

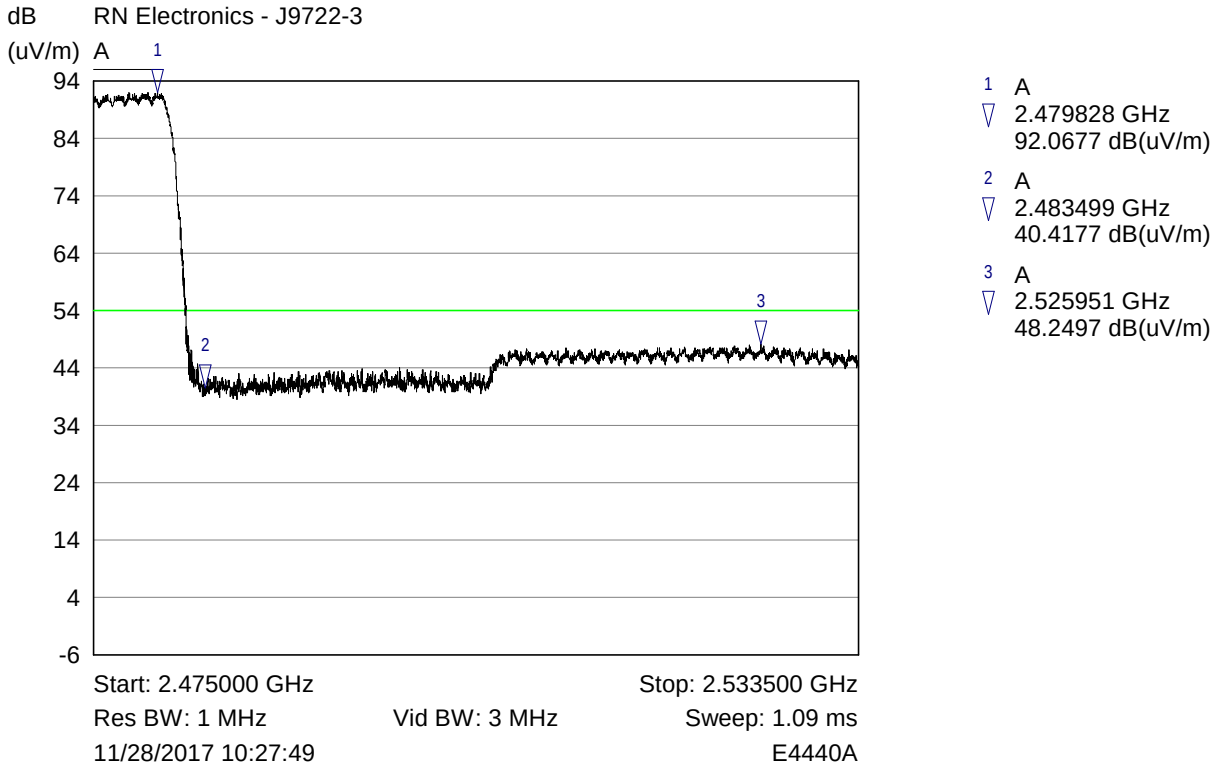


Restricted band edge Peak Plot

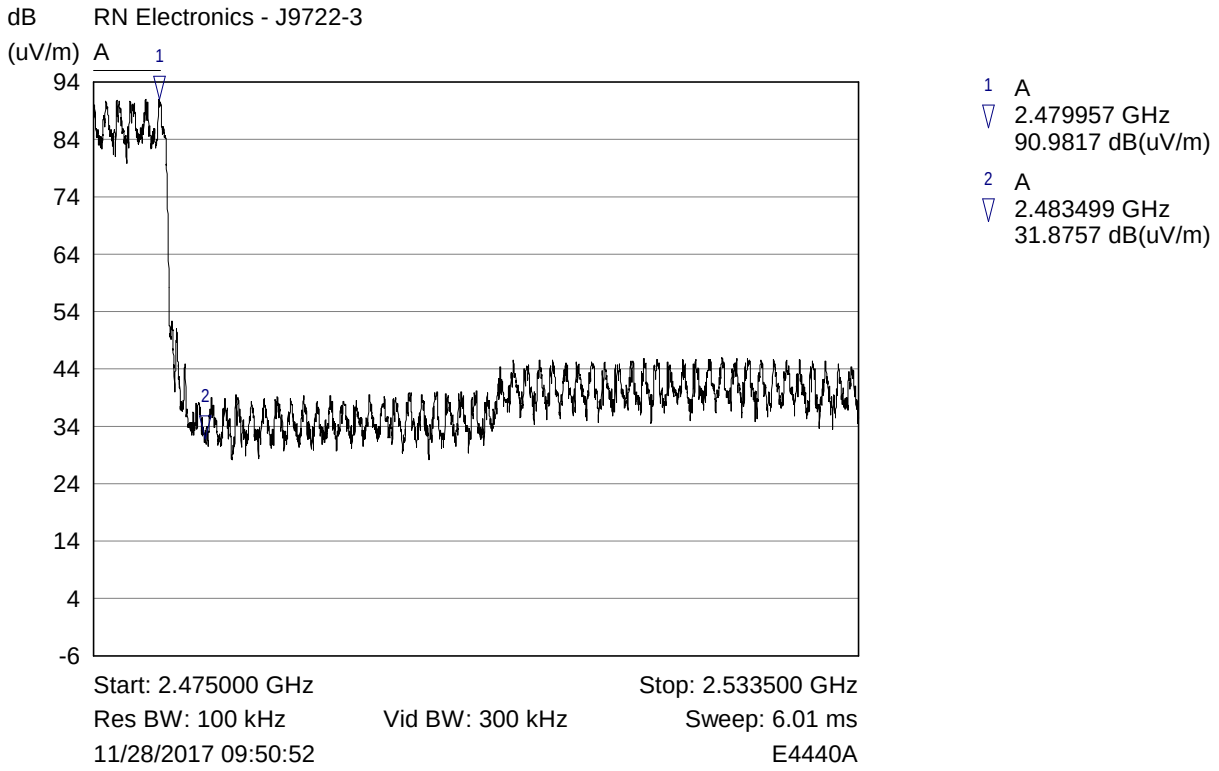


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH3, Channel High hopping

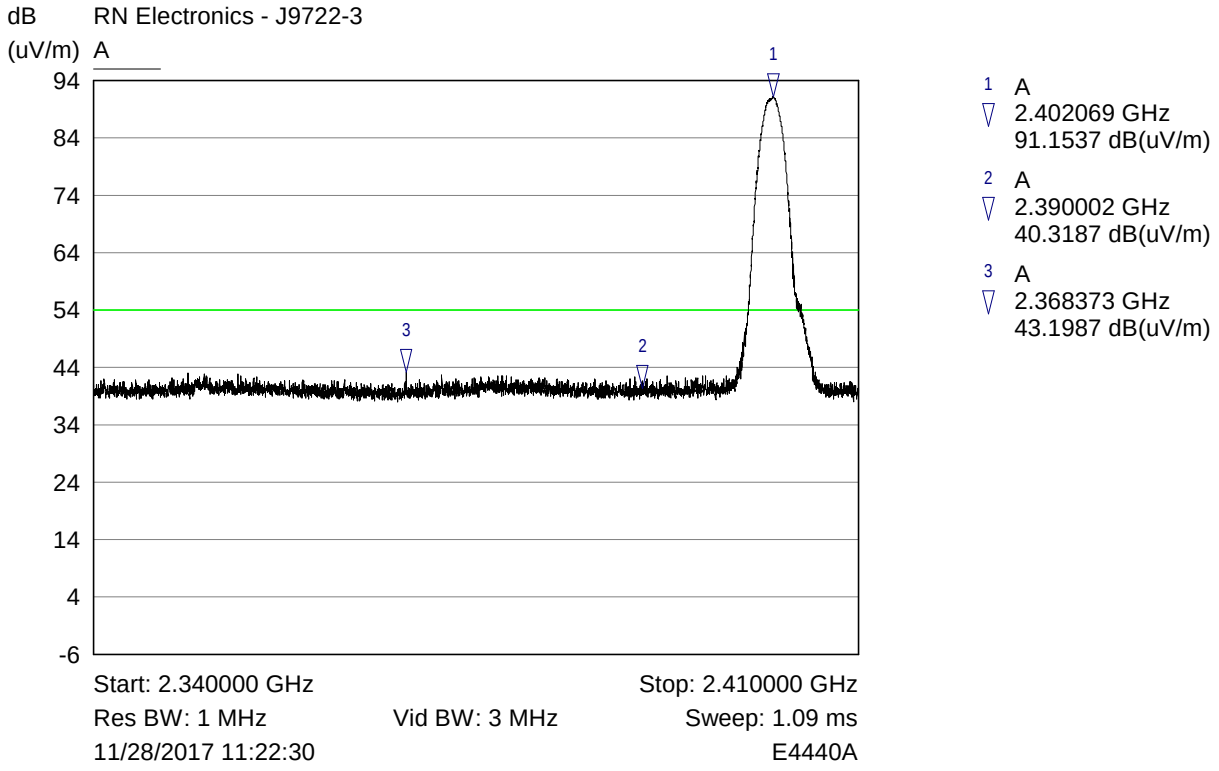


Restricted band edge Peak Plot

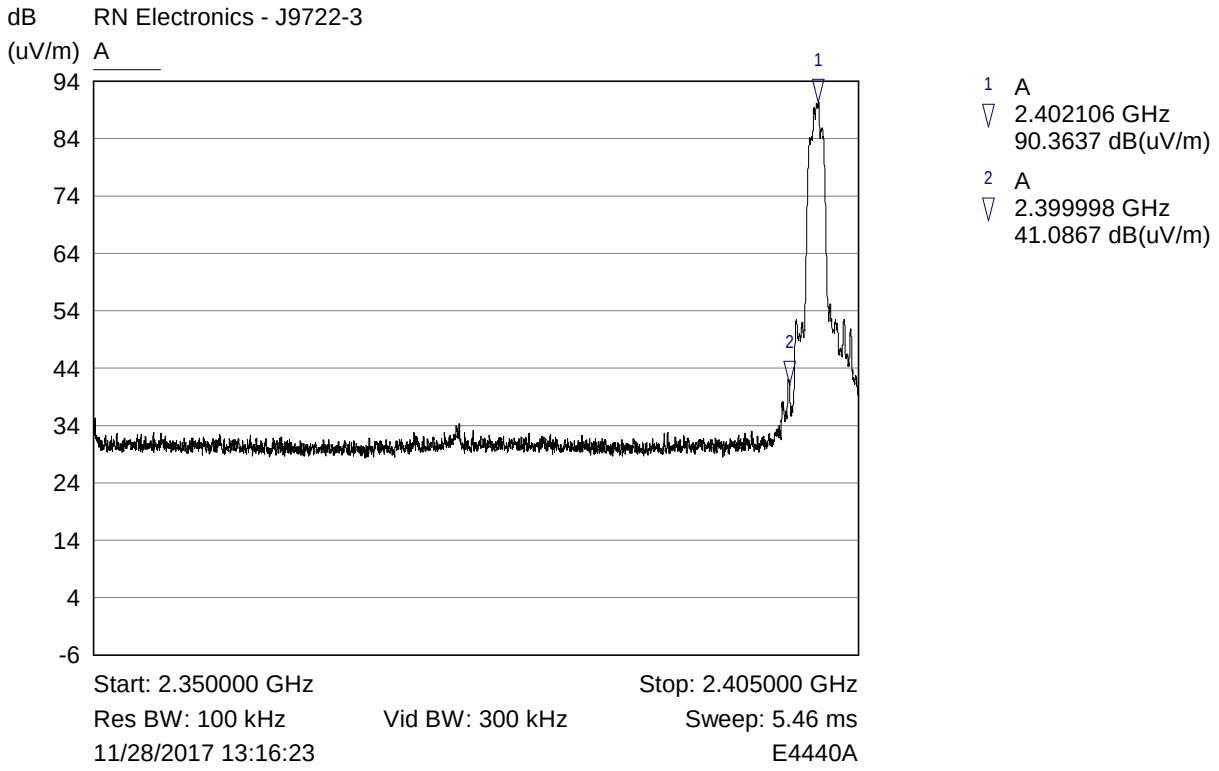


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH3, Channel 2402 MHz

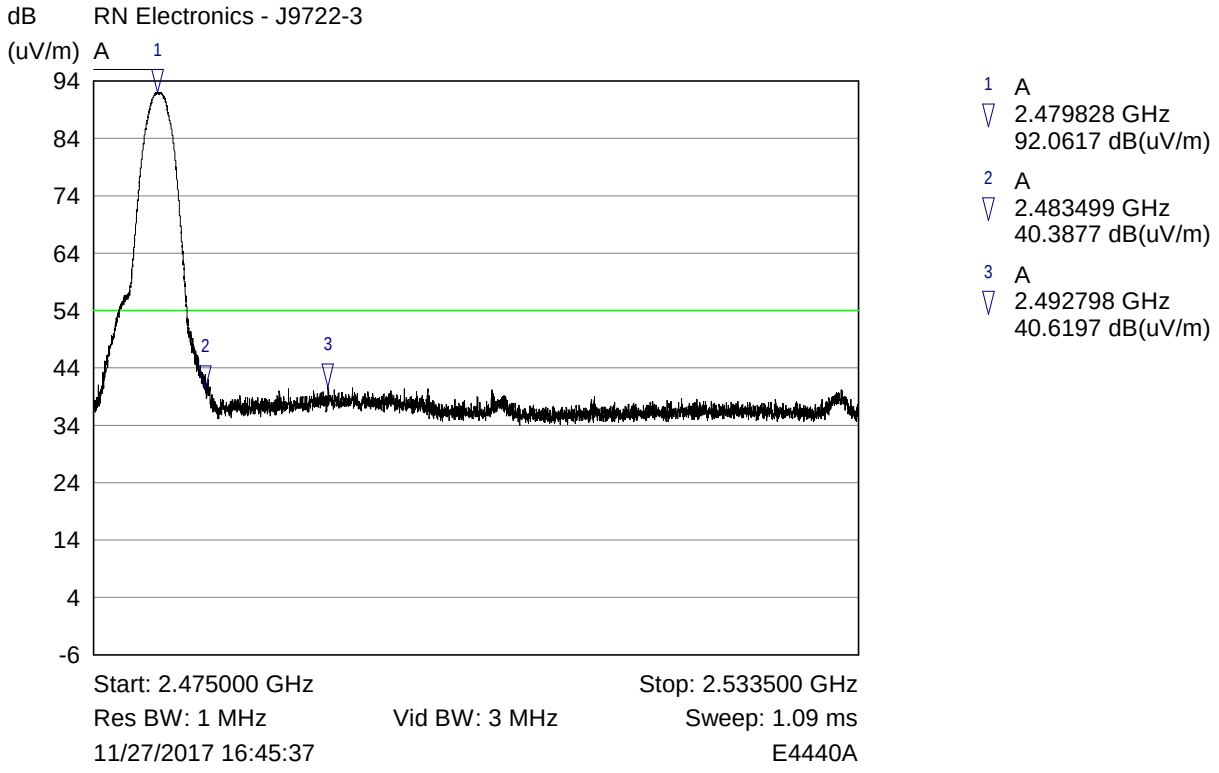


Restricted band edge Peak Plot

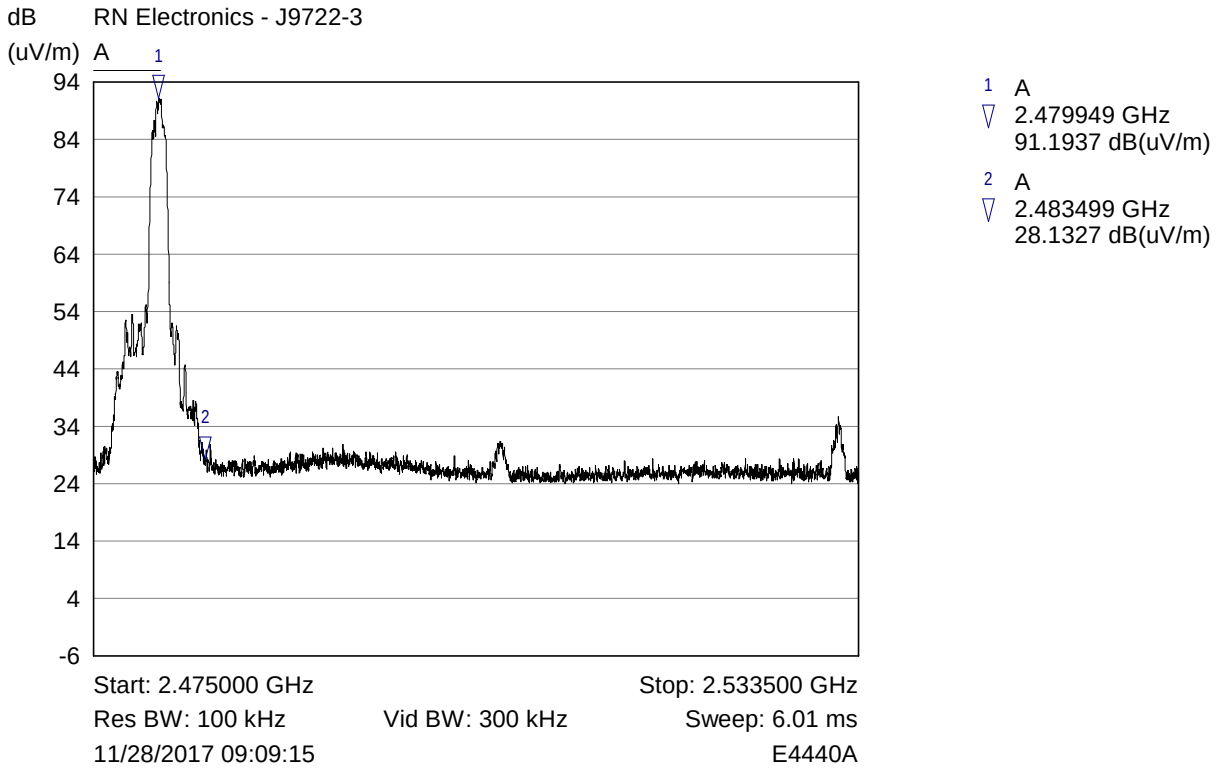


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH3, Channel 2480 MHz

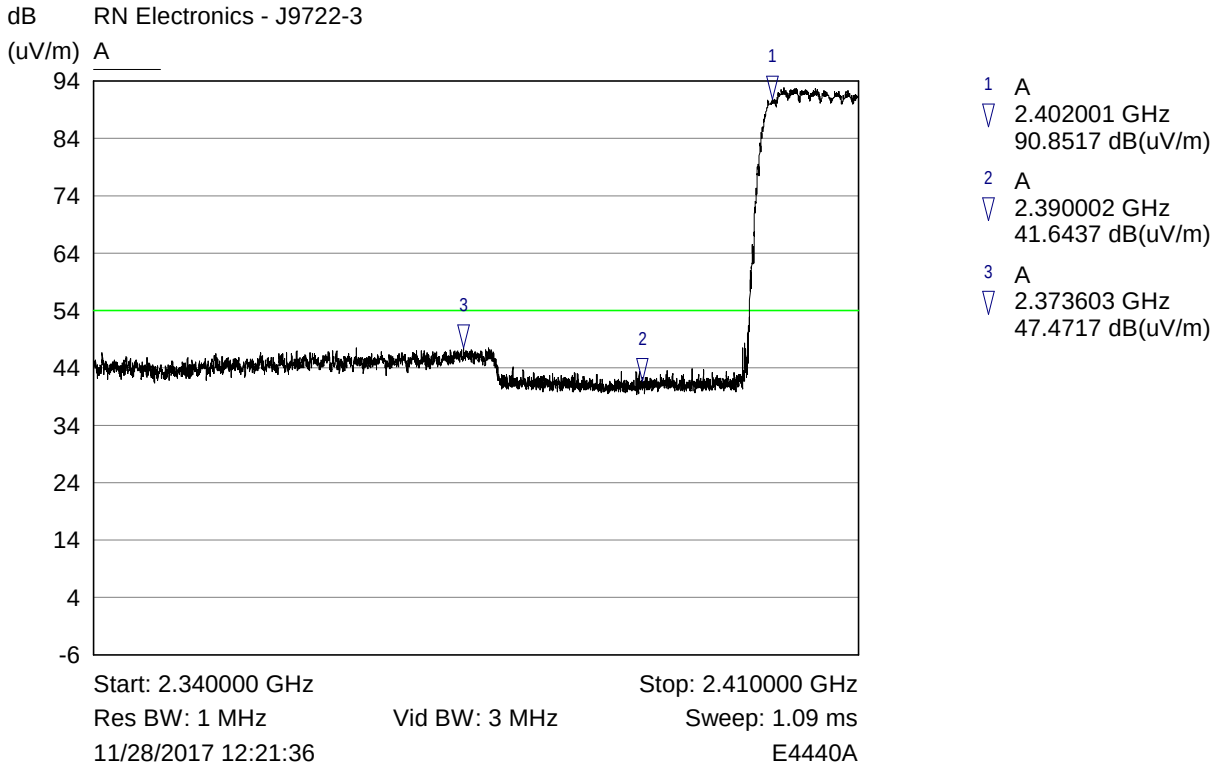


Restricted band edge Peak Plot

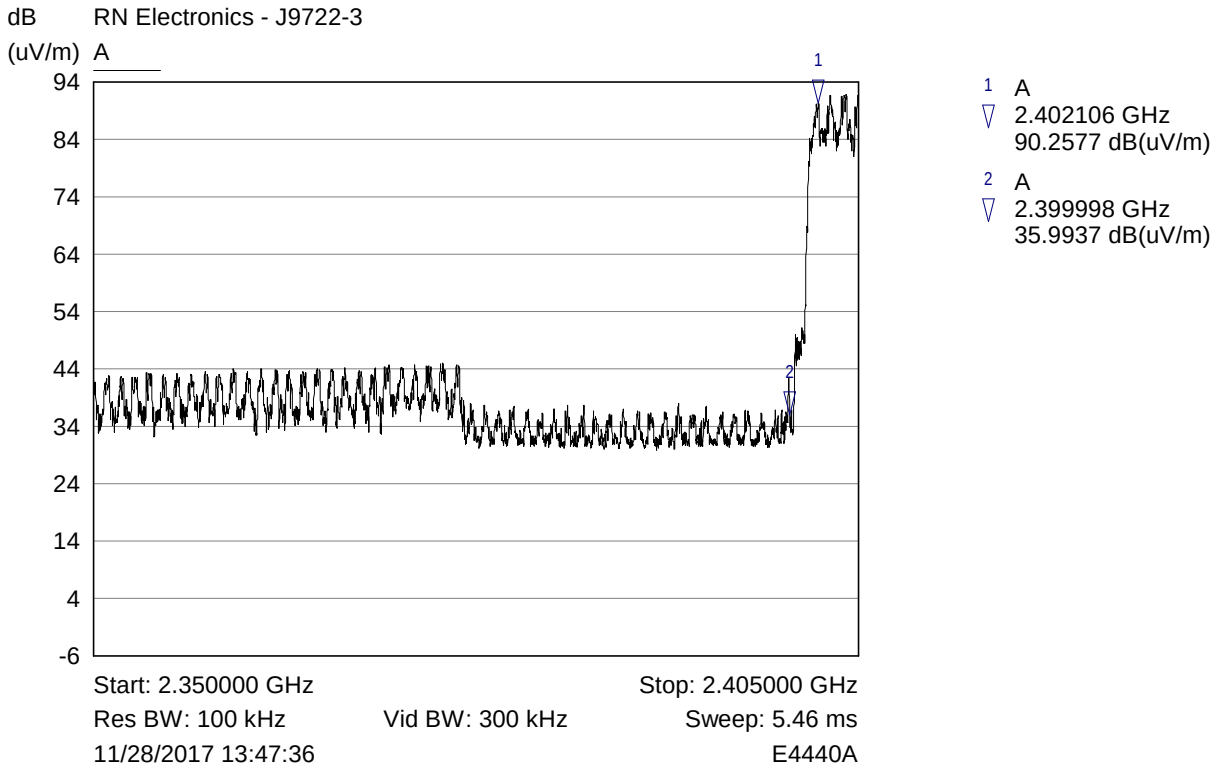


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH3, Channel Low hopping

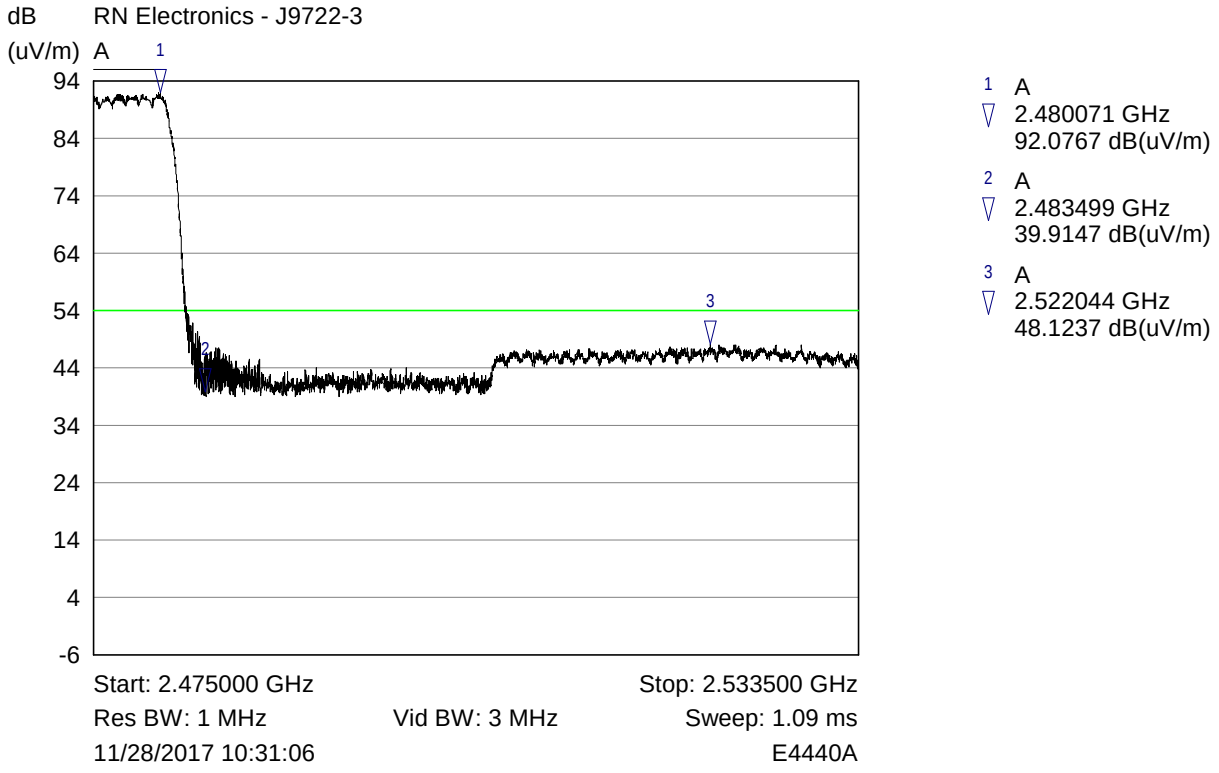


Restricted band edge Peak Plot

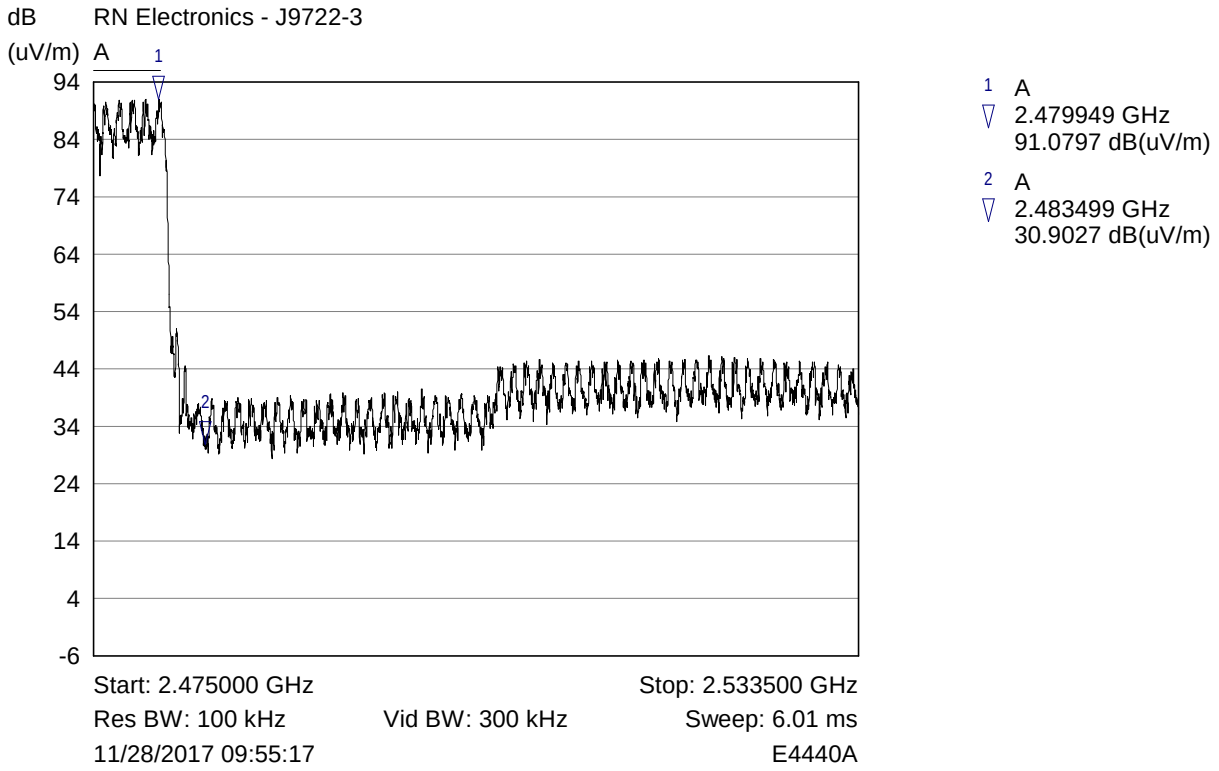


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH3, Channel High hopping

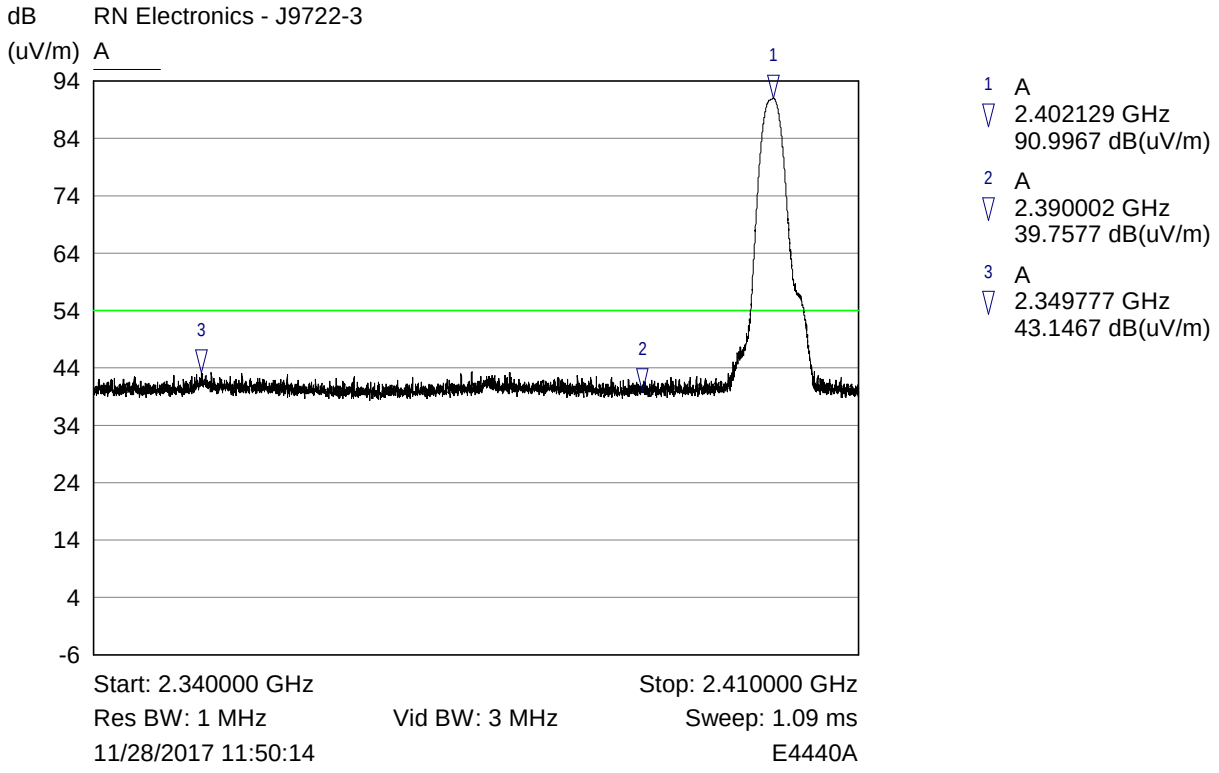


Restricted band edge Peak Plot

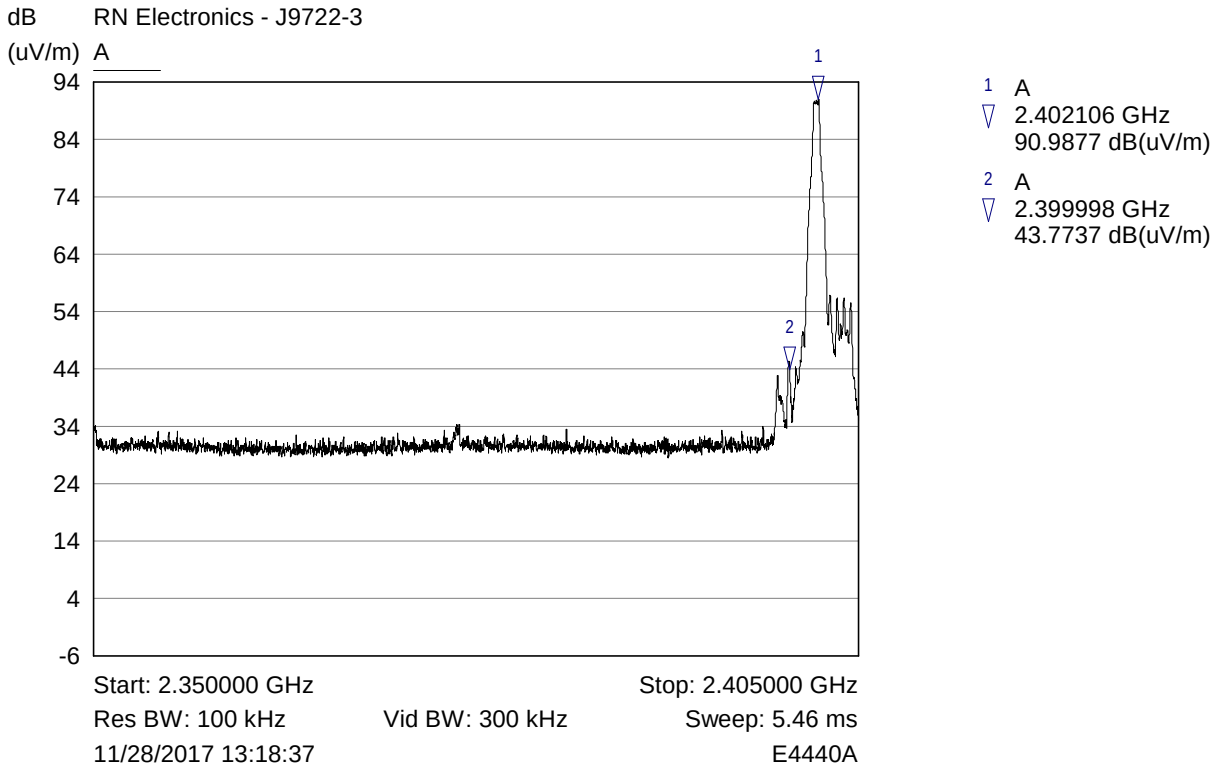


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH5, Channel 2402 MHz

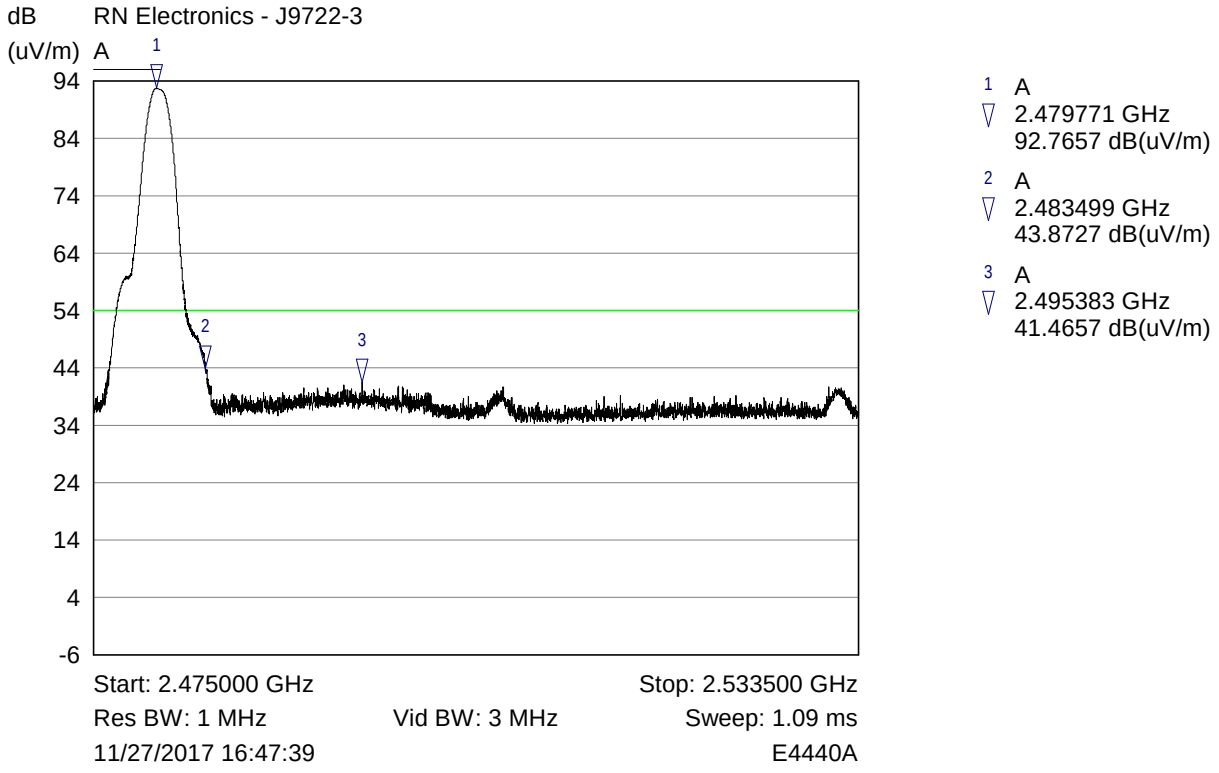


Restricted band edge Peak Plot

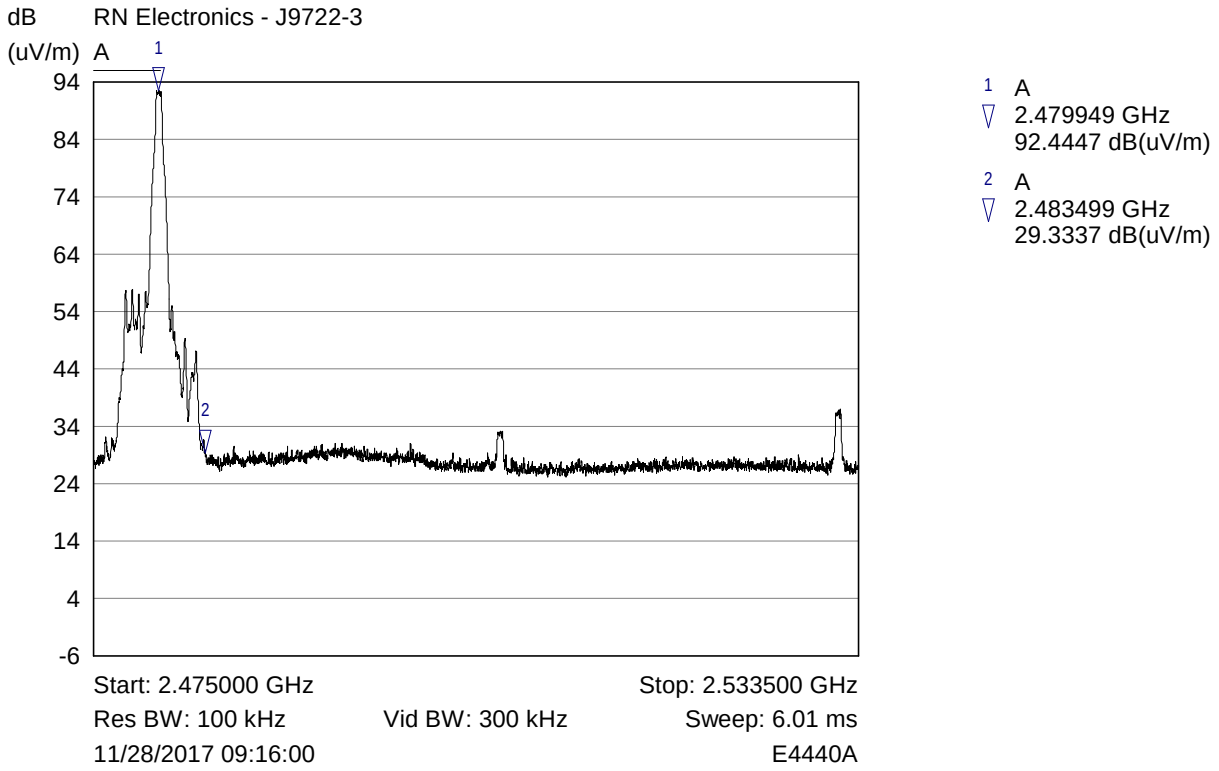


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH5, Channel 2480 MHz

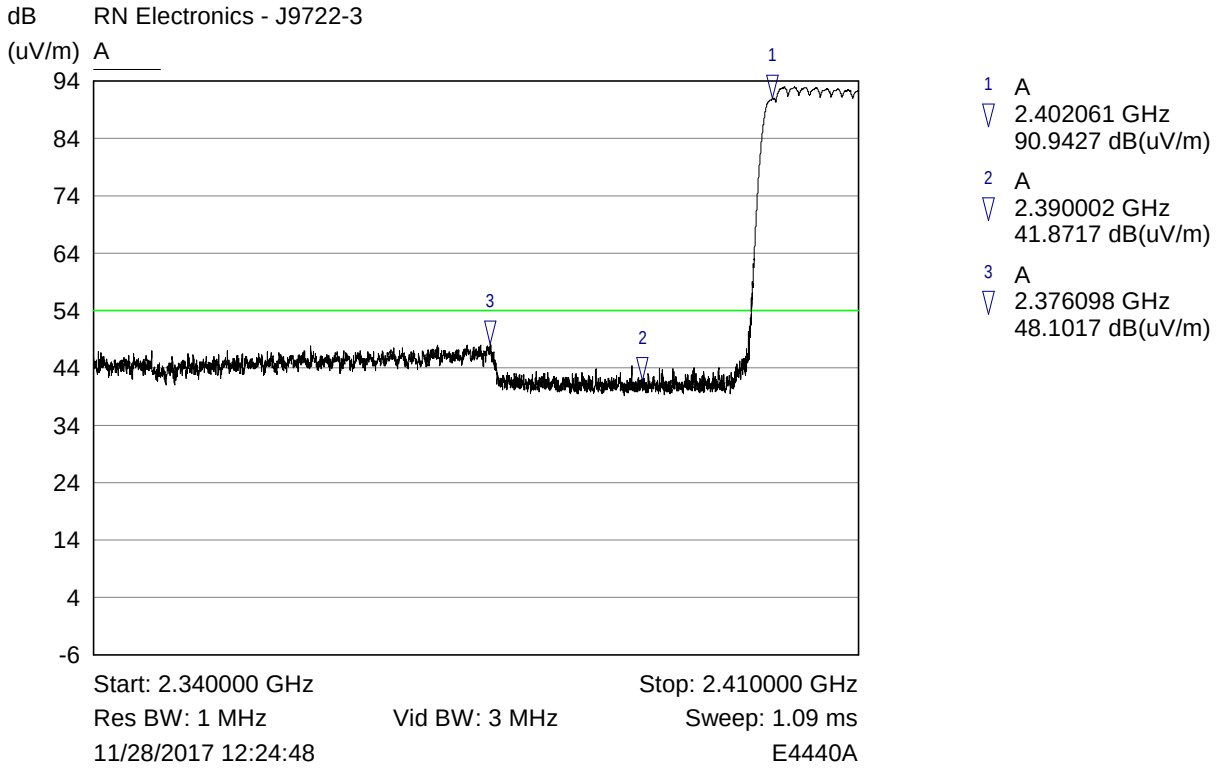


Restricted band edge Peak Plot

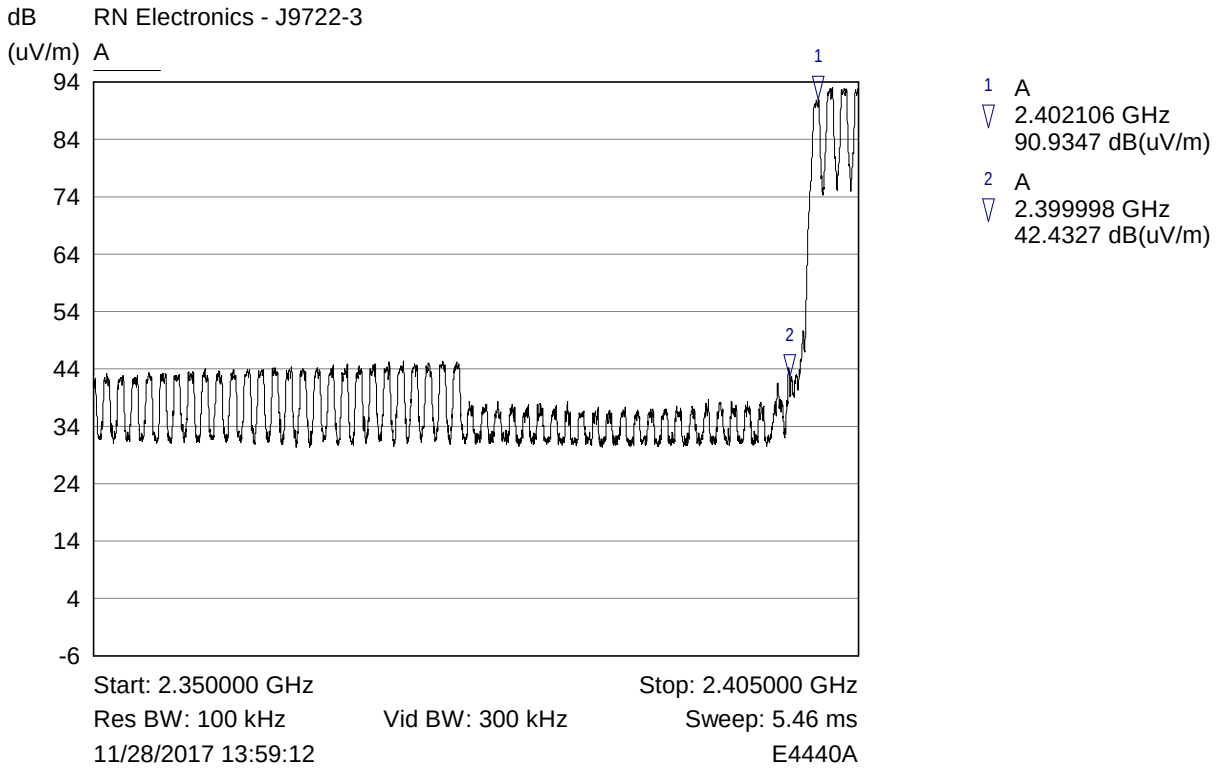


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH5, Channel Low hopping

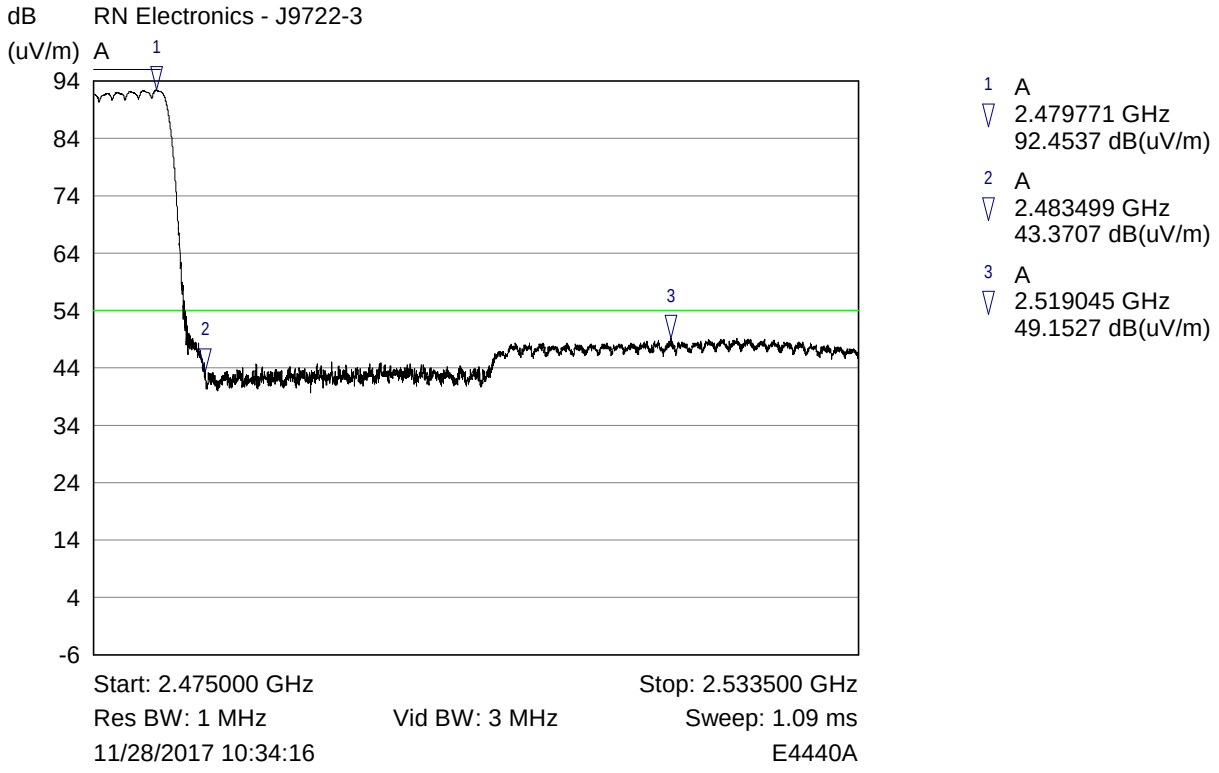


Restricted band edge Peak Plot

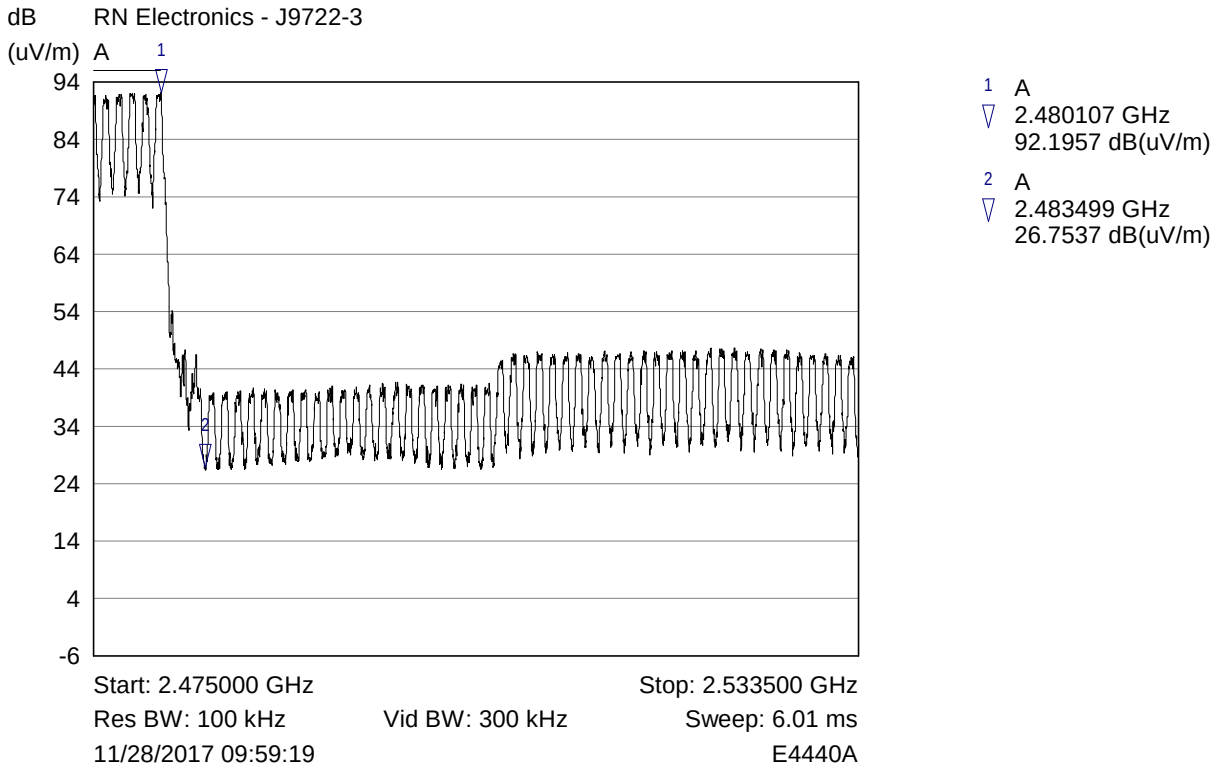


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH5, Channel High hopping

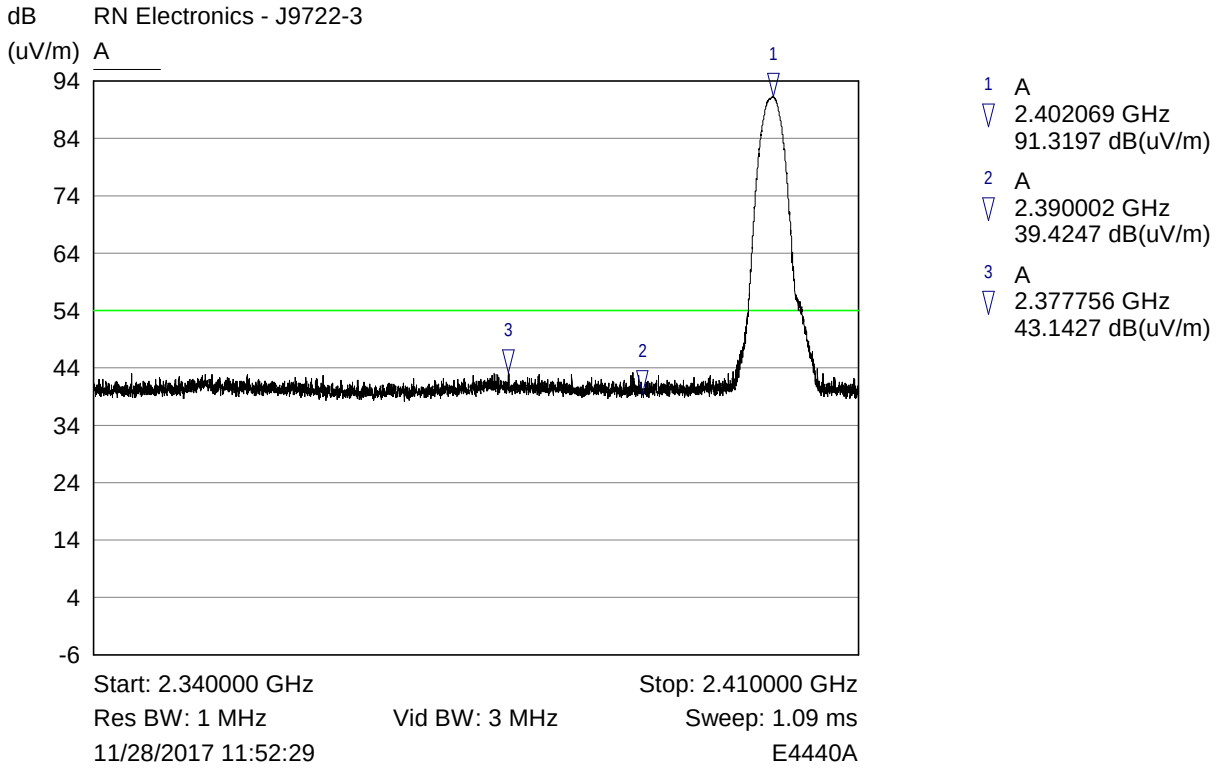


Restricted band edge Peak Plot

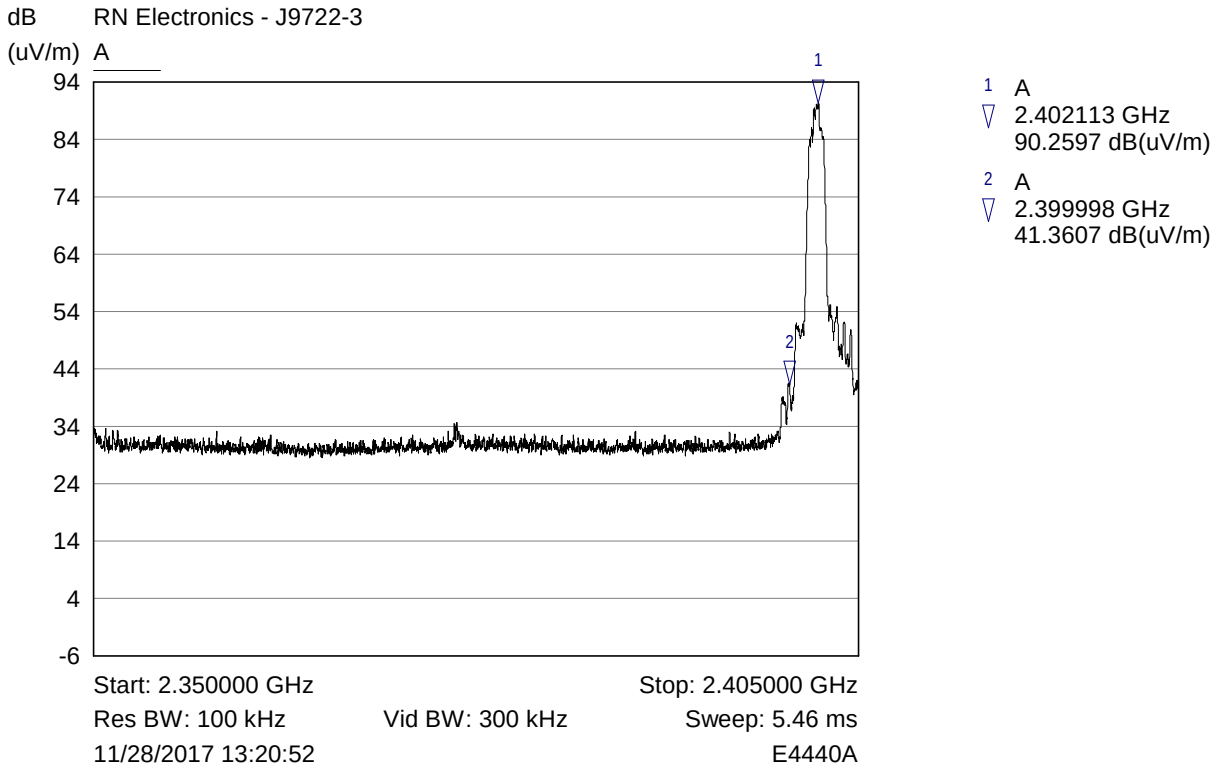


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH5, Channel 2402 MHz

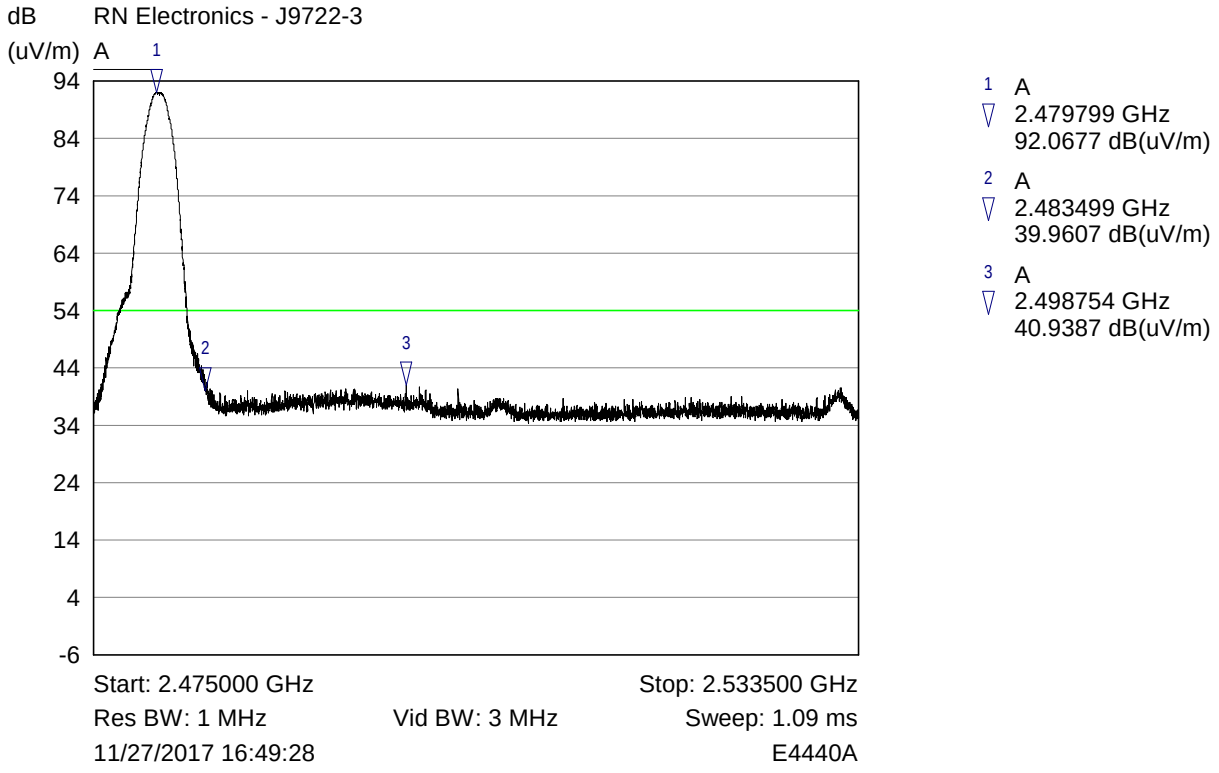


Restricted band edge Peak Plot

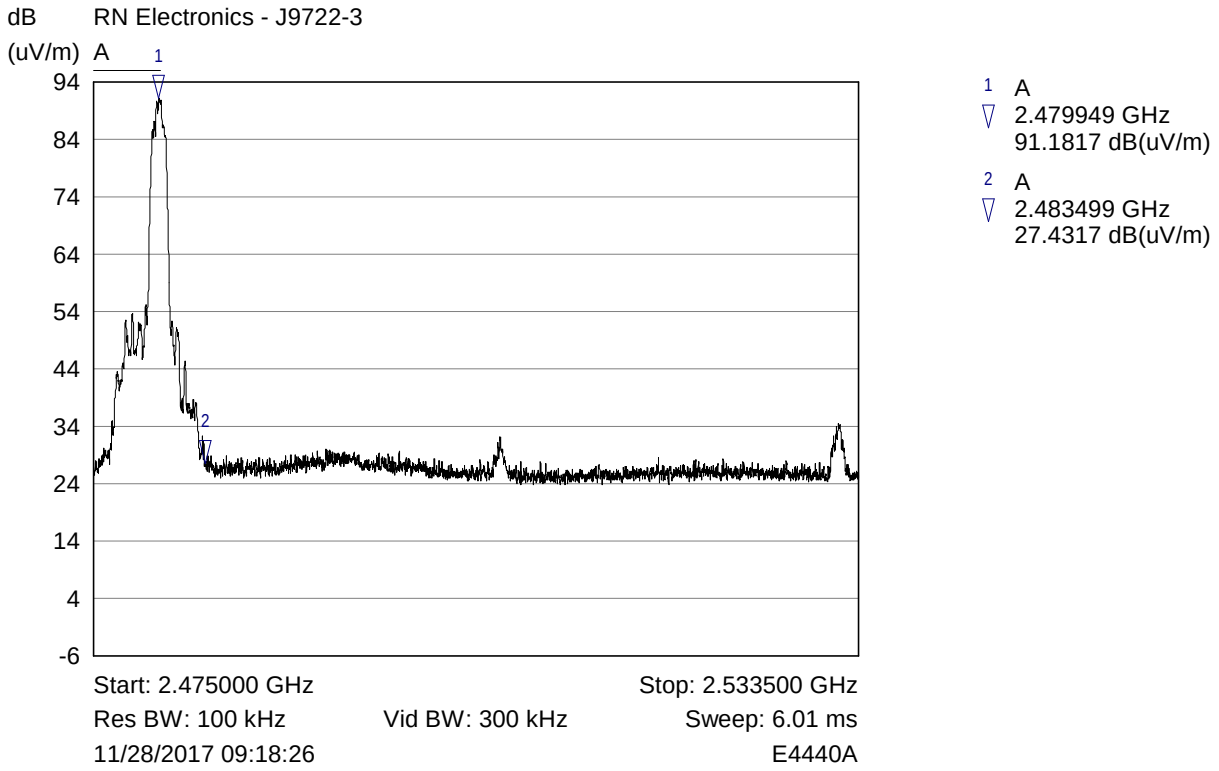


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH5, Channel 2480 MHz

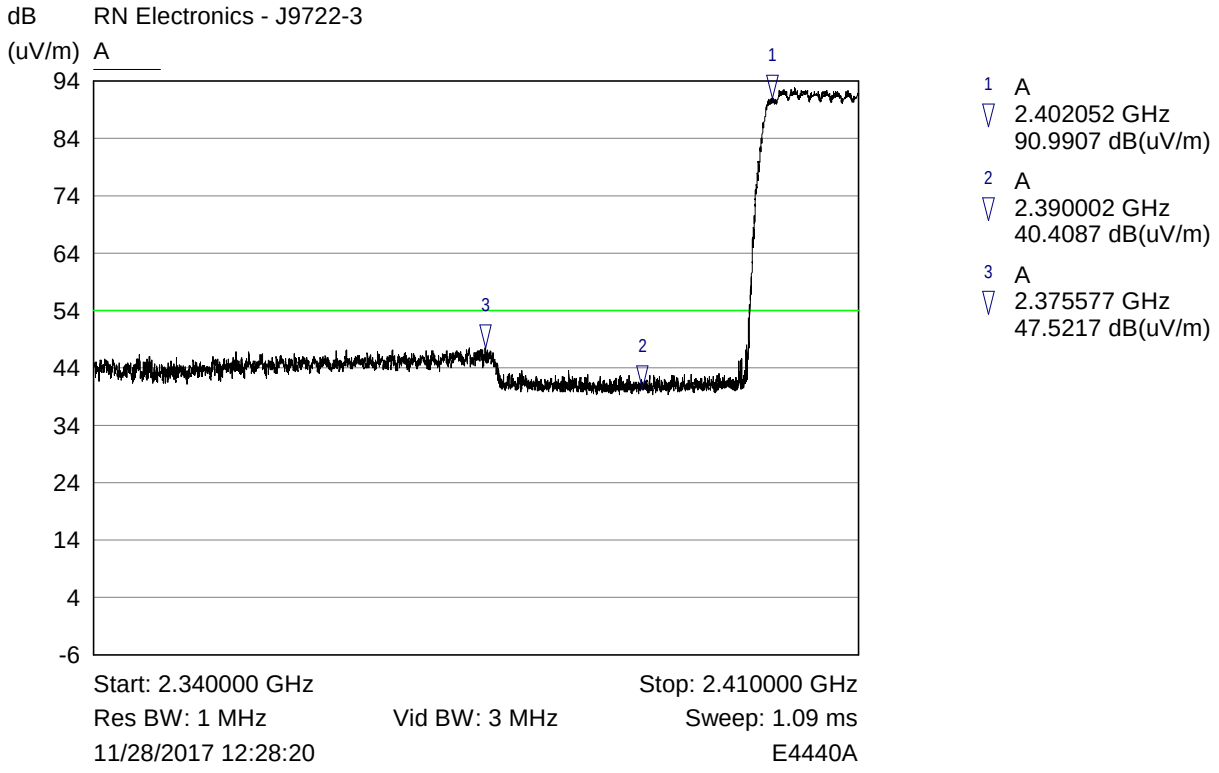


Restricted band edge Peak Plot

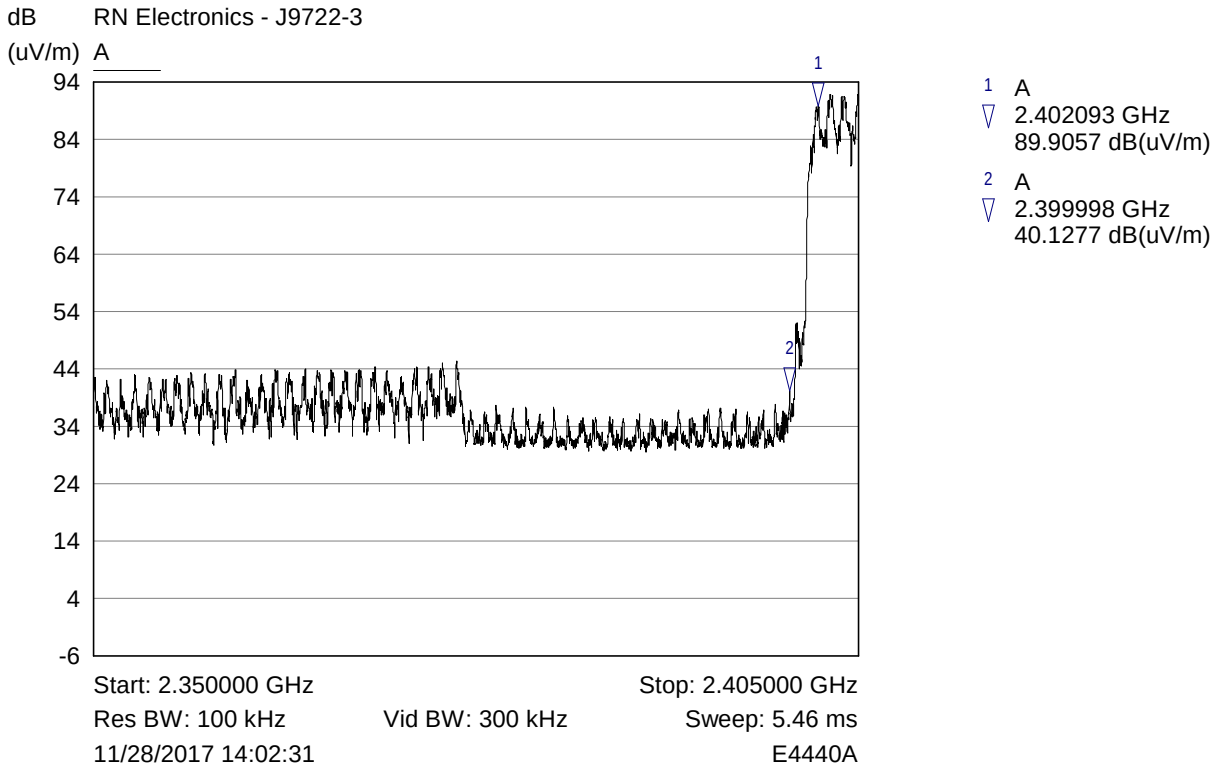


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH5, Channel Low hopping

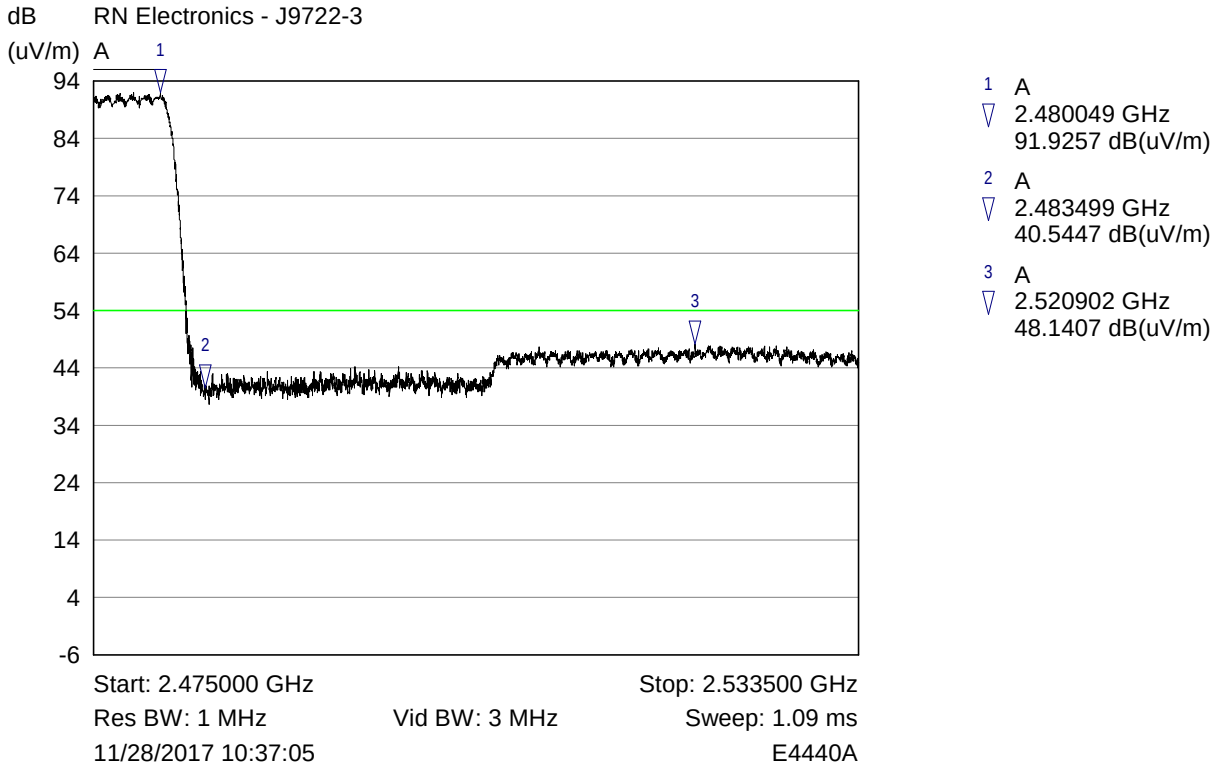


Restricted band edge Peak Plot

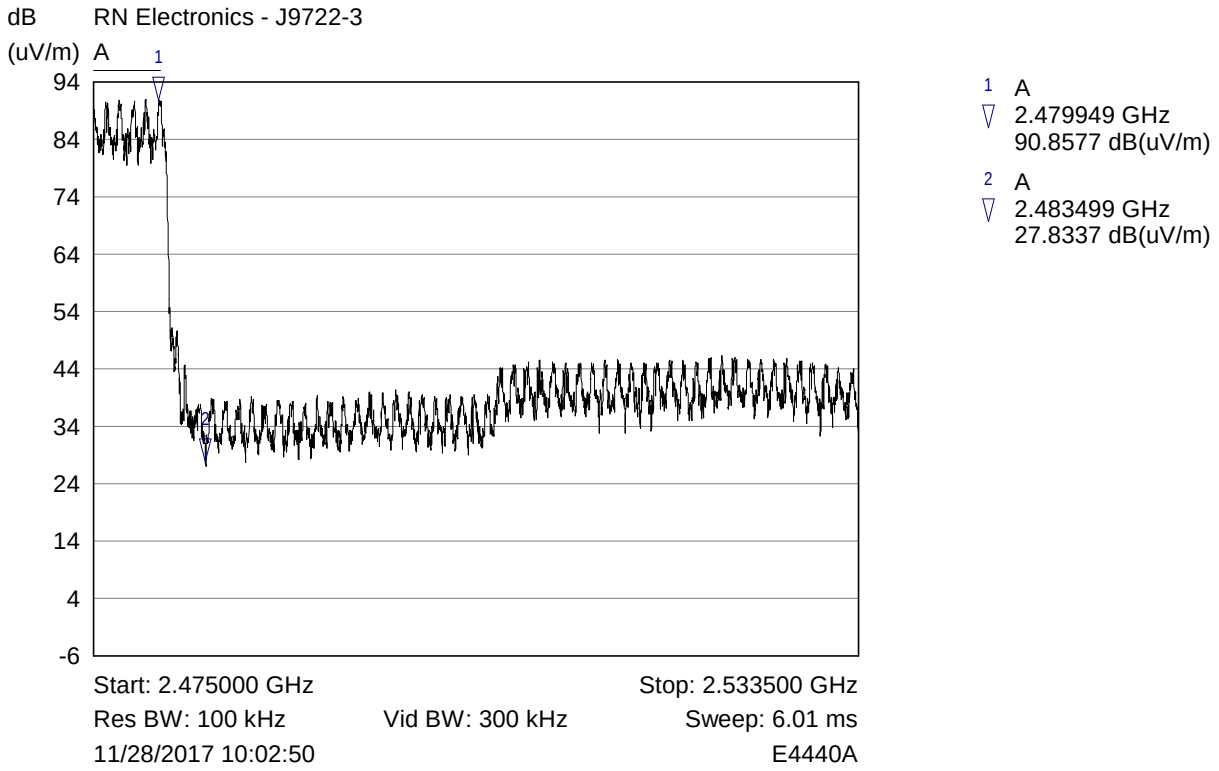


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH5, Channel High hopping

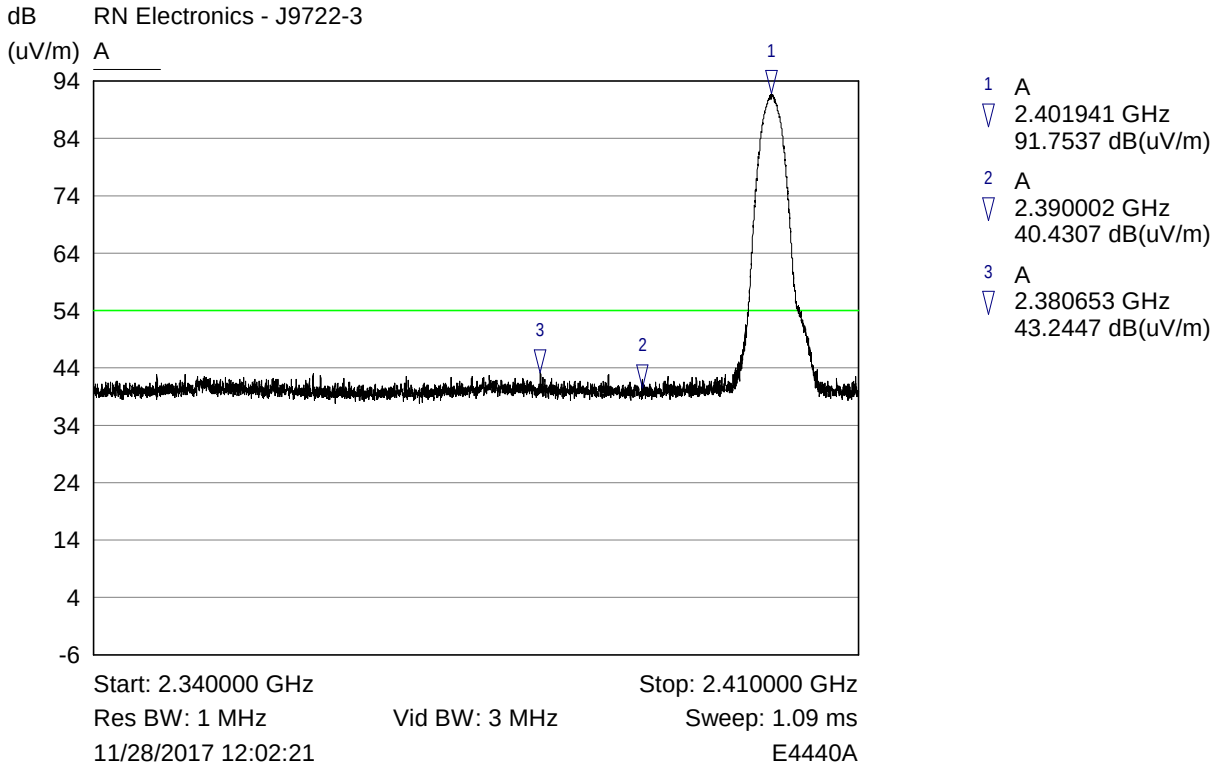


Restricted band edge Peak Plot

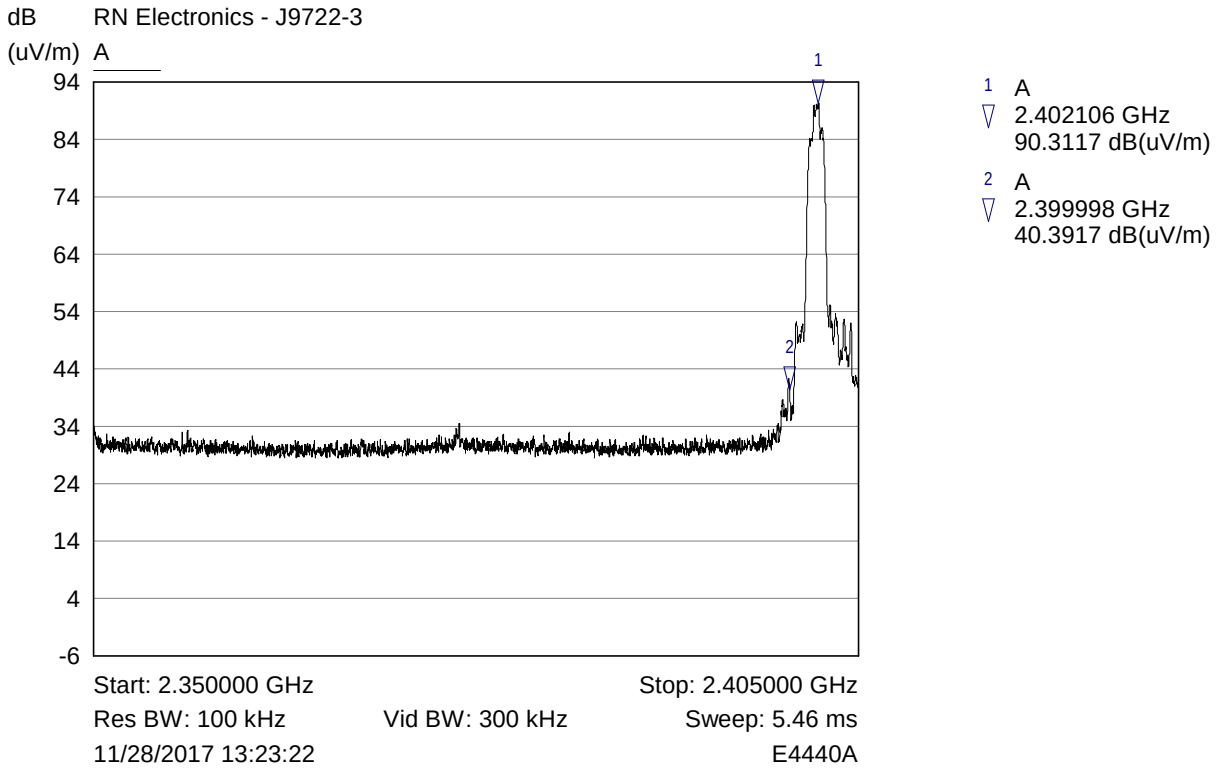


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH5, Channel 2402 MHz

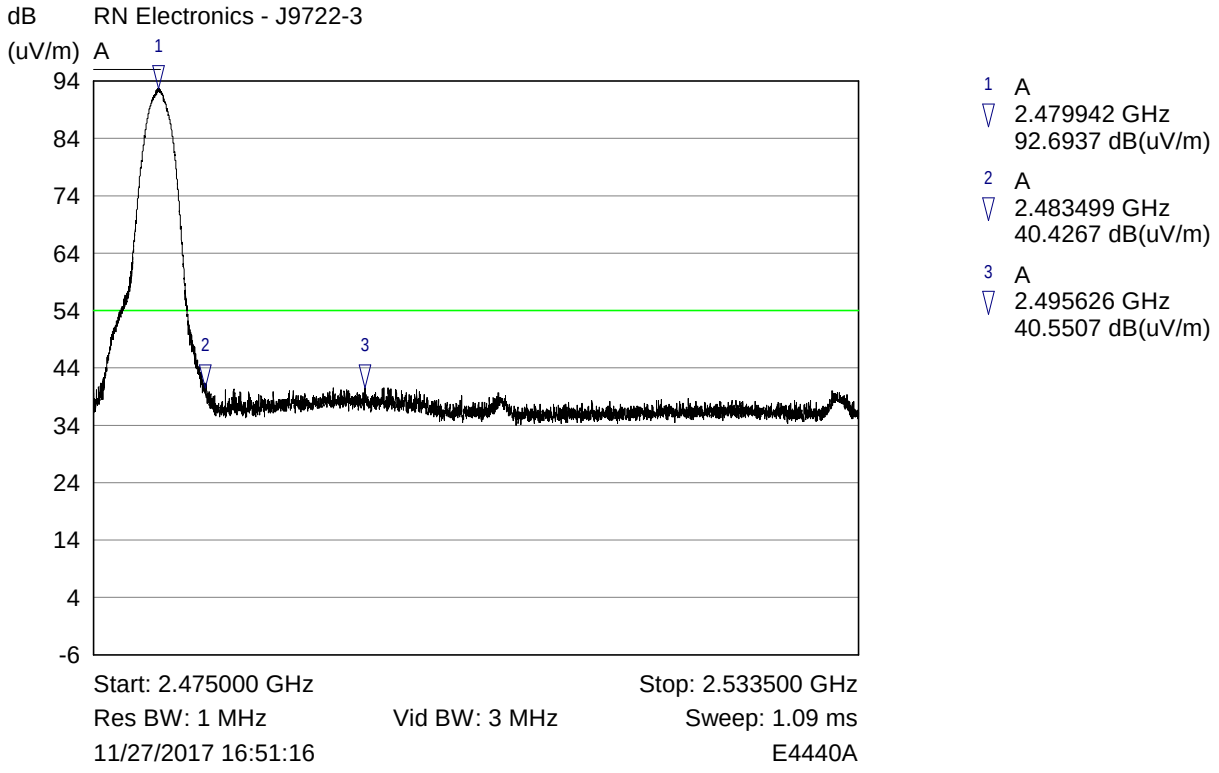


Restricted band edge Peak Plot

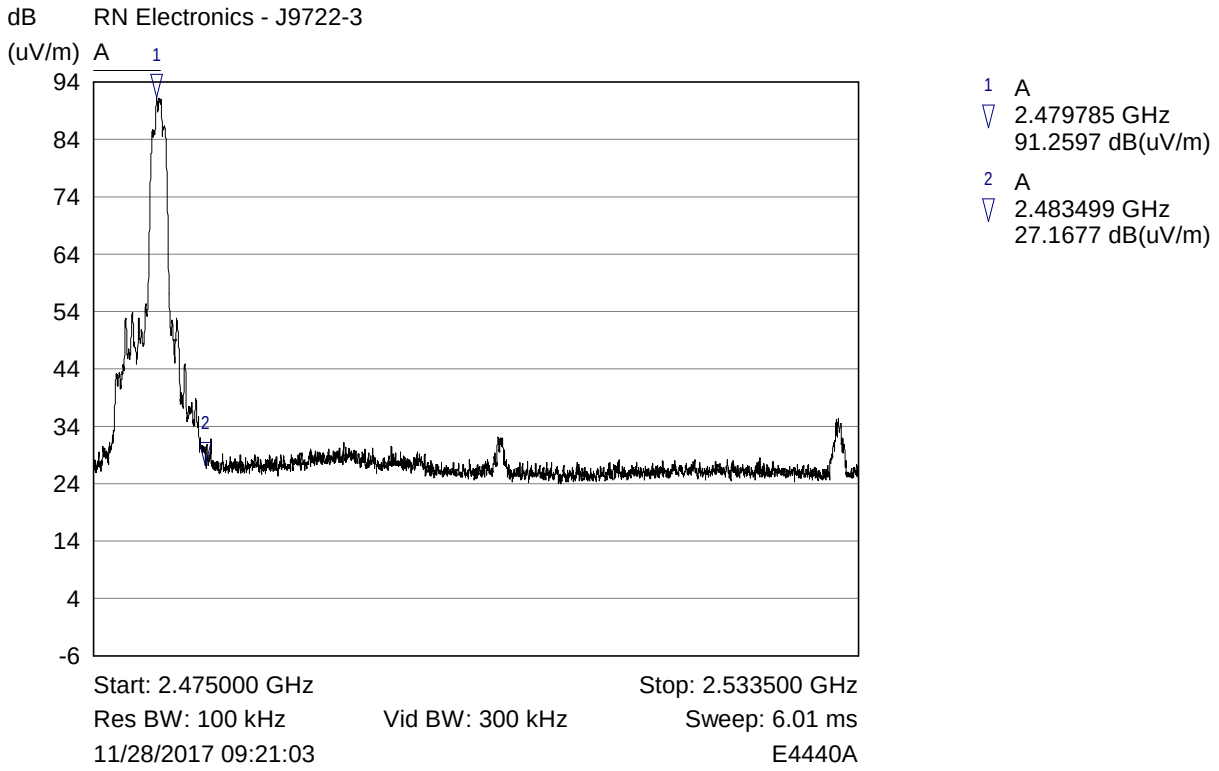


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH5, Channel 2480 MHz

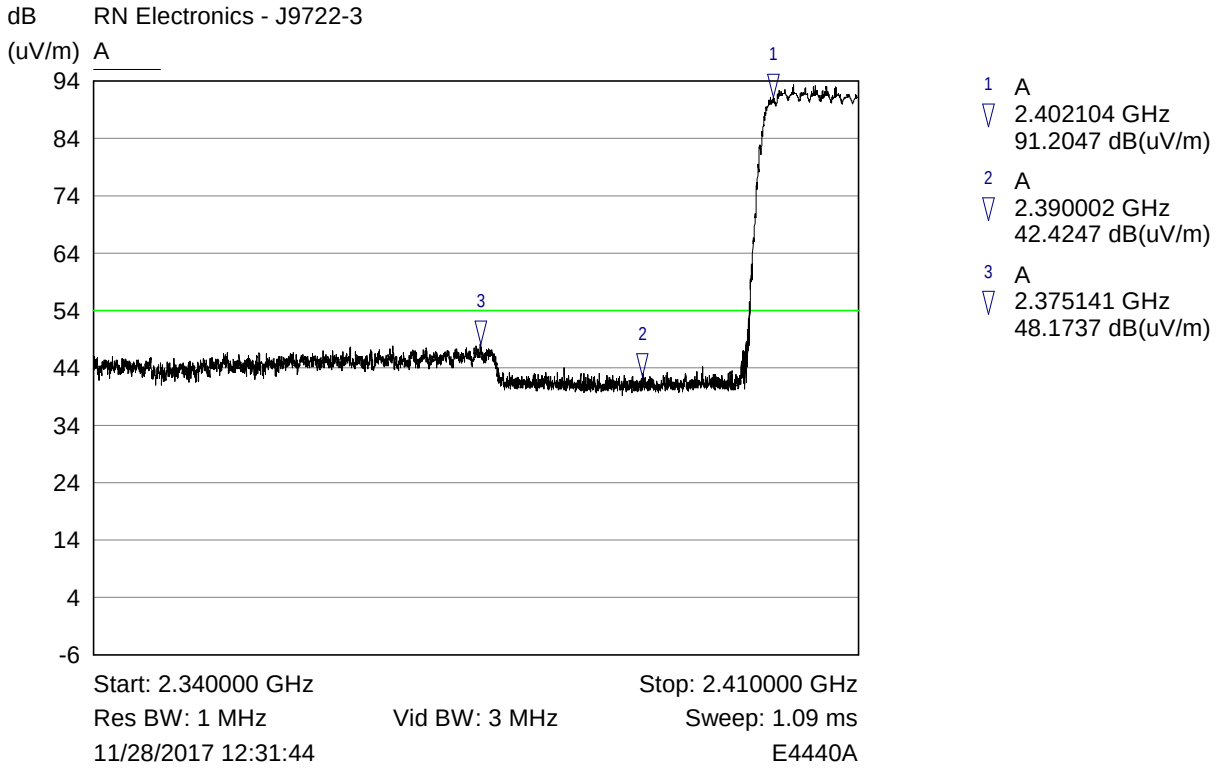


Restricted band edge Peak Plot

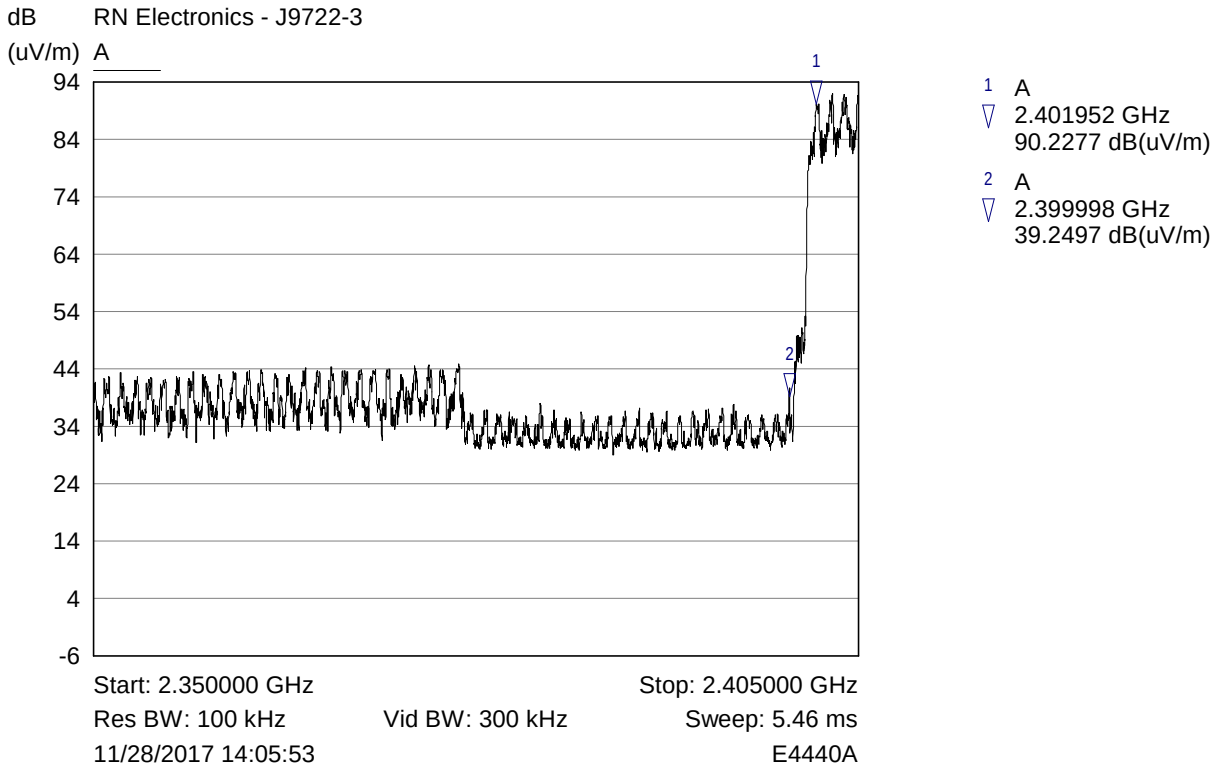


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH5, Channel Low hopping

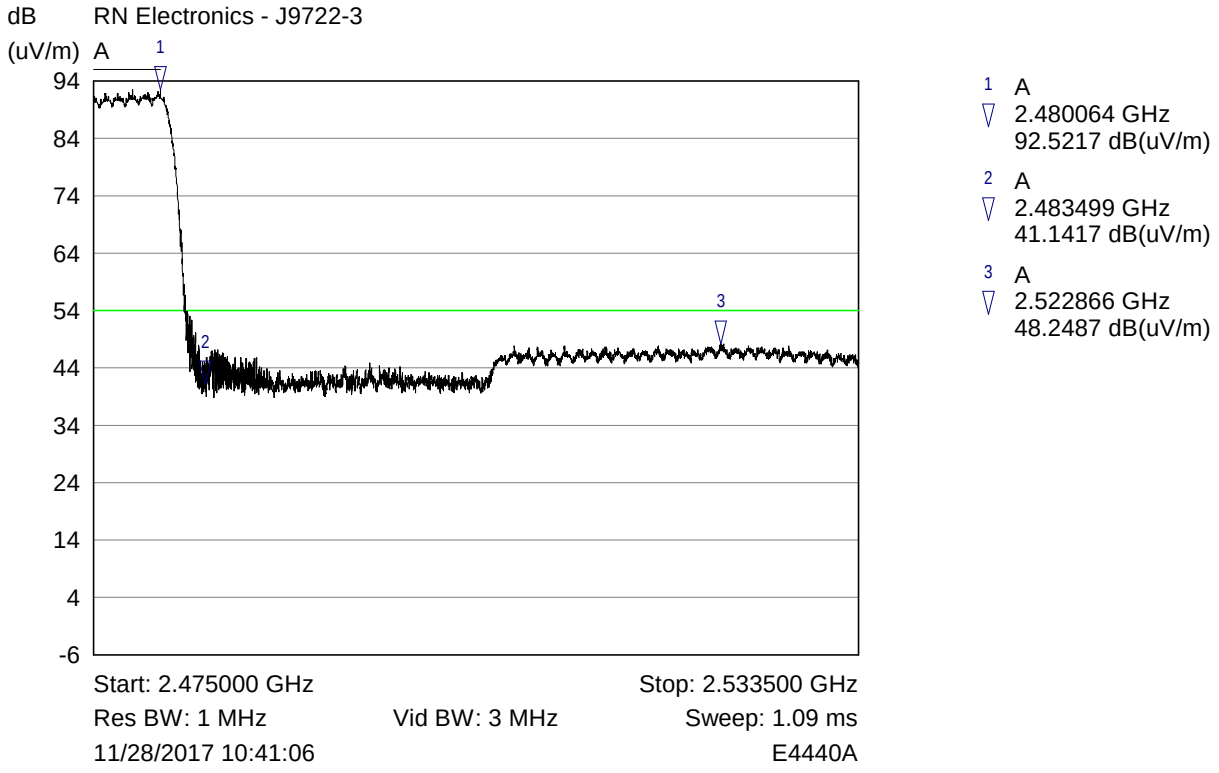


Restricted band edge Peak Plot

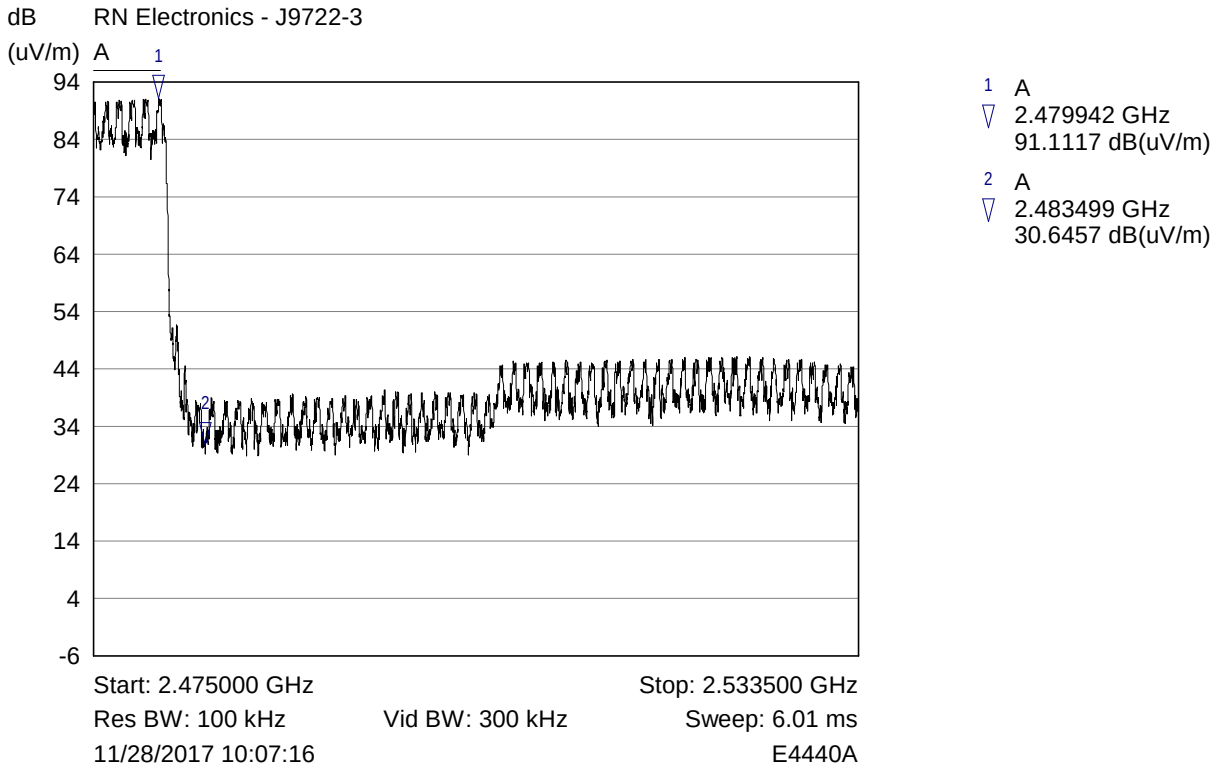


Authorised Band Edge Plot

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH5, Channel High hopping



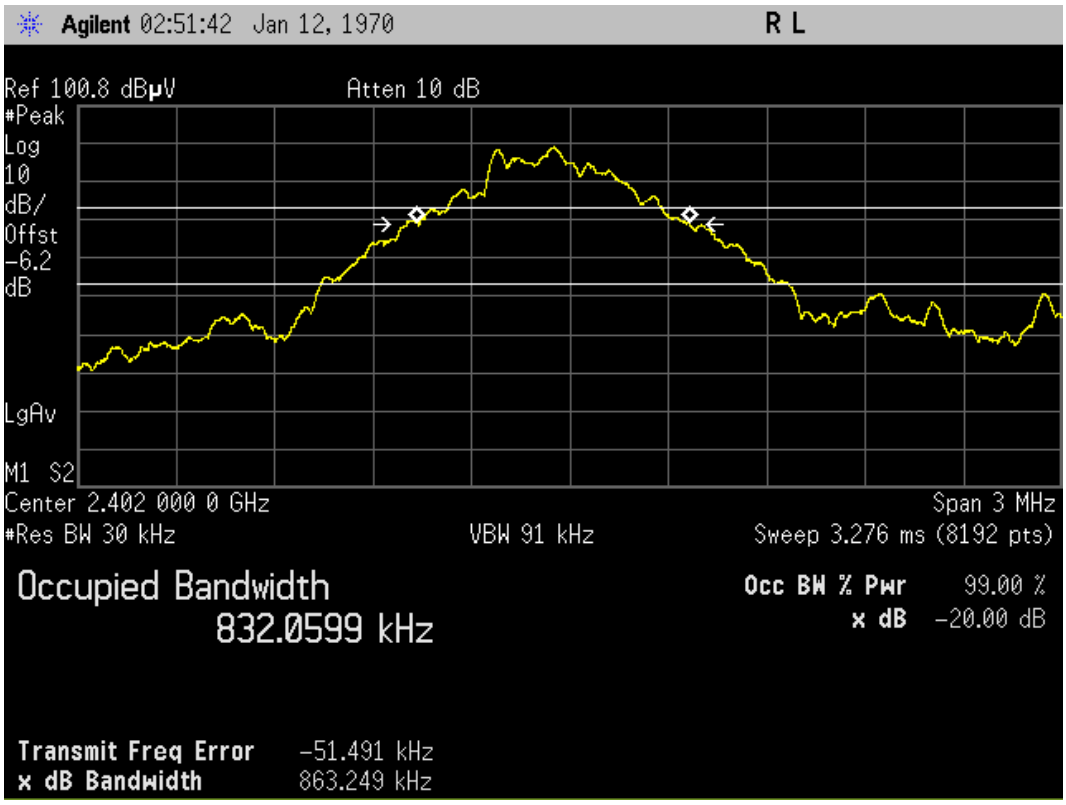
Restricted band edge Peak Plot



Authorised Band Edge Plot

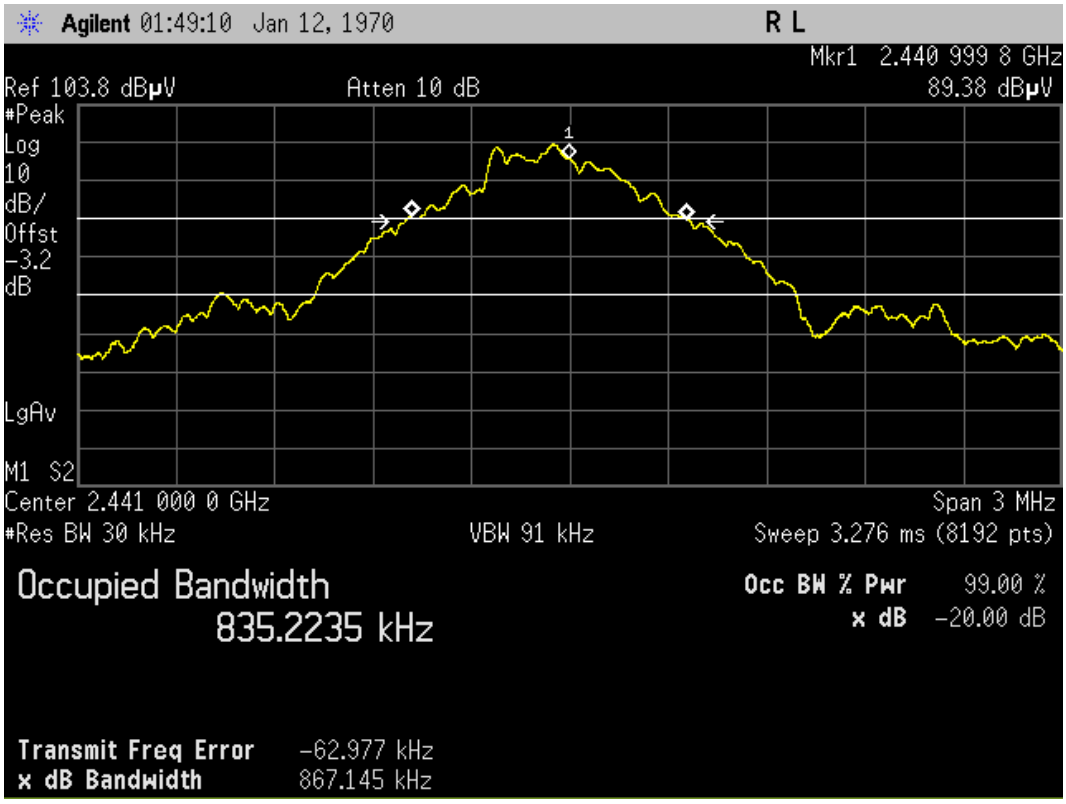
6.6 Occupied bandwidth

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH1, Channel 2402 MHz



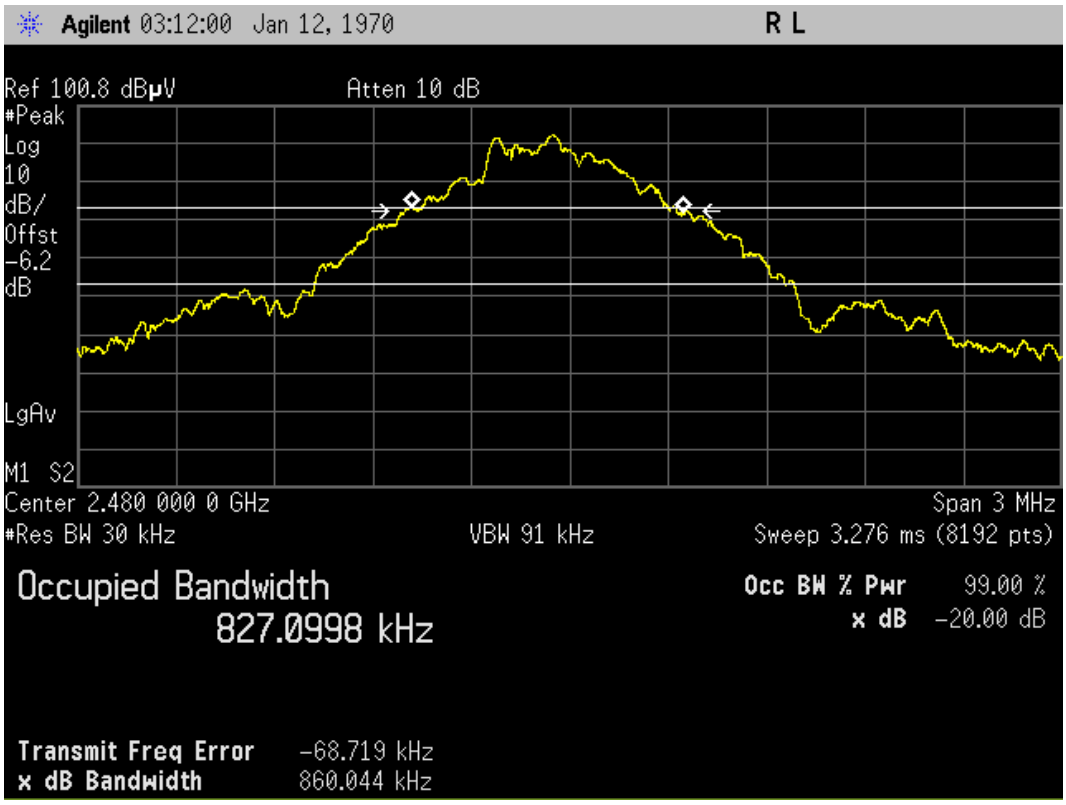
Plot for 20 dB Bandwidth (kHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH1, Channel 2441 MHz



Plot for 20 dB Bandwidth (kHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH1, Channel 2480 MHz

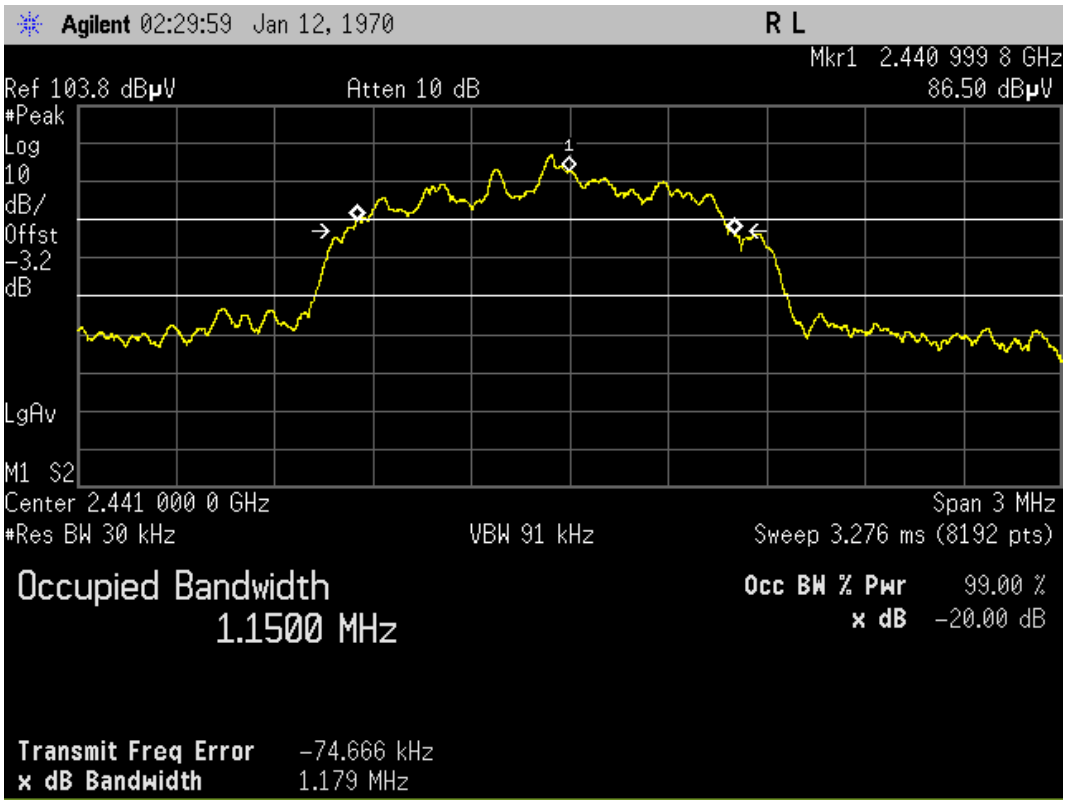


Plot for 20 dB Bandwidth (kHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH1, Channel 2402 MHz

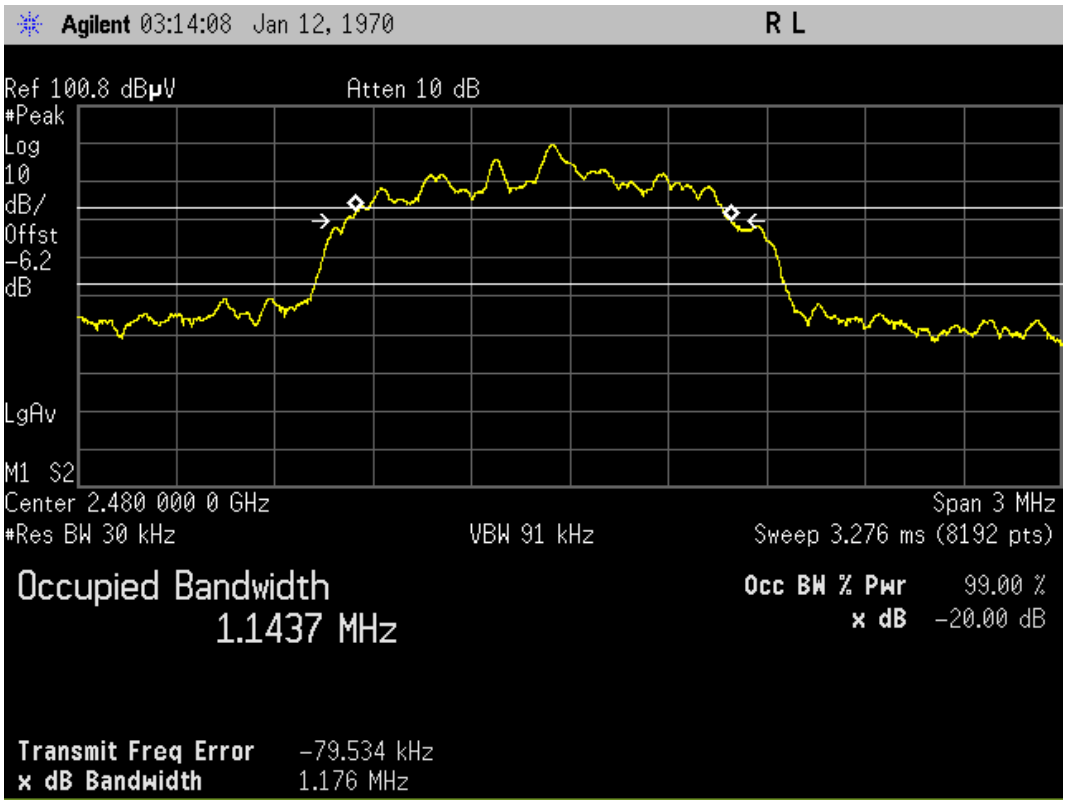
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH1, Channel 2441 MHz



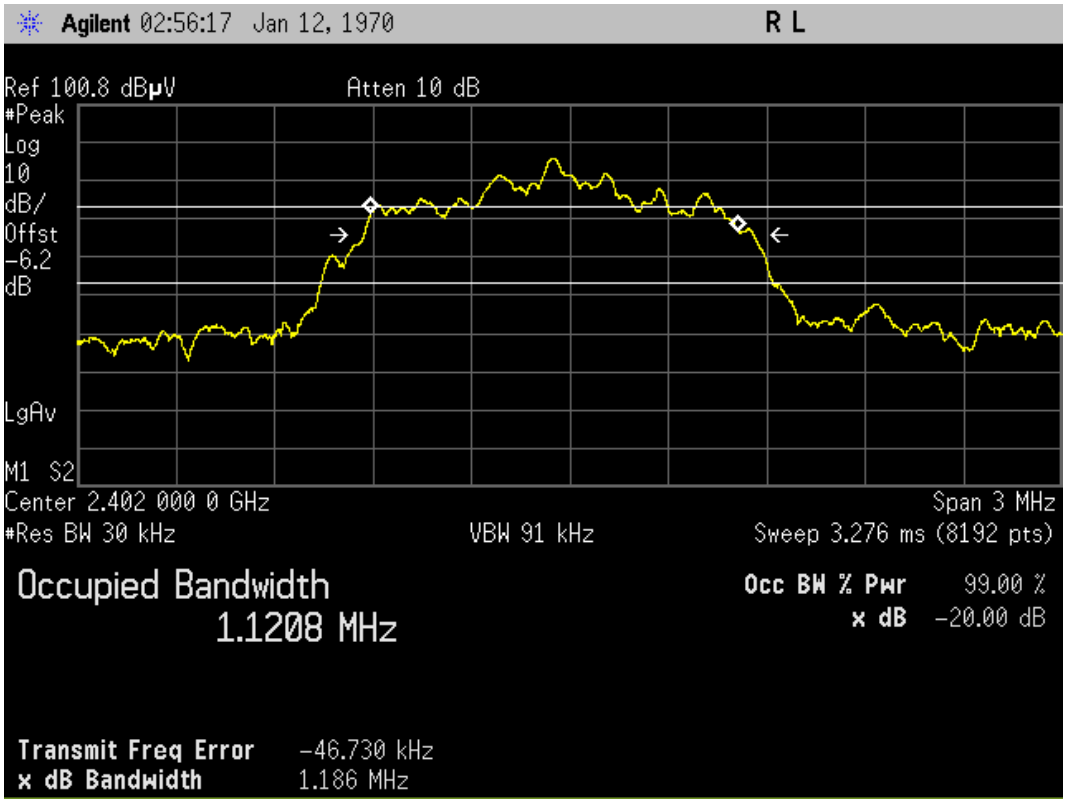
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH1, Channel 2480 MHz



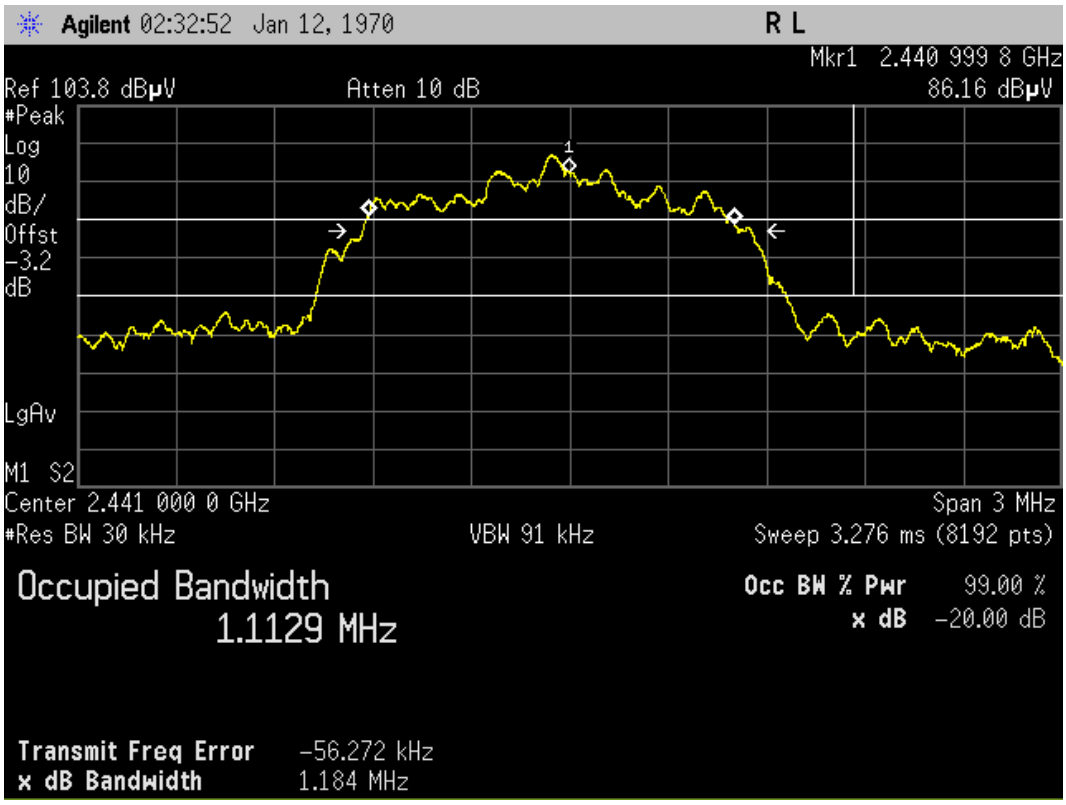
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH1, Channel 2402 MHz



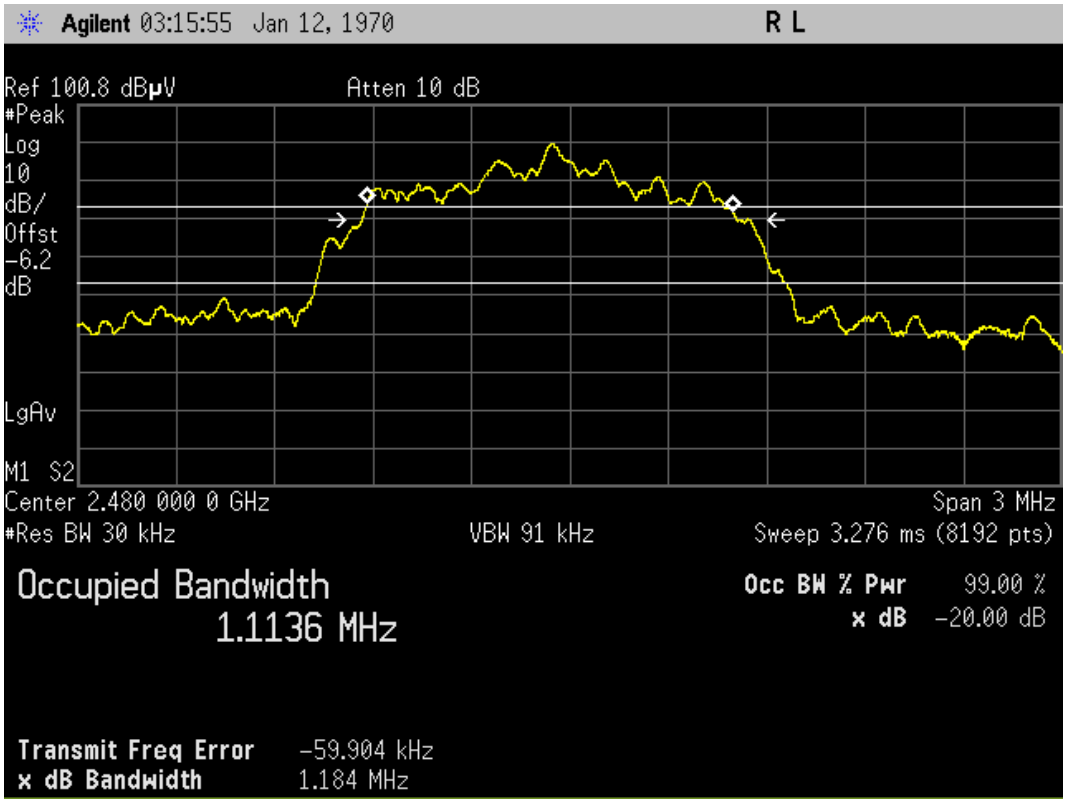
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH1, Channel 2441 MHz



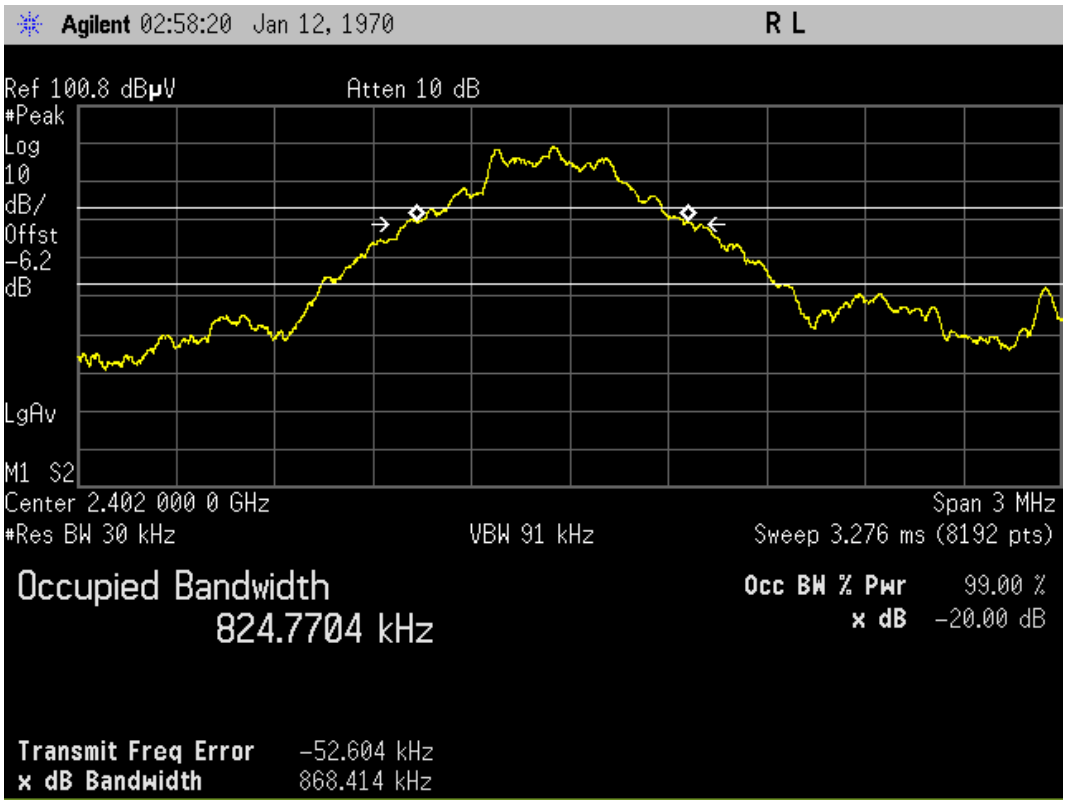
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH1, Channel 2480 MHz



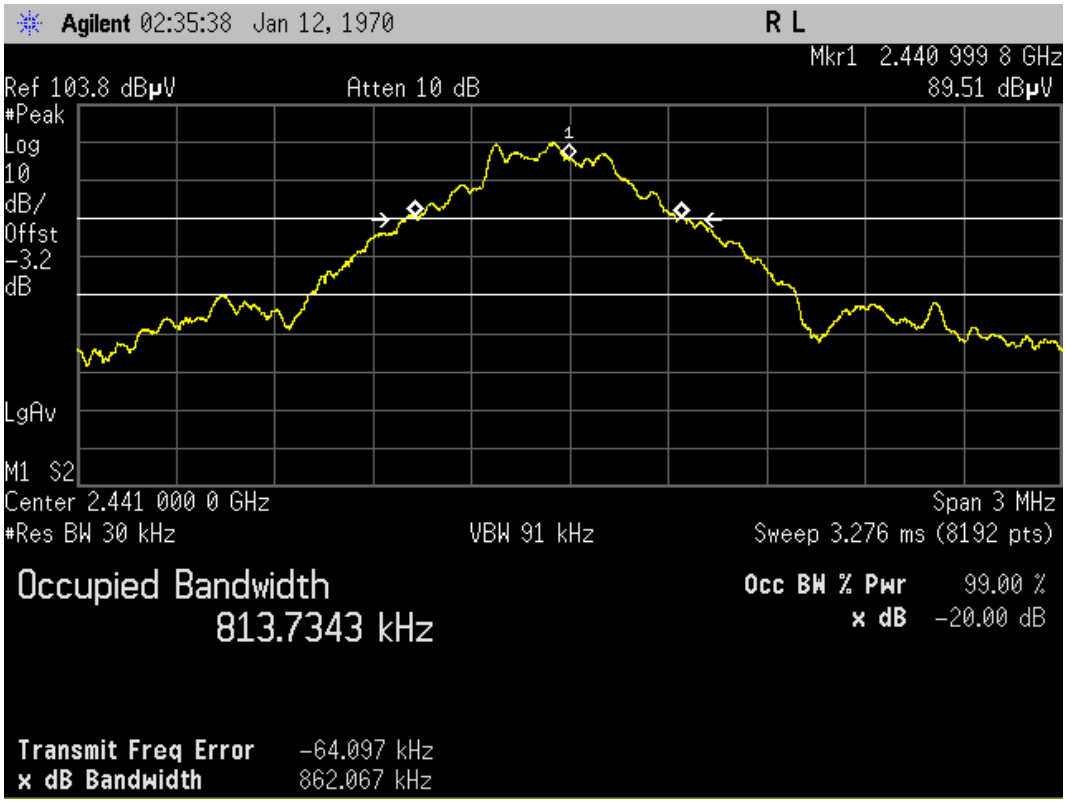
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH3, Channel 2402 MHz



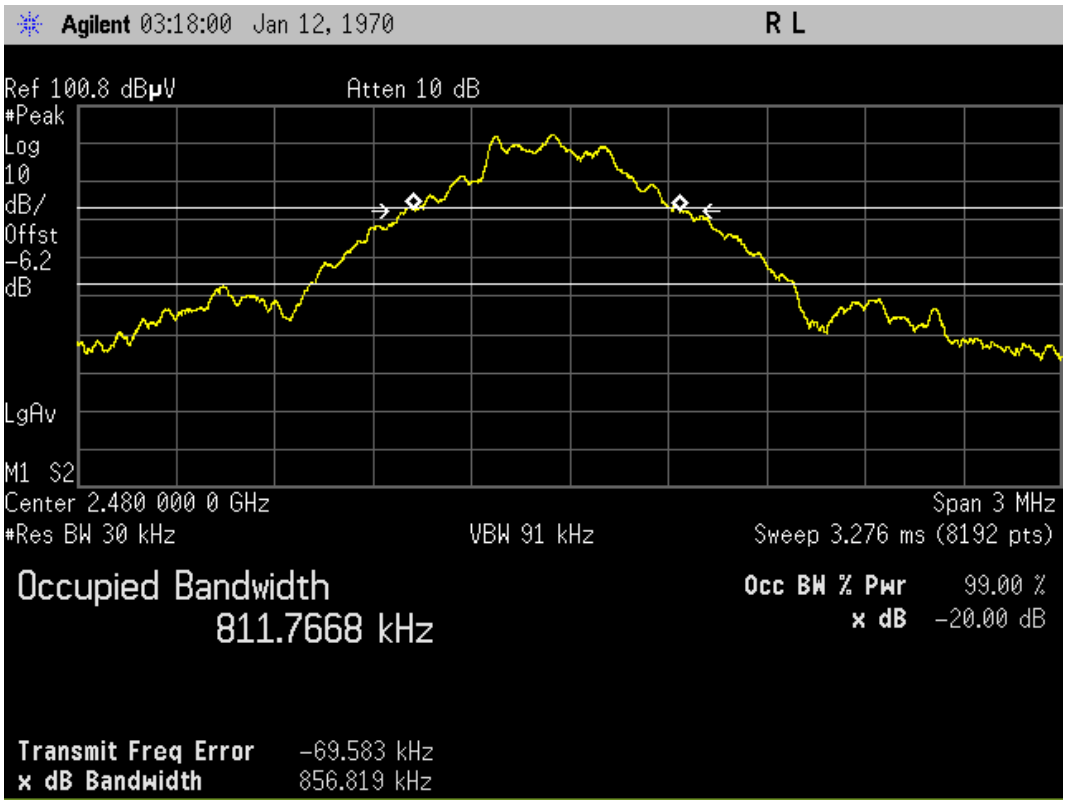
Plot for 20 dB Bandwidth (kHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH3, Channel 2441 MHz



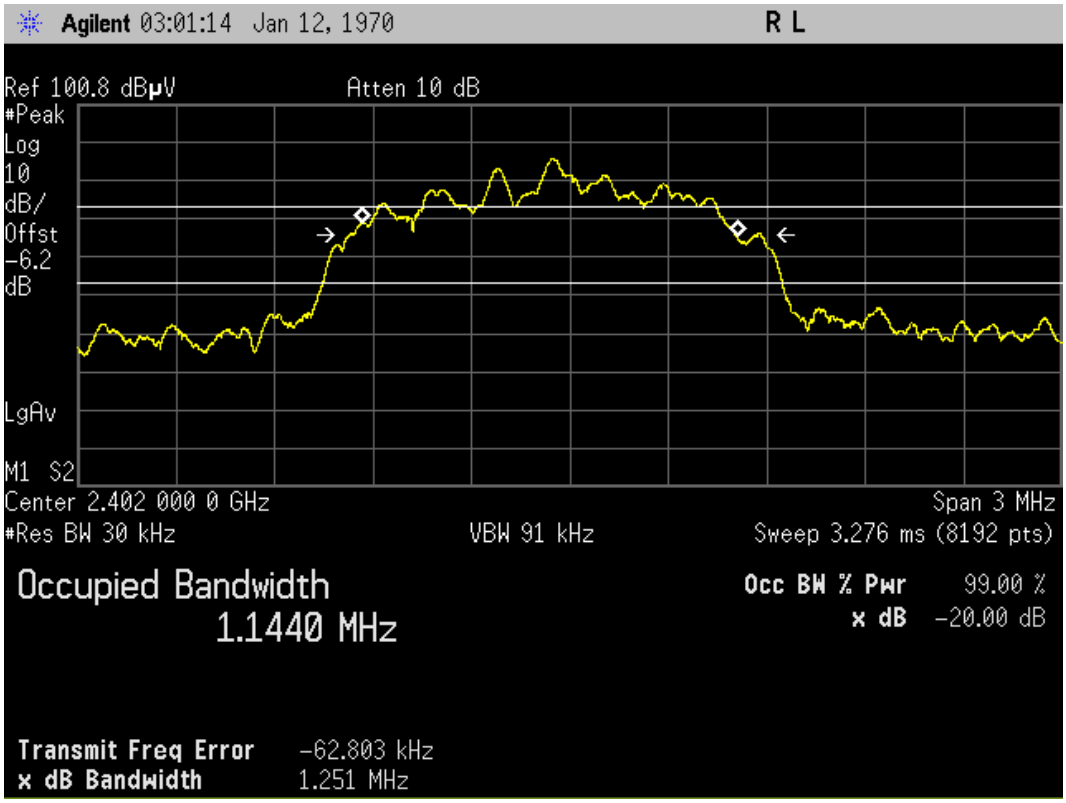
Plot for 20 dB Bandwidth (kHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH3, Channel 2480 MHz



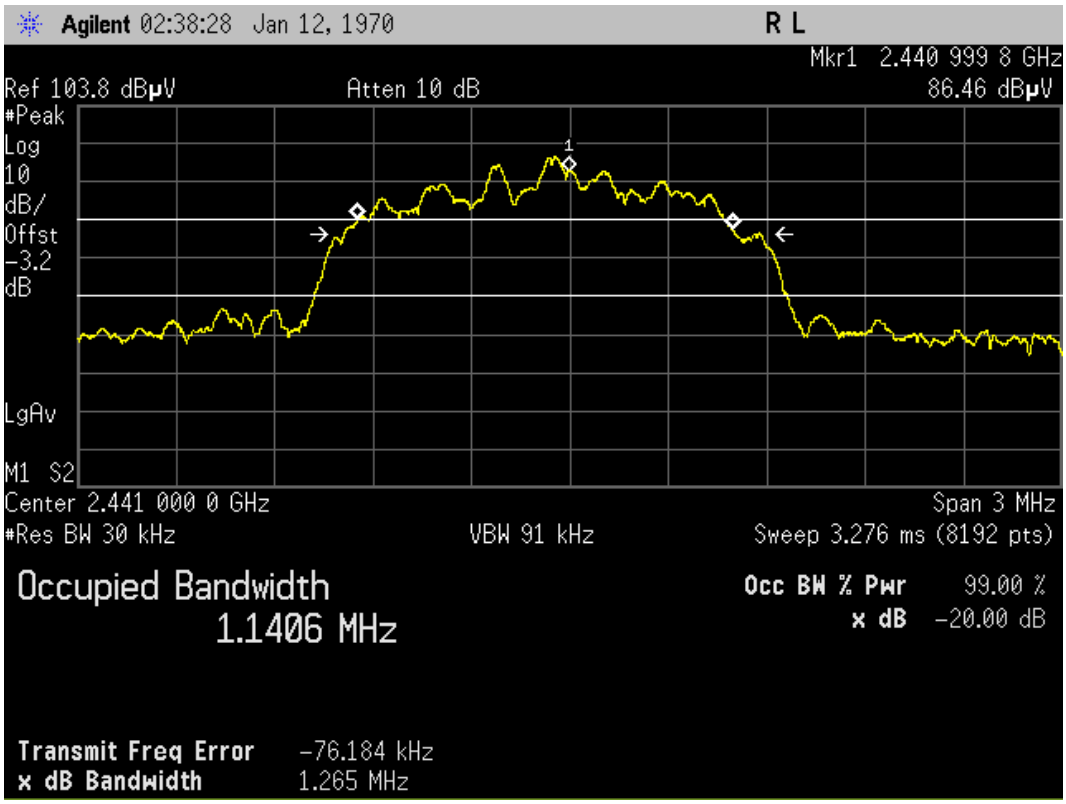
Plot for 20 dB Bandwidth (kHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH3, Channel 2402 MHz



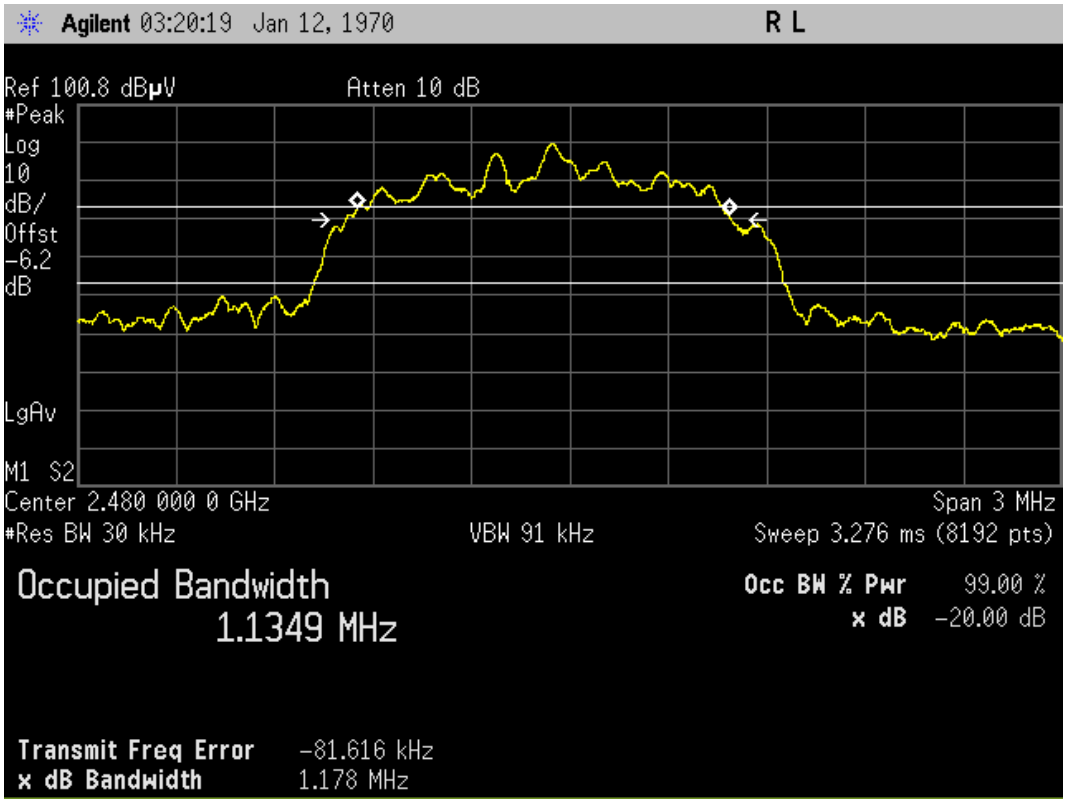
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH3, Channel 2441 MHz



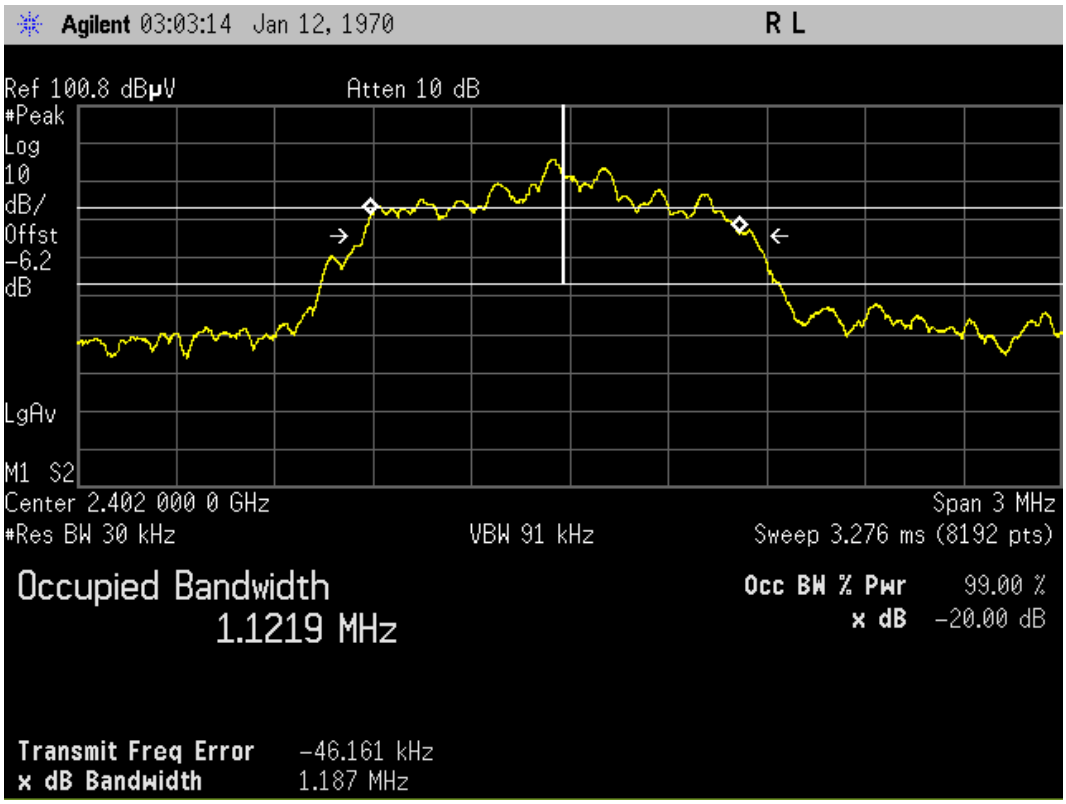
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH3, Channel 2480 MHz



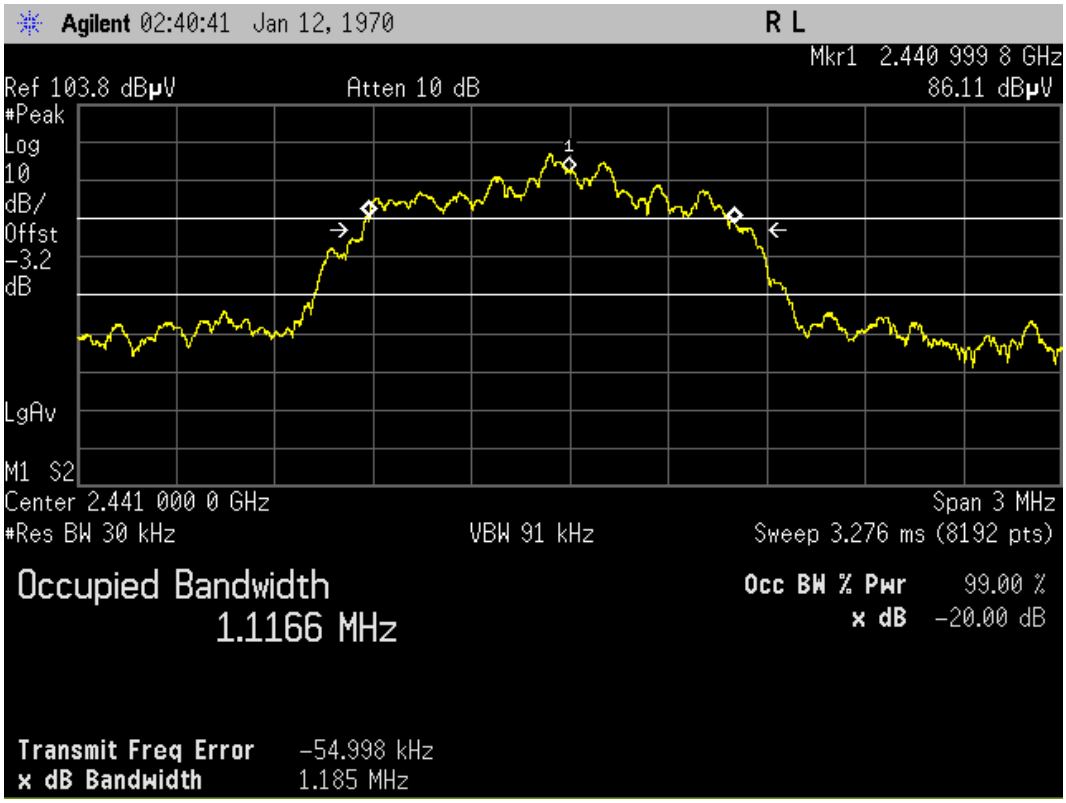
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH3, Channel 2402 MHz



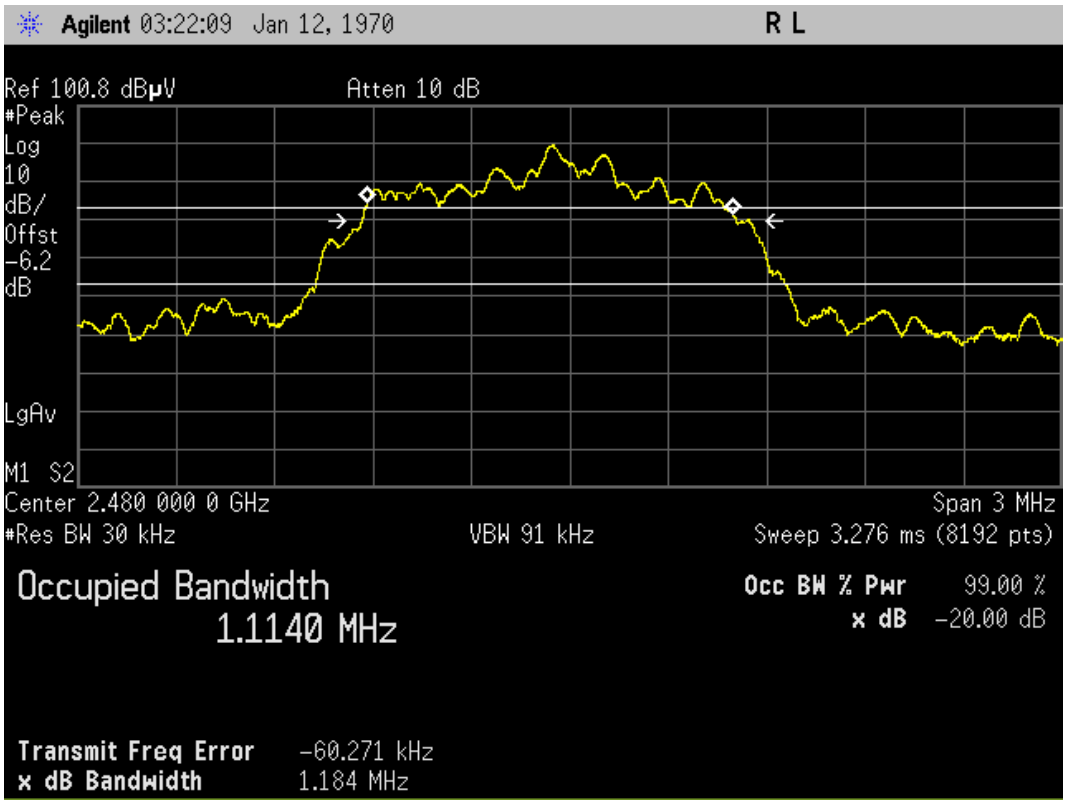
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH3, Channel 2441 MHz



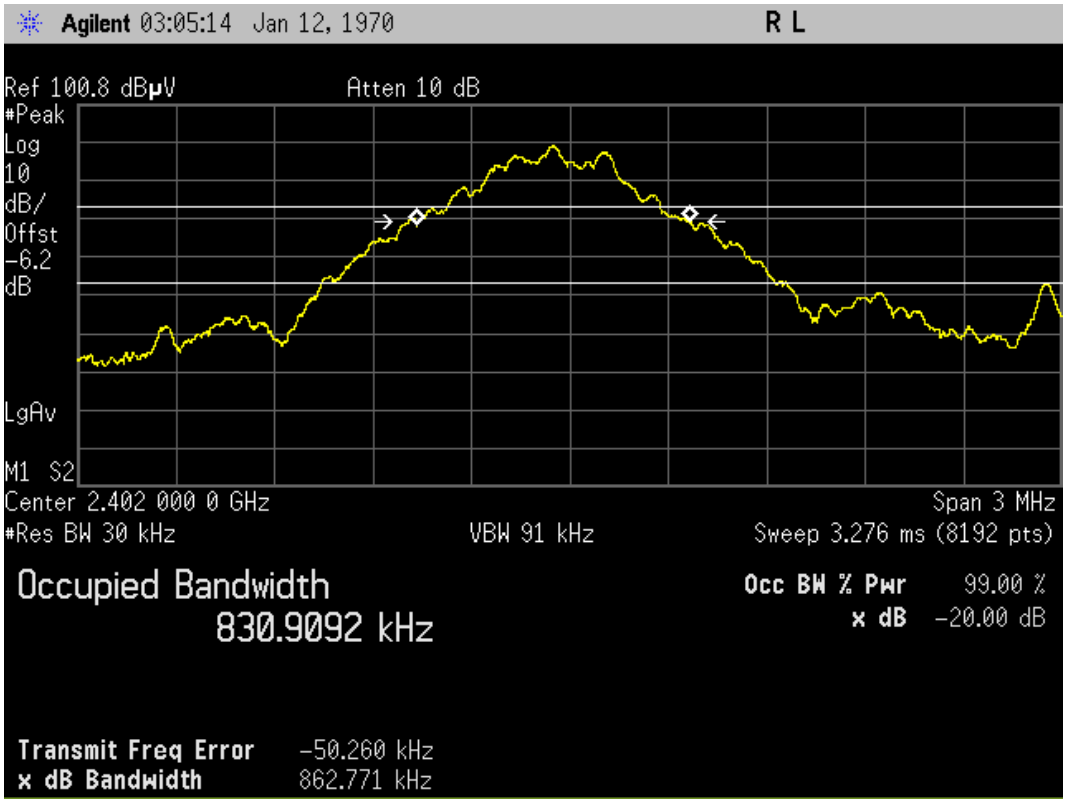
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH3, Channel 2480 MHz



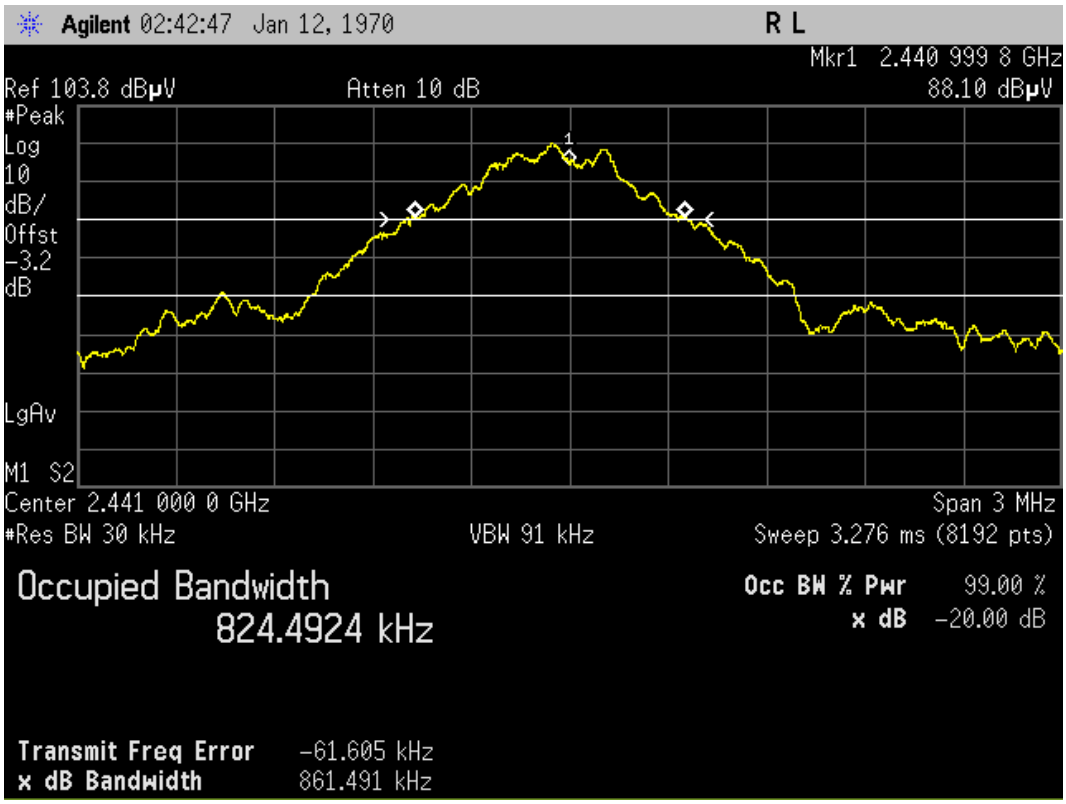
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH5, Channel 2402 MHz



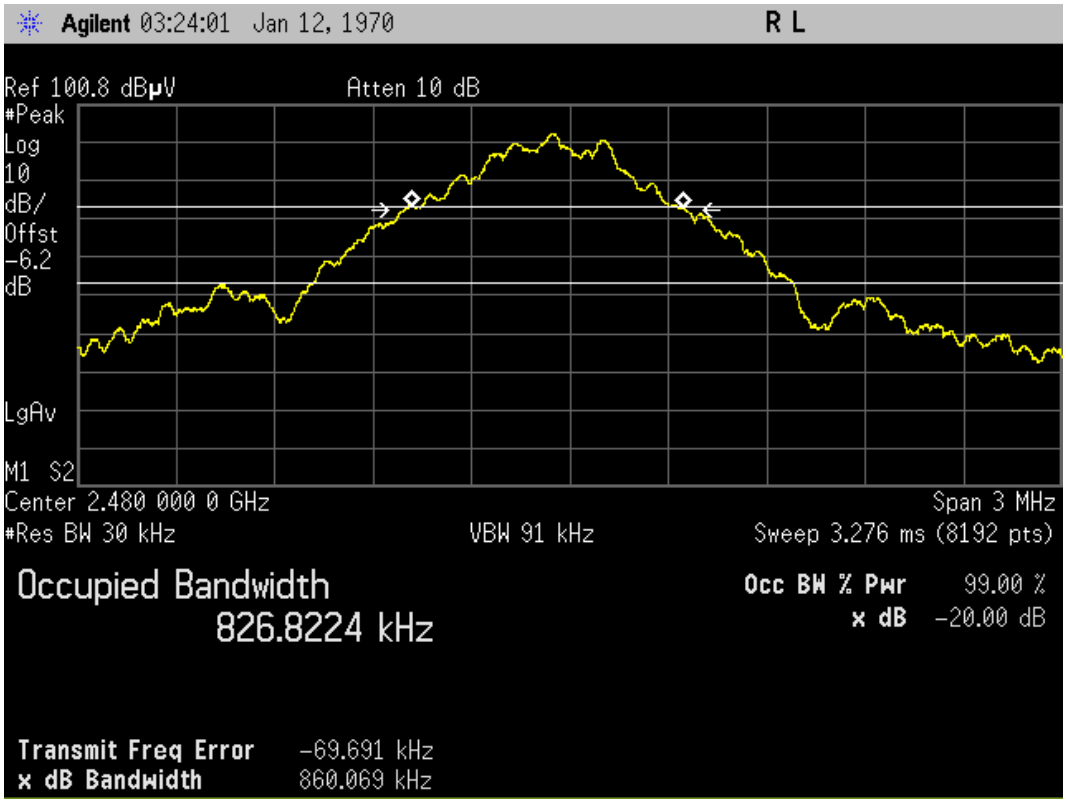
Plot for 20 dB Bandwidth (kHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH5, Channel 2441 MHz



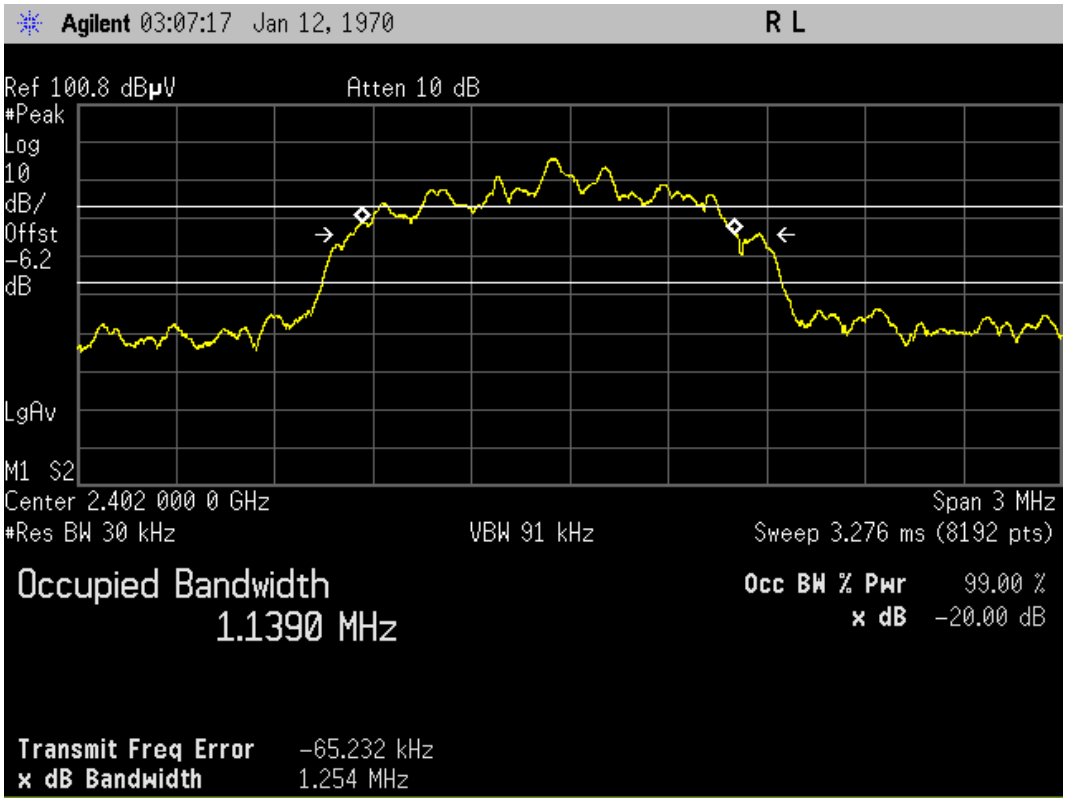
Plot for 20 dB Bandwidth (kHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation DH5, Channel 2480 MHz



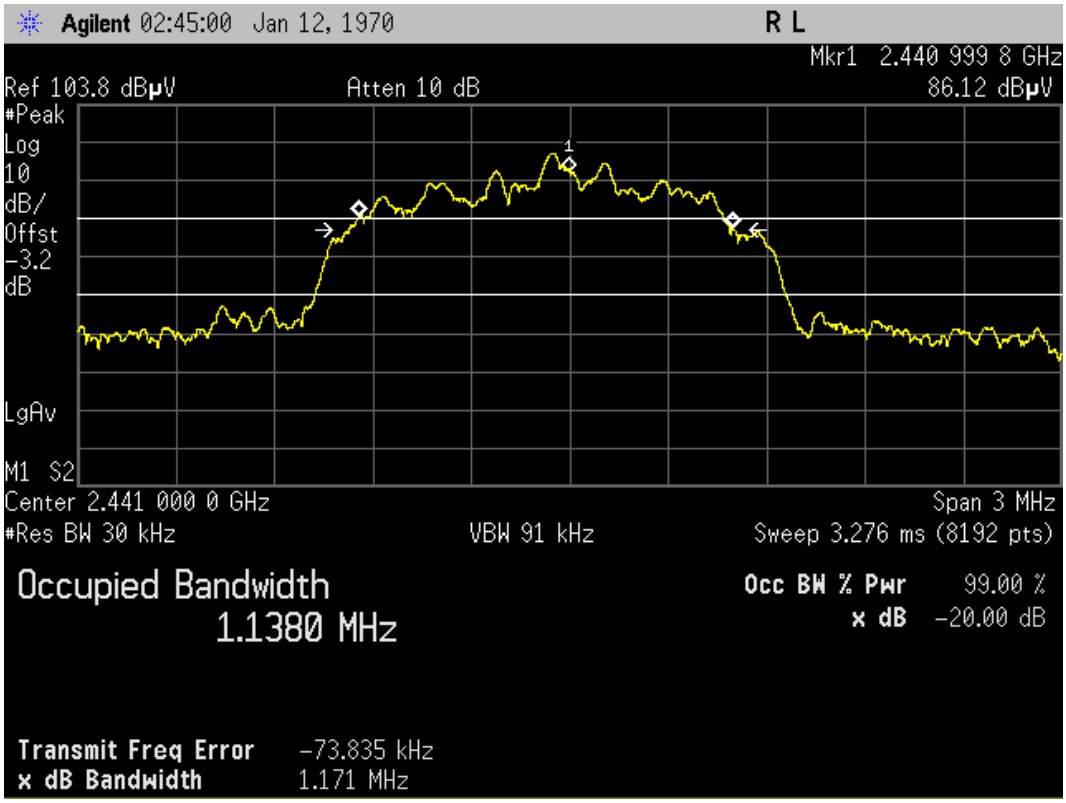
Plot for 20 dB Bandwidth (kHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH5, Channel 2402 MHz



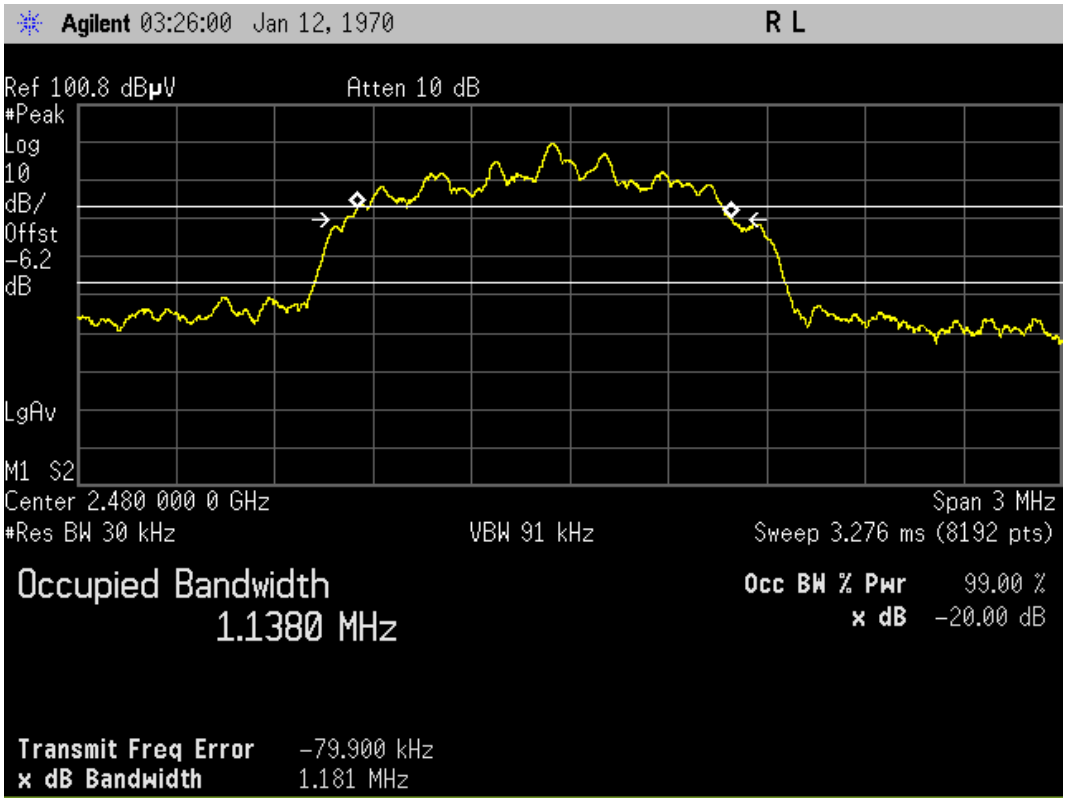
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH5, Channel 2441 MHz



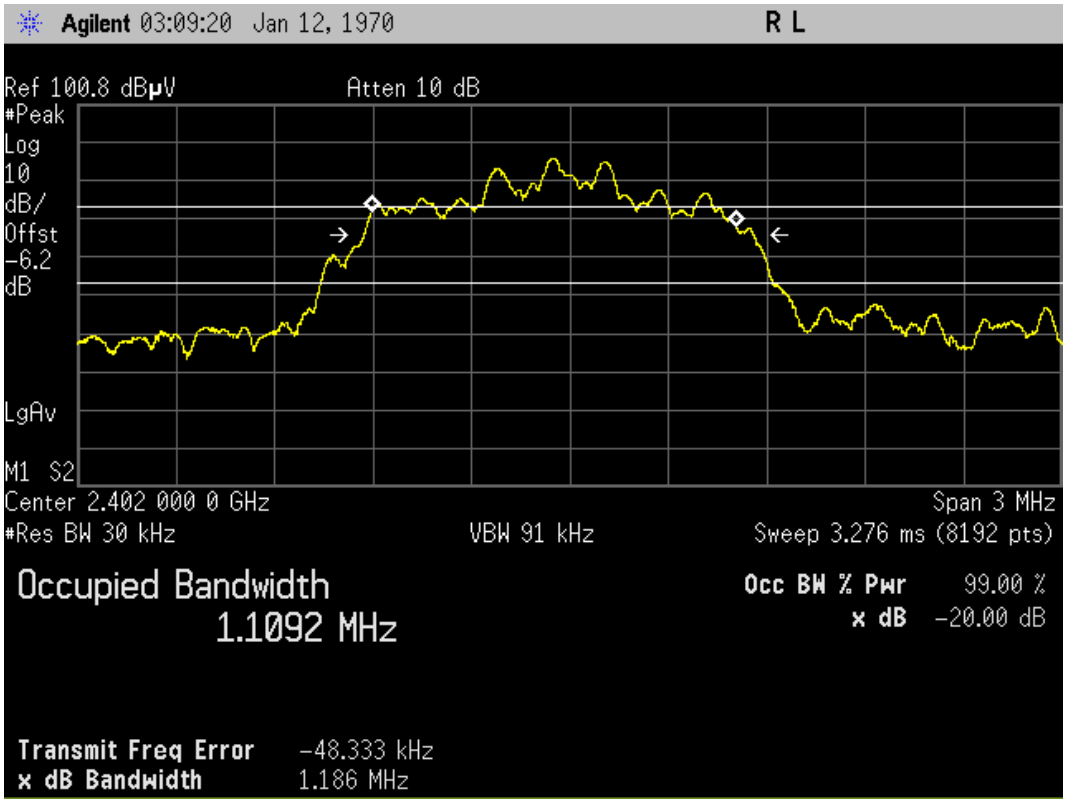
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 2DH5, Channel 2480 MHz



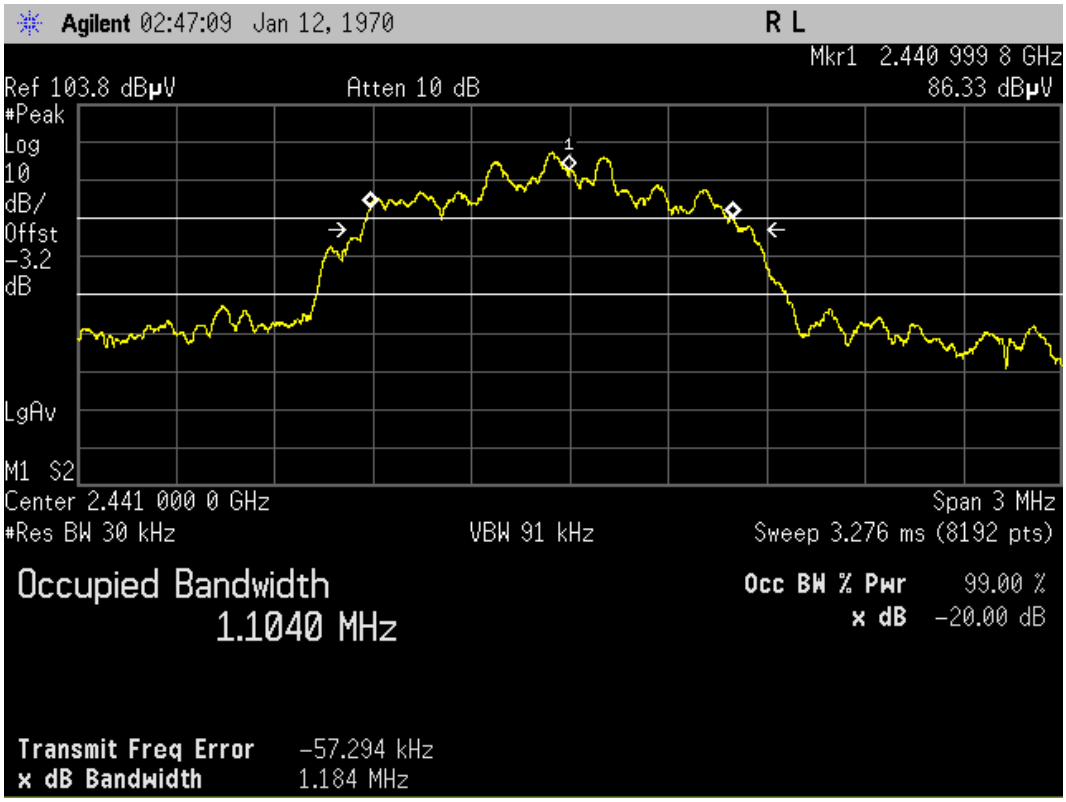
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH5, Channel 2402 MHz



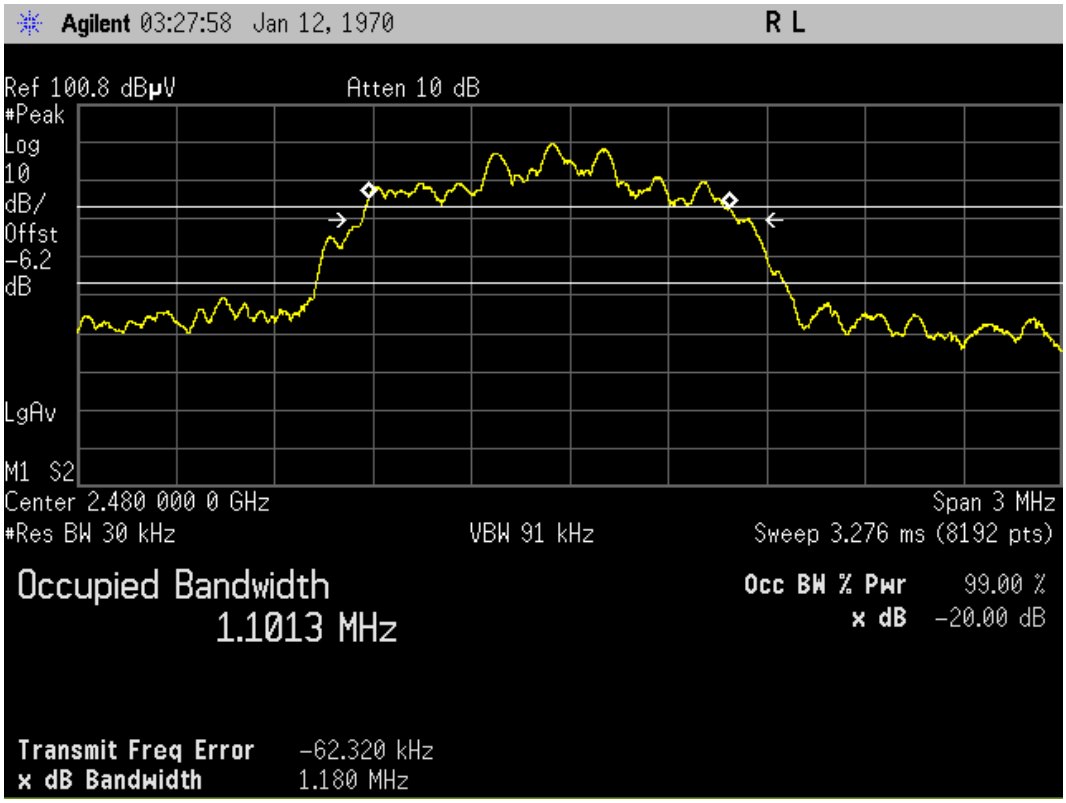
Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH5, Channel 2441 MHz



Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

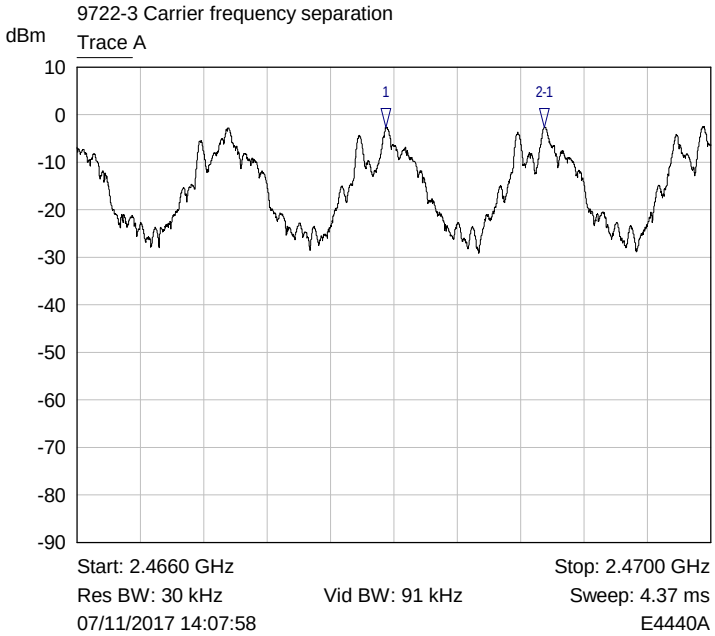
RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH5, Channel 2480 MHz



Plot for 20 dB Bandwidth (MHz) Nominal Temp & Volts

6.7 FHSS carrier frequency separation

RF Parameters: Band 2400-2483.5 MHz, Power 4dBm, Channel Spacing 1 MHz, Modulation DH1

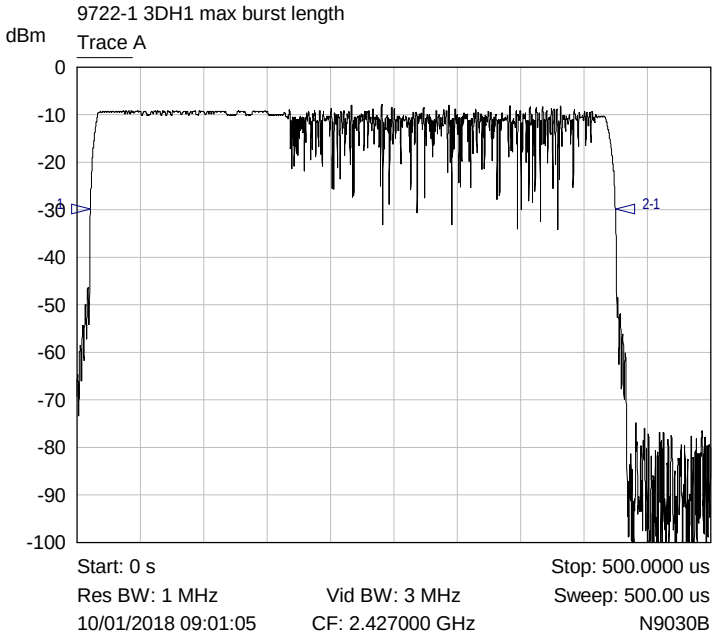


Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4680 GHz	-2.58 dBm	
2-1 ▽	Trace A	998.1687 kHz	-2.60 dBm	

Plot of Separation (kHz)

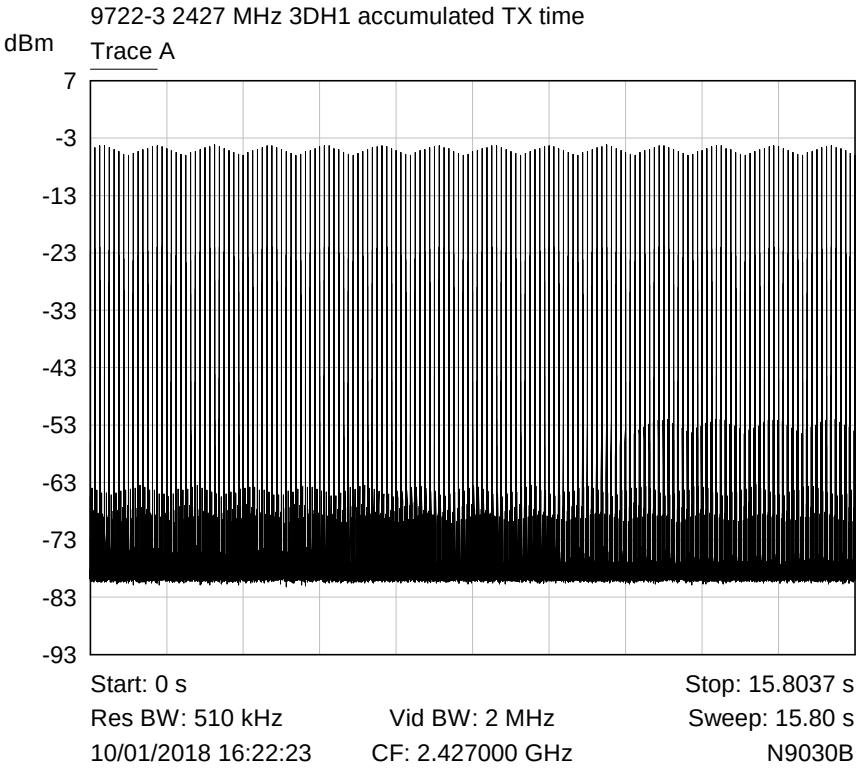
6.8 Average time of occupancy

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH1, Channel Hopping



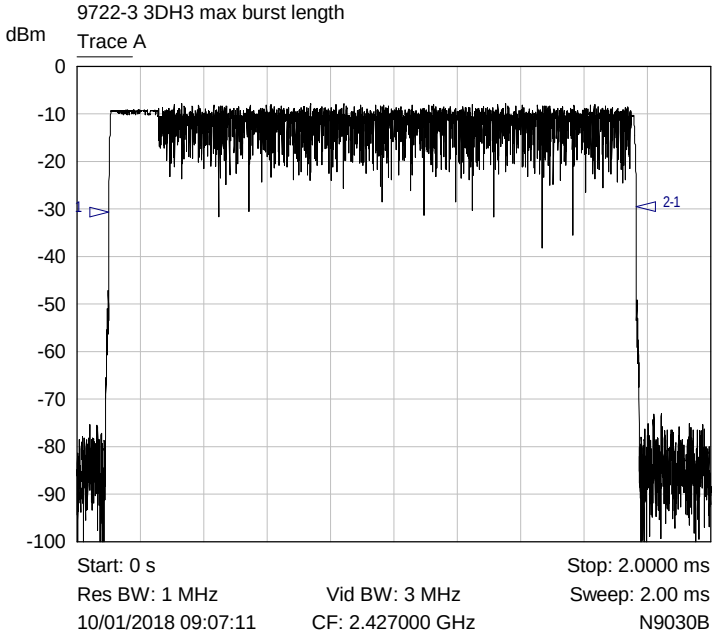
Mkr	Trace	X-Axis	Value	Notes
1	Trace A	10.4510 us	-29.90 dBm	
2-1	Trace A	414.2414 us	-29.80 dBm	

Measured Dwell time/pulse width (ms)



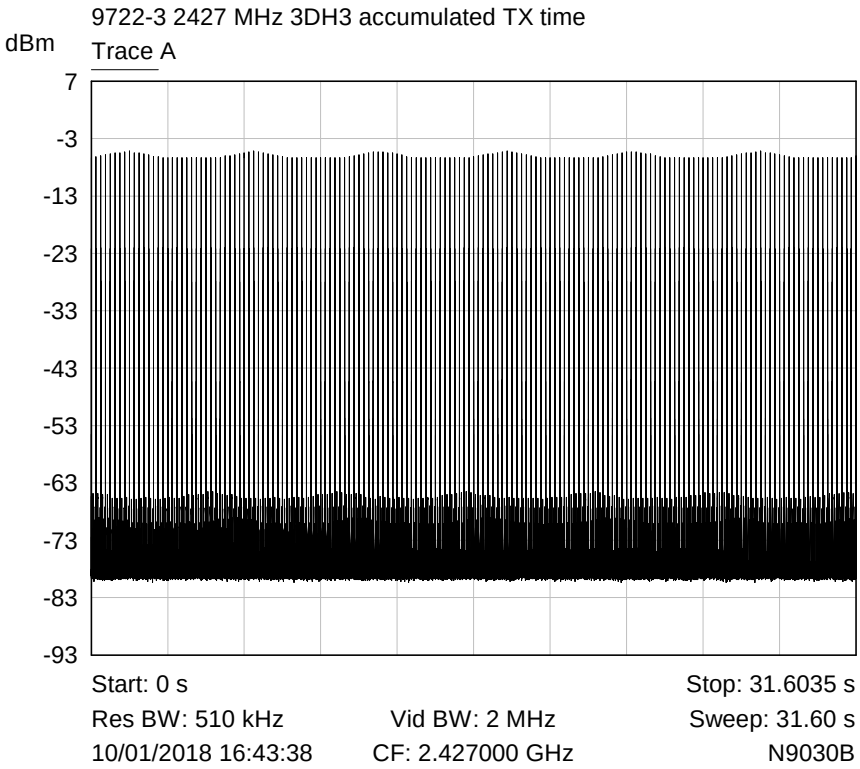
Period time (s)

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH3, Channel Hopping



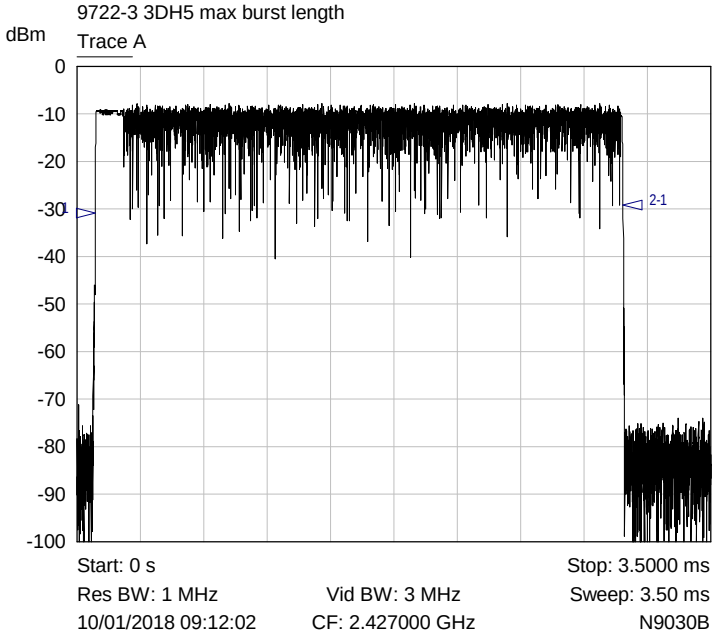
Mkr	Trace	X-Axis	Value	Notes
1	Trace A	100.4100 us	-30.75 dBm	
2-1	Trace A	1.6644 ms	-29.44 dBm	

Measured Dwell time/pulse width (ms)



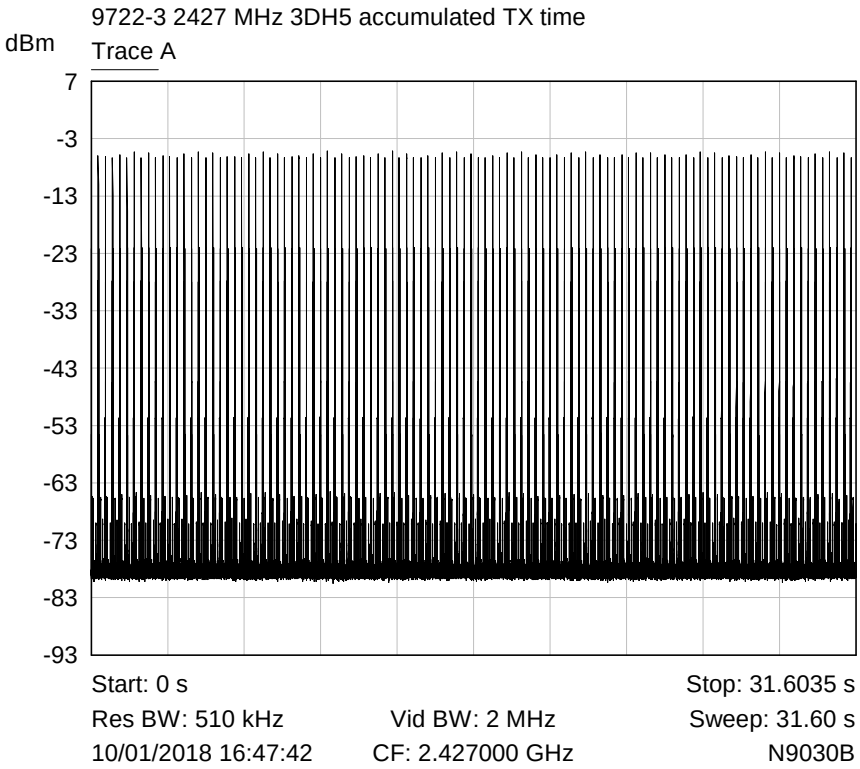
Period time (s)

RF Parameters: Band 2400-2483.5 MHz, Power 4 dBm, Channel Spacing 1 MHz, Modulation 3DH5, Channel Hopping



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	100.1100 us	-30.85 dBm	
2-1	Trace A	2.9158 ms	-29.13 dBm	

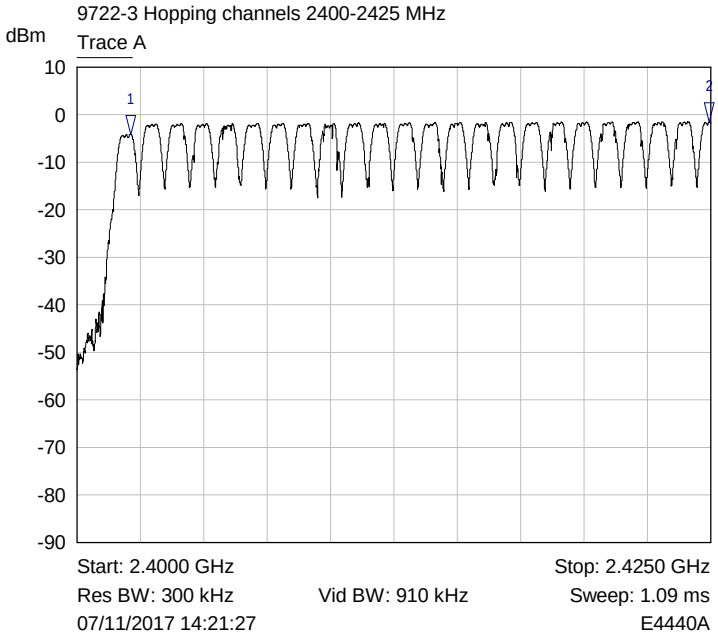
Measured Dwell time/pulse width (ms)



Period time (s)

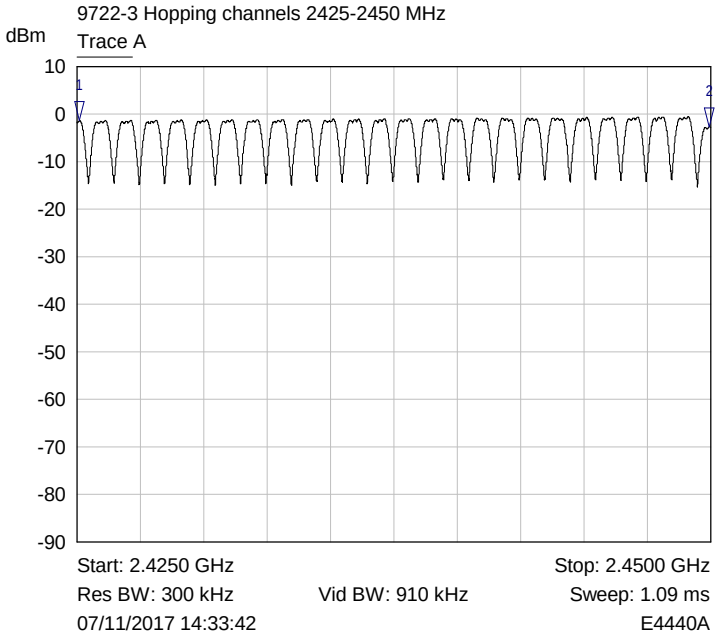
6.9 Number of Hop Channels

RF Parameters: Band 2400-2483.5 MHz, Power 4dBm, Channel Spacing 1 MHz, Modulation DH1, Channel Hopping



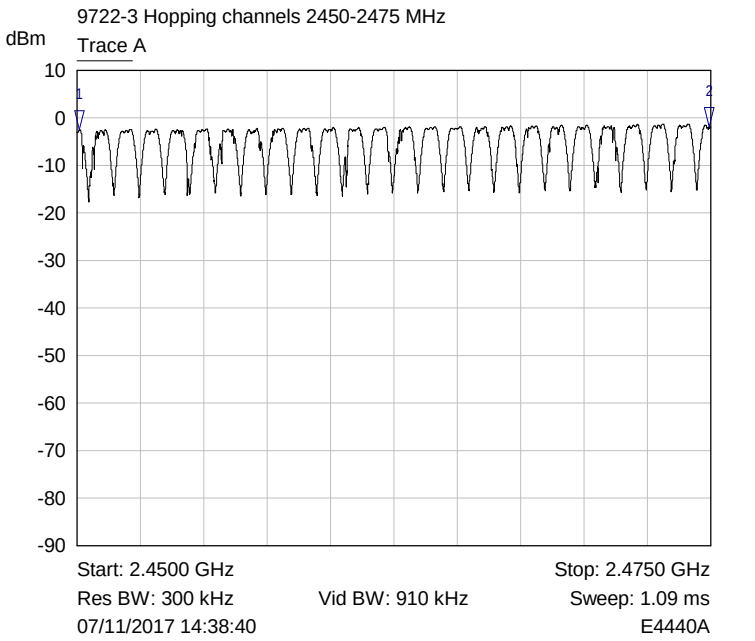
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4021 GHz	-4.09 dBm	
2 ▽	Trace A	2.4249 GHz	-1.53 dBm	

Plot of Hopping Channels 1-24



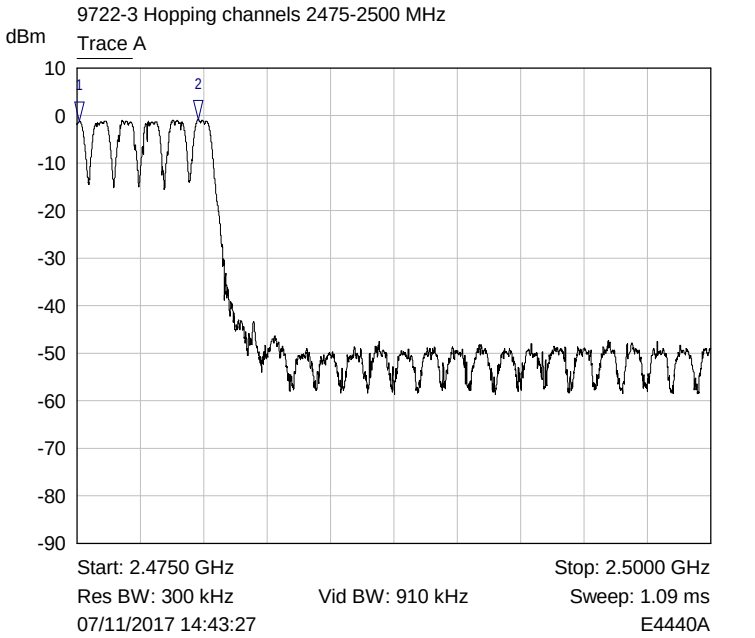
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4251 GHz	-1.36 dBm	
2 ▽	Trace A	2.4499 GHz	-2.68 dBm	

Plot of Hopping Channels 24-49



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4501 GHz	-2.55 dBm	
2 ▽	Trace A	2.4749 GHz	-1.84 dBm	

Plot of Hopping Channels 49-74



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4751 GHz	-1.22 dBm	
2 ▽	Trace A	2.4798 GHz	-0.87 dBm	

Plot of Hopping Channels 74-79

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

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(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

8 Photographs

All photographs showing product are not visible for confidentiality at request of applicant.

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

Photos not included in test report at client's request.

8.7 EUT Internal photos

Photos not included in test report at client's request.

8.8 EUT ID Label

EUT not provided with a label attached.

8.10 AC power line conducted emissions

8.11 Radiated emissions 150 kHz - 30 MHz

8.12 Radiated emissions 30 MHz -1 GHz

Conducted unit

8.13 Radiated emissions above 1 GHz

8.14 Radiated emission diagram

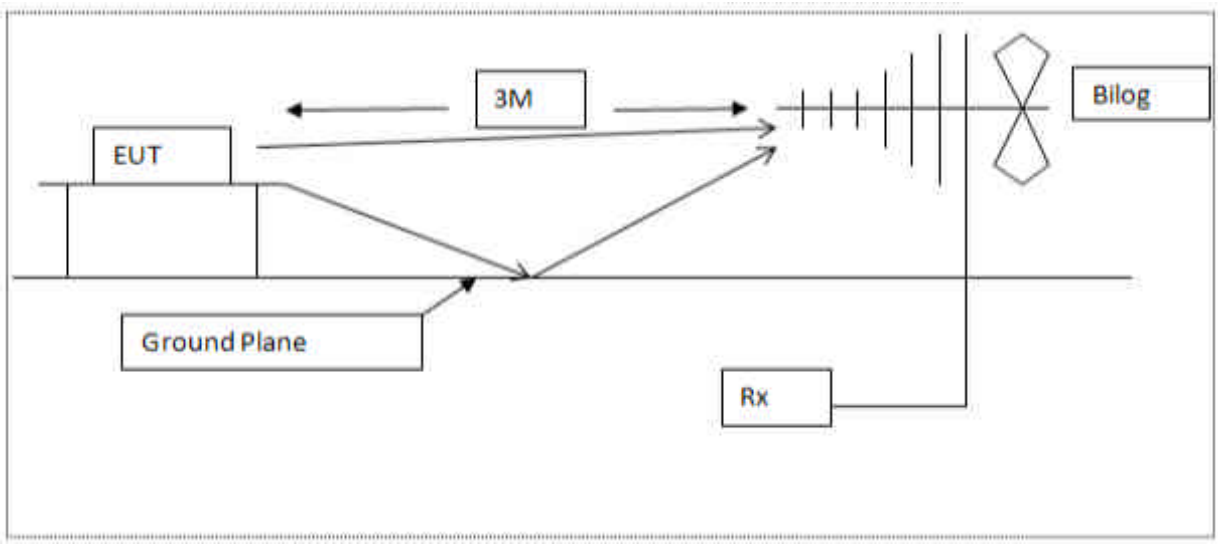

Diagram of the radiated emissions test setup 30 - 1000 MHz

8.15 AC powerline conducted emission diagram

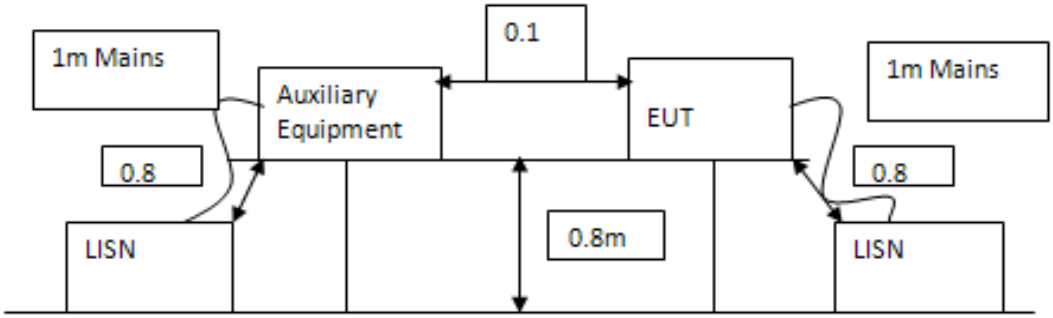

Diagram of the AC conducted emissions test setup

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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
E010	MN2050	LISN 13A	Chase	28-Apr-2017	12 months
E035	11947A	Transient Limiter + 10dB Atten.	Hewlett Packard	#27-Nov-2017	6 months
E136	3105	Horn Antenna 12.5GHz	EMCO	03-Apr-2017	12 months
E410	N5181A	Signal Generator 3 GHz MXG	Agilent Technologies	30-Apr-2015	36 months
E411	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	11-Jul-2017	12 months
E412	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	10-Jul-2017	24 months
E461	1	Attenuator N Type 12.4GHz 20 dB	Weinschel Engineering	#22-Nov-2017	12 months
E465	PCR2000LA	AC Power Supply	Kikusui	08-Jun-2017	12 months
E533	N5182A	Signal Generator 6 GHz MXG	Agilent Technologies	18-Jan-2017	36 months
E534	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	18-Jan-2017	24 months
E535	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	18-Jan-2017	12 months
E547	8493A	Attenuator 20dB 12.4GHz	Hewlett Packard	#27-Nov-2017	12 months
E611	RPR3006W	USB RF Power Sensor 10MHz - 6GHz	DARE Instruments	26-Apr-2017	12 months
E624	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	#09-Jan-2018	24 months
E743	RR2017 4/2dB	Attenuator 4/2dB 30-1000MHz	RN Electronics	15-Feb-2017	12 months
E755	N9030B	3Hz to 50GHz PXA	Keysight	08-May-2017	12 months
LPE261	3115	Horn Antenna 1-18 GHz	EMCO	03-Apr-2017	12 months
LPE333	8449B	Pre-amplifier 1GHz - 26.5GHz	Hewlett Packard	10-May-2017	24 months
LPE364	CBL6112A	Antenna Bilog 30MHz - 2GHz	Chase Electronics Ltd	22-Jan-2016	24 months
NSA1	NSA - M	NSA - Site M	RN Electronics	08-Jan-2015[1]	36 months
TMS78	3160-08	Std Gain Horn Antenna 12.4-18 GHz	ETS Systems	25-Jul-2017	12 months
TMS79	3160-09	Std Gain Horn Antenna 18-26.5 GHz	ETS Systems	25-Jul-2017	12 months
TMS81	6502	Antenna Active Loop	EMCO	08-Jun-2017	24 months
TMS82	8449B	Pre Amplifier 1 - 26 GHz	Agilent Technologies	#19-Dec-2017	12 months
ZSW1	V2.2	Measurement Software Suite	RN Electronics	NOT APPLICABLE	

Items so marked were in calibration for the date of test. Since this date, the equipment has been re-calibrated and the new date has been detailed here.
1 Tests related to calibration NSA1 were performed before the calibration expiry date.

10 Auxiliary and peripheral equipment

10.1 Customer supplied equipment

Item No.	Model No.	Description	Manufacturer	Serial No.
1	Latitude D630	Laptop and PSU	Dell	-

10.2 RN Electronics supplied equipment

No RN Electronics Ltd supplied equipment was used.

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.

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