Radio Test Report

Salunda Ltd

LHW 1701E

PS

47 CFR Part 15.247 Effective Date 1st October 2023
DTS: Digital Transmission System
Test Date: 14th October 2024 to 17th October 2024
Report Number: 10-14291-1-24 Issue 02
Supersedes report: 10-14291-1-24 Issue 01

The testing was carried out by Kiwa Electrical Compliance, an independent test house, at their test facility located at:

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

Certificate of Test 14291-1

The equipment noted below has been fully tested by Kiwa Electrical Compliance and, where appropriate, conforms to the relevant subpart of 47 CFR Part 15.247. This is a certificate of test only and should not be confused with an equipment authorisation. Other standards may also apply.

Equipment:	LHW 1701E
Model Number:	PS
Unique Serial Number:	61900045 (PSD, Conducted Power) 61900043 (All other tests)
Applicant:	Salunda Ltd Unit 6 Avonbury Business Park Howes Lane Bicester Oxfordshire OX26 2UA
Full measurement results are detailed in Report Number:	10-14291-1-24 Issue 01
Test Standards:	47 CFR Part 15.247 Effective Date 1st October 2023 DTS: Digital Transmission System

NOTE:
Certain tests were not performed based upon applicant's declarations. Certain other requirements are subject to applicant's declaration only and have not been tested/verified. For details refer to section 3 of this report.

DEVIATIONS:
No deviations have been applied.

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

Date of Test: 14th October 2024 to 17th October 2024

Test Engineer:
Graham Blake

Graham Blake
Digitally signed by: Graham Blake
DN: CN = Graham Blake email = graham.blake@kiwa.com C = GB OU = Kiwa Electrical Compliance
Date: 2025.01.03 16:13:42 Z

Approved By:
Radio Approvals Manager

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Customer Representative:

ilac-MRA UKAS TESTING 2360

1 Contents

2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	Salunda Ltd Unit 6 Avonbury Business Park Howes Lane Bicester Oxfordshire OX26 2UA	
Manufacturer of EUT	Salunda Ltd	
Full Name of EUT	LHW 1701E	
Model Number of EUT (HVIN)	PS	
Serial Number of EUT	61900045 (PSD, Conducted Power) 61900043 (All other tests)	
Date Received	14th October 2024	
Date of Test:	14th October 2024 to 17th October 2024	
Date Report Issued	3rd January 2025	
Main Function	To provide angle feedback of the position latch.	
EUT Specification	Height	30 mm
	Width	30 mm
	Depth	40 mm
	Weight	0.1 kg
	Voltage	3.6 VDC
	Current	Not declared

2.2 Applicant declarations for testing

General Parameters	
EUT Normal use position	In metal Latch
Choice of model(s) for type tests	Engineering production Sample
Antenna details	Integral PCB etched antenna
Antenna port	No
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	2480 MHz
Lowest Signal generated in EUT	38.4 MHz
Hardware Version (HVIN)	PS
Software Version	Salunda NFC Lite V1.9.1
Firmware Version (FVIN)	5.29
Technology Type	IEEE 802.15.4
Geo-location (yes/no)	No
TX Parameters	
Alignment range – transmitter	2405 - 2480 MHz
EUT Declared Modulation Parameters	DSSS
EUT Declared Power level	8 dBm
EUT Declared Signal Bandwidths	2 MHz
EUT Declared Channel Spacing's	5 MHz
EUT Declared Duty Cycle	Transmit on event
Unmodulated carrier available?	Yes
Declared frequency stability	10 ppm
RX Parameters	
Alignment range – receiver	2405 - 2480 MHz
EUT Declared RX Signal Bandwidth	2 MHz
FCC Parameters	
FCC Transmitter Class	DTS: Digital Transmission System

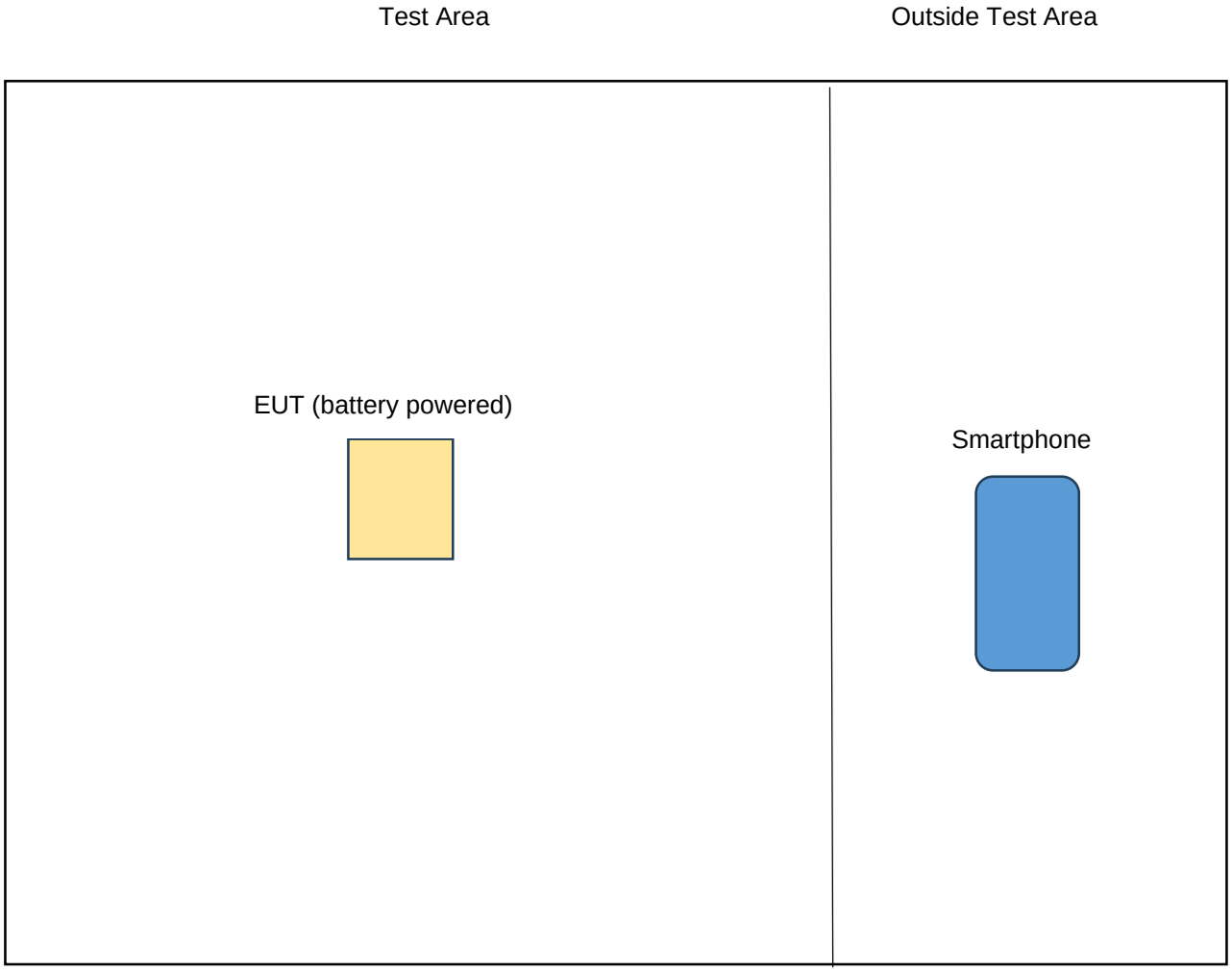
2.3 Functional description

To provide the angle of a latch for feedback wirelessly via 2.4 GHz radio. The EUT also contain a passive RFID tag.

2.4 Modes of operation

Mode Reference	Description	Used for testing
TX LOW	Continuous bursts of data transmitted at 2405 MHz	Yes
TX MID	Continuous bursts of data transmitted at 2440 MHz	Yes
TX HIGH	Continuous bursts of data transmitted at 2480 MHz	Yes

2.5 Emissions configuration



The EUT was powered from the internal 3.6V lithium battery. A separate test sample was supplied for making conducted measurements in which the integral antenna was bypassed and a temporary SMA semi-rigid cable soldered in its place. DC power cables were also attached to the conducted sample to allow the unit to be powered from a bench power supply. A support smartphone was supplied which was used to configure the EUT in the relevant test modes. The channel and power setting were first set on the phone using the 'Salunda NFC Light' application' and then the phone was presented to the EUT and configuration sent via NFC.

The declared power settings and Lowest, Middle and Highest channels used for test are stated below:

Low Channel (Channel 11: 2405 MHz): Power setting: 8
Mid Channel (Channel 18: 2440 MHz): Power setting: 8
High Channel (Channel 26: 2480 MHz): Power setting: 8

Duty cycle correction factor calculated based on RMS linear voltage averaging and ANSI C63.10 Clause 11.12.2.5.2.1 formula: 20 Log (1/D), where D is 0.648, giving 3.8dB to add to average emission values.

2.5.1 Signal leads

None.

Note: A Modified EUT with Temporary DC supply wires was provided for PSD and conducted peak power tests.

3 Summary of test results

The LHW 1701E, PS was tested for compliance to the following standard:

47 CFR Part 15.247 Effective Date 1st October 2023
DTS: Digital Transmission System

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 15.247 Part 15.207	NOT APPLICABLE[1]
2. Radiated emissions 9 - 150 kHz	47 CFR Part 15.247 Part 15.209	PASSED
3. Radiated emissions 150 kHz - 30 MHz	47 CFR Part 15.247 Part 15.209	PASSED
4. Radiated emissions 30 MHz -1 GHz	47 CFR Part 15.247 Part 15.247(d) & 15.209	PASSED
5. Radiated emissions above 1 GHz	47 CFR Part 15.247 Part 15.247(d) & 15.209	PASSED[6]
6. Effective radiated power field strength	47 CFR Part 15.247 Part 15.247(d)	PASSED
7. Band Edge Compliance	47 CFR Part 15.247 Part 15.215 & 15.247(d)	PASSED
8. Occupied bandwidth	47 CFR Part 15.247 Part 15.247(a)(2)	PASSED
9. Maximum Average conducted output power	47 CFR Part 15.247 Part 15.247(b3)	NOT APPLICABLE[2]
10. Maximum Peak conducted output power	47 CFR Part 15.247 Part 15.247(b)(3)	PASSED
11. Maximum Power Spectral Density	47 CFR Part 15.247 Part 15.247(e)	PASSED
12. Antenna power conducted emissions	47 CFR Part 15.247 Part 15.247(d)	NOT APPLICABLE[3]
13. Duty cycle	47 CFR Part 15.247 Part 15.35(c)	NOT APPLICABLE[4]
14. FHSS carrier frequency separation	47 CFR Part 15.247 Part 15.247(a1)	NOT APPLICABLE[5]
15. Average time of occupancy	47 CFR Part 15.247 Part 15.247(a)(1)(i)/(ii)/(iii)	NOT APPLICABLE[5]
16. Number of Hop Channels	47 CFR Part 15.247 Part 15.247(a)(1)(i)/(ii)/(iii)	NOT APPLICABLE[5]

[1] EUT does not operate from the AC power lines nor contain provisions for operation while connected to AC power lines.

[2] Peak conducted power measurements performed instead.

[3] Applies to EUT's with an antenna port. The EUT has an integral antenna only.

[4] No limits apply, however duty cycle measurement performed to verify any possible correction factors for average emissions. EUT Duty was confirmed as operating at 64.8% for tests, providing a correction factor of 3.8dB.

[5] EUT does not employ FHSS technology.

[6] Spectrum investigated up to a frequency of 25GHz based on 10 times the highest channel/ signal generated in equipment of 2480MHz.

4 Specifications

The tests were performed and operated in accordance with Kiwa Electrical Compliance procedures and the relevant standards listed below.

4.1 Relevant standards

Ref.	Standard Number	Version	Description
4.1.1	47 CFR Part 15.247	2023	Part 15 - Radio Frequency Devices - Subpart C - Intentional Radiators
4.1.2	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
4.1.3	ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
4.1.4	KDB 558074 D01 v05r02	2019	Federal Communications Commission Office of Engineering and Technology Laboratory Division; GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES

4.2 Deviations

No deviations were applied.

5 Tests, methods and results

5.1 AC power line conducted emissions

NOT APPLICABLE: EUT does not operate from the AC power lines nor contain provisions for operation while connected to AC power lines.

5.2 Radiated emissions 9 - 150 kHz

5.2.1 Test methods

Test Requirements:	47 CFR Part 15.247 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 15.247 Part 15.209/15.247(d) [Reference 4.1.1 of this report]

5.2.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was rotated in all three orthogonal planes. Radiated Emissions testing was performed with a new battery.

In a pre-test it was established that there was no difference between test channels and therefore full testing was performed in TX MID mode.

5.2.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.
Measurements were made in a semi-anechoic chamber (pre-scan) with any final measurements required performed on an OATS without a ground plane. The antenna was placed 1m above the ground. The equipment was rotated 360 degrees to record the worst-case emissions.

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

Tests were performed using Test Site M.

5.2.4 Test equipment

E411, E624, TMS81, ZSW1

See Section 8 for more details

5.2.5 Test results

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

Band	2400-2483.5 GHz
Power Level	8 dBm
Channel Spacing	5 MHz
Mod Scheme	DSSS
Mid channel	2440 MHz

Plot refs
14291-1 Rad 1 9k-150kHz Para
14291-1 Rad 1 9k-150kHz Perp

Peak detector “Max held” Analyser plots against the Quasi-Peak / Average limit line(s) can be found in Section 6 of this report.
No discernible difference was noted in emissions between channel settings (exploratory measurements), therefore final measurements are presented for TX mid channel mode only for these test ranges.

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:
9kHz to 30MHz ±3.11dB (UE30)

5.3 Radiated emissions 150 kHz - 30 MHz

5.3.1 Test methods

Test Requirements:	47 CFR Part 15.247 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 15.247 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 turntable 0.8 metres in height. 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 with a new battery.

In a pre-test it was established that there was no difference between test channels and therefore full testing was performed in TX MID 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 any final measurements required performed on an OATS without a ground plane. The antenna was placed 1m above the ground. The equipment was rotated 360 degrees to record the worst case emissions.

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

Tests were performed using Test Site M.

5.3.4 Test equipment

TMS81, ZSW1, E624, E411

See Section 8 for more details

5.3.5 Test results

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

Band	2400-2483.5 GHz
Power Level	8 dBm
Channel Spacing	5 MHz
Mod Scheme	DSSS
Mid channel	2440 MHz

Plot refs
14291-1 Rad 1 150k-30MHz Para
14291-1 Rad 1 150k-30MHz Perp

Peak detector “Max held” Analyser plots against the Quasi-Peak / Average limit line(s) can be found in Section 6 of this report.
No discernible difference was noted in emissions between channel settings (exploratory measurements), therefore final measurements are presented for TX mid channel mode only for these test ranges.

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: 9kHz to 30MHz ±3.11dB (UE30)

5.4 Radiated emissions 30 MHz -1 GHz

5.4.1 Test methods

Test Requirements:	47 CFR Part 15.247 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 15.247 Part 15.247(d) & 15.209 [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 with a new battery.

In a pre-test it was established that there was no difference between test channels and therefore full testing was performed in TX MID mode.

5.4.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. The equipment was rotated 360 degrees and the antenna scanned 1 – 4 metres in both horizontal and vertical polarisations to record the worst case emissions.

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

Tests were performed using Test Site M.

5.4.4 Test equipment

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

See Section 8 for more details

5.4.5 Test results

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

Band	2400-2483.5 GHz
Power Level	8 dBm
Channel Spacing	5 MHz
Mod Scheme	DSSS
Mid channel	2440 MHz

Plot refs
14291-1 Rad 1 VHF Horiz
14291-1 Rad 1 VHF Vert
14291-1 Rad 1 UHF Horiz
14291-1 Rad 1 UHF Vert

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 only for these test ranges

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 15.247 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 15.247 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 with a new battery.
The EUT was operated in TX LOW, TX MID and TX HIGH 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. Note: No continuous transmit was available and therefore ‘trace averaging’ and duty cycle correction has been applied to average measurements as described in ANSI C63.10 clause 11.12.2.5.2. Duty cycle was confirmed to be 64.8% which resulted in a corresponding duty cycle correction of 3.8 dB using 20Log(1/0.648).

At least 6 signals within 20dB and all signals within 10dB of the limit were investigated. Tests were performed using Test Site M.

5.5.4 Test equipment

E136, E411, E429, E478, E574, E624, TMS78, TMS79, TMS82

See Section 8 for more details

5.5.5 Test results

Temperature of test environment	19°C
Humidity of test environment	50%
Pressure of test environment	101kPa

Setup Table

Band	2400-2483.5 GHz
Power Level	8 dBm
Channel Spacing	5 MHz
Mod Scheme	DSSS
Low channel	2405 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
4810◆	50.6	-23.4	42.4	-11.6	Flat	Vertical
4810◆	48.9	-25.1	41.5	-12.5	Upright	Horizontal
7215	53.0	-24.5	47.8	-19.7	Flat	Vertical
12025◆	47.2	-26.8	39.5	-14.5	Flat	Vertical
12025◆	49.0	-25.0	42.0	-12.0	Upright	Horizontal
16835	53.1	-24.4	47.8	-19.7	Flat	Vertical

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Setup Table

Band	2400-2483.5 GHz
Power Level	8 dBm
Channel Spacing	5 MHz
Mod Scheme	DSSS
Mid channel	2440 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
4880◆	50.0	-24.0	43.2	-10.8	Flat	Vertical
4880◆	49.1	-24.9	42.2	-11.8	Upright	Horizontal
7320◆	50.4	-23.6	46.0	-8.0	Flat	Vertical
7320◆	51.6	-22.4	47.3	-6.7	Upright	Horizontal

Plots
14291-1 Radiated Emissions Mid channel 1 - 3 GHz Horiz
14291-1 Radiated Emissions Mid channel 1 - 3 GHz Vert
14291-1 Radiated Emissions Mid channel 3 - 5.15 GHz Horiz
14291-1 Radiated Emissions Mid channel 3 - 5.15 GHz Vert
14291-1 Radiated Emissions Mid channel 5.15 - 6 GHz Horiz
14291-1 Radiated Emissions Mid channel 5.15 - 6 GHz Vert
14291-1 Radiated Emissions Mid channel 6 - 7.77 GHz Horiz
14291-1 Radiated Emissions Mid channel 6 - 7.77 GHz Vert
14291-1 Radiated Emissions Mid channel 7.77 - 10 GHz Horiz
14291-1 Radiated Emissions Mid channel 7.77 - 10 GHz Vert
14291-1 Radiated Emissions Mid channel 10 - 12.5 GHz Horiz
14291-1 Radiated Emissions Mid channel 10 - 12.5 GHz Vert
14291-1 Radiated Emissions Mid channel 12.5 - 15 GHz Horiz
14291-1 Radiated Emissions Mid channel 12.5 - 15 GHz Vert
14291-1 Radiated Emissions Mid channel 15 - 18 GHz Horiz
14291-1 Radiated Emissions Mid channel 15 - 18 GHz Vert
14291-1 Radiated Emissions Mid channel 18 - 21 GHz Horiz
14291-1 Radiated Emissions Mid channel 18 - 21 GHz Vert
14291-1 Radiated Emissions Mid channel 21 - 25 GHz Horiz
14291-1 Radiated Emissions Mid channel 21 - 25 GHz Vert

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Setup Table

Band	2400-2483.5 GHz
Power Level	8 dBm
Channel Spacing	5 MHz
Mod Scheme	DSSS
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
4960◆	50.6	-23.4	44.2	-9.8	Flat	Vertical
4960◆	47.9	-26.1	42.9	-11.1	Upright	Horizontal
7440◆	47.9	-26.1	44.9	-9.1	Flat	Vertical
7440◆	49.3	-24.7	43.3	-10.7	Upright	Horizontal
17360	56.3	-21.2	49.6	-17.9	Flat	Vertical
17360	58.8	-18.7	51.8	-15.7	Upright	Horizontal
22320◆	48.3	-25.7	40.5	-13.5	Side	Vertical
22320◆	50.2	-23.8	42.6	-11.4	Upright	Horizontal

◆Denotes that the emission falls within a restricted band per 47CFR Clause 15.205. Emissions within these bands must comply with the peak / average limits of 15.209 (74 / 54 dBuv/m@3m). Other emissions must be attenuated by at least 20/30dB from the level of the in-band fundamental, measured with 100kHz RBW.

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.

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:

1GHz - 6GHz ±4.81dB (UE77)
6GHz to 12.5GHz ±5.39dB (UE79)
12GHz to 25GHz ±5.38dB (UE80)

5.6 Effective radiated power field strength

5.6.1 Test methods

Test Requirements:	47 CFR Part 15.247 Part 15.247(d) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.5/6.6 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15.247 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 TX LOW, TX MID and TX HIGH modes.

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 maximum Peak field strength. Tests were performed in test site M.

5.6.4 Test equipment

E136, E411, E624, E874, TMS82

See Section 8 for more details

5.6.5 Test results

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

Band	2400-2483.5 GHz
Power Level	8 dBm
Channel Spacing	5 MHz
Mod Scheme	DSSS
Low channel	2405 MHz
Mid channel	2440 MHz
High channel	2480 MHz

	Low channel	Mid channel	High channel
Peak Level (dBµV/m @3m)	96.10	97.50	96.10
Plot reference	14291-1 ERP Low channel	14291-1 ERP Mid channel	14291-1 ERP High channel
Antenna Polarisation	Horiz	Horiz	Horiz
EUT Polarisation	Side	Side	Side

Analyser plots can be found in Section 6 of this report.

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:

1GHz to 3GHz ±4.81dB (UE77)

5.7 Band Edge Compliance

5.7.1 Test methods

Test Requirements:	47 CFR Part 15.247 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 15.247 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 TX LOW and TX HIGH 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 using Test Site M.

5.7.4 Test equipment

E136, E624, TMS82

See Section 8 for more details

5.7.5 Test results

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

Band	2400-2483.5 GHz
Power Level	8 dBm
Channel Spacing	5 MHz
Mod Scheme	DSSS
Low channel	2405 MHz
Mid channel	2440 MHz
High channel	2480 MHz

Restricted Band Edges	Low channel	High channel
Restricted Peak Level measured (dBuV/m)	43.4	50.5
Restricted band edge Peak Plot	14291-1 Restricted band edge - Low Channel Peak	14291-1 Restricted band edge - High Channel Peak
Restricted Average Level measured (dBuV/m)	Peak complies with average limit	44.5
Restricted band edge Average Plot	Not applicable	14291-1 Restricted band edge - High Channel (Reduced VBW)

Authorised Band Edges	Low channel	High channel
Authorised Band Edge (dBc) value measured	56.2	53.4
Authorised Band Edge Plot	14291-1 Authorised band edge - Low Channel Peak	14291-1 Authorised band edge - High Channel Peak

Analyser plots for the Band Edge Compliance can be found in Section 6 of this report. These show the 20dBc 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.

The tables list the field strengths observed in the adjacent restricted bands, which are required to meet the tighter 15.209 limits.

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:
1GHz to 3GHz ±4.81dB (UE77)

5.8 Occupied bandwidth

5.8.1 Test methods

Test Requirements: 47 CFR Part 15.247 Part 15.247(a)(1)(i)/ (ii)/(iii)/ 15.247(a)(2) [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 15.247 Part 15.215(c) 15.247(a)(2) [Reference 4.1.1 of this report]

5.8.2 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 TX LOW, TX MID and TX HIGH modes.

5.8.3 Test procedure

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

Tests were performed using Test Site M.

5.8.4 Test equipment

E136, E411, E624, TMS82

See Section 8 for more details

5.8.5 Test results

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

Band	2400-2483.5 GHz
Power Level	8 dBm
Channel Spacing	5 MHz
Mod Scheme	DSSS
Low channel	2405 MHz
Mid channel	2440 MHz
High channel	2480 MHz

	Low channel	Mid channel	High channel
6 dB Bandwidth Result (MHz)	1.608	1.608	1.84
Plot for 6 dB Bandwidth Result (MHz)	14291-1 OBW LOW	14291-1 OBW MID	14291-1 OBW HIGH
99 % Bandwidth Result (MHz)	2.2733	2.2785	2.294
Frequency Error (kHz) (include sign)	-38.194	-39.76	-41.017
Operating frequency (MHz)	2405	2440	2480
6 dB FLOW Worst case (MHz)	2404.157806	2439.15624	2479.038983
6 dB FHIGH Worst case (MHz)	2405.765806	2440.76424	2480.878983

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

LIMITS:
15.247(a)(2) The minimum 6dB bandwidth shall be at least 500kHz.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows: ± 0.17 % (UR19B)

5.9 Maximum Average conducted output power

NOT APPLICABLE: Peak conducted power measurements performed instead.

5.10 Maximum Peak conducted output power

5.10.1 Test methods

Test Requirements:	47 CFR Part 15.247 Part 15.247(b)(3) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 11.9 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15.247 Part 15.247(b)(3) [Reference 4.1.1 of this report]

5.10.2 Configuration of EUT

EUT was measured on a bench using a spectrum analyser 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 TX LOW, TX MID and TX HIGH modes for this test.

5.10.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below.
Peak stated reading is maximum power observed using a spectrum analyser set with a RBW greater than the 6dB BW of the EUT. Measurements were made on a test bench in site A.

5.10.4 Test equipment

E412, F307, S032

See Section 8 for more details

5.10.5 Test results

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

Band	2400-2483.5 GHz
Power Level	8 dBm
Channel Spacing	5 MHz
Mod Scheme	DSSS
Low channel	2405 MHz
Mid channel	2440 MHz
High channel	2480 MHz

Nominal voltage result (dBm)	7.46	8.04	7.75
Single port Plot reference	14291-1 Conducted peak power - Low channel	14291-1 Conducted peak power - Mid channel	14291-1 Conducted peak power - High channel
Limit in dBm	30.00	30.00	30.00
Maximum result (dBm)	7.47	8.04	7.75
Margin to Limit (dB)	-22.53	-21.96	-22.25
Result in (W)	0.006	0.006	0.006

LIMITS:
15.247(b)(3): For systems using digital modulation in the 2400-2483.5 MHz band 1 Watt (+30dBm).

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 GHz ±0.56 dB

5.11 Maximum Power Spectral Density

5.11.1 Test methods

Test Requirements:	47 CFR Part 15.247 Part 15.247(e) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 10.10 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15.247 Part 15.247(e) [Reference 4.1.1 of this report]

5.11.2 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 TX LOW, TX MID and TX HIGH modes for this test.

5.11.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment& noted below.
Measurements & plots were taken with the span set to at least 1.5 times the measured DTS bandwidth.
Tests were performed using Test Site A.

5.11.4 Test equipment

E412, F307

See Section 8 for more details

5.11.5 Test results

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

Band	2400-2483.5 GHz
Power Level	8 dBm
Channel Spacing	5 MHz
Mod Scheme	DSSS
Low channel	2405 MHz
Mid channel	2440 MHz
High channel	2480 MHz

	Low channel	Mid channel	High channel
Measured PSD conducted (dBm/3kHz)	-2.56	-2.05	-2.35
PSD Limit (dBm/3kHz)	8	8	8
RF Ant port 1 Margin (dB)	-10.56	-10.05	-10.35
RF Ant port 1 PSD Plot reference	14291-1 Power Spectral Density (Peak) Low channel	14291-1 Power Spectral Density (Peak) Mid channel	14291-1 Power Spectral Density (Peak) High channel

Analyser plots can be found in Section 6 of this report.

LIMITS:
15.247(e) +8dBm/3kHz.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows: ±0.97 dB (UR66A)

5.12 Antenna power conducted emissions

NOT APPLICABLE: Applies to EUT's with an antenna port. The EUT has an integral antenna only.

5.13 Duty cycle

NOT APPLICABLE: No limits apply, however duty cycle measurement performed to verify any possible correction factors for average emissions. EUT Duty was confirmed as operating at 64.8% for tests, providing a correction factor of 3.8dB.

5.14 FHSS carrier frequency separation

NOT APPLICABLE: EUT does not employ FHSS technology

5.15 Average time of occupancy

NOT APPLICABLE: EUT does not employ FHSS technology

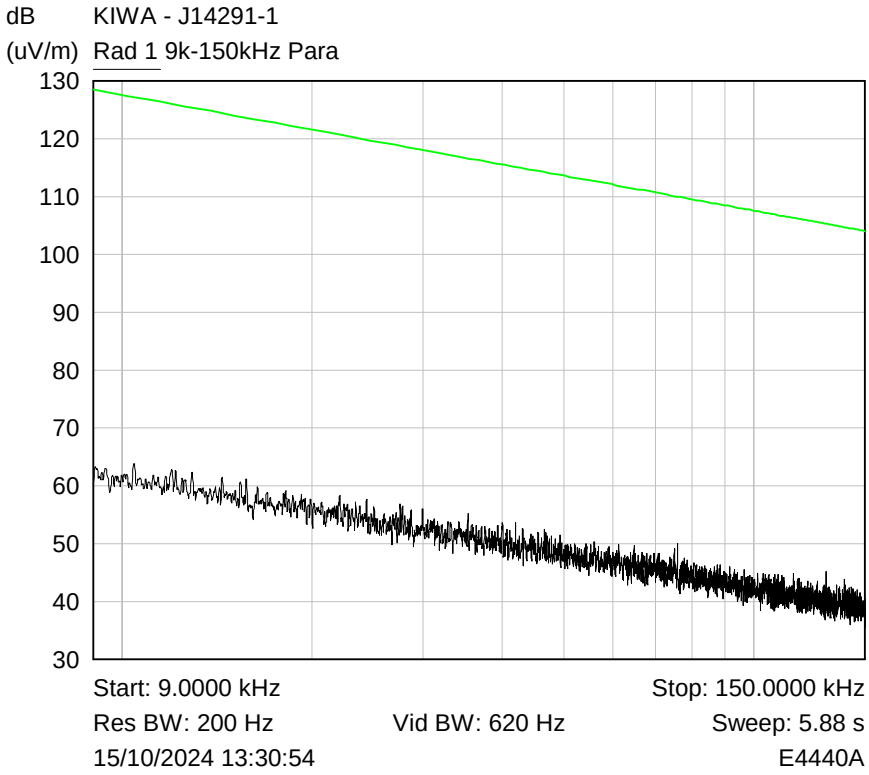
5.16 Number of Hop Channels

NOT APPLICABLE: EUT does not employ FHSS technology

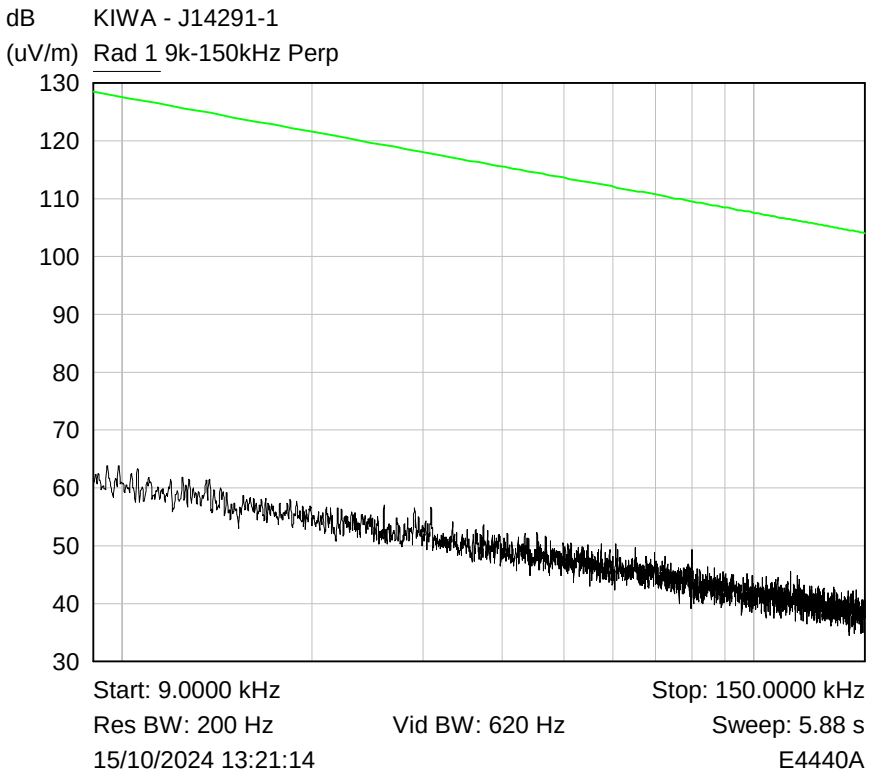
6 Plots/Graphical results

6.1 Radiated emissions 9 - 150 kHz

RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2440 MHz



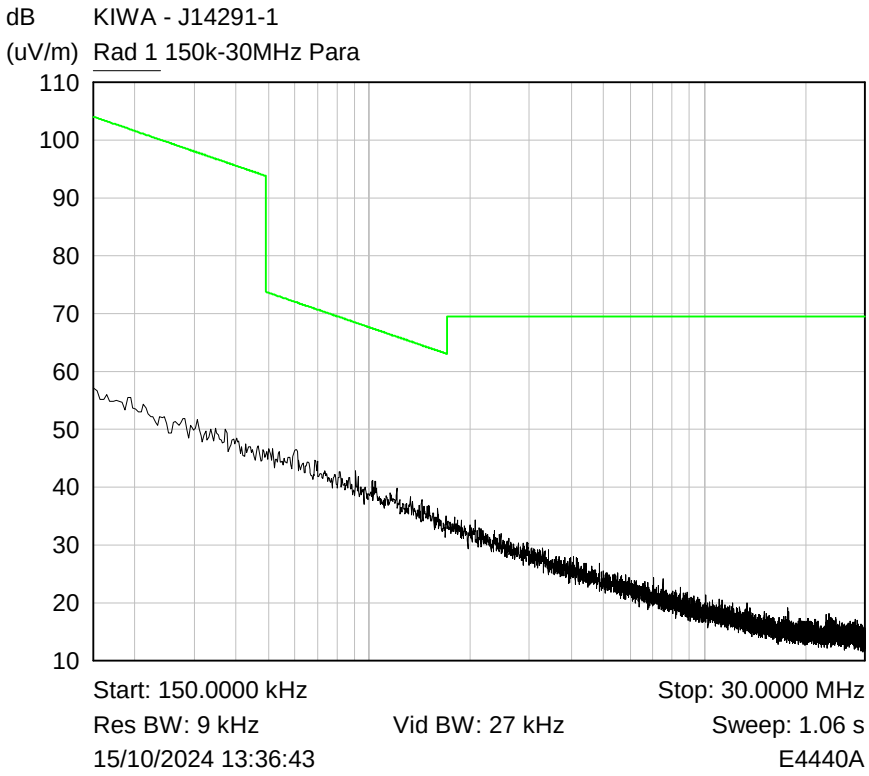
Plot of 9k-150kHz Parallel



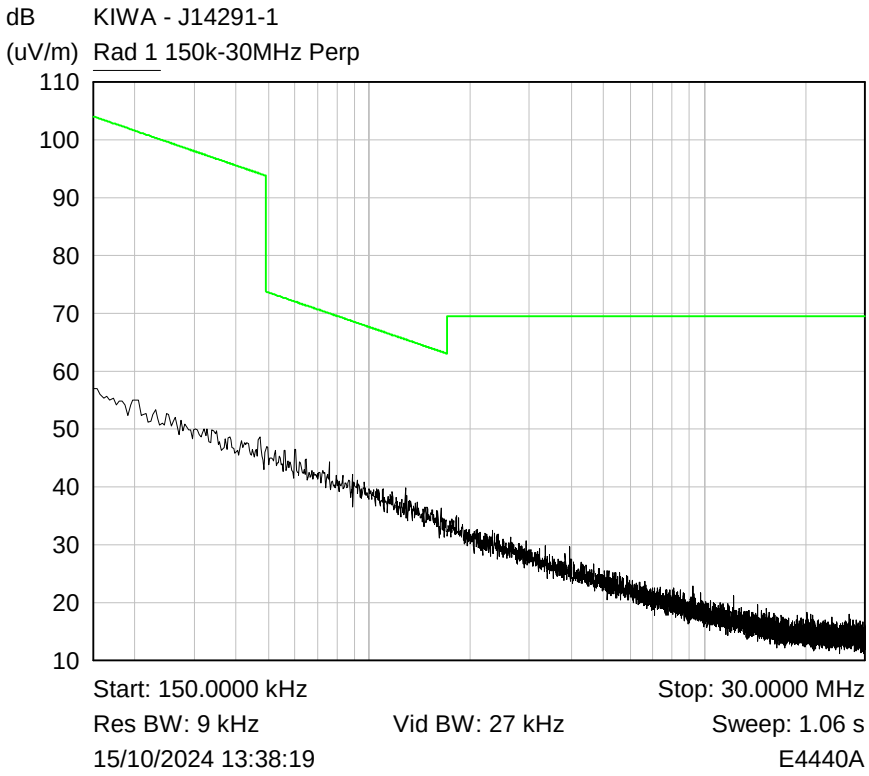
Plot of 9k-150kHz Perpendicular

6.2 Radiated emissions 150 kHz - 30 MHz

RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2440 MHz



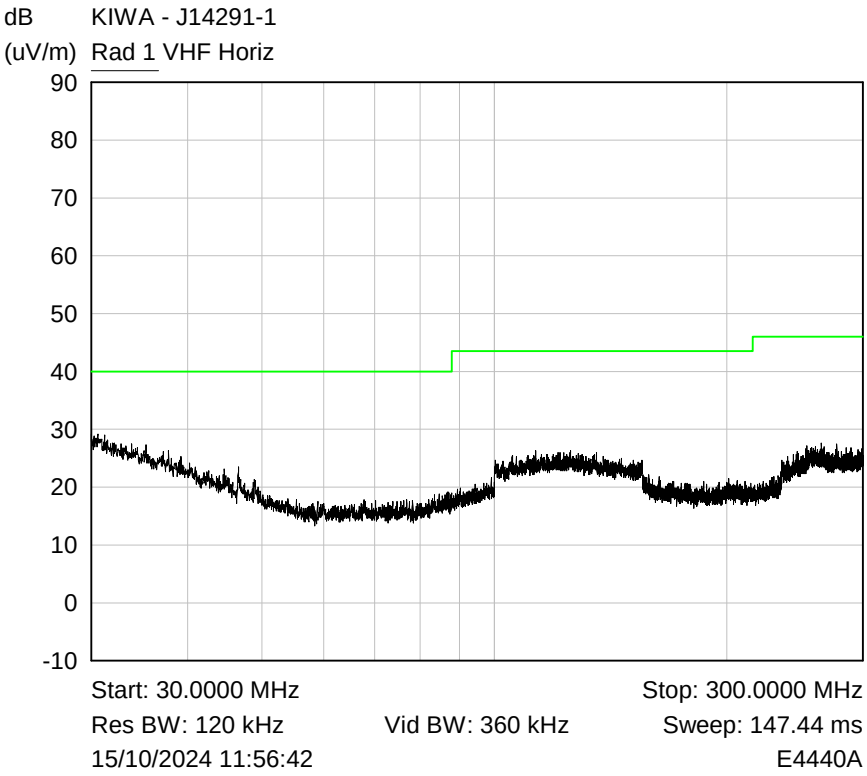
Plot of 150kHz-30MHz Parallel



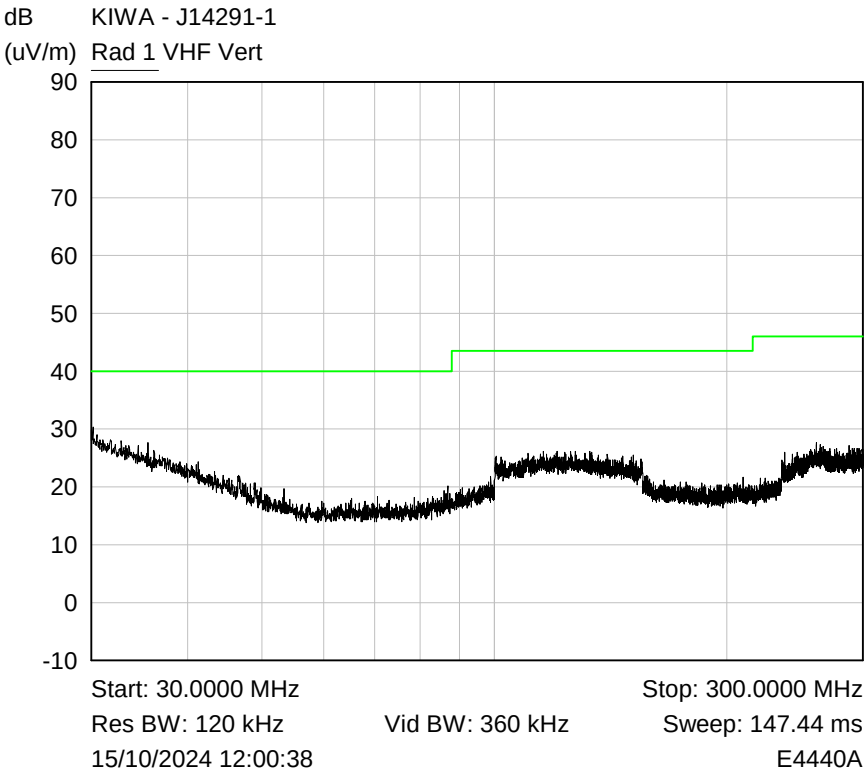
Plot of 150kHz-30MHz Perpendicular

6.3 Radiated emissions 30 MHz -1 GHz

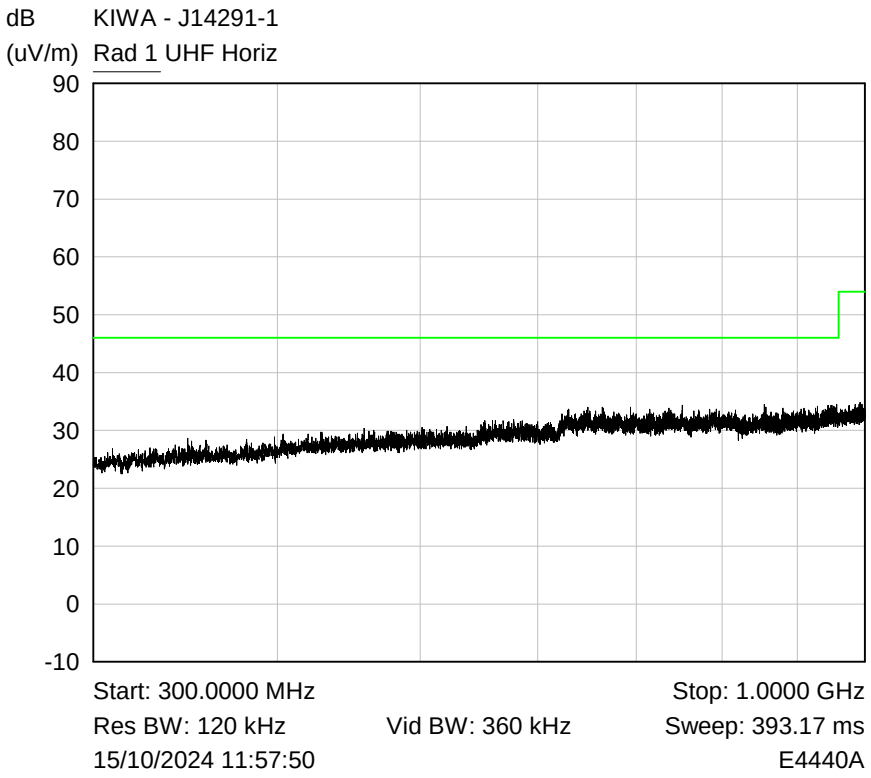
RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2440 MHz



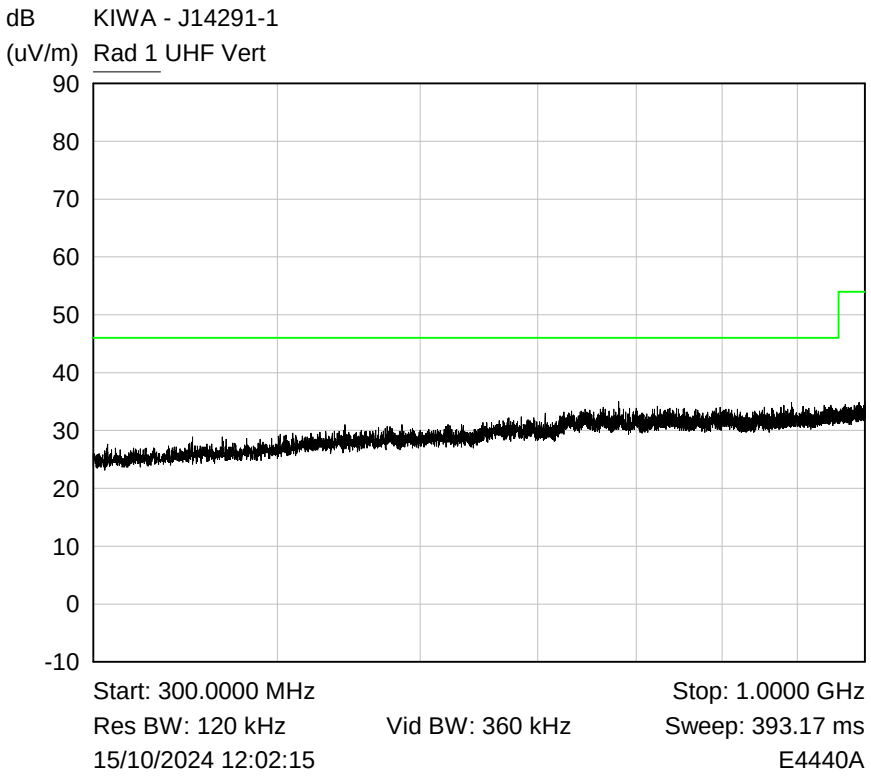
Plot of Peak emissions for VHF Horizontal against the QP limit line.



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



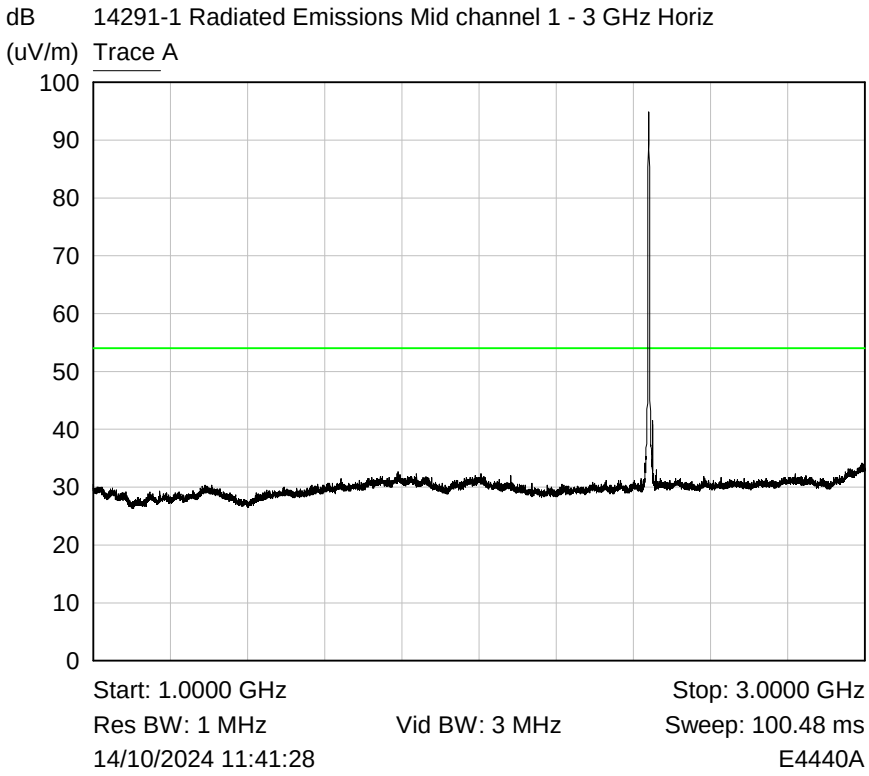
Plot of Peak emissions for UHF Horizontal against the QP limit line.

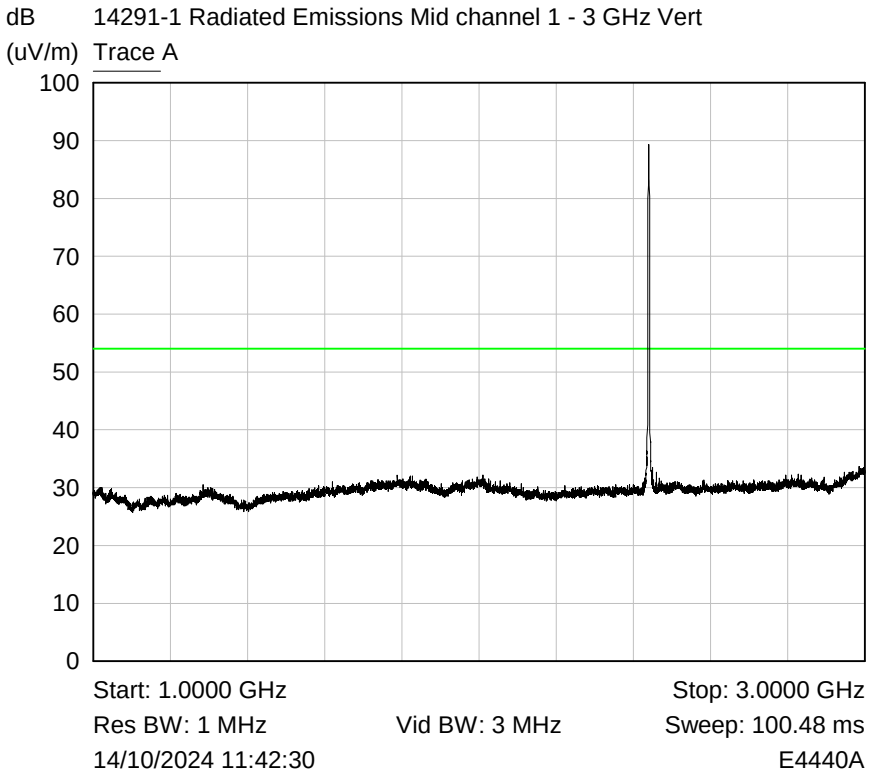


Plot of Peak emissions for UHF Vertical against the QP limit line.

6.4 Radiated emissions above 1 GHz

RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2440 MHz





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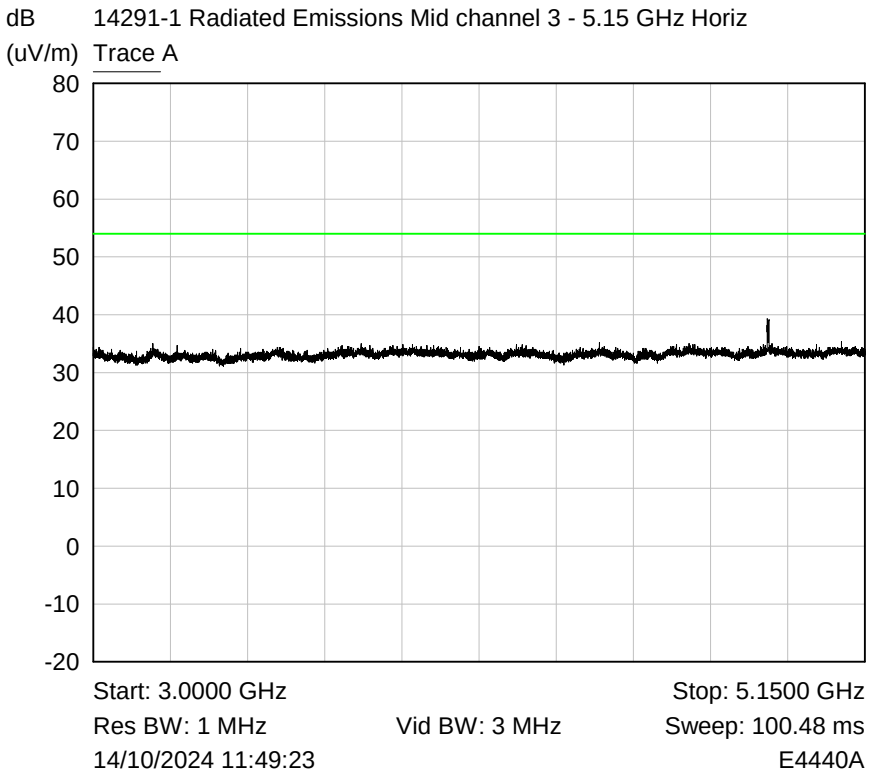

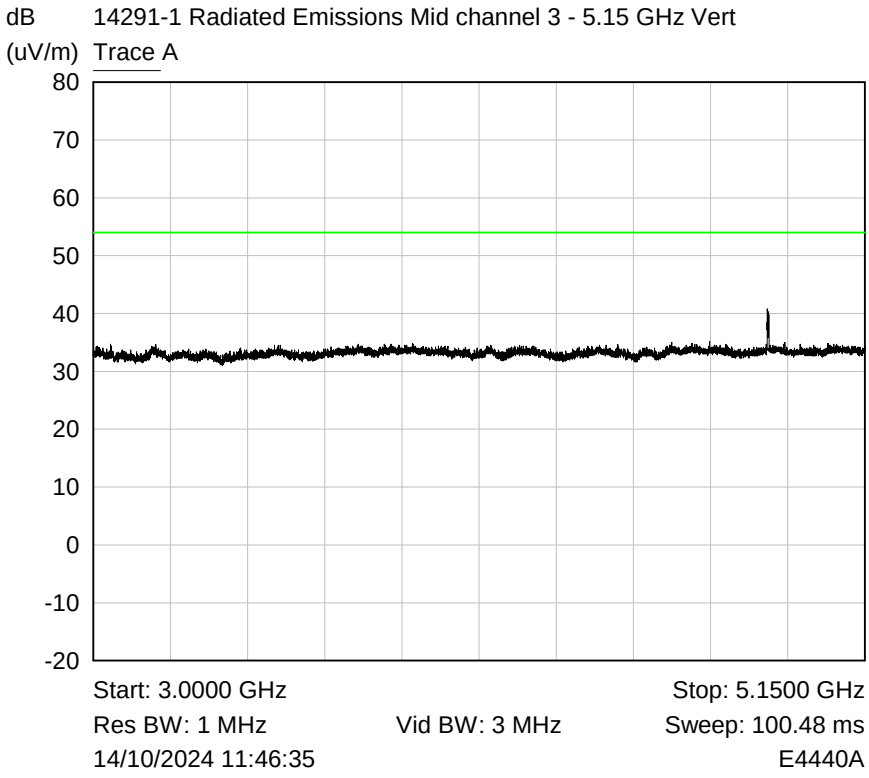

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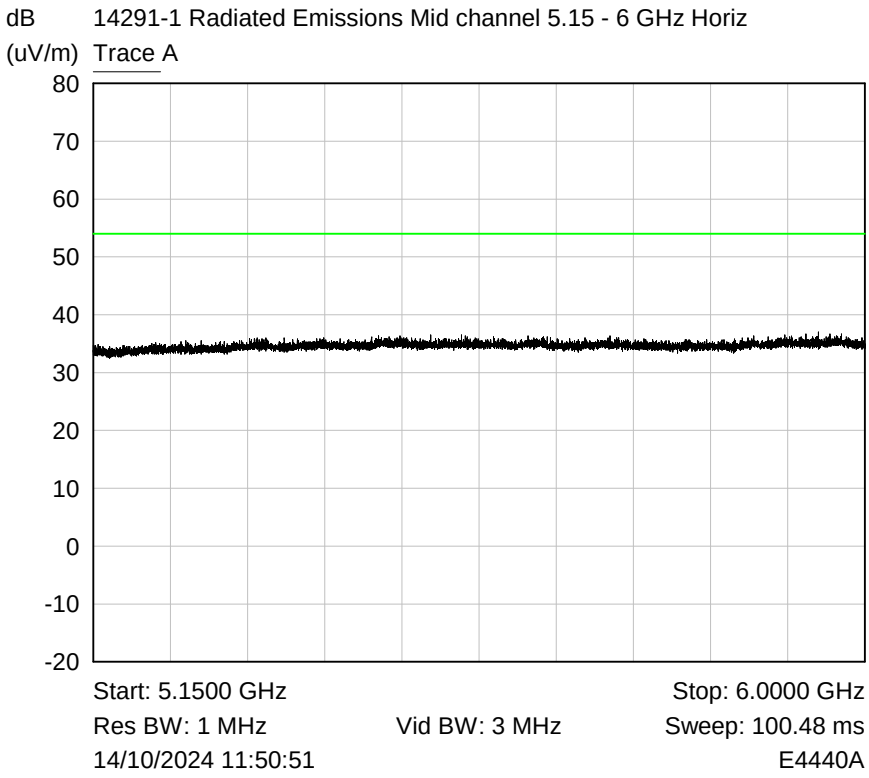

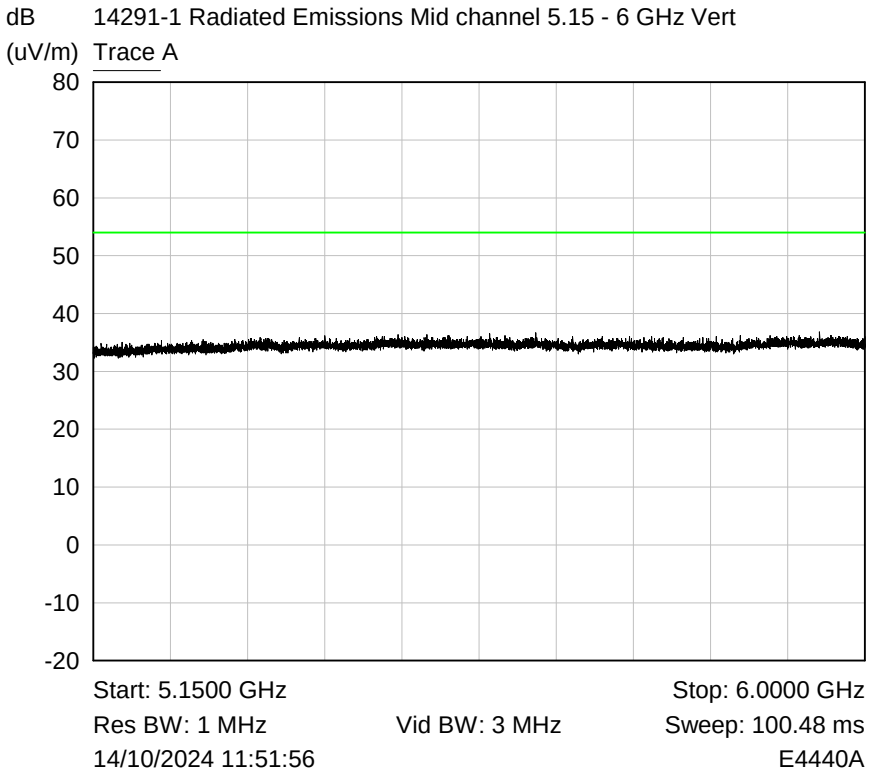

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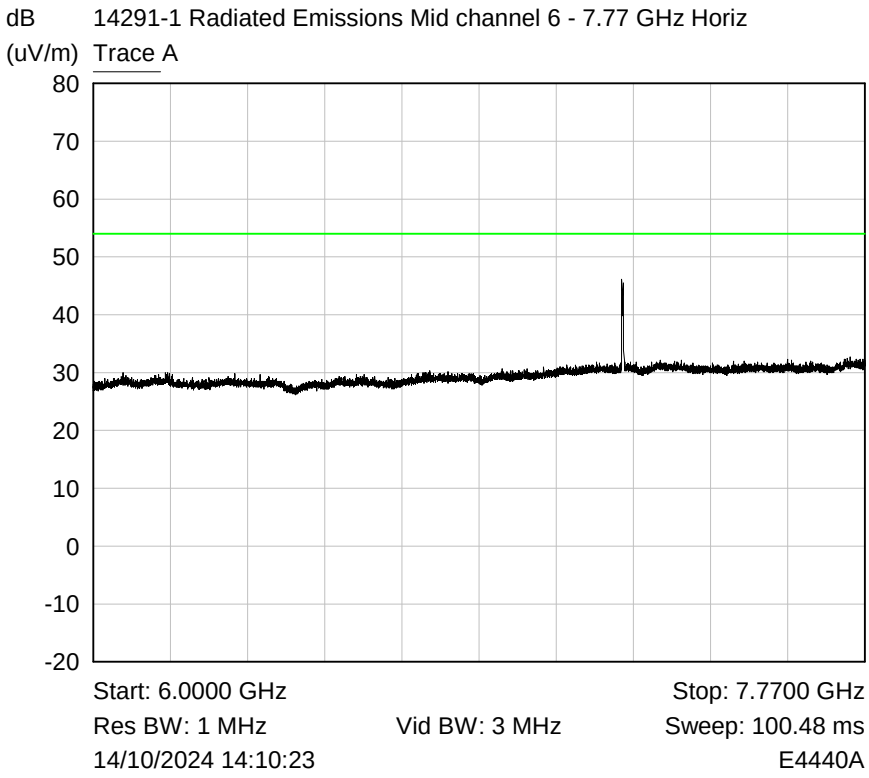

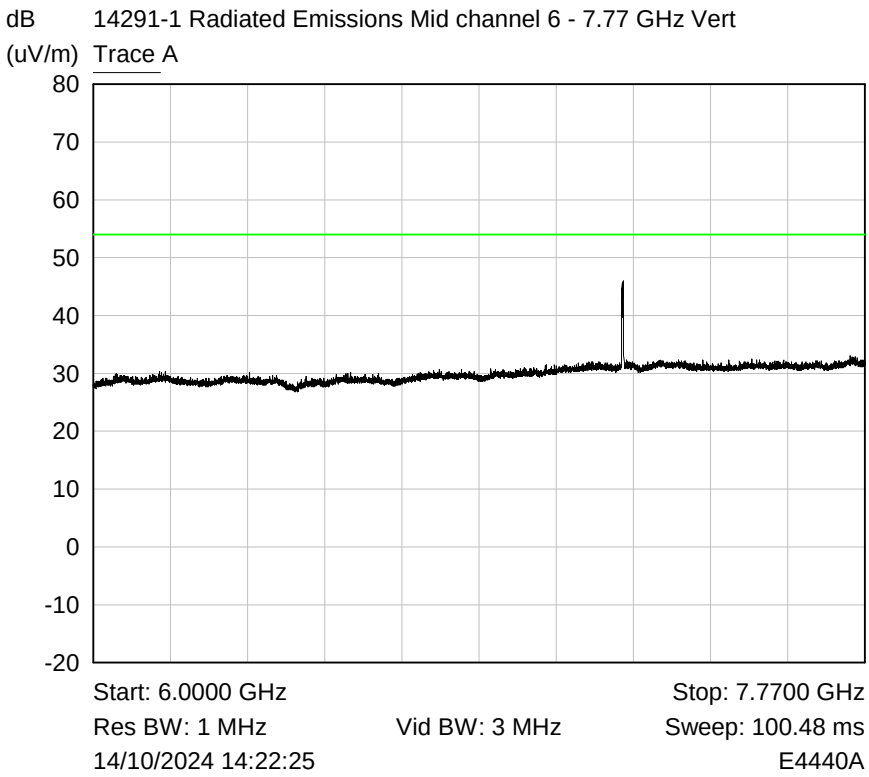

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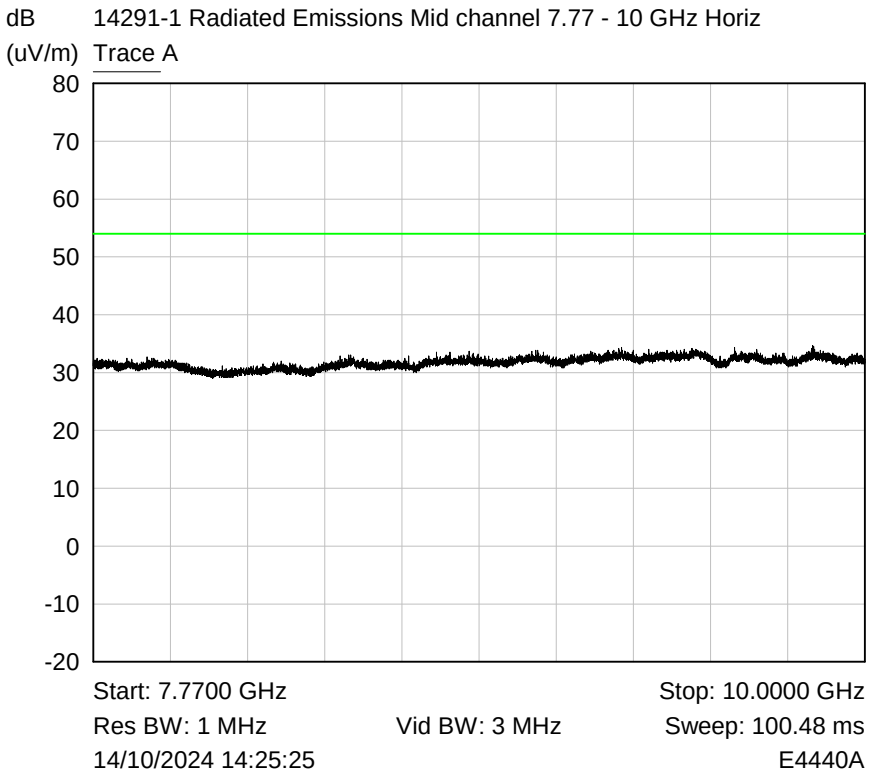

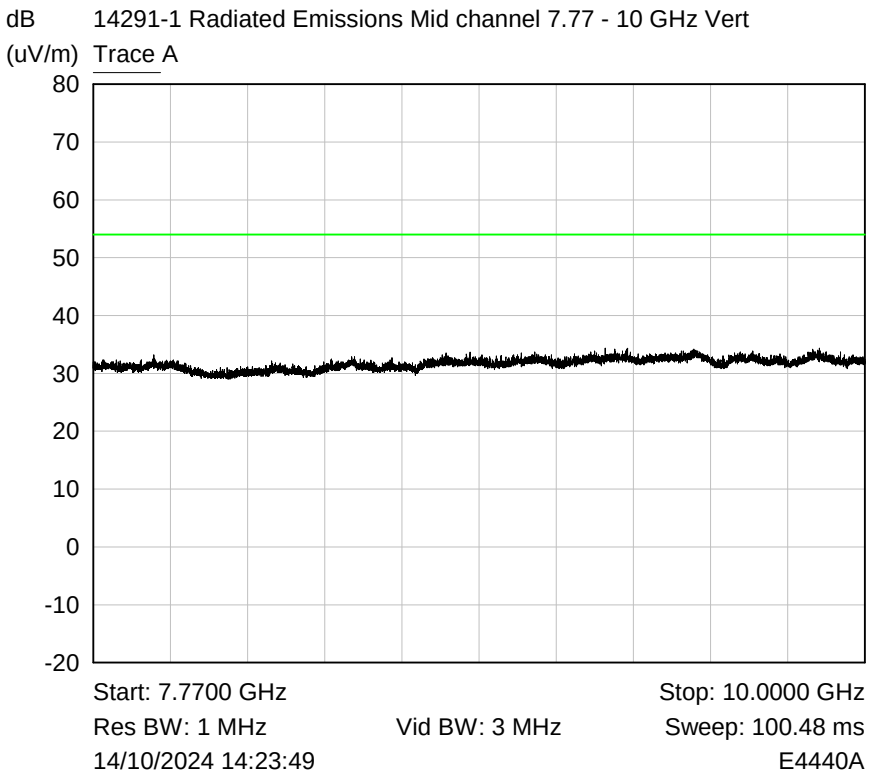

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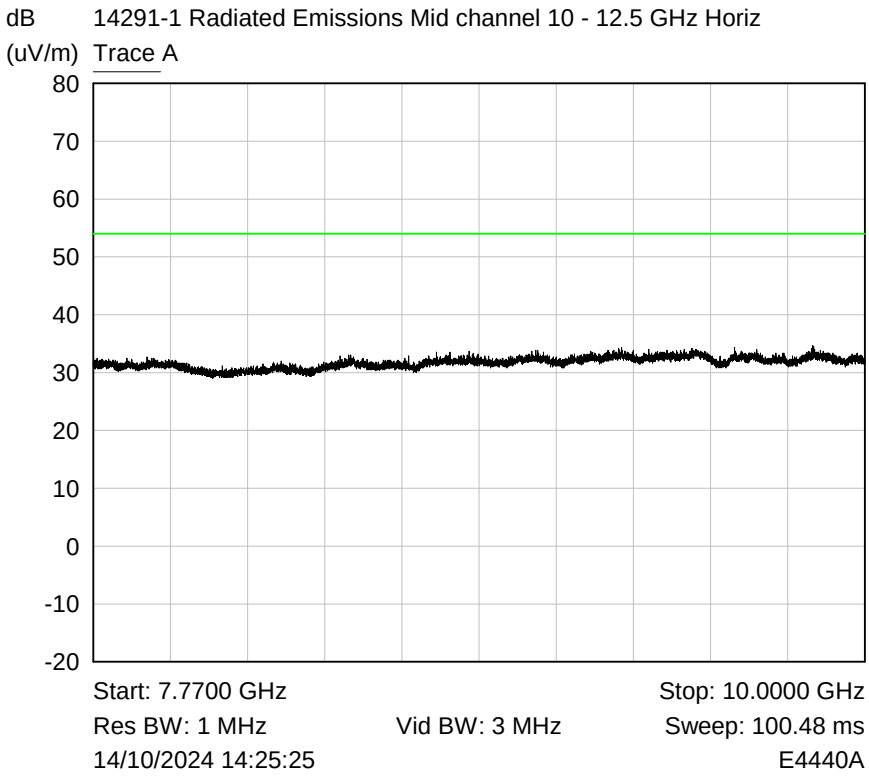

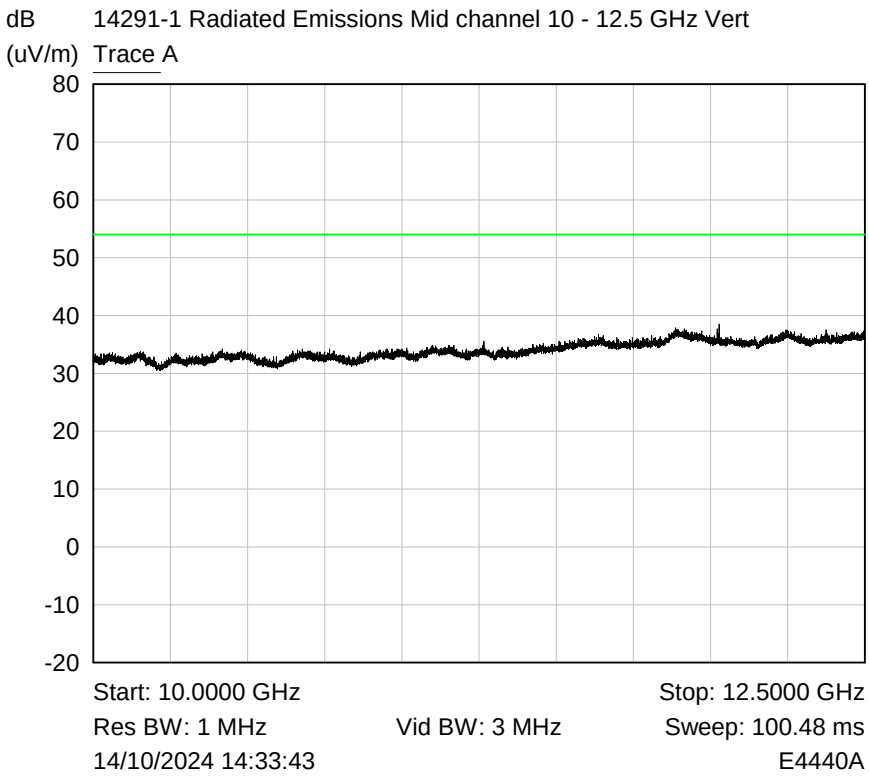

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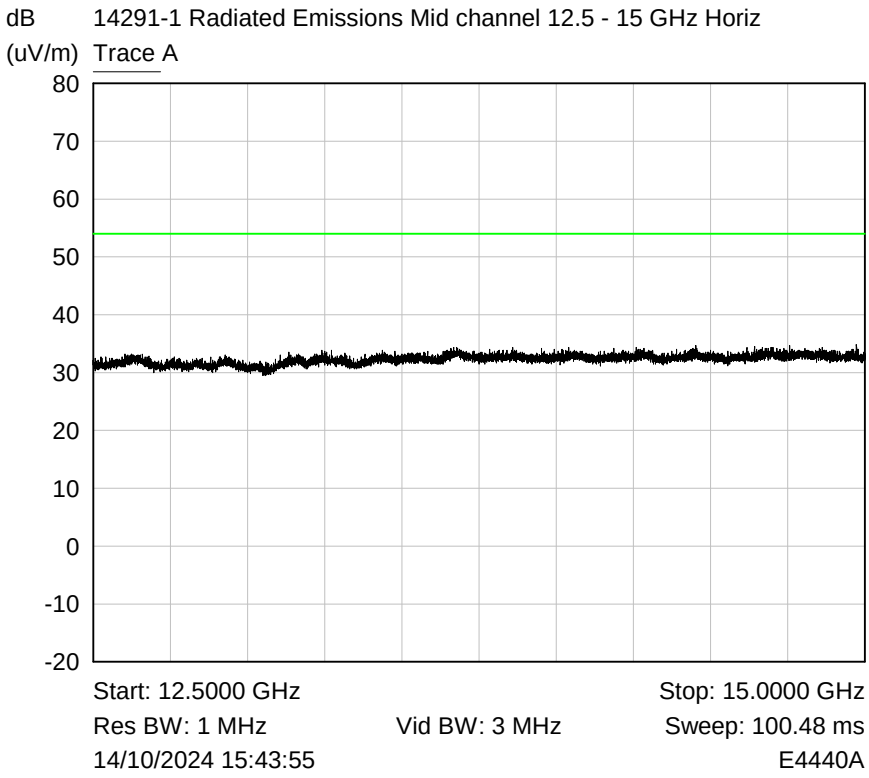

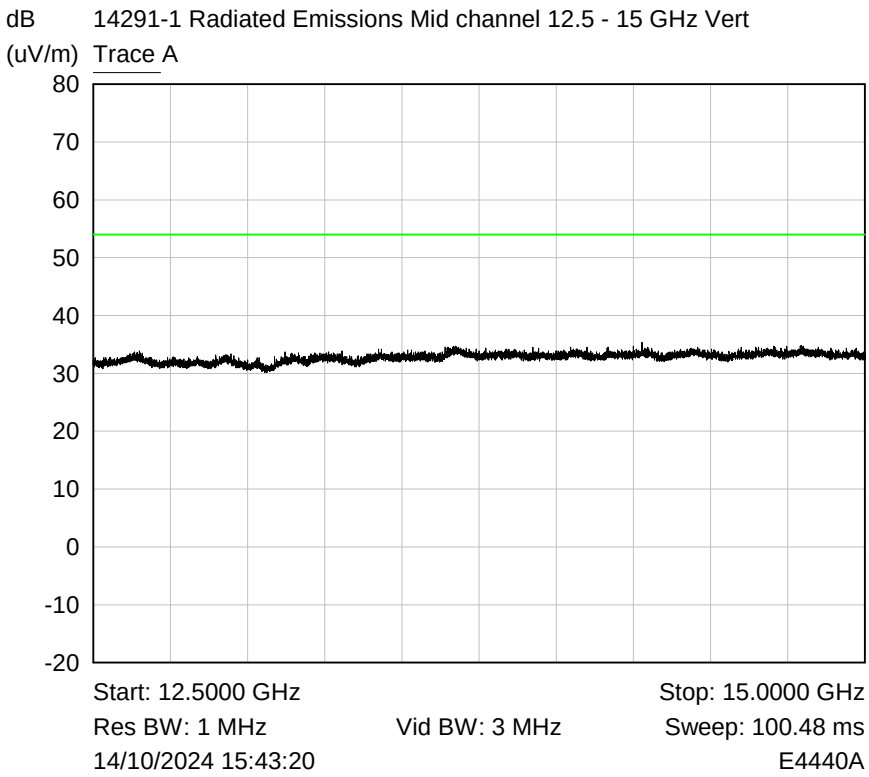

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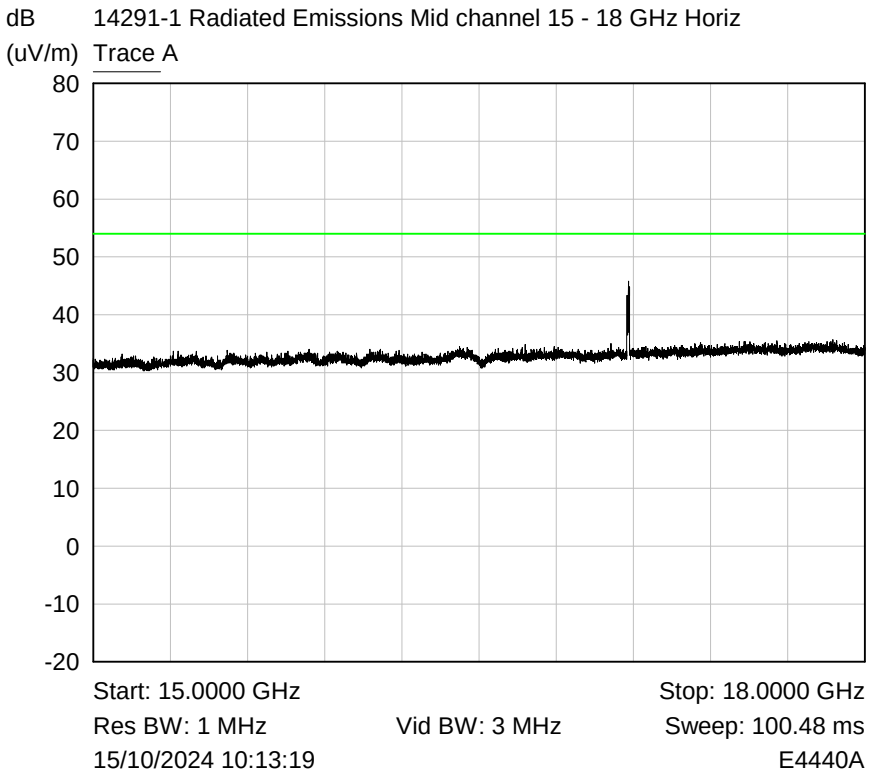

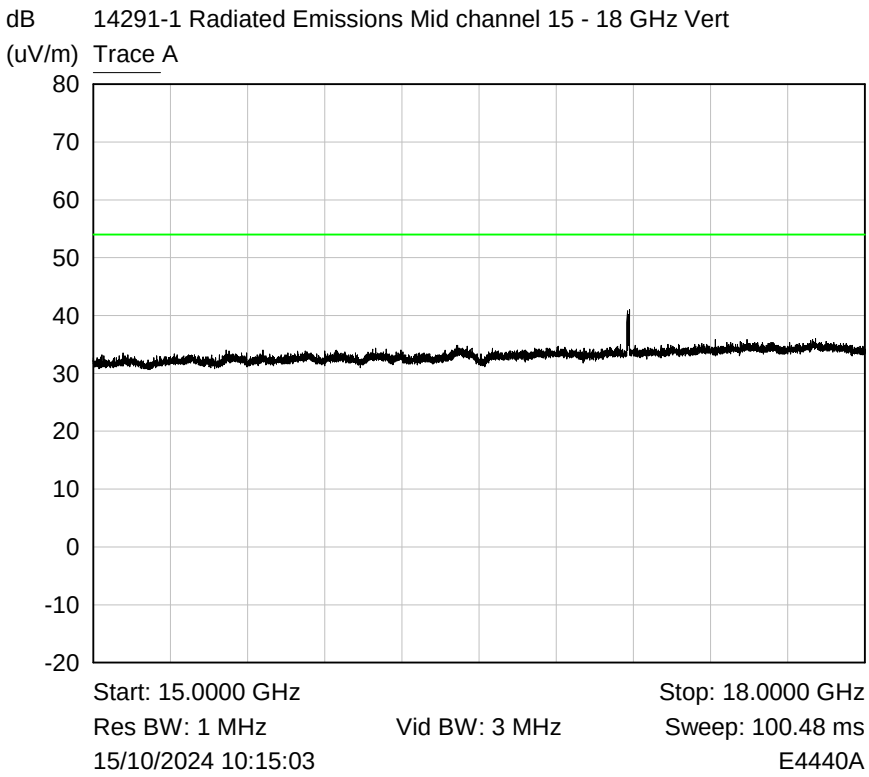

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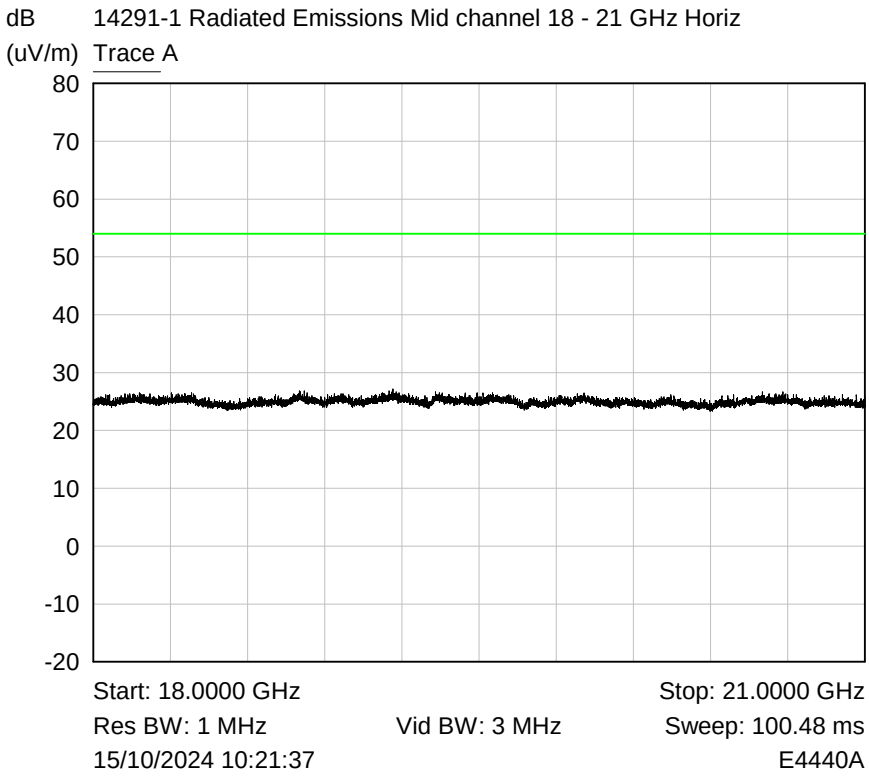

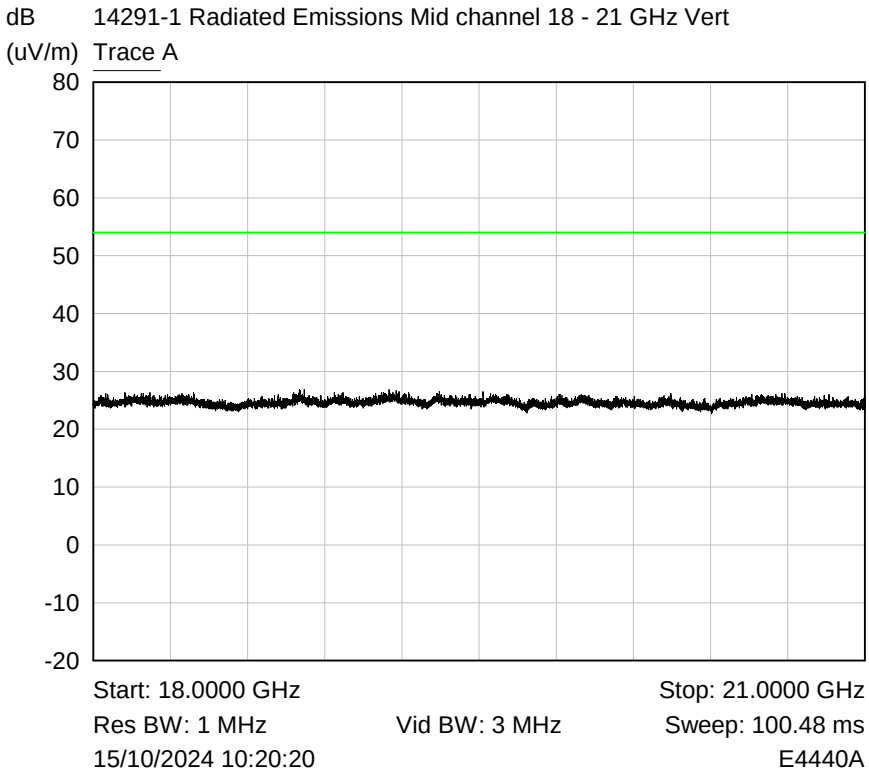

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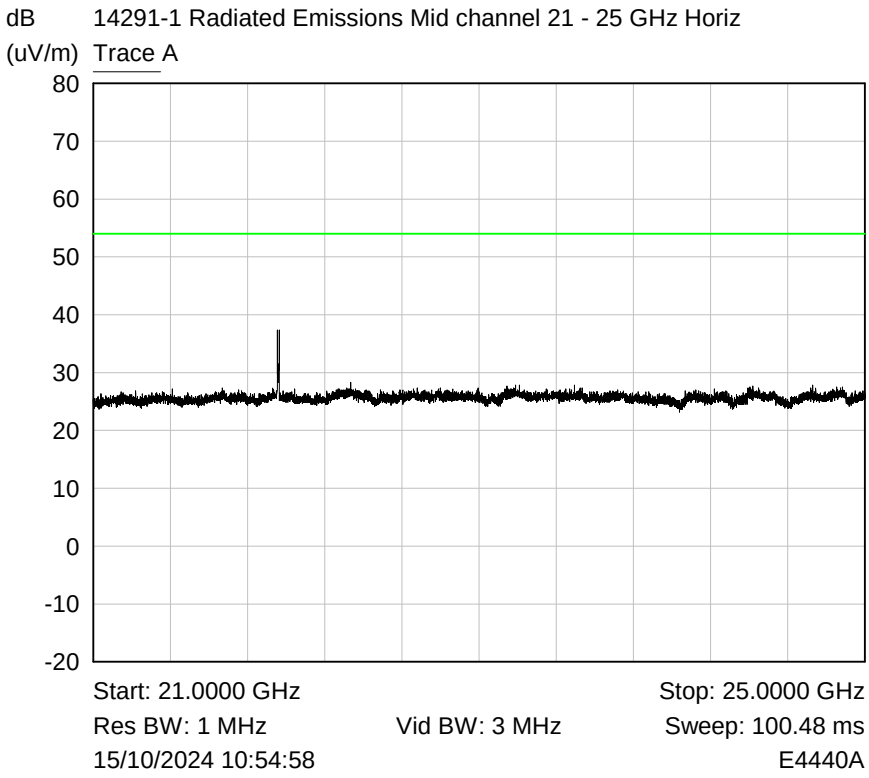
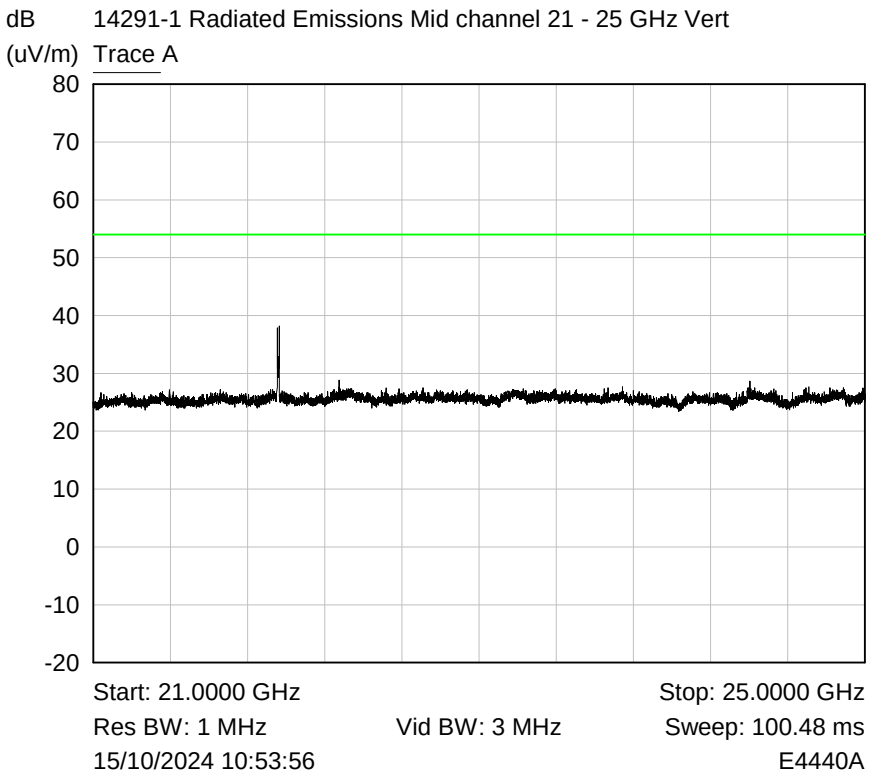
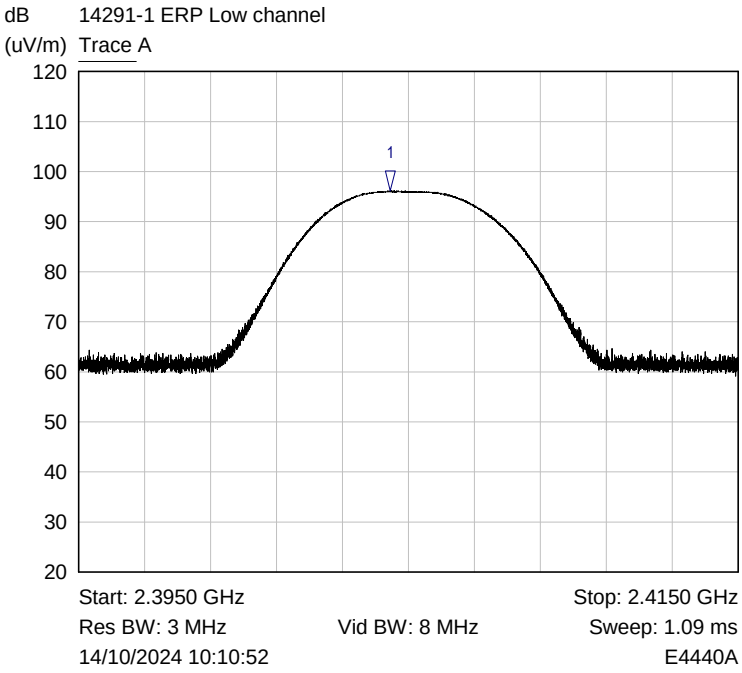




6.5 Effective radiated power field strength

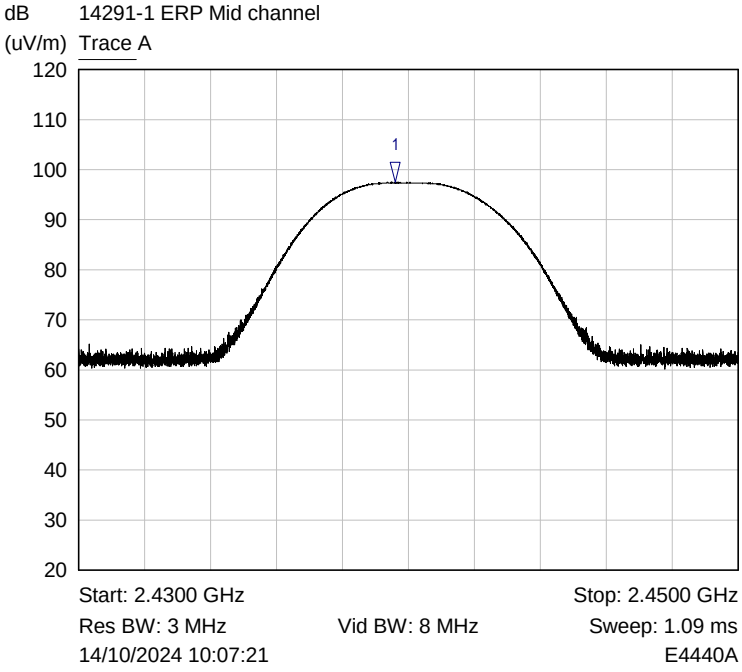
RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2405 MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4044 GHz	96.14 dB(uV/m)	

Plot of Horiz polarisation and EUT in Side position

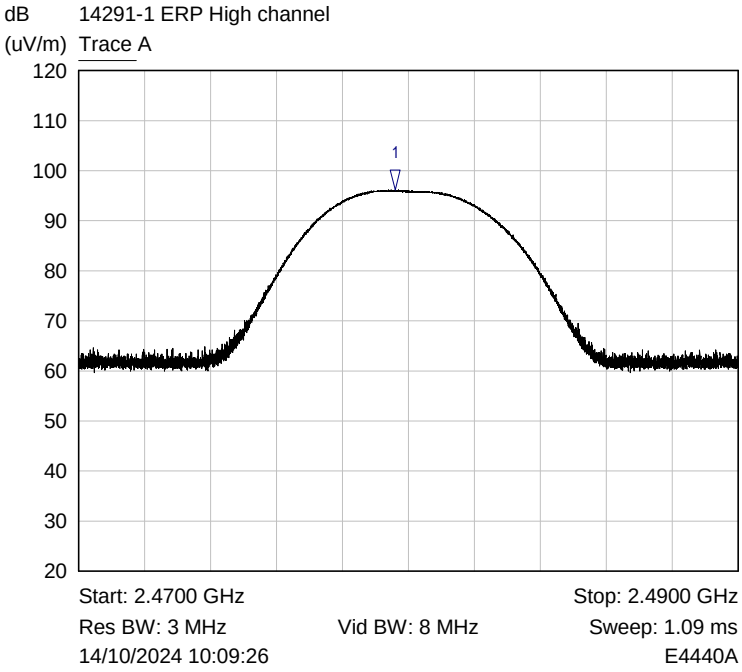
RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2440 MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4396 GHz	97.50 dB(uV/m)	

Plot of Horiz polarisation and EUT in Side position

RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2480 MHz

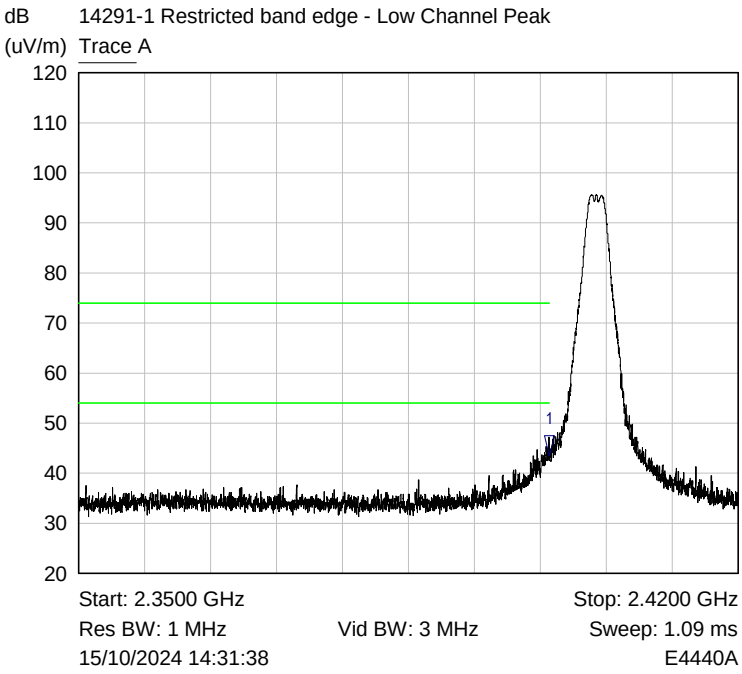


Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4796 GHz	96.13 dB(uV/m)	

Plot of Horiz polarisation and EUT in Side position

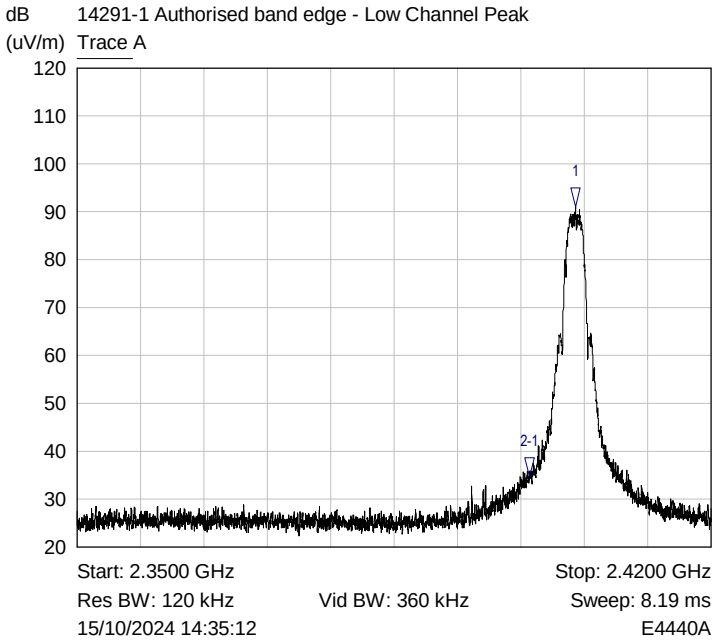
6.6 Band Edge Compliance

RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2405 MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4000 GHz	43.42 dB(uV/m)	

Restricted band edge Peak Plot



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4050 GHz	90.95 dB(uV/m)	
2-1 ▽	Trace A	-5.0165 MHz	-56.24 dB	dBc

Authorised Band Edge Plot

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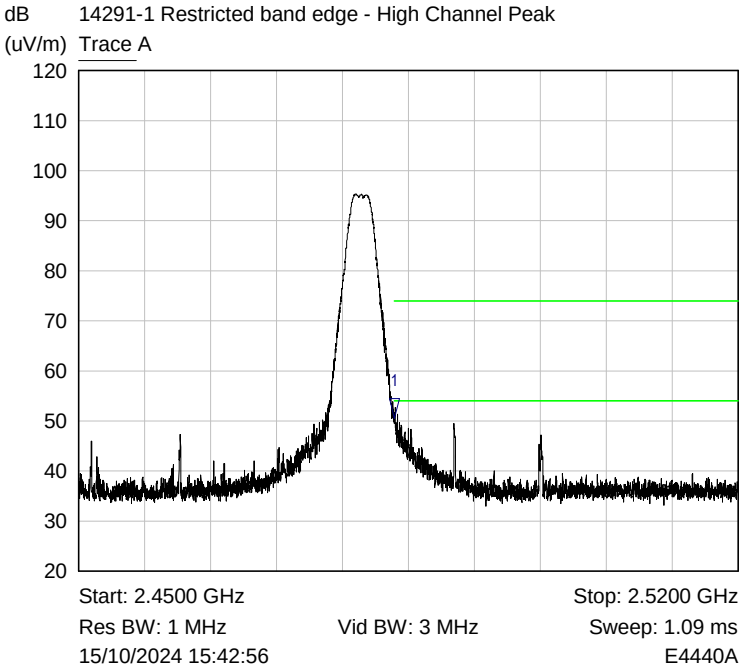
RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2480 MHz

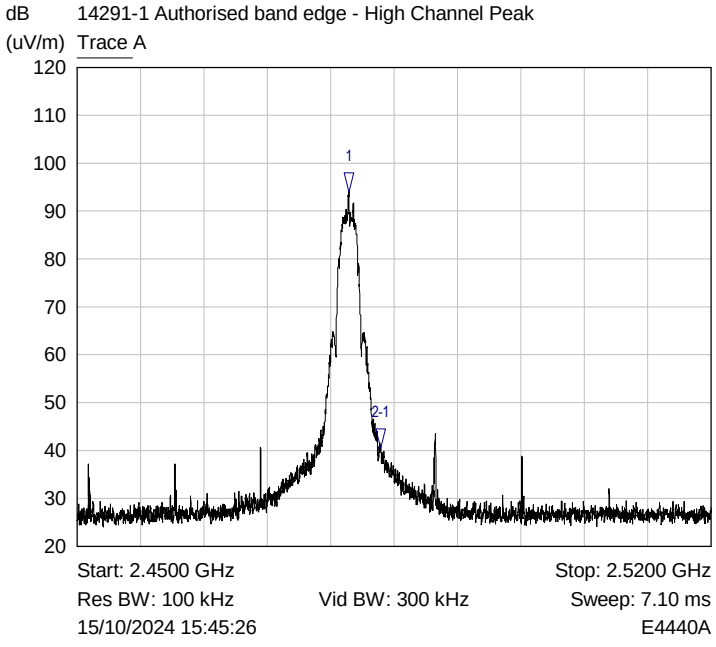


Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4835 GHz	50.51 dB(uV/m)	

Restricted band edge Peak Plot

Note: The peak plot complies with the average limit however a further plot was taken with a reduced VBW which shows a greater margin to the limit. See plot below.

Restricted band edge Average Plot



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4800 GHz	93.97 dB(uV/m)	
2-1 ▽	Trace A	3.5038 MHz	-53.41 dB	dBc

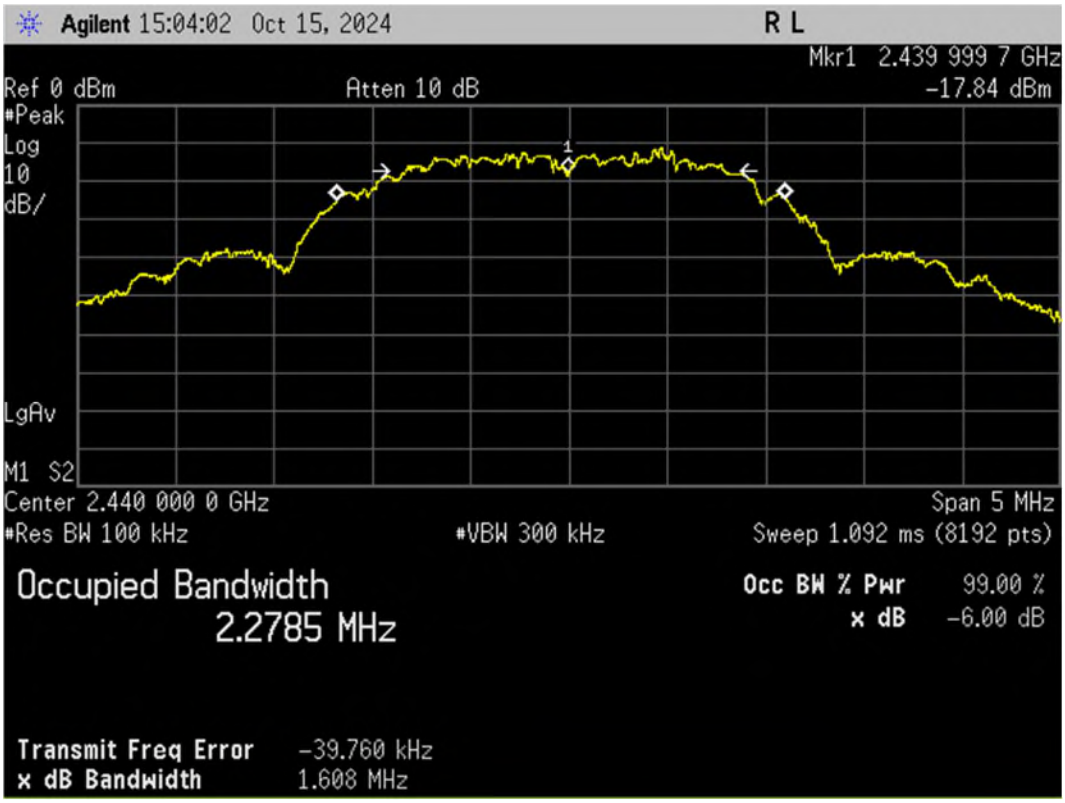
Authorised Band Edge Plot

6.7 Occupied bandwidth

RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2405 MHz

Plot for 6 dB Bandwidth Result

RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2440 MHz



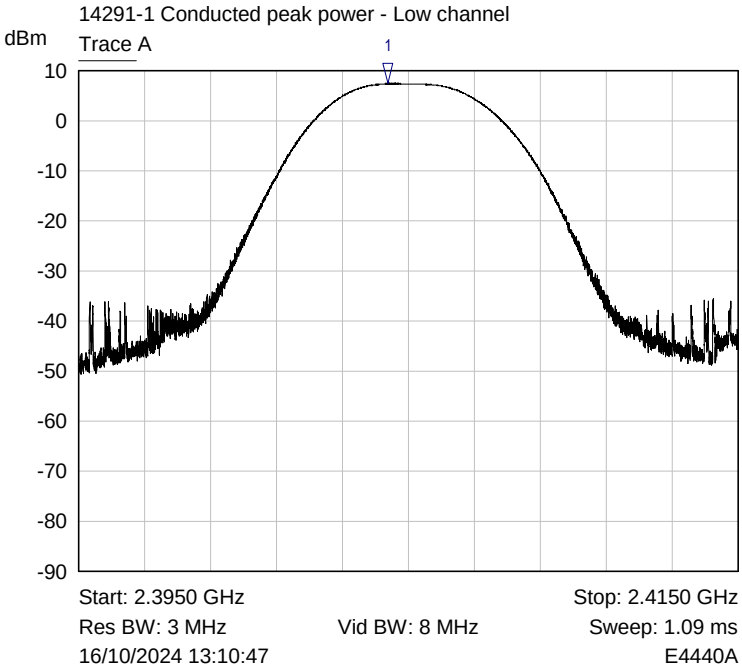
Plot for 6 dB Bandwidth Result

RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2480 MHz

Plot for 6 dB Bandwidth Result

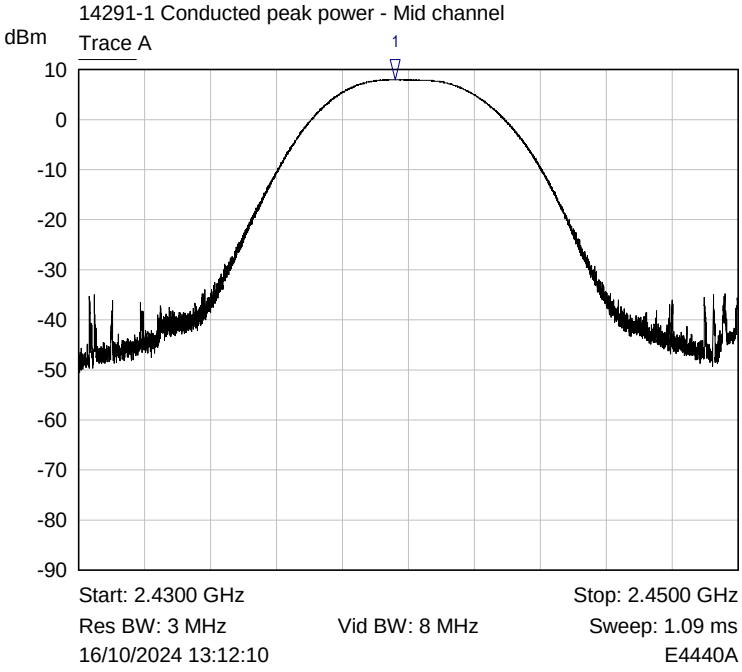
6.8 Maximum Peak conducted output power

RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2405 MHz



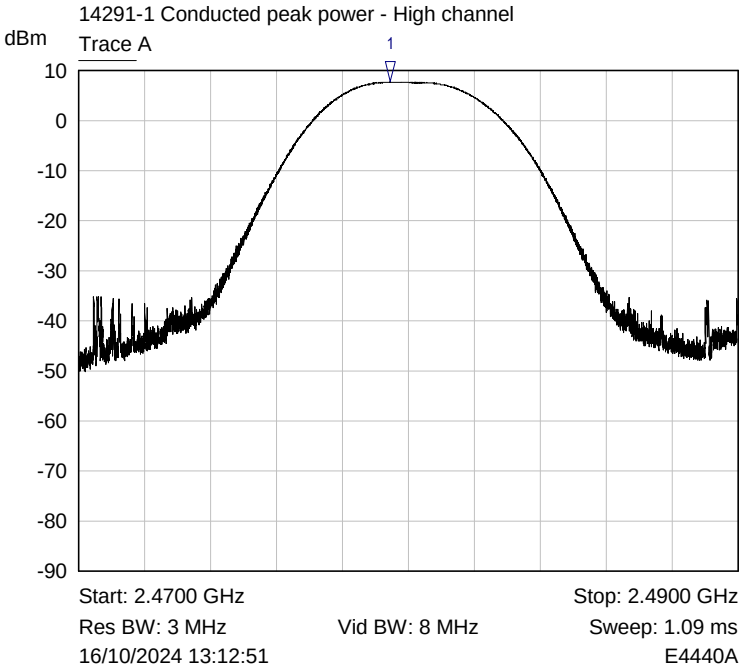
Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4044 GHz	7.46 dBm	

RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2440 MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4396 GHz	8.04 dBm	

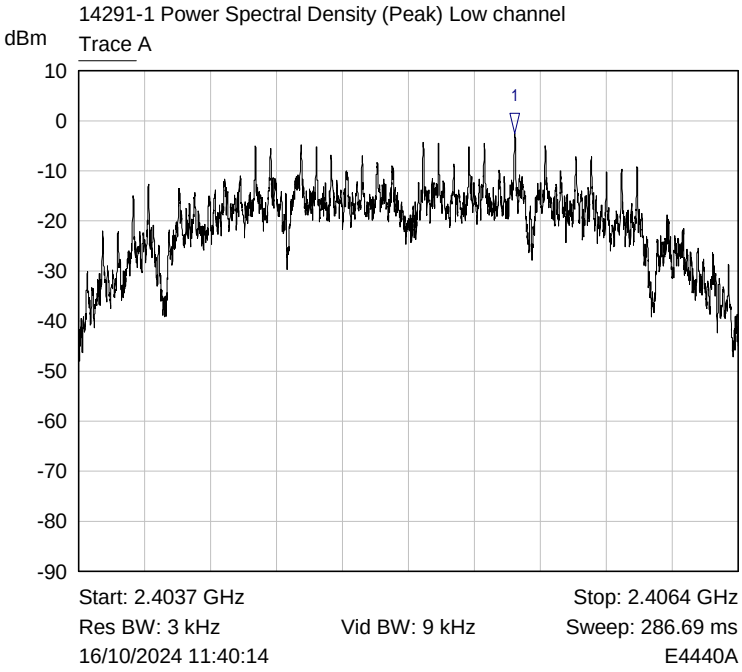
RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2480 MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4795 GHz	7.75 dBm	

6.9 Maximum Power Spectral Density

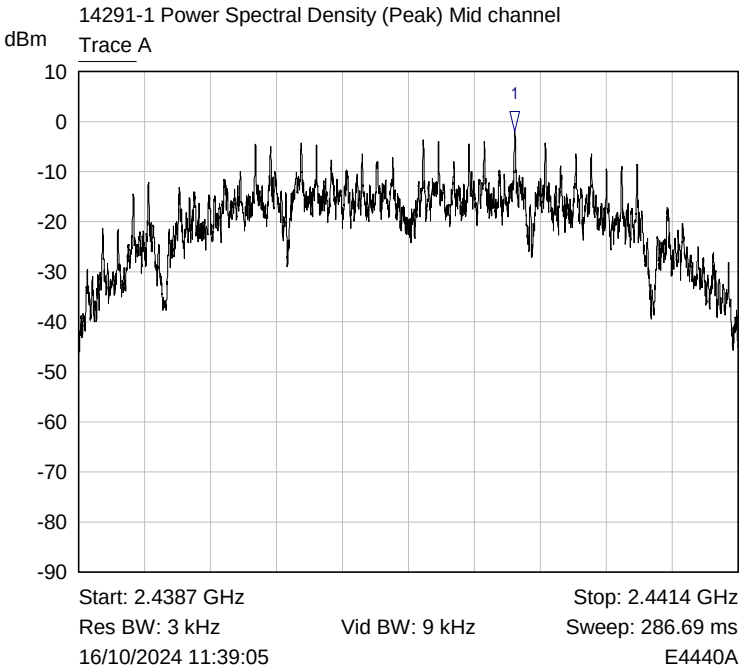
RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2405 MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4054 GHz	-2.56 dBm	dBm / 3kHz

PSD Plot

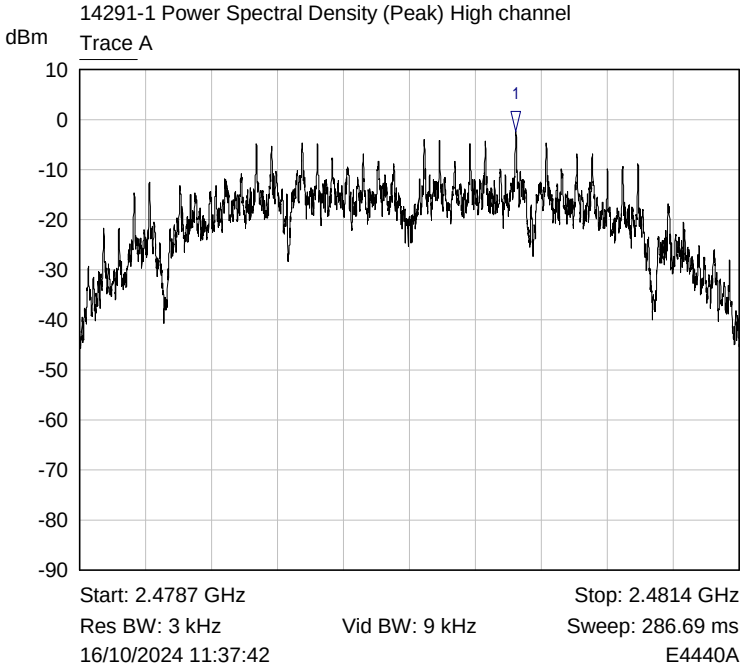
RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2440 MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4404 GHz	-2.05 dBm	dBm / 3kHz

PSD Plot

RF Parameters: Band 2400-2483.5 GHz, Power 8 dBm, Channel Spacing 5 MHz, Modulation DSSS, Channel 2480 MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	2.4804 GHz	-2.35 dBm	dBm / 3kHz

PSD Plot

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. Kiwa Electrical Compliance calibrate the test set-up to account for any path losses, antenna gains, etc. so that the value read at the receiver relates directly to the absolute value required, except that it is expressed in dB relative to one microVolt and may need to take account of any alternative measuring distance used. Examples:

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

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

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

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

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

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

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

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

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

Where:

E_{Linear} is the field strength of the emission in V/m

E_{Log} is the field strength of the emissions in dBµV/m

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

Where:

EIRP is equivalent isotropically radiated power in dBm

E_{Meas} is the field strength of the emission at the measurement distance in dBµV/m

d_{Meas} is the measurement distance in metres

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

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

Where:

PD is the power density at distance specified by the limit, in W/m^2

$EIRP_{Linear}$ is the equivalent isotropically radiated power in Watts

d is the distance at which the power density limit is specified in metres

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

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

Where:

PD is the power density at distance specified by the limit, in W/m^2

$E_{spec\ limit}$ is the field strength at the distance specified by the limit in V/m

Example:

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

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

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

And

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

And

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

8 Photographs

No photos included due to confidentiality requested by client towards FCC Certification.

8.1 Radiated emission diagrams

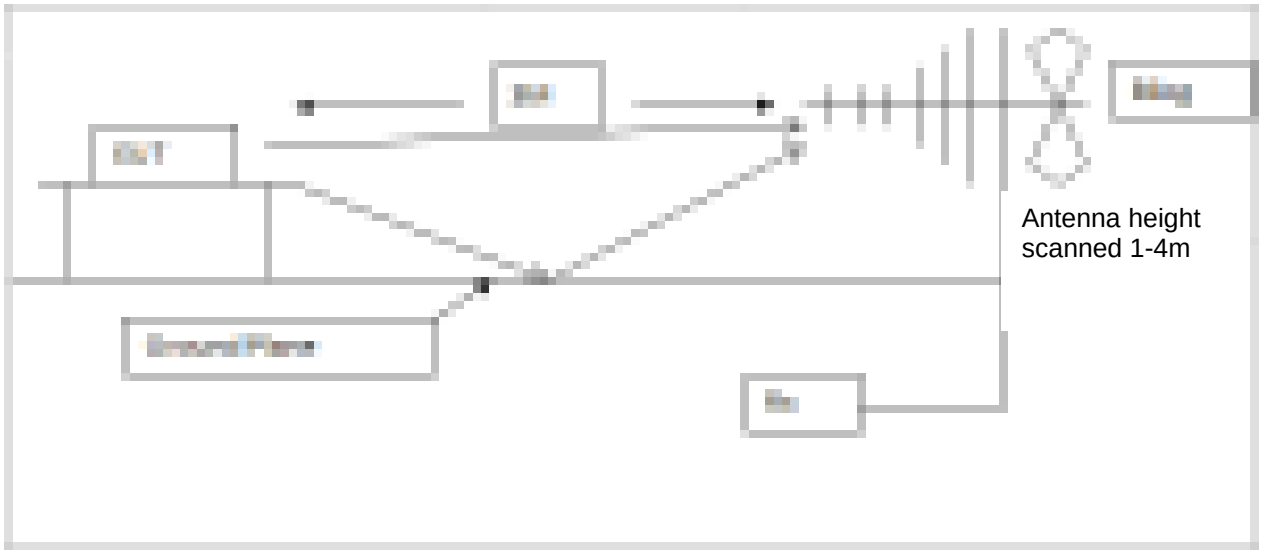


Diagram of the radiated emissions test setup 30 - 1000 MHz

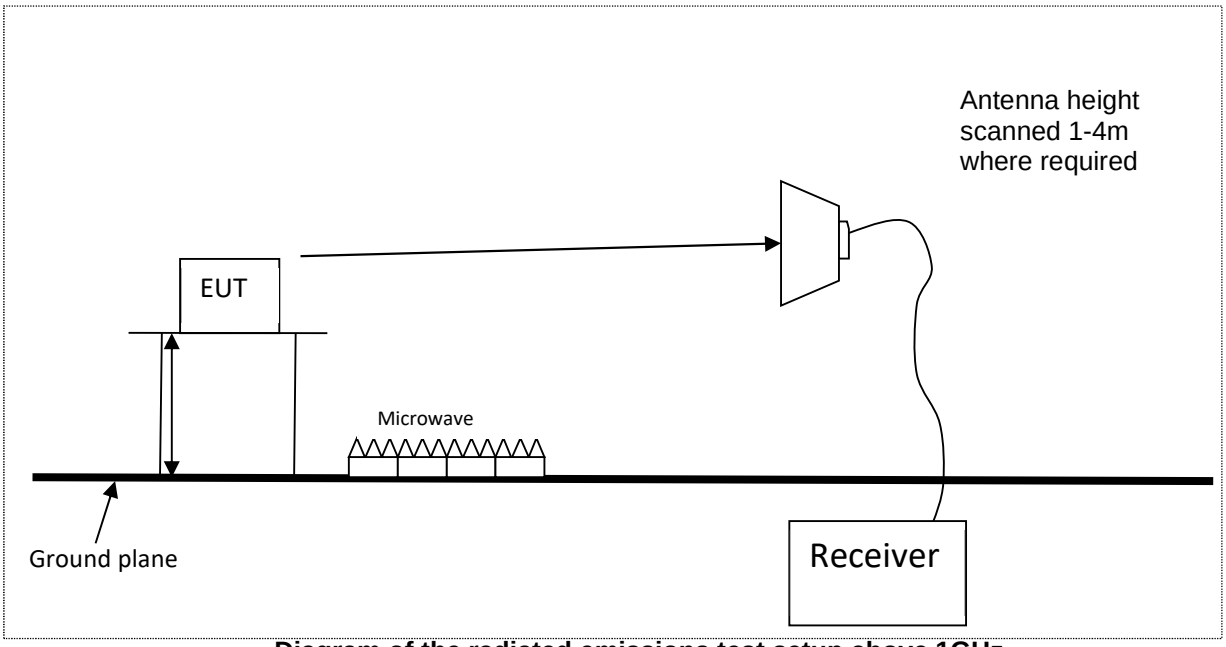


Diagram of the radiated emissions test setup above 1GHz

9 Test equipment calibration list

The following is a list of the test equipment used by Kiwa Electrical Compliance 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.

KEC No	Model	Description	Manufacturer	Calibrated Date	Period
E136	3105	Horn Antenna 1 - 12.5 GHz	EMCO	15/05/2024	12 months
E874	Model2-20	Attenuator N type 20dB 18GHz	Weinschel	03/04/2024	12 months
E411	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	02/07/2024	12 months
E412	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	22/09/2023	24 months
E429	-	Filter Box 5 Switch Filters 0.91 GHz - 16.3 GHz	RN Electronics	14/08/2024	12 months
E478	LQ2992/H	Filter Band pass 1-3GHz	RACAL-MESL	11/04/2024	12 months
E574	15093-SF50	Transition	Flann (FMI)	Not applicable	
E624	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	06/07/2023	24 months
E743	2017 4/2dB	Attenuator 4/2dB 30-1000MHz	RN Electronics	22/02/2024	12 months
F307	AA18-10H	Attenuator 10dB 18GHz SMA	Atlantic Microwave	10/05/2024	12 months
LPE364	CBL6112A	Antenna BiLog 30MHz - 2GHz	Chase Electronics Ltd	28/03/2022	36 months
NSA-M	NSA - M	NSA - Site M	RN Electronics	29/11/2021	36 months
S032	177	True RMS Multimeter	Fluke	15/07/2024	12 months
TMS78	3160-08	Horn Std Gain 12.4 - 18 GHz	ETS Systems	26/09/2024	12 months
TMS79	3160-09	Horn Std Gain 18 - 26.5 GHz	ETS Systems	11/07/2024	12 months
TMS81	6502	Antenna Active Loop	EMCO	17/08/2023	24 months
TMS82	8449B	Pre-Amplifier 1GHz - 26.5GHz	Agilent Technologies	08/01/2024	12 months
ZSW1	V2.5.7	KEC Measurement Software Suite	KEC	Not applicable	

10 Auxiliary and peripheral equipment

10.1 Customer supplied equipment

Item No.	Model No.	Description	Manufacturer	Serial No.
1	Galaxy A20e	Smartphone	Samsung	RF8N92XY0CJ

10.2 Kiwa Electrical Compliance supplied equipment

No Kiwa Electrical Compliance 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 Kiwa Electrical Compliance.

11.2 Modifications during test

No modifications were made during test by Kiwa Electrical Compliance.

12 Description of test sites

Site A Radio Laboratory and Anechoic Chamber

Site B Semi-Anechoic Chamber and Control Room
FCC Registration No. 654321, ISED Registration No. 5612A-4

Site C Transient Laboratory

Site D Screened Room (Conducted Immunity)

Site E Screened Room (Control Room for Site D)

Site F Screened Room (Conducted Emissions)

Site G Screened Room (Control Room for Site H)

Site H 3m Semi-Anechoic Chamber (indoor OATS)
FCC Registration No. 654321, ISED Registration No. 5612A-2, VCCI Registration No. 4065

Site J Transient Laboratory

Site K Screened Room (Control Room for Site M)

Site M 3m Semi-Anechoic Chamber (indoor OATS)
FCC Registration No. 654321, ISED Registration No. 5612A-3

Site N Radio Laboratory

Site Q Fully-Anechoic Chamber

Site OATS 3m and 10m Open Area Test Site
FCC Registration No. 654321, ISED Registration No. 5612A-1

Site R Screened Room (Conducted Immunity)

Site S Safety Laboratory

Site T Transient Laboratory

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

13 Abbreviations and units

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

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

13 Revision History

Issue Number	Revision History	Page Reference(s)
01	First Issue	-
02	Updated EUT name and model number per client's request. Updated report & filename issue to 02 in all headers/footers	1, 2, 4, 5 and 7 All.

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