



Radio Test Report

Cellular Highways Ltd

Highway1

10000-1001

47 CFR Part 15.225 Effective Date 1st October 2022

Test Date: 11th January 2024 to 29th January 2024

Report Number: 01-14546-5-24 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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A part of



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

Certificate of Test 14546-5

The equipment noted below has been fully tested by Kiwa Electrical Compliance 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: | Highway1 |
| Model Number: | 10000-1001 |
| Unique Serial Number: | 4500000021 |
| Applicant: | Cellular Highways Ltd TTP Campus Cambridge Road Cambridgeshire SG8 6HQ |
| Proposed FCC ID | 2BD8H-HIGHWAY1 |
| Full measurement results are detailed in Report Number: | 01-14546-5-24 Issue 01 |
| Test Standards: | 47 CFR Part 15.225 Effective Date 1st October 2022 |

NOTE:

None.

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: 11th January 2024 to 29th January 2024

Test Engineer:
Jack Chilvers

Approved By:
Radio Approvals
Manager

Customer
Representative:



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2 Equipment under test (EUT)

2.1 Equipment specification

| | | |
|---------------------------|--|-----------------|
| Applicant | Cellular Highways Ltd TTP Campus Cambridge Road Cambridgeshire SG8 6HQ | |
| Manufacturer of EUT | Cellular Highways Ltd | |
| Full Name of EUT | Highway1 | |
| Model Number of EUT | 10000-1001 | |
| Serial Number of EUT | 4500000021 | |
| Date Received | 11th January 2024 | |
| Date of Test: | 11th January 2024 to 29th January 2024 | |
| Purpose of Test | To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations. | |
| Date Report Issued | 8th February 2024 | |
| Main Function | The Highway1 Cell Sorting System is a research-use only (RUO) tool that may be used to sort cells based on optical measurements of light scattering and fluorescent markers. | |
| Information Specification | Height | 570 mm |
| | Width | 210 mm |
| | Depth | 318 mm |
| | Weight | 20 kg |
| | Voltage | 100-240 VAC |
| | Current | 2A |
| EUT Supplied PSU | Manufacturer | TDK Lambda |
| | Model number | DTM250PW240D |
| | Serial number | 22100061 |
| | Input voltage | 100-240 VAC |
| | Input current | 01.4-2.8 A |
| | Output | 24 VDC 10.416 A |

2.2 Configurations for testing

| General Parameters | |
|------------------------------------|------------------------|
| EUT Normal use position | Bench top |
| Choice of model(s) for type tests | 10000-1001 |
| Antenna details | Integral |
| Antenna port | Integral |
| Baseband Data port (yes/no)? | No |
| Highest Signal generated in EUT | 2 GHz (main processor) |
| Lowest Signal generated in EUT | Not Declared |
| Hardware Version (HVIN) | revision B |
| Software Version | HW1B.1.12.0 |
| Firmware Version (FVIN) | HW1B.1.12.98 |
| Type of Equipment | RFID |
| Technology Type | RFID |
| Geo-location (yes/no) | No |
| TX Parameters | |
| Alignment range – transmitter | 13.56 MHz |
| EUT Declared Modulation Parameters | type A miller |
| EUT Declared Power level | <1W |
| EUT Declared Signal Bandwidths | 14 kHz |
| EUT Declared Channel Spacing's | 14 kHz |
| EUT Declared Duty Cycle | 100% |
| Unmodulated carrier available? | Yes |
| Declared frequency stability | 30 ppm |
| FCC Parameters | |
| FCC Transmitter Class | DXX |

2.3 Functional description

A user loads a single-use cartridge containing cells to be sorted into the Highway1 instrument and closes the door (laser safety interlock).

The user starts the run on the desktop PC interface, sets cell selection criteria (gates) and then the run is controlled by instrument automation (no user intervention).

The instrument reads the NFC tag on the cartridge to check type.

The instrument moves the cartridge into the optical field of view using a motorised XYZ stage.

The instrument controls fluid flow through the cartridge using a linear syringe drive and solenoid pinch valve.

The instrument controls temperature of the cartridge using a peltier cooling system.

The instrument actuates a magnetic stirrer in the cartridge using a motorised drive.

The instrument directs laser light into the cartridge and detects scattered & fluorescent light to make sorting decisions.

The instrument applies voltage to the cartridge to sort the selected cells.

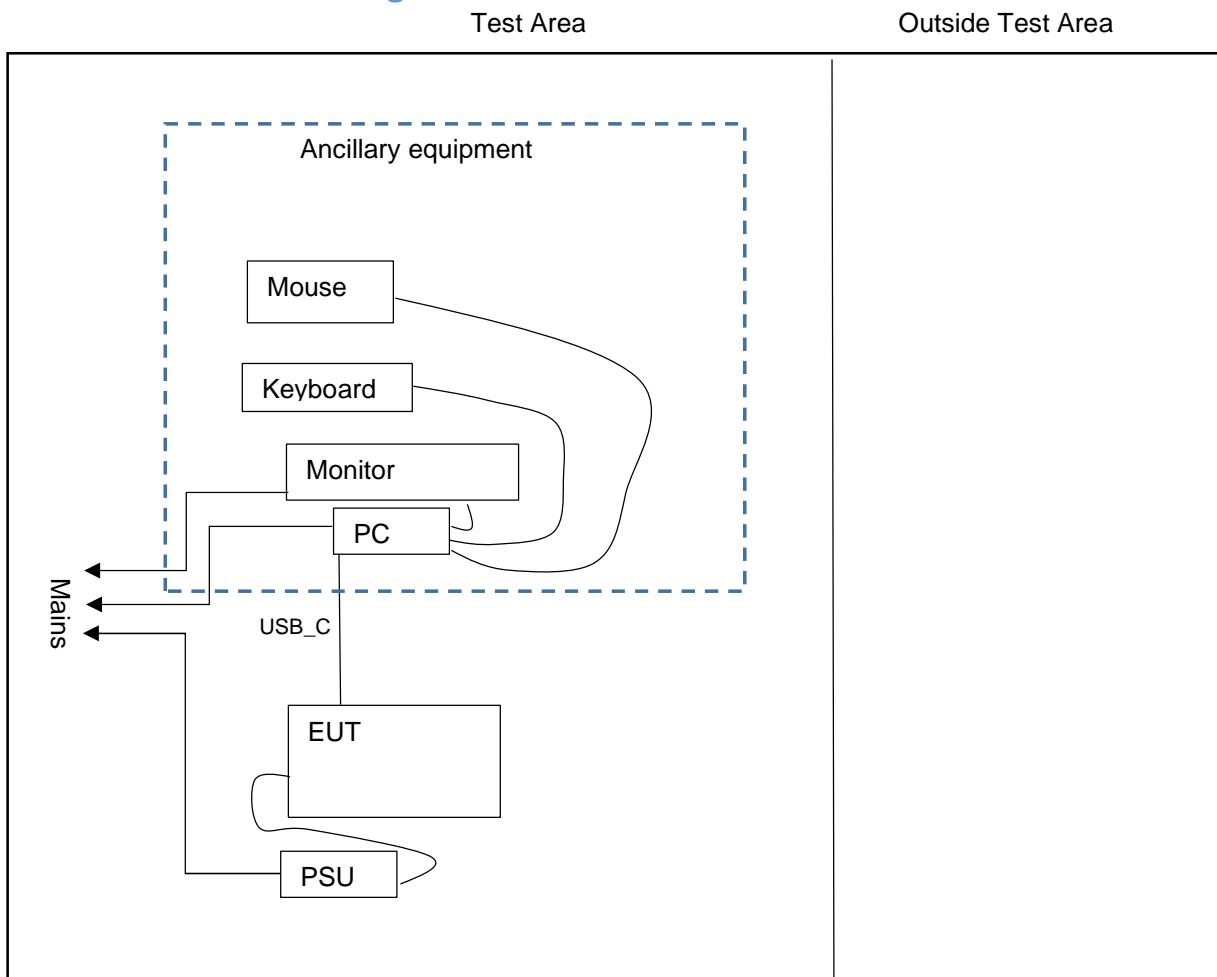
The instrument controls internal temperature using enclosure heaters & case fans to maintain stability.

The instrument reports to the user when the run is complete (LED display panel and desktop PC interface).

2.4 Modes of operation

| Mode Reference | Description | Used for testing |
|----------------|---|------------------|
| Mode 1 | Continuously performing present detection commands to the NFC tag over 13.56 MHz. | Yes |
| Mode 2 | Continuously reading and writing to the NFC tag every 1 second at 13.56 MHz. | Yes |
| Mode 3 | Continuously transmitting CW signal at 13.56 MHz. | Yes |
| Mode 4 | PRBS constantly transmitting random binary bit stream (type A miller) at a rate of 106. | Yes |

2.5 Emissions configuration



The unit was powered from the provided dedicated AC/DC adapter. The EUT was connected to the provided ancillary PC, monitor, Keyboard and Mouse and configured using the provided software on the ancillary PC. For conducted method tests a test fixture had to be used and was referenced to the fundamental radiated results from the OATS. The unit was configured with engineering menus in software to allow permanent transmit modes as stated within section 2.4 of this report. The transmit mode was 100% continuous with modulation at the default maximum power.

Single Channel – 13.56 MHz.

2.5.1 Signal leads

| Port Name | Cable Type | Connected |
|-----------|------------|-----------|
| Mains | 3 Core | Yes |
| USB_C | USB | Yes |

3 Summary of test results

The Highway1, 10000-1001 was tested for compliance to the following standard(s):

47 CFR Part 15.225 Effective Date 1st October 2022

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

| Title | References | Results |
|--|--------------------------------|---------------------|
| Transmitter Tests | | |
| 1. AC power line conducted emissions | 47 CFR Part 15C Part 15.207 | PASSED |
| 2. Radiated emissions 9 - 150 kHz | 47 CFR Part 15C Part 15.209 | PASSED |
| 3. Radiated emissions 150 kHz - 30 MHz | 47 CFR Part 15C Part 15.209 | PASSED |
| 4. Radiated emissions 30 MHz -1 GHz | 47 CFR Part 15C Part 15.225(d) | PASSED |
| 5. Radiated emissions above 1 GHz | 47 CFR Part 15C Part 15.209 | PASSED ¹ |
| 6. Intentional radiator field strength | 47 CFR Part 15C Part 15.225(a) | PASSED |
| 7. Occupied bandwidth | 47 CFR Part 15C Part 15.215 | PASSED |
| 8. Spectrum mask | 47 CFR Part 15C Part 15.225 | PASSED |
| 9. Frequency stability | 47 CFR Part 15C Part 15.225(e) | PASSED |

¹ Highest frequency test of 20GHz based on 10 times highest signal used/generated in the equipment of 2GHz (Processor speed)

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 15C | 2022 | Federal Communications Commission PART 15 – RADIO FREQUENCY DEVICES |
| 4.1.2 | ANSI C63.10 | 2013 | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |
| 4.1.3 | ANSI C63.4 | 2014 | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |

4.2 Deviations

No deviations were applied.

4.3 Tests at extremes of temperature & voltage

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

| Temperature Test Conditions | | Voltage Test Conditions | |
|-----------------------------|-------|-------------------------|---------|
| T nominal | 20 °C | V nominal | 120V DC |
| T minimum | 0 °C | V minimum | 100V DC |
| T maximum | 40 °C | V maximum | 240V DC |

Extremes of temperature are based upon manufacturer's declaration

The ambient test conditions of humidity and pressure in the laboratory were as specified in each specific test section within this report

4.4 Test fixtures

In order to measure RF parameters at temperature extremes, the EUT was tested in a temperature-controlled chamber as follows:

A test fixture was used for testing.

5 Tests, methods and results

5.1 AC power line conducted emissions

5.1.1 Test methods

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

5.1.2 Configuration of EUT

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

Details of the Peripheral and Ancillary Equipment connected for this test are listed in section 10.
During the initial scan, Mode 4 was found to be worst case mode of operation.

5.1.3 Test procedure

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

All signals within 20dB of the limit were investigated.

Tests were performed in Test Site F.

5.1.4 Test equipment

E150, E035, ZSW1, E624, E411

See Section 9 for more details

5.1.5 Test results

Temperature of test environment 20°C

Humidity of test environment 50%

Pressure of test environment 102kPa

| | |
|-----------------|-------------------|
| Band | 13.553-13.567 MHz |
| Power Level | Max Default |
| Channel Spacing | Single Channel |
| Mod Scheme | ASK |
| Single channel | 13.56 MHz |

Plot refs

14546-5 Cond 1 AC Live 150k-30M Average

14546-5 Cond 1 AC Live 150k-30M Quasi-Peak

14546-5 Cond 1 AC Neutral 150k-30M Average

14546-5 Cond 1 AC Neutral 150k-30M Quasi-Peak

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

LIMITS:

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

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
UE70 9kHz to 150kHz ± 3.76 dB, UE71 150kHz to 30MHz ± 3.4 dB

5.2 Radiated emissions 9 - 150 kHz

5.2.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.209 [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 6.4 [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Part 15.225(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 antenna was orientated in both Parallel and Perpendicular polarisations. The EUT was rotated in all three orthogonal planes. The EUT was powered using the mains power supply connected to a 120 VAC 60 Hz power source. The EUT was operated in Mode 4.

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.

All signals within 20dB of the limit were investigated.

Tests were performed using Test Site H.

5.2.4 Test equipment

TMS81, ZSW1, E642, F238

See Section 9 for more details

5.2.5 Test results

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

| | |
|-----------------|-------------------|
| Band | 13.553-13.567 MHz |
| Power Level | Max Default |
| Channel Spacing | Single Channel |
| Mod Scheme | ASK |
| Single channel | 13.56 MHz |

| |
|------------------------------|
| Plot refs |
| 14546-5 Rad 1 9k-150kHz Para |
| 14546-5 Rad 1 9k-150kHz Perp |

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

LIMITS:

15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.

n.b. the general limits of 15.209 are as drawn on the respective plots.

These results show that the EUT has PASSED this test.

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

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 15.225(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 antenna was orientated in both Parallel and Perpendicular polarisations. The EUT was rotated in all three orthogonal planes. The EUT was powered using the mains power supply connected to a 120 VAC 60 Hz power source. The EUT was operated in Mode 4.

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.

All signals within 20dB of the limit were investigated.

Tests were performed using Test Site H.

5.3.4 Test equipment

TMS81, ZSW1, E642, F238

See Section 9 for more details

5.3.5 Test results

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

| | |
|-----------------|-------------------|
| Band | 13.553-13.567 MHz |
| Power Level | Max Default |
| Channel Spacing | Single Channel |
| Mod Scheme | ASK |
| Single channel | 13.56 MHz |

| |
|-------------------------------|
| Plot refs |
| 14546-5 Rad 1 150k-30MHz Para |
| 14546-5 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.

LIMITS:

15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.

n.b. the general limits of 15.209 are as drawn on the respective plots.

These results show that the EUT has PASSED this test.

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

5.4 Radiated emissions 30 MHz -1 GHz

5.4.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.225(d) [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 15.225(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. The EUT was powered using the mains power supply connected to a 120 VAC 60 Hz power source. The EUT was operated in Mode 4.

5.4.3 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. The antenna was height scanned between 1 and 4metres and the equipment was rotated 360 degrees to record the worst-case emissions. Both Horizontal and vertical polarisations of measuring antenna were tested. Tests were performed in Test Site H.

5.4.4 Test equipment

E914, E744, NSA-H, ZSW1, E642, F238

See Section 9 for more details

5.4.5 Test results

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

| | |
|-----------------|-------------------|
| Band | 13.553-13.567 MHz |
| Power Level | Max Default |
| Channel Spacing | Single Channel |
| Mod Scheme | ASK |
| Single channel | 13.56 MHz |

| |
|-------------------------|
| Plot refs |
| 14546-5 Rad 1 VHF Horiz |
| 14546-5 Rad 1 VHF Vert |
| 14546-5 Rad 1 UHF Horiz |
| 14546-5 Rad 1 UHF Vert |

Table of signals measured for Rad 1 Horizontal Signal List

| Signal No. | Freq (MHz) | Peak Amp (dBuV/m) | QP Amp (dBuV/m) | QP -Lim (dB) |
|------------|------------|-------------------|-----------------|--------------|
| 1 | 51.186 | 29.8 | 23.9 | -16.1 |
| 2 | 132.113 | 27.5 | 22.5 | -21.0 |
| 3 | 185.533 | 31.5 | 26.4 | -17.1 |
| 4 | 245.394 | 40.4 | 34.5 | -11.5 |
| 5 | 247.803 | 44.0 | 38.0 | -8.0 |
| 6 | 306.962 | 32.9 | 28.5 | -17.5 |
| 7 | 394.522 | 31.9 | 27.6 | -18.4 |
| 8 | 395.310 | 34.9 | 30.2 | -15.8 |

Table of signals measured for Rad 1 Vertical Signal List

| Signal No. | Freq (MHz) | Peak Amp (dBuV/m) | QP Amp (dBuV/m) | QP -Lim (dB) |
|------------|------------|-------------------|-----------------|--------------|
| 1 | 31.828 | 41.3 | 36.9 | -3.1 |
| 2 | 35.249 | 40.2 | 35.3 | -4.7 |
| 3 | 43.217 | 36.7 | 31.0 | -9.0 |
| 4 | 78.077 | 32.6 | 25.4 | -14.6 |
| 5 | 104.899 | 34.1 | 27.8 | -15.7 |
| 6 | 124.982 | 30.9 | 24.5 | -19.0 |
| 7 | 185.855 | 36.1 | 30.4 | -13.1 |
| 8 | 480.000 | 37.6 | 34.5 | -11.5 |
| 9 | 554.997 | 33.5 | 27.2 | -18.8 |
| 10 | 627.981 | 33.9 | 28.3 | -17.7 |

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

LIMITS:

15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.

n.b. the general limits of 15.209 are as drawn on the respective plots.

These results show that the EUT has PASSED this test.

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

30MHz - 1000MHz \pm 6.1dB

5.5 Radiated emissions above 1 GHz

5.5.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.209 [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 6.6 [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Part 15.209/15.225(d) [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. The EUT was powered using the mains power supply connected to a 120 VAC 60 Hz power source.

The EUT was operated in Mode 4.

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. The EUT was raised, and antenna was placed 1.5m above the ground plane in line with the EUT. The EUT was rotated through 360 degrees to record the worst case emissions. A measurement distance of 3m was used between the test range 1GHz - 6GHz, 1.2m was used in the test range 6-18GHz and 0.3m was used in the test range 18-20GHz. Tests were performed in Test Site M.

5.5.4 Test equipment

E136, E411, E624, TMS78, TMS79, TMS82, VSWR-M, ZSW1

See Section 9 for more details

5.5.5 Test results

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

Setup Table

| | |
|-----------------|-------------------|
| Band | 13.553-13.567 MHz |
| Power Level | Max Default |
| Channel Spacing | Single Channel |
| Mod Scheme | ASK |
| Single channel | 13.56 MHz |

| Spurious Frequency (MHz) | Measured Peak Level (dB μ V/m) | Difference to Peak Limit (dB) | Measured Average Level (dB μ V/m) | Difference to Average Limit (dB) | EUT Polarisation | Antenna Polarisation |
|--------------------------|------------------------------------|-------------------------------|---------------------------------------|----------------------------------|------------------|----------------------|
| 1597.824 | 50.9 | -23.1 | 36.2 | -17.8 | Upright | Horizontal |
| 1599.1 | 54.3 | -19.7 | 38.9 | -15.1 | Upright | Vertical |
| 1599.217 | 54 | -20 | 38.7 | -15.3 | Upright | Vertical |
| 1599.647 | 51 | -23 | 35 | -19 | Upright | Horizontal |

| Plots |
|-----------------------------------|
| 14546-5 Rad 1 1-2GHz Horiz |
| 14546-5 Rad 1 1-2GHz Vert |
| 14546-5 Rad 1 2-5GHz Horiz |
| 14546-5 Rad 1 2-5GHz Vert |
| 14546-5 Rad 1 5-6GHz Horiz |
| 14546-5 Rad 1 5-6GHz Vert |
| 14546-5 Rad 1 6upto10GHz Horiz |
| 14546-5 Rad 1 6upto10GHz Vert |
| 14546-5 Rad 1 10upto12_5GHz Horiz |

| |
|----------------------------------|
| 14546-5 Rad 1 10upto12_5GHz Vert |
| 14546-5 Rad 1 12-15GHz Horiz |
| 14546-5 Rad 1 12-15GHz Vert |
| 14546-5 Rad 1 15-18GHz Horiz |
| 14546-5 Rad 1 15-18GHz Vert |
| 14546-5 Rad 1 18-22GHz Horiz |
| 14546-5 Rad 1 18-22GHz Vert |

Note: Only signals within 20dB of limits using the applicable detector are reported. Peak detector "Max held" Analyser plots against the Average limit line 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 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 - 6 GHz \pm 4.7dB, 6 – 18 GHz \pm 4.95dB, 18 – 26.5 GHz \pm 3.1dB

5.6 Intentional radiator field strength

5.6.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.225(a) [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 15.225(a)/(b)/(c)/(d) [Reference 4.1.1 of this report]

5.6.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The antenna was orientated in both Parallel and Perpendicular polarisations. The EUT was rotated in all three orthogonal planes. The EUT was operated in Mode 4.

5.6.3 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 performed on an OATS without a ground plane. The antenna was placed 1m above the ground. Both the equipment and the antenna were rotated 360 degrees to record the maximised emission.

Measurements were made at Site H.

5.6.4 Test equipment

TMS81, ZSW1, E642, F238

See Section 9 for more details

5.6.5 Test results

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

| | |
|-----------------|-------------------|
| Band | 13.553-13.567 MHz |
| Power Level | Max Default |
| Channel Spacing | Single Channel |
| Mod Scheme | ASK |
| Single channel | 13.56 MHz |

| | |
|-----------------------|----------------|
| | Single channel |
| Duty Cycle (%) | 100.00 |
| Duty Cycle correction | 0.00 |

| | |
|-------------------------------|-----------------------------|
| | Single channel |
| Peak Level (dB μ V/m) @3m | 51.84 |
| Plot reference | Peak power Upright Parallel |
| Antenna Polarisation | Parallel |
| EUT Polarisation | Upright |

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

An extrapolation factor of 40dB/decade per ANSI C63.10:2013 clause 6.4 is applied to the 3m results to give the following field strengths at 30m for comparison to the limits:

| | |
|--------------------------------|----------------|
| | Single channel |
| Peak Level (dB μ V/m) @30m | 11.84 |
| Limit dB μ V/m at 30M | 84 |

LIMITS:

- 15.225(a) QP/Peak = the field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 μ V/m @ 30m = 84 dB μ V/m @ 30m.
- 15.225(b) QP/Peak = within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 μ V/m @ 30m = 50.5 dB μ V/m @ 30m.
- 15.225(c) QP/Peak = within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 μ V/m @ 30m = 40.5 dB μ V/m @ 30m.
- 15.225(d) QP/Peak = outside of the 13.110-14.010 MHz band shall not exceed the general radiated emissions 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:
 ± 3.9 dB

5.7 Occupied bandwidth

5.7.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.215 [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 [Reference 4.1.1 of this report]

5.7.2 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 tested whilst connected to the AC power for maximised emissions. The EUT was operated in Mode 4.

5.7.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. A 120kHz RBW, 3x VBW, auto sweep time and max hold settings were used for the 20 dB bandwidth.

Measurements were made in a semi-anechoic chamber. Tests were performed using Test Site H.

5.7.4 Test equipment

TMS81, ZSW1, E642, F238

See Section 9 for more details

5.7.5 Test results

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

| | |
|-----------------|-------------------|
| Band | 13.553-13.567 MHz |
| Power Level | Max Default |
| Channel Spacing | Single Channel |
| Mod Scheme | ASK |
| Single channel | 13.56 MHz |

| 99 % Bandwidth (MHz) Nominal Temp & Volts | Single channel |
|--|----------------------------|
| Plot for 99 % Bandwidth (MHz) Nominal Temp & Volts | 956.3122 14546-5 Tag in |

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

LIMITS:

No limits apply however, per 15.215, the 20dB bandwidth of the emission is to remain within the band over expected variations in temperature and supply voltage. It is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimise the possibility of out-of-band operation.

These results show that the EUT has PASSED this test.

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

5.8 Spectrum mask

5.8.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.225 [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 15.225(a)/(b)/(c)/(d) [Reference 4.1.1 of this report]

5.8.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The EUT was measured at a distance of 3 metres. The EUT and antenna were positioned for maximum field strength and referenced to the field strength measured on the OATS. The EUT was operated in Mode 4.

5.8.3 Test procedure

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

Plots were taken, and results were referenced to limits at 30m by using the extrapolation factor of 40dB/decade, per ANSI C63.10 clause 6.4 Measurements were made at Site H.

5.8.4 Test equipment

E642, F238, TMS81, ZSW1

See Section 9 for more details

5.8.5 Test results

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

| | |
|-----------------|-------------------|
| Band | 13.553-13.567 MHz |
| Power Level | Max Default |
| Channel Spacing | Single Channel |
| Mod Scheme | ASK |
| Channel | 13.56 MHz |

| | |
|---|--------------------------------------|
| | Single channel |
| Nominal, Maximised RF Output / field strength | 51.84 |
| Nominal plot reference | 14546-5 Spectrum mask - RFID reading |

3m result converted to 30m is 11.84 dB μ V/m @30m. Analyser plots can be found in Section 6 of this report.

LIMITS:

15.225(a) QP/Peak = the field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 μ V/m @ 30m = 84 dB μ V/m @ 30m.
15.225(b) QP/Peak = within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 μ V/m @ 30m = 50.5 dB μ V/m @ 30m.
15.225(c) QP/Peak = within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 μ V/m @ 30m = 40.5 dB μ V/m @ 30m.
15.225(d) QP/Peak = outside of the 13.110-14.010 MHz band shall not exceed the general radiated emissions 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:
 ± 4.1 dB

5.9 Frequency stability

5.9.1 Test methods

Test Requirements: 47 CFR Part 15C Part 15.225(e) [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 6.8 [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Part 15.225(e) [Reference 4.1.1 of this report]

5.9.2 Configuration of EUT

The EUT's power port was connected to a variable power supply. This allowed the battery/voltage end points to be set as declared by the manufacturer/required by the specification.

The EUT was placed in a temperature controlled chamber. The EUT emissions were observed by means of a test fixture. The EUT was operated in Mode 3 mode.

5.9.3 Test procedure

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

Temperature stability was achieved at each test level before taking measurements. A frequency count was made on a CW signal. At nominal temperature the EUT supply was varied by the applicants declared max and min voltage.

A Frequency count was made using a spectrum analyser connected to an off-air frequency standard. The Analyser's frequency counter function was used to monitor the frequency of the carrier. The analyser was set with a suitable span, RBW and VBW to allow for a measurement resolution of 1Hz.

Tests were performed using Test Site A.

5.9.4 Test equipment

E555, E755, L264, LPE315, TMS38

See Section 9 for more details

5.9.5 Test results

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

| | |
|-----------------|-------------------|
| Band | 13.553-13.567 MHz |
| Power Level | Max Default |
| Channel Spacing | Single Channel |
| Mod Scheme | ASK |
| Single channel | 13.56 MHz |

| Test conditions | | Frequency Error (MHz) Single channel |
|--------------------------|---------------------|---|
| 0°C | Volts Nominal (100) | 13.560115 |
| 10°C | Volts Nominal (120) | 13.560039 |
| 20°C | Volts Minimum (100) | 13.560580 |
| | Volts Nominal (120) | 13.560560 |
| | Volts Maximum (240) | 13.560580 |
| 30°C | Volts Nominal (120) | 13.560540 |
| 40°C | Volts Nominal (240) | 13.560058 |
| Max Frequency Error (Hz) | | +20 / -521 |

LIMITS:

+/- 0.01%. (+/- 1.356kHz)

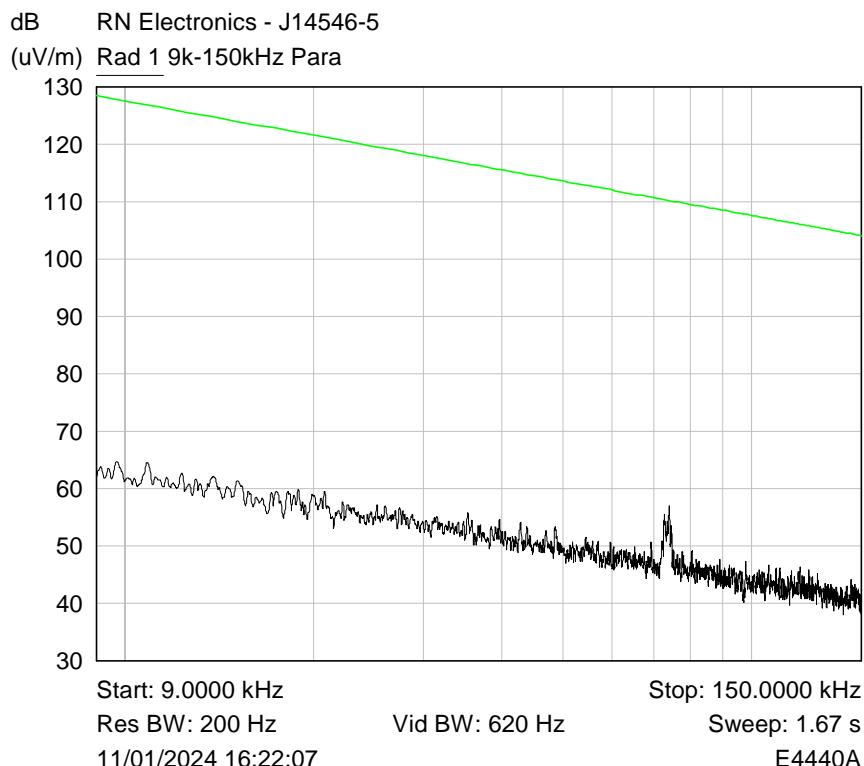
These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 0.0002 ppm (PSA Ext Ref)

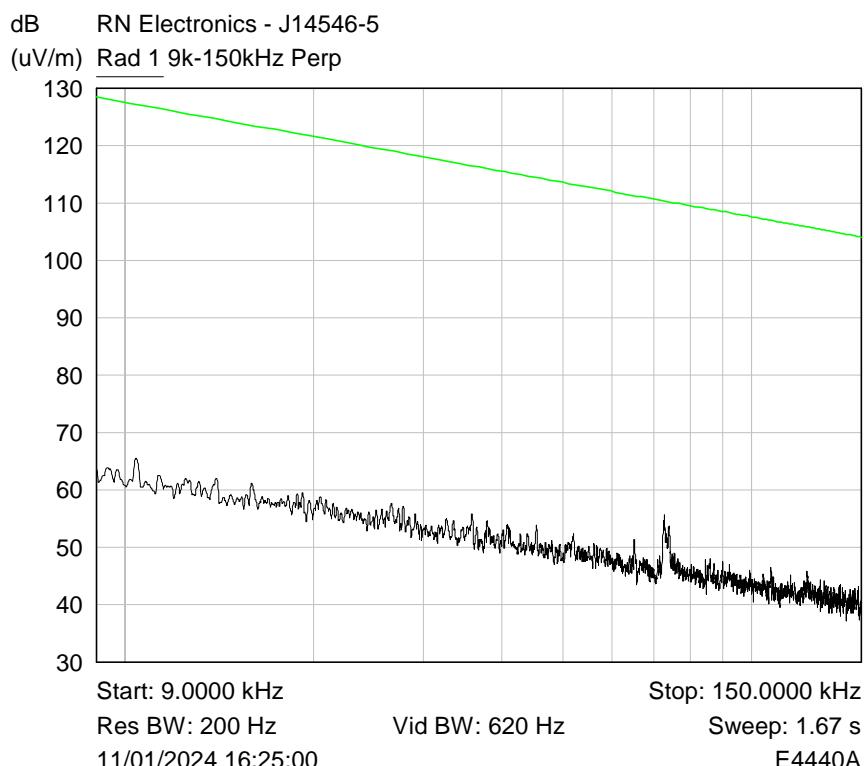
6 Plots/Graphical results

6.1 Radiated emissions 9 - 150 kHz

RF Parameters: Band 13.553-13.567 MHz, Power Max Default, Channel Spacing Single Channel, Modulation ASK, Channel 13.56 MHz



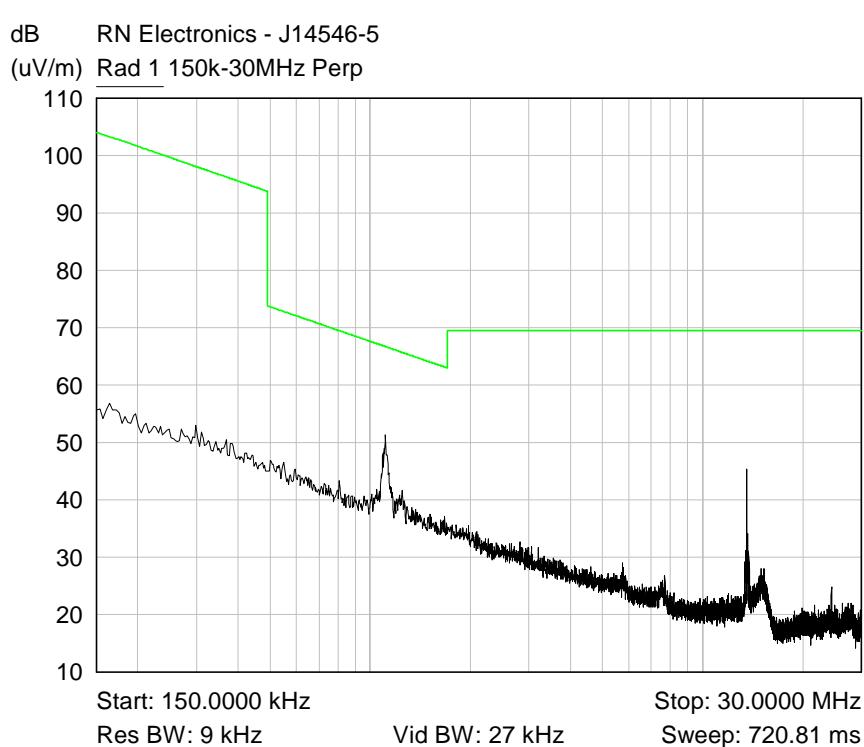
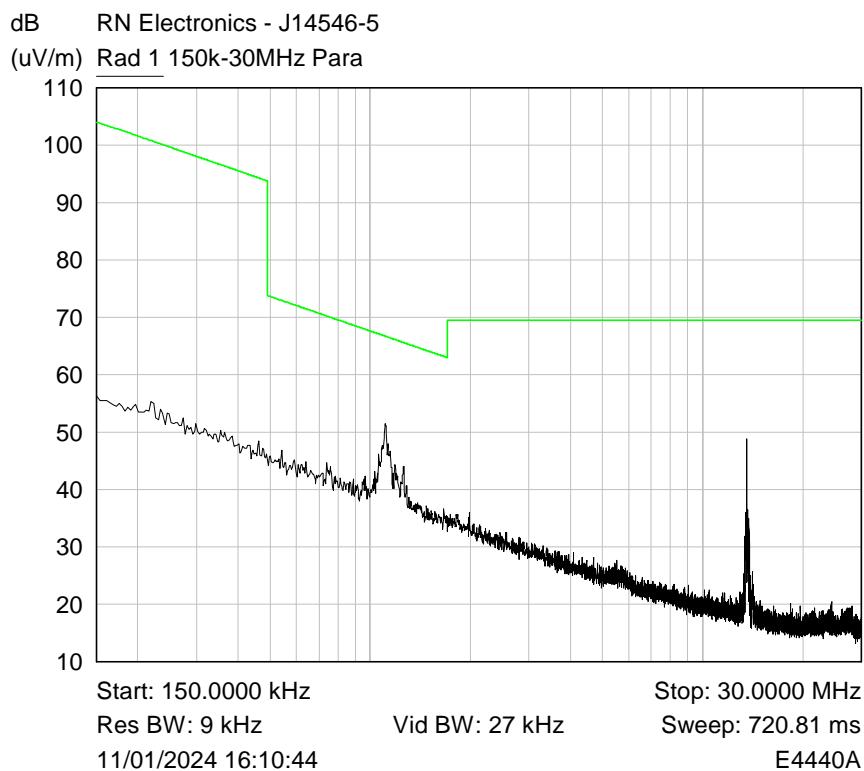
Plot of 9k-150kHz Parallel



Plot of 9k-150kHz Perpendicular

6.2 Radiated emissions 150 kHz - 30 MHz

RF Parameters: Band 13.553-13.567 MHz, Power Max Default, Channel Spacing Single Channel, Modulation ASK, Channel 13.56 MHz

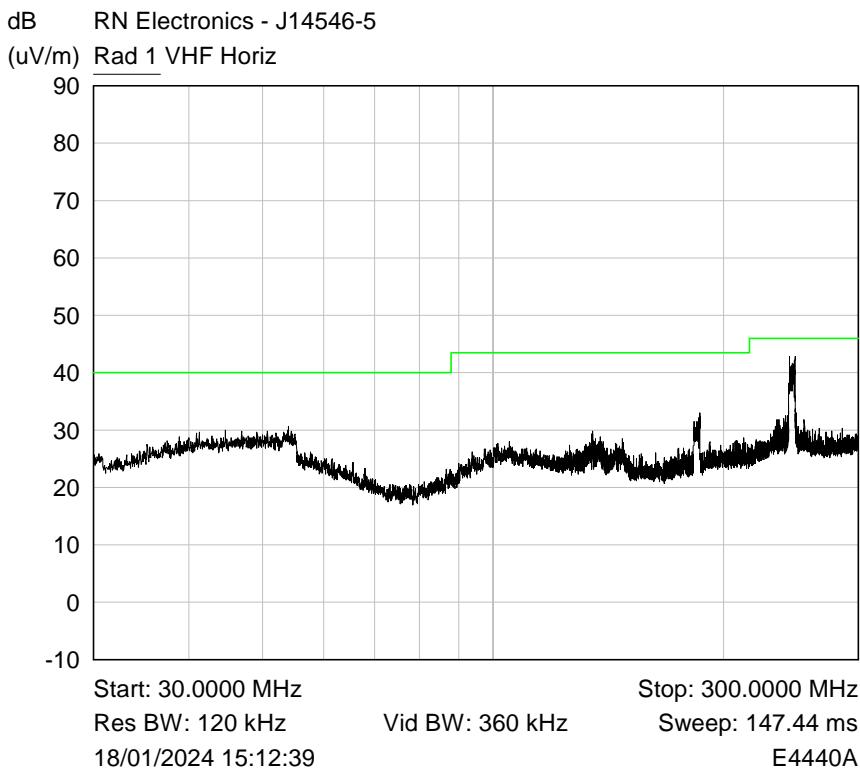


Plot of 150kHz-30MHz Perpendicular

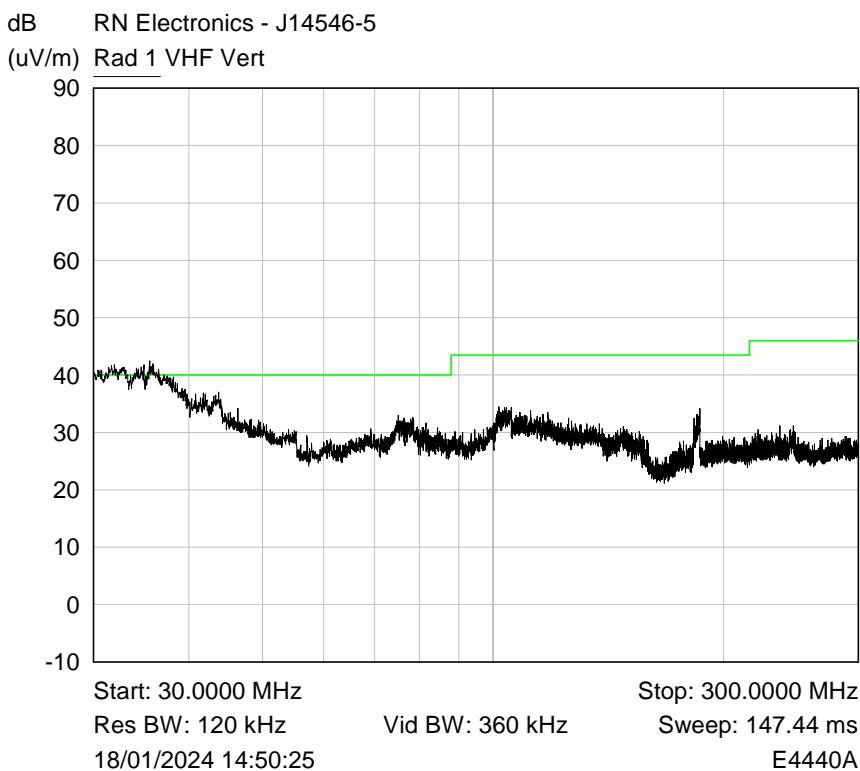
6.3 Radiated emissions 30 MHz -1 GHz

Note: Peak detector "Max held" Analyser plots are shown against the Quasi-Peak / Average limit line(s), refer to specific test section for results tables using the relevant detector.

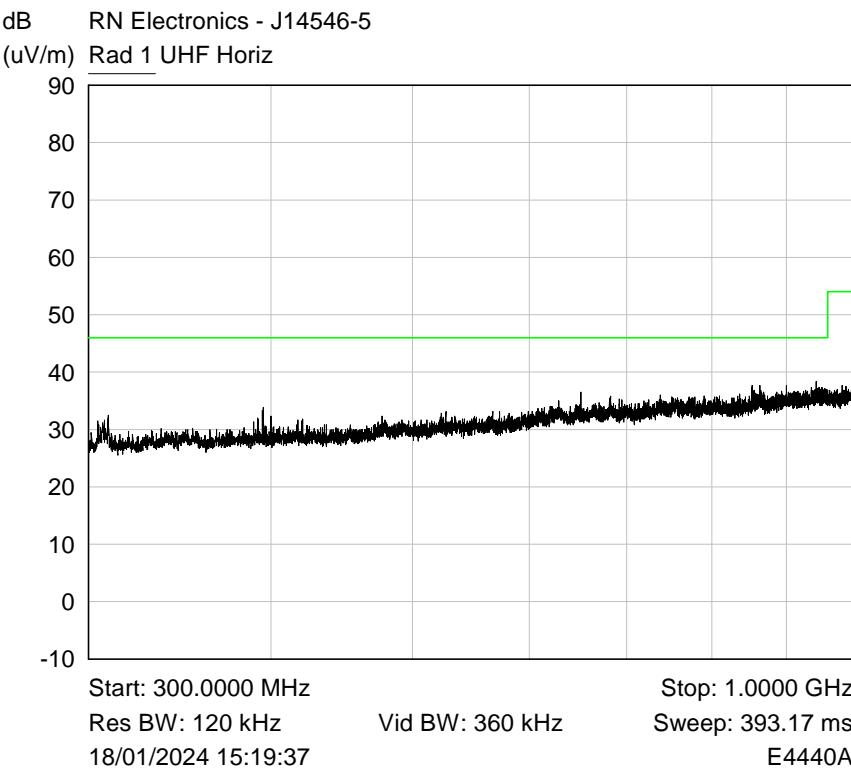
RF Parameters: Band 13.553-13.567 MHz, Power Max Default, Channel Spacing Single Channel, Modulation ASK, Channel 13.56 MHz



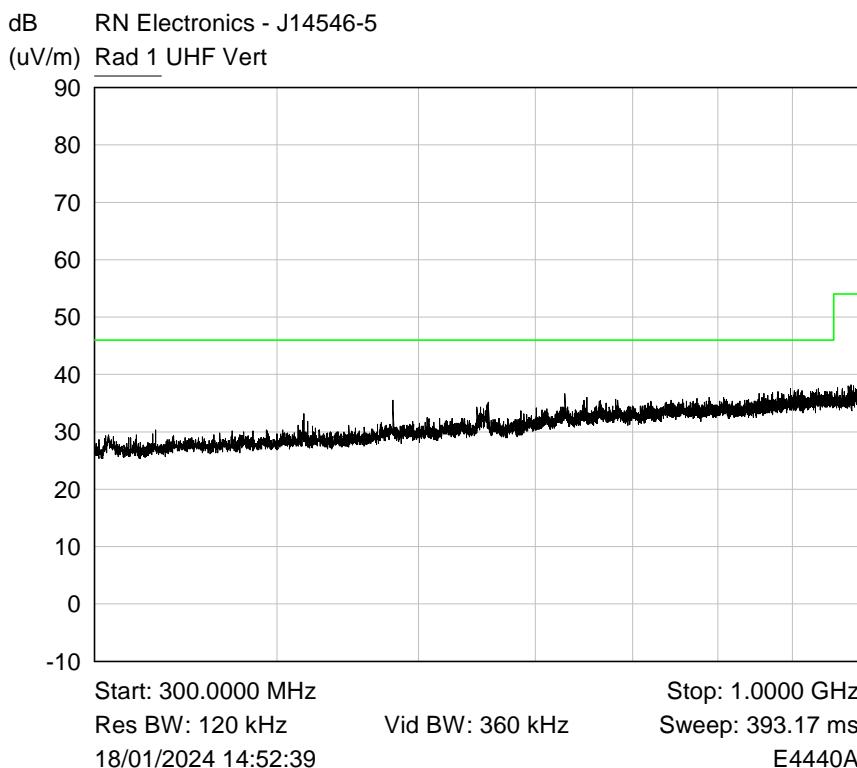
Plot of Peak emissions for VHF Horizontal against the QP limit line.



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



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

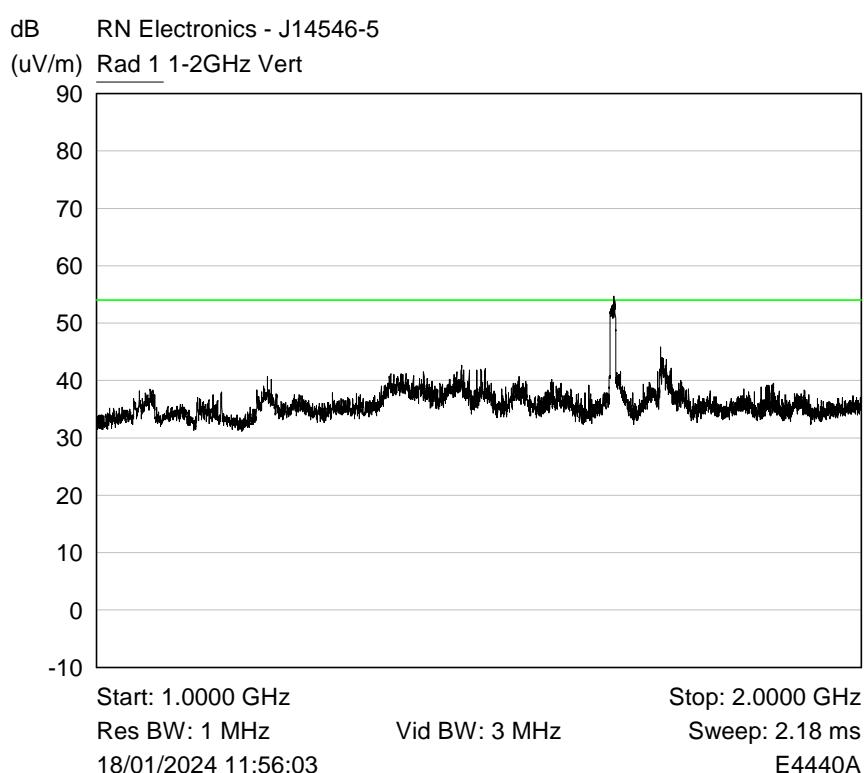
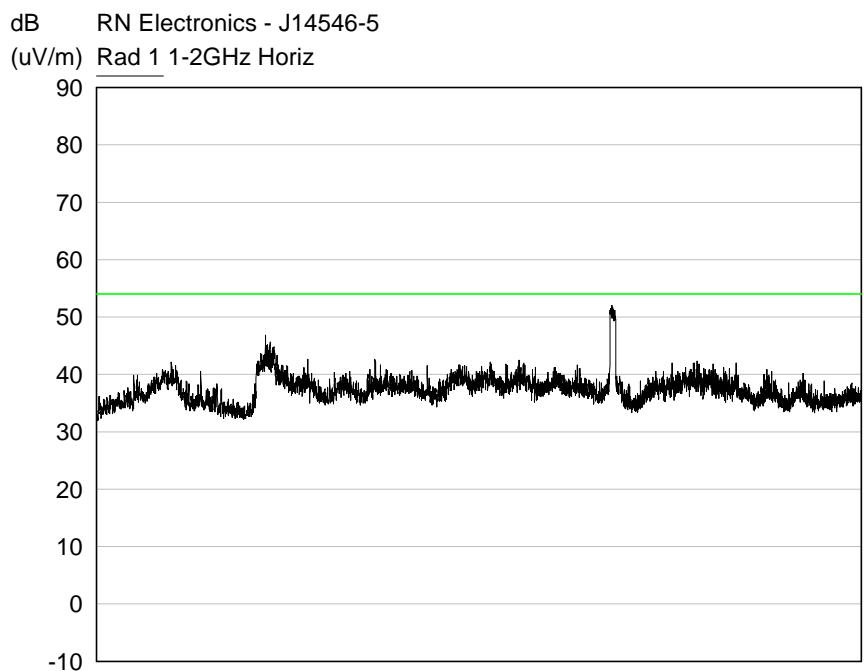


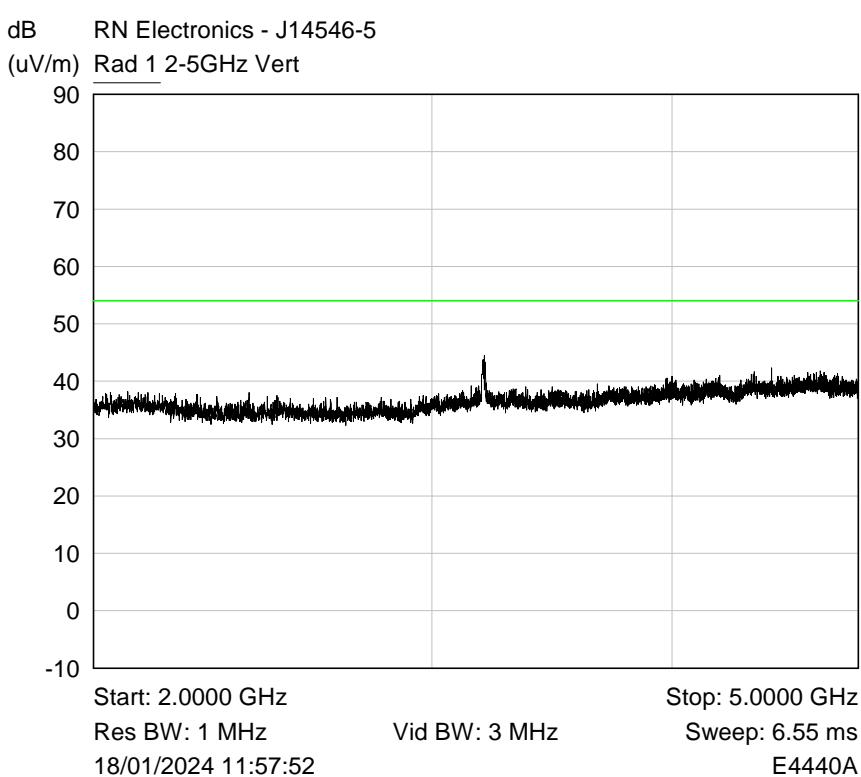
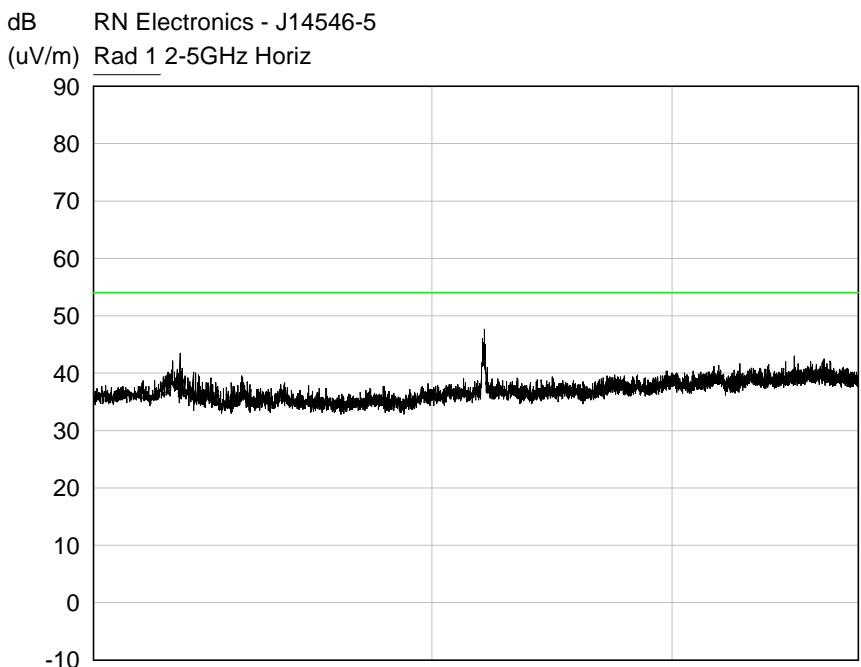
Plot of Peak emissions for UHF Vertical against the QP limit line.

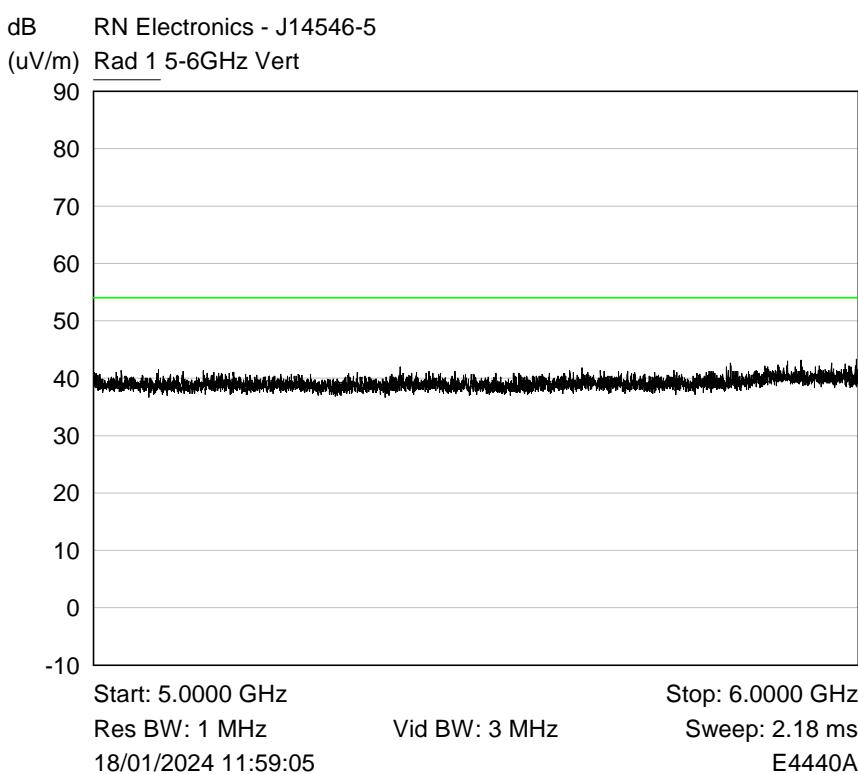
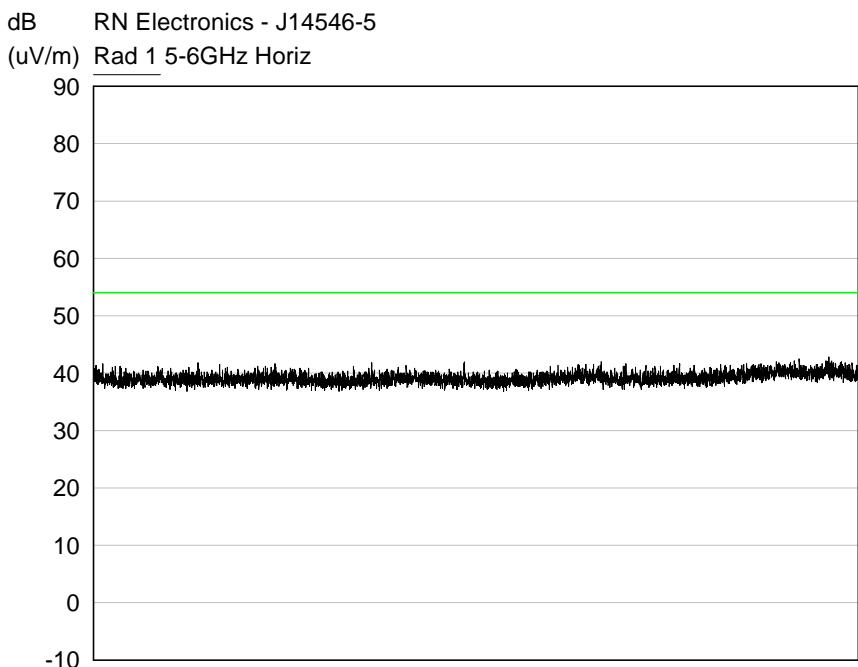
6.4 Radiated emissions above 1 GHz

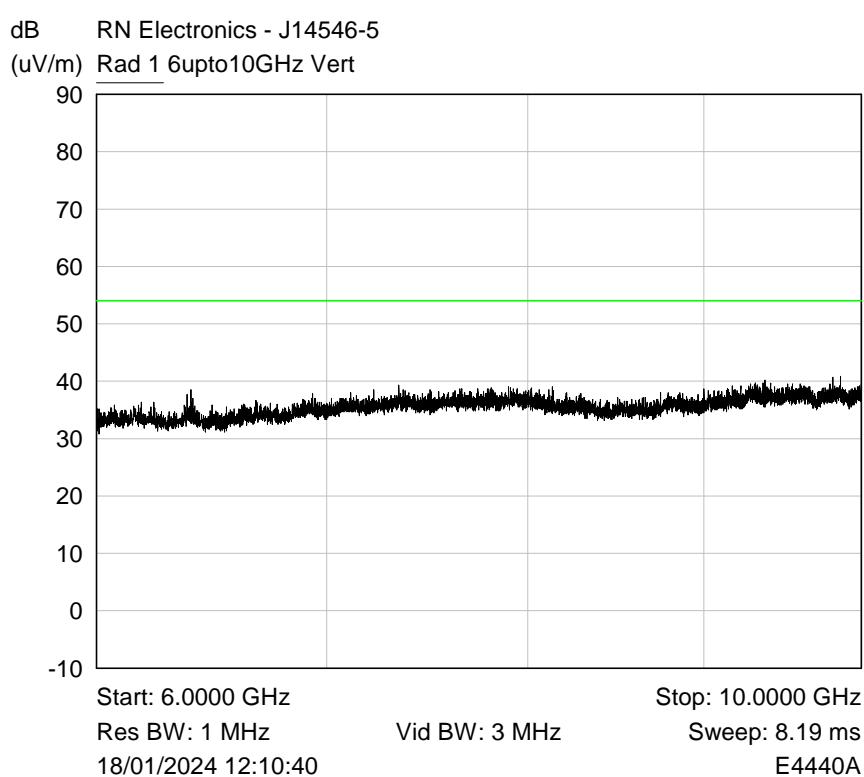
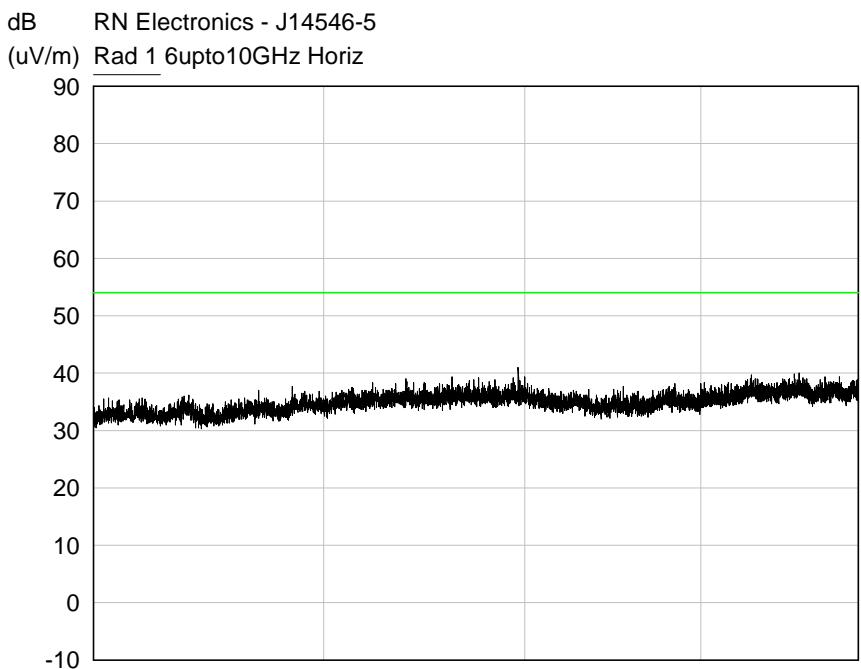
Note: Peak detector "Max held" Analyser plots are shown against the Average limit line, refer to specific test section for results tables using the relevant detector.

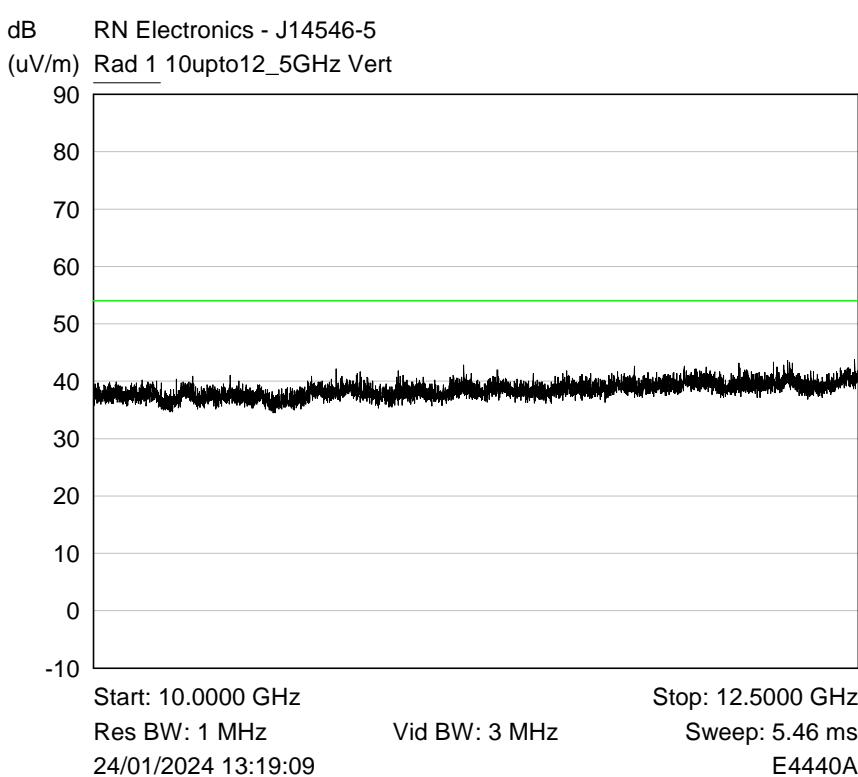
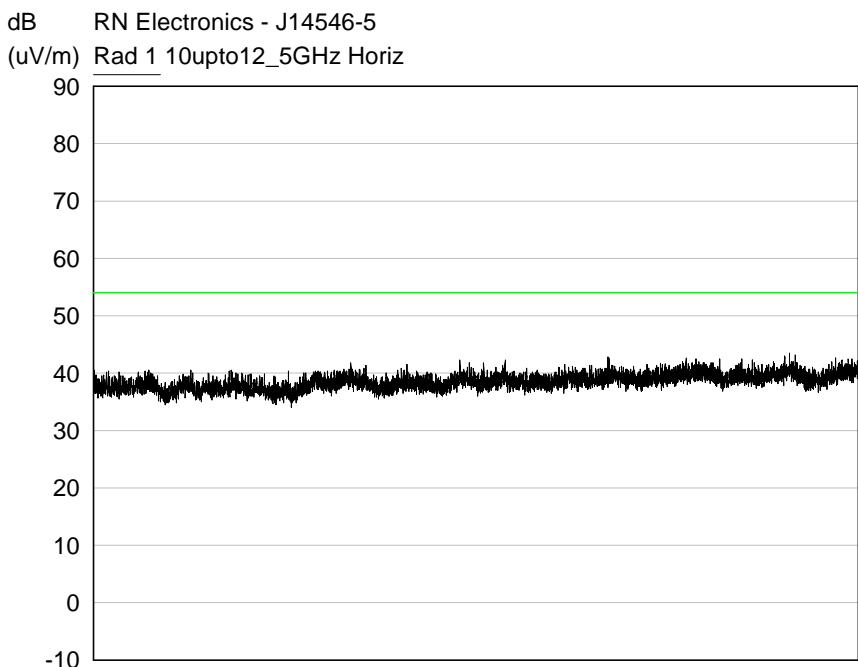
RF Parameters: Band 13.553-13.567 MHz, Power Max Default, Channel Spacing Single Channel, Modulation ASK, Channel 13.56 MHz

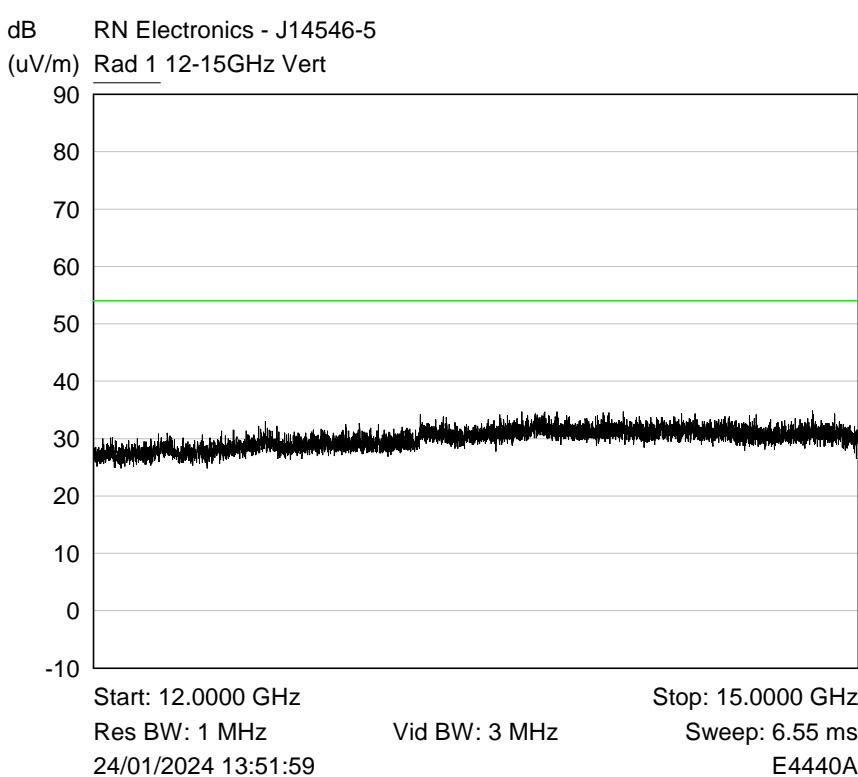
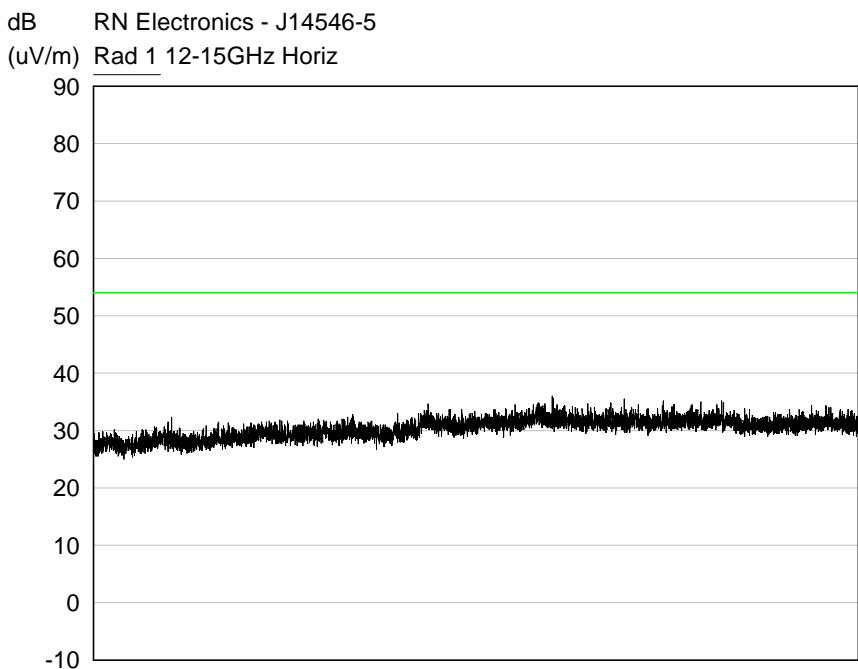


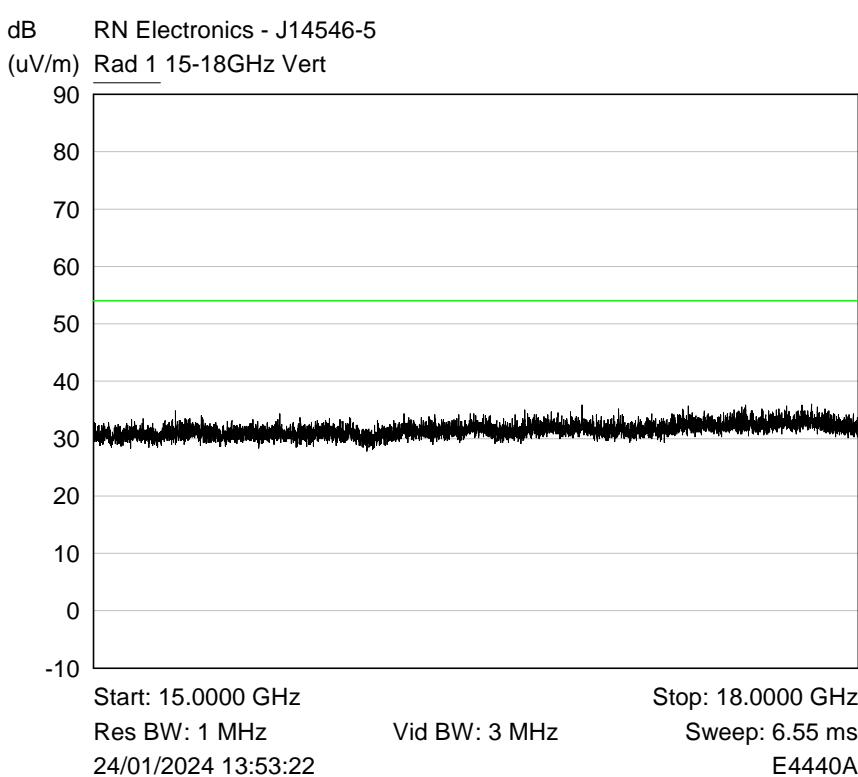
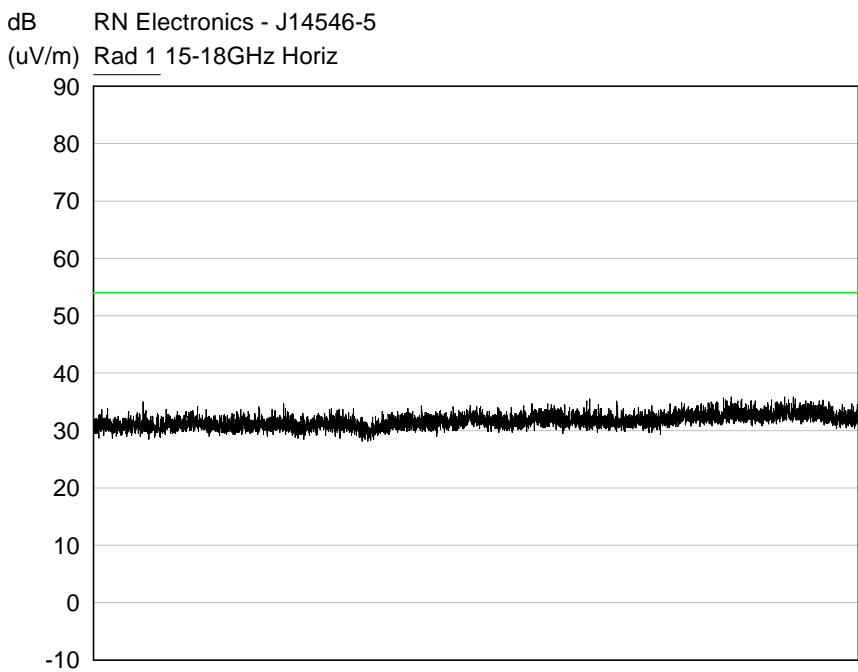


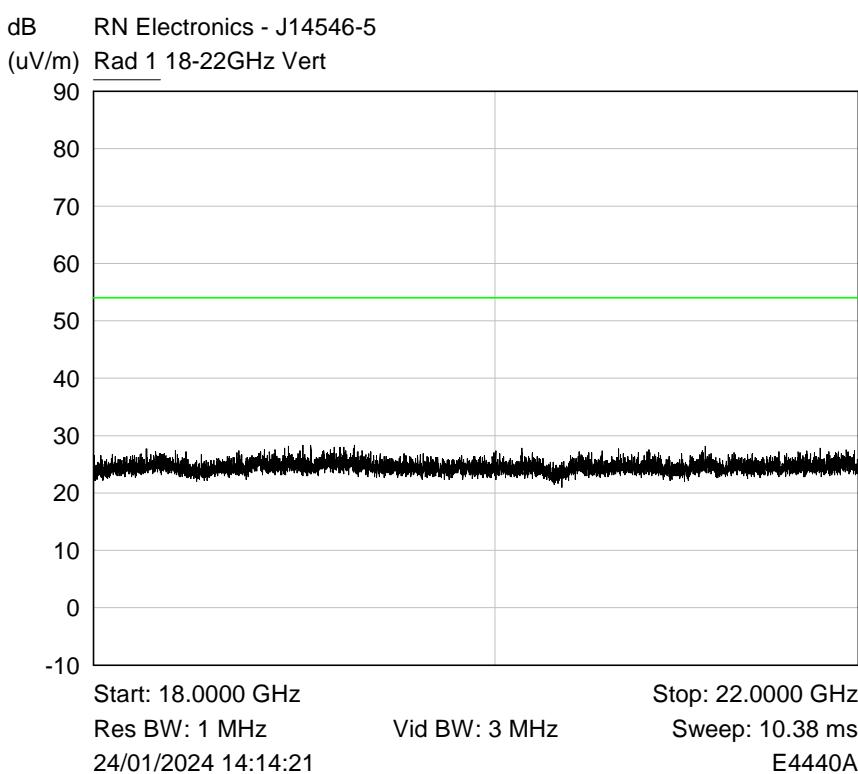
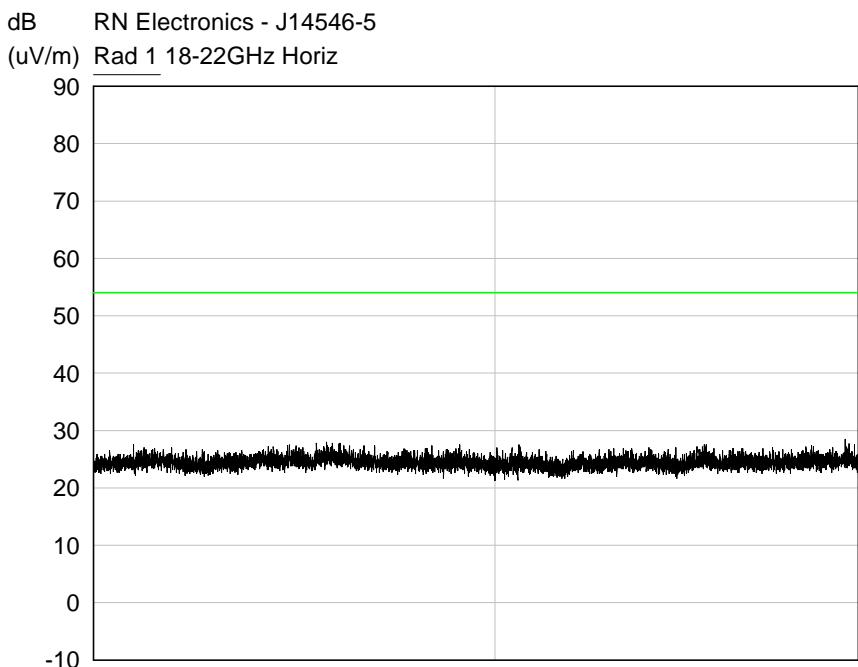






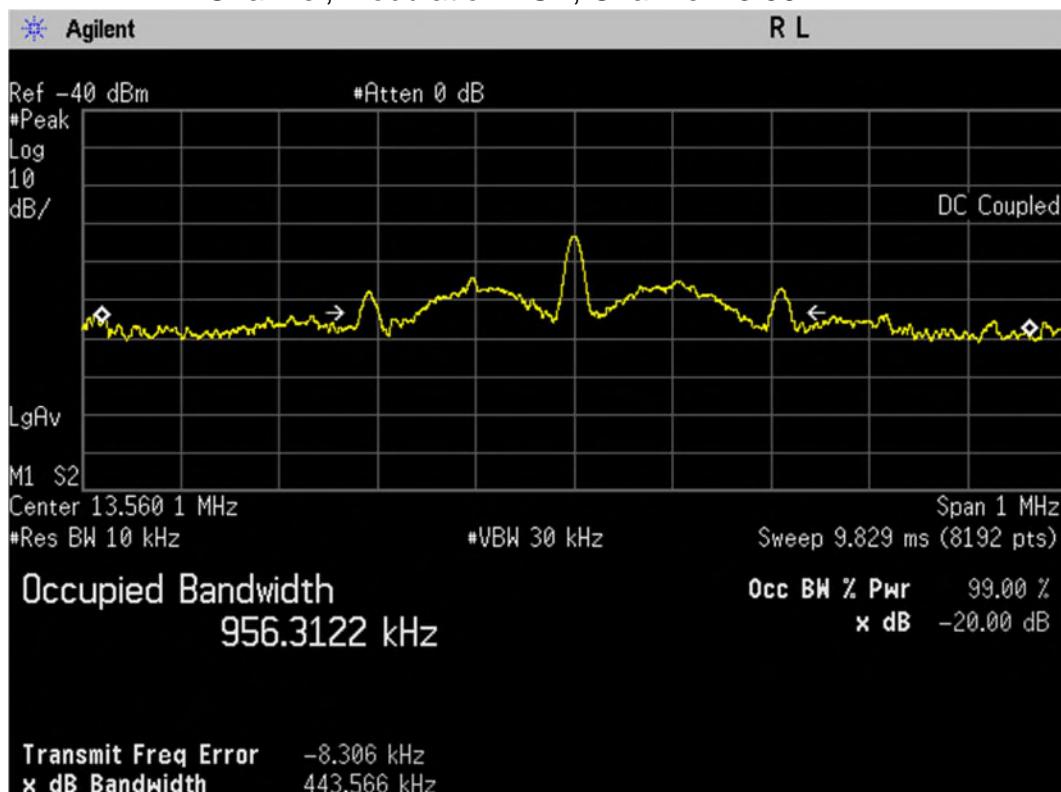






6.5 Occupied bandwidth

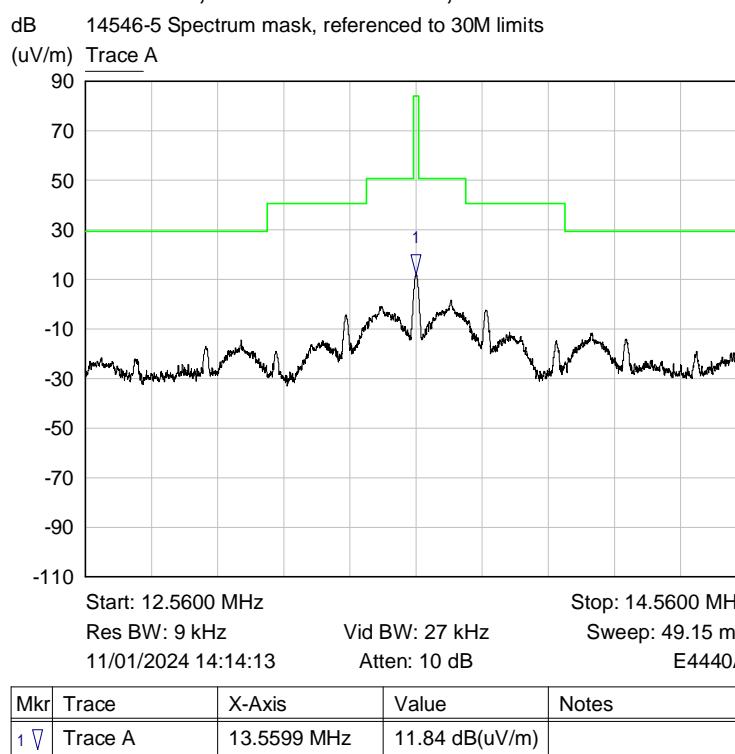
RF Parameters: Band 13.553-13.567 MHz, Power Max Default, Channel Spacing Single Channel, Modulation ASK, Channel 13.56 MHz



Plot for 99 % Bandwidth (MHz) Nominal Temp & Volts

6.6 Spectrum mask

RF Parameters: Band 13.553-13.567 MHz, Power Max Default, Channel Spacing Single Channel, Modulation ASK, Channel 13.56 MHz



Nominal Temperature, Nominal Voltage

File Name: Cellular Highways Ltd.14546-5 Issue 01

QMF21J - Issue 05 - RNE Issue 03; 47 CFR Part 15C 2021

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 (dB μ V) | Pk – Lim 1 (dB) | QP Amp (dB μ V) | QP - Lim1 (dB) | Av Amp (dB μ V) | 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 (dB μ V) is the level of received signal that was measured in dB above 1 μ V 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 (dB μ V) is the level of received signal that was measured in dB above 1 μ V 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 (dB μ V) is the level of received signal that was measured in dB above 1 μ V 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 μ V/m at a specified distance), whereas the measured values are expressed as peak, quasi peak or average values in dB μ V/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:

- limit of 500 μ V/m equates to $20 \log(500) = 54$ dB μ V/m.
- limit of 300 μ V/m at 10m equates to $20 \log(300 \cdot 10/3) = 60$ dB μ V/m at 3m
- limit of 30 μ V/m at 30m, but below 30MHz, equates to $20 \log(30) + 40 \log(30/3) = 69.5$ dB μ V/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) |
|-------------------------|--------------------------|-----------------|---------------------------------|
| 20dB μ V | 25 dB | 3 dB | 48dB μ V/m |

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

Equation 21: $E_{\text{Linear}} = 10((E_{\text{Log}} - 120)/20)$

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

Where:

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

E_{Log} is the field strength of the emissions in dB μ V/m

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

Where:

$EIRP$ is equivalent isotropically radiated power in dBm

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

d_{Meas} is the measurement distance in metres

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

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

Where:

PD is the power density at distance specified by the limit, in W/m²

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

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

Equation 26: $PD = E_{\text{Spec limit}}^2 / 377$

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

Where:

PD is the power density at distance specified by the limit, in W/m²

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

Example:

Radiated spurious emissions limit at 3metres of 90pW/cm².

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

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

And

Equation 26 transposed: $E_{\text{Spec limit}} = \sqrt{(0.9 \times 10^{-6} \times 377)} = 0.01842 \text{ V/m.}$

And

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

8 Photographs

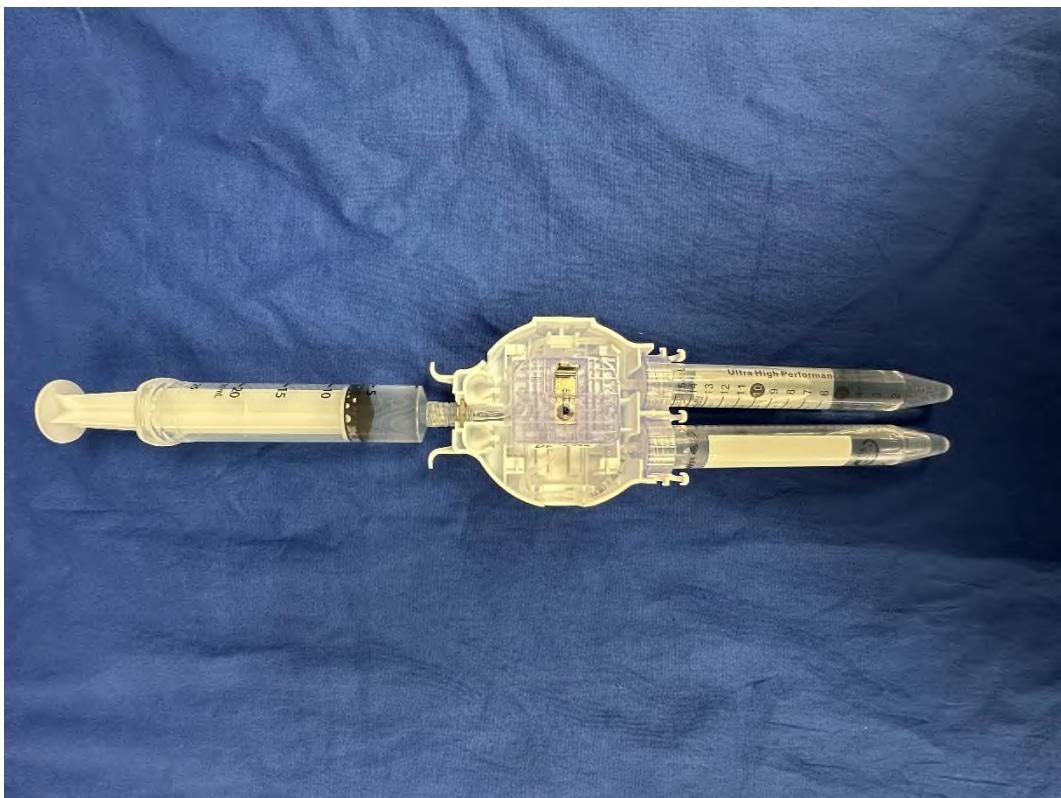
8.1 EUT Front View







8.2 EUT Reverse Angle





8.3 EUT Left side View



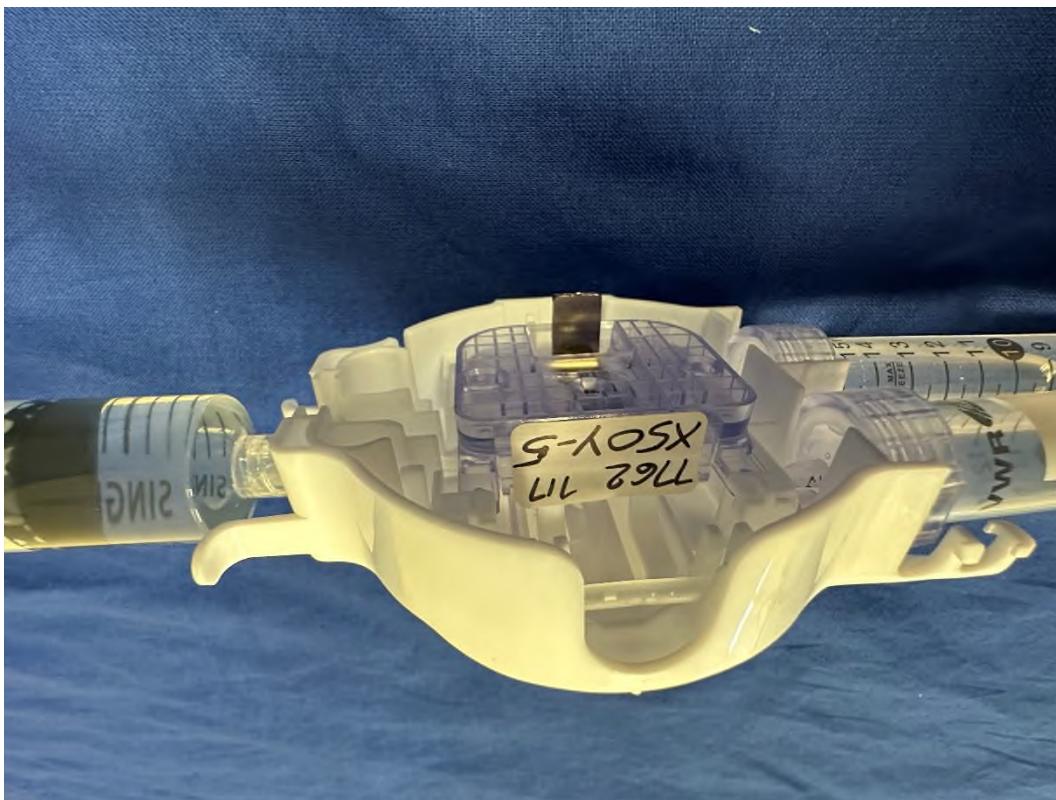
8.4 EUT Right side View



8.5 EUT Display & Controls



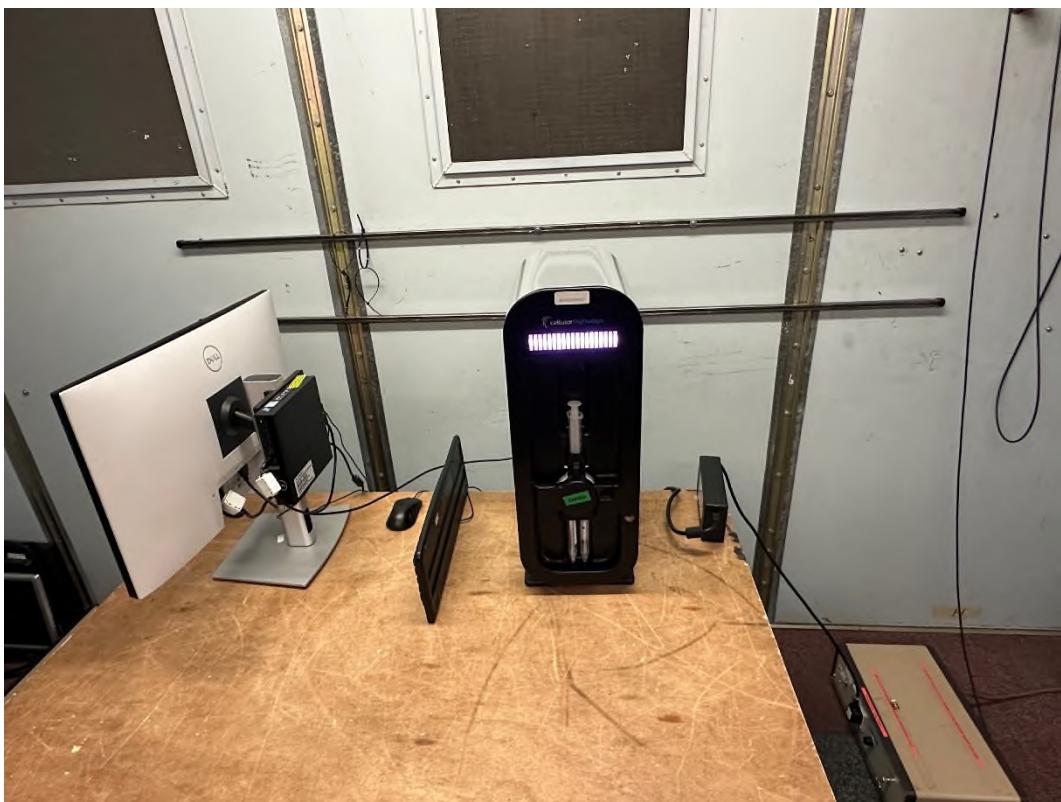
8.6 EUT ID Label



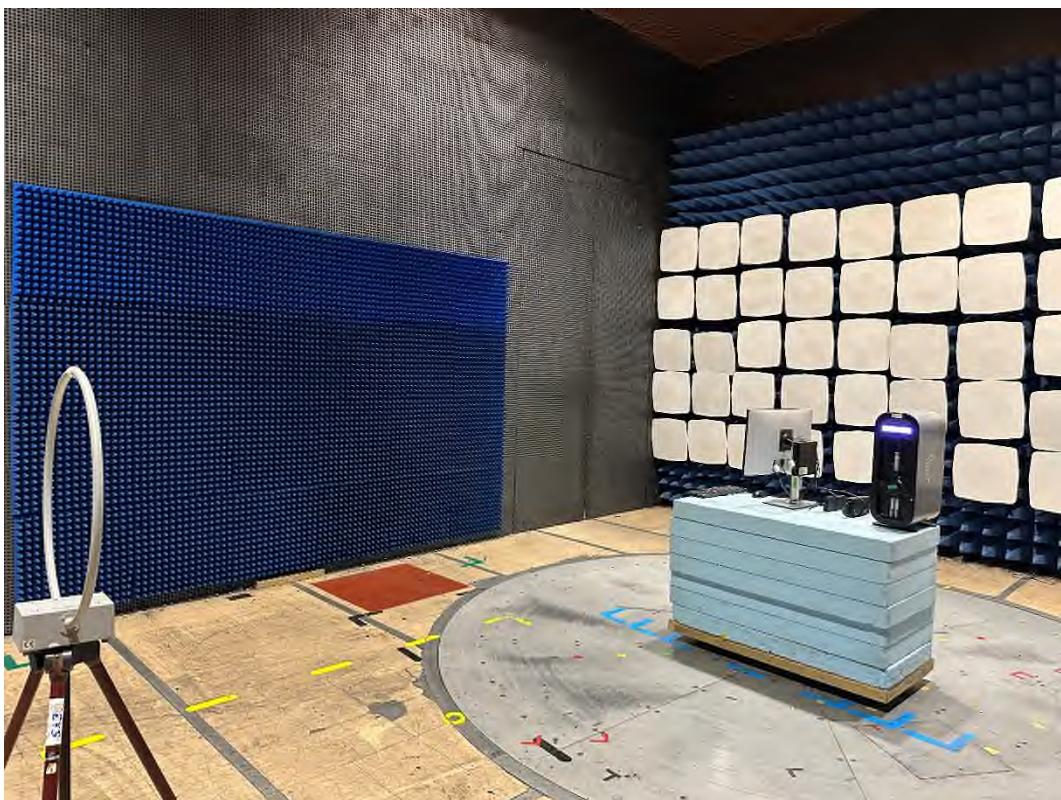
8.7 EUT Chassis

See ID photos

8.8 AC power line conducted emissions



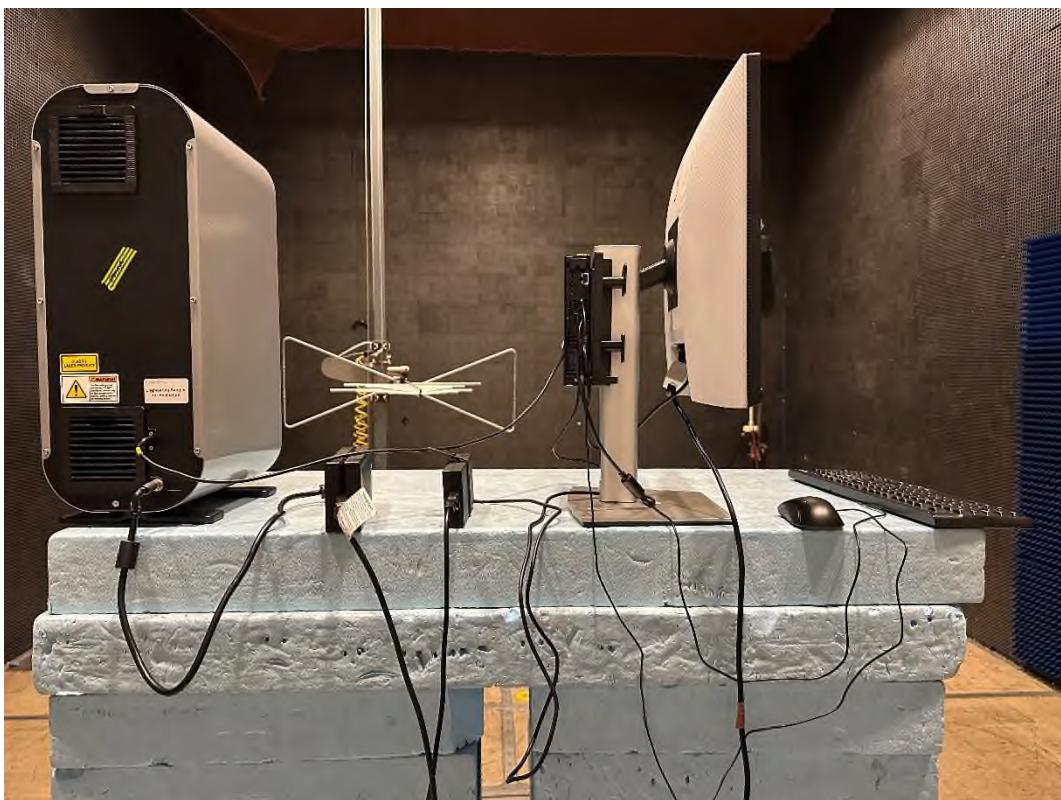
8.9 Radiated emissions 9 - 150 kHz



8.10 Radiated emissions 150 kHz - 30 MHz



8.11 Radiated emissions 30 MHz - 1 GHz



Upright Position



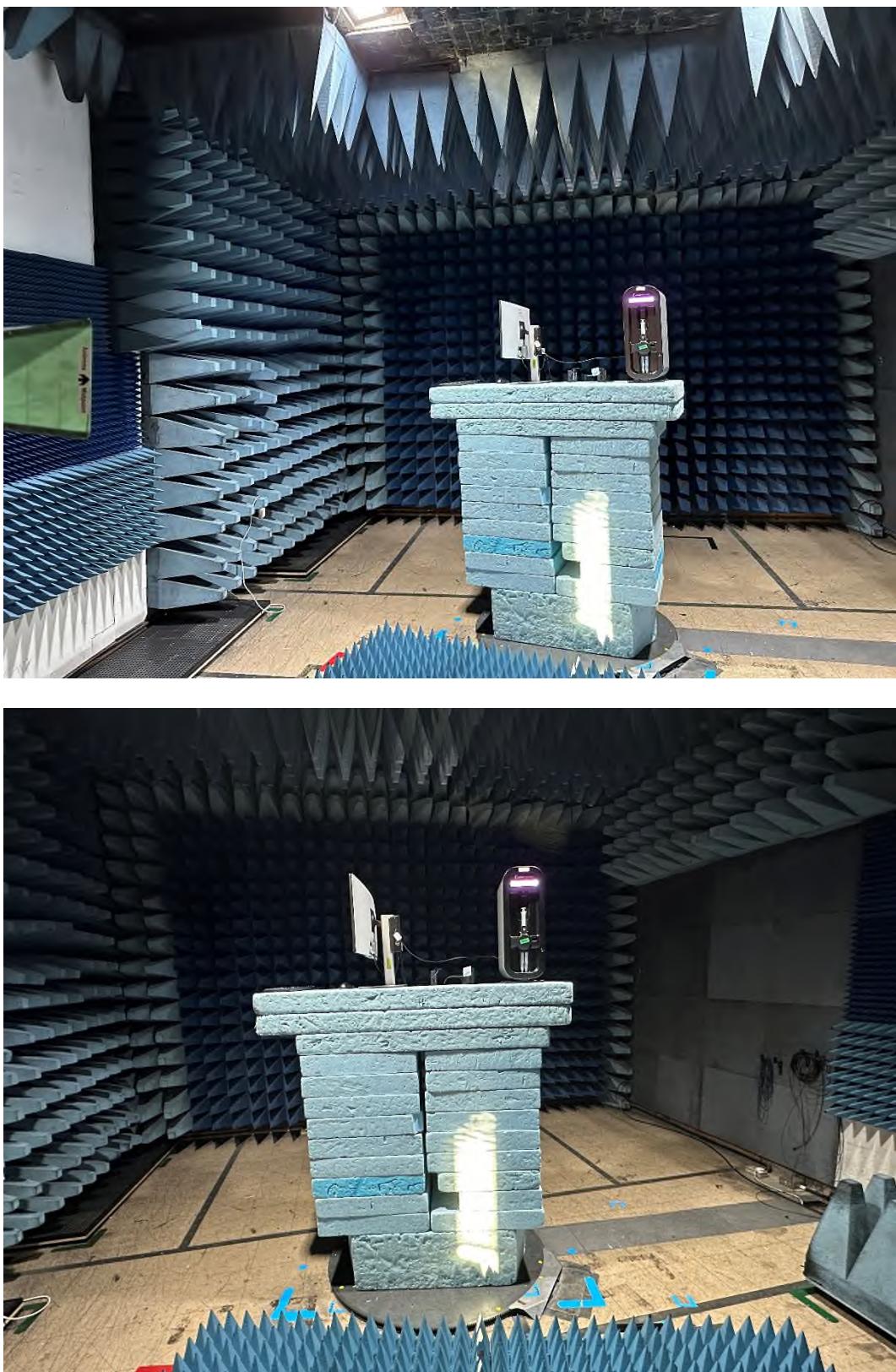
Side Position

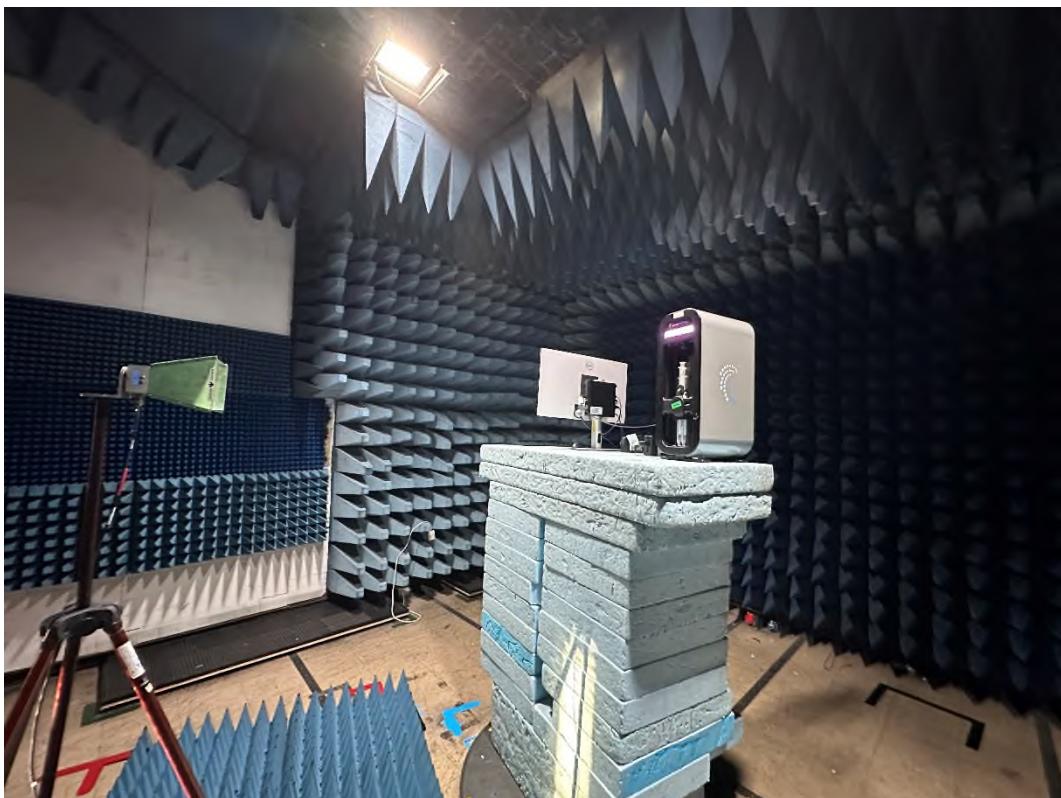


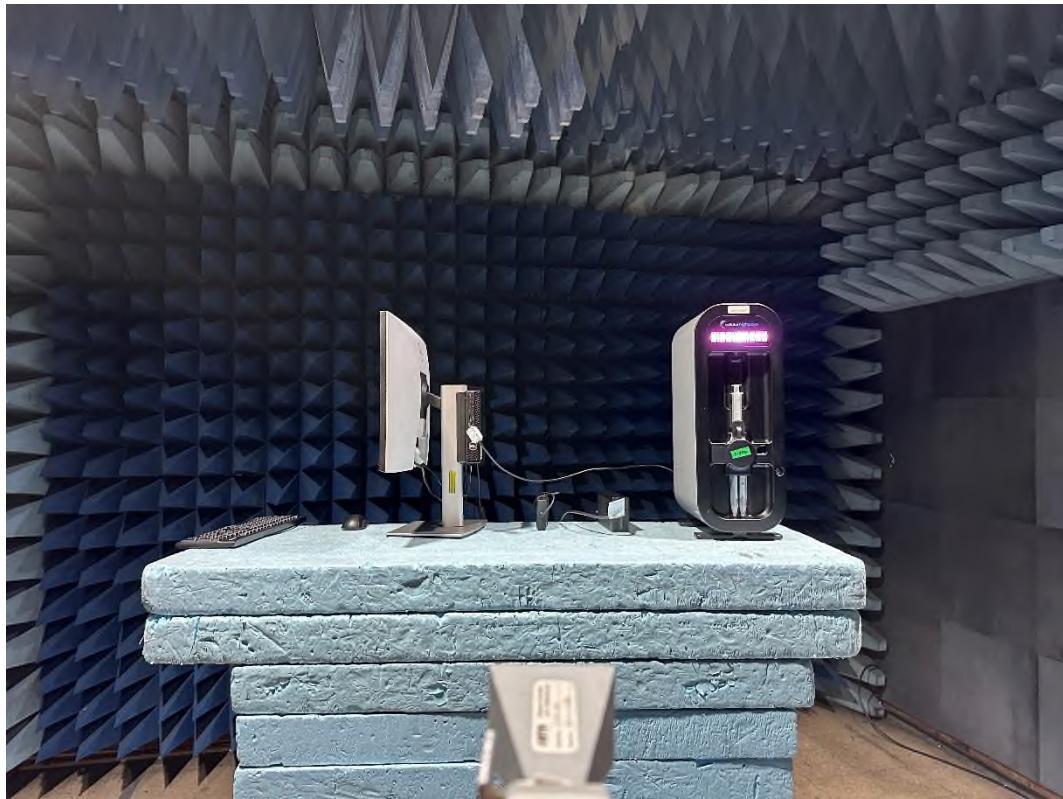
Flat Position

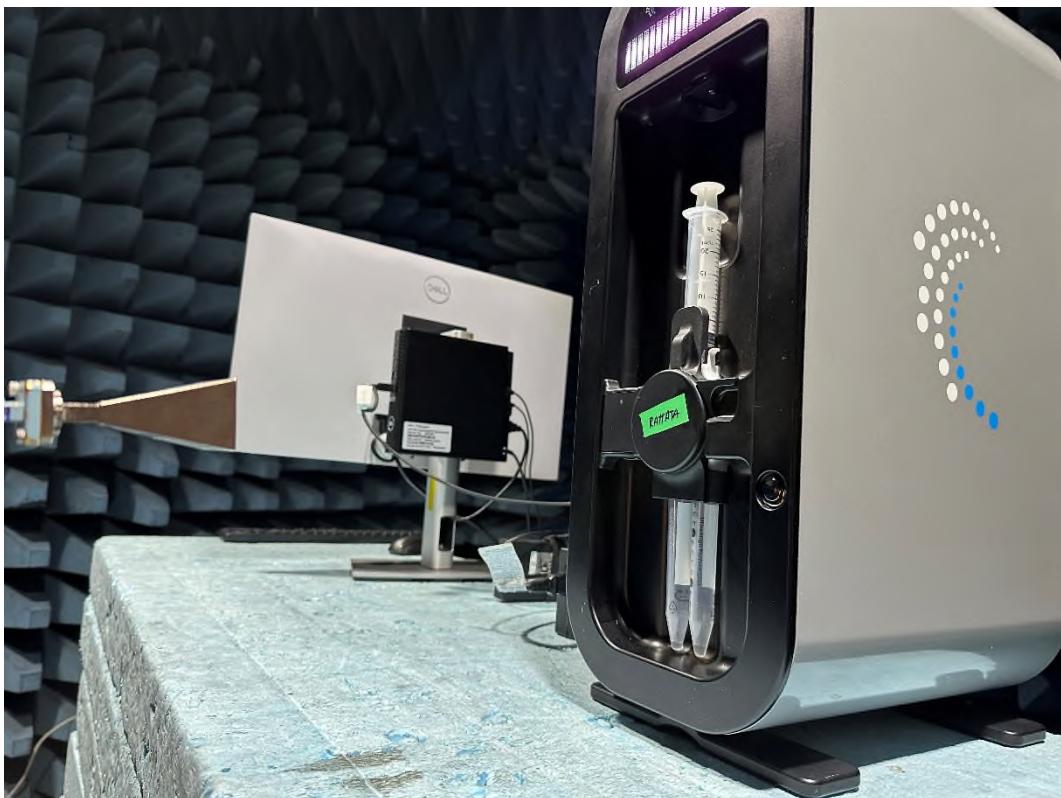
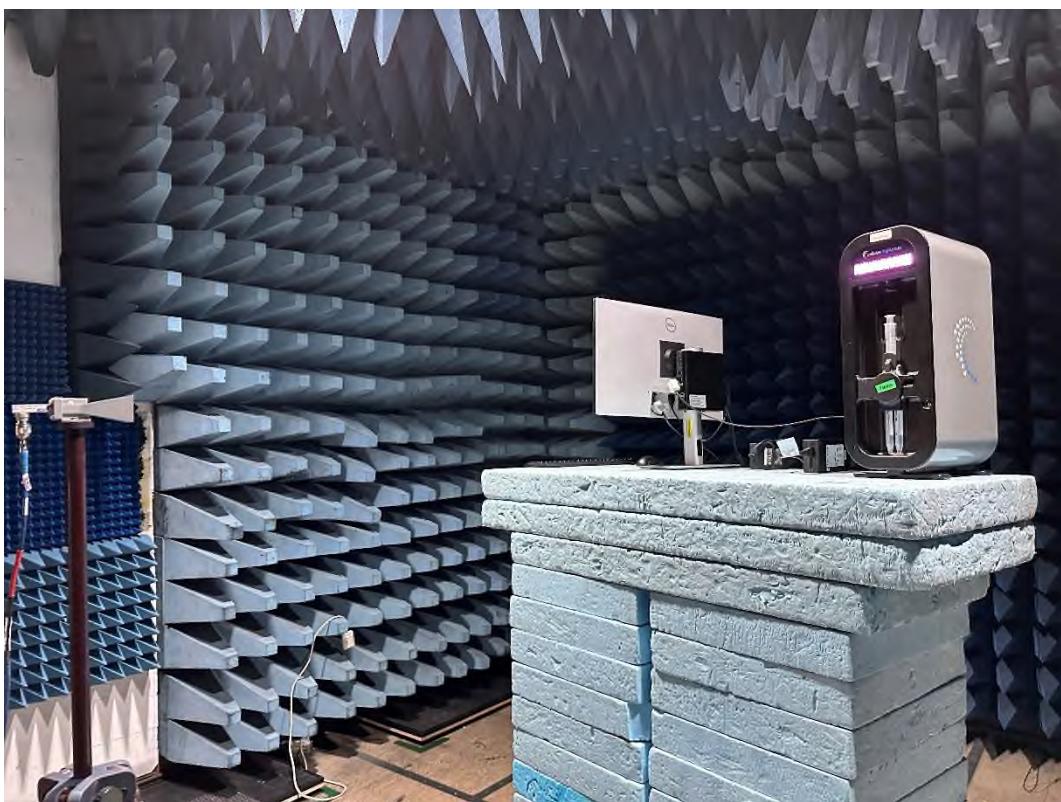


8.12 Radiated emissions above 1 GHz











8.13 Radiated emission diagrams

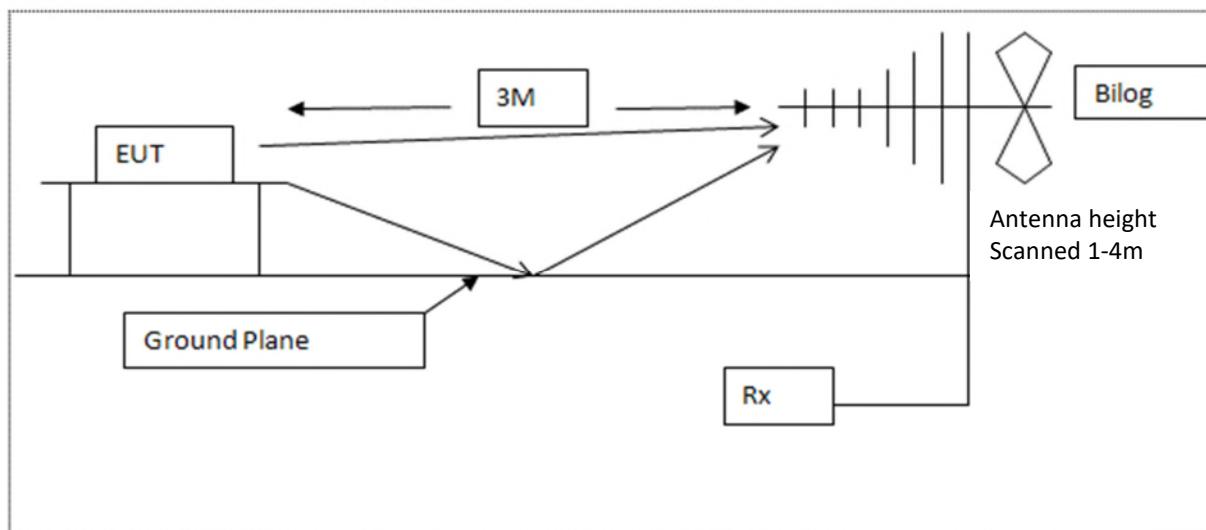


Diagram of the radiated emissions test setup 30 - 1000 MHz

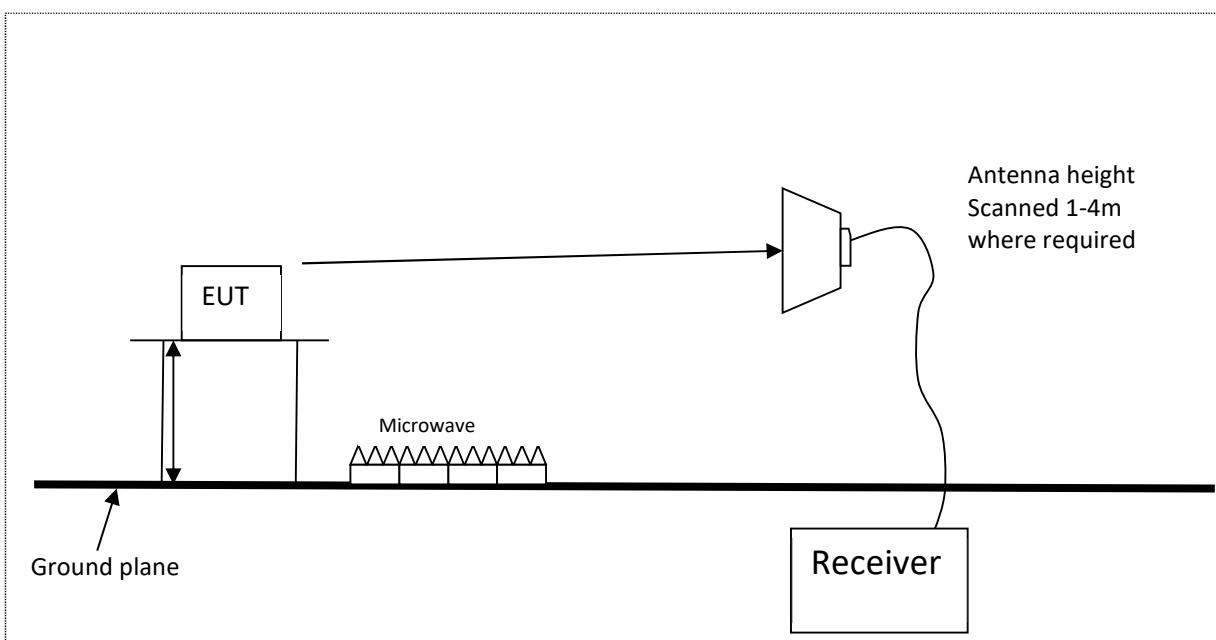


Diagram of the radiated emissions test setup above 1GHz

8.14 AC powerline conducted emission diagram

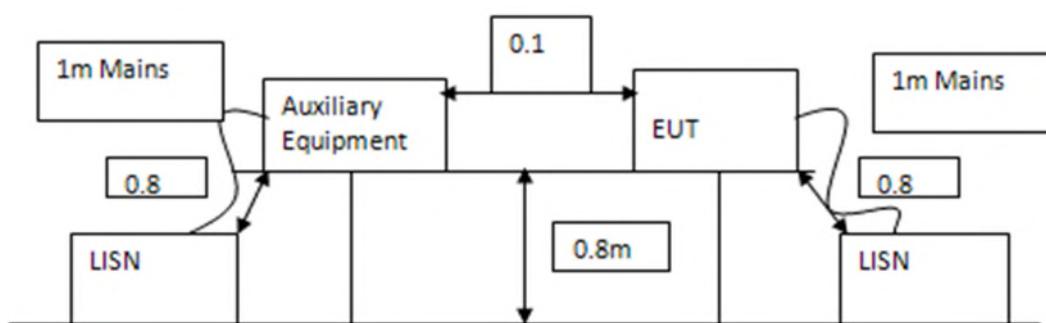


Diagram of the AC conducted emissions test setup

9 Test equipment calibration list

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

| RN No. | Model No. | Description | Manufacturer | Calibration date | Cal period |
|--------|------------|------------------------------------|-----------------------|------------------|----------------|
| E035 | 11947A | Transient Limiter 9kHz - 200MHz | Hewlett Packard | 03-Jan-2024 | 12 months |
| E136 | 3105 | Horn Antenna 1 - 12.5 GHz | EMCO | 02-Apr-2023 | 12 months |
| E150 | MN2050 | LISN 13A | Chase | 03-May-2023 | 12 months |
| E411 | N9039A | 9 kHz - 1 GHz RF Filter Section | Agilent Technologies | 05-Jul-2023 | 12 months |
| E555 | CMV 5E-1 | Variac 5A | Carroll & Meynell Ltd | 08-Jan-2024 | 12 months |
| E624 | E4440A | PSA 3 Hz - 26.5 GHz | Agilent Technologies | 06-Jul-2023 | 24 months |
| E642 | E4440A | PSA 3 Hz - 26.5 GHz | Agilent Technologies | 24-Nov-2023 | 24 months |
| E744 | 2017 4/2dB | Attenuator 4/2dB 30-1000MHz | RN Electronics | 24-Feb-2023 | 12 months |
| E755 | N9030B | PXA Signal Analyser 3 Hz to 50 GHz | Keysight Technologies | 14-Aug-2023 | 12 months |
| E914 | VULB 9163 | Antenna BiLog 30MHz to 3GHz | Schwarzbeck | 23-Apr-2022 | 24 months |
| F238 | N9039A | 9 kHz - 1 GHz RF Filter Section | Agilent Technologies | 23-Aug-2023 | 12 months |
| L264 | DT75 | Digital Thermometer | Instrotech Ltd | 20-Dec-2021 | 24 months |
| LPE315 | 34401A | Digital Multimeter 6.5 digit | Agilent Technologies | 05-Dec-2023 | 12 months |
| NSA-H | NSA - H | NSA - Site H | RN Electronics | 17-May-2023 | 36 months |
| TMS38 | VMT04/140 | Environmental Oven | Heraeus Votsch | 13-Mar-2023 | 12 months |
| TMS78 | 3160-08 | Horn Std Gain 12.4 - 18 GHz | ETS Systems | 05-Oct-2023 | 12 months |
| TMS79 | 3160-09 | Horn Std Gain 18 - 26.5 GHz | ETS Systems | 23-May-2023 | 12 months |
| TMS81 | 6502 | Antenna Active Loop | EMCO | 17-Aug-2023 | 24 months |
| TMS82 | 8449B | Pre-Amplifier 1GHz - 26.5GHz | Agilent Technologies | 08-Jan-2024 | 12 months |
| VSWR-M | VSWR | VSWR 1-18GHz | RN Electronics | 24-Nov-2021 | 36 months |
| ZSW1 | V2.5.2 | Measurement Software Suite | RN Electronics | | Not Applicable |

10 Auxiliary and peripheral equipment

10.1 Customer supplied equipment

| Item No. | Model No. | Description | Manufacturer | Serial No. |
|----------|-------------|--------------------|-------------------|------------------------------|
| 1 | D15U | PC | Dell | WJ1J7 A00 |
| 2 | S2722DZ | Flat Panel Monitor | Dell | CN-06T3CV-WSL00-237-CU4L-A01 |
| 3 | 0XN967 | Mouse | Dell | J020OKIM |
| 4 | 820-004515 | Keyboard | Logitech | 1311MG008H78 |
| 5 | HA130PM190 | PC AC/DC PSU | Dell | CN-0YJ6MW-CH200-28T-00MW-A01 |
| 6 | 100000-1015 | Tag and Syringe | Cellular Highways | 105 |

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

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

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