



A part of



# Radio Test Report

**Salunda Ltd**

**6891**

**D10**

47 CFR Part 15.250 Effective Date 1st October 2021

WBT: Wideband Transmitter

Test Date: 28th November 2022 to 14th February 2023

Report Number: 02-13917-5-23 Issue 01

The testing was carried out by RN Electronics Ltd, an independent test house, at their test facility located at:

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## Certificate of Test 13917-5

The equipment noted below has been fully tested by R.N. Electronics Limited and, where appropriate, conforms to the relevant subpart of 47 CFR Part 15C. This is a certificate of test only and should not be confused with an equipment authorisation. Other standards may also apply.

|                                                         |                                                                                                   |
|---------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Equipment:                                              | 6891                                                                                              |
| Model Number:                                           | D10                                                                                               |
| Unique Serial Number:                                   | 0044 (Radiated)<br>0055 (Conducted)                                                               |
| Applicant:                                              | Salunda Ltd<br>Unit 6 Avonbury Business Park<br>Howes Lane<br>Bicester<br>Oxfordshire<br>OX26 2UA |
| Proposed FCC ID                                         | 2ALTW18016891                                                                                     |
| Full measurement results are detailed in Report Number: | 02-13917-5-23 Issue 01                                                                            |
| Test Standards:                                         | 47 CFR Part 15.250 Effective Date 1st October 2021<br>WBT: Wideband Transmitter                   |

NOTE: This report pertains to UWB operation, for 2.4GHz ZigBee operation please refer to RN report 01-13917-2-23.

### 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: 28th November 2022 to 14th February 2023

Test Engineer:

Approved By:  
Radio Manager

Customer  
Representative:



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## 2 Equipment under test (EUT)

### 2.1 Equipment specification

|                           |                                                                                                          |              |
|---------------------------|----------------------------------------------------------------------------------------------------------|--------------|
| Applicant                 | Salunda Ltd<br>Unit 6 Avonbury Business Park<br>Howes Lane<br>Bicester<br>Oxfordshire<br>OX26 2UA        |              |
| Manufacturer of EUT       | Salunda Ltd                                                                                              |              |
| Full Name of EUT          | 6891                                                                                                     |              |
| Model Number of EUT       | D10                                                                                                      |              |
| Serial Number of EUT      | 0044 (Radiated)<br>0055 (Conducted)                                                                      |              |
| Date Received             | 12th December 2022                                                                                       |              |
| Date of Test:             | 28th November 2022 to 14th February 2023                                                                 |              |
| Purpose of Test           | To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations. |              |
| Date Report Issued        | 26th July 2023                                                                                           |              |
| Main Function             | Personal / Equipment Locating                                                                            |              |
| Information Specification | Height                                                                                                   | 71.5 mm      |
|                           | Width                                                                                                    | 41.5 mm      |
|                           | Depth                                                                                                    | 5 mm         |
|                           | Weight                                                                                                   | 0.02 kg      |
|                           | Voltage                                                                                                  | 3 - 4.2 VDC  |
|                           | Current                                                                                                  | Not declared |

## 2.2 Configurations for testing

| General Parameters                 |                                                                                                              |
|------------------------------------|--------------------------------------------------------------------------------------------------------------|
| EUT Normal use position            | Body worn                                                                                                    |
| Choice of model(s) for type tests  | Sample                                                                                                       |
| Antenna details                    | Integral. Taoglas UWCCP.01                                                                                   |
| Antenna port                       | No                                                                                                           |
| Baseband Data port (yes/no)?       | No                                                                                                           |
| Highest Signal generated in EUT    | 6.5 GHz                                                                                                      |
| Lowest Signal generated in EUT     | 12 MHz                                                                                                       |
| Hardware Version (HVIN)            | Version 1                                                                                                    |
| Software Version                   | 'Salunda NFC Lite' Phone App: 1.7                                                                            |
| Firmware Version (FVIN)            | 2.4GHz RF Processor: 4.251 – GIT Hash: 6b72d63<br>UWB Main processor: 5.251 – GIT Hash: 67e984d<br>IMU: 1.14 |
| Type of Equipment                  | Personal/Equipment Locating                                                                                  |
| Technology Type                    | UWB IEEE 802.15.4                                                                                            |
| Geo-location (yes/no)              | Location by radio determination                                                                              |
| TX Parameters                      |                                                                                                              |
| Alignment range – transmitter      | 6.5GHz                                                                                                       |
| EUT Declared Modulation Parameters | 802.15.4                                                                                                     |
| EUT Declared Power level           | -41.3 dBm/MHz                                                                                                |
| EUT Declared Signal Bandwidths     | 500 MHz                                                                                                      |
| EUT Declared Channel Spacing's     | Single channel                                                                                               |
| EUT Declared Duty Cycle            | max 10% in operation                                                                                         |
| Unmodulated carrier available?     | Yes                                                                                                          |
| Declared frequency stability       | 0.5ppm                                                                                                       |
| RX Parameters                      |                                                                                                              |
| Alignment range – receiver         | 6.5GHz                                                                                                       |
| EUT Declared RX Signal Bandwidth   | 500 MHz                                                                                                      |
| FCC Parameters                     |                                                                                                              |
| FCC Transmitter Class              | WBT: Wideband Transmitter                                                                                    |

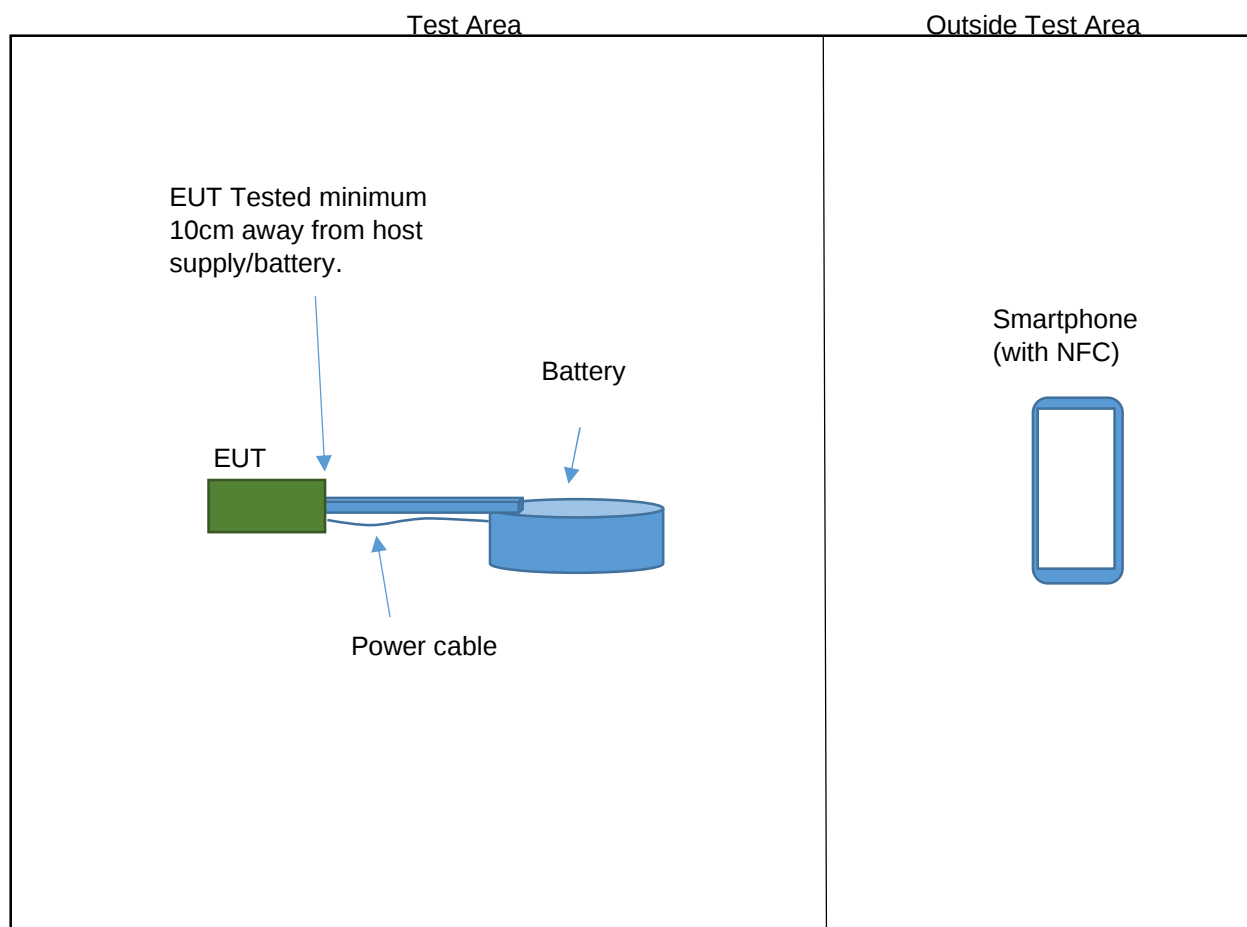
## 2.3 Functional description

Locates via UWB and sends location back to server, configuration over the 2.4GHz network, can also operate as gateway which responds to request to range.

## 2.4 Modes of operation

| Mode Reference | Description                                                                                                                 | Used for testing |
|----------------|-----------------------------------------------------------------------------------------------------------------------------|------------------|
| TX1            | Transmitting continuously at 6500 MHz with system modulation. ZigBee transmitting @ 2440 MHz simultaneously.                | Yes              |
| TX2            | Transmitting at 10% test mode duty cycle at 6500 MHz with system modulation. ZigBee transmitting @ 2440 MHz simultaneously. | Yes              |

## 2.5 Emissions configuration



The unit was powered from a fully charged battery and was positioned on a bracket 10 centimetres away from the battery. For conducted tests a separate test unit was provided where the internal antenna had been removed and an SMA semi-rigid cable assembly was fitted in its place. For AC conducted emissions the EUT and battery were connected to an AC mains powered charger at 120V AC 60Hz. The unit was configured using a Smartphone running Salunda NFC Lite engineering software. The relevant radio settings were configured in the app and then the settings were transmitted to the EUT using NFC (13.56MHz) via the smart phone. Refer to section 2.4 for the modes used during testing. The transmit mode used for Peak power tests was 100% duty cycle. For Average power measurements the transmit mode was 10% duty cycle which was the maximum declared duty cycle. The power setting provided by the applicant and used during test to give maximum output power was: -

Single Channel (6500 MHz centre frequency) = Power setting UWB Power Coarse 12.5, UWB Power Fine 3.

Note: Intermodulation emissions checks were performed with the UWB transmitting simultaneously with the ZigBee transmitter.

### 2.5.1 Signal leads

| Port Name | Cable Type      | Connected |
|-----------|-----------------|-----------|
| DC Power  | 2 x single core | Yes       |

### 3 Summary of test results

The 6891, D10 was tested for compliance to the following standard:

47 CFR Part 15.250 Effective Date 1st October 2021  
WBT: Wideband Transmitter

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

| Title                                  | References                                    | Results             |
|----------------------------------------|-----------------------------------------------|---------------------|
| <b>Transmitter Tests</b>               |                                               |                     |
| 1. 10dB Bandwidth                      | 47 CFR Part 15C Clause 15.250(a) / (b)        | PASSED              |
| 2. Peak & Average EIRP                 | 47 CFR Part 15C Clause 15.250(d)(1) / (d)(3)  | PASSED              |
| 3. Radiated emissions 30 MHz -960 MHz  | 47 CFR Part 15C Clause 15.250 (d)(1) / 15.209 | PASSED              |
| 4. Radiated emissions above 960 MHz    | 47 CFR Part 15C Clause 15.250 (d)(1) / 15.209 | PASSED <sup>1</sup> |
| 5. Radiated emissions 150 kHz - 30 MHz | 47 CFR Part 15C Clause 15.209                 | PASSED              |
| 6. Radiated emissions 9 - 150 kHz      | 47 CFR Part 15C Clause 15.209                 | PASSED              |
| 7. AC power line conducted emissions   | 47 CFR Part 15C Part 15.207                   | PASSED              |

<sup>1</sup> Spectrum investigated up to a frequency of 40GHz based on the highest channel/ signal generated in equipment of 6500 MHz.

## 4 Specifications

The tests were performed and operated in accordance with R.N. Electronics Ltd procedures and the relevant standards listed below.

### 4.1 Relevant standards

| Ref.  | Standard Number | Version | Description                                                                                                                                                         |
|-------|-----------------|---------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 4.1.1 | 47 CFR Part 15C | 2021    | 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               | 3.6V DC |
| T minimum                   | -30 °C | V minimum               | 3.0V DC |
| T maximum                   | 50 °C  | V maximum               | 4.2V DC |

Extremes of voltage are based on nominal manufacturer's declaration.

Extremes of temperature are based upon 47 CFR Clause 2.1055.

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 temporary RF port was created for testing.

## 5 Tests, methods and results

### 5.1 10dB Bandwidth

#### 5.1.1 Test methods

|                    |                                                                         |
|--------------------|-------------------------------------------------------------------------|
| Test Requirements: | 47 CFR Part 15C Clause 15.250(a) / (b) [Reference 4.1.1 of this report] |
| Test Method:       | ANSI C63.10 Clause 10.1 [Reference 4.1.3 of this report]                |
| Limits:            | 47 CFR Part 15C Clause 15.250(a) / (b) [Reference 4.1.1 of this report] |

#### 5.1.2 Configuration of EUT

The EUT was placed in an environmental chamber and was connected to a spectrum analyser using suitable attenuation. Measurements were made at the temporary RF port. The EUT was powered using a bench power supply. This allowed the supply voltage to be varied during tests to the manufactures declared end-points as stated in section 4.3. The EUT was operated in TX1 mode.

#### 5.1.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment listed below. A 1MHz RBW, 3x VBW, auto sweep time and max hold settings were used for the 10 dB bandwidth. The peak of the signal was found and markers referenced to it were used to determine -10dB Bandwidth. Measurements were performed in an environmental oven at the specified temperature.

Tests were performed using test Site A.

#### 5.1.4 Test equipment

E227, E412, E434, N579, TMS38, TMS80

See Section 9 for more details

### 5.1.5 Test results

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

|                 |                |
|-----------------|----------------|
| Band            | 5925-7250 MHz  |
| Power Level     | 15.5 dBm       |
| Channel Spacing | Single Channel |
| Mod Scheme      | UWB            |
| Single channel  | 6489 MHz       |

| EUT supply voltage | FL (MHz)                                | FH (MHz)  | OCC BW (MHz) | Calculated centre frequency FC (MHz) | Highest frequency FM (MHz) | Fractional bandwidth. $2(FH-FL)/(FH+FL)$ |
|--------------------|-----------------------------------------|-----------|--------------|--------------------------------------|----------------------------|------------------------------------------|
| Nom Voltage        | 6142.7330                               | 6837.0340 | 694.0000     | 6489.7330                            | 6644.5670                  | 0.106982                                 |
| Plot ref           | 13917-5 Occupied Bandwidth T 20deg Vnom |           |              |                                      |                            |                                          |
| Min Voltage        | 6144.5530                               | 6832.2730 | 687.7200     | 6488.4130                            | 6645.6660                  | 0.105992                                 |
| Plot ref           | 13917-5 Occupied Bandwidth T 20deg Vmin |           |              |                                      |                            |                                          |
| Max Voltage        | 6143.1380                               | 6836.7380 | 693.6000     | 6489.9380                            | 6645.1160                  | 0.106873                                 |
| Plot ref           | 13917-5 Occupied Bandwidth T 20deg Vmax |           |              |                                      |                            |                                          |
| Nom Voltage        | 6074.3510                               | 6942.3330 | 867.9820     | 6508.3420                            | 6646.5810                  | 0.133365                                 |
| Plot ref           | 13917-5 Occupied Bandwidth T-30deg Vnom |           |              |                                      |                            |                                          |
| Nom Voltage        | 6103.1720                               | 6913.1220 | 809.9500     | 6508.1470                            | 6644.9330                  | 0.124452                                 |
| Plot ref           | 13917-5 Occupied Bandwidth T-20deg Vnom |           |              |                                      |                            |                                          |
| Nom Voltage        | 6109.4680                               | 6874.2090 | 764.7410     | 6491.8385                            | 6645.4830                  | 0.117800                                 |
| Plot ref           | 13917-5 Occupied Bandwidth T-10deg Vnom |           |              |                                      |                            |                                          |
| Nom Voltage        | 6109.0640                               | 6875.2080 | 766.1440     | 6492.1360                            | 6645.1160                  | 0.118011                                 |
| Plot ref           | 13917-5 Occupied Bandwidth T 0deg Vnom  |           |              |                                      |                            |                                          |
| Nom Voltage        | 6142.8320                               | 6846.0210 | 703.1890     | 6494.4265                            | 6645.3000                  | 0.108276                                 |
| Plot ref           | 13917-5 Occupied Bandwidth T 10deg Vnom |           |              |                                      |                            |                                          |
| Nom Voltage        | 6143.1530                               | 6834.9730 | 691.8200     | 6489.0630                            | 6644.9330                  | 0.106613                                 |
| Plot ref           | 13917-5 Occupied Bandwidth T 30deg Vnom |           |              |                                      |                            |                                          |
| Nom Voltage        | 6143.1370                               | 6836.0650 | 692.9280     | 6489.6010                            | 6644.7500                  | 0.106775                                 |
| Plot ref           | 13917-5 Occupied Bandwidth T 40deg Vnom |           |              |                                      |                            |                                          |
| Nom Voltage        | 6143.7730                               | 6835.6760 | 691.9030     | 6489.7245                            | 6644.2010                  | 0.106615                                 |
| Plot ref           | 13917-5 Occupied Bandwidth T 50deg Vnom |           |              |                                      |                            |                                          |

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

#### LIMITS:

47 CFR Part 15C Clause 15.250(a): The -10 dB bandwidth of the fundamental emission must be contained within the 5925-7250 MHz band under all conditions of operation.

47 CFR Part 15C Clause 15.250(b): The -10 dB bandwidth of the fundamental emission shall be at least 50 MHz.

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:  
 $\leq \pm 1.9 \%$

## 5.2 Peak & Average EIRP

### 5.2.1 Test methods

|                    |                                                                               |
|--------------------|-------------------------------------------------------------------------------|
| Test Requirements: | 47 CFR Part 15C Clause 15.250(d)(1) / (d)(3) [Reference 4.1.1 of this report] |
| Test Method:       | ANSI C63.10 Clause 10.3 [Reference 4.1.3 of this report]                      |
| Limits:            | 47 CFR Part 15C Clause 15.250(d)(1) / (d)(3) [Reference 4.1.1 of this report] |

### 5.2.2 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 1 metre. The EUT was tested using a fully charged battery. The transmit mode used for Peak power tests was 100% duty cycle. For Average power measurements the transmit mode was 10% duty cycle. The EUT was operated in TX1 mode for Peak measurements and TX2 mode for Average measurements.

### 5.2.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment listed below. For peak power measurements a 50MHz RBW, 80MHz VBW, Peak detector and max hold settings were used. The analyser was then switched to an RMS average sweep using a sweep time of 1ms per analyser point at the same frequency to determine Average EIRP.

Tests were performed using test Site M.

### 5.2.4 Test equipment

E602, E268, E595, H079

See Section 9 for more details

### 5.2.5 Test results

|                                 |        |
|---------------------------------|--------|
| Temperature of test environment | 12°C   |
| Humidity of test environment    | 50%    |
| Pressure of test environment    | 102kPa |

|                 |                |
|-----------------|----------------|
| Band            | 5925-7250 MHz  |
| Power Level     | 15.5 dBm       |
| Channel Spacing | Single Channel |
| Mod Scheme      | UWB            |
| Single channel  | 6500 MHz       |

| Highest detected frequency<br>FM (from Bw Test) (MHz) | RBW used (MHz) | Results dBm                                 |
|-------------------------------------------------------|----------------|---------------------------------------------|
| 6753.120000                                           | 50             |                                             |
| Peak result 50MHz RBW (dBm)                           |                | -1.60                                       |
| Peak Plot Max held Filename ref                       |                | 13917-5 Peak power - Power setting 15.5 dBm |

|                            |                                                |
|----------------------------|------------------------------------------------|
| AV PSD result 1MHz (dBm)   | -41.37                                         |
| AV PSD result filename ref | 13917-5 Average power - Power setting 15.5 dBm |

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

**LIMITS:**

47 CFR Part 15C Clause 15.250(d)(1): The limit for operation in the 5925 to 7250 MHz band is -41.3 dBm EIRP

47 CFR Part 15C Clause 15.250(d)(3): Peak level of the emissions contained within a 50 MHz bandwidth:  
0dBm EIRP

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

## 5.3 Radiated emissions 30 MHz - 960 MHz

### 5.3.1 Test methods

Test Requirements: 47 CFR Part 15C Clause 15.250 (d)(4) / 15.209 [Reference 4.1.1 of this report]  
Test Method: ANSI C63.10 Clause 10.2 [Reference 4.1.2 of this report]  
Limits: 47 CFR Part 15C Clause 15.250 (d)(4) / 15.209 [Reference 4.1.1 of this report]

### 5.3.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was rotated in all three orthogonal planes. Radiated Emissions testing was performed with a fully charged battery. The EUT was operated in TX1 mode.

### 5.3.3 Test procedure

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

Measurements were made on a site listed with the FCC. The equipment was rotated 360 degrees and the antenna scanned 1 – 4 metres in both horizontal and vertical polarisations to record the worst-case emissions.

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

Tests were performed using Test Site M.

### 5.3.4 Test equipment

LPE364, E743, NSA-M, ZSW1, E412, E411

See Section 9 for more details

### 5.3.5 Test results

Temperature of test environment 12°C  
Humidity of test environment 60%  
Pressure of test environment 101 kPa

|                 |                |
|-----------------|----------------|
| Band            | 5925-7250 MHz  |
| Power Level     | 15.5 dBm       |
| Channel Spacing | Single Channel |
| Mod Scheme      | UWB            |
| Single channel  | 6500 MHz       |

|                         |
|-------------------------|
| Plot refs               |
| 13917-5 Rad 1 VHF Horiz |
| 13917-5 Rad 1 VHF Vert  |
| 13917-5 Rad 1 UHF Horiz |
| 13917-5 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          | 164.730    | 30.4              | 24.9            | -18.6        |
| 2          | 214.611    | 37.0              | 31.5            | -12.0        |
| 3          | 351.290    | 34.0              | 28.6            | -17.4        |
| 4          | 451.665    | 36.2              | 31.1            | -14.9        |
| 5          | 621.665    | 41.5              | 36.8            | -9.2         |
| 6          | 915.000    | 36.9              | 31.5            | -14.5        |

### 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          | 214.702    | 32.2              | 26.3            | -17.2        |
| 2          | 355.894    | 31.6              | 25.5            | -20.5        |
| 3          | 459.894    | 37.7              | 30.5            | -15.5        |
| 4          | 613.054    | 36.2              | 31.0            | -15.0        |
| 5          | 630.051    | 34.7              | 28.8            | -17.2        |
| 6          | 918.050    | 36.9              | 31.3            | -14.7        |

Note: signals measured above were generic signals present whether UWB was transmitting or not.

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.

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  $\pm 5.6$ dB

## 5.4 Radiated emissions above 960 MHz

### 5.4.1 Test methods

|                    |                                                                                                |
|--------------------|------------------------------------------------------------------------------------------------|
| Test Requirements: | 47 CFR Part 15C Clause 15.250 (d)(1) / 15.250 (d)(2) / 15.209 [Reference 4.1.1 of this report] |
| Test Method:       | ANSI C63.10 Clause 10.3 [Reference 4.1.3 of this report]                                       |
| Limits:            | 47 CFR Part 15C Clause 15.250 (d)(1) / 15.250 (d)(2) / 15.209 [Reference 4.1.1 of this report] |

### 5.4.2 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 1 metre. The EUT was rotated in all three orthogonal planes. Radiated Emissions testing was performed with a fully charged battery

The EUT was operated in TX1 mode.

### 5.4.3 Test procedure

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

Measurements were made in a semi-anechoic chamber with appropriate absorbing material for use in this range. Horn antennas were used at heights where the whole of the EUT was contained within the main beam. The EUT was rotated through 360 degrees to record the worst-case emissions. A measurement distance of 1m was used between the test range 960MHz and 12.5GHz and a 0.3m distance was used in the test range 12.5 and 40GHz. Measurements were made using an RMS detector and a 1 MHz RBW was used except in the frequency ranges of 1164 – 1240 MHz and 1559 – 1610 MHz where a 1 kHz RBW was used as per 47 CFR Part 15C Clause 15.250(d)(2).

Note: As per 47 CFR Part 15C Clause 15.250(d)(5), Emissions from digital circuitry used to enable the operation of the transmitter may comply with the limits in 47 CFR Part 15C Clause 15.209.

During emissions tests over the frequency range 960 – 1990 MHz the limit was approached / exceeded. In order to demonstrate the emissions were associated to the digital circuitry and not radiated from the transmitter, the UWB antenna was unsoldered from the board and a second measurement was performed. Where no difference in the emission profile was observed, the emissions were assessed to 15.209 Limits. Please refer to the plots in section 6.

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

Tests were performed using test Site B.

### 5.4.4 Test equipment

CAL07, E330, E331, E411, E412, E428, E429, E433, E452, E453, E580, E602, E642, E717, E725, E755, E856, E904, F119, F225, P168, TMS78, TMS79

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    | 101kPa |

Setup Table

|                 |                |
|-----------------|----------------|
| Band            | 5925-7250 MHz  |
| Power Level     | 15.5 dBm       |
| Channel Spacing | Single Channel |
| Mod Scheme      | UWB            |
| Single channel  | 6500 MHz       |

| Spurious Frequency (MHz) | Applicable FCC 15.250 Limit / 15.209 limit (dBuV/m) | Measured Average Level (dBuV/m) | Difference to Average Limit (dB) | EUT Polarisation | Antenna Polarisation | Antenna Polarisation |
|--------------------------|-----------------------------------------------------|---------------------------------|----------------------------------|------------------|----------------------|----------------------|
| 12980                    | 33.9                                                | 21.4                            | -12.5                            | Side             | Horiz                | Horiz                |
| 14430                    | 54                                                  | 29.1                            | -24.9                            | Side             | Vert                 | Vert                 |
| 14430                    | 54                                                  | 28.8                            | -25.2                            | Side             | Horiz                | Horiz                |
| 16835                    | 54                                                  | 24.9                            | -29.1                            | Side             | Vert                 | Vert                 |
| 16835                    | 54                                                  | 23.3                            | -30.7                            | Side             | Horiz                | Horiz                |

Note: Only emissions within 20dB of the 47 CFR Part 15C Clause 15.250 Limit (or where appropriate the 47 CFR Part 15C Clause 15.209 limits) have been included. Signals found at 14430 and 16835 MHz were related to ZigBee transmitter operating at 2405MHz and as such have been referenced against 15.209 limits for indication only. ZigBee radio was simultaneously transmitting for tests. see RN report 01-13917-2-23 for ZigBee radio test requirements and radiated emissions.

| Plot reference table                                       |
|------------------------------------------------------------|
| 13917-5 Radiated Emissions 960 - 1610 MHz Horiz            |
| 13917-5 Radiated Emissions 960 - 1610 MHz Vert             |
| 13917-5 Radiated Emissions 1610 - 1990 MHz Horiz           |
| 13917-5 Radiated Emissions 1610 - 1990 MHz Vert            |
| 13917-5 Radiated Emissions 1990 - 3100 MHz Horiz           |
| 13917-5 Radiated Emissions 1990 - 3100 MHz Vert            |
| 13917-5 Radiated Emissions 1990 - 3100 MHz ZigBee ON Horiz |
| 13917-5 Radiated Emissions 1990 - 3100 MHz ZigBee ON Vert  |
| 13917-5 Radiated Emissions 3100 - 5925 MHz Horiz           |
| 13917-5 Radiated Emissions 3100 - 5925 MHz Vert            |
| 13917-5 Radiated Emissions 5925 - 7250 MHz Horiz           |
| 13917-5 Radiated Emissions 5925 - 7250 MHz Vert            |
| 13917-5 Radiated Emissions 7250 - 10600 MHz Horiz          |
| 13917-5 Radiated Emissions 7250 - 10600 MHz Vert           |
| 13917-5 Radiated Emissions 10.6 - 12.5 GHz Horiz           |
| 13917-5 Radiated Emissions 10.6 - 12.5 GHz Vert            |
| 13917-5 Radiated Emissions 12.5 - 15 GHz @0.3m horiz       |
| 13917-5 Radiated Emissions 12.5 - 15 GHz @0.3m vert        |
| 13917-5 Radiated Emissions 15 - 18 GHz @0.3m horiz         |
| 13917-5 Radiated Emissions 15 - 18 GHz @0.3m vert          |
| 13917-5 Radiated Emissions 18 - 22 GHz @0.3m horiz         |
| 13917-5 Radiated Emissions 18 - 22 GHz @0.3m vert          |
| 13917-5 Radiated Emissions 22 - 26 GHz @0.3m horiz         |
| 13917-5 Radiated Emissions 22 - 26 GHz @0.3m vert          |
| 13917-5 Radiated Emissions 26 - 26.5 GHz @0.3m horiz       |

| Plot reference table                                   |
|--------------------------------------------------------|
| 13917-5 Radiated Emissions 26 - 26.5 GHz @0.3m vert    |
| 13917-5 Radiated Emissions 26.5 - 30 GHz @0.3m horiz   |
| 13917-5 Radiated Emissions 26.5 - 30 GHz @0.3m vert    |
| 13917-5 Radiated Emissions 30 - 33 GHz @0.3m horiz     |
| 13917-5 Radiated Emissions 30 - 33 GHz @0.3m vert      |
| 13917-5 Radiated Emissions 33 - 36 GHz @0.3m horiz     |
| 13917-5 Radiated Emissions 33 - 36 GHz @0.3m vert      |
| 13917-5 Radiated Emissions 36 - 40 GHz @0.3m horiz     |
| 13917-5 Radiated Emissions 36 - 40 GHz @0.3m vert      |
| 13917-5 Radiated Emissions 1.164 - 1.202 GHz @1m horiz |
| 13917-5 Radiated Emissions 1.164 - 1.202 GHz @1m vert  |
| 13917-5 Radiated Emissions 1.202 - 1.24 GHz @1m horiz  |
| 13917-5 Radiated Emissions 1.202 - 1.24 GHz @1m vert   |
| 13917-5 Radiated Emissions 1.559 - 1.61 GHz @1m horiz  |
| 13917-5 Radiated Emissions 1.559 - 1.61 GHz @1m vert   |

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

#### LIMITS:

47 CFR Part 15C Clause 15.250 (d)(1)

| Frequency in MHz | EIRP in dBm | Equivalent in dBuV/m @ 3 metres |
|------------------|-------------|---------------------------------|
| 960-1610         | -75.3       | 19.9                            |
| 1610-1990        | -63.3       | 31.9                            |
| 1990-3100        | -61.3       | 33.9                            |
| 3100-5925        | -51.3       | 43.9                            |
| 5925-7250        | -41.3       | 53.9                            |
| 7250-10600       | -51.3       | 43.9                            |
| Above 10600      | -61.3       | 33.9                            |

In addition to the radiated emission limits specified in the table in paragraph (above), transmitters operating under the provisions of this section shall not exceed the following RMS average limits when measured using a resolution bandwidth of no less than 1 kHz:

47 CFR Part 15C Clause 15.250 (d)(2)

| Frequency in MHz | EIRP in dBm | Equivalent in dBuV/m @ 3 metres |
|------------------|-------------|---------------------------------|
| 1164-1240        | -85.3       | 9.9                             |
| 1559-1610        | -85.3       | 9.9                             |

47 CFR Part 15C Clause 15.209 Average Limit: 54dBuV/m at 3m.

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:

960 – 18 GHz  $\pm 3.5$ dB, 18 – 26.5 GHz  $\pm 3.9$ dB, 26.5 – 40 GHz  $\pm 3.9$ dB

## 5.5 Radiated emissions 150 kHz - 30 MHz

### 5.5.1 Test methods

Test Requirements: 47 CFR Part 15C Clause 15.209 [Reference 4.1.1 of this report]  
Test Method: ANSI C63.10 Clause 6.4 [Reference 4.1.3 of this report]  
Limits: 47 CFR Part 15C Clause 15.209 [Reference 4.1.1 of this report]

### 5.5.2 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 fully charged battery. The EUT was operated in TX1 mode.

### 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 (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.

### 5.5.4 Test equipment

TMS81, ZSW1, E412, E411

See Section 9 for more details

### 5.5.5 Test results

Temperature of test environment 12°C  
Humidity of test environment 60%  
Pressure of test environment 101kPa

|                 |                |
|-----------------|----------------|
| Band            | 5925-7250 MHz  |
| Power Level     | 15.5 dBm       |
| Channel Spacing | Single Channel |
| Mod Scheme      | UWB            |
| Single channel  | 6500 MHz       |

|                               |
|-------------------------------|
| Plot refs                     |
| 13917-5 Rad 1 150k-30MHz Para |
| 13917-5 Rad 1 150k-30MHz Perp |

Note: No emissions observed within 20dB of limits.

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

#### LIMITS:

15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.  
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  $\pm 3.9$ dB

## 5.6 Radiated emissions 9 - 150 kHz

### 5.6.1 Test methods

|                    |                                                                |
|--------------------|----------------------------------------------------------------|
| Test Requirements: | 47 CFR Part 15C Clause 15.209 [Reference 4.1.1 of this report] |
| Test Method:       | ANSI C63.10 Clause 6.4 [Reference 4.1.3 of this report]        |
| Limits:            | 47 CFR Part 15C Clause 15.209 [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 EUT was rotated in all three orthogonal planes. Radiated Emissions testing was performed with a fully charged battery. The EUT was operated in TX1 mode.

### 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 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.

### 5.6.4 Test equipment

TMS81, ZSW1, E412, E411

See Section 9 for more details

### 5.6.5 Test results

|                                 |        |
|---------------------------------|--------|
| Temperature of test environment | 12°C   |
| Humidity of test environment    | 60%    |
| Pressure of test environment    | 101kPa |

|                 |                |
|-----------------|----------------|
| Band            | 5925-7250 MHz  |
| Power Level     | 15.5 dBm       |
| Channel Spacing | Single Channel |
| Mod Scheme      | UWB            |
| Single channel  | 6500 MHz       |

|                              |
|------------------------------|
| Plot refs                    |
| 13917-5 Rad 1 9k-150kHz Para |
| 13917-5 Rad 1 9k-150kHz Perp |

Note: No emissions observed within 20dB of limits.

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

#### LIMITS:

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

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:  
UE70 9kHz to 150kHz  $\pm 3.76$ dB

## 5.7 AC power line conducted emissions

### 5.7.1 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]

### 5.7.2 Configuration of EUT

The EUT was placed inside the charging station along with a second test unit and this was positioned 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.

For final test the EUT was operated in mode TX1.

### 5.7.3 Test procedure

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

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

Tests were performed in Test Site F.

### 5.7.4 Test equipment

E150, E035, ZSW1, E412, E411

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 101 kPa

|                 |                |
|-----------------|----------------|
| Band            | 5925-7250 MHz  |
| Power Level     | 15.5 dBm       |
| Channel Spacing | Single Channel |
| Mod Scheme      | UWB            |
| Single channel  | 6500 MHz       |

|                                               |
|-----------------------------------------------|
| Plot refs                                     |
| 13917-5 Cond 1 AC Live 150k-30M Average       |
| 13917-5 Cond 1 AC Live 150k-30M Quasi-Peak    |
| 13917-5 Cond 1 AC Neutral 150k-30M Average    |
| 13917-5 Cond 1 AC Neutral 150k-30M Quasi-Peak |

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

| Signal No. | Freq (MHz) | Peak Amp (dBuV) | QP Amp (dBuV) | QP -Lim (dB) | AV Amp (dBuV) | AV -Lim (dB) |
|------------|------------|-----------------|---------------|--------------|---------------|--------------|
| 1          | 0.156      | 48.8            | 47.9          | -17.8        | 37.0          | -18.7        |
| 2          | 0.187      | 43.0            | 42.0          | -22.2        | 32.4          | -21.8        |
| 3          | 0.343      | 44.1            | 43.5          | -15.6        | 42.0          | -7.1         |
| 4          | 0.374      | 43.2            | 42.5          | -15.9        | 41.6          | -6.8         |
| 5          | 0.374      | 43.4            | 42.3          | -16.1        | 41.5          | -6.9         |
| 6          | 19.935     | 38.9            | 37.1          | -22.9        | 34.7          | -15.3        |

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

| Signal No. | Freq (MHz) | Peak Amp (dBuV) | QP Amp (dBuV) | QP -Lim (dB) | AV Amp (dBuV) | AV -Lim (dB) |
|------------|------------|-----------------|---------------|--------------|---------------|--------------|
| 1          | 0.156      | 48.8            | 47.9          | -17.8        | 37.3          | -18.4        |
| 2          | 0.343      | 44.0            | 43.5          | -15.6        | 41.9          | -7.2         |
| 3          | 0.374      | 43.2            | 42.4          | -16.0        | 41.6          | -6.8         |
| 4          | 0.467      | 33.9            | 33.0          | -23.6        | 31.5          | -15.1        |
| 5          | 19.798     | 32.7            | 29.1          | -30.9        | 22.0          | -28.0        |
| 6          | 19.932     | 39.9            | 38.6          | -21.4        | 36.6          | -13.4        |
| 7          | 20.201     | 39.1            | 37.5          | -22.5        | 34.7          | -15.3        |

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.

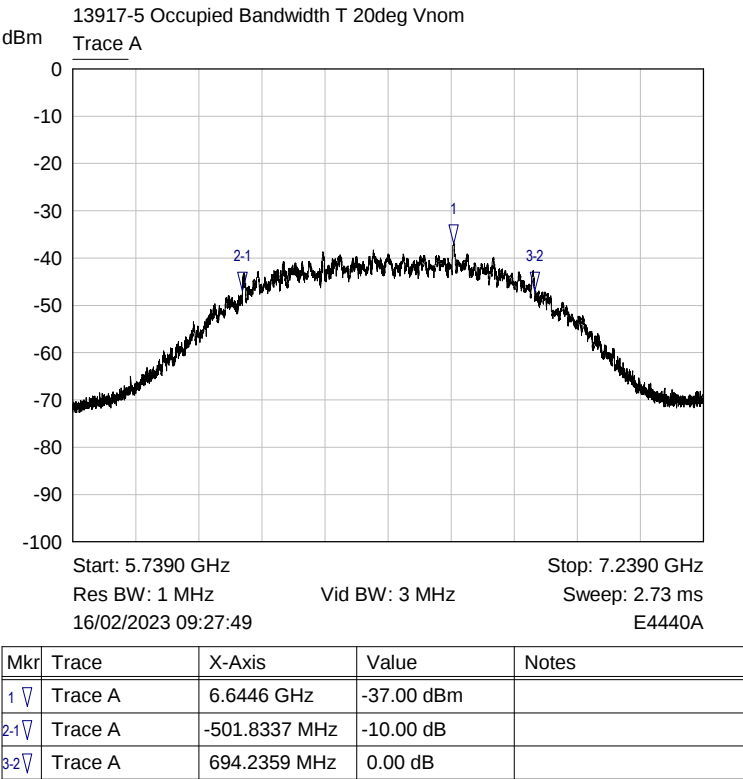
The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:

UE71 150kHz to 30MHz  $\pm 3.4$ dB

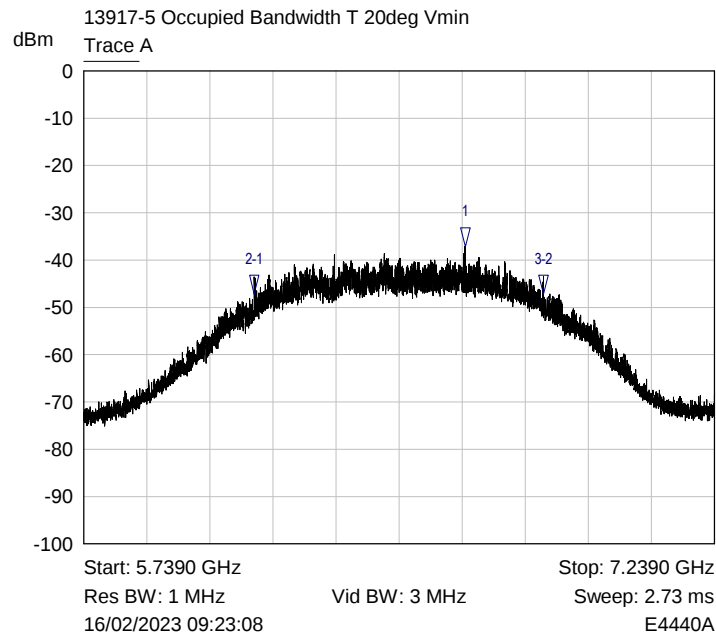
6 Plots/Graphical results

6.1 10dB Bandwidth

RF Parameters: Band 5925-7250 MHz, Power 15.5 dBm, Channel Spacing Single Channel, Modulation UWB, Channel 6500 MHz (Span set to 6489 MHz Centre)

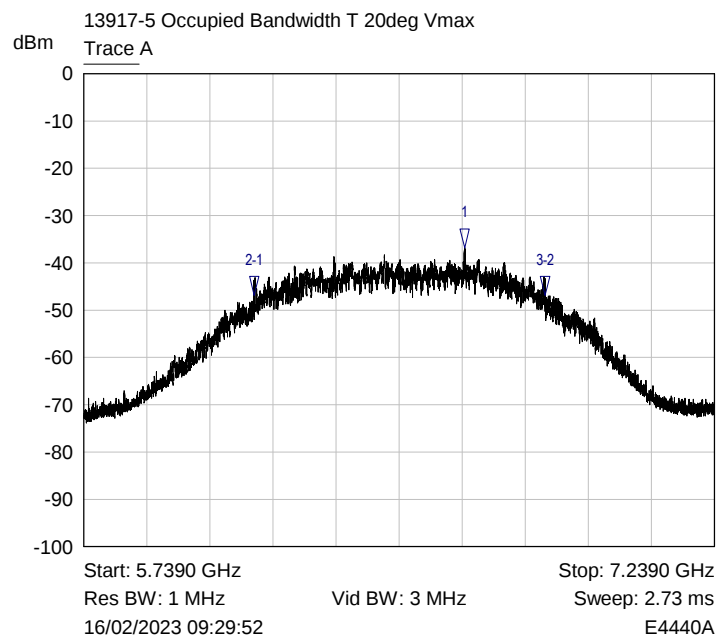


Nom temp (20°C) Nom Voltage



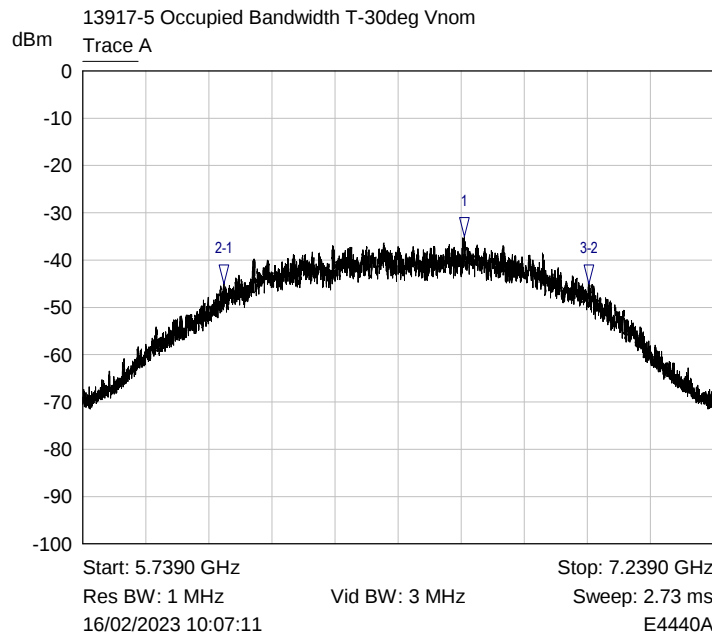
| Mkr   | Trace   | X-Axis        | Value      | Notes |
|-------|---------|---------------|------------|-------|
| 1 ▽   | Trace A | 6.6457 GHz    | -37.13 dBm |       |
| 2-1 ▽ | Trace A | -501.1130 MHz | -10.00 dB  |       |
| 3-2 ▽ | Trace A | 687.7943 MHz  | -0.00 dB   |       |

### Nom temp (20°C) Min Voltage



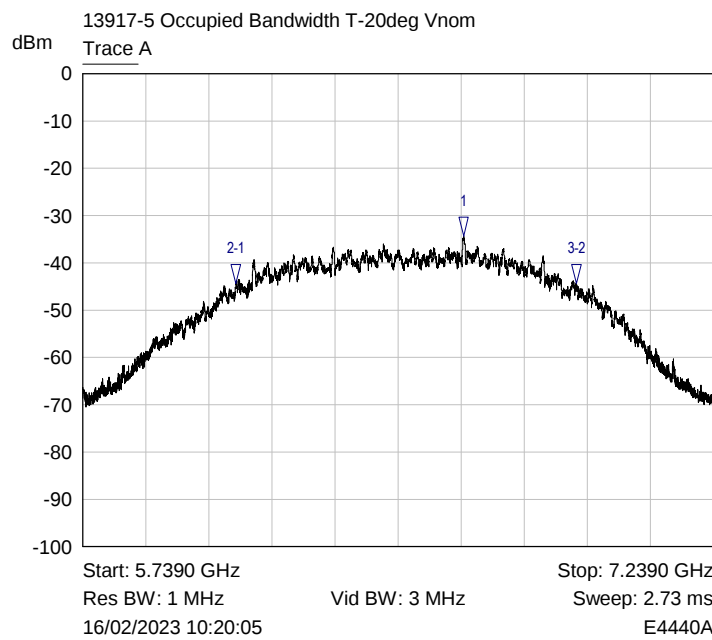
| Mkr   | Trace   | X-Axis        | Value      | Notes |
|-------|---------|---------------|------------|-------|
| 1 ▽   | Trace A | 6.6451 GHz    | -36.83 dBm |       |
| 2-1 ▽ | Trace A | -501.9789 MHz | -10.00 dB  |       |
| 3-2 ▽ | Trace A | 693.6006 MHz  | -0.00 dB   |       |

### Nom temp (20°C) Max Voltage



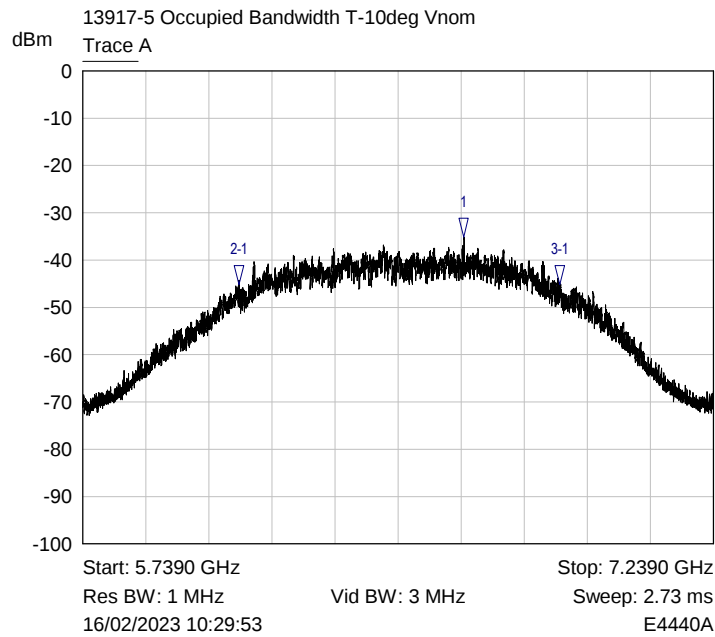
| Mkr   | Trace   | X-Axis        | Value      | Notes |
|-------|---------|---------------|------------|-------|
| 1 ▽   | Trace A | 6.6466 GHz    | -35.06 dBm |       |
| 2-1 ▽ | Trace A | -572.2304 MHz | -10.00 dB  |       |
| 3-2 ▽ | Trace A | 867.9819 MHz  | -0.00 dB   |       |

### -30°C Nom Voltage



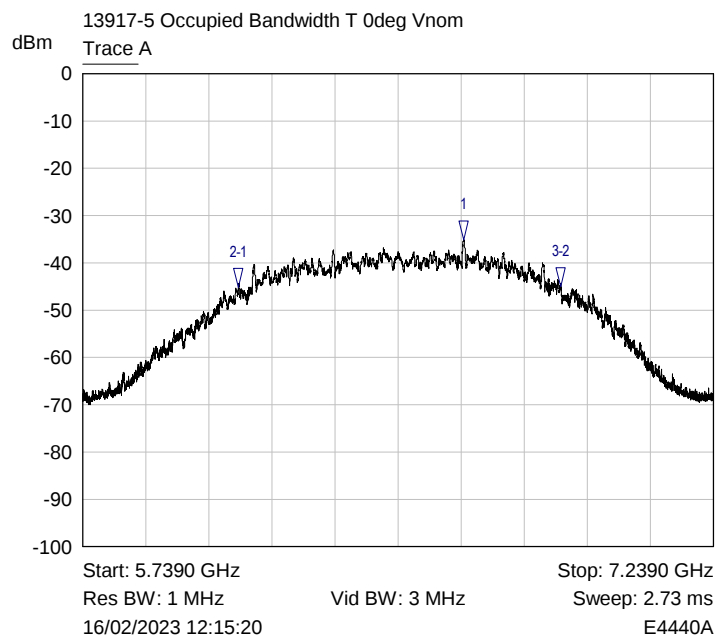
| Mkr   | Trace   | X-Axis        | Value      | Notes |
|-------|---------|---------------|------------|-------|
| 1 ▽   | Trace A | 6.6449 GHz    | -34.38 dBm |       |
| 2-1 ▽ | Trace A | -541.7613 MHz | -10.00 dB  |       |
| 3-2 ▽ | Trace A | 809.9504 MHz  | -0.00 dB   |       |

### -20°C Nom Voltage



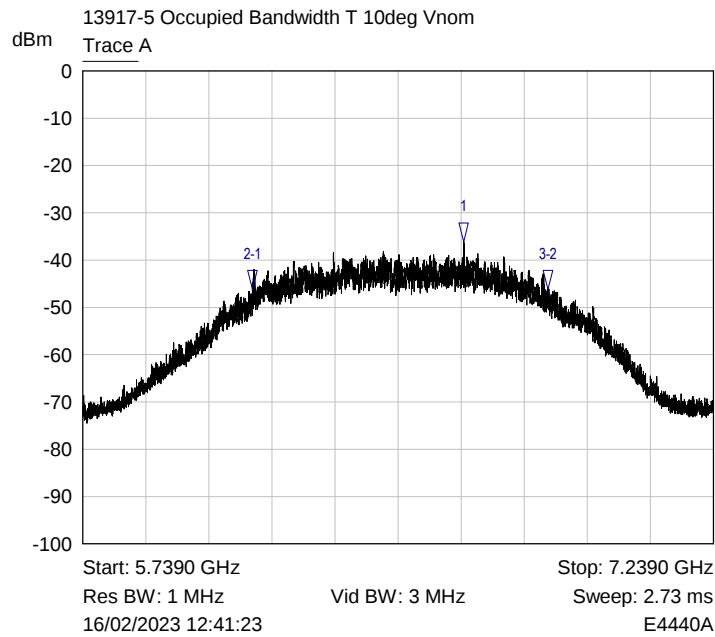
| Mkr   | Trace   | X-Axis        | Value      | Notes |
|-------|---------|---------------|------------|-------|
| 1 ▽   | Trace A | 6.6455 GHz    | -35.13 dBm |       |
| 2-1 ▽ | Trace A | -536.1003 MHz | -10.00 dB  |       |
| 3-1 ▽ | Trace A | 228.7749 MHz  | -10.00 dB  |       |

### -10°C Nom Voltage

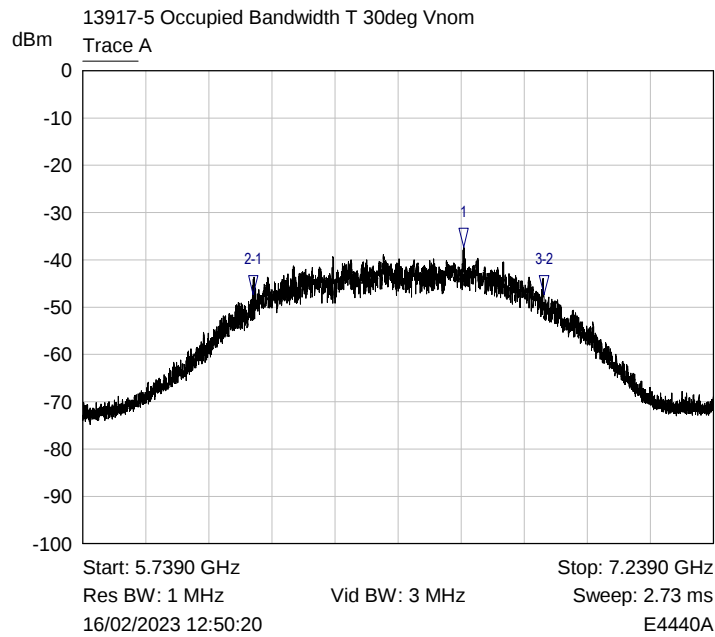


| Mkr   | Trace   | X-Axis        | Value      | Notes |
|-------|---------|---------------|------------|-------|
| 1 ▽   | Trace A | 6.6451 GHz    | -35.09 dBm |       |
| 2-1 ▽ | Trace A | -536.0524 MHz | -10.00 dB  |       |
| 3-2 ▽ | Trace A | 766.1442 MHz  | -0.00 dB   |       |

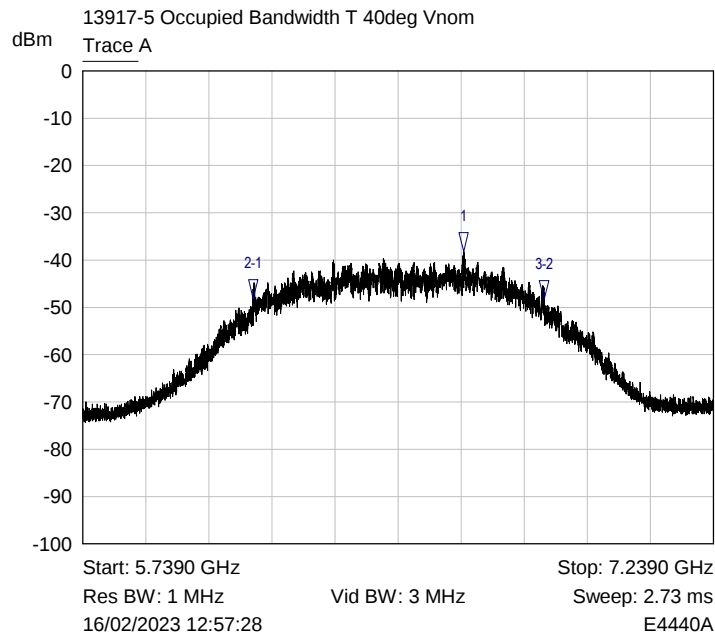
### 0°C Nom Voltage



### 10°C Nom Voltage

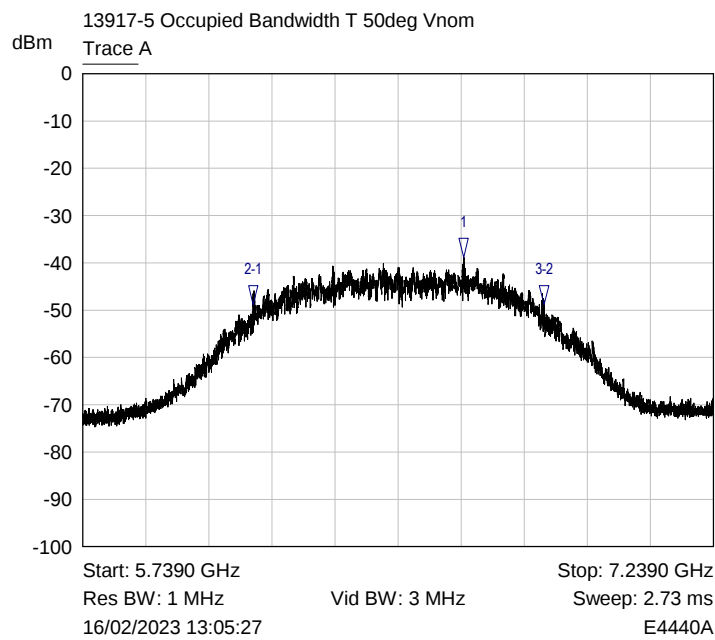


### 30°C Nom Voltage



| Mkr   | Trace   | X-Axis        | Value      | Notes |
|-------|---------|---------------|------------|-------|
| 1 ▽   | Trace A | 6.6448 GHz    | -38.22 dBm |       |
| 2-1 ▽ | Trace A | -501.6128 MHz | -10.00 dB  |       |
| 3-2 ▽ | Trace A | 692.9273 MHz  | 0.00 dB    |       |

#### 40°C Nom Voltage

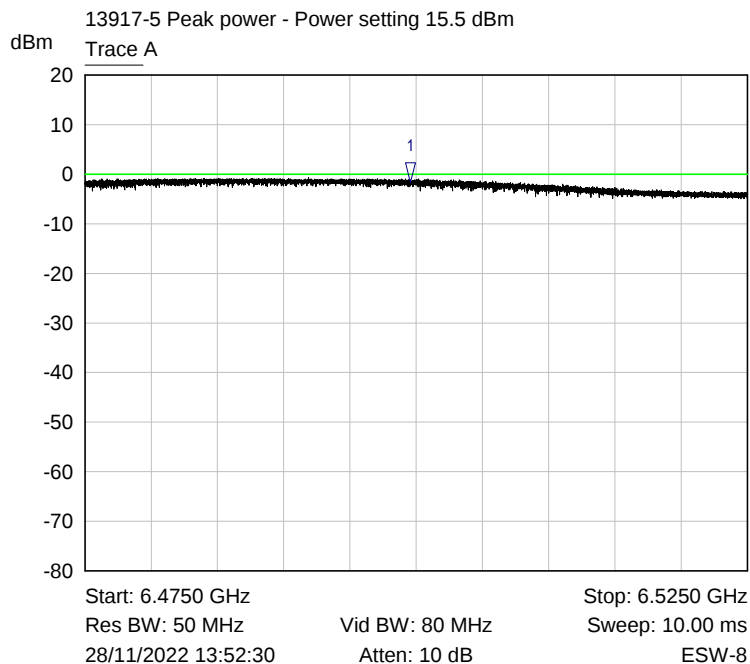


| Mkr   | Trace   | X-Axis        | Value      | Notes |
|-------|---------|---------------|------------|-------|
| 1 ▽   | Trace A | 6.6442 GHz    | -38.80 dBm |       |
| 2-1 ▽ | Trace A | -500.4278 MHz | -10.00 dB  |       |
| 3-2 ▽ | Trace A | 691.9027 MHz  | -0.00 dB   |       |

#### 50°C Nom Voltage

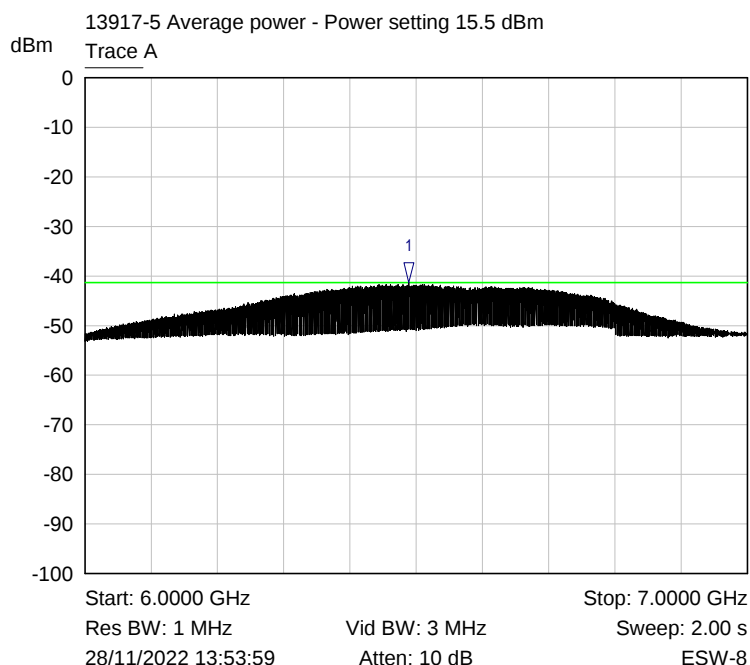
## 6.2 Peak & Average EIRP

RF Parameters: Band 5925-7250 MHz, Power 15.5 dBm, Channel Spacing Single Channel, Modulation UWB, Channel 6500 MHz



| Mkr | Trace   | X-Axis     | Value     | Notes |
|-----|---------|------------|-----------|-------|
| 1 ▽ | Trace A | 6.4995 GHz | -1.60 dBm |       |

Peak Plot Max held

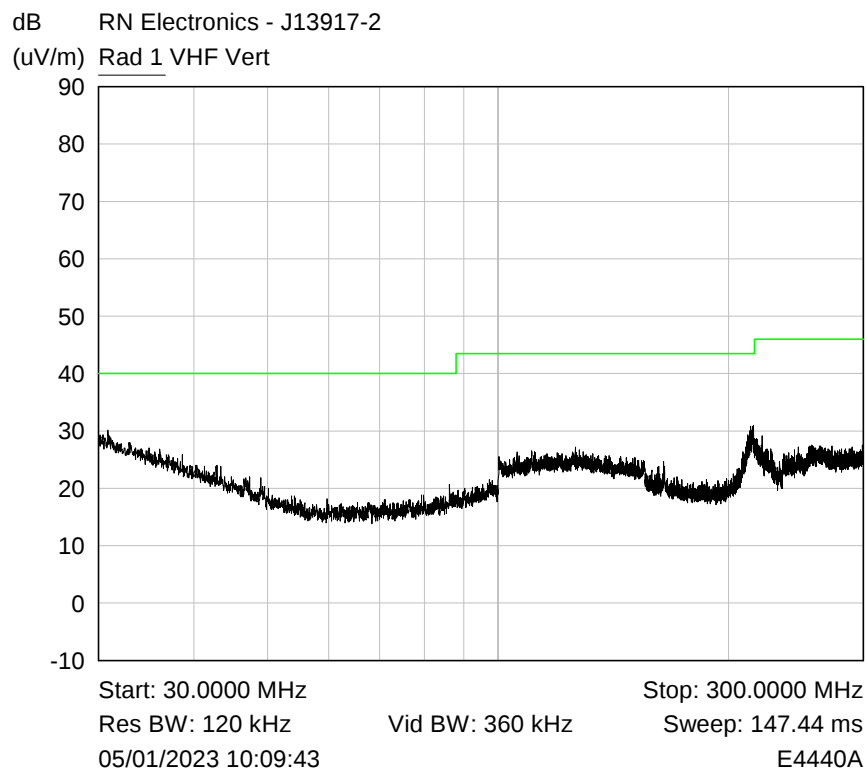
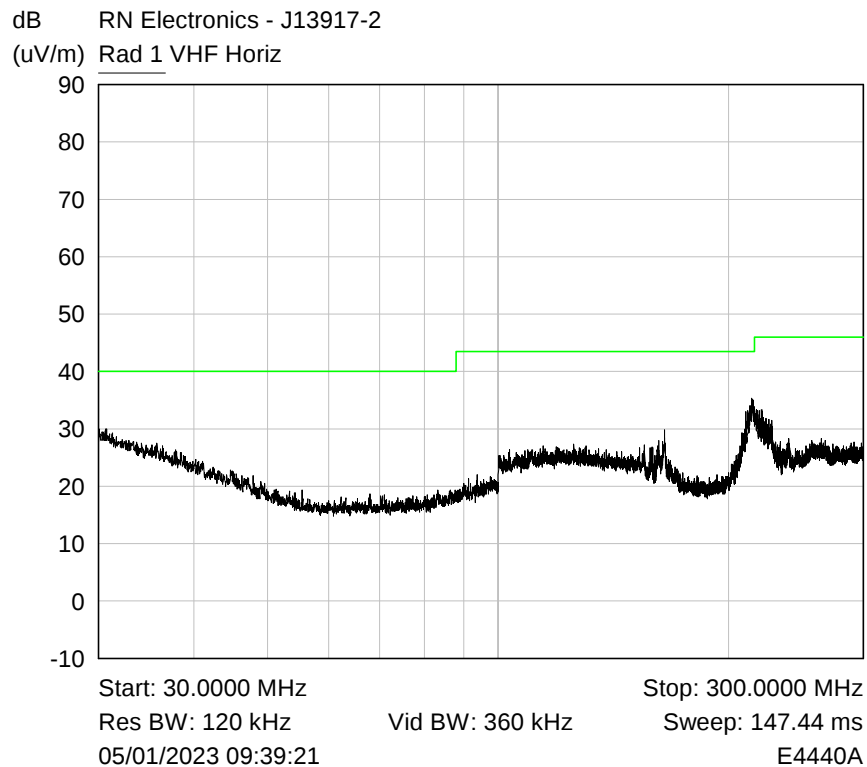


| Mkr | Trace   | X-Axis     | Value      | Notes |
|-----|---------|------------|------------|-------|
| 1 ▽ | Trace A | 6.4892 GHz | -41.37 dBm |       |

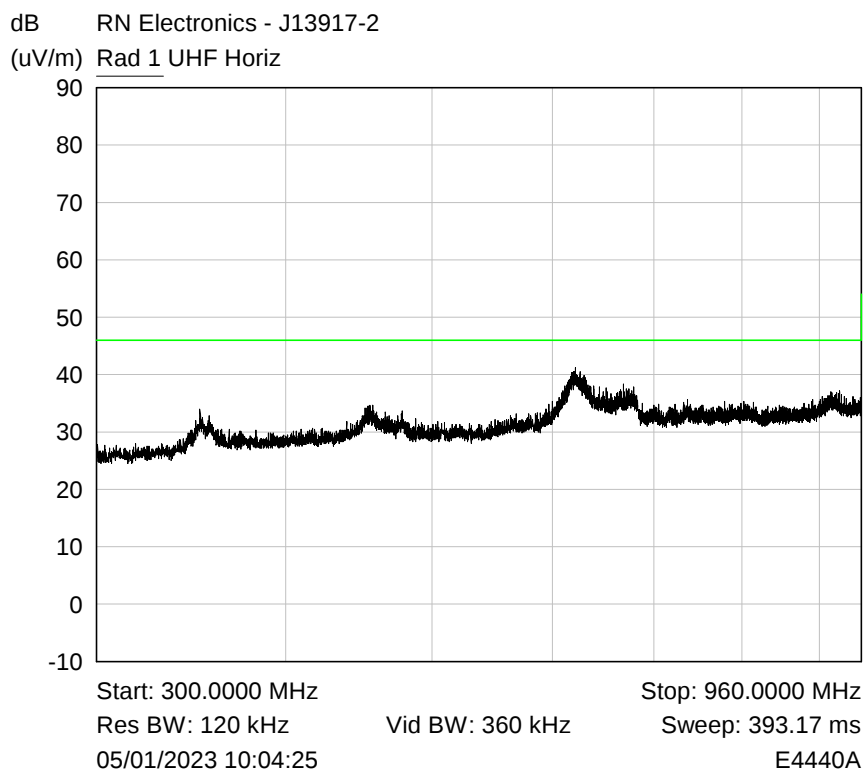
AV RMS plot 1ms per point sweep time

### 6.3 Radiated emissions 30 - 960 MHz

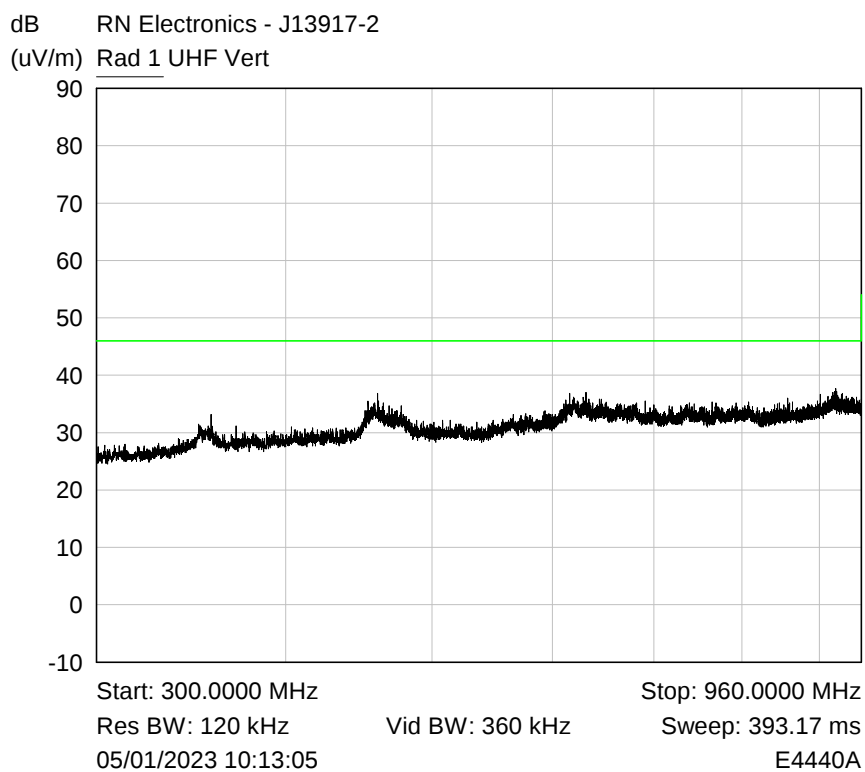
RF Parameters: Band 5925-7250 MHz, Power 15.5 dBm, Channel Spacing Single Channel,  
Modulation UWB, Channel 6500 MHz



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



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

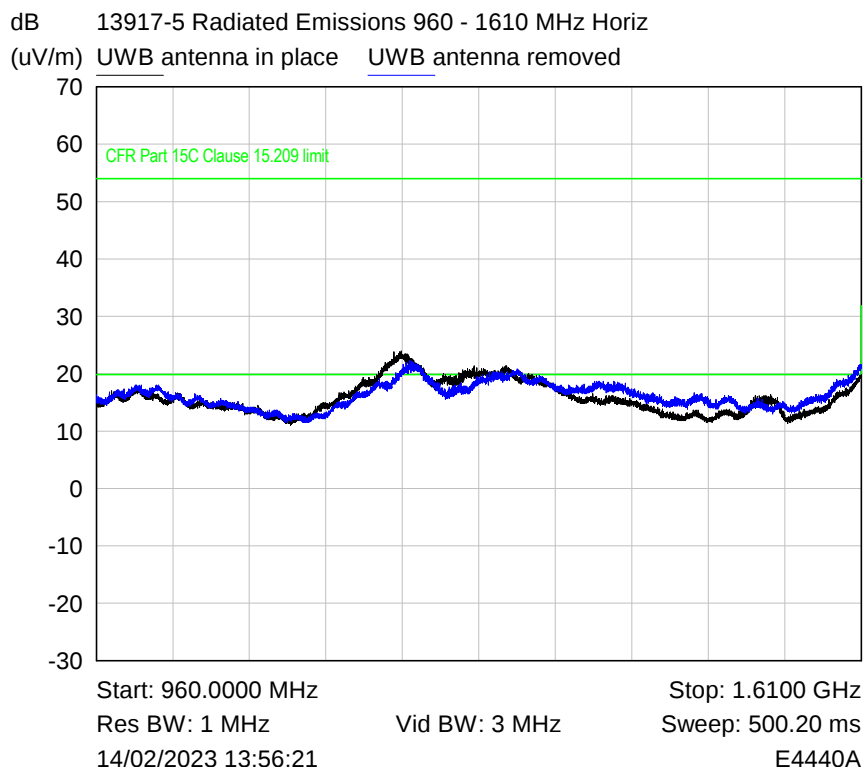


Plot of Peak emissions for UHF Horizontal against the QP limit line.

## 6.4 Radiated emissions above 960 MHz

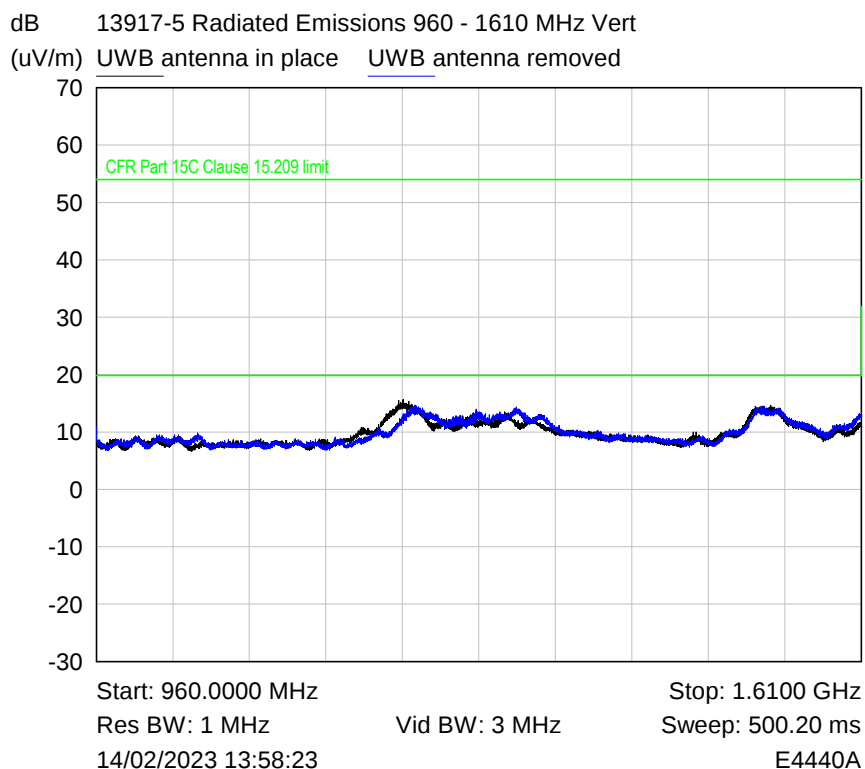
Note: All emissions plots were taken with the antenna fitted for the entire test range, the unit was then taken out of the test chamber and the antenna unsoldered, care was taken to try and position the EUT back in the exact same/correct position, before any plots with antenna removed were re-maximised and re-plotted as a second trace.

RF Parameters: Band 5925-7250 MHz, Power 15.5 dBm, Channel Spacing Single Channel, Modulation UWB, Channel 6500 MHz



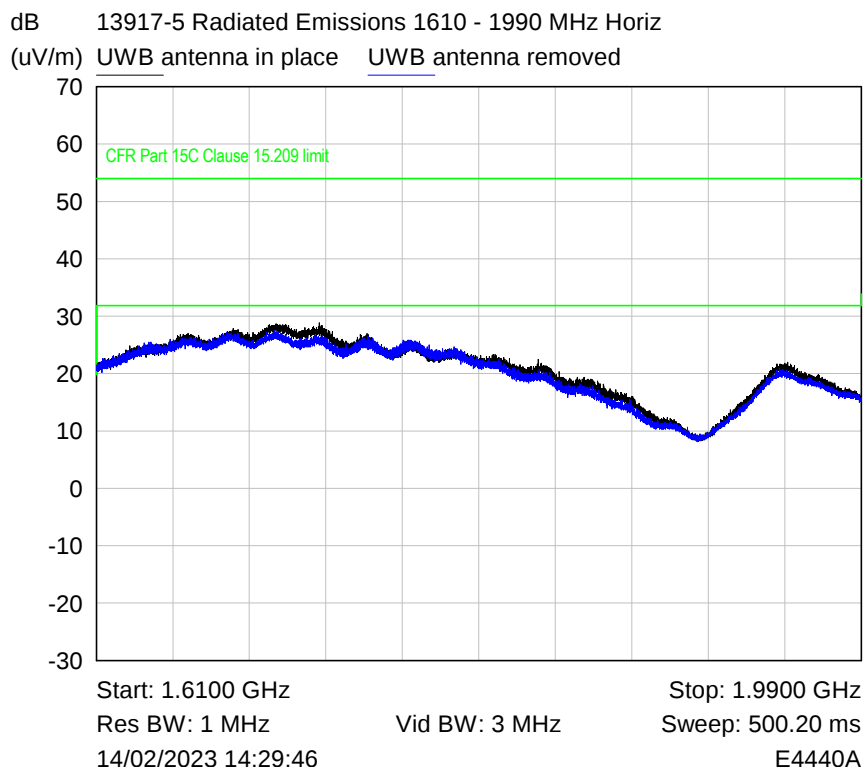
Note: As per CFR Part 15C Clause 15.250(d)(5), Emissions from digital circuitry used to enable the operation of the transmitter may comply with the limits in CFR Part 15C Clause 15.209.

During emissions tests over the frequency range 960 – 1990 MHz the limit was approached / exceeded. In order to demonstrate the emissions were associated to the digital circuitry and not radiated from the transmitter, the UWB antenna was unsoldered from the board and a second measurement was performed. Where no difference in the emission profile was observed, the emissions were assessed to 15.209 Limits.



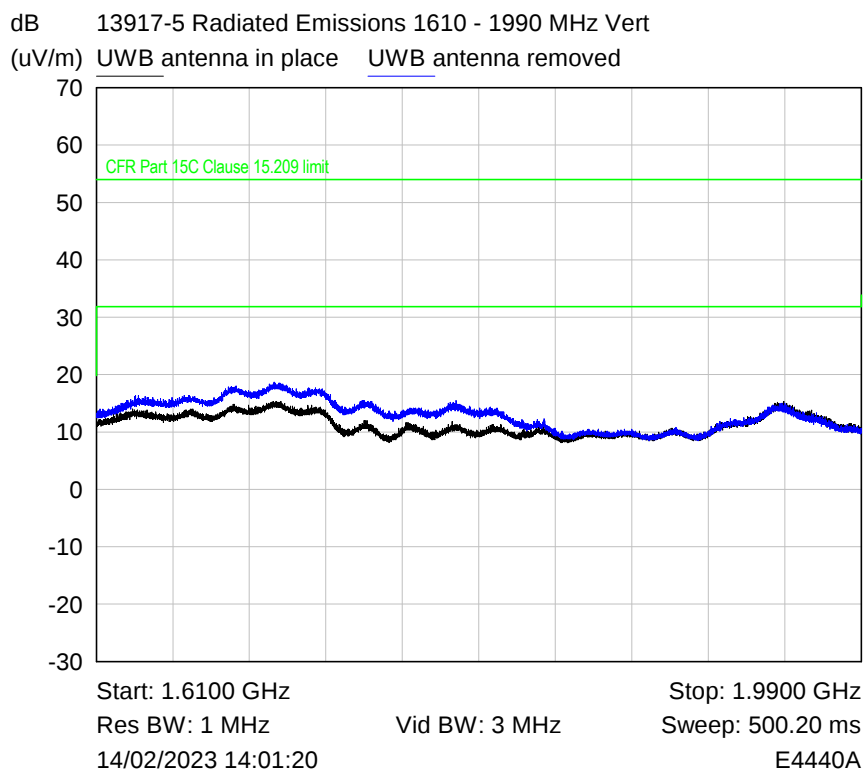
Note: As per CFR Part 15C Clause 15.250(d)(5), Emissions from digital circuitry used to enable the operation of the transmitter may comply with the limits in CFR Part 15C Clause 15.209.

During emissions tests over the frequency range 960 – 1990 MHz the limit was approached / exceeded. In order to demonstrate the emissions were associated to the digital circuitry and not radiated from the transmitter, the UWB antenna was unsoldered from the board and a second measurement was performed. Where no difference in the emission profile was observed, the emissions were assessed to 15.209 Limits.



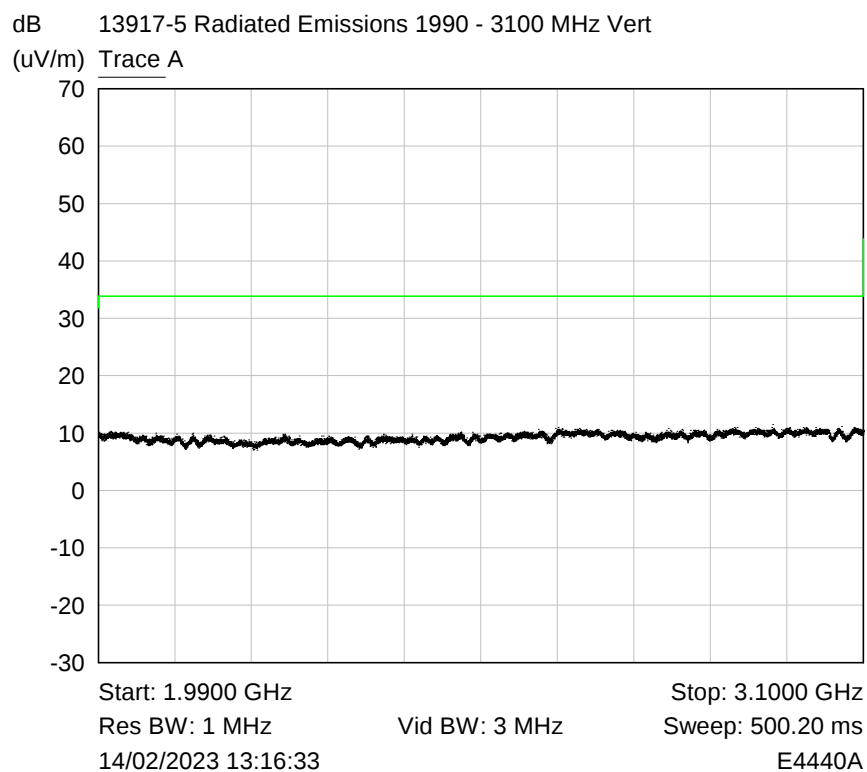
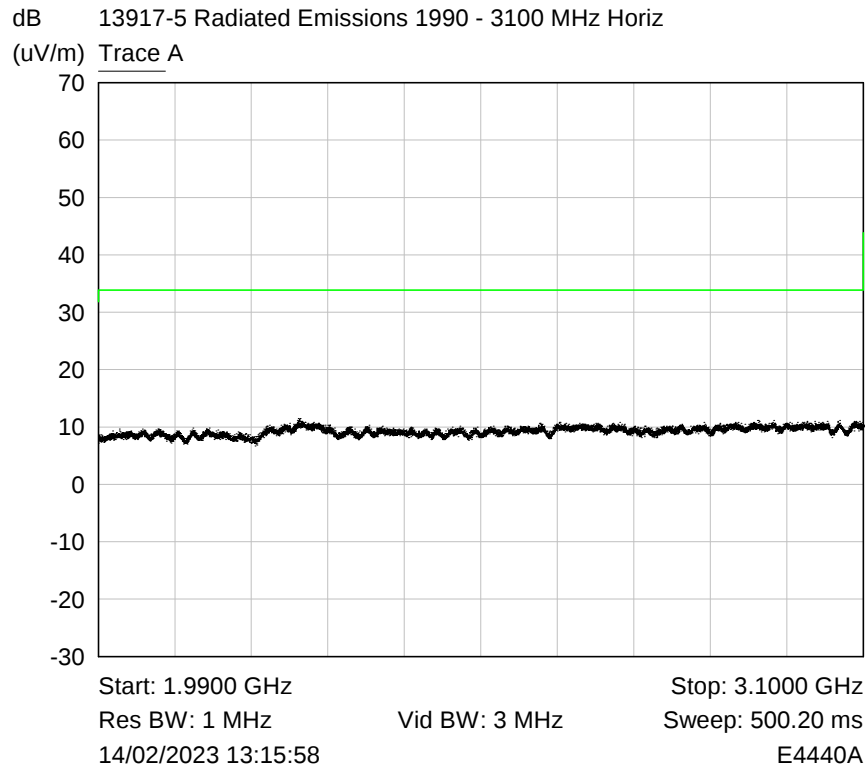
Note: As per CFR Part 15C Clause 15.250(d)(5), Emissions from digital circuitry used to enable the operation of the transmitter may comply with the limits in CFR Part 15C Clause 15.209.

During emissions tests over the frequency range 960 – 1990 MHz the limit was approached / exceeded. In order to demonstrate the emissions were associated to the digital circuitry and not radiated from the transmitter, the UWB antenna was unsoldered from the board and a second measurement was performed. Where no difference in the emission profile was observed, the emissions were assessed to 15.209 Limits.

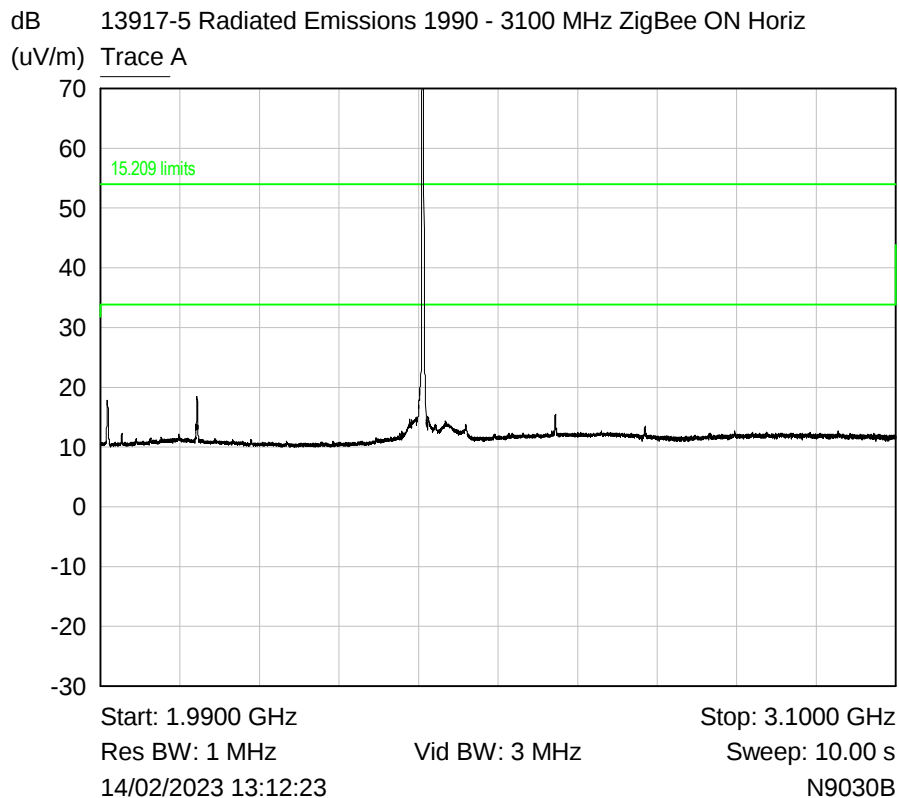


Note: As per CFR Part 15C Clause 15.250(d)(5), Emissions from digital circuitry used to enable the operation of the transmitter may comply with the limits in CFR Part 15C Clause 15.209.

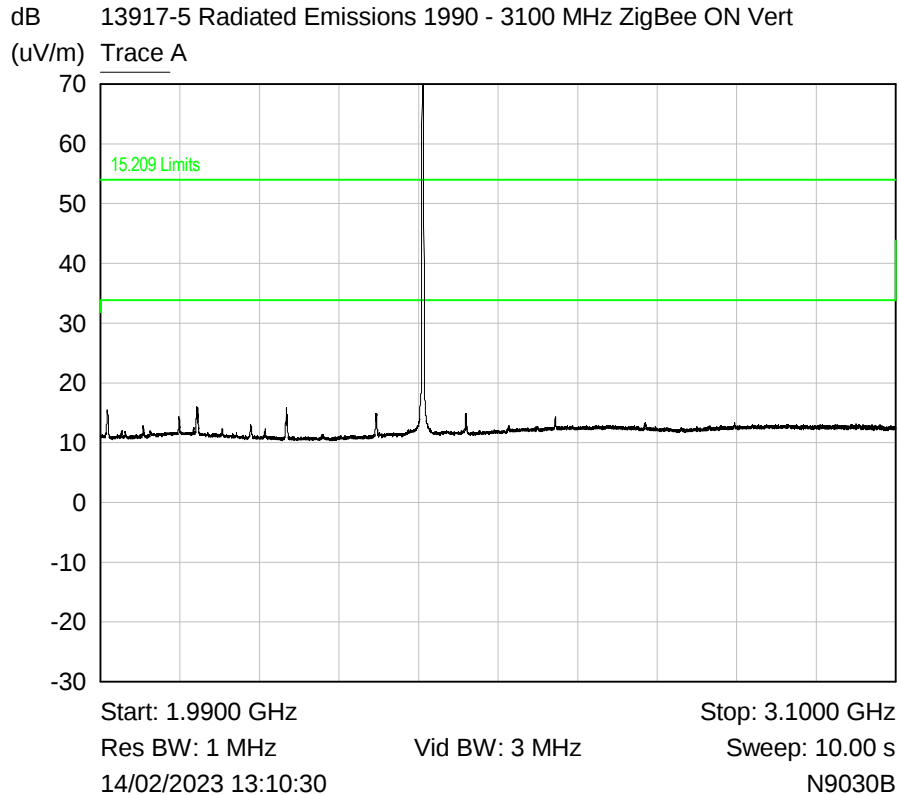
During emissions tests over the frequency range 960 – 1990 MHz the limit was approached / exceeded. In order to demonstrate the emissions were associated to the digital circuitry and not radiated from the transmitter, the UWB antenna was unsoldered from the board and a second measurement was performed. Where no difference in the emission profile was observed, the emissions were assessed to 15.209 Limits.



### Additional plots showing ZigBee emission fundamental on with UWB



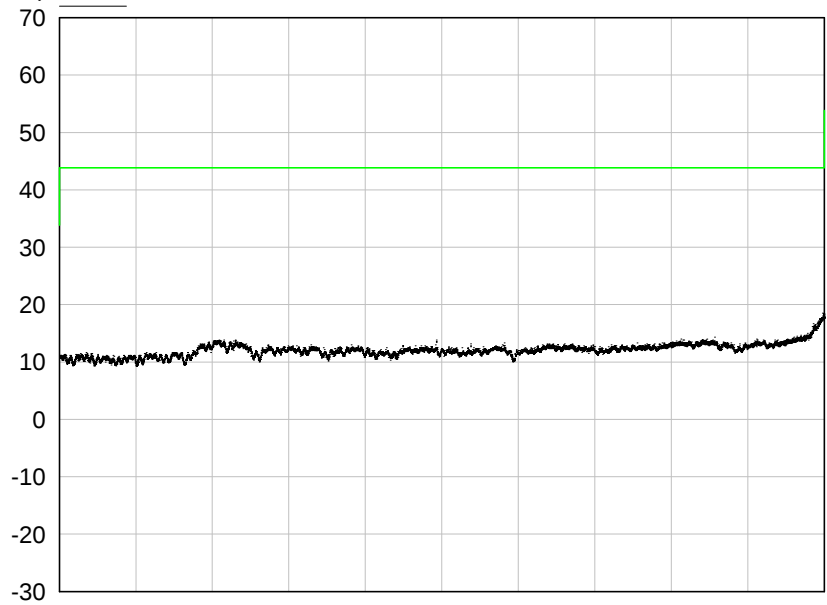
ZigBee fundamental shown on plot and associated emissions assessed to 15.209 limits and not within 20dB of those limits, see RN report 01-13917-2-23. UWB limits not applied to ZigBee emissions.



ZigBee fundamental shown on plot and associated emissions assessed to 15.209 limits and not within 20dB of those limits, see RN report 01-13917-2-23. UWB limits not applied to ZigBee emissions.

dB 13917-5 Radiated Emissions 3100 - 5925 MHz Horiz

(uV/m) Trace A



Start: 3.1000 GHz

Res BW: 1 MHz

14/02/2023 13:17:51

Vid BW: 3 MHz

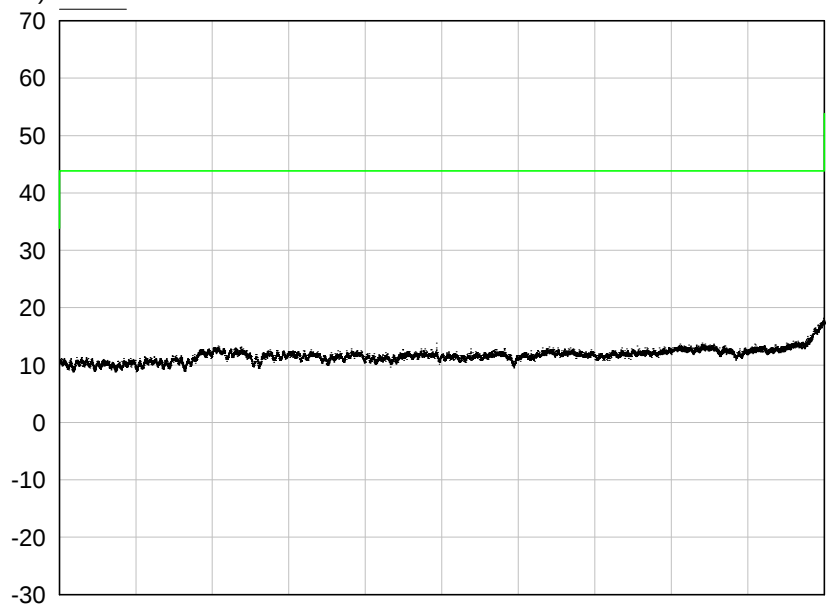
Stop: 5.9250 GHz

Sweep: 500.20 ms

E4440A

dB 13917-5 Radiated Emissions 3100 - 5925 MHz Vert

(uV/m) Trace A



Start: 3.1000 GHz

Res BW: 1 MHz

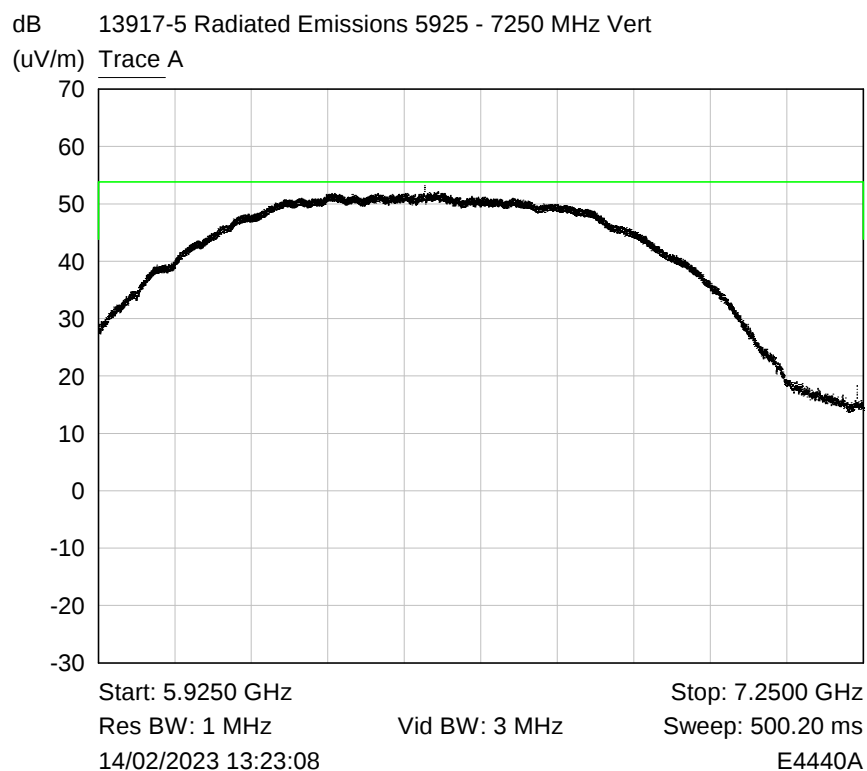
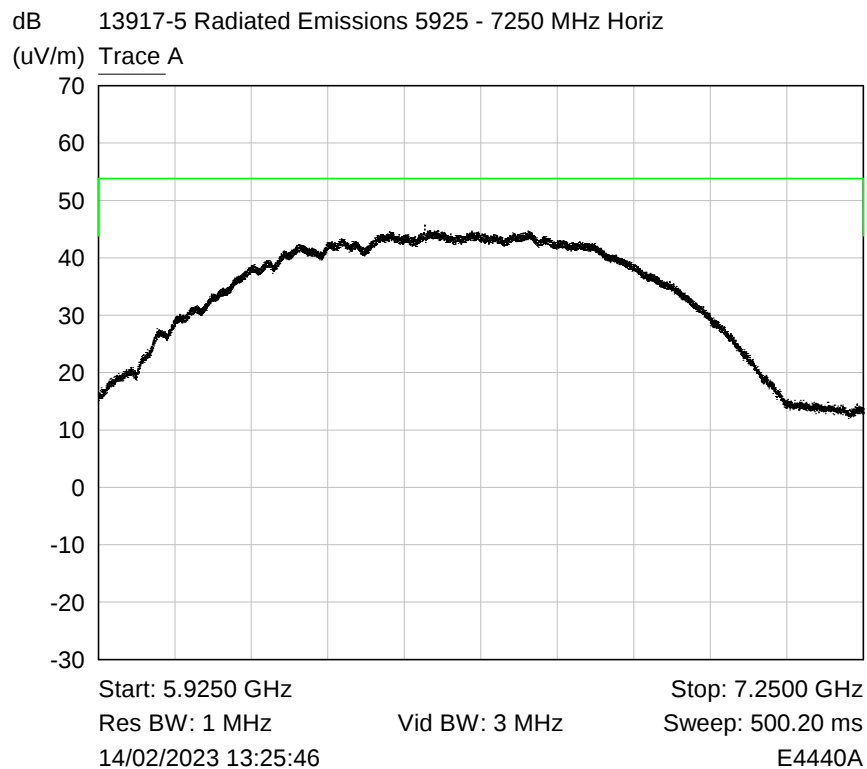
14/02/2023 13:17:07

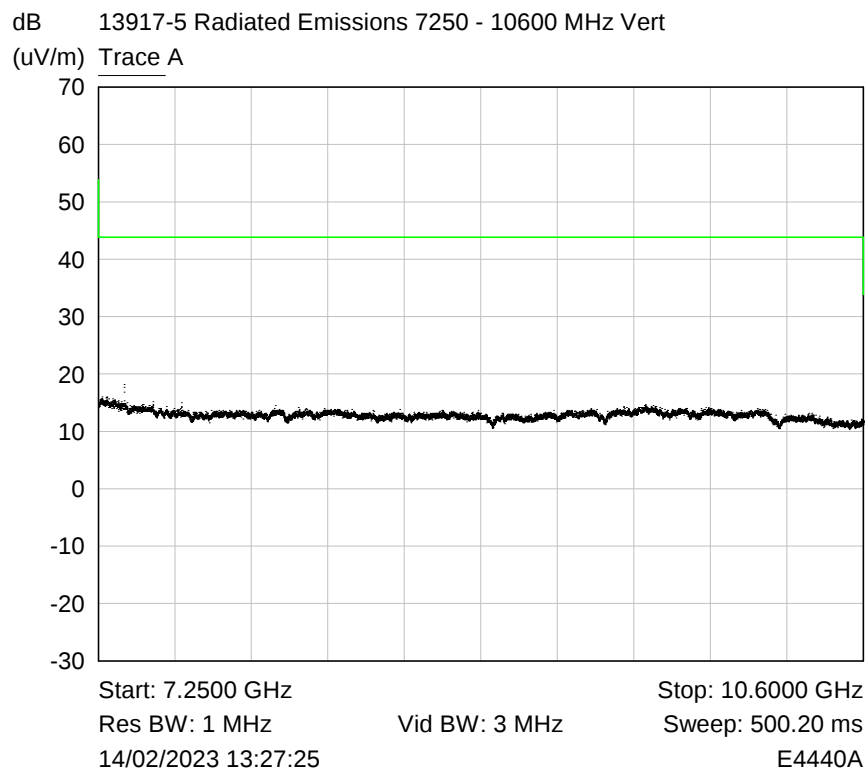
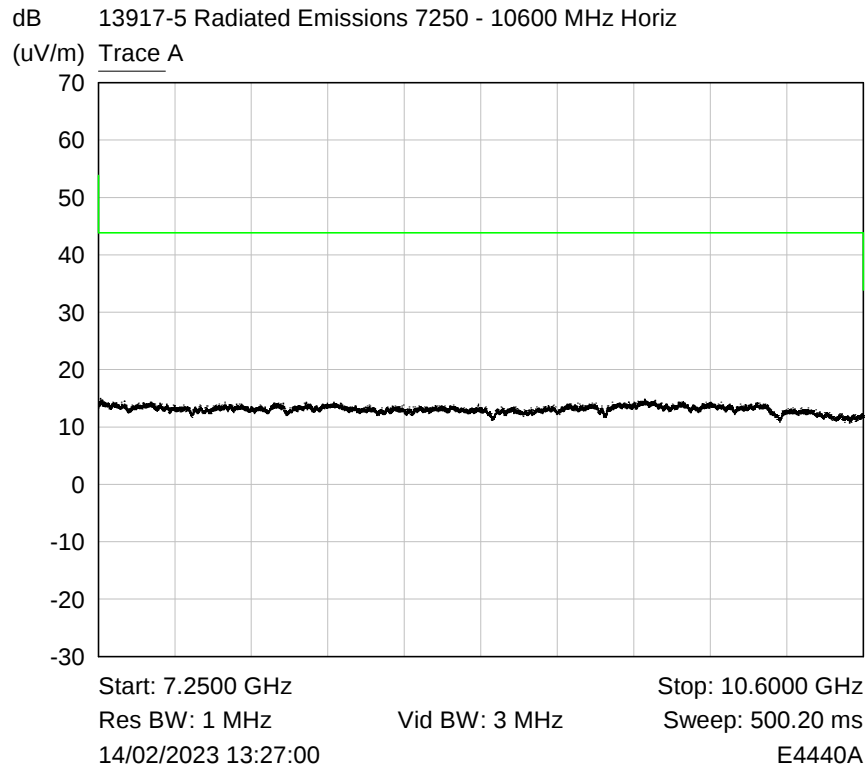
Vid BW: 3 MHz

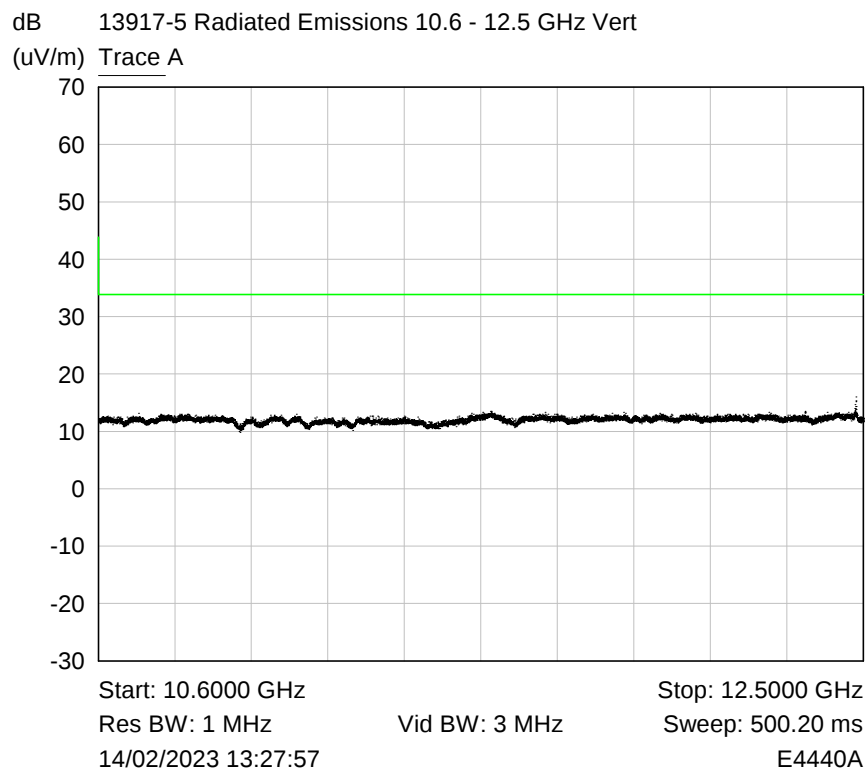
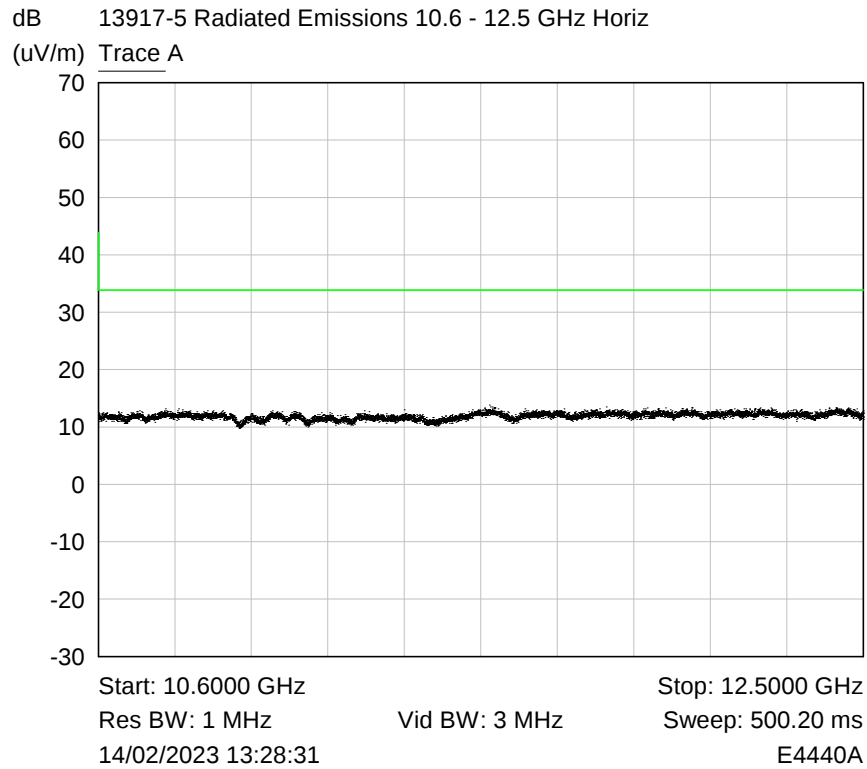
Stop: 5.9250 GHz

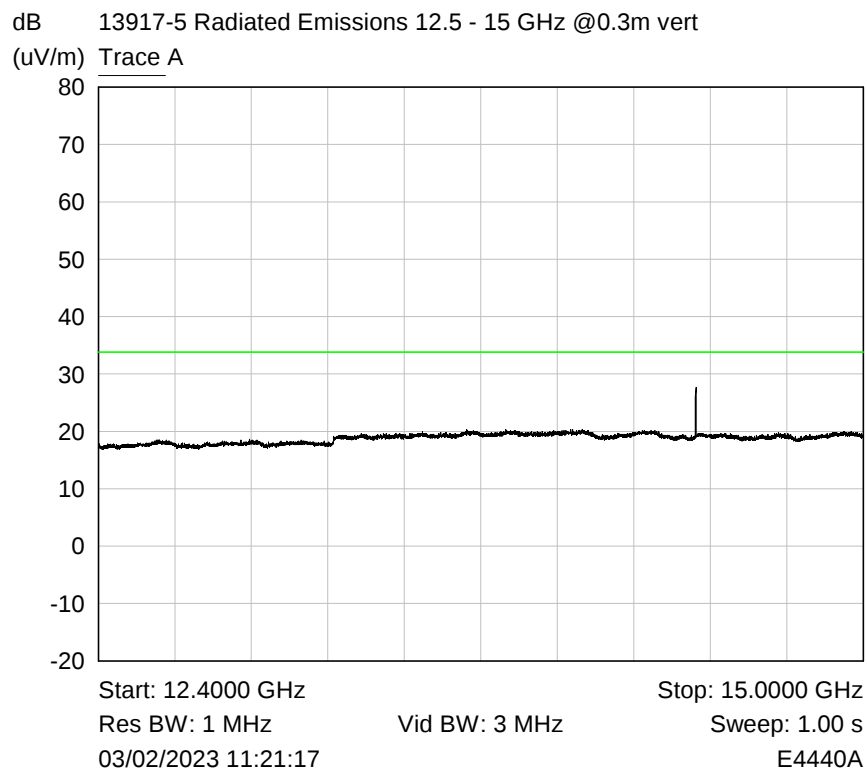
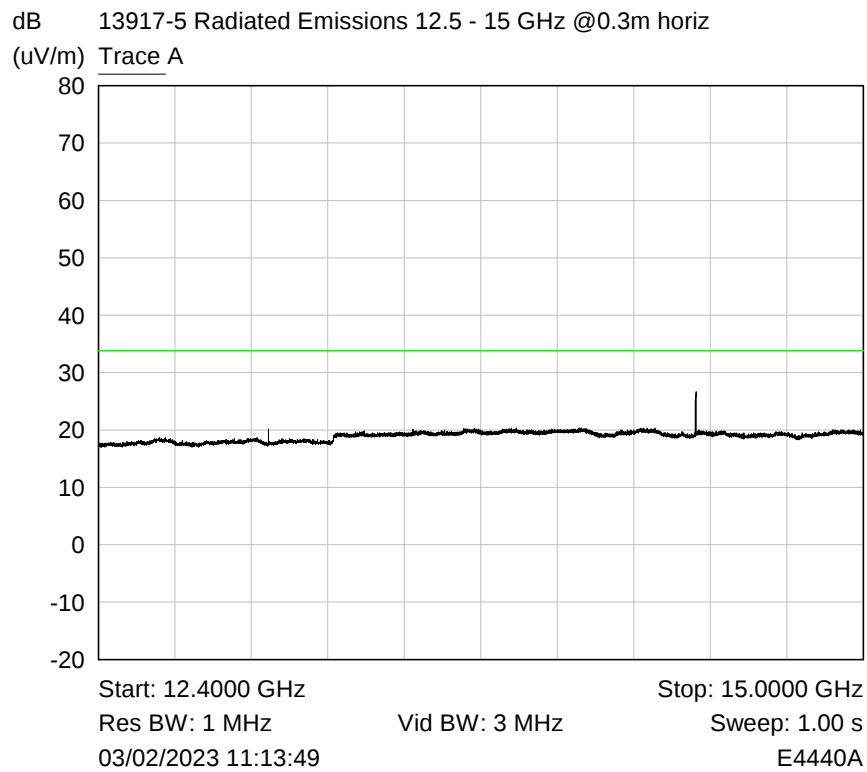
Sweep: 500.20 ms

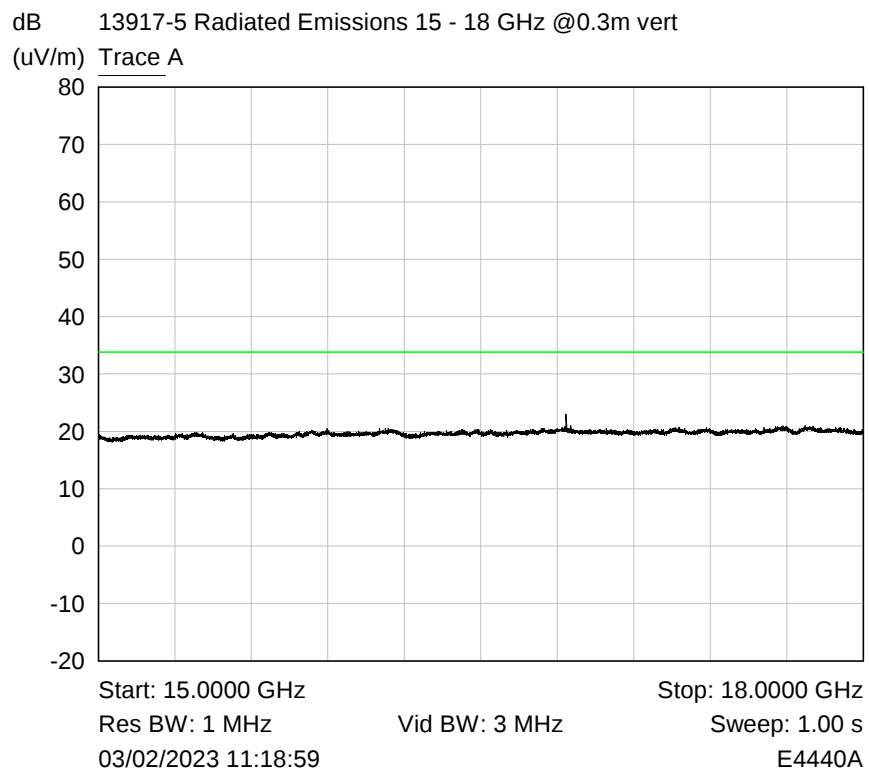
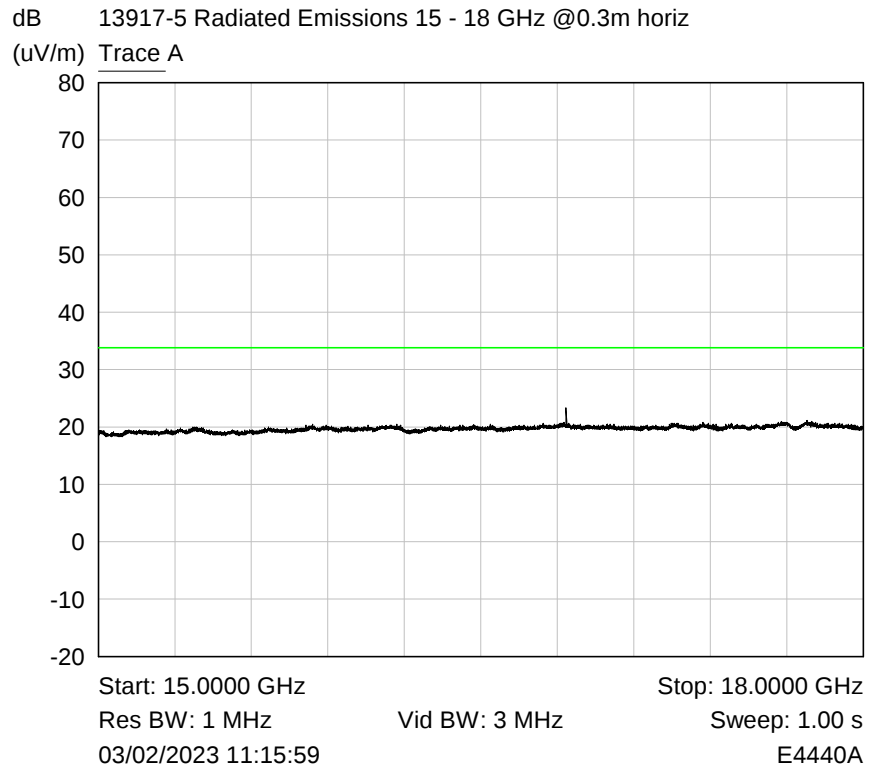
E4440A

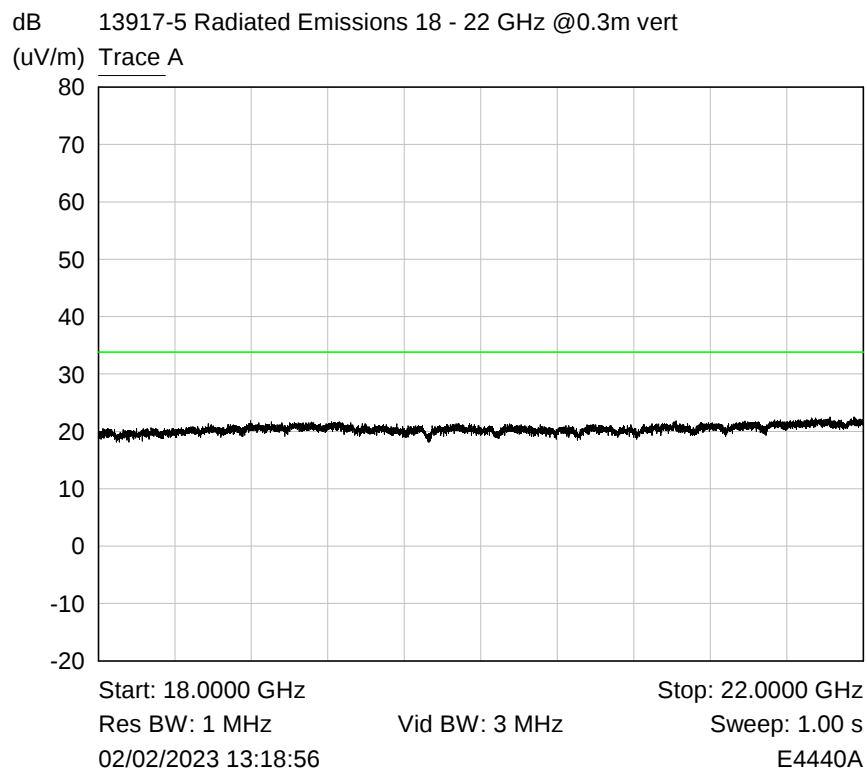
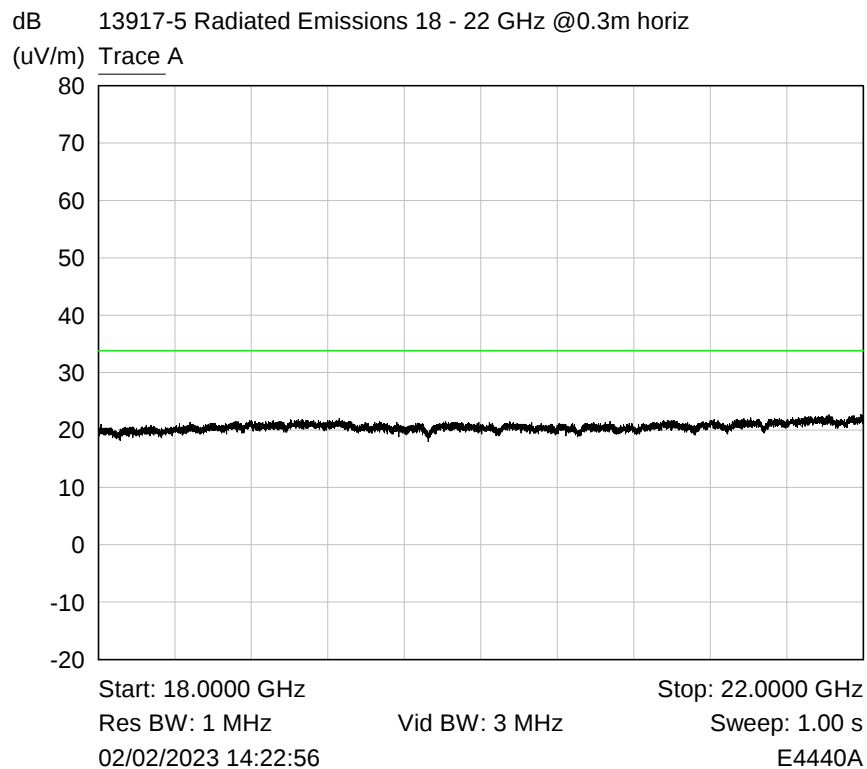


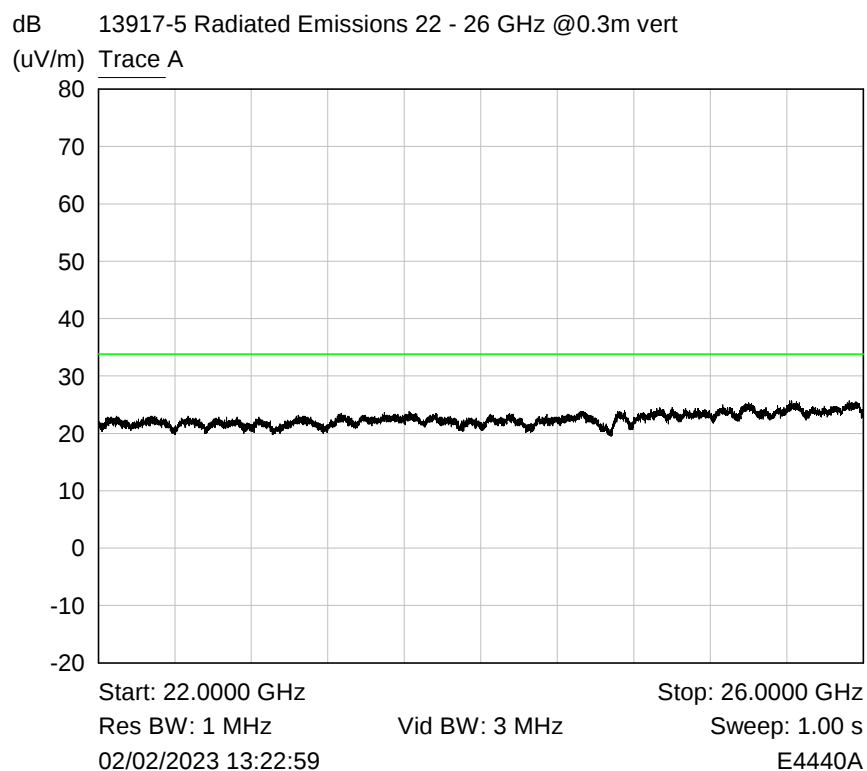
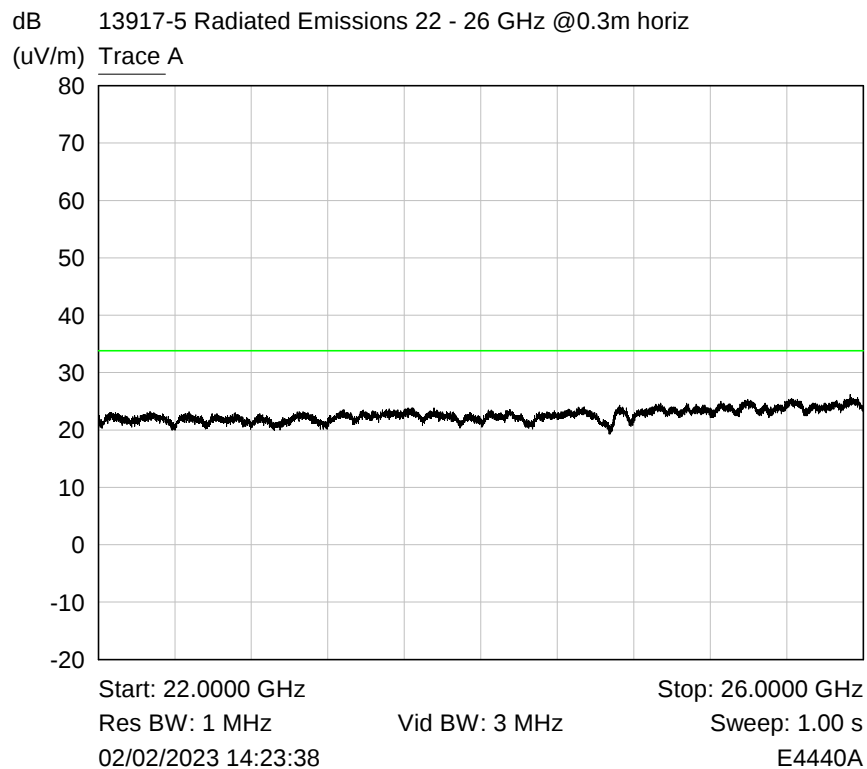


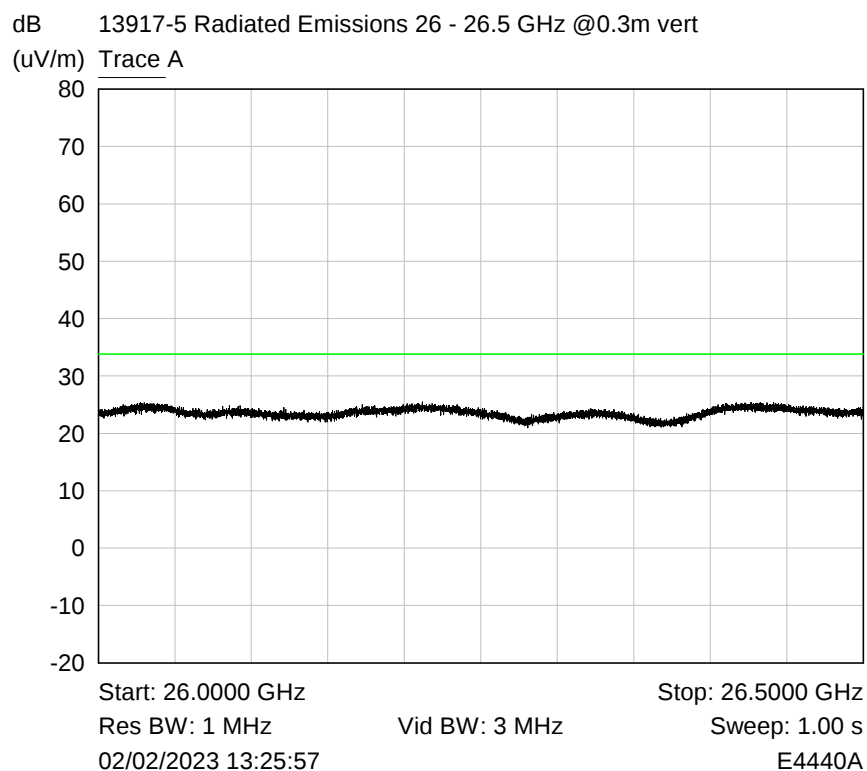
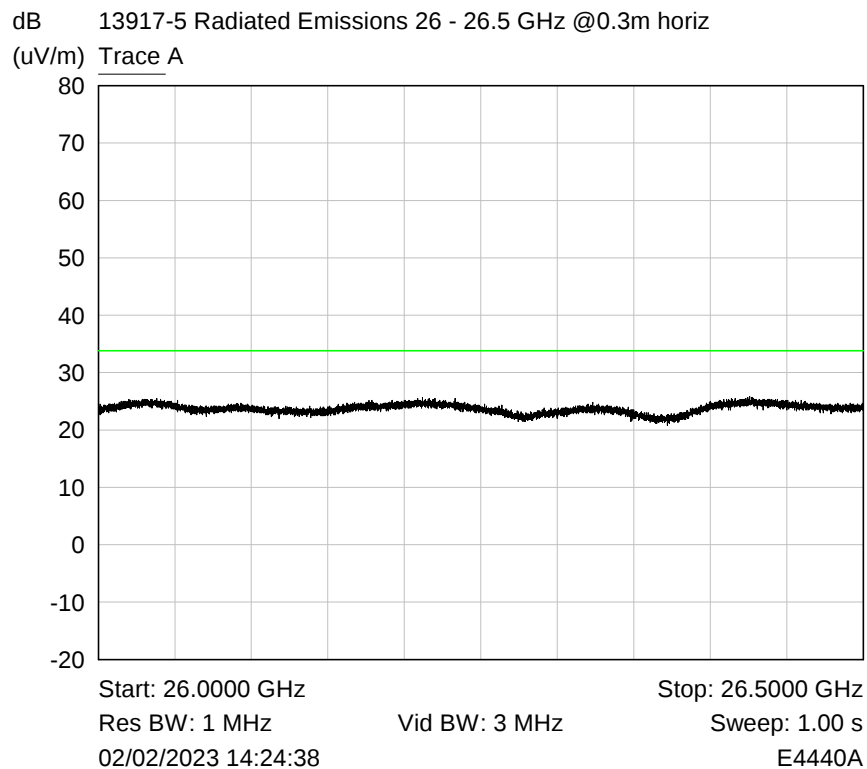


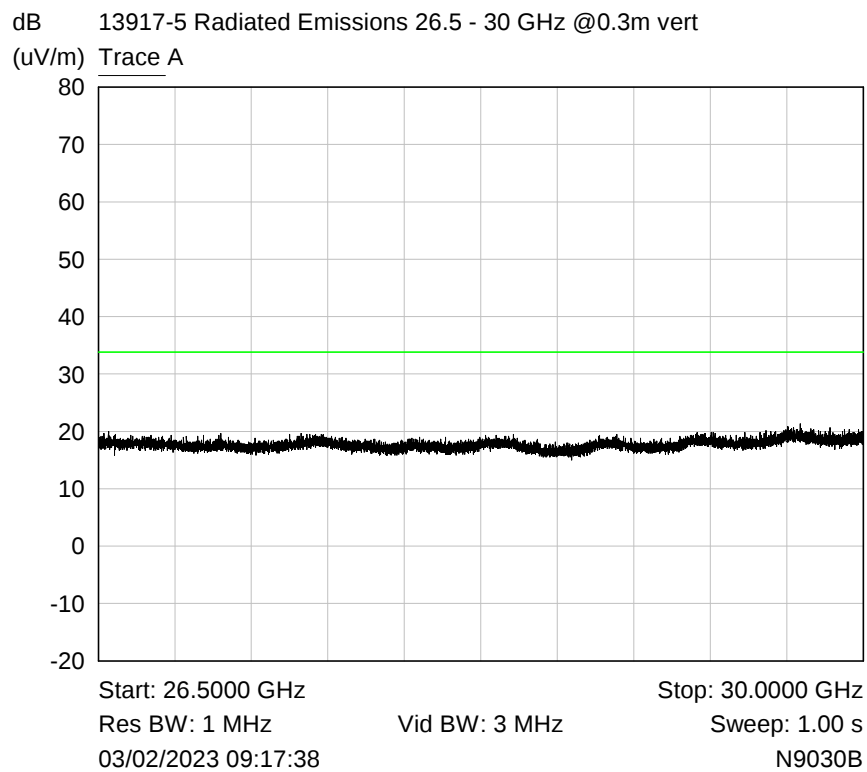
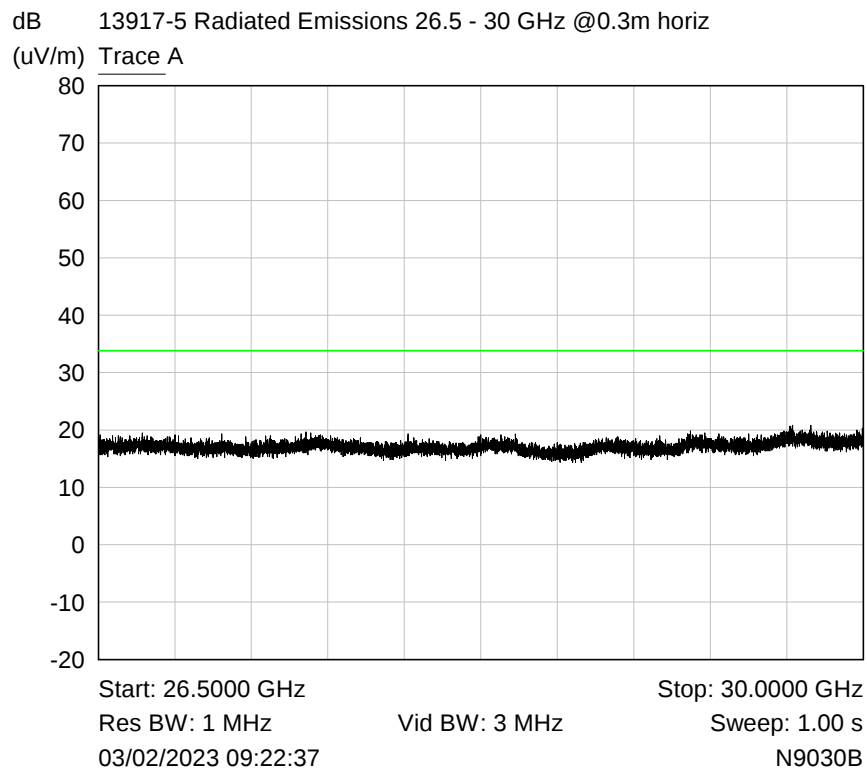






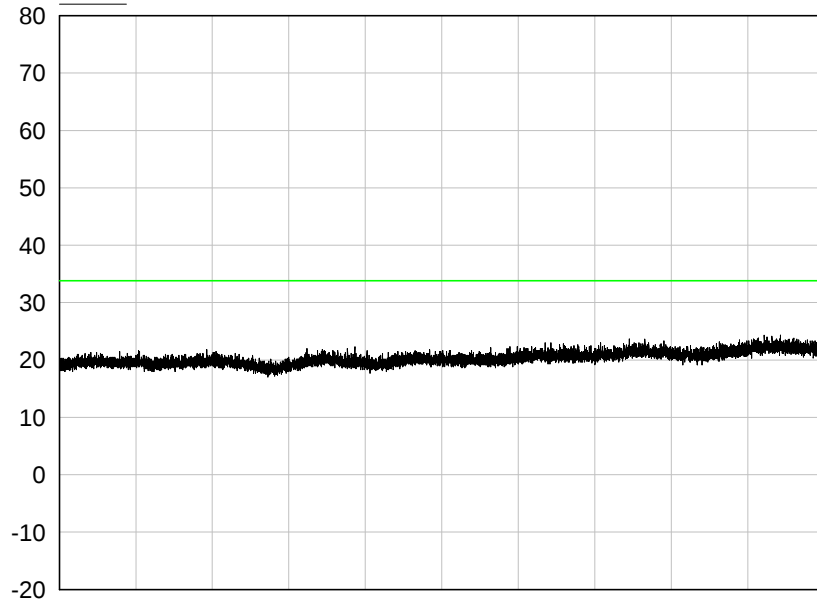






dB 13917-5 Radiated Emissions 30 - 33 GHz @0.3m horiz

(uV/m) Trace A



Start: 30.0000 GHz

Stop: 33.0000 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

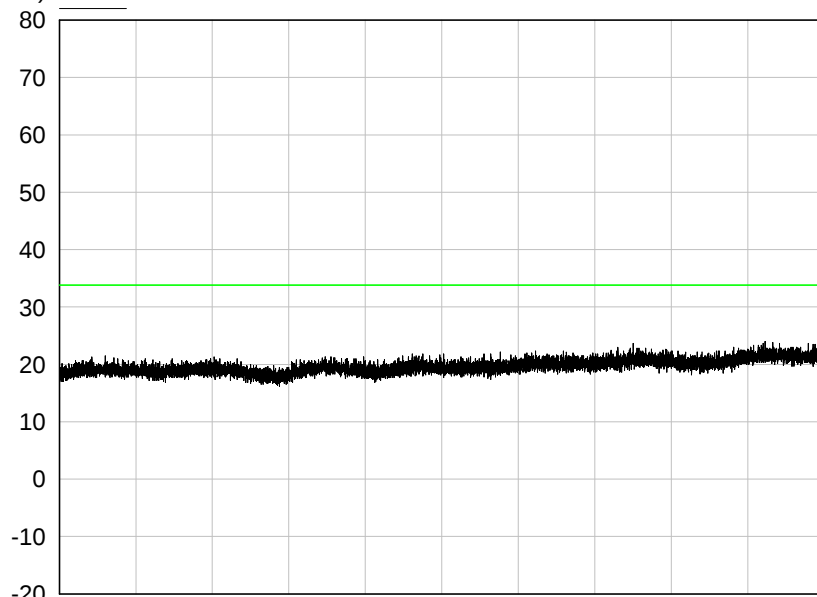
Sweep: 1.00 s

03/02/2023 09:23:55

N9030B

dB 13917-5 Radiated Emissions 30 - 33 GHz @0.3m vert

(uV/m) Trace A



Start: 30.0000 GHz

Stop: 33.0000 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

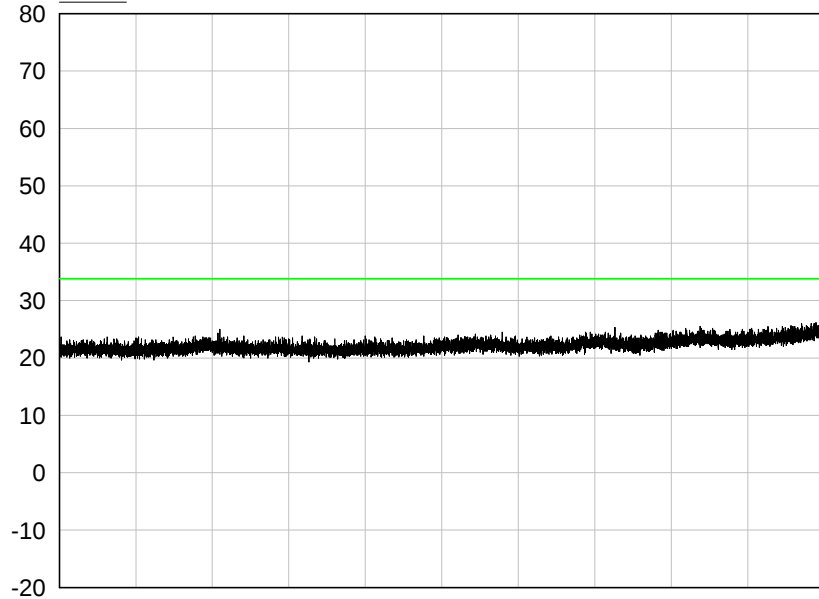
Sweep: 1.00 s

03/02/2023 09:18:39

N9030B

dB 13917-5 Radiated Emissions 33 - 36 GHz @0.3m horiz

(uV/m) Trace A



Start: 33.0000 GHz

Stop: 36.0000 GHz

Res BW: 1 MHz

Vid BW: 3 MHz

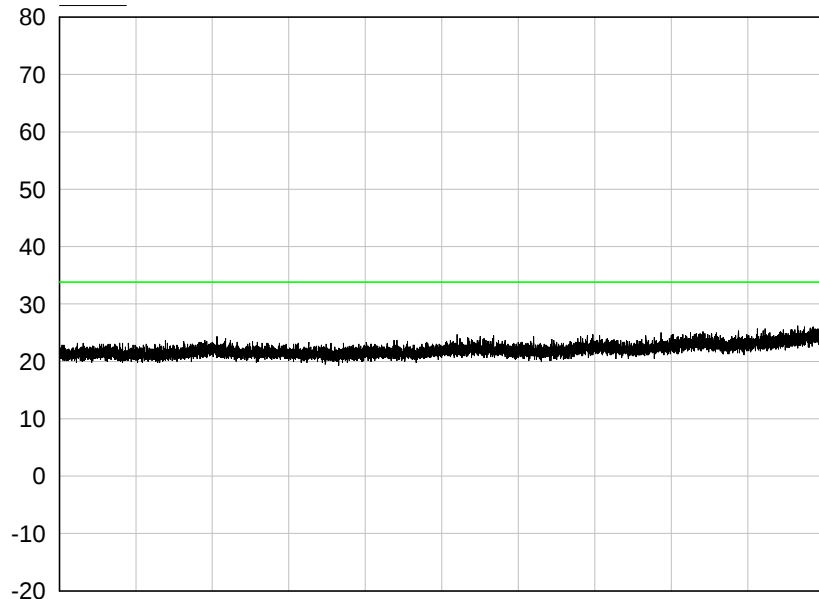
Sweep: 1.00 s

03/02/2023 09:24:59

N9030B

dB 13917-5 Radiated Emissions 33 - 36 GHz @0.3m vert

(uV/m) Trace A



Start: 33.0000 GHz

Stop: 36.0000 GHz

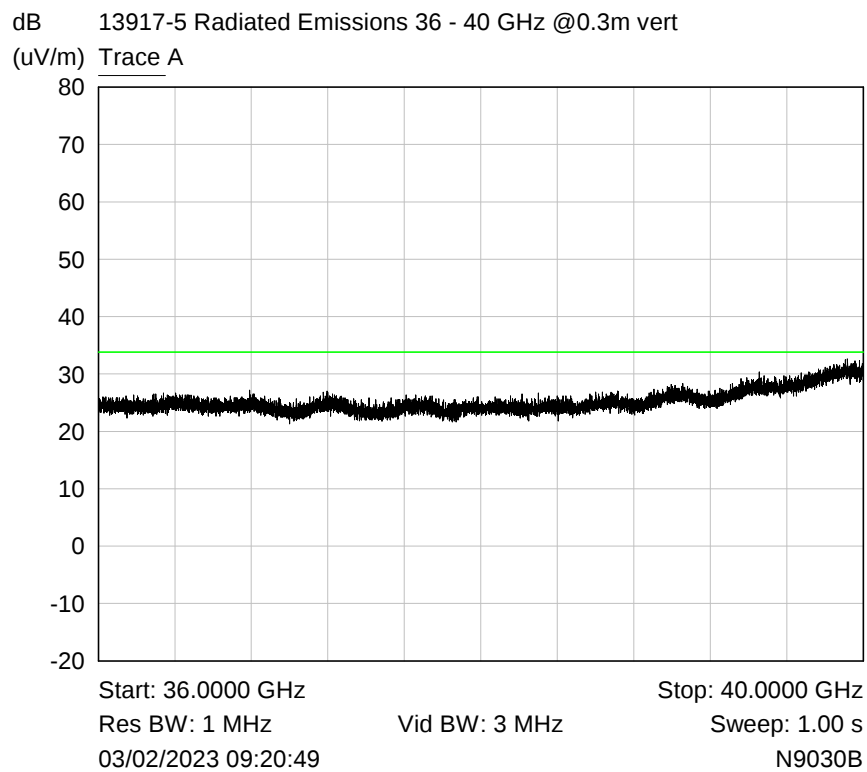
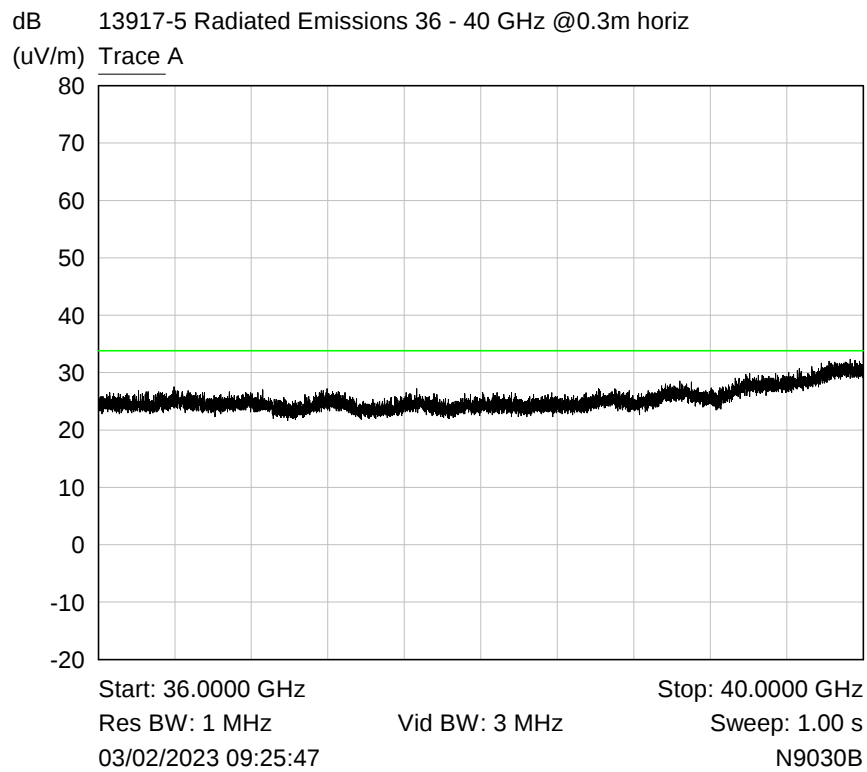
Res BW: 1 MHz

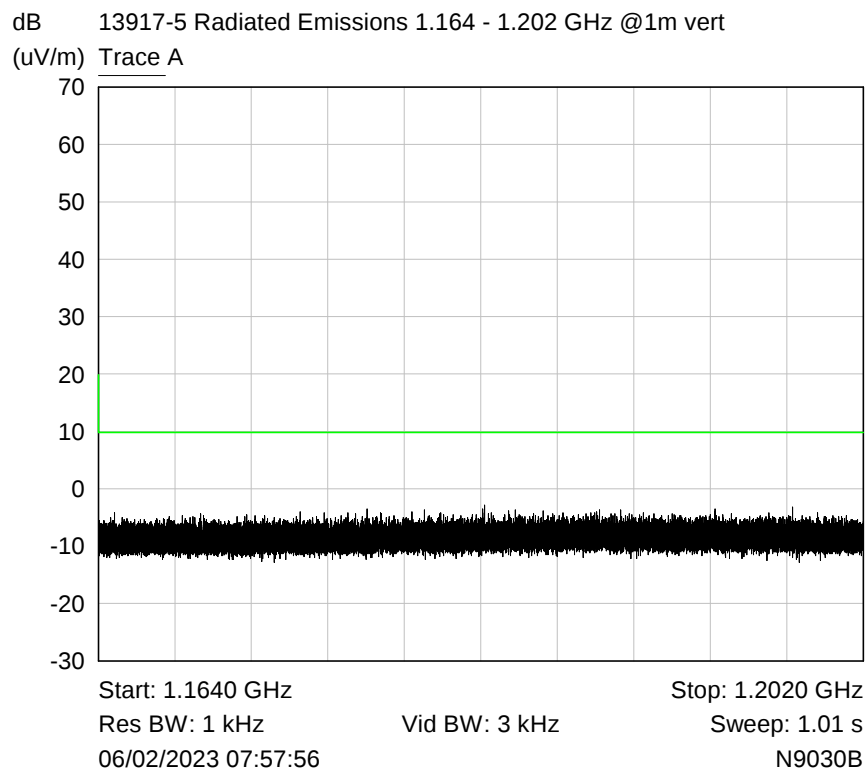
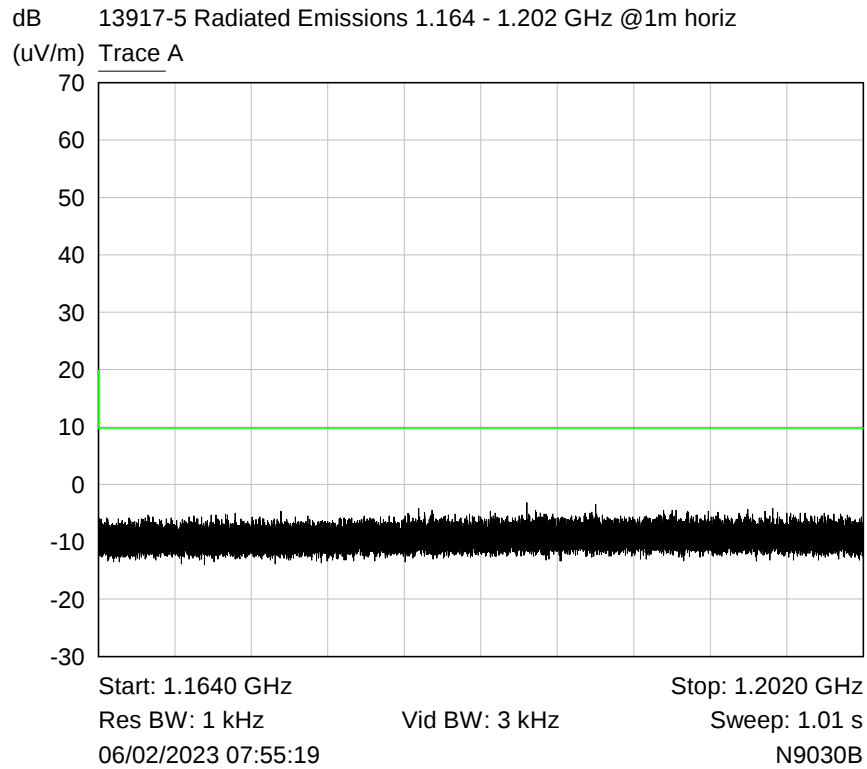
Vid BW: 3 MHz

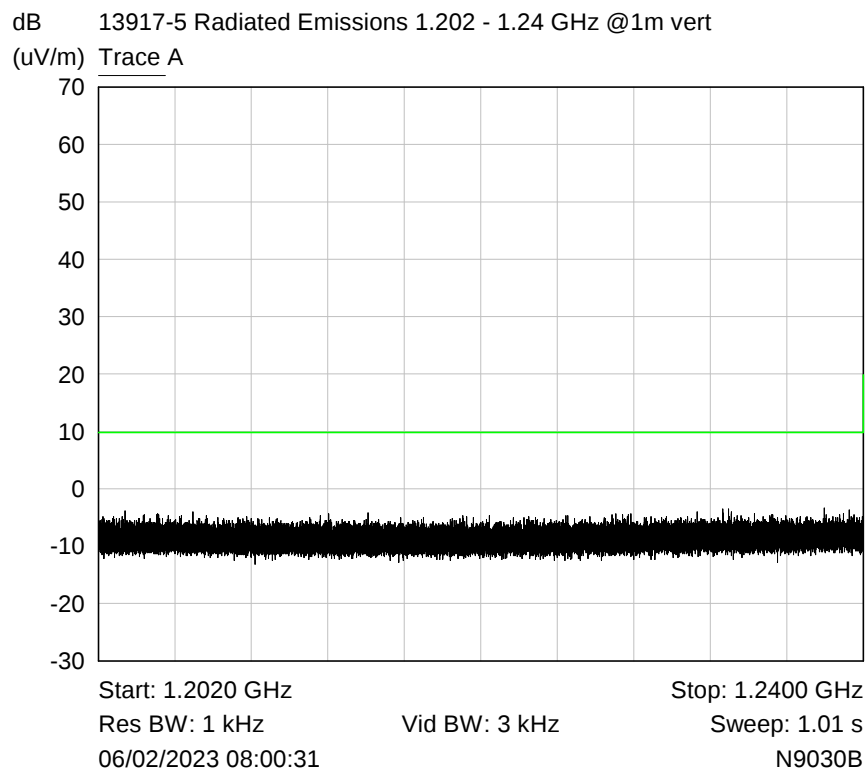
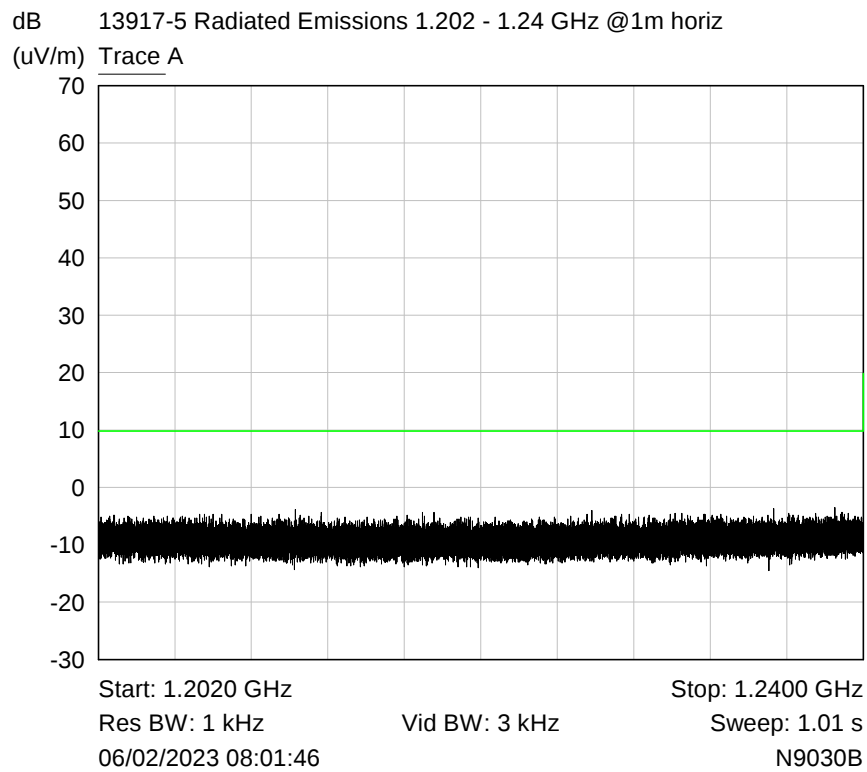
Sweep: 1.00 s

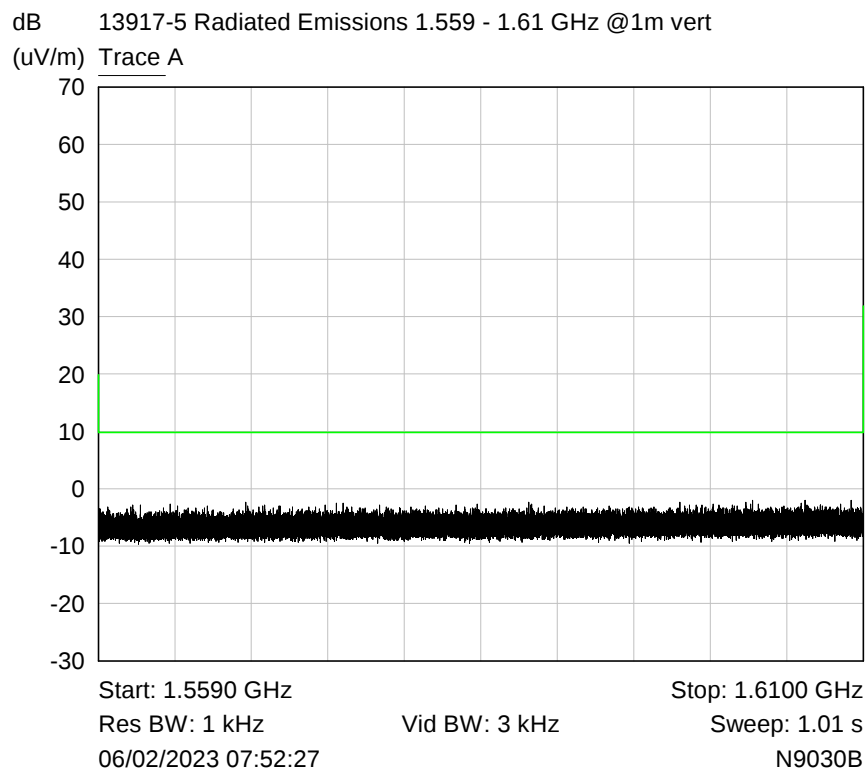
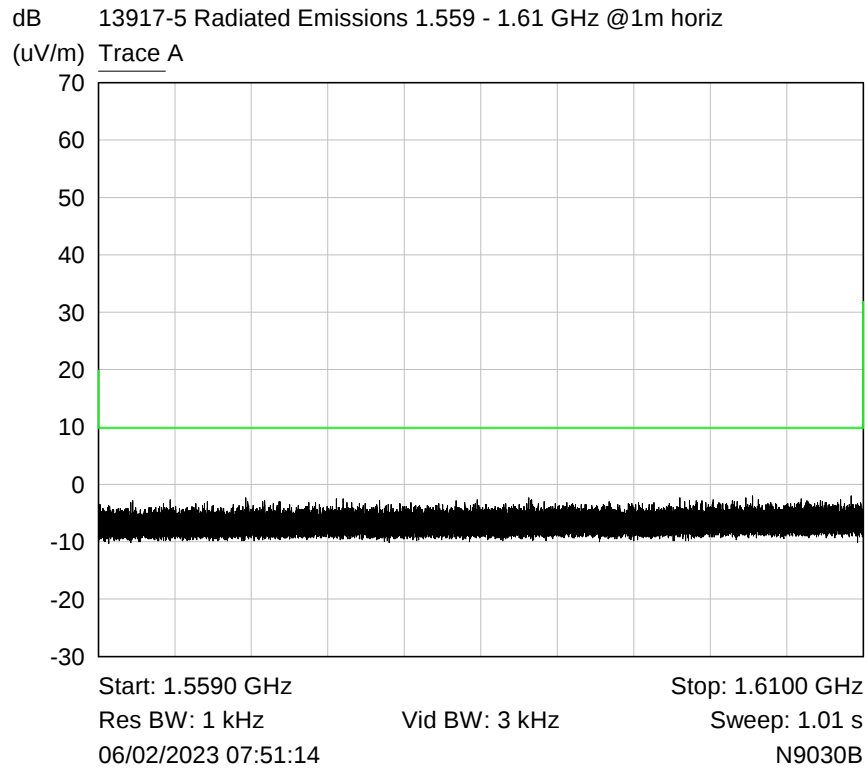
03/02/2023 09:19:55

N9030B



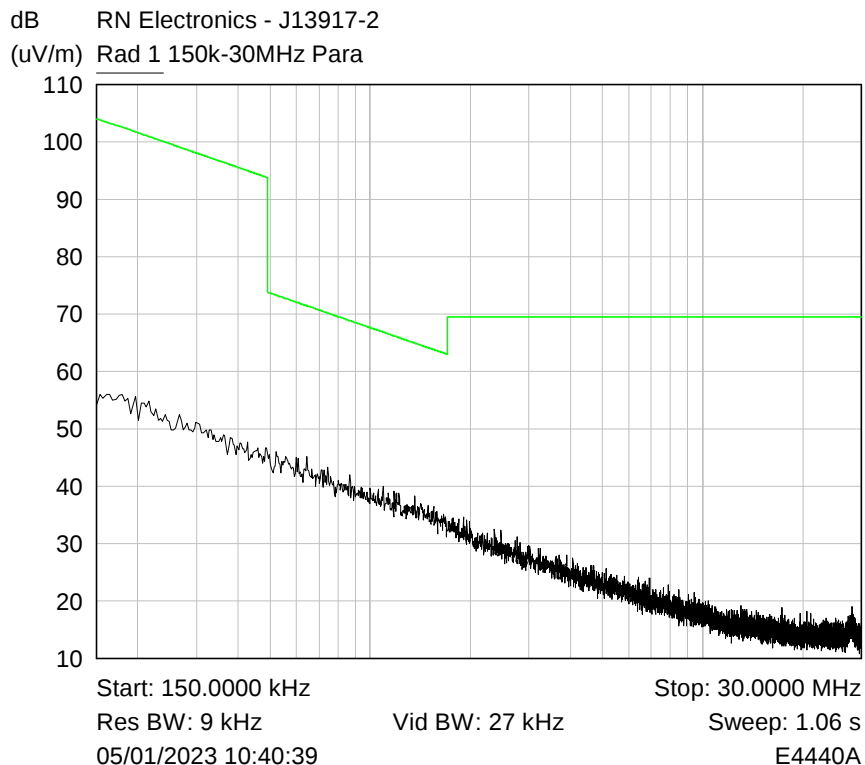




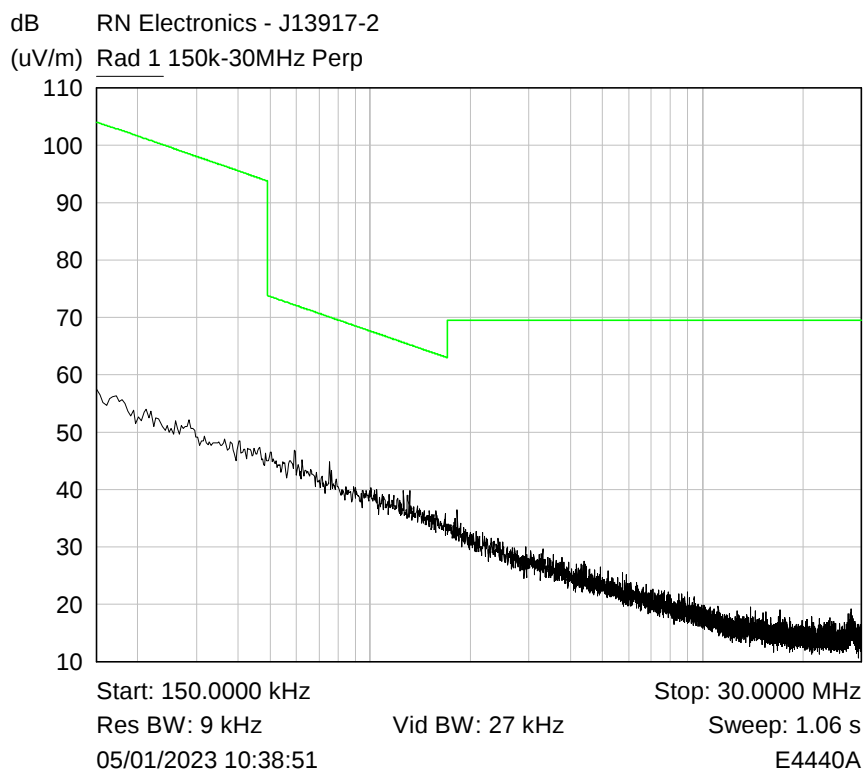


## 6.5 Radiated emissions 150 kHz - 30 MHz

RF Parameters: Band 5925-7250 MHz, Power 15.5 dBm, Channel Spacing Single Channel,  
Modulation UWB, Channel 6489 MHz



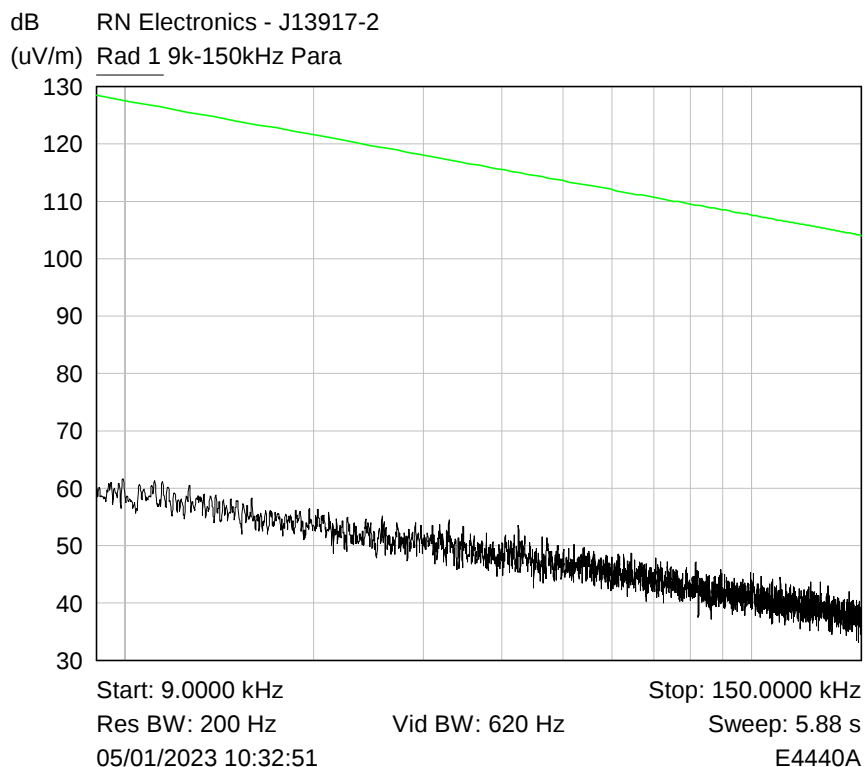
Plot of 150kHz-30MHz Parallel



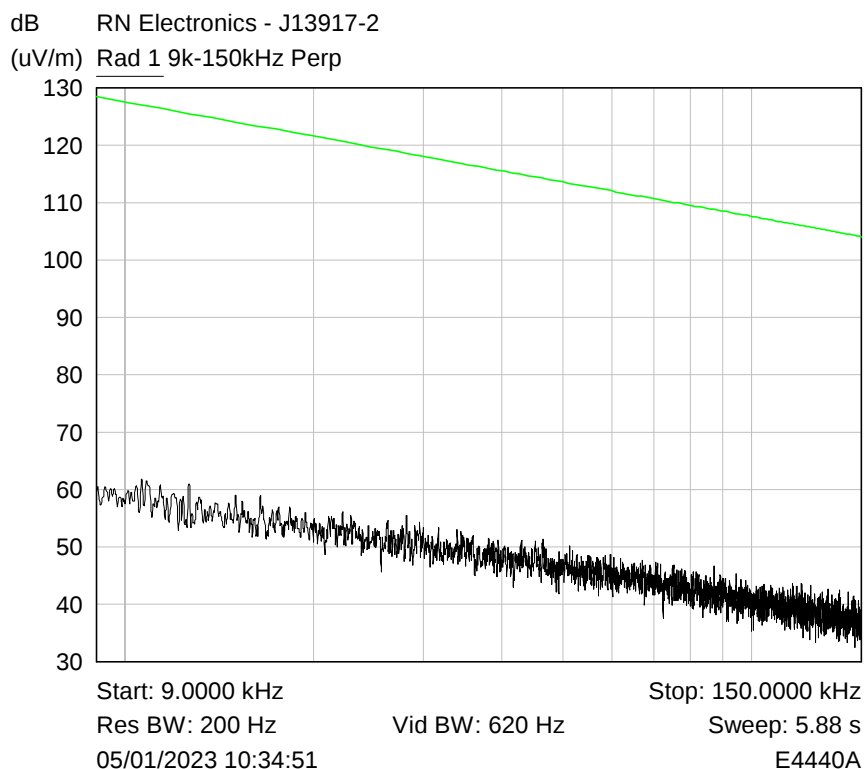
Plot of 150kHz-30MHz Perpendicular

## 6.6 Radiated emissions 9 - 150 kHz

RF Parameters: Band 5925-7250 MHz, Power 15.5 dBm, Channel Spacing Single Channel,  
Modulation UWB, Channel 6489 MHz



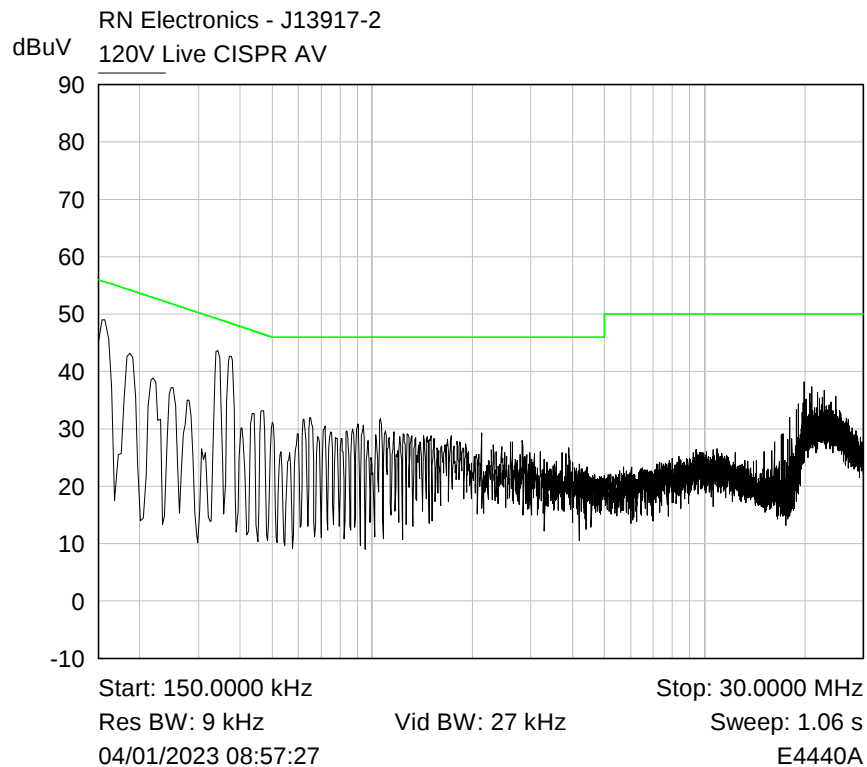
Plot of 9k-150kHz Parallel



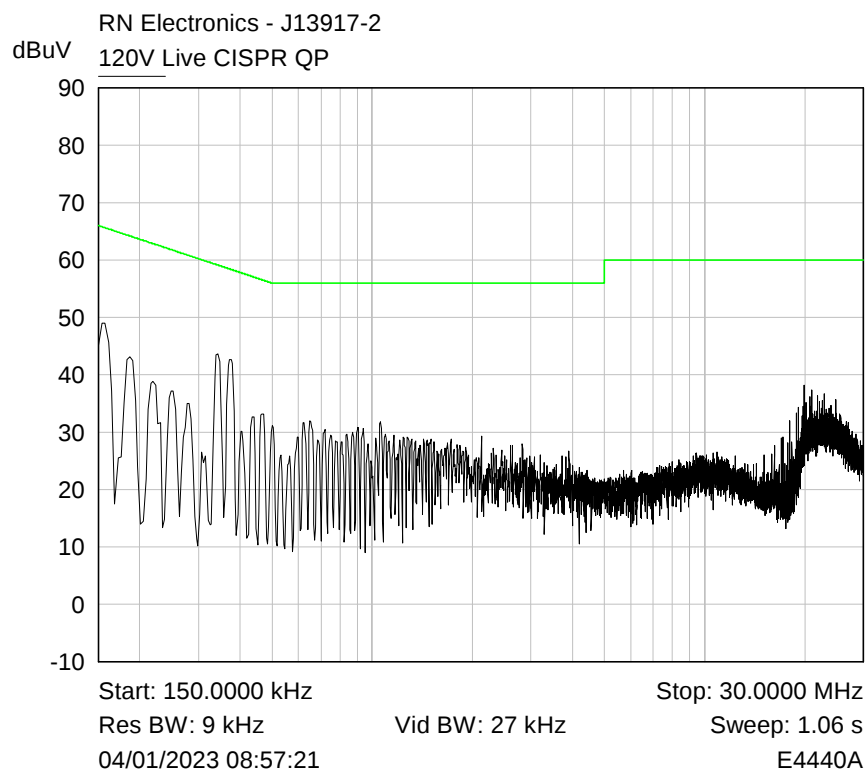
Plot of 9k-150kHz Perpendicular

## 6.7 AC power line conducted emissions

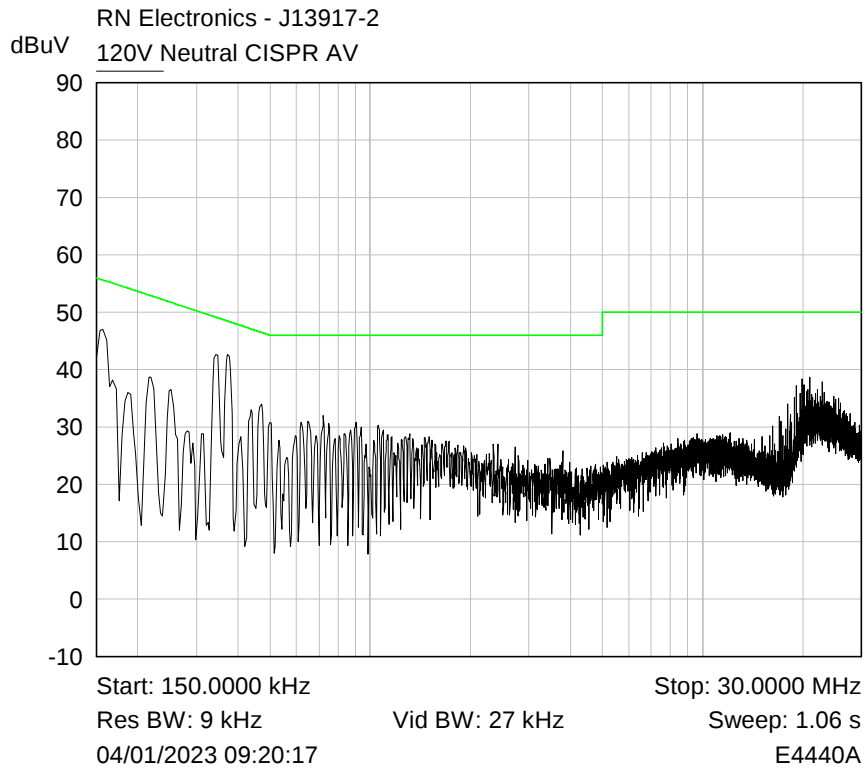
RF Parameters: Band 5925-7250 MHz, Power 15.5 dBm, Channel Spacing Single Channel, Modulation UWB, Channel 6489 MHz



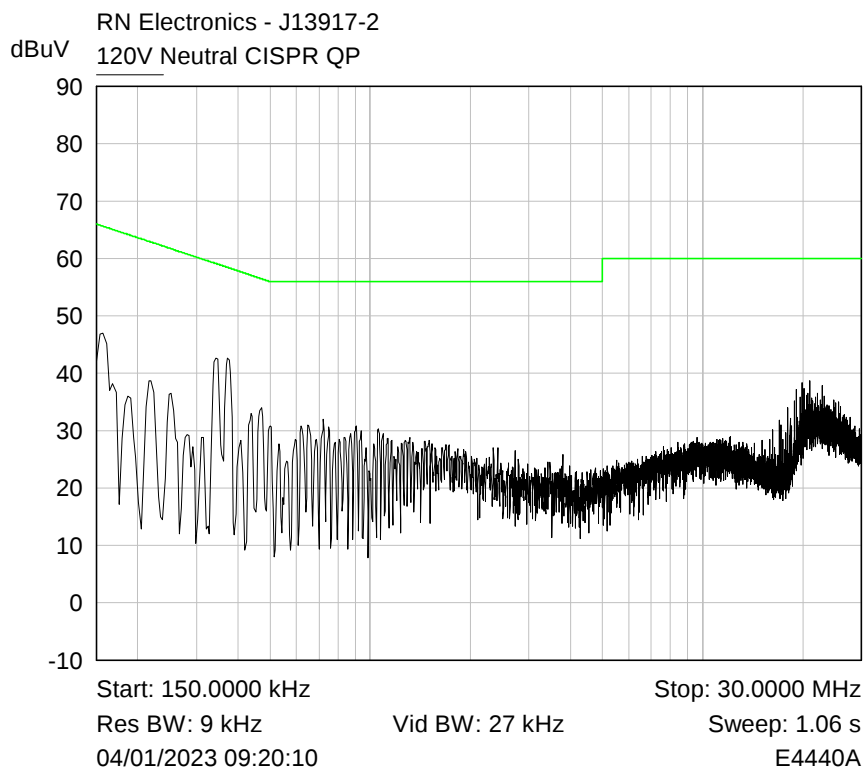
Plot of Live150k-30M Average



Plot of Live150k-30M Quasi-Peak



Plot of Neutral150k-30M Average



Plot of Neutral150k-30M Quasi-Peak

## 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 (dBμV) | Pk – Lim 1 (dB) | QP Amp (dBμV) | QP - Lim1 (dB) | Av Amp (dBμV) | 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  $\mu\text{V/m}$  at a specified distance), whereas the measured values are expressed as peak, quasi peak or average values in  $\text{dB}\mu\text{V/m}$  referenced to the measuring instrument inputs. RN Electronics calibrate the test set-up to account for any path losses, antenna gains, etc. so that the value read at the receiver relates directly to the absolute value required, except that it is expressed in dB relative to one microVolt and may need to take account of any alternative measuring distance used. Examples:

(a) limit of  $500 \mu\text{V/m}$  equates to  $20.\log(500) = 54 \text{ dB } \mu\text{V/m}$ .

(b) limit of  $300 \mu\text{V/m}$  at 10m equates to  $20.\log(300 \cdot 10/3) = 60 \text{ dB } \mu\text{V/m}$  at 3m

(c) limit of  $30 \mu\text{V/m}$  at 30m, but below 30MHz, equates to  $20.\log(30) + 40.\log(30/3) = 69.5 \text{ dB}\mu\text{V/m}$  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) |
|-------------------------|--------------------------|-----------------|---------------------------------|
| 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:**  $E_{\text{Linear}} = 10^{((E_{\log} - 120)/20)}$

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

Where:

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

$E_{\log}$  is the field strength of the emissions in  $\text{dB}\mu\text{V/m}$

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

Where:

EIRP is equivalent isotropically radiated power in dBm

$E_{\text{Meas}}$  is the field strength of the emission at the measurement distance in  $\text{dB}\mu\text{V/m}$

$d_{\text{Meas}}$  is the measurement distance in metres

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

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

Where:

PD is the power density at distance specified by the limit, in  $\text{W/m}^2$

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

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

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

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

Where:

PD is the power density at distance specified by the limit, in  $\text{W/m}^2$

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

**Example:**

Radiated spurious emissions limit at 3metres of 90pW/cm<sup>2</sup>.

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

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

And

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

And

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

## 8 Photographs

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

### 8.1 Radiated emission diagrams

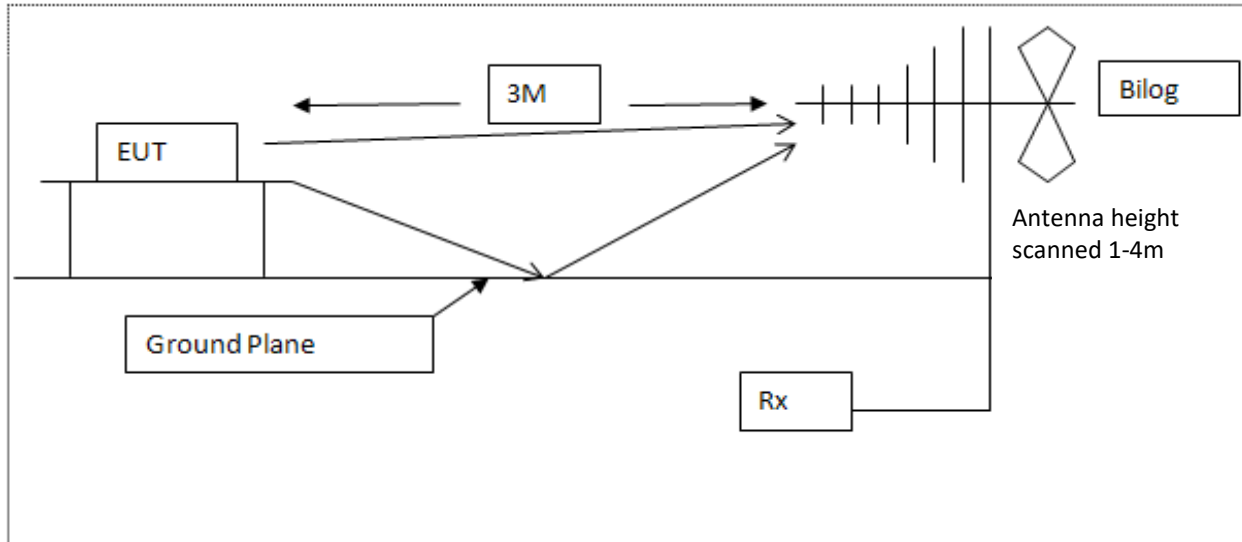


Diagram of the radiated emissions test setup 30 - 1000 MHz

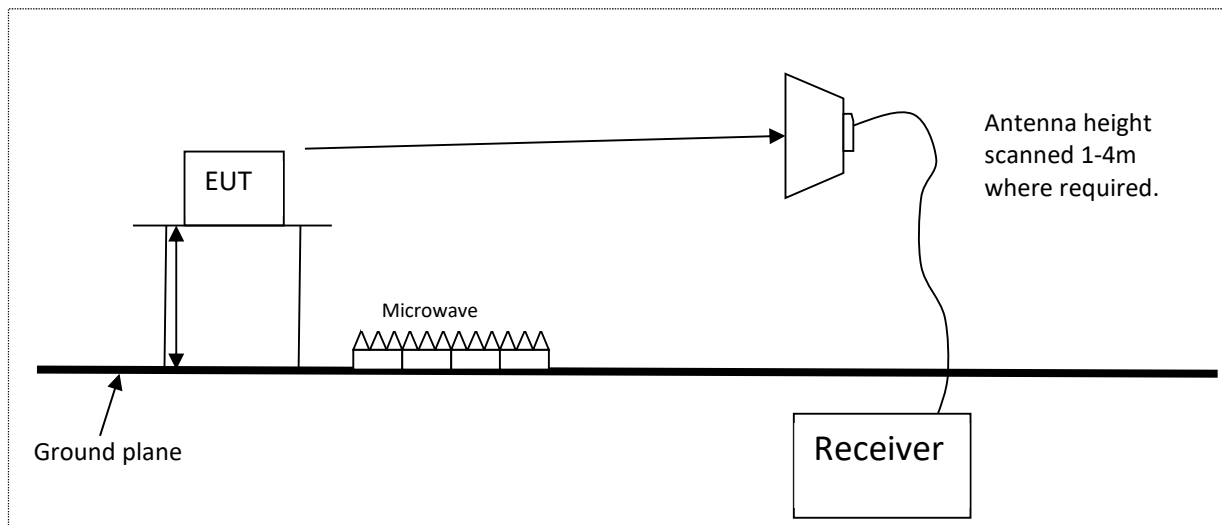


Diagram of the radiated emissions test setup above 1GHz

## 8.2 AC powerline conducted emission diagram

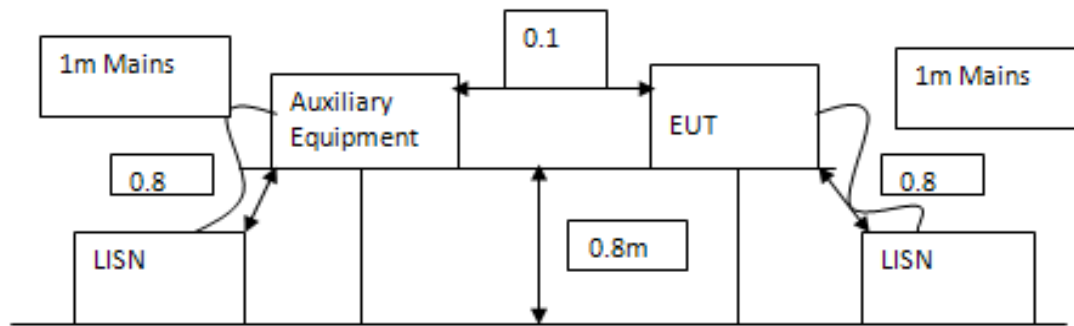


Diagram of the AC conducted emissions test setup

## 9 Test equipment calibration list

The following is a list of the test equipment used by R.N. Electronics Ltd to test the unit detailed within this report. In line with our procedures, the equipment was within calibration for the period during which testing was carried out.

| RN No. | Model No.          | Description                                     | Manufacturer          | Calibration date | Cal period |
|--------|--------------------|-------------------------------------------------|-----------------------|------------------|------------|
| CAL07  | MWX221             | Cable N Type to SMA Blue 2m                     | Junflon               | #16-Dec-2022     | 6 months   |
| E035   | 11947A             | Transient Limiter 9kHz - 200MHz                 | Hewlett Packard       | #16-Dec-2022     | 12 months  |
| E150   | MN2050             | LISN 13A                                        | Chase                 | 25-Apr-2022      | 12 months  |
| E227   | 6632A              | PSU System DC Power Supply                      | Hewlett Packard       | 21-Mar-2022      | 12 months  |
| E268   | BHA 9118           | Horn Antenna 1 - 18 GHz                         | Schaffner             | 02-Apr-2022      | 12 months  |
| E330   | 2224-20            | Horn Antenna 26.5-40GHz                         | Flann (FMI)           | 22-Apr-2022      | 12 months  |
| E331   | 22093-KF20         | Horn Antenna 26.5-40GHz                         | Flann (FMI)           | 22-Apr-2022      | 12 months  |
| E411   | N9039A             | 9 kHz - 1 GHz RF Filter Section                 | Agilent Technologies  | 07-Jul-2022      | 12 months  |
| E412   | E4440A             | PSA 3 Hz - 26.5 GHz                             | Agilent Technologies  | 21-Jun-2022      | 24 months  |
| E428   | HF906              | Horn Antenna 1 - 18 GHz                         | Rohde & Schwarz       | 02-Apr-2022      | 12 months  |
| E429   | -                  | Filter Box 5 Switch Filters 0.91 GHz - 16.3 GHz | RN Electronics        | 23-Aug-2022      | 12 months  |
| E433   | MG3693A            | Signal Generator 2 GHz - 30 GHz                 | Anritsu               | 03-Oct-2022      | 12 months  |
| E434   | G3RUH              | 10 MHz GPS Disciplined Oscillator               | G3RUH - James Miller  | 06-Mar-2023      | 12 months  |
| E452   | 22240-20           | Horn Std Gain 26.4 - 40.1 GHz                   | Flann (FMI)           | #18-Jan-2023     | 12 months  |
| E453   | 20240-20-AA        | Horn Std Gain 17.6 - 26.7 GHz                   | Flann (FMI)           | 25-May-2022      | 12 months  |
| E580   | 24240              | Horn Std Gain 40GHz - 60 GHz                    | Flann (FMI)           | 22-Apr-2022      | 12 months  |
| E602   | MG3692A            | Signal Generator 10 MHz - 20 GHz                | Anritsu               | 02-Mar-2023      | 12 months  |
| E642   | E4440A             | PSA 3 Hz - 26.5 GHz                             | Agilent Technologies  | #06-Dec-2022     | 24 months  |
| E717   | -                  | Horn Std Gain 50-75GHz                          | -                     | 22-Apr-2022      | 12 months  |
| E725   | 6610.42            | Attenuator 10dB 40GHz                           | Suhner                | 29-Mar-2022      | 12 months  |
| E743   | 2017 4/2dB         | Attenuator 4/2dB 30-1000MHz                     | RN Electronics        | 15-Mar-2023      | 12 months  |
| E755   | N9030B             | PXA Signal Analyser 3 Hz to 50 GHz              | Keysight Technologies | 03-Aug-2022      | 12 months  |
| E856   | N9039A             | 9 kHz - 1 GHz RF Filter Section                 | Agilent Technologies  | #06-Dec-2022     | 12 months  |
| E904   | 5086-7805          | Pre-Amplifier 1GHz - 26.5GHz                    | Hewlett Packard       | 04-Mar-2022      | 12 months  |
| F119   | AA40-10H           | Attenuator 2.92mm 10dB 40GHz                    | AtlanTecRF            | 07-Oct-2022      | 12 months  |
| F225   | JS4-26004000-40-8P | Pre Amplifier 26.5GHz to 40GHz 2.92mm           | Miteq                 | 20-Apr-2022      | 12 months  |
| H079   | ESW8               | Spectrum Analyser                               | Rohde & Schwarz       | #25-Nov-2022     | 12 months  |
| LPE364 | CBL6112A           | Antenna BiLog 30MHz - 2GHz                      | Chase Electronics Ltd | 28-Mar-2022      | 24 months  |
| N579   | 71043              | Frequency Standard Distribution                 | -                     | #19-Dec-2022     | 12 months  |
| NSA-M  | NSA - M            | NSA - Site M                                    | RN Electronics        | 29-Nov-2021      | 36 months  |
| P168   | LT30-2             | PSU 30V 2A                                      | Farnell               | 21-Jun-2022      | 12 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           | 30-Sep-2022      | 12 months  |
| TMS79  | 3160-09            | Horn Std Gain 18 - 26.5 GHz                     | ETS Systems           | 25-May-2022      | 12 months  |
| TMS80  | 206-3722           | Digital Thermometer & K Probe                   | RS Components         | 03-Nov-2022      | 12 months  |
| TMS81  | 6502               | Antenna Active Loop                             | EMCO                  | 22-Jul-2021      | 24 months  |
| ZSW1   | V2.5.2             | Measurement Software Suite                      | RN Electronics        | Not applicable   |            |

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

## 10 Auxiliary and peripheral equipment

### 10.1 Customer supplied equipment

| Item No. | Model No.    | Description         | Manufacturer | Serial No. |
|----------|--------------|---------------------|--------------|------------|
| 1        | XT2173-3     | Smartphone          | Motorola     | ZY22FCH44T |
| 2        | 1801A-ELC-6L | Battery charger     | Salunda      | 3          |
| 3        | GST120A24    | Battery charger PSU | Mean Well    | ECO51A6911 |

### 10.2 RN Electronics supplied equipment

| RN No. | Model No. | Description | Manufacturer | Serial No |
|--------|-----------|-------------|--------------|-----------|
| P260   | 36V5      | PSU 36V 5A  | Kingshill    | 205       |

## **11 Condition of the equipment tested**

In order for the EUT to produce the results shown within this report the following modifications, if any, were implemented.

### **11.1 Modifications before test**

No modifications were made before test by RN Electronics Ltd.

### **11.2 Modifications during test**

No modifications were made during test by RN Electronics Ltd.

## 12 Description of test sites

|           |                                                                                                                                  |
|-----------|----------------------------------------------------------------------------------------------------------------------------------|
| Site A    | Radio Laboratory and Anechoic Chamber                                                                                            |
| Site B    | Semi-Anechoic Chamber and Control Room<br>FCC Registration No. 293246, 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)<br>FCC Registration No. 293246, 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)<br>FCC Registration No. 293246, ISED Registration No. 5612A-3                             |
| Site N    | Radio Laboratory                                                                                                                 |
| Site Q    | Fully-Anechoic Chamber                                                                                                           |
| Site OATS | 3m and 10m Open Area Test Site<br>FCC Registration No. 293246, ISED Registration No. 5612A-1                                     |
| Site R    | Screened Room (Conducted Immunity)                                                                                               |
| Site S    | Safety Laboratory                                                                                                                |
| Site T    | Transient Laboratory                                                                                                             |

RN Electronics CAB identifier as issued by Innovation, Science and Economic Development Canada is UK0002  
RN Electronics CAB identifier as issued by FCC is UK0015

## 13 Abbreviations and units

|        |                                                                      |        |                                                   |
|--------|----------------------------------------------------------------------|--------|---------------------------------------------------|
| %      | Percent                                                              | dBμV   | decibel relative to 1μV                           |
| λ      | Wavelength                                                           | dBμV/m | decibel relative to 1μV/m                         |
| μA/m   | microAmps per metre                                                  | dBc    | decibel relative to Carrier                       |
| μV     | microVolts                                                           | dBd    | decibel relative to dipole gain                   |
| μW     | microWatts                                                           | dBi    | decibel relative to isotropic gain                |
| AC     | Alternating Current                                                  | dBm    | decibel relative to 1mW                           |
| ACK    | ACKnowledgement                                                      | dBr    | decibel relative to a maximum value               |
| ACP    | Adjacent Channel Power                                               | dBW    | decibel 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     | decibel                                                              | ITU    | International Telecommunications Union            |
| dBμA/m | decibel relative to 1μA/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 Multiplexing | U-NII | Unlicensed National Information Infrastructure |
| OOB    | Out Of Band                                | USB   | Universal Serial Bus                           |
| ppm    | Parts per million                          | UWB   | Ultra Wide Band                                |
| PER    | Packet Error Rate                          | V     | Volts                                          |
| PK     | Peak                                       | V/m   | Volts per metre                                |
| PMR    | Private Mobile Radio                       | VBW   | Video Band Width                               |
| PRBS   | Pseudo Random Bit Sequence                 | VHF   | Very High Frequency                            |
| PRF    | Pulse Repetition Frequency                 | VSAT  | Very Small Aperture Terminal                   |
| PSD    | Power Spectral Density                     | W     | Watts                                          |
| PSU    | Power Supply Unit                          |       |                                                |

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