# FCC 47CFR part 15C
# Test Report
## For
## Nomad Key
## NRT302

Reference Standard: FCC 47CFR part 15C
Manufacturer: Maynetronics Ltd
For type of equipment and serial number, refer to section 3
Report Number: 09-7226-2-14 Issue 01
Report Produced by: -

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# Certificate of Test 7226-2

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

| | |
|---|---|
| Equipment: | Nomad Key |
| Model Number: | NRT302 |
| Proposed FCC ID: | OOANRT302 |
| Unique Serial Number: | 8396 |
| Manufacturer: | Maynetronics Ltd.<br>Oak Cottage<br>Ashey Road<br>Ashey<br>Isle of Wight<br>PO33 4BD |
| Full measurement results are detailed in Report Number: | 09-7226-2-14 Issue 01 |
| Test Standards: | FCC 47CFR Part 15.249<br>effective date **October 1st 2013,**<br>Class DXT Intentional Radiator |

DEVIATIONS:
None.

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: 29th July - 29th September 2014

Test Engineer: Graham Blake
Digitally signed by: Graham Blake
DN: CN = Graham Blake C = GB O = RN Electronics Ltd
Date: 2015.01.20 13:38:40 +01'00'

Approved By:
Technical Director

Customer Representative:

# 1 Contents

# 2 Equipment Under Test (EUT)

## 2.1 Equipment Specification

| | | |
|---|---|---|
| Applicant | Maynetronics Ltd.<br>Oak Cottage,<br>Ashey Road,<br>Ashey,<br>Isle of Wight.<br>PO33 4BD | |
| | | |
| Manufacturer of EUT | Maynetronics Ltd. | |
| Brand name of EUT | Nomad Key | |
| Model Number of EUT | NRT302 | |
| Serial Number of EUT | 8396 | |
| Date when equipment was received by RN Electronics | 13th June 2014 | |
| Date of test: | 29th July - 29th September 2014 | |
| | | |
| Visual description of EUT: | A small plastic enclosure designed to be hand-held. The unit features a membrane type numerical keypad with additional function buttons to navigate the menu system. A backlit LCD screen is recessed into the unit. The unit is powered by two 1.5V AA NiMh rechargeable batteries, and the unit is charged by placing it into a spare bay of the five-way docking / charging station. The docking / charging station is powered using a 110V 60Hz power supply. | |
| Main function of the EUT: | A portable terminal to allow users to scan RFID tags using the built-in 13.56MHz reader/writer, and to make data entries. The EUT can be polled from a central location for data updates using the 915 MHz radio link. | |
| Height | 120 mm | |
| Width | 170 mm | |
| Depth | 16 mm | |
| Weight | 0.1 kg | |
| Voltage | 2.2 – 15 V DC | |
| Current required from above voltage source | 0.03 A | |
| | | |
| EUT supplied PSU: | Manufacturer | EMS Power |
| | Model number | Model 9090 |
| | Serial number | Not specified |
| | Input voltage | 115 Vac / 230 Vac |
| | Input current | Not specified |
| | Output | +/- 12 Vdc, 3 Amp |

## 2.2 EUT Configurations for testing

| **General parameters** | |
|---|---|
| EUT Normal use position | Hand held |
| Choice of model(s) for type tests | Production prototype |
| Antenna details | 2 x integral antenna (PCB etched) |
| Antenna port | No |
| Baseband Data port (yes/no)? | No |
| Highest Signal generated in EUT | 915 MHz |
| Lowest Signal generated in EUT | 2 MHz |
| **TX Parameters** | |
| Alignment range – transmitter | 915 MHz (fixed frequency equipment) |
| EUT Declared Modulation Parameters | FM |
| EUT Declared Power level | 94dBuV/m @ 3m |
| EUT Declared Signal Bandwidths | 40 kHz |
| EUT Declared Channel Spacing's | Single channel equipment. |
| EUT declared Duty Cycle | Not stated |
| Unmodulated carrier available? | No |
| Declared frequency stability | 10 ppm |
| **RX Parameters** | |
| Alignment range – receiver | 915 MHz (fixed frequency equipment) |
| EUT Declared RX Signal Bandwidth | 80 kHz |

## 2.3 Functional Description

The Nomad Key NRT302 incorporates two separate radio modules, a 915 MHz transceiver and a 13.56 MHz RFID reader / writer. In normal operation, the user scans RFID tags with the unit, and makes data entries using the keypad. The EUT can be polled from a central location using the 915 MHz radio link, for data updates.
The manufacturer states that the two radios operate asynchronously, and therefore only one radio will transmit at any point in time. This function is controlled in the EUT's firmware. Both of the EUT's antennas are integral and are etched into the printed circuit board. The unit features a backlit LCD screen to provide the user with status information and a sounder.

## 2.4 EUT Modes

| Mode Reference | Description | Used for testing |
|---|---|---|
| TX 13.56 MOD (Docked) | Transmitting for 38ms every 480ms with modulation, On charge (docked) in the docking station | No |
| TX 13.56 MOD (Undocked) | Transmitting for 38ms every 480ms with modulation, standalone (undocked) configuration | No |
| TX 13.56 RFID TAG (Docked) | Scanning RFID tag. EUT Transmits a single burst for 85ms, On charge (docked) in the docking station | No |
| TX 13.56 RFID TAG (Undocked) | Scanning RFID tag. EUT Transmits a single burst for 85ms, standalone (undocked) configuration | No |
| TX 915 MOD (Docked) | Transmitting continuously at 915 MHz with modulation, On charge (docked) in the docking station | Yes |
| TX 915 MOD (Undocked) | Transmitting continuously at 915 MHz with modulation, standalone (undocked) configuration | Yes |
| RX 915 (Docked) | Receiving continuously at 915 MHz, On charge (docked) in the docking station | No |
| RX 915 (Undocked) | Receiving continuously at 915 MHz standalone (undocked) configuration | No |

The Nomad Key NRT302 incorporates two separate radio modules, a 915 MHz transceiver and a 13.56 MHz RFID reader / writer. For the purposes of testing, the EUT was supplied with a docking charger. As the Nomad NRT302 could be used whilst docked in the charger and in a standalone (handheld) configuration, pre-tests were performed in order to determine any worst case modes/configurations for final tests. Refer to specific test results sections (section 5) for details. A special engineering menu was provided on the unit and this allowed the EUT to be set to transmit using either of the two radios. The 915 MHz radio could be set to transmit continuously with modulation, and the 13.56MHz radio could be set to transmit in bursts of 38ms every 480ms.

All modes were verified using a spectrum analyser tuned to the fundamental frequency. The manufacturer has stated that this engineering menu will not be available to the end-user in the final product.

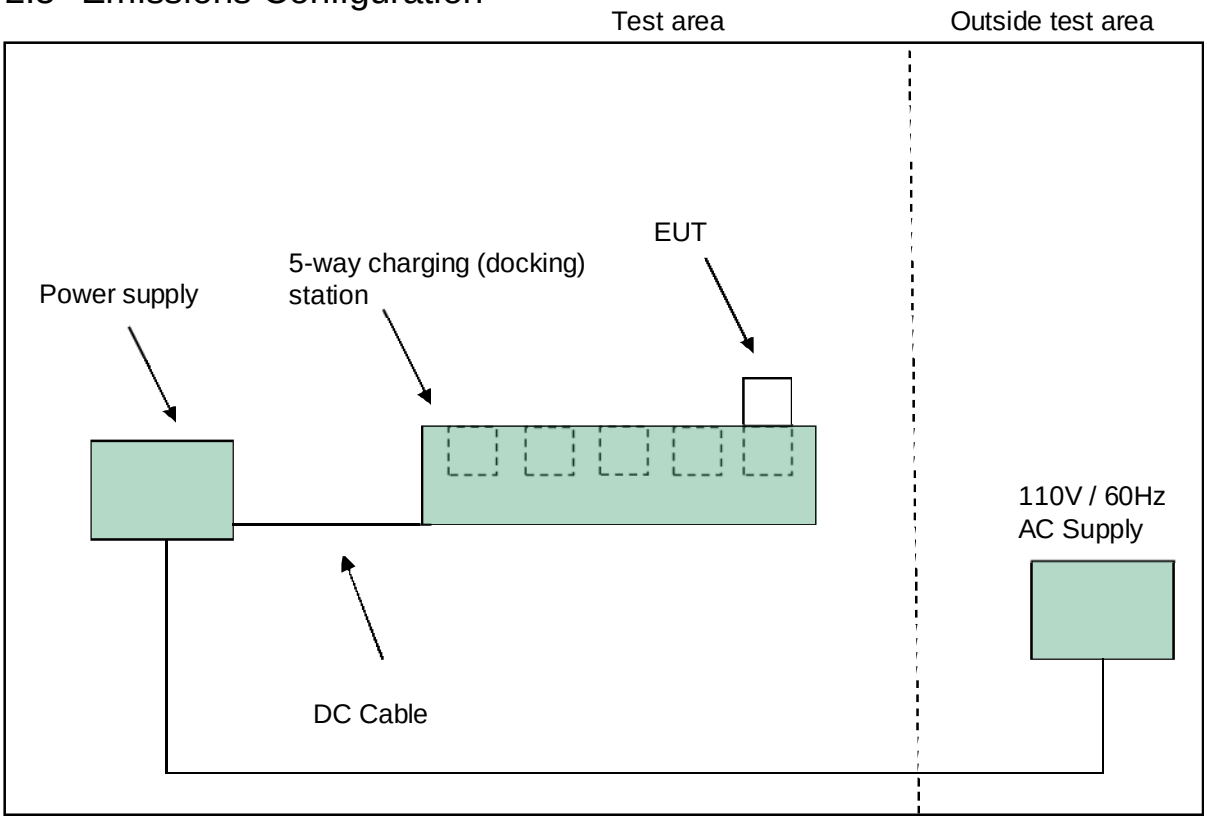
This test report pertains to the 915 MHz radio and as such, **TX 13.56 MHz** modes have not been used for testing. Please refer to RN Electronics test report 09-7226-5-14 Issue 01 for test results for the 13.56 MHz radio.

Description of ancillary equipment connected to the equipment under test, for the purpose of tests, can be found in Section 11.

Any modifications made to the EUT, whilst under test, can be found in Section 12.

This report was printed on: 20 January 2015

## 2.5 Emissions Configuration




Initially the EUT was pre-tested to establish any worst-case in terms of radiated emissions. The EUT was pre-tested whilst powered from its internal batteries, and also whilst charging on the five-way docking station. Worst case radiated emissions in the range 30-1000MHz were observed when the EUT was on charge in docking bay 2, for all other tests where the docking/charger was used there was no discernible difference in emissions between docking bays.

For AC conducted emissions there was no discernible difference in emissions between any of the five charging bay positions, so for full-test the first bay was used.

For Effective radiated power field strength and occupied bandwidth measurements, the EUT was pre-tested whilst operating on its internal batteries, and also whilst charging in each of the five-way docking station bays. It was found that there was no discernible difference in performance when the EUT was powered using batteries, or when on charge in any of the five charging bays, therefore for ease of test, the EUT was powered using the internal batteries in a stand-alone configuration for full-test.

The charging station was powered using the manufacturer's presented power supply. The power supply was connected to a 110V AC / 60 Hz mains supply positioned outside of the test area.

# 3 Summary of test results

The **Nomad Key NRT302** was tested to the following standards: -

**FCC 47CFR Part 15.249 (effective date October 1st, 2013); Class DXT Intentional Radiator**

Any compliance statements are made reliant on the modes of operation as instructed to us by the Manufacturer based on their specific knowledge of the application and functionality of the equipment tested. 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, particularly under different conditions to those during testing.

| Title | Reference | Results |
|---|---|---|
| 1. AC power line conducted emissions | ANSI C63.10 §6.2. | PASSED |
| 2. Intentional radiator field strength | ANSI C63.10 §6.10. | PASSED |
| 3. Radiated emissions | ANSI C63.10 §6.4 – 6.6. | PASSED |
| 4. Frequency stability | ANSI C63.10 §6.8. | NOT APPLICABLE[1] |
| 5. Occupied bandwidth | ANSI C63.10 §6.9. | PASSED |
| 6. Band Edge | | PASSED |
| 7. Duty cycle | ANSI C63.10 §7.5. | PASSED[2] |

[1] EUT is not for fixed, point-to-point operation, therefore no limits are specified.
[2] No limits apply, however duty cycle check made to verify that the TX mode used was 100% constant.

# 4 Specifications

The tests were performed and operated in accordance with the RN Electronics procedures and the basic standards listed below.

| Reference | Standard Number | Year | Description |
|---|---|---|---|
| 4.1.1 | 47CFR15 | 2013 | Federal Communications Commission<br>PART 15 – RADIO FREQUENCY DEVICES |
| 4.1.2 | ANSI C63.10 | 2009 | American National Standard for Testing Unlicensed Wireless Devices |
| 4.1.3 | ANSI C63.4 | 2003 | 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 |

R.N. Electronics is accredited as a Conformity Assessment Body (CAB) for Declaration of Conformity (DOC) under parts 15B & 18. Designation Number UK0015. Test Firm Registration number 966349.
Test sites M and OATS are listed with the FCC. Registration Number 293246.

## 4.1 Deviations

None.

## 4.2 Measurement Uncertainties

| Parameter | Uncertainty |
|---|---|
| Transmitter Tests | |
| Occupied bandwidth | ± 1.9 % |
| Radiated RF power | ± 3.5 dB |
| Radiated spurious emissions | <± 3.4 dB |
| AC line conducted emissions | 150kHz to 30MHz ±3.6dB |

# 5 Tests, Methods and Results

## 5.1 Conducted emissions

### 5.1.1 Test Methods

Test Requirements FCC Part 15C, Reference (15.207)

Test Method: ANSI C63.10, Reference (6.2)

### 5.1.2 Configuration of EUT

The Nomad Key NRT302 was placed on a wooden table 0.8m above the ground plane and placed in the charging station. The charging station was powered using the manufacturers presented power supply. The power supply was connected to a LISN via a 1m mains cable, and powered using 110V / 60Hz AC supply.

Details of the Peripheral and Ancillary Equipment connected for this test is listed in section 11.

During the initial pre-scan, the EUT was checked in all five charging bays; however there was no discernible difference between bays, so for full test the unit was docked in the first bay. The EUT was operated in **TX 915 MOD (Docked)** mode.

### 5.1.3 Test Procedure

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

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

Tests were performed in Test Site F.

### 5.1.4 Test Equipment used

E150, E035, E410, E411, E412, E465

See Section 10 for more details.

### 5.1.5 Test results

Ambient conditions.
Temperature: 25 °C Relative humidity: 47 %

Peak detector "Max held" Analyser plots against the Quasi-Peak / Average limit line(s) can be found in Section 6.1 of this report.

Plot reference tables

| Frequency range | Plot reference |
|---|---|
| 150kHz to 30MHz | 7226-2 Cond 1 AC Live 150k-30M Average |
| 150kHz to 30MHz | 7226-2 Cond 1 AC Live 150k-30M Quasi-Peak |
| 150kHz to 30MHz | 7226-2 Cond 1 AC Neutral 150k-30M Average |
| 150kHz to 30MHz | 7226-2 Cond 1 AC Neutral 150k-30M Quasi-Peak |

**LIMITS:**
As drawn on the respective plots.

These results show that the **EUT** has **PASSED** this test.

## 5.2 Intentional radiator field strength

### 5.2.1 Test Methods

| | |
|---|---|
| Test Requirements | FCC Part 15C, Reference (15.249 a) |
| Test Method: | ANSI C63.10, Reference (6.3 / 6.5) |

### 5.2.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. Initially the EUT was pre-tested to establish the worst-case in terms of field strength. The EUT was pre-tested whilst operating on its internal batteries, and also whilst charging in each of the five-way docking station bays. It was found that there was no discernible difference in intentional radiator field strength when the EUT was powered using batteries or when on charge in any of the five charging bays. For full-test the EUT was placed on-charge in the end bay of the charger. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The antenna was scanned 1-4m in height in both Horizontal and Vertical polarisations. The EUT was rotated in all three orthogonal planes. The EUT was operated in **TX 915 MOD (Docked)** mode.

### 5.2.3 Test Procedure

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

Measurements were made in a semi-anechoic chamber. This site is listed with the FCC.

Both the equipment and the antenna were rotated 360° to record the maximised emission.

Tests were performed using Test Site M**.**

### 5.2.4 Test Equipment used

E411, E412, TMS933, E570

See Section 10 for more details

### 5.2.5 Test results

Ambient conditions.
Temperature: 24°C Relative humidity: 39 % Pressure: 102 kPa

Radio Parameter 1

| | |
|---|---|
| **Band** | 902-928 MHz |
| **Power level** | 94 dBuV/m @ 3m |
| **Channel spacing** | Single frequency equipment |
| **Mod scheme** | FM |
| **Low channel** | 915 MHz |

Duty Cycle Table relating to Radio Parameters 1

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

Results relating to Radio Parameters 1

| | Single channel |
|---|---|
| **Peak Level (dBµV/m)** | 91.30 |
| **Plot reference** | 7226-2 915 MHz Upright Vert |
| **Antenna Polarisation** | Vert |
| **EUT Polarisation** | Upright |

Any Analyser plots can be found in Section 6.2 of this report.

**LIMITS:**

15.249(a) 50 mV/m @ 3m (94 dBµV/m @ 3m).

These results show that the EUT has **PASSED** this test.

# 5.3 Radiated emissions

## 5.3.1 Test Methods

Test Requirements: FCC Part 15C, Reference (15.209)

Test Method: ANSI C63.10, Reference (6.4 – 6.6.)

## 5.3.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. Initially the EUT was pre-tested to establish the worst-case in terms of emissions. The EUT was pre-tested whilst operated on its internal batteries, and also whilst charging in each of the five-way docking station bays. Worst case emissions were observed when the EUT was on charge, and located in docking bay 2 position, so for full-test this bay was used. The front edge of the EUT was initially positioned facing the antenna. The EUT was rotated in all three orthogonal planes. The EUT was operated in **TX 915 MOD (Docked)** test mode.

## 5.3.3 Test Procedure

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

Below 30MHz, measurements were made in a semi-anechoic chamber (pre-scan) with final measurements on an OATS without a ground plane. The antenna was placed 1m above the ground. The equipment and the antenna were rotated 360° to record the worst case emissions.

30MHz - 1GHz, measurements were made on a site listed with the FCC. The equipment was rotated 360° and the antenna scanned 1 – 4 metres in both horizontal and vertical polarisations to record the worst case emissions.

1 – 6 GHz, measurements were made in a semi-anechoic chamber with appropriate absorbing material for use in this range. The EUT was rotated through 360° to record the worst case emissions. A measurement distance of 3m was used.

6 – 10 GHz, measurements were made in a semi-anechoic chamber with appropriate absorbing material for use in this range. The EUT was rotated through 360° to record the worst case emissions. A measurement distance of 1.2m was used.

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

Tests were performed using Test Site M and OATS**.**

## 5.3.4 Test Equipment used

E411, E412, TMS81, TMS933, E570, E428, TMS82

See Section 10 for more details

### 5.3.5 Test results

Ambient conditions
Temperature: 24 °C Relative humidity: 39 %

Peak detector "Max held" Analyser plots against the Quasi-Peak / Average limit line(s) and any tables of signals within 20dB of the limit line can be found in Section 6.3 of this report.

Note: EUT tested in a continuous transmit mode for ease of test.

#### 5.3.5.1 Below 30MHz.

No significant emissions were observed below 30MHz.

Plot references for Radiated emissions measurements (150kHz - 30MHz)

| Channel | Parallel Plots | Perpendicular Plots |
|---|---|---|
| 915 MHz | 7226-2 LF Emissions 150kHz - 3MHz parallel (13.56MHz transmitting) | 7226-2 LF Emissions 150kMHz - 3MHz perpendicular (13.56MHz transmitting) |
| 915 MHz | 7226-2 LF Emissions 3MHz - 30MHz parallel (13.56MHz transmitting) | 7226-2 LF Emissions 3MHz - 30MHz perpendicular (13.56MHz transmitting) |

#### 5.3.5.2 30MHz - 1GHz.

Plot references for Radiated emissions measurements (30-1000MHz)

| Frequency Range | Antenna Polarisation | Plot reference |
|---|---|---|
| 30 – 300 MHz | Horizontal | 7226-2 Rad 1 VHF Horiz |
| 30 – 300 MHz | Vertical | 7226-2 Rad 1 VHF Vert |
| 300 – 1000 MHz | Horizontal | 7226-2 Rad 1 UHF Horiz |
| 300 – 1000 MHz | Vertical | 7226-2 Rad 1 UHF Vert |

**Table of signals measured**

Horizontal

| Signal No. | Freq (MHz) | Peak Amp (dBuV) | QP Amp (dBuV) | QP Lim (dB) |
|---|---|---|---|---|
| 1 | 239.020 | 35.3 | 30.2 | -15.8 |
| 2 | 277.419 | 41.9 | 37.5 | -8.5 |
| 3 | 423.570 | 38.9 | 33.0 | -13.0 |
| 4 | 448.700 | 36.3 | 29.5 | -16.5 |
| 5 | 451.089 | 38.1 | 32.2 | -13.8 |
| 6 | 452.800 | 39.8 | 33.1 | -12.9 |
| 7 | 454.000 | 37.8 | 31.9 | -14.1 |
| 8 | 460.841 | 38.3 | 32.7 | -13.3 |
| 9 | 467.160 | 39.0 | 32.4 | -13.6 |

Vertical

| Signal No. | Freq (MHz) | Peak Amp (dBuV) | QP Amp (dBuV) | QP Lim (dB) |
|---|---|---|---|---|
| 1 | 277.490 | 36.2 | 31.3 | -14.7 |
| 2 | 411.100 | 33.7 | 27.9 | -18.1 |
| 3 | 453.029 | 32.9 | 26.4 | -19.6 |
| 4 | 456.801 | 34.9 | 28.7 | -17.3 |
| 5 | 464.397 | 34.8 | 27.9 | -18.1 |
| 6 | 468.010 | 35.3 | 28.6 | -17.4 |
| 7 | 943.680 | 37.3 | 30.9 | -15.1 |

### 5.3.5.3 Above 1GHz.

Radio Parameters 1

| | |
|---|---|
| **Band** | 902-928 MHz |
| **Power level** | 94 dBuV/m @ 3m |
| **Channel spacing** | single frequency |
| **Mod scheme** | FM |
| **Low channel** | 915 MHz |

Results relating to Radio Parameters 1

| Spurious Frequency (MHz) | Measured Peak Level (dBµV/m) | Difference to Peak Limit (dB) | Measured Average Level (dBµV/m) | Difference to Average Limit (dB) | Antenna Polarisation | EUT Polarisation |
|---|---|---|---|---|---|---|
| 1829.941 | 42.6 | -31.4 | 38.7 | -15.3 | Horizontal | Upright |
| 2744.932 | 43.8 | -30.2 | 38.3 | -15.7 | Horizontal | Upright |
| 3167.597 | 41.2 | -32.8 | 29.4 | -24.6 | Horizontal | Upright |
| 4574.853 | 54.5 | -19.5 | 51.9 | -2.1 | Horizontal | Upright |
| 1248.437 | 34.7 | -39.3 | 22.5 | -31.5 | Vertical | Upright |
| 2744.912 | 42.6 | -31.4 | 36.4 | -17.6 | Vertical | Upright |
| 4574.853 | 52.6 | -21.4 | 49.4 | -4.6 | Vertical | Upright |

Plot reference table

| Frequency Range | Antenna Polarisation | Plot reference |
|---|---|---|
| 1 - 2 GHz | Horizontal | 7226-2 Rad 1 1-2GHz Horiz |
| 1 - 2 GHz | Vertical | 7226-2 Rad 1 1-2GHz Vert |
| 2 - 5 GHz | Horizontal | 7226-2 Rad 1 2-5GHz Horiz |
| 2 - 5 GHz | Vertical | 7226-2 Rad 1 2-5GHz Vert |
| 5 - 6 GHz | Horizontal | 7226-2 Rad 1 5-6GHz Horiz |
| 5 - 6 GHz | Vertical | 7226-2 Rad 1 5-6GHz Vert |
| 6 - 10 GHz | Horizontal | 7226-2 Rad 1 6 up to10GHz Horiz |
| 6 - 10 GHz | Vertical | 7226-2 Rad 1 6 up to10GHz Vert |

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

15.249(a) harmonics must not exceed 500 µV/m @ 3m (-54 dBm).

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

These show that the **EUT** has **PASSED** this test.

## 5.4 Frequency stability

NOT APPLICABLE: EUT is not for fixed, point-to-point operation, therefore no limits are specified.

# 5.5 Occupied bandwidth (20dB)

## 5.5.1 Test Methods

Test Requirements**:** FCC Part 15C, Reference (15.215 (c)

Test Method: ANSI C63.10, Reference (6.9)

## 5.5.2 Configuration of EUT

For occupied bandwidth measurements, the EUT was pre-tested whilst operating on its internal batteries, and also whilst charging in each of the five-way docking station bays. It was found that there was no discernible difference in occupied bandwidth between the two methods. For full-test the EUT was tested whilst charging in the docking station.

The EUT was placed in a chamber and was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was referenced to maximum field strength as measured on an OATS. The EUT was operated in **TX 915 MOD (Docked)** mode.

## 5.5.3 Test Procedure

Tests were performed using Test Site M.

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. A 5kHz RBW, 3x VBW, auto sweep time and max hold settings were used for the 20dB bandwidth.

## 5.5.4 Test Equipment used

E411, E412, TMS933

See Section 10 for more details.

## 5.5.5 Test results

Ambient conditions.
Temperature: 22 °C Relative humidity: 44 % Pressure: 102 kPa

Radio Parameter 1

| | |
|---|---|
| **Band** | 902-928 MHz |
| **Power level** | 94 dBuV/m @ 3m |
| **Channel spacing** | single frequency equipment |
| **Mod scheme** | FM |
| **Low channel** | 915 MHz |

Results relating to Radio Parameters 1

| | **Single channel** |
|---|---|
| **20dB BW (MHz)** | 0.13 |
| **Plot reference** | 7226-2 20dB bandwidth |

**LIMITS:**
15.215(c) The 20dB bandwidth of the emission must be contained within the designated frequency band.

The result is also presented graphically. Please refer to section 6.4 of this report.

These results show that the EUT has **PASSED** this test.

# 5.6 Band Edge

## 5.6.1 Test Methods

Test Requirements: FCC Part 15C, Reference (15.215 and 15.247)

Test Method: FCC Part 15C, Reference (15.215)
ANSI C63.10-2009, Reference clause 6.9.3

## 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 tested whilst charging in the docking station and positioned for maximised emissions. The EUT was operated in **TX 915 MOD (Docked)** mode.

## 5.6.3 Test Procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. The emission from the EUT was maximised before taking the plots.

Tests were performed using Test Site **M**.

## 5.6.4 Test Equipment used

E411, E412, TMS933, E570

See Section 10 for more details.

## 5.6.5 Test results

Ambient conditions.
Temperature: 24 °C Relative humidity: 39 % Pressure: 102 kPa

Radio Parameter 1

| | |
|---|---|
| **Band** | 902-928 MHz |
| **Power level** | 94 dBuV/m @ 3m |
| **Channel spacing** | single frequency equipment |
| **Mod scheme** | FM |
| **Low channel** | 915 MHz |

Band Edge Results relating to Radio Parameters 1

| | Lower edge | Upper edge |
|---|---|---|
| **Peak Level (dBµV/m)** | 32.4 | 33.3 |
| **Plot reference** | J7226-2 Band edges 30MHz span | |

The result are presented graphically, please refer to section 6.5 for plots.

The restricted band edges closest to the EUT frequency of 902-928MHz are 614 & 960MHz.
Further wider span plots have been taken to show the fact that there are no spurious emissions above the restricted limits of 15.209. See radiated emissions results section 5.3.

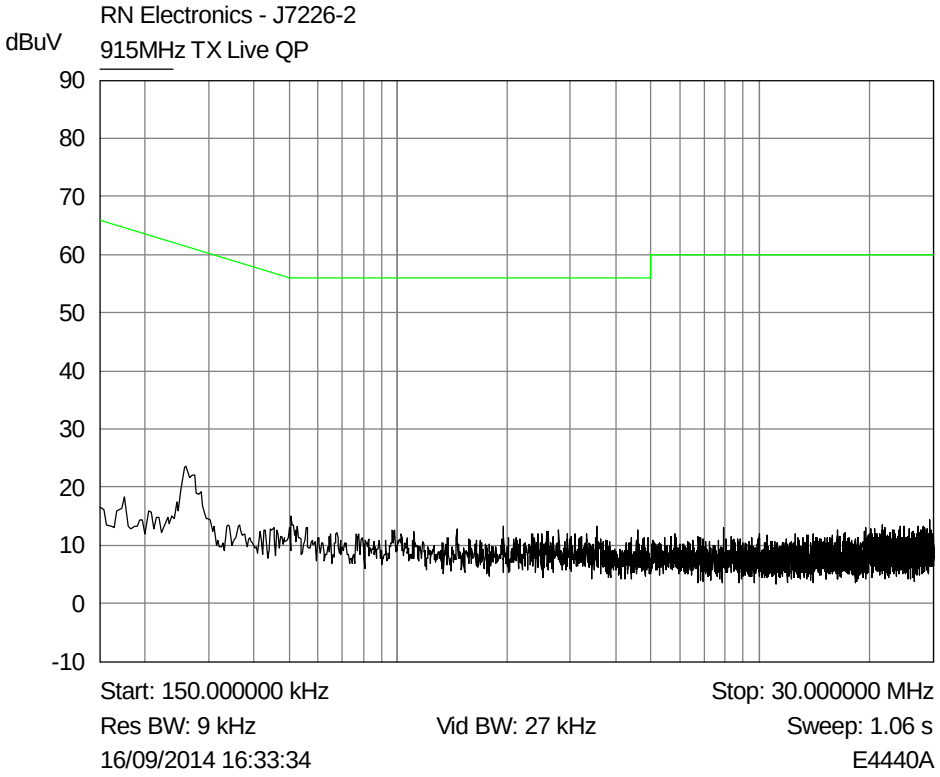
These results show that the **EUT** has **PASSED** this test.

## 5.7 Duty cycle

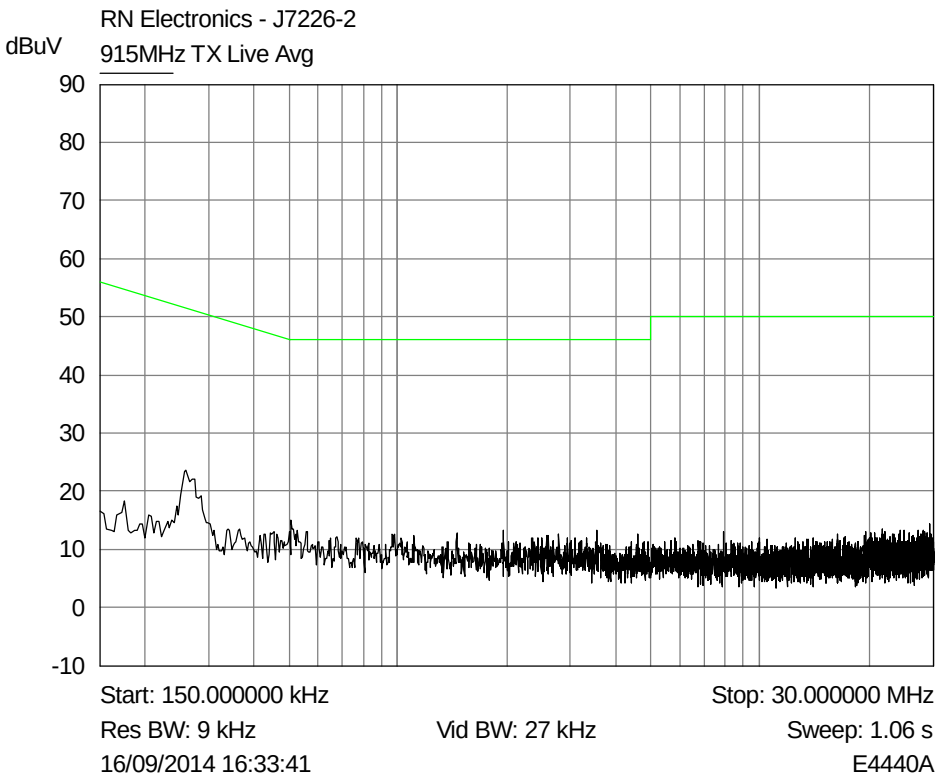
No limits apply, however duty cycle check made to verify that the TX mode used was 100% constant.

# 6 Plots and Results

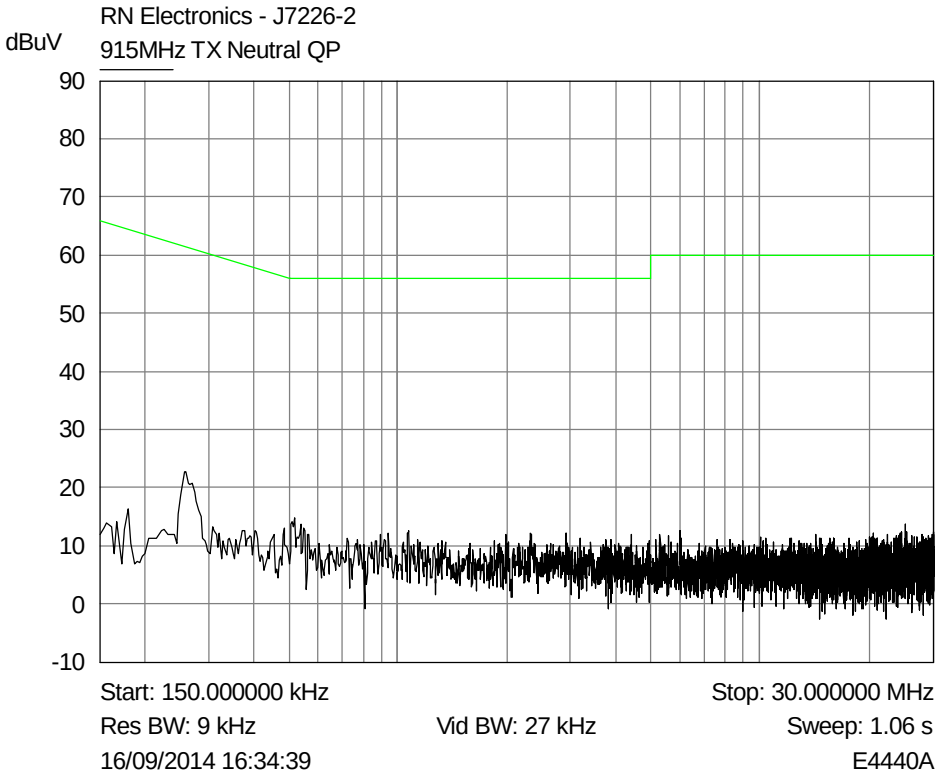
## 6.1 AC power line conducted emissions plots



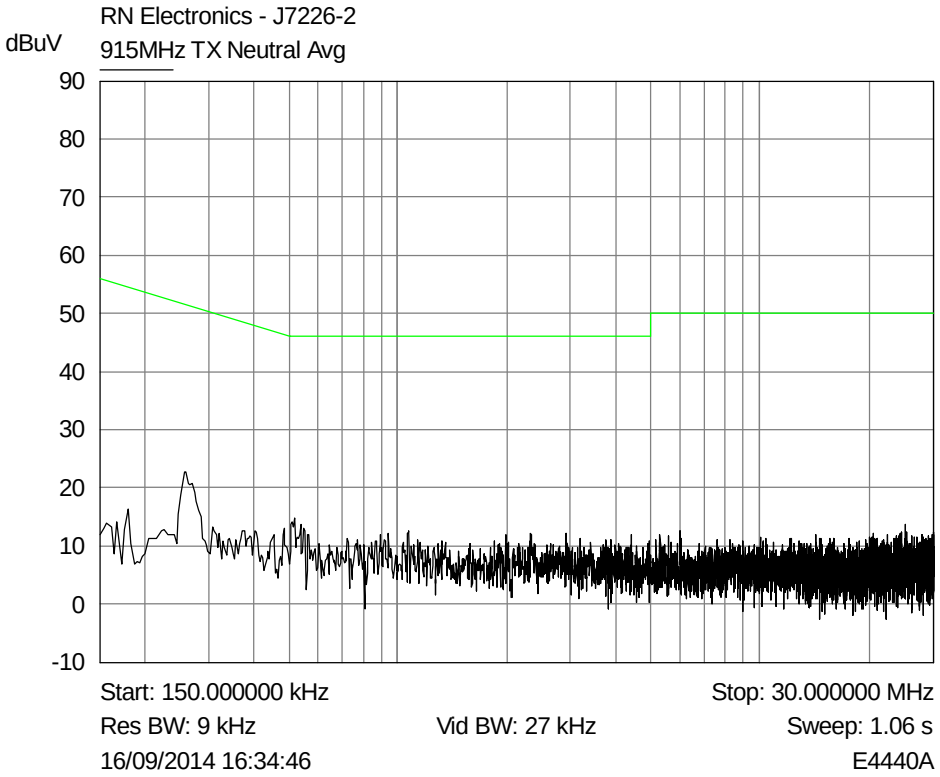

**Plot of peak emissions 150kHz - 30MHz on the 915MHz transmitting live terminal against the quasi-peak limit line.**




**Plot of peak emissions 150kHz - 30MHz on the 915MHz transmitting live terminal against the average limit line.**

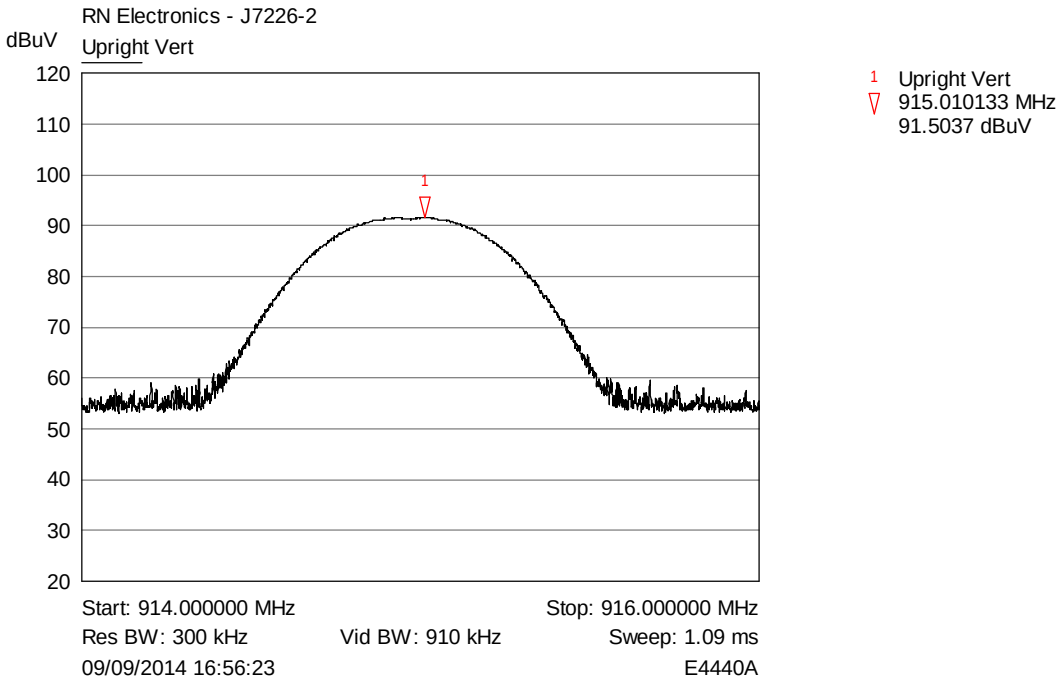



**Plot of peak emissions 150kHz - 30MHz on the 915MHz transmitting neutral terminal against the quasi-peak limit line.**



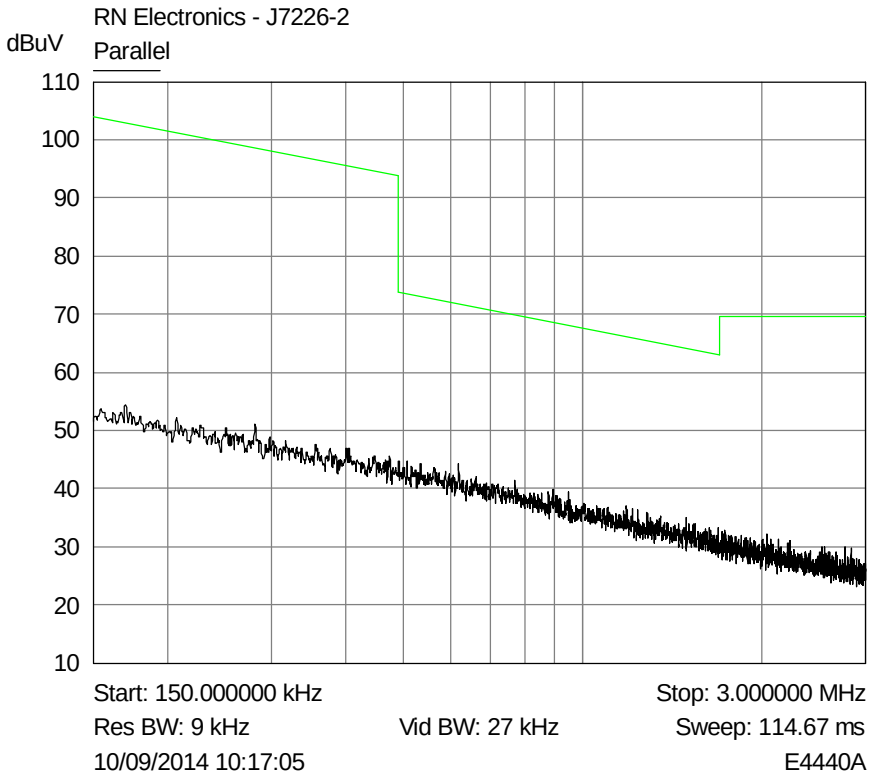

**Plot of peak emissions 150kHz - 30MHz on the 915MHz transmitting neutral terminal against the average limit line.**

## 6.2 Intentional radiator field strength plots

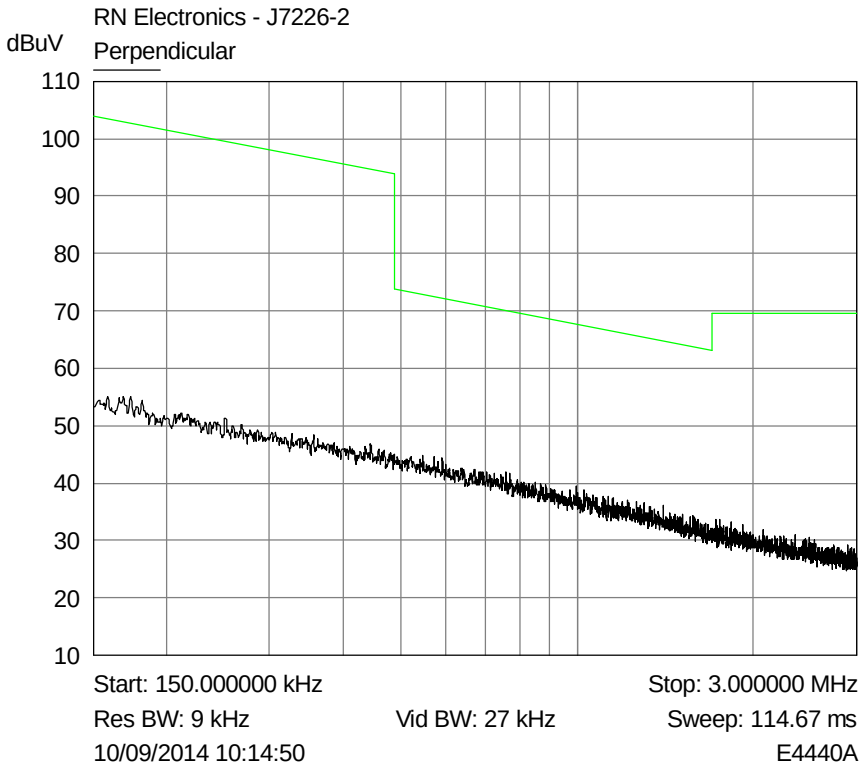



**Plot for Band 902-928 MHz, Power 94 dBuV, and FM Modulation.**

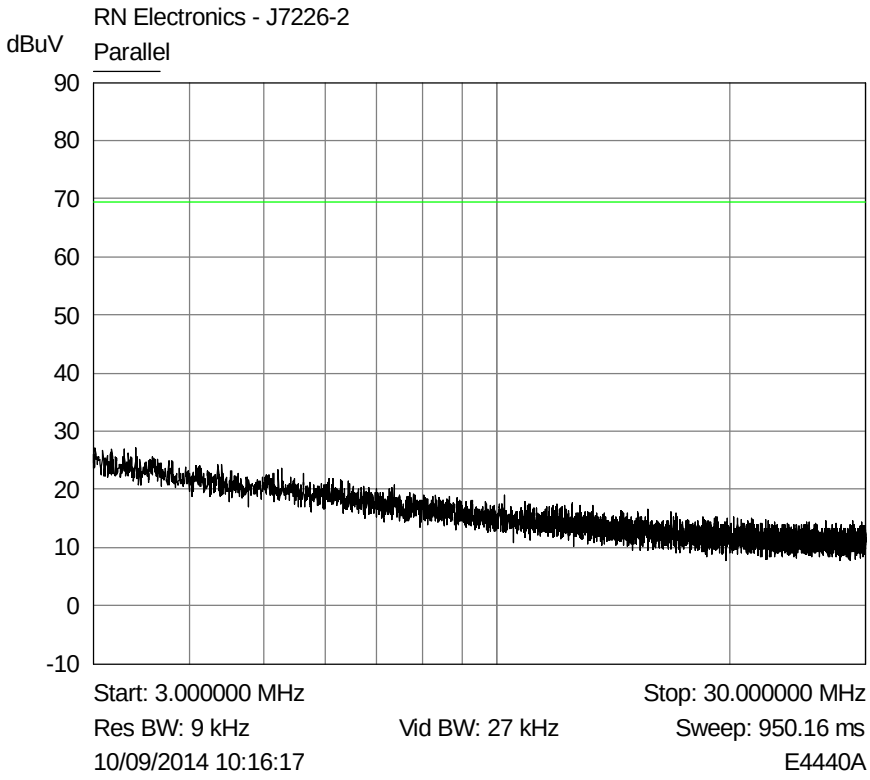
## 6.3 Radiated emissions plots



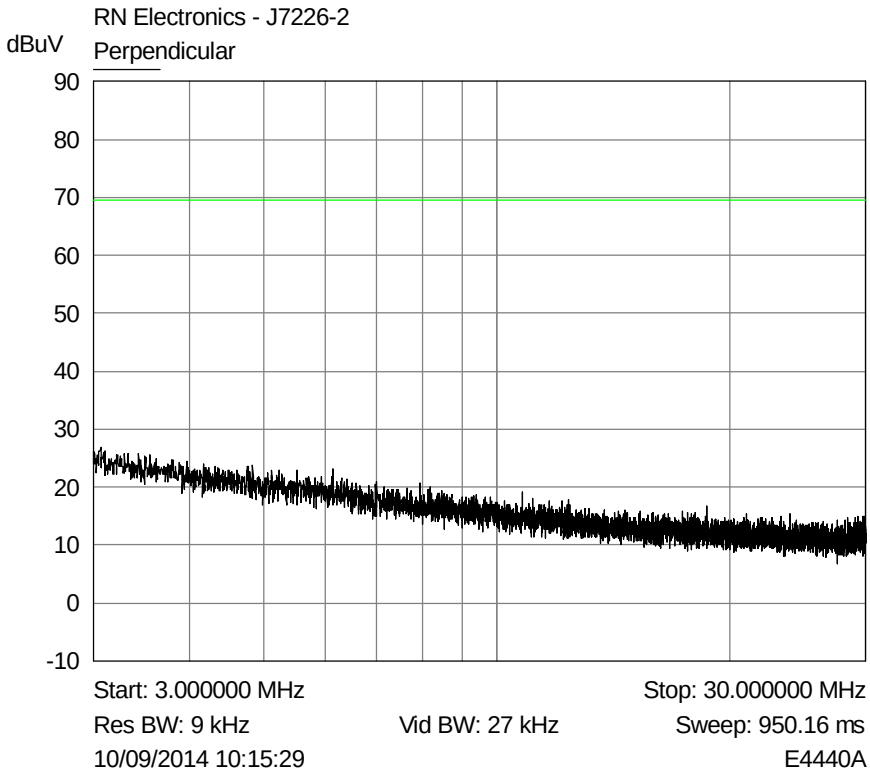

**915 MHz Transmitting – 150kHz – 3MHz Parallel Plot**



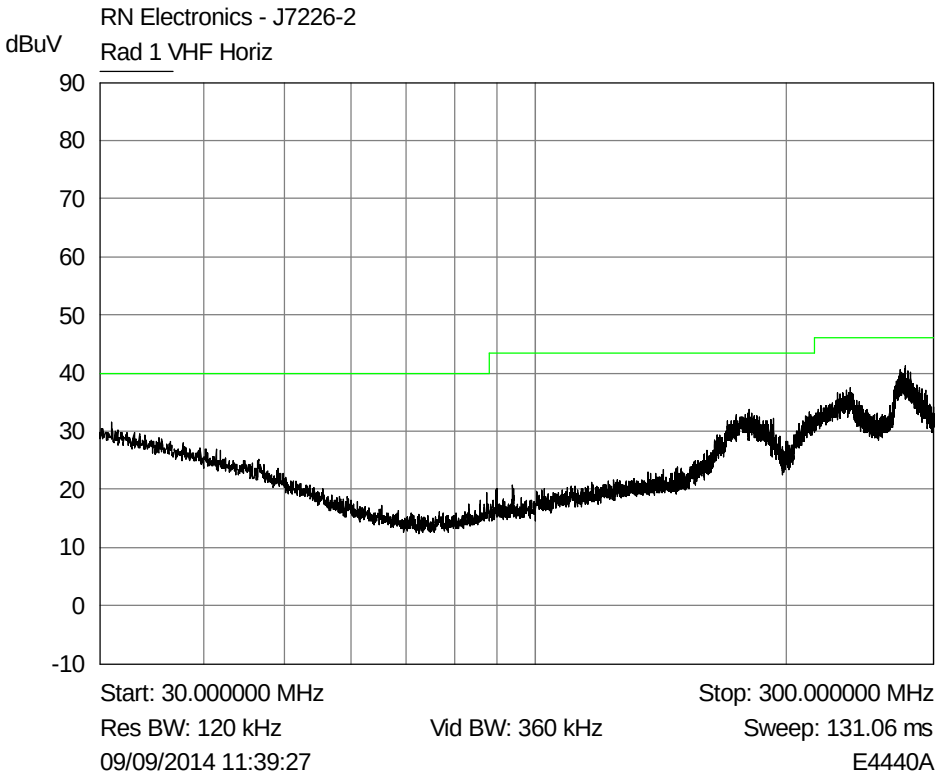

**915 MHz Transmitting – 150kHz – 3MHz Perpendicular Plot**



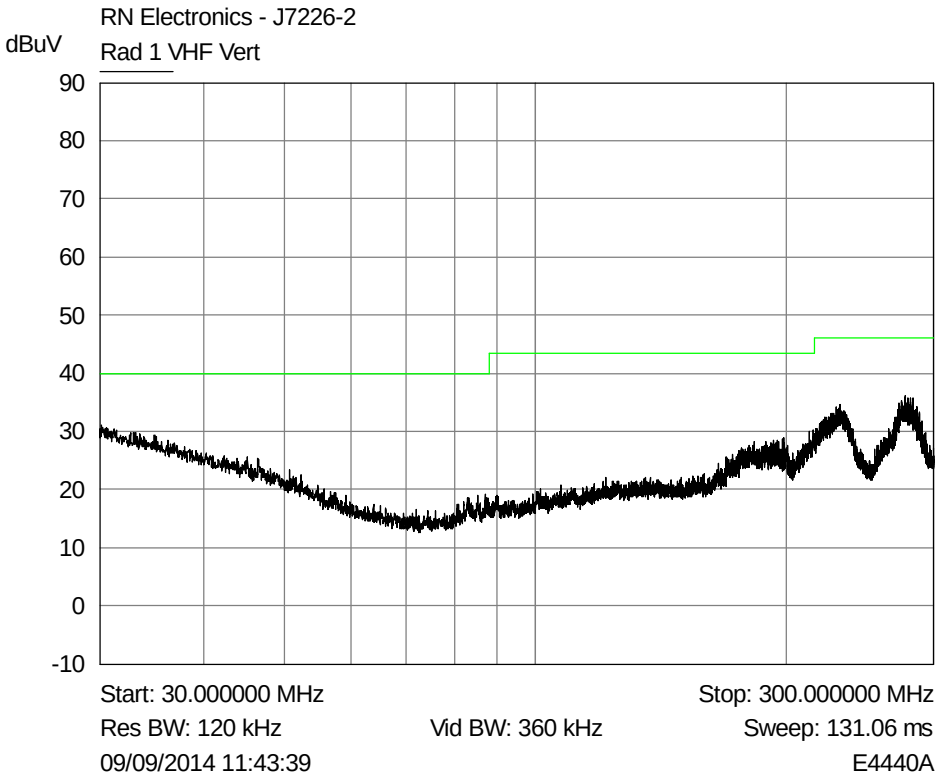

**915 MHz Transmitting – 3MHz – 30MHz Parallel Plot**



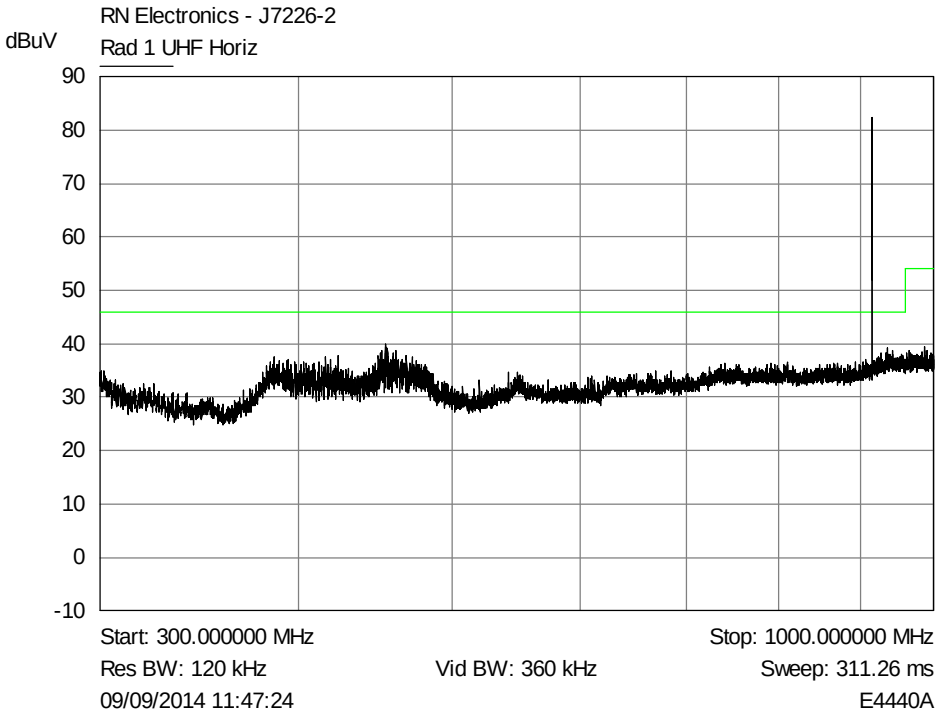

**915 MHz Transmitting – 3MHz – 30MHz Perpendicular Plot**




**Plot of peak horizontal emissions 30MHz - 300MHz against the quasi-peak limit line.**

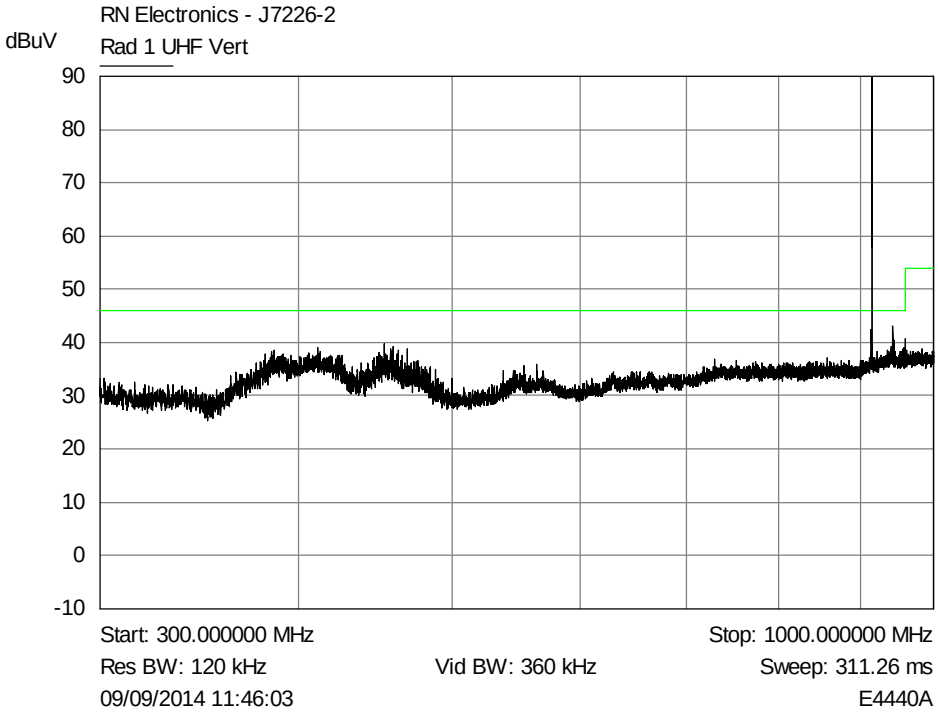



**Plot of peak vertical emissions 30MHz - 300MHz against the quasi-peak limit line.**



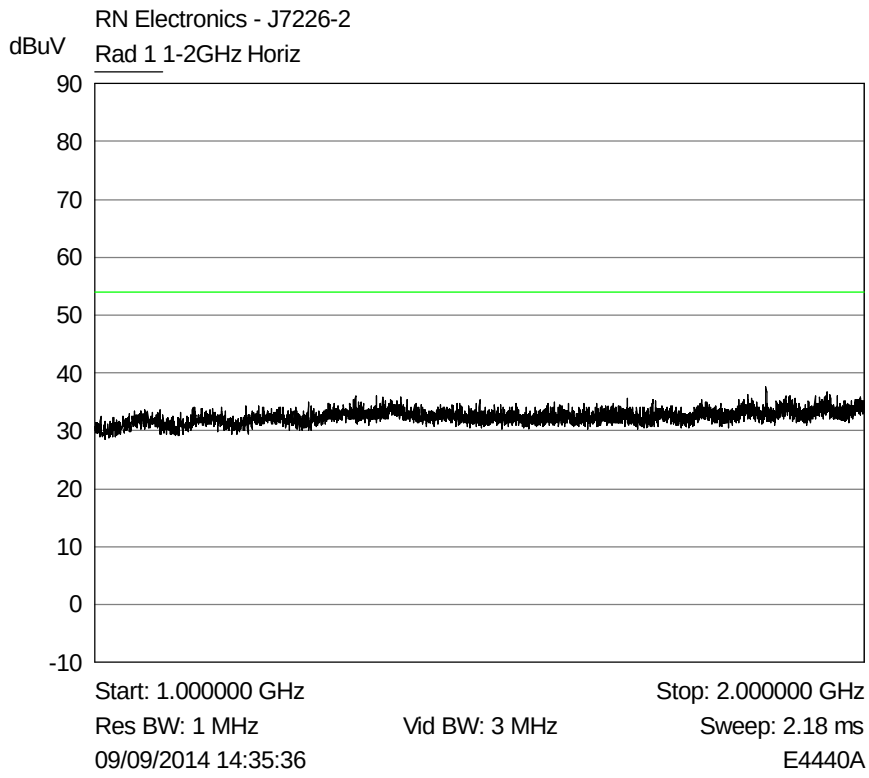

**Plot of peak horizontal emissions 300MHz - 1GHz against the quasi-peak limit line.**

Note: Plot shows the EUT's fundamental frequency at 915MHz.

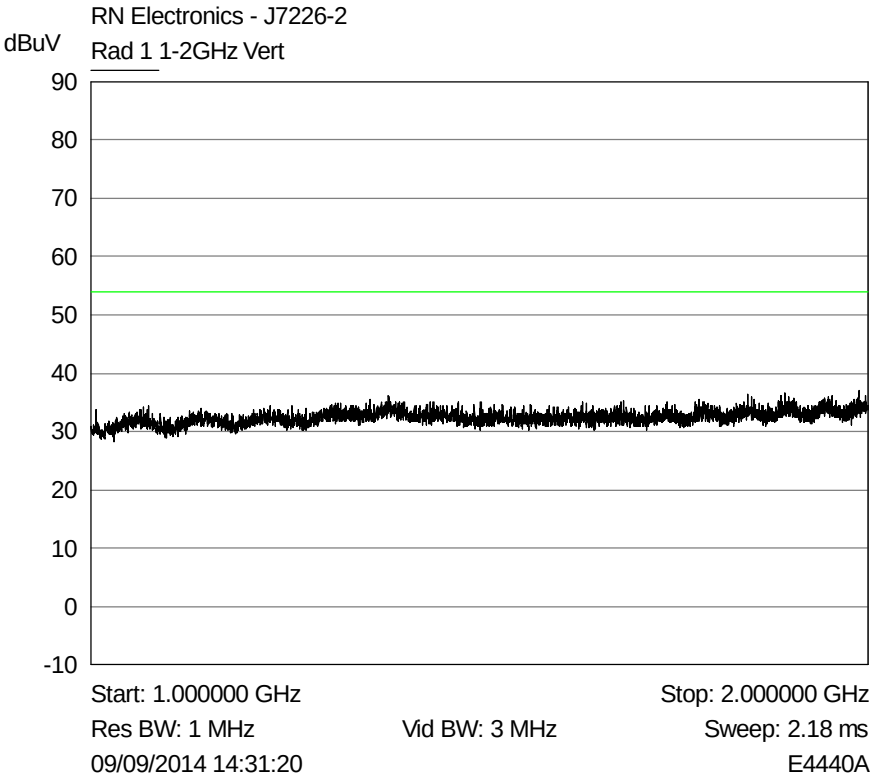



**Plot of peak vertical emissions 300MHz - 1GHz against the quasi-peak limit line.**

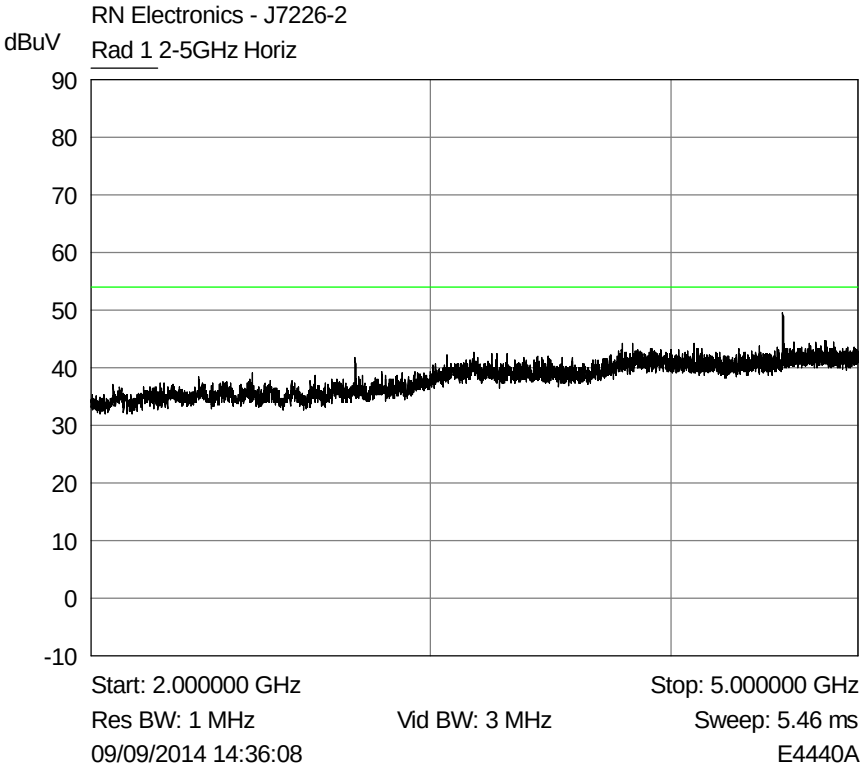
Note: Plot shows the EUT's fundamental frequency at 915MHz.



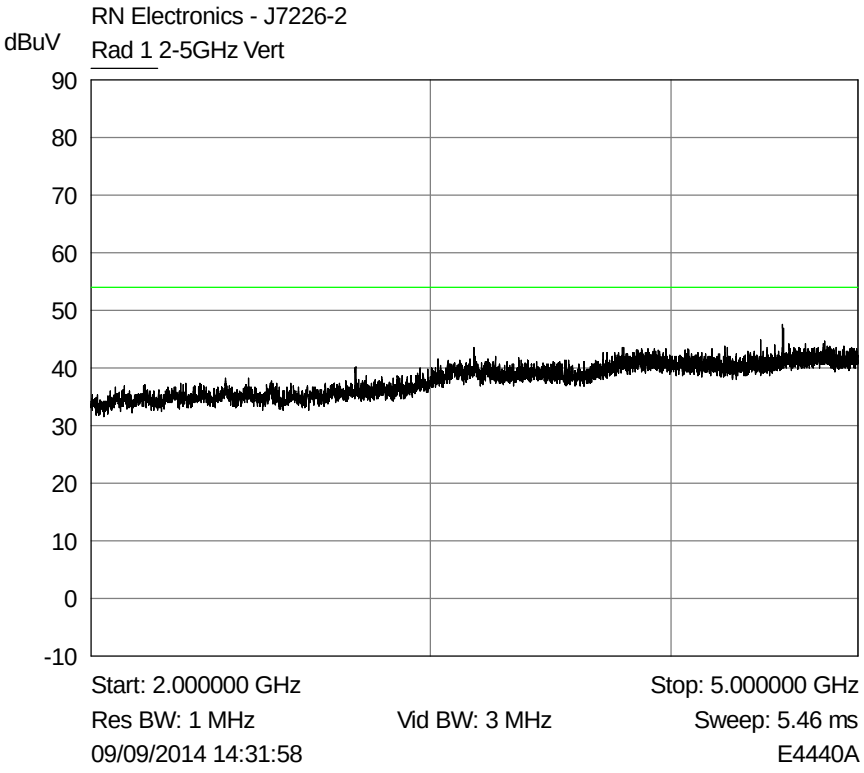

**Plot of peak horizontal emissions 1GHz - 2GHz against average limit line.**



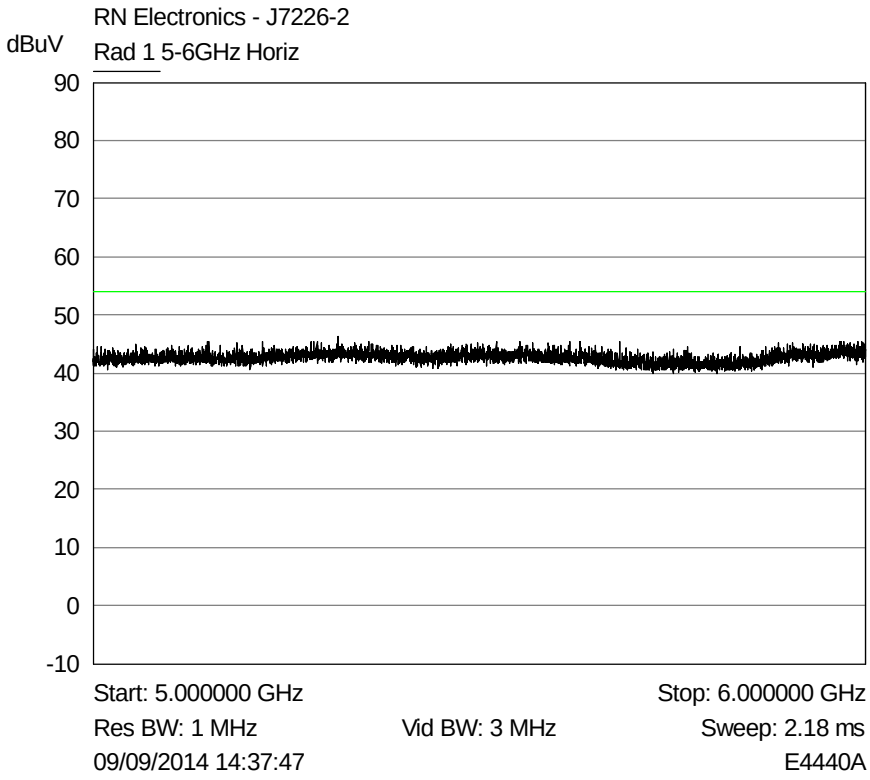

**Plot of peak vertical emissions 1GHz - 2GHz against the average limit line.**



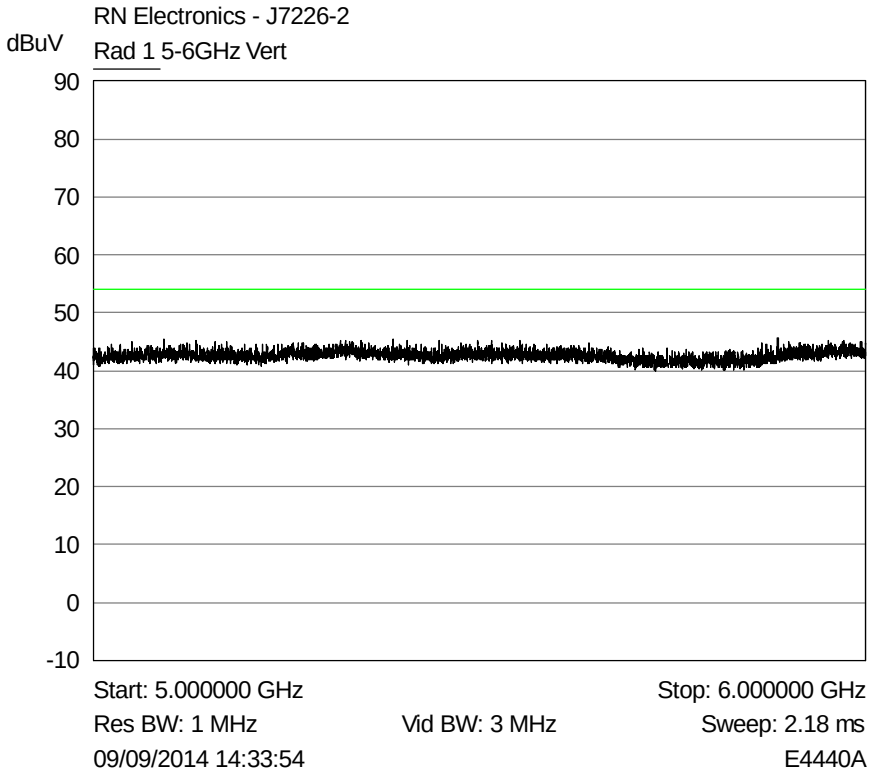

**Plot of peak horizontal emissions 2GHz - 5GHz against the average limit line.**



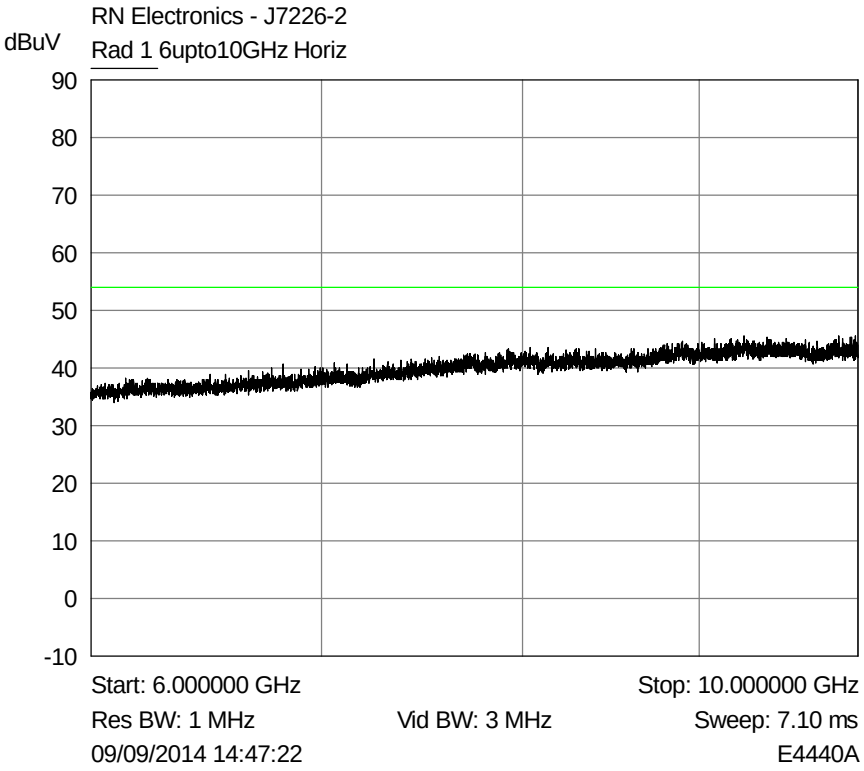

**Plot of peak vertical emissions 2GHz - 5GHz against the average limit line.**



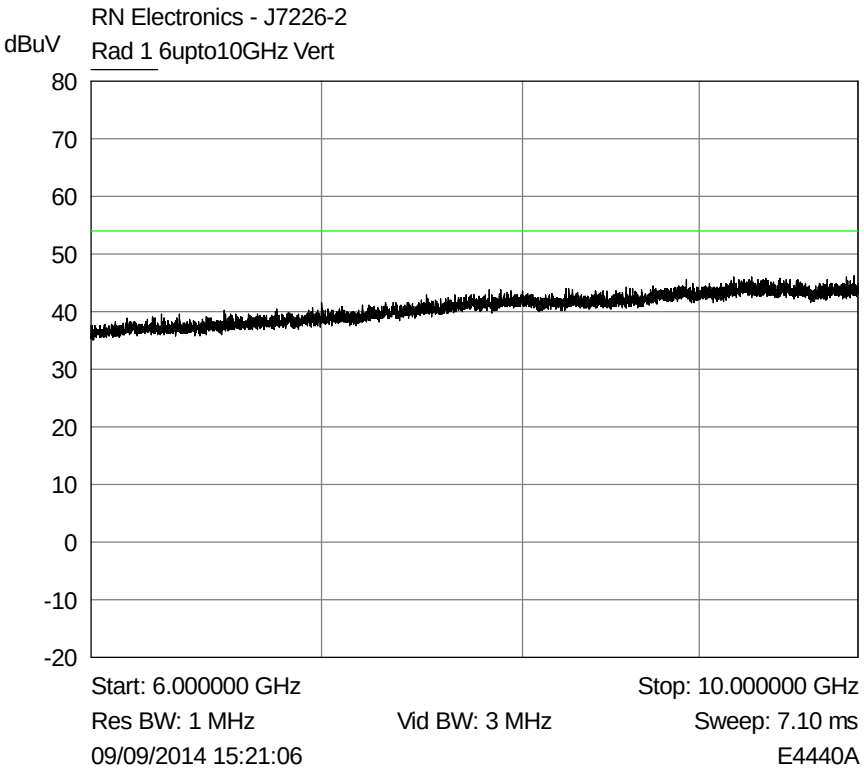

**Plot of peak horizontal emissions 5GHz - 6GHz against the average limit line.**




**Plot of peak vertical emissions 5GHz - 6GHz against the average limit line.**

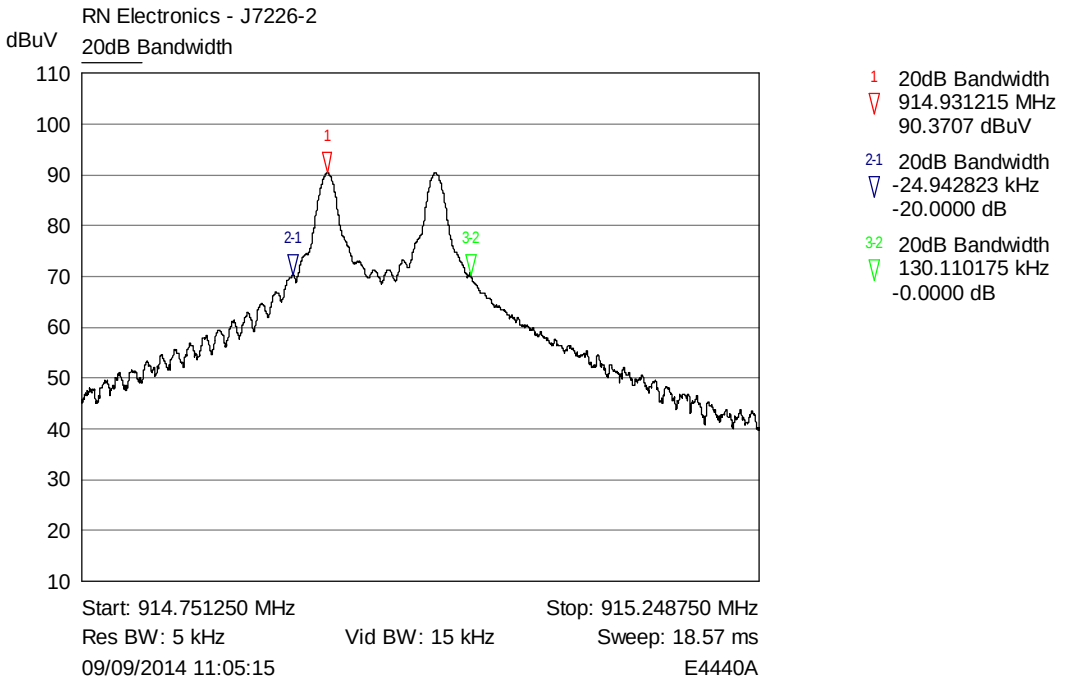



**Plot of peak horizontal emissions 6GHz - 10GHz against the average limit line.**



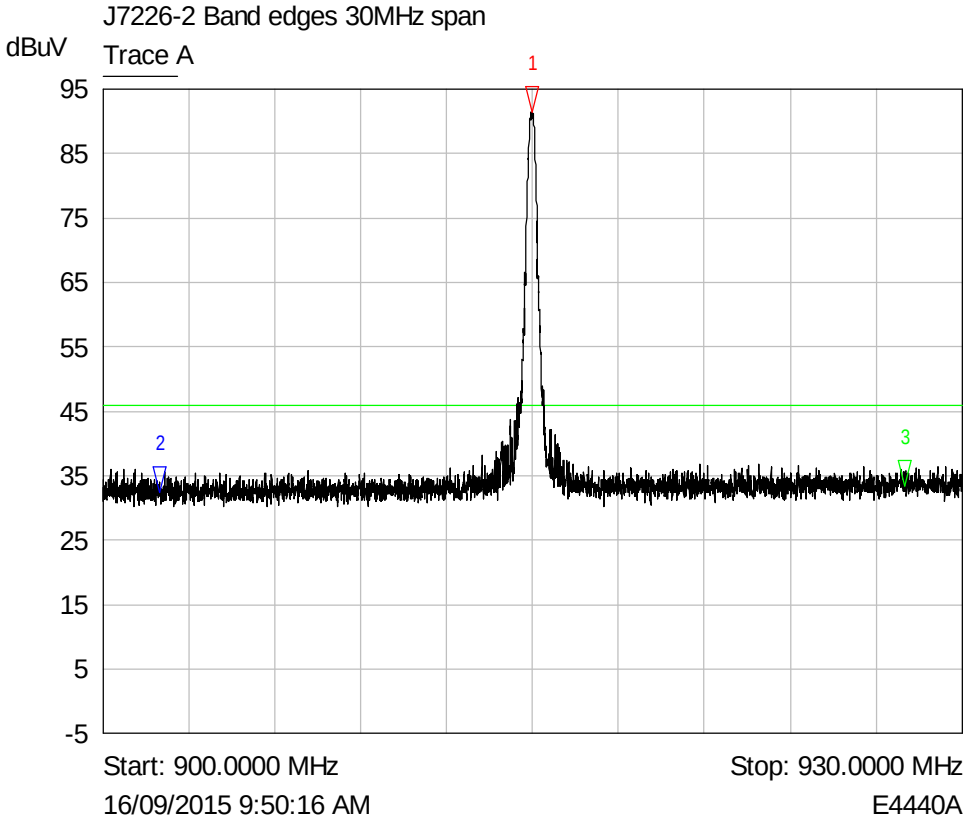

**Plot of peak vertical emissions 6GHz - 10GHz against the average limit line.**

## 6.4 20dB bandwidth plot




**Plots for Band 902-928 MHz, Power 94 dBuV/m @ 3m and FM Modulation.**

## 6.5 Band edge compliance plots




| Mkr | Trace | X-Axis | Value | Notes |
|---|---|---|---|---|
| 1 | Trace A | 915.0092 MHz | 91.28 dBuV | |
| 2 | Trace A | 901.9998 MHz | 32.38 dBuV | |
| 3 | Trace A | 928.0002 MHz | 33.33 dBuV | |

**Plots for Band 902-928 MHz, Power 94 dBuV/m @ 3m and FM Modulation.**

# 7 Explanatory Notes

## 7.1 Explanation of Table of Signals Measured

Measurements are made as required by the standard. These measurements are made and recorded using detectors, either peak, quasi peak or average dependant on the test. A table of results has been given following the relevant plots. This table looks similar to the one illustrated below dependant on the measurements required by the test: -

| Signal No. | Freq (MHz) | Peak Amp (dBuV) | Pk – Lim 1 (dB) | QP Amp (dBuV) | QP - Lim1 (dB) | Av Amp (dBuV) | Av - Lim1 (dB) |
|---|---|---|---|---|---|---|---|
| 1 | 12345 | 54.9 | -10.5 | 48.0 | -12.6 | 37.6 | -14.4 |

Column One - Labelled Signal No. is an incremental number that the receiver has given to each signal that has been measured.

Column Two - Labelled Freq (MHz) is the approximate frequency of the signal received.

Column Three - Labelled Peak Amp (dBμV) is the level of received signal that was measured in dB above 1μV using the peak detector.

Column Four - Labelled Pk - Lim1 (dB) is the difference in level from the peak signal given to the active limit line. If this column appears in the table the peak detector measurement is required by the standard for this test. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.

Column Five - Labelled QP Amp (dBμV) is the level of received signal that was measured in dB above 1μV using the quasi-peak detector.

Column Six - Labelled QP - Lim1 (dB) is the difference in level from the quasi-peak signal given to the active limit line. If this column appears in the table the quasi-peak detector measurement is required by the standard for this test. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.

Column Seven - Labelled Av Amp (dBμV) is the level of received signal that was measured in dB above 1μV using the average detector.

Column Eight - Labelled Av - Lim1 (dB) is the difference in level from the average signal given to the active limit line. If this column appears in the table the average detector measurement is required by the standard for this test. The results entered in this column indicate the signal level relative to the compliance limit required. Negative numbers indicate that the product is compliant.

Only signals highlighted in red are deemed to exceed the limit of the detector required.

## 7.2 Explanation of limit line calculations for radiated measurements

The limits given in the test standard are normally expressed as absolute values (e.g. in μV/m at a specified distance), whereas the measured values are expressed as peak, quasi peak or average values in dBμV/m referenced to the measuring instrument inputs. RN Electronics calibrate the test set-up to account for any path losses, antenna gains, etc. so that the value read at the receiver relates directly to the absolute value required, except that it is expressed in dB relative to one microVolt and may need to take account of any alternative measuring distance used. Examples:

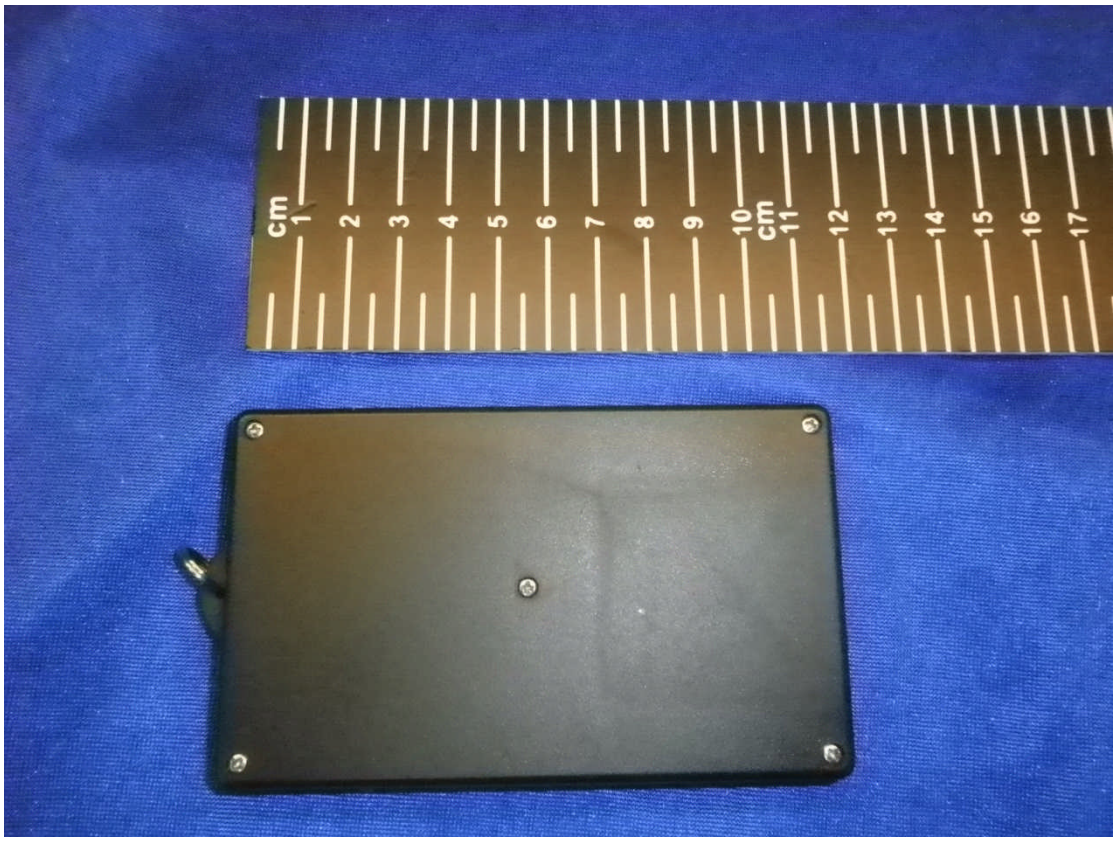
(a) limit of 500 μV/m equates to 20.log (500) = 54 dB μV/m.
(b) limit of 300 μV/m at 10m equates to 20.log (300 . 10/3) = 60 dB μV/m at 3m

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

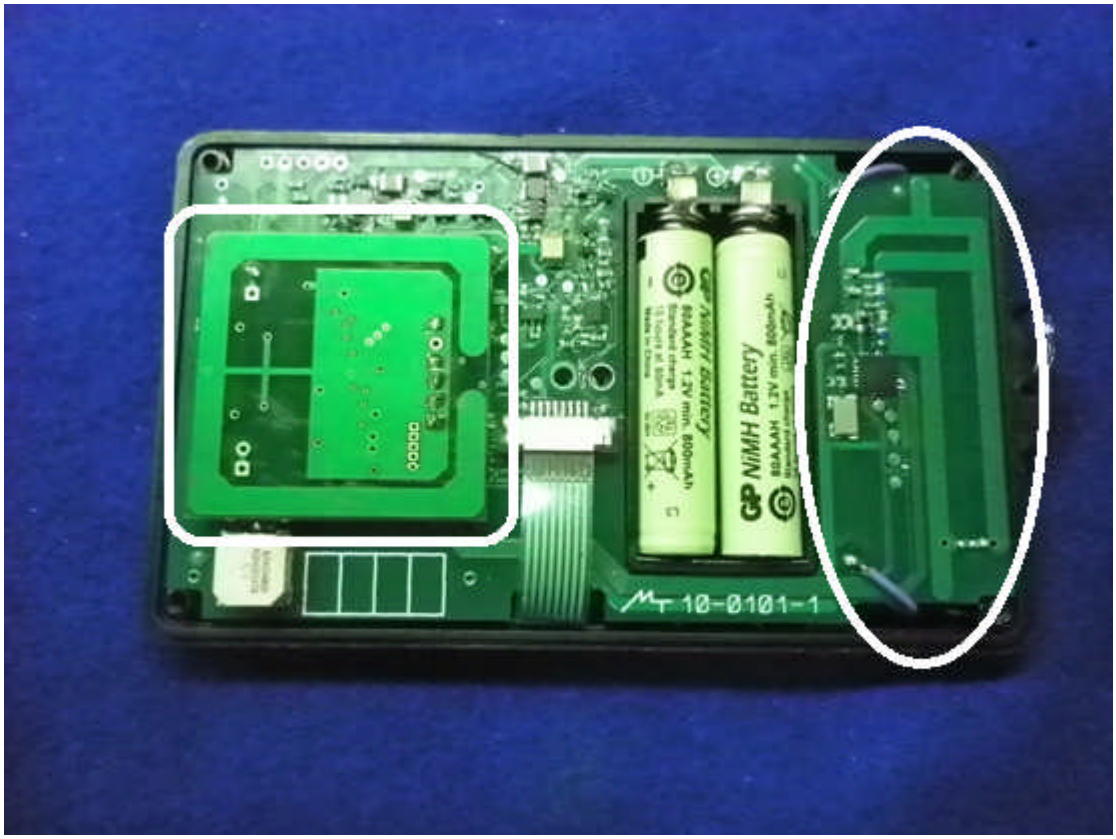
# 8 Photographs

## 8.1 EUT Front view


## 8.2 EUT rear view



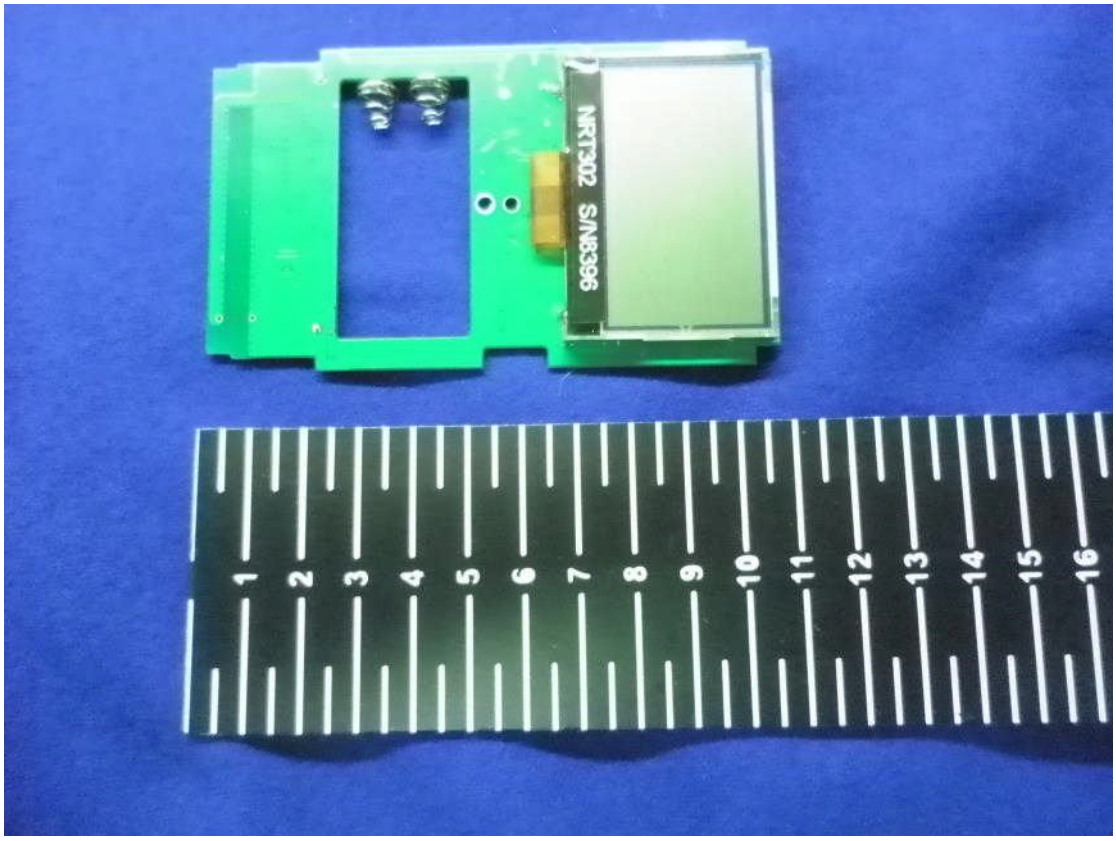
## 8.3 EUT antenna / RF connector port

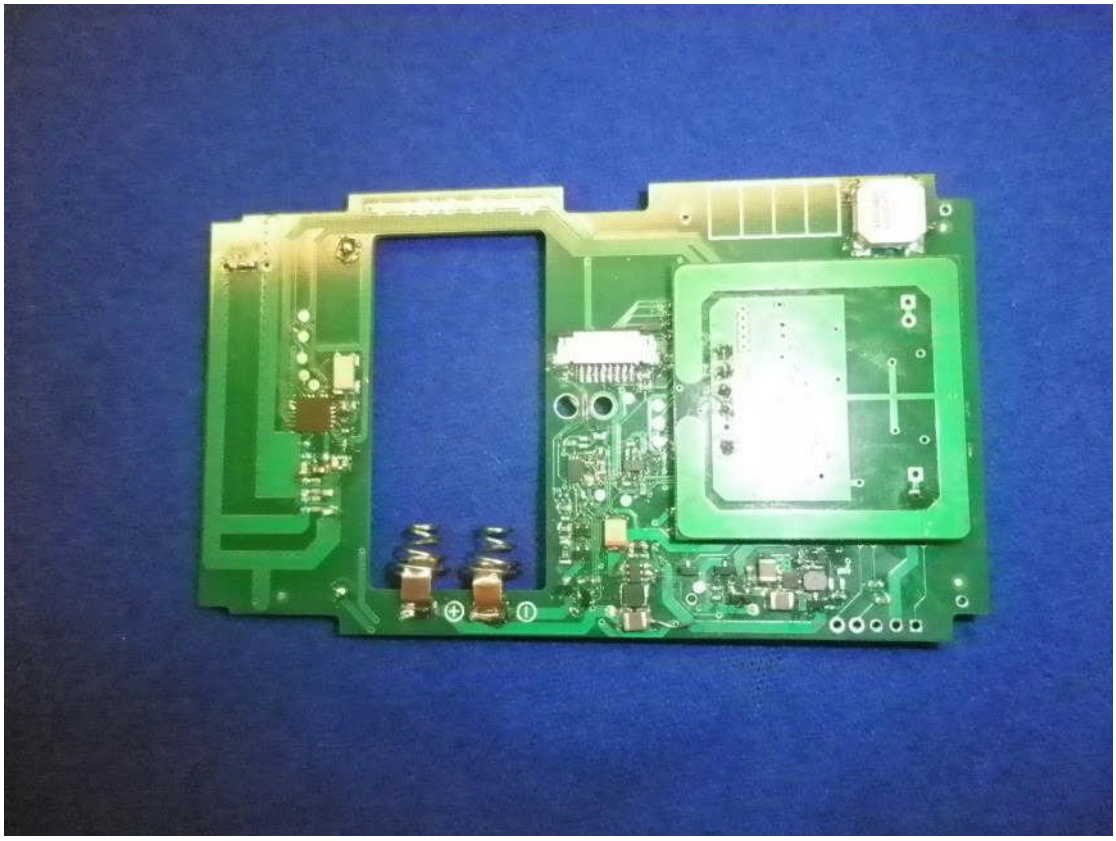


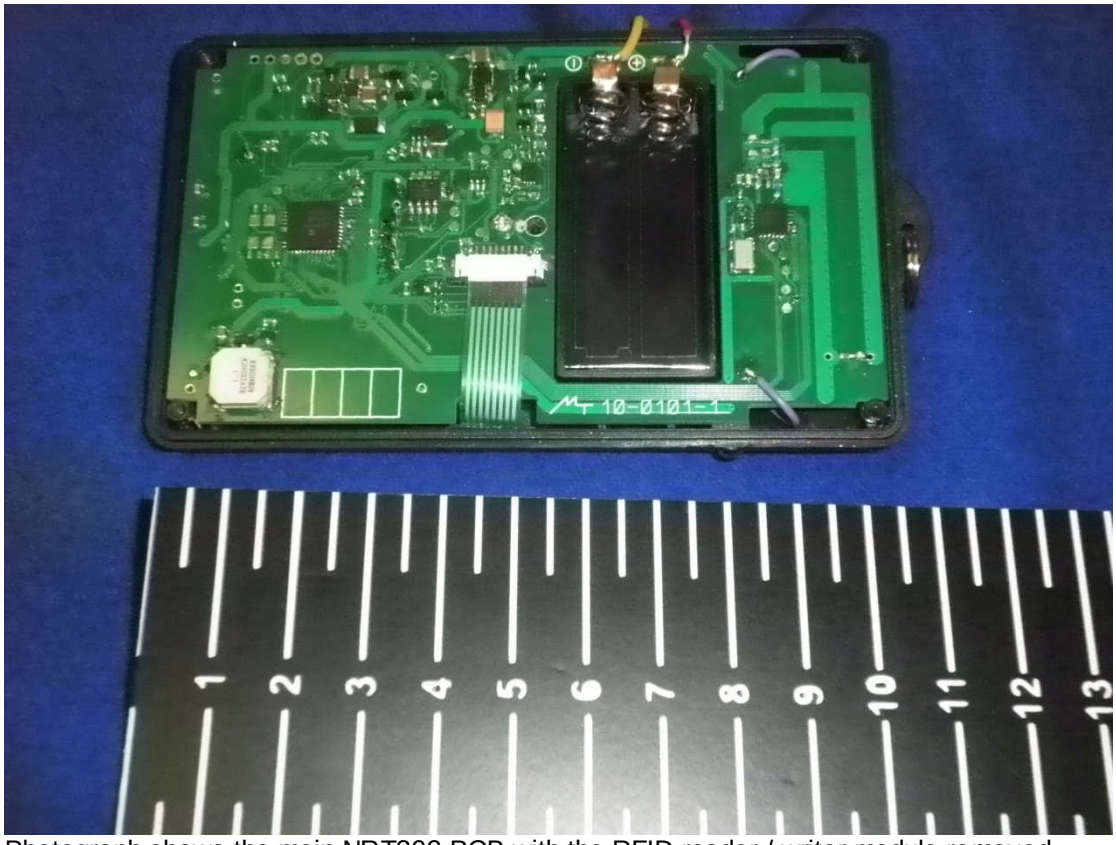

Photograph shows the two integral antennas etched into the PBC's. The 13.56 MHz RFID reader / writer shown on the left, and the 915 MHz transceiver shown on the right.

## 8.4 EUT Display / Controls

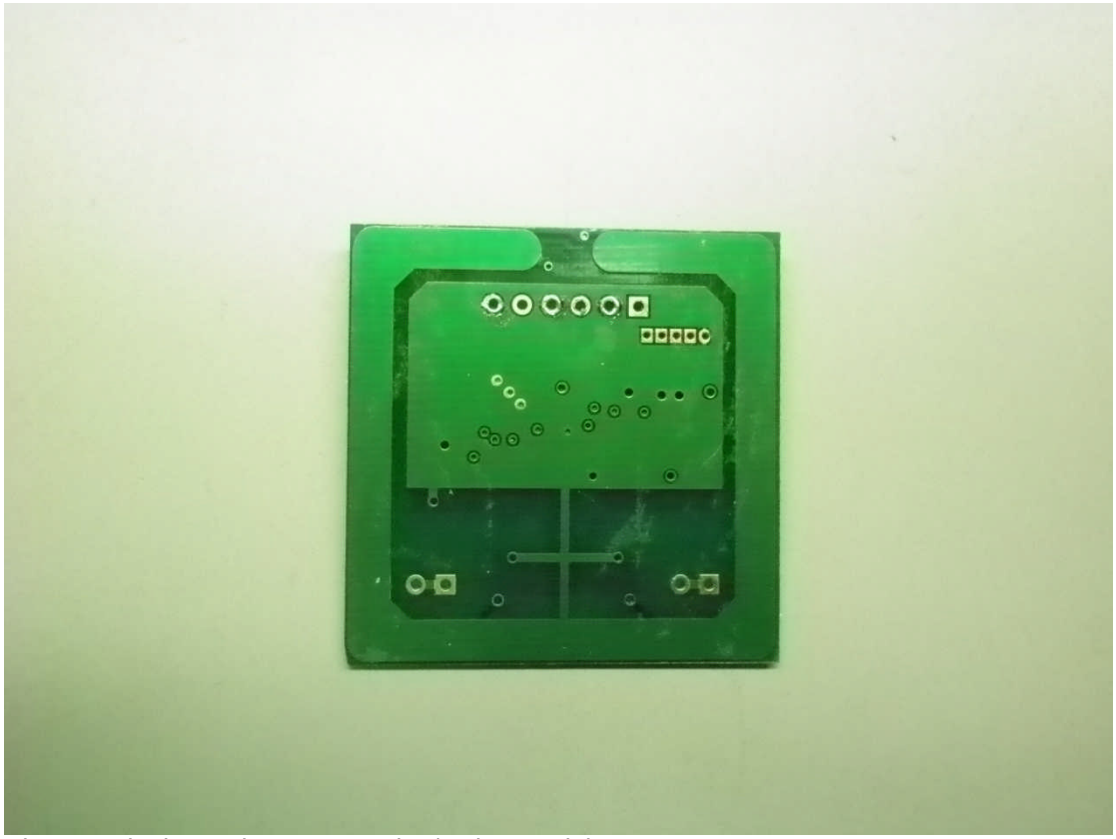
## 8.5 EUT internal construction



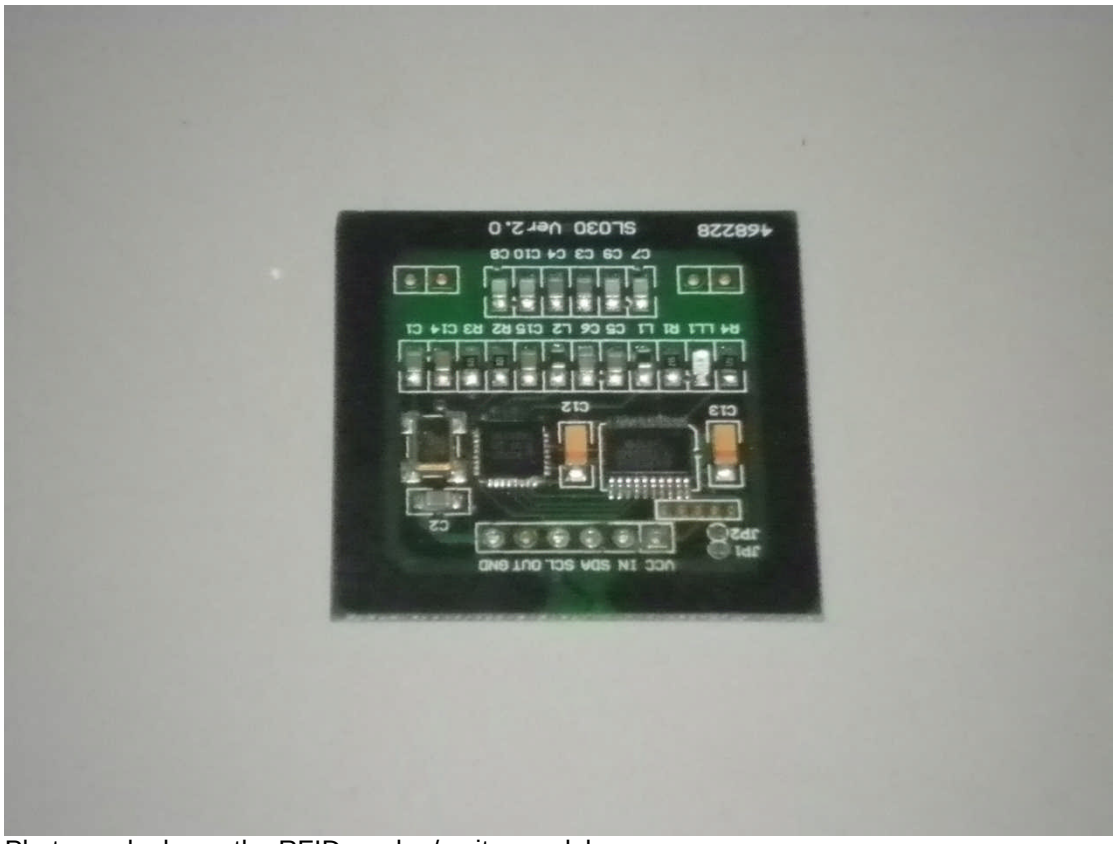




Photograph shows the main NRT302 PCB with the RFID reader / writer module removed.

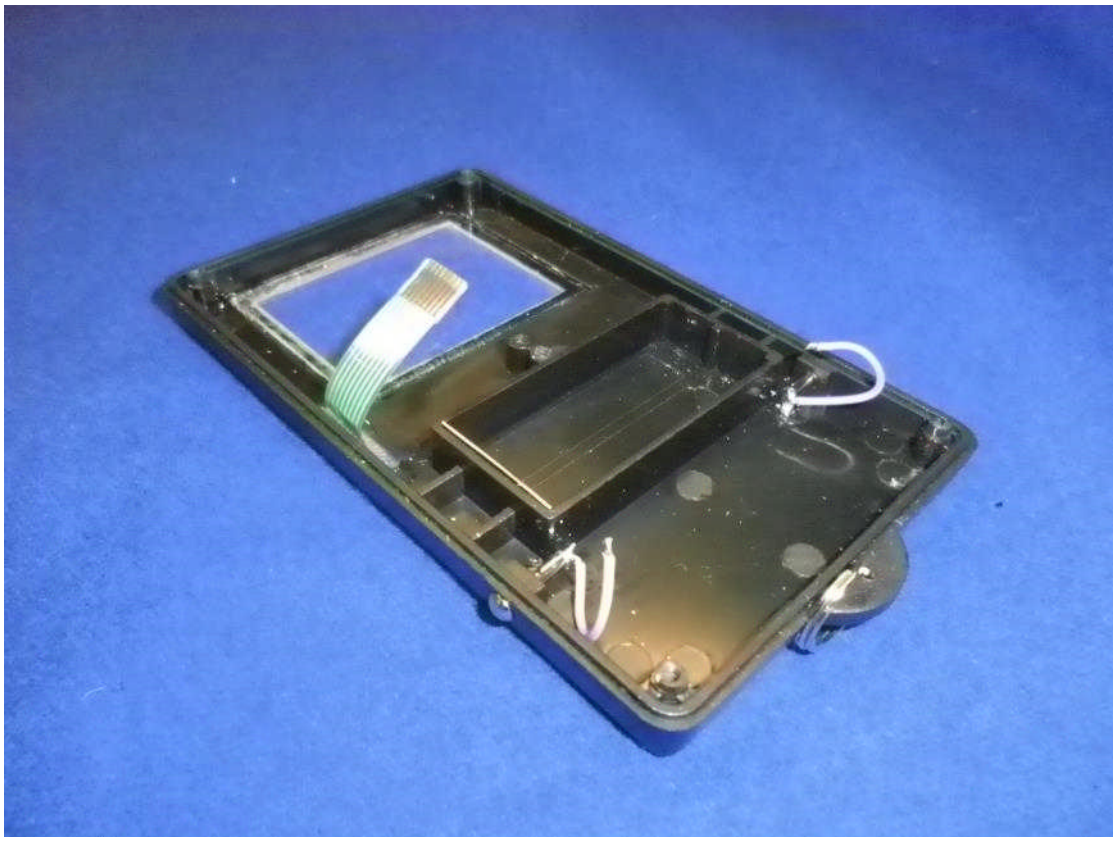


Photograph shows the RFID reader / writer module.

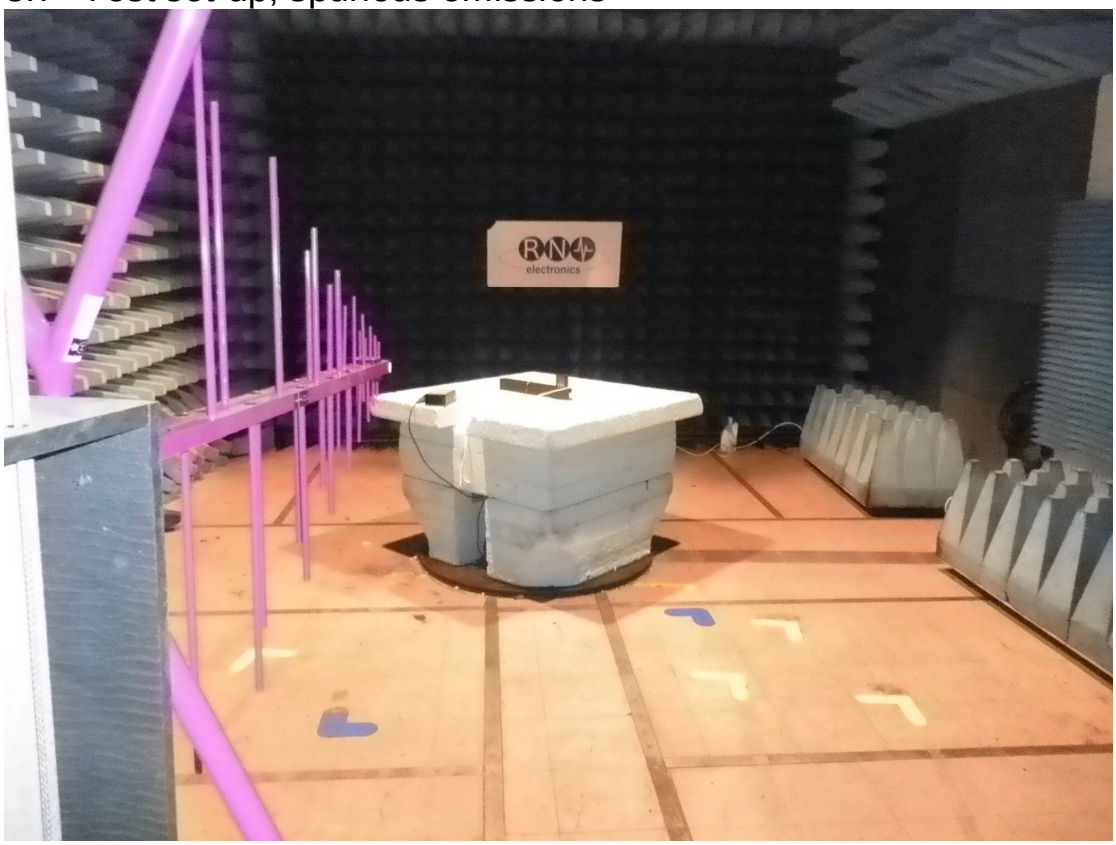


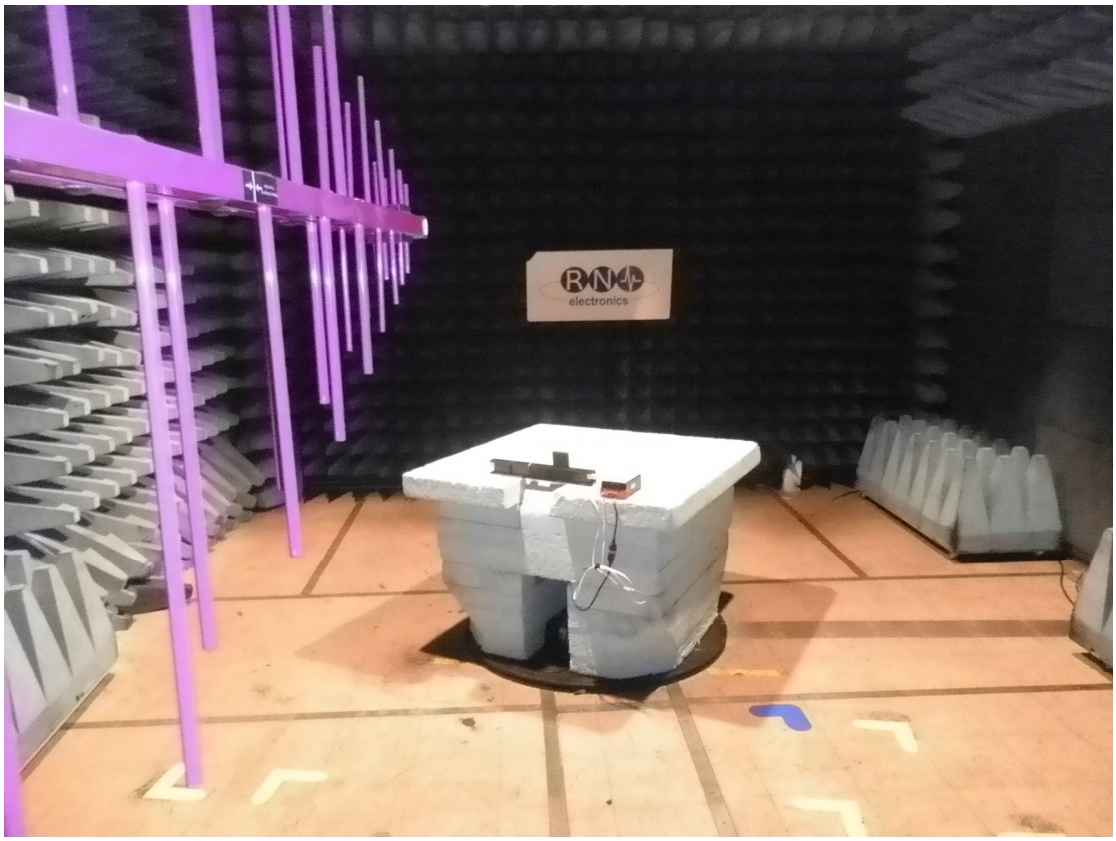

Photograph shows the RFID reader / writer module.

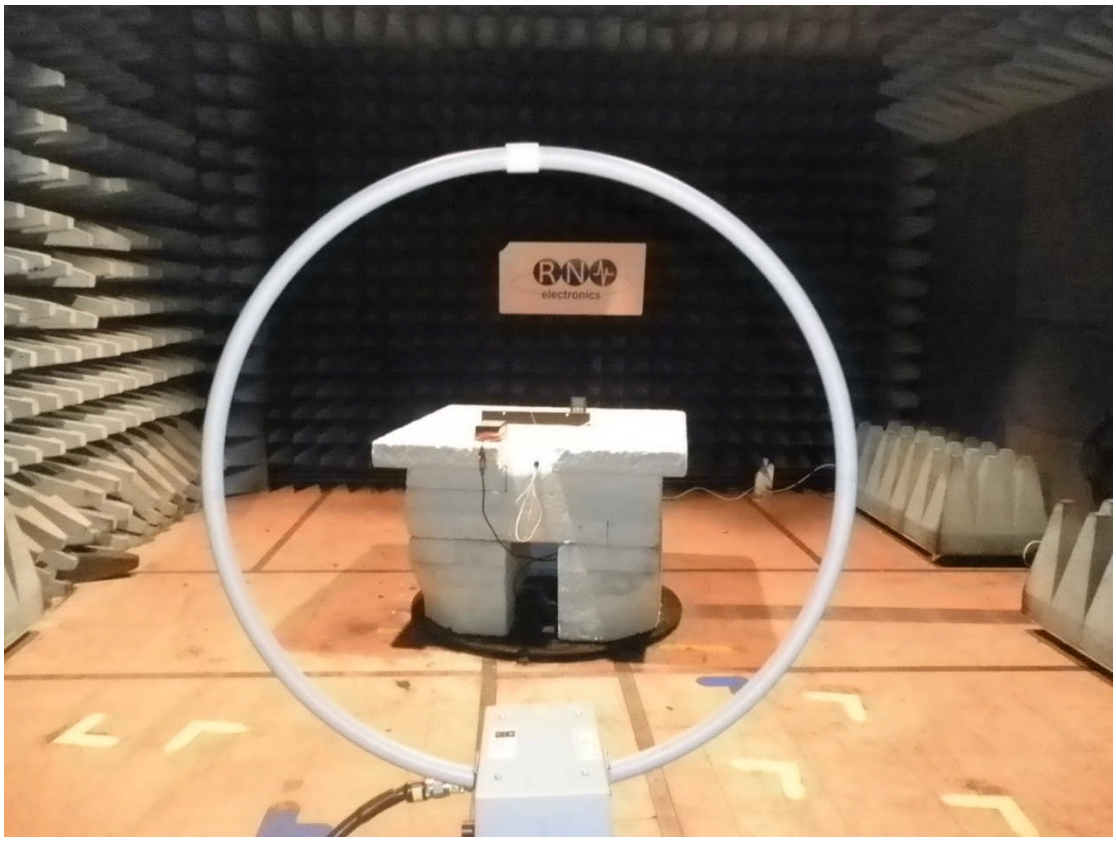
## 8.6 EUT Chassis

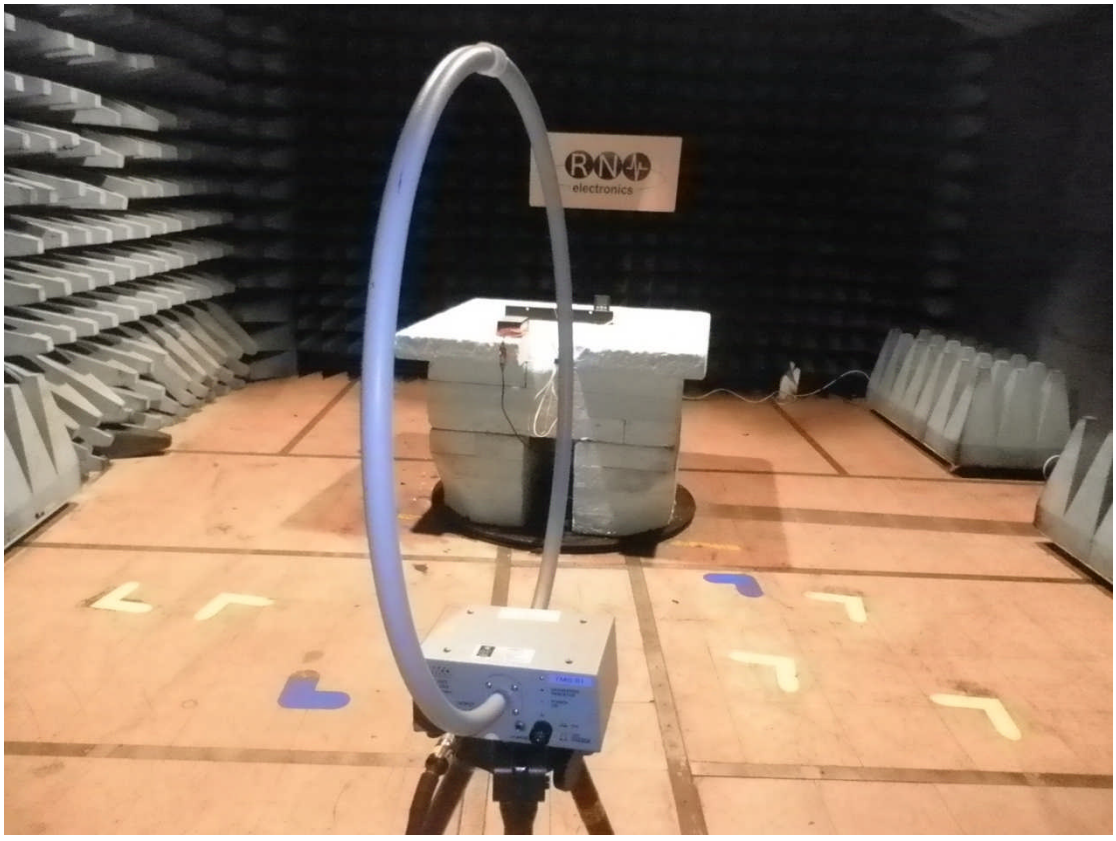


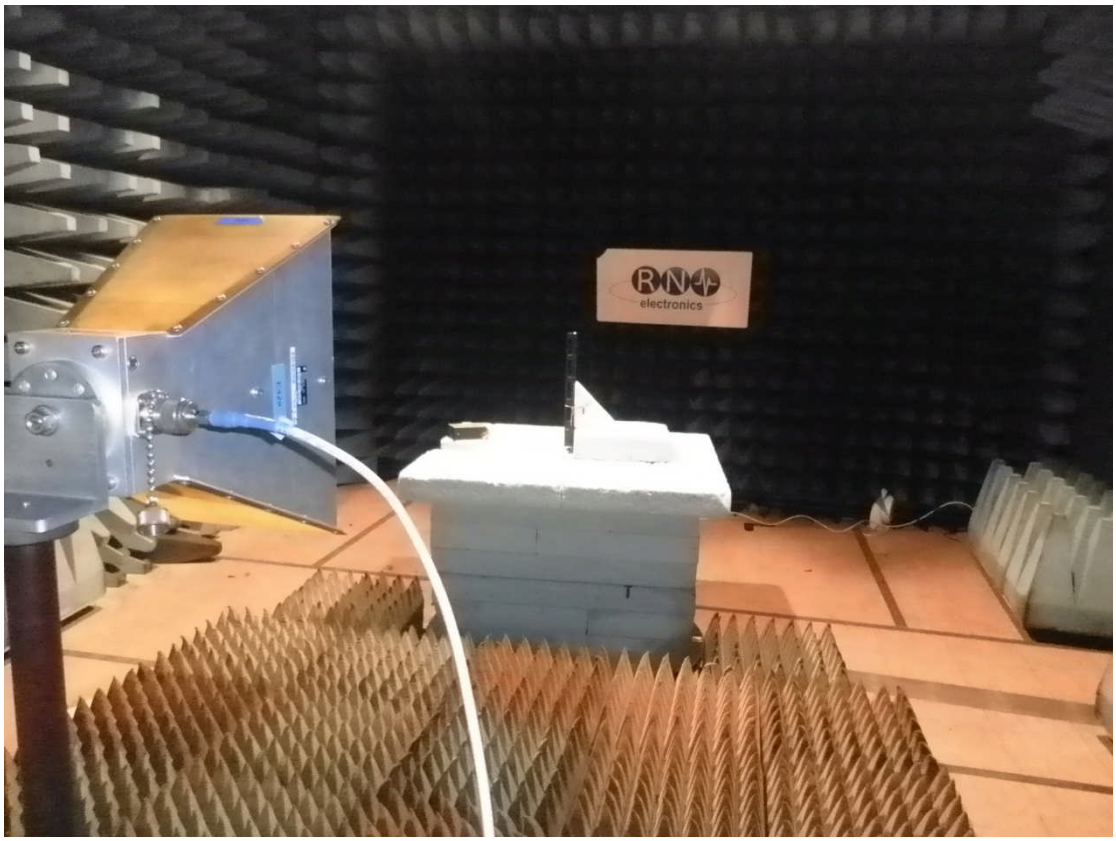
## 8.7 Test set-up, spurious emissions




RNE
electronics


RNE
electronics


RNE
electronics


RNE
electronics

## 8.8 Test set-up, AC power line conducted emissions

## 8.9 Test set-up diagrams

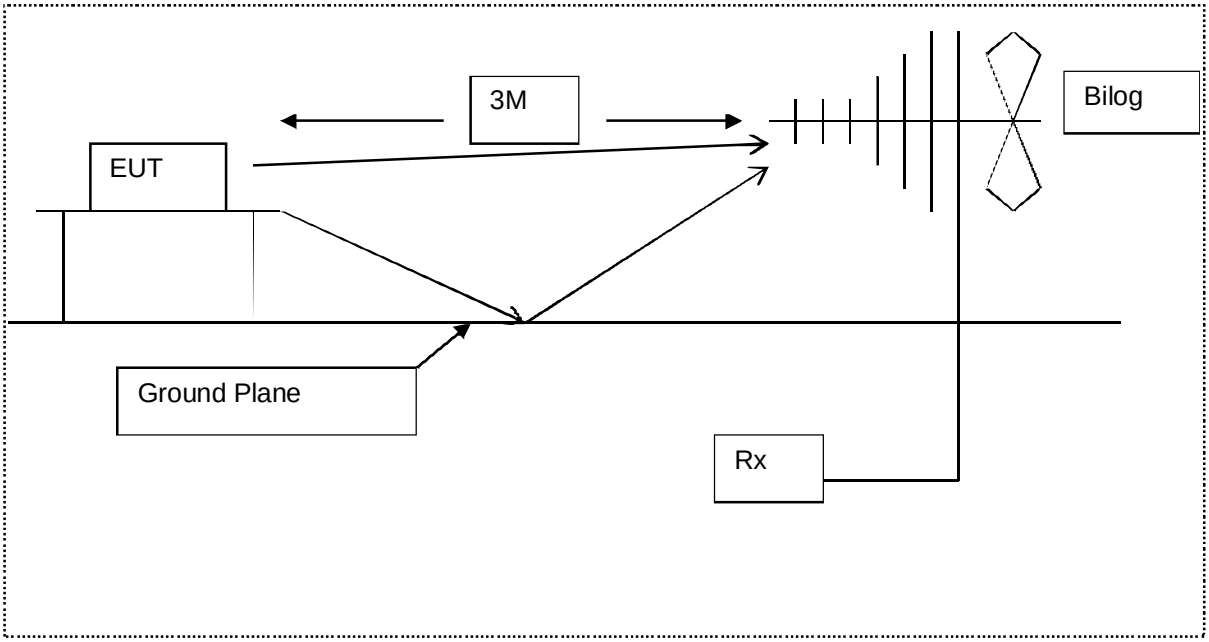



**Diagram of the radiated emissions 30-1000 MHz test setup.**

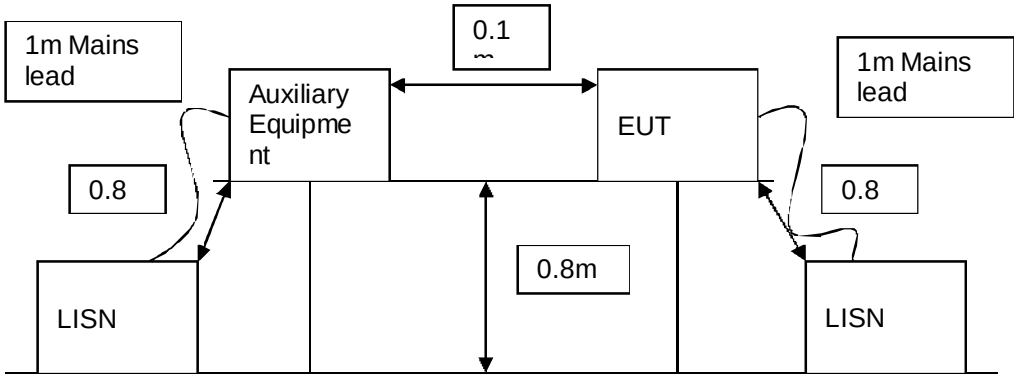



**Diagram of the conducted emissions test setup.**

# 9 Signal Leads

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

Note: This lead was the supply lead to the charger / docking station and as such was connected to the EUT via the docking station for “Docked” mode tests only.

# 10 Test Equipment Calibration list

The following table lists the test equipment used, last calibration date and calibration interval. All test equipment used has been maintained within the calibration requirements of ***R.N. Electronics Ltd.*** test facility quality system. Calibration intervals are regularly reviewed dependent on equipment manufacturer's recommendations and actual usage of the equipment.

| RN No. | Model | Description | Manufacturer | Calibration date | Cal period |
|---|---|---|---|---|---|
| E035 | HP11947A | Transient Limiter + 10dB Atten. | Hewlett Packard | *15-Dec-14 | 6 months |
| E150 | MN2050 | LISN 13A | Chase | *06-Oct-14 | 12 months |
| E410 | N5181A | 3 GHz MXG Signal Generator | Agilent Technologies | *28-Oct-14 | 36 months |
| E411 | N9039A | 9 kHz - 1 GHz RF Filter Section | Agilent Technologies | 21-Jan-14 | 12 months |
| E412 | E4440A | 3 Hz - 26.5 GHz PSA | Agilent Technologies | 21-Jan-14 | 24 months |
| E428 | HF906 | 1-18 GHz Horn Antenna | Rhode & Schwarz | 28-Jan-14 | 24 months |
| E570 | K050120400F | 3 Phase Power Supply | Harmer & Simmons | *5-Jan-15 | 12 months |
| E465 | PCR2000LA | AC Power Supply | KIKUSUI | 08-May-14 | 12 months |
| TMS81 | 6502 | Active loop antenna | EMCO | *10-Dec-14 | 24 months |
| TMS82 | 8449B | Pre Amplifier 1 - 26 GHz | Agilent | *10-Dec-14 | 12 months |
| TMS933 | CBL6141A | Bilog Antenna 30MHz - 2GHz | York EMC | *29-Sep-14 | 24 months |

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

# 11 Auxiliary equipment

## 11.1 Customer supplied Equipment

| Item No. | Model No. | Description | Manufacturer | Serial No. |
|---|---|---|---|---|
| 1 | Unknown | Charging / docking station | Maynetronics | Unknown |
| 2 | 9090 | Unregulated power supply | EMS Power | 986723 |

## 11.2 Supplied by RN Electronics Limited

No auxiliary equipment was supplied by RN Electronics

# 12 Modifications

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

## 12.1 Table of modifications

| Test | Modification | Time of modification |
|---|---|---|
| Intentional radiator field strength | Manufacturers' power level set to 'level 10'. This was the first test performed. | During testing |

## 12.2 Modifications before test

No modifications were made before test by RN Electronics Ltd.

## 12.3 Modifications during test

For test purposes, the manufacturer supplied a test unit programmed with 'engineering firmware' that allowed the RF power to be adjusted. During the Intentional radiator field strength test, the RF output power was set to a level below the power limit. The power level was set with guidance provided by the manufacturer to allow for variation due to manufacturing tolerances. The manufacturer states that the final production firmware will not allow the user to change the RF power level.

A power level of '10' was selected since this gave a level of 91.3dBuV/m at 3m, where the standard states a maximum power level of 94dBuV/m at 3m.

# 13 Compliance information

Products subject to the Declaration of Conformity procedure are required to be supplied with a compliance information statement. A copy of this statement may be included here:

Certified equipment – DoC not required.

# 14 Description of Test Sites

| | |
|---|---|
| Site A | Radio / Calibration Laboratory and anechoic chamber |
| Site B | Semi-anechoic chamber |
| Site B1 | Control Room for Site B |
| Site C | Transient Laboratory |
| Site D | Screened Room (Conducted Immunity) |
| Site E | Screened Room (Control Room for Site D) |
| Site F | Screened Room (Conducted Emissions)<br>VCCI Registration No. C-2823 |
| Site G | Screened Room (Control Room for Site H) |
| Site H | 3m Semi-anechoic chamber (indoor OATS)<br>FCC Registration No. 293246<br>IC Registration No. 5612A-2 |
| Site K | Screened Room (Control Room for Site M) |
| Site M | 3m Semi-anechoic chamber (indoor OATS)<br>FCC Registration No. 293246 |
| Site Q | Fully-anechoic chamber |
| Site OATS | 3m and 10m Open Area Test Site<br>FCC Registration No. 293246<br>IC Registration No. 5612A-1<br>VCCI Registration No. R-2580 |
| Site R | Screened Room (Conducted Immunity) |
| Site S | Safety Laboratory |
| Site T | Transient Laboratory |

# 15 Abbreviations and Units

| | |
|---|---|
| % | Percent |
| µV | microVolts |
| µW | microWatts |
| AC | Alternating Current |
| ALSE | Absorber Lined Screened Enclosure |
| AM | Amplitude Modulation |
| Amb | Ambient |
| ANSI | American National Standards Institute |
| ºC | Degrees Celsius |
| CFR | Code of Federal Regulations |
| CS | Channel Spacing |
| CW | Continuous Wave |
| dB | deciBels |
| dBµV | deciBels relative to 1µV |
| dBc | deciBels relative to Carrier |
| dBm | deciBels relative to 1mW |
| DC | Direct Current |
| EIRP | Equivalent Isotropic Radiated Power |
| ERP | Effective Radiated Power |
| EUT | Equipment Under Test |
| FCC | Federal Communications Commission |
| FM | Frequency Modulation |
| FSK | Frequency Shift Keying |
| g | Grams |
| GHz | GigaHertz |
| Hz | Hertz |
| IF | Intermediate Frequency |
| kHz | kiloHertz |
| LO | Local Oscillator |
| mA | milliAmps |
| max | maximum |
| kPa | kilopascals |
| MHz | MegaHertz |
| min | minimum |
| mm | milliMetres |
| ms | milliSeconds |
| mW | milliWatts |
| NA | Not Applicable |
| nom | Nominal |
| nW | nanoWatt |
| OATS | Open Area Test Site |
| OFDM | Orthogonal Frequency Division Multiplexing |
| ppm | Parts per million |
| QAM | Quadrature Amplitude Modulation |
| QPSK | Quadrature Phase Shift Keying |
| Ref | Reference |
| RF | Radio Frequency |
| RTP | Room Temperature and Pressure |
| s | Seconds |
| Tx | Transmitter |
| V | Volts |