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 2
Report Number: 09-7226-5-14 Issue 01
Report Produced by: -

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Certificate of Test 7226-5

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. Oak Cottage Ashey Road Ashey Isle of Wight PO33 4BD
Full measurement results are detailed in Report Number:	09-7226-5-14 Issue 01
Test Standards:	FCC 47CFR Part 15C Effective date **October 1st 2013,** Class DXX 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 13:40:49 +01'00'

Approved By:
Technical Director

Customer Representative:

1 Contents

2 Equipment Under Test (EUT)

2.1 Equipment Specification

Applicant	Maynetronics Ltd. Oak Cottage Ashey Road Ashey Isle of Wight 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 - 15V 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	13.56 MHz (fixed frequency equipment)
EUT Declared Modulation Parameters	As per ISO14443A requirements
EUT Declared Power level	1.5A/m – 7.5A/m
EUT Declared Signal Bandwidths	Not stated
EUT Declared Channel Spacing's	Single channel equipment.
EUT declared Duty Cycle	Not stated
Unmodulated carrier available?	Yes
Declared frequency stability	13.56 MHz (± 7kHz)
RX Parameters	
Alignment range – receiver	13.56 MHz (fixed frequency equipment)
EUT Declared RX Signal Bandwidth	Not stated

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	Yes
TX 13.56 MOD (Undocked)	Transmitting for 38ms every 480ms with modulation, standalone (undocked) configuration	Yes
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	No
TX 915 MOD (Undocked)	Transmitting continuously at 915 MHz with modulation, standalone (undocked) configuration	No
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. **TX 13.56 RFID TAG** modes were not used for test, because the EUT would require resetting manually before another transmission could be triggered, which made testing impractical; however, pre-tests showed no difference in results between **TX 13.56 RFID TAG** and **TX 13.56 MOD** modes.

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 13.56 MHz radio only, and as such, **TX 915 MOD** and **RX 915** test modes have not been used for testing.

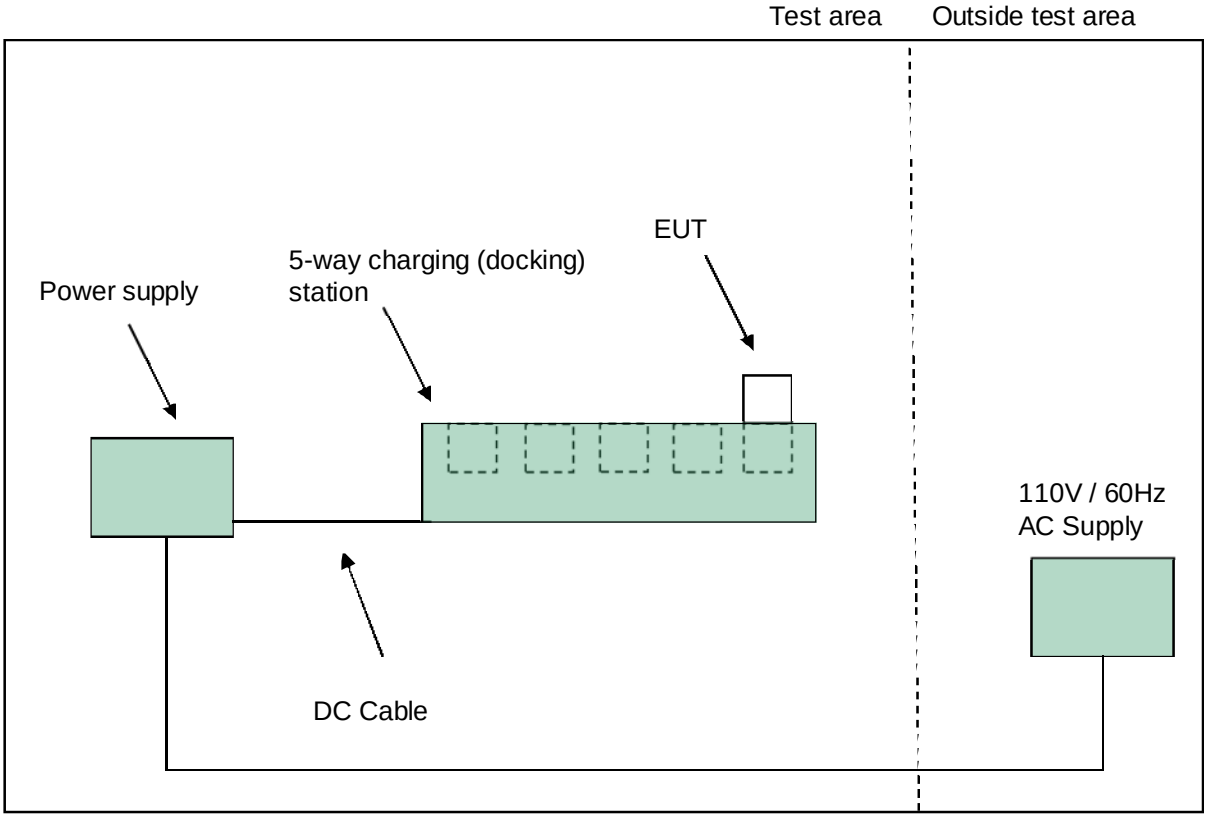
Please refer to RN Electronics test report 09-7226-2-14 Issue 01 for test results for the 915MHz radio.

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 testing purposes, the manufacturer supplied two identical RFID tags. When a tag was placed in close proximity to the EUT the 13.56MHz carrier signal modulated in amplitude.

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.

For intentional radiator 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.

For frequency stability measurements the internal battery was removed and a bench top supply connected in its place. This allowed the battery end points to be set as declared by the manufacturer. A Frequency error measurement at nominal temperature / voltage extremes was also made with the unit docked in the charger to verify running from internal batteries was worst case for this test.

3 Summary of test results

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

FCC 47CFR Part 15.225 (effective date October 1st, 2013); Class DXX 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	FCC Part 15C §15.207	PASSED
2. Intentional radiator field strength & spectrum mask	FCC Part 15C §15.225(a)(b)(c)	PASSED
3. Radiated emissions	FCC Part 15C §15.205, §15.209 and §15.225(d)	PASSED
4. Frequency stability	FCC Part 15C §15.225(e)	PASSED
5. Occupied bandwidth	FCC Part 15C §15.215	PASSED[1]

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

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 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
Test site H is listed with the FCC; Registration Number 823977

4.1 Deviations

None.

4.2 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 amb	20 °C	V nom	3 V dc
T cold	-30 °C	V min	2.2 V dc
T hot	50 °C	V max	3 V dc

Extremes of voltage are based on manufacturer's end point declaration for the internal battery operation.
Extremes of temperature are based upon 15.225 requirement.
The ambient test conditions of humidity and pressure in the laboratory were as follows:
45 %; 102 kPa.

4.2.1 Test fixtures

To enable testing at extremes the following test fixtures were utilised:

☐ A permanent internal RF port was used for testing.
☒ A test fixture was used for testing.
☐ A temporary RF port was created for testing.
☐ The equipment external RF port was used for testing.

4.3 Measurement Uncertainties

Parameter	Uncertainty
Transmitter Tests	
RF frequency	<± 0.7 ppm
AC power line conducted emissions	150kHz to 30MHz ±3.6dB
Bandwidth	<± 1.9 %
Radiated RF Power	<± 3.5 dB
Radiated Spurious Emissions	<± 3.4 dB

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 are listed in section 11.

Pre-tests showed no difference in results between **TX 13.56 RFID TAG** and **TX 13.56 MOD** modes, also 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 13.56 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	7226-5 Cond 1 AC Live 150k-30M Average
150kHz to 30MHz	7226-5 Cond 1 AC Live 150k-30M Quasi-Peak
150kHz to 30MHz	7226-5 Cond 1 AC Neutral 150k-30M Average
150kHz to 30MHz	7226-5 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 & spectrum mask

5.2.1 Test Methods

Test Requirements FCC Part 15C, Reference (15.225)

Test Method: ANSI C63.10, Reference (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, therefore for ease of test, the EUT was powered using the internal batteries in a stand-alone configuration for full-test. Pre-tests also showed no difference in results between **TX 13.56 RFID TAG** and **TX 13.56 MOD** modes; therefore the EUT was operated in **TX 13.56 MOD (Undocked)** mode for this test. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at distances of 3 metres. The antenna was orientated in both Parallel and perpendicular polarisations. The EUT was rotated in all three orthogonal planes.

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 and on an OATS. This site is listed with the FCC.

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

5.2.4 Test Equipment used

E411, E412, TMS81

See Section 9 for more details

5.2.5 Test results

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

Radio Parameter 1

Band	13.11-14.01 MHz
Power level	Maximum
Channel spacing	single frequency
Low channel	13.56 MHz

Distance	PK Result dBuV/m	Plot reference
3 metres	29.4	7226-5 field strength upright parallel 3m
Spectrum mask at 30metres	-10.6	7226-5 Spectrum mask at 30metres

Highest field strength was measured with the EUT upright and the loop antenna in the parallel position. 3 metre distance was used to increase the fundamental signal amplitude with respect to the noise floor. An extrapolation figure of 40 dB was used as per ANSI C63.10. This gave a field strength result at 30 metres of -10.6 dBuV/m.

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

LIMITS:
15.225(a) QP/Peak = the field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 µV/m @ 30m = 84 dBµV/m @ 30m.
15.225(b) QP/Peak = within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 µV/m @ 30m = 50.5 dBµV/m @ 30m.
15.225(c) QP/Peak = within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 µV/m @ 30m = 40.5 dBµV/m @ 30m.
15.225(d) QP/Peak = outside of the 13.110-14.010 MHz band shall not exceed the general radiated emissions limits of 15.209.

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

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, 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. Pre-tests also showed no difference in results between **TX 13.56 RFID TAG** and **TX 13.56 MOD** modes; therefore, the EUT was operated in **TX 13.56 MOD (Docked)** mode for full test. The front edge of the EUT was initially positioned facing the antenna. The EUT was rotated in all three orthogonal planes.

Note: This test report pertains to the 13.56 MHz radio only, and as such, emissions have been measured up to 1GHz. For test results for the 915MHz radio, including radiated emissions up to 10GHz, please refer to the RN Electronics test report 09-7226-2-14 Issue 01.

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 centre of 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.

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,

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.

5.3.5.1 Below 30MHz.

No significant emissions were observed below 30MHz, with the exception of the fundamental frequency.

Plot references for Low Frequency Radiated emissions measurements (150kHz to 30MHz)

Channel	Parallel Plots	Perpendicular Plots
13.56 MHz	7226-5 LF Emissions 150kHz - 3MHz parallel (13.56MHz transmitting)	7226-5 LF Emissions 150kMHz - 3MHz perpendicular (13.56MHz transmitting)
13.56 MHz	7226-5 LF Emissions 3MHz - 30MHz parallel (13.56MHz transmitting)	7226-5 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 2 VHF Horiz
30 – 300 MHz	Vertical	7226-2 Rad 2 VHF Vert
300 – 1000 MHz	Horizontal	7226-2 Rad 2 UHF Horiz
300 – 1000 MHz	Vertical	7226-2 Rad 2 UHF Vert

Table of signals measured (13.56 MHz transmitting)

Horizontal

Signal No.	Freq (MHz)	Peak Amp (dBuV)	QP Amp (dBuV)	QP Lim (dB)
1	216.985	26.1	26.4	-19.6
2	239.020	35.3	*30.2	-15.8
3	271.231	31.2	26.8	-19.2
4	277.419	41.9	*37.5	-8.5
5	423.570	38.9	*33.0	-13.0
6	448.700	36.3	*29.5	-16.5
7	451.089	38.1	*32.2	-13.8
8	452.800	39.8	*33.1	-12.9
9	454.000	37.8	*31.9	-14.1
10	460.841	38.3	*32.7	-13.3
11	467.160	39.0	*32.4	-13.6
12	662.860	32.7	26.9	-19.1

*These signals were found to be generic emissions associated with the charger tested with the unit (i.e. not associated with the RFID transmitter) and as such the requirements of part 15.215 (b) are considered satisfied.

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	575.690	30.5	24.0	-22.0
8	943.680	37.3	*30.9	-15.1

*These signals were found to be generic emissions associated with the charger/docking station tested with the unit (i.e. not associated with the RFID transmitter) and as such the requirements of part 15.215 (b) are considered satisfied.

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

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

5.4 Frequency stability

5.4.1 Test Methods

Test Requirements	FCC Part 15C, Reference (15.225)
Test Method:	ANSI C63.10, Reference (6.8)

5.4.2 Configuration of EUT

The EUTs' internal batteries were removed and a bench top supply was connected directly to the battery terminals. This allowed the battery end points to be set as declared by the manufacturer. The EUT was placed in a temperature controlled chamber. The EUT emissions were observed by means of a test fixture. The EUT was operated in **TX 13.56 MOD (Undocked)** mode for this test.

5.4.3 Test Procedure

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

Temperature stability was achieved at each test level before taking measurements. The spectrum analyser was used to monitor the frequency of the carrier. The analyser was set with a suitable span, RBW and VBW to allow for a measurement resolution of 1Hz.

The carrier frequency was also assessed at RTP with the EUT placed in the charging station with supply varied 85-115% around 110V AC. No discernible difference in frequency was observed compared with the EUT operating on its internal batteries.

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

5.4.4 Test Equipment used

E227, E412, L264, TMS80, E411, TMS82, TMS38, E434

See Section 10 for more details

5.4.5 Test results

Ambient conditions.
Temperature: 22 °C Relative humidity: 45 % Pressure: 102 kPa

Radio Parameter 1

Band	13.11-14.01 MHz
Power level	Maximum
Channel spacing	single frequency
Low channel	13.56 MHz

Results relating to Radio Parameters 1

Temp (°C)	Voltage (V)	Single channel (MHz)
-30	**3**	13.561729
-20	**3**	13.561782
-10	**3**	13.561880
0	**3**	13.561903
10	**3**	13.561916
20	**2.2**	13.561895
20	**3**	13.561896
30	**3**	13.561894
40	**3**	13.561886
50	**3**	13.561873
Max Frequency Error per chan (MHz)		**+0.00002 / -0.000167**
Max Frequency Error observed (MHz)		-0.000167

Maximum variation observed was 167Hz **from nominal** temperature and voltage.

LIMITS:
15.225(e) ±0.01% (±1.356 kHz)

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

5.5 Occupied bandwidth (20 dB)

5.5.1 Test Methods

Test Requirements	FCC Part 15C, Reference (15.215)
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 bandwidth when the EUT was powered using batteries in a stand-alone configuration, or when on charge in any of the five charging bays. Pre-tests also showed no difference in results between **TX 13.56 RFID TAG** and **TX 13.56 MOD** modes: therefore for ease of test, the EUT was powered using the internal battery in a stand-alone configuration using mode **TX 13.56 MOD (Undocked)** mode for full-test.

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.

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 10kHz RBW, 3x VBW, auto sweep time and max hold settings were used for the 20 dB bandwidth. The 99% occupied bandwidth was also measured.

5.5.4 Test Equipment used

E410, E411, E412, TMS81

See Section 10 for more details.

5.5.5 Test results

Ambient conditions.
Temperature: 25 °C Relative humidity: 47 % Pressure: 102 kPa

Analyser plots for the 20 dB bandwidth can be found in Section 6.4 of this report.

Radio Parameter 1

Band	13.11-14.01 MHz
Power level	Maximum
Channel spacing	single frequency
Frequency	13.56 MHz

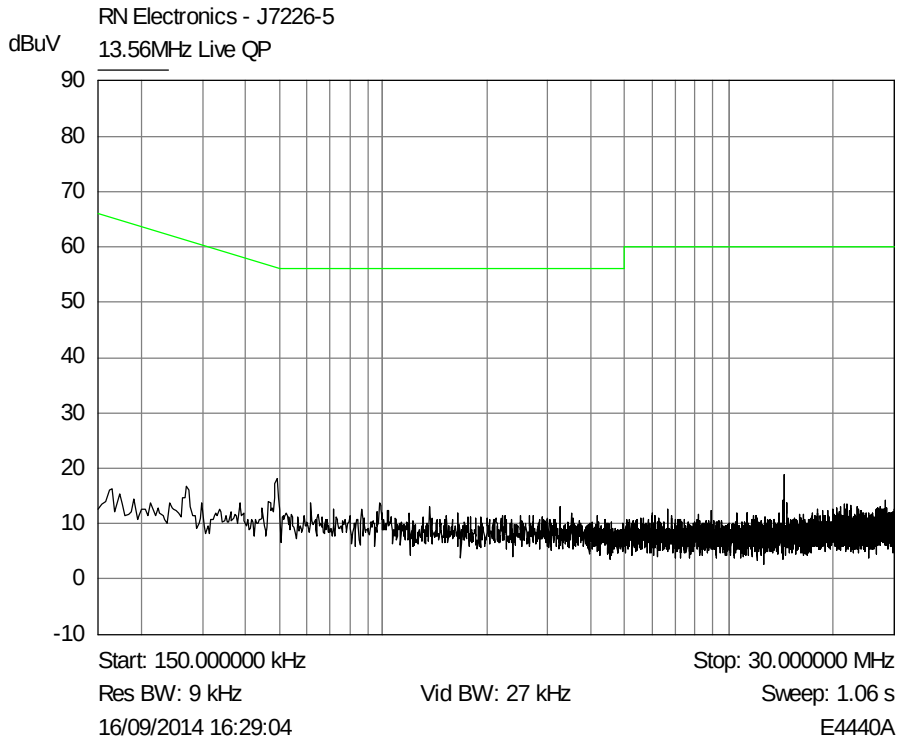
	Single channel
20dB BW (MHz)	0.213
99% BW (MHz)	0.432
Plot reference	7226-5 OBW (10kHz RBW)

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

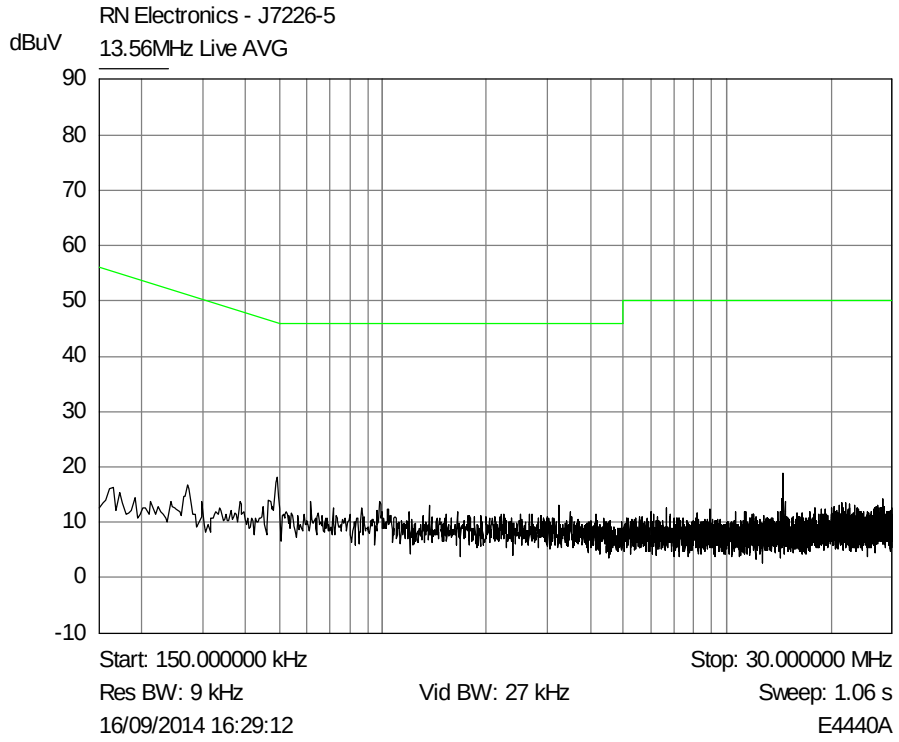
These results show that the EUT has **PASSED** this test.

6 Plots and Results

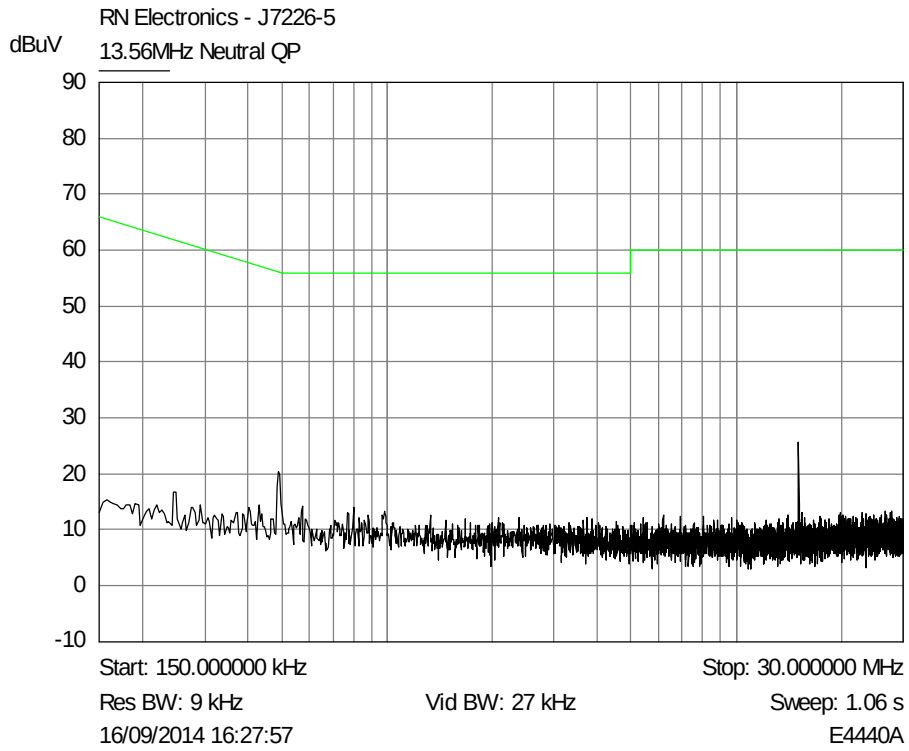
6.1 AC power line conducted emissions plots



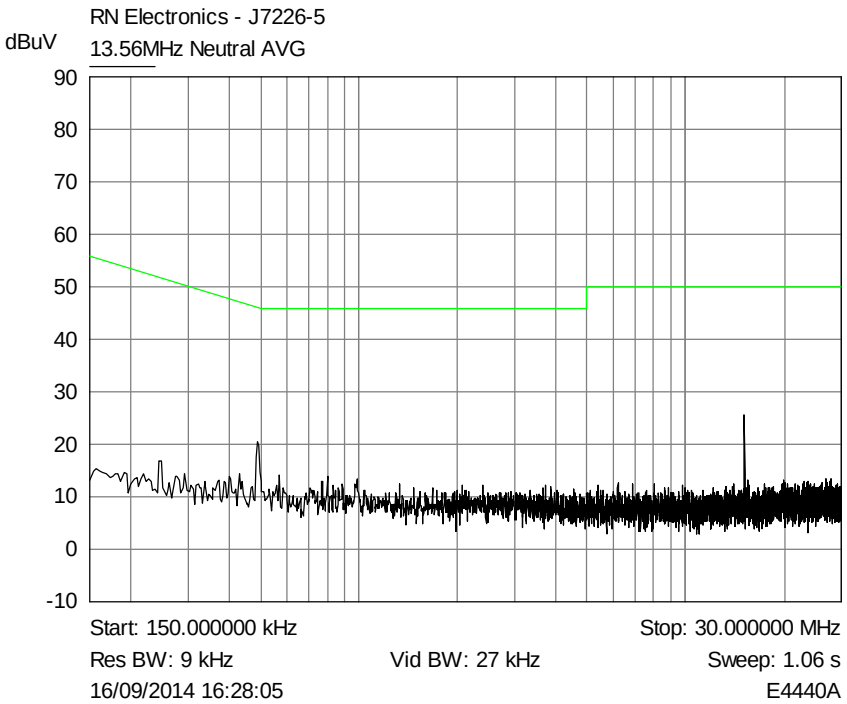
Plot of peak emissions 150kHz - 30MHz on the Mains live terminal against the quasi-peak limit line.



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

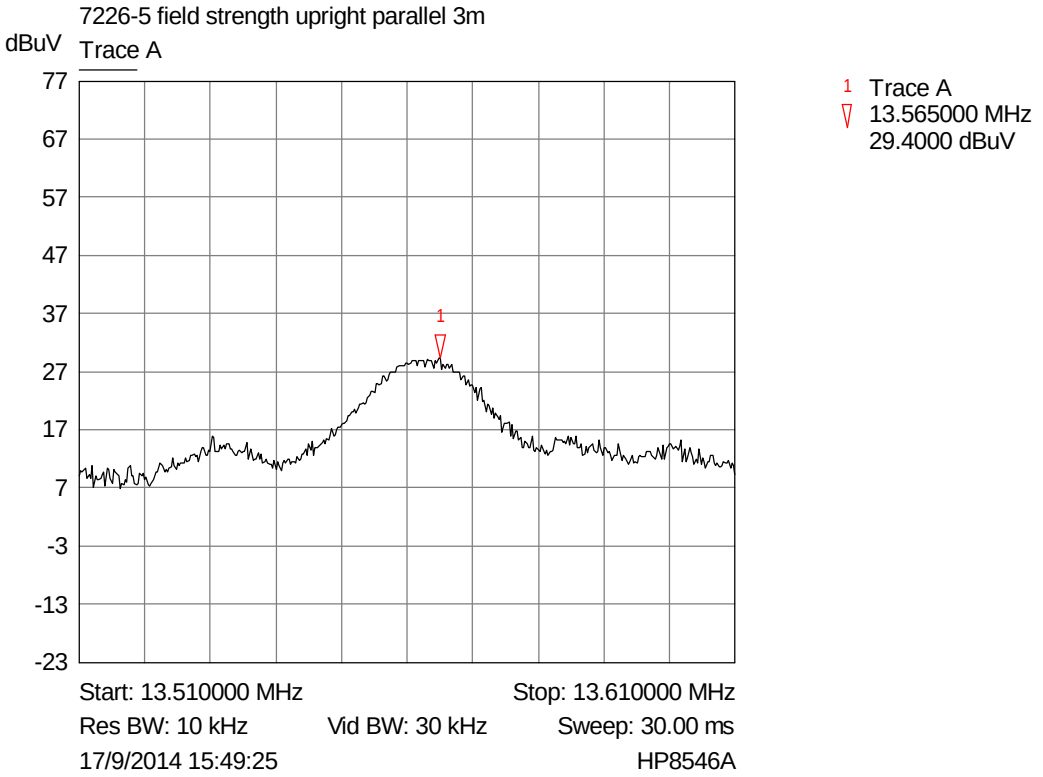


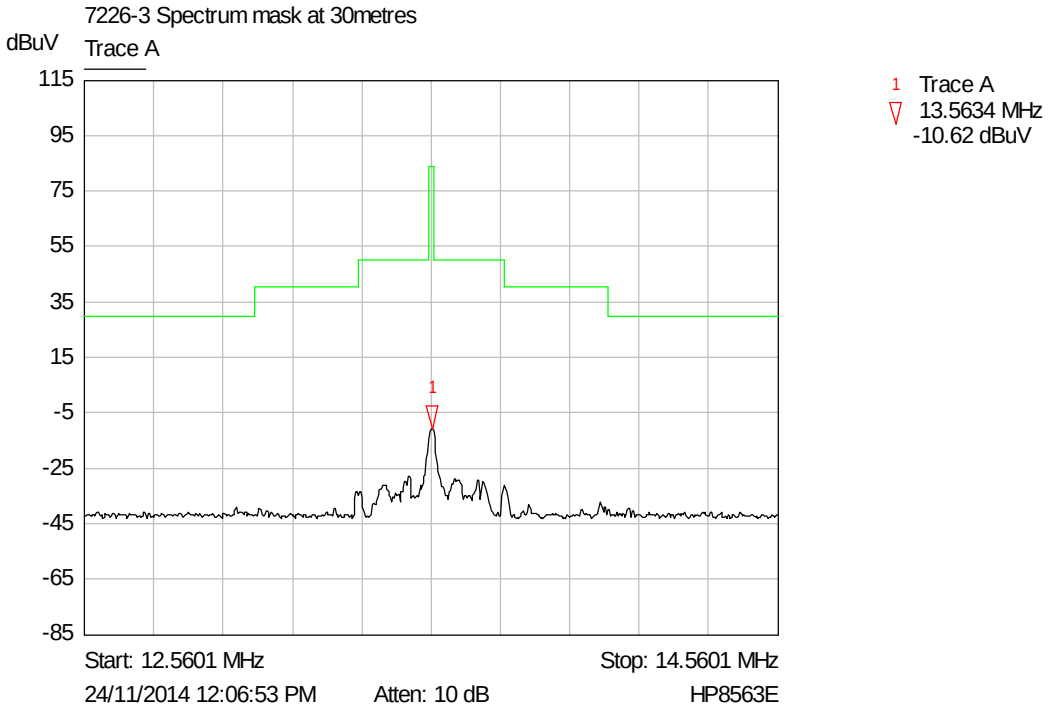
Plot of peak emissions 150kHz - 30MHz on the Mains neutral terminal against the quasi-peak limit line.



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

6.2 Intentional radiator field strength & spectrum mask

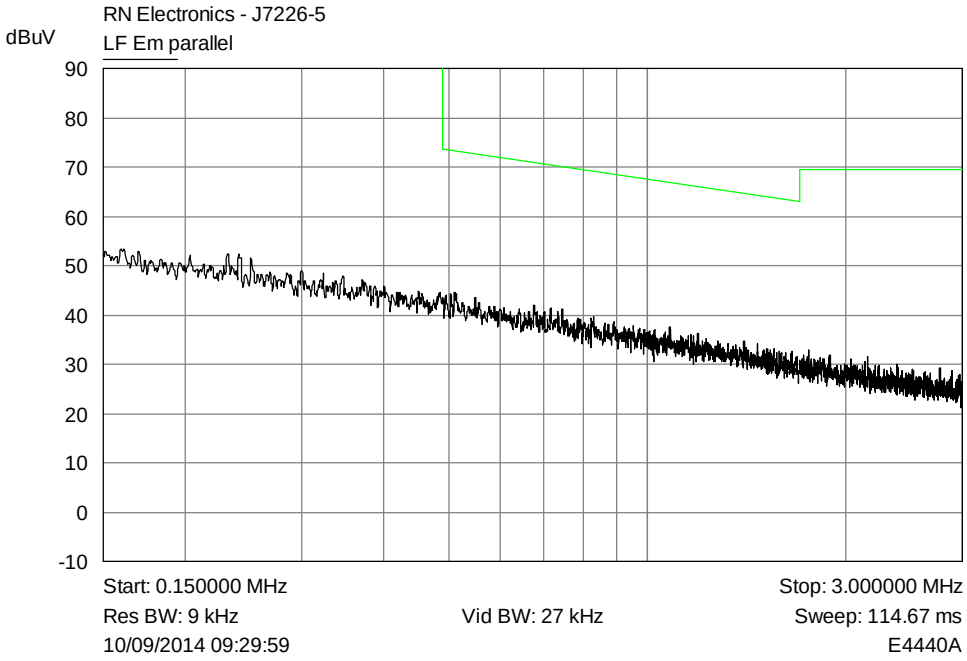




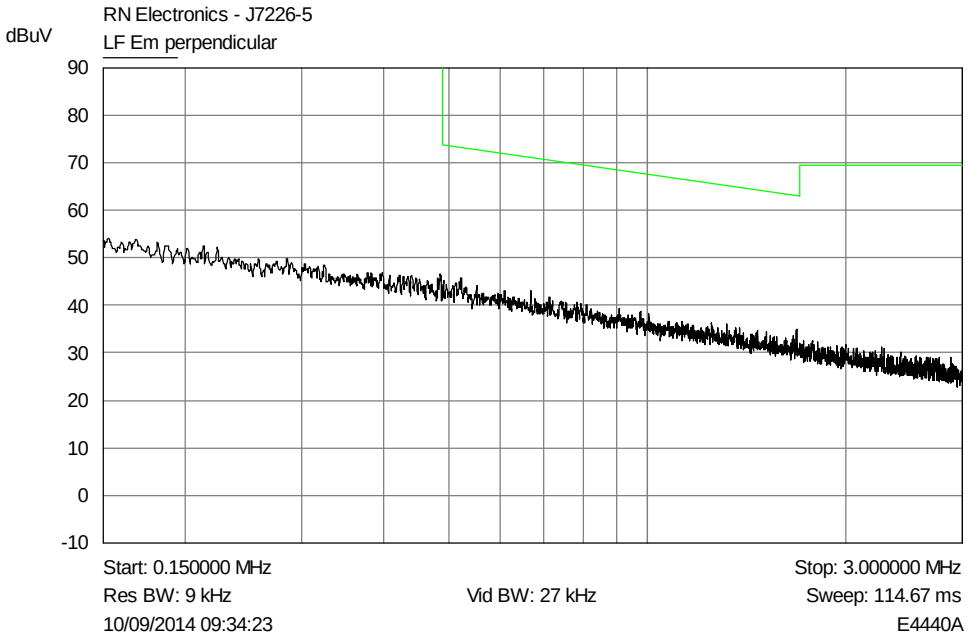
Plots for Band 13.11-14.01 MHz, Spacing single frequency, and Modulation

6.3 Radiated emissions plots

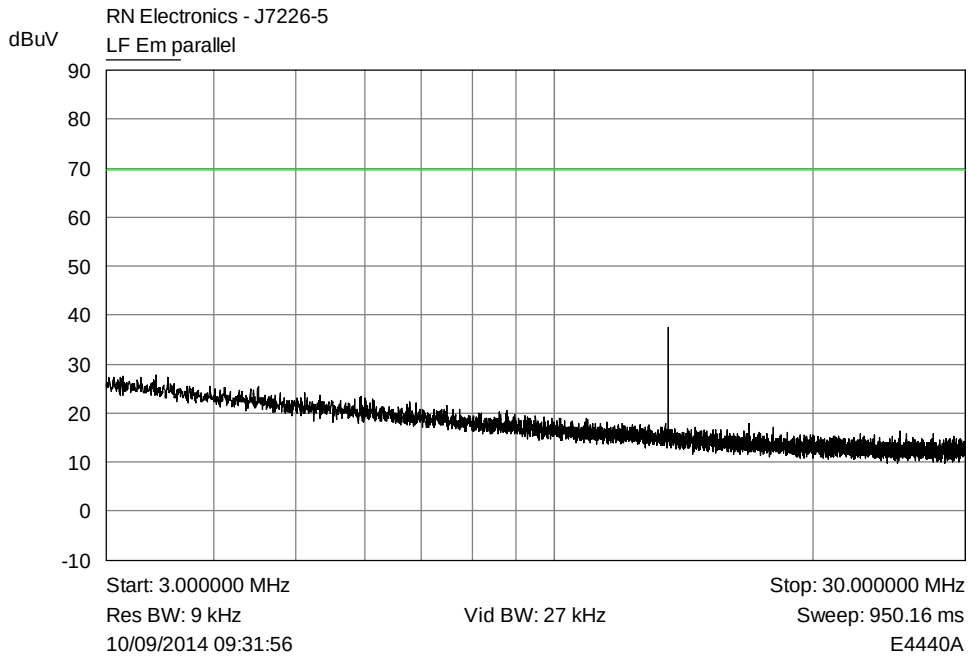
6.3.1 Radiated emissions plots 150kHz – 30MHz



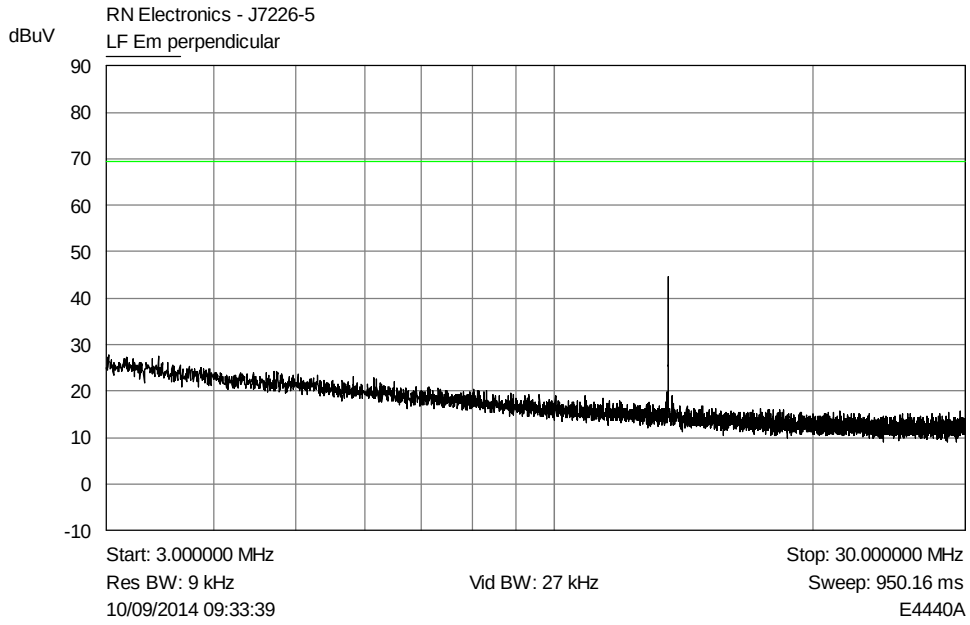
Plot of radiated peak emissions 150kHz - 3MHz against the quasi peak limit line.



Plot of radiated peak emissions 150kHz - 3MHz against the quasi peak limit line.

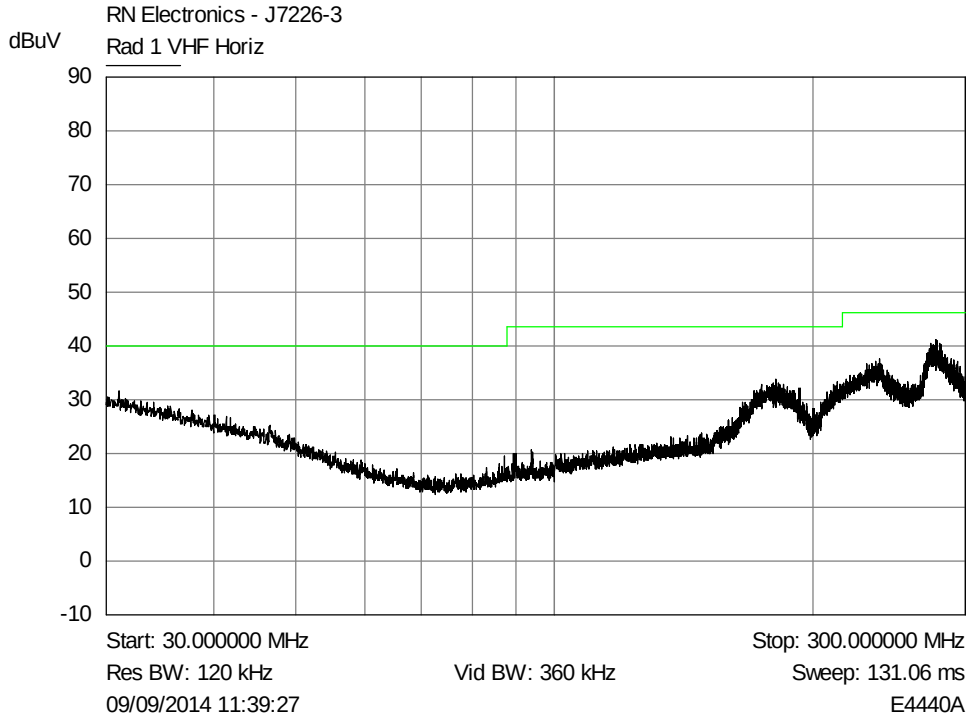


Plot of radiated peak emissions 3 - 30MHz against the quasi peak limit line.

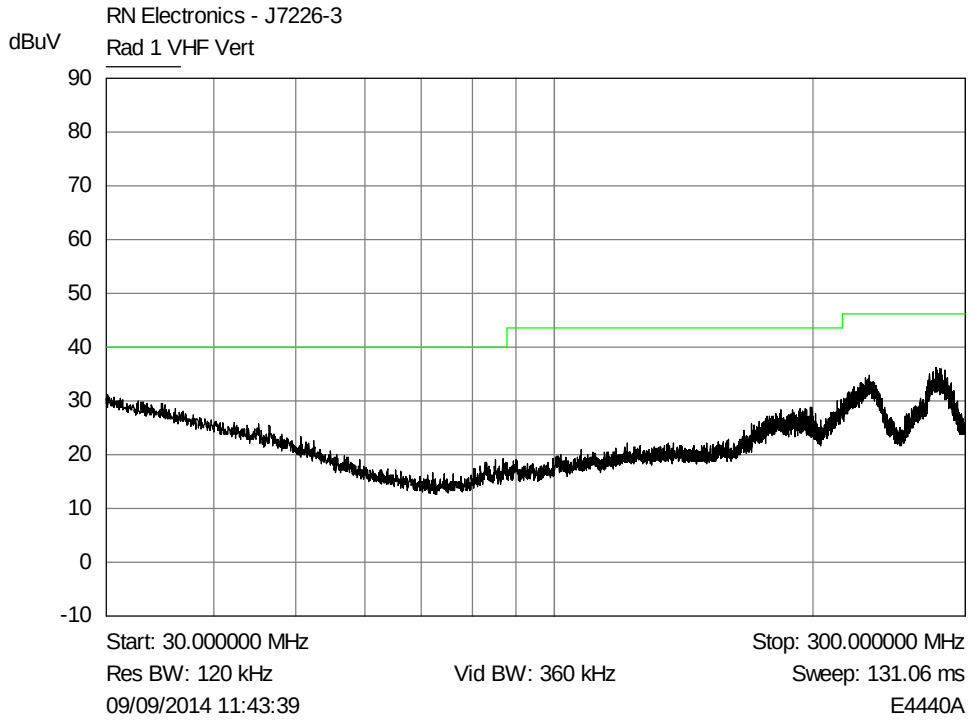


Plot of radiated peak emissions 3 - 30MHz against the quasi peak limit line.

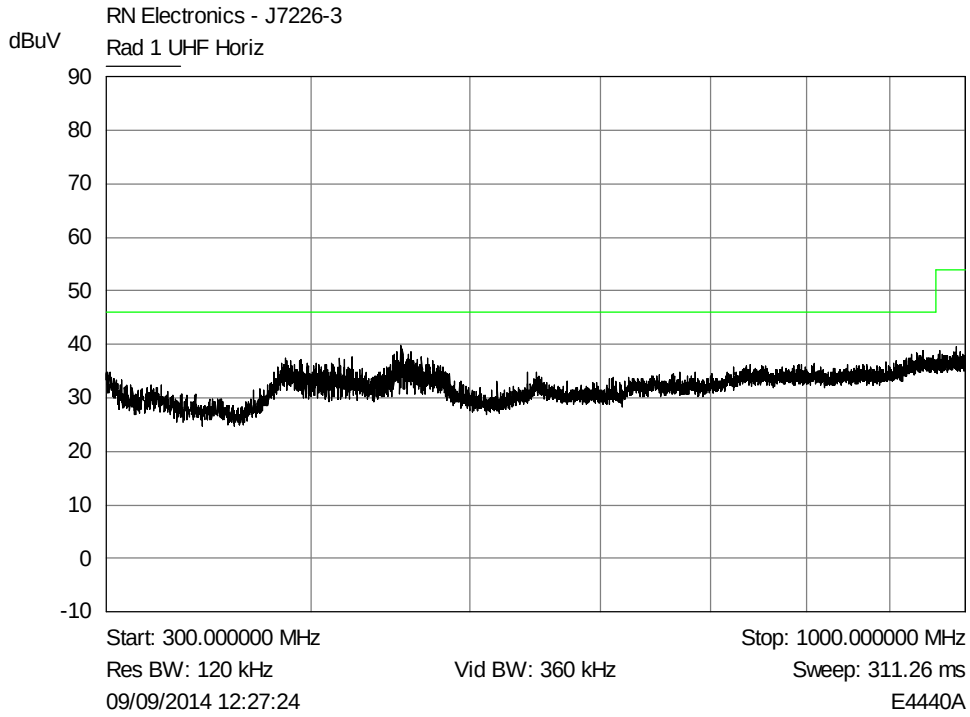
6.3.2 Radiated emissions - 30MHz - 1GHz



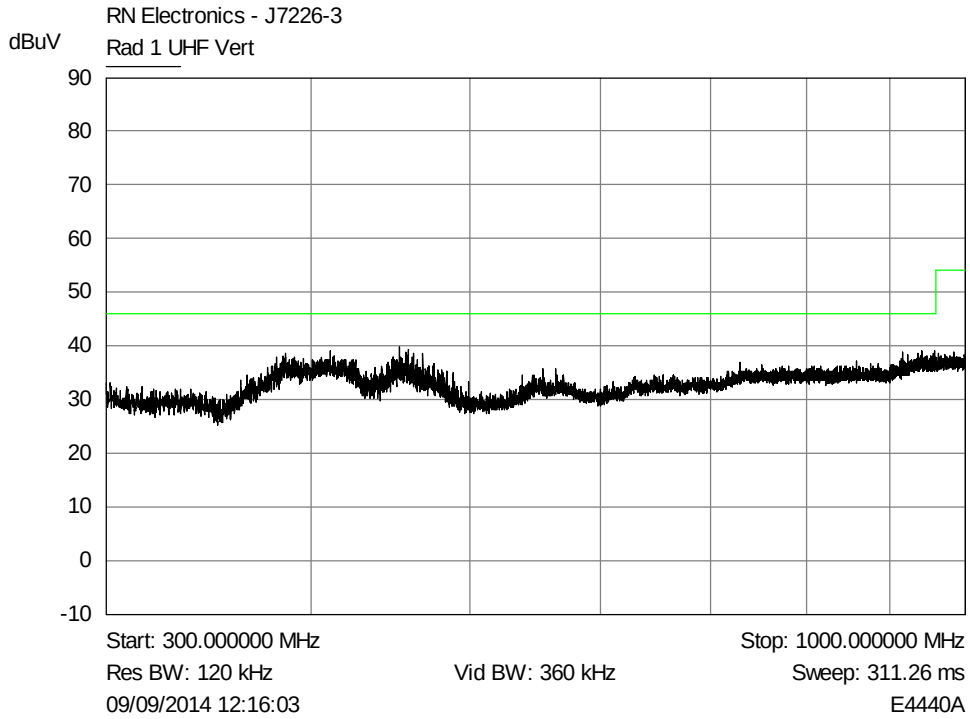
13.56 MHz transmitting: Plot of peak horizontal emissions 30MHz - 300MHz against the quasi-peak limit line.



13.56 MHz transmitting: Plot of peak vertical emissions 30MHz - 300MHz against the quasi-peak limit line.

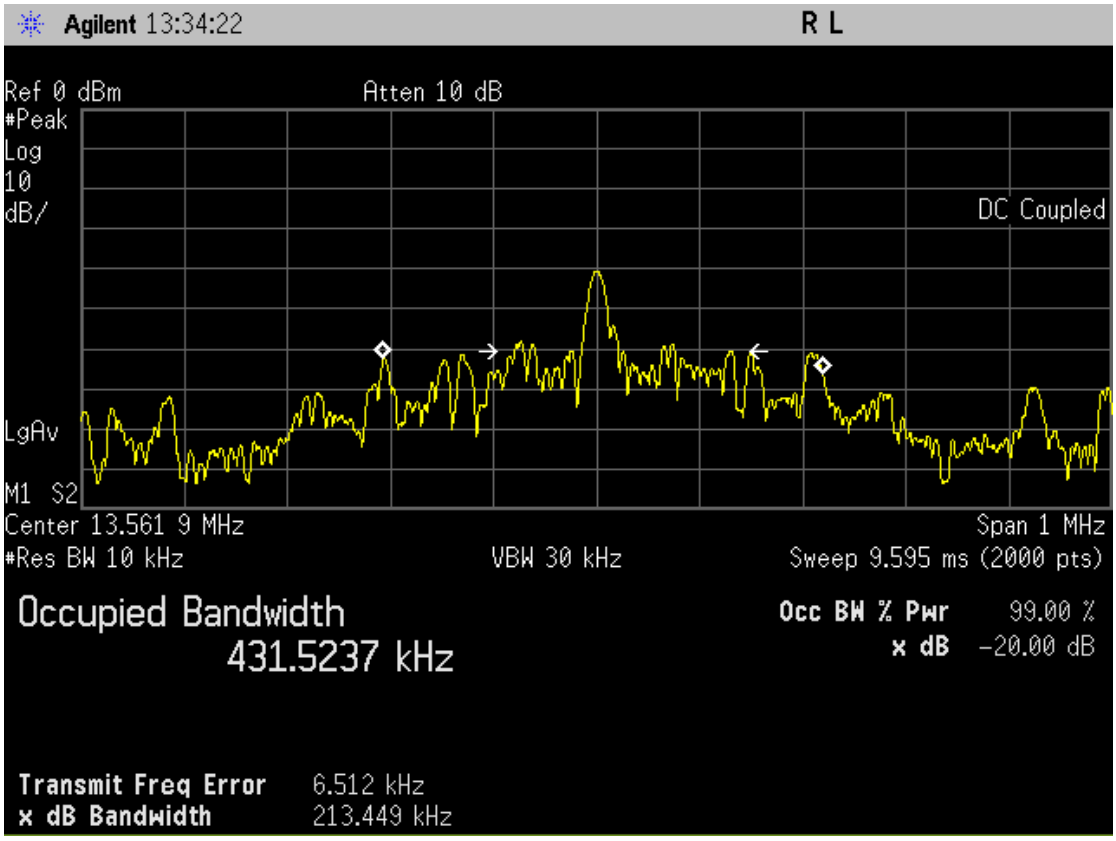


13.56 MHz transmitting: Plot of peak horizontal emissions 300MHz - 1GHz against the quasi-peak limit line.



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

6.4 Occupied bandwidth plot



Plot for Band 13.11-14.01 MHz

Plot shows the 20 dB bandwidth (213.449 kHz) and 99% bandwidth (431.5237 kHz)

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

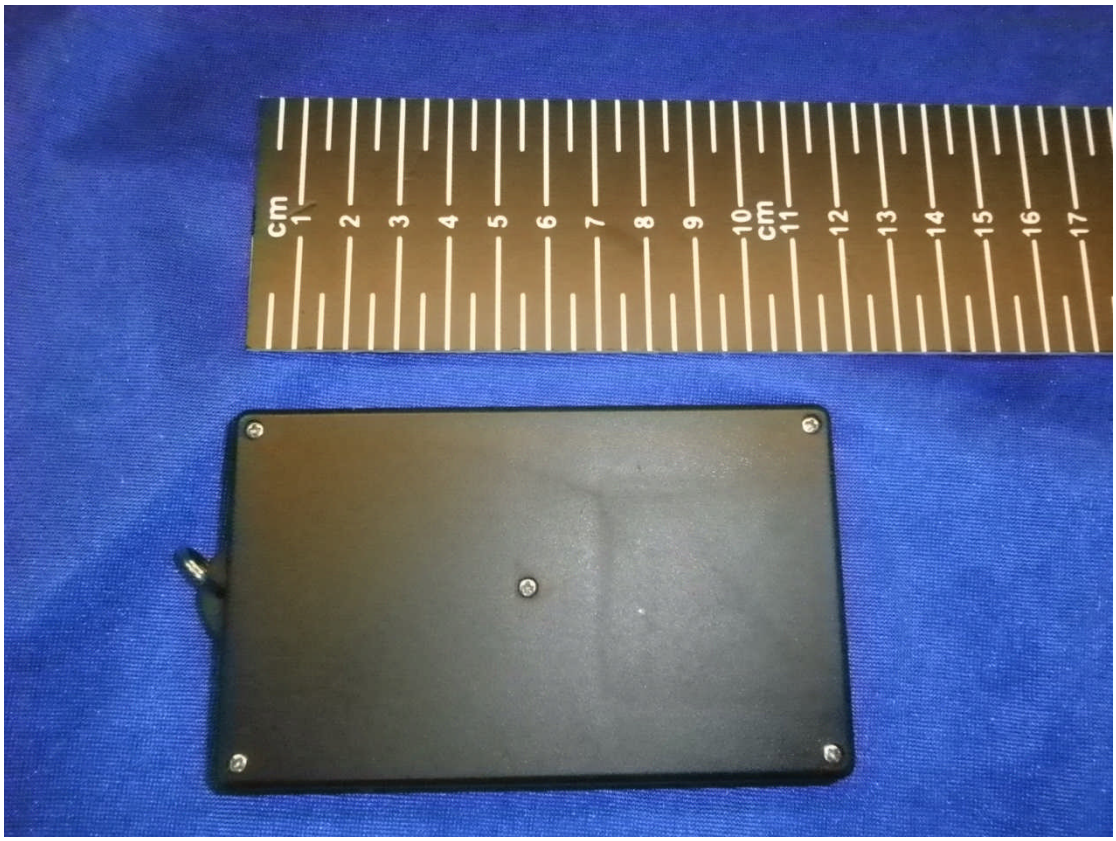
(c) limit of 30 µV/m at 30m, but below 30MHz, equates to 20.log(30) + 40.log(30/3) = 69.5 dBµV/m at 3m, as extrapolation factor below 30MHz is 40dB/decade per 15.31(f)(2).

8 Photographs

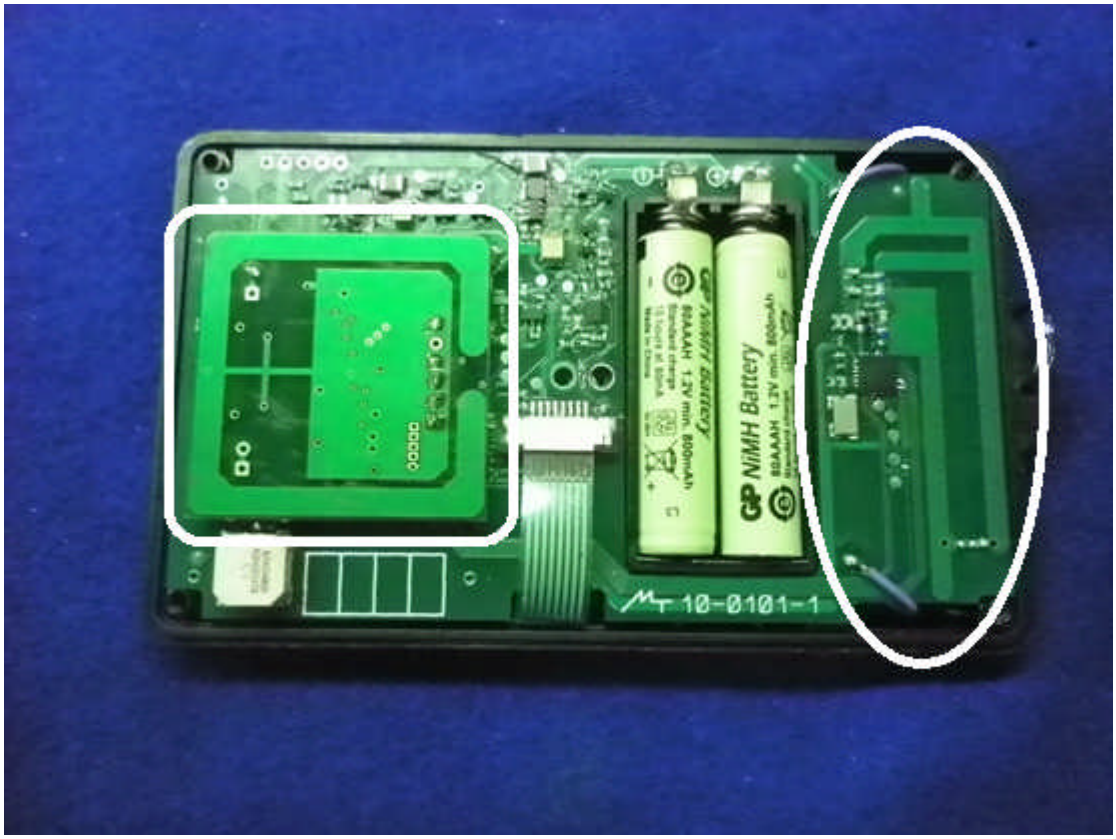
8.1 EUT front view

Photograph shows the EUT along with an RFID tag (supplied for testing purposes).

8.2 EUT rear view



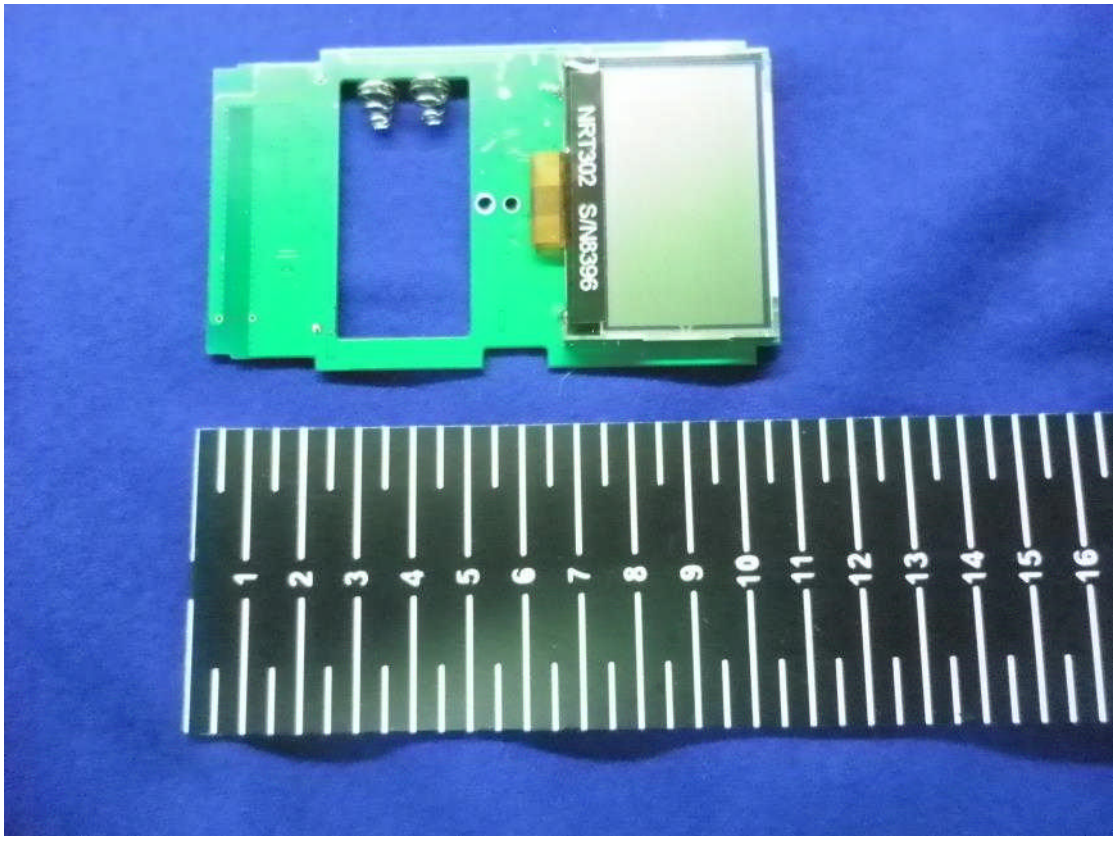
8.3 EUT antenna / RF connector port

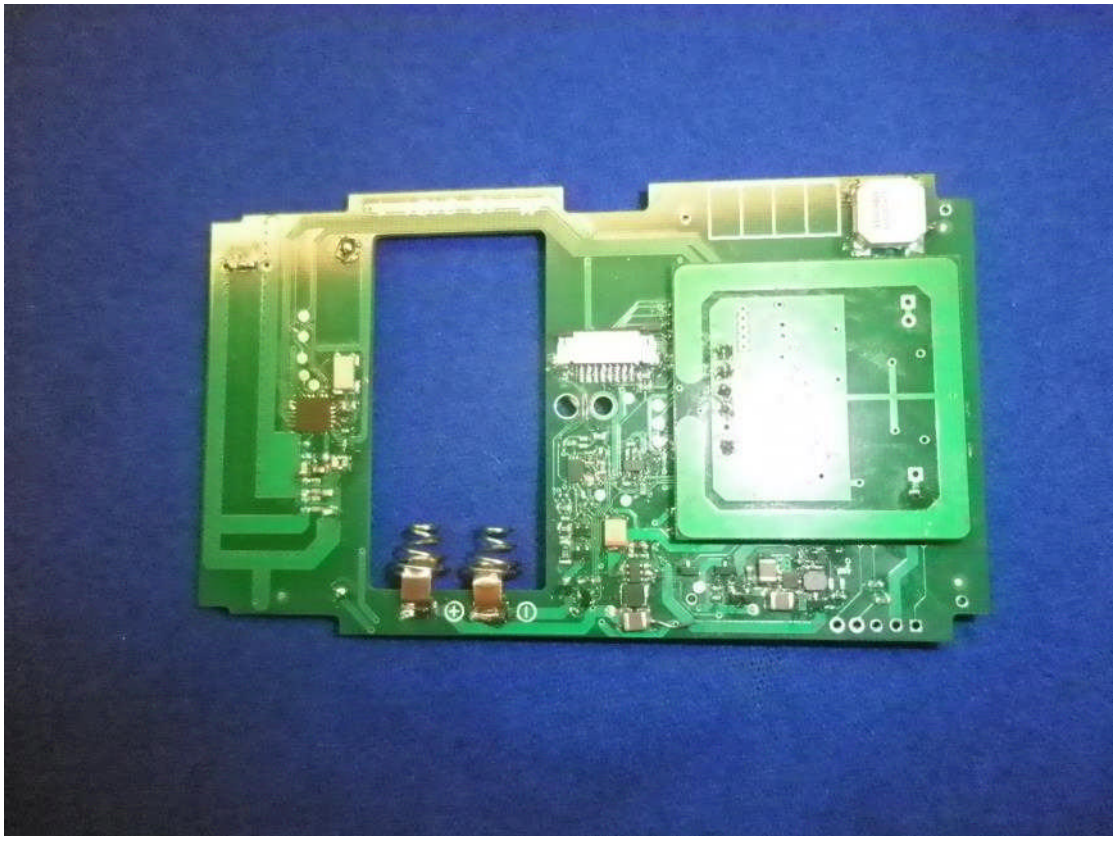


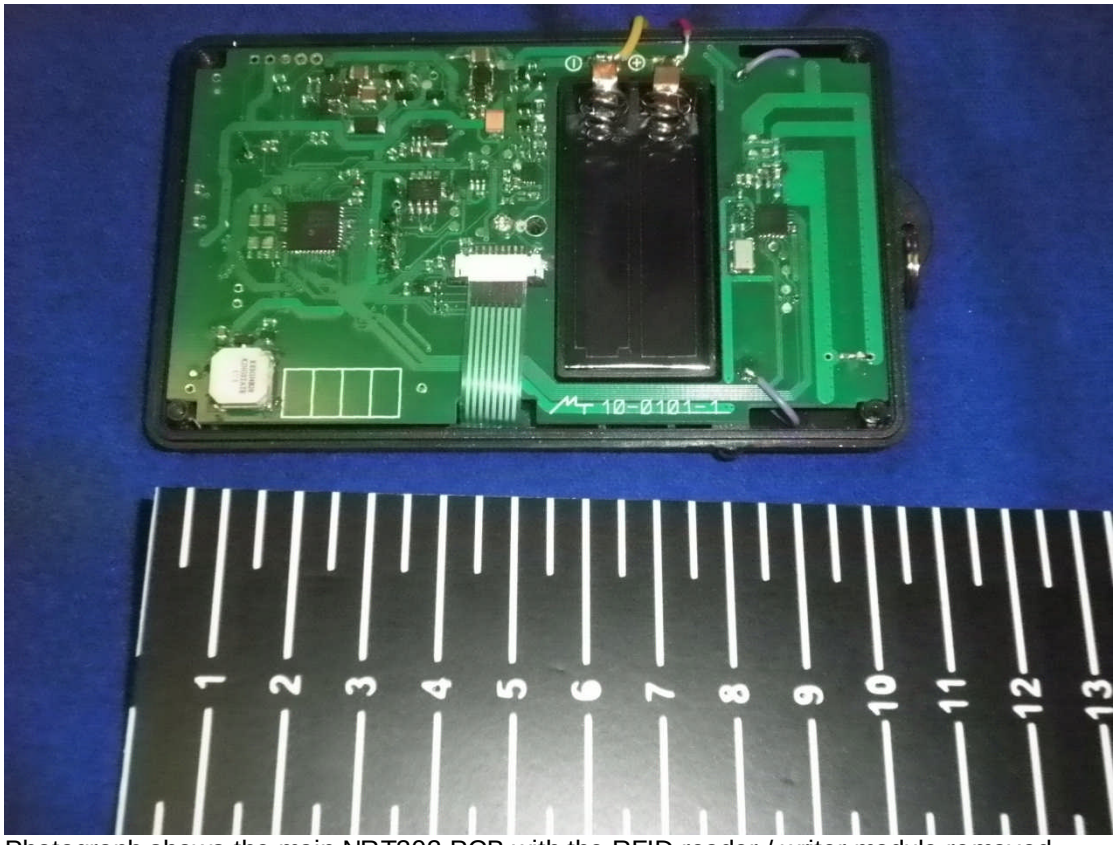
Photograph shows the two integral antennas etched into the PBC's. The 13.56 MHz RFID reader / writer shown on the left, and the 915 MHz transceiver shown on the right.

8.4 EUT Display / Controls

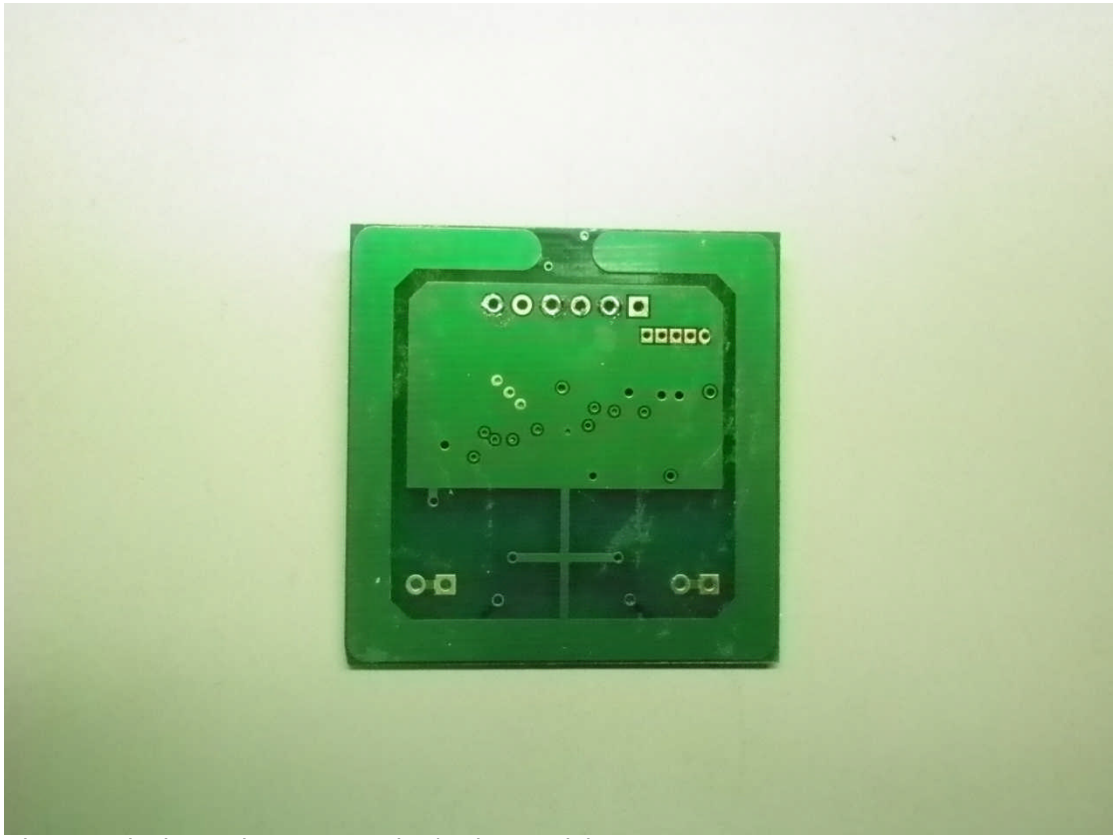
8.5 EUT internal construction



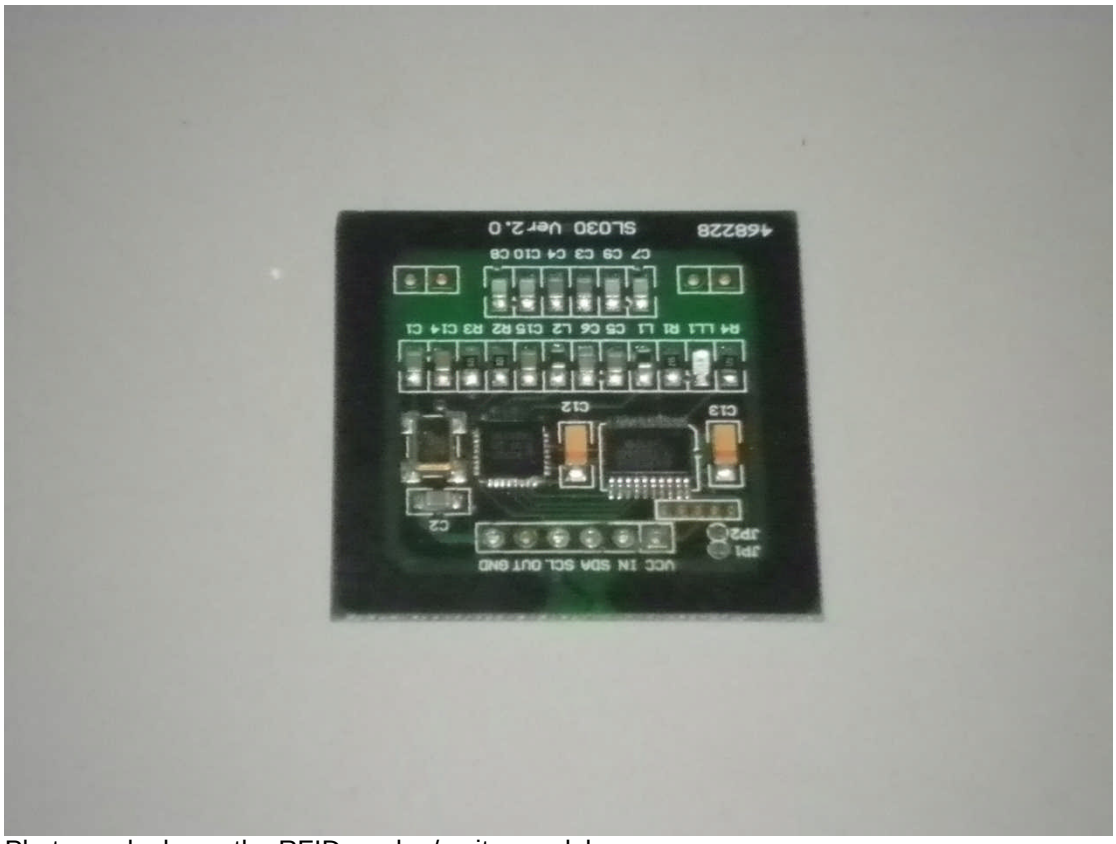




Photograph shows the main NRT302 PCB with the RFID reader / writer module removed.

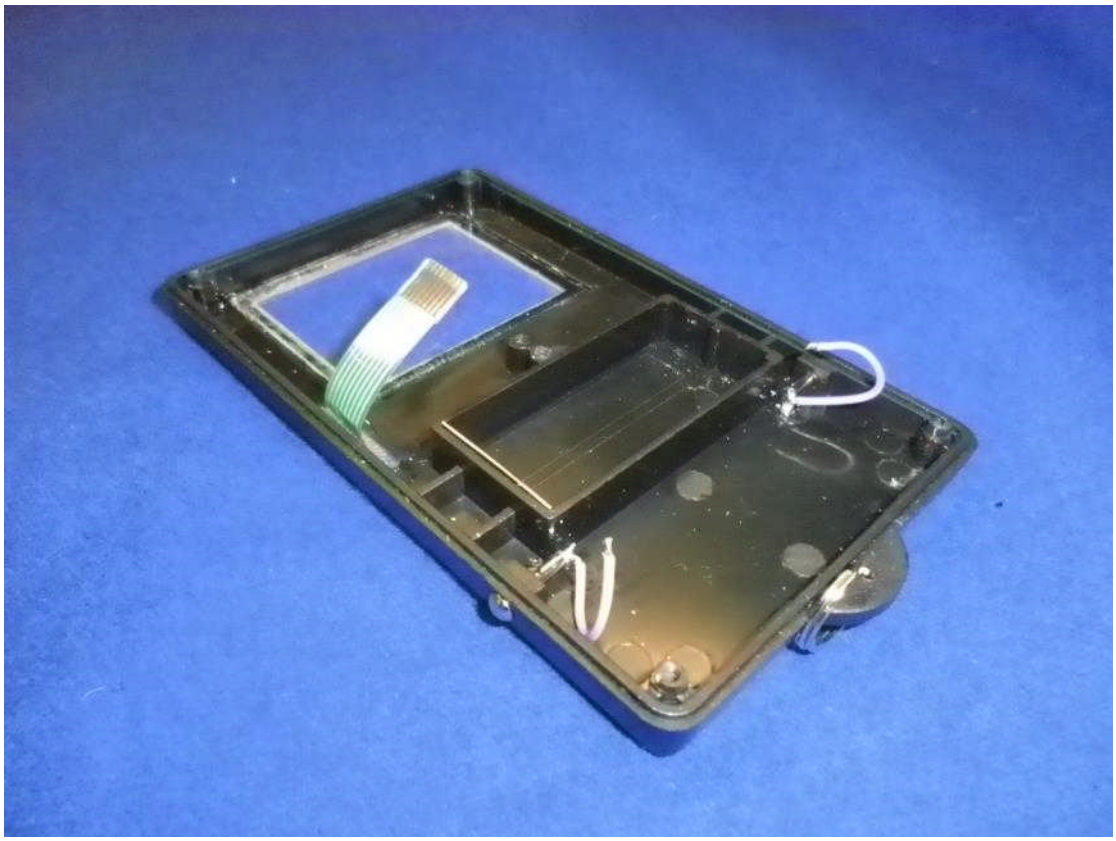


Photograph shows the RFID reader / writer module.



Photograph shows the RFID reader / writer module.

8.6 EUT Chassis

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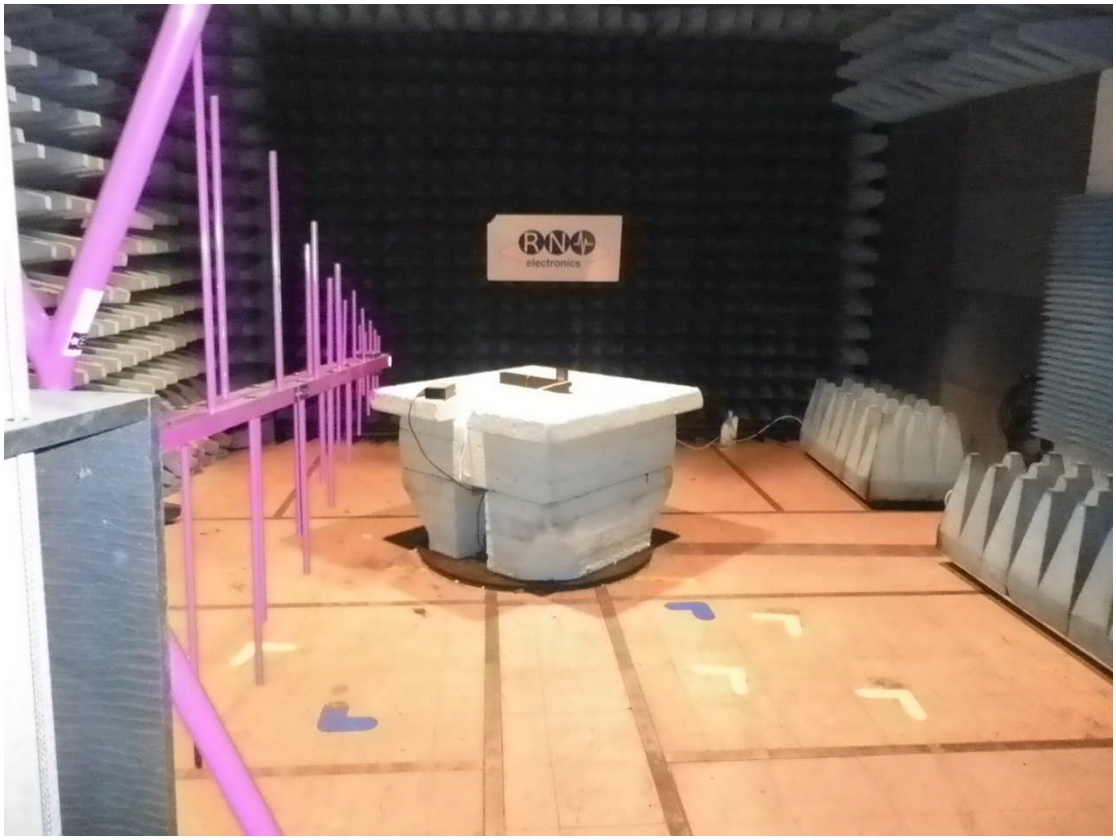
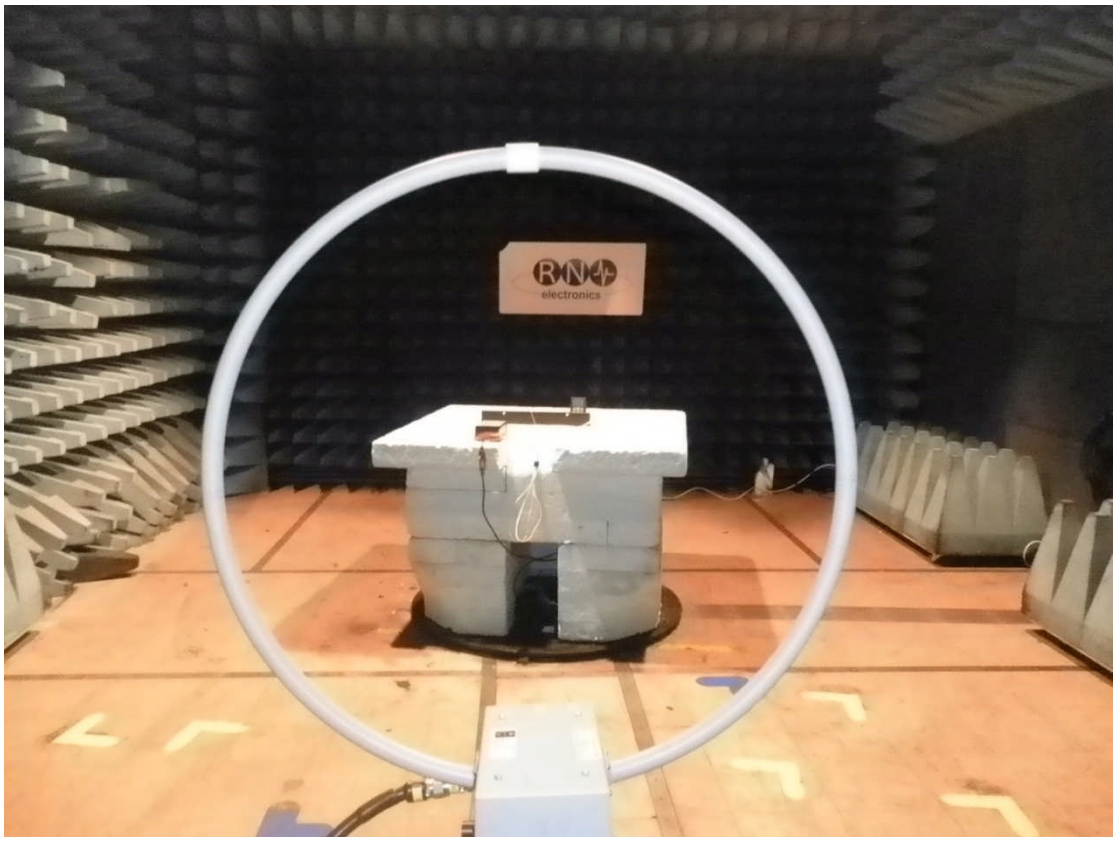
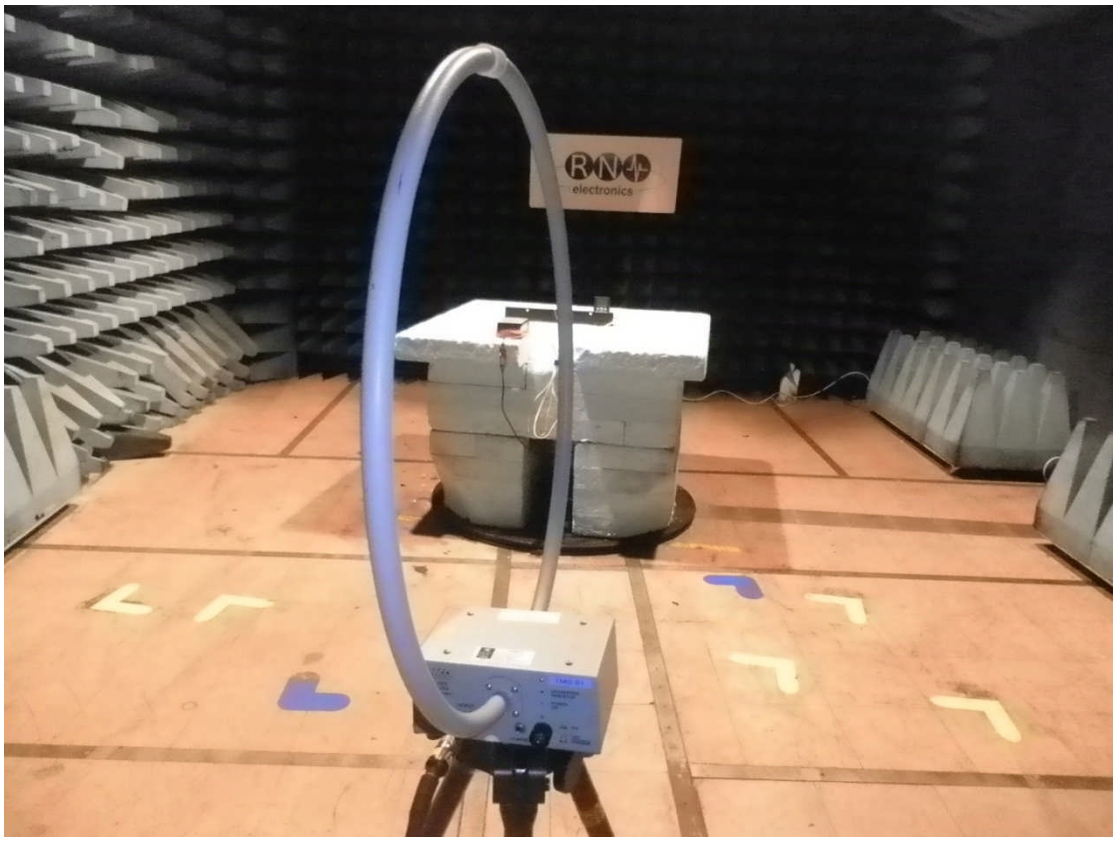
8.7 Test set-up, spurious emissions



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8.8 Test set-up, AC power line conducted emissions

8.9 OATS Field strength

8.10 Test set-up diagrams

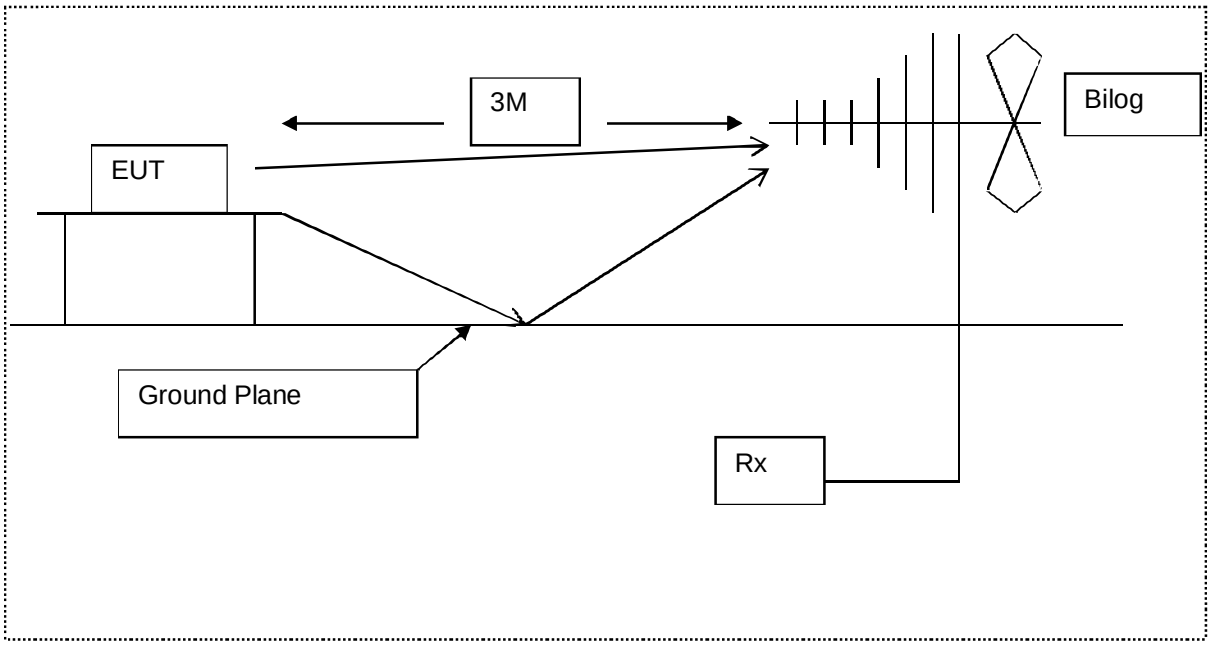

Diagram of the radiated emissions test setup 30-1000MHz.

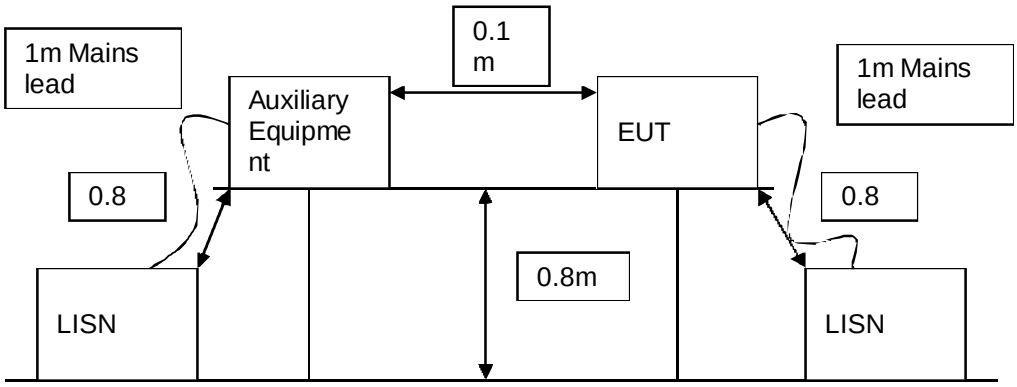

Diagram of the AC power line conducted emissions test setup.

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
E227	6632A	System DC Power Supply	Hewlett Packard	20-Feb-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
E434	G3RUH	10 MHz GPS oscillator	James Miller	N/A	N/A
L264	DT75	Digital Thermometer	Instrotech Ltd	06-Dec-13	24 months
TMS38	VMT04/140	Environmental oven	Heraeus Votsch	N/A	N/A
TMS80	206-3722	Digital Thermometer & K Probe	RS Components Ltd	*07-Nov-14	12 months
TMS81	6502	Active loop antenna	EMCO	*10-Dec-14	24 months
TMS933	CBL6141A	Bilog Antenna 30MHz - 2GHz	York EMC	*29-Sep-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

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

11 Auxiliary equipment

11.1 Customer supplied Equipment

Auxiliary equipment used for the purpose of test supplied by the above has been listed below

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, if any, were implemented.

12.1 Modifications before test

No modifications were made before test by RN Electronics Ltd.

12.2 Modifications during test

No modifications were made during test by RN Electronics Ltd.
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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) VCCI Registration No. C-2823
Site G	Screened Room (Control Room for Site H)
Site H	3m Semi-anechoic chamber (indoor OATS) FCC Registration No. 293246 IC Registration No. 5612A-2
Site J	Screened Room
Site K	Screened Room (Control Room for Site M)
Site M	3m Semi-anechoic chamber (indoor OATS) FCC Registration No. 293246
Site Q	Fully-anechoic chamber
Site OATS	3m and 10m Open Area Test Site FCC Registration No. 293246 IC Registration No. 5612A-1 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
DSC	Part 15 security / remote control transmitter
DSR	Part 15 remote control / security device transceiver
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