Radio Test Report

Slingco Ltd

Load Sensing Device

ZSW4405

47 CFR Part 15.247
Effective Date 1st October 2014

Test Date: 13th August 2015 to 18th August 2015
Report Number: 08-8128-4-15 Issue 02

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Certificate of Test 8128-4

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

Equipment:	Load Sensing Device
Model Number:	ZSW4405
Unique Serial Number:	24556
Manufacturer:	Slingco Ltd Station Road, Facit, Whitworth Lancashire OL12 8LJ
Full measurement results are detailed in Report Number:	08-8128-4-15 Issue 02
Test Standards:	47 CFR Part 15.247 Effective Date 1st October 2014 Class DSS, Part 15 Spread Spectrum Transmitter

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

DEVIATIONS:
Deviations have not been applied.

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

Date Of Test: 13th August 2015 to 18th August 2015

Test Engineer:

Digitally signed by: Daniel Sims
DN: CN = Daniel Sims C = GB O = RN Electronics Ltd
Date: 2016.07.12 09:02:21 Z

Approved By:
Technical Director

Customer Representative:

1 Contents

2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	Slingco Ltd Station Road Facit Whitworth Lancashire OL12 8LJ	
Manufacturer of EUT	Slingco Ltd	
Brand name of EUT	LSD	
Model Number of EUT	ZSW4405	
Serial Number of EUT	24556	
Date Received	13th August 2015	
Date of Test:	13th August 2015 to 18th August 2015	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Created	17th September 2015	
Visual Description	Cylindrical steel enclosure with a battery compartment and fixing boltholes at one end. The antenna is housed inside a potting compound a third of the way up the enclosure.	
Main Function	To measure the load applied, log the information and then transmit it to a receiver connected to a PC, which allows the user to monitor real time graphs/info of the applied load.	
Information Specification	Height	70 mm
	Width	285 mm
	Depth	70 mm
	Weight	3.2 kg
	Voltage	3.7 V nominal lithium battery
	Current	Not specified

2.2 Configurations for testing

General Parameters	
EUT Normal use position	Horizontally fixed at end of line being tensioned
Choice of model(s) for type tests	Production prototype
Antenna details	Molex 105262-0002, ISM 868/915MHz, 1.3dBi Gain
Antenna port	No, Integral antenna
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	908.96MHz
Lowest Signal generated in EUT	Not specified
TX Parameters	
Alignment range – transmitter	907-908.96MHz
EUT Declared Modulation Parameters	2-FSK, 2400Baud
EUT Declared Power level	+14dBm conducted declared
EUT Declared Signal Bandwidths	9.2kHz
EUT Declared Channel Spacing's	40kHz
EUT Declared Duty Cycle	Maximum 300ms TX burst with minimum 700ms off time between hops
Unmodulated carrier available?	Yes
Declared frequency stability	30ppm
RX Parameters	
Alignment range – receiver	907-908.96MHz
EUT Declared RX Signal Bandwidth	10kHz
FHSS Parameters	
No. Of hop channels	50
Dwell time per hop channel	276ms

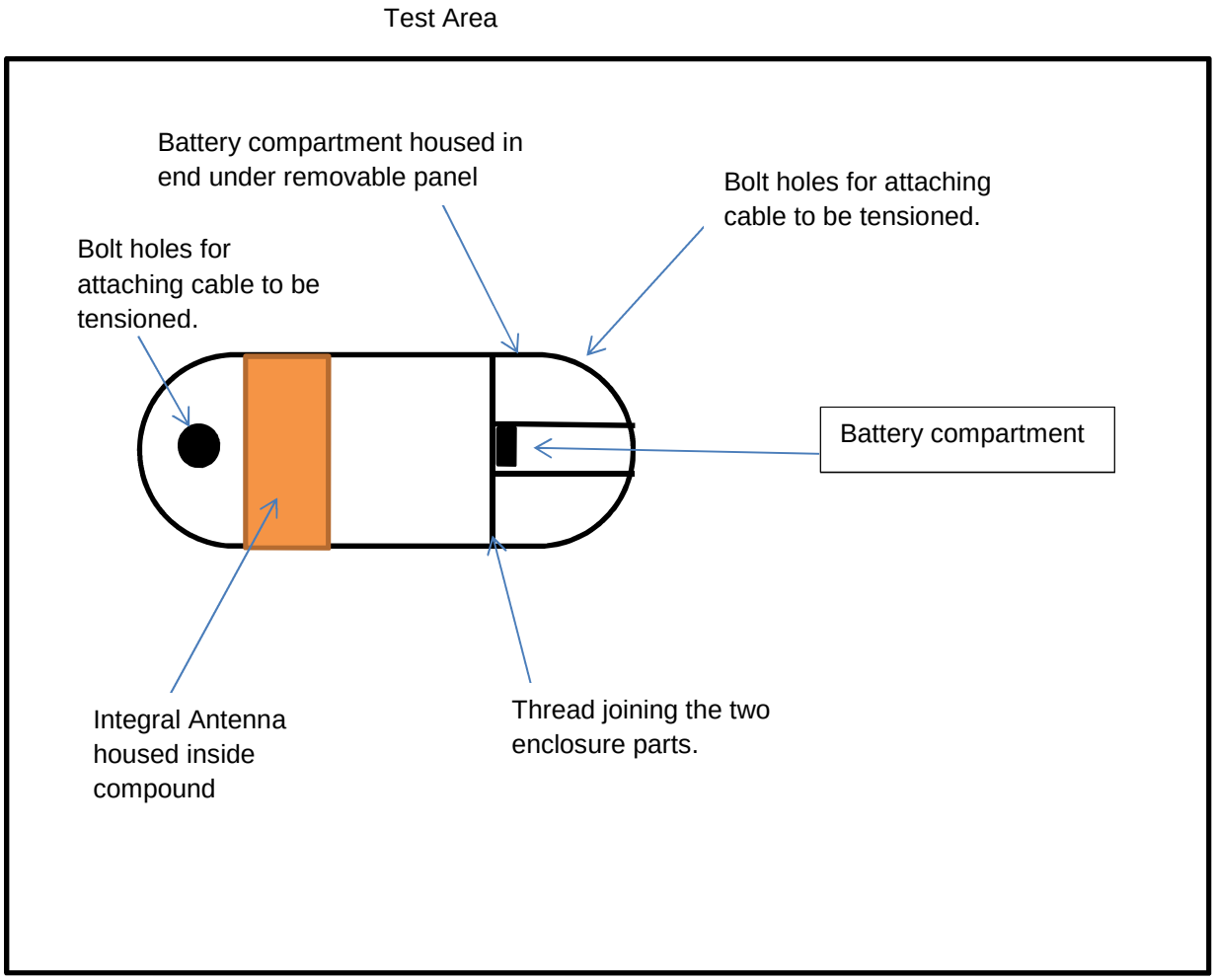
2.3 Functional description

The Slingco LSS is a device for regularly measuring a load on a cable via a built in strain gauge, storing the load value, and regularly transmitting the measured value to a receiver connected to a pc such that the load can be displayed to users in real time. Additionally, acceleration and temperature values are measured at the same interval as the load measurement, and these values are stored locally as well as being transmitted to the remote location. The LSS has transceiver circuitry in built which enables the unit to operate as either a transmitter or a receiver in the 907 – 908.96MHz band, however once configured, then the unit will only operate in one mode, i.e. as an LSS transmitter, or as a LSS receiver, but one board will not operate with both functions.
The LSS is a FHSS Transmitter and the unit is always on whenever a suitable battery is connected. There are two on modes – standby and logging. When in standby mode the LSS will measure the load on a regular interval, nominal one read per second. If the read exceeds a manufacturer programmed "wake up" threshold, then the LSS will go into logging mode. In this mode the readings are taken, stored within the internal memory and transmitted via rf. An internal two hour countdown timer is started at this point. All load readings are compared with the wake up threshold, and if they exceed the threshold then the 2 hour timer is restarted. Should the two hour countdown timer reach zero then the LSS will cease to transmit and log load values.

2.4 Modes of operation

Mode Reference	Description	Used for testing
907MHz Constant TX	EUT constantly transmitting on 907MHz	Yes
908.96MHz Constant TX	EUT constantly transmitting on 908.65MHz	Yes
Normal mode	EUT Hopping across all 50 channels repeatedly	Yes

2.5 Emissions configuration



The unit was powered from a fully charged battery. Battery voltage was checked and maintained within +- 10% of nominal. Three internal PCB units were provided for tests, each one programmed into a different mode. Each one of the units was fitted in turn, into a single EUT enclosure dependent on the test mode required. The EUT enclosure s/n was 24556. Two of the three units provided gave constant Transmission on Low and High channels, and the third was configured for normal hopping operation. Refer to section 2.4 within this report for details. Power levels were not adjustable and the 3 units came set at maximum power by the manufacturer. The integral antenna was “potted” into a rubberised compound.

An RF port was available internally to the unit enclosure, and as such conducted power measurements were performed, However, due to the nature of the products enclosure design, actual radiated fundamental field strength levels were considerably lower than expected. This was found to be attributed to the proximity of the antenna to the steel enclosure and the rubberised compound fitted over the antenna to secure it in place. Slingco Ltd have confirmed this acceptable to their operation of the device in normal use.

2.5.1 Signal leads

The EUT is battery powered and has no signal leads/ports.

3 Summary of test results

The Load Sensing Device, ZSW4405 was tested for compliance to the following standard(s) :

47 CFR Part 15.247, Effective Date 1st October 2014
Class DSS, Part 15 Spread Spectrum Transmitter

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

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

[1] EUT does not operate from the AC power lines nor contain provisions for operation while connected to AC power lines.
[2] EUT is integral antenna equipment only. Radiated emissions tests have been performed with antenna in place.
[3] Maximum PK conducted power measured instead.
[4] Only Applicable to DSSS equipment for determining any Average emissions relaxation pertaining to FCC 15.35
[5] This test is for DSSS equipment only. EUT is FHSS equipment.

4 Specifications

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

4.1 Relevant standards

Ref.	Standard Number	Version	Description
4.1.1	47 CFR Part 15C	2014	Federal Communications Commission PART 15 – RADIO FREQUENCY DEVICES
4.1.2	ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
4.1.3	ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
4.1.4	DA 00-705	2000	PUBLIC NOTICE Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
4.1.5	KDB 558074 D01 v03r03	2013	Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

R.N. Electronics Ltd sites H, M and OATS are listed with the FCC. Registration Number 293246

4.2 Deviations

Deviations have not been applied.

4.3 Tests at extremes of temperature & voltage

Not required.

4.4 Test fixtures

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

The equipment integral antenna was used for testing.

5 Tests, methods and results

5.1 AC power line conducted emissions

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

5.2 Radiated emissions 9 kHz - 150 kHz

5.2.1 Test methods

Test Requirements:	47 CFR Part 15C Clause 15.209 [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.4 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Clause 15.209/15.247(d) [Reference 4.1.1 of this report]

5.2.2 Configuration of EUT

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

The EUT was operated in 907MHz Constant TX and 908.96MHz Constant TX modes.

5.2.3 Test procedure

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

Measurements were made in a semi-anechoic chamber (pre-scan) with 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 degrees to record the worst case emissions.
At least 6 signals within 20dB and all signals within 10dB of the limit were investigated.
Tests were performed using Test Site H & OATS.

5.2.4 Test equipment

E533, E534, E535, TMS81

See Section 9 for more details

5.2.5 Test results

Temperature of test environment	23°C
Humidity of test environment	53%
Pressure of test environment	101kPa

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
Low channel	907 MHz

Plot refs
8128-4 Rad 1 9-150kHz Para
8128-4 Rad 1 9-150kHz Perp

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
High channel	908.96 MHz

Plot refs
8128-4 Rad 2 9-150kHz Para
8128-4 Rad 2 9-150kHz Perp

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

LIMITS:
15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.
15.247(d) other emissions, outside the intentional band, must be attenuated by at least 20/30dB from the level of the fundamental / meet the general limits of 15.209.
The general limits of 15.209 are as drawn on the respective plots.

These results show that the EUT has PASSED this test.

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

5.3 Radiated emissions 150 kHz - 30 MHz

5.3.1 Test methods

Test Requirements:	47 CFR Part 15C Clause 15.209 [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.4 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Clause 15.209/15.247(d) [Reference 4.1.1 of this report]

5.3.2 Configuration of EUT

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

The EUT was operated in 907MHz Constant TX and 908.96MHz Constant TX modes.

5.3.3 Test procedure

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

Measurements were made in a semi-anechoic chamber (pre-scan) with 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 degrees to record the worst case emissions.
At least 6 signals within 20dB and all signals within 10dB of the limit were investigated.
Tests were performed using Test Site H & OATS.

5.3.4 Test equipment

E533, E534, E535, TMS81

See Section 9 for more details

5.3.5 Test results

Temperature of test environment	24°C
Humidity of test environment	53%
Pressure of test environment	101kPa

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
Low channel	907 MHz

Plot refs
8128-4 Rad 1 150k-30MHz Para
8128-4 Rad 1 150k-30MHz Perp

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
High channel	908.96 MHz

Plot refs
8128-4 Rad 2 150k-30MHz Para
8128-4 Rad 2 150k-30MHz Perp

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

LIMITS:
15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.
15.247(d) other emissions, outside the intentional band, must be attenuated by at least 20/30dB from the level of the fundamental / meet the general limits of 15.209.
The general limits of 15.209 are as drawn on the respective plots.

These results show that the EUT has PASSED this test.

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

5.4 Radiated emissions 30 MHz -1 GHz

5.4.1 Test methods

Test Requirements:	47 CFR Part 15C Clause 15.247(d) & 15.209 [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.5 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Clause 15.209/15.247(d) [Reference 4.1.1 of this report]

5.4.2 Configuration of EUT

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

The EUT was operated in 907MHz Constant TX and 908.96MHz Constant TX modes.

5.4.3 Test procedure

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

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 H.

5.4.4 Test equipment

LPE364, TMS45, E534, E535

See Section 9 for more details

5.4.5 Test results

Temperature of test environment	22.5 - 24°C
Humidity of test environment	53 - 63%
Pressure of test environment	101kPa

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
Low channel	907 MHz

Plot refs
8128-4 Rad 1 VHF Horiz
8128-4 Rad 1 VHF Vert
8128-4 Rad 1 UHF Horiz
8128-4 Rad 1 UHF Vert

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
High channel	908.96 MHz

Plot refs
8128-4 Rad 2 VHF Horiz
8128-4 Rad 2 VHF Vert
8128-4 Rad 2 UHF Horiz
8128-4 Rad 2 UHF Vert

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

LIMITS:
15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.
15.247(d) other emissions, outside the intentional band, must be attenuated by at least 20dB from the level of the fundamental / meet the general limits of 15.209.
The general limits of 15.209 are as drawn on the respective plots.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
30MHz - 1000MHz ±5.1dB

5.5 Radiated emissions above 1 GHz

5.5.1 Test methods

Test Requirements:	47 CFR Part 15C Clause 15.247(d) & 15.209 [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.6 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Clause 15.247(d) & 15.209 [Reference 4.1.1 of this report]

5.5.2 Configuration of EUT

The EUT was placed on a 1.5 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was rotated in all three orthogonal planes. Radiated Emissions testing was performed with a fully charged battery.

The EUT was operated in 907MHz Constant TX, 908.96MHz Constant TX and Normal modes.

5.5.3 Test procedure

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

Measurements were made in a semi-anechoic chamber with appropriate absorbing material for use in this range. Horn antennas were used at heights where the whole of the EUT was contained within the main beam. The EUT was rotated through 360° to record the worst case emissions. A measurement distance of 3m was used between the test range 1 - 6GHz, and 1.2m was used in the test range 6 - 10GHz.

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

Tests were performed using Test Site H.

5.5.4 Test equipment

LPE261, LPE333, E534, E535

See Section 9 for more details

5.5.5 Test results

Temperature of test environment	23°C
Humidity of test environment	52%
Pressure of test environment	101kPa

Setup Table

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel	40 kHz
Mod Scheme	FHSS FSK
Low channel	907 MHz

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	Plot Reference
1814	43.2	-30.8	38.1	-15.9	Horizontal	Vertical	Refer to plot refs below
2721	42.7	-31.3	35.8	-18.2	Horizontal	Vertical	Refer to plot refs below
1814	48.6	-25.4	46.3	-7.7	Horizontal	Horizontal	Refer to plot refs below
2721	49.3	-24.7	46.8	-7.2	Horizontal	Horizontal	Refer to plot refs below
3628	44.8	-29.2	37.6	-16.4	Horizontal	Horizontal	Refer to plot refs below
							8128-4 Rad 1 1-2GHz Horiz
							8128-4 Rad 1 1-2GHz Vert
							8128-4 Rad 1 2-5GHz Horiz
							8128-4 Rad 1 2-5GHz Vert
							8128-4 Rad 1 5-6GHz Horiz
							8128-4 Rad 1 5-6GHz Vert

Setup Table

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel	40 kHz
Mod Scheme	FHSS FSK
High channel	908.96 MHz

Spurious	Measured Peak	Difference	Measured	Difference to	Antenna	EUT	Plot Reference
3635.84	44.5	-29.5	36.7	-17.3	Horizontal	Vertical	Refer to plot refs below
1817.92	47.8	-26.2	45.2	-8.8	Horizontal	Horizontal	Refer to plot refs below
2726.88	45.4	-28.6	40.3	-13.7	Horizontal	Horizontal	Refer to plot refs below
3635.84	49.5	-24.5	46.0	-8.0	Horizontal	Horizontal	Refer to plot refs below
							8128-4 Rad 2 1-2GHz Horiz
							8128-4 Rad 2 1-2GHz Vert
							8128-4 Rad 2 2-5GHz Horiz
							8128-4 Rad 2 2-5GHz Vert
							8128-4 Rad 2 5-6GHz Horiz
							8128-4 Rad 2 5-6GHz Vert

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

LIMITS:
15.209 limits are applicable in the restricted bands of 15.205 with the relevant detector.
15.247(d) other emissions, outside the intentional band, must be attenuated by at least 20dB from the level of the fundamental / meet the general limits of 15.209.
The general limits of 15.209 are as drawn on the respective plots.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
1 – 18 GHz ±3.5dB

5.6 Effective radiated power field strength

5.6.1 Test methods

Test Requirements: 47 CFR Part 15C Clause 15.247(b)(2) [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 6.5/6.6 [Reference 4.1.2 of this report]
Public notice DA 00-705 [Reference 4.1.4 of this report]
Limits: 47 CFR Part 15C Clause 15.247(b)(2) & 15.209(a) [Reference 4.1.1 of this report]

5.6.2 Configuration of EUT

The EUT was placed on a 0.8 metre high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was rotated in all three orthogonal planes to maximise emissions. Final measurements were taken at 3m. The EUT was operated in 907MHz Constant TX, 908.96MHz Constant TX and Normal modes. Highest field strengths were measured with the EUT in hopping mode.

5.6.3 Test procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment listed in the 'Test Equipment used' section. The power stated is Peak field strength. Tests were performed in test site H.

5.6.4 Test equipment

E534, E535, LPE264

See Section 9 for more details

5.6.5 Test results

Temperature of test environment	23°C
Humidity of test environment	54%
Pressure of test environment	101kPa

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
Low channel	907 MHz
High channel	908.96 MHz

	Low	High
Peak Level (dBµV/m) @3m	93.80	93.60
Plot reference	J8128-4 Radiated PK power Low channel all hopping	J8128-4 Radiated PK power Top channel all hopping
Antenna Polarisation	Horiz	Horiz
EUT Polarisation	Horiz	Horiz

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

Radiated fundamental field strength was measured and was a much lower level than anticipated. This was found to be attributed to the proximity of the steel enclosure to the antenna and the rubberised potting compound securing the antenna in position. Slingco Ltd confirmed at the time of test that this is acceptable to their operation of the device in use.
Calculated antenna Gain/Loss based on Radiated and Conducted measurements within this report is Low channel = -15.43dB & High channel = -15.13 dB.

LIMITS:
The maximum output power in all cases is 30dBm/ 1watt Conducted.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 3.9 dB

5.7 Band Edge Compliance

5.7.1 Test methods

Test Requirements:	47 CFR Part 15C Clause 15.215 & 15.247(d) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.10 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Clause 15.209(a) & 15.247(d) [Reference 4.1.1 of this report]

5.7.2 Configuration of EUT

The EUT was placed on a 0.8 metre high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres.

The EUT was operated in 907MHz Constant TX, 908.96MHz Constant TX and Normal modes.

5.7.3 Test procedure

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

Tests were performed using Test Site H.

5.7.4 Test equipment

E534, E535, LPE364

See Section 9 for more details

5.7.5 Test results

Temperature of test environment	23°C
Humidity of test environment	54%
Pressure of test environment	101kPa

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
Low channel	907 MHz
High channel	908.96 MHz

	Low Channel	High Channel
Peak Level (dBµV/m @3m)	34.4	34.7
Peak Plot reference	J8128-4 Radiated Band edge Low channel	J8128-4 Radiated Band edge Top channel

	All Channels
Band Edge Plot reference	J8128-4 Radiated Band edge hopping

Analyser plots for the Band Edge Compliance can be found in Section 6 of this report. These show the 20dBc requirement of 15.247(d) are met at the band edges of 902 and 928 MHz. Restricted band edge plots are also shown in section 6. Peak restricted band edge results show compliance with the QP limit, therefore only peak level results are shown.

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

LIMITS:
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

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, please refer to radiated emissions 30-1000MHz section within this report.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
<± 3.9 dB

5.8 Occupied bandwidth

5.8.1 Test methods

Test Requirements: 47 CFR Part 15C Clause 15.247(a)(1)(i) [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 6.9 [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Clause 15.215(c) 15.247(a)(1)(i) [Reference 4.1.1 of this report]

5.8.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was operated in 907MHz Constant TX, 908.96MHz Constant TX and Normal modes.

5.8.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. A 510Hz RBW, 3x VBW, 40kHz span, auto sweep time and max hold settings were used for the 20dB bandwidth. Tests were performed using Test Site H.

5.8.4 Test equipment

E534, E535, LPE264

See Section 9 for more details

5.8.5 Test results

Temperature of test environment	23°C
Humidity of test environment	54%
Pressure of test environment	101kPa

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
Low channel	907 MHz
High channel	908.96 MHz

	Low	High
20dB Bandwidth (MHz)	0.015	0.015
Plot reference	J8128-4, 20dB BW low channel 510Hz RBW	J8128-4, 20dB BW High channel 510Hz RBW

Analyser plots for the 20dB bandwidth can be found in Section 6 of this report.

LIMITS:
15.215(c) The 20dB bandwidth of the emission must be contained within the designated frequency band.
15.247(a)(1)(i) The maximum allowed 20dB bandwidth of the hopping channel is 500kHz.

These results show that the EUT has PASSED this test.

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

5.9 Maximum Peak conducted output power

5.9.1 Test methods

Test Requirements: 47 CFR Part 15C Clause 15.247(b)(2) [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 7.8.5 [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Clause 15.247(b)(2) [Reference 4.1.1 of this report]

5.9.2 Configuration of EUT

The EUT was tested on a bench. Measurements were made at the EUT's internal RF port using a Peak Power meter. The EUT was operated in 907MHz Constant TX, 908.96MHz Constant TX and Normal modes. Highest powers were measured with the EUT in hopping mode.

5.9.3 Test procedure

Tests were made in accordance with the Test Method noted above using the measuring equipment listed in the 'Test Equipment used' section. The power stated is Peak conducted power. Tests were performed in test site H.

5.9.4 Test equipment

E611

See Section 9 for more details

5.9.5 Test results

Temperature of test environment	20°C
Humidity of test environment	43%
Pressure of test environment	101kPa

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
Low channel	907 MHz
High channel	908.96 MHz

	Low channel result	High channel
Peak Conducted level (dBm)	+14.04	+13.5

LIMITS:
The maximum output power in all cases is 30dBm/ 1watt.

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows: <± 1.97 dB

5.10 Maximum Average conducted output power

NOT APPLICABLE: Maximum PK conducted power measured.

5.11 Maximum Power Spectral Density

NOT APPLICABLE: This test is for DSSS equipment only. EUT is FHSS equipment.

5.12 Antenna power conducted emissions

NOT APPLICABLE: EUT is integral antenna equipment only. Radiated emissions tests have been performed with antenna in place.

5.13 Duty cycle

NOT APPLICABLE: Only Applicable to DSSS equipment for determining any Average emissions relaxation pertaining to FCC 15.35

5.14 FHSS carrier frequency separation

5.14.1 Test methods

Test Requirements: 47 CFR Part 15C Clause 15.247(a1) [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 7.8 [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Clause 15.247(a1) [Reference 4.1.1 of this report]

5.14.2 Configuration of EUT

The EUT was tested in the chamber and ambient conditions were monitored. The EUT was operated in Normal mode.

5.14.3 Test procedure

Tests were made using the measuring equipment listed in the 'Test Equipment' Section. With the EUT hopping, a span was set on the spectrum analyser to show two adjacent channel peaks. The analyser was set to Peak detector and a max held trace, the trace was allowed enough sweeps to stabilise.

Tests were performed in test site H.

5.14.4 Test equipment

E534, E535, LPE264

See Section 9 for more details

5.14.5 Test results

Temperature of test environment	23°C
Humidity of test environment	55%
Pressure of test environment	101kPa

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
Single channel	907 MHz

	Single
Separation (kHz)	40
Plot of separation, two adjacent channels	J8128-4, Channel Separation

Analyser plots for the carrier separation can be found in Section 6 of this report

LIMITS:
FHSS shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

These results show that the EUT has PASSED this test.

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

5.15 Average time of occupancy

5.15.1 Test methods

Test Requirements: 47 CFR Part 15C Clause 15.247(a)(1)(i) [Reference 4.1.1 of this report]
Test Method: ANSI C63.10 Clause 7.8 [Reference 4.1.2 of this report]
Limits: 47 CFR Part 15C Clause 15.247(a)(1)(i) [Reference 4.1.1 of this report]

5.15.2 Configuration of EUT

The EUT was placed on a 0.8 metre high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured in the same position as for the field strength tests. Ambient conditions were monitored. The EUT was operated in Normal mode for this test.

5.15.3 Test procedure

Tests were made using the measuring equipment listed in the 'Test Equipment' Section. With the EUT hopping, a suitable sweep time was set on the spectrum analyser in zero span mode centred on a hopping channel. Both the TX time period and the repetition time were measured and plotted for comparison to the limits.

Tests were performed in test site H.

5.15.4 Test equipment

E534, E535, LPE364, E364, E367

See Section 9 for more details

5.15.5 Test results

Temperature of test environment	23°C
Humidity of test environment	54%
Pressure of test environment	101kPa

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
Low channel	907 MHz

Measured Dwell time/pulse width (ms)	276.3
Period time (s)	20
Instances of pulse within period time	1
Average time of occupancy (ms)	276.3
Measured Dwell time/pulse width (ms) plot reference	J8128-4 Pulse width conducted low channel
Period time (s) plot reference	J8128-4 repetition within 25second period channel 907MHz

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
High channel	908.96 MHz

Measured Dwell time/pulse width (ms)	276.6
Period time (s)	20
Instances of pulse within period time	1
Average time of occupancy (ms)	276.6
Measured Dwell time/pulse width (ms) plot reference	J8128-4 Pulse width conducted high channel
Period time (s) plot reference	J8128-4 repetition within 25second period channel 908.96MHz

Analyser plots showing pulse width and period /repetition can be found in Section 6 of this report.

LIMITS:
For FHSS in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period.

These results show that the EUT has PASSED this test.

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

5.16 Number of Hop Channels

5.16.1 Test methods

Test Requirements:	47 CFR Part 15C Clause 15.247(a)(1)(i) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 7.8 [Reference 4.1.2 of this report]
Limits:	47 CFR Part 15C Clause 15.247(a)(1)(i) [Reference 4.1.1 of this report]

5.16.2 Configuration of EUT

The EUT was placed on a 0.8 metre high turntable. The front edge of the EUT was initially positioned facing the antenna. Ambient conditions were monitored. The EUT was operated in Normal mode for this test.

5.16.3 Test procedure

Tests were made using the measuring equipment noted in the 'Test Equipment' Section at Site H. With the EUT hopping, a suitable span was set on the spectrum analyser to show clearly over a plot the number of channels being used by the EUT. The analyser was set to Peak detector and max held and the trace was allowed to stabilise before the plot was taken.

5.16.4 Test equipment

E534, E535, LPE364, E364, E367

See Section 9 for more details

5.16.5 Test results

Temperature of test environment	23°C
Humidity of test environment	54%
Pressure of test environment	101kPa

Band	902-928 MHz
Power Level	declared max +14 dBm
Channel Spacing	40 kHz
Mod Scheme	FHSS FSK
Channel	Hopping All channels

No of hopping channels	50
Minimum No. Required number by specification	50
Plot of Hopping Channels 1-50	J8128-4, Number of Hopping Channels

Analyser plots showing the number of hopping channels can be found in Section 6 of this report.

LIMITS:
For FHSS in the band 902-928 MHz: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels.

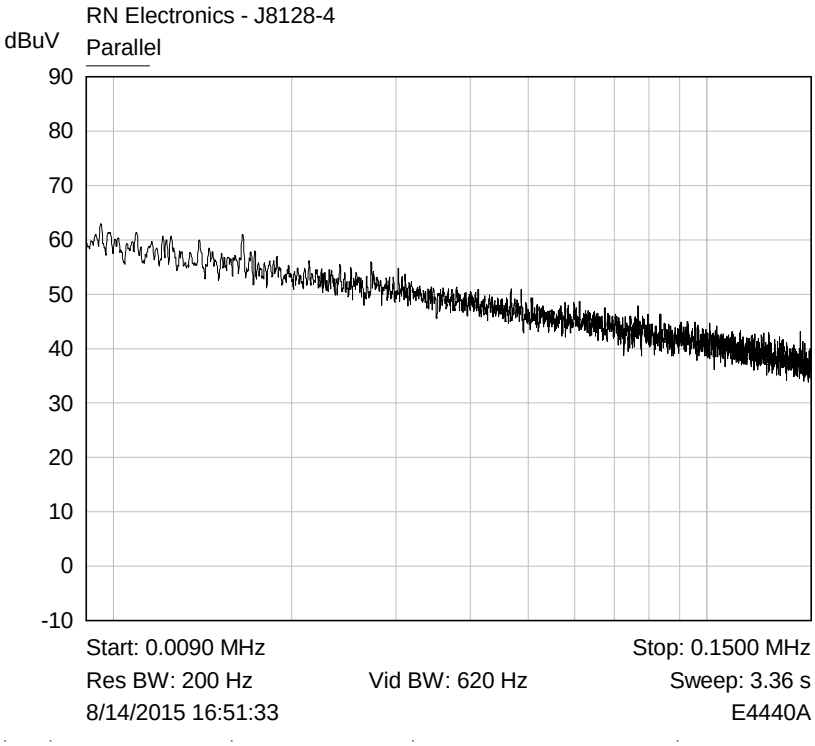
These results show that the EUT has PASSED this test.

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

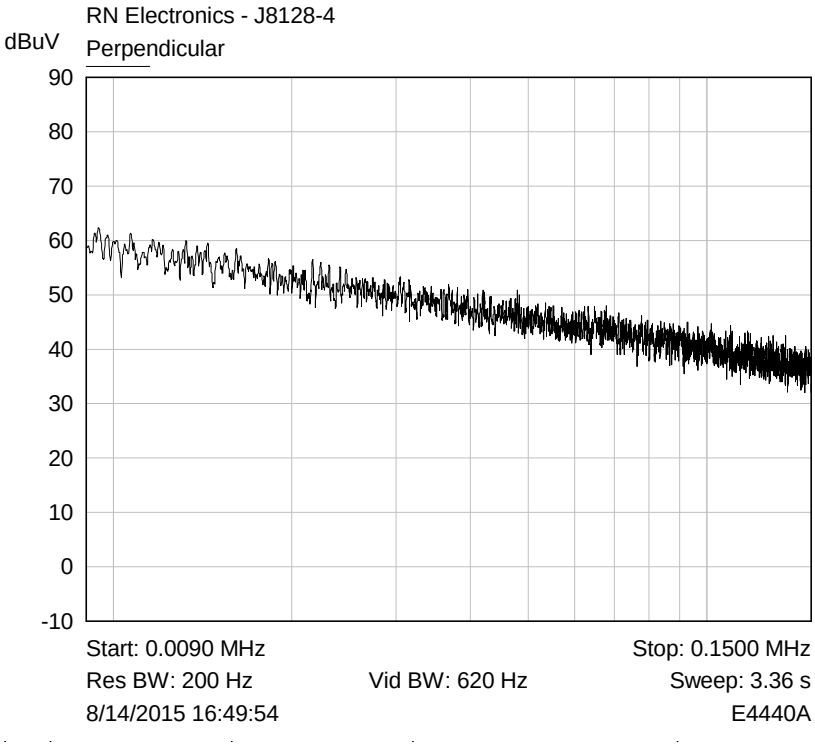
6 Plots/Graphical results

6.1 Radiated emissions 9 kHz - 150 kHz

RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 907 MHz

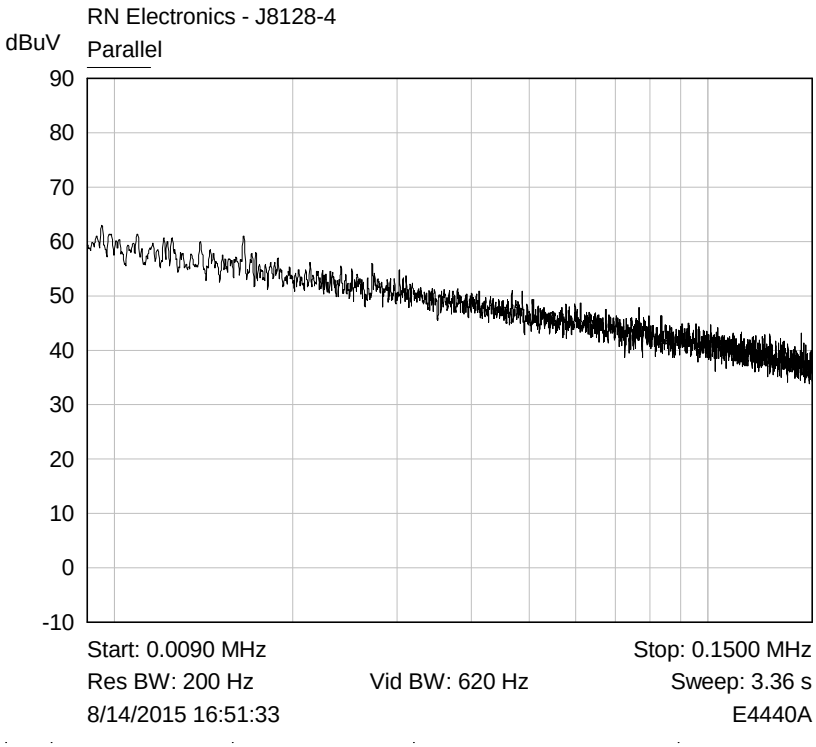


Plot of 9-150kHz Parallel

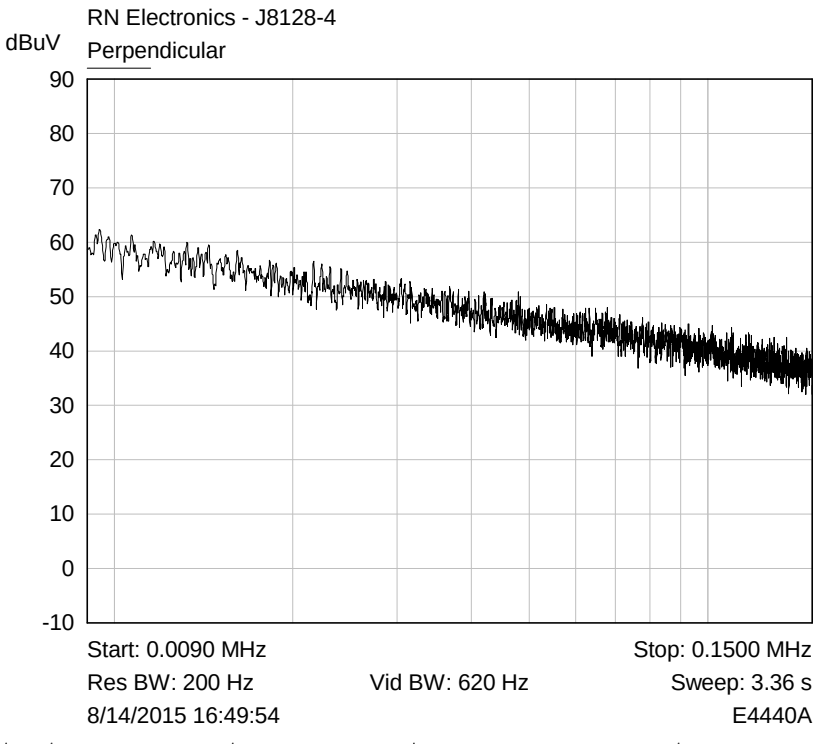


Plot of 9-150kHz Perpendicular

RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 908.96 MHz



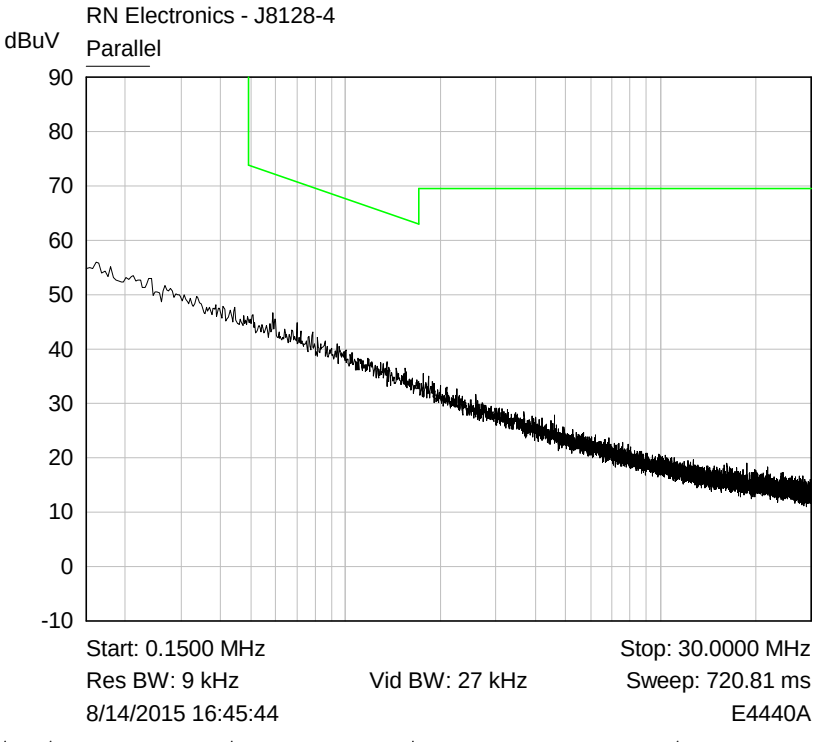
Plot of 9-150kHz Parallel



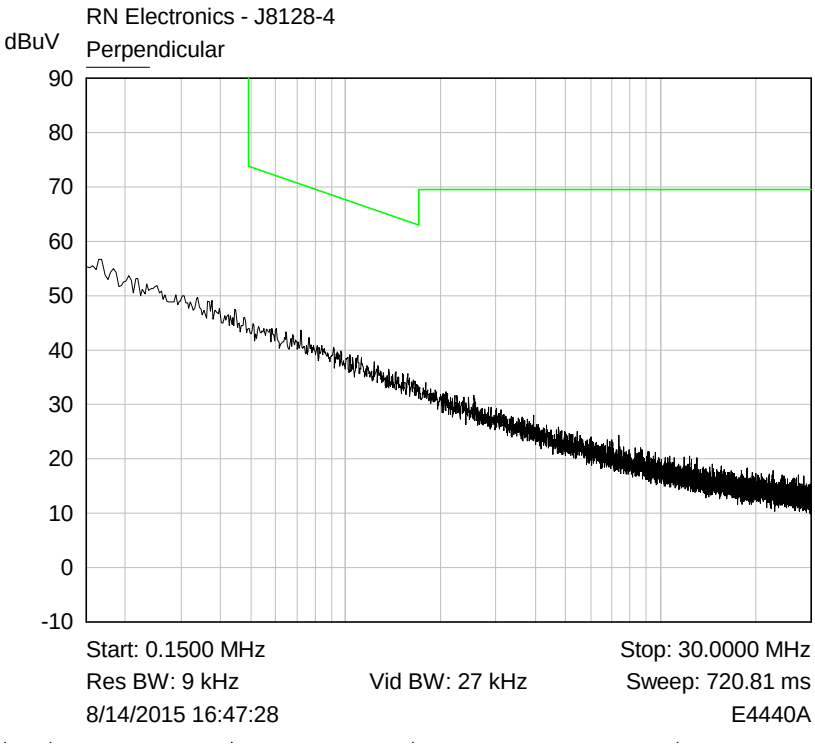
Plot of 9-150kHz Perpendicular

6.2 Radiated emissions 150 kHz - 30 MHz

RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 907 MHz

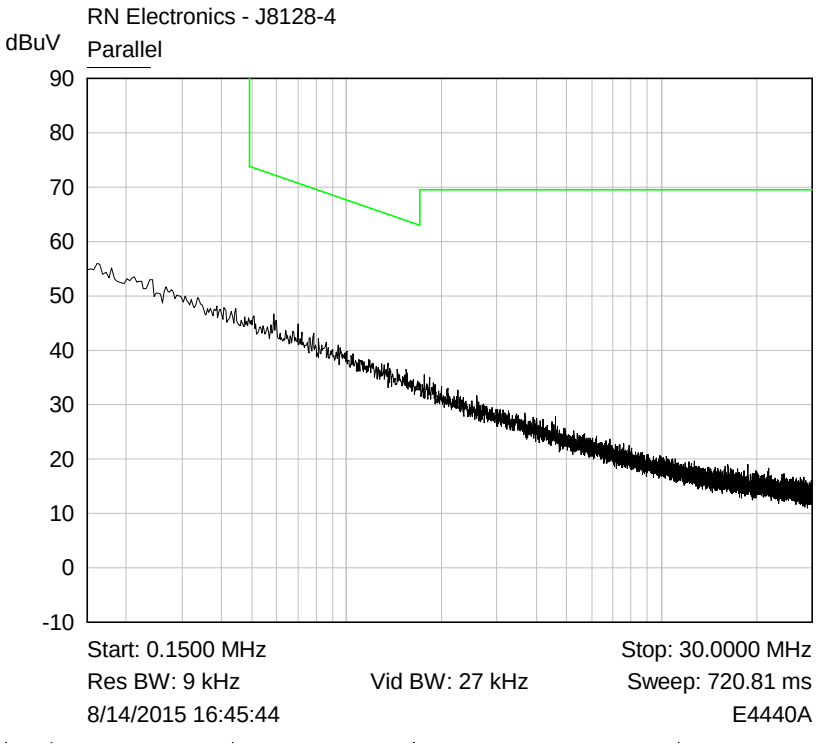


Plot of 150k-30MHz Parallel

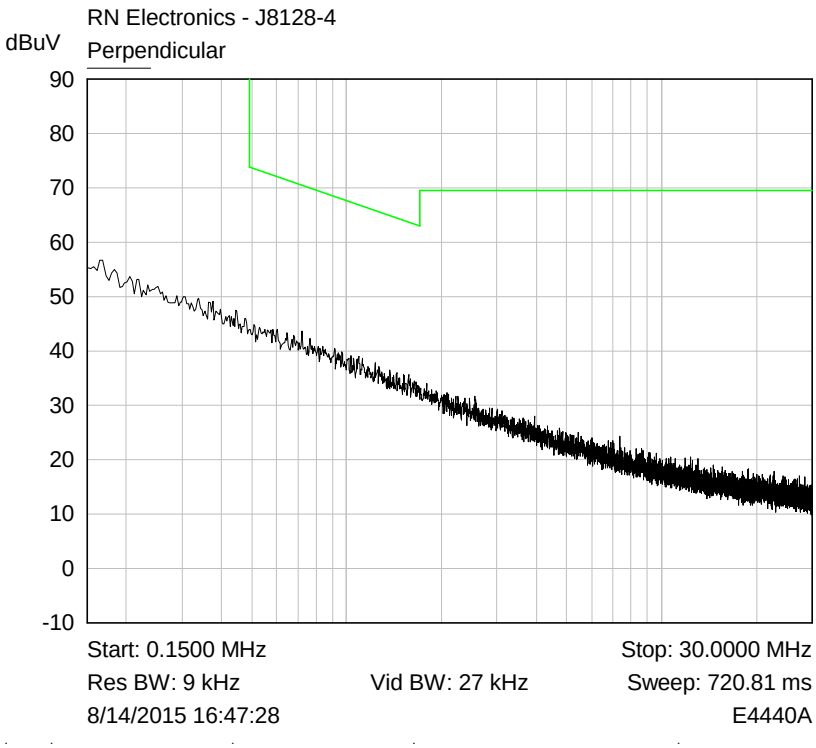


Plot of 150k-30MHz Perpendicular

RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 908.96 MHz



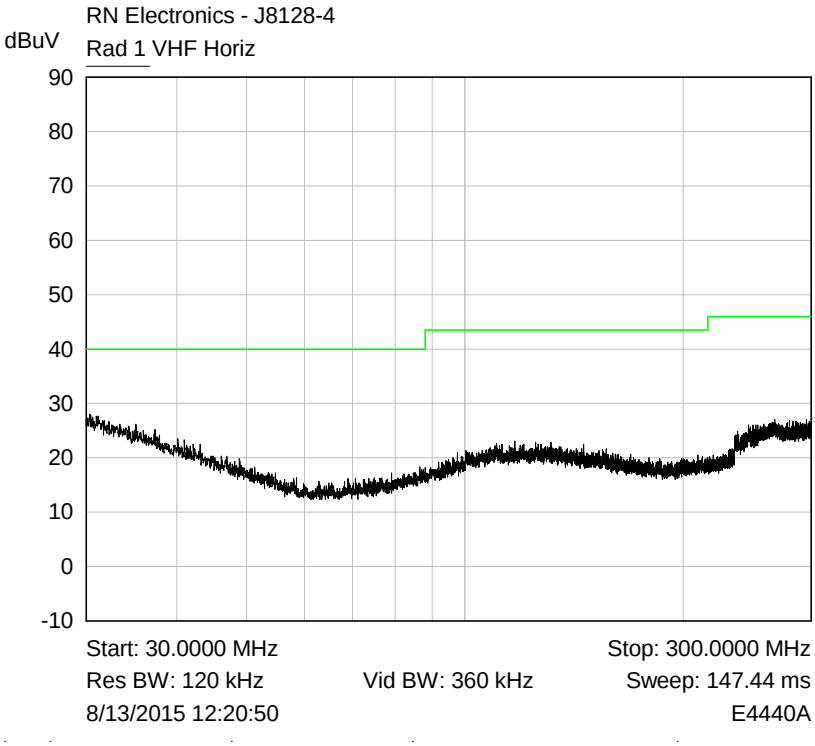
Plot of 150k-30MHz Parallel



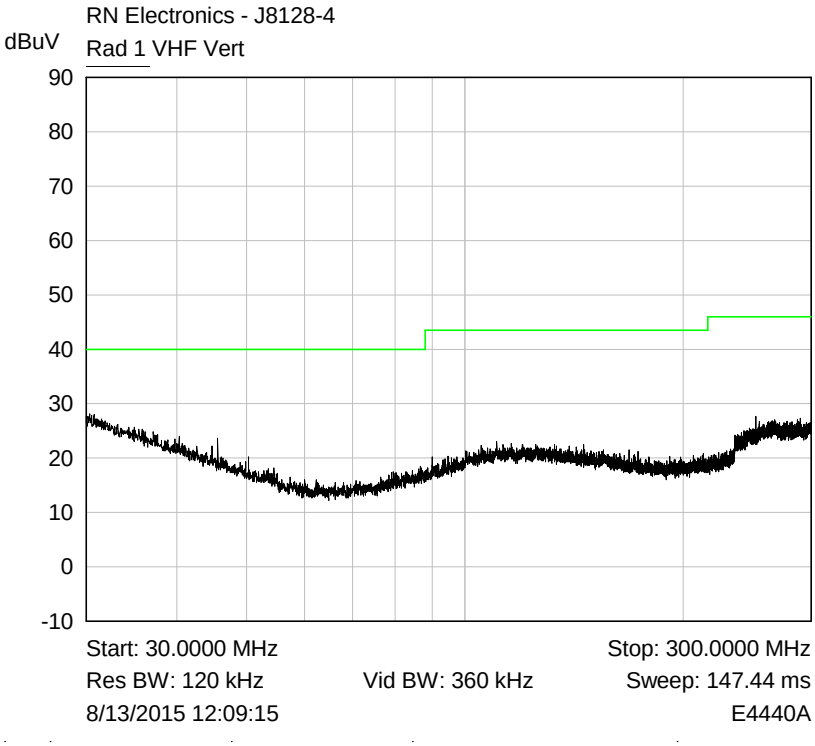
Plot of 150k-30MHz Perpendicular

6.3 Radiated emissions 30 MHz -1 GHz

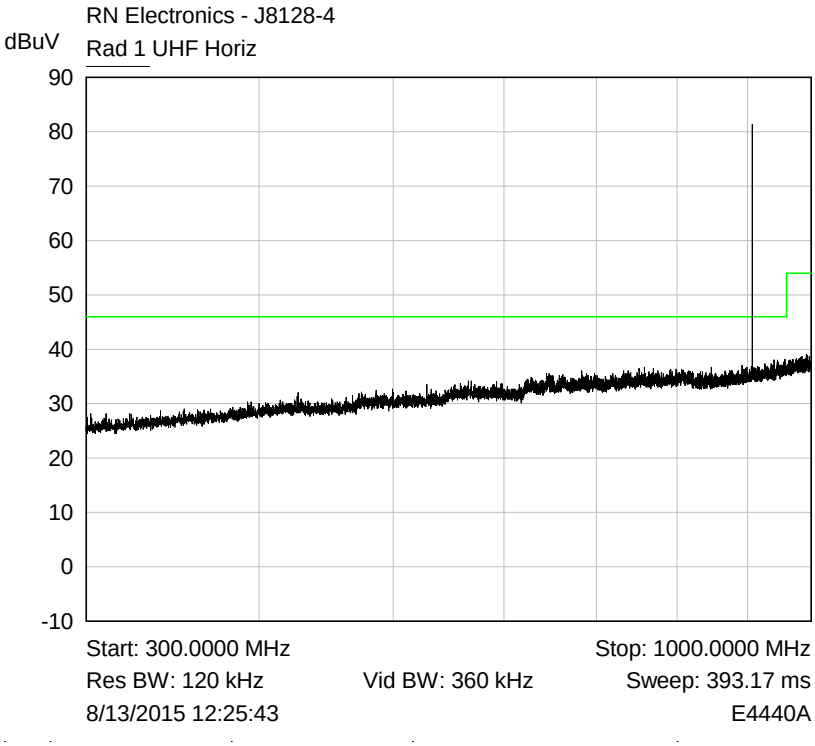
RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 907 MHz



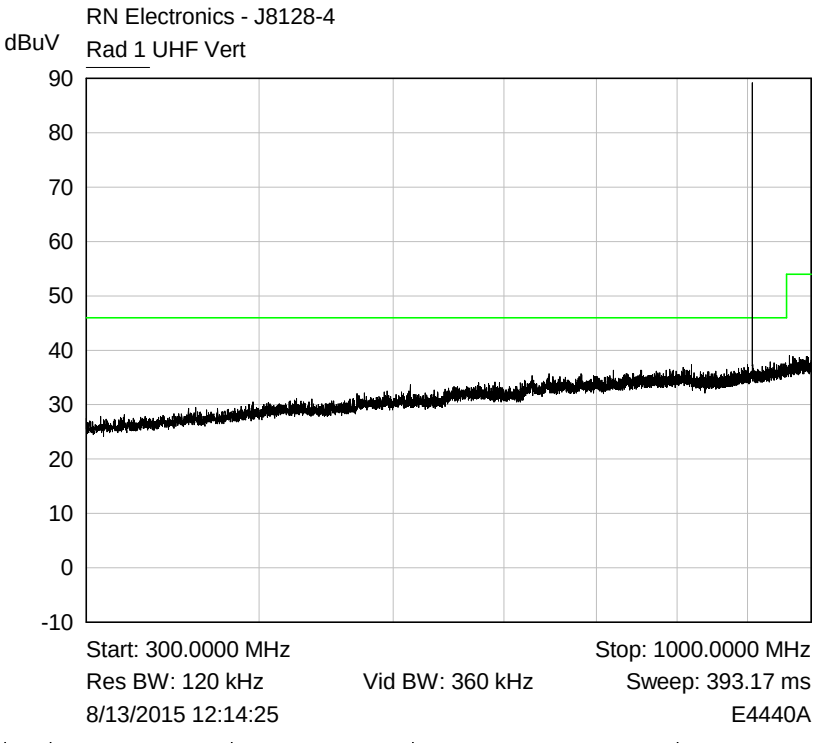
Plot of Peak emissions for VHF Horizontal against the QP limit line.



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

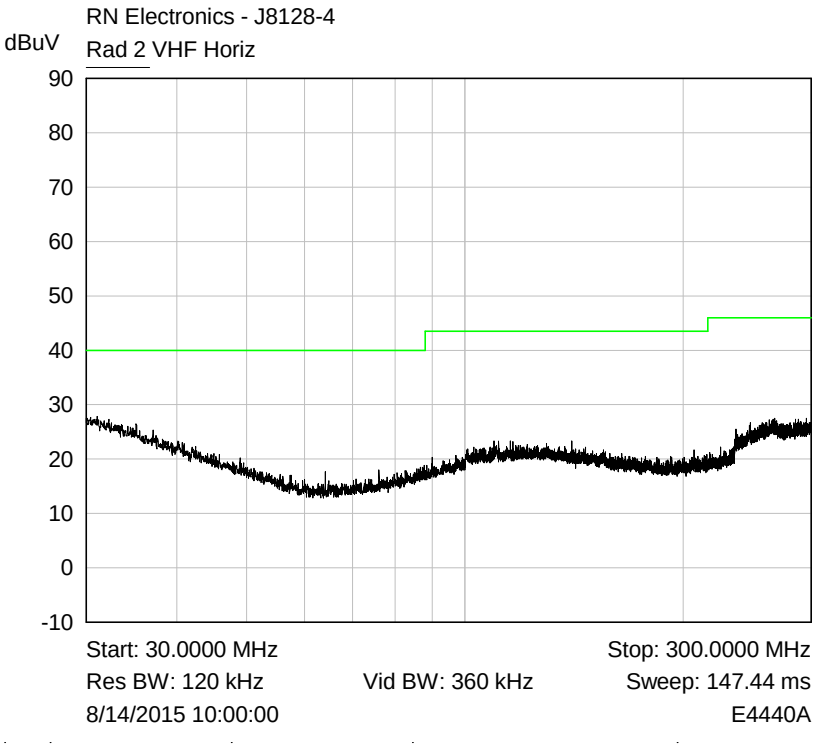


Plot of Peak emissions for VHF Vertical against the QP limit line.
Note: signal shown above the limits is the fundamental TX signal.

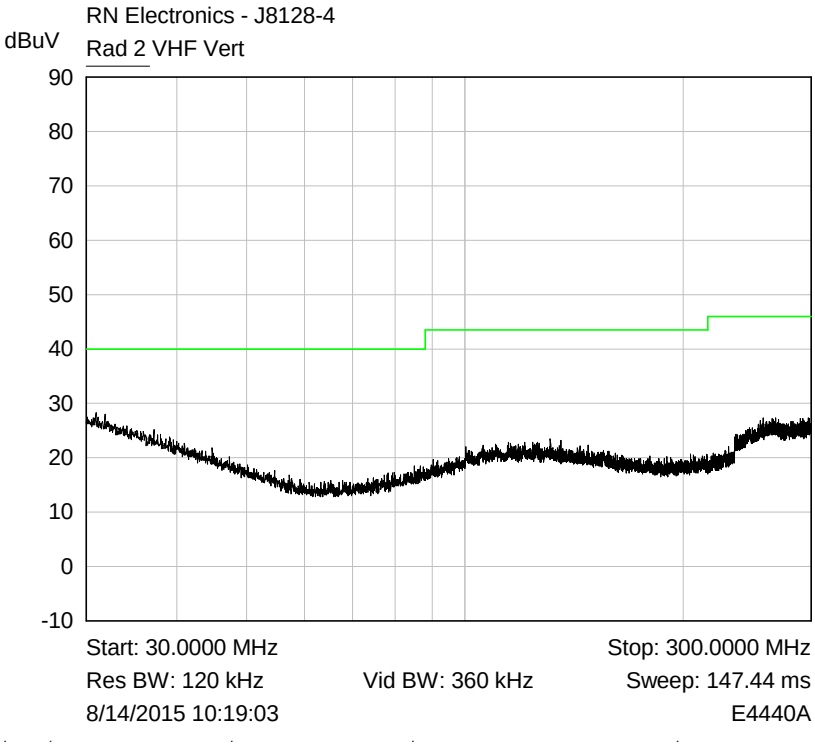


Plot of Peak emissions for UHF Vertical against the QP limit line.
Note: signal shown above the limits is the fundamental TX signal.

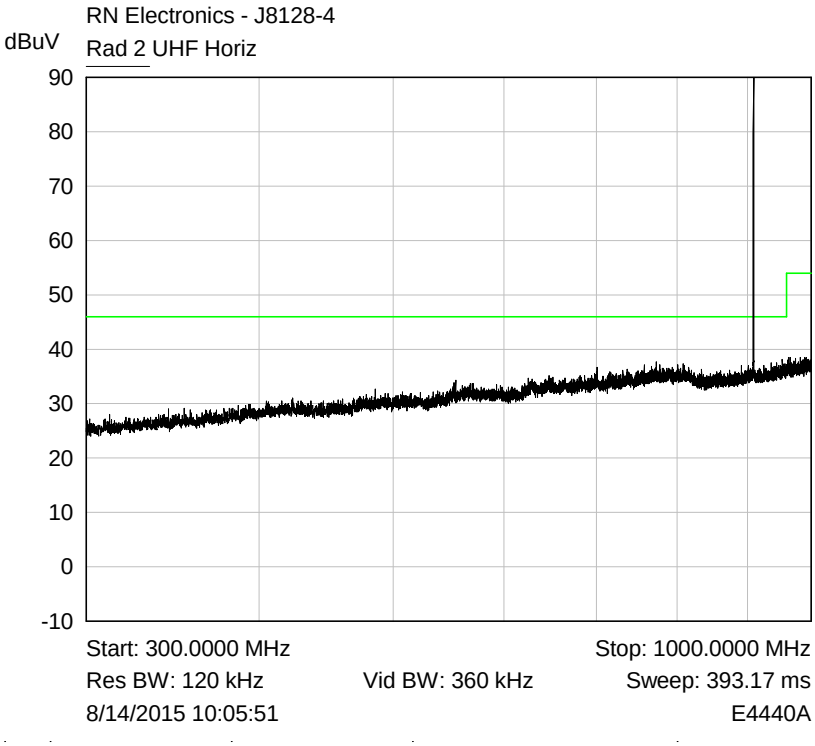
RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 908.96 MHz



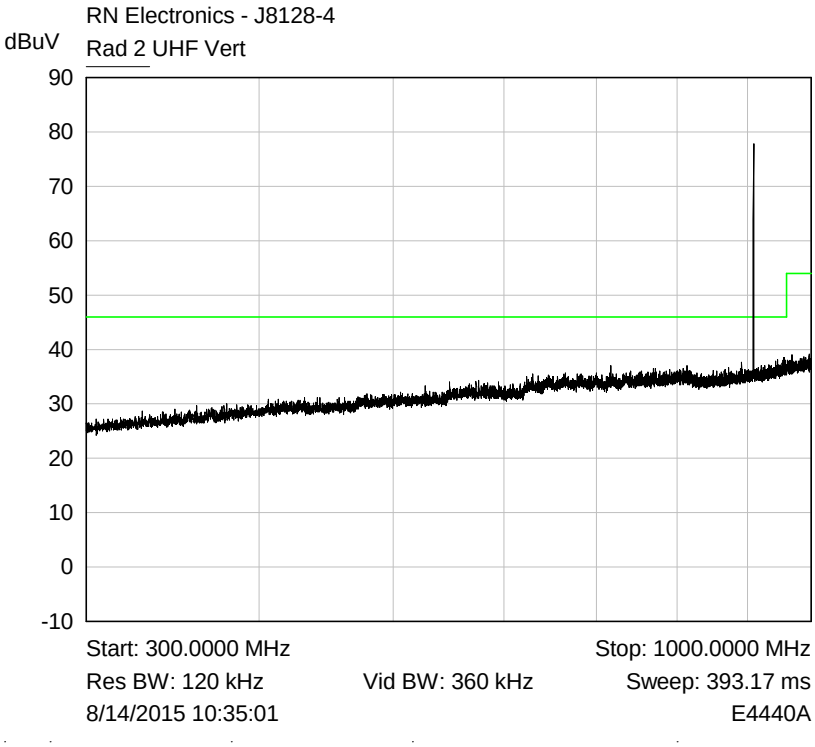
Plot of Peak emissions for VHF Horizontal against the QP limit line.



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



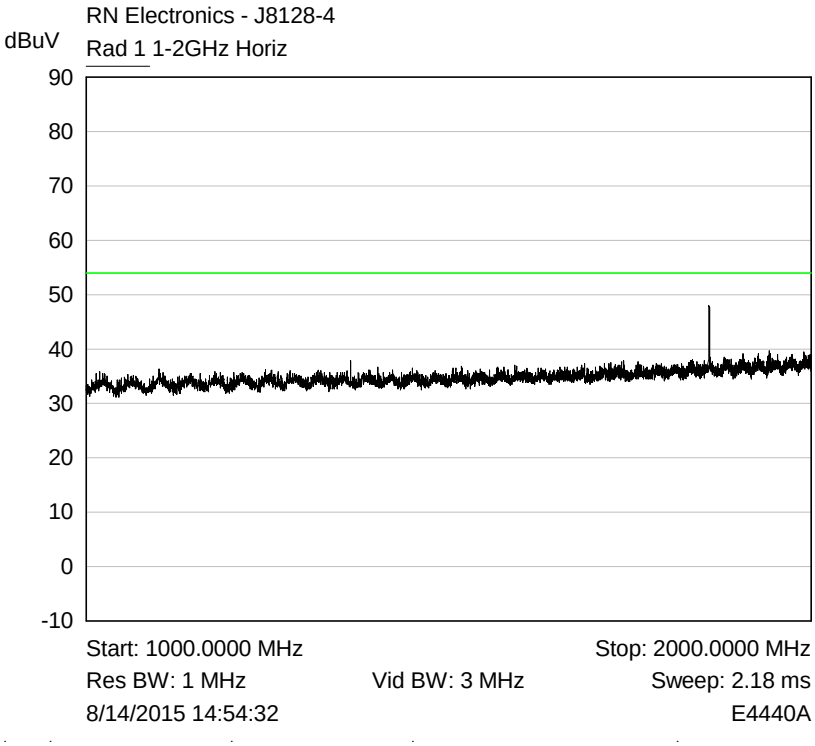
Plot of Peak emissions for VHF Vertical against the QP limit line.
Note: signal shown above the limits is the fundamental TX signal.

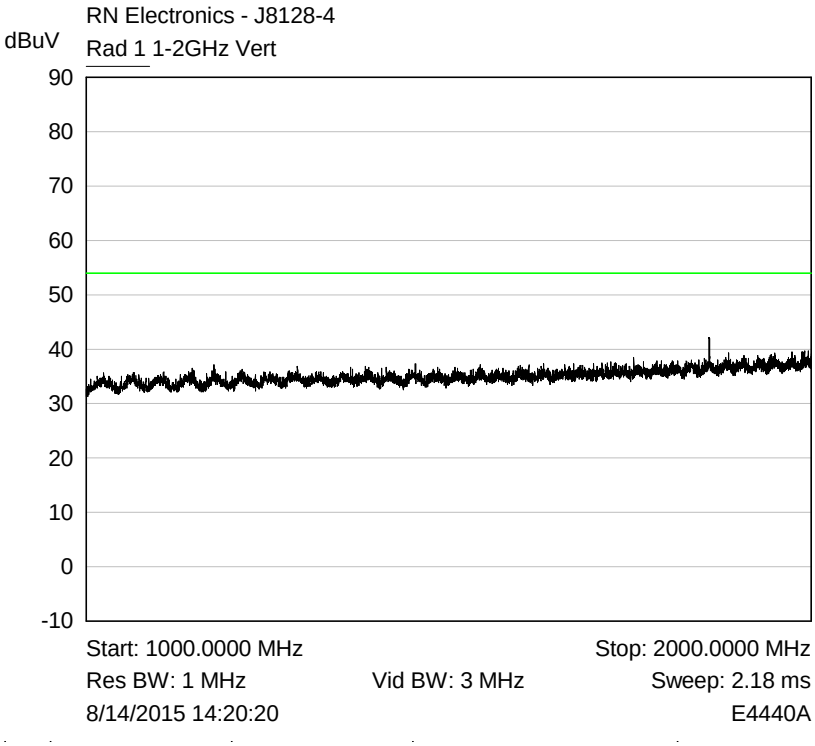


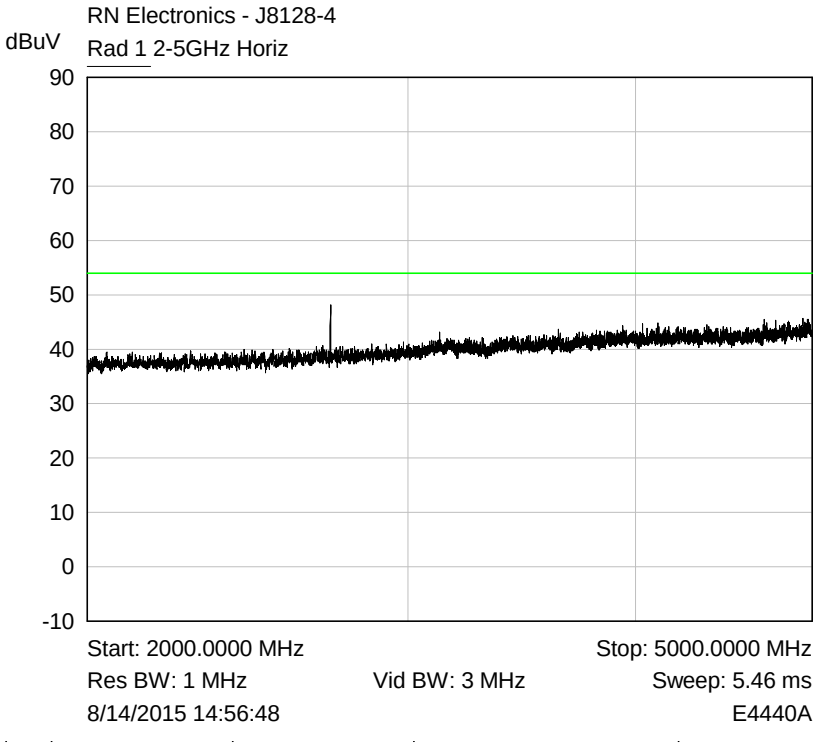
Plot of Peak emissions for UHF Vertical against the QP limit line.
Note: signal shown above the limits is the fundamental TX signal.

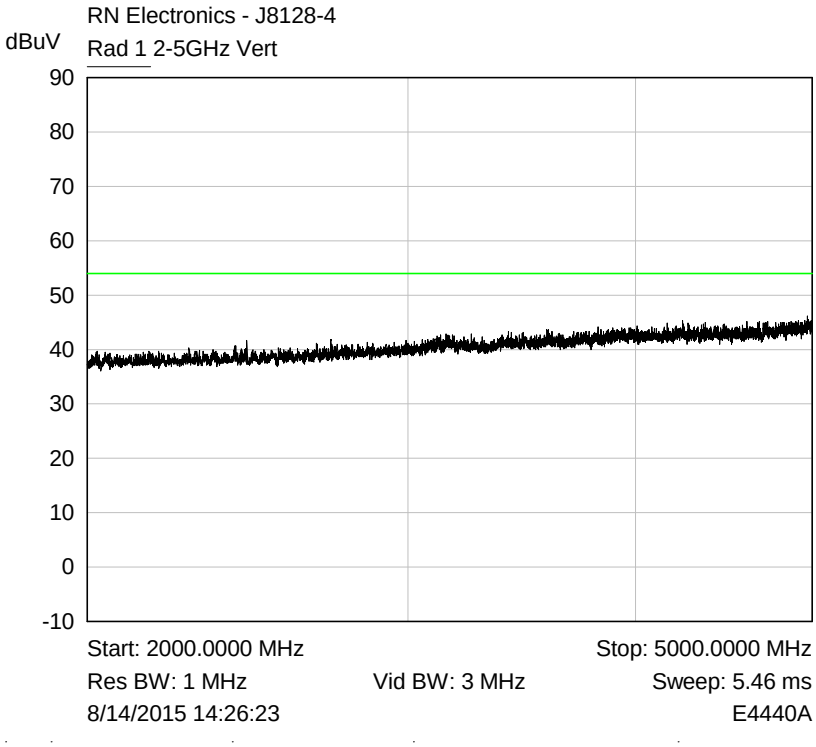
6.4 Radiated emissions above 1 GHz

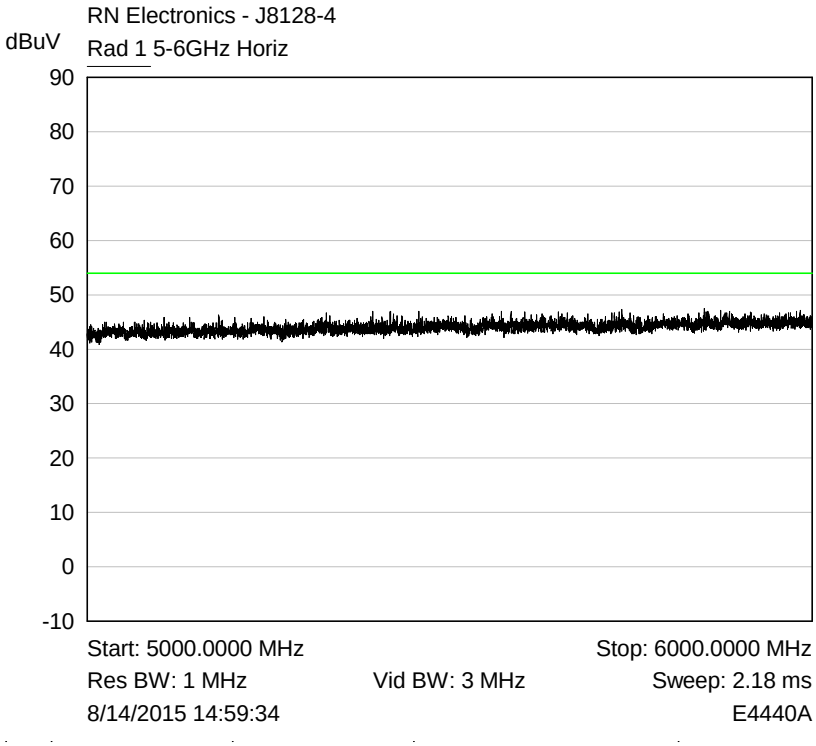
RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 907 MHz

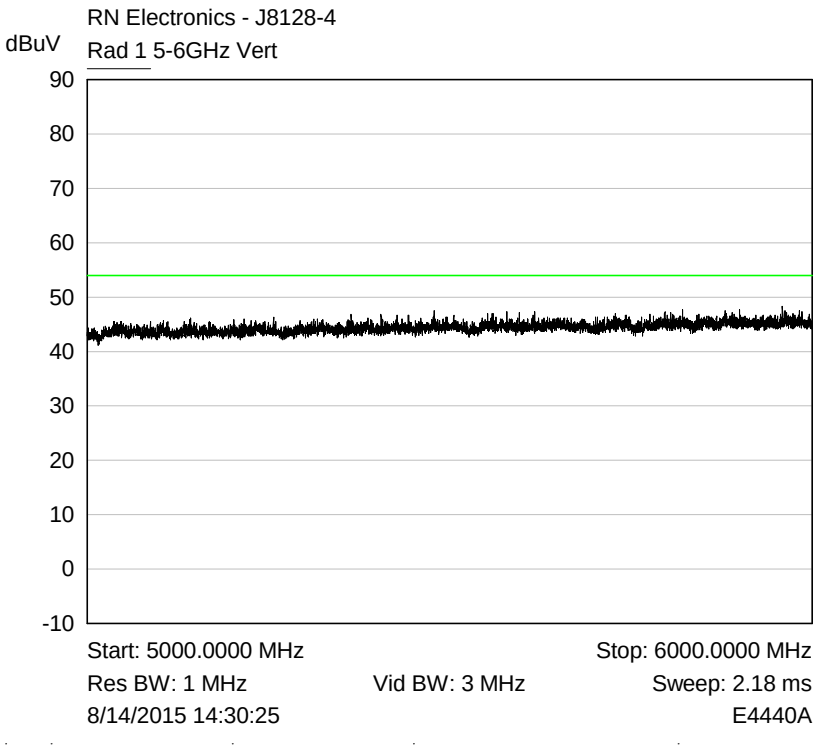


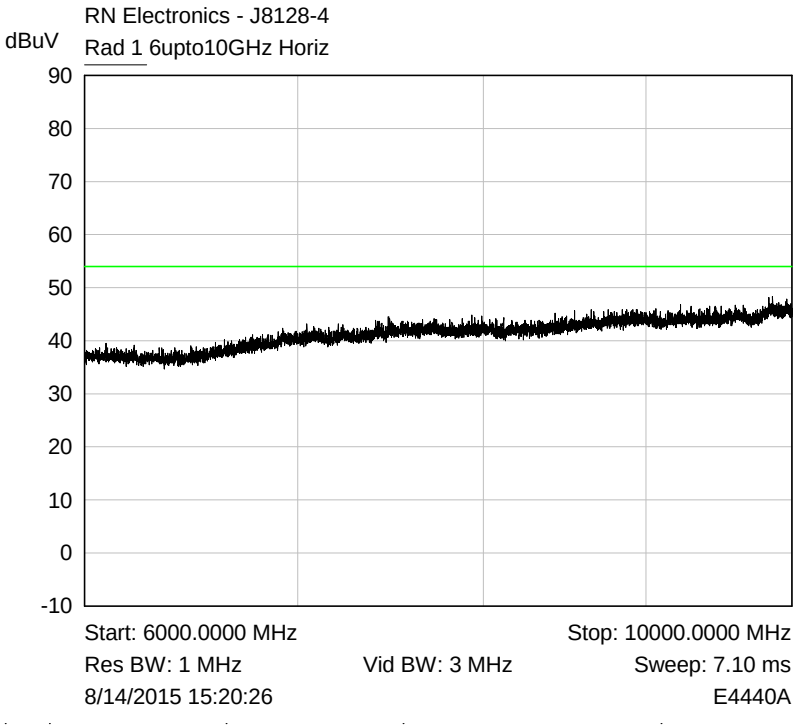


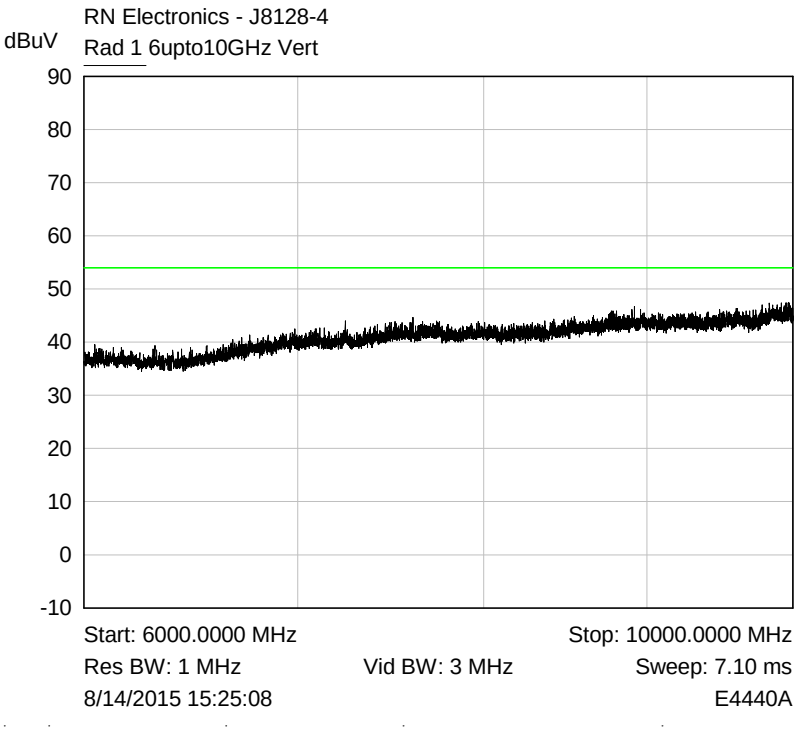




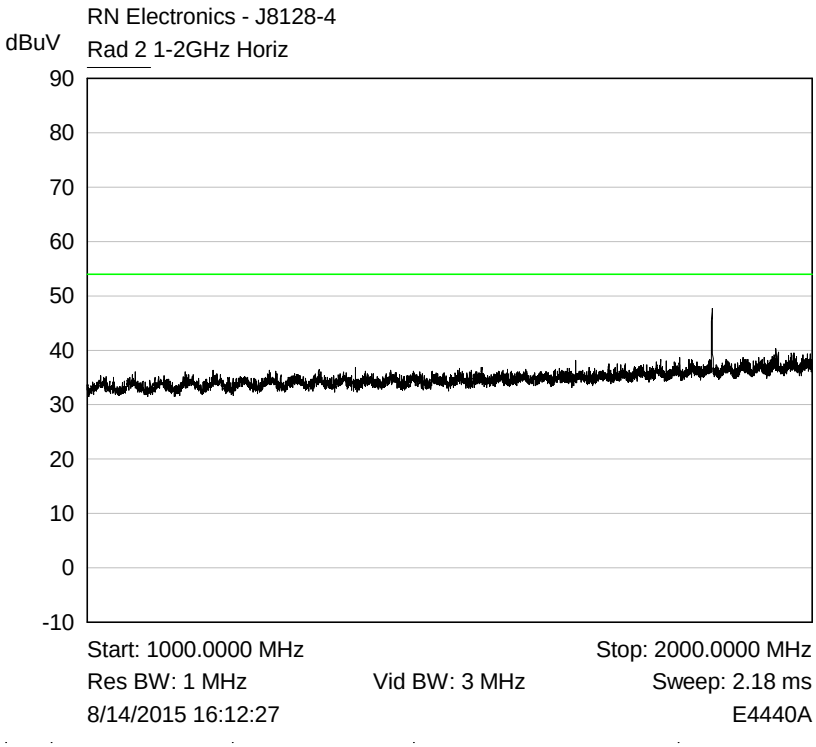


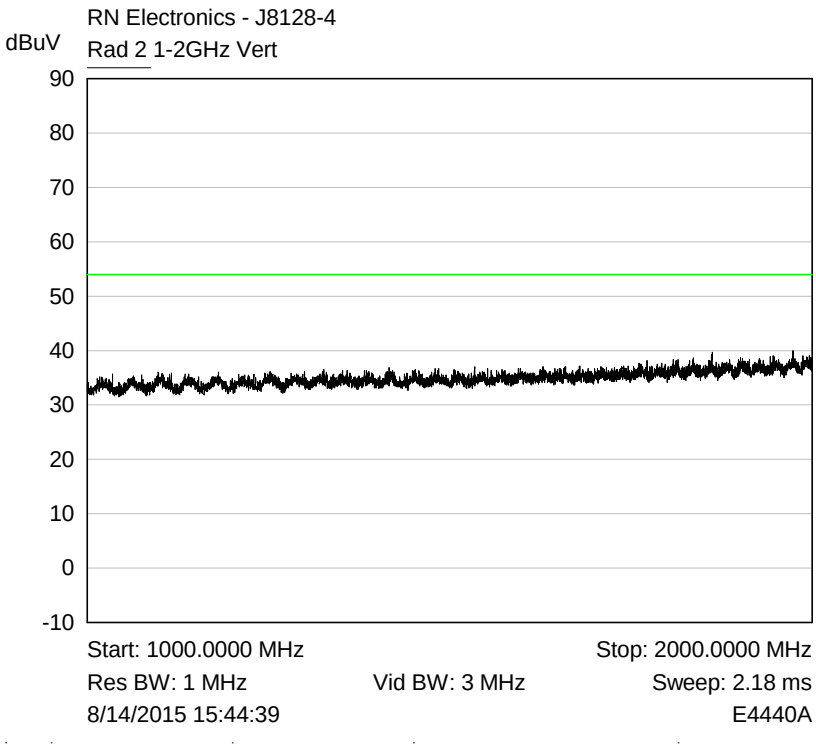


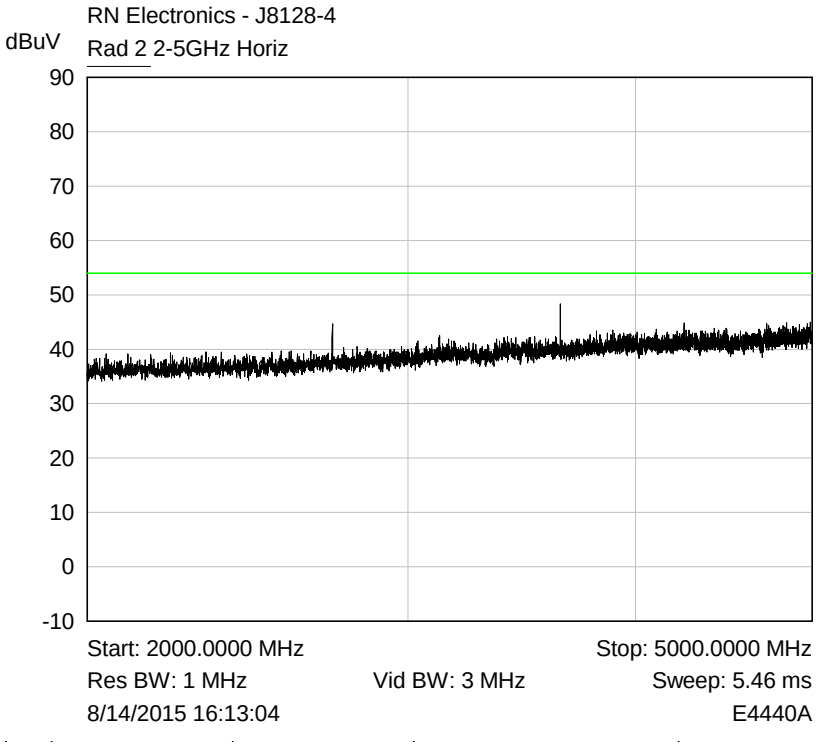


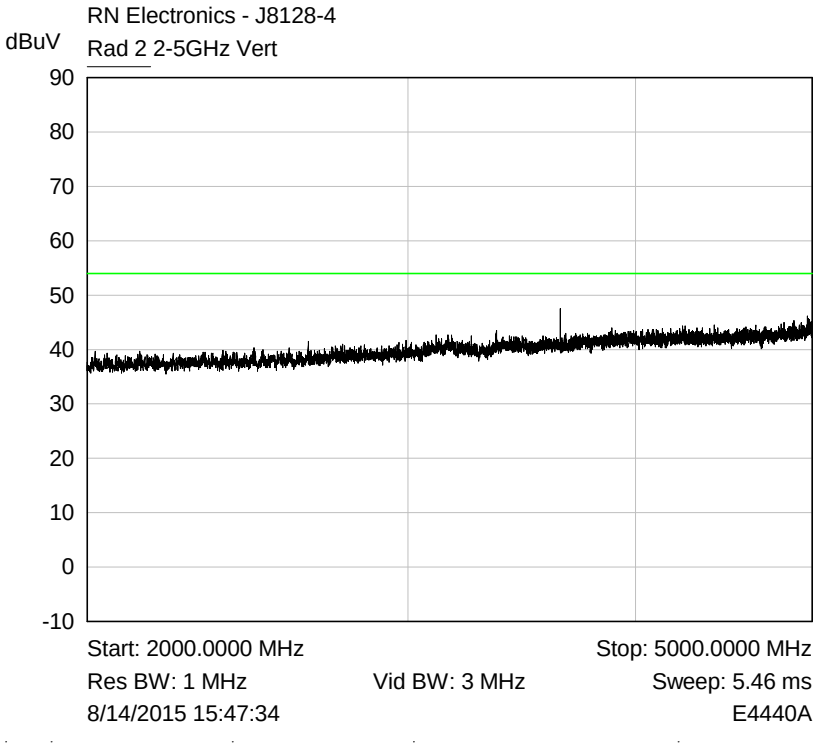


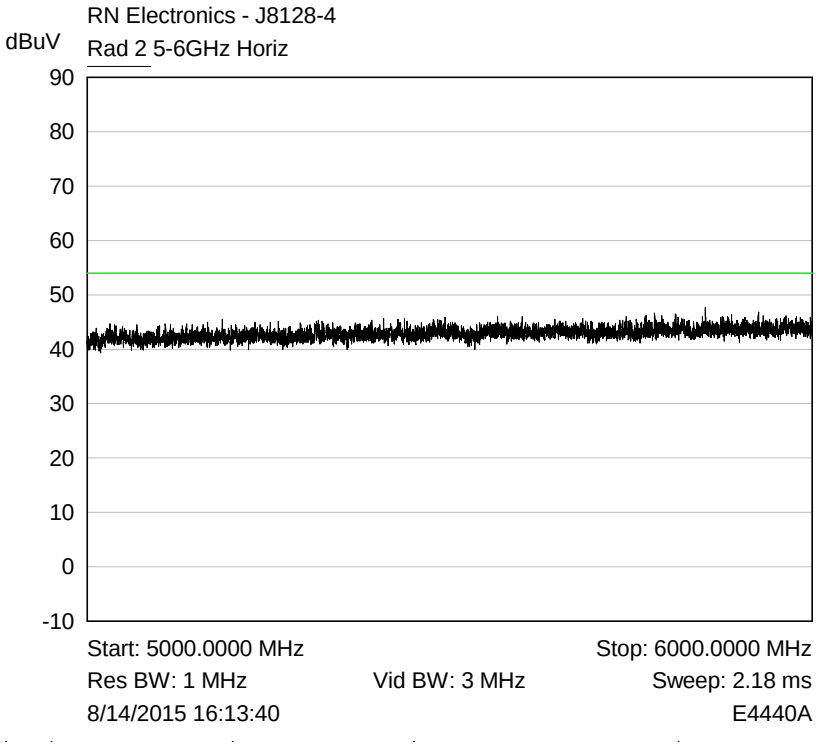
RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 908.96 MHz

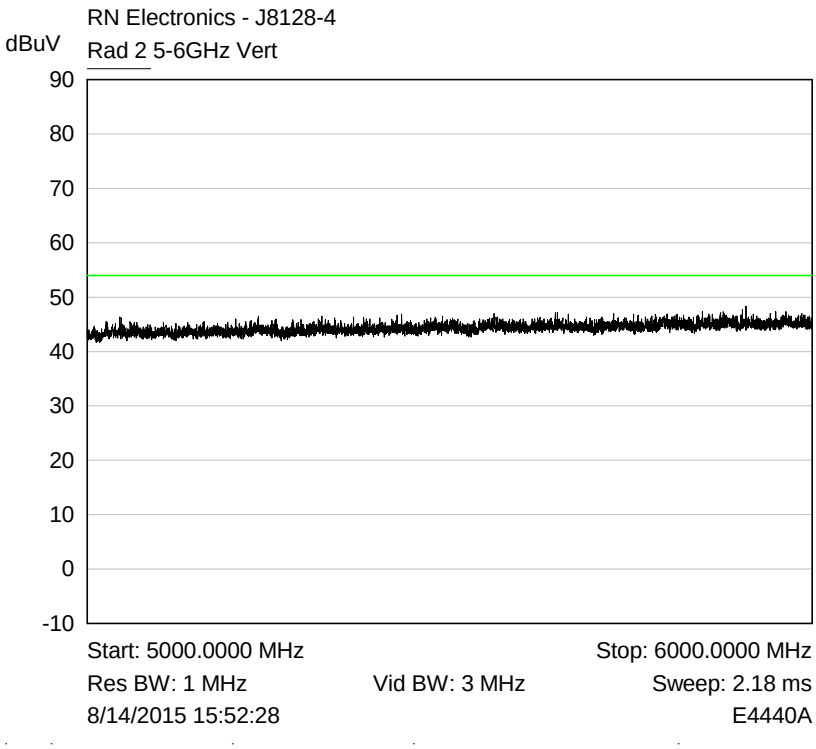


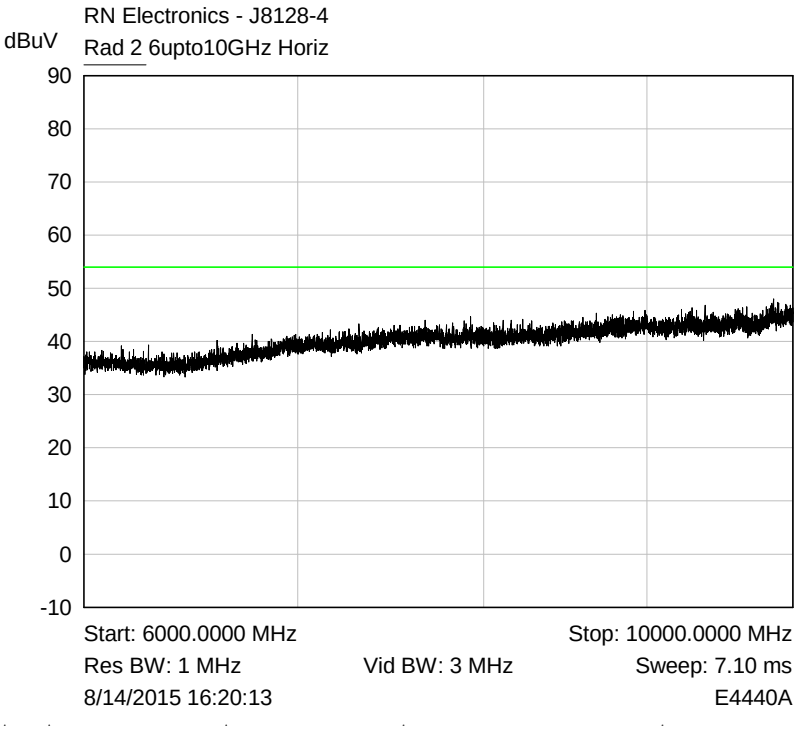


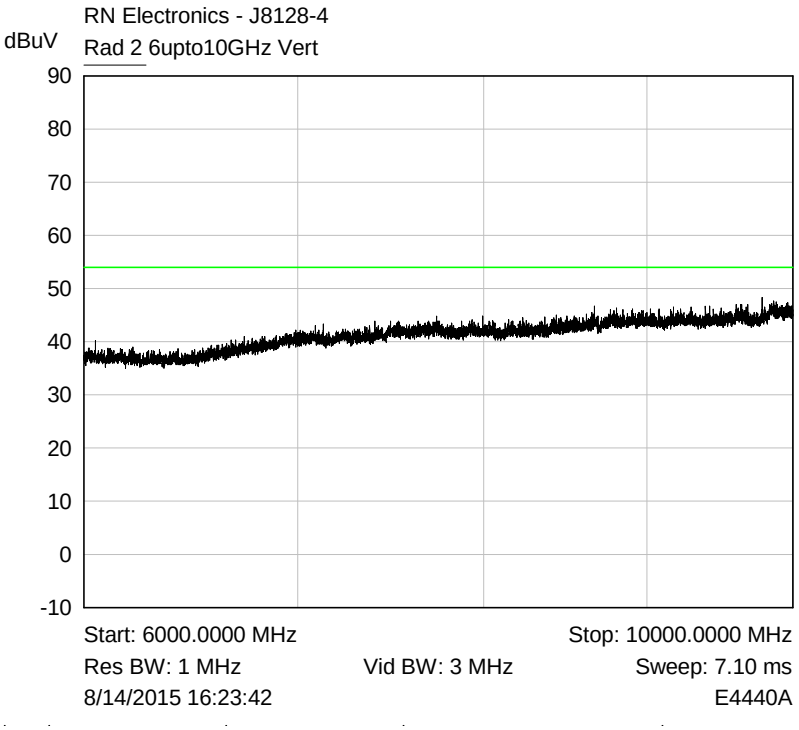






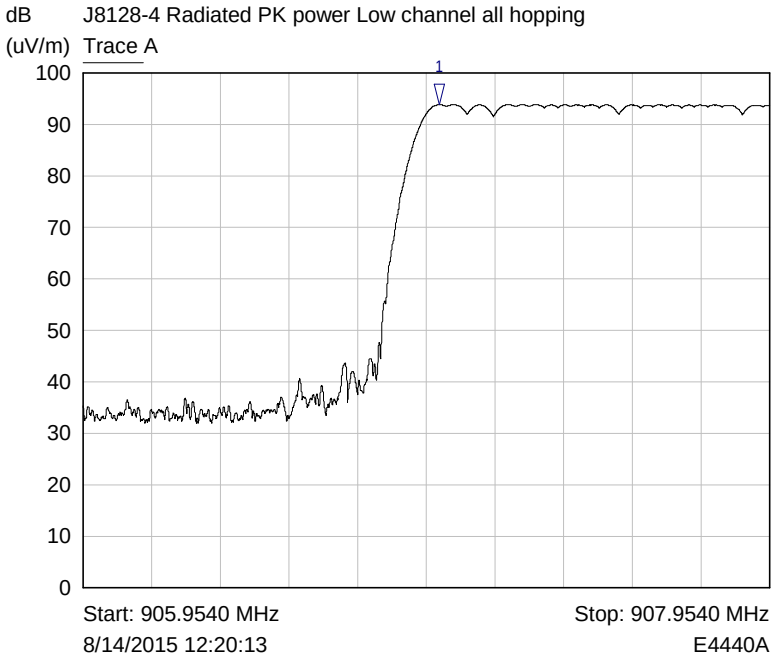






6.5 Effective radiated power field strength

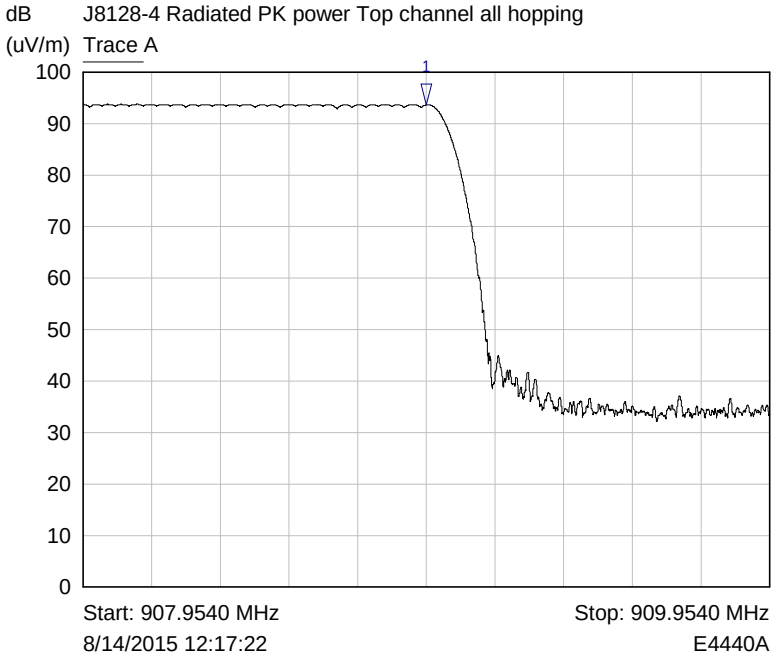
RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 907MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	906.9907 MHz	93.77 dB(uV/m)	

Plot of Horiz polarisation and Horiz EUT position

RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 908.96 MHz

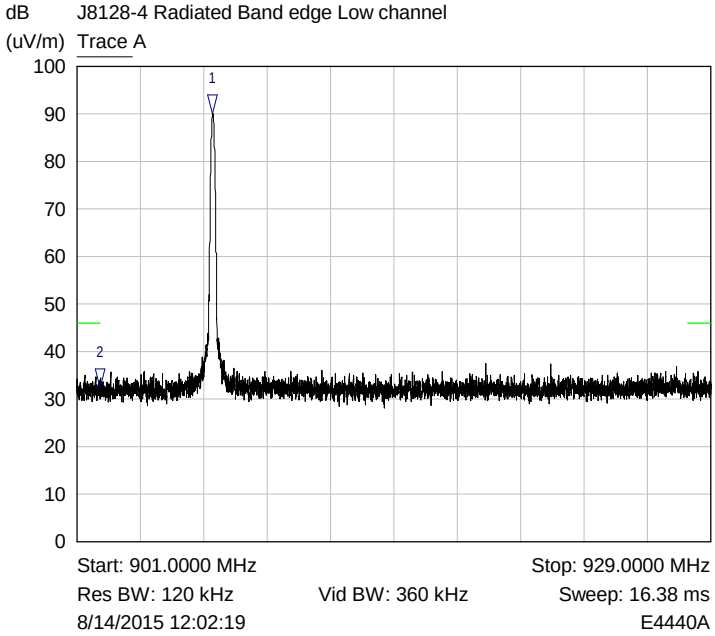


Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	908.9541 MHz	93.64 dB(uV/m)	

Plot of Horiz polarisation and Horiz EUT position

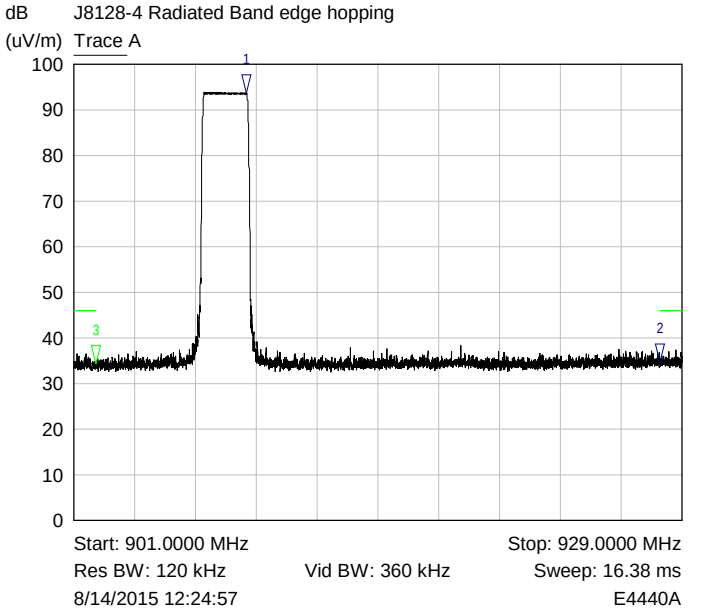
6.6 Band Edge Compliance

RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 907 MHz



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	906.9924 MHz	89.95 dB(uV/m)	
2 ▽	Trace A	902.0016 MHz	32.38 dB(uV/m)	

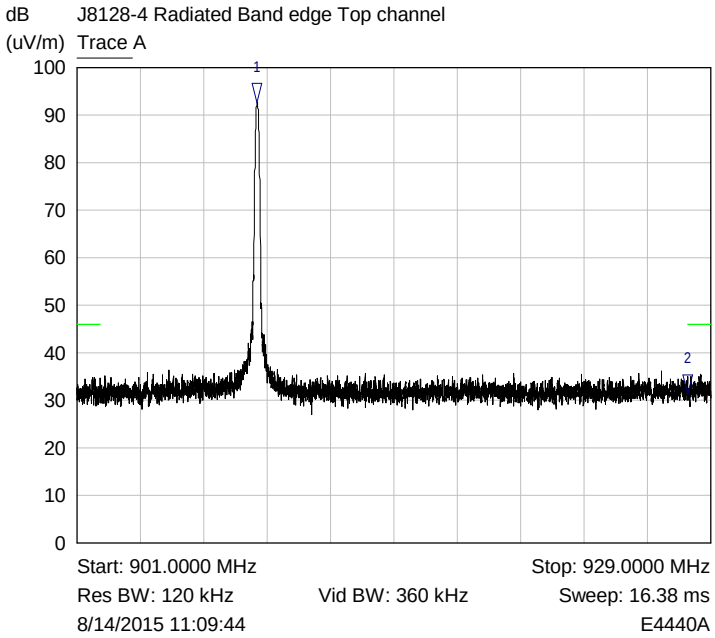
Band edge Peak Plot low channel non-hopping



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	908.9546 MHz	93.67 dB(uV/m)	
2 ▽	Trace A	928.0018 MHz	34.68 dB(uV/m)	
3 ▽	Trace A	902.0016 MHz	34.41 dB(uV/m)	

Band Edge Plot – Hopping all channels

RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 908.96 MHz

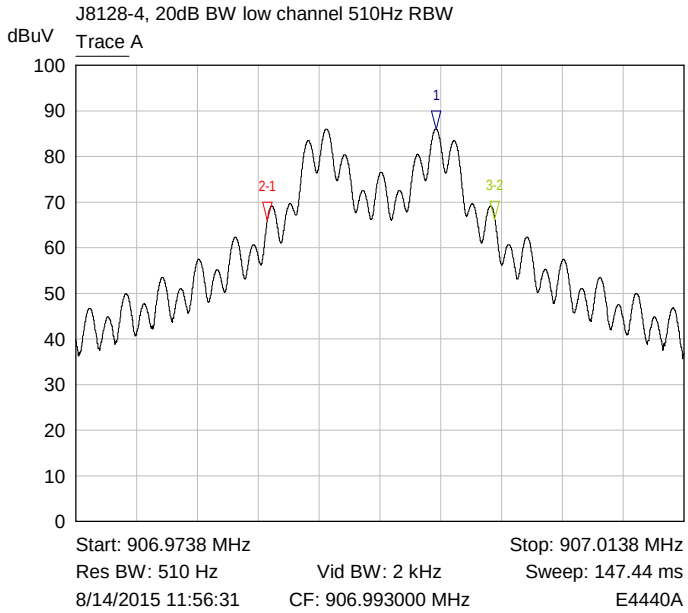


Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	908.9546 MHz	92.74 dB(uV/m)	
2 ▽	Trace A	928.0018 MHz	31.36 dB(uV/m)	

Band edge Peak Plot High channel non-hopping

6.7 Occupied bandwidth

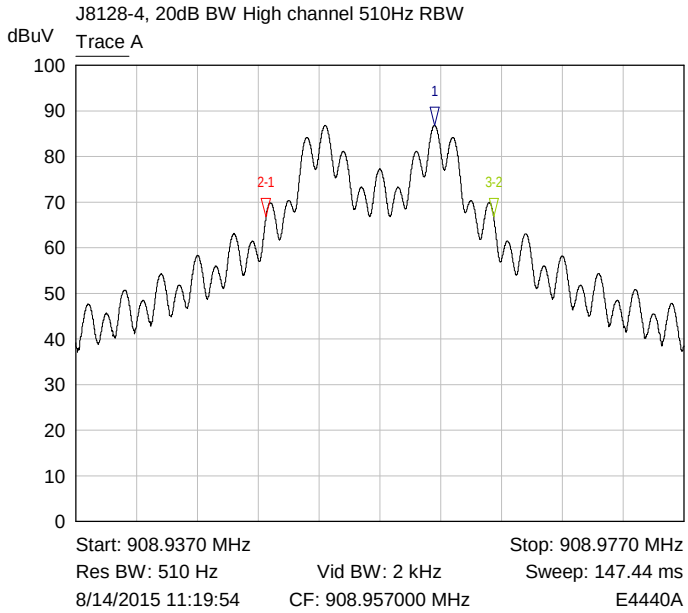
RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 907 MHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	906.9975 MHz	86.08 dBuV	
2-1	Trace A	-0.0111 MHz	-20.01 dB	
3-2	Trace A	0.0150 MHz	0.05 dB	

Plot of 20dB BW

RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 908.96 MHz

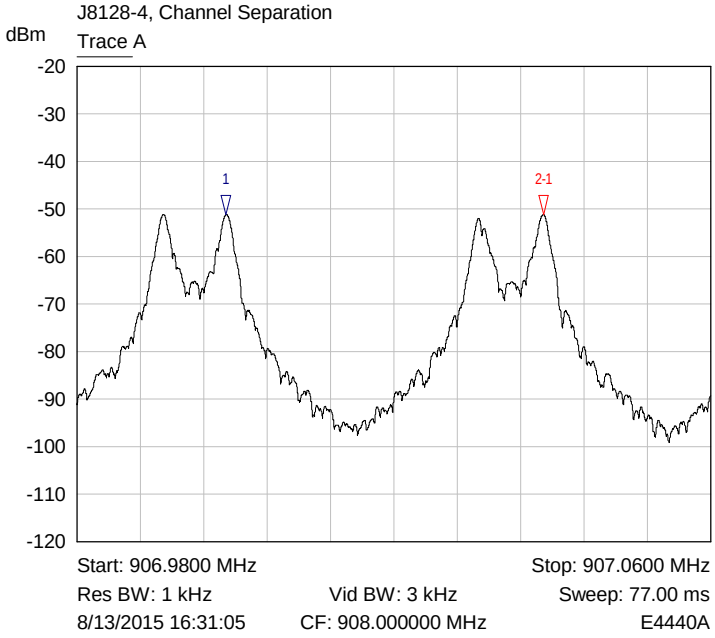


Mkr	Trace	X-Axis	Value	Notes
1	Trace A	908.9606 MHz	86.79 dBuV	
2-1	Trace A	-0.0111 MHz	-20.03 dB	
3-2	Trace A	0.0150 MHz	0.05 dB	

Plot of 20dB BW

6.8 FHSS carrier frequency separation

RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK

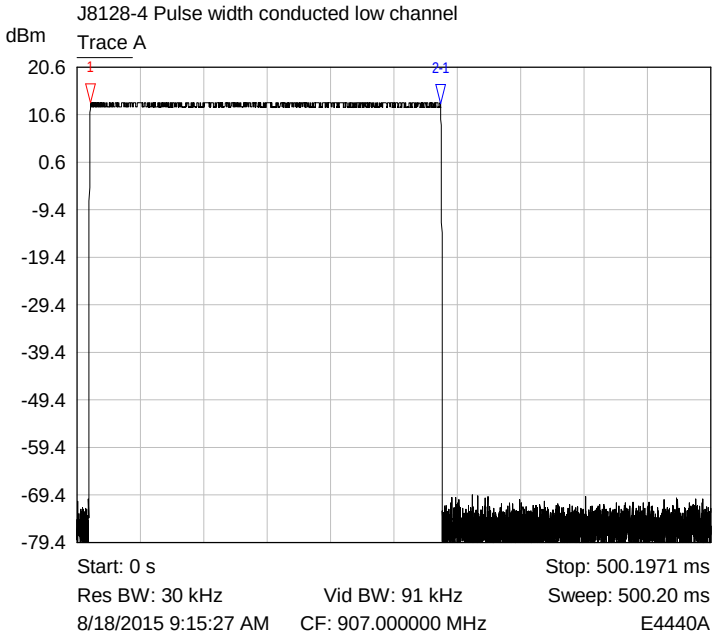


Mkr	Trace	X-Axis	Value	Notes
1	Trace A	906.9988 MHz	-51.16 dBm	
2-1	Trace A	0.0400 MHz	-0.01 dB	

Plot of separation, two adjacent channels

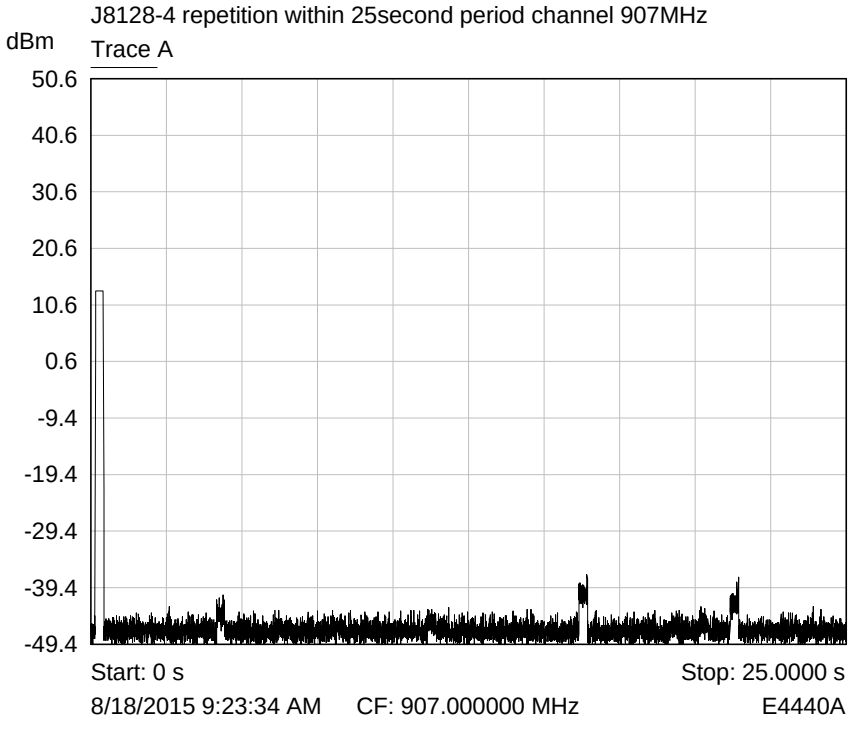
6.9 Average time of occupancy

RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 907 MHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	10.4424 ms	13.06 dBm	
2-1	Trace A	276.2656 ms	-0.17 dB	

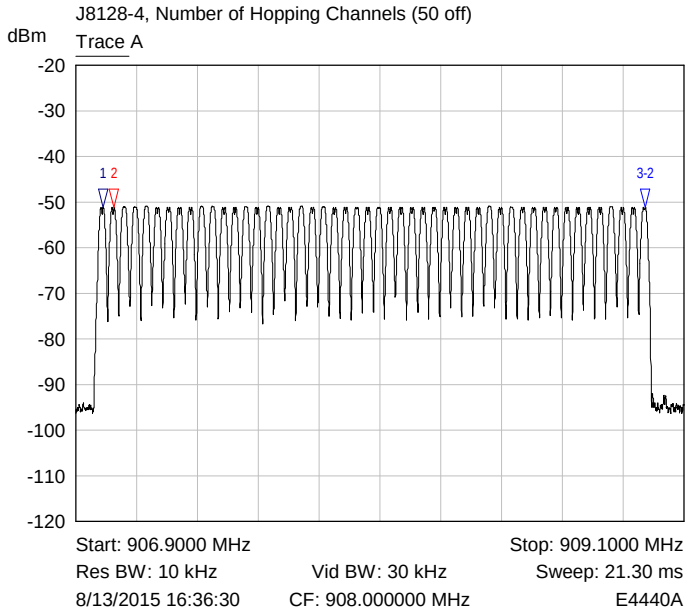
Measured Dwell time/pulse width (ms)



Period time (s)

6.10 Number of Hop Channels

RF Parameters: Band 902-928 MHz, Power declared max +14 dBm, Channel Spacing 40 kHz, Modulation FHSS FSK, Channel 907 MHz



Mkr	Trace	X-Axis	Value	Notes
1	Trace A	906.9991 MHz	-51.20 dBm	
2	Trace A	907.0389 MHz	-51.19 dBm	
3-2	Trace A	1.9220 MHz	0.02 dB	

Plot of Hopping Channels 1 to 50

7 Explanatory Notes

7.1 Explanation of Table of Signals Measured

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

Signal No.	Freq (MHz)	Peak Amp (dBuV)	Pk – Lim 1 (dB)	QP Amp (dBuV)	QP - Lim1 (dB)	Av Amp (dBuV)	Av - Lim1 (dB)
1	12345	54.9	-10.5	48	-12.6	37.6	-14.4

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

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

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

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

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

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

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

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

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

7.2 Explanation of limit line calculations for radiated measurements

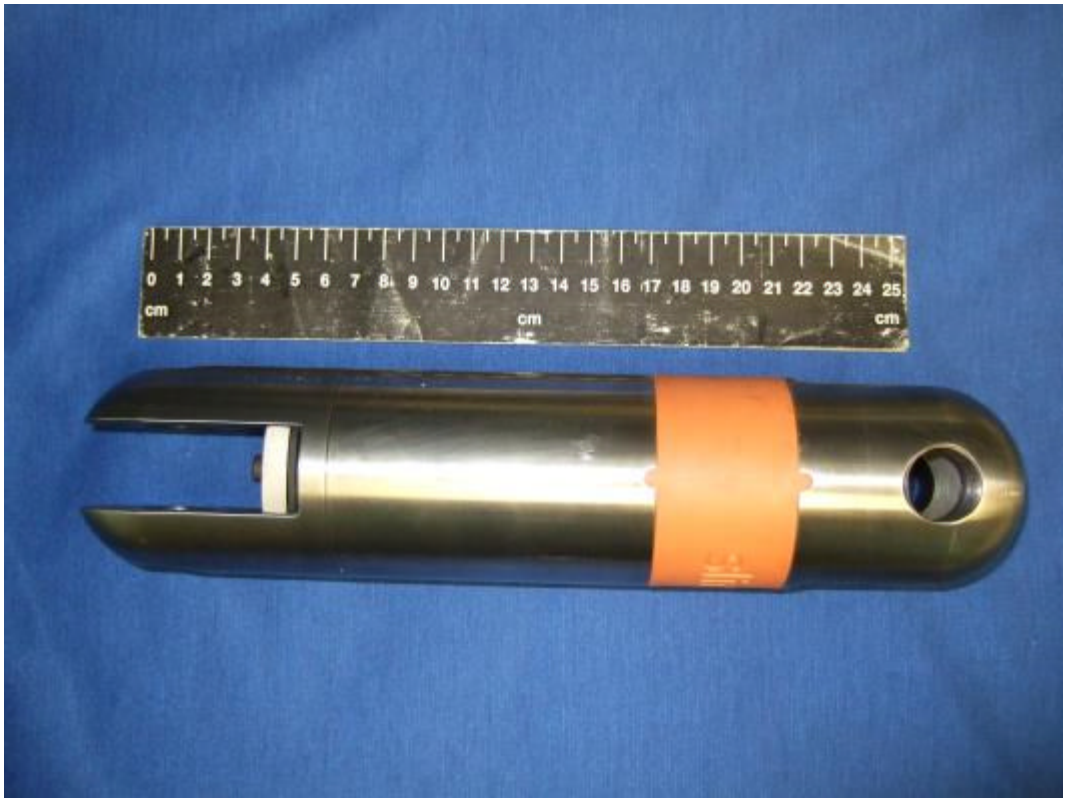
The limits given in the test standard are normally expressed as absolute values (e.g. in μV/m at a specified distance), whereas the measured values are expressed as peak, quasi peak or average values in dBμV/m referenced to the measuring instrument inputs. RN Electronics calibrate the test set-up to 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).

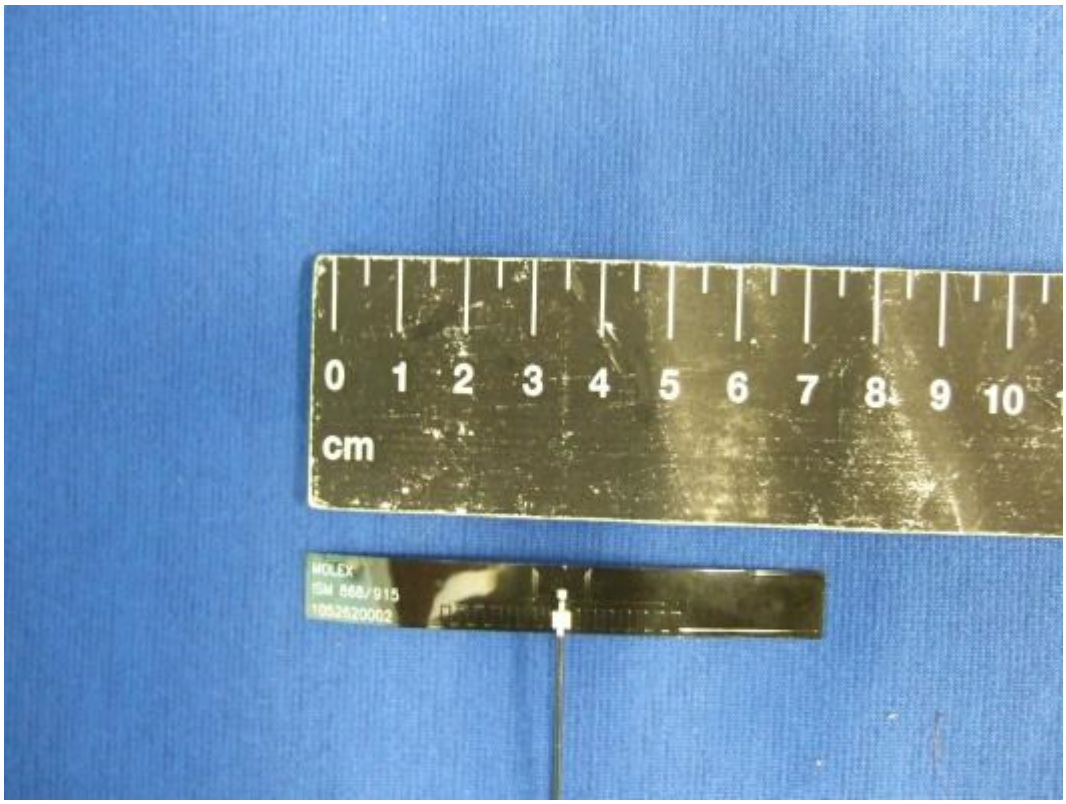
8 Photographs

8.1 EUT Front View

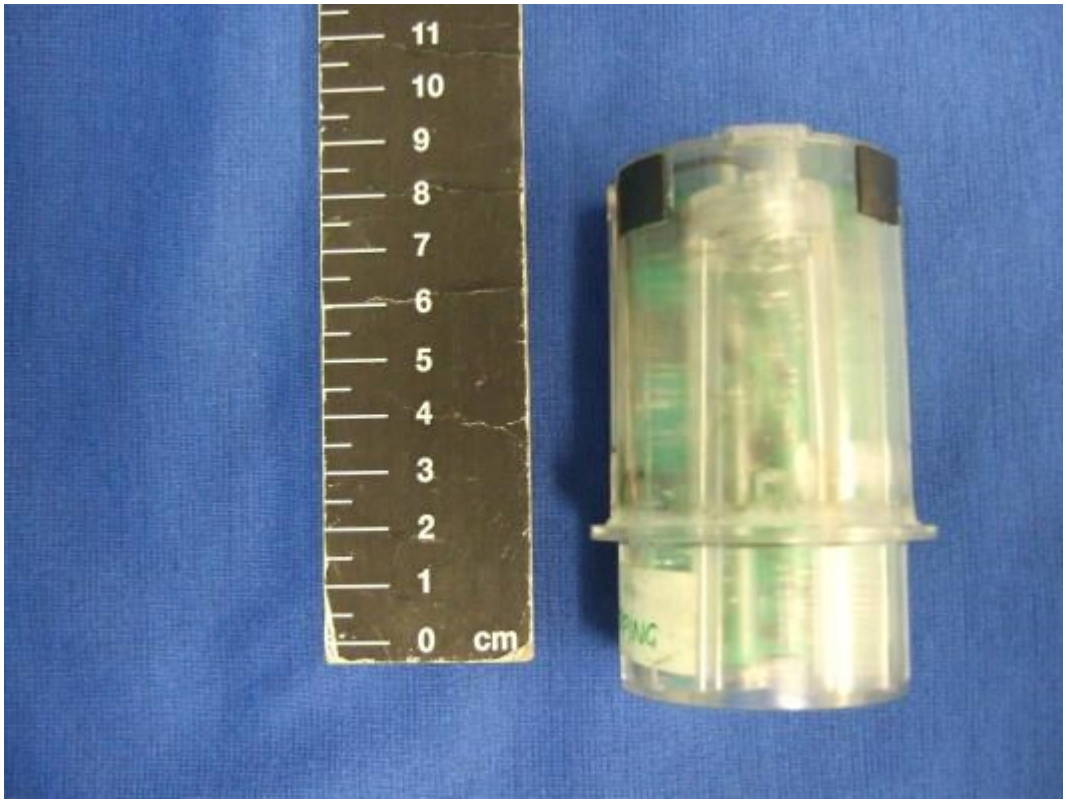


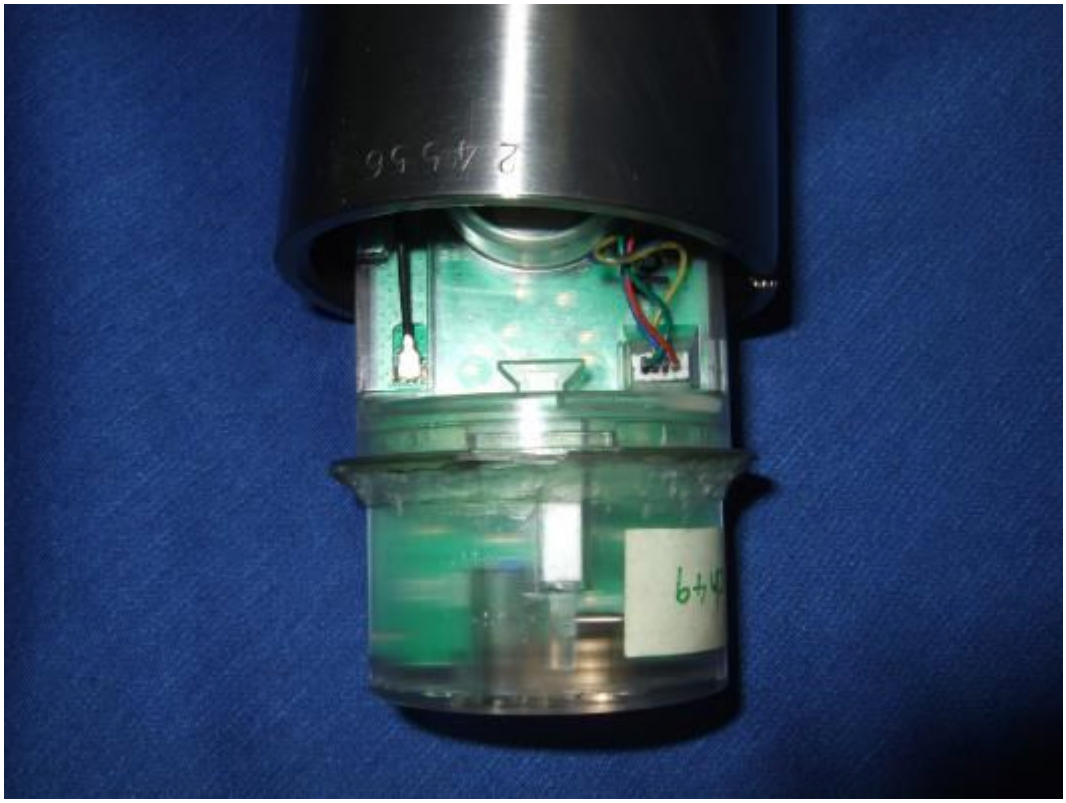
8.2 EUT Reverse Angle

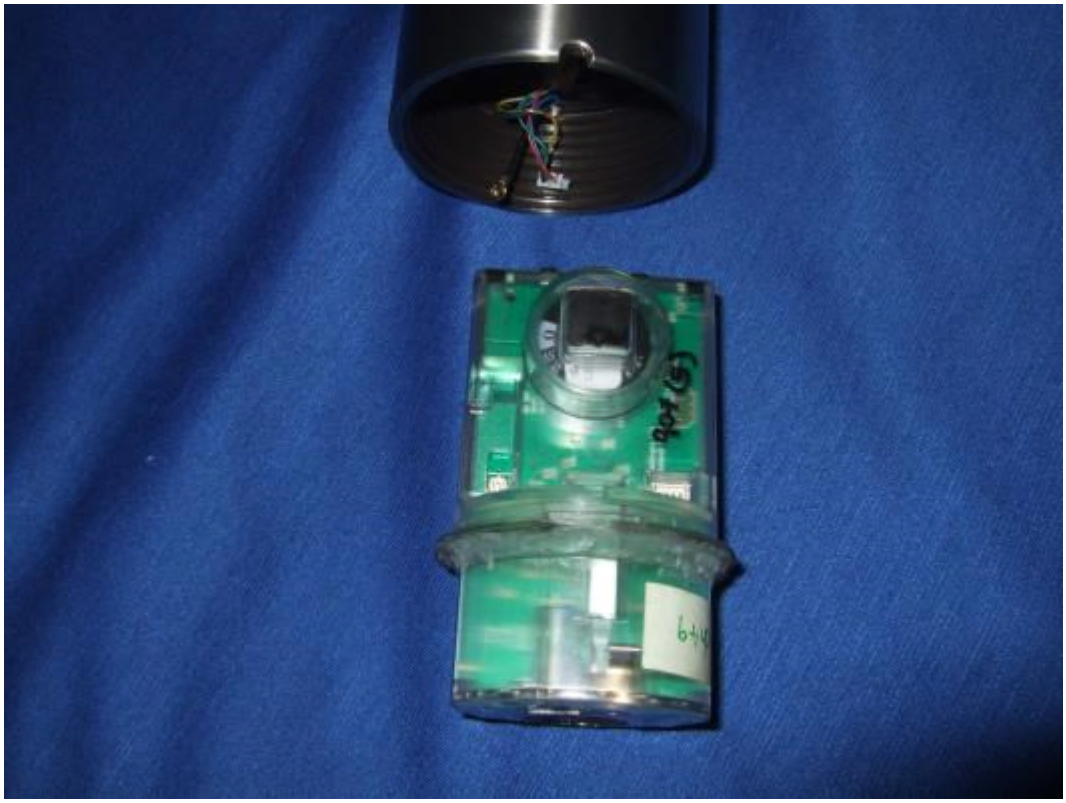
8.3 EUT Antenna Port

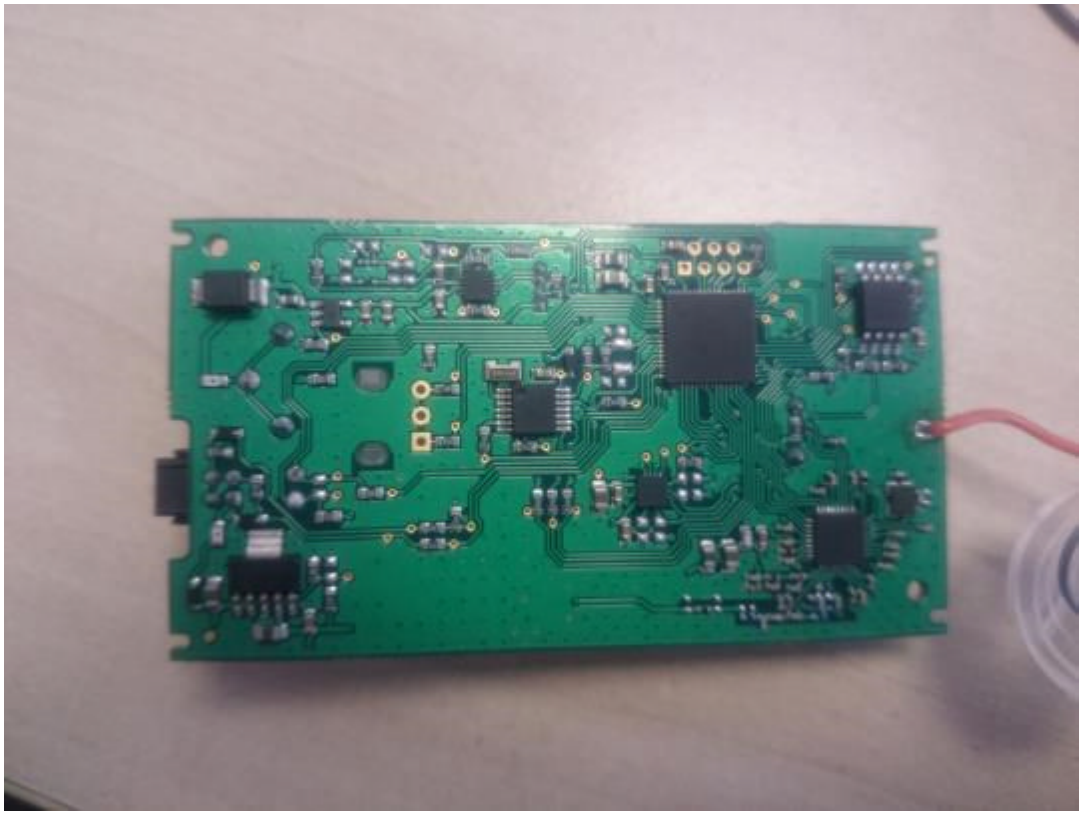


8.4 EUT Internal photos



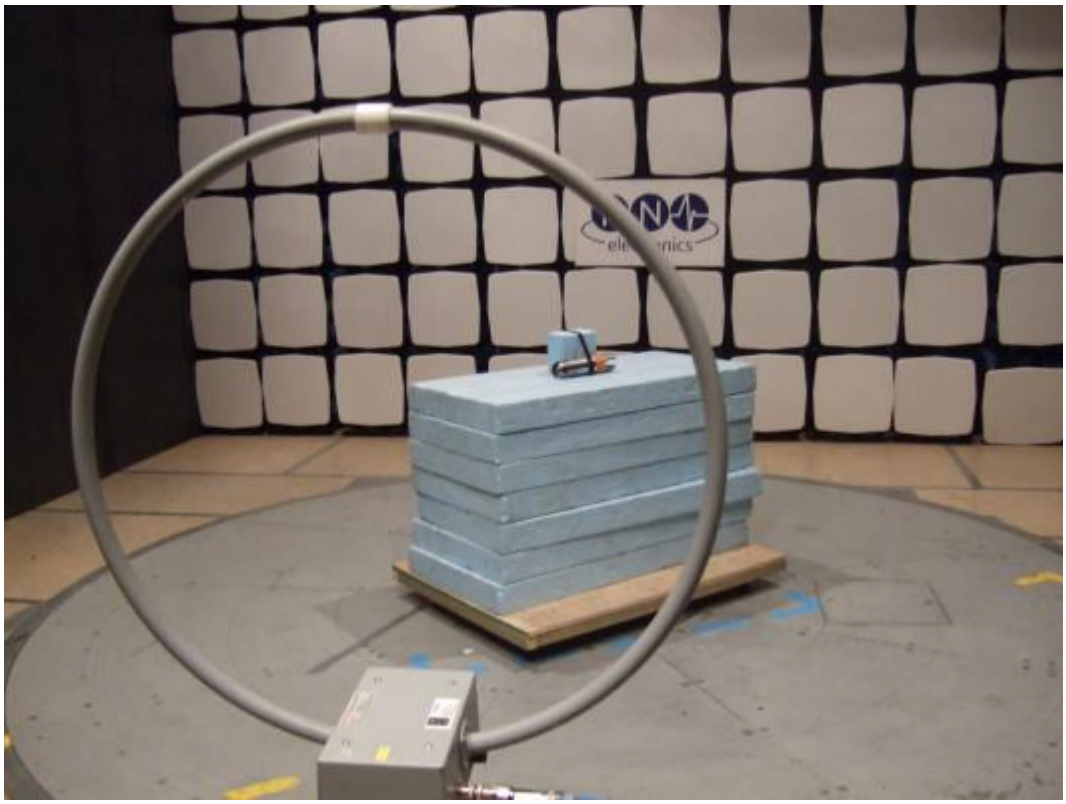




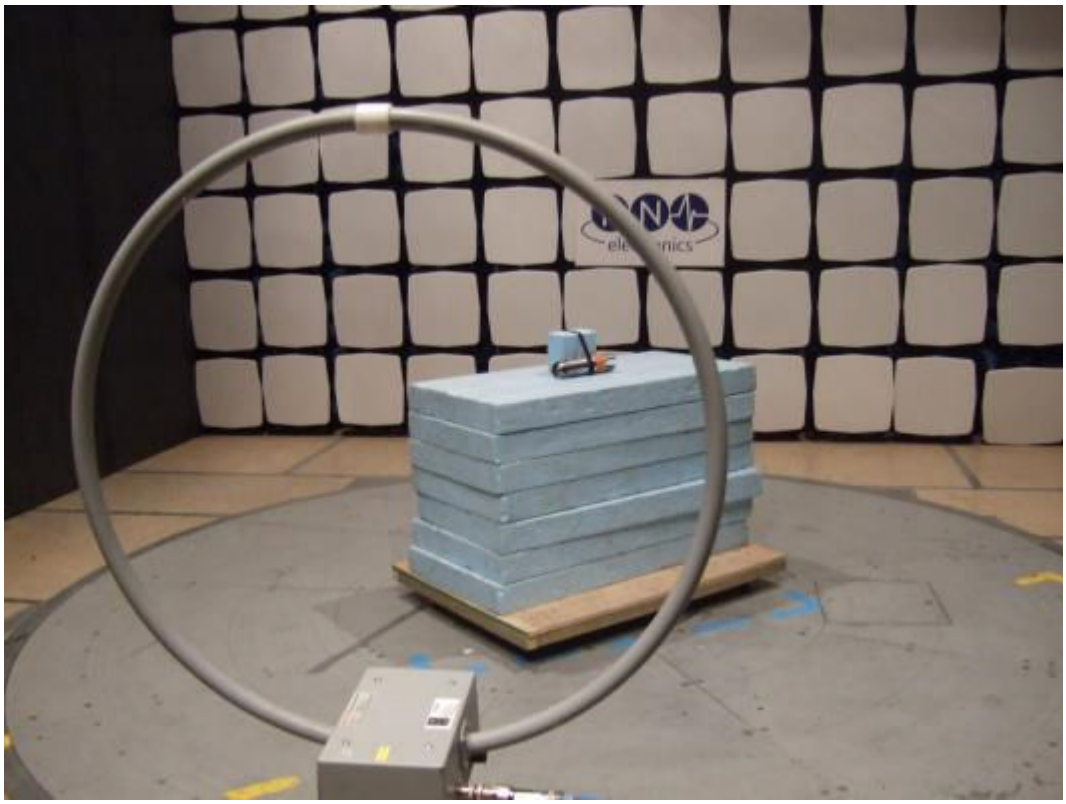


8.5 EUT Chassis

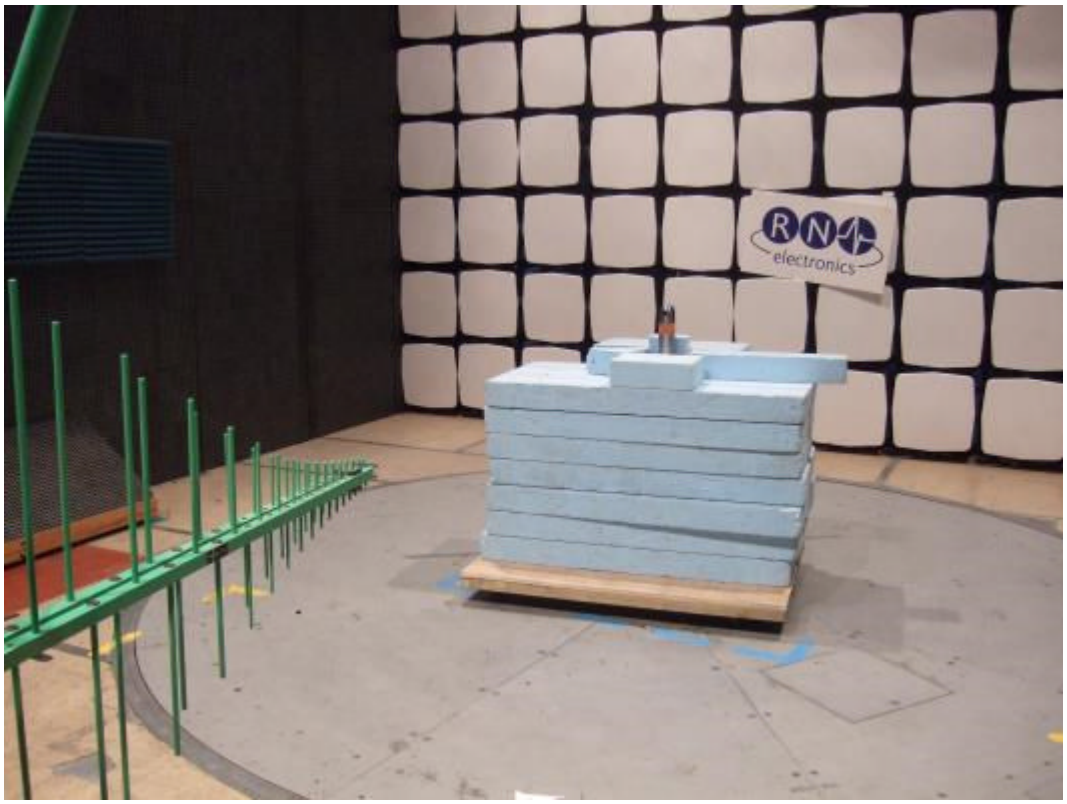
8.6 Radiated emissions 9 kHz - 150 kHz

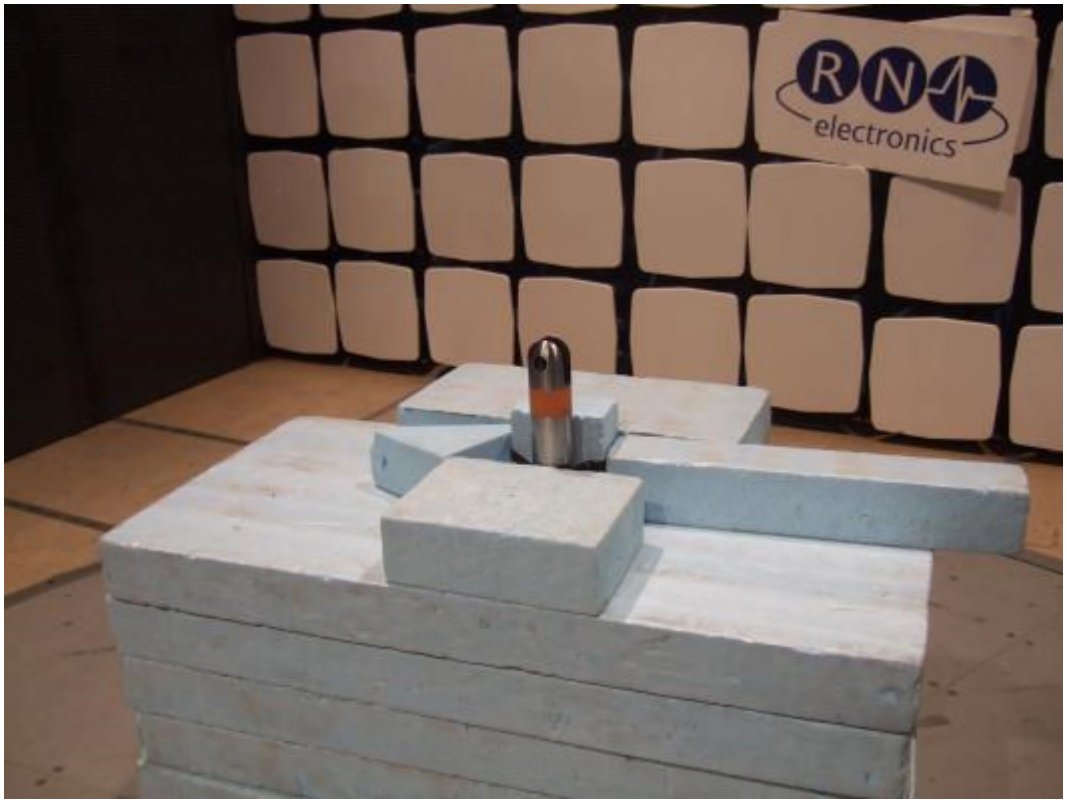


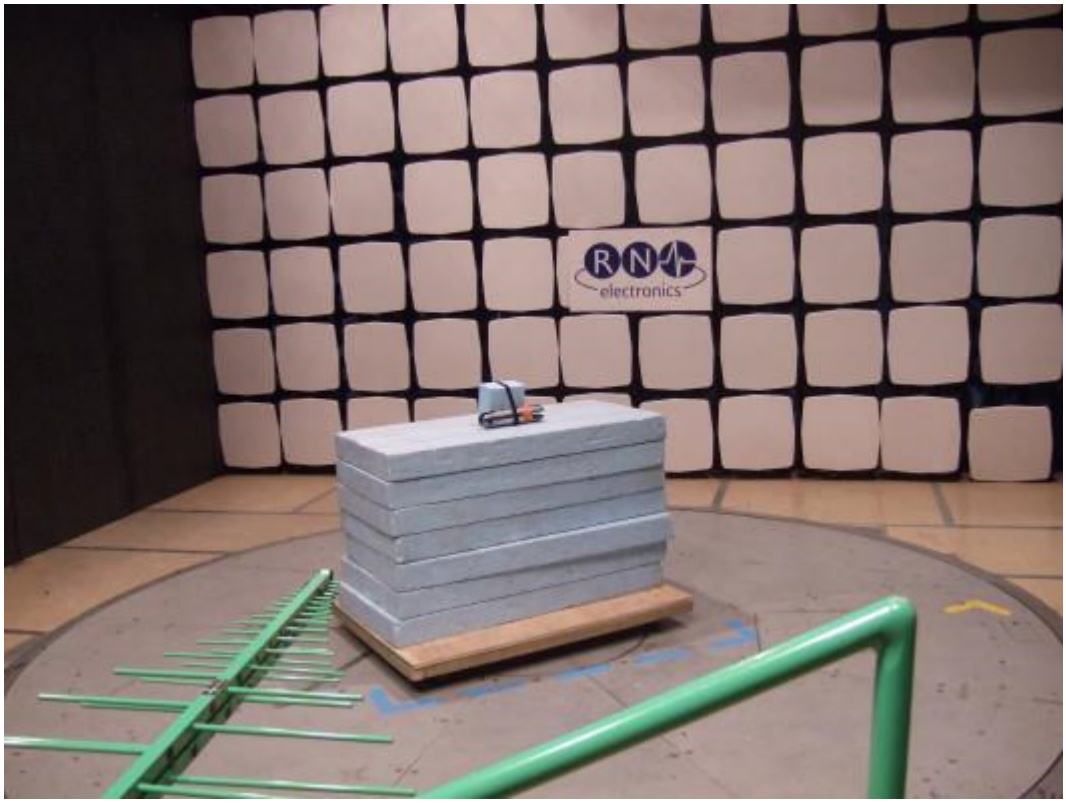
8.7 Radiated emissions 150 kHz - 30 MHz

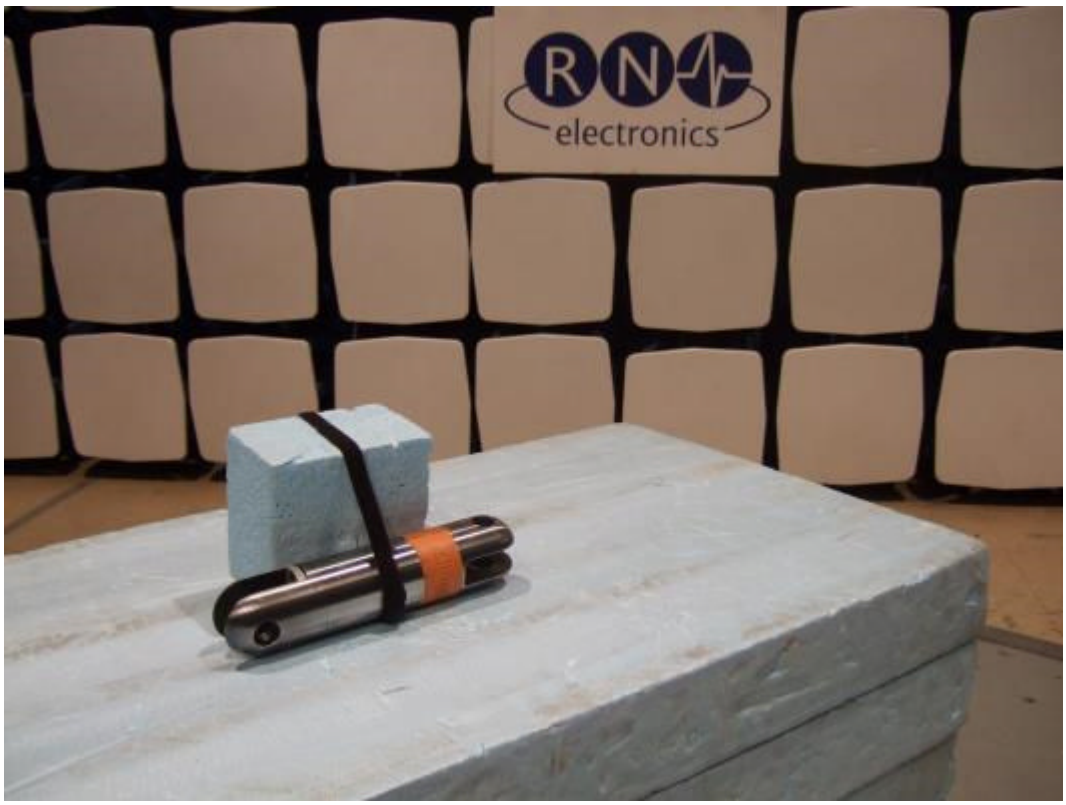


8.8 Radiated emissions 30 MHz -1 GHz

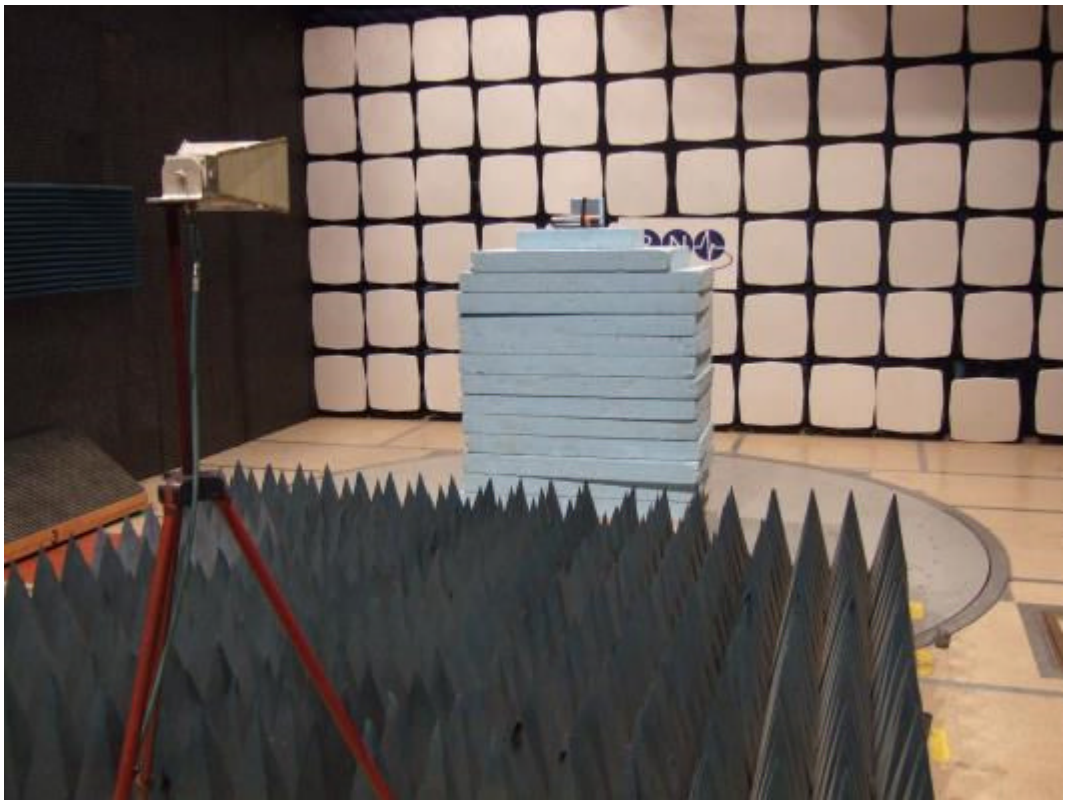


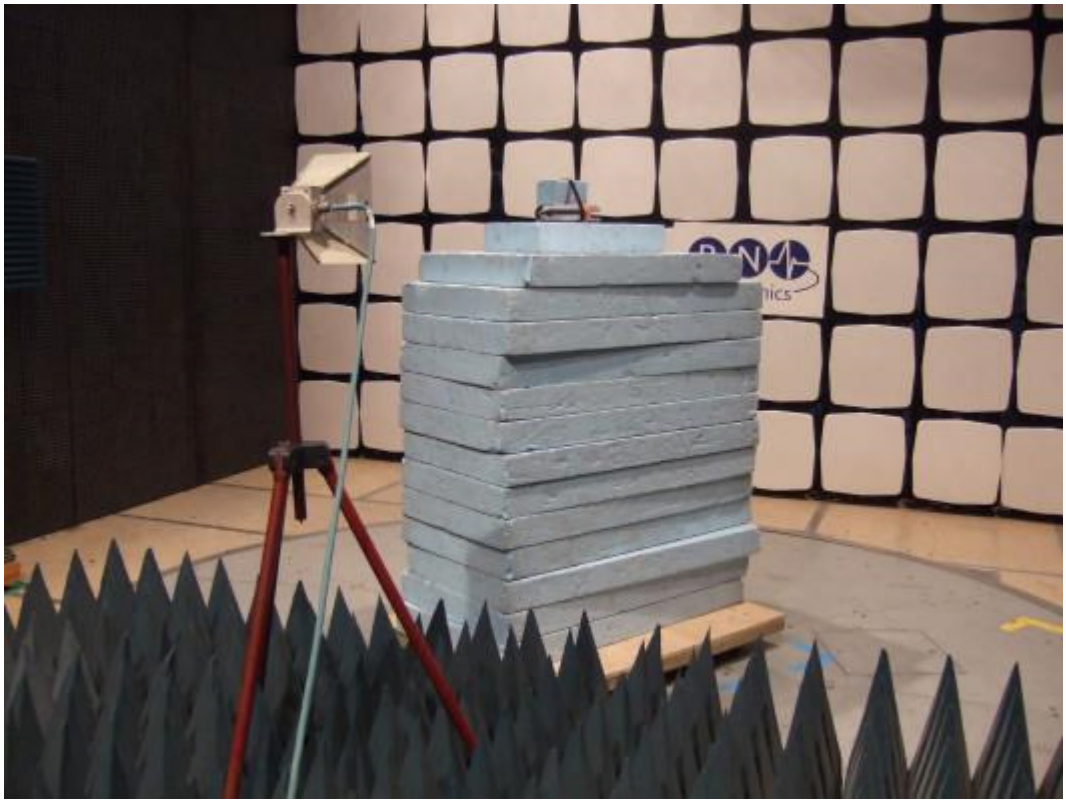


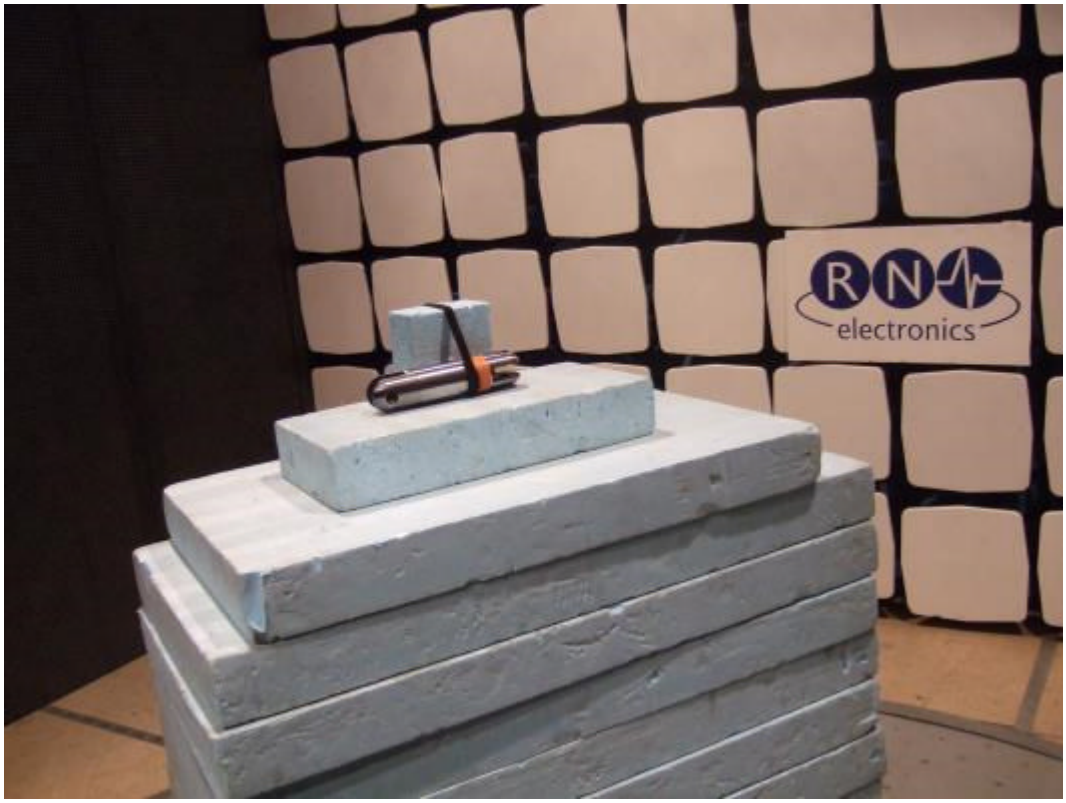




8.9 Radiated emissions above 1 GHz







8.10 Set-up diagrams

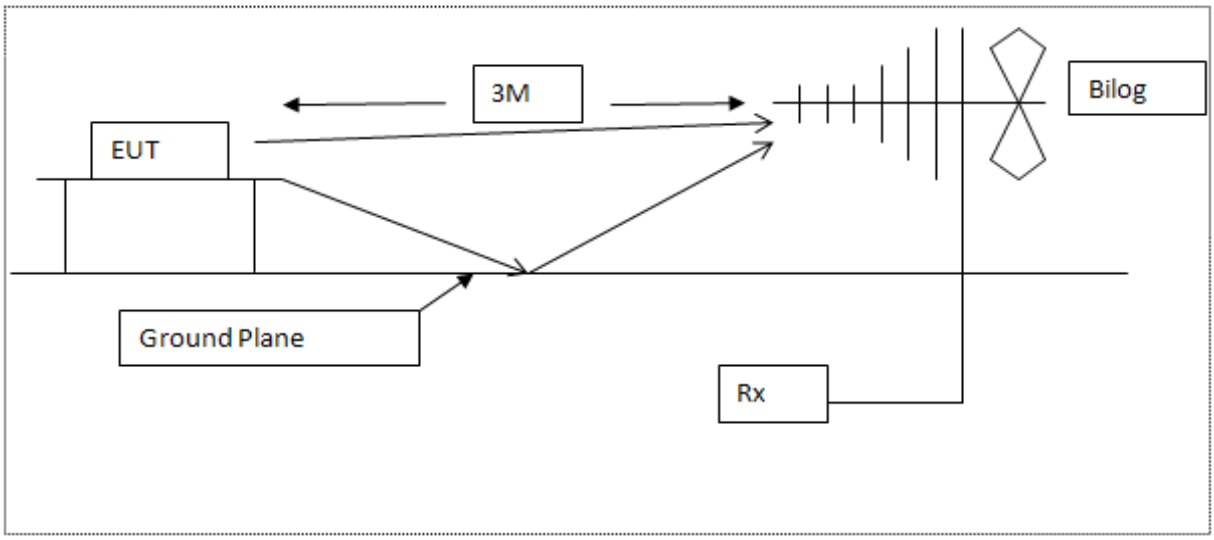


Diagram of the radiated emissions test setup 30 - 1000 MHz

8.11 Set-up diagrams

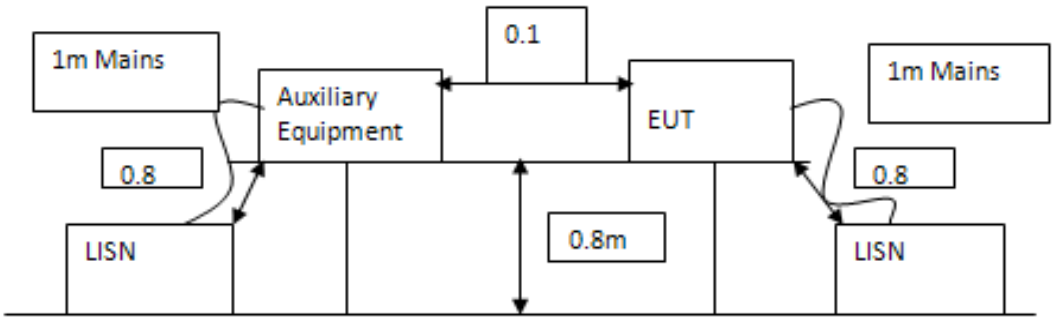


Diagram of the AC conducted emissions test setup

9 Test equipment calibration list

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

RN No.	Model No.	Description	Manufacturer	Calibration date	Cal period
E364	HP8664A	0.1 - 3000 MHz Signal Generator	HP	30-Mar-2015	36 months
E367	6534/4	20dB Attenuator	Marconi Instruments	19-May-2015	12 months
E533	N5182A	6 GHz MXG Signal Generator	Agilent Technologies	26-Feb-2013	36 months
E534	E4440A	3 Hz - 26.5 GHz PSA	Agilent Technologies	26-Feb-2015	24 months
E535	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	26-Jan-2015	12 months
E611	RPR3006W	USB RF PK power meter	Dare Instruments	06-Mar-2015	12 months
E624	E4440A	3 Hz - 26.5 GHz PSA	Agilent Technologies	23-Sep-2013	26 months
LPE261	3115	1-18GHz Horn	EMCO	18-Feb-2014	24 months
LPE333	8449B	Pre-amplifier 1GHz - 26.5GHz	HP	29-Jan-2015	24 months
LPE364	CBL6112A	30MHz - 2GHz Bilog Antenna	Chase Electronics Ltd	02-Dec-2013	24 months
TMS45	Model1	Attenuator	Weinschel	07-Jul-2015	12 months
TMS81	6502	Active Loop Antenna	EMCO	27-Apr-2015	24 months

10 Auxiliary and peripheral equipment

10.1 Customer supplied equipment

No customer equipment was supplied.

10.2 RN Electronics supplied equipment

No RN Electronics Ltd supplied equipment was used.

11 Condition of the equipment tested

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

11.1 Modifications before test

No modifications were made before test by RN Electronics Ltd.

11.2 Modifications during test

No modifications were made during test by RN Electronics Ltd.

12 Description of test sites

Site A Radio / 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

13 Abbreviations and units

%	Percent	LBT	Listen Before Talk
µA/m	microAmps per metre	LO	Local Oscillator
µV	microVolts	mA	milliAmps
µW	microWatts	max	maximum
AC	Alternating Current	kPa	Kilopascal
ALSE	Absorber Lined Screened Enclosure	Mbit/s	MegaBits per second
AM	Amplitude Modulation	MHz	MegaHertz
Amb	Ambient	mic	Microphone
ATPC	Automatic Transmit Power Control	min	minimum
BER	Bit Error Rate	mm	milliMetres
ºC	Degrees Celsius	ms	milliSeconds
C/I	Carrier / Interferer	mW	milliWatts
CEPT	European Conference of Postal and Telecommunications Administrations	NA	Not Applicable
COFDM	Coherent OFDM	nom	Nominal
CS	Channel Spacing	nW	nanoWatt
CW	Continuous Wave	OATS	Open Area Test Site
dB	deciBels	OFDM	Orthogonal Frequency Division Multiplexing
dBµA/m	deciBels relative to 1µA/m	ppm	Parts per million
dBµV	deciBels relative to 1µV	PRBS	Pseudo Random Bit Sequence
dBc	deciBels relative to Carrier	QAM	Quadrature Amplitude Modulation
dBm	deciBels relative to 1mW	QPSK	Quadrature Phase Shift Keying
DC	Direct Current	R&TTE	Radio and Telecommunication Terminal Equipment
DTA	Digital Transmission Analyser	Ref	Reference
EIRP	Equivalent Isotropic Radiated Power	RF	Radio Frequency
ERP	Effective Radiated Power	RFC	Remote Frequency Control
EU	European Union	RSL	Received Signal Level
EUT	Equipment Under Test	RTP	Room Temperature and Pressure
FM	Frequency Modulation	RTPC	Remote Transmit Power Control
FSK	Frequency Shift Keying	Rx	Receiver
g	Grams	s	Seconds
GHz	GigaHertz	SINAD	Signal to Noise And Distortion
Hz	Hertz	Tx	Transmitter
IF	Intermediate Frequency	V	Volts
kHz	kiloHertz		