



Radio Test Report

RF Solutions Ltd
FOBBER 8 button FM keyfob
FOBBER-433

47 CFR Part 15.231 Effective Date 1st October 2015

Test Date: 16th February 2016 to 27th June 2016
Report Number: 06-8408-1-16 Issue 01

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Certificate of Test 8408-1

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:	FOBBER 8 button FM keyfob
Model Number:	FOBBER-433
Unique Serial Number:	None specified
Applicant:	RF Solutions Ltd William Alexander House, William Way Burgess Hill, West Sussex RH15 9AG
Proposed FCC	F90FOBBER001
Full measurement results are detailed in Report Number:	06-8408-1-16 Issue 01
Test Standards:	47 CFR Part 15.231 Effective Date 1st October 2015

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:

No deviations 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: 16th February 2016 to 27th June 2016

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2 Equipment under test (EUT)

2.1 Equipment specification

Applicant	RF Solutions Ltd William Alexander House William Way Burgess Hill West Sussex RH15 9AG	
Manufacturer of EUT	RF Solutions Ltd	
Full Name of EUT	FOBBER 8 button FM keyfob	
Model Number of EUT	FOBBER-433	
Serial Number of EUT	None specified	
Date Received	16th December 2015	
Date of Test:	16th February 2016 to 27th June 2016	
Purpose of Test	To demonstrate design compliance to the relevant rules of Chapter 47 of the Code of Federal Regulations.	
Date Report Created	5th July 2016	
Main Function	Low power RF switching transmitter.	
Information Specification	Height	59.2 mm
	Width	32.7 mm
	Depth	8 mm
	Weight	0.0163 kg
	Voltage	2.3-3.3 Vdc
	Current	16.5 mA

2.2 Configurations for testing

General Parameters	
EUT Normal use position	Hand held
Choice of model(s) for type tests	Pre-production sample
Antenna details	Integral on board
Antenna port	Integral antenna
Baseband Data port (yes/no)?	No
Highest Signal generated in EUT	433.92 MHz
Lowest Signal generated in EUT	8 MHz
Hardware Version	Not declared
Software Version	Not declared
Firmware Version	Not declared
Type of Equipment	Standalone radio
Technology Type	Not declared
Geo-location (yes/no)	No
TX Parameters	
Alignment range – transmitter	433.92 MHz
EUT Declared Modulation Parameters	FSK
EUT Declared Power level	+10 dBm
EUT Declared Signal Bandwidths	60 kHz
EUT Declared Channel Spacing's	Single Channel
EUT Declared Duty Cycle	10%
Unmodulated carrier available?	No
Declared frequency stability	10 ppm
SRD Parameters	
List Annex and Band designation	Annex A Band g1

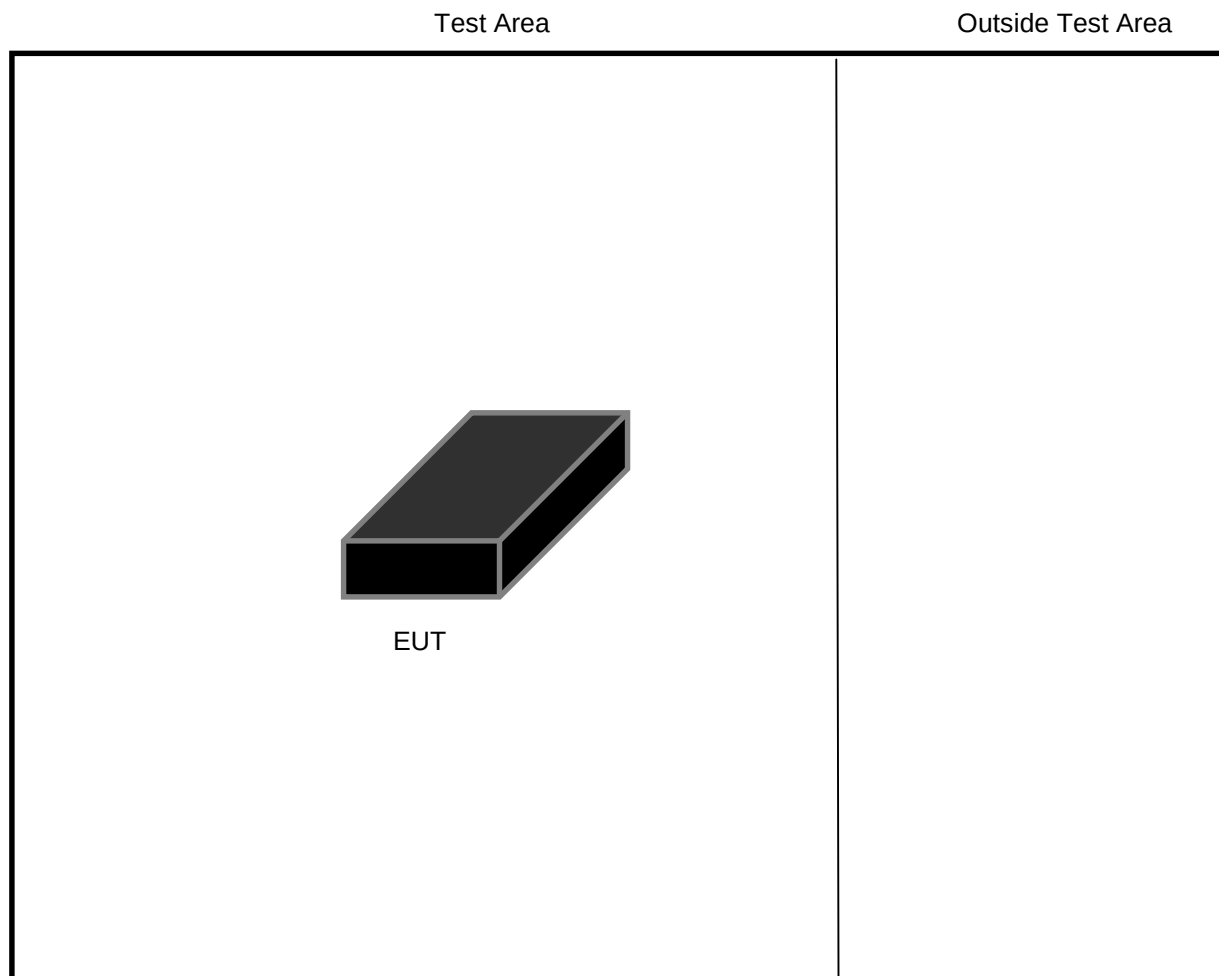
2.3 Functional description

Press the required button to transmit.

2.4 Modes of operation

Mode Reference	Description	Used for testing
Sleep	Sleep	No
TX1	TX 1 burst/second 433.93 MHz	Yes
TX2	Continuous TX 433.92 MHz	Yes

2.5 Emissions configuration



The unit was powered from a new battery. The special test modes were made available on spare buttons on the unit. The transmit mode was 100% continuous with modulation and the power settings for each channel were as stated below:-

Single Channel (433.92 MHz) = +10 dBm (declared by the manufacturer as the power from the Integrated Circuit manufacturer). Actual radiated field strength was found to be much lower than expected. The unit was confirmed as being programmed to +10dBm by the manufacturer. Please refer to section 5.6 within this report.

The unit tested has eight buttons (FOBBER-4T8). The manufacturer declares that 1, 2, 3, 4, 5, 6 and 8 button versions (FOBBER-4T1, FOBBER-4T2, FOBBER-4T3, FOBBER-4T4, FOBBER-4T5, FOBBER-4T6, FOBBER-4T7, and FOBBER-4T8) are available as options. The PCB has functionality for 8 buttons and a different switch membrane is fitted to provide the number of buttons required. Units with 3 and 4 buttons were also tested to verify no change in performance. The manufacturer also declares three more variants, FOBLOQ-4T1, FOBLOQ-4T2 and FOBLOQ-4T4. These variants have exactly the same hardware and RF performance as the units tested but have a more secure protocol for security applications.

3 Summary of test results

The FOBBER 8 button FM keyfob, FOBBER-433 was tested for compliance to the following standard(s) :

47 CFR Part 15.231 Effective Date 1st October 2015

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	Part 15.207	NOT APPLICABLE ¹
2. Radiated emissions 9 - 150 kHz	Part 15.209 & 15.33(a)	PASSED
3. Radiated emissions 150 kHz - 30 MHz	Part 15.209 & 15.33(a)	PASSED
4. Radiated emissions 30 MHz -1 GHz	Part 15.231(b) & 15.209	PASSED
5. Radiated emissions above 1 GHz	Part 15.209 & 15.33(a)	PASSED ⁴
6. Intentional radiator field strength	Part 15.231(b)	PASSED
7. Band edge compliance	Part 15.231(d)/15.205	NOT APPLICABLE ²
8. Occupied bandwidth	Part 15.231(c)	PASSED
9. Periodic operation	Part 15.231(a)	PASSED
10. Frequency stability	Part 15.231(d)	NOT APPLICABLE ²
Receiver Tests		
11. Antenna Power conducted emissions for receivers	Part 15.111	NOT APPLICABLE ³

¹ EUT does not operate from the AC power lines nor contain provisions for operation while connected to AC power lines.

² EUT does not operate in the 40.66 - 40.70 MHz band.

³ EUT has no receiver.

⁴ Manufacturer declares highest internal source of the EUT to be 433.92 MHz, therefore the measurement is only made up to 5000 MHz.

4 Specifications

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

4.1 Relevant standards

Ref.	Standard Number	Version	Description
4.1.1	47 CFR Part 15C	2015	Federal Communications Commission PART 15 – RADIO FREQUENCY DEVICES
4.1.2	ANSI C63.10	2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
4.1.3	ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

4.2 Deviations

No deviations have been applied.

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 - 150 kHz

5.2.1 Test methods

Test Requirements:	Part 15.209 & 15.33(a) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.4 [Reference 4.1.2 of this report]
Limits:	Part 15.209 [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 new battery. The EUT was operated in TX2 mode.

5.2.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. Measurements were made in a semi-anechoic chamber (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. Tests were performed in Test Site M.

5.2.4 Test equipment

E411, E624, TMS81

See Section 9 for more details

5.2.5 Test results

Temperature of test environment	21°C
Humidity of test environment	57%
Pressure of test environment	102kPa

Band	433.05-434.79 MHz
Power Level	10 dBm
Channel Spacing	Single Channel
Mod Scheme	FSK
Mid channel	433.92 MHz

Plot refs
8408-1 Rad 1 9-150kHz Para
8408-1 Rad 1 9-150kHz Perp

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.

15.231(b) limits are applicable elsewhere, although 15.209 limits may be used where these allow a higher field strength.

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

These results show that the EUT has PASSED this test.

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

5.3 Radiated emissions 150 kHz - 30 MHz

5.3.1 Test methods

Test Requirements:	Part 15.209 & 15.33(a) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.4 [Reference 4.1.2 of this report]
Limits:	Part 15.209 [Reference 4.1.1 of this report]

5.3.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The EUT was rotated in all three orthogonal planes. Radiated Emissions testing was performed with a new battery. The EUT was operated in TX2 mode.

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. Tests were performed in Test Site M.

5.3.4 Test equipment

E411, E624, TMS81

See Section 9 for more details

5.3.5 Test results

Temperature of test environment	21°C
Humidity of test environment	57%
Pressure of test environment	102kPa

Band	433.05-434.79 MHz
Power Level	10 dBm
Channel Spacing	Single Channel
Mod Scheme	FSK
Mid channel	433.92 MHz

Plot refs
8408-1 Rad 1 150k-30MHz Para
8408-1 Rad 1 150k-30MHz Perp

Peak detector "Max held" Analyser plots against the 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.

15.231(b) limits are applicable elsewhere, although 15.209 limits may be used where these allow a higher field strength.

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

These results show that the EUT has PASSED this test.

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

5.4 Radiated emissions 30 MHz -1 GHz

5.4.1 Test methods

Test Requirements:	Part 15.231(b) & 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:	Clause 15.231(b) & 15.209 [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 new battery. The EUT was operated in TX2 mode.

5.4.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. The equipment was rotated 360 degrees and the antenna scanned 1 – 4 metres in both horizontal and vertical polarisations to record the worst case emissions. At least 6 signals within 20dB and all signals within 10dB of the limit were investigated. Tests were performed in Test Site M.

5.4.4 Test equipment

E411, E624, E660, E655, ZSW1

See Section 9 for more details

5.4.5 Test results

Temperature of test environment	20°C
Humidity of test environment	47%
Pressure of test environment	102kPa

Band	433.05-434.79 MHz
Power Level	10 dBm
Channel Spacing	Single Channel
Mod Scheme	FSK
Mid channel	433.92 MHz

Plot refs
8408-1 Rad 1 VHF Horiz
8408-1 Rad 1 VHF Vert
8408-1 Rad 1 UHF Horiz
8408-1 Rad 1 UHF Vert

Table of signals measured for Rad 1 Horizontal Sig List

Signal No.	Freq (MHz)	Peak Amp (dBuV/m)	Calculated Av Amp (dBuV/m)	Av Lim (dB)
1	867.833	55.2	41.2	-19.6

Table of signals measured for Rad 1 Vertical Sig List

Signal No.	Freq (MHz)	Peak Amp (dBuV/m)	Calculated Av Amp (dBuV/m)	Av Lim (dB)
1	867.809	46.2	32.2	-28.6

Duty cycle correction of $20 \log (19.4 \text{ ms}/100 \text{ ms}) = -14.2 \text{ dB}$ applied to peak measured values. See section 5.9.

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.

15.231(b) limits are applicable elsewhere, although 15.209 limits may be used where these allow a higher field strength.

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

These results show that the EUT has PASSED this test.

The uncertainty gives a 95% confidence interval in the measurement. Expanded uncertainty (K=2) is as follows:
30MHz - 1000MHz $\pm 6.1\text{dB}$

5.5 Radiated emissions above 1 GHz

5.5.1 Test methods

Test Requirements:	Part 15.209 & 15.33(a) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.6 [Reference 4.1.2 of this report]
Limits:	Part 15.209/15.231(b) [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 new battery. The EUT was operated in TX2 mode.

5.5.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. Measurements were made in a semi-anechoic chamber with appropriate absorbing material for use in this range. The EUT was raised and antenna was placed 1.5m above the ground in line with the EUT, which was rotated through 360 degrees to record the worst case emissions. A measurement distance of 3m was used between the test range 1GHz - 5GHz. Tests were performed in Test Site M.

5.5.4 Test equipment

E136, TMS82, E624, E411, E410

See Section 9 for more details

5.5.5 Test results

Temperature of test environment	19°C
Humidity of test environment	56%
Pressure of test environment	101kPa

Setup Table

Band	433.05-434.79 MHz
Power Level	10 dBm
Channel Spacing	Single Channel
Mod Scheme	FSK
Single channel	433.92 MHz

Spurious Frequency (MHz)	Measured Peak Level (dBµV/m)	Difference to Peak Limit (dB)	Calculated Average Level (dBµV/m)	Difference to Average Limit (dB)	EUT Position	Antenna Polarisation
1301.76	63.8	-10.2	49.6	-4.4	Upright	Vertical
1301.76	65.1	-8.9	50.9	-3.1	Flat	Horizontal
1735.68	65.4	-15.4	51.2	-9.6	Upright	Vertical
1735.68	63.1	-17.7	48.9	-11.9	Flat	Horizontal
2169.60	56.3	-24.5	42.1	-18.7	Upright	Vertical
2169.60	56.7	-24.1	42.5	-18.3	Flat	Horizontal
2603.52	61.5	-19.3	47.3	-13.5	Upright	Vertical
2603.52	63.7	-17.1	49.5	-11.3	Flat	Horizontal
3905.28	50.5	-23.5	36.3	-17.7	Upright	Vertical
3905.28	51.6	-22.4	37.4	-16.6	Flat	Horizontal
4339.20	48.4	-25.6	34.2	-19.8	Upright	Vertical
4339.20	52.6	-21.4	38.4	-15.6	Flat	Horizontal
4773.12	50.9	-23.1	36.7	-17.3	Upright	Vertical
4773.12	49.3	-24.7	35.1	-18.9	Flat	Horizontal

Plots
8408-1 Rad 1 1-2GHz Horiz
8408-1 Rad 1 1-2GHz Vert
8408-1 Rad 1 2-5GHz Horiz
8408-1 Rad 1 2-5GHz Vert

Duty cycle correction of $20 \log (19.4 \text{ ms}/100 \text{ ms}) = -14.2 \text{ dB}$ applied to peak measured values. See section 5.9.

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.

15.231(b) limits are applicable elsewhere, although 15.209 limits may be used where these allow a higher field strength.

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

These results show that the EUT has PASSED this test.

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

1 – 18 GHz $\pm 3.5\text{dB}$

5.6 Intentional radiator field strength

5.6.1 Test methods

Test Requirements:	Part 15.231(b) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.5/6.6 [Reference 4.1.2 of this report]
Limits:	Part 15.231(b)/15.35 [Reference 4.1.1 of this report]

5.6.2 Configuration of EUT

The EUT was placed on a 0.8 metres high turntable. The front edge of the EUT was initially positioned facing the antenna. The EUT was measured at a distance of 3 metres. The antenna was scanned 1-4m in height in both Horizontal and Vertical polarisations. The EUT was rotated in all three orthogonal planes. The EUT was operated in TX2 mode. Because low fundamental field strength was measured, the manufacturer was asked to confirm that the output power level was set to +10 dBm for testing.

5.6.3 Test procedure

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

Measurements were made in a semi-anechoic chamber. This site is listed with the FCC. Both the equipment and the antenna were rotated 360 degrees to record the maximised emission.

Measurements were made at Site M.

5.6.4 Test equipment

E410, E411, E624, E660, E655

See Section 9 for more details

5.6.5 Test results

Temperature of test environment	20°C
Humidity of test environment	47%
Pressure of test environment	102kPa

Band	433.05-434.79 MHz
Power Level	10 dBm
Channel Spacing	Single Channel
Mod Scheme	FSK
Single channel	433.92 MHz

	Single
Peak Level (dBµV/m)	74.7
Plot reference	8408-1 Fund flat horiz
Antenna Polarisation	Horiz
EUT Polarisation	Flat

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

LIMITS:

Fc = 433.92MHz 15.231(b) Average = 11,000 uV/m = 80.8 dBuV/m @ 3m.

15.35 Peak = 20dB above the maximum permitted average emission limit = 100.8 dBuV/m @ 3m.

These results show that the EUT has PASSED this test.

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

5.7 Band edge compliance

NOT APPLICABLE: EUT does not operate in the 40.66 - 40.70 MHz band. Wide span plots showing the restricted bands of 410 & 608 MHz are shown in section 6.3.

5.8 Occupied bandwidth

5.8.1 Test methods

Test Requirements:	Part 15.231(c) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 6.9 [Reference 4.1.2 of this report]
Limits:	Part 15.231(c) [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 TX2 mode.

5.8.3 Test procedure

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

5.8.4 Test equipment

E410, E411, E624

See Section 9 for more details

5.8.5 Test results

Temperature of test environment	21°C
Humidity of test environment	48%
Pressure of test environment	102kPa

Band	433.05-434.79 MHz
Power Level	10 dBm
Channel Spacing	Single Channel
Mod Scheme	FSK
Mid channel	433.92 MHz

20dB Bandwidth (MHz) Plot reference	Mid
	0.1024
	8408-1 8404-1 OBW

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

LIMITS:

15.231(c) must be <0.25% (70-900 MHz fundamentals) of centre frequency.

$F_c = 433.92\text{MHz}$, $433.92 \times 0.25\% = 1.085\text{MHz}$.

These results show that the EUT has PASSED this test.

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

$<\pm 1.9\%$

5.9 Periodic operation

5.9.1 Test methods

Test Requirements:	Part 15.231(a) [Reference 4.1.1 of this report]
Test Method:	ANSI C63.10 Clause 7.4/7.5/7.6 [Reference 4.1.2 of this report]
Limits:	Part 15.231(a) [Reference 4.1.1 of this report]

5.9.2 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 TX1 mode.

5.9.3 Test procedure

Tests were made in accordance with FCC Part 15 using the measuring equipment noted below. A zero span was set on the analyser with the frequency set to the fundamental frequency of the EUT. Suitable triggering was set and the TX on time and repetition times were evaluated and plotted.

Tests were performed using Test Site H.

5.9.4 Test equipment

E412, E624, E410

See Section 9 for more details

5.9.5 Test results

Temperature of test environment	17°C
Humidity of test environment	60%
Pressure of test environment	102kPa

Band	433.05-434.79 MHz
Power Level	10 dBm
Channel Spacing	Single Channel
Mod Scheme	FSK
Single channel	433.92 MHz

	Single
TX on time (mS)	19.422
TX on Plot filename	8408-1 TX on time (standard unit)
TX repetition time (S)	0.24
TX repetition Plot filename	8408-1 TX repetition (standard
Calculated TX Duty cycle (%)	8.0925

Analyser plots for the dwell time and duty cycle can be found in Section 6 of this report.

LIMITS:

15.231(a)(1)(2) Manual or automatic transmitters shall automatically deactivate within 5seconds. 15.231(a)(3) Periodic transmissions at regular pre-determined intervals are not permitted. However, polling or supervision transmissions, including data to determine system integrity in safety and security systems applications are allowed, if the total transmission time does not exceed more than 2 seconds per hour for each transmitter. There is no limit on the number of individual transmissions, providing the total transmit time does not exceed 2 seconds per hour. 15.231(a)(4) Intentional radiators used during emergencies involving Fire, Security and Safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

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

5.10 Antenna Power conducted emissions for receivers

NOT APPLICABLE: EUT has no receiver.

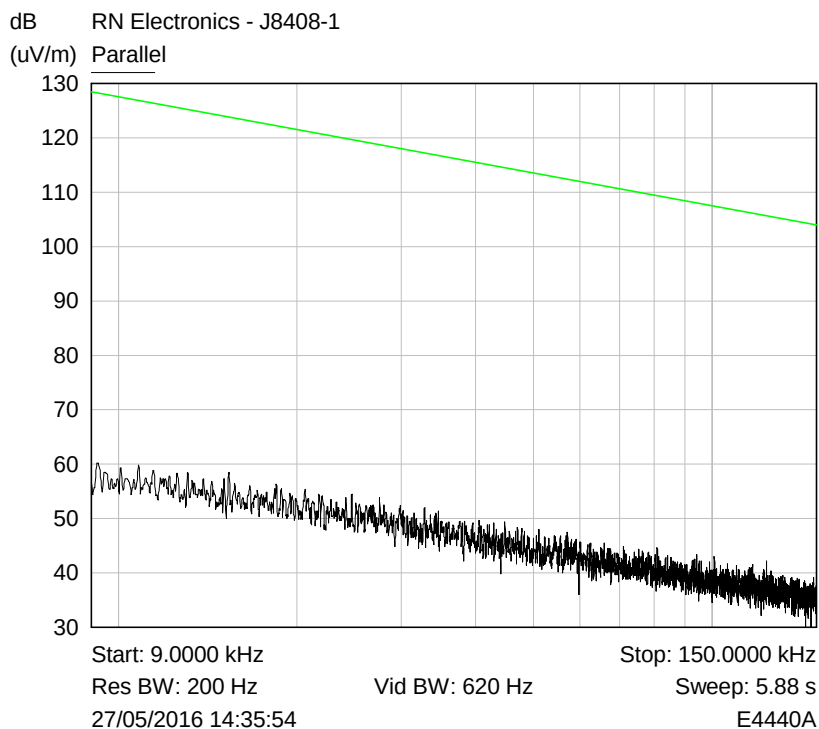
5.11 Frequency stability

NOT APPLICABLE: EUT does not operate in the 40.66 - 40.70 MHz band.

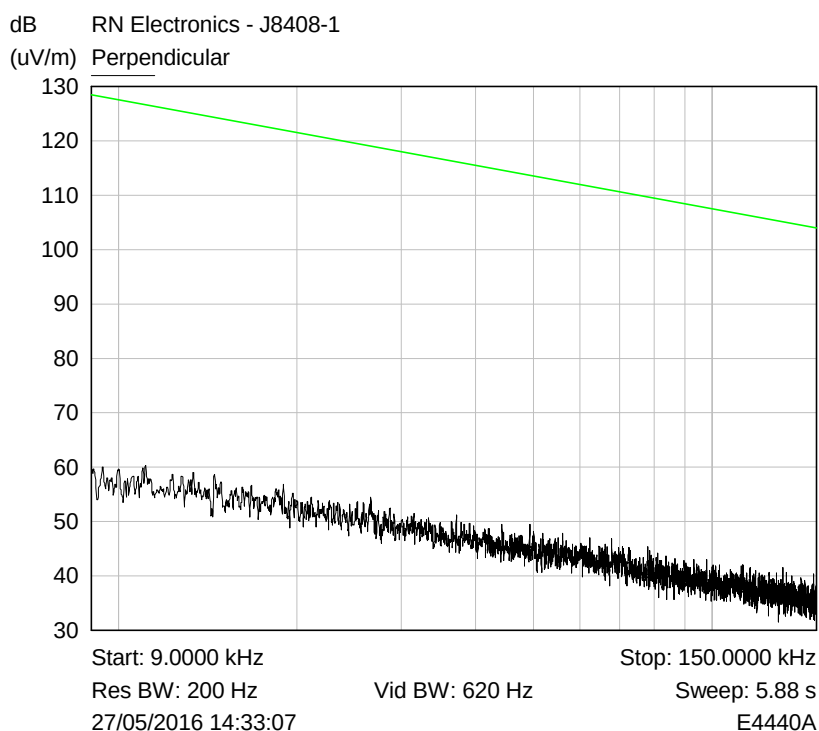
6 Plots/Graphical results

6.1 Radiated emissions 9 - 150 kHz

RF Parameters: Band 433.05-434.79 MHz, Power 10 dBm, Channel Spacing Single Channel, Modulation FSK, Channel 433.92 MHz



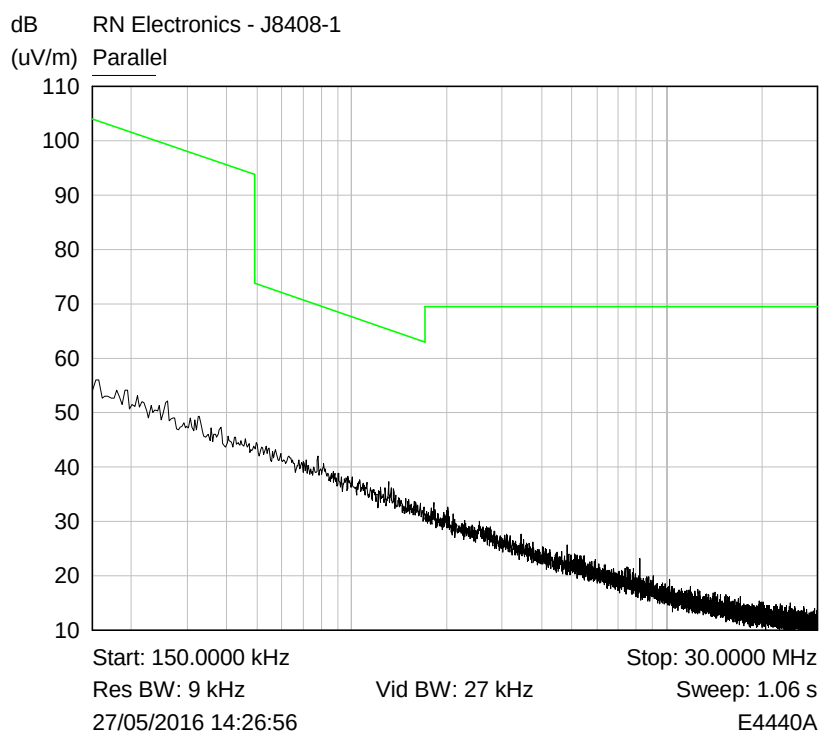
Plot of 9-150kHz Parallel



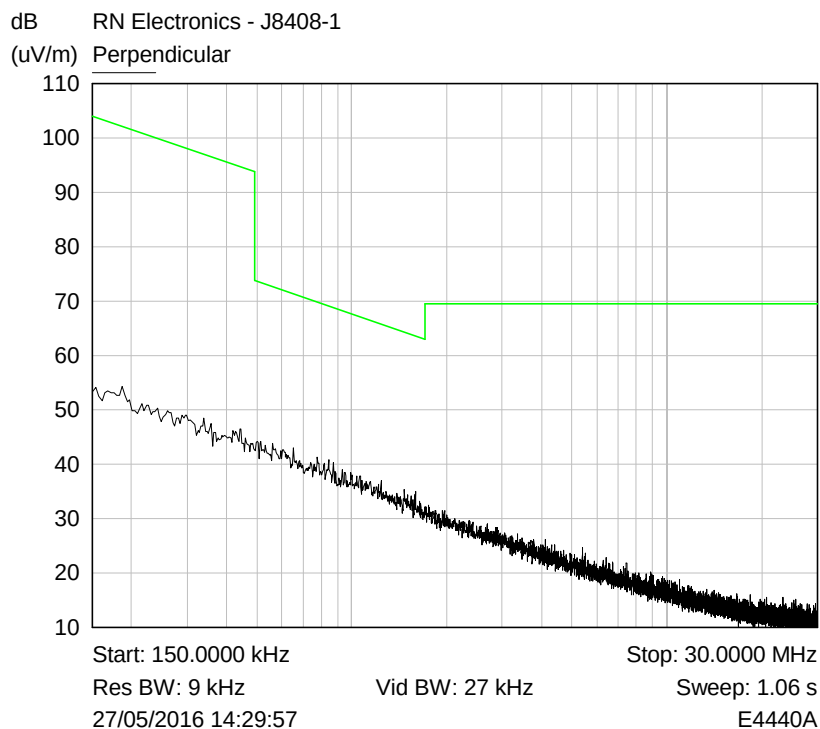
Plot of 9-150kHz Perpendicular

6.2 Radiated emissions 150 kHz - 30 MHz

RF Parameters: Band 433.05-434.79 MHz, Power 10 dBm, Channel Spacing Single Channel, Modulation FSK, Channel 433.92 MHz



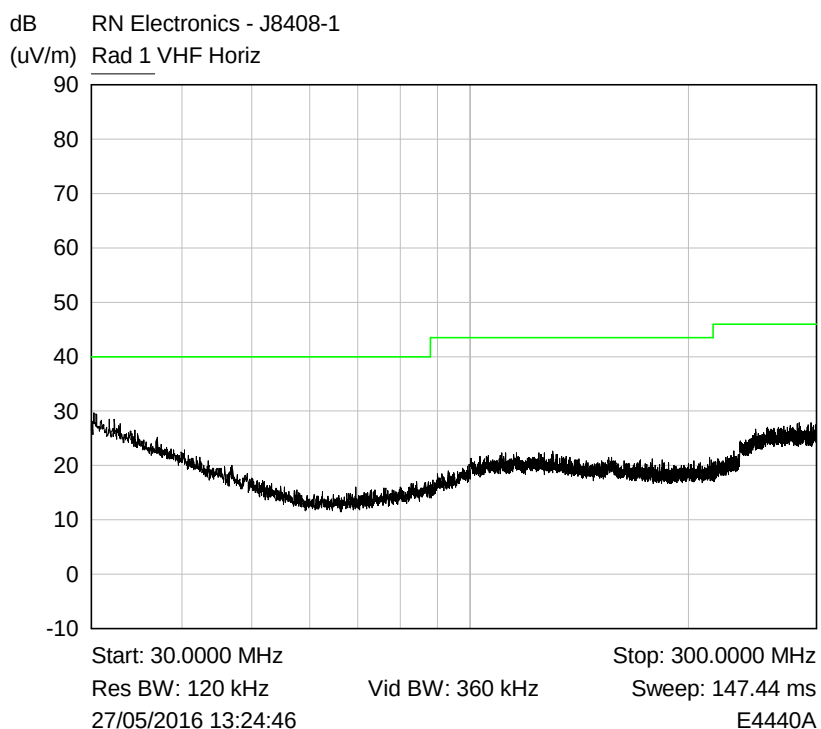
Plot of 150kHz-30MHz Parallel



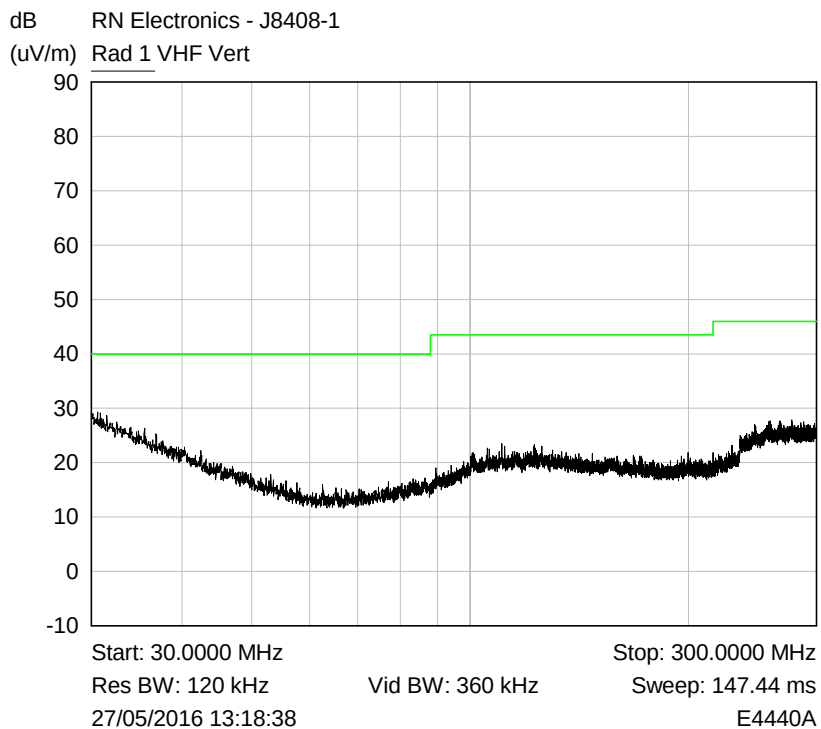
Plot of 150kHz-30MHz Perpendicular

6.3 Radiated emissions 30 MHz -1 GHz

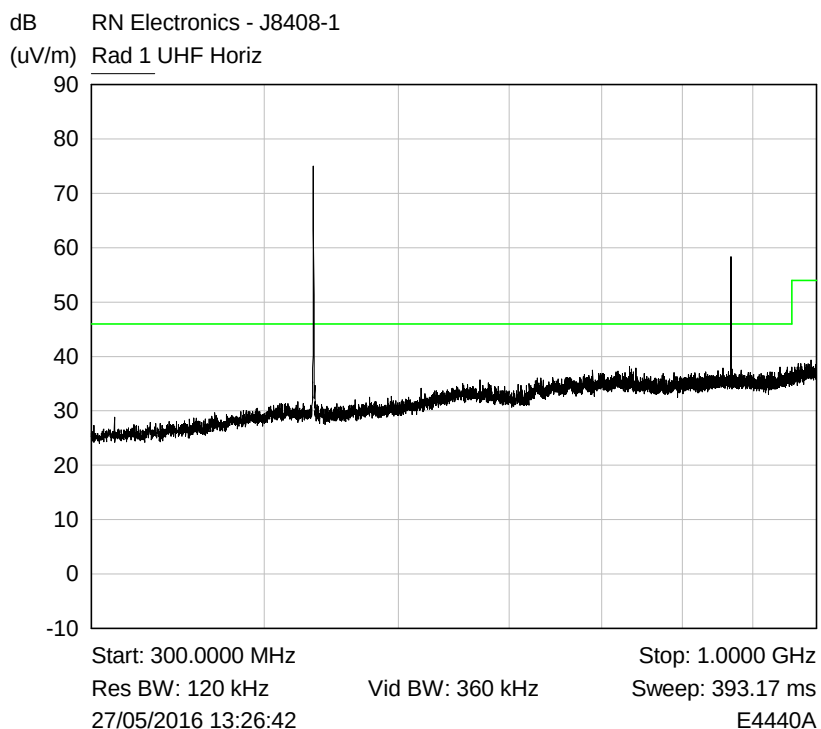
RF Parameters: Band 433.05-434.79 MHz, Power 10 dBm, Channel Spacing Single Channel, Modulation FSK, Channel 433.92 MHz



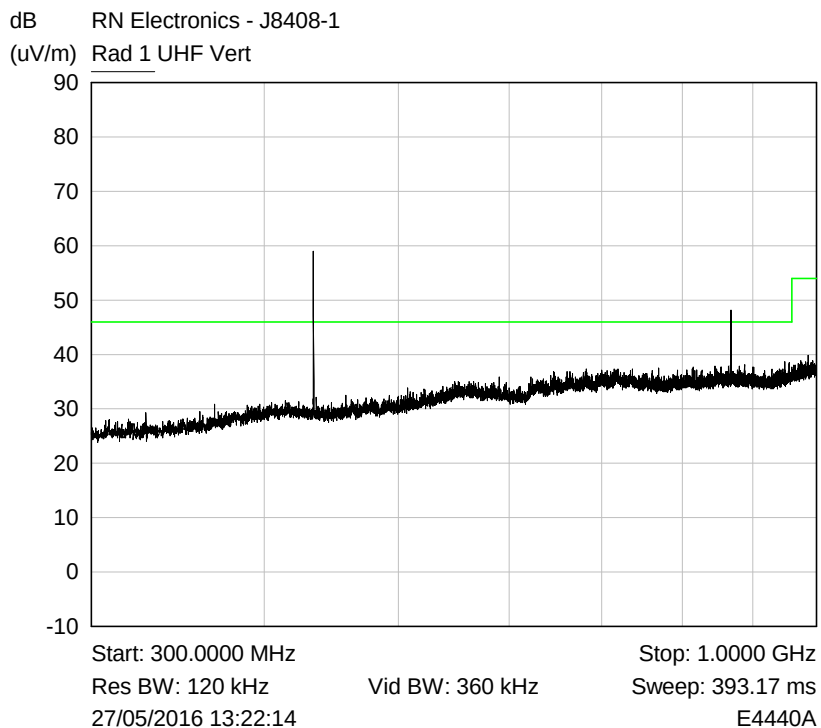
Plot of Peak emissions for VHF Horizontal against the QP limit line.



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



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

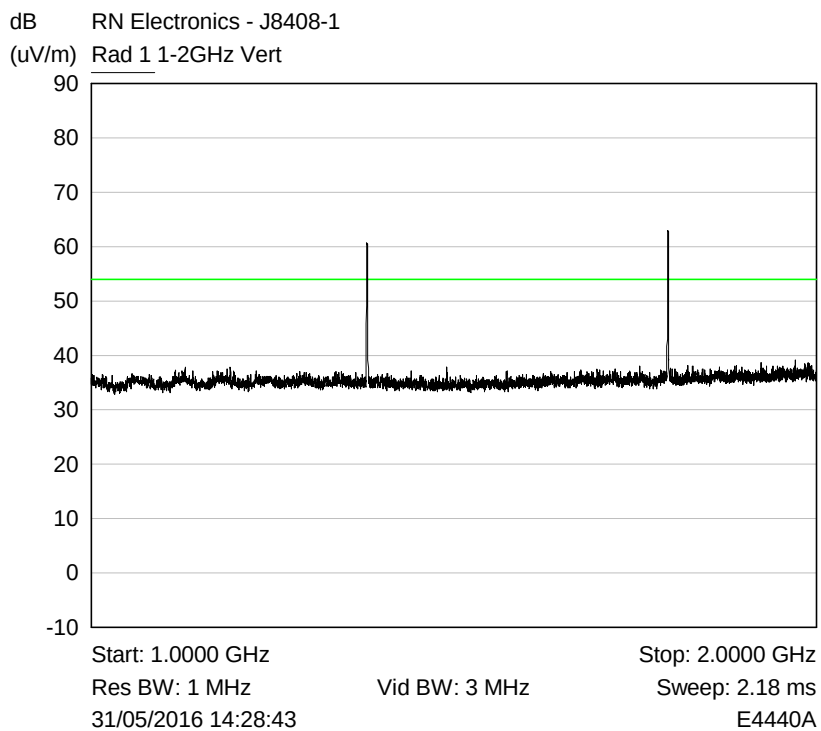
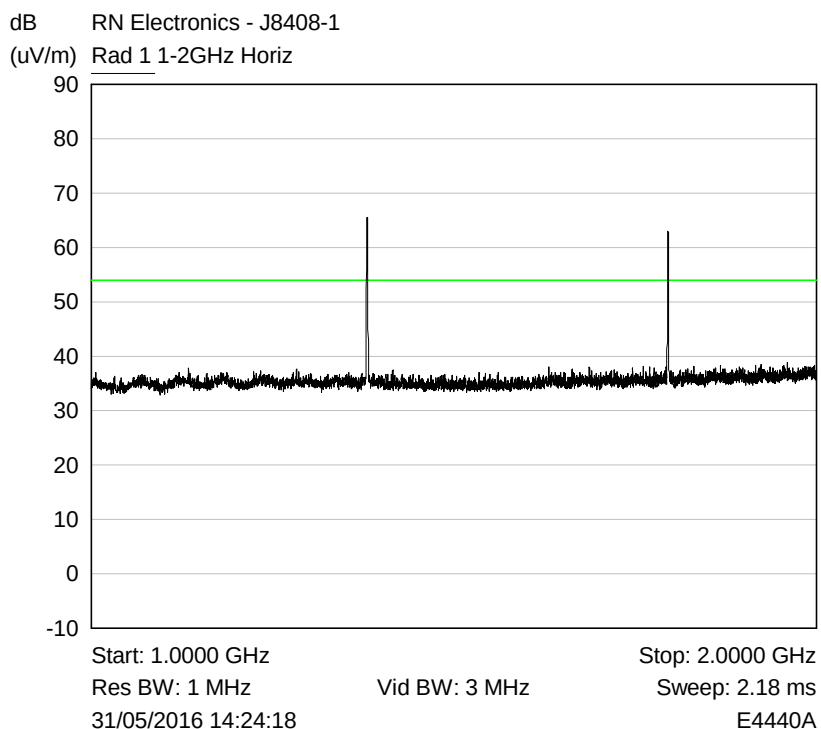


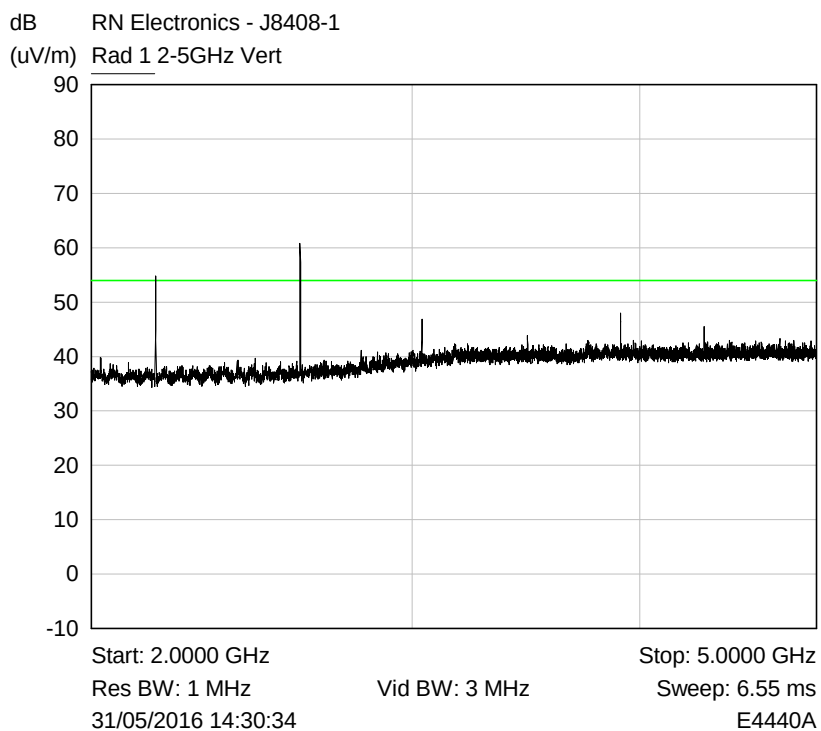
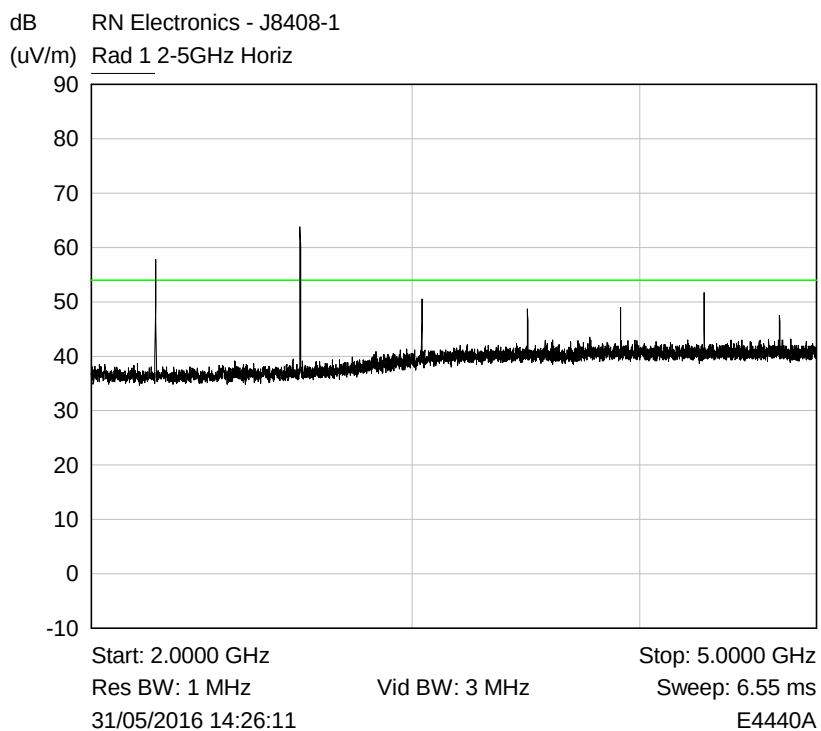
Plot of Peak emissions for UHF Vertical against the QP limit line.

6.4 Radiated emissions above 1 GHz

Note: Plots shown are max held peak plots to the average limit line.

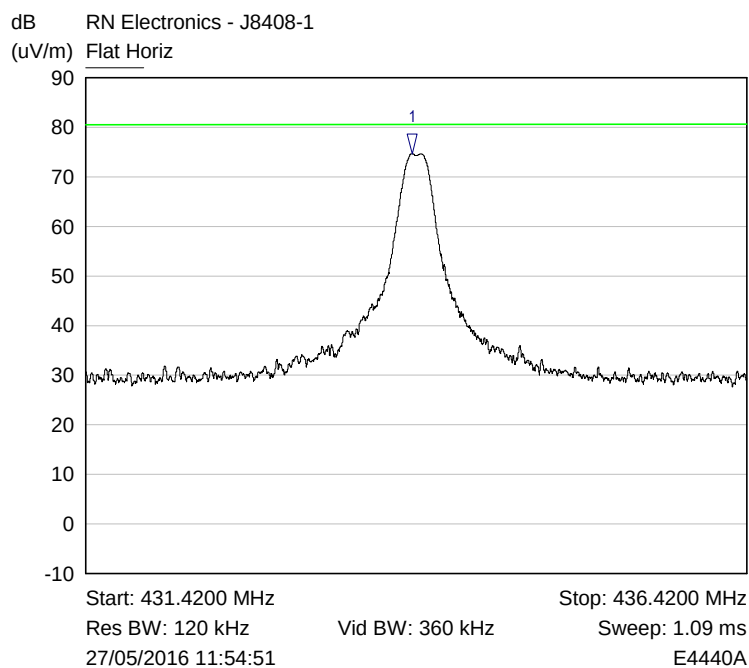
RF Parameters: Band 433.05-434.79 MHz, Power 10 dBm, Channel Spacing Single Channel, Modulation FSK, Channel 433.92 MHz





6.5 Intentional radiator field strength

RF Parameters: Band 433.05-434.79 MHz, Power 10 dBm, Channel Spacing Single Channel, Modulation FSK, Channel 433.92 MHz

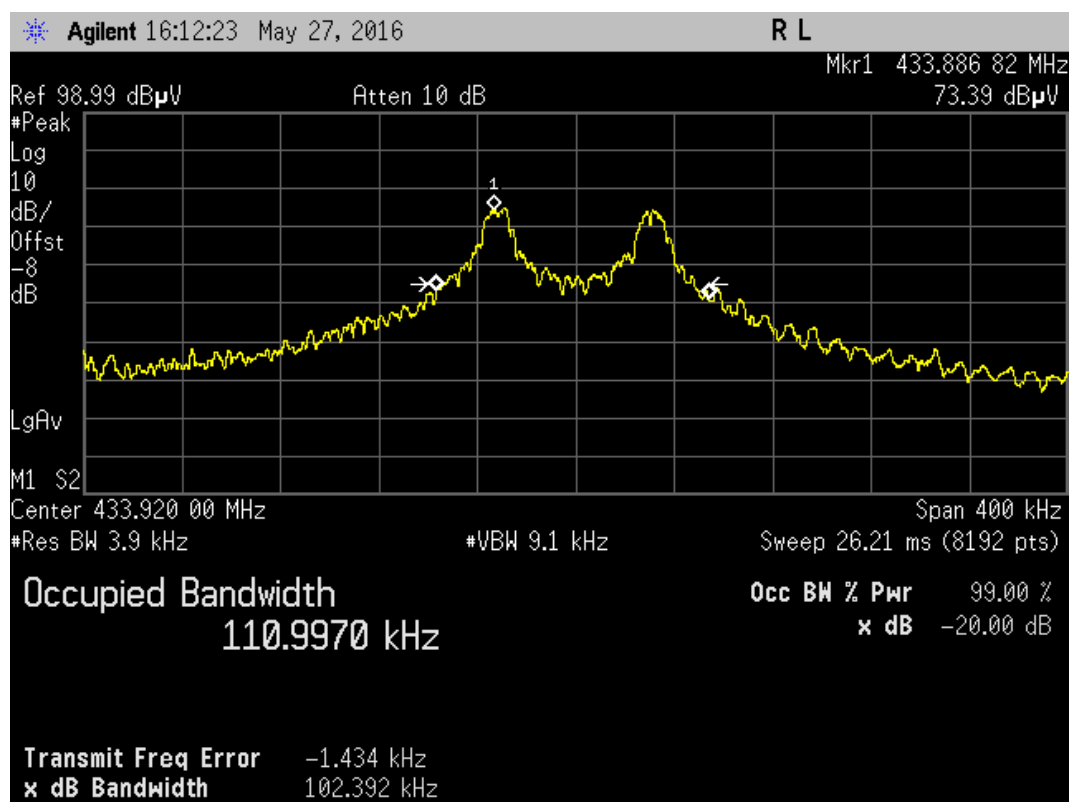


Mkr	Trace	X-Axis	Value	Notes
1 ▽	Flat Horiz	433.8837 MHz	74.74 dB(uV/m)	

Plot of Horiz polarisation and EUT in Flat position

6.6 Occupied bandwidth

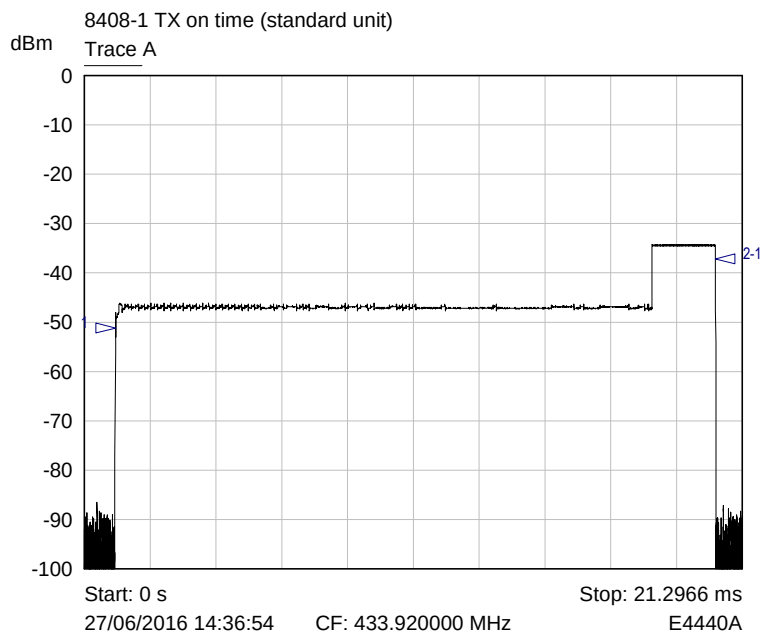
RF Parameters: Band 433.05-434.79 MHz, Power 10 dBm, Channel Spacing Single Channel, Modulation FSK, Channel 433.92 MHz



Plot for 20dB Bandwidth (MHz)

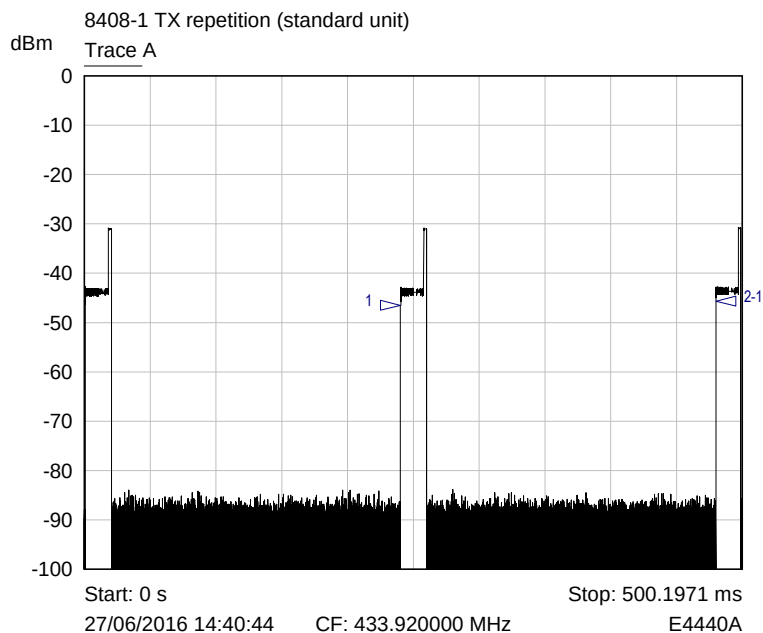
6.7 Periodic operation

RF Parameters: Band 433.05-434.79 MHz, Power 10 dBm, Channel Spacing Single Channel, Modulation FSK



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	1.0010 ms	-51.09 dBm	
2-1 ▽	Trace A	19.4220 ms	13.88 dB	

TX on time (mS)



Mkr	Trace	X-Axis	Value	Notes
1 ▽	Trace A	240.3584 ms	-46.54 dBm	
2-1 ▽	Trace A	239.6256 ms	0.87 dB	

TX repetition time (S)

7 Explanatory Notes

7.1 Explanation of Table of Signals Measured

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

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

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

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

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

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

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

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

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

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

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

7.2 Explanation of limit line calculations for radiated measurements

The limits given in the test standard are normally expressed as absolute values (e.g. in 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 $\mu\text{V/m}$ equates to $20.\log(500) = 54 \text{ dB } \mu\text{V/m}$.

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

(c) limit of 30 $\mu\text{V/m}$ at 30m, but below 30MHz, equates to $20.\log(30) + 40.\log(30/3) = 69.5 \text{ dB}\mu\text{V/m}$ at 3m, as extrapolation factor below 30MHz is 40dB/decade per 15.31(f)(2).

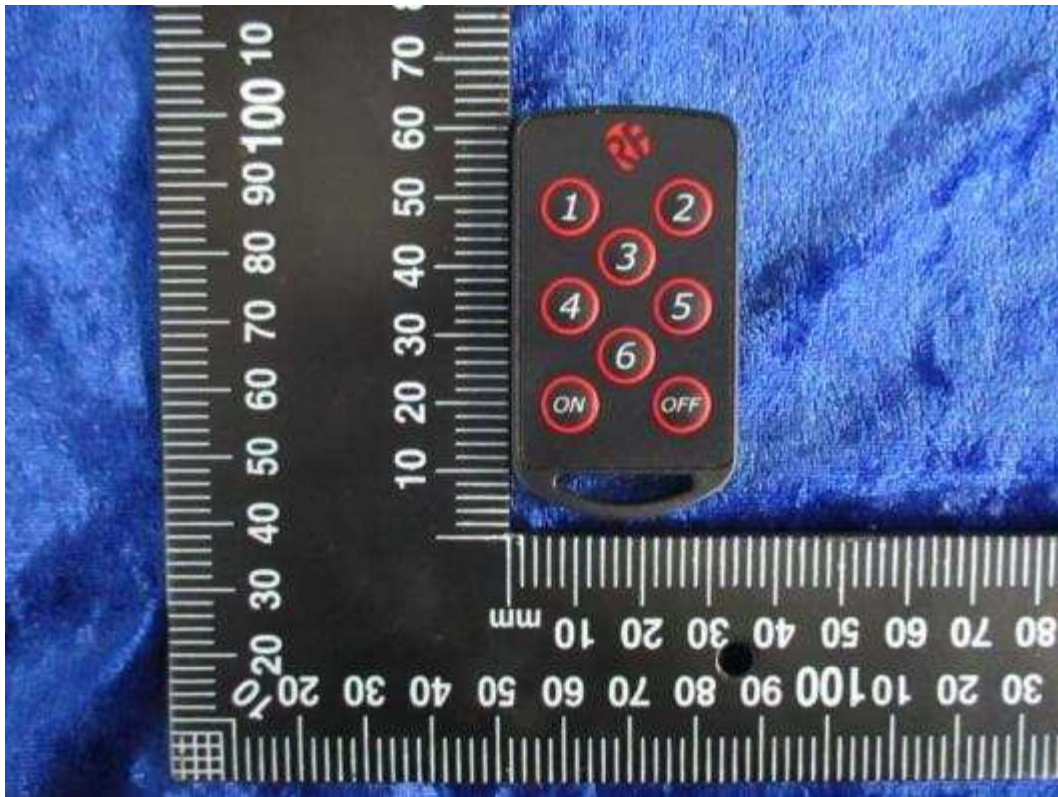
The measurement receiver used for emissions testing, performs the field strength (FS) calculations automatically. The receiver combines the signal amplitude (RA), Antenna Factor (AF) and Cable Loss (CL) factors for the frequency to be measured.

Example calculation: - $\text{FS} = \text{RA} + \text{AF} + \text{CL}$.

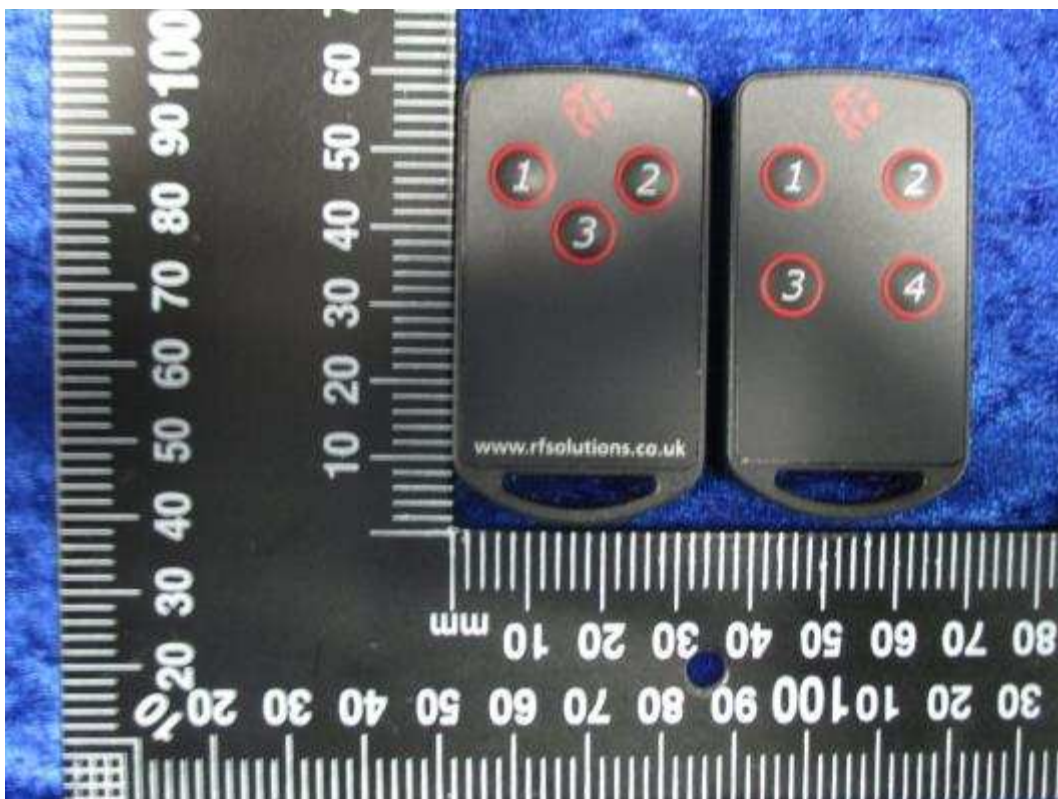
Receiver amplitude (RA)	Antenna factor (3m) (AF)	Cable loss (CL)	Field strength result (3m) (FS)
20dBuV	25 dB	3 dB	48dBuV/m

8 Photographs

8.1 EUT Front View

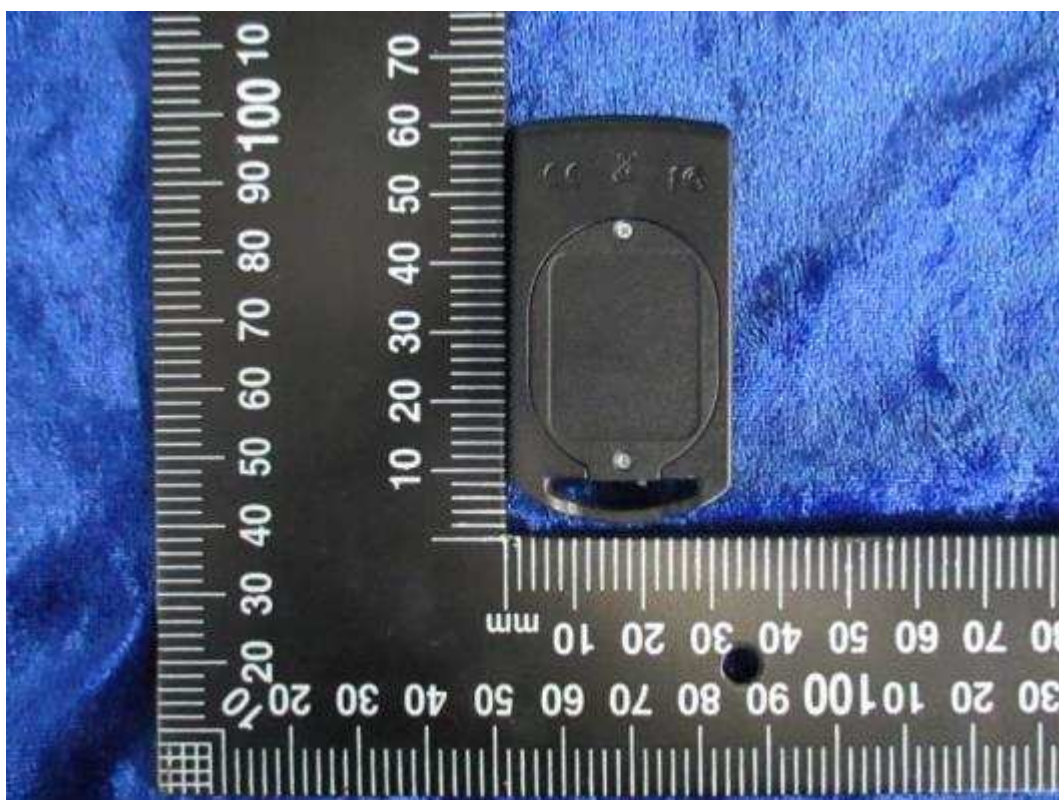


8 button version

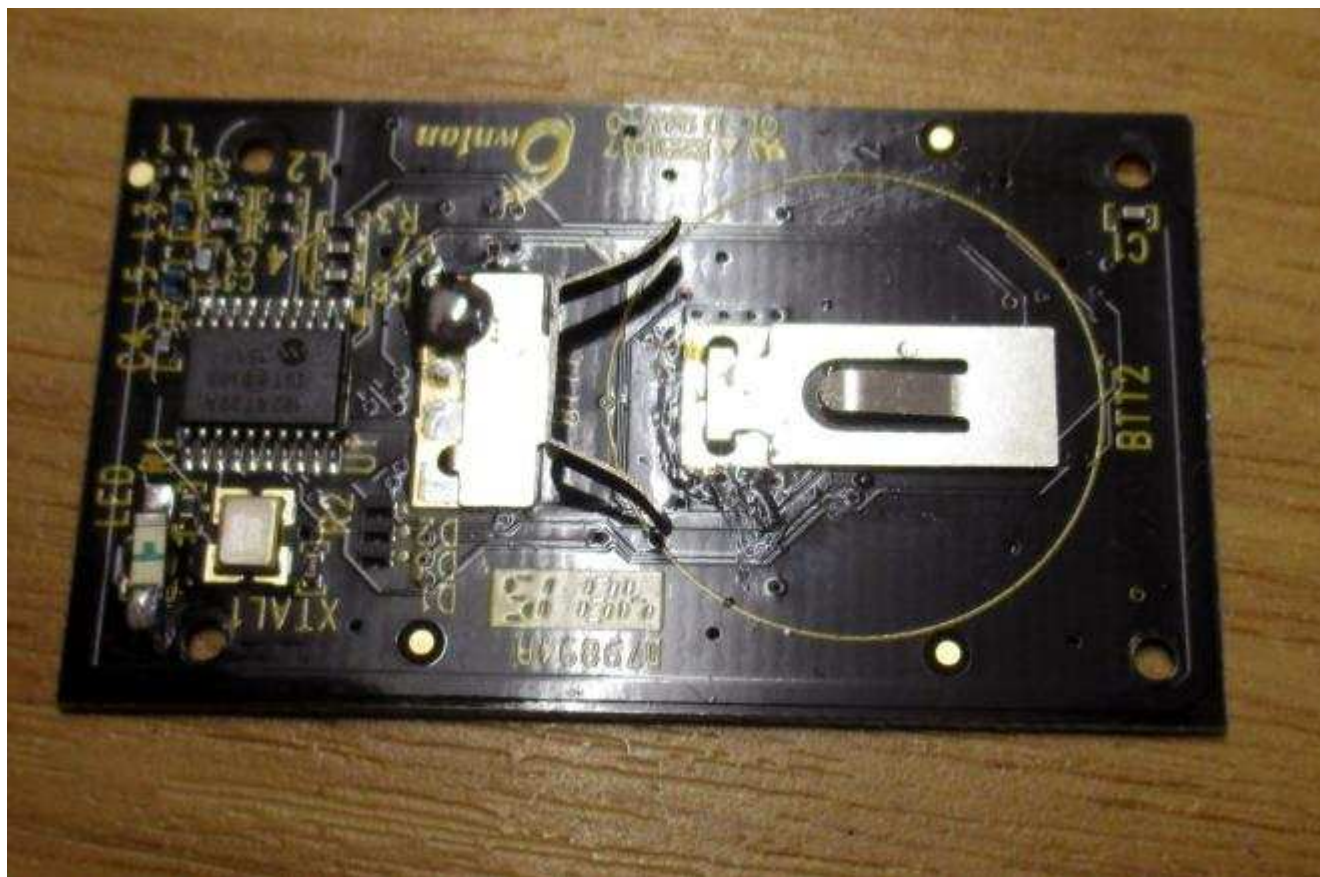


3 and 4 button versions

8.2 EUT Reverse Angle



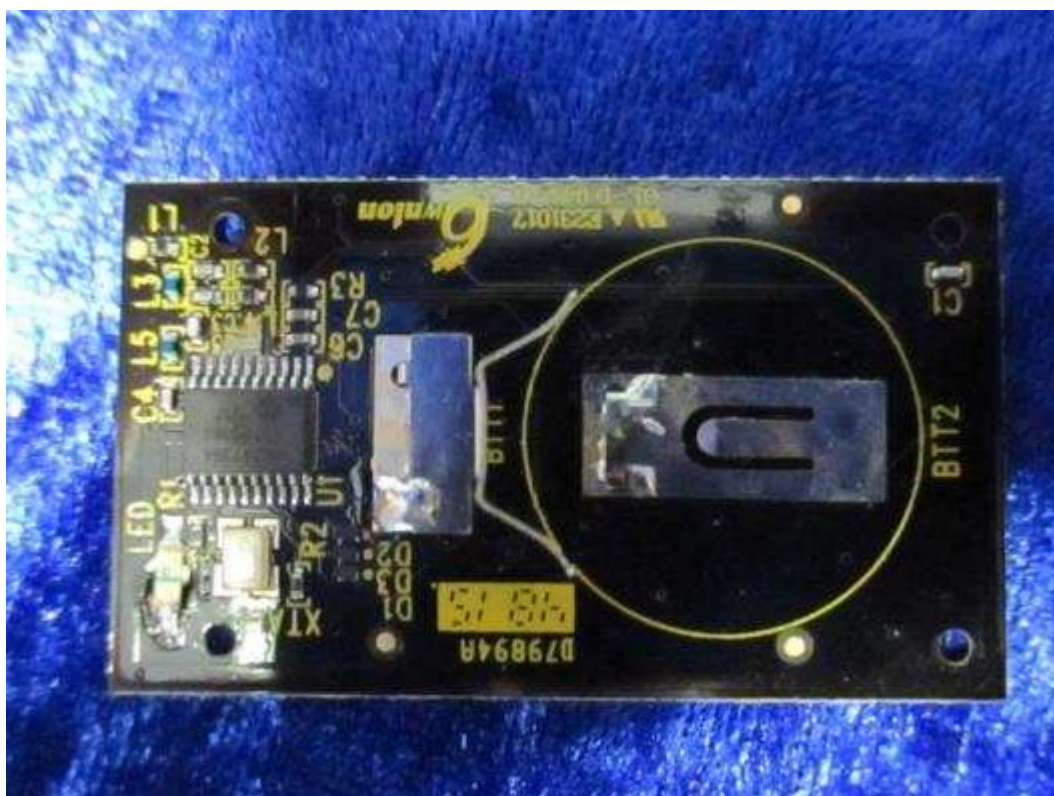
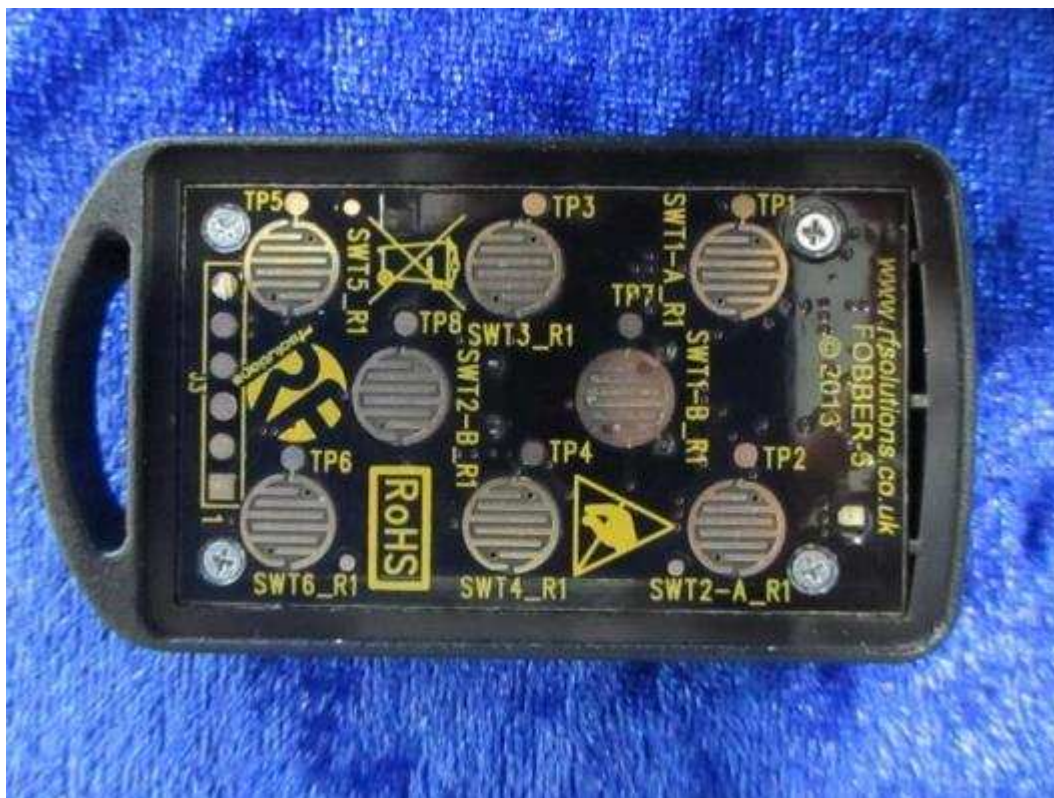
8.3 EUT Antenna Port

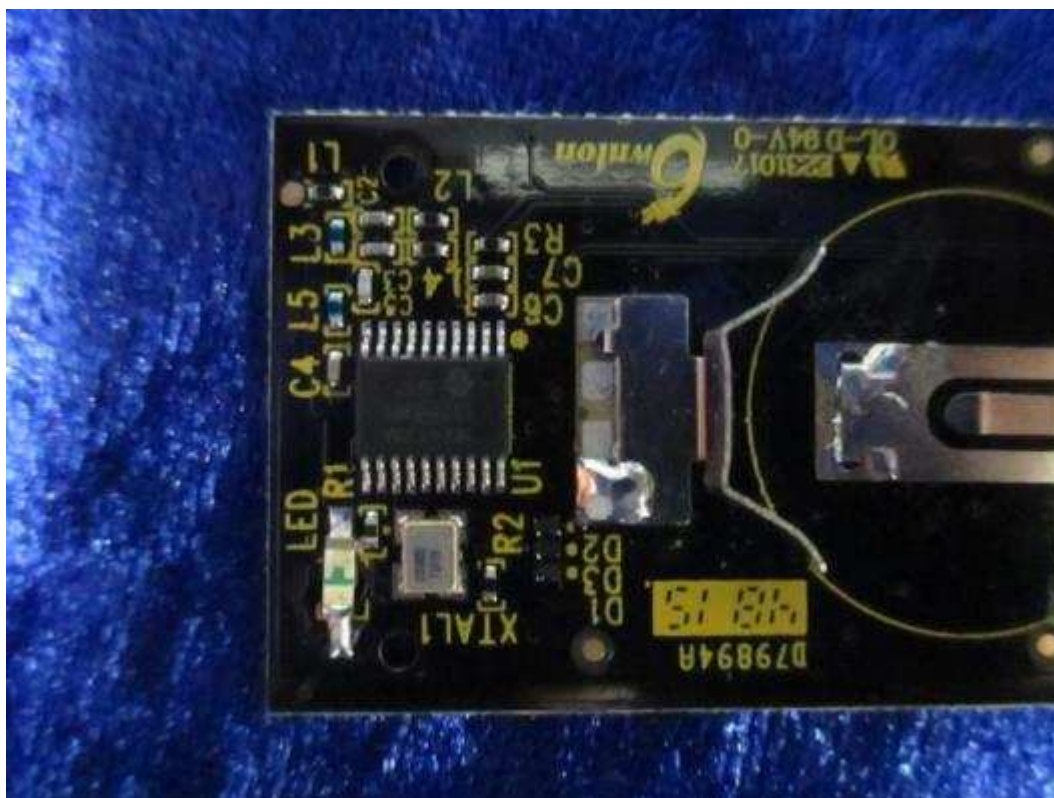


Antenna trace is located on long the left, bottom and right hand sides of the above photograph.

8.4 EUT Display & Controls







8.6 EUT ID Label

The EUT was not provided with a label on at the time of test.

8.7 Radiated emissions 9 - 150 kHz



8.8 Radiated emissions 150 kHz - 30 MHz



8.9 Radiated emissions 30 MHz -1 GHz



8.10 Radiated emissions above 1 GHz



8.11 Radiated emission diagram

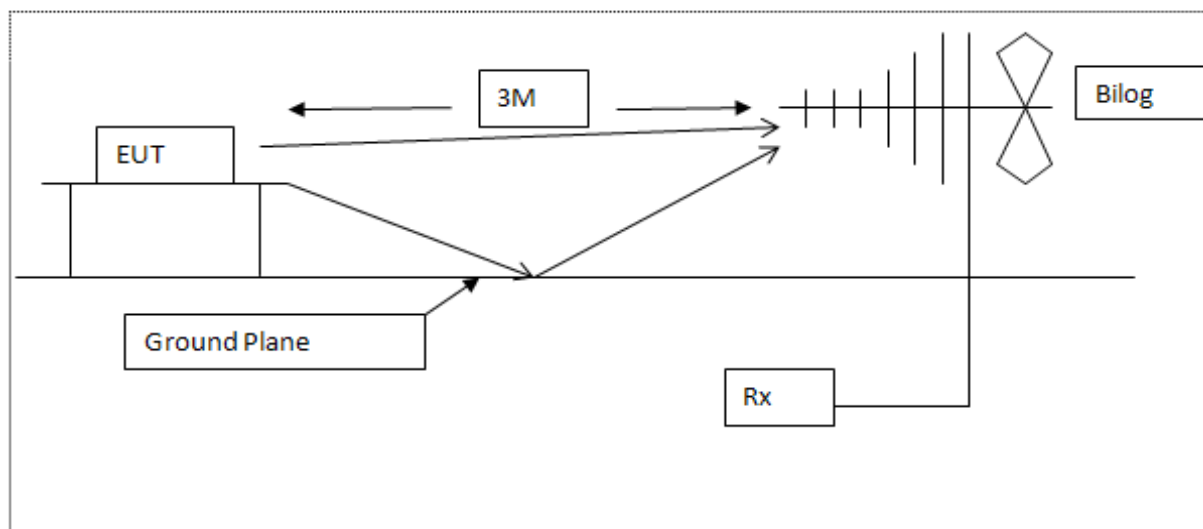


Diagram of the radiated emissions test setup 30 - 1000 MHz

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
E136	3105	Horn Antenna 12.5GHz	EMCO	*04-Apr-2016	12 months
E410	N5181A	Signal Generator 3 GHz MXG	Agilent Technologies	30-Apr-2015	36 months
E411	N9039A	9 kHz - 1 GHz RF Filter Section	Agilent Technologies	*29-Apr-2016	12 months
E412	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	29-Apr-2015	24 months
E624	E4440A	PSA 3 Hz - 26.5 GHz	Agilent Technologies	22-Dec-2015	24 months
E655	R-6052-A04	Attenuator 4dB	-	*23-Mar-2016	12 months
E660	CBL6112	30MHz - 2GHz Bilog Antenna	Chase	*29-Apr-2016	24 months
TMS81	6502	Active Loop Antenna	EMCO	27-Apr-2015	24 months
TMS82	8449B	Pre Amplifier 1 - 26 GHz	Agilent Technologies	17-Dec-2015	12 months
ZSW1	V2.0	Measurement Software Suite	RN Electronics	N/A	N/A

* Items Marked were in calibration at the time of test and have been re-calibrated during/after tests.

10 Auxiliary and peripheral equipment

10.1 Customer supplied equipment

No customer supplied equipment was used.

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
°C	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		