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Radio-Communications Compliance Test Report

FCC CFR 47 Subpart C Intentional Radiators
Report Number: TR3125ERev1



Banlaw
HV Dry Break Wireless Swivel Module
Model No: BNMF800

The results detailed in this test report relate only to the specific sample/s tested. It is the Manufacturer's responsibility to ensure that all production units are manufactured with equivalent EMC characteristics. This report is not to be reproduced except in full, without written approval from Compliance Engineering Pty Ltd.



COMPLIANCE CERTIFICATE

Client Details: Rod McLoughlin
Banlaw Pty Ltd
19 Metro Ct,
Gateshead 2290, NSW
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Email: rmcloughlin@banlaw.com

Device: HV Dry Break Wireless Swivel Module
Model No.: BNMF800
Serial No: DBVQ
FCC ID No: 2A28Y-BRTWSMA


Reference Standard: FCC CFR 47 Subpart C Intentional Radiators (section 15.231)

Summary Result: **FCC CFR 47 Subpart C Intentional Radiators (section 15.231)**
Fundamental field strength: **Complies**
Transmitter spurious: **Complies**
20dB Band width: **Complies**
Transmission Time: **Complies**

Test Date: 27th July 2021 to 17th February 2022

Tests Performed by: Gabriel Mendez
Compliance Engineering Pty Ltd
90 Indian Drive,
Keysborough, Victoria, Australia 3173.
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The **HV Dry Break Wireless Swivel Module** complies with the requirements in FCC CFR 47 Subpart C Intentional Radiators (section 15.231)

		23 rd February 2022
Prepared: Gabriel Mendez Test Engineer Compliance Engineering Pty Ltd	Approved: Andrew Burden Technical Manager Compliance Engineering Pty Ltd	Date



Revision History			
Revision	Issue Date	Remarks	Revised by
1	6-9-2022	Initial release	
2	22-2-2022	Revised to 15.231	GM

Radio-communications Compliance Test Report

1. INTRODUCTION

Radio-communications compliance tests were performed on the HV Dry Break Wireless Swivel Module in accordance with the requirements of FCC CFR 47 Subpart C Intentional Radiators (section 15.231). Test procedure tested in accordance with ANSI C63.10:2020.

2. RESULTS SUMMARY

FCC CFR 47 Subpart C Intentional Radiators (section 15.231)

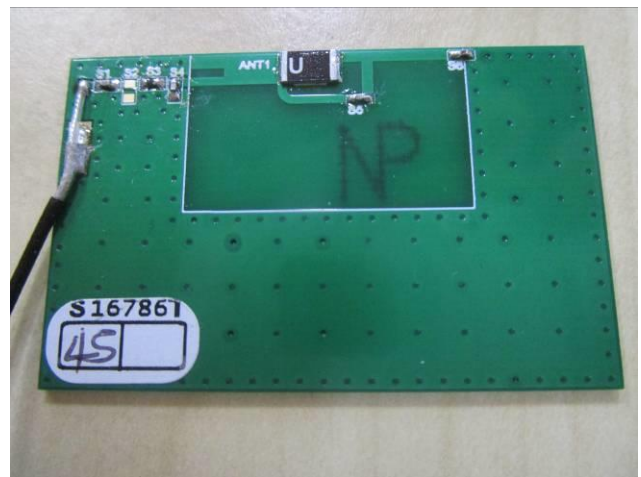
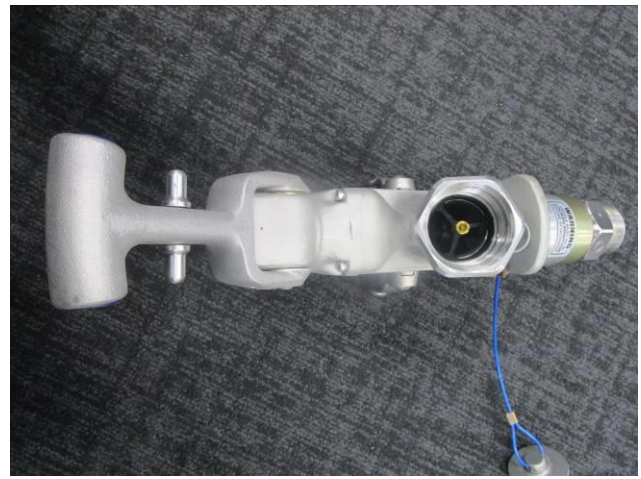
Maximum Peak output power:	Complies
Transmitter spurious: 30 MHz – 6 GHz:	Complies
20dB Bandwidth:	Complies
Transmission Time:	Complies

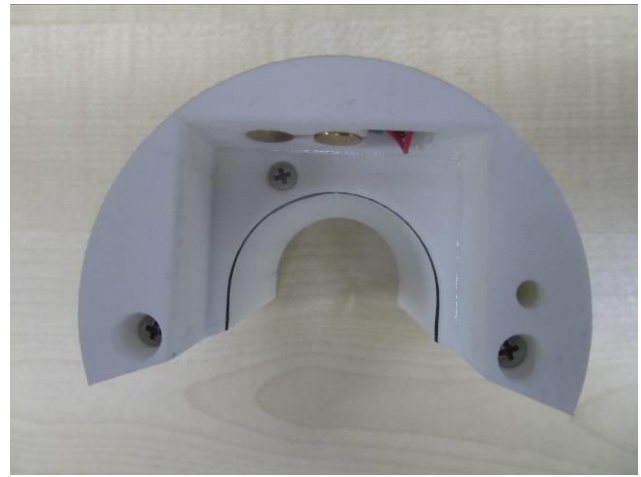
3. TEST SAMPLE

The equipment under test (EUT) is described as follows:

Equipment Under Test (Information supplied by client):	
Product Name	HV Dry Break Wireless Swivel Module
Model No:	BNMF800
Serial No:	DBVQ
Nominal Operating frequency:	433.92 MHz
Operating Channel Width:	100 kHz
Channels:	1
Modulation:	OOK
Antenna Type:	Ceramic Loop PCB
Antenna Gain:	-10 dBi
Max RF power:	11 dBm







4. MODIFICATIONS

No modifications were performed on the above sample by Compliance Engineering.

5. CONFIGURATION

The HV Dry Break Wireless Swivel Module was powered from an internal 3.6 V primary lithium-thionyl chloride high energy density AA-size bobbin cell battery. The HV Dry Break Wireless Swivel Module was configured to transmit continuously at its nominal frequency with an output power of 11 dBm.

6. TEST FACILITY

All measurements were performed inside Compliance Engineering's, 3m Semi-Anechoic (iOATS) enclosure located at 90 Indian Drive, Keysborough, Victoria, Australia.

A2LA (ISO 17025-2017) – Certificate No: 2829.01

Compliance Engineering Pty Ltd, is accredited to ISO 17025-2017 by American Association for Laboratory Accreditation (A2LA) which is an ILAC member and has mutual recognition agreements with the National Voluntary Laboratory Accreditation Program (NVLAP)

All tests within this report have been conducted in accordance with Compliance Engineering's scope of A2LA accreditation.

The current full scope of accreditation can be found on the A2LA website: www.a2la.org

FCC – Registration No: 982700

Compliance Engineering Pty Ltd, has been recognized and is listed as an FCC part 47 CFR 2.948 measurement facility to perform compliance testing on equipment under Parts 15 and 18. The Designation Number is AU0006 and the Test Firm Registration Number is 982700.

Innovation, Science & Economic Development Canada (ISED) - Registration No: 27266

Compliance Engineering's 3m indoor semi-anechoic chamber (iOATS) has been accepted by Innovation, Science & Economic Development Canada (ISED) for performing radiated measurements in accordance with RSS-102, RSS-GEN, RSS-210, RSS-247, RSS-248 – ISED Canada Registration No: 27266

7. FIELD STRENGTH CALCULATION

All emission measurements are automatically calculated via the dedicated EMC software using the pre-stored calibration factors. The following equation simplifies the actual calculation performed.

$$\text{Corr.Ampl} = V_{\text{RAW}} + \text{AF} - \text{G} + \text{L}$$

Where:

Corr.Ampl = Corrected amplitude in dBμV/m (for radiated) & dBμV (for conducted)

V_{RAW} = Raw voltage receiver/analyser reading in dBμV

AF = Antenna Factor in dB (stored as a data array of factor vs frequency)

G = Preamplifier Factor in dB (stored as a data array of gain vs frequency)

L = Cable Loss Factor in dB (stored as a data array of insertion loss vs frequency)

Margin:

This is the margin of compliance below the FCC limit. The units are given in dB. A negative margin indicates the emission was below the limit. A positive margin indicates that the emission exceeds the limit.

Example Calculation:

A peak emission is observed at 100 MHz at 21.5 dBμV. An antenna factor for that frequency is 10 dB. The preamplifier gain factor is 30 dB and the cable loss at that same frequency 1.5 dB. Hence the overall Correction Amplitude is as follows;

$$V_{\text{RAW}} + \text{AF} - \text{G} + \text{L} : \text{Corr.Amp} - \text{CISPR Limit} = \text{Margin}$$

$$31.5 + 10 - 20 + 1.5 : 23 \text{ dB}\mu\text{V/m} - 57.0 \text{ dB}\mu\text{V/m} = -34 \text{ dB}$$

8. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

Measurement	Frequency / Range	Uncertainty (k=2)
Temperature	15.5°C to 24°C	0.5°C
Humidity	15% to 60%	2%
20dB Bandwidth		± 2.38
Transmission Time		± 0.15
Radiated Emissions (Horizontal Polarisation)	30 MHz to 200 MHz	± 4.98
Radiated Emissions (Vertical Polarisation)	30 MHz to 200 MHz	± 5.23
Radiated Emissions (Horizontal Polarisation)	200 MHz to 1000 MHz	± 5.24
Radiated Emissions (Vertical Polarisation)	200 MHz to 1000 MHz	± 5.92
Radiated Emissions (Log Periodic Antenna)	1 GHz to 6 GHz	± 5.14
Radiated Emissions (Log Periodic Antenna)	6 GHz to 18 GHz	± 6.11
Radiated Emissions (Horn Antenna)	18 GHz to 26 GHz	± 6.11
Radiated Emissions (Horn Antenna)	26 GHz to 40 GHz	± 6.11

Note 1: These uncertainties represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Note 2: The reference uncertainty standard specifies that although the measurement uncertainty shall be documented within the test report, the actual determination of compliance shall be based on measurements without taking into account the measurement uncertainty.

9. FIELD STRENGTH OF FUNDAMENTAL

9.1 REQUIREMENTS

FCC CFR 47 Subpart C Intentional Radiators (section 15.231(b)(1))
Average output power @ 433.92 MHz: 10,200 μ V/m @ 3m (80.2 dB μ V/m)
Peak detector used for measurement

Fundamental frequency (MHz)	Field strength of fundamental (microvolts/meter)	Field strength of spurious emissions (microvolts/meter)
40.66-40.70	2,250	225
70-130	1,250	125
130-174	¹ 1,250 to 3,750	¹ 125 to 375
174-260	3,750	375
260-470	¹ 3,750 to 12,500	¹ 375 to 1,250
Above 470	12,500	1,250

9.2 TEST EQUIPMENT

Asset No	Equipment	Model No	Serial No	Cal Due
644	EMI Receiver	ESIB7	100338	Jul 22
97	20 dB Attenuator	UNAT-20	15542	Apr-22
733	Log Periodic Antenna	USLP 9143 B	USLP 9143B 136	Aug 22
94	Preamplifier	UTC10-221-1	9603-4230	Feb 23
760	iOATS (11m x 7m x 6m)	CE-iOATS	2021	Oct 23
TER-S004	Measurement Software	Radimation	Rev: 2021.1.7	-

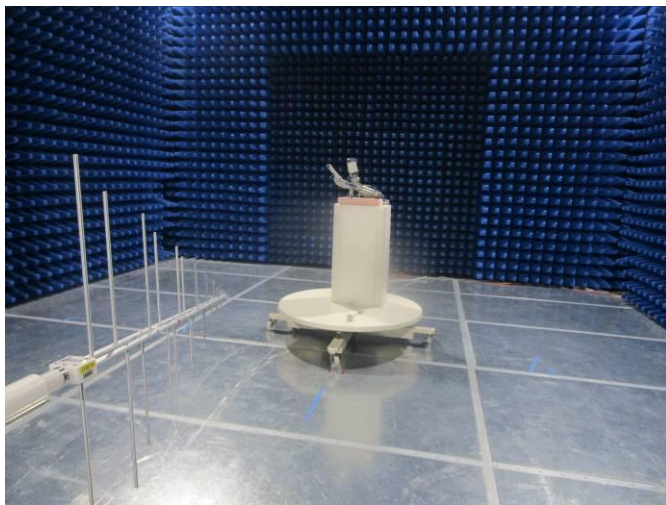
9.3 PROCEDURE

Radiated RF emission measurements were performed at distance of 3 metres, inside a semi anechoic chamber (SAC) in the frequency range of 433MHz.

The EUT was placed directly onto the turntable and slowly rotated through 360° in order to capture the highest emission profile. The tests were conducted with the EUT in operating mode.

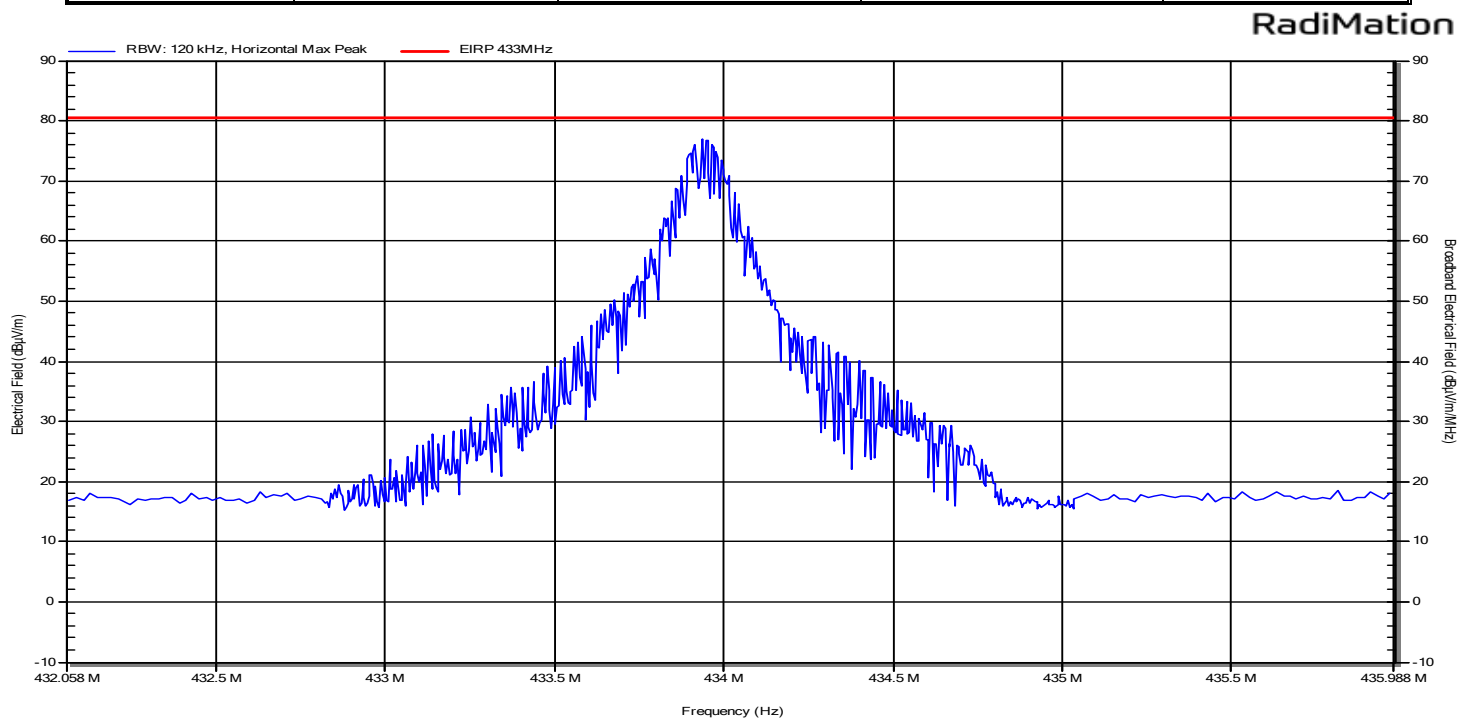
Plots of the accumulated measurement data, including all transducer correction factors were then produced.

EUT was configured by Test Firmware on a laptop to operate in its transmission mode.



9.4 RESULTS

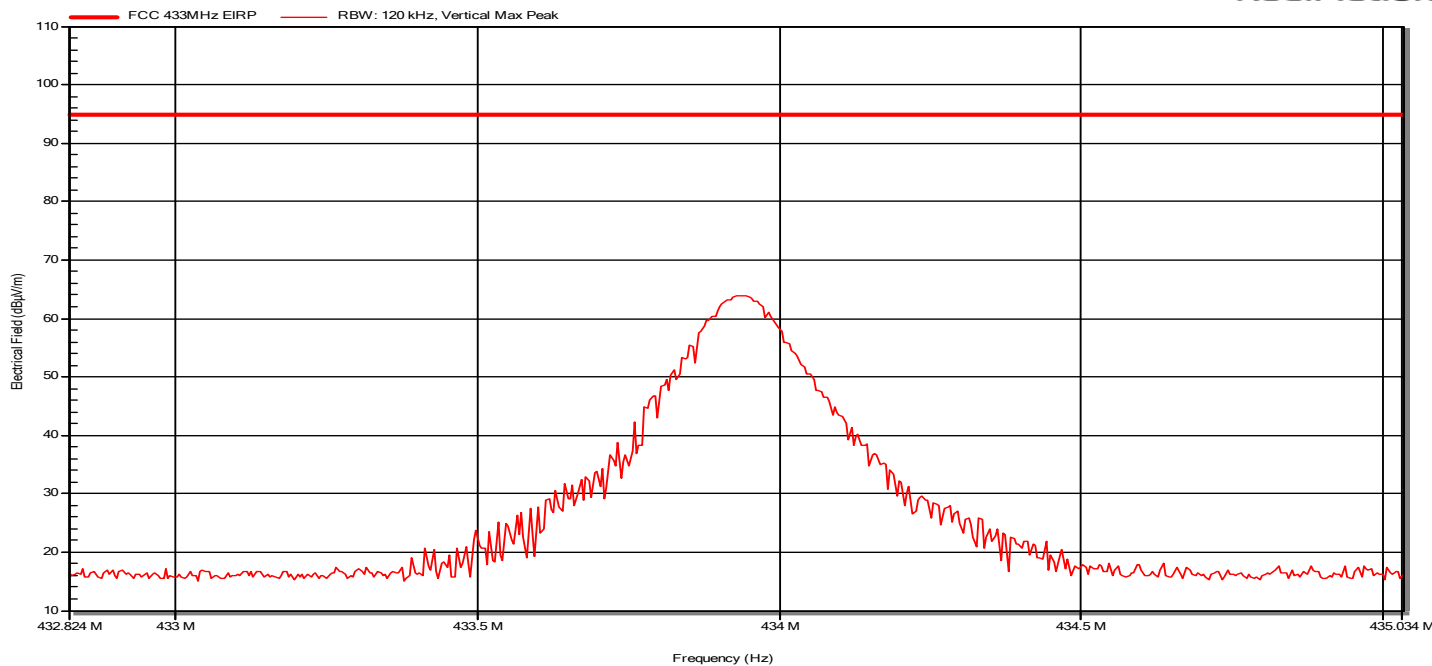
Radiated RF Emission Measurements – Horizontal Polarisation				
Frequency (MHz)	Peak (dB μ V/m)	(3 Metre) Average Limit (dB μ V/m)	Delta Limit (dB)	Result
433	76.9	80.2	-3.3	Pass



Radiated RF Emission Measurements – Vertical Polarisation

Frequency (MHz)	Peak (dBµV/m)	(3 Metre) Average Limit (dBµV/m)	Delta Limit (dB)	Result
433	63.9	80.2	-16.3	Pass

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Environmental Conditions: Temperature 20°C, Humidity 51%

9.5 ASSESSMENT

The HV Dry Break Wireless Swivel Module complies with the requirements detailed in FCC CFR 47 Subpart C Intentional Radiators (section 15.231). The EUT's transmitted maximum EIRP is below the specified limit.

10. TRANSMITTER SPURIOUS EMISSIONS - ENCLOSURE

FCC CFR 47 Subpart C Intentional Radiators (section 15.231) refer to the section 15.209 for emissions radiating outside the specified band.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100 **	3
88-216	150 **	3
216-960	200 **	3
Above 960	500	3

10.1 TEST EQUIPMENT

Asset	Equipment	Model No	Serial No	Cal Due
644	EMI Receiver	ESIB7	100338	Jul 22
733	Log Periodic Antenna	USLP 9143 B	USLP 9143B 136	Aug 22
731	Biconical Antenna	VHBB 9124+BBA 9106	9124-1461	Aug 22
734	Stacked Log Periodic	STLP 9148	176	Aug 22
94	Preamplifier	UTC10-221-1	9603-4230	Feb 23
457	Notch Filter	WBLB-T-BR-433.92-1.74-L	J1091140120001	Feb 23
376	High Pass Filter	JXWBLB-T-HP-950-5000	J1084110719001	Feb 23
760	iOATS (11m x 7m x 6m)	CE-iOATS	2021	Oct 23
TER-S004	Measurement Software	Radimation	Rev: 2021.1.7	-

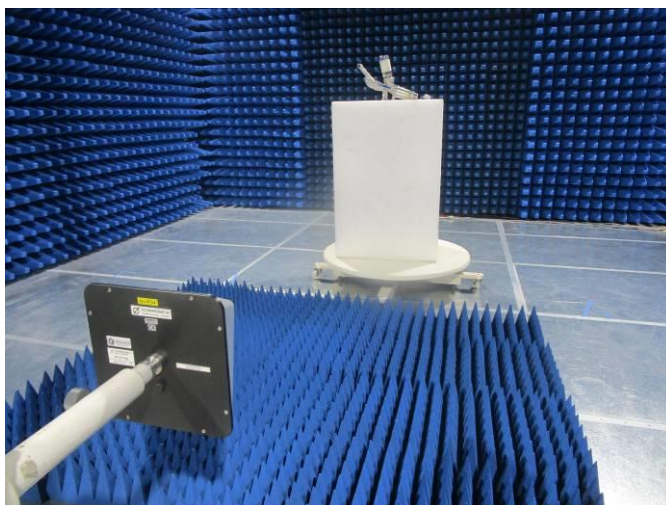
10.2 PROCEDURE

Transmitter spurious emission measurements were performed at distance of 3 metres, inside a semi anechoic chamber (SAC) in the frequency range of 30 MHz to 6 GHz. For measurements above 1 GHz the metal ground plane was covered by RF absorbing material.

The measuring antenna was oriented in turn in both horizontal and vertical polarisations and the height varied between 1 and 4 metres.

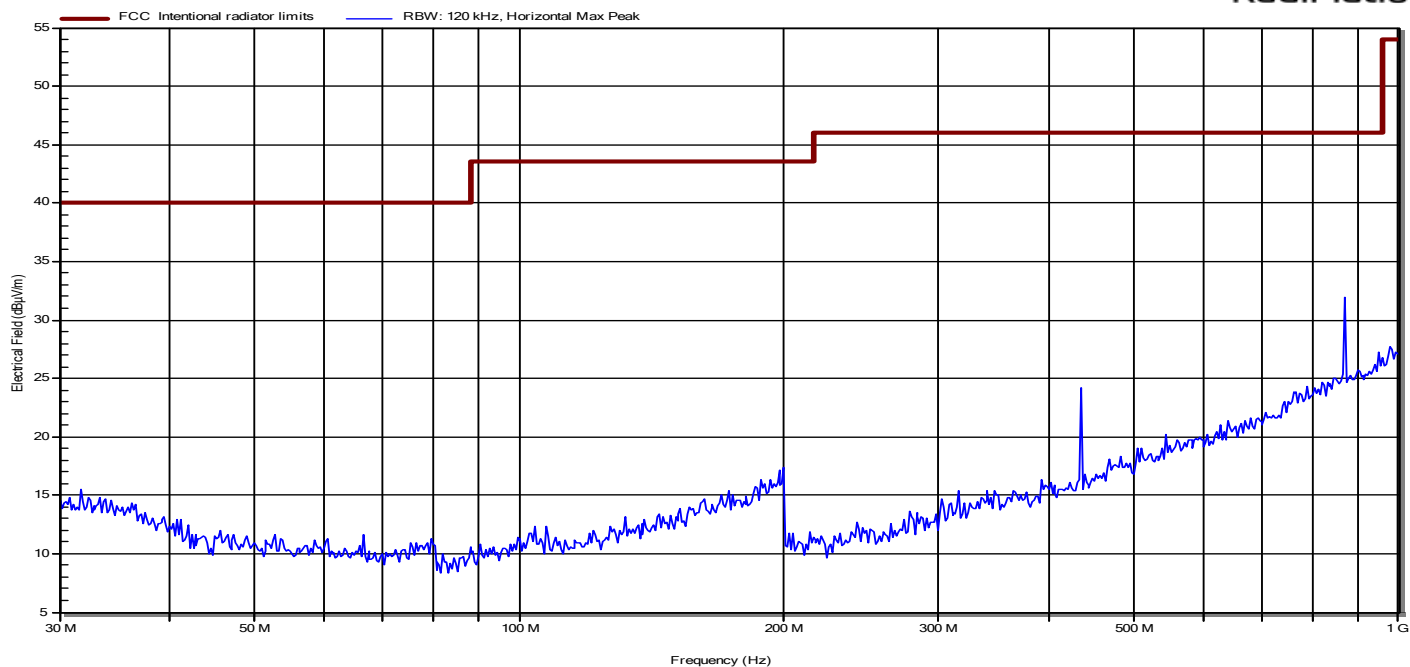
The EUT was placed directly onto the turntable and slowly rotated through 360° in order to capture the highest emission profile.

Plots of the accumulated measurement data, including all site and transducer correction factors were then produced.



10.3 RESULTS

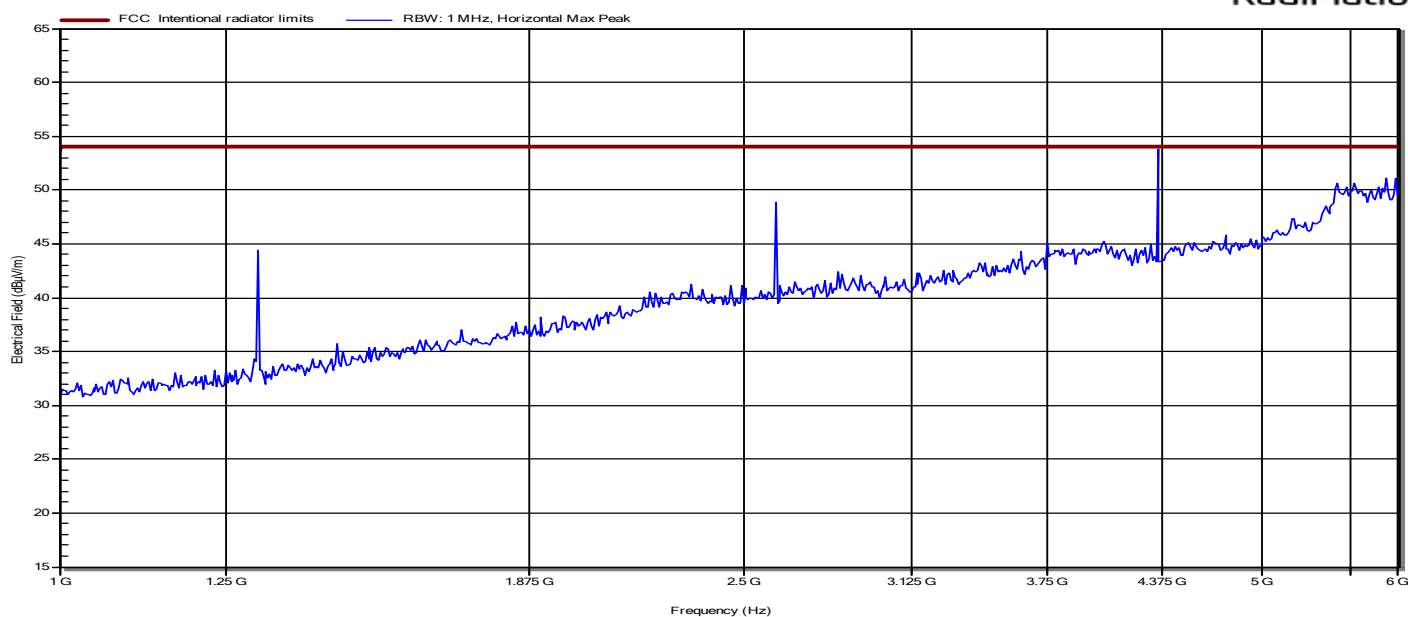
Transmitter Spurious Emissions – Radiated Antenna Method 30 MHz to 1 GHz - Horizontal				
Frequency (MHz)	Peak (dB μ V/m)	3 m Limit (dB μ V/m)	Delta Limit (dB)	Result
866.0	32.0	46.0	-14.0	Pass
433.0	Fundamental Transmitter Emission			N/A





Transmitter Spurious Emissions – Radiated Antenna Method
1 GHz to 6 GHz - Horizontal

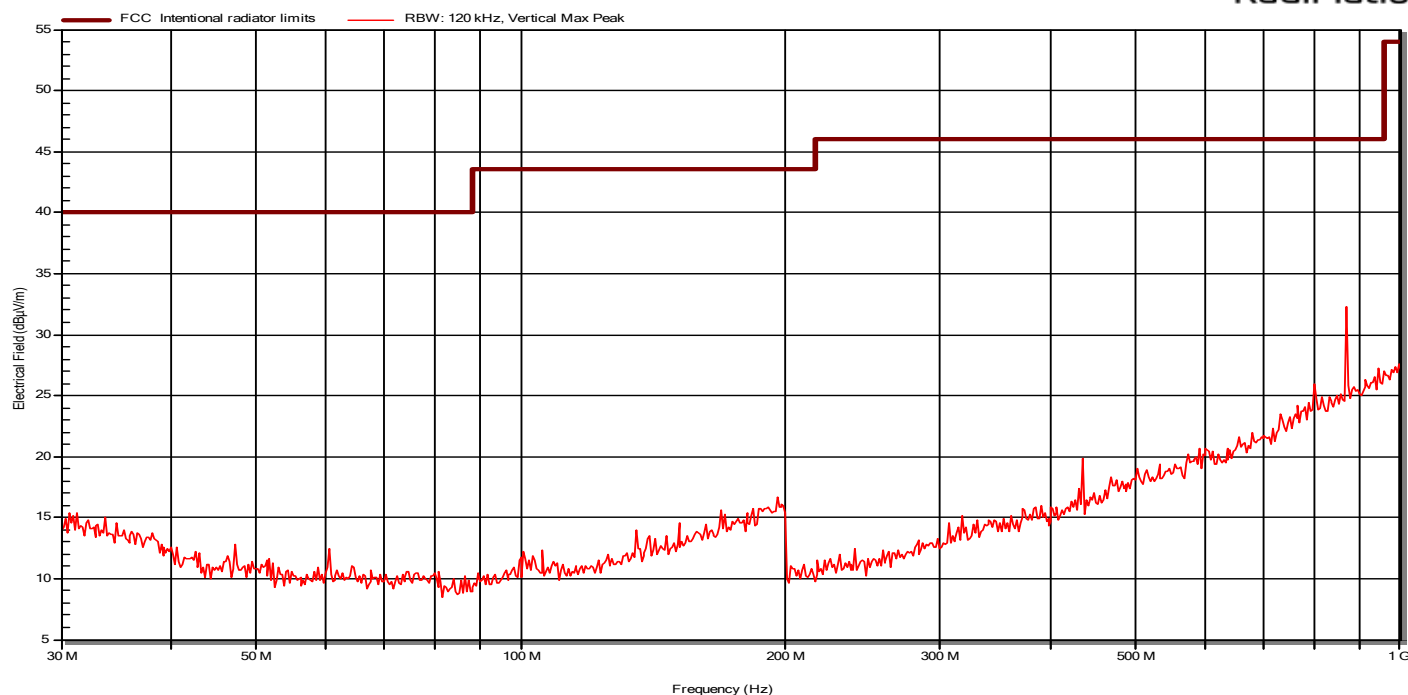
Frequency (MHz)	Peak (dB μ V/m)	3 m Limit (dB μ V/m)	Delta Limit (dB)	Result
1301.0	44.3	54.0	-9.7	Pass
2601.0	48.8	54.0	-5.2	Pass
4337.0	53.8	54.0	-0.2	Pass



RadiMation

Transmitter Spurious Emissions – Radiated Antenna Method
30 MHz to 1 GHz - Vertical

Frequency (MHz)	Quasi Peak (dB μ V/m)	3 m Limit (dB μ V/m)	Delta Limit (dB)	Result
867.7	32.3	46.0	-13.7	Pass
433.0	Fundamental Transmitter Emission			N/A



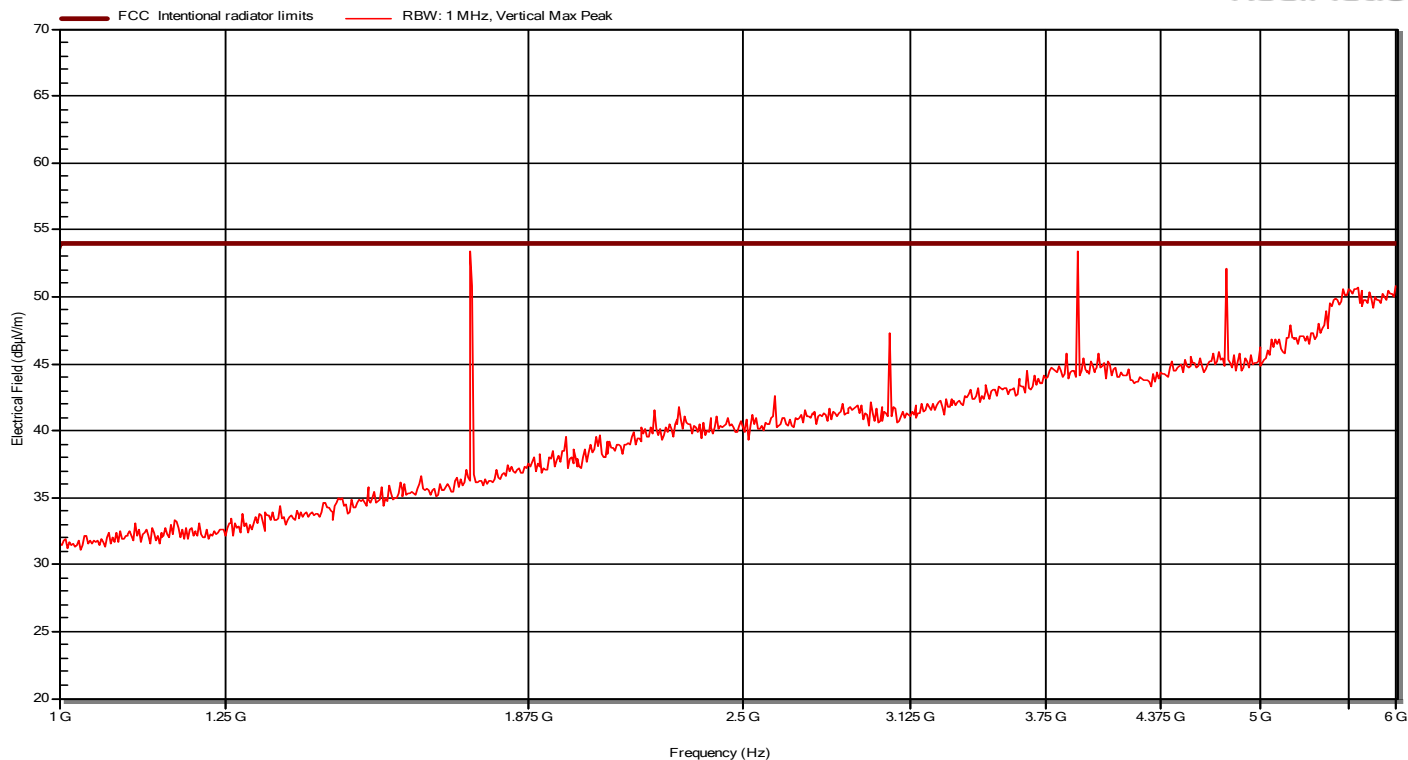
RadiMation



**Transmitter Spurious Emissions – Radiated Antenna Method
1 GHz to 6 GHz - Horizontal**

Frequency (MHz)	Peak (dBμV/m)	3 m Limit (dBμV/m)	Delta Limit (dB)	Result
1735.0	53.4	54.0	-0.6	Pass
3038.0	47.3	54.0	-6.7	Pass
3908.0	53.4	54.0	-0.6	Pass
4774	52.1	54.0	-1.9	Pass

RadiMation



Environmental Conditions: Temperature 20°C, Humidity 55%

10.4 ASSESSMENT

The HV Dry Break Wireless Swivel Module complies with the requirements detailed in FCC CFR 47 Subpart C Intentional Radiators section 15.209.

11. 20 dB BANDWIDTH MEASUREMENTS

11.1 REQUIREMENTS

The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

11.2 TEST EQUIPMENT

Asset No	Equipment	Model No	Serial No	Cal Due
1	Spectrum Analyser	HP8595EM	3536A00126	Jan 23
97	20 dB Attenuator	UNAT-20	15542	Apr-22
6	Log Periodic Antenna	LP1000	LP01	Sep 22
94	Preamplifier	UTC10-221-1	9603-4230	Sep 22

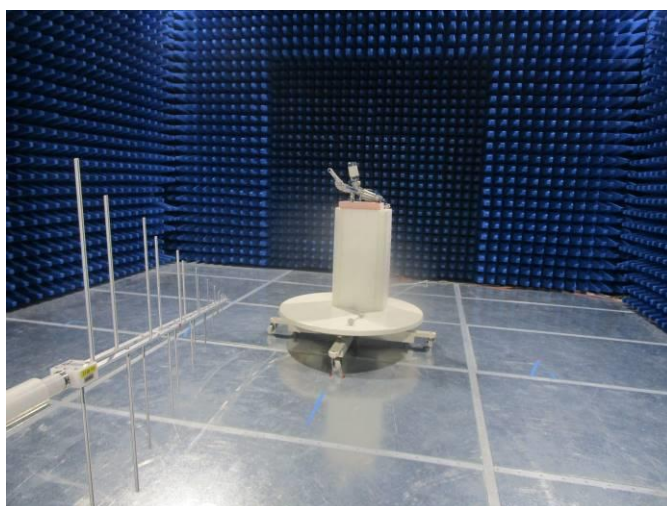
11.3 PROCEDURE

Radiated RF emission measurements were performed at distance of 3 metres, inside a semi anechoic chamber (SAC) in the frequency range of 433 MHz.

The EUT was placed directly onto the turntable and slowly rotated through 360° in order to capture the highest emission profile. The tests were conducted with the EUT in operating mode.

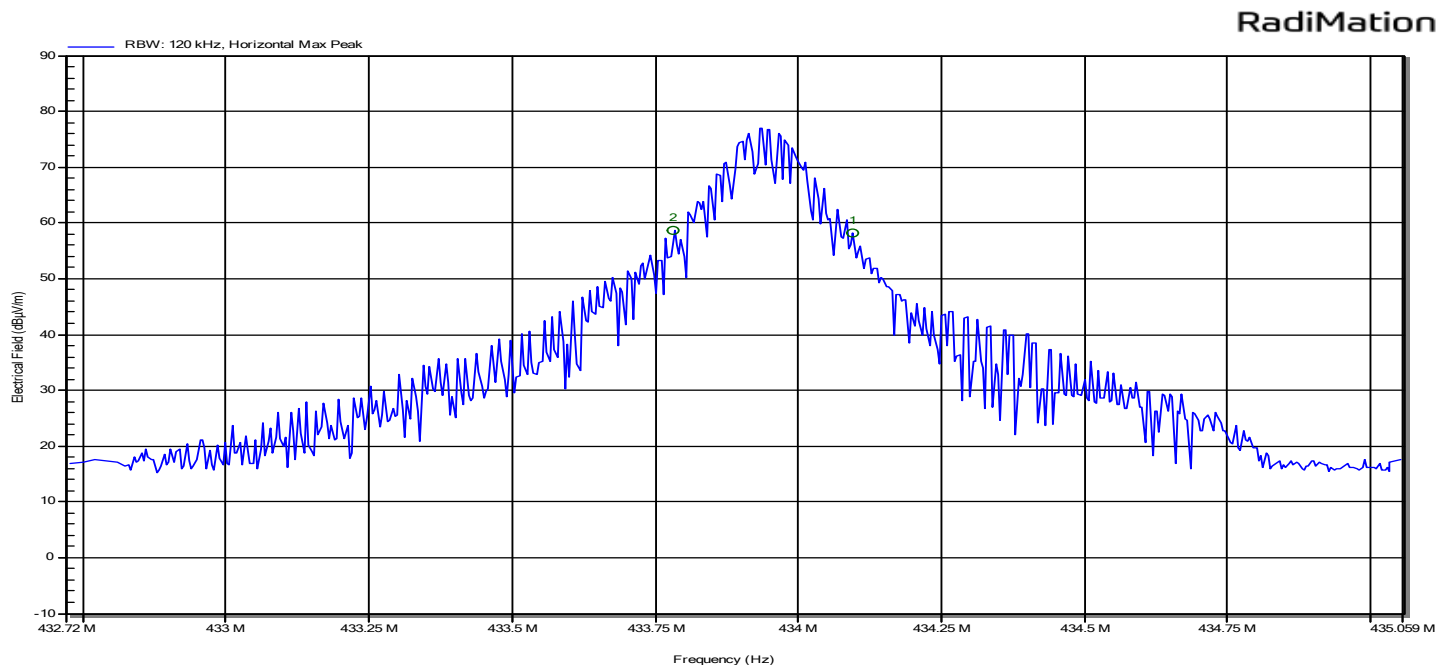
Plots of the accumulated measurement data, including all transducer correction factors were then produced.

EUT was configured by Test Firmware on a laptop to operate in its transmission mode.



11.4 RESULTS

20 dB Frequency BW	Frequency Range (MHz)	Limit (kHz)	Result
315 kHz	433.92	1084	Pass



Environmental Conditions: Temperature 17 °C, Humidity 76%

11.5 ASSESSMENT

The HV Dry Break Wireless Swivel Module complies with the requirements detailed in FCC CFR 47 Subpart C Intentional Radiators section 15.231(c).

12. TRANSMISSION TIME

12.1 REQUIREMENTS

A transmitter activated automatically shall cease transmission within 5 seconds after activation.

12.2 TEST EQUIPMENT

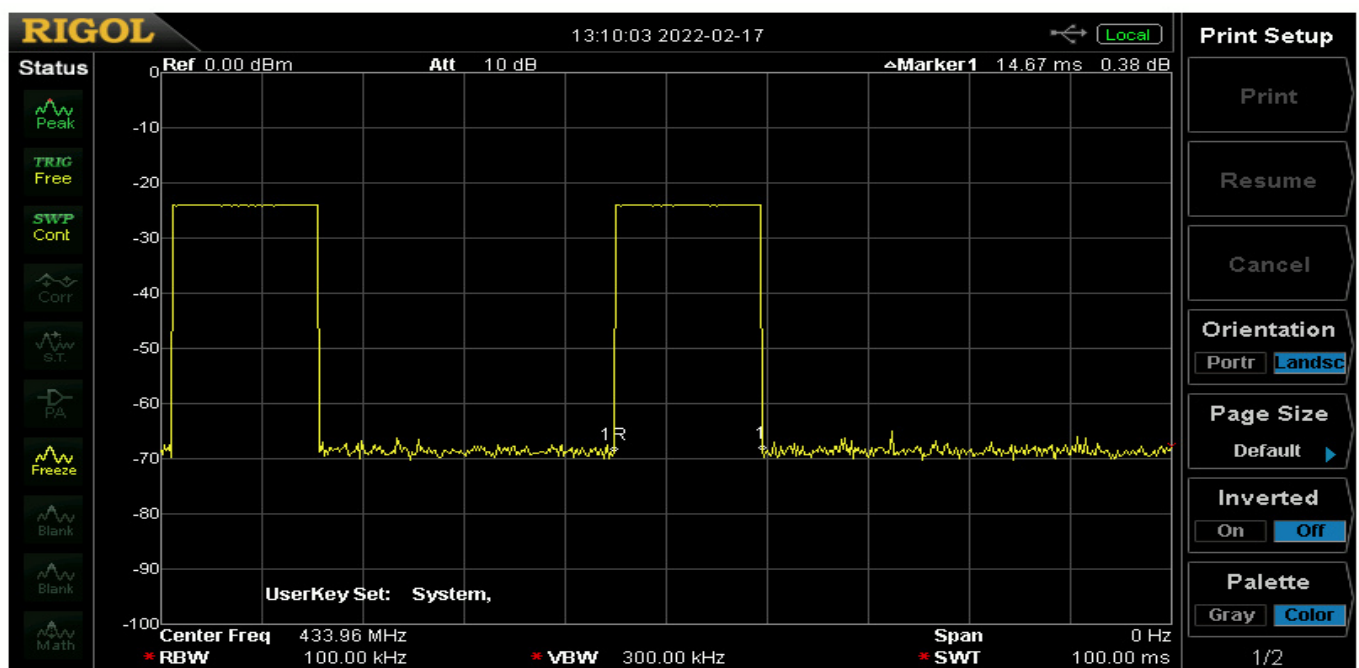
Asset No	Equipment	Model No	Serial No	Cal Due
743	Spectrum Analyser	DSA 815	DSA8B223300443	Sep 22

12.3 PROCEDURE

The EUT's antenna was placed next to a receive antenna connected to a spectrum analyser. The transmitter was set to a frequency of 433.92 MHz. The spectrum analyser was set to zero span.

12.4 RESULTS

Frequency (MHz)	Transmission Time (ms)	Limit (ms)	Result
433.92	14.67	5000	Pass



Environmental Conditions: Temperature 17 °C, Humidity 76%

12.5 ASSESSMENT

The HV Dry Break Wireless Swivel Module complies with the requirements detailed in FCC CFR 47 Subpart C Intentional Radiators section 15.231(a)(2).

13. CONCLUSION

The **HV Dry Break Wireless Swivel Module** complies with applicable requirements detailed in FCC CFR 47 Subpart C Intentional Radiators (section 15.231).