

# Test report

**279529-2TRFWL**

Date of issue: May 21, 2015

Applicant:

**DEI Headquarters, Inc.**

Product:

**Remote Control**

Model:

**7816V**

FCC ID:

**EZSDEI7816**

IC Registration number:

**1513A-7816**

Specifications:

◆ **FCC 47 CFR Part 15 Subpart C, §15.247**

Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz

◆ **RSS-210, Issue 8, December 2010, Annex 8**

Frequency Hopping and Digital Modulation Systems Operating in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz Bands

#### Test location

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Website:	www.nemko.com
Site number:	FCC: 176392; IC: 2040A-4 (3 m semi anechoic chamber)

Tested by:	Kevin Rose, Wireless/EMC Specialist and Daniel Hynes, Senior EMC Specialist
Reviewed by:	Andrey Adelberg, Senior Wireless/EMC Specialist
Date:	May 21, 2015
Signature:	

#### Limits of responsibility

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Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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## Section 1. Report summary

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### 1.1 Applicant and manufacturer

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Company name:	DEI Headquarters, Inc.
Address:	1 Viper Way
City:	Vista
Province/State:	CA
Postal/Zip code:	92081
Country:	USA

### 1.2 Test specifications

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FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, 5725–5850 MHz
RSS-210, Issue 8 Annex 8	Frequency Hopping and Digital Modulation Systems Operating in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz Bands

### 1.3 Test methods

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DA 00-705 Released March 30, 2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
ANSI C63.10 v 2013	American National Standard for Testing Unlicensed Wireless Devices

### 1.4 Statement of compliance

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In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See “Summary of test results” for full details.

### 1.5 Exclusions

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None

### 1.6 Test report revision history

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Revision #	Details of changes made to test report
TRF	Original report issued

## Section 2. Summary of test results

### 2.1 FCC Part 15 Subpart C, general requirements test results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.31(e)	Variation of power source	Pass <sup>1</sup>
§15.203	Antenna requirement	Pass <sup>2</sup>

Notes: <sup>1</sup> Measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, was performed with the performed using a new battery.

<sup>2</sup> The Antennas are located within the enclosure of EUT and not user accessible.

### 2.2 FCC Part 15 Subpart C, intentional radiators test results

Part	Test description	Verdict
§15.247(a)(1)(i)	Frequency hopping systems operating in the 902–928 MHz band	Pass
§15.247(a)(1)(ii)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
§15.247(a)(1)(iii)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
§15.247(a)(2)	Minimum 6 dB bandwidth for systems using digital modulation techniques	Not applicable
§15.247(b)(1)	Maximum peak output power of frequency hopping systems operating in the 2400–2483.5 MHz band and 5725–5850 MHz band	Not applicable
§15.247(b)(2)	Maximum peak output power of Frequency hopping systems operating in the 902–928 MHz band	Pass
§15.247(b)(3)	Maximum peak output power of systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands	Not applicable
§15.247(b)(4)	Maximum peak output power	Not applicable
§15.247(c)(1)	Fixed point-to-point operation with directional antenna gains greater than 6 dBi	Not applicable
§15.247(c)(2)	Transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams	Not applicable
§15.247(d)	Spurious emissions	Pass
§15.247(e)	Power spectral density for digitally modulated devices	Not applicable
§15.247(f)	Time of occupancy for hybrid systems	Not applicable

### 2.3 IC RSS-GEN, Issue 4, test results

Part	Test description	Verdict
6.6	Occupied bandwidth	Pass
7.2.4	AC power lines conducted emission limits	Not applicable

Notes: <sup>1</sup> According to Notice 2012-DRS0126 (from January 2012) section 2.2 of RSS-Gen, Issue 4 has been revised. The EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

## 2.4 IC RSS-210, Issue 8, test results

Part	Test description	Verdict
A8.1	Frequency hopping systems	
A8.1 (a)	Bandwidth of a frequency hopping channel	Pass
A8.1 (b)	Minimum channel spacing for frequency hopping systems	Pass
A8.1 (c)	Frequency hopping systems operating in the 902–928 MHz band	Pass
A8.1 (d)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
A8.1 (e)	Frequency hopping systems operating in the 5725–5850 MHz band	Not applicable
A8.2	Digital modulation systems	
A8.2 (a)	Minimum 6 dB bandwidth	Not applicable
A8.2 (b)	Maximum power spectral density	Not applicable
A8.3	Hybrid systems	
A8.3 (1)	Digital modulation turned off	Not applicable
A8.3 (2)	Frequency hopping turned off	Not applicable
A8.4	Transmitter output power and e.i.r.p. requirements	
A8.4 (1)	Frequency hopping systems operating in the 902–928 MHz band	Pass
A8.4 (2)	Frequency hopping systems operating in the 2400–2483.5 MHz band	Not applicable
A8.4 (3)	Frequency hopping systems operating in the 5725–5850 MHz	Not applicable
A8.4 (4)	Systems employing digital modulation techniques	Not applicable
A8.4 (5)	Point-to-point systems in 2400–2483.5 MHz and 5725–5850 MHz band	Not applicable
A8.4 (6)	Transmitters which operate in the 2400–2483.5 MHz band with multiple directional beams	Not applicable
A8.5	Out-of-band emissions	Pass

Notes: None

## Section 3. Equipment under test (EUT) details

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### 3.1 Sample information

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Receipt date	March 4, 2015
Nemko sample ID number	133-000130

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### 3.2 EUT information

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Product name	Remote Control
Model	7816V
Serial number	None

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### 3.3 Technical information

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Operating band	902–928 MHz
Operating frequency	907.095–923.835 MHz
Modulation type	FSK
Occupied bandwidth (99 %)	304.5
Emission designator	304KF1D
Power requirements	3 V <sub>DC</sub> battery
Antenna information	Internal antenna with 0 dBi gain and the EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

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### 3.4 Product description and theory of operation

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Two way transmitter for car remote starter.

### 3.5 EUT exercise details

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The EUT was modified to transmit low, mid, and high channels.

### 3.6 EUT setup diagram

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*Figure 3.6-1: Setup diagram*



## Section 4. Engineering considerations

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### 4.1 Modifications incorporated in the EUT

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There were no modifications performed to the EUT during this assessment.

### 4.2 Technical judgment

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None

### 4.3 Deviations from laboratory tests procedures

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No deviations were made from laboratory procedures.

## Section 5. Test conditions

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### 5.1 Atmospheric conditions

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Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 mbar

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

### 5.2 Power supply range

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The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages  $\pm 5\%$ , for which the equipment was designed.

## Section 6. Measurement uncertainty

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### 6.1 Uncertainty of measurement

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Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of  $K = 2$  with 95% certainty.

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

## Section 7. Test equipment

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### 7.1 Test equipment list

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*Table 7.1-1: Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002532	1 year	Oct. 16/15
Flush mount turntable	Sunol	FM2022	FA002550	—	NCR
Controller	Sunol	SC104V	FA002551	—	NCR
Antenna mast	Sunol	TLT2	FA002552	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	Jan. 07/16
Bilog antenna (20–2000 MHz)	Sunol	JB1	FA002517	1 year	Aug. 29/15
Horn antenna (1–18 GHz)	EMCO	3115	FA001452	1 year	Aug. 26/15
Pre-amplifier (0.5–18 GHz)	COM-POWER	PAM-118A	FA002561	1 year	July 9/15

Note: NCR - no calibration required

## Section 8. Testing data

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### 8.1 FCC 15.247(a)(1)(i) and RSS-210 A8.1(a) Average time of occupancy and 20 dB BW.

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#### 8.1.1 Definitions and limits

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**FCC and IC:**

For frequency hopping systems operating in the 902–928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

#### 8.1.2 Test summary

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Test date:	March 4, 2015	Temperature:	22 °C
Test engineer:	Kevin Rose	Air pressure:	1002 mbar
Verdict:	Pass	Relative humidity:	32 %

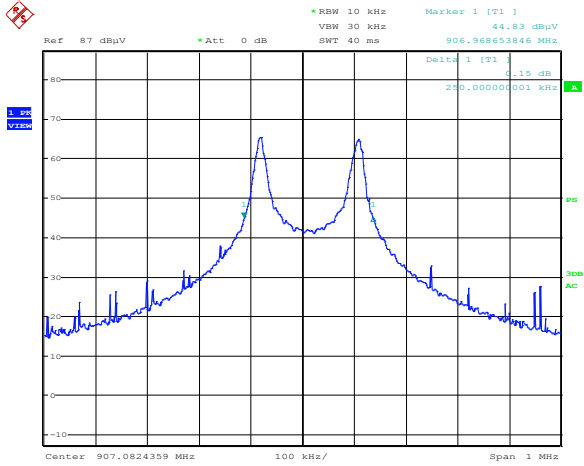
#### 8.1.3 Observations, settings and special notes

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Spectrum analyser settings:

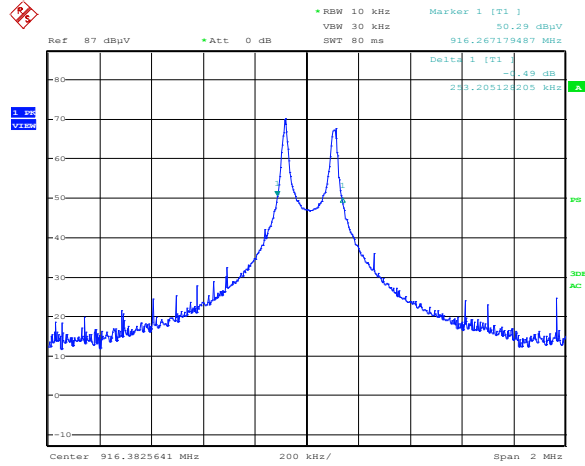
Resolution bandwidth:	1–5 % span (no wider than 100 kHz)
Video bandwidth:	$\geq 3 \times$ RBW
Frequency span:	1 MHz
Detector mode:	Peak
Trace mode:	Max Hold

8.1.4 Test data



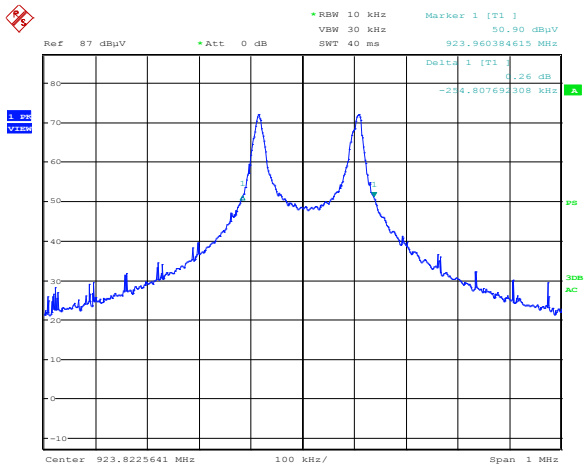
Date: 5.MAR.2015 14:24:48

Figure 8.1-1: 20 dB bandwidth on Low channel



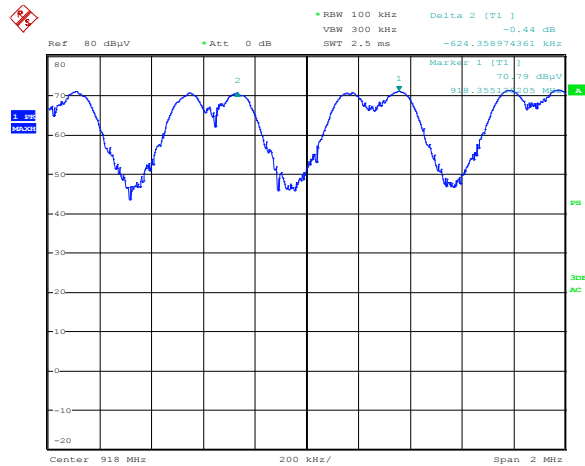
Date: 5.MAR.2015 14:31:15

Figure 8.1-2: 20 dB bandwidth on Mid channel



Date: 5.MAR.2015 14:36:52

Figure 8.1-3: 20 dB bandwidth on High channel



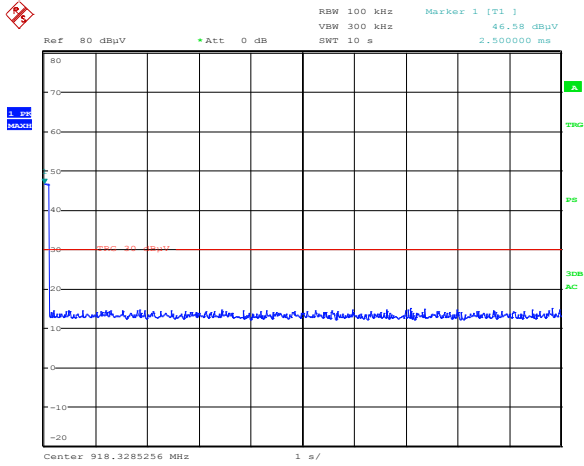
Date: 5.MAR.2015 14:49:30

Figure 8.1-4: Channel Spacing

Table 8.1-1: 20 dB bandwidth results

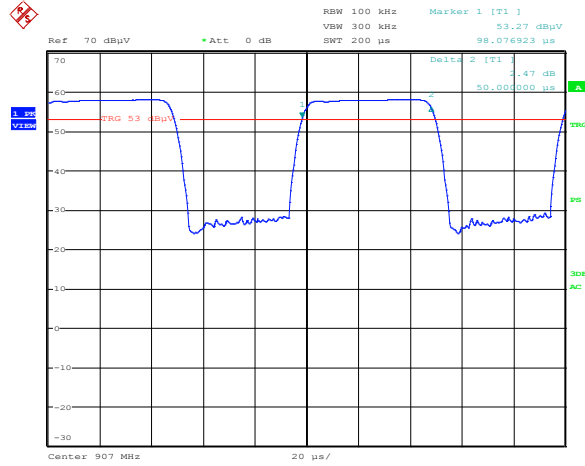
Frequency, MHz	20 dB bandwidth, kHz	Limit, kHz	Margin, kHz
907.095	250.0	500	250.0
916.395	253.2	500	246.8
923.835	254.8	500	245.2

8.1.4 Test data, continued



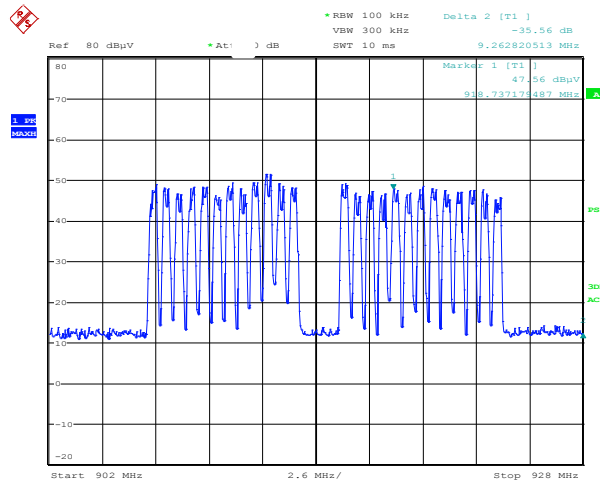
Date: 4.MAR.2015 19:54:41

Figure 8.1-5: Number of pulses in 10 seconds



Date: 4.MAR.2015 17:54:43

Figure 8.1-6: Duration of pulse



Date: 4.MAR.2015 19:49:57

Figure 8.1-7: Number of hopping channels (25)

Since 20 dB BW is more than 250 kHz, the minimum number of channels limit is 25.

Table 8.1-2: Time of Occupancy results

Pulse duration, ms	Number of pulses within 10 sec	Total on-time in 10 sec, ms	Limit, ms	Margin, ms
98.08	1	98.08	400	301.92

## 8.2 RSS-Gen 6.6 Occupied bandwidth

### 8.2.1 Definitions and limits

The emission bandwidth (×dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated × dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3× the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3×RBW.

Note: Video averaging is not permitted.

A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

### 8.2.2 Test summary

Test date:	March 4, 2015	Temperature:	21 °C
Test engineer:	Kevin Rose	Air pressure:	1003 mbar
Verdict:	Pass	Relative humidity:	30 %

### 8.2.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	≥1 % of OBW
Video bandwidth:	≥RBW
Detector mode:	Peak
Trace mode:	Max Hold

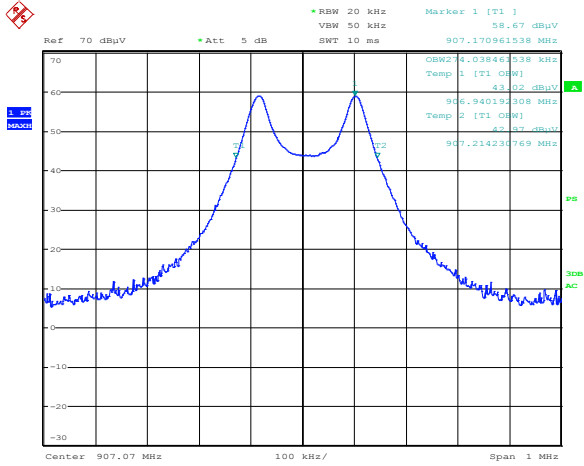
### 8.2.4 Test data

**Table 8.2-1: 99 % bandwidth results**

Frequency, MHz	99 % bandwidth, kHz
907.095	274.1
916.395	304.8
923.835	296.5

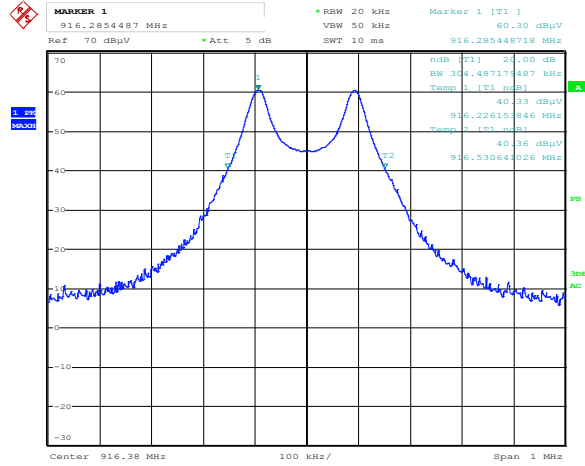


8.2.4 Test data, continued



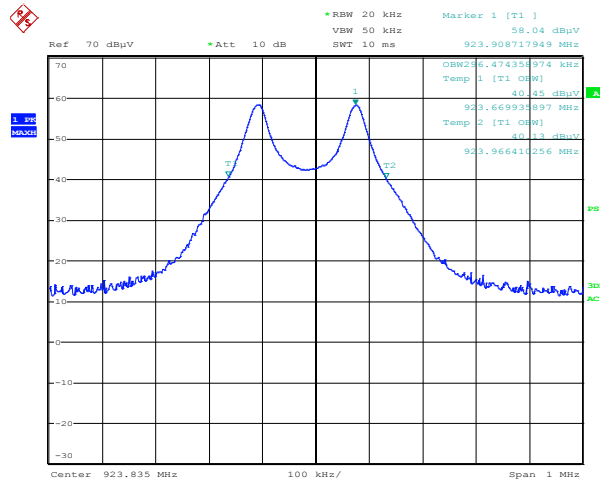
Date: 4.MAR.2015 17:49:37

Figure 8.2-1: 99 % bandwidth on Low channel



Date: 4.MAR.2015 17:47:01

Figure 8.2-2: 99 % bandwidth on Mid channel



Date: 4.MAR.2015 17:38:45

Figure 8.2-3: 99 % bandwidth on High channel

### 8.3 FCC 15.247(b)(2) and RSS-210 A8.4 (4) Transmitter output power and e.i.r.p. requirements

#### 8.3.1 Definitions and limits

**FCC and IC:**

For frequency hopping systems operating in the 902–928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels.

#### 8.3.2 Test summary

Test date:	March 5, 2015	Temperature:	22 °C
Test engineer:	Kevin Rose	Air pressure:	1002 mbar
Verdict:	Pass	Relative humidity:	32 %

#### 8.3.3 Observations, settings and special notes

Output power [dBm] = Field Strength [dBµV/m] – 95.23 [dB] – Antenna gain [dBi]

Theoretical conversion from Field Strength measured at 3 m to power conducted from the intentional radiator to the antenna:

$$P (W) = \frac{E^2 R^2}{30G}$$

E = Measured field strength value (V/m)

R = Measurement distance (m)

G = Antenna Gain (numeric)

Therefore dBW = dBV/m + 20Log(3) – 10Log(30) – 10Log(G)

From which we obtain

dBmW = dBµV/m – 120 + 20Log(3) – 10Log(30) – 10Log(G) + 30

= dBµV/m – 95.23 – 10Log(G)

Output power [dBm] = Field Strength [dBµV/m] – 95.23 [dB] – Antenna gain [dBi]

The EUT was measured on three orthogonal axis.

All measurements were performed at a distance of 3 m.

All measurements were performed using a peak detector with RBW wider than emission bandwidth

#### 8.3.4 Test data

**Table 8.3-1: Output power measurements results**

Frequency, MHz	Antenna Pol.	Received field strength, dBµV/m	Conversion Factor, dB	Antenna gain, dBi	Output power, dBm	Limit, dBm	Margin, dB
907.095	V	109.9	95.23	0	14.67	24	9.33
	H	108.2	95.23	0	12.97	24	11.03
916.395	V	106.6	95.23	0	11.37	24	12.63
	H	108.5	95.23	0	13.27	24	10.73
923.835	V	104.6	95.23	0	9.37	24	14.63
	H	106.4	95.23	0	11.17	24	12.83

## 8.4 FCC 15.247(d) and RSS-210 A8.5 Spurious (out-of-band) emissions

### 8.4.1 Definitions and limits

#### FCC:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

#### IC:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency 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, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required.

**Table 8.4-1: FCC §15.209 and RSS-Gen – Radiated emission limits**

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.

For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test

**Table 8.4-2: IC restricted frequency bands**

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677–5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

Note: Certain frequency bands listed in Table 8.4-2 and above 38.6 GHz are designated for low-power licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in this Standard

8.4.1 Definitions and limits, continued

**Table 8.4-3: FCC restricted frequency bands**

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.4.2 Test summary

Test date:	March 5, 2015	Temperature:	22 °C
Test engineer:	Kevin Rose	Air pressure:	1002 mbar
Verdict:	Pass	Relative humidity:	32 %

8.4.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10<sup>th</sup> harmonic.  
 Radiated measurements were performed at a distance of 3 m

$$\text{Duty cycle / average factor} = 20 \times \log_{10} \left( \frac{T_{x_{100ms}}}{100ms} \right)$$

Spectrum analyser settings for radiated measurements within restricted bands below 1 GHz:

Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for peak radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold



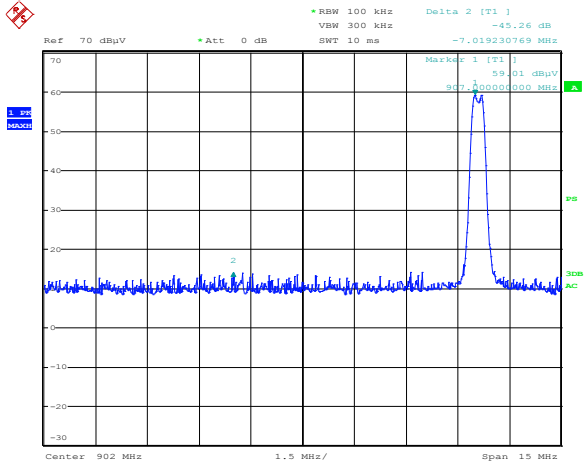
8.4.4 Test data

*Table 8.4-4: Radiated field strength measurement*

Channel	Frequency, MHz	Antenna polarity	Peak Field strength, dB $\mu$ V/m		Margin, dB
			Measured	Avg Limit	
Low	2721.51	V	49.6	54	4.4
Low		H	47.9	54	6.1
Mid	2749.41	V	45.8	54	8.2
Mid		H	45.5	54	8.5
High	2771.73	V	45.7	54	8.3
High		H	45.6	54	8.4

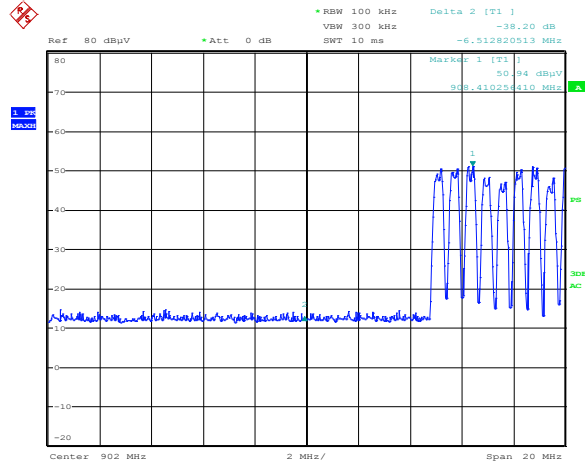
Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable. Peak measured Value is lower than Average limit.

8.4.4 Test data, continued



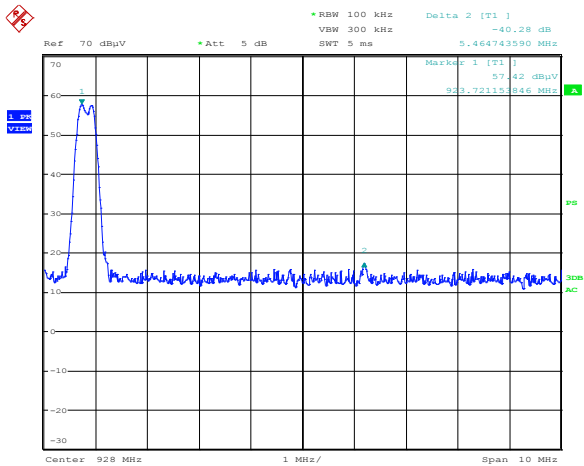
Date: 4.MAR.2015 17:52:03

Figure 8.4-1: Lower band edge not hopping (F1 is 902 MHz)



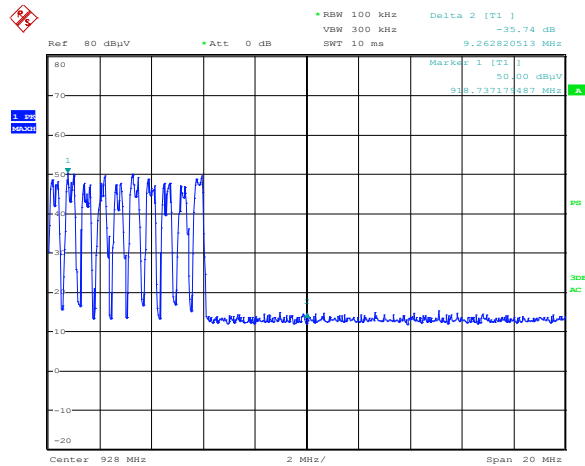
Date: 4.MAR.2015 19:46:58

Figure 8.4-2: Lower band edge hopping (F1 is 902 MHz)



Date: 4.MAR.2015 17:42:30

Figure 8.4-3: Upper band edge not hopping (F1 is 928 MHz)



Date: 4.MAR.2015 19:48:36

Figure 8.4-4: Upper band edge hopping (F1 is 928 MHz)

## Section 9. Block diagrams of test set-ups

### 9.1 Radiated emissions set-up

