

Test report

260500-1TRFWL

Date of issue: August 26, 2014

Applicant:

Craneequipment.ca Inc.

Product:

Remote control for the automated sling release for crane

Model:

DL300

FCC ID:

2ACHR-DL300

IC Registration number:

12042A-DL300

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
Reviewed by:	Andrey Adelberg, Senior Wireless/EMC Specialist
Date:	August 26, 2014
Signature:	

Limits of responsibility

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

1.1 Applicant and manufacturer

Company name	Craneequipment.ca Inc.
Address	675A boul. Lionel-Boulet
City	Varennnes
Province/State	Québec
Postal/Zip code	J3X1P7
Country	Canada

1.2 Test specifications

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

ANSI C64.3 v 2003	American National Standard for Methods of Measurement of Radio- Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
DA 00-705 Released March 30, 2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems

1.4 Statement of compliance

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

None

1.6 Test report revision history

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 ³
§15.31(e)	Variation of power source	Pass ¹
§15.203	Antenna requirement	Pass ²

Notes: ¹ 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 supply voltage varied between 85 % and 115 % of the nominal rated supply voltage.

For battery operated equipment, the equipment tests shall be performed using a new battery.

No noticeable output power variation was observed

² The Antennas are located within the enclosure of EUT and not user accessible.

³ The EUT is a battery operated device.

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(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 3, test results

Part	Test description	Verdict
4.6.1	Occupied bandwidth	Pass
4.7	Transmitter frequency stability	Not applicable
6.1	Receiver spurious emissions limits (radiated)	Not applicable
6.2	Receiver spurious emissions limits (antenna conducted)	Not applicable
7.2.4	AC power lines conducted emission limits	Not applicable

Notes: ¹ According to Notice 2012-DRS0126 (from January 2012) section 2.2 of RSS-Gen, Issue 3 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

3.1 Sample information

Receipt date	June 9, 2014
Nemko sample ID number	1,2, and 3

3.2 EUT information

Product name	Transmetteur portable DL 300 mètres
Model	DL300
Serial number	None

3.3 Technical information

Operating band	902–928 MHz
Operating frequency	902.5–927.5 MHz
Modulation type	FSK
Occupied bandwidth (20 dB)	117
Emission designator	F1D
Power requirements	3 V _{DC} battery
Antenna information	The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

Remote control for the automated sling release for crane

3.5 EUT exercise details

Client provided software to control the channels for testing.

3.6 EUT setup diagram



Figure 3.6-1: Setup diagram

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

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

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

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

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

6.1 Uncertainty of measurement

Nemko Canada Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 "Uncertainty in EMC measurements." Measurement uncertainty was calculated using the methods described in CISPR 16-4 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of $K=2$ with 95% certainty.

Section 7. Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Mar. 18/15
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	Oct. 24/14
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Mar. 12/15
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Mar. 10/15
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	June 21/14
50 Ω coax cable	Huber + Suhner	NONE	FA002392	1 year	July. 17/14
50 Ω coax cable	C.C.A.	None	FA002555	1 year	Oct. 07/14

Note: NCR - no calibration required,

Section 8. Testing data

8.1 FCC 15.247(a)(1)(i) and RSS-210 A8.1(c) Frequency hopping systems operating in the 902–928 MHz band

8.1.1 Definitions and limits

FCC and IC:

For frequency hopping systems operating in the 902–928 MHz band:

- a) 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;
- b) 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.
- c) The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

8.1.2 Test summary

Test date:	June 11, 2014	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	42 %

8.1.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	100 kHz
Video bandwidth:	$\geq 3 \times \text{RBW}$
Detector mode:	Peak
Trace mode:	Max Hold

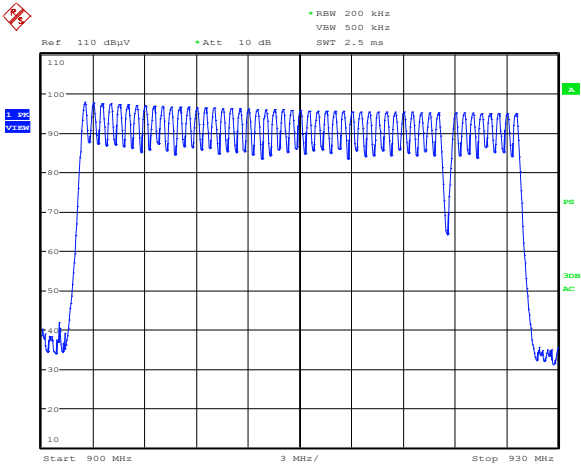
8.1.4 Test data

Table 8.1-1: Occupied Bandwidth measurement results

Occupied Bandwidth, kHz	Limit, kHz	Margin, kHz
117	500	383

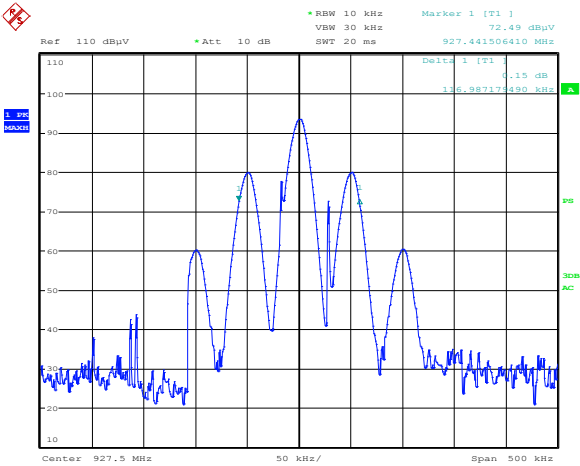
Table 8.1-2: Number of channels

Number of channels	≥Limit
50	50



Date: 11.JUN.2014 19:47:33

Figure 8.1-1: Number of Hopping channels (50)



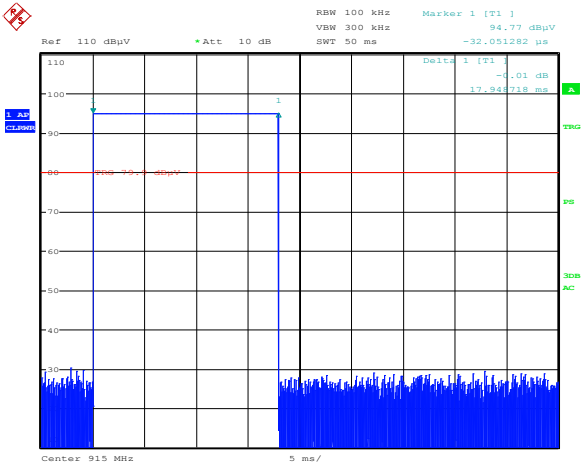
Date: 11.JUN.2014 20:32:33

Figure 8.1-2: Occupied Bandwidth

8.1.4
Test data continued

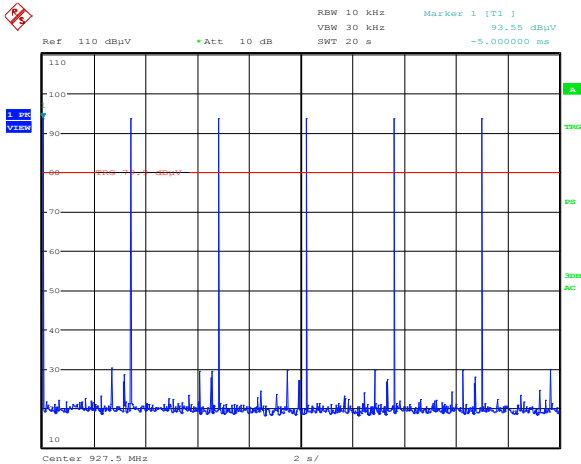
Table 8.1-3: 20 second On-time measurement results

Pulse width, ms	Number of Pulses ¹	Total transmission On time, ms	Limit, ms	Margin, ms
17.95	6	107.7	400	292.3



Date: 11.JUN.2014 19:59:08

Figure 8.1-3: Pulse period (17.95 ms)



Date: 11.JUN.2014 20:34:48

Figure 8.1-4: Number of pulses in 20 seconds (6)

8.2 RSS-Gen 4.6.1 Occupied bandwidth

8.2.1 Definitions and limits

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99 percent 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 shall be set to as close to 1 percent of the selected span as is possible without being below 1 percent. The video bandwidth shall be set to 3 times the resolution bandwidth. Video averaging is not permitted. Where practical, a sampling detector shall be used since a peak or, peak hold, may produce a wider bandwidth than actual.

The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 percent of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is recorded.

The span between the two recorded frequencies is the occupied bandwidth.

8.2.2 Test summary

Test date:	June 11, 2014	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	42 %

8.2.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	≥1 % of span
Video bandwidth:	≥3 × RBW
Detector mode:	Peak
Trace mode:	Max Hold

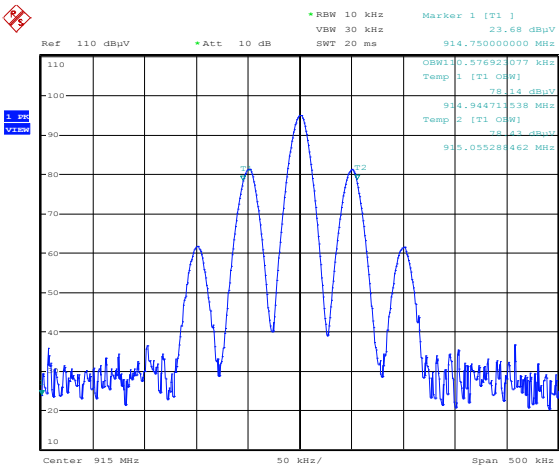
8.2.4 Test data

Table 8.2-1: 99 % bandwidth results

Frequency, MHz	99 % bandwidth, MHz
902.5	112.2
915.0	110.6
927.5	111.4

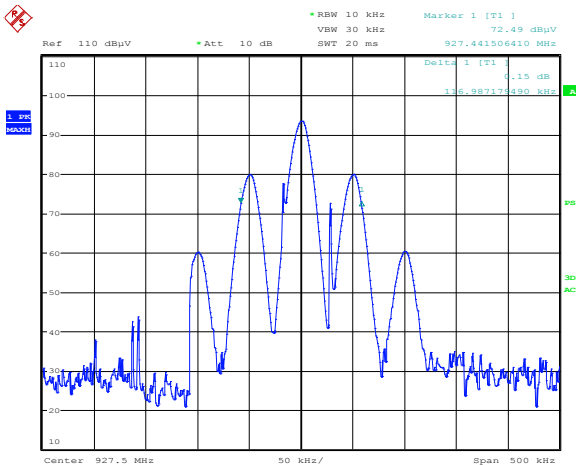
Table 8.2-2: 20 dB bandwidth results

Frequency, MHz	20 dB bandwidth
902.5	116.2
915.0	115.4
927.5	117.0



Date: 11.JUN.2014 20:12:52

Figure 8.2-1: 99 % bandwidth, sample plot



Date: 11.JUN.2014 20:32:33

Figure 8.2-2: 20dB bandwidth, sample plot

8.3 FCC 15.247(b)(2) and RSS-210 A8.4 (1) Transmitter output power and e.i.r.p. requirements

8.3.1 Definitions and limits

FCC:

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, as permitted under paragraph (a)(1)(i) of this section.

IC:

For frequency hopping systems operating in the band 902–928 MHz, the maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 50 or more hopping channels; the maximum peak conducted output power shall not exceed 0.25 W, and the e.i.r.p. shall not exceed 1 W if the hopset uses less than 50 hopping channels.

8.3.2 Test summary

Test date:	June 11, 2014	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	42 %

8.3.1 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	> the 20 dB bandwidth of the emission being measured
Video bandwidth:	$\geq 3 \times \text{RBW}$
Detector mode:	Peak
Trace mode:	Max Hold

8.3.2 Observations, settings and special notes

Radiated measurements were performed:

The EUT was measured on three orthogonal axis.

All measurements were performed at a distance of 3 m.

8.3.3 Test data

Table 8.3-1: EIRP results

Frequency, MHz	Field strength dBμV/m	EIRP, dBm	Limit, dBm	Margin, dBm
902.5	110.52	15.29	36.00	20.71
915.0	108.89	13.66	36.00	22.34
927.5	108.35	13.12	36.00	22.88

Note: EIRP [dBm] = Field strength [dBμV/m] – 95.23 [dB]

Table 8.3-2: Conducted results

Frequency, MHz	EIRP, dBm	Antenna Gain, dBi	Conducted power, dBm	Limit, dBm	Margin, dBm
902.5	15.29	0.30	14.99	30.00	15.01
915.0	13.66	0.30	13.36	30.00	16.64
927.5	13.12	0.30	12.82	30.00	17.18

Note: Conducted power [dBm]=EIRP [dBm] –antenna gain [dBi]

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:	June 11, 2014	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	42 %

8.4.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.
EUT was set to transmit with 100 % duty cycle.
Radiated measurements were performed at a distance of 3 m
Since fundamental power was tested using peak method, the spurious emissions limit is -20 dBc/100 kHz

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

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

Resolution bandwidth:	1 MHz
Video bandwidth:	10 Hz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for conducted spurious emissions measurements:

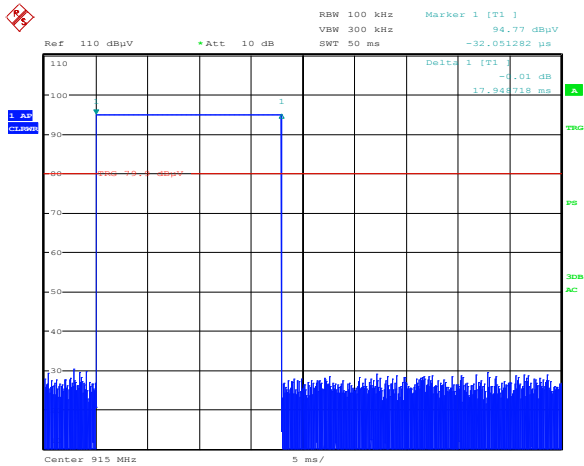
Resolution bandwidth:	100 kHz
Video bandwidth:	300 kHz
Detector mode:	Peak
Trace mode:	Max Hold

8.4.4 Test data

Table 8.4-4: Duty cycle correction results

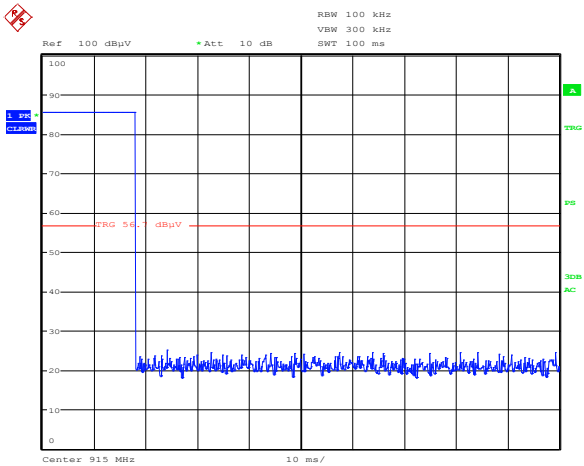
TX on time, ms	Number of pulses in 100 ms	Correction factor, dB
17.95	1	-15.14

$$\text{Dutycycle/averagefactor} = 20 \times \log_{10} \left(\frac{T_{x100ms}}{100ms} \right)$$



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Figure 8.4-1: Pulse period (17.95 ms)



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Figure 8.4-2: Number of pulses in 100 ms (1)

Table 8.4-5: Radiated Peak field strength measurement results

Channel	Frequency, MHz	Peak Field strength, dBμV/m	Limit, dBμV/m	Margin, dB
low	5414.988	58.5	74	15.5
high	4637.504	58.1	74	15.9

Table 8.4-6: Radiated Average field strength results

Channel	Frequency, MHz	Peak Field strength, dBμV/m	Duty cycle correction, dB	Average Field strength, dBμV/m	Limit, dBμV/m	Margin, dB
low	5414.988	58.5	-15.14	43.36	54	10.64
high	4637.504	58.1	-15.14	42.96	54	11.04

Notes: Average Field strength = Peak field strength + duty cycle correction

8.4.5 Test data, continued

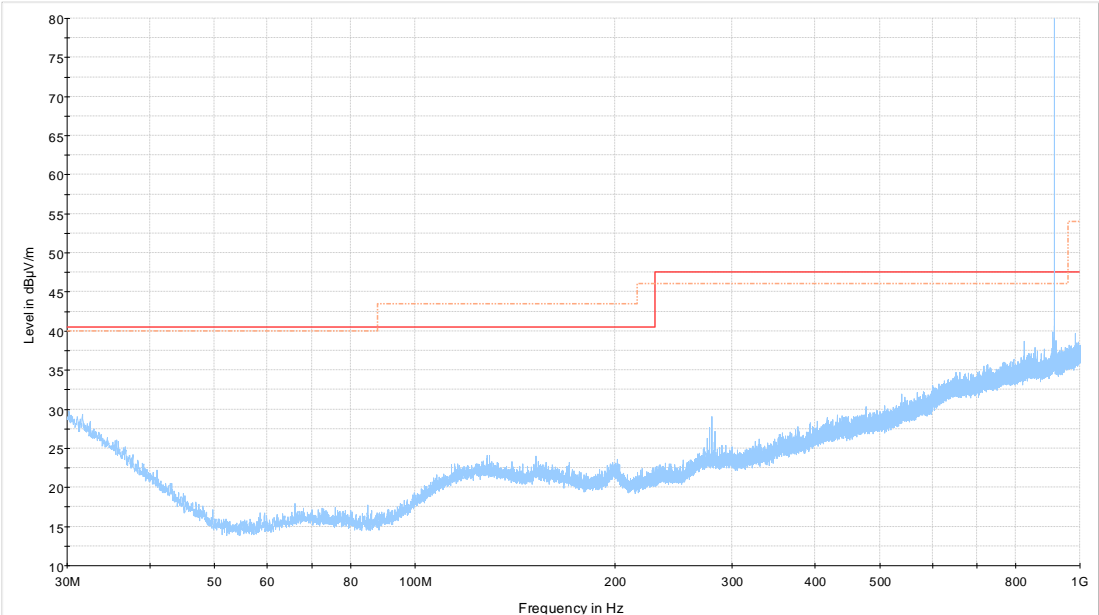


Figure 8.4-3: Radiated spurious emissions 30-1000 MHz. sample plots

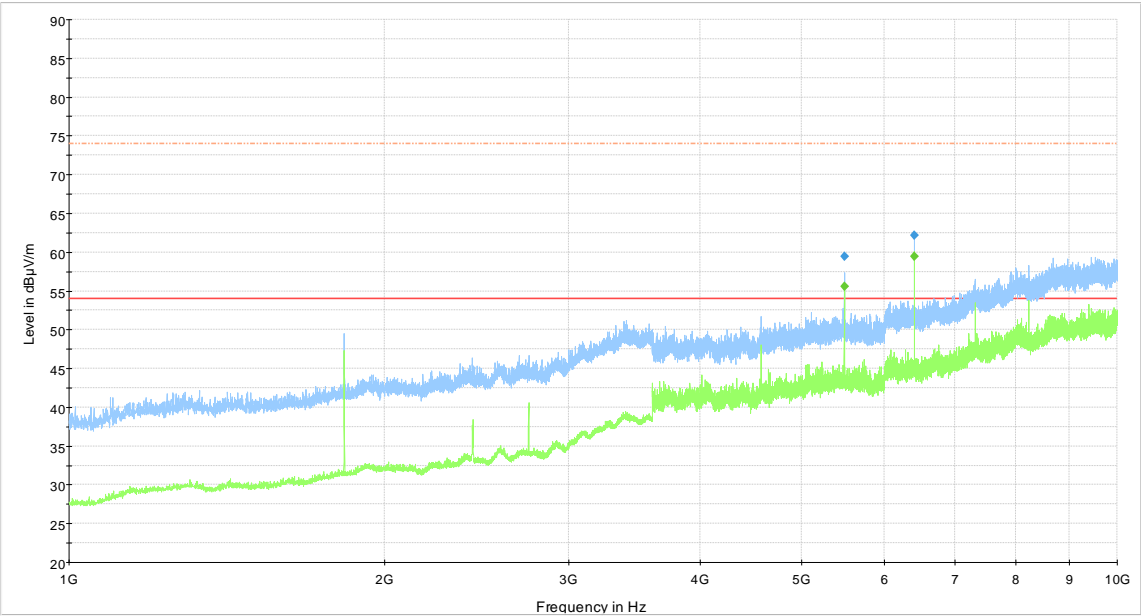
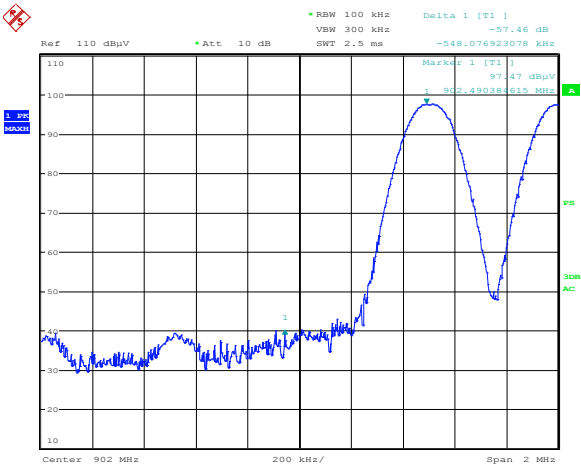


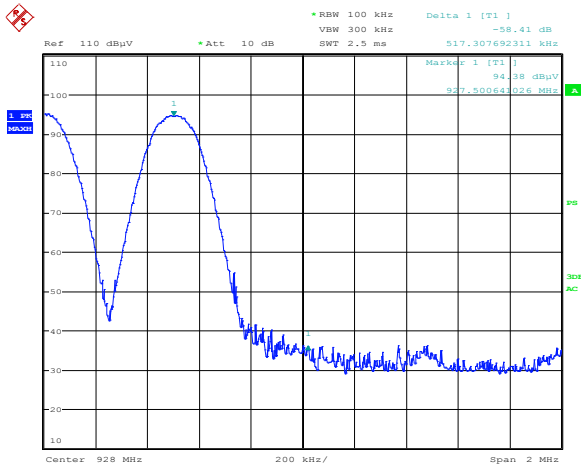
Figure 8.4-4: Radiated spurious emissions 1-10 GHz. sample plots

8.4.4 Test data, continued



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Figure 8.4-5: Lower band edge



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Figure 8.4-6: upper band edge

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up

