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Test report

246943-1TRFWL

Date of issue: November 6, 2013

Applicant:

KS Technologies, LLC.

Product:

Particle

Model:

3010

Model variant:

Particle™ (family includes KST3010, KST3011, KST3012, and KST3013)

FCC ID:

2AA3A-SENSORE

IC Registration number:

11487A-SENSORE

Specifications:

- FCC 47 CFR Part 15 Subpart E, §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

Company name:	Nemko Canada Inc.
Address:	303 River Road
City:	Ottawa
Province:	Ontario
Postal code:	K1V 1H2
Country:	Canada
Telephone:	+1 613 737 9680
Facsimile:	+1 613 737 9691
Toll free:	+1 800 563 6336
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:	November 6, 2013
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.

Copyright notification

Table of contents

Section 1. Report summary

1.1 Applicant

Company name:	KS Technologies, LLC
Address:	1910 Vindicator Drive, Suite 100
City:	Colorado Springs
Province/State:	CO
Postal/Zip code:	80919
Country:	USA

1.2 Manufacturer

Company name:	Linear Manufacturing
Address:	1096 Elkton Drive
City:	Colorado Springs
Province/State:	CO
Postal/Zip code:	80907
Country:	USA

1.3 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

1.4 Test methods

Guidance for compliance measurements on DTS operating under 15.247	558074 D01 Meas Guidance v03r01 (April 9, 2013)
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

1.5 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.

1.6 Exclusions

None

1.7 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
§15.31(e)	Variation of power source	Pass[1]
§15.203	Antenna requirement	Pass[2]

Notes: [1] The EUT was tested with a new battery

[2] The Antenna is 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	Not applicable
§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	Pass
§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	Not applicable
§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	Pass
§15.247(b)(4)	Maximum peak output power	Pass
§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	Pass
§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	Not applicable
A8.1 (b)	Minimum channel spacing for frequency hopping systems	Not applicable
A8.1 (c)	Frequency hopping systems operating in the 902–928 MHz band	Not applicable
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	Pass
A8.2 (b)	Maximum power spectral density	Pass
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	Not applicable
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	Pass
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	October 25, 2013
Nemko sample ID number	1, 2, and 3

3.2 EUT information

Product name	Particle
Model	3010
Model variant	Particle™ (family includes KST3010, KST3011, KST3012, and KST3013)
Serial number	NA

3.3 Technical information

Operating band	2400–2483.5 MHz
Operating frequency	2402–2480 MHz
Modulation type	Gaussian Frequency Shift Keying (GFSK)
Occupied bandwidth (99 %)	1.867 MHz
Emission designator	F1D
Power requirements	$3V_{DC}$ CR2032 Lithium Battery
Antenna information	The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator. 5.3 dBi antenna gain

3.4 Product description and theory of operation

This device is a coin-cell operated Bluetooth Low Energy radio. It operates in both a connection-less mode as well as a special connection-mode that allows configuration. Its primary use is as a connection-less proximity and location beaconing device for mobile devices.

Upon placing a coin cell battery within the package, the device begins advertising packets approximately every 1200 ms. Per the Bluetooth Special Interest Group (or Bluetooth SIG), the device advertises packages on three advertisement channels. Every mobile device within approximately 50 m can detect the advertisements and use the unique identification information contained within to display significant meta-data.

3.5 EUT exercise details

The EUT's have all been flashed with three different firmware loads that place the device into a continuous burst mode. One sample device bursts at the highest, middle, and lowest frequencies.

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

Each model uses a different firmware load that advertises different wireless data based on different uses and applications. Hardware stays the same in every model variant.

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 ±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. 09/14
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	Feb. 21/14
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	Feb. 21/14
Pre-amplifier (1–18 GHz)	JCA	JCA118-503	FA002091	1 year	June 21/14
Pre-amplifier (18–26 GHz)	Narda	BBS-1826N612	FA001550	—	VOU
Horn antenna (18–40 GHz)	EMCO	3116	FA001847	2 year	Sept. 06/14

Note: NCR - no calibration required, VOU - verify on use

Section 8. Testing data

8.1 FCC 15.247(a)(2) and RSS-210 A8.2(a) Minimum 6 dB bandwidth for systems using digital modulation techniques

8.1.1 Definitions and limits

FCC and IC:

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

8.1.2 Test summary

Test date:	October 28, 2013	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	35 %

8.1.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth:	1–5 % of DTS BW (no wider than 100 kHz)
Video bandwidth:	≥3 × RBW
Detector mode:	Peak
Trace mode:	Max Hold

8.1.4 Test data

Table 8.1-1: *6 dB bandwidth*

Frequency, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz
2402	849.4	500	349.4
2440	825.3	500	325.3
2480	857.4	500	357.4

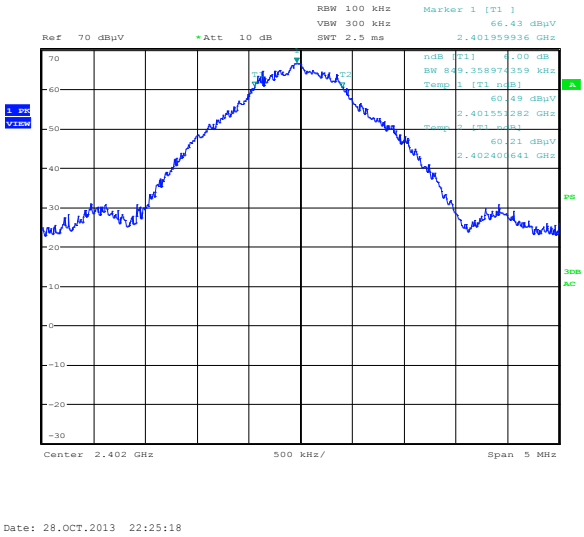

Figure 8.1-1: *6 dB bandwidth example*

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:	October 28, 2013	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	35 %

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*

Frequency, MHz	99% bandwidth, MHz
2402	1.867
2440	1.867
2480	1.851

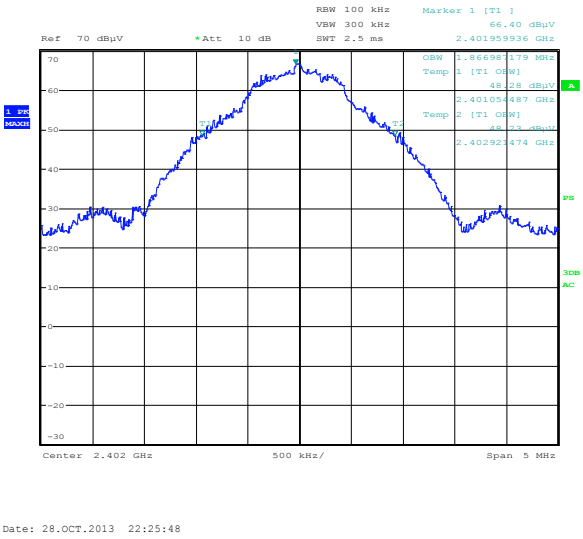

Figure 8.2-1: *99% bandwidth example*

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

8.3.1 Definitions and limits

FCC:

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:

(3) For systems using digital modulation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands: 1 W (30 dBm). As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Fixed, point-to-point operation, as used in paragraphs (b)(3)(i) and (b)(3)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

(c) Operation with directional antenna gains greater than 6 dBi.

(2) In addition to the provisions in paragraphs (b)(1), (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400–2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

IC:

A8.4 (4) Transmitter Output Power and e.i.r.p. Requirements for systems employing digital modulation techniques operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz bands

For systems employing digital modulation techniques operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz, the maximum peak conducted output power shall not exceed 1 W. Except as provided in Section A8.4(5), the e.i.r.p. shall not exceed 4 W.

As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power (see RSS-Gen).

8.3.2 Test summary

Test date:	October 28, 2013	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	35 %

8.3.3 Observations, settings and special notes

The test was performed according to 558074 D01 DTS Meas Guidance v03r01.

8.3.4 Test data

Table 8.3-1: *Output power measurements*

Frequency, MHz	Field strength, dBµV/m	Output power, dBm	Limit, dBm	Margin, dBm
2402	104.70	4.17	30.00	25.83
2440	105.45	4.92	30.00	25.08
2480	105.57	5.04	30.00	24.96

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

$(P \times G)/(4\pi d^2) = E^2/120\pi$

Output power [dBm] = Field strength [dBµV/m] − 95.23 [dB] − Antenna gain [dBi]

Table 8.3-2: *EIRP measurements*

Frequency, MHz	EIRP, dBm	Limit, dBm	Margin, dBm
2402	9.47	36.00	26.53
2440	10.22	36.00	25.78
2480	10.34	36.00	25.66

Note: EIRP [dBm] = Output power [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:	October 28, 2013	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	35 %

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 90 % duty cycle.
All measurement were performed radiated at 3m distance
Duty cycle correction was used for the average measurement as the transmitter was not transmitting greater than 98%

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

Duty cycle correction was applied to the peak measurement to obtain the average measurement.

$$Dutycycle/averagefactor = 20\times\log_{10}\left(\frac{Tx_{100\,ms}}{100ms}\right)$$

Table 8.4-4: *Duty cycle correction factor results*

Number of pulses per 100 ms	Width of pulse, ms	Total TX time within 100 ms, ms	Correction Factor, dB
3	0.4	1.2	−38.4

8.4.4 Test data

Table 8.4-5: *Radiated field strength measurement results for Peak*

Channel	Frequency, MHz	Peak Field strength, dBµV/m		Margin, dB
		Measured	Limit	
Low	2358.6	67.4	74.0	6.6
Low	4804.2	55.9	74.0	18.1
Low	7205.9	60.3	74.0	13.7
Mid	2562.7	50.9	74.0	23.1
Mid	4880.2	56.8	74.0	17.2
Mid	7319.7	59.7	74.0	14.3
High	2570.2	67.0	74.0	7.0
High	4960.5	56.9	74.0	17.1
High	7439.8	63.4	74.0	10.6

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Table 8.4-6: *Radiated field strength measurement results for Average*

Channel	Frequency, MHz	Average field strength, dBµV/m				Margin, dB
		Measured peak	Duty cycle correction, dB	Corrected average	Limit	
Low	2358.6	67.4	38.4	29.0	54.0	25.0
Low	4804.2	55.9	38.4	17.5	54.0	36.5
Low	7205.9	60.3	38.4	21.9	54.0	32.1
Mid	2562.7	50.9	38.4	12.5	54.0	41.5
Mid	4880.2	56.8	38.4	18.4	54.0	35.6
Mid	7319.7	59.7	38.4	21.3	54.0	32.7
High	2570.2	67.0	38.4	28.6	54.0	25.4
High	4960.5	56.9	38.4	18.5	54.0	35.5
High	7439.8	63.4	38.4	25.0	54.0	29.0

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

Table 8.4-7: *Marker delta for upper band edge*

Channel	Frequency, MHz	Measured Emission peak, dBµV/m/MHz	Measured Fundamental peak, dBµV/m/MHz	Measured Emission peak, dBµV/m/100 kHz	Marker delta correction factor, dB	Corrected result, dBµV/m/MHz	Limit, dBµV/m	Margin, dB
High	2483.5	81.50	105.57	59.96	45.61	35.89	54.0	18.11

Note: Corrected result (dBµV/m/MHz) = Measured emission peak (dBµV/m/MHz) – marker delta correction factor (dB)

8.4.4 Test data, continued

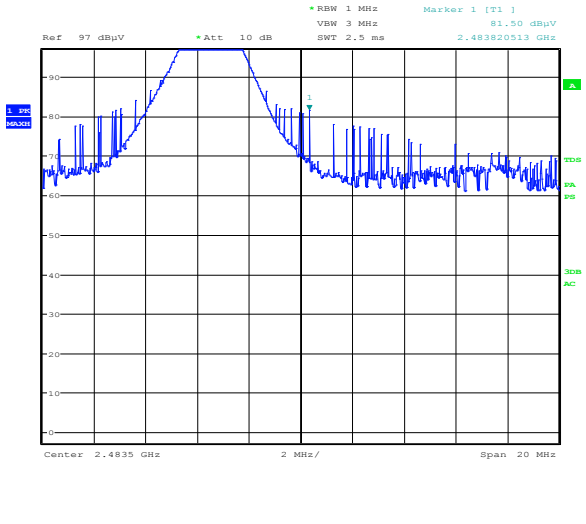

Figure 8.4-1: *Marker delta plot 1 MHz RBW*

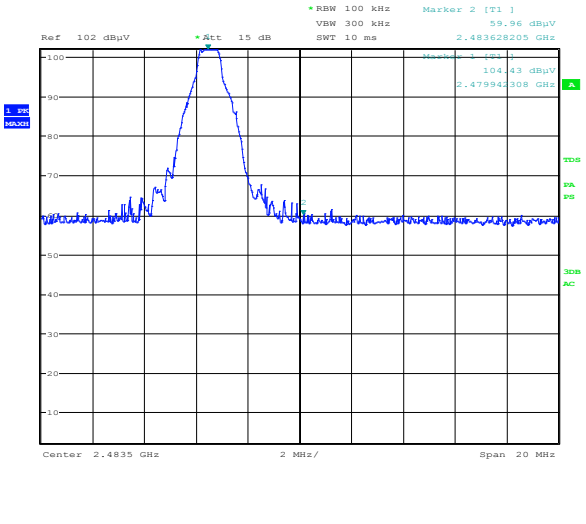

Figure 8.4-2: *Marker delta plot 100 kHz RBW*

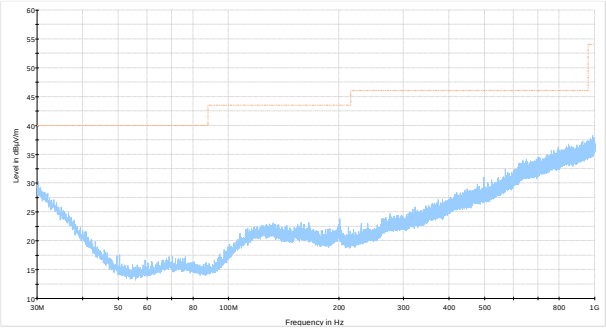

Figure 8.4-3: *Radiated Emissions 30-1000 MHz example*

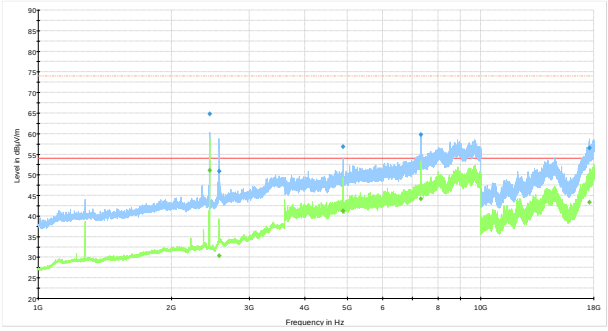

Figure 8.4-4: *Radiated Emissions 1-18 MHz example*

8.4.4 Test data, continued

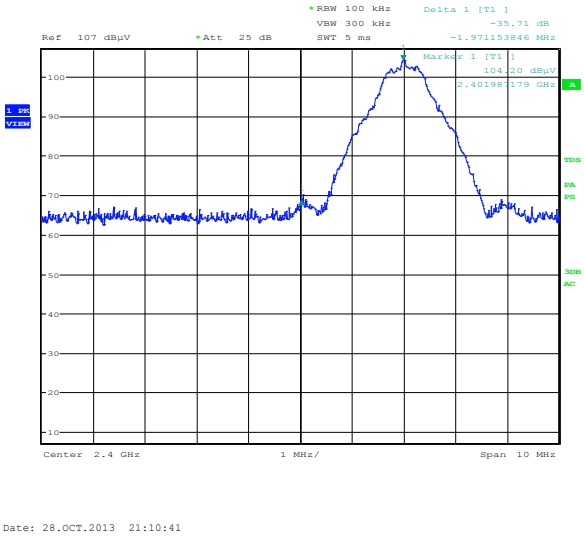

Figure 8.4-5: *Lower band edge*

8.5 FCC 15.247(e) and RSS-210 A8.2(b) Power spectral density for digitally modulated devices

8.5.1 Definitions and limits

FCC:
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

IC:
The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission or over 1.0 second if the transmission exceeds 1.0-second duration. This power spectral density shall be determined in accordance with the provisions of Section A8.4(4); (i.e. the power spectral density shall be determined using the same method for determining the conducted output power).

8.5.2 Test summary

Test date:	October 28, 2013	Temperature:	23 °C
Test engineer:	Kevin Rose	Air pressure:	1004 mbar
Verdict:	Pass	Relative humidity:	35 %

8.5.3 Observations, settings and special notes

The test was performed using method described in 558074 D01 DTS Meas Guidance v03r01.
Spectrum analyser settings:

Resolution bandwidth:	3 kHz
Video bandwidth:	3 times RBW
Detector mode:	Peak

8.5.4 Test data

Table 8.5-1: *PSD measurements*

Frequency, MHz	PSD, dBm/3 kHz	PSD limit, dBm/3 kHz	Margin, dB
2402	-4.51	8.00	12.51
2440	-2.13	8.00	10.13
2480	-1.83	8.00	9.83

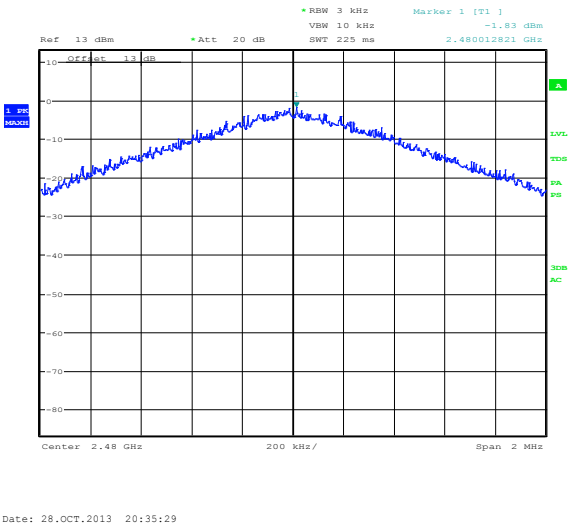

Figure 8.5-1: *PSD sample plot example*

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up