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Wireless test report – 353863-2TRFWL

Date of issue: August 2, 2018

Applicant:

dormakaba Canada Inc.

Product name:

Saffire

Model:

LX

FCC ID:

Q8SSAFFIRELX

IC Registration number:

4652A-SAFFIRELX

Specifications:

FCC 47 CFR Part 15.225

Operation within the band 13.110–14.010 MHz

RSS-210 Issue 9, August 2016, Annex B.6

Devices operating in 13.110–14.010 MHz frequency band for any application

www.nemko.com

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FCC 15.225 and RSS-210 B.6.docx; Date: September 2016



Test location

Company name	Nemko Canada Inc.		
Facility Name	Ottawa	Montreal	Almonte
Address	303 River Road	292 Labrosse Avenue	1500 Peter Robinson Road
City	Ottawa	Pointe-Claire	West Carleton
Province	ON	QC	ON
Postal code	K1V 1H2	H9R 5L8	K0A 1L0
Country	Canada	Canada	Canada
Telephone	+1 613 737 9680	+1 514 694 2684	+1 613 256-9117
Facsimile	+1 613 737 9691	+1 514 694 3528	+1 613 256-8848
Toll free	+1 800 563 6336		
Website	www.nemko.com		

Tested by	Yong Huang, Wireless/EMC Specialist
Reviewed by	Kevin Rose, Wireless/EMC Specialist
Date	August 2, 2018
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 contained 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	dormakaba Canada Inc.
Address	7301 Decarie H4P 2G7 Montreal QC Canada

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.225	Operation in the 13.110–14.010 MHz
RSS-210 Issue 9, August 2016, Annex B.6	Devices operating in 13.110–14.010 MHz frequency band for any application

1.3 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.

1.4 Exclusions

None

1.5 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
§15.215(c)	20 dB bandwidth	Pass

Notes: EUT is battery operated equipment.

¹ For battery operated equipment, the equipment tests shall be performed using a new battery.

² 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
§15.225(a)	Field strength within 13.553–13.567 MHz band	Pass
§15.225(b)	Field strength within 13.410–13.553 MHz and 13.567–13.710 MHz bands	Pass
§15.225(c)	Field strength within 13.110–13.410 MHz and 13.710–14.010 MHz bands	Pass
§15.225(d)	Field strength outside 13.110–14.010 MHz band	Pass
§15.225(e)	Frequency tolerance of carrier signal	Pass

Notes: None

2.3 IC RSS-GEN, Issue 4, test results

Part	Test description	Verdict
6.6	Occupied bandwidth	Pass
7.1.2	Receiver radiated emission limits	Not applicable
7.1.3	Receiver conducted emission limits	Not applicable
8.8	Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus	Not applicable

Notes: ¹ According to sections 5.2 and 5.3 of RSS-Gen, Issue 4 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

2.4 IC RSS-210, Issue 9, test results

Annex	Test description	Verdict
B.6 (a)	The field strength within the band 13.553–13.567 MHz	Pass
B.6 (b)	The field strength within the bands 13.410–13.553 MHz and 13.567–13.710 MHz	Pass
B.6 (c)	The field strength within the bands 13.110–13.410 MHz and 13.710–14.010 MHz	Pass
B.6 (d)	The field strength outside the band 13.110–14.010 MHz	Pass
B.6	Carrier frequency stability	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	May 22, 2018
Nemko sample ID number	Item#1

3.2 EUT information

Product name	Saffire
Model	LX
Serial number	J1091.0000836
Part number	S012-ELCB-PECAA-10L

3.3 Technical information

Operating band	13.553–13.567 MHz
Operating frequency	13.56 MHz
Modulation type	OOK
Occupied bandwidth (99 %)	2.2 kHz
Power requirements	4.5 V _{DC}
Emission designator	K1D
Antenna information	The EUT uses a non-detachable antenna to the intentional radiator.

3.4 Product description and theory of operation

Battery operated door lock using an RFID card reader and BLE radio.

3.5 EUT exercise details

EUT was set with test firmware up by client on site, continuous transmit mode was configured during transmitter tests.

3.6 EUT setup diagram

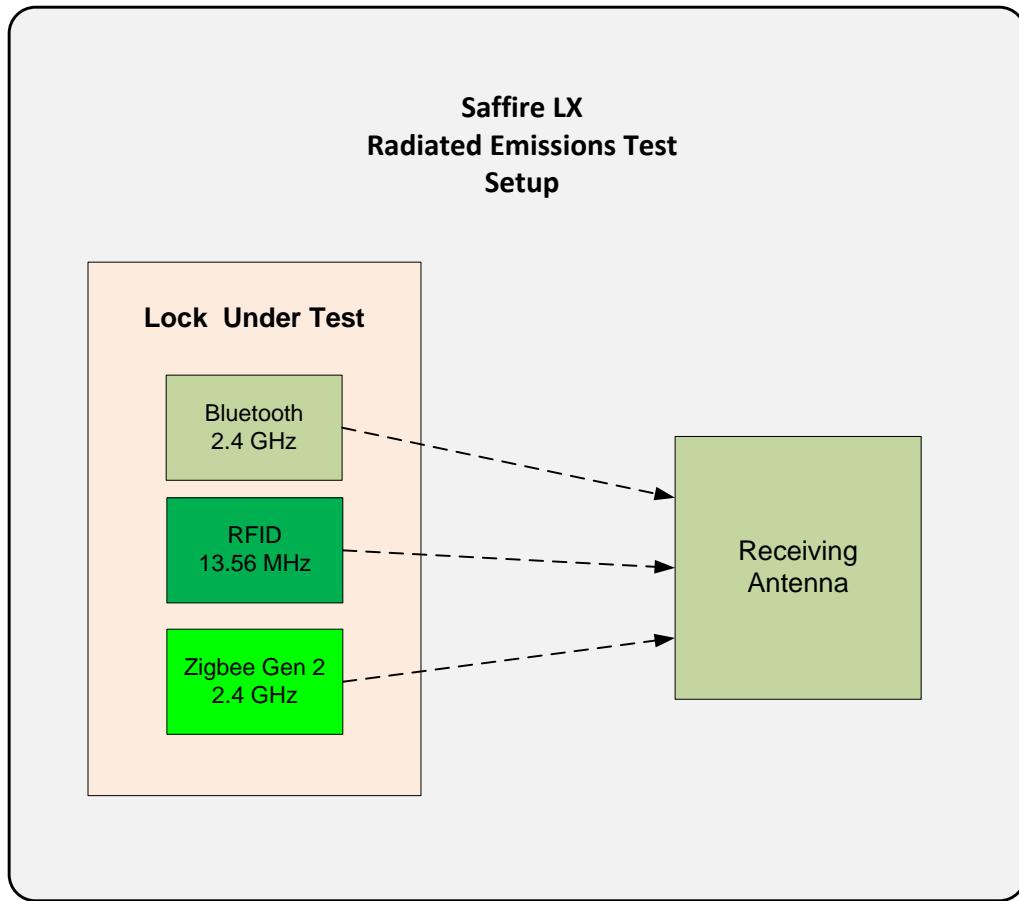


Figure 3.6-1: Setup diagram

Note: As per client, Zigbee is not included in the scope of this test report.

3.7 EUT sub assemblies

Table 3.7-1: EUT sub assemblies

Description	Brand name	Model/Part number	Serial number
Main lock PCB	dormakaba	PN: 124-515270-002, Rev. 3.0	SN: J1091.0000836
RFID Antenna PCB	dormakaba	PN: 124-515394-001, Rev. 1.2	SN: J0991.1006111
ZigBee Module*	dormakaba	PN: 515123-AMM, Rev. 3.12	None

Note: *As per client, Zigbee is not included in the scope of this test report.

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

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

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	FA002532	2 year	June 5/19
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	Sept. 18/18
Bilog antenna (20–2000 MHz)	Sunol	JB1	FA002517	1 year	Dec. 6/18
Active loop antenna (9 kHz–30 MHz)	COM-POWER	AL-130	FA002674	1 year	June 21/18
50 Ω coax cable	C.C.A.	None	FA002603	—	VOU
50 Ω coax cable	Sucoflex	None	FA002563	—	VOU
50 Ω coax cable	C.C.A.	None	FA002831	—	VOU
Environmental Chamber	ESPEC	EPX-4H	FA002736	1 year	May 16/19
Variable Attenuator	API Weinschel, Inc.	AF117A-69-33	FA002813	—	VOU
Power Splitter	Mini-Circuits	ZN2PD-63-S+	FA002861	—	VOU

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

Section 8. Testing data

8.1 FCC 15.215(c) and RSS-Gen 6.6 Occupied (Emission) bandwidth

8.1.1 Definitions and limits

FCC

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80 % of the permitted band in order to minimize the possibility of out-of-band operation.

IC

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.

8.1.2 Test summary

Test date	June 8, 2018	Temperature	24 °C
Test engineer	Yong Huang	Air pressure	1009 mbar
Verdict	Pass	Relative humidity	40 %

8.1.3 Observations, settings and special notes

Spectrum analyzer settings:

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

8.1.4 Test data

Table 8.1-1: Lower 20 dBc frequency cross result

Fundamental frequency, MHz	Lower 20 dBc frequency cross, MHz	Limit, MHz	Margin, kHz
13.560	13.559	13.553	6

Table 8.1-2: Upper 20 dBc frequency cross result

Fundamental frequency, MHz	Upper 20 dBc frequency cross, MHz	Limit, MHz	Margin, kHz
13.560	13.561	13.567	6

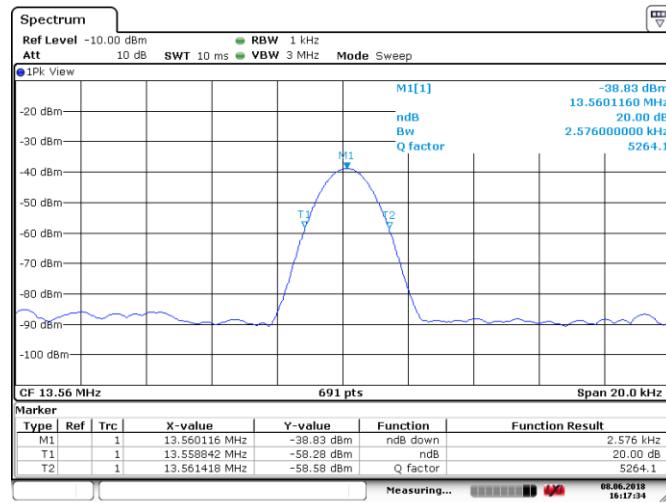


Figure 8.1-1: 20 dB bandwidth

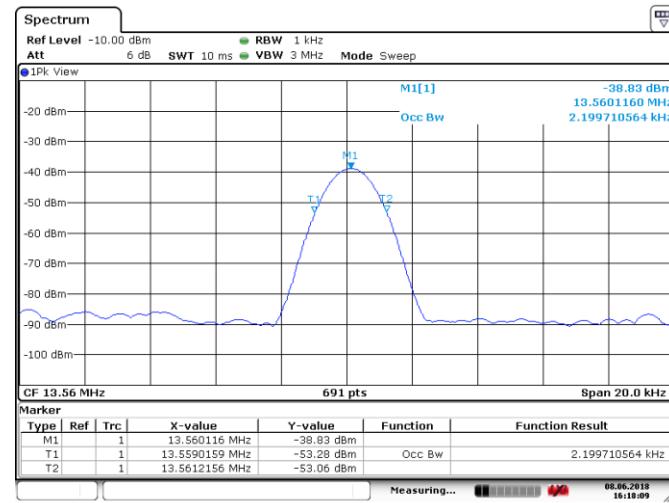


Figure 8.1-2: 99% bandwidth

8.2 FCC 15.225(a–c) and RSS-210 B.6 (a–c) Field strength within the 13.110–14.010 MHz band

8.2.1 Definitions and limits

- a) The field strength of any emissions within the band 13.553–13.567 MHz shall not exceed 15848 μ V/m (84 dB μ V/m) at 30 m.
- b) Within the bands 13.410–13.553 MHz and 13.567–13.710 MHz, the field strength of any emissions shall not exceed 334 μ V/m (50.5 dB μ V/m) at 30 m.
- c) Within the bands 13.110–13.410 MHz and 13.710–14.010 MHz the field strength of any emissions shall not exceed 106 μ V/m (40.5 dB μ V/m) at 30 m.

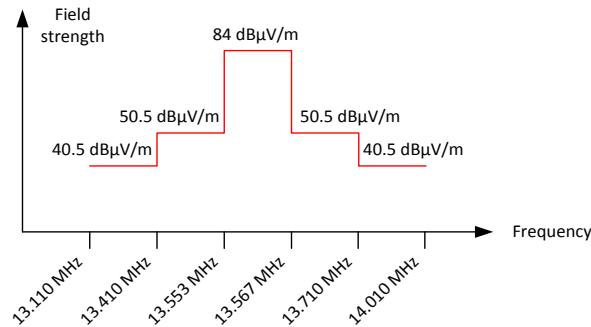


Figure 8.2-1: In-band spurious emissions limit

8.2.2 Test summary

Test date	May 23, 2018	Temperature	24 °C
Test engineer	Yong Huang	Air pressure	1009 mbar
Verdict	Pass	Relative humidity	40 %

8.2.3 Observations/special notes

The measurements were performed at the distance of 3 m. 40 dB distance correction factor* was applied to the measurement result in order to comply with 30 m limits.

* 30 m to 3 m distance correction factor calculation (for 13 MHz band):

$$40 \times \log_{10} (3 \text{ m}/30 \text{ m}) = 40 \times \log_{10} (0.1) = -40 \text{ dB}$$

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	10 kHz
Video bandwidth	30 kHz
Trace mode	Max Hold

8.2.4 Test data

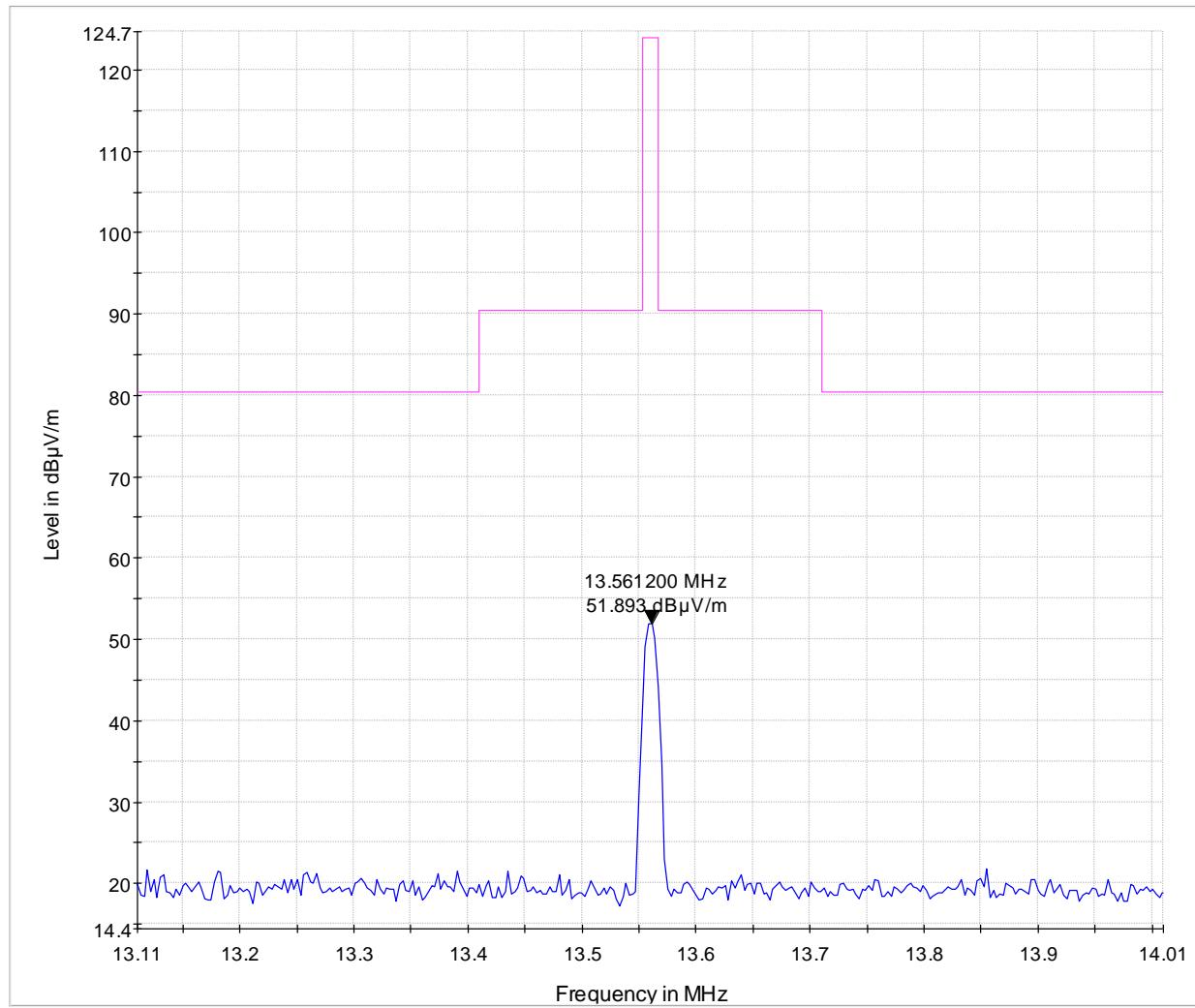


Figure 8.2-2: Field strength within 13.56 MHz mask

8.3 FCC 15.225(d) and RSS-210 B.6(d) Field strength of emissions outside 13.110–14.010 MHz band

8.3.1 Definitions and limits

FCC:

The field strength of any emissions appearing outside of the 13.110–14.010 MHz band shall not exceed the general radiated emission limits in §15.209. The field strength of emissions appearing within restricted bands (as specified in §15.205) shall not exceed the limits from §15.209.

ISED:

RSS-Gen general field strength limits for frequencies outside the band 13.110–14.010 MHz.

Table 8.3-1: 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 × log ₁₀ (F)	300
0.490–1.705	24000/F	87.6 – 20 × 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 8.3-2: 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 above 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

Table 8.3-3: 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			

8.3.2 Test summary

Test date	May 23, 2018	Temperature	24 °C
Test engineer	Yong Huang	Air pressure	1009 mbar
Verdict	Pass	Relative humidity	40 %

8.3.3 Observations, settings and special notes

The spectrum was searched from 9 kHz to 1 GHz.

Radiated measurements were performed at a distance of 3 m.

Spectrum analyzer settings for frequencies below 30 MHz:

Detector mode	Quasi-Peak
Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Trace mode	Max Hold
Measurement time	100 ms

Spectrum analyzer settings for frequencies above 30 MHz:

Detector mode	Peak
Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Trace mode	Max Hold
Measurement time	100 ms

8.3.4 Test data

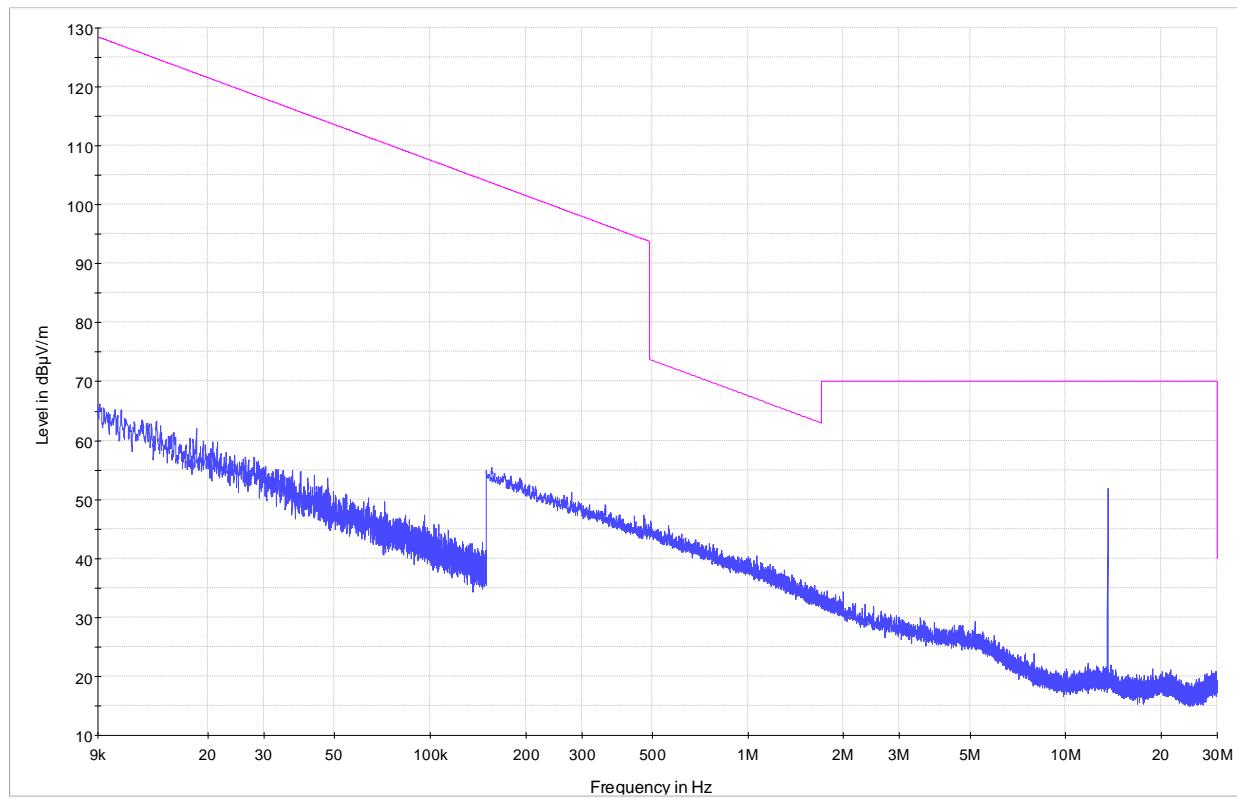


Figure 8.3-1: Field strength of spurious emissions below 30 MHz

Table 8.3-4: Field strength measurement results within 13.11–14.01 MHz band at 3 m distance

Frequency, MHz	Field strength, dBμV/m	Limit _{3 m} , dBμV/m	Margin, dB
13.56	51.9	124.0	72.1

8.3.4 Test data, continued

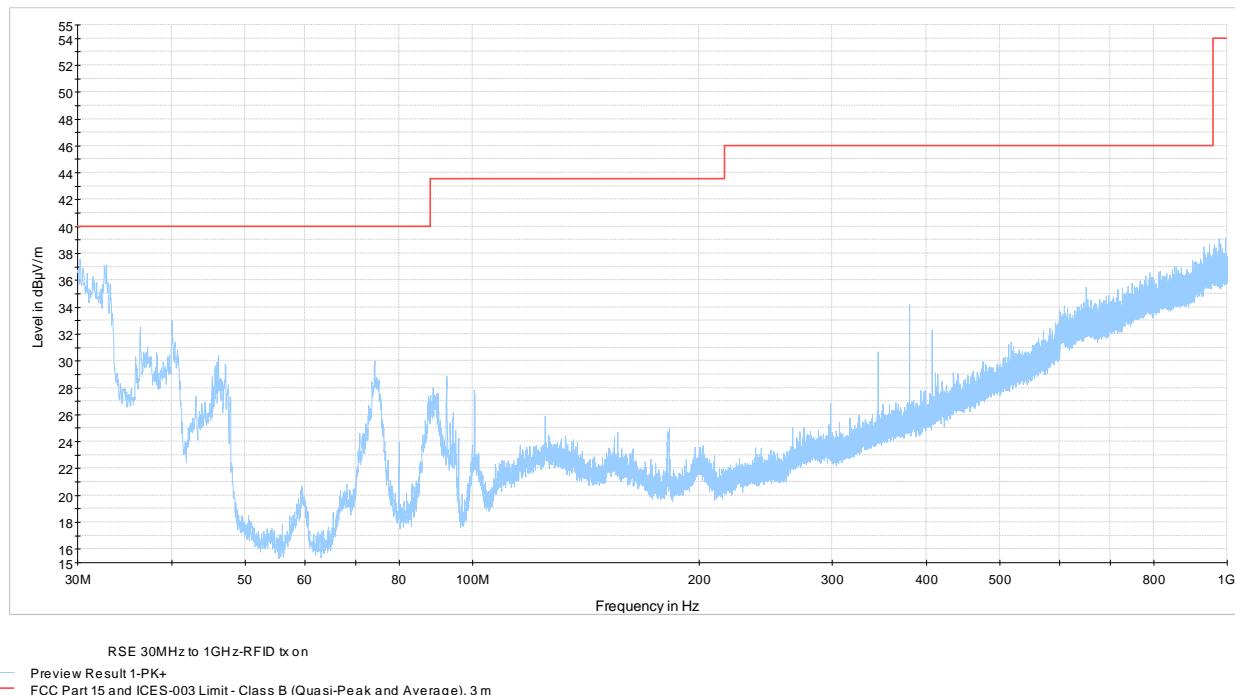


Figure 8.3-2: Field strength of spurious emissions above 30 MHz

Note: all measurement results indicated in the plot were taken with a peak detector, which is more stringent measurement, and still comply with quasi-peak limit.

Table 8.3-5: Radiated emissions (Quasi-Peak) results

Frequency (MHz)	Quasi-Peak field strength ¹ (dBμV/m)	3 m Quasi-Peak limit ³ (dBμV/m)	Margin (dB)	Measurement time (ms)	Bandwidth (kHz)	Antenna height (cm)	Pol. (V/H)	Turn table position (°)	Correction factor ² (dB)
30.240	32.2	40.0	7.8	100	120	121	H	19	23.2
32.550	30.9	40.0	9.1	100	120	146	V	186	21.5
32.760	29.2	40.0	10.8	100	120	234	V	28	21.3

Notes:

¹ Field strength (dBμV/m) = receiver/spectrum analyzer value (dBμV) + correction factor (dB)

² Correction factor = antenna factor ACF (dB) + cable loss (dB)

³ Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Sample calculation: 32.2 dBμV/m (field strength) = 9.0 dBμV (receiver reading) + 23.2 dB (Correction factor)

8.4 FCC 15.225(e) and RSS-210 B.6 Frequency tolerance of the carrier signal

8.4.1 Definitions and limits

The frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ (± 100 ppm) of the operating frequency over a temperature variation of $-20\text{ }^{\circ}\text{C}$ to $+50\text{ }^{\circ}\text{C}$ at normal supply voltage, and for a variation in the primary supply voltage from 85 % to 115 % of the rated supply voltage at a temperature of $20\text{ }^{\circ}\text{C}$. For battery operated equipment, the equipment tests shall be performed using a new battery.

8.4.2 Test summary

Test date	May 23, 2018	Temperature	24 °C
Test engineer	Yong Huang	Air pressure	1009 mbar
Verdict	Pass	Relative humidity	40 %

8.4.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	$\geq 1\%$ of emission bandwidth
Video bandwidth	RBW $\times 3$
Trace mode	Max Hold

8.4.4 Test data

Table 8.4-1: Frequency drift measurements results

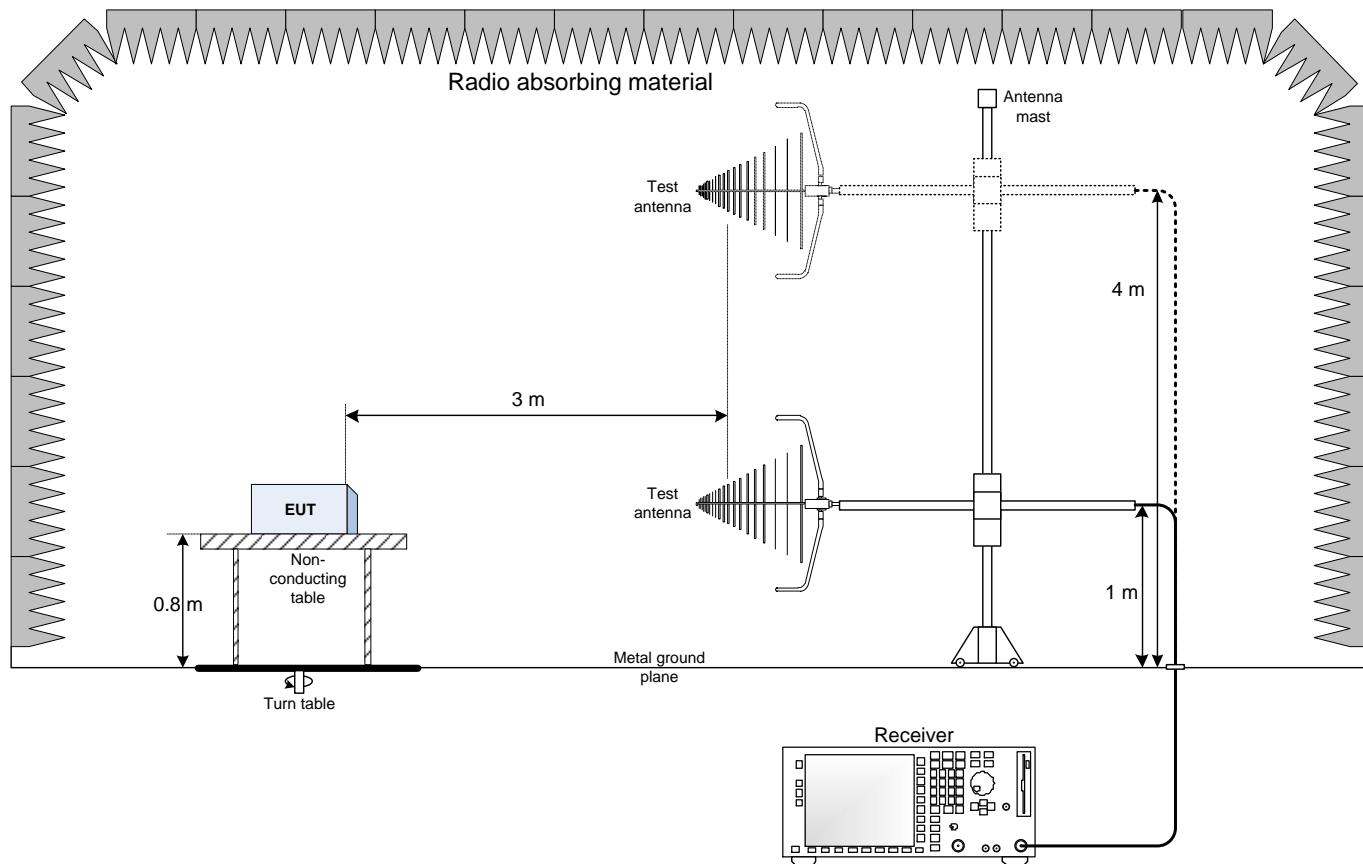
Test conditions	Frequency, MHz	Frequency drift, \pm ppm	Limit, \pm ppm	Margin, ppm
+50 °C, Nominal	13.560140	0	100	100
+20 °C, +15 %	13.560140	0	100	100
+20 °C, Nominal	13.560140	Reference	Reference	Reference
+20 °C, -15 %	13.560140	0	100	100
-20 °C, Nominal	13.560000	10.3	100	89.7

Note: frequency drift was calculated as follows:

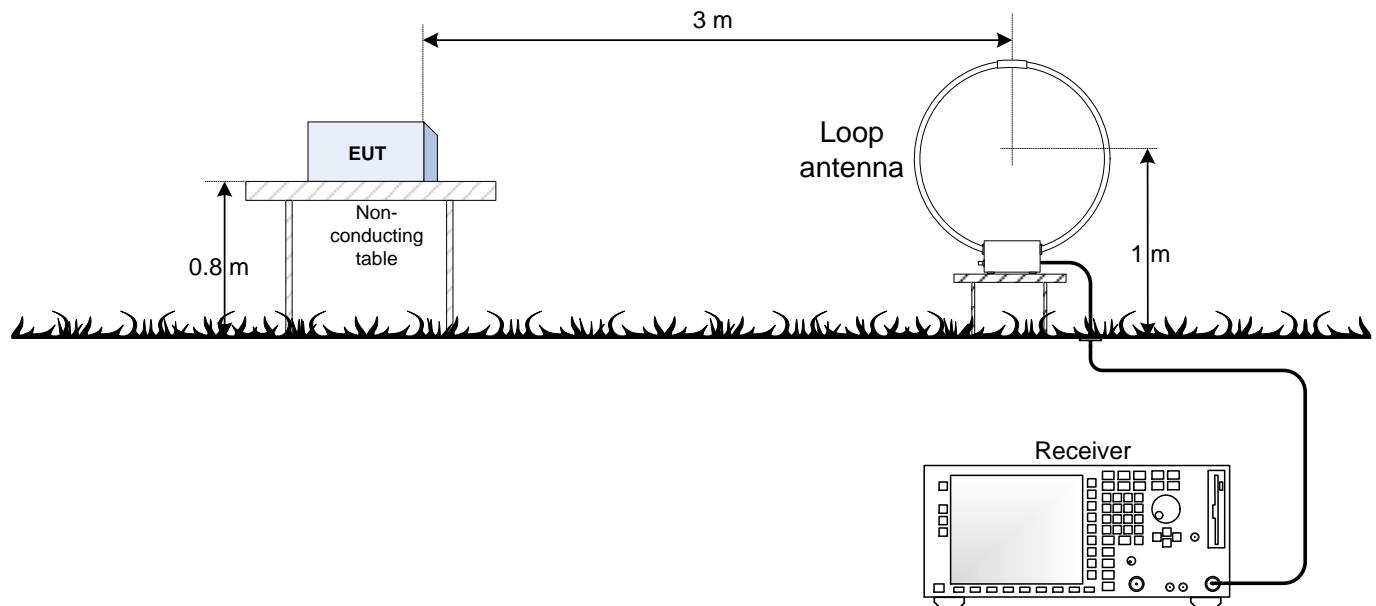
$$\text{Frequency drift (ppm)} = ((F_{\text{measured}} - F_{\text{reference}}) \div F_{\text{reference}}) \times 1 \times 10^6$$

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up



9.2 Radiated emissions set-up below 30 MHz



(End of report)