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Wireless test report – 349742-1TRFWL

Date of issue: October 17, 2018

Applicant:

Waltz Labs Canada

Product name:

NFC reader wall mount

Model:

NFC-PN532

FCC ID:

2AO3T-NFCPN532

IC Registration number:

23675-NFCPN532

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

Test location

Company name	Nemko Canada Inc.		
Facility Name	Montreal		
Address	292 Labrosse Avenue		
City	Pointe-Claire		
Province	QC		
Postal code	H9R 5L8		
Country	Canada		
Telephone	+1 514 694 2684		
Facsimile	+1 514 694 3528		
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	October 17, 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 contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Table of contents

Table of contents **3**
Section 1. Report summary **4**
1.1 Applicant and manufacturer 4
1.2 Test specifications 4
1.3 Statement of compliance 4
1.4 Exclusions 4
1.5 Test report revision history 4
Section 2. Summary of test results **5**
2.1 FCC Part 15 Subpart C, general requirements test results 5
2.2 FCC Part 15 Subpart C, intentional radiators test results 5
2.3 ISED RSS-GEN, Issue 4, test results 5
2.4 ISED RSS-210, Issue 9, test results 5
Section 3. Equipment under test (EUT) details **6**
3.1 Sample information 6
3.2 EUT information 6
3.3 Technical information 6
3.4 Product description and theory of operation 6
3.5 EUT exercise details 6
3.6 EUT setup diagram 7
3.7 EUT bill of materials 7
Section 4. Engineering considerations **8**
4.1 Modifications incorporated in the EUT 8
4.2 Technical judgment 8
4.3 Deviations from laboratory tests procedures 8
Section 5. Test conditions **9**
5.1 Atmospheric conditions 9
5.2 Power supply range 9
Section 6. Measurement uncertainty **10**
6.1 Uncertainty of measurement 10
Section 7. Test equipment **11**
7.1 Test equipment list 11
Section 8. Testing data **12**
8.1 FCC 15.215(c) and RSS-Gen 6.6 Occupied (Emission) bandwidth 12
8.2 FCC 15.225(a–c) and RSS-210 B.6 (a–c) Field strength within the 13.110–14.010 MHz band 14
8.3 FCC 15.225(d) and RSS-210 B.6(d) Field strength of emissions outside 13.110–14.010 MHz band 16
8.4 FCC 15.225(e) and RSS-210 B.6 Frequency tolerance of the carrier signal 20
Section 9. Block diagrams of test set-ups **21**
9.1 Radiated emissions set-up below 30 MHz 21
9.2 Radiated emissions set-up 30 MHz to 1 GHz 22

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Waltz Labs Canada
Address	460 Ste-Catherine W, Suite 200 H3B 1A7 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 DC powered.

[1] Supply voltage variation was performed on DC.

[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 ISED 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 ISED 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	August 1, 2018
Nemko sample ID number	Item#1

3.2 EUT information

Product name	NFC reader wall mount
Model	NFC-PN532
Serial number	NFC000151

3.3 Technical information

Operating band	13.553–13.567 MHz
Operating frequency	13.56 MHz
Modulation type	OOK
Occupied bandwidth (99 %)	6 kHz
Power requirements	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

The Waltz NFC reader is mostly based on the PN532 board manufactured by Elechouse, epoxy-potted and connected to an industry standard rectangular housing connector with 4 white wires, the cable protection being ensured by a transparent sheath.
Ferrites are added to each output line of the board, and decoupling capacitor placed between its power supply voltage rail and ground. The goal of this is to reduce the EMI emissions to an acceptable level.

3.5 EUT exercise details

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

3.6 EUT setup diagram

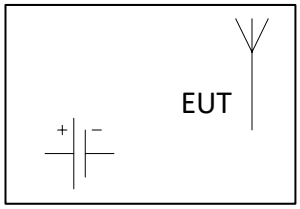


Figure 3.6-1: *Setup diagram*

3.7 EUT bill of materials

Table 3.7-1: *EUT bill of materials*

Description	Manufacturer	Manufacturer part number	Quantity
NFC board	Elechouse	PN532	1
Ferrite	Murata	BLM21BD152SN1	4
10nF decoupling capacitor	Murata	GRM155R71H103KA88D	1
10uF decoupling capacitor	Samsung Electro-Mechanics	CL21A106KQFNNNE	1
Cabling	Alpha wire	A1851W-100	4
Transparent sheath	Alpha wire	P1058 CL005	1
Housing connector	Molex	0039012040	4

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

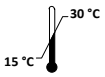
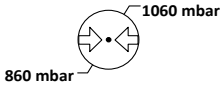
None

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 ±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	Oct. 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	FA002722	1 year	Aug. 10/19
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

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

Table 7.1-2: *test software details*

Manufacturer of Software	Details
Rohde & Schwarz	EMC32, Software for EMC Measurements, Version 9.26.01

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 start date	October 2, 2018
Test engineer	Yong Huang

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	13.562	13.567	5

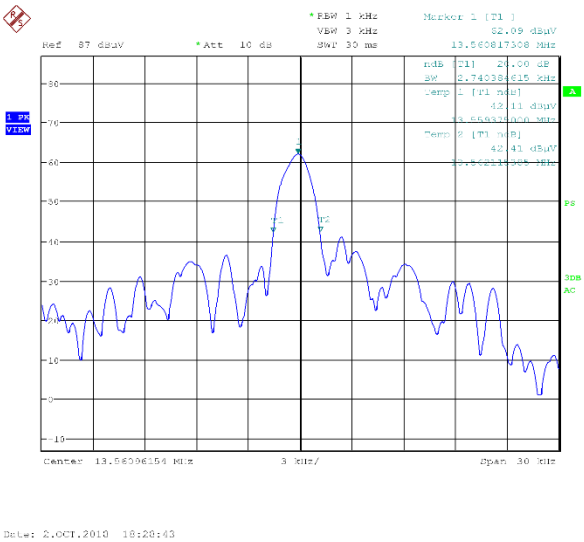


Figure 8.1-1: *20 dB bandwidth*

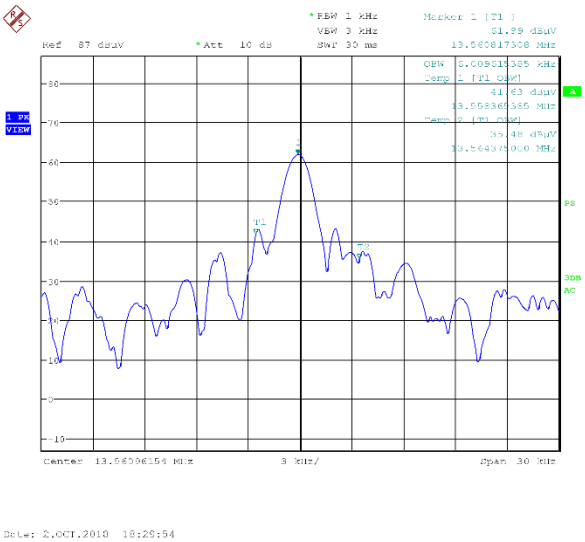


Figure 8.1-2: *99% dB bandwidth*

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 µV/m (84 dBµV/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 µV/m (50.5 dBµV/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 µV/m (40.5 dBµV/m) at 30 m.

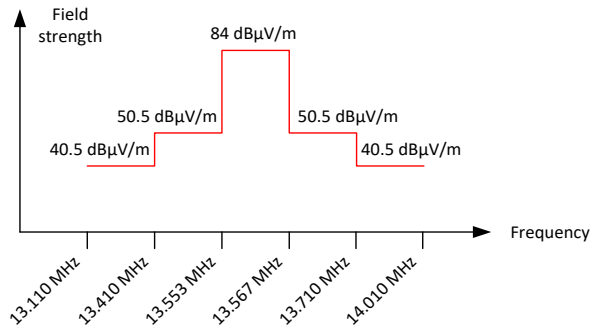


Figure 8.2-1: *In-band spurious emissions limit*

8.2.2 Test summary

Test start date	October 2, 2018
Test engineer	Yong Huang

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):

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

Spectrum analyzer settings:

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

8.2.4 Test data

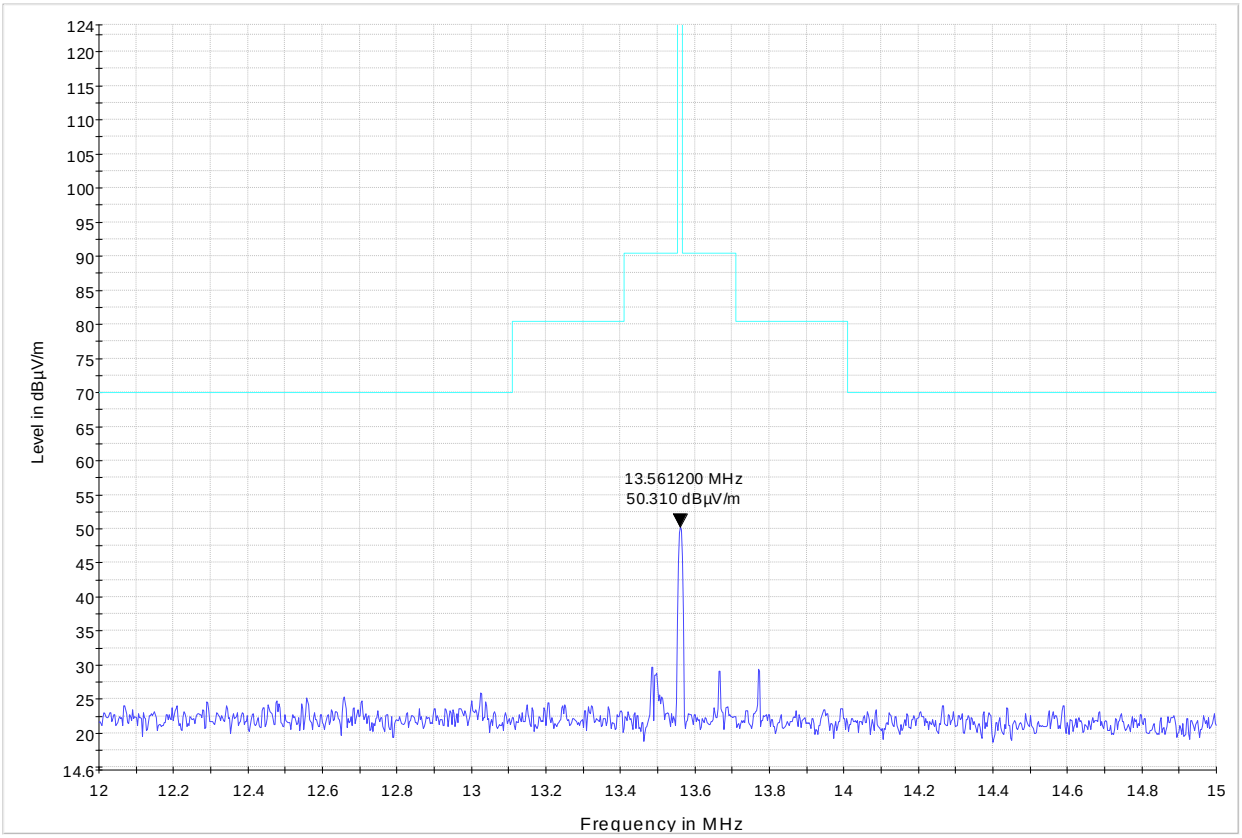


Figure 8.2-2: *Field strength within 13.56 MHz mask*

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 µV/m	dBµV/m	Measurement distance, 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 8.3-2: *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 start date	October 2, 2018
Test engineer	Yong Huang

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

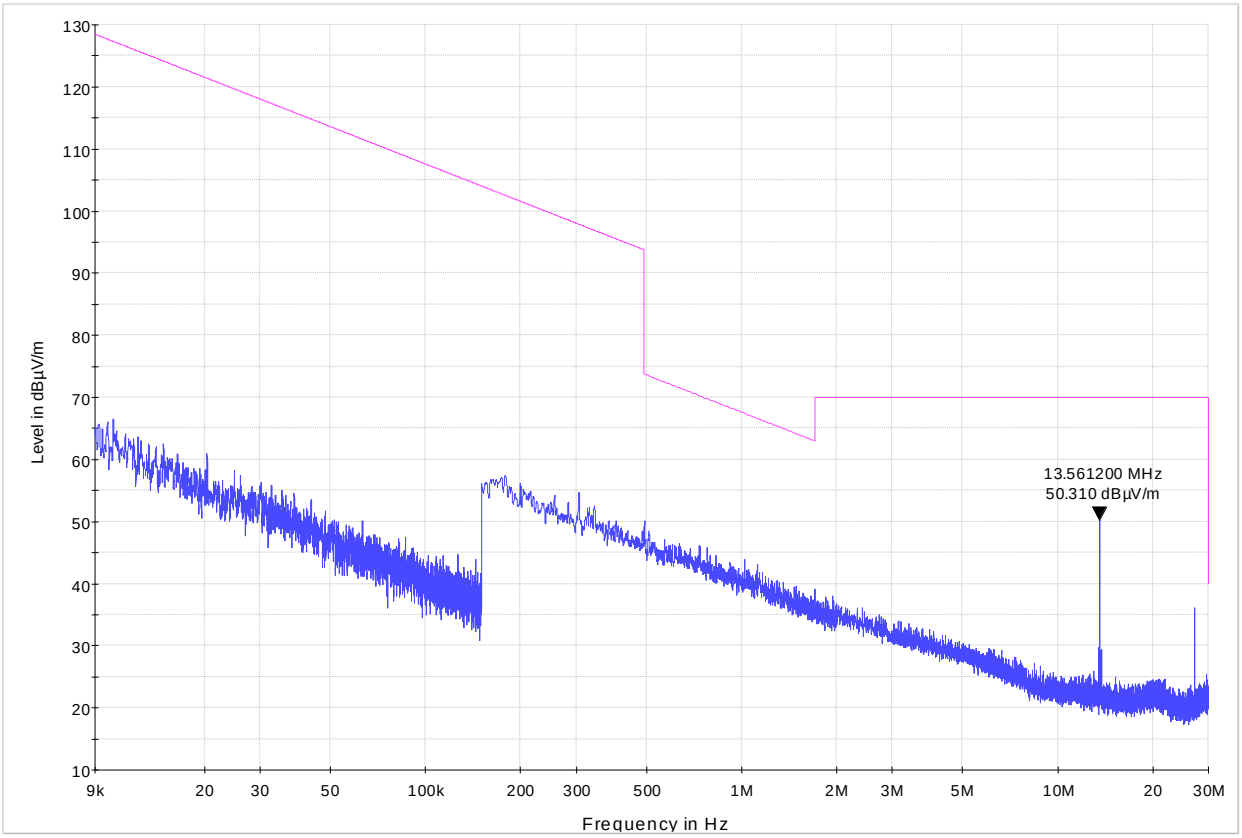


Figure 8.3-1: *Field strength of spurious emissions below 30 MHz*

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	50.3	124.0	73.7

8.3.4 Test data, continued

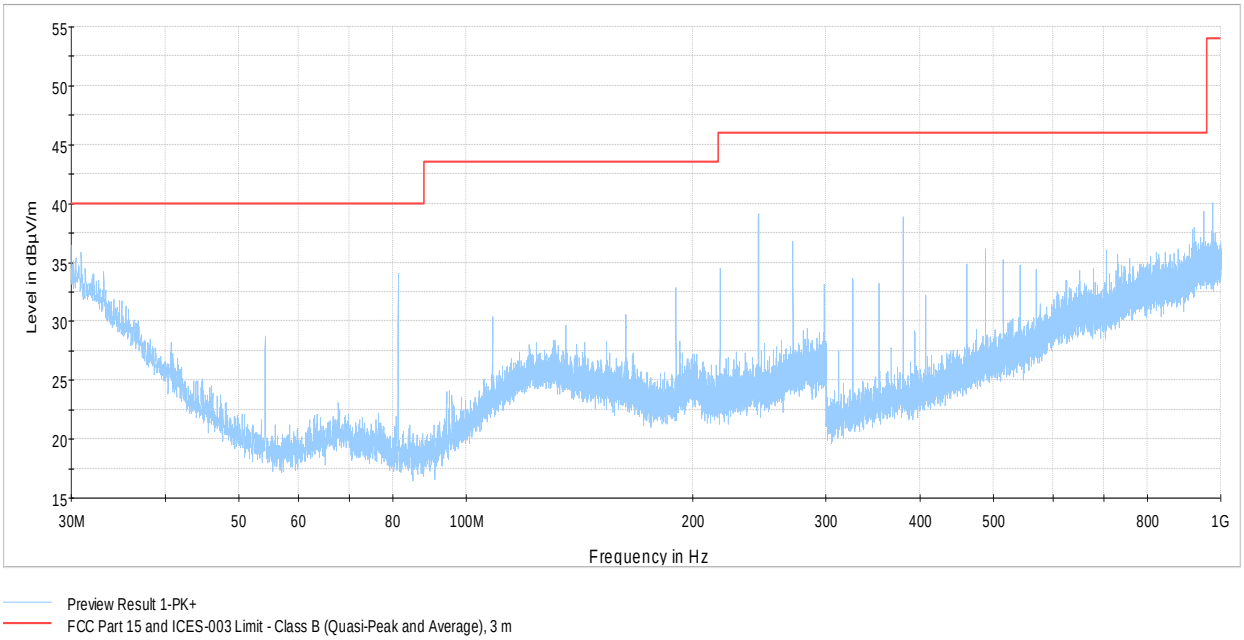


Figure 8.3-2: *Field strength of spurious emissions above 30 MHz*

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)
379.66	33.4	46.0	12.6	100	120	103	H	310	18.0
488.16	34.7	46.0	11.3	100	120	104	V	19	20.5

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 ±0.01 % (±100 ppm) of the operating frequency over a temperature variation of −20 °C to +50 °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 °C. For battery operated equipment, the equipment tests shall be performed using a new battery.

8.4.2 Test summary

Test start date	October 10, 2018
Test engineer	Yong Huang

8.4.3 Observations, settings and special notes

Spectrum analyzer settings:

Detector mode	Peak
Resolution bandwidth	1 Hz
Video bandwidth	1 Hz
Trace mode	Max Hold

8.4.4 Test data

Table 8.4-1: *Frequency drift measurements results*

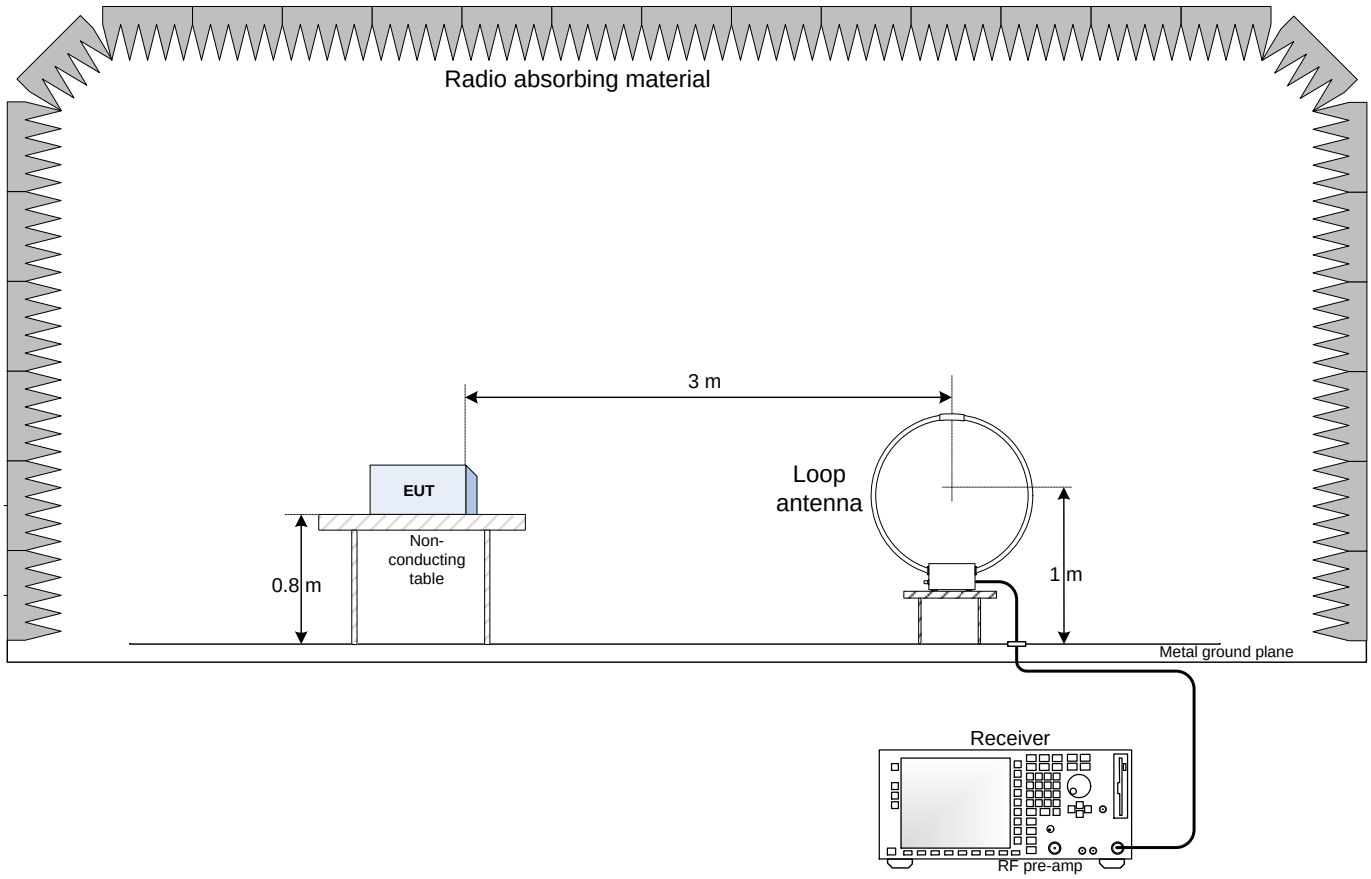
Test conditions	Frequency, MHz	Frequency drift, ±ppm	Limit, ±ppm	Margin, ppm
+50 °C, Nominal	13.5607820	-3.1708985	100	96.83
+20 °C, +15 %	13.5608250	0	100	100
+20 °C, Nominal	13.5608250	*Reference*	*Reference*	*Reference*
+20 °C, −15 %	13.5608250	0	100	100
−20 °C, Nominal	13.5609120	6.4155389	100	93.58

Note: frequency drift was calculated as follows:

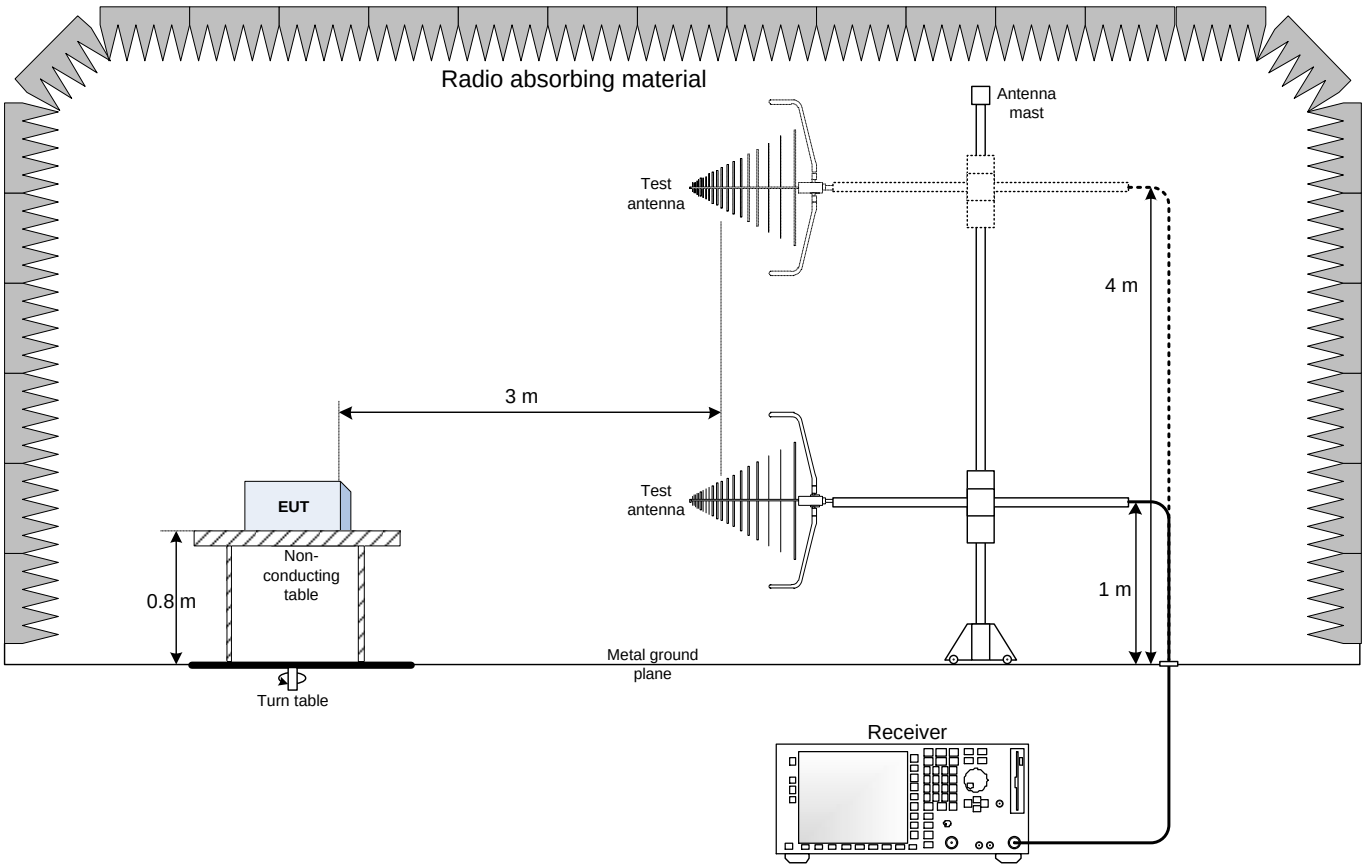
Frequency drift (ppm) = $((F_{measured} - F_{reference}) \div F_{reference}) \times 1\times10^6$

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up below 30 MHz



9.2 Radiated emissions set-up 30 MHz to 1 GHz



(End of report)