

Wireless test report – 369969-2TRFWL

Date of issue: May 7, 2019

Applicant:

TR Controls Inc

Product:

Access Management Keypad

Model:

K1

FCC ID:

2AL9H-112015

IC Registration number:

22769-112015

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.			
Facilities	Ottawa site:	Montréal site:	Cambridge site:	Almonte site:
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Test site registration	Organization Recognition numbers and location FCC/ISED CA2040 (Ottawa/Almonte); CA2041 (Montreal); CA0101 (Cambridge)			
Website	www.nemko.com			

Tested by	Kevin Rose, Wireless/EMC Specialist
Reviewed by	Andrey Adelberg, Senior Wireless/EMC Specialist
Date	May 7, 2019
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

Company name	TR Controls Inc.
Address	955 Green Valley Road
City	London
Province/State	Ontario
Postal/Zip code	N6N 1E4
Country	Canada

1.2 Manufacturer

Company name	Microart Services Inc.
Address	190 Duffield Drive
City	Markham
Province/State	Ontario
Postal/Zip code	L6G 1B5
Country	Canada

1.3 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

1.4 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-Gen, Issue 5 Amendment 1, March 2019	General Requirements for Compliance of Radio Apparatus

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
\$15.215(c)	20 dB bandwidth	Pass

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. No noticeable output power variation was observed

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 ISSED RSS-GEN, Issue 5, test results

Part	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable
7.4	Receiver conducted emission limits	Not applicable
6.9	Operating bands and selection of test frequencies	Pass
8.8	AC power-line conducted emissions limits	Not applicable

Notes: ¹ According to sections 5.2 and 5.3 of RSS-Gen, Issue 5 the EUT does not have a stand-alone receiver neither scanner receiver, therefore exempt from receiver requirements.

EUT is an DC powered device.

2.4 ISSED 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	April 3, 2019
Nemko sample ID number	#4

3.2 EUT information

Product name	Access Management Keypad
Model	K1
Serial number	None

3.3 Technical information

Operating band	13.553–13.567 MHz
Operating frequency	13.56 MHz fixed
Modulation type	100% ASK
Occupied bandwidth (99 %)	879 Hz
Power requirements	12 V _{DC}
Emission designator	A1D
Antenna information	The EUT is professionally installed.

3.4 Product description and theory of operation

The K1 is an access control device with NFC/RFID (13.56 MHz) and PIN keypad entry options.
The device will be polling with a wake-up message every 5ms with modulated signal at 13.56 MHz
The modulation used is specific to the ISO14443A protocol which is 106 kbit/s data rate and 100% ASK.

3.5 EUT exercise details

- The EUT is powered with 12 V DC source and unit transmits signals at frequency 13.56 MHz
- When connections are made, observe the LED's on the keypad
- Yellow LED will initially light up to indicate the keypad is connected

3.6 EUT setup diagram

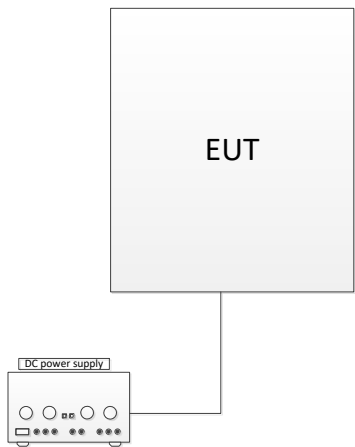


Figure 3.6-1: Setup diagram

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

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.
Receiver/spectrum analyzer	Rohde & Schwarz	ESR 26	FA002969	1 year	Jun-01/2019
3m EMI Test chamber	TDK	SAC-3	FA003012	1 year	Aug-22/2019
Flush mount table	SUNAR	FM2022	FA003006	-	NCR
Controller	SUNAR	SC110V	FA002976	-	NCR
Antenna mast	SUNAR	TLT2	FA003007	-	NCR
Bilog Antenna(20-2000 MHz)	SUNAR	JB1	FA003009	1year	Sep-06/2019
Loop Antenna (9 kHz-30 MHz)	COM-Power	AL-130R	FA003002	1 year	Aug-08-2019
Receiver/spectrum analyzer	Rohde & Schwarz	FSW	FA002969	1 year	Jun-01-2019
Temperature chamber	Espec	EPX-4H	FA003033	-	NCR

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

Section 8. Testing data

8.1 FCC 15.215(c) and RSS-Gen 6.7 Occupied bandwidth (or 99% emission bandwidth) and x dB 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	April 12, 2019	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	980 mbar
Verdict	Pass	Relative humidity	29 %

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	13.55996	13.553	6.96

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	13.56072	13.567	6.28

Section 8
Test name
Specification

Testing data
FCC 15.215(c) and RSS-Gen 6.7 Occupied (Emission) bandwidth
FCC 15 Subpart C and RSS-Gen

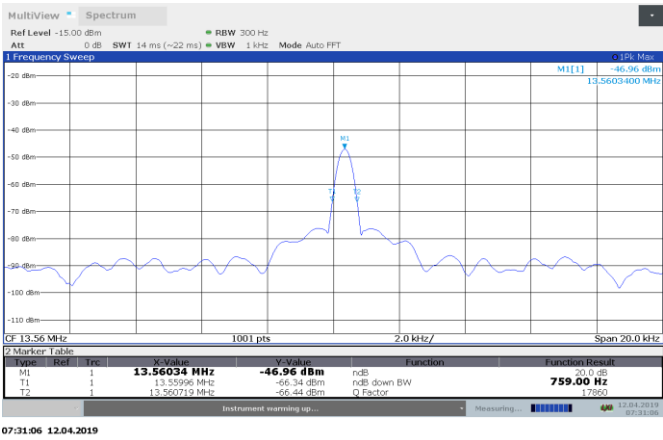


Figure 8.1-1: 20 dB bandwidth

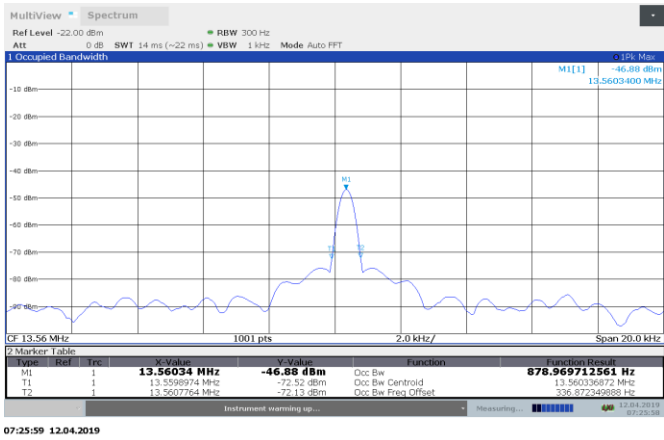


Figure 8.1-2: 99% dB bandwidth

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 $\mu\text{V/m}$ (84 dB $\mu\text{V/m}$) 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 $\mu\text{V/m}$ (50.5 dB $\mu\text{V/m}$) 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 $\mu\text{V/m}$ (40.5 dB $\mu\text{V/m}$) at 30 m.

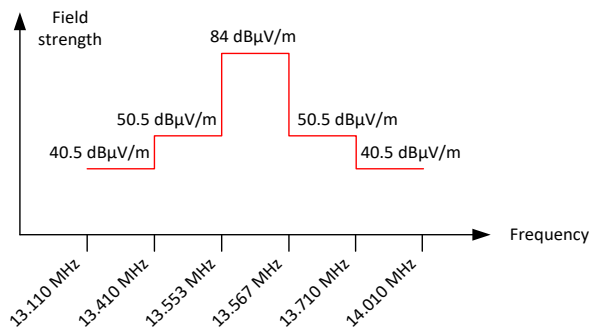


Figure 8.2-1: In-band spurious emissions limit

8.2.2 Test summary

Test date	April 9, 2019	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	990 mbar
Verdict	Pass	Relative humidity	22 %

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	9 kHz
Video bandwidth	30 kHz
Trace mode	Max Hold

8.2.4 Test data

Table 8.2-1: Field strength measurements results Parallel position

Frequency range, MHz	Frequency, MHz	Field strength at 3 m, dBμV/m	Calculated field strength at 30 m, dBμV/m	Limit, dBμV/m	Margin, dB
13.553–13.567	13.559	73.9	33.9	84.00	50.1
13.410–13.553	13.454	52.5	12.5	50.50	38.0
13.567–13.710	13.667	51.6	11.6	50.50	38.9
13.110–13.410	13.348	55.6	15.6	40.50	24.9
13.710–14.010	13.774	53.8	13.8	40.50	26.7

Note: Calculated field strength at 30 m = Measured field strength at 3 m – 40 dB

Table 8.2-2: Field strength measurements results Perpendicular position

Frequency range, MHz	Frequency, MHz	Field strength at 3 m, dBμV/m	Calculated field strength at 30 m, dBμV/m	Limit, dBμV/m	Margin, dB
13.553–13.567	13.561	72.9	32.9	84.00	51.1
13.410–13.553	13.462	52.0	12.0	50.50	38.5
13.567–13.710	13.659	48.3	8.3	50.50	42.2
13.110–13.410	13.349	53.1	13.1	40.50	27.4
13.710–14.010	13.776	49.1	9.1	40.50	31.4

Note: Calculated field strength at 30 m = Measured field strength at 3 m – 40 dB

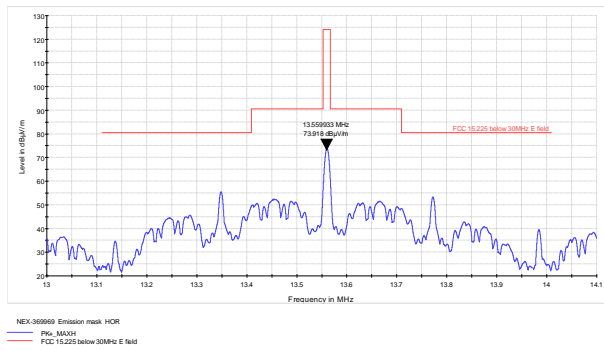


Figure 8.2-2: Field strength within 13.110–14.010 MHz band Parallel

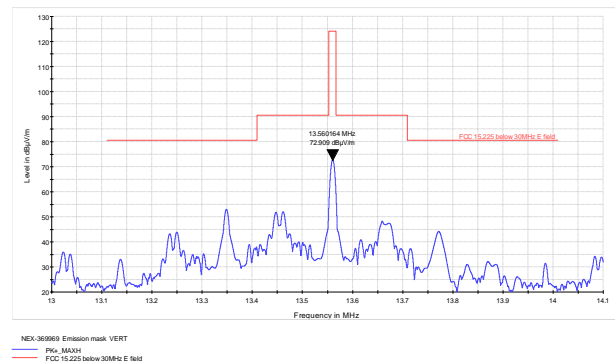


Figure 8.2-3: Field strength within 13.110–14.010 MHz band perpendicular

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	$67.6 - 20 \times \log_{10}(F)$	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: ISED restricted frequency bands

MHz	MHz	MHz	GHz
0.090–0.110	12.57675–12.57725	399.9–410	7.25–7.75
0.495–0.505	13.36–13.41	608–614	8.025–8.5
2.1735–2.1905	16.42–16.423	960–1427	9.0–9.2
3.020–3.026	16.69475–16.69525	1435–1626.5	9.3–9.5
4.125–4.128	16.80425–16.80475	1645.5–1646.5	10.6–12.7
4.17725–4.17775	25.5–25.67	1660–1710	13.25–13.4
4.20725–4.20775	37.5–38.25	1718.8–1722.2	14.47–14.5
5.677–5.683	73–74.6	2200–2300	15.35–16.2
6.215–6.218	74.8–75.2	2310–2390	17.7–21.4
6.26775–6.26825	108–138	2483.5–2500	22.01–23.12
6.31175–6.31225	149.9–150.05	2655–2900	23.6–24.0
8.291–8.294	156.52475–156.52525	3260–3267	31.2–31.8
8.362–8.366	156.7–156.9	3332–3339	36.43–36.5
8.37625–8.38675	162.0125–167.17	3345.8–3358	
8.41425–8.41475	167.72–173.2	3500–4400	
12.29–12.293	240–285	4500–5150	Above 38.6
12.51975–12.52025	322–335.4	5350–5460	

Note: Certain frequency bands listed in and above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to related devices are set out in the 200 and 300 series of RSSs.

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	April 8, 2019	Temperature	24 °C
Test engineer	Kevin Rose	Air pressure	975 mbar
Verdict	Pass	Relative humidity	32 %

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 150 kHz:

Detector mode	Peak
Resolution bandwidth	300 Hz
Video bandwidth	9 kHz
Trace mode	Max Hold
Measurement time	100 ms

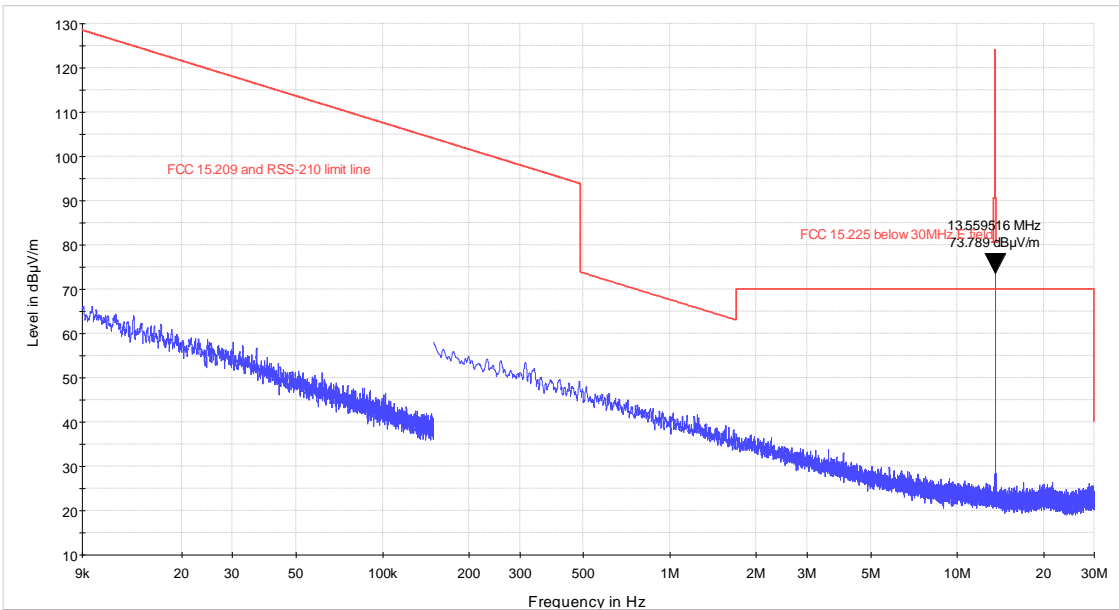
Spectrum analyzer settings for frequencies 150 kHz-30 MHz:

Detector mode	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:

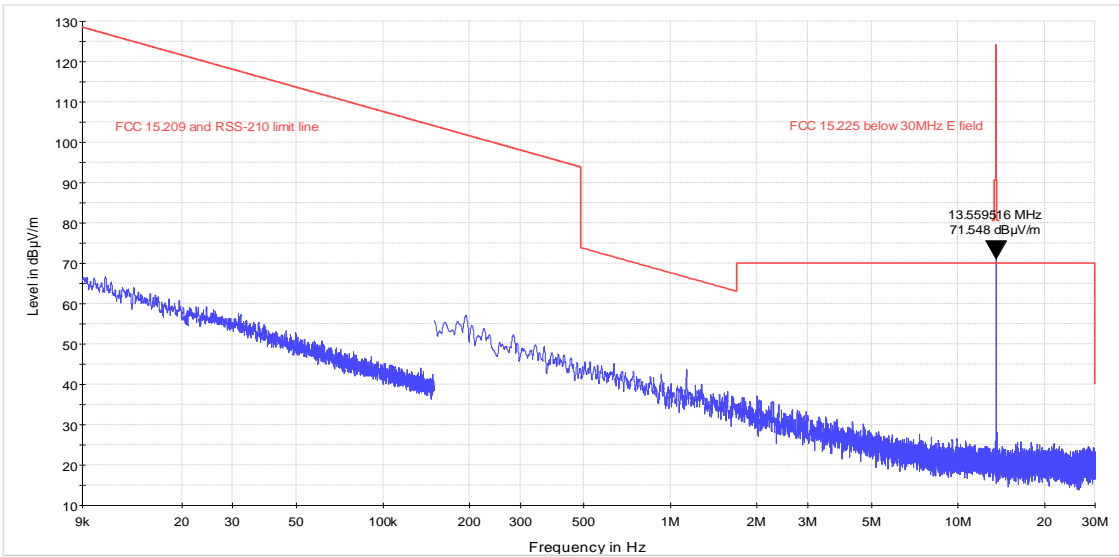
Detector mode	Peak and Quasi Peak
Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Trace mode	Max Hold
Measurement time	100 ms

8.3.4 Test data



NEX-369969 C 9 kHz - 30 MHz Radiated Emission Parallel
PK+_MAXH
FCC 15.209 and RSS-210 limit line
FCC 15.225 below 30MHz E field

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



NEX-369969 C 9 kHz - 30 MHz Radiated Emission Perpendicular
PK+_MAXH
FCC 15.209 and RSS-210 limit line
FCC 15.225 below 30MHz E field

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

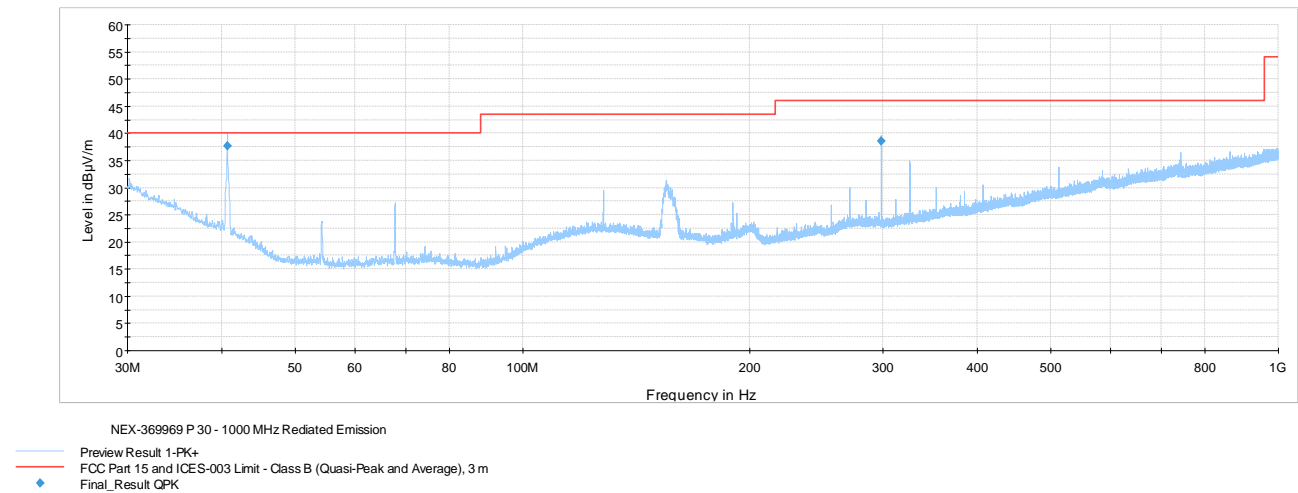


Figure 8.3-3: Field strength of spurious emissions above 30 MHz

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.

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	April 11, 2019	Temperature	24 $^{\circ}\text{C}$
Test engineer	Kevin Rose	Air pressure	985 mbar
Verdict	Pass	Relative humidity	31 %

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

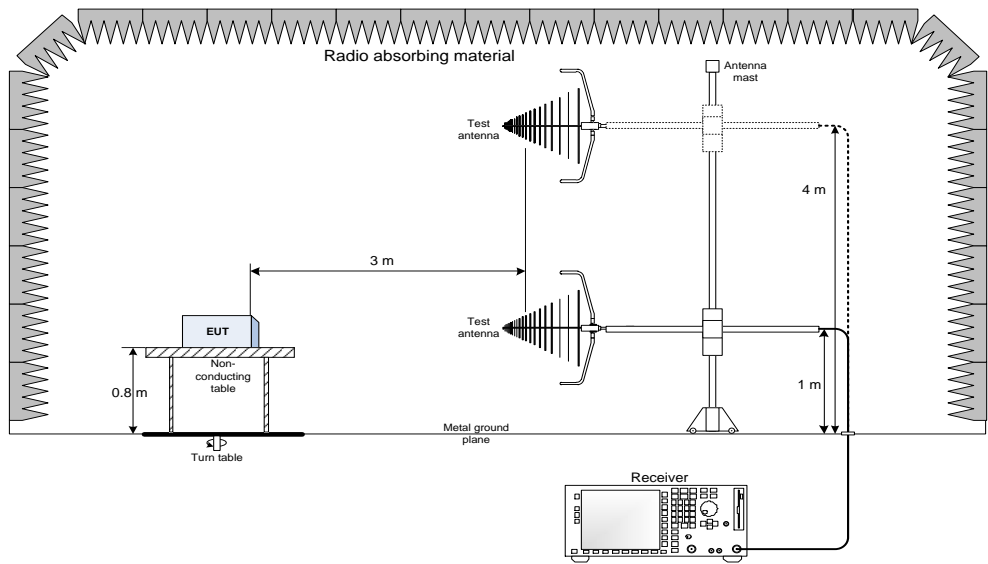
Test conditions	Frequency, MHz	Frequency drift, \pm ppm	Limit, \pm ppm	Margin, ppm
+80 $^{\circ}\text{C}$, Nominal	13.5603	-7.3744	100	92.6256
+50 $^{\circ}\text{C}$, Nominal	13.5603	-7.3744	100	92.6256
+40 $^{\circ}\text{C}$, Nominal	13.5603	-7.3744	100	92.6256
+30 $^{\circ}\text{C}$, Nominal	13.5603	-7.3744	100	92.6256
+20 $^{\circ}\text{C}$, +15 %	13.5604	0	100	100
+20 $^{\circ}\text{C}$, Nominal	13.5604	Reference	Reference	Reference
+20 $^{\circ}\text{C}$, -15 %	13.5604	0	100	100
+10 $^{\circ}\text{C}$, Nominal	13.5604	0	100	100
0 $^{\circ}\text{C}$, Nominal	13.5604	0	100	100
-10 $^{\circ}\text{C}$, Nominal	13.5604	0	100	100
-20 $^{\circ}\text{C}$, Nominal	13.5603	-7.3744	100	92.6256
-40 $^{\circ}\text{C}$, Nominal	13.5601	-22.123	100	77.8768

Note: frequency drift was calculated as follows:

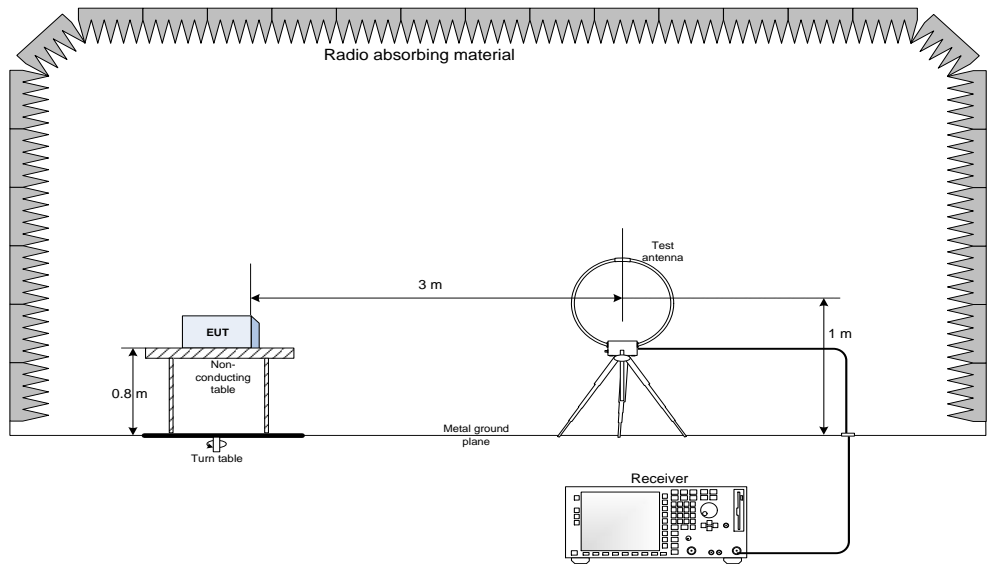
$$\text{Frequency drift (ppm)} = ((F_{\text{measured}} - F_{\text{reference}}) \div F_{\text{reference}}) \times 1 \times 10^6$$

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions ≥ 30 MHz set-up



9.2 Radiated emissions ≤ 30 MHz set-up



-End of test report-