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RADIO TEST REPORT

Report ID:
REP032423

Project number:
PRJ0054229

Type of assessment:
Final product testing

Applicant:
PTI Security Systems, Inc.

Description of the product:
Smart Lock with wireless communication

Model (HVIN):
810-00045, 810-00047

Product marketing name (PMN):
ProEdge Lock

FCC identifier:
FCC ID: 2BFJY-34000223

ISED certification number:
IC: 32223-34000223

Specifications:

- FCC 47 CFR Part 15 Subpart C, §15.225
- RSS-210, Issue 10, December 2019, Annex B.6

Date of issue: April 19, 2024

Tarek Elkholy, EMC/RF Specialist
Tested by

Tarek Elkholy
Signature

Nimish Kapoor, EMC/RF Specialist
Reviewed by

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Lab locations

Company name	Nemko Canada Inc.		
Facilities	*Ottawa site:* 303 River Road Ottawa, Ontario Canada K1V 1H2 Tel: +1 613 737 9680 Fax: +1 613 737 9691	*Montréal site:* 292 Labrosse Avenue Pointe-Claire, Québec Canada H9R 5L8 Tel: +1 514 694 2684 Fax: +1 514 694 3528	*Cambridge site:* 1-130 Saltsman Drive Cambridge, Ontario Canada N3E 0B2 Tel: +1 519 650 4811

Test site identifier	**Organization**	**Ottawa**	**Montreal**	**Cambridge**
	FCC:	CA2040	CA2041	CA0101
	ISED:	2040A-4	2040G-5	24676
Website	www.nemko.com			

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.

Copyright notification

Table of Contents

Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.225	Operation within the band 13.110–14.010 MHz
RSS-210, Issue 10, Dec 2019, Annex B.6	Licence-Exempt Radio Apparatus: Category I Equipment. Devices operating in frequency bands for any application Band 13.110–14.010 MHz

1.2 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.3 Exclusions

None

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.3 above. Results obtained indicate that the product under test complies In full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.5 Test report revision history

Table 1.5-1: *Test report revision history*

Report ID	Date of issue	Details of changes made to test report
REP032423	April 19, 2024	Original report issued

Section 2 Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

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

2.2 Technical judgment

None.

2.3 Model variant declaration

The EUT comes in two model variants: 810-00045 and 810-00047.

1. Both models are electrically identical.
2. The antennas are the same
3. The enclosure are identical between the two models. The **only** difference between the two models is the backplate as seen in figure 1. This difference enables the lock to be mounted on two different door types – a flat door and a corrugated door.

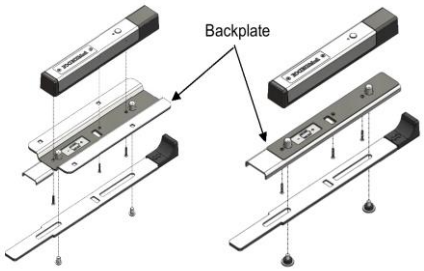

Figure 1

2.4 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3 Test conditions

3.1 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 4 Information provided by the applicant

4.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results contained within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

4.2 Applicant/Manufacturer

Applicant name	PTI Security Systems, Inc.
Applicant address	9160 East Bahia Drive, Suite 100, Scottsdale, AZ, 85260, United States
Manufacturer name	Same as applicant
Manufacturer address	Same as applicant

4.3 EUT information

Product	Smart Lock with wireless communication
Model name (PMN)	ProEdge Lock
Model number (HVIN)	810-00045, 810-00047
Serial number	PEL20613010000584
Part number	810-00045
Power supply requirements	$LiMnO_2$ battery: 3 V_{DC}
Product description and theory of operation	ProEdge lock is a self-contained smart lock with wireless communication primarily targeted for use as a replacement for the mechanical locks used within the Self-Storage sector.
Operational frequencies	Source: Frequency CPU: 64 MHz CPU, RTC: 32.768 kHz CPU, PWM module: 250 kHz SPI: 1 MHz LED PWM: 1 kHz Accelerometer module: 8 MHz NFC external oscillator: 27.12 MHz SAM chip: 60 MHz
Software details	The firmware configures the available radios into receiver mode and operates the other hardware functions at the same or higher rate than normal operation.

4.4 Radio technical information

Frequency band	13.553–13.567 MHz
Frequency Min (MHz)	13.56
Frequency Max (MHz)	13.56
Field strength @ 3 m	45.1 dBµV/m
Measured BW, 99% OBW	571.2 Hz
Type of modulation	ASK, OOK
Transmitter spurious, dBµV/m @ 3 m	13.84 MHz, Peak
Module manufacturer	NXP
Brand/Model	NXP CLRC66303HNY (OM964203HNY)
Antenna information	NFC flex PCB antenna, Coiled inductor (0.72 µH) for 13.56 MHz

4.5 EUT setup details

4.5.1 Radio exercise details

Operating conditions	The RFID reader was forced into continuous transmission at the maximum possible power level as per the EUT's typical application. Firmware 510-00039v01.00.06 with adjustments for the test samples as follows: Radio NFC: The firmware only operates the NFC radio by continuously transmitting data.
Transmitter state	Transmitter set in to continuous mode.

4.5.2 EUT setup configuration

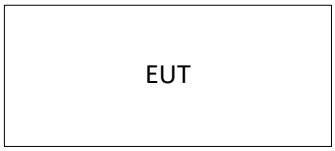

Figure 4.5-1: *Radiated testing block diagram*

Section 5 Summary of test results

5.1 Testing period

Test start date	March 16, 2024	Test end date	March 18, 2024

5.2 Sample information

Receipt date	March 14, 2024	Nemko sample ID number(s)	PRJ00542290003

5.3 FCC Part 15 Subpart A and C, general requirements test results

Table 5.3-1: *FCC general requirements results*

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable[1]
§15.31(e)	Variation of power source	Not applicable[1]
§15.31(m)	Number of tested frequencies	Pass
§15.203	Antenna requirement	Pass
§15.215	Occupied bandwidth	Pass

Notes: [1]EUT is a battery-operated device, the testing was performed using fresh batteries.

5.4 FCC Part §15.225 test results

Table 5.4-1: *FCC §15.225 requirements 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

5.5 ISED RSS-Gen, Issue 5, test results

Table 5.5-1: *RSS-Gen requirements results*

Clause	Test description	Verdict
7.3	Receiver radiated emission limits	Not applicable[1]
7.4	Receiver conducted emission limits	Not applicable[1]
6.9	Operating bands and selection of test frequencies	Pass
8.8	AC power-line conducted emissions limits	Not applicable[2]
6.7	Occupied bandwidth	Pass

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 a battery operated device, the testing was performed using fresh batteries.

5.6 ISED RSS-210, Issue 10, test results

Table 5.6-1: *ISED RSS-210 requirements results*

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

Notes: None

Section 6 Test equipment

6.1 Test equipment list

Table 6.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA003012	1 year	January 22, 2025
Flush mount turntable	SUNAR	FM2022	FA003006	—	NCR
Controller	SUNAR	SC110V	FA002976	—	NCR
Antenna mast	SUNAR	TLT2	FA003007	—	NCR
AC Power source	Chroma	61605	FA003034	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESR26	FA002969	1 year	May 9, 2024
Bilog antenna (30–2000 MHz)	SUNAR	JB1	FA003010	1 year	July 14, 2024
Active loop antenna (0.01–30 MHz)	Com-Power	AL-130R	FA003002	1 year	April 25, 2024
50 Ω coax cable	Huber + Suhner	None	FA003047	1 year	July 27, 2024
50 Ω coax cable	Huber + Suhner	None	FA003402	1 year	July 27, 2024
Temperature humidity Chamber	LIK	LKPTH-100E	FA003430	-	VOU
Temperature meter	VAISALA	MI70/ HMP76B	FA003318	1 year	May 31, 2024

Notes: NCR - no calibration required, VOU - verify on use
All equipment related to the contribution of measurement has been included in this list. Such items include, but are not limited to, cables, attenuators, directional couplers, and pre-amps.

Table 6.1-2: *Automation software details*

Test description	Manufacturer of Software	Details
EMC/Radio test software	Rohde & Schwarz	EMC32, Software for EMC Measurements, Version 10.60. 00

Table 6.1-3: *Measurement uncertainty calculations based on equipment list*

Measurement	Measurement uncertainty, ±dB
Radiated spurious emissions (9 kHz to 30 MHz)	3.42
Radiated spurious emissions (30 MHz to 1 GHz)	4.27

Notes: UKAS Lab 34, TIA-603 and ETSI TR 100 028-1&2 have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Section 7 Testing data

7.1 Variation of power source

7.1.1 References, definitions and limits

FCC §15.31:

(e) For intentional radiators, measurements of the variation of the input power or the radiated signal level of the fundamental frequency component of the emission, as appropriate, shall be performed with the supply voltage varied between 85% and 115% of the nominal rated supply voltage. For battery operated equipment, the equipment tests shall be performed using a new battery.

7.1.2 Test summary

Verdict	Pass		
Test date	March 16, 2024	Temperature	22 °C
Tested by	Tarek Elkholy	Air pressure	972 mbar
Test location	Cambridge	Relative humidity	45 %

7.1.3 Observations, settings and special notes

The testing was performed as per ANSI C63.10 Section 5.13.

a) Where the device is intended to be powered from an external power adapter, the voltage variations shall be applied to the input of the adapter provided with the device at the time of sale. If the device is not marketed or sold with a specific adapter, then a typical power adapter shall be used.
b) For devices, where operating at a supply voltage deviating ±15% from the nominal rated value may cause damages or loss of intended function, test to minimum and maximum allowable voltage per manufacturer's specification and document in the report.
c) For devices with wide range of rated supply voltage, test at 15% below the lowest and 15% above the highest declared nominal rated supply voltage.
d) For devices obtaining power from an input/output (I/O) port (USB, firewire, etc.), a test jig is necessary to apply voltage variation to the device from a support power supply, while maintaining the functionalities of the device.

For battery-operated equipment, the equipment tests shall be performed using a variable power supply.

7.1.4 Test data

EUT Power requirements:	☐ AC	☐ DC	☒ Battery
If EUT is an AC or a DC powered, was the noticeable output power variation observed?	☐ YES	☐ NO	☒ N/A
If EUT is battery operated, was the testing performed using fresh batteries?	☒ YES	☐ NO	☐ N/A
If EUT is rechargeable battery operated, was the testing performed using fully charged batteries?	☐ YES	☐ NO	☒ N/A

7.2 Number of frequencies

7.2.1 References, definitions and limits

FCC §15.31:

(m) Measurements on intentional radiators or receivers shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table 7.2-1.

RSS-Gen, Clause 6.9:

Except where otherwise specified, measurements shall be performed for each frequency band of operation for which the radio apparatus is to be certified, with the device operating at the frequencies in each band of operation shown in table below. The frequencies selected for measurements shall be reported in the test report.

Table 7.2-1: *Frequency Range of Operation*

Frequency range over which the device operates (in each band)	Number of test frequencies required	Location of measurement frequency inside the operating frequency range
1 MHz or less	1	Center (middle of the band)
1–10 MHz	2	1 near high end, 1 near low end
Greater than 10 MHz	3	1 near high end, 1 near center and 1 near low end

Notes: "near" means as close as possible to or at the centre / low end / high end of the frequency range over which the device operates.

7.2.2 Test summary

Verdict	Pass		
Test date	March 16, 2024	Temperature	22 °C
Tested by	Tarek Elkholy	Air pressure	972 mbar
Test location	Cambridge	Relative humidity	45 %

7.2.3 Observations, settings and special notes

ANSI C63.10, Clause 5.6.2.1:

The number of channels tested can be reduced by measuring the center channel bandwidth first and then applying the following relaxations as appropriate:

a) For each operating mode, if the measured channel bandwidth on the middle channel is at least 150% of the minimum permitted bandwidth, then it is not necessary to measure the bandwidth on the high and low channels.

b) For multiple-input multiple-output (MIMO) systems, if the measured channel bandwidth on testing the middle channel exceeds the minimum permitted bandwidth by more than 50% on one transmit chain, then it is not necessary to repeat testing on the other chains.

c) If the measured channel bandwidth on the middle channel is less than 50% of the maximum permitted bandwidth, then it is not necessary to measure the bandwidth on the high and low channels.

ANSI C63.10, Clause 5.6.2.2:

For devices with multiple operating modes, measurements on the middle channel can be used to determine the worst-case mode(s). The worst-case modes are as follows:

a) Band edge requirements—Measurements on the mode with the widest bandwidth can be used to cover the same channel (center frequency) on modes with narrower bandwidth that have the same or lower output power for each modulation family (e.g., OFDM and direct sequence spread spectrum).

b) Spurious emissions—Measure the mode with the highest output power and the mode with the highest output power spectral density for each modulation family (e.g., OFDM and direct sequence spread spectrum).

c) In-band PSD—Measurements on the mode with the narrowest bandwidth can be used to cover all modes within the same modulation family of an equal or lower output power provided the result is less than 50% of the limit.

7.2.4 Test data

Table 7.2-2: *Test channels selection*

Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range bandwidth, kHz	Single Tx frequency, MHz
13.553	13.567	14	13.560

7.3 Antenna requirement

7.3.1 References, definitions and limits

FCC §15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with §15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

RSS-Gen, Clause 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report.

7.3.2 Test summary

Verdict	Pass		
Test date	March 16, 2024	Temperature	22 °C
Tested by	Tarek Elkholy	Air pressure	972 mbar
Test location	Cambridge	Relative humidity	45 %

7.3.3 Observations, settings and special notes

None

7.3.4 Test data

Must the EUT be professionally installed? ☐ YES ☒ NO

Does the EUT have detachable antenna(s)? ☐ YES ☒ NO

If detachable, is the antenna connector(s) non-standard? ☐ YES ☐ NO ☒ N/A

Table 7.3-1: *Antenna information*

Antenna type	Manufacturer	Model number	Connector type
PCB antenna	NFC flex	Coiled inductor (0.72 µH)	Integrated antenna

7.4 Occupied bandwidth

7.4.1 References, definitions and limits

FCC Part §15.215:

Additional provisions to the general radiated emission limitations:

(c) 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.

ANSI C63.10-2013, Clause 6.9.3:

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

RSS-Gen, Clause 6.7:

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

7.4.2 Test summary

Verdict	Pass		
Test date	March 18, 2024	Temperature	22 °C
Tested by	Tarek Elkholy	Air pressure	973 mbar
Test location	Cambridge	Relative humidity	41 %

7.4.3 Observations, settings and special notes

The emission bandwidth was tested per ANSI C63.10, Clause 6.9.3. Spectrum analyser settings:

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

7.4.4 Test data

Table 7.4-1: *99% bandwidth results*

Frequency, MHz	99% bandwidth, Hz
13.56	571.2

Table 7.4-2: *Lower 20 dBc frequency cross result*

Fundamental frequency, MHz	Lower 20 dBc frequency cross, MHz	Limit, MHz	Margin, kHz
13.560	13.560	13.553	7.0

Table 7.4-3: *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	6.0

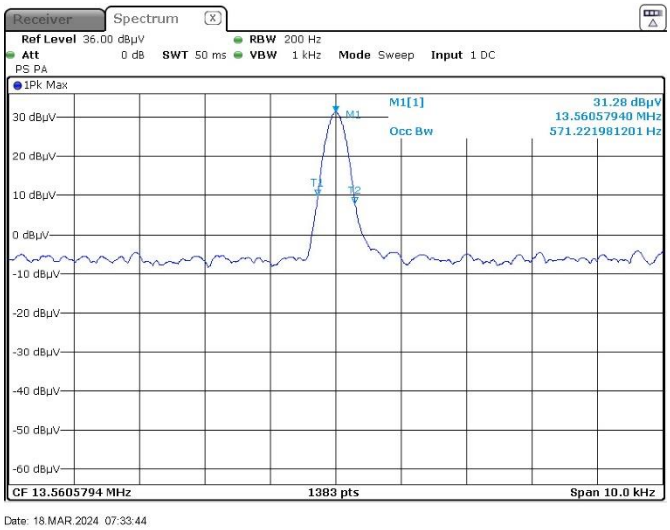

Figure 7.4-1: *99% bandwidth*

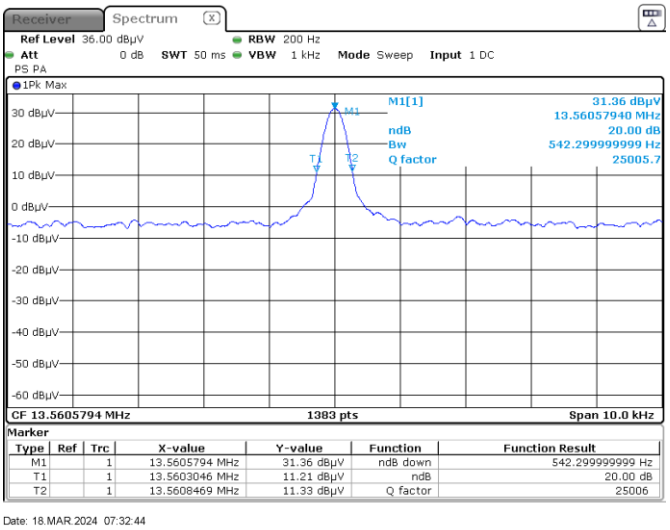

Figure 7.4-2: *20 dB bandwidth*

7.5 Field strength within 13.110–14.010 MHz band

7.5.1 References, definitions and limits

FCC §15.225:

(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 meters.

(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 meters.

(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 meters.

RSS-210, Annex B.6:

Devices shall comply with the following requirements:

a. the field strength of any emission shall not exceed the following limits:

i. 15.848 mV/m (84 dBµV/m) at 30 m, within the band 13.553–13.567 MHz

ii. 334 µV/m (50.5 dBµV/m) at 30 m, within the bands 13.410–13.553 MHz and 13.567–13.710 MHz

iii. 106 µV/m (40.5 dBµV/m) at 30 m, within the bands 13.110–13.410 MHz and 13.710–14.010 MHz

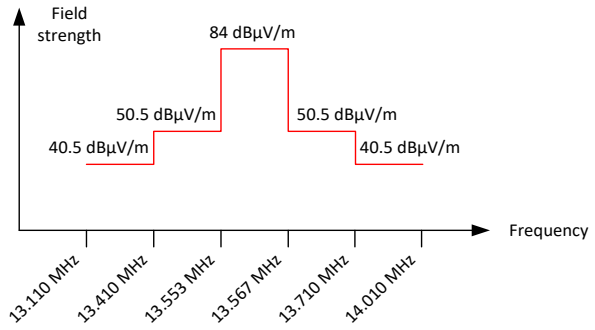

Figure 7.5-1: *In-band spurious emissions limit at 30 m*

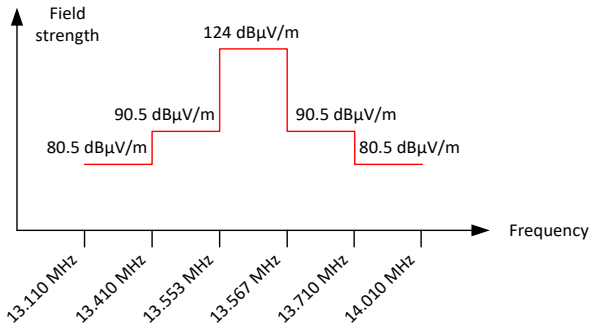

Figure 7.5-2: *In-band spurious emissions limit at 3 m*

7.5.2 Test summary

Verdict	Pass		
Test date	March 18, 2024	Temperature	22 °C
Tested by	Tarek Elkholy	Air pressure	973 mbar
Test location	Cambridge	Relative humidity	41 %

7.5.3 Observations, settings and 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.
* 3 m to 30 m distance correction factor calculation (for 13 MHz band):

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

- EUT was set to transmit with 100 % duty cycle.
- Radiated measurements were performed at a distance of 3 m.
- The spurious emission was tested per ANSI C63.10, Clause 6.4.

Spectrum analyser settings:

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

7.5.4 Test data

Table 7.5-1: *Field strength measurements results*

Frequency range, MHz	Frequency, MHz	Field strength at 3 m, dBµV/m	Calculated field strength at 30 m, dBµV/m	Limit at 30m, dBµV/m	Margin, dB
13.553–13.567	13.56	45.1	5.1	84.0	78.9
13.410–13.553	13.55	29.7	-10.3	50.5	60.8
13.567–13.710	13.57	31.5	-8.5	50.5	59.0
13.110–13.410	13.18	24.8	-15.2	40.5	55.7
13.710–14.010	13.84	25.2	-14.8	40.5	55.3

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

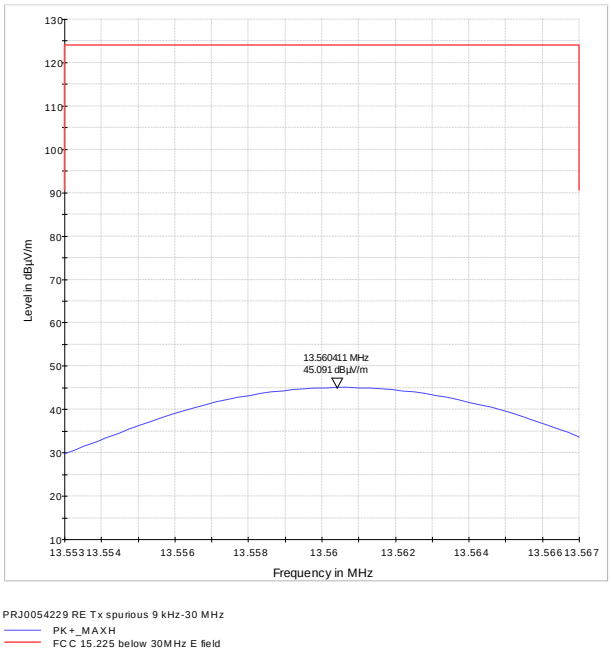

Figure 7.5-3: *Field strength within 13.553–13.567 MHz band*

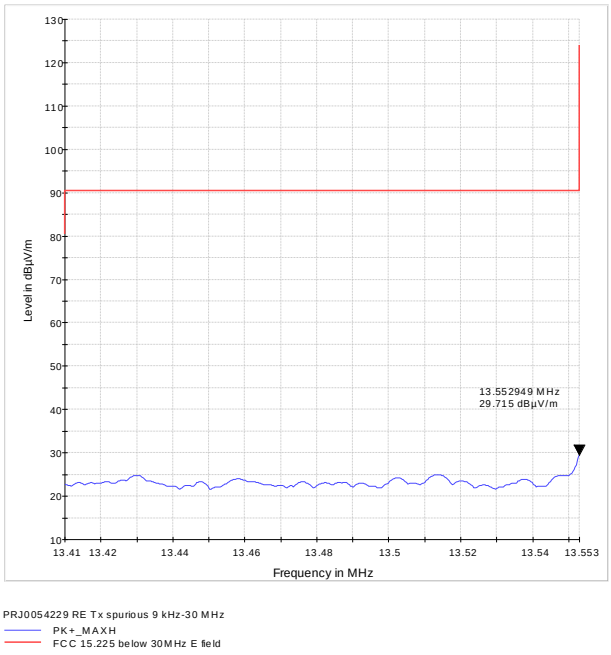

Figure 7.5-4: *Field strength within 13.410–13.553 MHz band*

Test data, continued

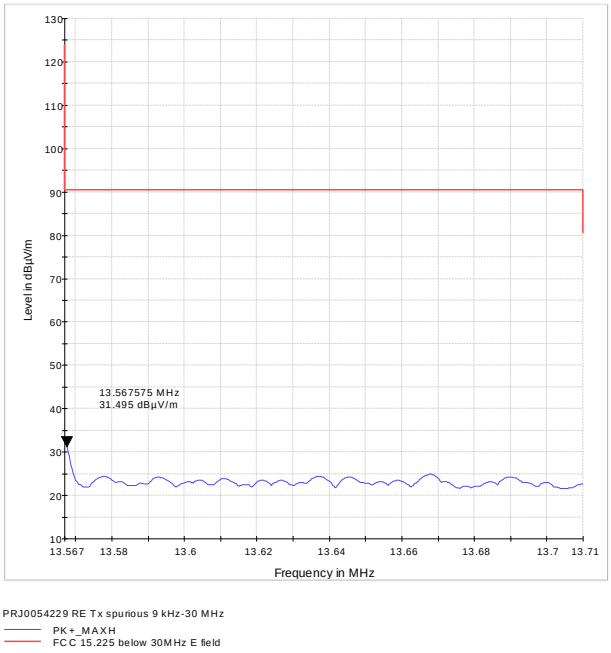

Figure 7.5-5: *Field strength within 13.567–13.710 MHz band*

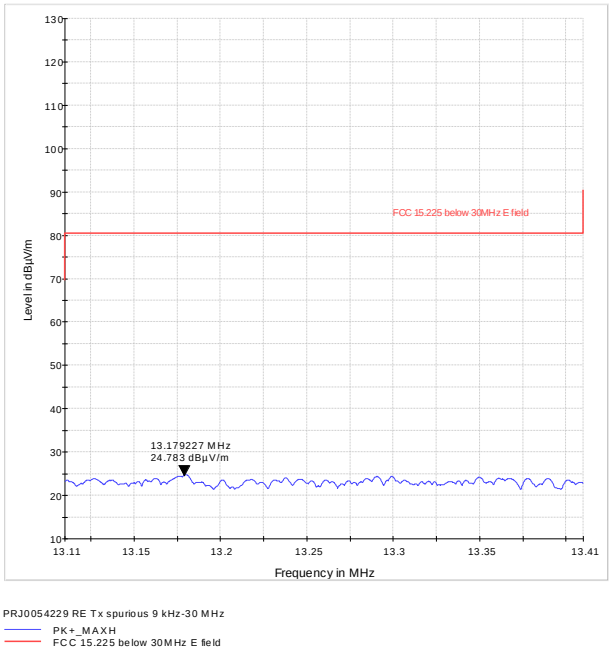

Figure 7.5-6: *Field strength within 13.110–13.410 MHz band*

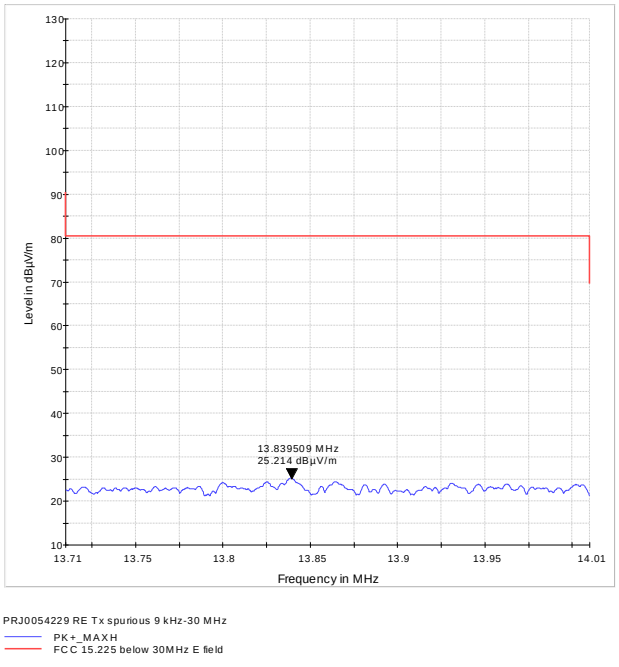

Figure 7.5-7: *Field strength within 13.710–14.010 MHz band*

7.6 Field strength outside 13.110–14.010 MHz band

7.6.1 References, definitions and limits

FCC §15.225:

(d) 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

RSS-210, Annex B.6:

Devices shall comply with the following requirements:

a. the field strength of any emission shall not exceed the following limits:

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

Table 7.6-1: *FCC §15.209 and RSS-Gen – Radiated emission limits*

	Field strength of emissions		
Frequency, MHz	**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.

References, definitions and limits, continued

Table 7.6-2: *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	Above 38.6
12.29–12.293	240–285	4500–5150	
12.51975–12.52025	322–335.4	5350–5460	

Note: Certain frequency bands listed in this table**Error! Reference source not found.** 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 7.6-3: *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			

7.6.2 Test summary

Verdict	Pass		
Test date	March 18, 2024	Temperature	22 °C
Tested by	Tarek Elkholy	Air pressure	973 mbar
Test location	Cambridge	Relative humidity	41 %

7.6.3 Observations, settings and special notes

- The spectrum was searched from 9 kHz to 1 GHz.
- EUT was set to transmit with 100 % duty cycle.
- Radiated measurements were performed at a distance of 3 m.
- The spurious emission was tested per ANSI C63.10, Clause 6.4 and 6.5.

Spectrum analyser settings for measurements below 150 kHz:

Resolution bandwidth:	200 Hz
Video bandwidth:	1 kHz
Detector mode:	Quasi-Peak
Trace mode:	Max Hold

Spectrum analyser settings for measurements below 30 MHz:

Resolution bandwidth:	9 kHz
Video bandwidth:	30 kHz
Detector mode:	Quasi-Peak
Trace mode:	Max Hold

Spectrum analyser settings for measurements below 1 GHz:

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

7.6.4 Test data

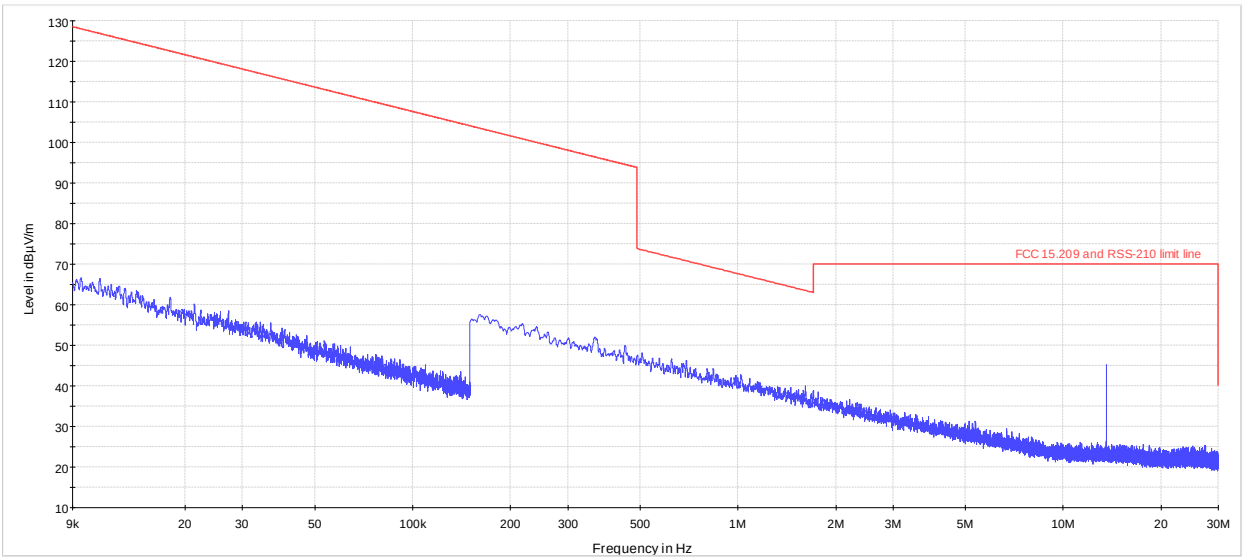

Figure 7.6-1: *Field strength of spurious emissions below 30 MHz*

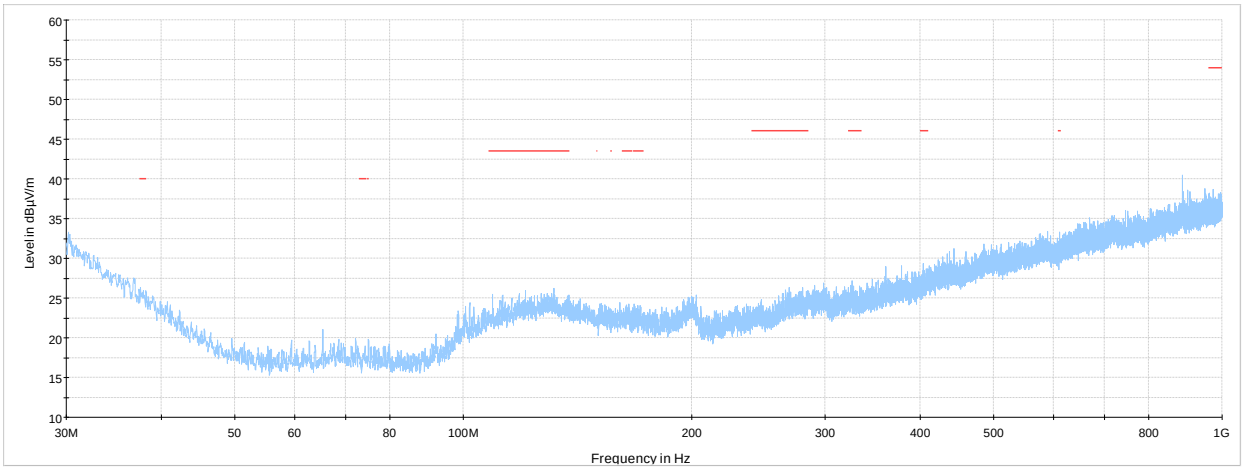

Figure 7.6-2: *Field strength of spurious emissions above 30 MHz*

7.7 Frequency stability

7.7.1 References, definitions and limits

FCC §15.225:

(e) The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to + 50 degrees 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 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

RSS-210, Annex B.6:

Devices shall comply with the following requirements:

b. the carrier frequency stability shall not exceed ±100 ppm

7.7.2 Test summary

Verdict	Pass		
Test date	March 18, 2024	Temperature	22 °C
Tested by	Tarek Elkholy	Air pressure	973 mbar
Test location	Cambridge	Relative humidity	41 %

7.7.3 Observations, settings and special notes

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

Frequency stability test was performed as per ANSI C63.10, Clause 6.8. Spectrum analyser settings:

Resolution bandwidth:	200 Hz
Video bandwidth:	≥ 3 x RBW
Detector mode:	Peak
Trace mode:	Max Hold

7.7.4 Test data

Table 7.7-1: *Frequency drift measurement*

Test conditions	Frequency, MHz	Drift, Hz	FCC Drift limit, Hz	Margin	Frequency drift, ppm	ISED Limit, ppm	Margin
+50 °C, Nominal	13.56051458	514.58	±1356	841.42	37.95	100.00	62.05
+40 °C, Nominal	13.56053135	531.35	±1356	824.65	39.18	100.00	60.82
+30 °C, Nominal	13.56055524	555.24	±1356	800.76	40.95	100.00	59.05
+20 °C, +15 %	13.56057874	578.74	±1356	777.26	42.68	100.00	57.32
+20 °C, Nominal	13.56057940	579.40	±1356	776.60	42.73	100.00	57.27
	13.56					*Reference*	
+20 °C, −15 %	13.56056179	561.79	±1356	794.21	41.43	100.00	58.57
+10 °C, Nominal	13.56056265	562.65	±1356	793.35	41.49	100.00	58.51
0 °C, Nominal	13.56059631	596.31	±1356	759.69	43.98	100.00	56.02
−10 °C, Nominal	13.56062040	620.40	±1356	735.60	45.75	100.00	54.25
−20 °C, Nominal	13.56063251	632.51	±1356	723.49	46.65	100.00	53.35
−30 °C, Nominal	13.56063509	635.09	±1356	720.91	46.84	100.00	53.16

End of the test report