Choose Scandinavian trust

RADIO TEST REPORT – 407621-7TRFWL

Type of assessment:

Modular transmitter integration

Applicant:

EXFO Inc.

Product:

Fiber Inspection Scope

Model:

FIP-500

FCC ID:

2AYQHFIP500

IC Registration number:

26882-FIP500

Contains Wi-Fi/BT module:

FCC ID: Z64-WL18SBMOD

IC Registration number: 451I-WL18SBMOD

Specifications:

- Unlicensed transmitters colocation test

Date of issue:

March 26, 2021

Andrey Adelberg, Senior EMC/RF Specialist

Tested by

Signature

Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada.
The tests included in this report are within the scope of this accreditation.
The SCC Accreditation Symbol is an official symbol of the Standards Council of Canada, used under licence.

SCC File Number: 15064 (Ottawa/Almonte); 151100 (Montreal); 151097 (Cambridge)

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	*Almonte site:* 1500 Peter Robinson Road West Carleton, Ontario Canada K0A 1L0 Tel: +1 613 256-9117
Test site identifier	**Organization**	**Ottawa/Almonte**	**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

Nemko Canada Inc. authorizes the applicant to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only.
Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.
Nemko Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.
© Nemko Canada Inc.

Table of Contents

Table of Contents **3**
Section 1 Report summary **4**
1.1 Test specifications 4
1.2 Test methods 4
1.3 Exclusions 4
1.4 Statement of compliance 4
1.5 Test report revision history 4
Section 2 Engineering considerations **5**
2.1 Modifications incorporated in the EUT for compliance 5
2.2 Technical judgment 5
2.3 Deviations from laboratory tests procedures 5
Section 3 Test conditions **6**
3.1 Atmospheric conditions 6
3.2 Power supply range 6
Section 4 Measurement uncertainty **7**
4.1 Uncertainty of measurement 7
Section 5 Information provided by the applicant **8**
5.1 Disclaimer 8
5.2 Applicant/Manufacture 8
5.3 EUT information 8
5.4 Radio technical information 9
5.5 EUT setup details 9
Section 6 Summary of test results **11**
6.1 Testing location 11
6.2 Testing period 11
6.3 Sample information 11
6.4 FCC test results 11
6.5 ISED test results 11
Section 7 Test equipment **12**
7.1 Test equipment list 12
Section 8 Testing data **13**
8.1 Spurious (out-of-band) unwanted emissions 13
Section 9 EUT photos **17**
9.1 External photos 17

Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.247	Operation in the 902–928 MHz, 2400–2483.5 MHz, and 5725–585 MHz
RSS-247, Issue 2, Feb 2017, Section 5	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
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

558074 D01 15.247 Meas Guidance v05r02 (April 2, 2019)	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules.
DA 00-705, Released March 30, 2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-102, Issue 5, March 19, 2015	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

1.3 Exclusions

The evaluation was done to ensure there are no additional radiated spurious emissions generated due to simultaneous-transmission operations compared to single transmitter operations testing, and to ensure compliance with the applicable FCC/ISED rules for the transmitters operating individually and simultaneously. This includes compliance for the summation of all emissions from all outputs occupying the same or overlapping frequency ranges, as defined by the applicable rules. All other requirements are excluded from the scope of this report.

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*

Revision #	Date of issue	Details of changes made to test report
TRF	March 26, 2021	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 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3 Test conditions

3.1 Atmospheric conditions

Temperature	15 °C – 35 °C
Relative humidity	20 % – 75 %
Air pressure	86 kPa (860 mbar) – 106 kPa (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.

3.2 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 4 Measurement uncertainty

4.1 Uncertainty of measurement

UKAS Lab 34 and TIA-603-B 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 budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of K = 2 with 95% certainty.

Table 4.1-1: *Measurement uncertainty calculations*

Test name	Measurement uncertainty, ±dB
All antenna port measurements	0.55
Occupied bandwidth	4.45
Conducted spurious emissions	1.13
Radiated spurious emissions	3.78
AC power line conducted emissions	3.55

Section 5 Information provided by the applicant

5.1 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.

5.2 Applicant/Manufacture

Applicant name	EXFO Inc.
Applicant address	400 Godin Avenue, Quebec, QC, CANADA, G1M 2K2
Manufacture name	Same as applicant
Manufacture address	Same as applicant

5.3 EUT information

Product	Fiber Inspection Scope
Model	FIP-500
Serial number	1404370
Version	ZD
Power supply requirements	Internal rechargeable battery or 5 V_{DC} USB Powered [via external 100–240 V_{AC}; 50/60 Hz USB power adapter]
Product description and theory of operation	The FIP-500 Fiber Inspection Scope is a portable video microscope equipped with a built-in 2.4-inch LCD capacitive touchscreen. The FIP-500 is used to inspect fiber ends, patchcord connectors, hard-to-reach optical connectors on the back of patch panels, and bulkhead adapters. The FIP-500 can be connected via Bluetooth® to a smartphone for sharing results. Wi-Fi connectivity for easy software updates without the need to connect to any external device. 13.56 MHz RFID capability.

5.4 Radio technical information

Frequency band (Wi-Fi/Bluetooth)	2400–2483.5 MHz
Frequency band (NFC)	13.553–13.567 MHz
Type of modulation (Wi-Fi)	802.11b: DSSS (CCK, DQPSK, DBPSK) 802.11g/n(HT20 and HT40): OFDM (QPSK, BPSK, 16-QAM, 64-QAM) + MIMO
Type of modulation (Bluetooth)	BR (GFSK), EDR (π/4-DQPSK, 8-DPSK)
Type of modulation (NFC)	ASK
RF module FCC ID	Z64-WL18SBMOD
RF module IC ID	451I-WL18SBMOD
RF module manufacturer	Texas Instruments Inc.

5.5 EUT setup details

5.5.1 Radio exercise details

Operating conditions	SW: fip500-antenna-certification-pkg-israel-pcb191-0.0.0.20342.1
Transmitter state	Transmitter set into continuous mode. According to the test plan and based on the preliminary tests the worst-case mode of operation was as follows: Wi-Fi 802.11g: mid channel, 6 Mbps NFC: Transmitter was set into continuous mode Bluetooth: Transmitter set into continuous mode at low channel with BR with 1 Mbps (GFSK).

5.5.2 EUT setup configuration

Table 5.5-1: *EUT interface ports*

Description	Qty.
USB port	1
Fiber port	1

Table 5.5-2: *Support equipment*

Description	Brand name	Model, Part number, Serial number, Revision level
USB Hub	Anker	MN: A8352, SN: AELS2C0A24101134
Keyboard	Adesso	MN: AKB-510HB, SN: K1704000512
AC power adapter	Edacpower Elec.	MN: EA1012AVRU-050

Table 5.5-3: *Inter-connection cables*

Cable description	From	To	Length (m)
USB (Type C)	EUT	USB Hub	0.3
USB	Keyboard	USB Hub	1.0
USB	USB Hub	AC adapter	1.5

EUT setup configuration, continued

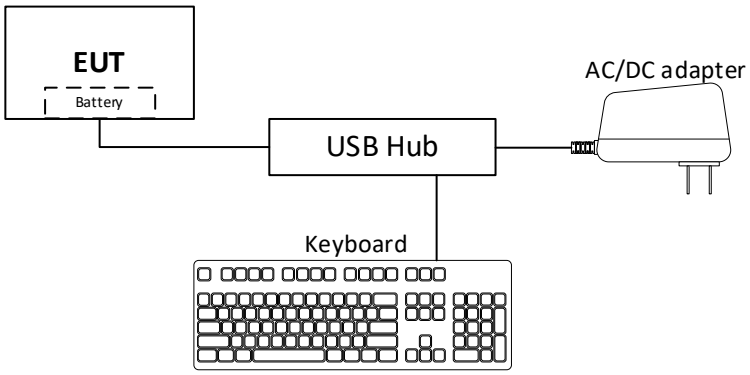

Figure 5.5-1: *Radiated testing block diagram*

Section 6 Summary of test results

6.1 Testing location

Test location (s)	Ottawa

6.2 Testing period

Test start date	January 13, 2021	Test end date	January 15, 2021

6.3 Sample information

Receipt date	December 16, 2020	Nemko sample ID number(s)	1

6.4 FCC test results

Table 6.4-1: *FCC requirements results*

Part	Test description	Verdict
§15.247(d)	Spurious emissions (Wi-Fi/Bluetooth)	Pass
§15.225(d)	Field strength outside 13.110–14.010 MHz band (NFC)	Pass

Notes: All other specification's requirements are not applicable for this type of assessment, therefore were removed from the table.

6.5 ISED test results

Table 6.5-1: *ISED requirements results*

Part	Test description	Verdict
RSS-247, 5.5	Unwanted emissions (Wi-Fi/Bluetooth)	Pass
RSS-210, Annex B.6 (a)(iv)	The field strength outside the band 13.110–14.010 MHz (NFC)	Pass

Notes: All other specification's requirements are not applicable for this type of assessment, therefore were removed from the table.

Section 7 Test equipment

7.1 Test equipment list

Table 7.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	January 24, 2021
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	November 6, 2021
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	January 14, 2021
Horn antenna (1–18 GHz)	EMCO	3115	FA000825	1 year	April 30, 2021
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002873	1 year	October 13, 2021
50 Ω coax cable	C.C.A.	None	FA002556	1 year	April 9, 2021
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	April 31, 2021
Horn antenna (18–40 GHz)	EMCO	3116	FA001847	1 year	May 7, 2021
Pre-amplifier (18–26 GHz)	Narda	BBS-1826N612	FA001550	—	VOU

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

Section 8 Testing data

8.1 Spurious (out-of-band) unwanted emissions

8.1.1 References, definitions and limits

FCC §15.247:

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

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-247, Clause 5.5:

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

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 8.1-1: *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 8.1-2: *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	Above 38.6
8.41425–8.41475	167.72–173.2	3500–4400	
12.29–12.293	240–285	4500–5150	
12.51975–12.52025	322–335.4	5350–5460	

Note: Certain frequency bands listed in Table 8.1-2 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 8.1-3: *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			

8.1.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	January 13, 2021

8.1.3 Observations, settings and special notes

- EUT was set to transmit with 100 % duty cycle on all three transmitters simultaneously.
- Radiated measurements were performed at a distance of 3 m.

Spectrum analyser settings for measurements below 150 kHz:

Resolution bandwidth:	300 Hz
Video bandwidth:	9 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 radiated measurements within restricted bands below 1 GHz:

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

Spectrum analyser settings for peak radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	3 MHz
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for average radiated measurements within restricted bands above 1 GHz:

Resolution bandwidth:	1 MHz
Video bandwidth:	10 Hz
Detector mode:	Peak
Trace mode:	Max Hold

8.1.4 Test data

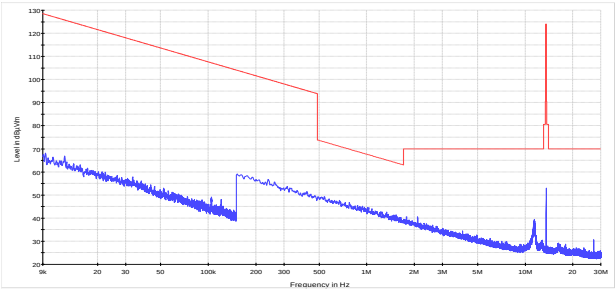

Figure 8.1-1: *Radiated spurious emissions below 30 MHz, Wi-Fi/BT and NFC transmit simultaneously*

Test data, continued

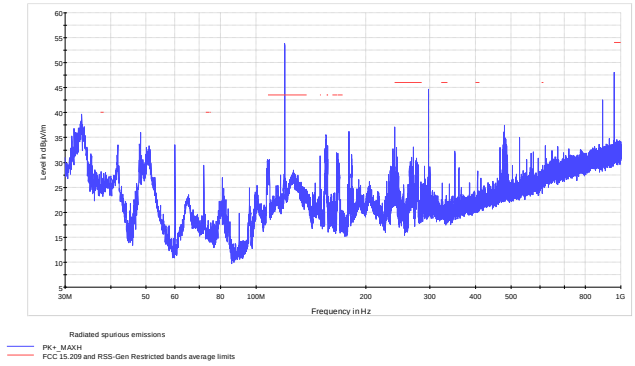

Figure 8.1-2: *Radiated spurious emissions within 30–1000 MHz, Wi-Fi/BT and NFC transmit simultaneously*

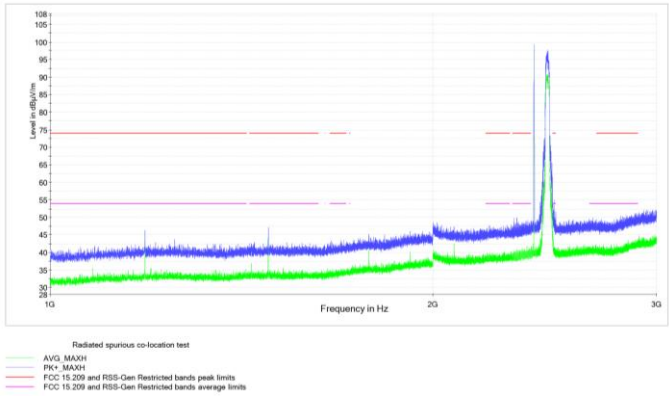

Figure 8.1-3: *Radiated spurious emissions within 1–3 GHz, Wi-Fi/BT and NFC transmit simultaneously*

Note: It was verified that the emission on the above plots that exceeds the limit at about 120 MHz frequency range originates from the auxiliary (support) equipment and therefore is exempt from the scope of this test report.

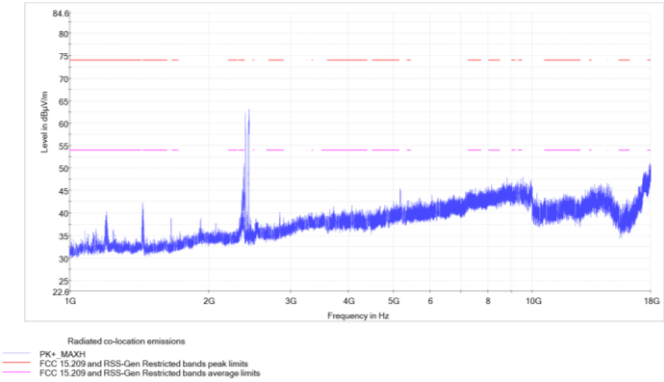

Figure 8.1-4: *Radiated spurious emissions within 1–18 GHz, Wi-Fi/BT and NFC transmit simultaneously*

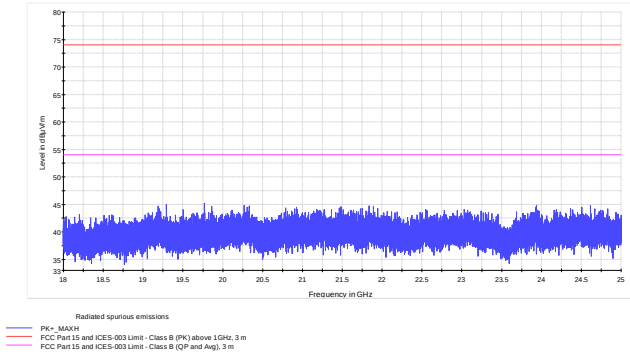

Figure 8.1-5: *Radiated spurious emissions within 18–25 GHz, Wi-Fi/BT and NFC transmit simultaneously*

Section 9 EUT photos

9.1 External photos

Figure 9.1-1: *Side view photo*

Figure 9.1-2: *Side view photo*

Figure 9.1-3: *Front view photo*

Figure 9.1-4: *Top view photo*

Figure 9.1-5: *Rear view photo*

Figure 9.1-6: *Bottom view photo*

End of the test report