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RADIO TEST REPORT – 398418-2R2TRFWL

Type of assessment:

Final product testing

Applicant:

Laserglow Technologies

Product name (type):

Smart Proximity Detection System
Pedestrian Tag

Model:

Pedestrian Tag

FCC ID:

2AWBN-SPDPT

IC Registration number:

26108-SPDPT

Specifications:

- FCC 47 CFR Part 15, Subpart F, §15.519
- RSS-220, Issue 1, July 2018

Date of issue: September 28, 2020

Tarek Elkholy, EMC/RF Specialist
Tested by

Signature

Kevin Rose, EMC/RF Lab Manager
Reviewed by

Signature

Company name	Nemko Canada Inc.	
Facilities	***Cambridge site:*** **1-130 Saltsman Drive** **Cambridge, Ontario** **Canada** **N3E 0B2** **Tel: +1 519 650 4811**	
Test site registration	**Organization**	**Recognition number and location**
	FCC/ISED	FCC: **CA0101 (Cambridge)**
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 F, Clause 15.519	Technical Requirements for Handheld UWB systems
RSS-220 , Issue 1, July 2018	Devices Using Ultra-Wideband (UWB) Technology

1.2 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
FCC KDB 393764 DO1 v 02 Jan 2018	Ultra-Wide Band (UWB) Devices
RSS-Gen, Issue 5, March 2019	General Requirements for Compliance of Radio Apparatus

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

Revision #	Date of issue	Details of changes made to test report
TRF	April 29, 2020	Original report issued
R1TRF	August 17, 2020	**Section 5.5** EUT technical info edited, **section 8.4.3** EIRP calculation, **Section 8.6** RSS field strength limits **Section 8.7** 10 dB & 99% OBW
R2TRF	September 28, 2020	**Section 5.4** EUT info**, Section 6.3** sample information**, Section 7** Equipment list **Section 8.5** Operational requirements for devices using UWB Technology

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 for Radio

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

Company name	Laserglow Technologies
Address	99 Ingram Drive #B, North York, ON, M6M 2L7, Canada

5.3 Manufacturer

Company name	Kyungwoo Systech, Inc.
Address	401 Daeryung Post Tower 5, 68, Digital-ro 9-gil, Geumchun-gu, Seoul, 08512, South Korea

5.4 EUT information

Product name	Smart Proximity Detection Pedestrian Tag
Model	Pedestrian Tag
Serial number	None
Part number	SPDPT0XXX
Operating conditions	The Vehicle Tag transmits a message every 250 ms to detect other devices in range. The Pedestrian Tag (handheld) does not transmit anything until it receives a message from the Vehicle Tag. Digital communication begins between the Vehicle Tag and the Pedestrian Tag after the Pedestrian Tag receives the first message from the Vehicle Tag.
Product description and theory of operation	Pedestrian arm or helmet mounted device listens for radio pulses transmitted by Vehicle Tags within range. If detected, devices use time-of-flight to determine distance and both devices sound an alarm if distance between devices is below a threshold value. Alarm alerts pedestrian and vehicle driver of possible collision.
Software details	V 6.0.0.0

5.5 Technical information

Applicant IC company number	26108
IC UPN number	SPDPT
All used IC test site(s) Reg. number	24676
RSS number and Issue number	RSS-220 Issue 1
Operation type	☒ Periodic ☐ Non-periodic
Frequency band	3100 – 10600 MHz
Frequency Min (MHz)	6489.6 MHz
Frequency Max (MHz)	6489.6 MHz
Channel numbers	Ultra-wide band signal
RF power Max (W), EIRP	$1.04 * 10^{-4}$ W (-9.81 dBm)
Field strength, dBµV/m @ 3 m	85.42 dBµV/m
Measured BW (MHz), 99% OBW	779.97 MHz
Measured BW (MHz), 10 dB BW	700.7 MHz
Type of modulation	BPM, BPSK
Emission classification	779MG2DN
Transmitter spurious, dBµV/m @ 3 m	29.3 dBµV/m, QPK @ 885.92 MHz
Power supply requirements	Battery: 5 V_{DC}
Antenna information	PCB antenna Manufacturer: Decawave Model: WB002 Peak Gain = 3.3 dBi

5.6 EUT setup details

5.6.1 EUT Exercise and monitoring

Methods used to exercise the EUT and all relevant ports:

- The EUT was powered ON to transmit as in practical operation.

Configuration details:

- The EUT setup in a configuration that was expected to produce the highest amplitude emissions relative to the limit and that satisfy normal operation/installation practice by the end user.
- The type and construction of cables used in the measurement set-up were consistent with normal or typical use. Cables with mitigation features (for example, screening, tighter/more twists per length, ferrite beads) have been noted below:
  - The following deviations were:
  - None
- The EUT was setup in a manner that was consistent with its typical arrangement and use. The measurement arrangement of the EUT, local AE and associated cabling was representative of normal practice. Any deviations from typical arrangements have been noted below:
  - The following deviations were:
  - None

Monitoring details:

- LED is ON

5.6 EUT setup details, continued

5.6.2 EUT test configuration

Table 5.6-1: EUT interface ports

Description	Qty.
recharging USB Power	1

Table 5.6-2: Inter-connection cables

Cable description	From	To	Length (m)
USB power cable	Power supply	EUT	0.3

Note: Only used for recharging

5.6 EUT setup details, continued

5.6.2 EUT test configuration, continued

Figure 5.6-1: Radiated testing block diagram

Section 6. Summary of test results

6.1 Testing location

Test location (s)	Cambridge

6.2 Testing period

Test start date	April 28, 2020	Test end date	April 29, 2020

6.3 Sample information

Receipt date	April 27, 2020	Nemko sample ID number(s)	2 and 10

6.4 FCC Part 15 Subpart F, general requirements test results

Table 6.4-1: FCC general requirements results

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.31I	Variation of power source	Pass
§15.31(m)	Number of tested frequencies	Pass
§15.203	Antenna requirement	Pass

Notes: EUT is a battery-operated device, the testing was performed using fully charged batteries.

6.5 FCC Part 15 Subpart F, intentional radiators test results

Table 6.5-1: FCC 15.519 requirements results

Part	Test description	Verdict
§15.519(a)	Operational Requirements	Pass
§15.519(c)	Field strength of emissions	Pass
§15.519(b)	Emission bandwidth	Pass
§15.519(d)	Field Strength of emissions within 1164-1240 and 1559-1610 MHz	Pass[1]
§15.519(e)	Peak Emissions within 50 MHz band	Pass

Notes: [1]EUT does not operate in 40.66–40.70 MHz band

6.6 ISED RSS-Gen, Issue 5, test results

Table 6.6-1: RSS-Gen 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.

6.7 ISED RSS-220, Issue 1, test results

Table 6.7-1: RSS-210 results

Section	Test description	Verdict
5.3.1 (a)	Antenna requirements	Pass
5.3.1 (b)	Operational requirements	Pass
5.3.1 (c) and (d)	Field strength of emissions	Pass
5.3.1 (e)	Field strength of emissions within 1164-1240 and 1559 -1610 MHz band	Pass
5.3.1 (g)	Peak emissions within 50 MHz bandwidth	Pass
5.1 (b)	Emission bandwidth	Pass

Notes: None

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	ESR26	FA002969	1 year	Dec 4, 2020
3 m EMI test chamber	TDK	SAC-3	FA003012	1 year	October 10, 2020
50 Ω coax cable	Huber + Suhner	None	FA003044	1 year	October 7, 2020
50 Ω coax cable	Huber + Suhner	None	FA003047	1 year	September 30, 2020
Flush mount turntable	SUNAR	FM2022	FA003006	—	NCR
Controller	SUNAR	SC110V	FA002976	—	NCR
Antenna mast	SUNAR	TLT2	FA003007	—	NCR
Bilog antenna (30–2000 MHz)	SUNAR	JB1	FA003010	1 year	September 17, 2020
Horn antenna (1–18 GHz)	ETS Lindgren	3117	FA002911	1 year	September 11, 2020
Horn antenna (18–40 GHz)	EMCO	3116B	FA002948	1 year	Jan 9, 2021
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002956	1 year	September 26, 2020
Receiver/spectrum analyzer	Rohde & Schwarz	FSW43	FA002971	1 year	Dec 21, 2020
Victor Signal Generator	Rohde & Schwarz	SMW200A	FA002970	1 year	Jan 16, 2021

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

Section 8. Testing data

8.1 FCC 15.31(e) Variation of power source

8.1.1 References, definitions and limits

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.

8.1.2 Test summary

Verdict	Pass		
Tested by	Tarek Elkholy	Test date	April 29, 2020

8.1.3 Observations, settings and special notes

None

8.1.4 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

8.2 FCC 15.31(m) and RSS-Gen 6.9 Number of frequencies

8.2.1 References, definitions and limits

FCC:
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.

ISED:
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 8.2-1: 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

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

8.2.2 Test summary

Verdict	Pass		
Tested by	Tarek Elkholy	Test date	April 28, 2020

8.2.3 Observations, settings and special notes

The EUT is an UWB device, so its full operating bandwidth is examined.

8.2.4 Test data

Table 8.2-2: Test channels selection

Start of Frequency range, MHz	End of Frequency range, MHz	Frequency range bandwidth, MHz	Center Frequency, MHz
3100	10600	644.05	6489.6

8.3 FCC 15.203 and RSS-Gen , section 6.8 Antenna requirement

8.3.1 References, definitions and limits

FCC:
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.

ISED:
RSS-Gen
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.

8.3.2 Test summary

Verdict	Pass		
Tested by	Tarek Elkholy	Test date	April 28, 2020

8.3.3 Observations, settings and special notes

None

8.3.4 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

8.4 FCC 15.519 (e) and RSS-220 5.3.1 (g) Peak emissions within 50 MHz band

8.4.1 References, definitions and limits

FCC:

There is a limit on the peak level of the emissions contained within a 50 MHz bandwidth centered on the frequency at which the highest radiated emission occurs, , f_M. That limit is 0 dBm EIRP. It is acceptable to employ a different resolution bandwidth, and a correspondingly different peak emission limit, following the procedures described in §15.521

When a peak measurement is required, it is acceptable to use a resolution bandwidth other than the 50 MHz specified in this subpart. This resolution bandwidth shall not be lower than 1 MHz or greater than 50 MHz, and the measurement shall be centered on the frequency at which the highest radiated emission occurs, , f_M. If a resolution bandwidth other than 50 MHz is employed, the peak EIRP limit shall be 20 log (RBW/50) dBm where RBW is the resolution bandwidth in megahertz that is employed. This may be converted to a peak field strength level at 3 meters using E(dBuV/m) = P(dBm EIRP) + 95.2. If RBW is greater than 3 MHz, the application for certification filed with the Commission must contain a detailed description of the test procedure, calibration of the test setup, and the instrumentation employed in the testing

ISED:

The peak level of the transmissions shall not exceed the peak equivalent of the average limit contained within any 50 MHz bandwidth, as defined in section 4 of the Annex.

Peak measurements shall be made in addition to average measurements. Transmissions shall not exceed 0 dBm e.i.r.p. in any 50 MHz bandwidth when the average limit is -41.3 dBm/MHz This is the equivalent peak limit as calculated by combining the 6 dB peak-to-average conversion with a resolution bandwidth (RBW) scaling factor of 20 log(1 MHz/50 MHz). Only the 50 MHz bandwidth, centered on the frequency , f_M where the highest power occurs, needs to be measured to satisfy the peak requirements for all frequencies. A different resolution bandwidth and a correspondingly different peak limit may also be used, in which case the RBW may be set anywhere between 1 MHz and 50 MHz The peak e.i.r.p. limit is then calculated as 20 log(RBW/50) dBm where the RBW is in MHz This may be converted to a peak field strength level at 3 meters using E(dBuV/m) = P(e.i.r.p.(dBm)) + 95.2. If the RBW is greater than 3 MHz, the application for certification shall contain a detailed description of the test procedure, the calibration of the test set-up and the instrumentation used in the testing.

8.4.2 Test summary

Verdict	Pass		
Tested by	Tarek Elkholy	Test date	April 29, 2020

8.4.3 Observations, settings and special notes

The EUT was set up as indicted in radiated procedures of ANSI C.63.10 v2.0.1

As per stated in 15.521, the limit is 95.2+20 Log (RBW/50); Limit =61.22

Peak fundamental signal Field strength (dBµV/m) = 51.42 (dBµV/m) + 34 dB (20 Log (50/RBW)) = 85.42 (dBµV/m)

Peak EIRP (dBm) @ 50 MHz Bw = 84.52 (dBµV/m) - 95.23 (dB) = -9.81 dBm

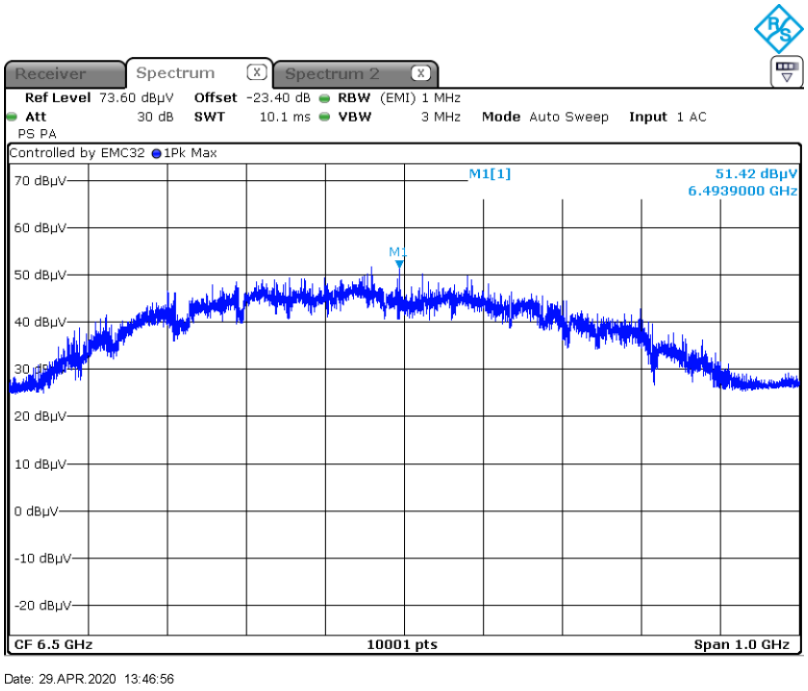
Receiver settings for preview measurements:

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

8.4.4 Test data

Table 8.4-1: Peak emissions within 50 MHz band results

Frequency, MHz	Peak result, dBµV	Limit, dBµV	Margin, dB
6494	51.42	61.22	9.8



Plot 8.4-1: Peak emissions plot

8.5 FCC 15.519(a) and RSS-220 5.3.1 (a) (b) Operational requirements for devices using UWB Technology

8.5.1 References, definitions and limits

FCC:

UWB devices operating under the provisions of this section must be hand held, i.e., they are relatively small devices that are primarily hand held while being operated and do not employ a fixed infrastructure.
A UWB device operating under the provisions of this section shall transmit only when it is sending information to an associated receiver. The UWB intentional radiator shall cease transmission within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB intentional radiator at least every 10 seconds or the UWB device must cease transmitting.
UWB devices operating under the provisions of this section may operate indoors or outdoors

ISED:

The device shall be designed so as to prevent its connection to antennas mounted on outdoor structures, e.g., antennas mounted on the outside of a building or on a telephone pole, or any fixed outdoors infrastructure.
The device is to transmit only when it is sending information to an associated receiver. The device shall cease transmission of information within 10 seconds unless it receives an acknowledgement from the associated receiver that its transmission is being received. An acknowledgment of reception must continue to be received by the UWB device at least every 10 seconds or the UWB device shall cease transmitting any information other than periodic signals used for the establishment or re-establishment of a communication link with an associated receiver.

8.5.2 Test summary

Verdict	Pass		
Tested by	Tarek Elkholy	Test date	September 28, 2020

8.5.3 Observations, settings and special notes

None.

8.5.4 Test data

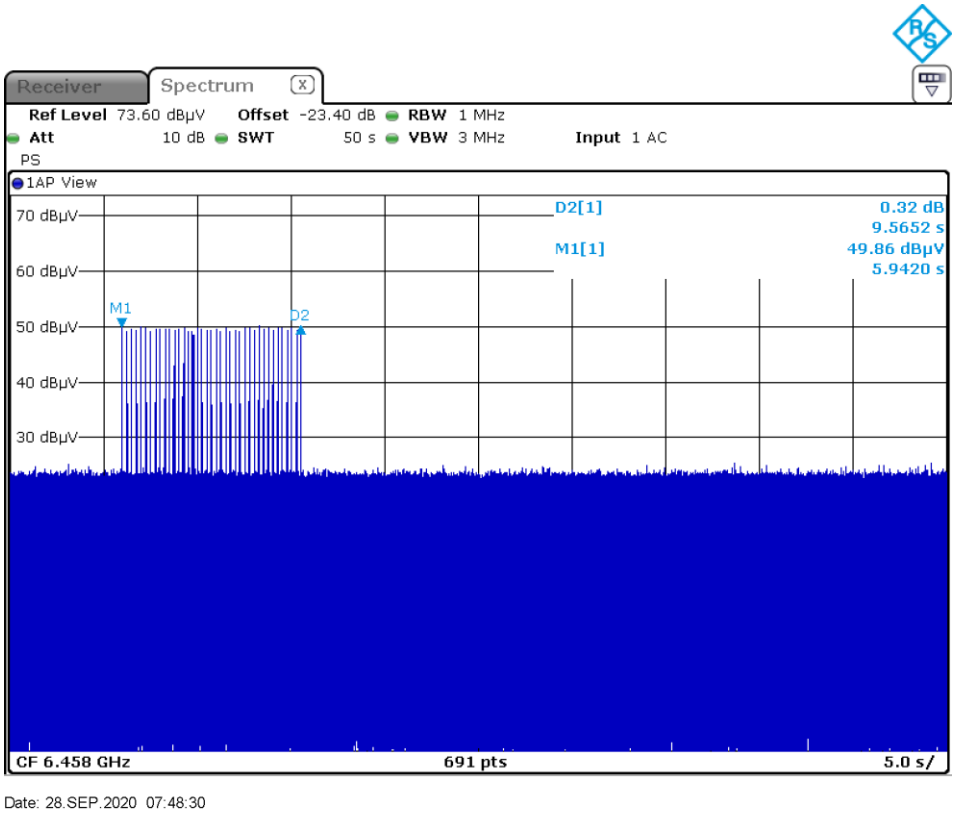


Figure 8.5-1: *PT ceases transmission once don't receive acknowledgment from associated device*

☒ EUT shall cease transmission within 10 seconds
☐ EUT receives acknowledgment of reception at least every 10 seconds

☒ EUT may operate indoors or outdoors

☒ The Antenna may be mounted only on handheld UWB device
☒ The Antenna will not be mounted on the outside of a building or on telephone pole or any fixed outdoor infrastructure
☒ The Antenna is designed to prevent its connection to antennas mounted on outdoor structures

☐ The EUT transmits set-up information
☐ The EUT does not transmit set-up information
☒ EUT complies with FCC 15.519 (a)(1) and RSS-220 5.3.1 (a)(b)

8.6 FCC 15.519(c) and RSS-220 5.3.1 (c) (d) Field strength of emissions

8.6.1 References, definitions and limits

FCC:

The radiated emissions at or below 960 MHz from a device operating under the provisions of this section shall not exceed the emission levels in §15.209. The radiated emissions above 960 MHz from a device operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz below:

ISED:

Radiated emissions at or below 960 MHz from a device shall not exceed the limits in section 3.4 (RSS-Gen) given below:
Radiated emissions above 960 MHz from a device shall not exceed the following average limits when measured using a resolution bandwidth of 1 MHz below:

Table 8.6-1: FCC 15.19 (c) Field strength limits

Fundamental frequency (MHz)	dBm	EIRP in RBW of 1MHz	(dBµV/m)
960 - 1610	-75.3		19.93
1610 – 1990	-63.3		31.93
1990 – 3100	-61.3		33.93
3100 – 10600	-41.3		53.93
10600 - 40000	-61.3		33.93

Notes: In the emission table above, the tighter limit applies at the band edges

Table 8.6-2: RSS-220 5.3.1 (d) Field strength limits

Fundamental frequency (MHz)	EIRP in RBW of 1MHz (dBm)	(dBµV/m)
960 - 1610	-75.3	19.93
1610 –4750	-70.0	25.23
4750 – 10600	-41.3	53.93
Above 10600	-61.3	33.93

8.6.1 References, definitions and limits, continued

Table 8.6-3: FCC §15.209 and RSS-Gen – Radiated emission limits

Frequency, MHz	Field strength of emissions µV/m	Field strength of emissions 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.
The limit above 960 MHz is not applicable

Table 8.6-4: 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 this table 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 8.6-5: 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			

8.6.2 Test summary

Verdict	Pass		
Tested by	Tarek Elkholy	Test date	April 29, 2020

8.6.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 40 GHz
Radiated measurements were performed at a distance of 30 cm.
Field Strength (dBµV/m) = Measured raw value (dBµV/m) + Path loses (dB) + Distance Correction Factor (-20 dB)

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

Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Detector mode	RMS
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	RMS
Trace mode	Max Hold

8.6.4 Test data

Table 8.6-6: Radiated field strength measurement results

Frequency, MHz	Q-Peak field strength, dBµV/m	Q-peak limit, dBµV/m	Margin, dB
208.23	17.8	43.5	25.7
233.95	17.1	46.0	28.9
249.23	16.5	46.0	29.5
430.13	17.0	46.0	29.0
582.14	20.2	46.0	25.8
885.92	29.3	46.0	16.7

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

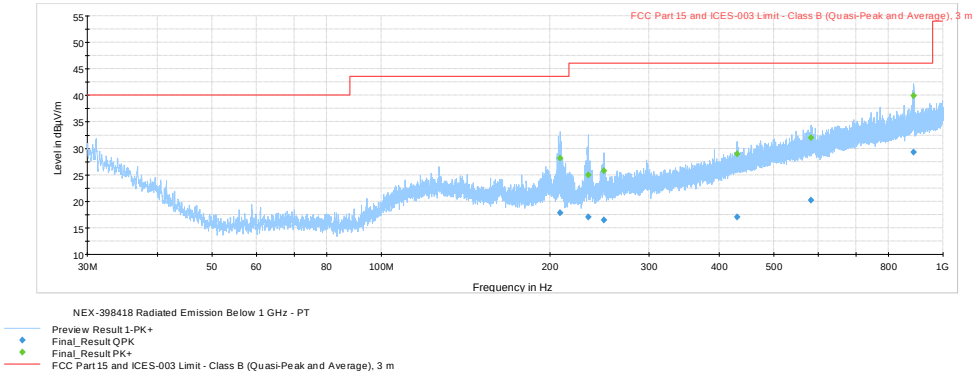


Figure 8.6-1: Spurious emissions below 1 GHz

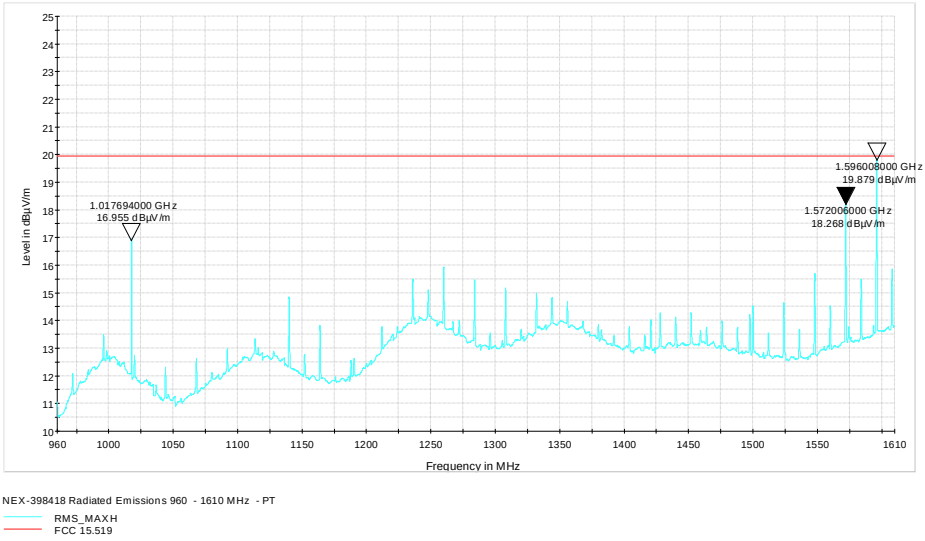


Figure 8.6-2: Spurious emissions 960 – 1610 MHz

8.6.4 Test data, continued

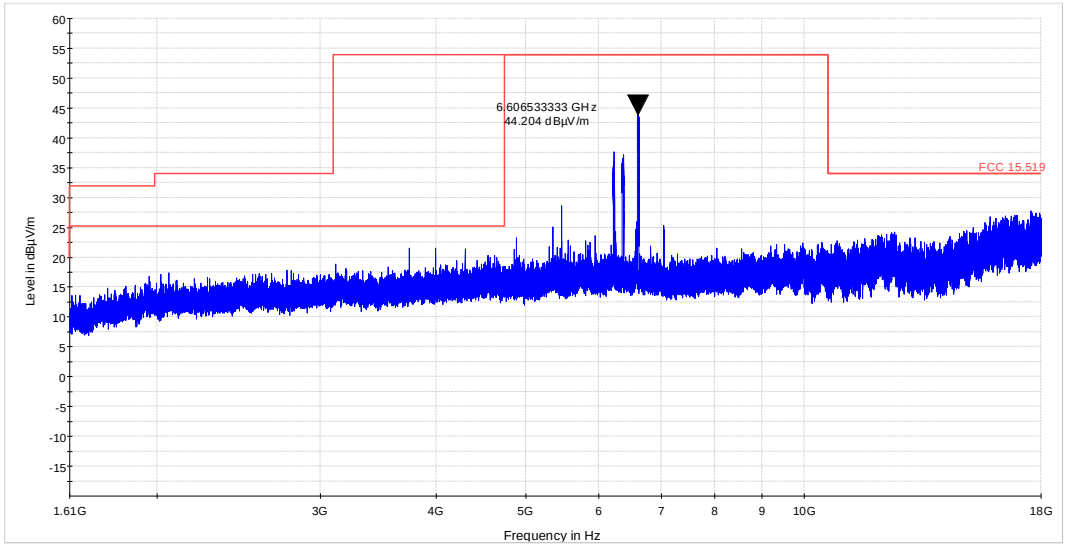


Figure 8.6-3: Spurious emissions 1610 MHz – 18 GHz

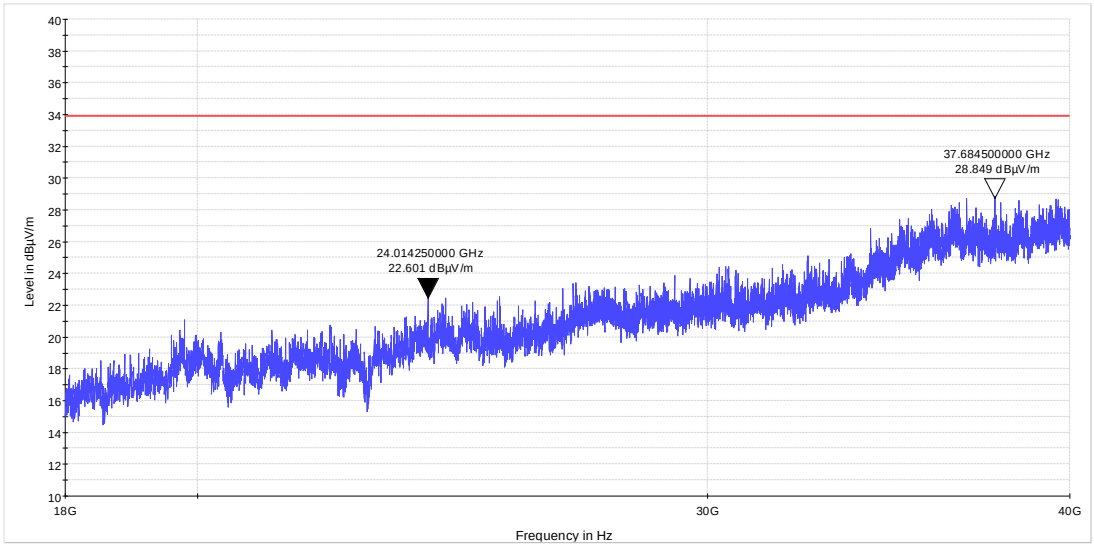


Figure 8.6-4: Spurious emissions 18 - 40 GHz

8.7 FCC 15.519(b) and RSS-220 5.1 (a) Emission bandwidth

8.7.1 References, definitions and limits

FCC:

The UWB bandwidth of a device operating under the provisions of this section must be contained between 3100 MHz and 10,600 MHz.
The frequency at which the highest radiated emission occurs, f_M , must be contained within the UWB bandwidth
Definitions.
(a) UWB bandwidth. For the purpose of this subpart, the UWB bandwidth is the frequency band bounded by the points that are 10 dB below the highest radiated emission, as based on the complete transmission system including the antenna. The upper boundary is designated fH and the lower boundary is designated fL. The frequency at which the highest radiated emission occurs is designated fM.
(b) Center frequency. The center frequency, fC, equals (fH + fL)/2.
(c) Fractional bandwidth. The fractional bandwidth equals 2(fH−fL)/ (fH + fL).
(d) Ultra-wideband (UWB) transmitter. An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth

ISED:

The -10 dB bandwidth of the device shall be totally contained in the band 3.1-10.6 GHz.

8.7.2 Test summary

Verdict	Pass		
Tested by	Tarek Elkholy	Test date	April 28, 2020

8.7.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	≥ 1 % of emission bandwidth
Video bandwidth	≥ 3 × RBW
Frequency span	Wider than emission bandwidth
Detector mode	Peak

8.7.4 Test data

Table 8.7-1: 10 dB bandwidth measurement result

10 dB bandwidth, MHz	Limit, MHz	Margin, MHz
700.7	>500	**144.05**

Table 8.7-2: bandwidth within frequency band measurement result

Lower Frequency f_L, MHz	Limit, MHz	Margin, MHz
6122.3	3100	**3022.33**
Upper Frequency f_H, MHz	Limit, MHz	Margin, kHz
6823.0	10600	**3777.0**

Table 8.7 1: 10 dB bandwidth measurement result

8.7.4 Test data, continued

99% occupied bandwidth, MHz	Limit, MHz	Margin, MHz
779.97	>500	**279.97**

Table 8.7-4: bandwidth within frequency band measurement result

Lower Frequency f_L, MHz	Limit, MHz	Margin, MHz
6082.98	3100	**2982.98**
Upper Frequency f_H, MHz	Limit, MHz	Margin, kHz
6862.95	10600	**3737.05**

Figure 8.7-1: 10 dB occupied bandwidth

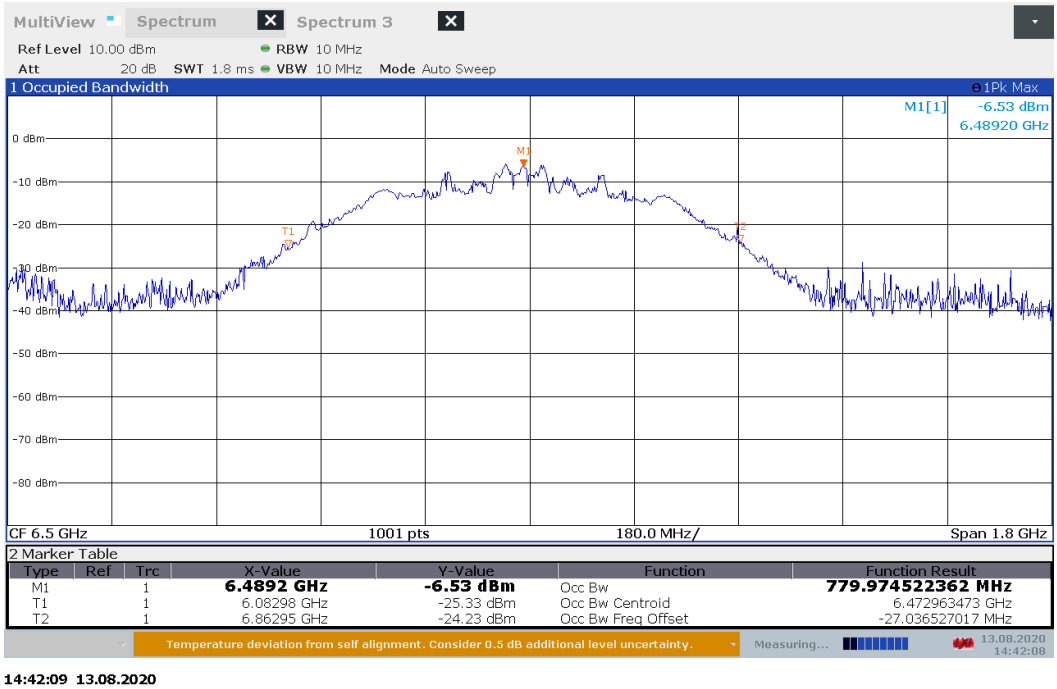


Figure 8.7-2: 99% occupied bandwidth

8.8 FCC 15.519(d) and RSS-220 (e) Field strength of emissions within 1164-1240 and 1559-1610 MHz band

8.8.1 References, definitions and limits

FCC:.
In addition to the radiated emission limits specified in the table in paragraph (c) of this section, UWB transmitters operating under the provisions of this section shall not exceed the following average limits when measured using a resolution bandwidth of no less than 1 kHz below:
ISED:
In addition to the limits specified in below table, radiated emissions shall not exceed the following average limits when measured using a resolution bandwidth greater than or equal to 1 kHz. The measurements shall demonstrate compliance with the stated limits at whatever resolution bandwidth is used.

Table 8.8-1: Field strength limits

Fundamental frequency (MHz)	EIRP in RBW no less than 1 kHz dBm	(dBµV/m)
1164-1240	-85.3	9.93
1559-1610	-85.3	9.93

Notes: In the emission table above, the tighter limit applies at the band edges

8.8.2 Test summary

Verdict	Pass		
Tested by	Tarek Elkholy	Test date	April 29, 2020

8.8.3 Observations, settings and special notes

Spectrum analyser settings:

Resolution bandwidth	1 kHz
Video bandwidth	3 kHz
Detector mode	RMS
Trace Mode	Max Hold

8.8.4 Test data

Table 8.8-2: Radiated field strength measurement results

Frequency, MHz	Average field strength, dBµV/m	Average limit, dBµV/m	Margin, dB
1190.35	-6.841	9.93	16.771
1571.99	-1.176	9.93	11.06
1574.39	-3.920	9.93	13.85
1595.99	0.126	9.93	9.804

Notes: Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.

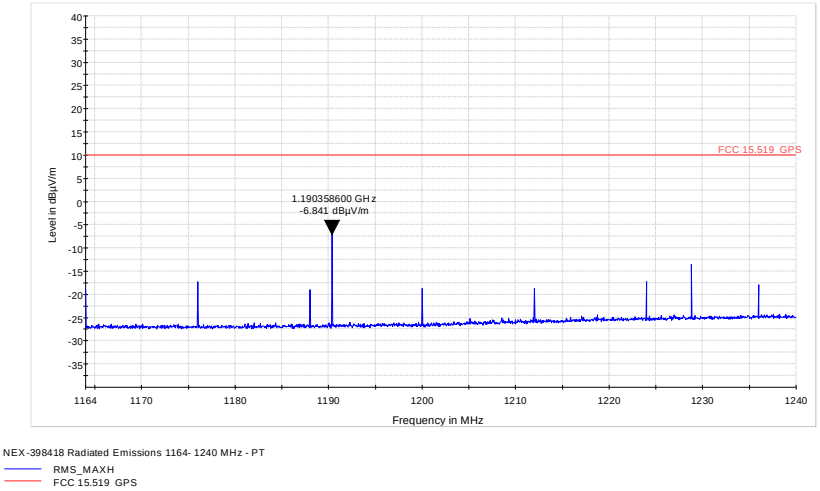


Figure 8.8-1: **Spurious emissions within 1164-1240 MHz**

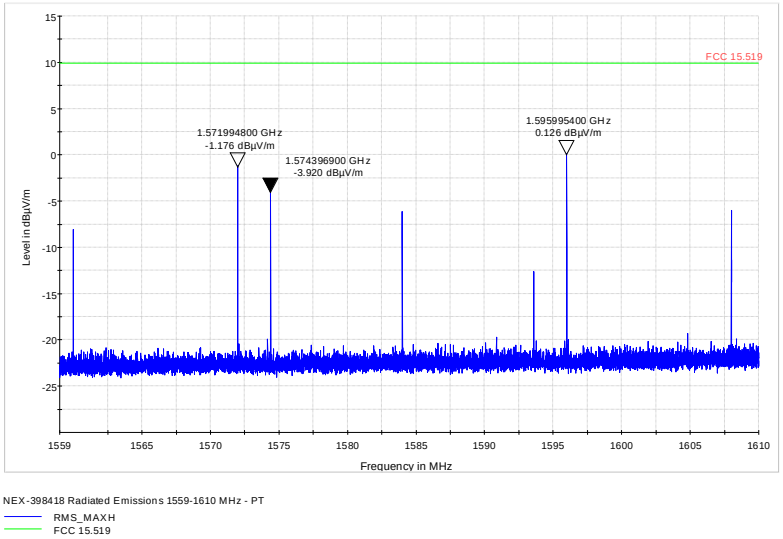
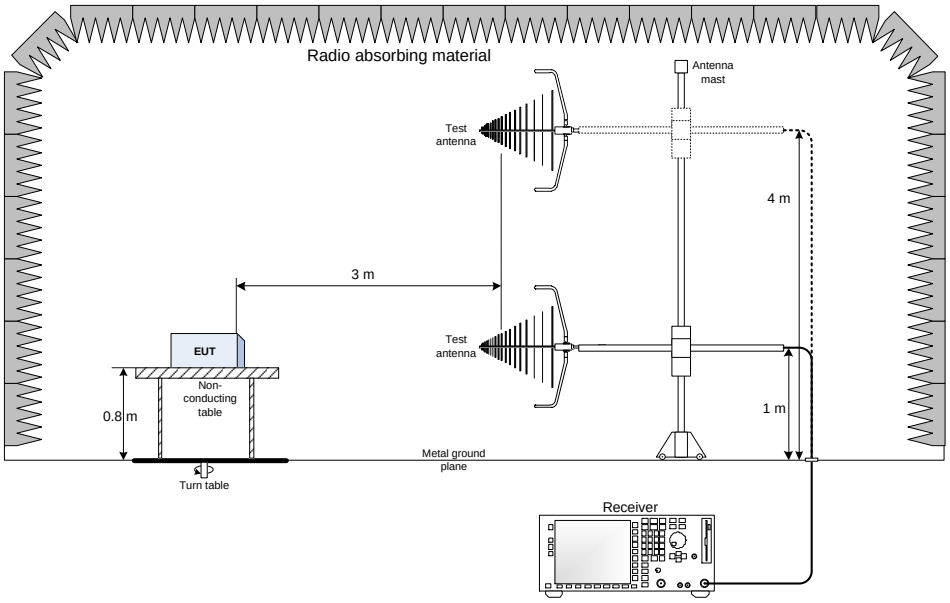


Figure 8.8-2: Spurious emissions within 1559-1610 MHz

Section 9. Block diagrams of test set-ups

9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz