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RADIO TEST REPORT – 398604-1R1TRFWL

Type of assessment:

Final product testing

Applicant for ISED:

Rohde & Schwarz Canada, Inc.

Product:

Quick Personnel Security Scanner

Applicant for FCC:

Rohde & Schwarz USA, Inc.

Model:

QPS201

Model variant:

LPS

FCC ID:

KVW-QPS201

IC Registration number:

3261A-QPS2XX

Specifications:

- FCC 47 CFR Part 15, Subpart C, §15.209
- RSS-210 Annex A.1, Issue 10, December 2019

Date of issue: September 8, 2020

Andrey Adelberg, Senior EMC/RF Specialist
Tested by


Signature

David Duchesne, EMC/RF Lab Manager
Reviewed by


Signature

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

Table of contents

Section 1. Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart C, Clause 15.209	Radiated emission limits; general requirements.
RSS-210 Annex A.1, Issue 10, December 2019	Licence-Exempt Radio Apparatus: Category I Equipment. Momentarily operated devices

1.2 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-Gen, Issue 5, March 2019	General Requirements for Compliance of Radio Apparatus
RSS-102, Issue 5, March 19, 2015	Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands)

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	August 20, 2020	Original report issued
R1TRF	September 8, 2020	Adding model variant LPS.

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

Due to a nature of the equipment under test some parts of the standards could not be fulfilled and required special authorization from the government authorities. It is up to manufacturer to obtain permission to operate in the frequency range and with the field strength of fundamental as tested and reported in this document.
EUT was tested as proposed in specially developed test plan for this project.

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/Manufacturer

	Manufacturer:	**ISED applicant:**	**FCC applicant:**
Company name	Rohde & Schwarz GmbH & Co. KG	Rohde & Schwarz Canada, Inc.	Rohde & Schwarz USA, Inc.
Address	Mühldorfstraße 15	1 Hines Road, Suite 100	6821 Benjamin Franklin Drive
City	München	Kanata	Columbia
Province/State	Bavaria	ON	MD
Postal/Zip code	81671	K2K 3C7	21046
Country	Germany	Canada	USA

5.3 EUT information

Product name	Quick Personnel Security Scanner
Model	QPS201
Model variant	LPS
Part number	1340.0030K02 (QPS201); 1340.8001.02 (LPS)
Serial number	101259-Qb
Power supply requirements	AC: 210–240 V, 50/60 Hz power cord
Software version tested	3.0.4
Product description and theory of operation	The EUT is a personnel security scanner that consists of two panels each with two microwave antenna arrays. The panels are arranged to face one another. Metallic or non-metallic objects can be detected by feeding the panels with a signal in the frequency range 70–80 GHz and evaluating the backscatter of the emitted signals. Each panel comprises two antenna arrays. Each Panel comprises 32 antenna clusters (QPS201) or 30 antenna clusters (LPS). Each antenna cluster is made up of 2 rows of 48 receive antennas and 2 columns of 48 transmit antennas. Each panel contains: 32 clusters × 2 columns × 48 antennas for a total of 3072 antennas (QPS201) 30 clusters × 2 columns × 48 antennas for a total of 2880 antennas (LPS). These antennas are scanned at 128 discrete frequencies, spaced equally within the 70–80 GHz band. The typical installation will be with a separation distance of approximately 1.5 metres separation between the two panels.

5.4 Radio technical information

Operation type	☒ Periodic ☐ Non-periodic
Frequency band	Above 38.6 GHz (within 69–80 GHz)
Frequency Min (MHz)	69895.2380952381
Frequency Max (MHz)	79895.2380952381
RF power Max (W), Conducted	N/A
Field strength, dBµV/m @ 3 m	101.96
Measured BW (kHz), 99% OBW	16962
Type of modulation	Pulsed Continuous Wave
Emission classification	P0N
Transmitter spurious, dBµV/m @ 3 m	39.68 @ 65 MHz
Antenna information	Two panels with two antenna arrays on each. Two panels with 32 antenna clusters each (QPS201) and two panels with 30 antenna clusters each (LPS). Each antenna cluster is made up of 2 rows of 48 receive antennas and 2 columns of 48 transmit antennas. Each panel contains: 32 clusters × 2 columns × 48 antennas for a total of 3072 antennas (QPS201) 30 clusters × 2 columns × 48 antennas for a total of 2880 antennas (LPS). Each antenna is 6 dBi gain. The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

5.5 EUT setup details

5.5.1 Radio exercise details

Operating conditions	**Configuration of the device during testing** Given that the dwell time of a given frequency on each transmit antenna is only 60 nanoseconds, it is desirable that the frequency step should be disabled so that the device will scan each antenna with a single frequency. This will allow for more accurate maximization of the emitted signal. One complete scan consists of 128 frequencies being transmitted each frequency being transmitted for 60 ns on each of the 3072 transmit antennas For the test program, for the P2 panel version: - 1000 scans, in total 193.7 seconds beeping followed by 3.3 s pause. - RF active duty cycle during scanning is 23.6/193.7 = 12.2% The device should be tested at three frequencies. 69895.2380952381 MHz 74886.9670702927 MHz 79895.2380952381 MHz The device shall be made to scan all antennas on each panel continuously at each measurement frequency. **Field strength measurement** The field strengths of the fundamental emissions and spurious emissions should be made at a distance of 3 metres if possible. Given the size of the panels this will allow the worst-case position to be determined more easily. If the noise floor of the measurement setup is not sufficient to detect signals within 6 dB of the emission limits stated in Table A1 of RSS 210 for fundamental emissions, the measurement may be made at a closer distance with a reduction of the measured level using a 20 dB/decade factor. The position of worst-case emission level shall be determined and measurements shall be made at that position. It is likely that the worst-case orientation would be parallel to the panels rather than perpendicular when two panels are installed facing one another. The receive antenna height and device under test azimuth shall be explored to determine the worst-case orientation at each frequency. **Correction for measurement distance** The expressed limits are based on the field strength at 3 metres. If the noise floor of the measurement is not sufficient, the measurement may be made at a closer distance. If measurement is made at a closer distance, the measured level should be reduced by a factor of 20 dB/decade. For example, If measurement is made at a distance of 2 metres the measured level would be reduced by adding: $20 \times \mathrm{Log}_{10}$ (2 m/3 m) = −3.52 dB **Field strength of fundamental emission** The field strength of the fundamental emission shall be reported as a peak and average measurement result. Average = Peak (dBµV/m @ 3 m) + (−57.19 dB) for QPS201 Average = Peak (dBµV/m @ 3 m) + (−57.56 dB) for LPS **Field strength of unwanted emissions** Unwanted emissions should be maximized and measured in the same way as fundamental emissions. Unwanted emissions are compared to the FCC §15.209 limits or the limits of ISED RSS-Gen, whichever is less stringent. The ISED RSS-210 less stringent limit is 12,500/10 = 1250 µV/m @ 3 m (62 dBµV/m). If this limit cannot be detected with a 6 dB margin of compliance at a distance of 3 metres, the measurement distance may be reduced using a 20 dB/decade reduction factor for the measured level.

5.5.2 EUT setup configuration

Table 5.5-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number
Laptop	Dell Latitude	E6430	BM70LX1
Monitor	Rohde&Schwarz	MN: R&S®QPS-Z10, PN: 1340.3400.02	N/A
Stand for monitor	Rohde&Schwarz	MN: QPS-Z115, PN: 1316.6031.02	N/A
Panel (master)	Rohde&Schwarz	MN: QPSP2, PN: 1340.0000.02	100873-dt
Panel (slave)	Rohde&Schwarz	MN: QPSP2, PN: 1340.0000.02	100872-MF
Floor panel	Rohde&Schwarz	N/A	N/A

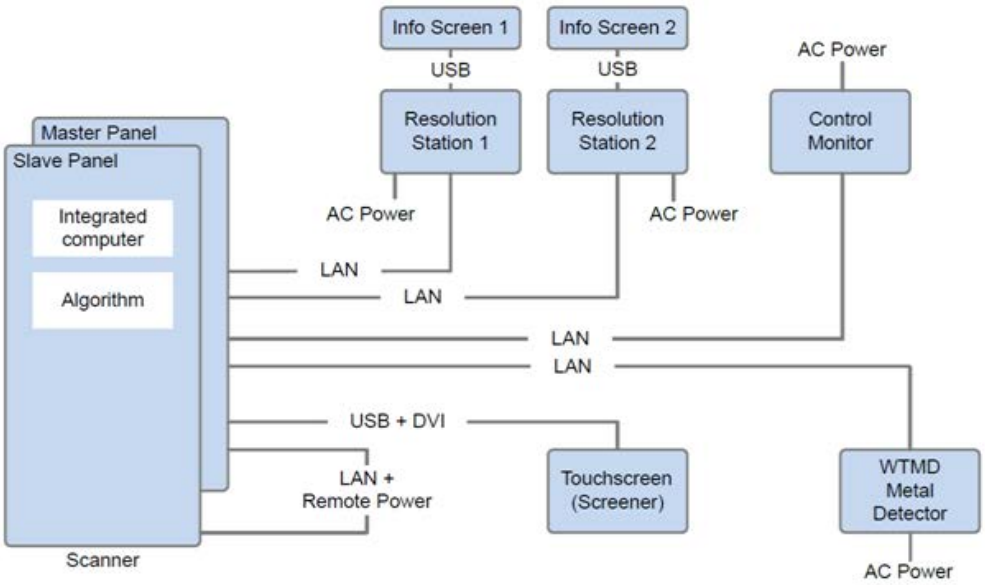


Figure 5.5-1: *Setup block diagram*

EUT setup configuration, continued

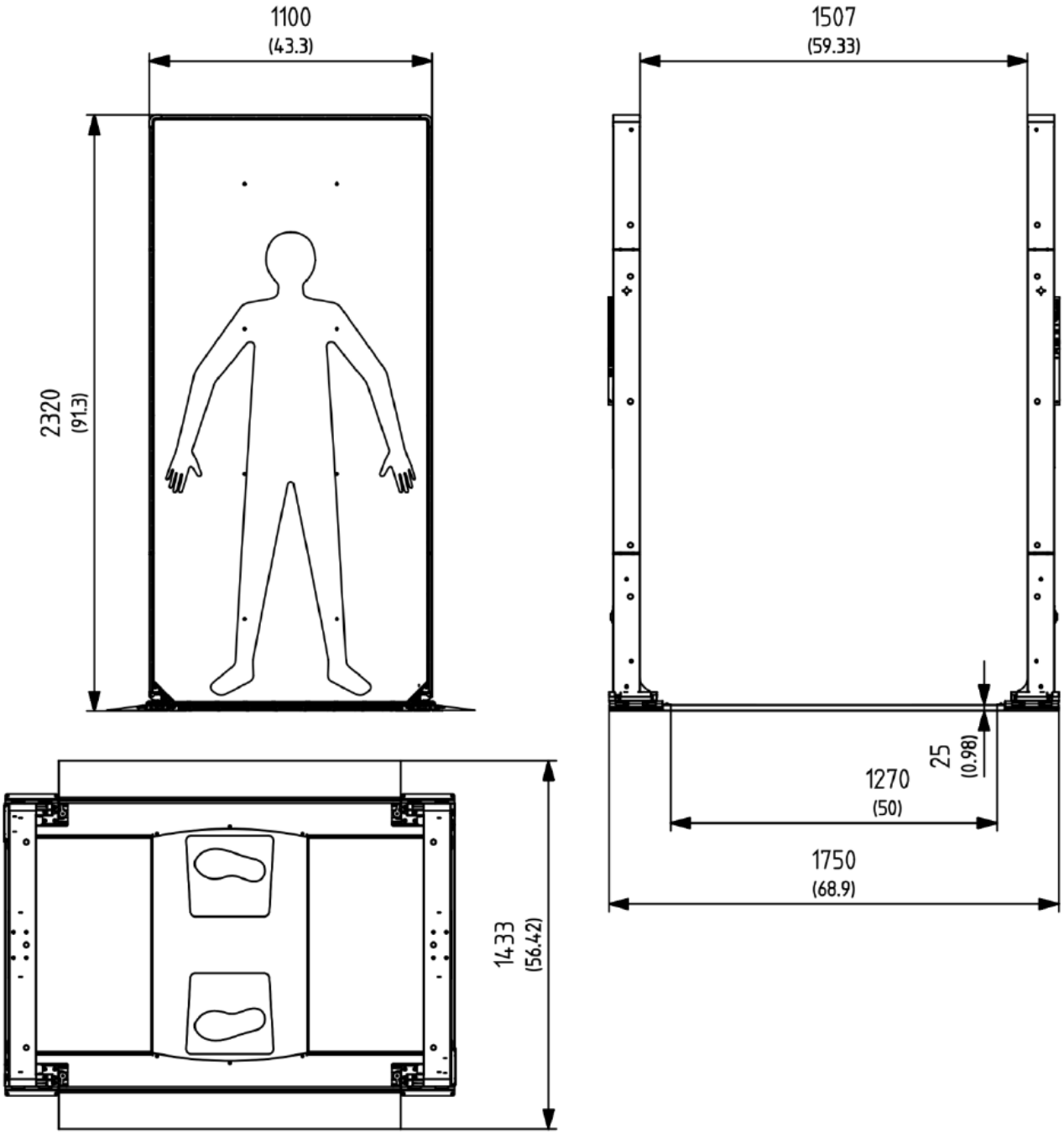


Figure 5.5-2: *EUT overview*

Section 6. Summary of test results

6.1 Testing location

Test location (s)	Ottawa

6.2 Testing period

Test start date	May 6, 2020	Test end date	May 7, 2020

6.3 Sample information

Receipt date	May 5, 2020	Nemko sample ID number(s)	1

6.4 FCC Part 15 Subpart A and C, requirements test results

Table 6.4-1: *FCC requirements results*

Part	Test description	Verdict
§15.207(a)	Conducted limits	Pass
§15.31(e)	Variation of power source	Pass
§15.31(m)	Number of tested frequencies	Pass
§15.203	Antenna requirement	Pass
§15.209	Field strength of emissions	Tested
ANSI C63.10, Clause 6.9	Emission bandwidth	Pass

6.5 ISED RSS-Gen, Issue 5, test results

Table 6.5-1: *RSS-Gen requirements results*

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

6.6 ISED RSS-210, Issue 10, test results

Table 6.6-1: *ISED requirements results*

Section	Test description	Verdict
A.1.1	Technical requirements	Pass
A.1.2	Field strengths	Pass
A.1.3	Bandwidth of momentary signals	Pass
A.1.4	Reduced field strengths	Not applicable

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
61505 AC source	Chroma	61509	FA003036	—	VOU
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	November 8, 2020
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	October 31, 2020
Horn (1–18 GHz)	ETS Lindgren	3117	FA002840	1 year	January 25, 2021
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002873	1 year	November 4, 2020
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	January 14, 2021
Horn antenna (18–40 GHz)	EMCO	3116	FA001847	1 year	November 7, 2020
Pre-amplifier (18–26 GHz)	Narda	BBS-1826N612	FA001550	—	VOU
Pre-amplifier (26–40 GHz)	Narda	DBL-2640N610	FA001556	—	VOU
Pre-amplifier (18–26 GHz)	Narda	BBS-1826N612	FA001550	—	VOU
40–60 GHz Harmonic mixer	OML	WR19 M19HWD	FA002322	3 year	July 29, 2022
40–60 GHz Standard gain horn	Millitech	U SGH-19	FA002322a	—	VOU
60–90 GHz Harmonic mixer	OML	WR12 M12HWD	FA001524	3 year	July 29, 2022
60–90 GHz Standard gain horn	Millitech	U SGH-12	FA001524a	—	VOU
90–140 GHz Harmonic mixer	OML	WR08 M08HWD	FA001525	3 year	July 29, 2022
90–140 GHz Standard gain horn	Millitech	U SGH-08	FA001525a	—	VOU
140–220 GHz Harmonic mixer	OML	WR05 M05HWD	FA001526	3 year	July 29, 2022
140–220 GHz Standard gain horn	Millitech	U SGH-05	FA001526a	—	VOU
LISN	Rohde & Schwarz	ENV216	FA002023	1 year	August 29, 2020
LISN	Rohde & Schwarz	ENV216	FA002515	1 year	January 18, 2021

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

Section 8. Testing data

8.1 Variation of power source

8.1.1 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.

8.1.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	May 6, 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 Number of frequencies

8.2.1 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.

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 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

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.

8.2.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	May 6, 2020

8.2.3 Observations, settings and special notes

None

8.2.4 Test data

Table 8.2-2: *Test channels selection*

Start of frequency band, GHz	End of frequency band, GHz	Frequency range bandwidth, GHz	Low channel, MHz	Mid channel, MHz	High channel, MHz
69	80	11	69,895.2380952381	74,886.9670702927	79,895.2380952381

8.3 Antenna requirement

8.3.1 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.

8.3.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	May 6, 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

Two panels with two antenna arrays on each.
Two panels with 32 antenna clusters each (QPS201); Two panels with 30 antenna clusters each (LPS);
Each antenna cluster is made up of 2 rows of 48 receive antennas and 2 columns of 48 transmit antennas.
Each panel contains:

32 clusters x 2 columns x 48 transmit antennas for a total of 3072 antennas (QPS201).
30 clusters x 2 columns x 48 transmit antennas for a total of 2880 antennas (LPS)
Each antenna is 6 dBi gain.

8.4 AC power line conducted emissions limits

8.4.1 References, definitions and limits

FCC §15.207:

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 Ω line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

ANSI C63.10, Clause 6.2:

If the EUT normally receives power from another device that in turn connects to the public utility ac power lines, measurements shall be made on that device with the EUT in operation to demonstrate that the device continues to comply with the appropriate limits while providing the EUT with power. If the EUT is operated only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines (600 VAC or less) to operate the EUT (such as an adapter), then ac power-line conducted measurements are not required.

For direct current (dc) powered devices where the ac power adapter is not supplied with the device, an "off-the-shelf" unmodified ac power adapter shall be used. If the device is supposed to be installed in a host (e.g., the device is a module or PC card), then it is tested in a typical compliant host.

RSS-Gen, Clause 8.8:

A radio apparatus that is designed to be connected to the public utility (AC) power line shall ensure that the radio frequency voltage, which is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz, shall not exceed the limits in table below.

Unless the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in table below. The more stringent limit applies at the frequency range boundaries.

Table 8.4-1: *Conducted emissions limit*

	Conducted limit, dBµV	
Frequency of emission, MHz	**Quasi-peak**	**Average****
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

Notes: * - The level decreases linearly with the logarithm of the frequency.
** - A linear average detector is required.

8.4.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	May 7, 2020

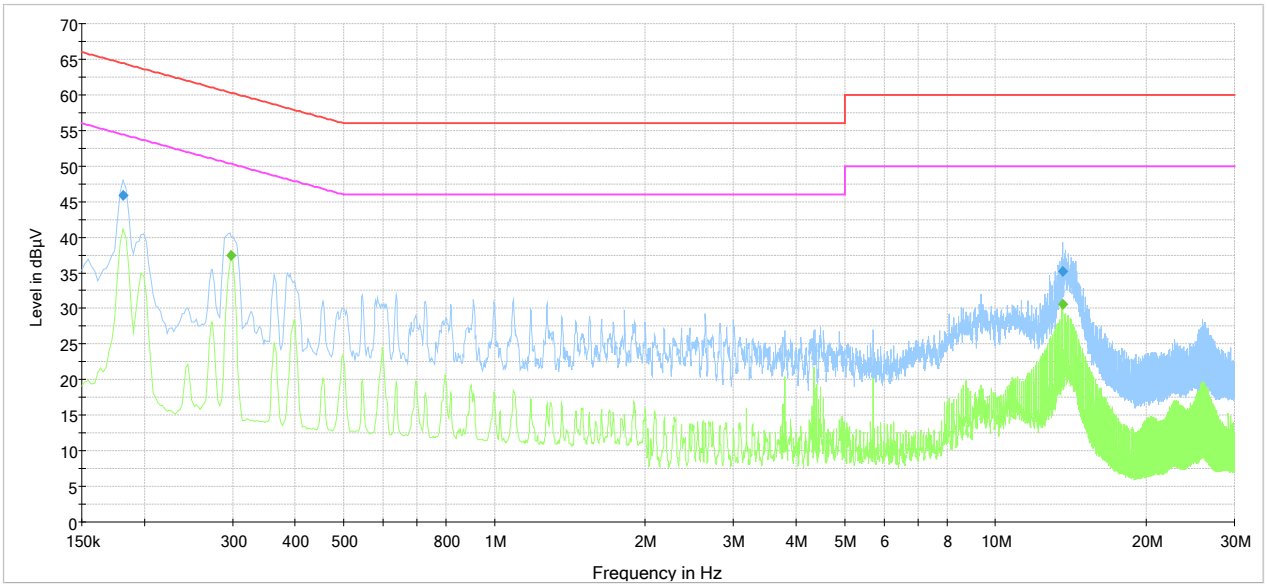
8.4.3 Observations, settings and special notes

Port under test – Coupling device	AC power input – Artificial Mains Network (AMN)
EUT power input during test	208 V_{AC}, 50/60 Hz;
EUT setup configuration	Floor standing
Measurement details	A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 10 dB or above the limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.
Additional notes:	– The EUT was set up as tabletop configuration per ANSI C63.10-2013 measurement procedure. – The spectral scan has been corrected with transducer factors (i.e. cable loss, LISN factors, and attenuators) for determination of compliance. Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (dB) – Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Receiver settings:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Peak and Average (Preview), Quasi-peak and CAverage (Final)
Trace mode	Max Hold
Measurement time	100 ms (Preview), 160 ms (Final)

8.4.4 Test data



Plot 8.4-1: *Conducted emissions on phase line*

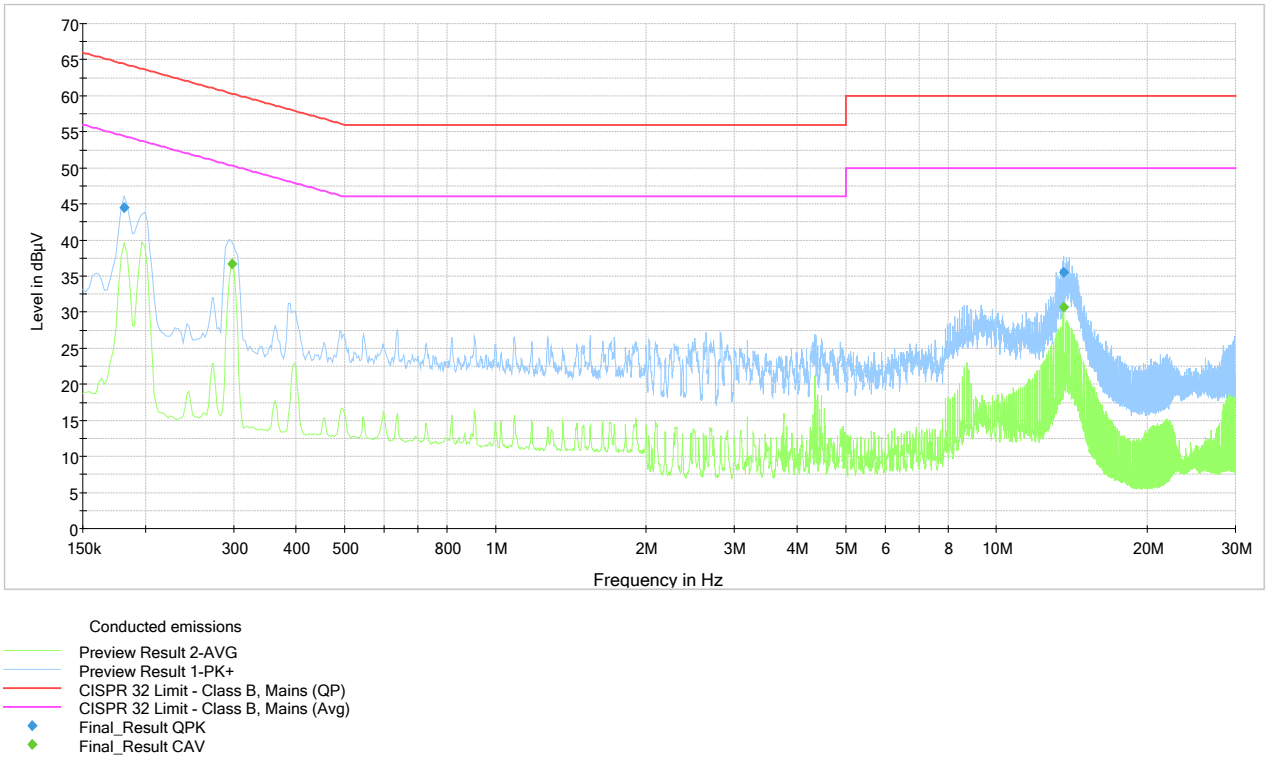
Table 8.4-2: *Quasi-Peak conducted emissions results on phase line*

Frequency, MHz	Q-Peak result, dBµV	Limit, dBµV	Margin, dB	Correction, dB
0.181500	45.90	64.42	18.52	10.3
13.633750	35.14	60.00	24.86	10.1

Table 8.4-3: *Average conducted emissions results on phase line*

Frequency, MHz	Average result, dBµV	Limit, dBµV	Margin, dB	Correction, dB
0.298500	37.45	50.28	12.83	10.1
13.633750	30.58	50.00	19.42	10.1

Test data, continued



Plot 8.4-2: *Conducted emissions on neutral line*

Table 8.4-4: *Quasi-Peak conducted emissions results on neutral line*

Frequency, MHz	Q-Peak result, dBµV	Limit, dBµV	Margin, dB	Correction, dB
0.181500	44.48	64.42	19.94	10.3
13.633750	35.50	60.00	24.50	10.1

Table 8.4-5: *Average conducted emissions results on neutral line*

Frequency, MHz	Average result, dBµV	Limit, dBµV	Margin, dB	Correction, dB
0.298500	36.68	50.28	13.60	10.1
13.633750	30.72	50.00	19.28	10.1

8.5 Conditions for intentional radiators to comply with periodic operation

8.5.1 References, definitions and limits

RSS-210 A.1.1:

Devices shall comply with the following for momentary operation:

a. A manually operated transmitter shall be equipped with a push-to-operate switch and be under manual control at all times during transmission. When released, the transmitter shall cease transmission within no more than 5 seconds of being released.
b. A transmitter that has been activated automatically shall cease transmission within 5 seconds of activation.
c. Periodic transmissions at regular, predetermined intervals are not permitted, except as specified in Section A.1.4. However, polling or supervision transmissions that determine system integrity of transmitters used in security or safety applications are permitted, provided the total duration of transmission does not exceed 2 seconds per hour for each transmitter.
d. Intentional radiators used for radio control during emergencies involving fire, security of goods (e.g. burglar alarms), and safety-of-life, when activated to signal an alarm, may operate during the interval of the alarm condition.

8.5.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	May 6, 2020

8.5.3 Observations, settings and special notes

The timing details were declared and provided by the manufacturer.

8.5.4 Test data

1)	The EUT is manually triggered?	☒ YES	☐ NO
2)	The EUT is activated automatically?	☐ YES	☒ NO
3)	The EUT is a periodic transmitter?	☐ YES	☒ NO
4)	The EUT's usage is for radio control purposes during emergencies?	☐ YES	☒ NO
5)	The EUT transmits set-up information?	☐ YES	☒ NO

Once manually triggered the transmit time for each of the two panels is 23.59 ms for QPS201 or 22.12 ms for LPS with 100 ms interval between them. Both panels cannot transmit simultaneously. Total duration of the transmission session is 147.2 ms (QPS201) or 144.2 ms (LPS).
The maximum limit is 5 s.

Detailed timing information:

	QPS201	LPS
Transmit time for each antenna:	60 ns	60 ns
Transmit time for all antennas:	60 ns × 3072 = 184.32 µs	60 ns × 2880 = 172.80 µs
Transmit time for each of the discrete frequency:	184.32 µs	172.80 µs
Transmit time for all 128 discrete frequencies:	128 × 184.32 µs = 23.59 ms	128 × 172.80 µs = 22.12 ms

8.6 Field strength of emissions

8.6.1 References, definitions and limits

FCC §15.209:

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the Table 8.6 2 below.

(d) The emission limits shown in the Table 8.6 2 below are based on measurements employing a CISPR quasi-peak detector except for the frequency bands above 1000 MHz where radiated emission limits are based on measurements employing an average detector.

(e) The provisions in §15.35 for limiting peak emissions apply to all devices operated under this part.

FCC §15.35:

(b) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, e.g., the total peak power level.

(c) When the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed; the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds.

RSS-210 A.1.2:

Following are the requirements for field strength of emissions:

a. The field strength of emissions from momentarily operated intentional radiators shall not exceed the limits in table below, based on the average value of the measured emissions. The requirements of the "Pulsed operation" section of RSS-Gen apply for averaging pulsed emissions and limiting peak emissions.
Alternatively, compliance with the limits in the table below may be demonstrated using an International Special Committee on Radio Interference (CISPR) quasi‑peak detector.

b. Unwanted emissions shall be 10 times below the fundamental emissions field strength limits in the table below or comply with the limits specified in RSS-Gen, whichever is less stringent.

Table 8.6-1: *RSS-210 field strength limits*

Fundamental frequency, MHz	Field strength of fundamental frequency		Field strength of spurious emissions	
	µV/m	dBµV/m	µV/m	dBµV/m
70–130	1250	61.9	125	41.9
130–174	1250 to 3750*	61.9 to 71.5	125 to 375	41.9 to 51.5
174–260	3750	71.5	375	51.5
260–470	3750 to 12500*	71.5 to 81.9	375 to 1250	51.5 to 61.9
Above 470	12500	81.9	1250	61.9

Notes: * Linear interpolation:
For 130–174 MHz: Field Strength limit (µV/m) = (56.82 × F[MHz]) – 6136
For 260–470 MHz: Field Strength limit (µV/m) = (41.67 × F[MHz]) – 7083

References, definitions and limits, continued

Table 8.6-2: *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

Table 8.6-3: *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 8.6-4: *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	Andrey Adelberg	Test date	May 6, 2020

8.6.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 220 GHz.
Radiated measurements for frequencies below 18 GHz were performed at a distance of 3 m. For frequencies above 18 GHz antenna was moved to 2 m distance and distance correction factor was applied.
Average radiated emissions were obtained by subtracting duty cycle correction factor from the peak measurement results.

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

8.6.4 Test data

Table 8.6-5: *Radiated field strength measurement results below 1 GHz*

Frequency, MHz	Peak field strength, dBµV/m	Peak limit, dBµV/m	Margin, dB
30.10	38.52	40.00	1.48
60.02	37.70	40.00	2.30
84.42	33.94	40.00	6.06
118.37	37.83	43.50	5.67
130.83	40.03	43.50	3.47
150.72	38.91	43.50	4.59
900.04	43.97	46.00	2.03

Table 8.6-6: *Radiated field strength spurious emissions measurement results above 1 GHz*

Frequency, GHz	Peak field strength, dBµV/m	Peak limit, dBµV/m	Margin, dB	Duty cycle factor, dB	Average field strength, dBµV/m	Average limit, dBµV/m	Margin, dB
4.000	49.74	74.0	24.26	-20.00	29.74	54.00	24.26
8.000	60.94	74.0	13.06	-20.00	40.94	54.00	13.06
12.000	61.29	74.0	12.71	-20.00	41.29	54.00	12.71
15.999	51.91	74.0	22.09	-20.00	31.91	54.00	22.09
17.751	60.92	74.0	13.08	-20.00	40.92	54.00	13.08
18.233	56.42	74.0	17.58	-20.00	36.42	54.00	17.58
18.576	54.22	74.0	19.78	-20.00	34.22	54.00	19.78
22.789	56.85	74.0	17.15	-20.00	36.85	54.00	17.15
25.423	57.37	74.0	16.63	-20.00	37.37	54.00	16.63
28.403	60.97	74.0	13.03	-20.00	40.97	54.00	13.03
35.676	65.73	74.0	8.27	-20.00	45.73	54.00	8.27
38.708	61.60	74.0	12.40	-20.00	41.60	54.00	12.40

Notes: Duty cycle correction factor is more than 20 dB, therefore 20 dB was used for average calculation of unintentional emissions.

Test data, continued

Table 8.6-7: *Radiated field strength of fundamental measurement results for QPS201*

Frequency, MHz	Peak field strength, dBµV/m @ 3 m	Duty cycle correction factor, dB	Average field strength, dBµV/m @ 3 m
69895.2380952381	104.15	-57.19	46.96
74886.9670702927	103.31	-57.19	46.12
79895.2380952381	100.13	-57.19	42.94

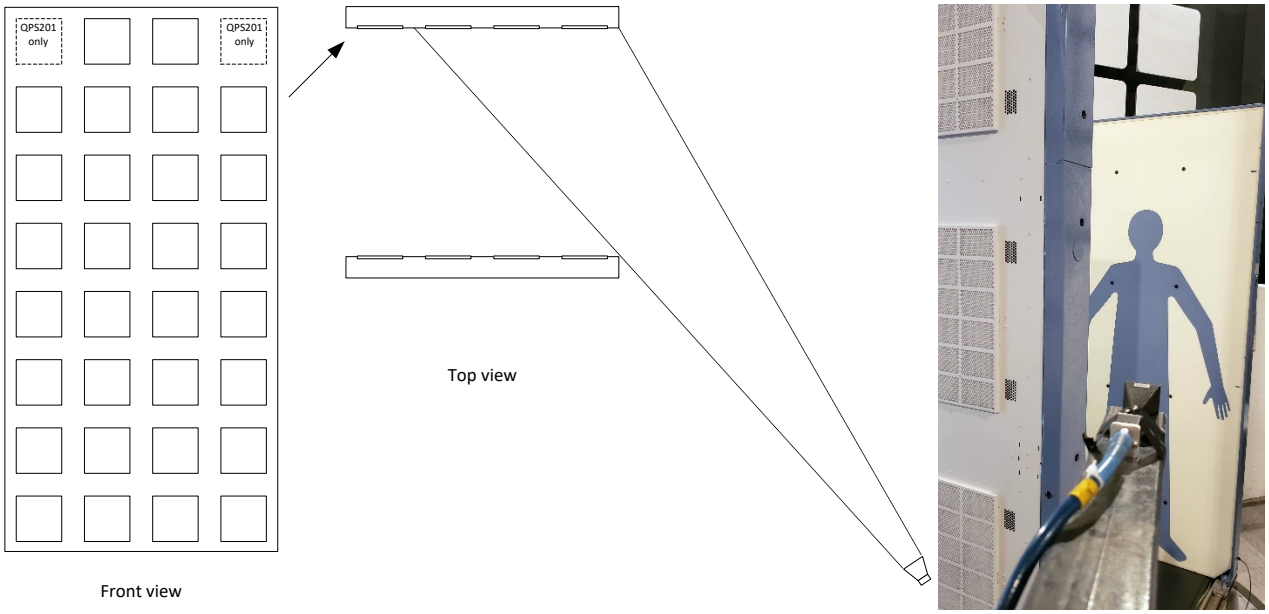
Table 8.6-8: *Radiated field strength of fundamental calculation results for LPS*

Frequency, MHz	Peak field strength, dBµV/m @ 3 m	Duty cycle correction factor, dB	Average field strength, dBµV/m @ 3 m
69895.2380952381	104.15	-57.56	46.59
74886.9670702927	103.31	-57.56	45.75
79895.2380952381	100.13	-57.56	42.57

For the fundamental emissions measurement natural setup obstruction was taken into account. The measurement was performed from distance of 2 meters from the EUT perimeter. Since from the angle with the maximum level of emission only partial EUT antenna clusters (24 out of the 32 in case of QPS201 or 23 out of 30 in case of LPS) were in the line of sight of the measuring equipment, duty cycle was corrected to include only active (visible) antennas by factor of 24/32 (or 3/4) for QPS201 or 23/30 (or 0.767) for LPS.

Since both panels do not transmit simultaneously, the total transmit time within any given 100 ms time window frame is only 23.59 ms for QPS201 or 22.12 ms for LPS (from single panel). Although the QPS201 transmits for 23.59 ms and LPS for 22.12 ms, the fundamental frequency during the single transmission is varied (increased by 78 MHz) every 184.32 µs in QPS201 and 172.80 µs in LPS, therefore within 100 ms window frame the Tx duration is 184.32 µs (QPS201) or 172.80 µs (LPS) at any frequency of fundamental.

The duty cycle correction factor was calculated as follows: $20 \times \log_{10}(¾ \times 0.18432 \text{ ms}/100 \text{ ms}) = -57.19$ dB (QPS201)
$20 \times \log_{10}(0.767 \times 0.17280 \text{ ms}/100 \text{ ms}) = -57.56$ dB (LPS)



Note: there are 8 out of 32 clusters are blocked in QPS201. In LPS variant the two top corner clusters are not present, so only 7 out of 30 clusters are blocked.

There is no limit for the fundamental at the tested frequencies in the specifications tested; therefore, the final result is subject for special authorization.

Test data, continued

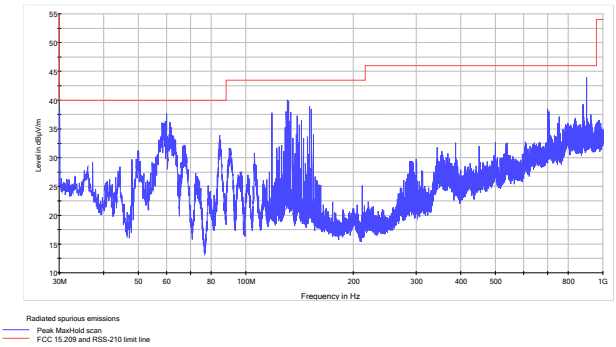


Figure 8.6-1: *Radiated spurious emissions below 1 GHz*

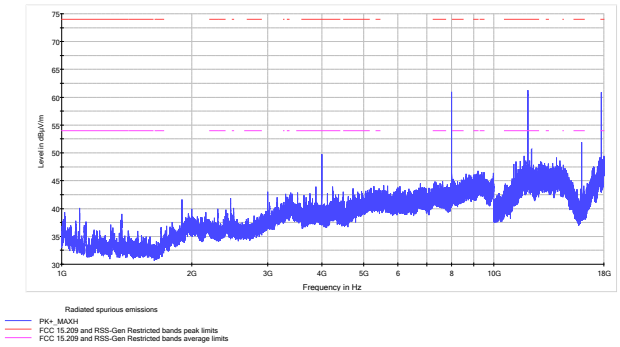


Figure 8.6-2: *Radiated spurious emissions within 1–18 GHz*

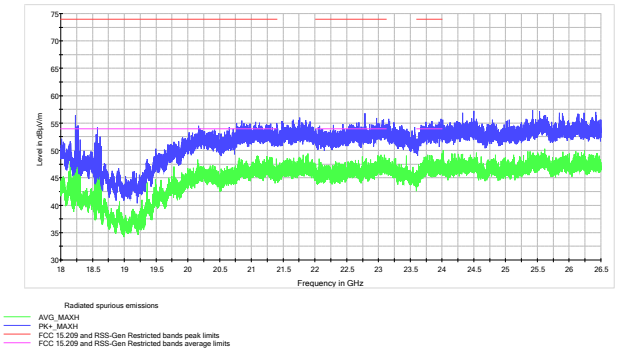


Figure 8.6-3: *Radiated spurious emissions within 18–26.5 GHz*

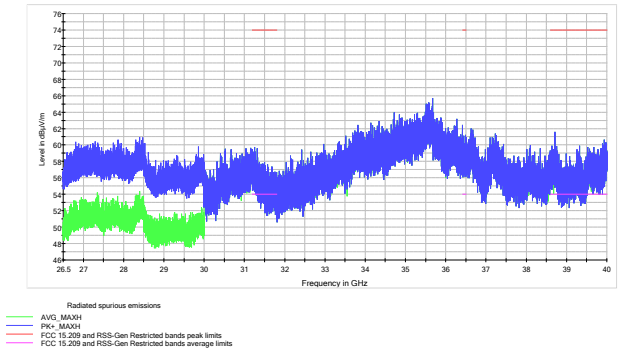


Figure 8.6-4: *Radiated spurious emissions within 26.5–40 GHz*

Test data, continued

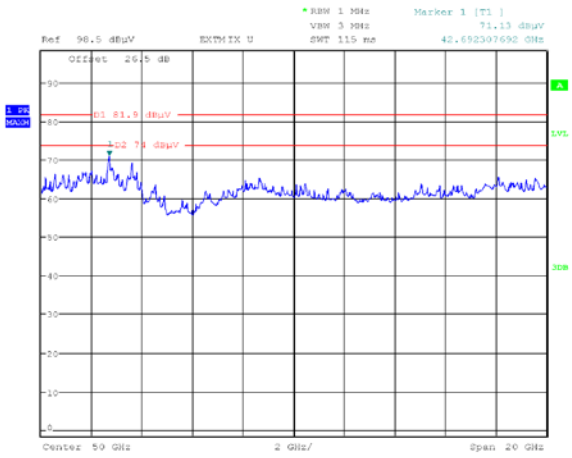


Figure 8.6-5: *Radiated spurious emissions within 40–60 GHz*

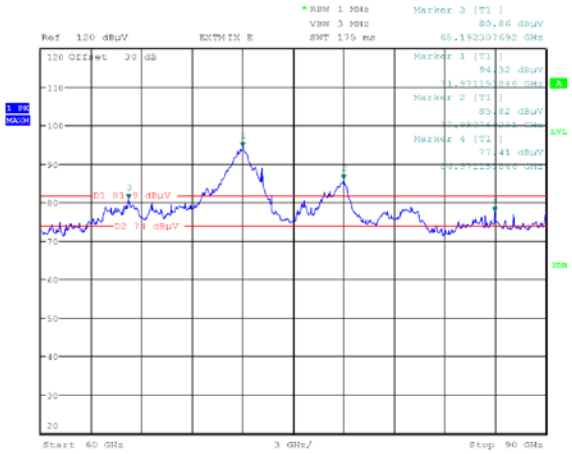


Figure 8.6-6: *Radiated spurious emissions within 60–90 GHz*

Note: RBW was also reduced to increase dynamic range and verify there are no RF related products buried below the noise floor. Frequency range of 40–90 GHz was scanned at the distance of 2 meters. Peak levels that exceeded the limit line were checked at much closer distance. All emissions on the plots above were verified that they are from the instrument noise floor and not from the EUT. Peak limit line is 81.9 dBµV/m.

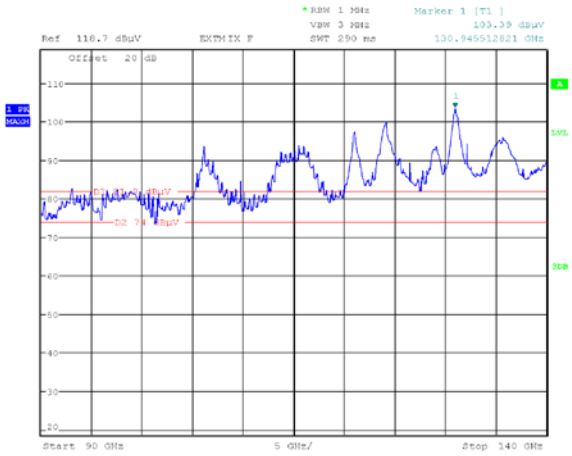


Figure 8.6-7: *Radiated spurious emissions within 90–140 GHz*

Figure 8.6-8: *Radiated spurious emissions within 140–220 GHz*

Note: RBW was reduced to increase dynamic range and verify there are no RF related products buried below the noise floor. Frequency range of 90–220 GHz was scanned at the distance of 2 meters. Peak levels that exceeded the limit line were checked at much closer distance. All emissions on the plots above were verified that they are from the instrument noise floor and not from the EUT. Peak limit line is 81.9 dBµV/m.

8.7 Emission bandwidth

8.7.1 References, definitions and limits

ANSI C63.10, Clause 6.9.3:

(c) 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-210 A.1.3:

The occupied bandwidth of momentarily operated devices shall be less than or equal to 0.25% of the centre frequency for devices operating between 70 MHz and 900 MHz. For devices operating above 900 MHz, the occupied bandwidth shall be less than or equal to 0.5% of the centre frequency.

8.7.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	May 7, 2020

8.7.3 Observations, settings and special notes

Limit: 0.5 % of 74.8 GHz is 374 MHz

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: *99 % occupied bandwidth measurement result*

Frequency, GHz	99 % occupied bandwidth, MHz	Limit, MHz	Margin, MHz
69.895	11.75	374.00	362.25
74.887	11.67	374.00	362.33
79.895	11.75	374.00	362.25

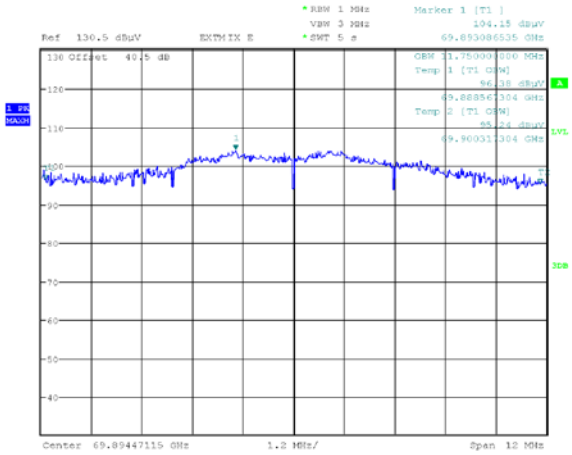


Figure 8.7-1: *99 % occupied bandwidth on low channel*

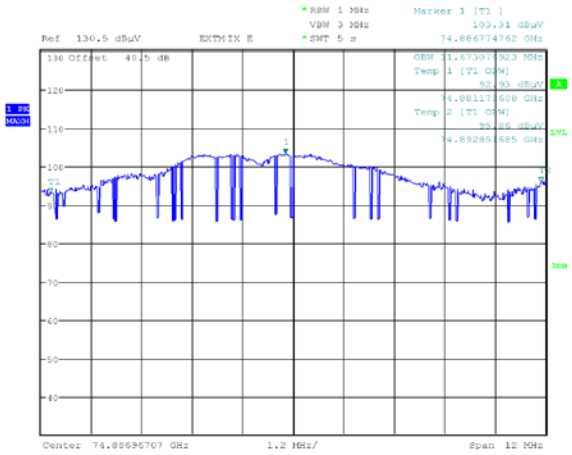


Figure 8.7-2: *99 % occupied bandwidth on mid channel*

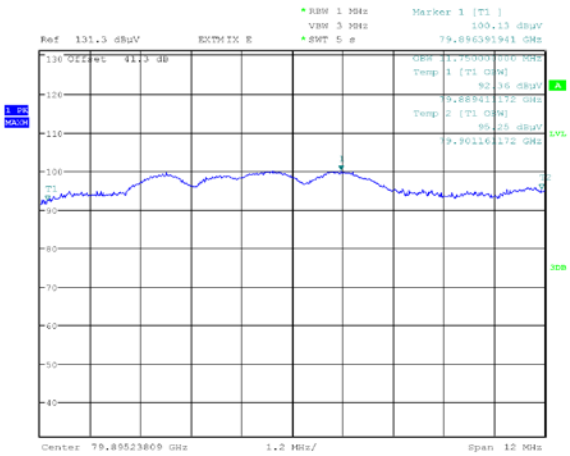
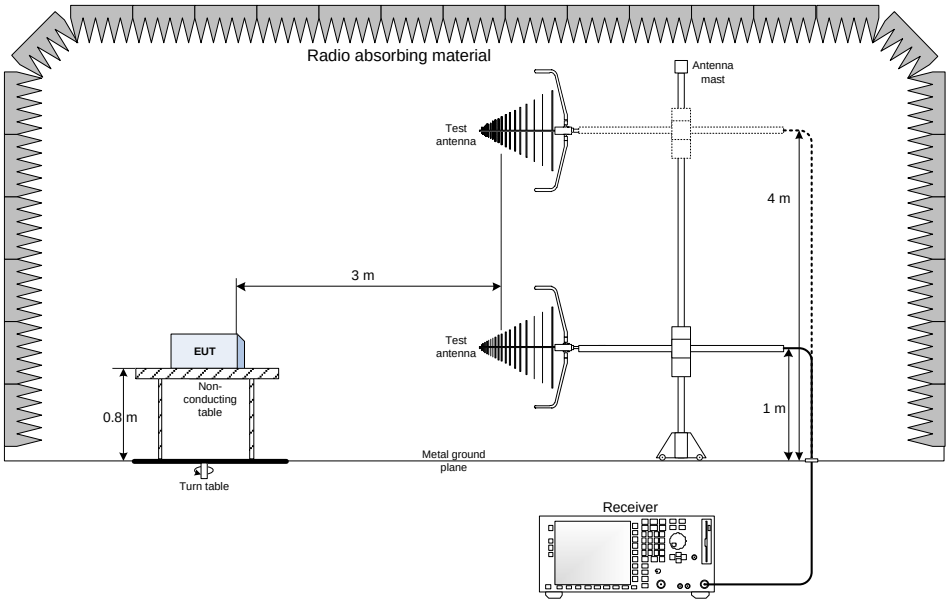


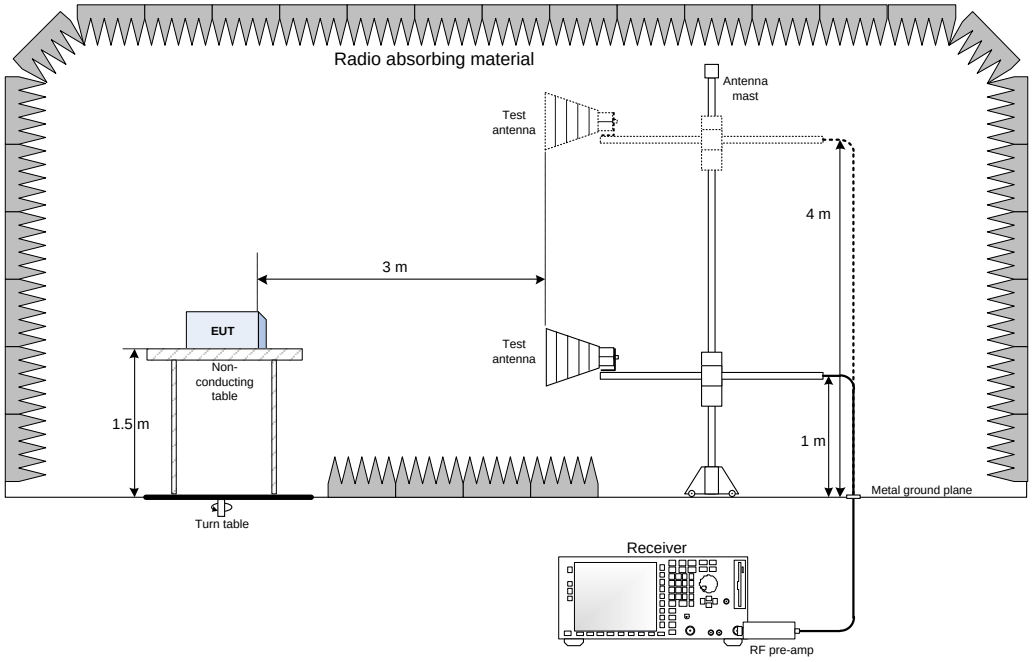
Figure 8.7-3: *99 % occupied bandwidth on high channel*

Section 9. Block diagrams of test set-ups

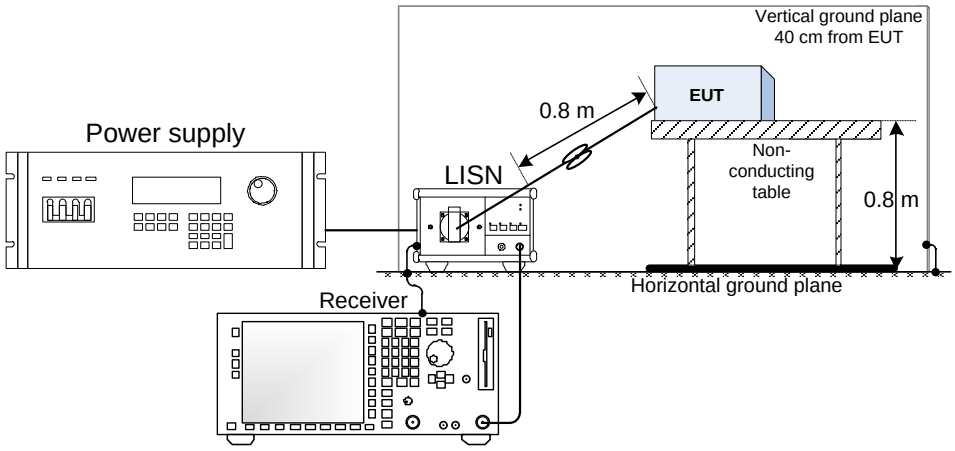
9.1 Radiated emissions set-up for frequencies below 1 GHz



9.2 Radiated emissions set-up for frequencies above 1 GHz



9.3 Conducted emissions set-up



9.4 Antenna port set-up