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RADIO TEST REPORT – 393942-1TRFWL

Applicant:

Qolsys Inc.

Product name (type):

Motion Detector

Model:

IQ Motion2-S

FCC ID:

2AAJXIQMOTION2S

IC Registration number:

11205A-IQMOTION2S

Specifications:

- FCC 47 CFR Part 15, Subpart C, §15.231
- RSS-210 Annex A.1, Issue 10, December 2019

Date of issue: April 23, 2020

Alvin Liu, EMC/RF Specialist
Tested by

Signature

Mark libbrecht, EMC/RF Specialist
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 numbers and location**
	FCC/ISED	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 C, Clause 15.231	Periodic operation in the band 40.66–40.70 MHz and above 70 MHz
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

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 23, 2020	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 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 and manufacturer

Company name	Qolsys Inc.
Address	1900 The Alameda, 4th Floor, San Jose, CA, United States

5.3 EUT information

Product name	Motion Detector
Model	IQ Motion2-S
Serial number	None
Part number	None
Operating conditions	Battery powered: 3 VDC (Lithium CR123A) HW: UA753 Rev. 01 SW: Ver. 1.0
Product description and theory of operation	IQ Motion2-S is a Wireless PIR Motion Detector used on protected premises. It detects motion in front of its lens and sends an alarm message using the integral RF transmitter (319.5 MHz) to a compatible receiver/alarm system combination.

5.4 Technical information

Applicant IC company number	11205A
IC UPN number	IQMOTION2S
All used IC test site(s) Reg. number	24676
RSS number and Issue number	RSS-210 Issue 10, Annex A.1
Operation type	☐ Periodic ☒ Non-periodic
Frequency Tx (MHz)	319.5
RF power Max (W), Conducted	N/A
Field strength, dBµV/m @ 3 m	71.9
Measured BW (kHz), 99% OBW	44.6
Type of modulation	Pulsed
Emission classification	L1D
Transmitter spurious, dBµV/m @ 3 m	36.6 @ 2556.081 MHz
Power supply requirements	Battery: 3 V_{DC} (Lithium CR123A)
Antenna information	PCB loop antenna, gain 2.5 dBi The EUT uses a unique antenna coupling/ non-detachable antenna to the intentional radiator.

5.5 EUT setup details

5.5.1 EUT Exercise and monitoring

Methods used to exercise the EUT and all relevant ports:

- Insert the 3 V battery into the battery holder at the back of the device, EUT can start the transmission.
- The device operates in 319.5MHz band, transmit only function, 1-way RF protocol.
- Periodic supervision transmission every 65-70 minutes, less than 2s total per hour.
- RF PROTOCOL DETAIL
  - There are 8 packets in an alarm and supervision transmissions, each has unique sequence number.
  - Packet length vary depends what data is. A single packet length varies from 15 ms – 23 ms.
  - The gap between each packet is randomly delayed from 100 ms to 255 ms. Typically overall transmission lasts about 2 seconds.
  - Supervision packet length is same as alarm packet.

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:
  - 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:
  - None

Section 6. Summary of test results

6.1 Testing location

Test location (s)	Cambridge

6.2 Testing period

Test start date	April 20, 2020	Test end date	April 21, 2020

6.3 Sample information

Receipt date	April 16, 2020	Nemko sample ID number(s)	1, 2

6.4 FCC Part 15 Subpart C, general requirements test results

Table 6.4-1: *FCC general requirements results*

Part	Test description	Verdict
§15.207(a)	Conducted limits	Not applicable
§15.31(e)	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 fresh batteries.

6.5 FCC Part 15 Subpart C, intentional radiators test results

Table 6.5-1: *FCC 15.231 requirements results*

Part	Test description	Verdict
§15.231(a)	Conditions for intentional radiators to comply with periodic operation	Pass
§15.231(b)	Field strength of emissions	Pass
§15.231(c)	Emission bandwidth	Pass
§15.231(d)	Requirements for devices operating within 40.66–40.70 MHz band	Not applicable[1]
§15.231(e)	Conditions for intentional radiators to comply with periodic operation	Not applicable[2]

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

[2]EUT complies with requirement §15.231(a).

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[1]
7.4	Receiver conducted emission limits	Not applicable[1]
6.9	Operating bands and selection of test frequencies	Pass
8.8	AC power-line conducted emissions limits	Not applicable[2]

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.

[2] EUT is a battery operated device, the testing was performed using fresh batteries.

6.7 ISED RSS-210, Issue 10, test results

Table 6.7-1: *RSS-210 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[1]

Notes: [1]EUT complies with requirement A.1.1

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	June 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
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002956	1 year	September 26, 2020
Receiver/spectrum analyzer	Rohde & Schwarz	FSW43	FA002971	1 year	June 21, 2020

Note: NCR - no calibration required

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	Alvin Liu	Test date	April 20, 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	Alvin Liu	Test date	April 20, 2020

8.2.3 Observations, settings and special notes

None

8.2.4 Test data

Single channel of operation at 319.5 MHz.

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:
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	Alvin Liu	Test date	April 20, 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
EUT utilizes internal, non-detachable antenna design			

8.4 FCC 15.231(a) and RSS-210 A.1.1 Conditions for intentional radiators to comply with periodic operation

8.4.1 References, definitions and limits

FCC:

(a) The provisions of this section are restricted to periodic operation within the band 40.66–40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal. The following conditions shall be met to comply with the provisions for this periodic operation:

(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

(2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

(3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety-of-life, when activated to signal an alarm, may operate during the pendency of the alarm condition.

(5) Transmission of set-up information for security systems may exceed the transmission duration limits in paragraphs (a)(1) and (a)(2) of this section, provided such transmissions are under the control of a professional installer and do not exceed ten seconds after a manually operated switch is released or a transmitter is activated automatically. Such set-up information may include data.

ISED:

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.

8.4.2 Test summary

Verdict	Pass		
Tested by	Alvin Liu	Test date	April 20, 2020

8.4.3 Observations, settings and special notes

None.

8.4.4 Test data

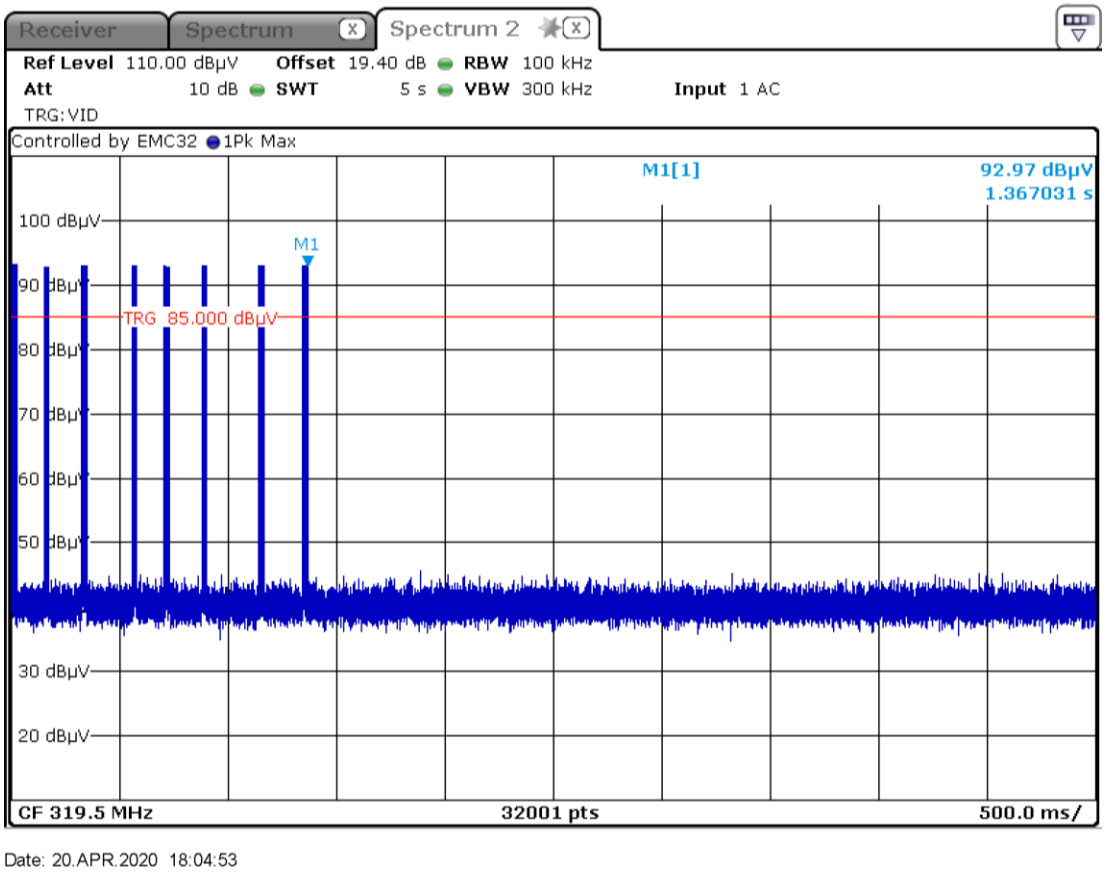


Figure 8.4-1: *Transmission duration after activation (within 5 seconds)*

Table 8.4-1: *Transmission duration after activation results*

Duration of transmission after activation	Limit of duration of transmission after activation	Margin (s)
1.4	5.0	3.6

8.4.1 Test data, continued

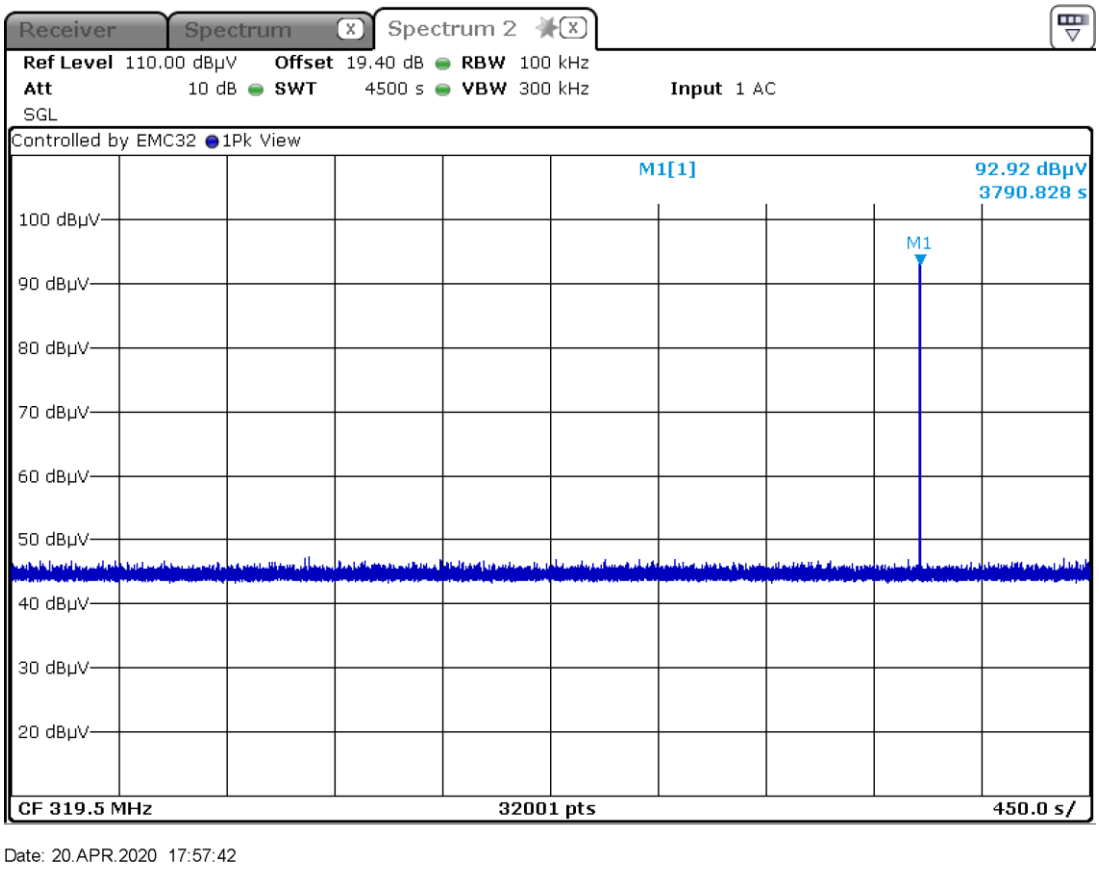


Figure 8.4-2: *Polling and supervision transmission(s) in 1-hour period*

Table 8.4-2: *Polling and supervision transmission(s) in a 1-hour period results*

Number of polling and supervision transmission(s) in 1-hour period	Length of transmission, (s)	Limit of transmissions in 1-hour period, (s)	Margin, (s)
1	1.4	2.0	0.6

8.5 FCC 15.231(b) and RSS-210 A.1.2 Field strength of emissions

8.5.1 References, definitions and limits

FCC:

(b) In addition to the provisions of §15.205 the field strength of emissions from intentional radiators operated under this section shall not exceed the following table.

1) The field strength limits in the table below are specified at a distance of 3 meters. The tighter limits apply at the band edges.
2) Intentional radiators operating under the provisions of this section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in §15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of §15.205 shall be demonstrated using the measurement instrumentation specified in that section.
3) The limits on the field strength of the spurious emissions in the table below are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in §15.209, whichever limit permits a higher field strength.

ISED:

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 8.5-1: *Field strength limits*

Fundamental frequency (MHz)	Field strength of fundamental (µV/m)	Field strength of fundamental (dBµV/m)	Field strength of spurious emissions (µV/m)	Field strength of spurious emissions (dBµV/m)
40.66–40.70[1]	2,250	67.0	225	47.0
70–130	1,250	61.9	125	41.9
130–174	1,250 to 3,750*	61.9 to 71.5*	125 to 375*	41.9 to 51.5*
174–260[2]	3,750	71.5	375	51.5
260–470[2]	3,750 to 12,500*	71.5 to 81.9*	375 to 1,250*	51.5 to 61.9*
Above 470	12,500	81.9	1,250	61.9

** Linear interpolation with frequency F in MHz:*
For 130–174 MHz: Field Strength (µV/m) = (56.82 × F) − 6136
For 260–470 MHz: Field Strength (µV/m) = (41.67 × F) – 7083

Notes: *[1]The levels applicable to FCC only.*
[2]Frequency bands 225–328.6 MHz and 335.4–399.9 MHz are designated for the exclusive use of the Government of Canada. Manufacturers should be aware of possible harmful interference and degradation of their licence-exempt radio equipment in these frequency bands.

Table 8.5-2: *FCC §15.209 and RSS-Gen – Radiated emission limits*

Frequency	Field strength of emissions		Measurement distance
MHz	µV/m	dBµV/m	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 8.5-3: *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 8.5-4: *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			

8.5.2 Test summary

Verdict	Pass		
Tested by	Alvin Liu	Test start date	April 20, 2020

8.5.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to the 10th harmonic.
Radiated measurements were performed at a distance of 3 m.
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

8.5.4 Test data

Duty cycle/average factor calculations

§15.35(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.

$$Duty\ cycle\ or\ average\ factor = 20 \times \log_{10}\left(\frac{Tx_{100ms}}{100_{ms}}\right)$$

Measured Duty cycle factor:

Total ON time for data train: Tx on time $_{100\ ms}$ = 0.625 + 0.15 × 58 = 9.325 ms

Calculated Duty cycle factor = 20 log (9.325/100) = -20.6 dB

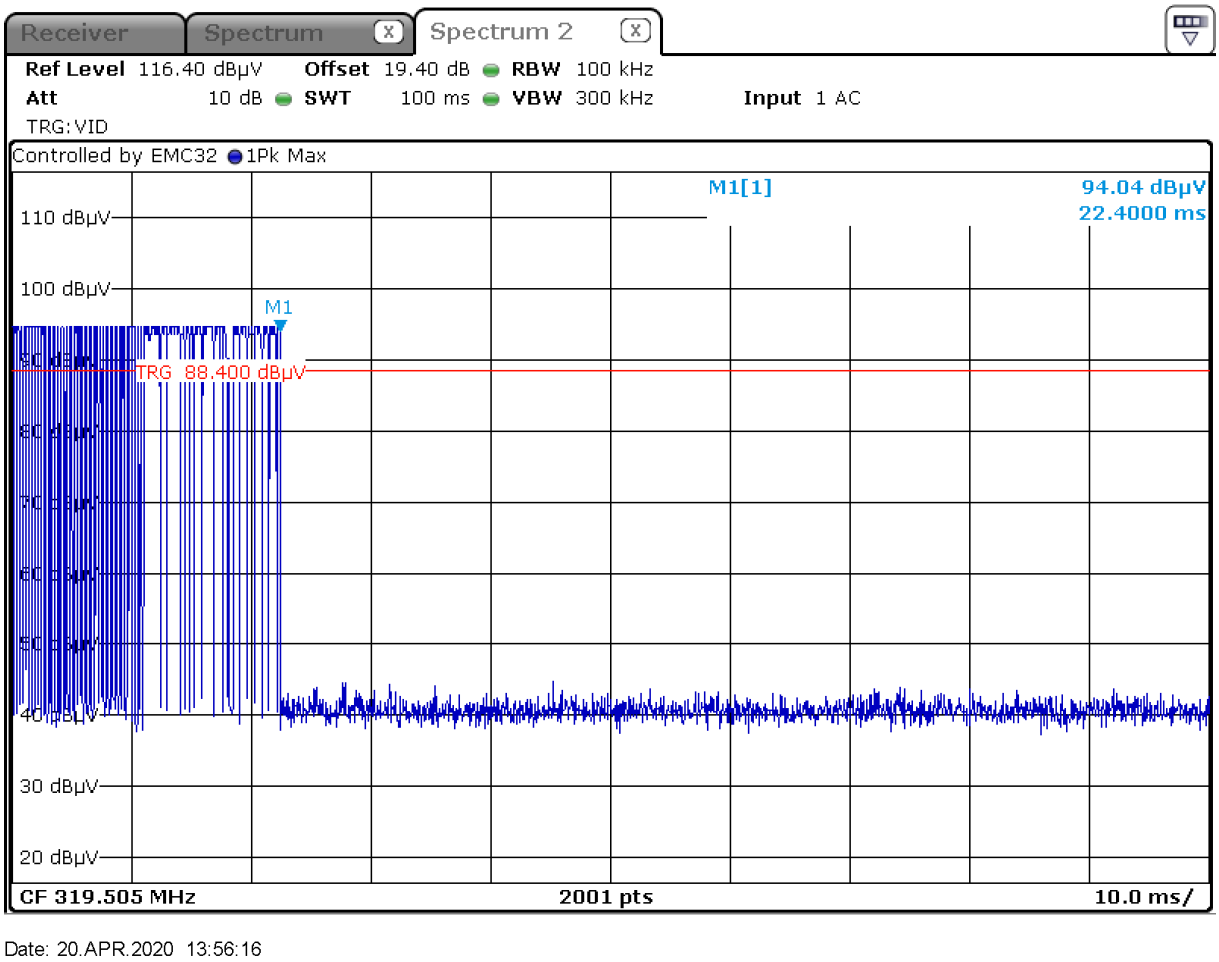
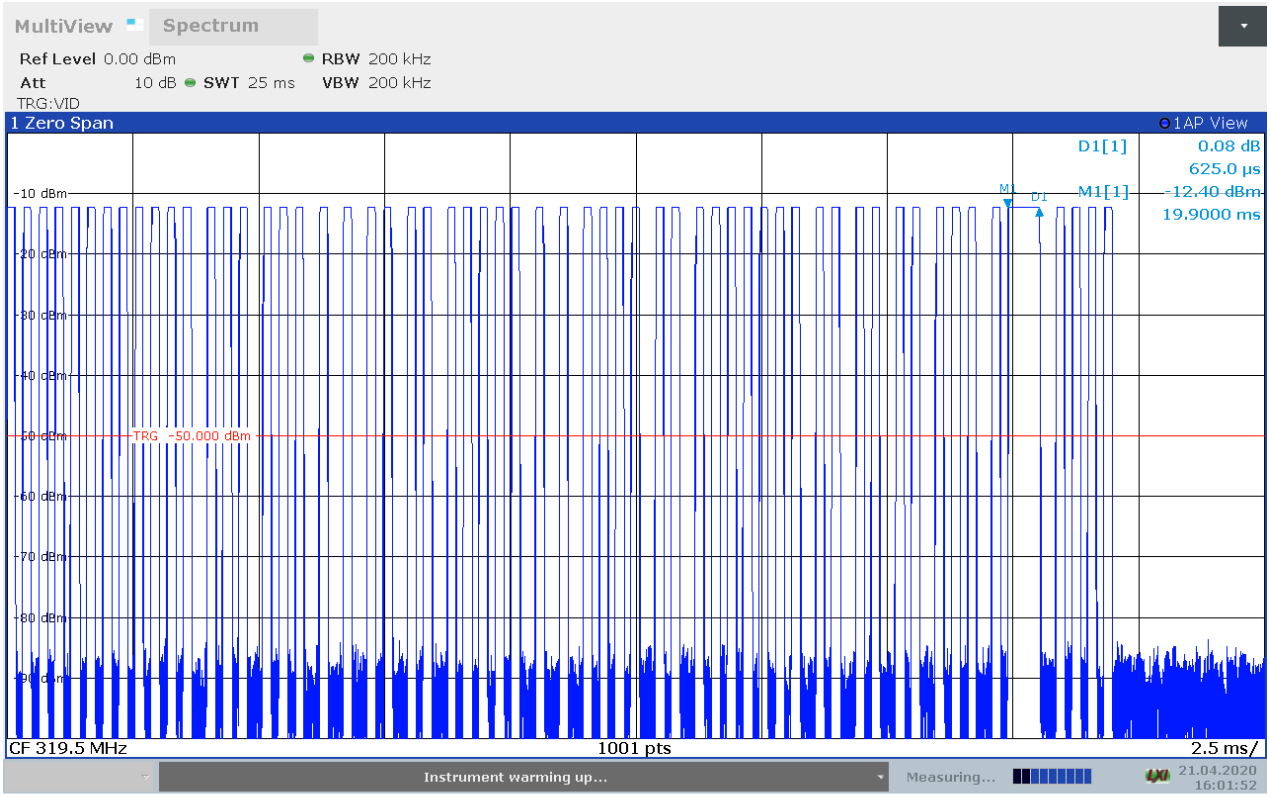


Figure 8.5-1: *Transmission length in 100 ms period*

8.5.5 Test data, continued



16:01:52 21.04.2020

Figure 8.5-2: *Pulse train*

8.5.6 Test data, continued

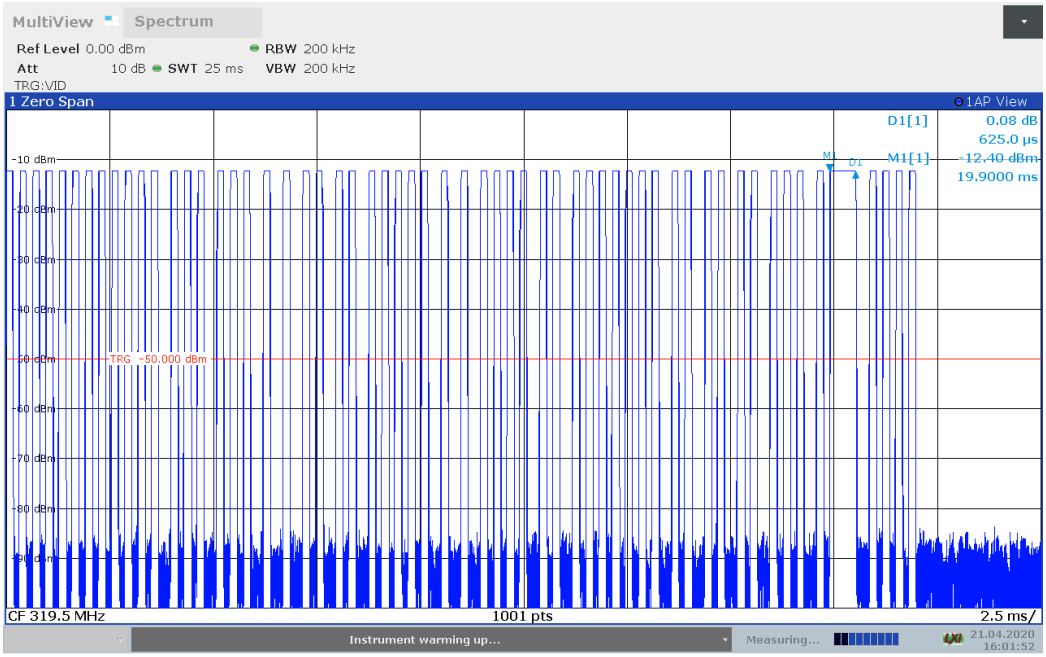


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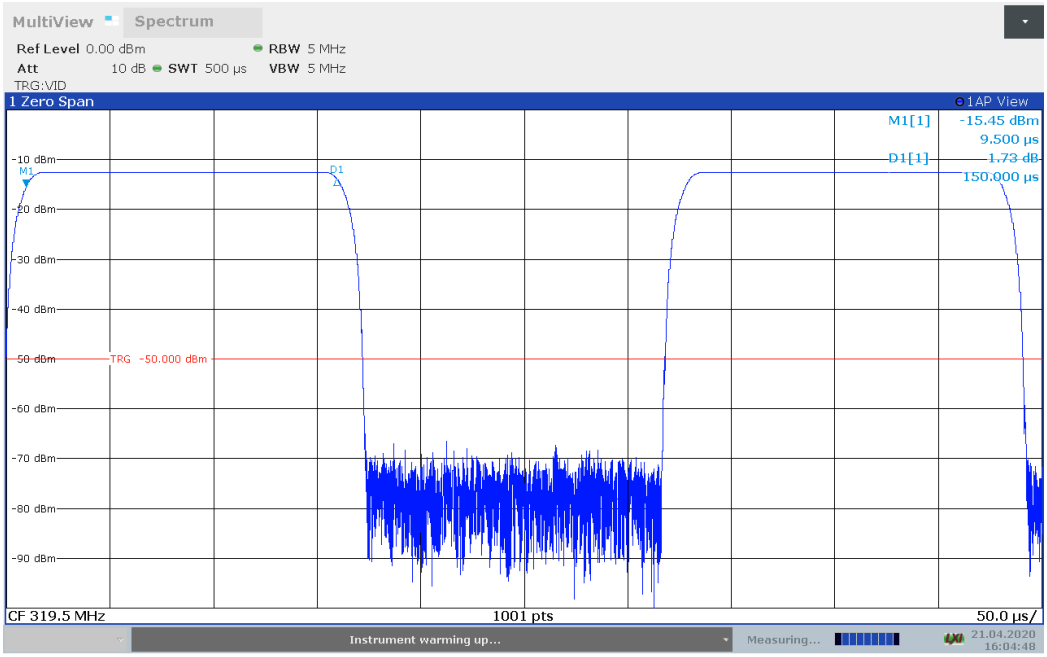
Figure 8.5-3: *Pulse width wide pulse = 1 × 0.625 ms = 0.625 ms*



16:04:49 21.04.2020

Figure 8.5-4: *Pulse width narrow pulse = 58 × 0.15 ms = 8.7 ms*

8.5.7 Test data, continued

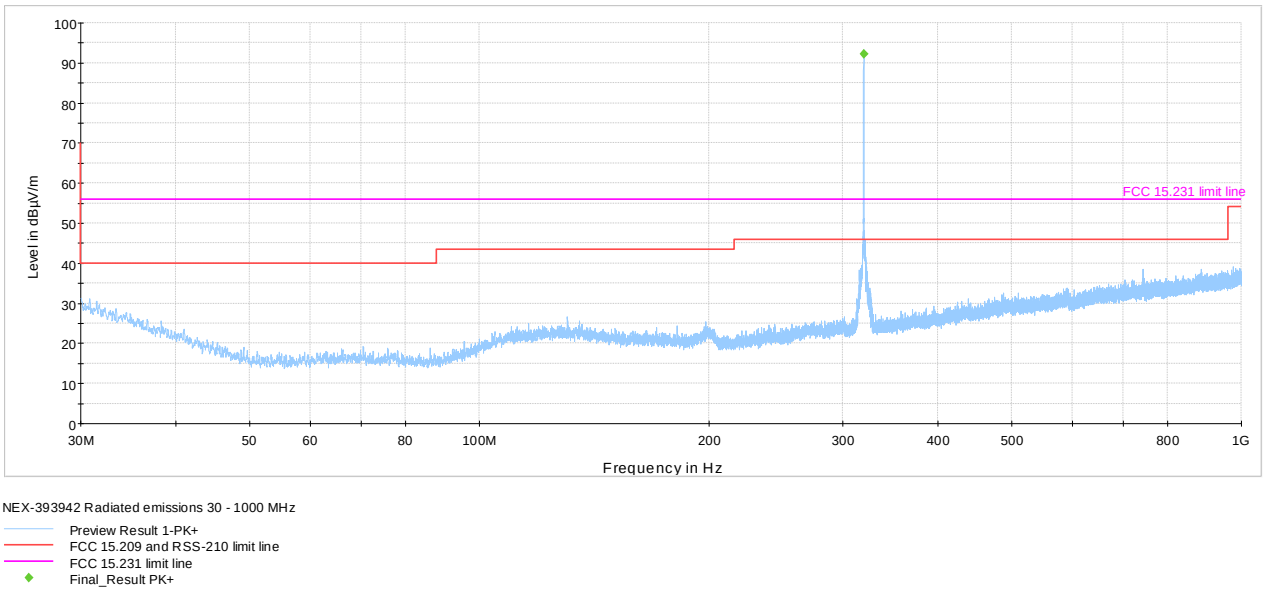


Figure 8.5-5: *Radiated spurious emissions 30 - 1000 MHz*

Table 8.5-5: *Radiated field strength of fundamental measurement results*

Frequency, MHz	Peak field strength, dBµV/m	Duty cycle factor, dB	Average field strength, dBµV/m	Average limit, dBµV/m	Margin, dB
319.5	92.5	-20.6	71.9	75.9	4.0

Notes:
- Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.
- Average field strength limt (dBµV/m) = 20 log ((41.67 × 319.5) – 7083) = 75.9
- Calculated average field strength (dBµV/m) = measured Peak field strength (dBµV/m) + Duty cycle factor (dB).

8.5.8 Test data, continued

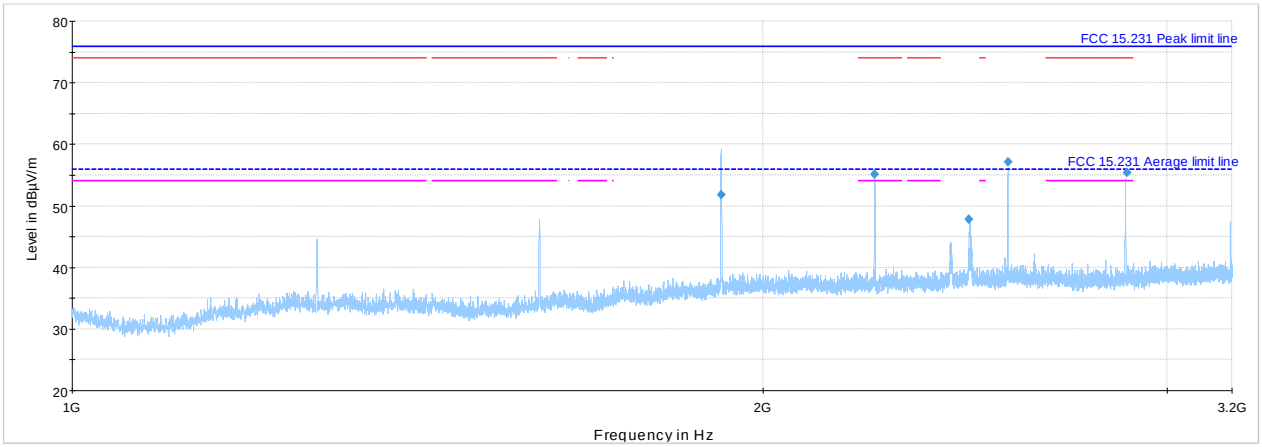


Figure 8.5-6: *Radiated spurious emissions 1 – 3.2 GHz*

Table 8.5-6: *Radiated field strength of spurious emissions measurement results outside restricted bands*

Frequency, MHz	Peak field strength, dBµV/m	Duty cycle factor, dB	Average field strength, dBµV/m	Average limit, dBµV/m	Margin, dB
1917.010	51.9	-20.6	31.3	55.9	22.7
2458.762	47.8	-20.6	27.2	55.9	26.8
2556.081	57.2	-20.6	36.6	55.9	17.4

Notes:
– Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.
– Average spurious emission field strength limit (dBµV/m) = 20 log ((41.67 × 319.5) – 7083) -20 = 55.9 dBµV/m
– Calculated average field strength (dBµV/m) = measured Peak field strength (dBµV/m) + Duty cycle factor (dB).

Table 8.5-7: *Radiated field strength of spurious emissions measurement results in restricted bands*

Frequency, MHz	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
2236.517	55.1	74.0	18.9	-20.6	34.5	54.0	19.5
2879.336	55.4	74.0	18.6	-20.6	34.8	54.0	19.2

Notes:
– Field strength includes correction factor of antenna, cable loss, amplifier, and attenuators where applicable.
– Calculated average field strength (dBµV/m) = measured Peak field strength (dBµV/m) + Duty cycle factor (dB).

8.6 FCC 15.231(c) and RSS-210 A.1.3 Emission bandwidth of momentary signals

8.6.1 References, definitions and limits

FCC:
The bandwidth of the emission shall be no wider than 0.25 % of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5 % of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

ISED:
The 99% bandwidth of momentarily operated devices shall be less 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 99% bandwidth shall be less or equal to 0.5% of the centre frequency.

8.6.2 Test summary

Verdict	Pass		
Tested by	Alvin Liu	Test date	April 20, 2020

8.6.3 Observations, settings and special notes

Limit: 0.25 % of 319.5 MHz is 799 kHz

Spectrum analyser settings:

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

8.6.4 Test data

Table 8.6-1: *20 dB bandwidth measurement result*

20 dB bandwidth, kHz	Limit, kHz	Margin, kHz
20.5	799.0	778.5

Table 8.6-2: *99 % occupied bandwidth measurement result*

99 % occupied bandwidth, kHz	Limit, kHz	Margin, kHz
44.6	799.0	754.4

8.6.4 Test data, continued

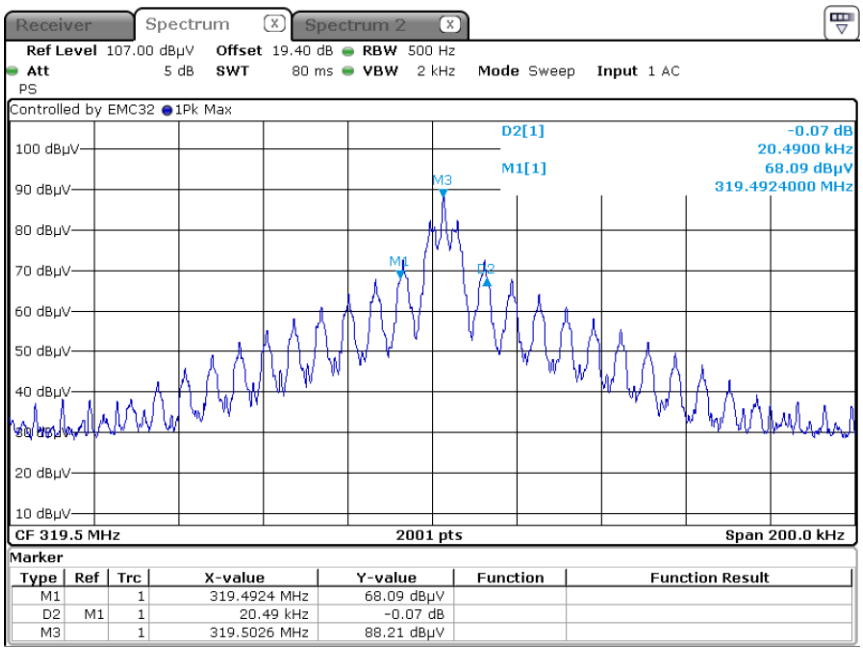


Figure 8.6-1: *20 dB occupied bandwidth*

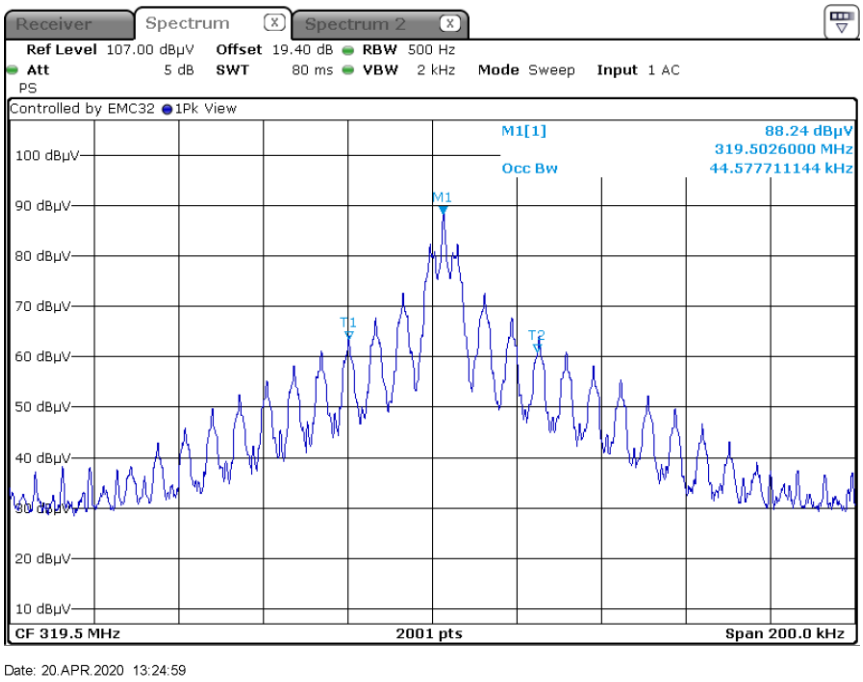
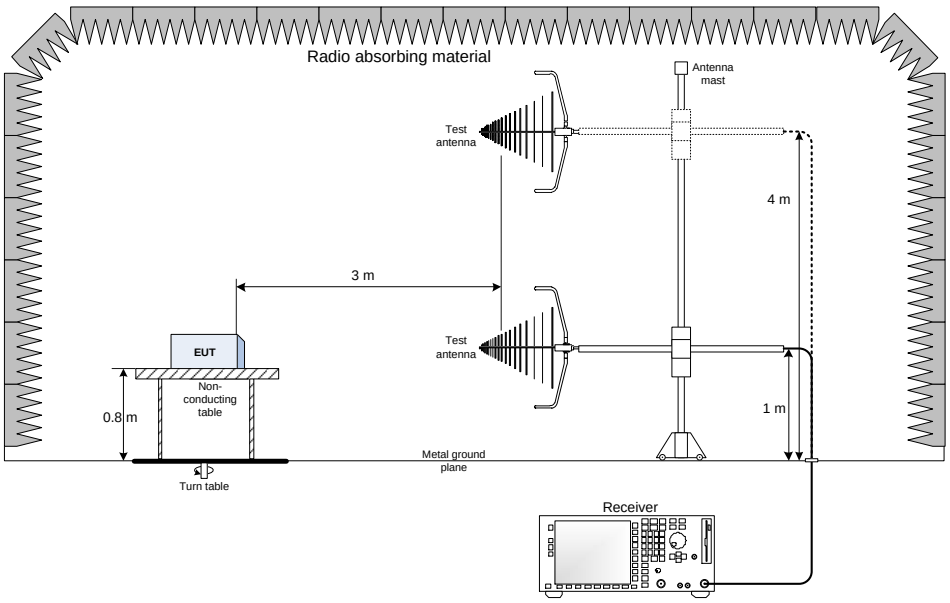


Figure 8.6-2*: 99 % occupied bandwidth*

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