ONE WORLD ○ OUR APPROVAL

Wireless test report – 355195-1TRFWL

Applicant:

Techsols Inc

Product name:

24 GHz Radar Module

Model:

RDR-FSK-01A

FCC ID:

2AP5G-RDR-FSK-01A

Specifications:

FCC 47 CFR Part 15 Subpart C, §15.249

Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHZ, and 24.0–24.25 GHz.

RSS-310 Issue 4, July 2015, Section 3.10

Licence-Exempt Radio Apparatus: Category II Equipment, operation in band 24–24.25 GHz

Date of issue: August 31, 2018

Test engineer(s):	Andrey Adelberg, Senior Wireless/EMC Specialist	Signature:
Reviewed by:	Yong Huang, Wireless/EMC Specialist	Signature:

Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada. The tests included in this report are within the scope of this accreditation

Test location

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Site number	FCC: CA2040; IC: 2040A-4 (3 m SAC)

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 contain in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1. Report summary

1.1 Applicant and manufacturer

Company name	Techsols Inc
Address	2586 Carp Rd
City	Ottawa
Province/State	ON
Postal/Zip code	K0A 1L0
Country	Canada

1.2 Test specifications

FCC 47 CFR Part 15, Subpart C, §15.249	Operation within the bands 902–928 MHz, 2400–2483.5 MHz, 5725–5875 MHz, and 24.0–24.25 GHz.
RSS-310 Issue 4, July 2015, Section 3.10	Licence-Exempt Radio Apparatus: Category II Equipment, operation in band 24–24.25 GHz

1.3 Test methods

ANSI C63.10 v2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-Gen, Issue 5, April 2018	General Requirements for Compliance of Radio Apparatus

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 1.5 below. 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 Exclusions

None

1.6 Test report revision history

Revision #	Date of issue	Details of changes made to test report
TRF	August 31, 2018	Original report issued

Section 2. Summary of test results

2.1 FCC Part 15 Subpart C, general requirements test results

Table 2.1-1: *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 an DC powered device.

2.2 FCC Part 15 Subpart C, intentional radiators test results

Part	Test description	Verdict
§15.249(a)	Radiated emissions not in restricted bands	Pass
§15.249(b)	Fixed Point-to-Point operation in the 24.0–24.25 GHz band	Not applicable
§15.249(d)	Spurious emissions (except harmonics)	Pass
§15.215(c)	20 dB bandwidth	Pass

Notes: None

2.3 IC RSS-GEN, Issue 5, test 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.

EUT is an DC powered device.

2.4 ISED RSS-310, Issue 4, test results

Section	Test description	Verdict
3.10	Radiated Emissions of fundamental	Pass
3.10	Radiated Emissions of harmonics	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	June 20, 2018
Nemko sample ID number	1

3.2 EUT information

Product name	24 GHz Radar Module
Model	RDR-FSK-01A
Model variant	None
Serial number	None

3.3 Technical information

RSS number and Issue number	RSS-310 Issue 4
Frequency band	24000–24250 MHz
Frequency Min (MHz)	24025
Frequency Max (MHz)	24025
RF power Max (W)	N/A
Field strength, dBµV/m @ 3 m	96.020
Measured BW (kHz) (99%)	440.4
Calculated BW (kHz), as per TRC-43	N/A
Emission classification (F1D, G1D, D1D)	N0N
Transmitter spurious (dBµV/m @ 3 m)	60.51 at 48 GHz
Power requirements	12 V_{DC} from vehicle (bus) battery
Antenna information	Internal antenna with adjustable gain (set to max for testing)

3.4 Product description and theory of operation

Doppler Radar module with an asymmetrical narrow beam antenna designed for long distance accurate speed and distance measurements. It is ideally suited for traffic supervision.

3.5 EUT exercise details

EUT was energized and transmission (normal operation) was verified.

3.6 EUT setup diagram

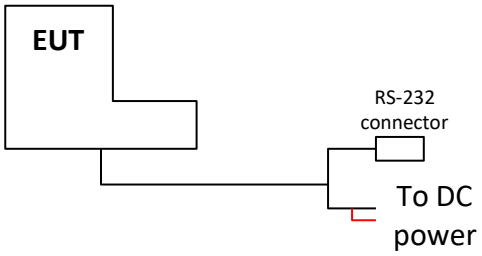


Figure 3.6-1: *Setup diagram*

Section 4. Engineering considerations

4.1 Modifications incorporated in the EUT

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

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 5. Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	860–1060 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.

5.2 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 6. Measurement uncertainty

6.1 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 6.1-1: *Measurement uncertainty*

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

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	Dec. 09/18
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
DC Power source	Ametek	SGA80X125C-0AAA	FA002737	—	VOU
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	March 26/19
Spectrum analyzer	Rohde & Schwarz	FSU	FA001877	1 year	July 18/18
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	June 27/18
Horn with Preamp (1–18 GHz)	ETS-Lindgren	3117	FA002840	1 year	Dec. 07/18
Horn antenna (18–40 GHz)	EMCO	3116	FA001847	1 year	June 27/18
Pre-amplifier (18–26 GHz)	Narda	BBS-1826N612	FA001550	—	VOU
Pre-amplifier (26–40 GHz)	Narda	DBL-2640N610	FA001556	—	VOU
40–60 GHz Harmonic mixer	OML	WR19 M19HWD	FA002322	3 year	May. 16/19
40–60 GHz Standard gain horn	Millitech	U SGH-19	FA002322	—	VOU
60–90 GHz Harmonic mixer	OML	WR12 M12HWD	FA001524	3 year	May. 16/19
60–90 GHz Standard gain horn	Millitech	U SGH-12	FA001524	—	VOU
90–140 GHz Harmonic mixer	OML	WR08 M08HWD	FA001525	3 year	May. 16/19
90–140 GHz Standard gain horn	Millitech	U SGH-08	FA001525	—	VOU

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 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 date

Start date	June 20, 2018

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 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 date

Start date	June 20, 2018

8.2.3 Observations, settings and special notes

EUT is a single frequency operation device

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	Low channel, MHz	Mid channel, MHz	High channel, MHz
24000	24250	250	–	24025	–

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

8.3.1 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 date

Start date	June 20, 2018

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 15.215(c) and RSS-Gen 6.7 Occupied (Emission) bandwidth

8.4.1 Definitions and limits

FCC
Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80 % of the permitted band in order to minimize the possibility of out-of-band operation.

ISED
The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

8.4.2 Test summary

Test date	June 20, 2018

8.4.3 Observations, settings and special notes

Spectrum analyzer settings:

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

8.4.4 Test data

Table 8.4-1: *Lower 20 dBc frequency cross result*

Lower 20 dBc frequency cross, MHz	Lower limit, MHz	Margin, MHz
24025.761218	24000.000	25.761

Table 8.4-2: *Upper 20 dBc frequency cross result*

Upper 20 dBc frequency cross, MHz	Upper limit, MHz	Margin, MHz
24026.298077	24250.000	223.702

Table 8.4-3: *99% occupied bandwidth result*

99% occupied bandwidth, kHz
440.705

Note: there is no 99% occupied bandwidth limit in the standard's requirements, the measurement results provided for information purposes only.

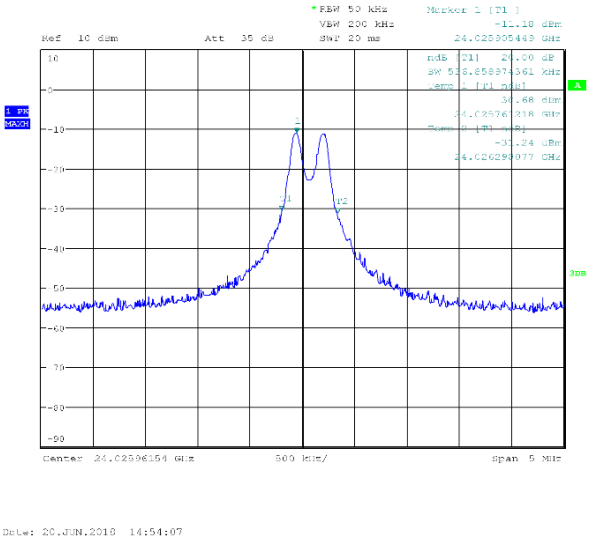


Figure 8.4-1: *20 dB bandwidth*

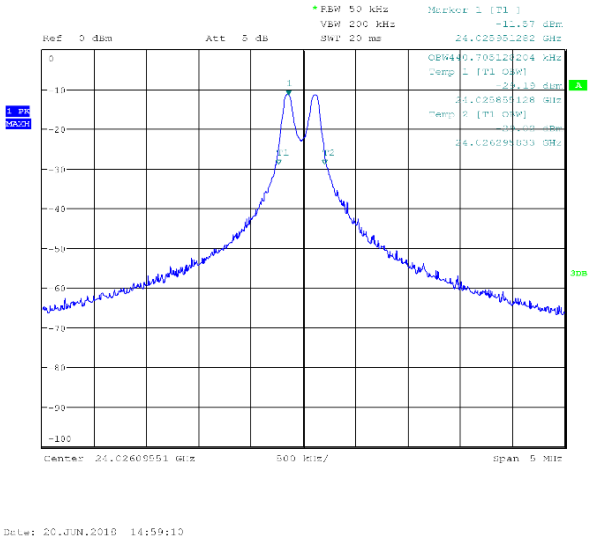


Figure 8.4-2: *99% dB bandwidth*

8.5 FCC 15.249(a) RSS 310, 3.10 Field strength of fundamental and harmonics outside restricted bands

8.5.1 Definitions and limits

FCC:
The field strength of emissions from intentional radiators shall comply with the following FCC table. Field strength limits are specified at a distance of 3 meters.
ISED:
The field strength shall not exceed 250 mV/m (108 dBμ/m) measured at 3 metres with an average detector.
The fundamental components of modulation shall lie within this band.

Table 8.5-1: *FCC field strength limits*

Fundamental frequencies, MHz	Field strength of fundamental		Field strength of harmonics	
	mV/m	dBμV/m	μV/m	dBμV/m
902–928	50	94	500	54
2400–2483.5	50	94	500	54
5725–5875	50	94	500	54
24.0–24.25	250	108	2500	68

Note: The field strength limits shall be measured using an average detector, except for the fundamental emission in the frequency band 902–928 MHz, which is based on measurements using an International Special Committee on Radio Interference (CISPR) quasi-peak detector.

8.5.2 Test summary

Test date	June 20, 2018

8.5.3 Observations, settings and special notes

The spectrum was searched from 30 MHz to 100 GHz.
Radiated measurements were performed at a distance of 3 m.

Spectrum analyzer settings for frequencies below 1000 MHz:

Detector mode	Peak or Quasi-Peak
Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Trace mode	Max Hold

Spectrum analyzer settings for peak measurements at the frequencies above 1000 MHz:

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

Spectrum analyzer settings for average measurements at the frequencies above 1000 MHz:

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

8.5.4 Test data

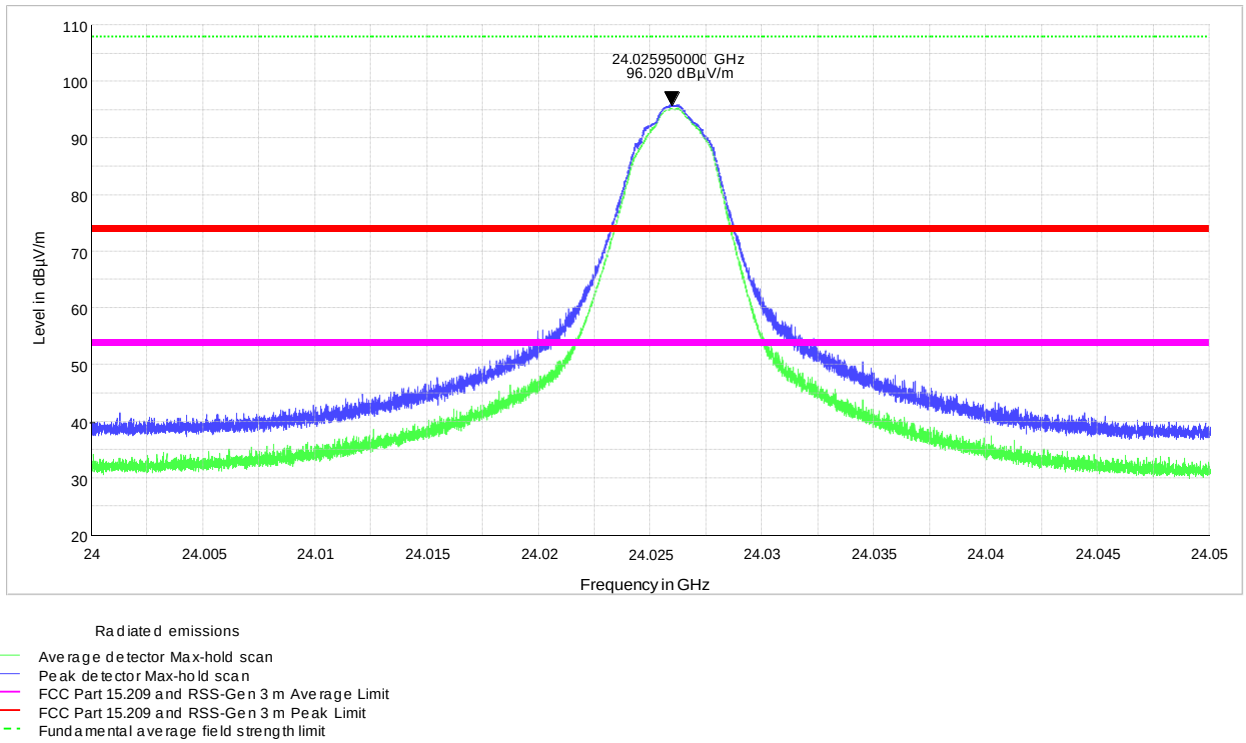


Figure 8.5-1: *Field strength of fundamental emission*

Table 8.5-2: *Field strength of fundamental emission results*

Frequency, MHz	Peak field strength, dBµV/m	Average limit, dBµV/m	Margin, dB
24025.95	96.020	108.000	11.98

Note: Peak field strength complies with Average limit, therefore no average testing was performed.
Both vertical and horizontal polarizations were assessed. Only highest value is reported.

Table 8.5-3: *Field strength of harmonics emission results for FCC*

Harmonic number	Frequency, GHz	Peak field strength, dBµV/m	Average limit, dBµV/m	Margin, dB
2	48.051	60.51	68.00	7.49

Note: Peak field strength complies with Average limit, therefore no average testing was performed.
Both vertical and horizontal polarizations were assessed. Only highest value is reported.

Table 8.5-4: *Field strength of 2nd harmonic emission results for ISED*

Frequency, GHz	Peak field strength, dBµV/m	Peak limit, dBµV/m	Peak margin, dB	Average field strength, dBµV/m	Average limit, dBµV/m	Average margin, dB
48.051	60.51	74.00	13.49	51.12	54.00	3.88

Both vertical and horizontal polarizations were assessed. Only highest value is reported.

8.6 FCC 15.249(d) and RSS-310, 3.10 Spurious emissions (except for harmonics)

8.6.1 Definitions and limits

FCC
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.
ISED
Emissions radiated outside the specified frequency band shall be attenuated by at least 50 dB below the level of the fundamental or to the general field strength limits listed in RSS-Gen, whichever is the less stringent.
The peak field strength of any emission shall not exceed the maximum permitted average limit specified above by more than 20 dB under any condition of modulation.

Table 8.6-1: *15.209 and RSS-Gen emissions field strength limits*

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/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 8.6-2: *ISED restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	12.57675–12.57725	399.9–410	7.25–7.75
0.495–0.505	13.36–13.41	608–614	8.025–8.5
2.1735–2.1905	16.42–16.423	960–1427	9.0–9.2
3.020–3.026	16.69475–16.69525	1435–1626.5	9.3–9.5
4.125–4.128	16.80425–16.80475	1645.5–1646.5	10.6–12.7
4.17725–4.17775	25.5–25.67	1660–1710	13.25–13.4
4.20725–4.20775	37.5–38.25	1718.8–1722.2	14.47–14.5
5.677–5.683	73–74.6	2200–2300	15.35–16.2
6.215–6.218	74.8–75.2	2310–2390	17.7–21.4
6.26775–6.26825	108–138	2483.5–2500	22.01–23.12
6.31175–6.31225	149.9–150.05	2655–2900	23.6–24.0
8.291–8.294	156.52475–156.52525	3260–3267	31.2–31.8
8.362–8.366	156.7–156.9	3332–3339	36.43–36.5
8.37625–8.38675	162.0125–167.17	3345.8–3358	Above 38.6
8.41425–8.41475	167.72–173.2	3500–4400	
12.29–12.293	240–285	4500–5150	
12.51975–12.52025	322–335.4	5350–5460	

Note: Certain frequency bands listed in 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 8.6-3: *FCC restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	Above 38.6
13.36–13.41			

8.6.2 Test summary

Test date	June 20, 2018

8.6.3 Observations, settings and special notes

The spectrum was searched from 30 kHz to 100 GHz.
Both vertical and horizontal polarizations were assessed. All plots below represent combination of both polarizations.
Radiated measurements were performed at a distance of 3 m for frequencies below 18 GHz, at a distance of 1 m for frequencies within 18–40 GHz and at a distance of 3 cm for frequencies above 40 GHz

Spectrum analyzer settings for frequencies below 1000 MHz:

Detector mode	Peak or Quasi-Peak
Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Trace mode	Max Hold

Spectrum analyzer settings for peak measurements at the frequencies above 1000 MHz:

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

Spectrum analyzer settings for average measurements at the frequencies above 1000 MHz:

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

8.6.4 Test data

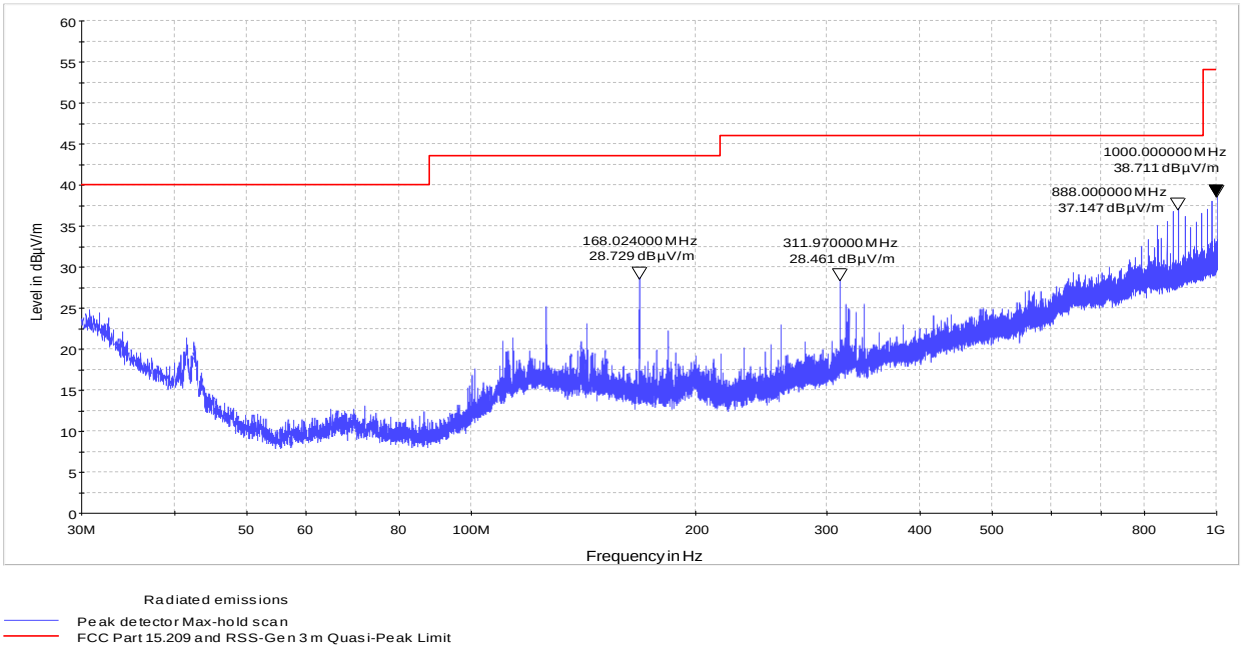


Figure 8.6-1: *Field strength of spurious emissions below 1000 MHz*

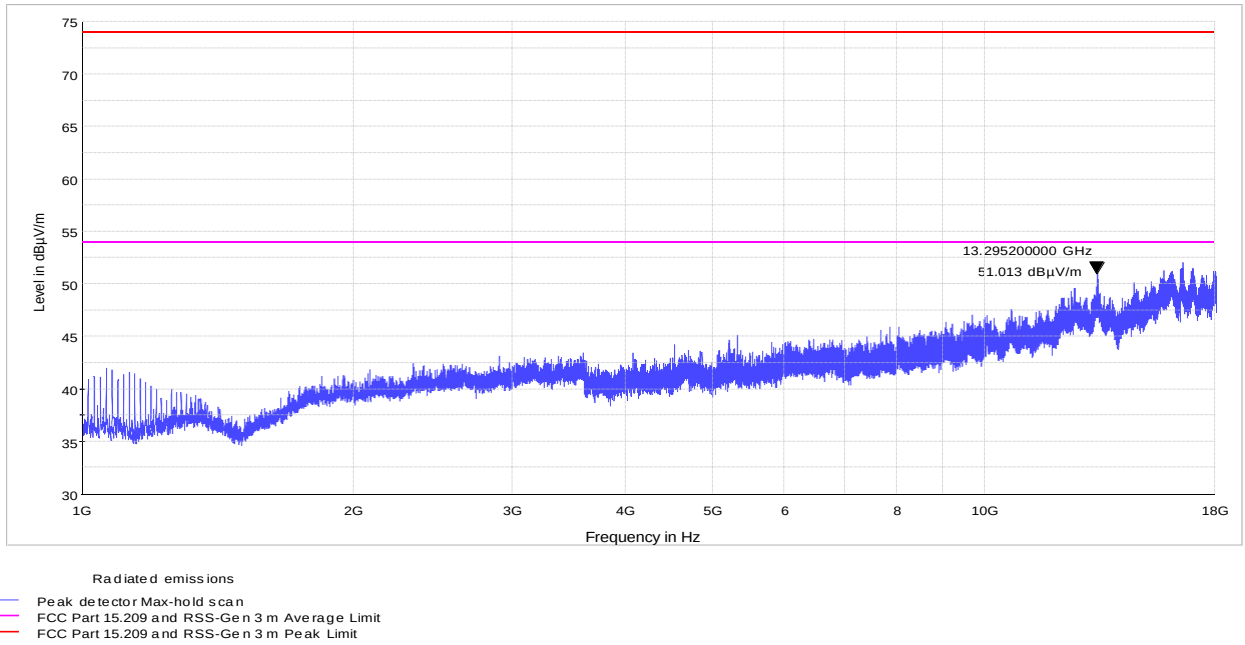


Figure 8.6-2: *Field strength of spurious emissions within 1–18 GHz*

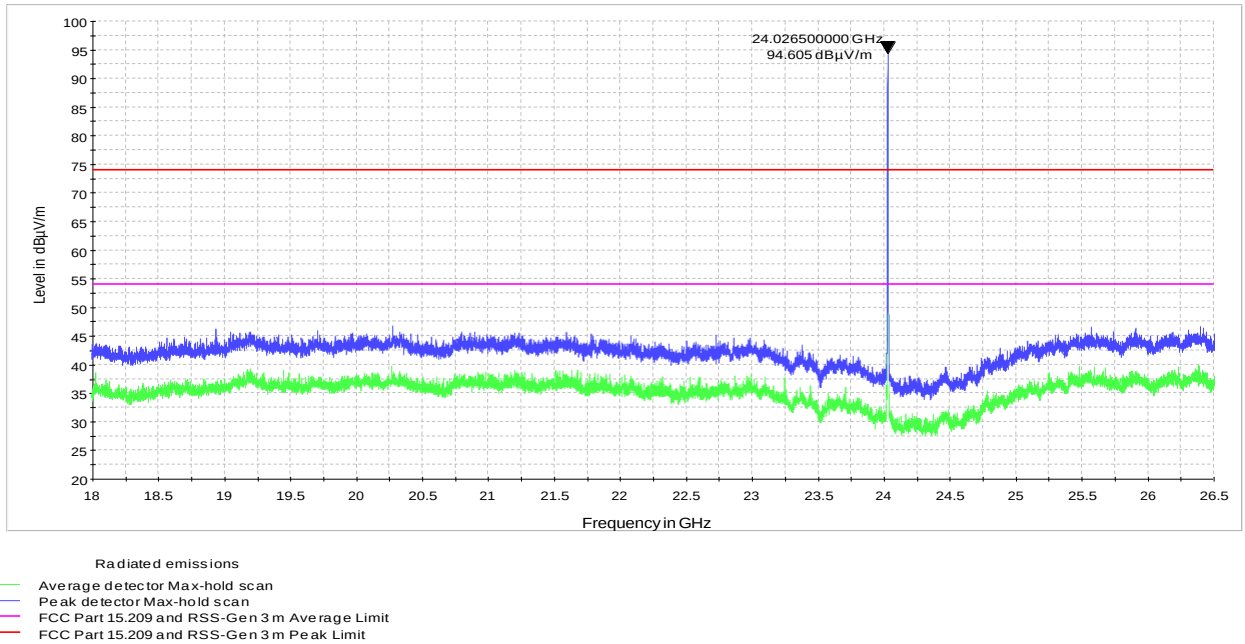


Figure 8.6-3: *Field strength of spurious emissions within 18–26.5 GHz*

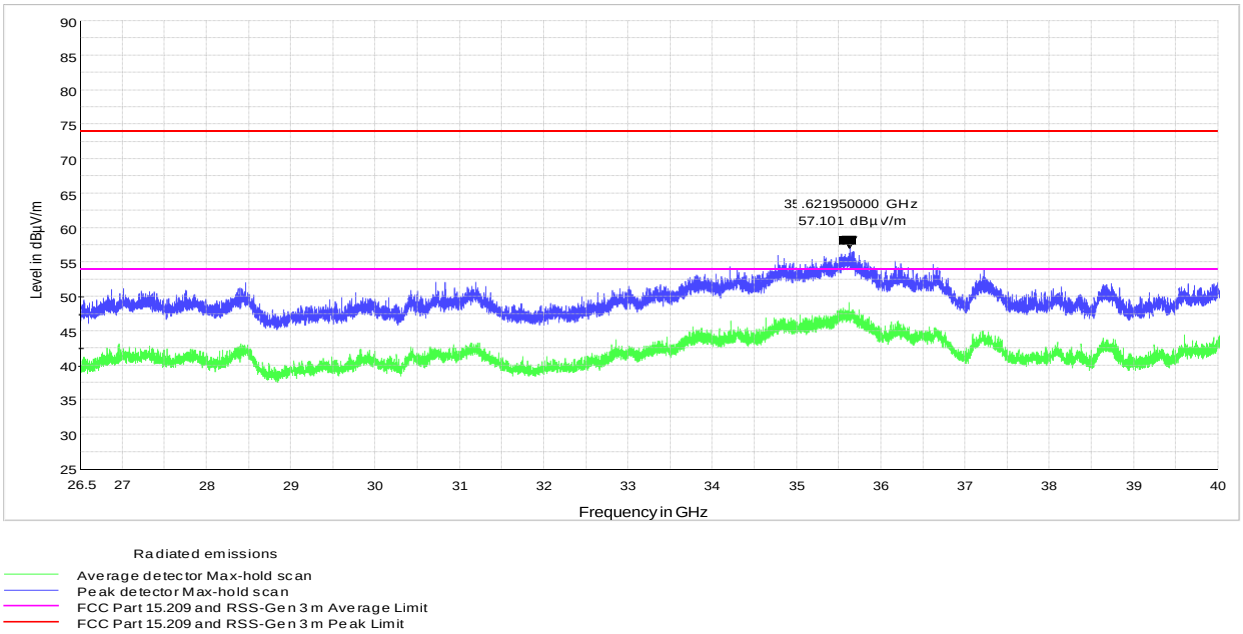
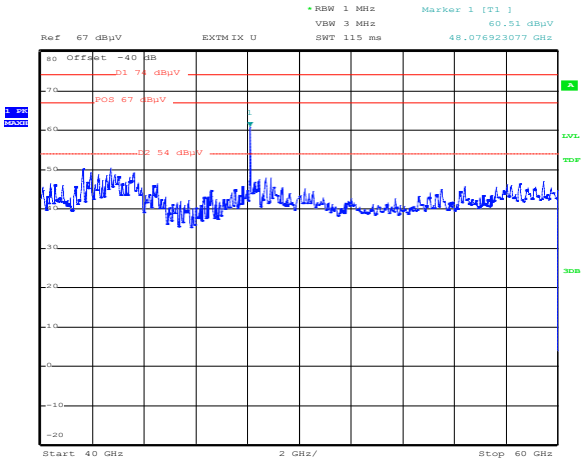
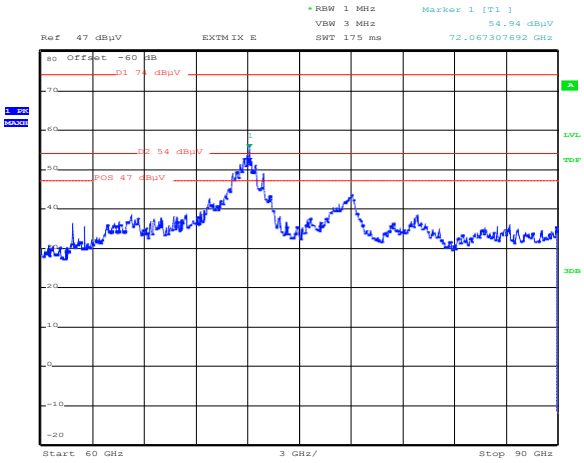


Figure 8.6-4: *Field strength of spurious emissions within 26.5–40 GHz*



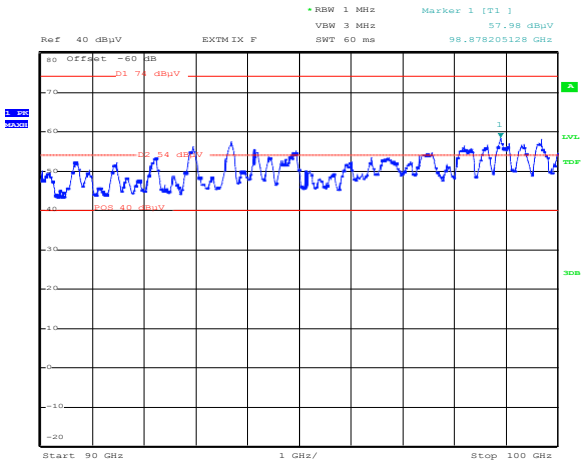
Date: 20.JUN.2018 15:27:16

Figure 8.6-5: *Field strength of spurious emissions within 40–60 GHz*



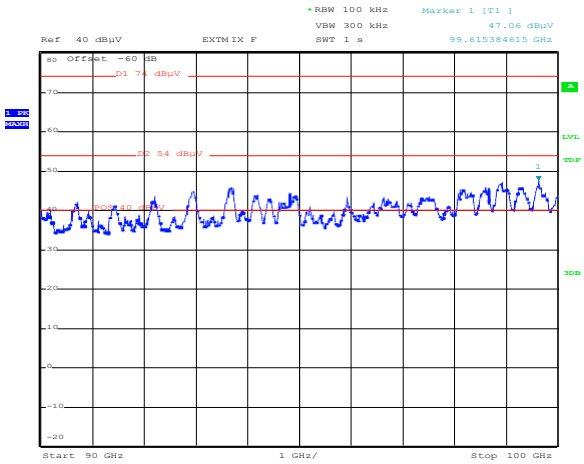
Date: 20.JUN.2018 15:40:24

Figure 8.6-6: *Field strength of spurious emissions within 60–90 GHz*



Date: 20.JUN.2018 15:43:50

Figure 8.6-7: *Field strength of spurious emissions within 90–100 GHz*

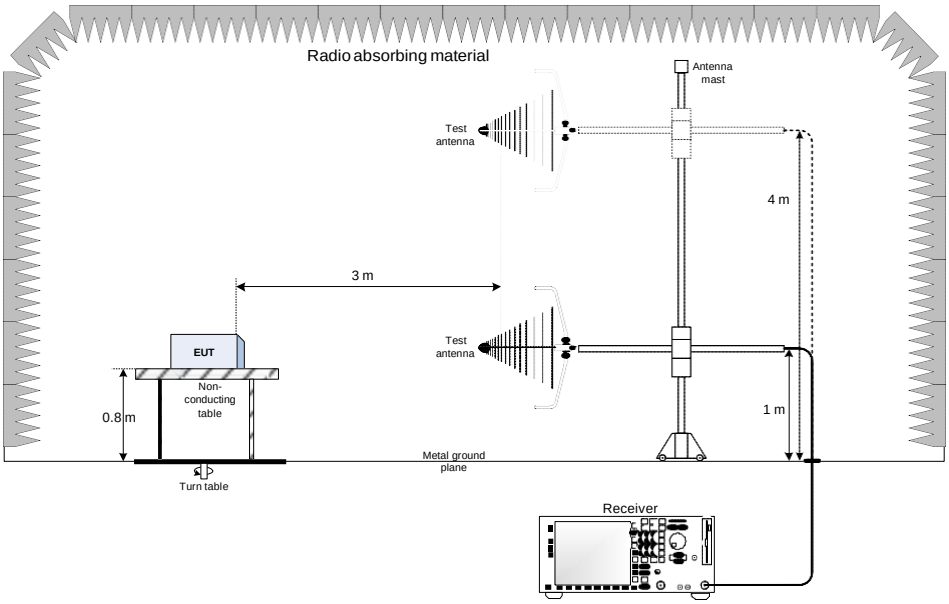
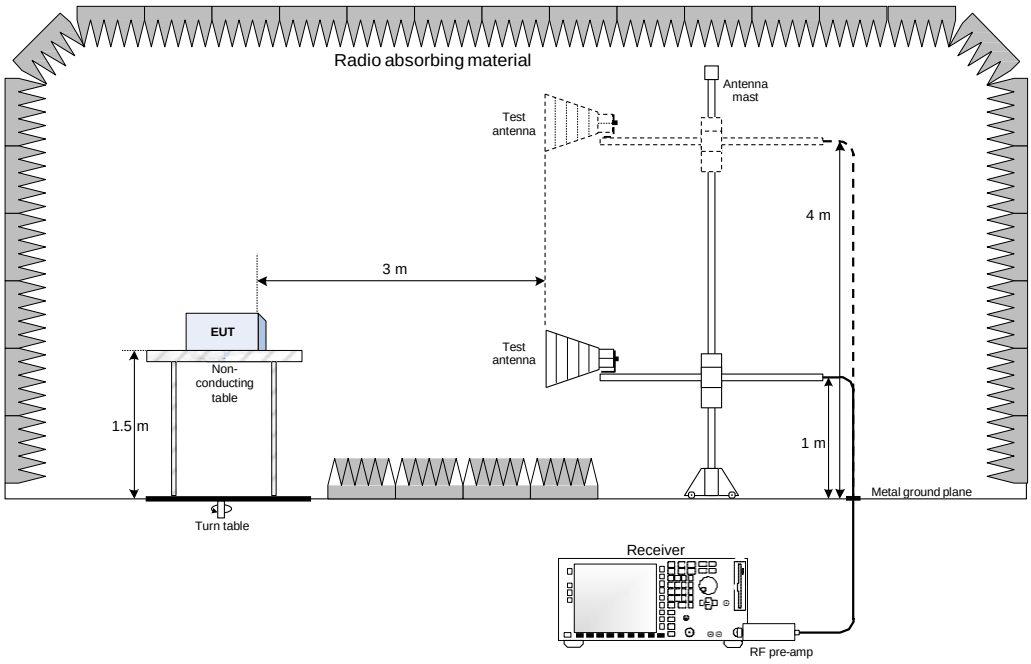


Date: 20.JUN.2018 15:44:20

Figure 8.6-8: *Field strength of spurious emissions with reduced RBW for the dynamic range increment within 90–100 GHz*

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