

Wireless test report – 462656-1TRFWL

Applicant:

ORBCOMM License Corp.

Product:

OGi V2

Model:

L900-400

FCC ID:

XGS-OGI200

IC Registration number:

11881A-OGI200

◆ FCC 47 CFR Part 25

Satellite communications

◆ RSS-170, Issue 3, July 9, 2015

Mobile Earth Stations (MESs) and Ancillary Terrestrial Component (ATC) Equipment Operating in the Mobile-Satellite Service (MSS) Bands

Date of issue: July 6, 2022

Moustapha Salah Toubeh, Wireless/EMC Specialist

Tested by



Signature

Andrey Adelberg, Senior Wireless/EMC Specialist

Reviewed by



Signature

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

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

FCC 47-25, RSS-170 RFID; Date: December 2015

Lab and test locations

Company name	Nemko Canada Inc.			
Facilities	☒ Ottawa site: 303 River Road Ottawa, Ontario Canada K1V 1H2 Tel: +1 613 737 9680 Fax: +1 613 737 9691	☐ Montréal site: 292 Labrosse Avenue Pointe-Claire, Québec Canada H9R 5L8 Tel: +1 514 694 2684 Fax: +1 514 694 3528	☐ Cambridge site: 1-130 Saltsman Drive Cambridge, Ontario Canada N3E 0B2 Tel: +1 519 650 4811	☐ Almonte site: 1500 Peter Robinson Road West Carleton, Ontario Canada K0A 1L0 Tel: +1 613 256-9117
Test site registration	Organization	Recognition numbers and location		
	FCC/ISED	CA2040 (Ottawa/Almonte); CA2041 (Montreal); 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

Nemko Canada Inc. authorizes the applicant to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only. Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties.

Nemko Canada Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

© Nemko Canada Inc.

Table of contents

Table of contents	2
Section 1. Report summary	3
1.1 Applicant and manufacturer	3
1.2 Test specifications	3
1.3 Test methods.....	3
1.4 Statement of compliance	3
1.5 Exclusions.....	3
1.6 Test report revision history	3
Section 2. Summary of test results.....	4
2.1 FCC Part 25 test results	4
2.2 ISSED RSS-GEN, Issue 5 test results	4
2.3 ISSED RSS-170, Issue 3 test results	4
Section 3. Equipment under test (EUT) details	5
3.1 Sample information.....	5
3.2 EUT information	5
3.3 Technical information	5
3.4 EUT exercise details.....	6
3.5 EUT setup diagram	6
3.6 EUT sub assemblies	6
Section 4. Engineering considerations.....	7
4.1 Modifications incorporated in the EUT.....	7
4.2 Technical judgment	7
4.3 Deviations from laboratory tests procedures.....	7
Section 5. Test conditions.....	8
5.1 Atmospheric conditions	8
5.2 Power supply range.....	8
Section 6. Measurement uncertainty	9
6.1 Uncertainty of measurement	9
Section 7. Test equipment	10
7.1 Test equipment list.....	10
Section 8. Testing data	11
8.1 FCC 2.1049 and RSS-Gen 6.7 Occupied bandwidth.....	11
8.2 FCC 25.204 and RSS-170 5.3.2 Transmitter e.i.r.p. for mobile earth stations	13
8.3 FCC 25.202(f) and RSS-170 5.4 Field strength of spurious emissions	16
8.4 FCC 25.202(d) and RSS-170 5.2 Frequency tolerance, Earth stations	29
8.5 FCC 25.216 and RSS-170 5.4.3.2 Limits on emissions from MESs for protection of aeronautical radionavigation-satellite service	31
Section 9. Block diagrams of test set-ups	34
9.1 Radiated emissions set-up for frequencies below 1 GHz.....	34
9.2 Radiated emissions set-up for frequencies above 1 GHz.....	34
9.3 Conducted measurement set-up.....	35

Section 1. Report summary

1.1 Applicant and manufacturer

Company name	ORBCOMM License Corp.
Address	395 W Passaic Street, Suite 325, Rochelle Park, NJ 07662 USA

1.2 Test specifications

FCC 47 CFR Part 25	Satellite communications
RSS-170, Issue 3, July 9, 2015	Mobile Earth Stations (MESS) and Ancillary Terrestrial Component (ATC) Equipment Operating in the Mobile-Satellite Service (MSS) Bands

1.3 Test methods

ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio services
KDB 273109 D01 Equip Auth Guide Part 25 TXReceiver v02r02 (2011)	Equipment Authorization Guidance for Part 25 Transceivers

1.4 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was completed against all relevant requirements of the test standard. 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	July 6, 2022	Original report issued

Section 2. Summary of test results

2.1 FCC Part 25 test results

Part	Test description	Verdict
25.204	Power limit	Pass
2.1046	Occupied bandwidth	Pass
25.202(f)	Spurious emissions at the antenna terminal	Pass
25.202(f)	Field strength of spurious emissions	Pass
25.202(d)	Frequency tolerance, earth stations	Pass
25.216	Limits for emissions from mobile earth stations for protection of aeronautical radionavigation satellite service	Pass

Notes: None

2.2 ISSED RSS-GEN, Issue 5 test results

Part	Test description	Verdict
6.7	Occupied bandwidth	Pass
7.3	Receiver radiated emission limits	Not applicable ¹
7.4	Receiver conducted emission limits	Not applicable ¹
8.8	Power Line Conducted Emissions Limits for Licence-Exempt Radio Apparatus	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 intended to be installed in a vehicle.

2.3 ISSED RSS-170, Issue 3 test results

Part	Test description	Verdict
5.1	Frequency bands	Pass
5.2	Frequency stability	Pass
5.3.1	Transmitter e.i.r.p. for ATC equipment	Not applicable
5.3.2	Transmitter e.i.r.p. for mobile earth stations (MESs)	Pass
5.4.1.1	Transmitter unwanted emissions for ATC Base Station Equipment within 1525–1559 MHz band	Not applicable
5.4.1.2	Transmitter unwanted emissions for ATC Base Station Equipment within 2000–2020 MHz and 2180–2200 MHz bands	Not applicable
5.4.1.3	Transmitter unwanted emissions for ATC Base Station Equipment within 2483.5–2500 MHz band	Not applicable
5.4.2.1	Transmitter unwanted emissions for ATC Mobile Equipment within 1610–1626.5 MHz band	Not applicable
5.4.2.2	Transmitter unwanted emissions for ATC Mobile Equipment within 1626.5–1660.5 MHz band	Pass
5.4.2.3	Transmitter unwanted emissions for ATC Mobile Equipment within 2000–2020 MHz band	Not applicable
5.4.3.1	Transmitter unwanted emissions for MESs in all frequency bands	Pass
5.4.3.2	Additional unwanted emission limits for MESs to protect radionavigation-satellite service	Pass
5.5	Carrier-off state emissions	Pass

Notes: None

Section 3. Equipment under test (EUT) details

3.1 Sample information

Receipt date	April 21, 2022
Nemko sample ID number	4626560003, 4626560004

3.2 EUT information

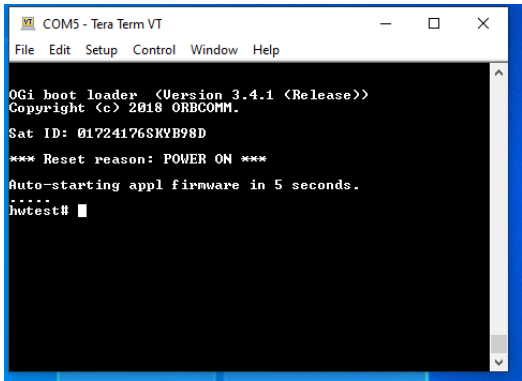
Product name	OGi V2
Model	L900-400
Serial number	15090076 (sample with Helix antenna) and 15090074 (sample with Patch antenna)
Part Number	15090076 (sample with Helix antenna) and 15090074 (sample with Patch antenna)
Software revision	4.0.3
Model Variant	N/A
Product description and theory of operation	The EUT is a Mobile Satellite Earth Station (MSES) modem. It consists of a MSES transceiver which is designed to operate in L-band (1.5/1.6 GHz).

3.3 Technical information

Frequency band	1626.5–1660.5 MHz
Frequency Min	1626.501 MHz
Frequency Max	1660.499 MHz
RF power Max	0.82 W (29.16 dBm)
Measured BW (99 %)	1.56 kHz
Type of modulation	OQPSK
Emission classification (F1D, G1D, D1D)	G1D
Power requirements	5–15 V _{DC}
Antenna information	There are two antenna options: - Patch antenna with 4.5 dBi gain maximum. - Quadrifilar Helix antenna with 2.5 dBi gain maximum. Antenna is connected to the modem via RF cable.
Stated EIRP	7 dBW (37 dBm) maximum

3.4 EUT exercise details

- EUT was controlled by TeraTerm, session from Laptop to run the module to transmit a modulated signal for 2 sec ON and 3 sec OFF.
- Serial to USB cable, Baud rate is 9600



3.5 EUT setup diagram

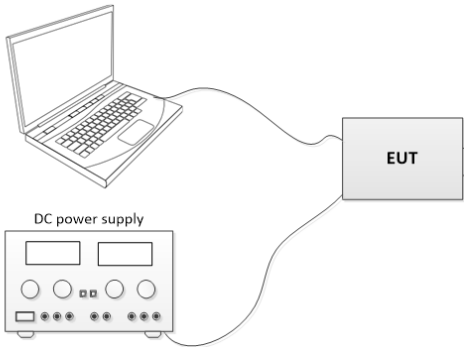


Figure 3.5-1: Setup diagram

3.6 EUT sub assemblies

Table 3.6-1: EUT sub assemblies

Description	Brand name	Model/Part number	Serial number
EUT (module RF and internal antenna connected by internal SMA cable.	None	L900-400	None
Feeding Cable (to feed EUT with the Power Supply)	None	None	None
Internal SMA Cable (to connect module RF output and internal antenna)	None	None	None
Cable USB to RS232 dongle	None	XS8801	None

Table 3.6-2: EUT support equipment

Description	Brand name	Model/Part number	Serial number
Laptop	Lenovo	80UD	MP16MXNF
DC power supply	GWInstek	GPC-3030D	None

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 $\pm 5\%$, 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	20-Jan-23
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	25-Nov-22
Horn (1–18 GHz)	ETS Lindgren	3117	FA002840	1 year	10-Feb-23
Preamplifier (1–18 GHz)	ETS Lindgren	124334	FA002873	1 year	22-Sep-22
Signal and Spectrum Analyzer	Rohde & Schwarz	FSW50	FA003267	1 year	29-Nov-22
Temperature chamber	Espec	EPX-4H	FA002735	1 year	05-Oct-22
High pass filter (3–18 GHz)	Thilithic Inc.	6HC3000/18000-1.3-KK	FA002231	1 year	15-Jun-22

Note: NCR - no calibration required

Section 8. Testing data

8.1 FCC 2.1049 and RSS-Gen 6.7 Occupied bandwidth

8.1.1 Definitions and limits

FCC:

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

IC:

The emission bandwidth (× dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated × dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3× the resolution bandwidth.

When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

8.1.2 Test summary

Test date	April 25, 2022
Test engineer	Moustapha Salah Toubeh
Verdict	Pass

8.1.3 Observations, settings and special notes

Measurement performed with reference to ANSI 63.26 section 5.4.4

Spectrum analyser settings for 99% occupied bandwidth:

Resolution bandwidth:	1 - 5 % OBW
Video bandwidth:	$\geq 3 \times \text{RBW}$
Detector mode:	Peak
Trace mode:	Max Hold

8.1.4 Test data

Table 8.1-1: 99 % bandwidth results

Frequency, MHz	99 % occupied bandwidth, kHz
1626.501	1.56
1642.000	1.52
1660.499	1.51

8.1.5 Test data, continued

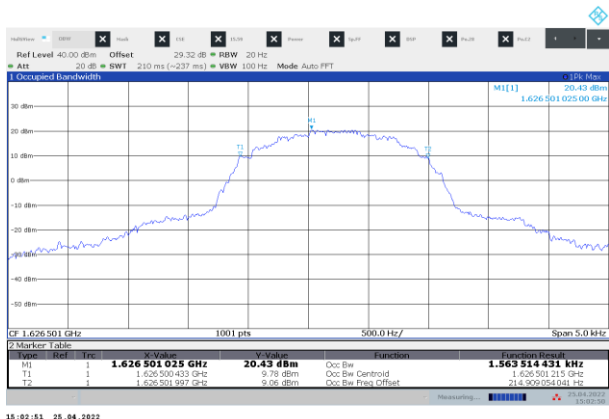


Figure 8.1-1: 99 % bandwidth on low channel

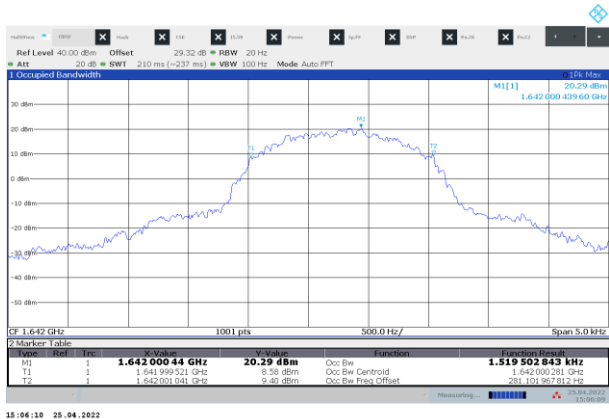


Figure 8.1-2: 99 % bandwidth on mid channel

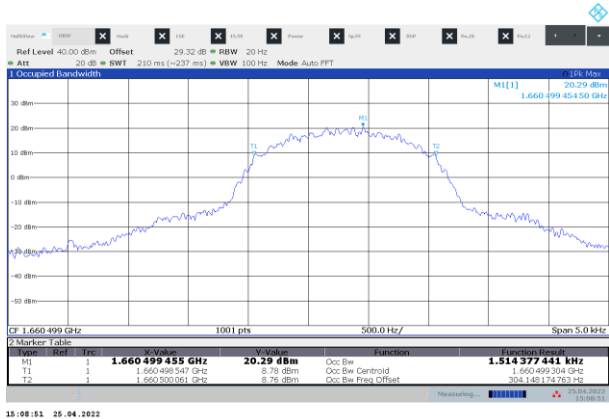


Figure 8.1-3: 99 % bandwidth on high channel

8.2 FCC 25.204 and RSS-170 5.3.2 Transmitter e.i.r.p. for mobile earth stations

8.2.1 Definitions and limits

FCC:

- (a) In bands shared coequally with terrestrial radio communication services, the equivalent isotropically radiated power transmitted in any direction towards the horizon by an earth station, other than an ESV, operating in frequency bands between 1 and 15 GHz, shall not exceed the following limits except as provided for in paragraph (c) below:
+40 dBW (70 dBm) in any 4 kHz band for $\Theta \leq 0^\circ$
+40 + 3 Θ dBW in any 4 kHz band for $0^\circ < \Theta \leq 5^\circ$
where Θ is the angle of elevation of the horizon viewed from the center of radiation of the antenna of the earth station and measured in degrees as positive above the horizontal plane and negative below it.
- (b) In bands shared coequally with terrestrial radiocommunication services, the equivalent isotropically radiated power transmitted in any direction towards the horizon by an earth station operating in frequency bands above 15 GHz shall not exceed the following limits except as provided for in paragraph (c) below:
+64 dBW (94 dBm) in any 1 MHz band for $\Theta \leq 0^\circ$
+64 + 3 Θ dBW in any 1 MHz band for $0^\circ < \Theta \leq 5^\circ$
where Θ is as defined in paragraph (a) above.
- (c) For angles of elevation of the horizon greater than 5° there shall be no restriction as to the equivalent isotropically radiated power transmitted by an earth station towards the horizon.
- (d) Notwithstanding the e.i.r.p. and e.i.r.p. density limits specified in the station authorization, each earth station transmission shall be conducted at the lowest power level that will provide the required signal quality as indicated in the application and further amended by coordination agreements.

ISED:

The application for MES certification shall state the MES e.i.r.p. that is necessary for satisfactory communication. The maximum permissible e.i.r.p. will be the stated e.i.r.p. plus a 2 dB margin. If a detachable antenna is used, the certification application shall state the recommended antenna type and manufacturer, the antenna gain and the maximum transmitter output power at the antenna terminal.

8.2.2 Test summary

Test date	April 25, 2022
Test engineer	Moustapha Salah Toubbeh
Verdict	Pass

8.2.3 Observations, settings and special notes

Measurements performed with reference to ANSI 63.26 section 5.2.3.3 for peak power of narrowband signal using a spectrum analyzer.
Resolution bandwidth of 5 kHz selected in lieu of a 4kHz to satisfy FCC requirement.

Spectrum analyser settings:

Resolution bandwidth	5 kHz
Video bandwidth	20 kHz
Detector mode	Peak
Trace mode	Max Hold

8.2.4 Test data

Table 8.2-1: Conducted peak output power measurement results – ISED with patch antenna

Frequency, MHz	Output power, dBm	Gain, dBi	EIRP, dBm	Stated EIRP, dBm	Maximum permissible EIRP, dBm	Margin, dB
1626.501	29.16	4.50	33.66	37.00	39.00	5.34
1642.000	29.04	4.50	33.54	37.00	39.00	5.46
1660.499	29.01	4.50	33.51	37.00	39.00	5.49

Note: Maximum permissible EIRP, dBm = Stated EIRP + 2 dB

Table 8.2-2: Conducted peak output power measurement results – ISED with Quadrifilar Helix antenna

Frequency, MHz	Output power, dBm	Gain, dBi	EIRP, dBm	Stated EIRP, dBm	Maximum permissible EIRP, dBm	Margin, dB
1626.501	29.16	2.50	31.66	37.00	39.00	7.34
1642.000	29.04	2.50	31.54	37.00	39.00	7.46
1660.499	29.01	2.50	31.51	37.00	39.00	7.49

Note: Maximum permissible EIRP, dBm = Stated EIRP + 2 dB

Table 8.2-3: Conducted peak output power measurement results - FCC with patch antenna

Frequency, MHz	Output power, dBm/5 kHz	Gain, dBi	EIRP, dBm/5 kHz	EIRP, dBm/4 kHz	EIRP limit, dBm/4kHz	Margin, dB
1626.501	29.16	4.50	33.66	32.69	70.00	37.31
1642.000	29.04	4.50	33.54	32.57	70.00	37.43
1660.499	29.01	4.50	33.51	32.54	70.00	37.46

Note: EIRP limit, dBm/4kHz= EIRP limit, dBm/5kHz + 10*Log10(4/5)

Table 8.2-4: Conducted peak output power measurement results - FCC with Quadrifilar Helix antenna

Frequency, MHz	Output power, dBm/5 kHz	Gain, dBi	EIRP, dBm/5 kHz	EIRP, dBm/4 kHz	EIRP limit, dBm/4kHz	Margin, dB
1626.501	29.16	2.50	31.66	30.69	70.00	39.31
1642.000	29.04	2.50	31.54	30.57	70.00	39.43
1660.499	29.01	2.50	31.51	30.54	70.00	39.46

Note: EIRP limit, dBm/4kHz= EIRP limit, dBm/5kHz + 10*Log10(4/5)

8.2.5 Test data

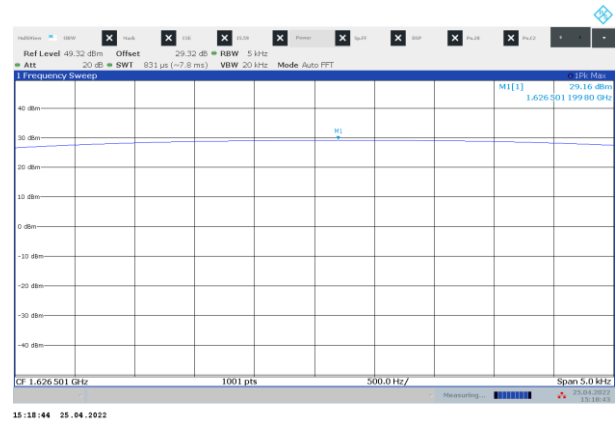


Figure 8.2-1: Conducted peak output power, low channel

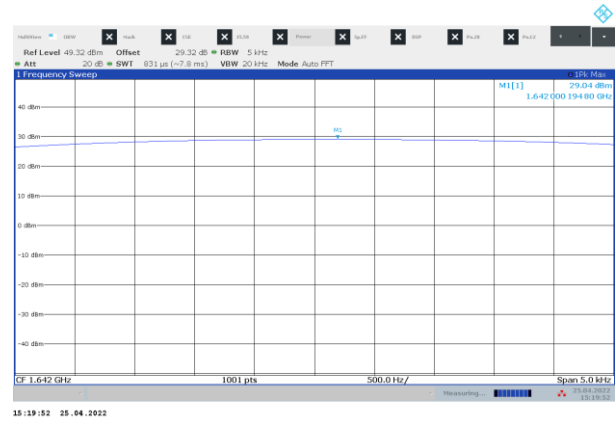


Figure 8.2-2: Conducted peak output power, mid channel

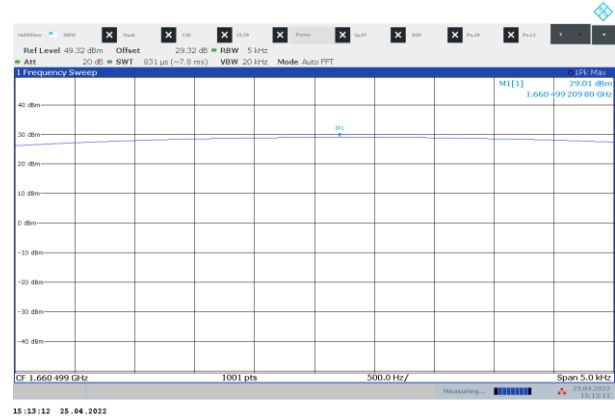


Figure 8.2-3: Conducted peak output power, high channel

8.3 FCC 25.202(f) and RSS-170 5.4 Field strength of spurious emissions

8.3.1 Definitions and limits

FCC:

(f) Emission limitations. The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

- (1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;
- (2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;
- (3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts (-13 dBm fixed);
- (4) In any event, when an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in paragraphs (f) (1), (2) and (3) of this section.

ISED:

The transmitter unwanted emissions shall be measured with the carrier frequency set at both the highest and lowest channels in which the equipment is designed to operate.

The e.i.r.p. density of unwanted and carrier-off emissions in this section shall be averaged over any 2 ms active transmission using a root-mean-square detector with a resolution bandwidth of 1 MHz for broadband emissions and a resolution bandwidth of 1 kHz for discrete emissions, unless stated otherwise.

5.4.3 Mobile Earth Stations

5.4.3.1 Mobile Earth Stations in All Frequency Bands

The average power of unwanted emissions shall be attenuated below the average output power, P(dBW), of the transmitter, as specified below:

- (1) 25 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 50%, up to and including 100% of the occupied bandwidth;
- (2) 35 dB in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 100%, up to and including 250% of the occupied bandwidth;
- (3) $43 + 10 \log p$ (watts) in any 4 kHz band, the centre frequency of which is offset from the channel frequency by more than 250% of the occupied bandwidth.

5.4.4 Carrier-off State Emissions

Mobile equipment with transmitting frequencies between 1 GHz and 3 GHz shall have the e.i.r.p. density of carrier-off state emissions in the band 1559–1610 MHz not exceed -80 dBW/MHz.

8.3.2 Test summary

Test date	May 12, 2022
Test engineer	Moustapha Salah Touben
Verdict	Pass

8.3.3 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 per ANSI 63.26, section 5.5.2 on a test site validated to the requirements of ANSI 63.10 Authorized bandwidth (2 kHz) > Occupied bandwidth (1.56 kHz). Therefore, the authorized bandwidth was used to calculate spurious emission mask.

50–100% Authorized bandwidth = ± 1 kHz, -25 dBc/ 4 kHz

100–250 % Authorized bandwidth = ± 2 kHz, -35 dBc/ 4 kHz

> 250% Authorized bandwidth = ± 5 kHz, -13 dBm/ 4 kHz

Conducted spurious measurements were performed with reference to ANSI 63.26 section 5.7.4

Conducted out of band emissions measurements performed with using the power integration method per ANSI 63.26 section 5.7.2 (a); the measured value is scaled using $10 \log (\text{Reference bandwidth})/(\text{Measurement bandwidth})$

Spectrum analyser settings for conducted spurious emissions measurements 30 MHz – 18 GHz:

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

Spectrum analyser settings for conducted bandedge spurious emission measurements outside assigned channel

Span	20 kHz
Resolution bandwidth	20 Hz
Video bandwidth	3 kHz
Detector mode	RMS
Trace mode	Averaging
Integration bandwidth	Fundamental dBm/2 kHz, 50-100% BW dBm/kHz, 100-250% BW dBm/3 kHz, $\geq 250\%$ BW dBm/5 kHz

Spectrum analyser settings for radiated spurious emissions measurements below 1 GHz:

Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Detector mode	Peak
Trace mode	Max Hold

Spectrum analyser settings for radiated spurious emissions measurements above 1 GHz:

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

8.3.4 Test data

Emissions in 50 - 100% Authorized bandwidth

Frequency, (MHz)	Mean output power, (dBm/2 kHz)	Scaled mean average power, (dBm/4 kHz)	Mean adjacent power 50 - 100% BW, (dBm/3kHz)	Scaled mean adjacent power 50 -100% BW, (dBm/4 kHz)	Limit, 50-100% dBc /4 kHz	Margin, (dB)
1626.501	22.86	25.87	-11.85	-5.83	0.87	6.70
1660.499.	22.88	25.89	-11.06	-5.04	0.89	5.93

Note: Scaled power = measured power + 10log(Reference BW/Measurement BW), Limit = scaled mean average power, dBm/4 kHz - 25 dBc

Emissions in 100 - 250 % Authorized bandwidth

Frequency, (MHz)	Mean output power, (dBm/2 kHz)	Scaled mean average power (dBm/4 kHz)	Mean adjacent power 100 - 250% BW, (dBm/3kHz)	Scaled mean adjacent power 100 - 250% BW, (dBm/4 kHz)	Limit 100-250% dBc /4 kHz	Margin, (dB)
1626.501	22.86	25.87	-22.15	-20.90	-9.13	11.77
1660.499.	22.88	25.89	-21.21	-19.96	-9.11	10.85

Note: Scaled power = measured power + 10log(Reference BW/Measurement BW), Limit = scaled mean average power, dBm/4 kHz - 35 dBc

Test data, continued, Conducted band edge spurious emissions

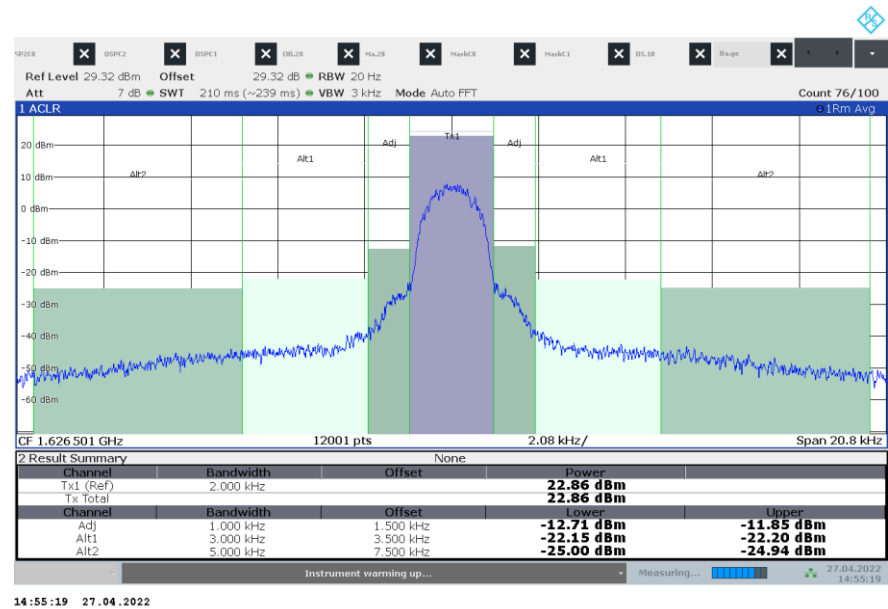


Figure 8.3-1: Conducted band edge spurious emissions outside assigned bandwidth, low channel

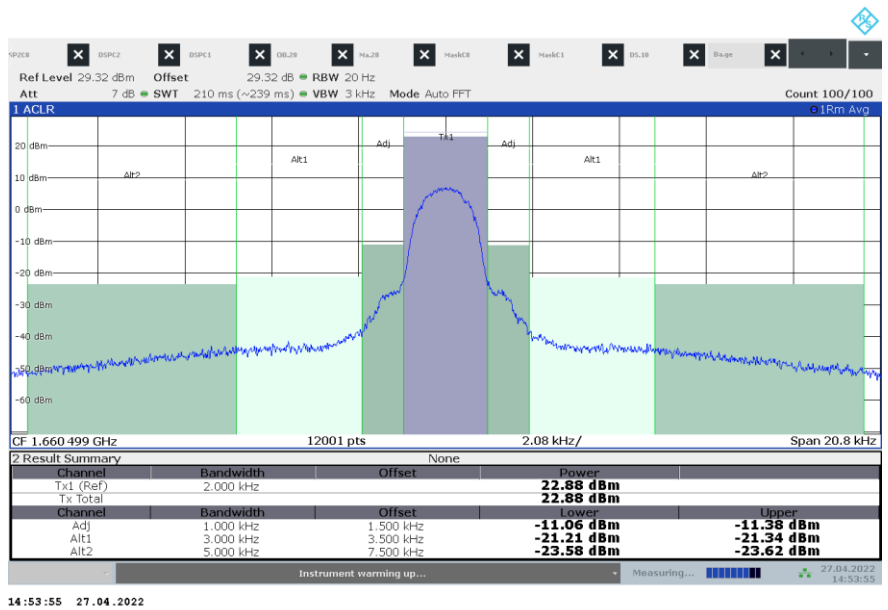
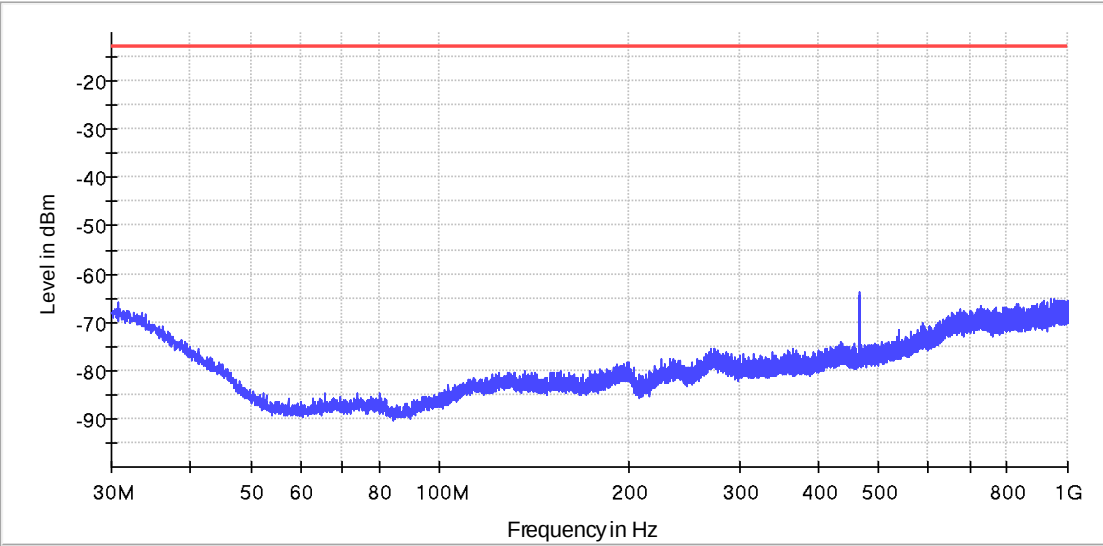


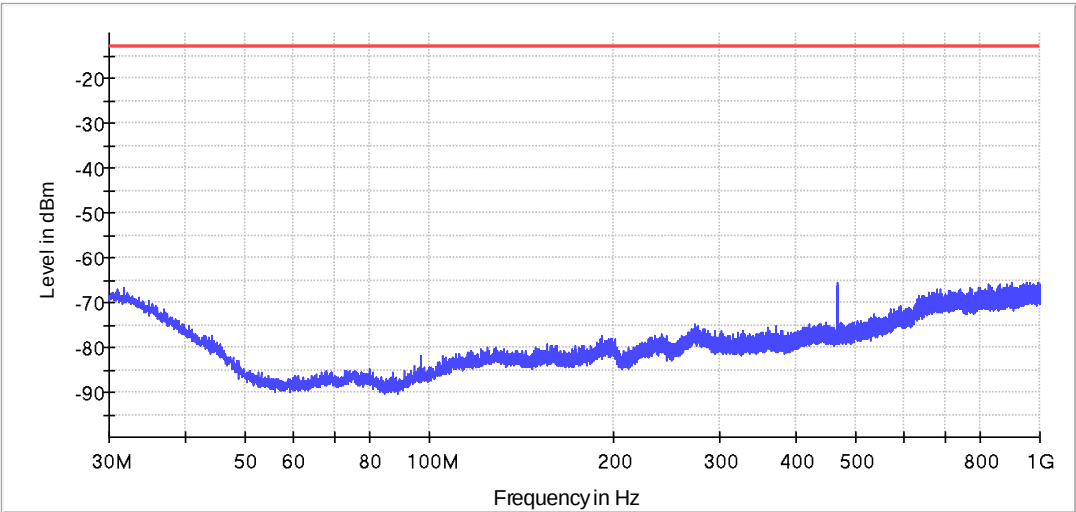
Figure 8.3-2: Conducted band edge spurious emissions outside assigned bandwidth, high channel

Test data, continued, Radiated spurious emissions 30 MHz – 1 GHz



Spurious_30-1000 MHz Low channel_Quadrifilar Antenna
— -13 dBm Limit
— PK+_MAXH

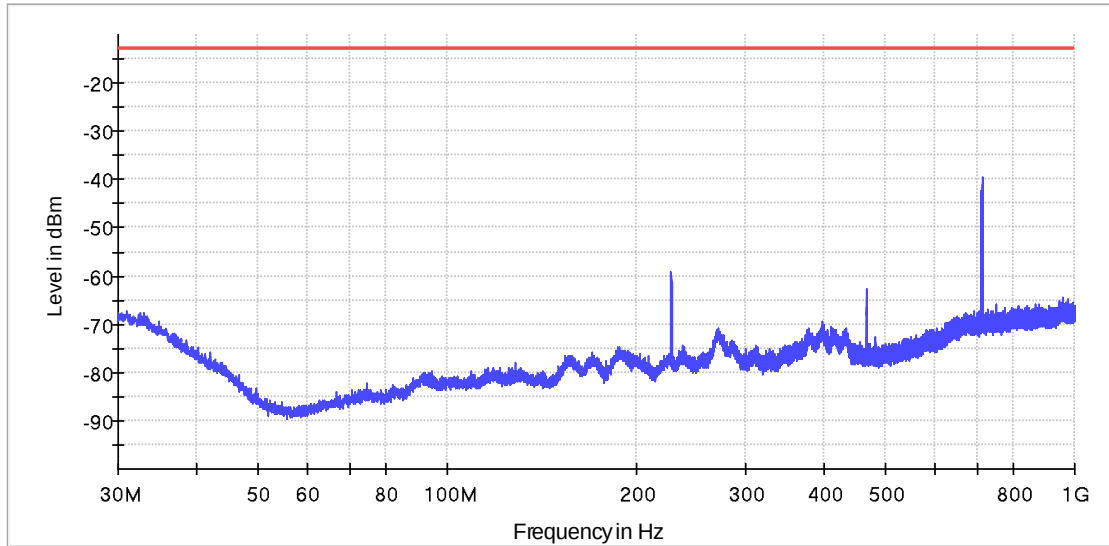
Figure 8.3-2: Spurious emissions below 1 GHz, low channel with Quadrifilar Helix antenna



Spurious_30-1000 MHz High channel_Quadrifilar Antenna
— -13 dBm Limit
— PK+_MAXH

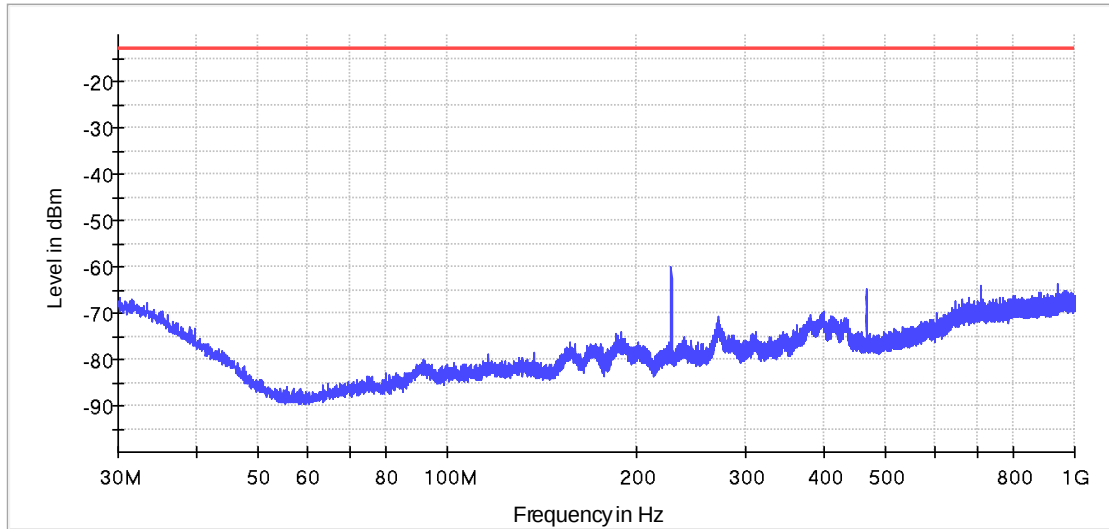
Figure 8.3-3: Spurious emissions below 1 GHz, high channel with Quadrifilar Helix antenna

Test data, continued, Radiated spurious emissions 30 MHz – 1 GHz



Spurious_30-1000 MHz Low channel_Patch Antenna
— -13 dBm Limit
— PK+_MAXH

Figure 8.3-4: Spurious emissions below 1 GHz, low channel with Patch antenna



Spurious_30-1000 MHz High channel_Patch Antenna
— -13 dBm Limit
— PK+_MAXH

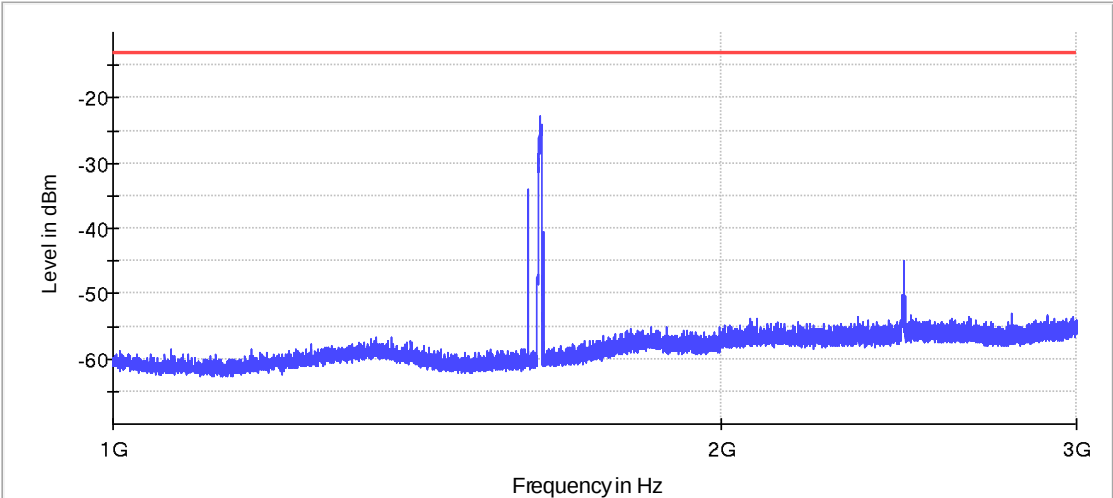
Figure 8.3-5: Spurious emissions below 1 GHz, high channel with Patch antenna

Section 8
Test name
Specification

Testing data
FCC 25.202(f) and RSS-170 5.4 Field strength of spurious emissions
FCC Part 25 and RSS-170, Issue 3

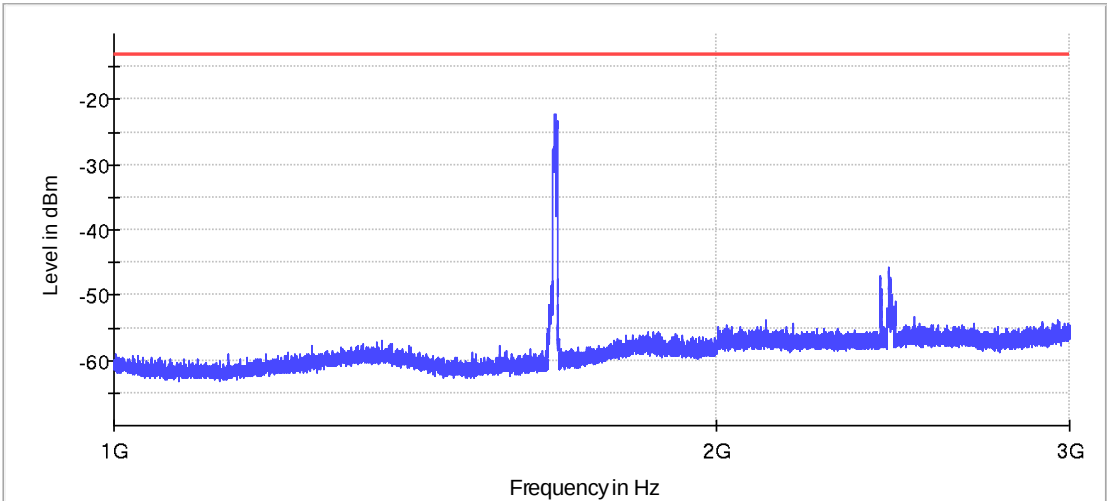


Test data, continued, Radiated spurious emissions 1 – 3 GHz



Spurious_1-3 GHz Low channel_Quadrifilar Antenna
— -13 dBm Limit
— PK+_MAXH

Figure 8.3-6: Radiated spurious emissions 1–3 GHz, low channel with Quadrifilar Helix antenna



Spurious_1-3 GHz High channel_Quadrifilar Antenna
— -13 dBm Limit
— PK+_MAXH

Figure 8.3-7: Radiated spurious emissions 1–3 GHz, high channel with Quadrifilar Helix antenna

Test data, continued, Radiated spurious emissions 1 – 3 GHz

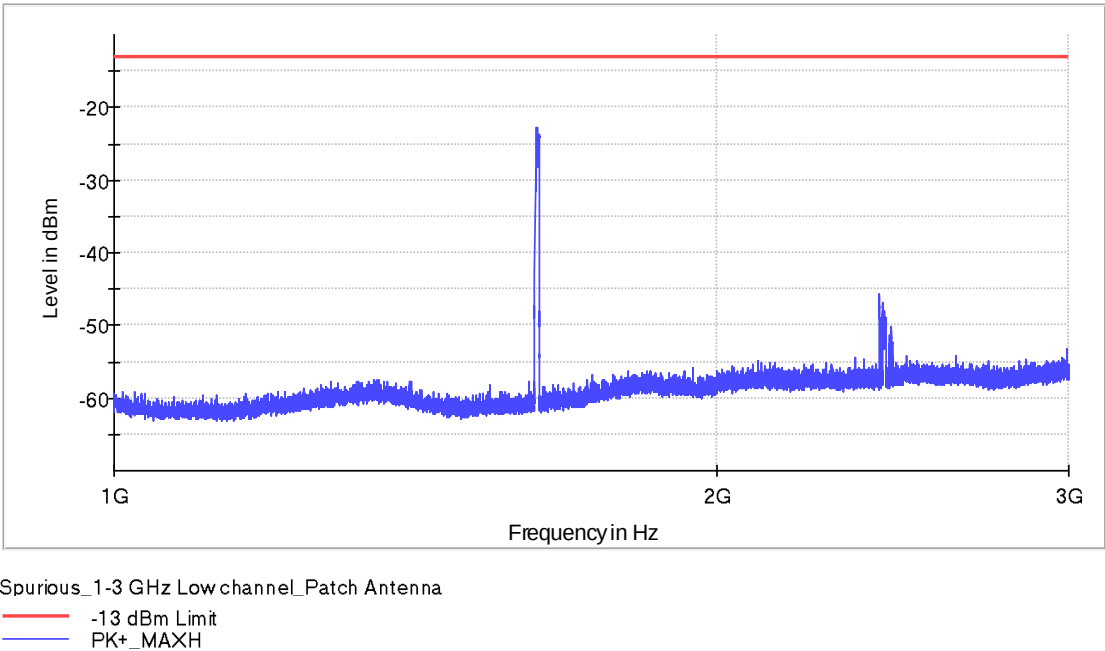


Figure 8.3-8: Radiated spurious emissions 1–3 GHz, low channel with Patch antenna

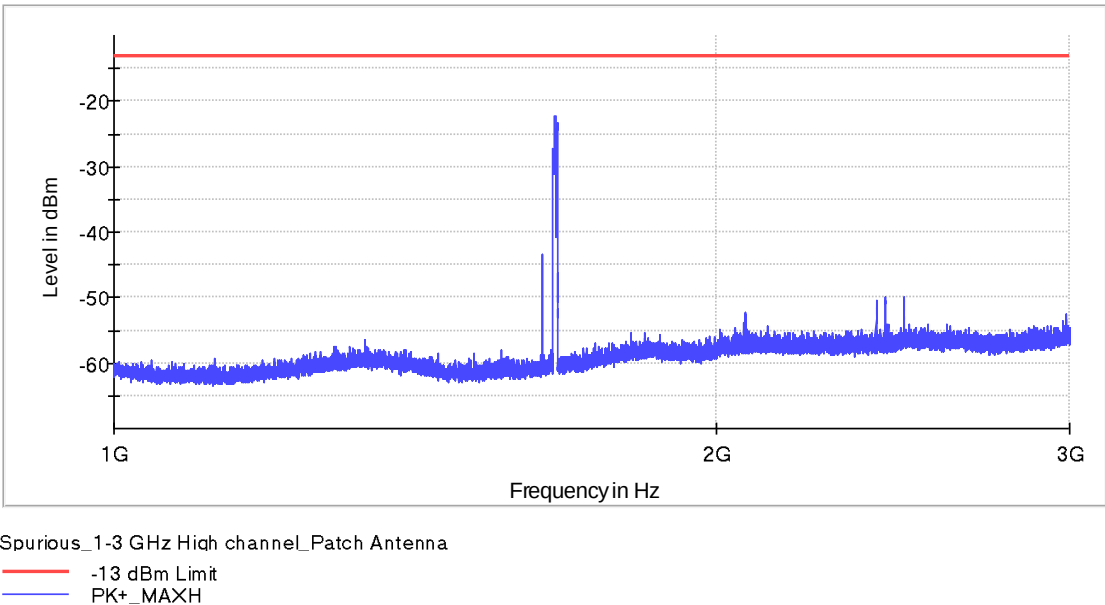
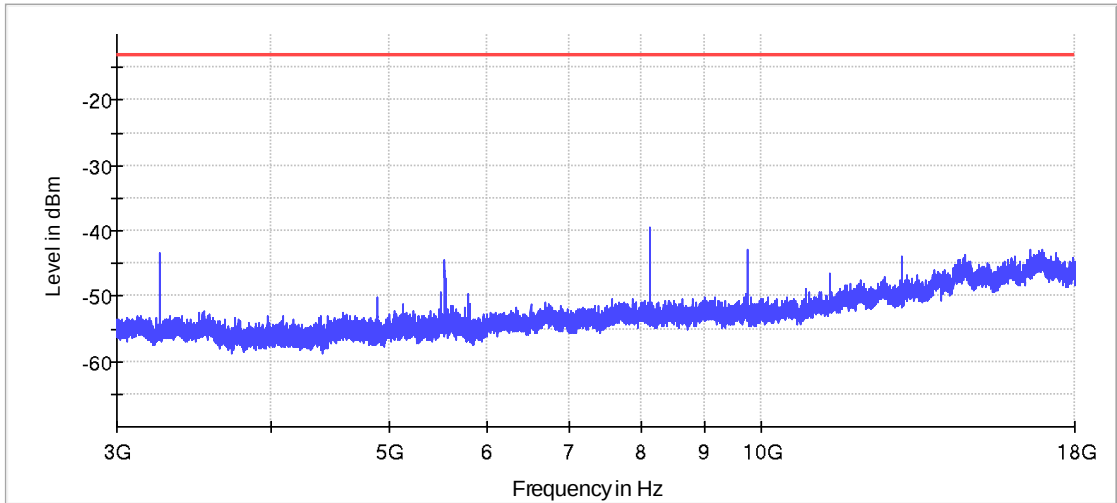


Figure 8.3-9: Radiated spurious emissions 1–3 GHz, high channel with Patch antenna

Test data, continued, Radiated spurious emissions 3 – 18 GHz

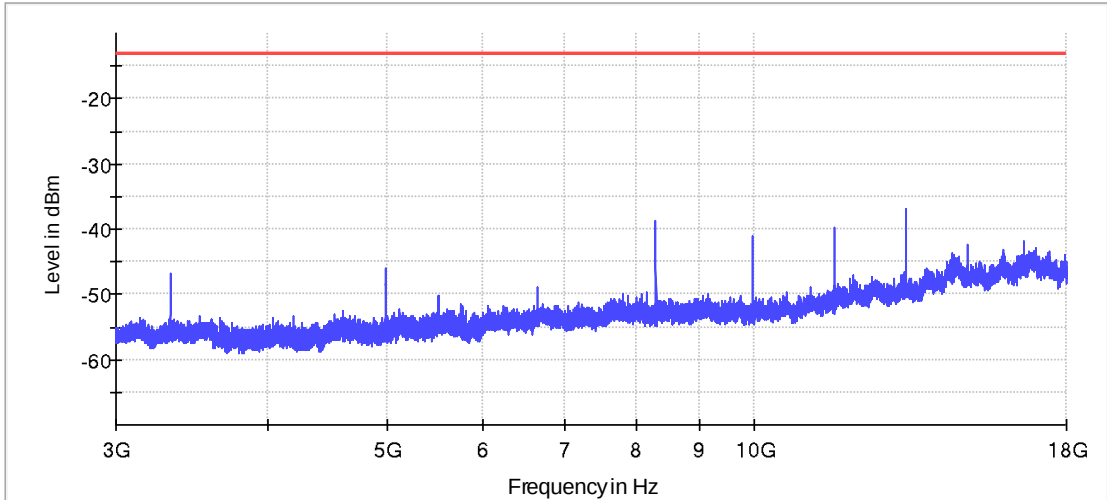


Spurious_3-18 GHz Low channel_Quadrifilar Antenna

— -13 dBm Limit

— PK+_MAXH

Figure 8.3-10: Radiated spurious emissions 3 – 18 GHz, low channel with Quadrifilar Helix antenna



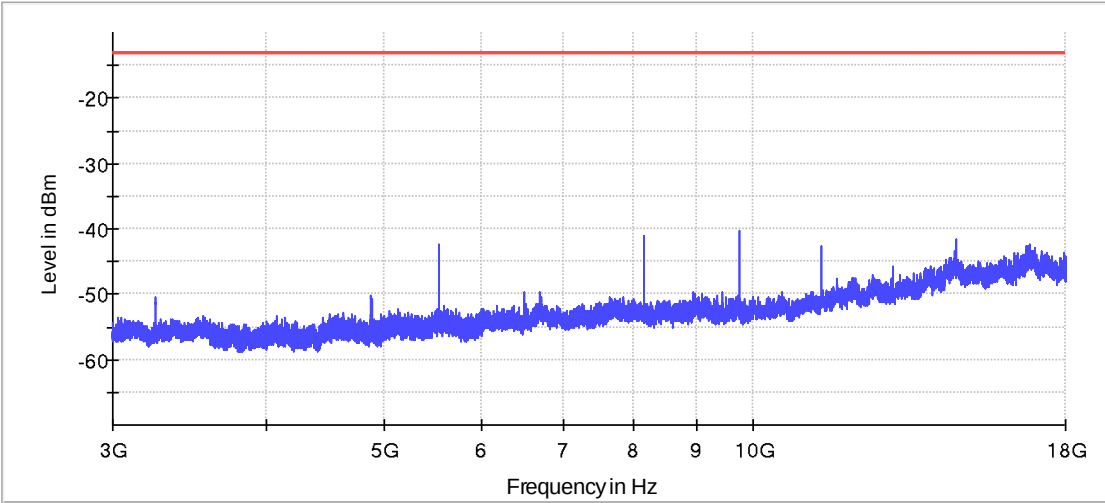
Spurious_3-18 GHz High channel_Quadrifilar Antenna

— -13 dBm Limit

— PK+_MAXH

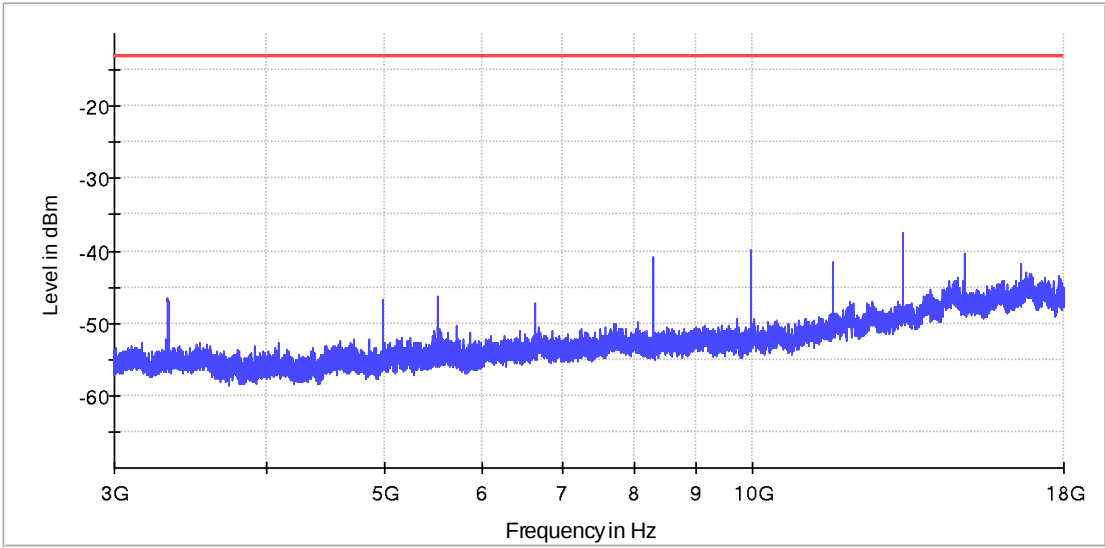
Figure 8.3-11: Radiated spurious emissions 3 – 18 GHz, high channel with Quadrifilar Helix antenna

Test data, continued, Radiated spurious emissions 3 – 18 GHz



Spurious_3-18 GHz Low channel_Patch Antenna
— -13 dBm Limit
— PK+_MAXH

Figure 8.3-12: Radiated spurious emissions 3 – 18 GHz, low channel Patch antenna



Spurious_3-18 GHz High channel_Patch Antenna
— -13 dBm Limit
— PK+_MAXH

Figure 8.3-13: Radiated spurious emissions 3 – 18 GHz, high channel Patch antenna

Test data, continued, conducted spurious emissions 30 MHz – 18 GHz

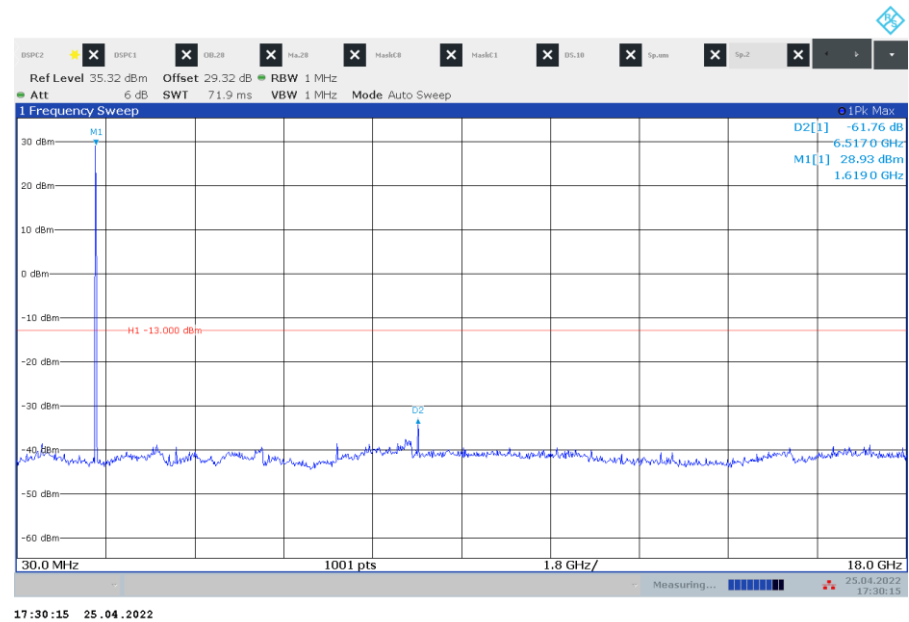


Figure 8.3-14: Conducted spurious emissions, low channel

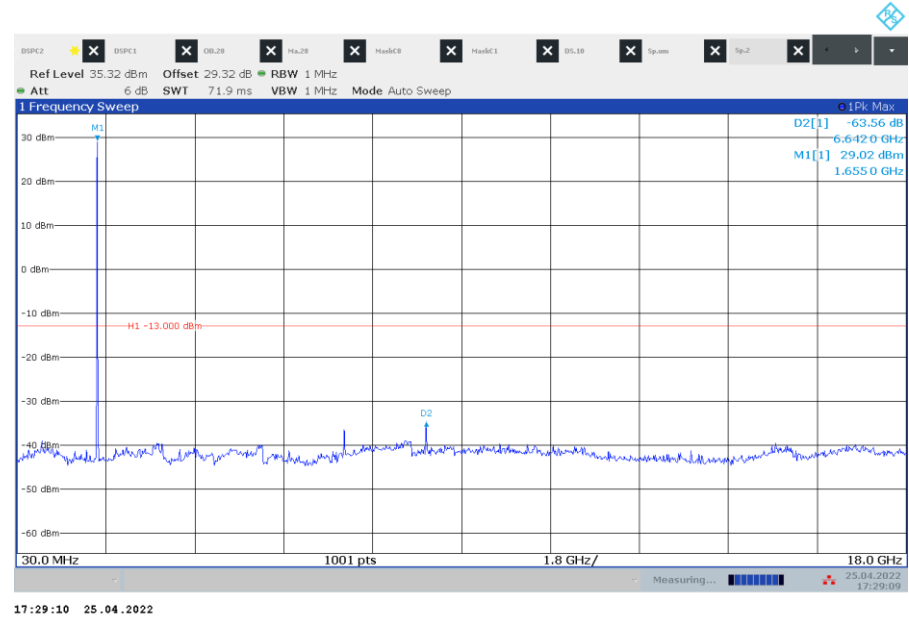


Figure 8.3-15: Conducted spurious emissions, high channel

Test data, continued, conducted carrier-off state emissions, 1559-1610 MHz

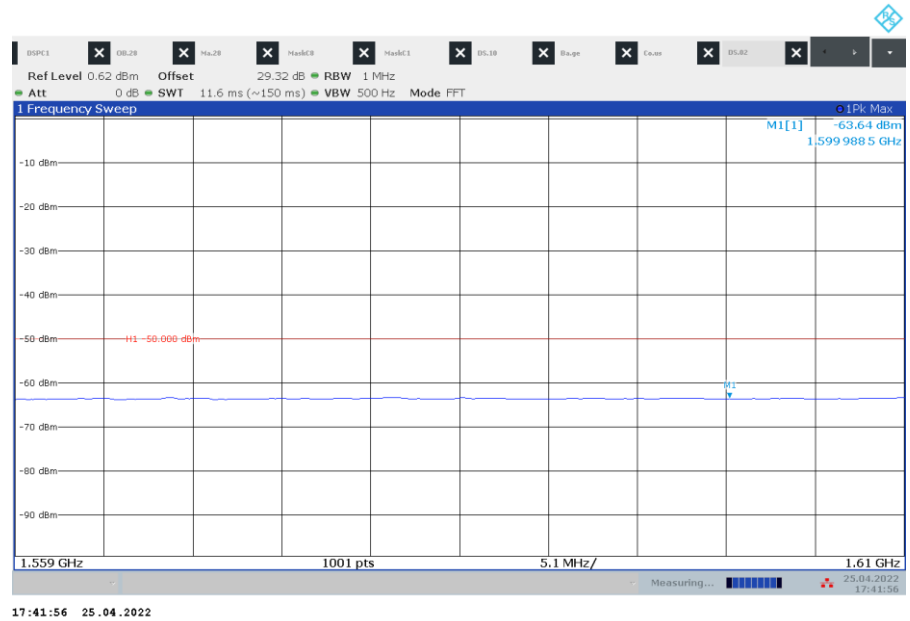


Figure 8.3-16: Conducted emissions 1559 – 1610 MHz, Carrier-off state

8.4 FCC 25.202(d) and RSS-170 5.2 Frequency tolerance, Earth stations

8.4.1 Definitions and limits

FCC:

The carrier frequency of each earth station transmitter authorized in these services shall be maintained within 0.001 percent (± 10 ppm) of the reference frequency.

§2.1055 Frequency stability

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From -30°C to $+50^{\circ}\text{C}$ for all equipment except that specified in paragraphs (a)(2) and (3) of this section

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10°C through the range.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

ISED:

For mobile earth station equipment, the carrier frequency shall not depart from the reference frequency by more than ± 10 ppm.

8.4.2 Test summary

Test date	April 25, 2022
Test engineer	Moustapha Salah Toubbeh
Verdict	Pass

8.4.3 Observations, settings and special notes

Frequency stability measurements were performed with reference to ANSI 63.26 section 5.6.3 and section 5.6.5

Spectrum analyser settings:

Resolution bandwidth:	20 Hz
Video bandwidth:	$\geq 3 \times \text{RBW}$
Detector mode:	Peak
Trace mode:	Max Hold

8.4.4 Test data

Table 8.4-1: Frequency tolerance measurement result – Low channel

Test conditions	Frequency, Hz	Offset, ppm	Limit, ±ppm	Margin, ppm
+50 °C, Nominal	1.626501298	0.16	10.00	9.84
+40 °C, Nominal	1.626501143	0.06	10.00	9.94
+30 °C, Nominal	1.626501084	0.03	10.00	9.97
+20 °C, +15 %	1.626500773	-0.17	10.00	9.83
+20 °C, Nominal	1.626501043		Reference	
+20 °C, -15 %	1.626500869	-0.11	10.00	9.89
+10 °C, Nominal	1.626500562	-0.30	10.00	9.70
0 °C, Nominal	1.626500474	-0.35	10.00	9.65
-10 °C, Nominal	1.626500571	-0.29	10.00	9.71
-20 °C, Nominal	1.626501022	-0.01	10.00	9.99
-30 °C, Nominal	1.626501805	0.47	10.00	9.53

Note: Offset was calculated as per the following formula: $\frac{F_{\text{Measured}} - F_{\text{reference}}}{F_{\text{reference}}} \times 1 \cdot 10^6$

Table 8.4-2: Frequency tolerance measurement result – Mid channel

Test conditions	Frequency, Hz	Offset, ppm	Limit, ±ppm	Margin, ppm
+50 °C, Nominal	1.642000317	0.15	10.00	9.85
+40 °C, Nominal	1.642000164	0.06	10.00	9.94
+30 °C, Nominal	1.642000105	0.02	10.00	9.98
+20 °C, +15 %	1.641999827	-0.15	10.00	9.85
+20 °C, Nominal	1.642000072		Reference	
+20 °C, -15 %	1.641999839	-0.14	10.00	9.86
+10 °C, Nominal	1.641999582	-0.30	10.00	9.70
0 °C, Nominal	1.641999452	-0.38	10.00	9.62
-10 °C, Nominal	1.641999600	-0.29	10.00	9.71
-20 °C, Nominal	1.641999962	-0.07	10.00	9.93
-30 °C, Nominal	1.642000908	0.51	10.00	9.49

Note: Offset was calculated as per the following formula: $\frac{F_{\text{Measured}} - F_{\text{reference}}}{F_{\text{reference}}} \times 1 \cdot 10^6$

Table 8.4-3: Frequency tolerance measurement result – High channel

Test conditions	Frequency, Hz	Offset, ppm	Limit, ±ppm	Margin, ppm
+50 °C, Nominal	1.660499321	0.13	10.00	9.87
+40 °C, Nominal	1.660499207	0.07	10.00	9.93
+30 °C, Nominal	1.660499121	0.01	10.00	9.99
+20 °C, +15 %	1.660498875	-0.13	10.00	9.87
+20 °C, Nominal	1.660499097		Reference	
+20 °C, -15 %	1.660498766	-0.20	10.00	9.80
+10 °C, Nominal	1.660498588	-0.31	10.00	9.69
0 °C, Nominal	1.660498446	-0.39	10.00	9.61
-10 °C, Nominal	1.660498616	-0.29	10.00	9.71
-20 °C, Nominal	1.660498905	-0.12	10.00	9.88
-30 °C, Nominal	1.660500025	0.56	10.00	9.44

Note: Offset was calculated as per the following formula: $\frac{F_{\text{Measured}} - F_{\text{reference}}}{F_{\text{reference}}} \times 1 \cdot 10^6$

8.5 FCC 25.216 and RSS-170 5.4.3.2 Limits on emissions from MESs for protection of aeronautical radionavigation-satellite service

8.5.1 Definitions and limits

FCC:

(c) The e.i.r.p. density of emissions from mobile earth stations with assigned uplink frequencies between 1610 MHz and 1660.5 MHz shall not exceed -70 dBW/MHz (-40 dBm/MHz), averaged over any 2 millisecond active transmission interval, in the band 1559–1605 MHz. The e.i.r.p. of discrete emissions of less than 700 Hz bandwidth from such stations shall not exceed -80 dBW (-50 dBm), averaged over any 2 millisecond active transmission interval, in the 1559–1605 MHz band.

(f) Mobile earth stations with assigned uplink frequencies in the 1610–1660.5 MHz band shall suppress the power density of emissions in the 1605–1610 MHz band to an extent determined by linear interpolation from -70 dBW/MHz (-40 dBm/MHz) at 1605 MHz to -10 dBW/MHz (20 dBm/MHz) at 1610 MHz.

IC:

Mobile earth stations with transmitting frequencies between 1626.5 and 1660.5 MHz shall have the e.i.r.p. density of unwanted emissions in the band 1605–1610 MHz, averaged over any 2 ms active transmission interval, not exceed the following limits:

- (1) -70 dBW/MHz (-40 dBm/MHz) at 1605 MHz, linearly interpolated to -46 dBW/MHz (-16 dBm/MHz) at 1610 MHz, for broadband emissions; and
- (2) -80 dBW/kHz (-50 dBm/kHz) at 1605 MHz, linearly interpolated to -56 dBW/kHz (-26 dBm/kHz) at 1610 MHz, for discrete emissions.

8.5.2 Test summary

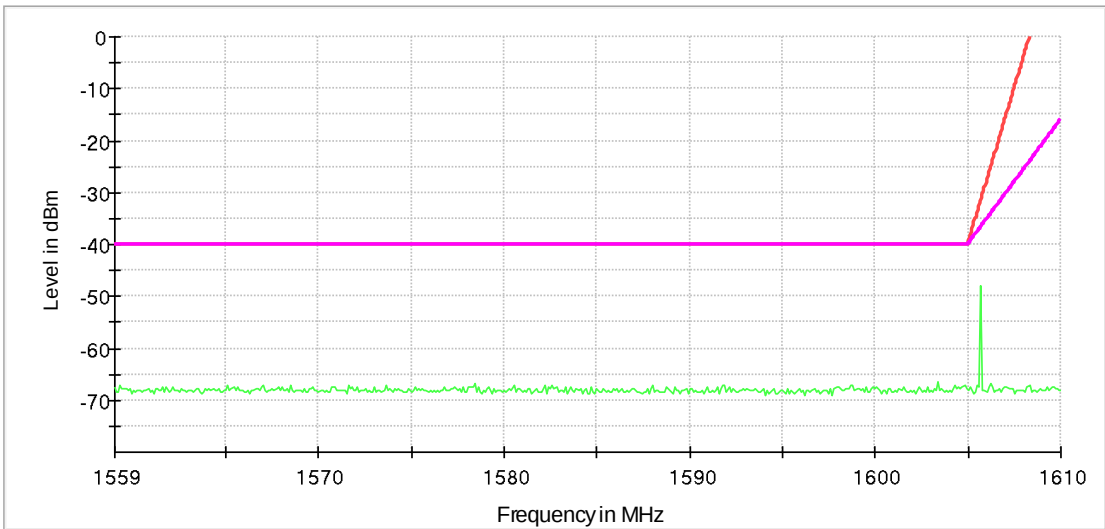
Test date	May 13, 2022
Test engineer	Moustapha Salah Toubbeh
Verdict	Pass

8.5.3 Observations, settings and special notes

The test was performed radiated at the distance of 3 m. (Direct radiated field strength method based on a pre-characterized path loss per ANSI 63.4)

Spectrum analyser settings:

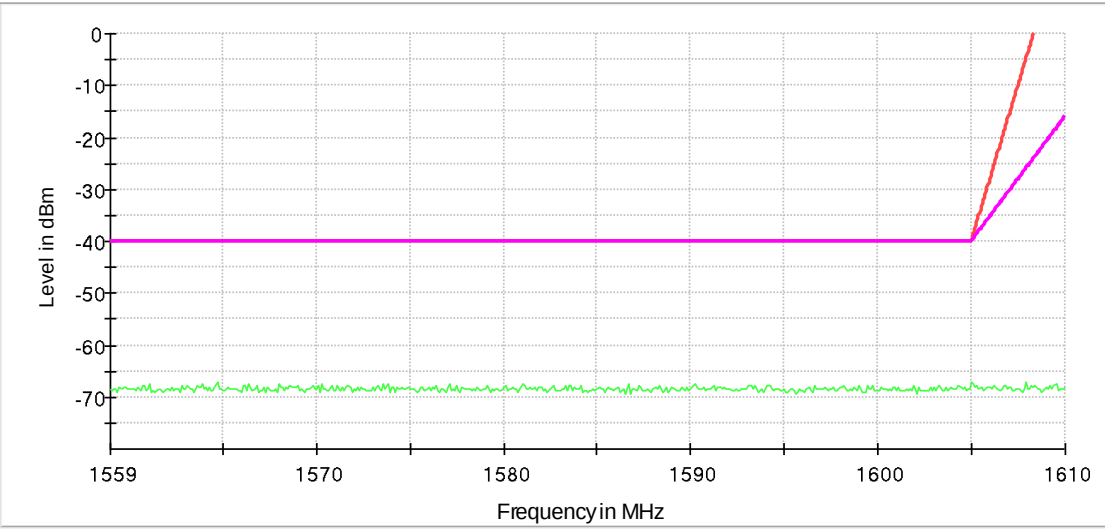
Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	RMS
Trace mode	Max-hold



Spurious_1.559 - 1.610 GHz Low channel_Quadrifilar Antenna

— FCC Part 25 Limit
— RSS 170 Limit
— RMS_MAXH

Figure 8.5-1: Radiated spurious emissions 1559–1610 MHz, low channel with Quadrifilar Helix antenna

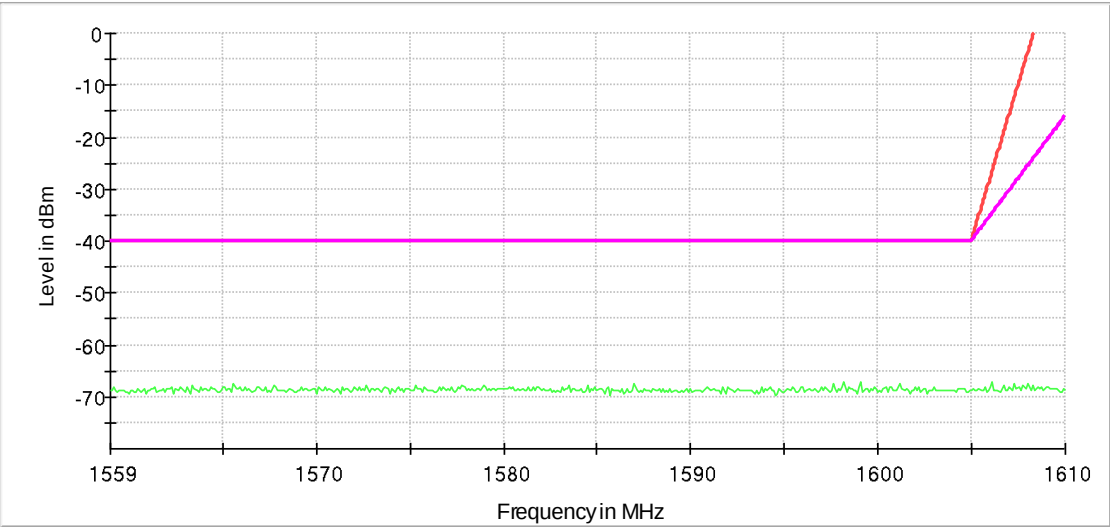


Spurious_1.559 - 1.610 GHz High channel_Quadrifilar Antenna

— FCC Part 25 Limit
— RSS 170 Limit
— RMS_MAXH

Figure 8.5-2: Radiated spurious emissions 1559–1610 MHz, high channel with Quadrifilar Helix antenna

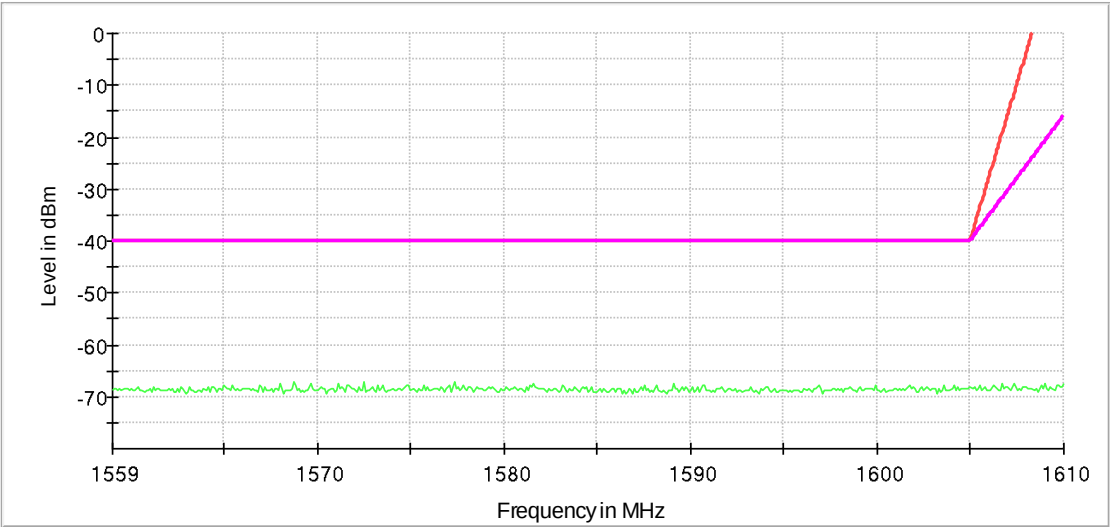
8.5.1 Test data



Spurious_1.559 - 1.610 GHz Low channel_Patch Antenna

- FCC Part 25_Limit
- RSS 170_Limit
- RMS_MAXH

Figure 8.5-3: Radiated spurious emissions 1559–1610 MHz, low channel with Patch antenna



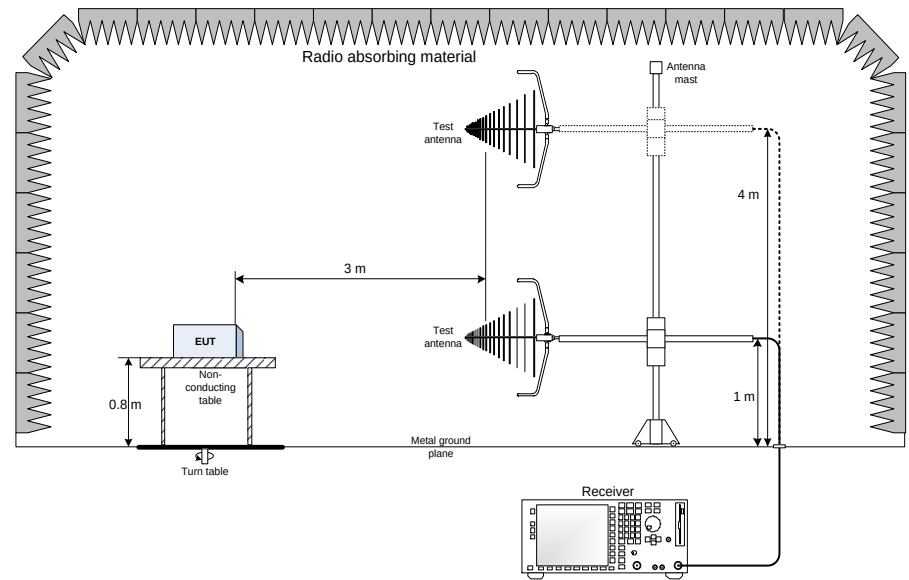
Spurious_1.559 - 1.610 GHz High channel_Patch Antenna

- FCC Part 25_Limit
- RSS 170_Limit
- RMS_MAXH

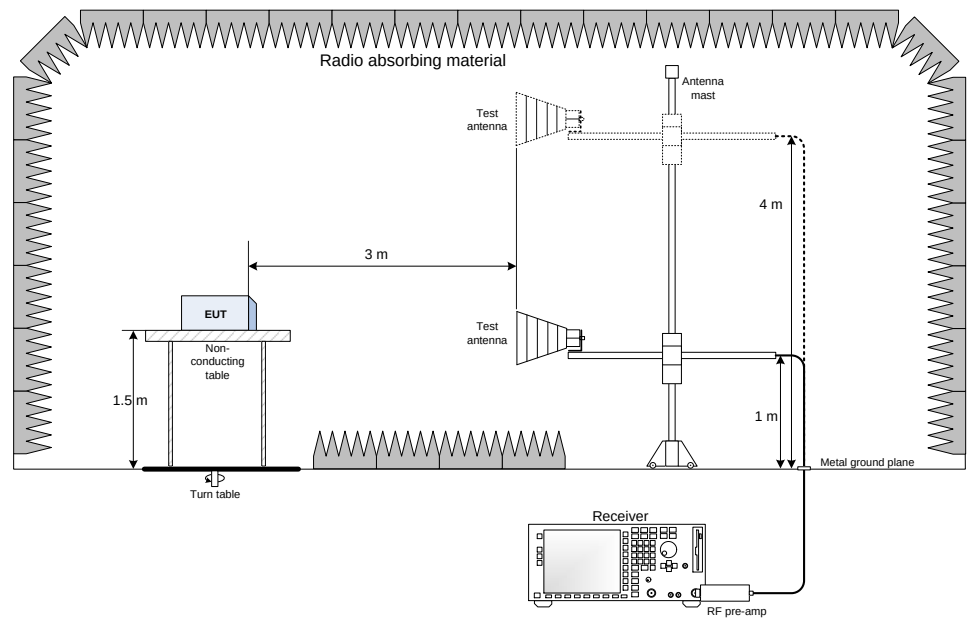
Figure 8.5-4: Radiated spurious emissions 1559–1610 MHz, high channel with Patch antenna

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 measurement set-up

