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RADIO TEST REPORT

Report ID
REP013518

Project ID
PRJ0039147

Type of assessment:
Final product testing

Applicant:
Tektelic Communications

Product:
IotaComm Dual-Band Gateway

Model (HVIN):
T0007752

Model variant:
T0007754

FCC ID:
2ALEPT0008765

ISED Certification number:
22504-T0008765

Specifications:

- FCC 47 CFR Part 90, Subpart I
- RSS-119 Issue 12, May 2015

Date of issue: August 3, 2023

Nimish Kapoor, EMC/RF Specialist	Nimish
Tested by	Signature
David Duchesne, EMC/RF Lab Manager	
Reviewed by	Signature

Lab locations

Company name	Nemko Canada Inc.			
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Test site registration	**Organization**	**Recognition numbers and location**		
	FCC/ISED	FCC: CA2040; IC: 2040A-4 (Ottawa/Almonte); FCC: CA2041; IC: 2040G-5 (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

Table of Contents

Report summary

1.1 Test specifications

FCC 47 CFR Part 90, Subpart I	Private land mobile radio services. General technical standards
RSS-119 Issue 12, May 2015	Land Mobile and Fixed Equipment Operating in the Frequency Range 27.41–960 MHz

1.2 Test methods

ANSI C63.26-2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
SRSP-502, Issue 5, November 2013, AMD: January 2023	Technical Requirements for Land Mobile and Fixed Radio Services Operating in the Bands 806-821/851-866 MHz and 821-824/866-869 MHz
FCC 47 CFR Part 2, Subpart J	Equipment authorization procedures
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*

Report ID	Date of issue	Details of changes made to test report
REP013518	August 3, 2023	Original report issued

Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

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

Section 2

2.2 Technical judgment

None

2.3 Model variant declaration

As declared by the applicant, the EUT model T0007752 has been chosen to be representative for both models. The model family, and the description of the variations, are as follows:.
The EUT model T0007752 contains a cellular modem to support 3G/4G while variant T0007754 does not contain cellular modem

2.4 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Test conditions

3.1 Atmospheric conditions

Se

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.

Information provided by the applicant

4.1 Disclaimer

Section 4

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.

4.2 Applicant/Manufacture

Name	Tektelic Communications
Address	7657 10 St NE, Calgary, AB T2E 8X2

4.3 EUT information

Product name	IotaComm Dual-Band Gateway
Model / HVIN	T0007752
Model variant(s)	T0007754
Serial number	2327K0001
Power supply requirements	55 V_{DC} (via external PoE powered by 100-240 V_{AC}, 50/60 Hz power adapter) or DC: 48 V
Product description and theory of operation	Custom dual-band gateway for Iota Communications Inc. Supports 900 MHz ISM band LoRa and 800 MHz PLMR band FSK.
Software details	BSP 5.0.5

4.4 Technical information

System type	Base/Fixed point-to-point system
Frequency band	851-866 MHz
Frequency Min (MHz)	854.0125 MHz
Frequency Max (MHz)	861.9875 MHz
Channel numbers	231-550
RF power Max (W), Conducted	Low Channel: 3.908 W (35.92 dBm) Mid Channel: 4.207 W (36.24 dBm) High Channel: 3.758 W (35.75 dBm)
Measured BW (kHz), 99% OBW	Low Channel: 13.025 kHz Mid Channel: 13.025 kHz High Channel: 13.025 kHz
Type of modulation	FSK
Emission classification	F1D
Antenna information	Type: Omnidirectional, manufacturer: L-Com, model: HGV-906U, gain: 6 dBi

4.5 EUT setup details

4.5.1 Radio exercise details

Operating conditions	Tx Tests: sending modulated packets of 98.5% duty cycle on the antenna port at the rated output power
Transmitter state	Transmitter set into continuous mode.

4.5.2 EUT setup configuration

Table 4.5-1: *EUT sub assemblies*

Description	Brand name	Model, Part number, Serial number, Revision level
IotaComm Dual-Band Gateway	Tektelic Communications	MN: T0007752, SN: 2327K0001, Rev. B1

Table 4.5-2: *EUT interface ports*

Description	Qty.
GPS	1
DC Input	1
Ant 0	1
Ant 1	1
3G/4G	1
Ethernet (For Power as well)	1

Table 4.5-3: *Support equipment*

Description	Brand name	Model, Part number, Serial number, Revision level
Laptop	Dell	MN: Latitude E7470, SN: FHV3NC2
Router	LinkSys	MN: BEFSR41, SN: C2181HB03069, Rev. 4.3
PoE Adapter	Planet	MN: POE-163, SN: AF004120301882 (008), Rev. V2
800/900 MHz Antenna	L-Com	MN: HGV-906U
300 W Load	Sierra	MN: 160B300, SN: 2759

Table 4.5-4: *Inter-connection cables*

Cable description	From	To	Length (m)
Cat 5e	EUT	PoE Adapter	2
RF Cable	Ant 1 (EUT)	800/900 MHz Antenna	Directly Connected
RF Cable	Ant 0 (EUT)	300 W Load	4

EUT setup configuration, continued

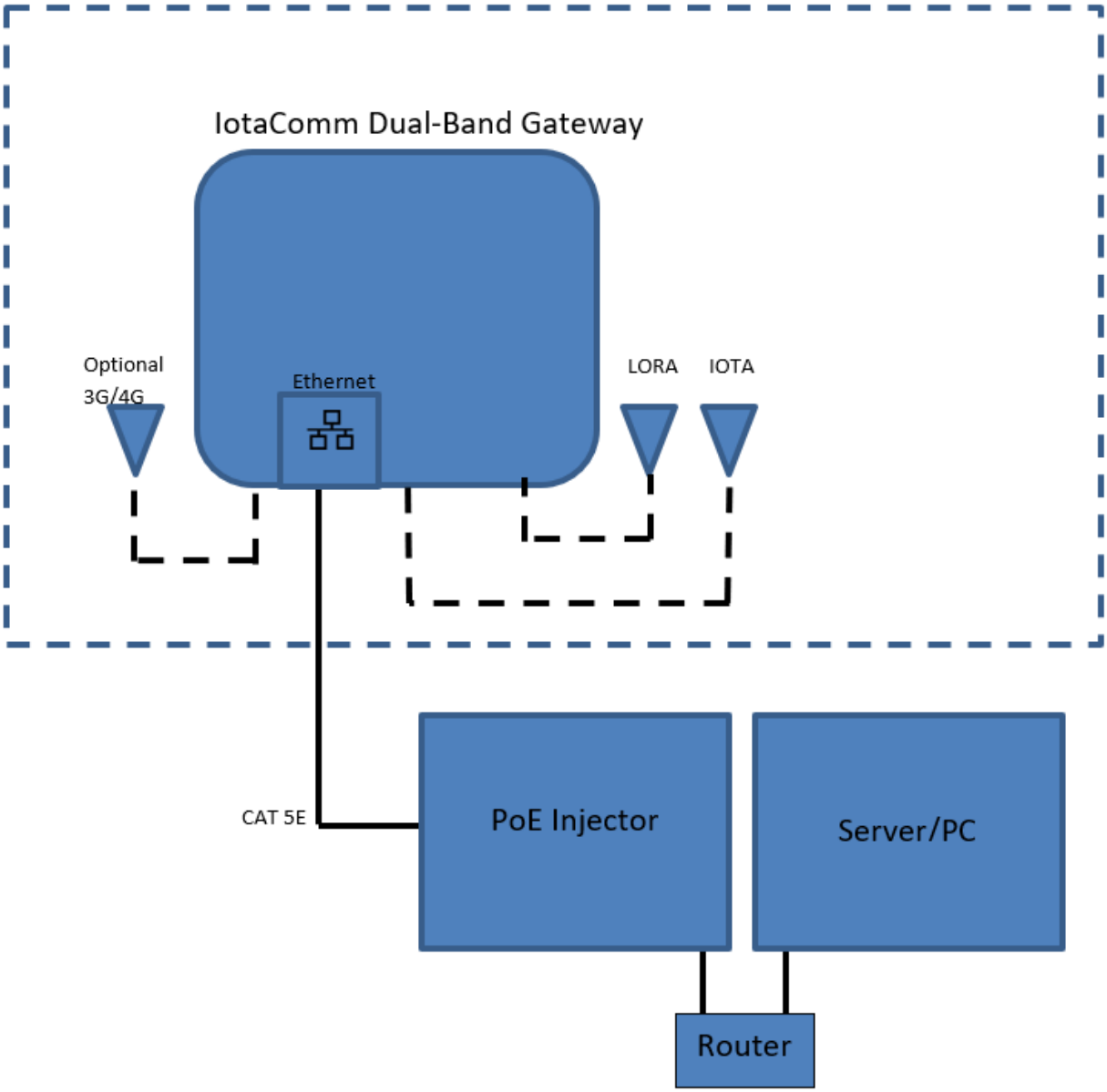


Figure 4.5-1: *Block diagram*

Summary of test results

5.1 Testing location

Test location (s)	Ottawa

Section 5

5.2 Testing period

Test start date	July 11, 2023	Test end date	July 26, 2023

5.3 Sample information

Receipt date	July 10, 2023	Nemko sample ID number(s)	PRJ00391470001

5.4 FCC Part 2 and 90 Subpart I test requirements results

Table 5.4-1: *FCC requirements results*

Part	Test description	Verdict
§2.1047	Modulation characteristics	Pass
§90.205(k)	Power and antenna height limits	Pass
§90.209(b)	Bandwidth limitations	Pass
§90.210	Emissions masks	Pass
§90.213(a)	Transmitter frequency stability	Pass
§90.214	Transient frequency behavior	Not applicable[1]
§90.221	Adjacent channel power limits	Not applicable[2]

Notes: [1]The EUT does not operate in the 150–174 MHz and 421–512 MHz frequency bands

[2] The EUT does not utilize authorized bandwidth of 22 kHz.

5.5 ISED RSS-119, Issue 12 and RSS-Gen, Issue 5 test requirements results

Table 5.5-1: *ISED requirements results*

Section	Test description	Verdict
RSS-119, 5.1	Interface Impedance	See note [1]
RSS-119, 5.2	Types of modulations	See note [2]
RSS-119, 5.3	Transmitter frequency stability	Pass
RSS-119, 5.4	Transmitter output power	Pass
RSS-119, 5.5	Channel Bandwidth, Authorized Bandwidth, Occupied Bandwidth and Spectrum Masks	Pass
RSS-119, 5.6	Fixed Equipment With an Occupied Bandwidth Larger Than the Authorized Bandwidth Permitted in This Standard	Not applicable[3]
RSS-119, 5.7	Equivalent channels	Not applicable
RSS-119, 5.8	Transmitter unwanted emissions	Pass
RSS-119, 5.9	Transient frequency behavior	Not applicable[4]
RSS-119, 5.10	Transmitters With an Output Power not Exceeding 120 mW	Not applicable[5]
RSS-119, 5.11	Interoperability Technical Standards for Equipment in the Bands 764–776 MHz and 794–806 MHz	Not applicable[6]
RSS-Gen, 6.9	Number of frequencies	Pass

Notes:
[1]This equipment has a 50-ohm external antenna connector.
[2]This equipment uses FSK digital modulation.
[3]The EUT does not utilize Occupied bandwidth larger than authorized bandwidth.
[4]The EUT does not operate in the 138–174 MHz and 406.1–512 MHz frequency bands.
[5]The transmitter power of EUT exceeds 120 mW.
[6]The EUT does not operate in the 764-776 MHz and 794-806 MHz frequency bands

Test equipment

6.1 Test equipment list

Section 6

Table 6.1-1: *Equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	January 19, 2024
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
61505 AC source	Chroma	61509	FA003036	—	VOU
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 40	FA002071	1 year	March 2, 2024
Horn (1–18 GHz)	ETS Lindgren	3117	FA002840	1 year	March 7, 2024
Preamp (1–18 GHz)	ETS Lindgren	124334	FA002873	1 year	August 16, 2023
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	March 7, 2024
Spectrum analyzer	Rohde & Schwarz	FSV 40	FA002731	1 year	March 2, 2024
High pass filter (3-18 GHz)	Thilithic Inc.	6HC3000/18000-1.3-KK	FA002231	1 year	June 9, 2024
Signal generator	Rohde & Schwarz	SMA100B	FA003313	1 year	April 26, 2024
50 Ω coax cable	Carlisle	WHU18-1818-072	FA002391	1 year	October 17, 2023

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

Table 6.1-2: *Automation software details*

Test description	Manufacturer of Software	Details
Radiated spurious emissions	Rohde & Schwarz	EMC32, Software for EMC Measurements, Version 11.20.00

6.2 Measurement uncertainty

Table 6.2-1: *Measurement uncertainty calculations based on equipment list*

Measurement	Standard uncertainty, ±dB	Measurement uncertainty, ±dB
Radiated spurious emissions (30 MHz to 1 GHz)	6.3	5.8
Radiated spurious emissions (1 GHz to 6 GHz)	5.2	4.7
Radiated spurious emissions (6 GHz to 18 GHz)	5.5	5.0
RF Output power measurement using Spectrum Analyzer		0.85
Conducted spurious emissions		1.13
Other antenna port measurements		0.94

Notes: UKAS Lab 34, TIA-603 and ETSI TR 100 028-1&2 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 calculations assume a coverage factor of K = 2 with 95% certainty.

Testing data

7.1 Number of frequencies

Section 7.1.1 References, definitions and limits

ANSI C63.26, Clause 5.1.2:

Measurements of transmitters shall be performed and, if required, reported for each frequency band in which the EUT can be operated with the device transmitting at the number of frequencies in each band specified in table below.

RSS-Gen, Clause 6.9:

Except where otherwise specified, measurements shall be performed for each frequency band of operation for which the radio apparatus is to be certified, with the device operating at the frequencies in each band of operation shown in table below. The frequencies selected for measurements shall be reported in the test report.

Table 7.1-1: *Frequency Range of Operation*

Frequency range over which the device operates (in each band)	Number of test frequencies required	Location of measurement frequency inside the operating frequency range
1 MHz or less	1	Center (middle of the band)
1–10 MHz	2	1 near high end, 1 near low end
Greater than 10 MHz	3	1 near high end, 1 near center and 1 near low end

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

7.1.2 Test summary

Verdict	Pass		
Test date	July 10, 2023	Temperature	21 °C
Tested by	Nimish Kapoor	Air pressure	995 mbar
Test location	Ottawa	Relative humidity	60 %

7.1.3 Observations, settings and special notes

None

7.1.4 Test data

Table 7.1-2: *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
851	866	15	854.0125	858.1125	861.9875

7.2 Transmitter Output Power

7.2.1 References, definitions and limits

FCC §90.205:

(k) Power and antenna height limits within 806-824 MHz, 851-869 MHz, 896-901 MHz and 935-940 MHz
Power and height limitations for frequencies in the 806–824 MHz and 851–869 MHz bands and for narrowband operations in the 896–901/935–940 MHz band are specified in § 90.635.

FCC §90.635:

(a) The effective radiated power and antenna height for base stations may not exceed 1 kilowatt (30 dBW or 60 dBm) and 304 m. (1,000 ft.) above average terrain (AAT), respectively, or the equivalent thereof as determined from the Table. These are maximum values, and applicants will be required to justify power levels and antenna heights requested.

(b) The maximum output power of the transmitter for mobile stations is 100 watts (20 dBW or 50 dBm).

Table 7.2-1: *Equivalent Power and Antenna Heights for Base Stations in the 851–869 MHz and 935–940 MHz Bands Which Have a Requirement for a 32 km (20 mi) Service Area Radius*

Antenna height (ATT) meters (feet)	Effective radiated power (watts)[1 2 4]
Above 1,372 (4, 500)	65
Above 1,220 (4,000) to 1,372 (4,500)	70
Above 1,067 (3,500) to 1,220 (4,000)	75
Above 915 (3,000) to 1,067 (3,500)	100
Above 763 (2,500) to 915 (3,000)	140
Above 610 (2,000) to 763 (2,500)	200
Above 458 (1,500) to 610 (2,000)	350
Above 305 (1,000) to 458 (1,500)	600
Up to 305 (1,000)	[3] 1,000

Notes:
[1]Power is given in terms of effective radiated power (ERP).
[2]Applicants in the Los Angeles, CA, area who demonstrate a need to serve both the downtown and fringe areas will be permitted to utilize an ERP of 1 kW at the following mountaintop sites: Santiago Park, Sierra Peak, Mount Lukens, and Mount Wilson.imum ERP of 500 watts allowed. Signal strength at the service area contour may be less than 39 dBu.
[3]Stations with antennas below 305 m (1,000 ft) (AAT) will be restricted to a maximum power of 1 kW (ERP)
[4]Licensees in San Diego, CA, will be permitted to utilize an ERP of 500 watts at the following mountaintop sites: Palomar, Otay, Woodson and Miguel

RSS-119, Clause 5.4:

The output power shall be within ±1 dB of the manufacturer's rated power listed in the equipment specifications.
The transmitter output power limits set forth in Table below will come into force upon the publication of Issue 12 of this standard and will apply to newly certified equipment.

Table 7.2-2: *Transmitter Output Power (ISED)*

Frequency Band, MHz	Transmitter Output Power for Base/Fixed Equipment, W (dBm)	Transmitter Output Power for Mobile Equipment, W (dBm)
806-821/851-866 and 821-824/866-869	110 (50.41)	30 (44.77)

7.2.2 Test summary

Verdict	Pass		
Test date	July 11, 2023	Temperature	23 °C
Tested by	Nimish Kapoor	Air pressure	1000 mbar
Test location	Ottawa	Relative humidity	56 %

7.2.3 Observations, settings and special notes

As per client specified, rated power is 3981.07 mW (36.00 dBm). The EUT is for fixed application, hence the corresponding limits

Measurement of peak power was performed per ANSI C63.26 subclause 5.2.3.3. Spectrum analyser settings:

Resolution bandwidth	100 kHz
Video bandwidth	300 kHz
Frequency span	700 kHz
Detector mode	Peak
Trace mode	Max Hold
Sweep time	Auto

7.2.4 Test data

Table 7.2-3: *Transmitter power results for FCC*

Modulation	Frequency, MHz	Output power, dBm	Antenna gain, dBd	ERP, dBm	ERP limit, dBm	Margin, dB
FSK	854.0125	35.92	3.86	39.78	60.00	20.22
FSK	858.1125	36.24	3.86	40.10	60.00	19.90
FSK	861.9875	35.75	3.86	39.61	60.00	20.39

Table 7.2-4: *Transmitter power results for ISED*

Modulation	Frequency, MHz	Output power, dBm	Output power limit, dBm	Margin, dB
FSK	854.0125	35.92	50.41	14.49
FSK	858.1125	36.24	50.41	14.17
FSK	861.9875	35.75	50.41	14.66

Table 7.2-5: *Rated vs measured power*

Modulation	Frequency, MHz	Rated output power, dBm	Measured output power, dBm	Difference, dB	Difference limit, ±dB	Margin, dB
FSK	854.0125	36.00	35.92	0.08	1.00	0.92
FSK	858.1125	36.00	36.24	-0.24	1.00	0.76
FSK	861.9875	36.00	35.75	0.25	1.00	0.75

Test data, continued

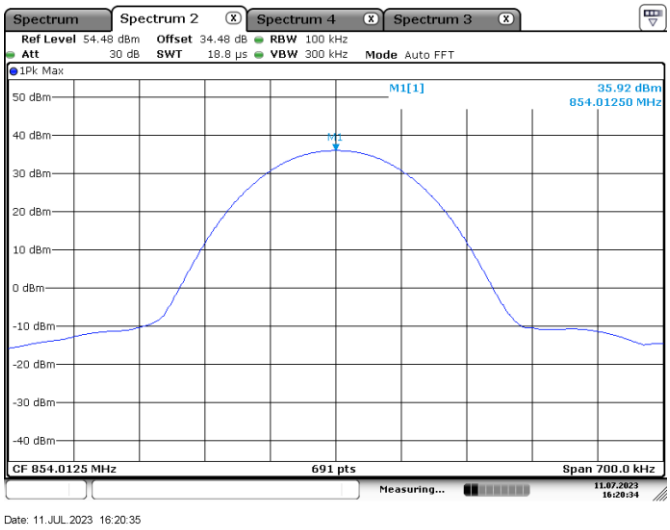


Figure 7.2-1: *Output power on low channel*

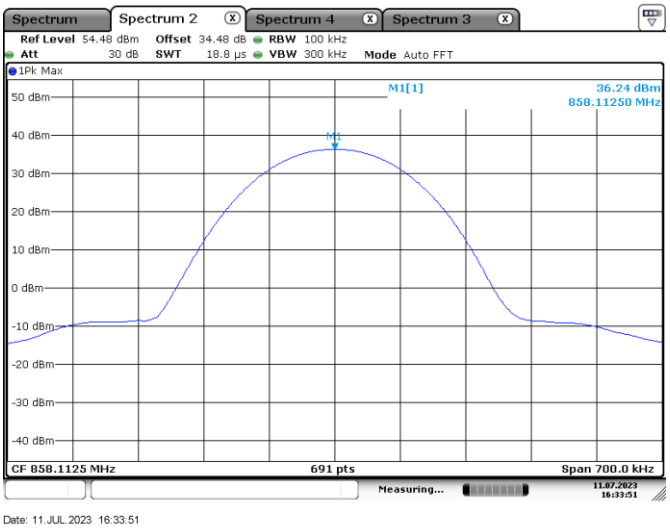


Figure 7.2-2: *Output power on mid channel*

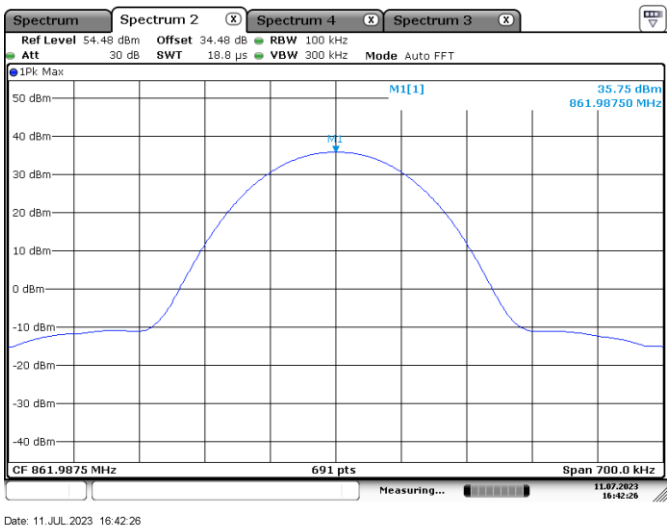


Figure 7.2-3: *Output power on high channel*

7.3 Bandwidth limitations

7.3.1 References, definitions and limits

FCC §90.209:

(b) The maximum authorized single channel bandwidth of emission corresponding to the type of emission specified in §90.207 is as follows:

(5) Unless specified elsewhere, channel spacings and bandwidths that will be authorized in the following frequency bands are given in the following table.

Table 7.3-1: *Standard Channel Spacing/Bandwidth*

Frequency band, MHz	Channel spacing, kHz	Authorized bandwidth[1], kHz
809–817/854–862	12.5	20 / 11.25

Note: [1]Operations using equipment designed to operate with a 25 kilohertz channel bandwidth may be authorized up to a 20 kilohertz bandwidth unless the equipment meets the Adjacent Channel Power limits of § 90.221 in which case operations may be authorized up to a 22 kilohertz bandwidth. Operations using equipment designed to operate with a 12.5 kilohertz channel bandwidth may be authorized up to an 11.25 kilohertz bandwidth.

(8) Applicants may begin to license 12.5 kilohertz bandwidth channels in the 809–817/854–862 MHz band segment only after the Wireless Telecommunications Bureau and the Public Safety and Homeland Security Bureau jointly release a public notice announcing the availability of those channels for licensing in a National Public Safety Planning Advisory Committee region.

RSS-119, Clause 5.5:

For the purpose of this document, channel bandwidth is the channel width in which the equipment is designed to operate.
The maximum permissible occupied bandwidth shall not exceed the authorized bandwidth specified in Table below for the equipment's frequency band. The authorized bandwidth is defined as the maximum width of the band of frequencies used to derive spectrum masks and is not necessarily equivalent to the bandwidth found on radio and spectrum licences.
The channel bandwidths and authorized bandwidths are given in Table below for equipment having an output power greater than 120 mW. For equipment with an output power that does not exceed 120 mW, Section 5.10 applies.

Table 7.3-2: *Channel Bandwidths, Authorized Bandwidths for 806-821/851-866 and 821-824/866-869 frequency band*

Channel bandwidth, kHz	Authorized bandwidth, kHz
25.00	20.00 or 22.00
12.50	11.25
6.25	6.00

7.3.2 Test summary

Verdict	Pass		
Test date	July 11, 2023	Temperature	23 °C
Tested by	Nimish Kapoor	Air pressure	1000 mbar
Test location	Ottawa	Relative humidity	56 %

7.3.3 Observations, settings and special notes

The test was performed as per ANSI C63.26, subclause 5.4.4.

Spectrum analyser settings:

Resolution bandwidth	1–5% of OBW
Video bandwidth	≥3 × RBW
Frequency span	≥1.5 × OBW
Detector mode	Peak
Trace mode	Max Hold

7.3.4 Test data

Table 7.3-3: *99% occupied bandwidth results*

Modulation	Frequency, MHz	99% occupied bandwidth, kHz	Limit, kHz	Margin, kHz
FSK	854.0125	13.025	20.000	6.975
FSK	858.1125	13.025	20.000	6.975
FSK	861.9875	13.025	20.000	6.975

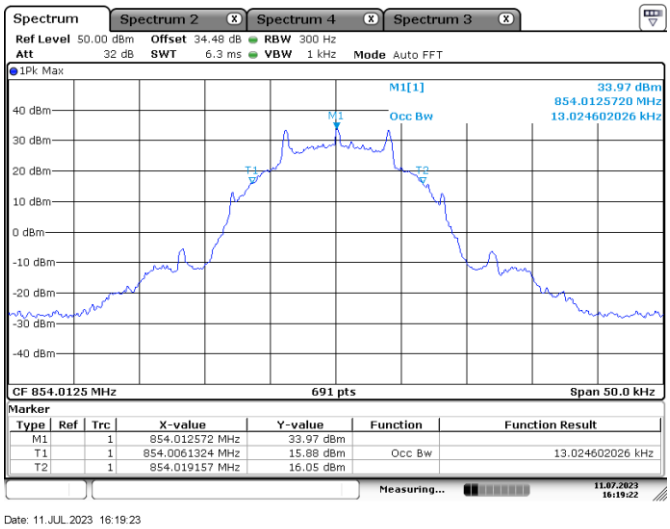


Figure 7.3-1: *99% occupied bandwidth on low channel*

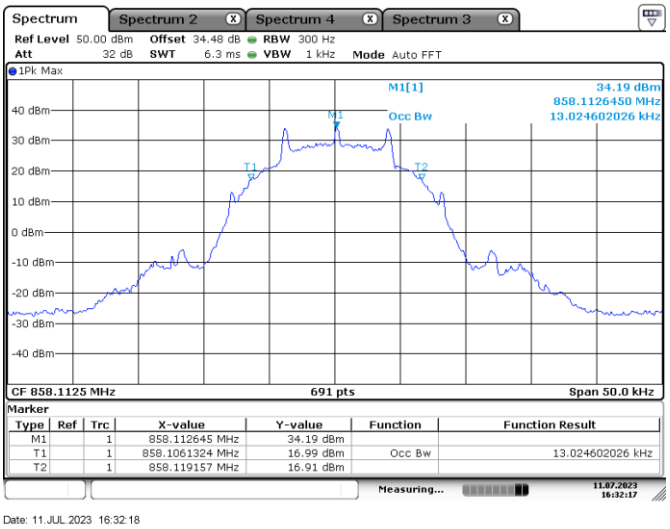


Figure 7.3-2: *99% occupied bandwidth on low channel*

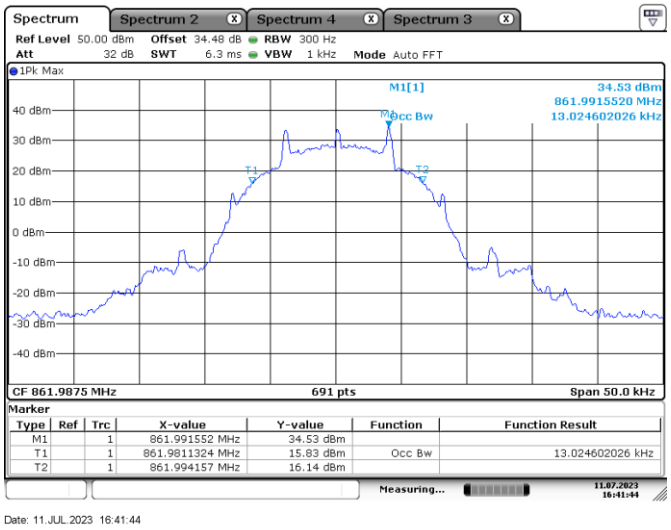


Figure 7.3-3: *99% occupied bandwidth on high channel*

7.4 Spectrum mask and spurious emissions

7.4.1 References, definitions and limits

FCC §90.210:

Except as indicated elsewhere in this part, transmitters used in the radio services governed by this part must comply with the emission masks outlined in this section. Unless otherwise stated, per paragraphs (d)(4), (e)(4), and (o) of this section, measurements of emission power can be expressed in either peak or average values provided that emission powers are expressed with the same parameters used to specify the unmodulated transmitter carrier power. For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated transmitter carrier power refers to the total power contained in the channel bandwidth. Unless indicated elsewhere in this part, the table in this section specifies the emission masks for equipment operating under this part.

Table 7.4-1: *Applicable Emission Masks*

Frequency band, MHz	Mask for equipment with audio low pass filter	Mask for equipment with audio low pass filter
809–824/854–869 [1 and 2]	B or D	D or G

Notes: [1] Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of § 90.691 of this chapter.
[2] Equipment designed to operate on 25 kilohertz bandwidth channels must meet the requirements of either Emission Mask B or G, whichever is applicable, while equipment designed to operate on 12.5 kilohertz bandwidth channels must meet the requirements of Emission Mask D. Equipment designed to operate on 25 kilohertz bandwidth channels may alternatively meet the Adjacent Channel Power limits of § 90.221.

(b) **Emission Mask B.** For transmitters that are equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

(d) **Emission Mask D**—12.5 kHz channel bandwidth equipment. For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(f_d–2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

(4) The reference level for showing compliance with the emission mask shall be established using a resolution bandwidth sufficiently wide (usually two or three times the channel bandwidth) to capture the true peak emission of the equipment under test. In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak hold mode. A sufficient number of sweeps must be measured to insure that the emission profile is developed. If video filtering is used, its bandwidth must not be less than the instrument resolution bandwidth. For emissions beyond 50 kHz from the edge of the authorized bandwidth, see paragraph (o) of this section. If it can be shown that use of the above instrumentation settings do not accurately represent the true interference potential of the equipment under test, an alternate procedure may be used provided prior Commission approval is obtained.

(g) **Emission Mask G**— For transmitters that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fd in kHz) of more than 10 kHz, but no more than 250 percent of the authorized bandwidth: At least 116 log (fd/6.1) dB, or 50 + 10 log (P) dB, or 70 dB, whichever is the lesser attenuation;

(2) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least 43 + 10 log (P) dB.

References, definitions and limits, continued

RSS-119, Clause 5.5:

The authorized bandwidth is defined as the maximum width of the band of frequencies used to derive spectrum masks and is not necessarily equivalent to the bandwidth found on radio and spectrum licences.

Table 7.4-2: *Spectrum Masks*

Frequency band, MHz	Channel Bandwidth (kHz)	Authorized Bandwidth (kHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
806-821/851-866 and 821-824/866-869	25.00	22.00 or 20.00	B or Y	G or Y
	12.50	11.25	D	D
	6.25	6.00	E	E

Notes: The spectrum masks are given in the table for equipment having an output power greater than 120 mW. For equipment with an output power that does not exceed 120 mW, Section 5.10 applies.

RSS-119, Clause 5.8:

The spectrum plots of the unwanted emissions shall comply with the masks specified in tables below.

The term *displacement frequency, f_d,* used in these sections refers to the difference between the channel frequency and the emission component frequency expressed in kilohertz, and *p* is the transmitter output power in Watts.

5.8.6 **Emission Mask G** for Transmitters not Equipped With an Audio Low-Pass Filter

The power of any emission shall be attenuated below the transmitter output power P (dBW) as specified in Table below:

Table 7.4-3: *Emission Mask G*

Displacement Frequency, f_d (kHz)	Minimum Attenuation (dB)	Resolution Bandwidth (Hz)
$10 < f_d \leq 50$	Whichever is the lesser: 70 or 116 log10(f_d /6.11) or 50 + 10 log10(p)	300
$f_d > 50$	43 + 10 log10(p)	As specified in Section 4.2.1 of RSS-119

References, definitions and limits, continued

RSS-119, Clause 4.2:

When the transmitter unwanted emissions are being measured, a sufficient number of sweeps must be measured to ensure that the emission profile is developed. The video bandwidth shall be at least three times the width of the instrument resolution bandwidth.

For transmitters that do not produce a full power unmodulated carrier, reference to the unmodulated carrier power refers to the total output power contained in the occupied bandwidth when the transmitter is modulated with signals representative of those encountered in a real system operation.

4.2.1 Emission Masks B, C, G, I and J

Unwanted emission measurements can be in peak or averaging mode, provided that the same parameter, peak power or average power, used for the transmitter's output power measurement is also used for the unwanted emission measurements.
Except where otherwise stated, on any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth, a resolution bandwidth of at least 100 kHz must be used for frequencies to be measured at or below 1 GHz, and a resolution bandwidth of at least 1 MHz must be used for frequencies to be measured above 1 GHz. If a narrower resolution bandwidth is used, power integration shall be applied.

4.2.2 Emission Masks D, E, F and Y

In order to show compliance with the emission mask up to and including 50 kHz removed from the edge of the authorized bandwidth, adjust the resolution bandwidth to 100 Hz with the measuring instrument in a peak mode. For emissions beyond 50 kHz from the edge of the authorized bandwidth, the resolution bandwidth shall be 100 kHz for frequencies at or below 1 GHz, and 1 MHz for frequencies above 1 GHz. However, for emission mask F, at a displacement frequency of less than 3.75 kHz, the resolution bandwidth shall be 30 Hz.

7.4.2 Test summary

Verdict	Pass		
Test date	July 26, 2023	Temperature	22 °C
Tested by	Nimish Kapoor	Air pressure	1001 mbar
Test location	Ottawa	Relative humidity	62 %

7.4.3 Observations, settings and special notes

As per client specified, the EUT has 25 kHz channel bandwidth and 20 kHz authorized bandwidth, without audio filter, hence mask G applied

Spectrum analyser settings for spectrum mask:

Resolution bandwidth:	300 Hz
Video bandwidth:	> RBW
Detector mode:	Peak
Trace mode:	Max Hold

Spectrum analyser settings for spurious emissions:

Resolution bandwidth:	100k Hz (below 1 GHz); 1 MHz (above 1 GHz)
Video bandwidth:	> RBW
Detector mode:	Peak
Trace mode:	Max Hold

7.4.4 Test data

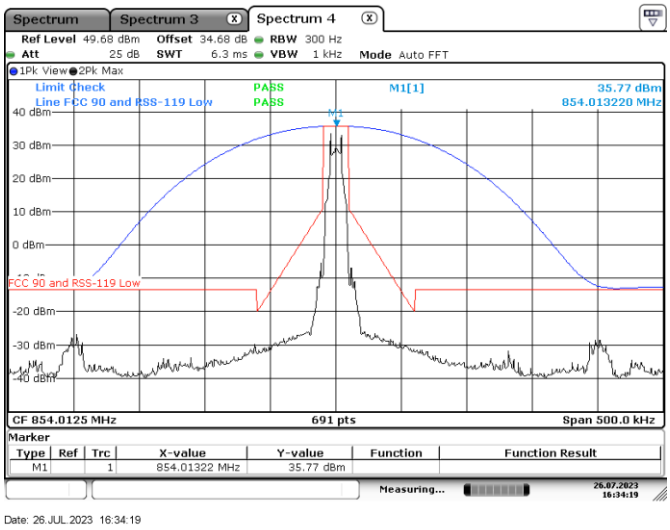


Figure 7.4-1: *Emission mask G for low channel*

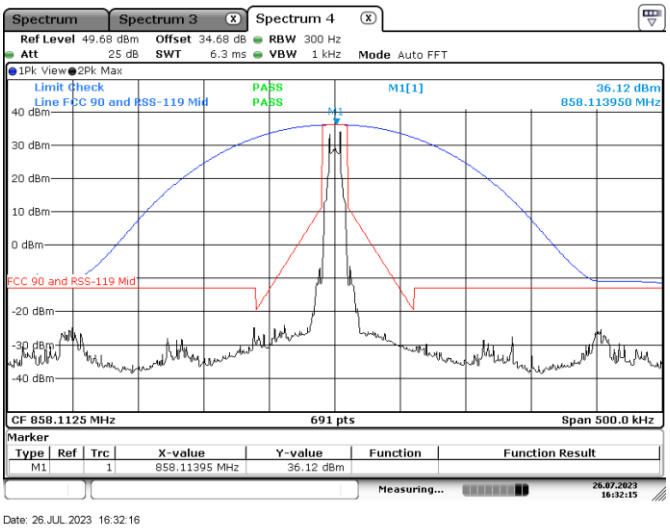


Figure 7.4-2: *Emission mask G for mid channel*

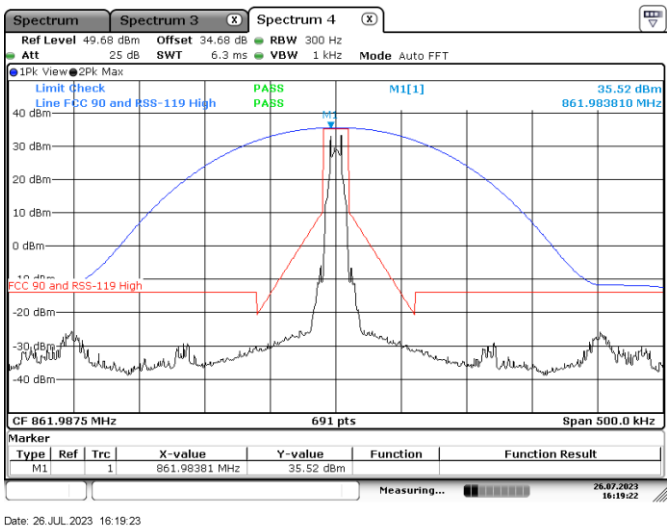


Figure 7.4-3: *Emission mask G for high channel*

Test data, continued

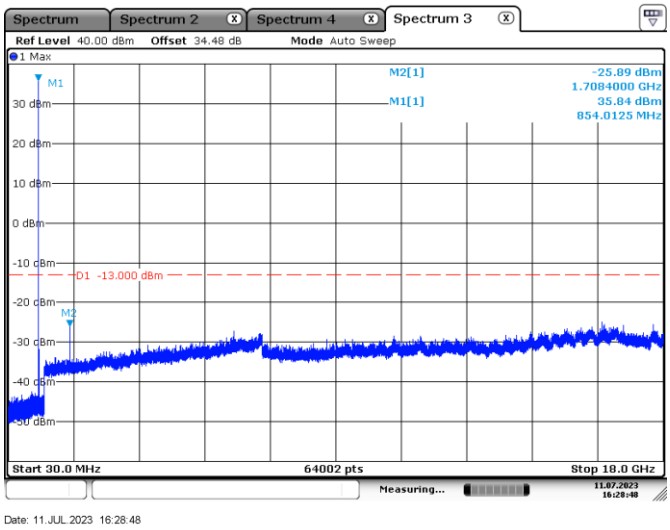


Figure 7.4-4: *Conducted spurious emissions for low channel*

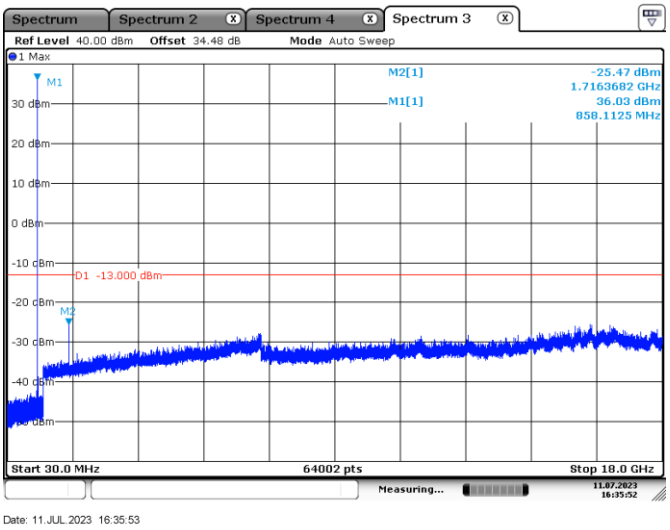


Figure 7.4-5: *Conducted spurious emissions for mid channel*

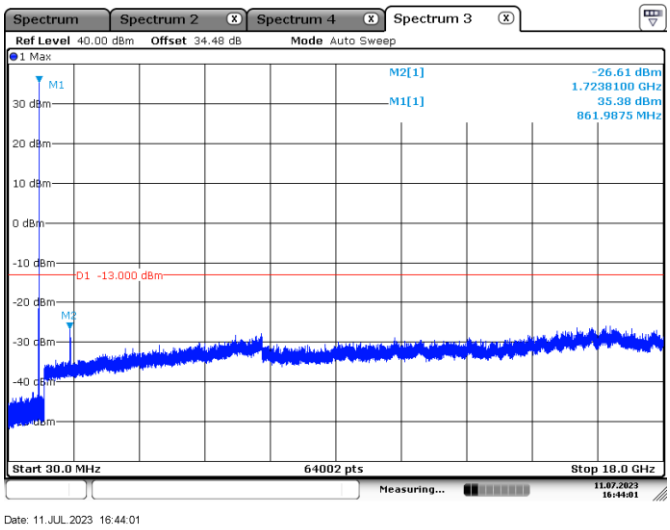


Figure 7.4-6: *Conducted spurious emissions for high channel*

Test data, continued

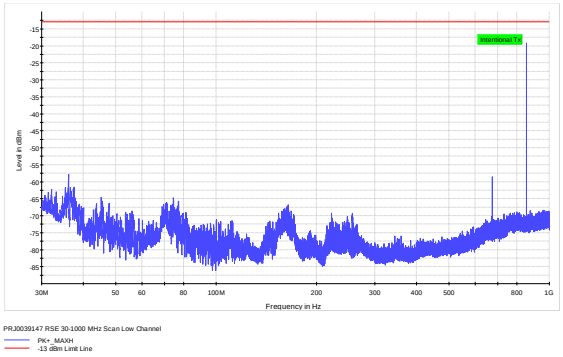


Figure 7.4-7: *Radiated spurious emissions from 30-1000 MHz for low channel*

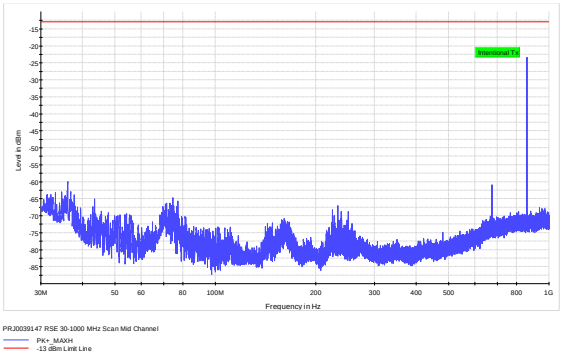


Figure 7.4-8: *Radiated spurious emissions from 30-1000 MHz for mid channel*

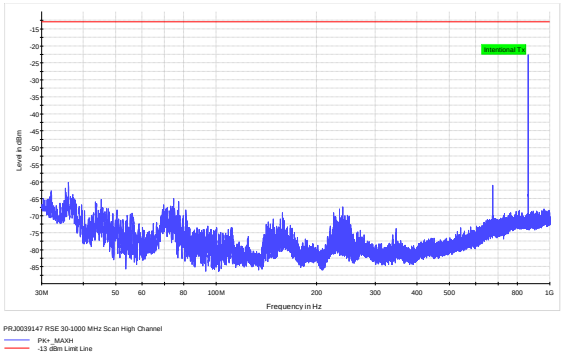


Figure 7.4-9: *Radiated spurious emissions from 30-1000 MHz for high channel*

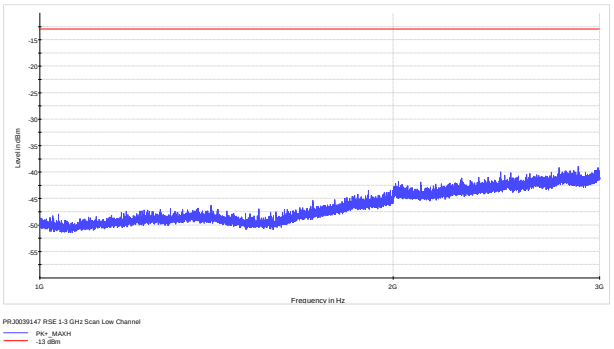


Figure 7.4-10: *Radiated spurious emissions from 1-3 GHz for low channel*

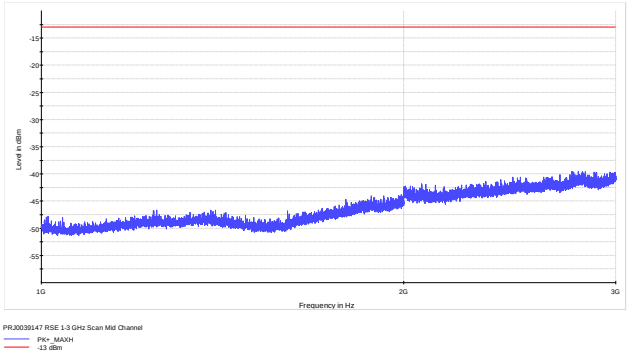


Figure 7.4-11: *Radiated spurious emissions from 1-3 GHz for mid channel*

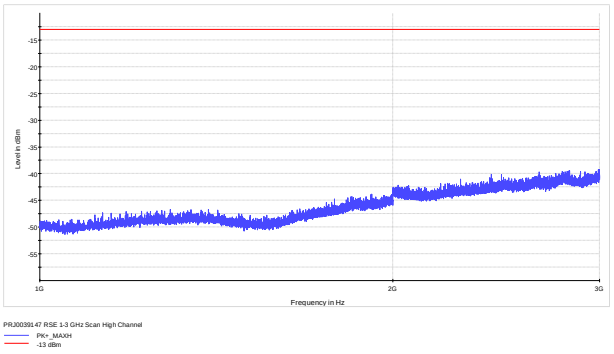


Figure 7.4-12: *Radiated spurious emissions from 1-3 GHz for high channel*

Test data, continued

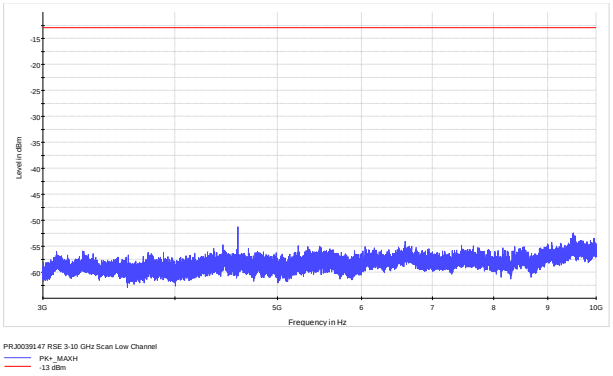


Figure 7.4-13: *Radiated spurious emissions from 3-10 GHz for low channel*

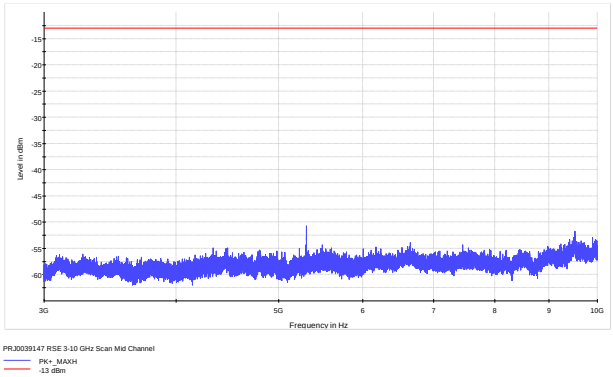


Figure 7.4-14: *Radiated spurious emissions from 3-10 GHz for mid channel*

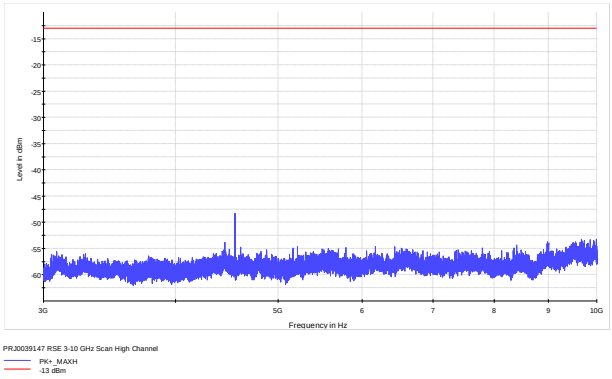


Figure 7.4-15: *Radiated spurious emissions from 3-10 GHz for high channel*

7.5 Transmitter frequency stability

7.5.1 References, definitions and limits

FCC §90.213:

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

Table 7.5-1: *Minimum frequency stability*

Frequency range (MHz)	Fixed and base stations	Mobile stations over 2 watts output power	Mobile stations 2 watts or less output power
854–869	±1.5 ppm	±2.5 ppm	±2.5 ppm

Notes: None

RSS-119, Clause 5.3:

The carrier frequency shall not depart from the reference frequency in excess of the values given in Table below. For transmitters that have an output power of less than 120 mW, the frequency stability shall comply with the limits listed in Table below or, alternatively, with the conditions in Section 5.10.

For fixed and base station equipment, in lieu of meeting the frequency stability limit specified in Table below, the test report can show that the frequency stability is met by demonstrating that the unwanted emission limits, related to the equipment's nominal carrier frequency measured under normal operation, are met when the equipment is tested at the temperature and supply voltage variations specified for the frequency stability measurement in RSS-Gen.

Table 7.5-2: *Transmitter frequency stability*

Frequency range (MHz)	Channel bandwidth (kHz)	Frequency stability for Base/Fixed stations (±ppm)	Frequency stability for mobile stations with output power >2 W (±ppm)	Frequency stability for mobile stations with output power ≤2 W (±ppm)
806-821/851-866 and 821-824/866-869 [1]	25 [2]	0.1	0.1	0.1
	25	1.5	2.5	2.5
	12.5	1	1.5	1.5
	6.25	0.1	0.4	0.4

Notes:
[1] Control stations may operate with the frequency stability specified for associated mobile frequencies.
[2] This provision is for digital equipment with a channel bandwidth of 25 kHz and an occupied bandwidth greater than 20 kHz. The mobile station's frequency stability values given in Table 1 are for mobile, portable and control transmitters using automatic frequency control (AFC) to lock onto the base station signal. When the mobile, portable and control transmitters are operating without using AFC to lock onto the base station signal, the frequency stability limit shall be better than 1 kHz and the equipment's unwanted emissions measured with maximum frequency shift shall still comply with emission mask Y (Section 5.8.10) at nominal carrier frequency.

7.5.2 Test summary

Verdict	Pass		
Test date	July 20, 2023	Temperature	21 °C
Tested by	Nimish Kapoor	Air pressure	995 mbar
Test location	Ottawa	Relative humidity	62 %

7.5.3 Observations, settings and special notes

The EUT was DC powered during the test. Therefore, the voltage variation of ± 15% is based on 48 V_{DC}.

7.5.4 Test data

Table 7.5-3: *Transmitter frequency stability results – Low Channel*

Test conditions	Frequency, Hz	Drift, ppm	Limit ±ppm	Margin, ppm
+50 °C, Nominal	854.012861800	0.42	1.50	1.08
+40 °C, Nominal	854.012861800	0.42	1.50	1.08
+30 °C, Nominal	854.012789400	0.34	1.50	1.16
+20 °C, +15 %	854.012572400	0.08	1.50	1.42
+20 °C, Nominal	854.012500000		**Reference**	
+20 °C, -15 %	854.012500000	0.00	1.50	1.50
+10 °C, Nominal	854.012536200	0.04	1.50	1.46
0 °C, Nominal	854.012355300	-0.17	1.50	1.33
−10 °C, Nominal	854.012138200	-0.42	1.50	1.08
−20 °C, Nominal	854.012065800	-0.51	1.50	0.99
−30 °C, Nominal	854.012138200	-0.42	1.50	1.08

Table 7.5-4: *Transmitter frequency stability results – Mid Channel*

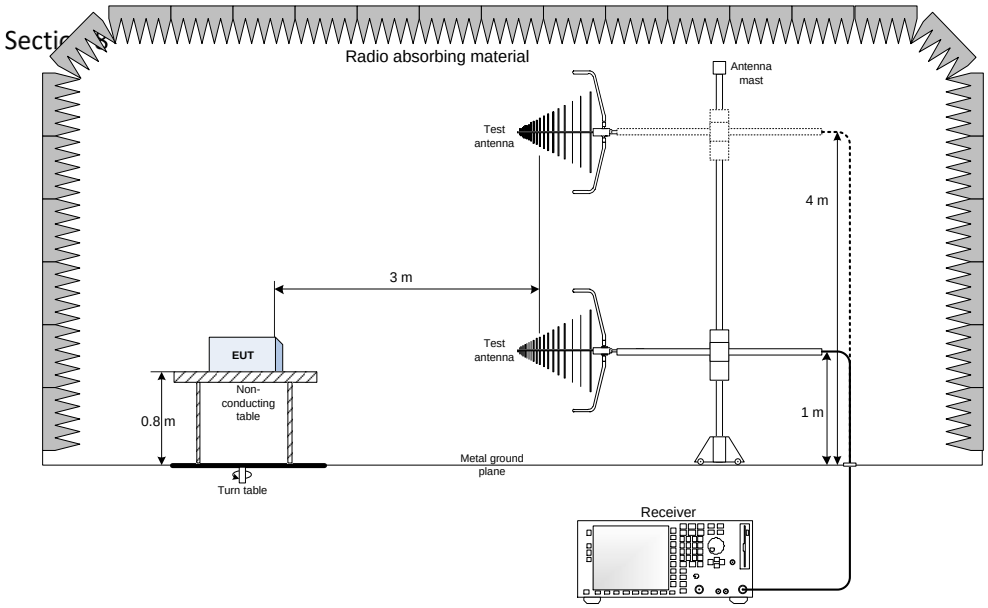
Test conditions	Frequency, Hz	Drift, ppm	Limit ±ppm	Margin, ppm
+50 °C, Nominal	858.112789400	0.25	1.50	1.25
+40 °C, Nominal	858.112789400	0.25	1.50	1.25
+30 °C, Nominal	858.112789400	0.25	1.50	1.25
+20 °C, +15 %	858.112572400	0.00	1.50	1.50
+20 °C, Nominal	858.112572400		**Reference**	
+20 °C, -15 %	858.112608550	0.04	1.50	1.46
+10 °C, Nominal	858.112572400	0.00	1.50	1.50
0 °C, Nominal	858.112355300	-0.25	1.50	1.25
−10 °C, Nominal	858.112138200	-0.51	1.50	0.99
−20 °C, Nominal	858.111993500	-0.67	1.50	0.83
−30 °C, Nominal	858.112138200	-0.51	1.50	0.99

Table 7.5-5: *Transmitter frequency stability results – High Channel*

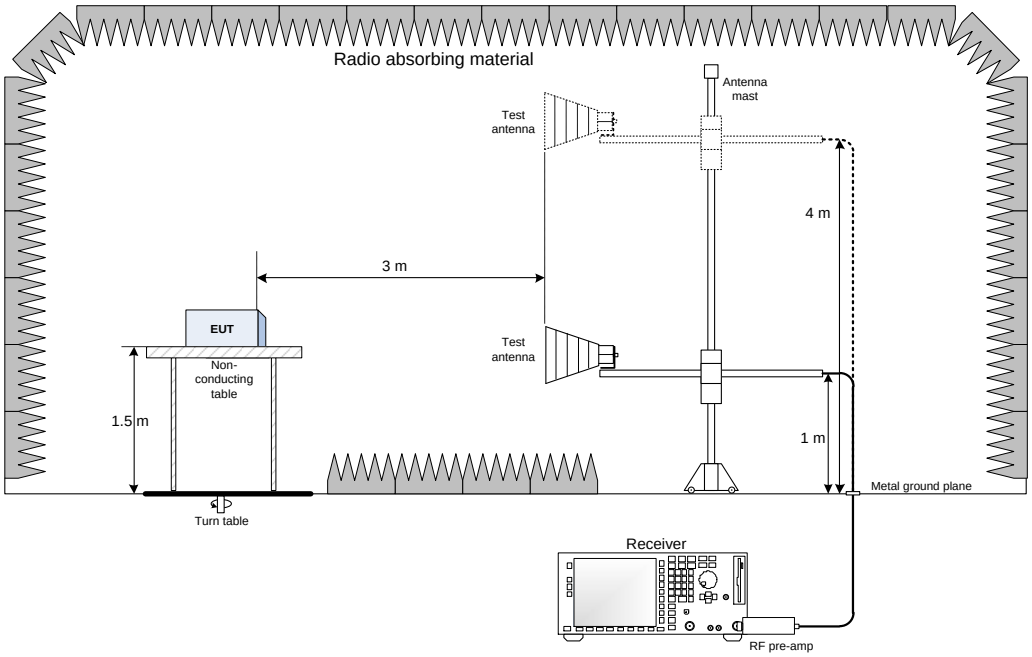
Test conditions	Frequency, Hz	Drift, ppm	Limit ±ppm	Margin, ppm
+50 °C, Nominal	861.987789400	0.34	1.50	1.16
+40 °C, Nominal	861.987861800	0.42	1.50	1.08
+30 °C, Nominal	861.987789400	0.34	1.50	1.16
+20 °C, +15 %	861.987500000	0.00	1.50	1.50
+20 °C, Nominal	861.987500000		**Reference**	
+20 °C, -15 %	861.987500000	0.00	1.50	1.50
+10 °C, Nominal	861.987572400	0.08	1.50	1.42
0 °C, Nominal	861.987282900	-0.25	1.50	1.25
−10 °C, Nominal	861.987138200	-0.42	1.50	1.08
−20 °C, Nominal	861.987065800	-0.50	1.50	1.00
−30 °C, Nominal	861.987138200	-0.42	1.50	1.08

Test setup diagrams

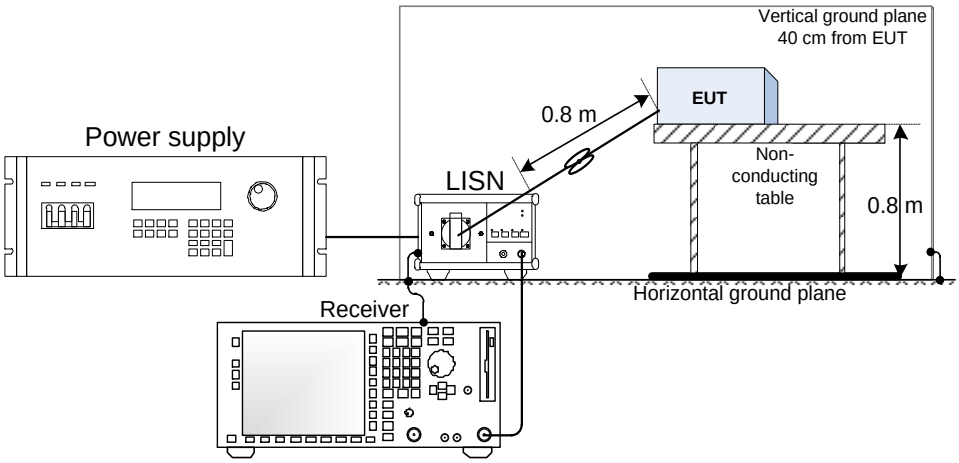
8.1 Radiated emissions set-up for frequencies below 1 GHz



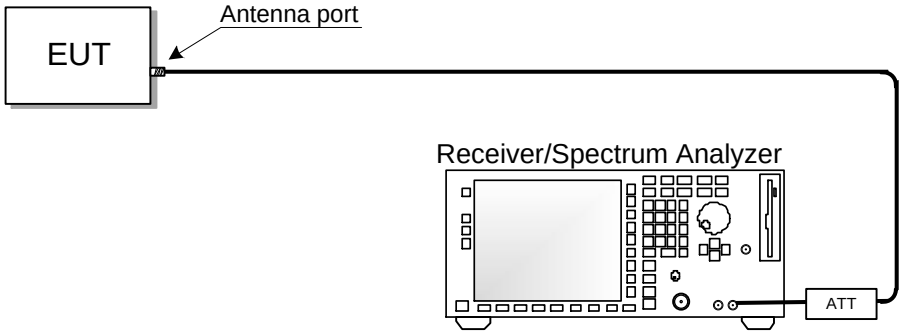
8.2 Radiated emissions set-up for frequencies above 1 GHz



8.3 AC mains conducted emissions set-up



8.4 Antenna port set-up



End of the test report