RF Test Report

Standard(s): FCC Part 15 Subpart 15.249,
RSS-210 Issue 10:2019
Unlicensed Intentional Radiators

Issued To: Broy Engineering Ltd
92 Advance Rd
Toronto, Ontario, M8Z 2T7
Canada

Product Name: BR-RC1190-Mod
Model: BR-RC1190-Mod
FCC ID: 2A8AC-BRRC1190MOD
IC: 28892-BRRC1190MOD

Report No. MEGA290694-RF00
Date of Issue: December 7, 2022

Report Prepared By:

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Reviewed By:

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1. Revision History

Project No. & Revision	Report Date	Initials	Description
MEGA290694-RF00	December 7, 2022	AE	Initial Release
-	-	-	-

NOTE:

- The latest revision replaces previous revisions.
- This report relates only to the sample(s) identified in this report.

2. Summary of Test Results

2.1 Test Verdict

Unless otherwise stated, the results shown in this test report relate only to the sample(s) tested.

Requirement		Test Type	Result	Remark
FCC	ISED			
15.203	--	Antenna Requirement	Pass	Omni-Directional RP-SMA with -0.3dBi Gain
15.249(a)	RSS-210 B.10(a)	Maximum Output Power	Pass	---
15.249(d)	RSS-210 B.10(b)	Transmitter Spurious Radiated Emissions	Pass	---
15.205	RSS-GEN (Table 7)	Restricted Bands for Intentional Operation	Pass	---
--	RSS-GEN 6.7	99% Emission Bandwidth	Pass	---
15.207	RSS-GEN (Table 4)	Power Line Conducted Emissions	N/A	DUT is a module which is DC powered and does not connect to any mains network

N/A = Not Applicable

2.1.1 Test Verdict Notes

The DUT was mounted in three orthogonal axes and worst-case results were obtained in the X-axis. Worst case results are presented. See the Test Setup Photos for axis details.

Antenna details obtained from Antenna Manufacturer's Datasheet. As per FCC 15.203, the antenna uses a Reverse Polarity connection and has less than 6dBi gain.

2.2 Test Standards

Standard	Description
ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10:2013	American National Standard for Testing Unlicensed Wireless Devices
CFR 47 FCC 15 Subpart C	Code of Federal Regulations – Radio Frequency Devices, Intentional Radiators
FCC KDB 558074:2019	FCC KDB 558074 Digital Transmission Systems, measurements and procedures
ICES-003 Issue 7:2020	Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
RSS-GEN Issue 5:2021	General Requirements and Information for the Certification of Radio Apparatus
RSS-210 Issue 10:2019	Licence-Exempt Radio Apparatus: Category I Equipment
ISO 17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories

2.3 Test Facility

All tests were performed at Megalab Group Inc., located at 150 Addison Hall Circle, Aurora, ON, L4G 3X8, Canada.
The 10-meter semi-anechoic chamber for radiated emission and radiated immunity is designed to handle weights of up to 10,000lb and has power capability of over 100A. The turntable is capable of supporting test devices or systems either floor standing or table top of up to 4 meters wide and 3m tall. Conducted emissions, unless otherwise specified, are performed on a 2.44m x 2.48m ground plane and using a 2.44m x 2.48m vertical ground plane if applicable.

2.3.1 Accreditations

This report does not indicate any product endorsement by any government, accreditation agency, or Megalab Group Inc. Megalab Group Inc. shall have no liability for any deductions, interpretations or generalizations drawn by the client or others from the issued reports. If any opinions or interpretations are expressed in this report, they are outside Megalab Group Inc.'s scope of accreditation and do not necessarily reflect the opinions of Megalab Group Inc., unless otherwise specified.

A2LA (Certificate #5179.02)

Megalab Group Inc. is accredited to ISO/IEC 17025:2017 by the American Association for Laboratory Accreditation (A2LA) with Testing Certificate #5179.02. The laboratories current scope of accreditation can be found as listed on A2LA's website.

ISED

Megalab Group Inc. is registered with and recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory.
Company Number: 28697

FCC

Megalab Group Inc. is registered with and recognized by the Federal Communications Commission (FCC) as an accredited testing laboratory.
Registration No. 200040

2.3.2 Measurement Uncertainty

As per ISO/IEC 17025 requirements, an evaluation of the measurement uncertainties associated with the emission test results should be included in the test report.

Where relevant, the following measurement uncertainty levels have been estimated for the tests performed on the DUT as specified in CISPR 16-4-2. The measurement uncertainties given below are based on a coverage factor k = 2 which yields approximately a 95% level of confidence for the near-normal distribution typical of most measurement results.

Measurement	Frequency Range	Uncertainty
Conducted Emissions at AC Mains Power Port	150kHz to 30MHz	2.27 dB
Radiated Emissions	30MHz to 1GHz	5.22 dB
	1GHz to 18GHz	4.76 dB

2.3.3 Sample Calculations

Radiated Emissions

Emission Level (dBµV/m) =	Read Level (dBµV)	+	Antenna Factor (dB/m)	+	Cable Loss (dB)	-	Pre-Amp Gain (dB)	
=	52.4	+	9.4	+	1.3	-	29.2	
=	33.9							

Margin (dB) =	Limit (dBµV/m)	-	Emission Level (dBµV/m)
=	50.0	-	33.9
=	16.1		

3. General Information

3.1 Client Information

Company	Broy Engineering Ltd
Address	92 Advance Rd Toronto, Ontario, M8Z 2T7 Canada
Contact	David Fancie
Email	david2010@broy.com
Phone	416-231-5535 ext. 230

3.2 Device Under Test (DUT)

3.2.1 DUT Information

DUT Name	BR-RC1190-Mod
DUT Model(s)	BR-RC1190-Mod
Power Source (AC / DC / Battery)	DC
Input Voltage (V) or Range	5VDC +-10%
Frequency (Hz) or Range	N/A
Mode(s) of Operation	- Continuous Operation - 30% Duty Cycle Operation
Connectors Available on DUT	Power/Ground, UART (TXD-, RXD-), Reset, Config Mode
DUT Dimensions (L x W x H)	35.05mm x 38.10mm x 13.90mm (L: 48.45mm including antenna connector)
Transmitter Information	
FCC ID	2A8AC-BRRC1190MOD
IC	28892-BRRC1190MOD
Technology Used	RC232™ Embedded Protocol
Operating Frequency	902-928MHz
Modulation Type	GFSK
Number of Channels	50
Data Rate	1.2kbit/s max 4 bytes 4.8kbit/s max 18 bytes 19.0kbit/s max 71 bytes 32.768kbit/s max 122 bytes 76.8kbit/s max 288 bytes 100kbit/s max 375 bytes
Antenna Manufacturer	Linx
Antenna Model	ANT-916-CW-HD
Antenna Type	Omni-Directional RP-SMA
Antenna Gain	-0.3dBi

Note: Above antenna information is provided by the client. The characteristics and gain are obtained from the Antenna Manufacturer's Data Sheet.

3.2.2 DUT Description

The BR-RC1190-Mod is a multi-channel RF transceiver module designed for GFSK operation in the 902-928MHz frequency band. It uses the Embedded RC232 protocol and features a two-wire UART interface.

3.3 Test Setup of DUT

3.3.1 Configuration

The DUT was configured with the following parameters

- For all the tests, the DUT was set to transmit continuously with 100% duty cycle
- Output Power: -5dBm
- Channels: 1 (low), 25 (Mid), 50 (High)
- CRC Disabled
- Device is limited to 30% duty cycle under normal operation. Maximum output power was measured with the device configured for 30% duty cycle with the following parameters
    - Data Rate: 19.2kbps
    - Packet length: 64 bytes
    - Send 8 random bytes every 1s

3.3.2 Support Equipment

Device	Manufacturer	Model	S/N
DC Power Source	Agilent	E3630A	N/A
Laptop	Samsung	N/A	N/A
RC232-CCT Test Software v1.13	Radiocrafts	N/A	N/A

3.4 Modifications for Compliance

No modifications were made to the device under test to achieve compliance with the testing requirements.

4. Test Results

4.1 Maximum Output Power

Test Date:	October 31, 2022	Initials:	AE
Temperature (°C)	20.3		
Relative Humidity (%)	33.7		
Barometric Pressure (kPa)	97.6		

4.1.1 Limits

Fundamental Frequency	Field Strength of Fundamental At 3m	Field Strength of Harmonics At 3m
902 – 928MHz	50 mV/m (94 dBuV/m)	500 uV/m (54 dBuV/m)

Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits, whichever is less stringent, as listed in FCC 15.209 and RSS-Gen 8.9 Table 5 and 6. See also the Spurious Radiated Emissions section of this test report.

For fundamental frequencies below or equal to 1000 MHz, the limit shown is based on a CISPR Quasi-Peak detector with measurement bandwidth of 120kHz. For any frequencies above 1000 MHz, the limit is based on an average detector with a minimum measurement bandwidth of 1MHz.

4.1.2 Test Procedure

Tested according to ANSI C63.10 Section 6.5.4.

The device under test was setup inside a semi-anechoic chamber with remotely controlled turntable and antenna positioner at a 3m test distance. The DUT was placed on a non-metallic, RF transparent stand 0.8 meters above the ground plane for frequencies below 1GHz and 1.5 meters for frequencies above 1GHz.

Measurements were performed with the DUT rotated from 0° to 360°, the antenna height varied between 1 m and 4 m, and the antenna rotated to repeat the measurements for both the horizontal and vertical antenna polarizations.

The DUT was verified in X, Y, and Z axes.

4.1.3 Test Results

Frequency (MHz)	Detector	Antenna Polarization	Reading (dBµV)	Correction Factor (dB)	Emission Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Test Result
DUT Axis: X								
902.50	QP	Vert	51.4	42.3	93.6	94.0	0.4	Pass
902.50	QP	Horz	50.8	42.3	93.1	94.0	0.9	Pass
914.48	QP	Vert	50.3	43.1	93.5	94.0	0.5	Pass
914.48	QP	Horz	48.4	43.1	91.5	94.0	2.5	Pass
926.96	QP	Vert	49.7	44.1	93.8	94.0	0.2	Pass
926.96	QP	Horz	47.2	44.1	91.3	94.0	2.7	Pass
DUT Axis: Y								
902.50	QP	Vert	50.5	42.3	92.7	94.0	1.3	Pass
902.50	QP	Horz	42.6	42.3	84.9	94.0	9.1	Pass
DUT Axis: Z								
902.50	QP	Vert	42.4	42.3	84.6	94.0	9.4	Pass
902.50	QP	Horz	49.4	42.3	91.6	94.0	2.4	Pass

4.1.4 Test Equipment List

Equipment ID	Description	Manufacturer	Model	Calibration Date	Calibration Due
EQ_EMC_58	EMI Receiver	Rohde & Schwarz	ESW 44	Feb 03, 2022	Feb 03, 2024
EQ_EMC_59	BiLog Antenna	ETS Lindgren	3142E	Feb 27, 2022	Feb 27, 2024
EQ_EMC_68	6dB Attenuator	Fairview Microwave	SA3NS-06	NCR	NCR
EQ_EMC_70	10dB Attenuator	Fairview Microwave	SA3N5W-10	NCR	NCR
EQ_EMC_85	RF Cable <1GHz	Times Microwave	LMR-400	NCR	NCR

NCR = No Calibration Required

4.2 Spurious Radiated Emissions

Test Date:	October 31, 2022	Initials:	AE
Temperature (°C)	20.3		
Relative Humidity (%)	33.7		
Barometric Pressure (kPa)	97.6		

4.2.1 Limits

Frequency Range (MHz)	Field Strength Limit		Field Strength at 3m (dBµV/m)	Detector Type / Measurement Bandwidth
	µV/m	Distance		
0.009 – 0.150	2400/F(kHz)	300	128.5 – 104.1	Quasi-Peak‡ / 200Hz
0.150 – 0.490	2400/F(kHz)	300	104.1 – 93.8	Quasi-Peak‡ / 9kHz
0.490 – 1.705	24000/F(kHz)	30	73.8 – 63.0	Quasi-Peak / 9kHz
1.705 – 30	30	30	69.5	Quasi-Peak / 9kHz
30 – 88	100	3	40.0	Quasi-Peak / 120kHz
88 – 216	150	3	43.5	Quasi-Peak / 120kHz
216 – 960	200	3	46.0	Quasi-Peak / 120kHz
960 – 1000	500	3	54.0	Quasi-Peak / 120kHz
Above 1000	500	3	54.0	Average / 1MHz
Above 1000	5000	3	74.0	Peak / 1MHz

‡The emission limits below 1GHz shown in the above table are based on measurements employing a CISPR Quasi-Peak detector except for the frequency bands 9-90 kHz and 110-490 kHz. Radiated emission limits in these two bands are based on measurements employing an average detector.

4.2.2 Test Procedure

Tested according to ANSI C63.10 Section 6.3.

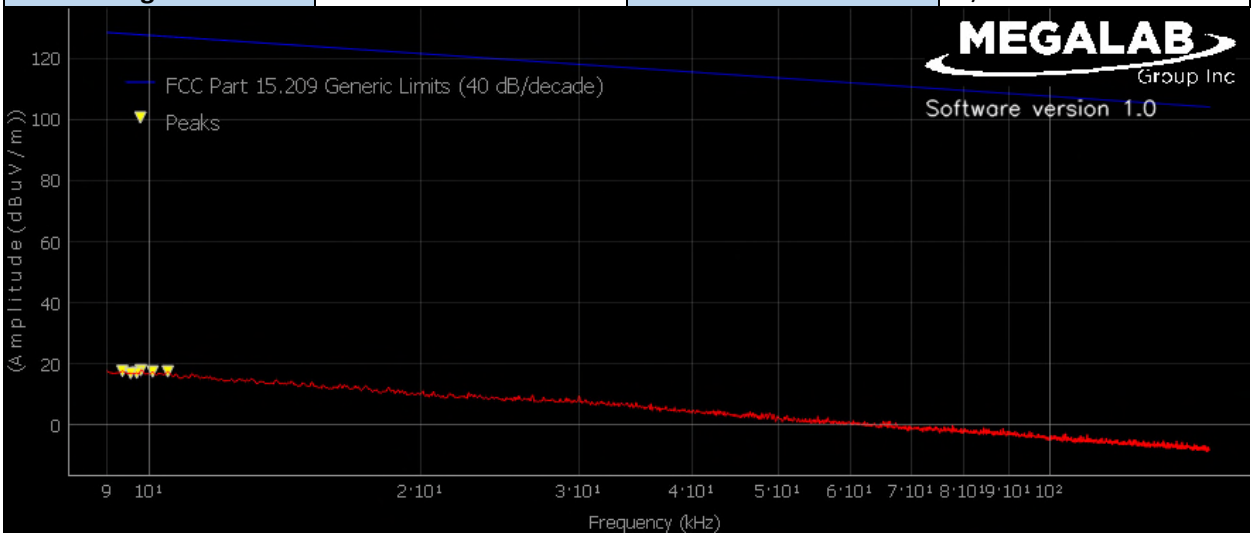
The device under test was setup inside a semi-anechoic chamber with remotely controlled turntable and antenna positioner at a 3m test distance. The DUT was placed on a non-metallic stand 0.8 meters above the ground plane for frequencies below 1GHz and 1.5 meters for frequencies above 1GHz.

To determine the emission characteristics of the DUT, exploratory radiated emission scans were made while rotating the turntable 0° to 360° and using a Peak detector. The results were recorded in graphical form. As per FCC Part 15, Subpart A, Section 15.33, the DUT was scanned to the 10th harmonic of the highest fundamental frequency (a minimum of 9280 MHz).

For each suspected emission, final measurements of the DUT radiated emissions with the Quasi-Peak, Average or Peak detector, as defined in the limits table above, were made with the turntable azimuth rotated 0° to 360° and antenna height varied from 1m to 4m. The antenna was positioned to receive emissions in the vertical and horizontal polarizations such that the maximum radiated emission levels were detected.

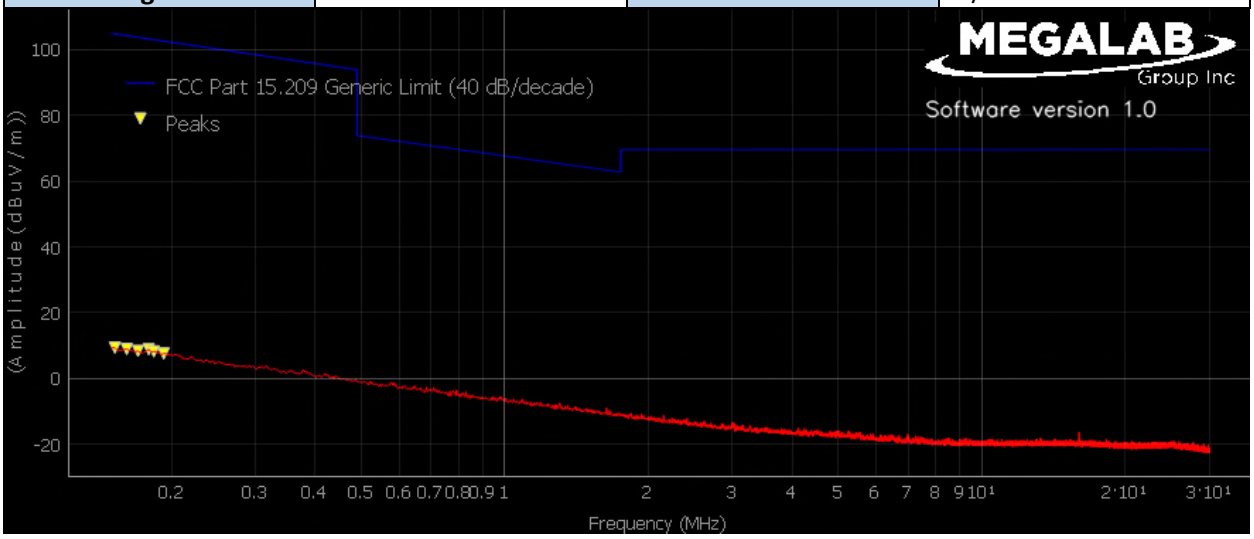
4.2.3 Test Results

Range:	9kHz to 150kHz	Tx Frequency	902.50MHz
Test Voltage:	5Vdc	Antenna Polarization	N/A



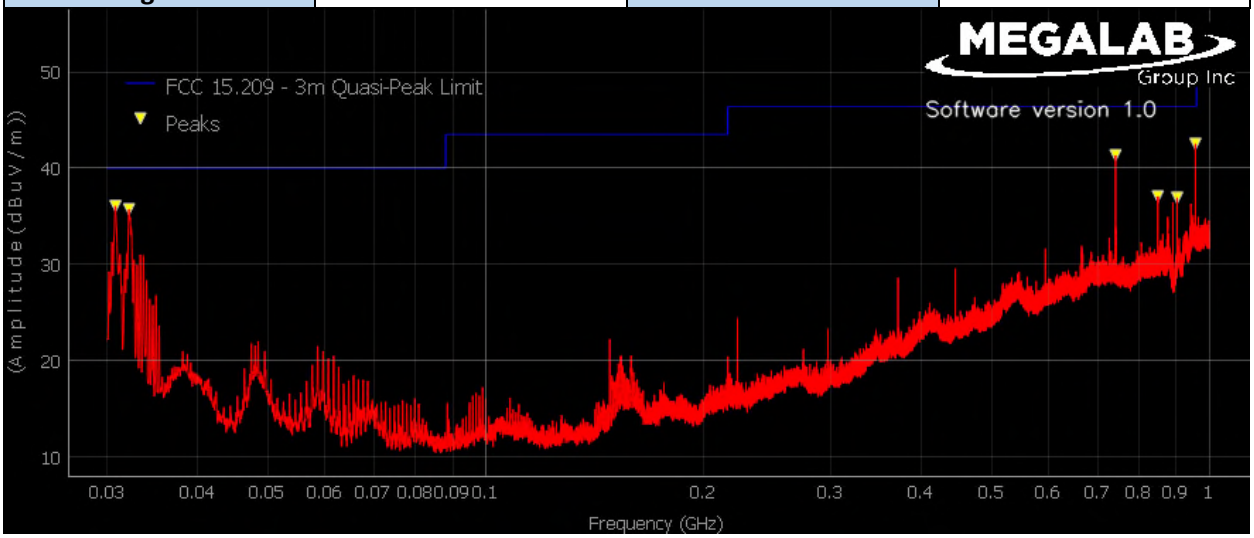
Remark: Peak Emission Plot

Range:	150kHz to 30MHz	Tx Frequency	902.50MHz
Test Voltage:	5Vdc	Antenna Polarization	N/A



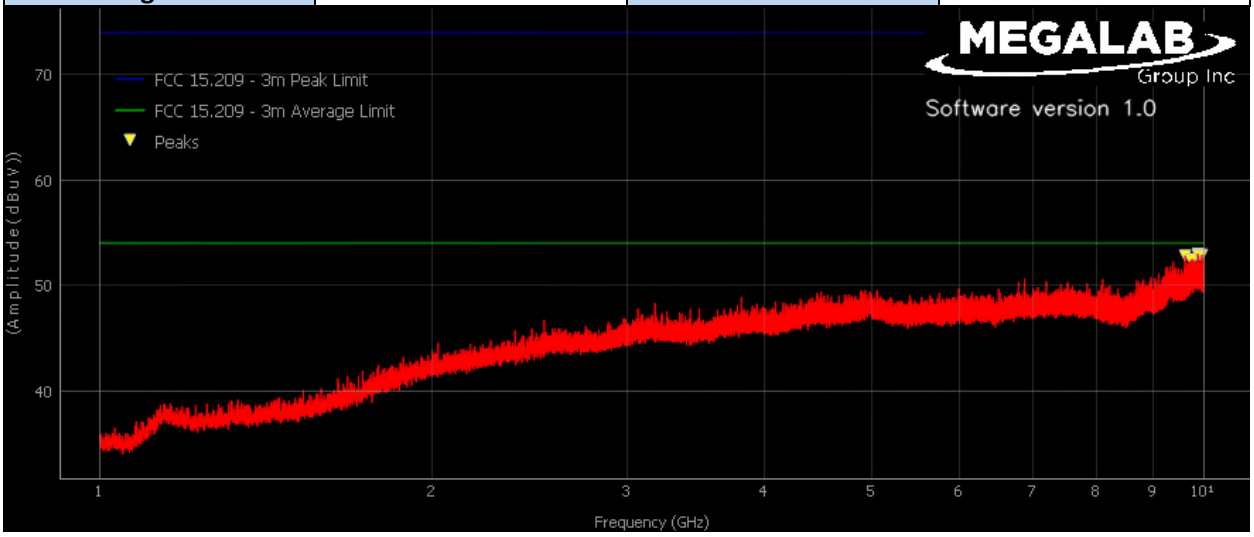
Remark: Peak Emission Plot

Range:	30MHz to 1GHz	**Tx Frequency**	902.50MHz
Test Voltage:	5Vdc	**Antenna Polarization**	Horizontal



Remark: - Peak Emission Plot
- A Notch filter was used to filter out the fundamental

Range:	1GHz to 10GHz	**Tx Frequency**	902.50MHz
Test Voltage:	5Vdc	**Antenna Polarization**	Horizontal

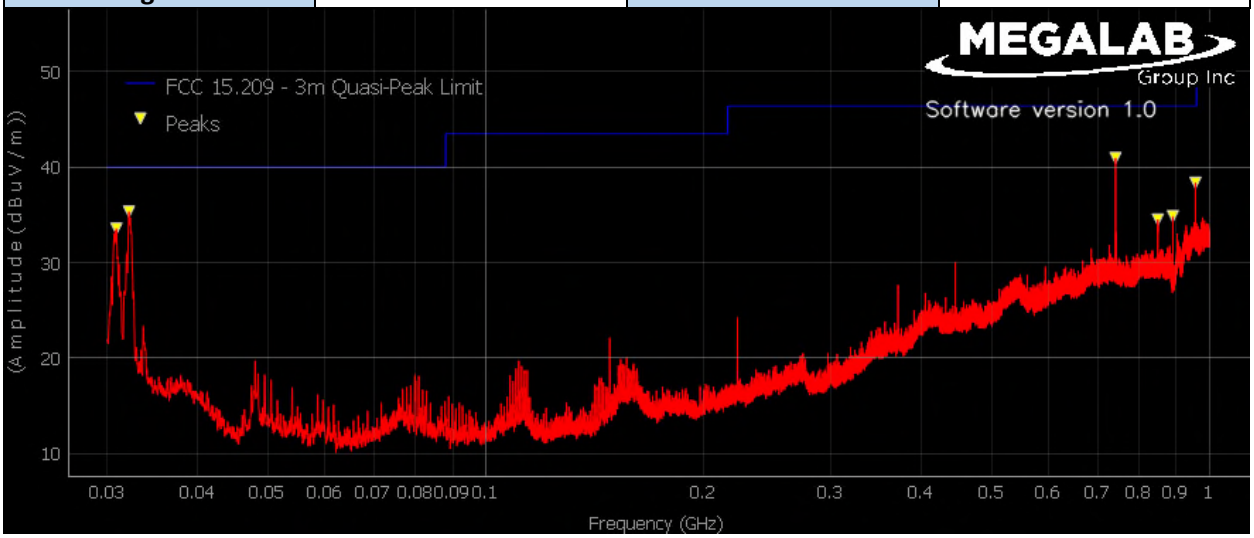


Remark: Peak Emission Plot

Horizontal Antenna Polarization							
Frequency (MHz)	**Detector**	**Reading (dBµV)**	**Correction Factor (dB)**	**Emission Level (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Test Result**
956.55	QP	34.7	5.5	40.2	46.4	6.2	Pass
741.75	QP	35.6	1.8	37.4	46.4	9.0	Pass
30.78	QP	43.4	-7.3	30.8	40.0	9.2	Pass
32.13	QP	43.9	-8.1	32.1	40.0	7.9	Pass
848.46	PEAK	34.2	2.8	37.1	46.4	9.3	Pass
902.46	PEAK	33.8	3.1	36.9	46.4	9.5	Pass
9754.75	AVG	31.8	7.9	39.7	54.0	14.3	Pass
9819.25	AVG	31.7	8.1	39.7	54.0	14.3	Pass

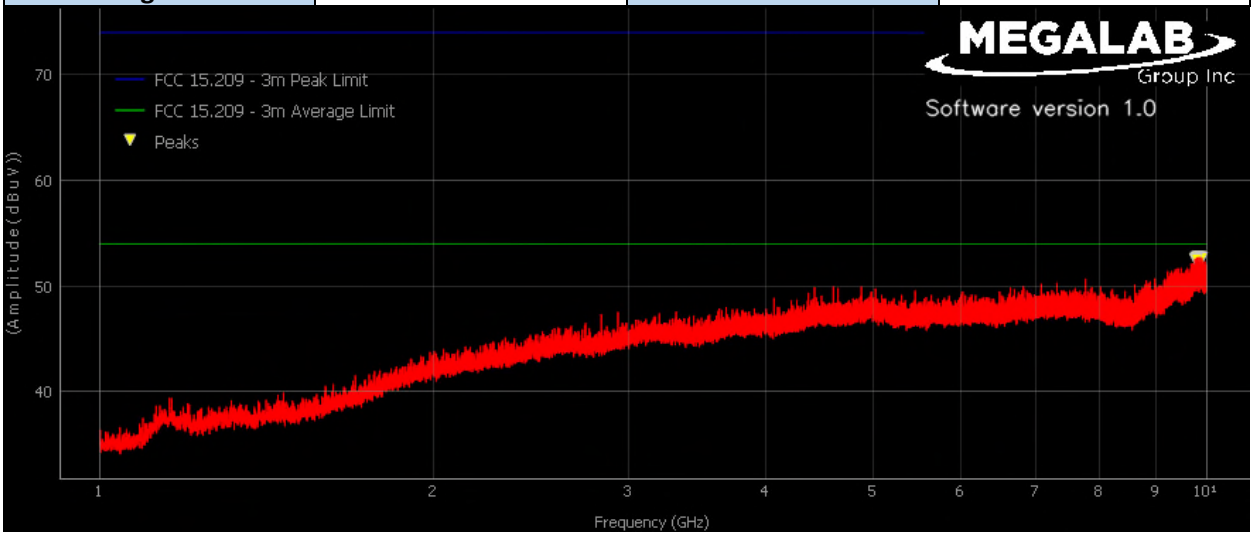
Worst case position: Angle: 0 Deg
Height: 151 cm

Range:	30MHz to 1GHz	Tx Frequency	902.50MHz
Test Voltage:	5Vdc	Antenna Polarization	Vertical



Remark: - Peak Emission Plot
- A Notch filter was used to filter out the fundamental

Range:	1GHz to 10GHz	Tx Frequency	902.50MHz
Test Voltage:	5Vdc	Antenna Polarization	Vertical



Remark: Peak Emission Plot

Vertical Antenna Polarization							
Frequency (MHz)	**Detector**	**Reading (dBµV)**	**Correction Factor (dB)**	**Emission Level (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Test Result**
741.75	QP	36.5	1.8	38.3	46.4	8.1	Pass
32.13	QP	37.1	-8.1	35.3	40.0	4.7	Pass
956.55	PEAK	32.9	5.5	38.4	46.4	8.0	Pass
890.10	PEAK	32.4	2.5	34.9	46.4	11.6	Pass
848.46	PEAK	31.7	2.8	34.5	46.4	11.9	Pass
30.87	PEAK	40.9	-7.4	33.5	40.0	6.5	Pass
9655.00	AVG	31.5	7.7	39.2	54.0	14.9	Pass
9819.00	AVG	32.2	8.1	40.3	54.0	13.8	Pass

Worst case position: Angle: 205 Deg
Height: 155 cm

4.2.4 Test Equipment List

Equipment ID	Description	Manufacturer	Model	Calibration Date	Calibration Due
EQ_EMC_58	EMI Receiver	Rohde & Schwarz	ESW 44	Feb 03, 2022	Feb 03, 2024
EQ_EMC_48	Loop Antenna	Com-Power	AL-130R	May 4, 2022	May 4, 2024
EQ_EMC_59	BiLog Antenna	ETS Lindgren	3142E	Feb 27, 2022	Feb 27, 2024
EQ_EMC_60	Horn Antenna	ETS Lindgren	3117	Mar 11, 2022	Mar 11, 2024
EQ_EMC_68	6dB Attenuator	Fairview Microwave	SA3NS-06	NCR	NCR
EQ_EMC_85	RF Cable <1GHz	Times Microwave	LMR-400	NCR	NCR
EQ_EMC_75	RF Cable >1GHz	MegaPhase	EMC2	NCR	NCR
EQ_EMC_89	Preamplifier 9kHz-1GHz	Teseq	LNA 6901	May 12, 2022	May 12, 2024
EQ_EMC_42	Preamplifier 1GHz-18GHz	Com-Power	PAM-118A	Mar 24, 2022	Mar 24, 2024
EQ_EMC_107	902 - 928MHz Notch Filter	Micro-Tronics	BRC50722	NCR	NCR
EQ_EMC_110	1.0 - 18GHz HPF Filter	Micro-Tronics	HPM50108	NCR	NCR
EQ_EMC_96	Emissions Software	Megalab Group	EMI V1.0	NCR	NCR

NCR = No Calibration Required

4.3 Emission Bandwidth

Test Date:	September 8, 2022	Initials:	AE
Temperature (°C)	23.2		
Relative Humidity (%)	52.6		
Barometric Pressure (kPa)	97.9		

4.3.1 Limits

The 99% bandwidth of devices using digital modulation techniques shall fall completely within the operating frequency band of 902 to 928 MHz at all times.

4.3.2 Test Procedure

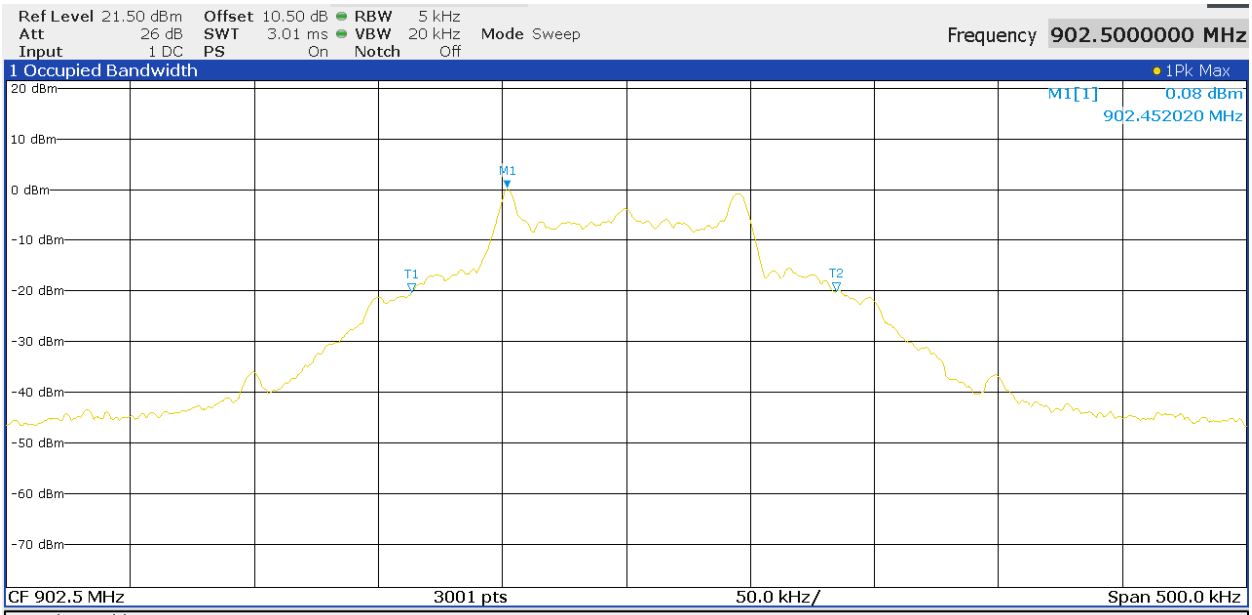
Tested according to ANSI C63.10 Section 6.9.3 and RSS-GEN 6.7.

The resolution bandwidth (RBW) was set in the range of 1% to 5% of the actual occupied bandwidth and the video bandwidth (VBW) was set to no smaller than three times the RBW value.

4.3.3 Test Results

99% Bandwidth				
Frequency (MHz)	**F_{LOW} (MHz)**	**F_{HIGH} (MHz)**	**Occupied Bandwidth (kHz)**	**Test Result**
902.50	902.4134	902.5848	171.35	Pass
914.48	914.3975	914.5685	171.04	Pass
926.96	926.8804	927.0517	171.36	Pass

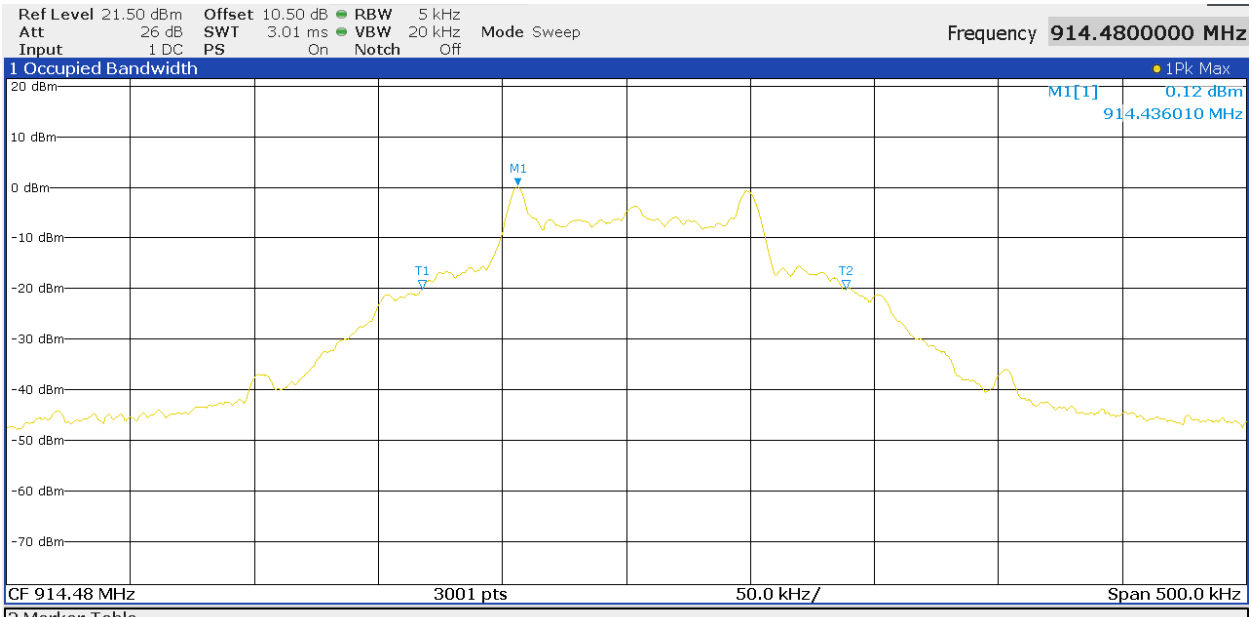
4.3.4 Plots



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**902.45202 MHz**	**0.08 dBm**	Occ Bw	**171.351494659 kHz**
T1		1	902.413443 MHz	-20.22 dBm	Occ Bw Centroid	902.499119185 MHz
T2		1	902.584795 MHz	-20.03 dBm	Occ Bw Freq Offset	-880.815474391 Hz

Figure 1 – 99% Bandwidth - Low Channel



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**914.43601 MHz**	**0.12 dBm**	Occ Bw	**171.036393139 kHz**
T1		1	914.397519 MHz	-20.04 dBm	Occ Bw Centroid	914.483037047 MHz
T2		1	914.568555 MHz	-20.10 dBm	Occ Bw Freq Offset	3.037046878 kHz

Figure 2 – 99% Bandwidth - Mid Channel

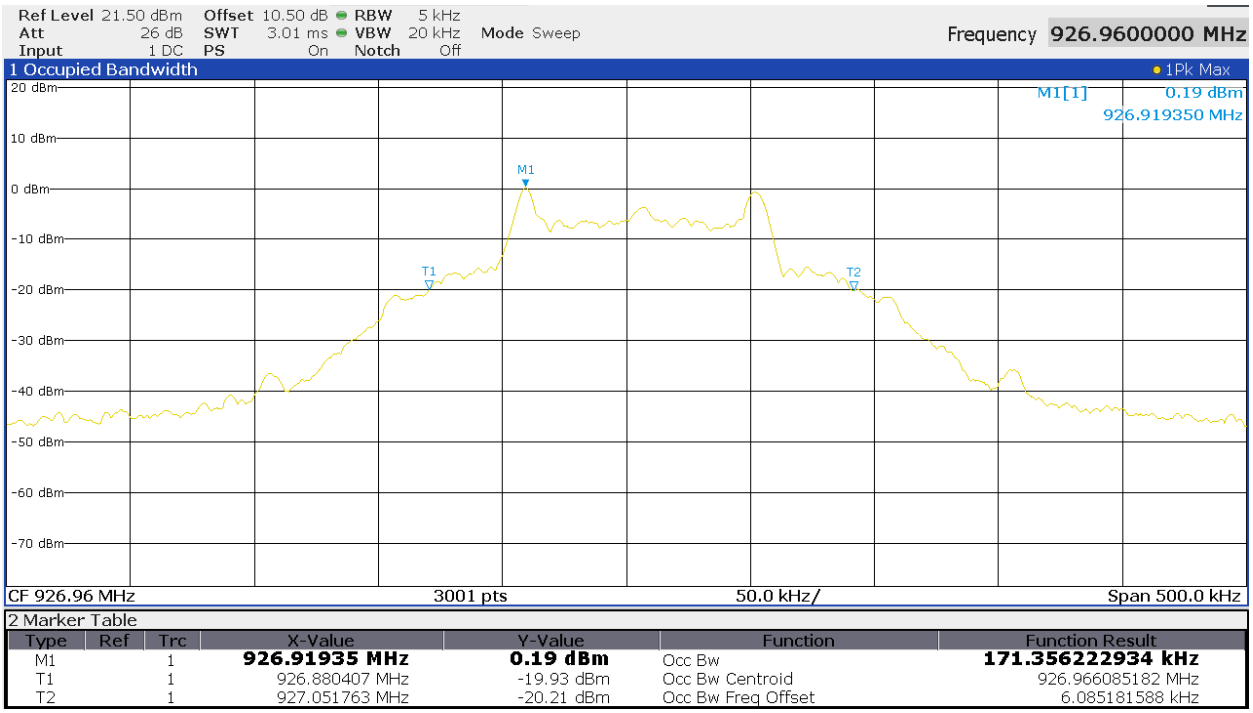


Figure 3 – 99% Bandwidth - High Channel

4.3.5 Test Equipment List

Equipment ID	Description	Manufacturer	Model	Calibration Date	Calibration Due
EQ_EMC_58	EMI Receiver	Rohde & Schwarz	ESW 44	Feb 03, 2022	Feb 03, 2024
EQ_EMC_115	10dB Attenuator	Fairview Microwave	SA18E-10	NCR	NCR

NCR = No Calibration Required

5. Test Setup Photos

Refer to Test Setup Photos file separate from this report

---------- End of Test Report ----------