REGULATORY COMPLIANCE TEST REPORT

FCC Part 15 Subpart C 15.247 (DTS)
ISED RSS-247 Issue 3

Report No.: PELC01-U2 Rev A

Company: Pelican Wireless Systems

Model Name: 915 MHz Module

REGULATORY COMPLIANCE TEST REPORT

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Model Name: 915 MHz Module

To: FCC Part 15 Subpart C 15.247 (DTS) & ISED RSS-247 Issue 3

Test Report Serial No.: PELC01-U2 Rev A

This report supersedes: NONE

Applicant: Pelican Wireless Systems
2655 Collier Canyon Rd
Livermore, CA 94551
United States of America

Issue Date: 8th May 2024

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.
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ACCREDITED
TESTING CERT #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

Table of Contents

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

1. ACCREDITATION, LISTINGS & RECOGNITION

1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2017. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-01.pdf

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Accredited Laboratory

A2LA has accredited

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for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

CORPORATE SEAL 1978 A2LA

Presented this 28th day of February 2024.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2025

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

1.2. RECOGNITION

MiCOM Labs, Inc is widely recognized for its wireless testing and certification capabilities. In addition to being recognized for Testing and Certification under Phase 2 Mutual Recognition Agreements (MRA) with Canada, Europe, United Kingdom and Japan, our international recognition includes Conformity Assessment Body (CAB) designation status under agreements with Asia Pacific (APEC) MRA Phase 1 countries giving acceptance of MiCOM Labs test reports. MiCOM Labs test reports are accepted globally.

Country	Recognition Body	Status	MRA Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	US0159 Test Firm Designation#: US1084
Canada	Industry Canada (ISED)	FCB	APEC MRA 2	US0159 ISED#: 4143A
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	Japan MRA 2	RCB 210
	Japan Approvals Institute for Telecommunication Equipment (JATE)			
	VCCI	--	--	A-0012
Europe	European Commission	NB	EU MRA 2	NB 2280
United Kingdom	Department for Business, Energy & Industrial Strategy (BEIS)	AB	UK MRA 2	AB 2280
Mexico	Instituto Federal de Telecomunicaciones (IFT)	CAB	Mexico MRA 1	US0159
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)			
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)			
Singapore	Infocomm Development Authority (IDA)			
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)			
Vietnam	Ministry of Communication (MIC)			

TCB – Telecommunications Certification Bodies (TCB)
FCB – Foreign Certification Body
CAB – Conformity Assessment Body
NB – Notified Body
AB – Approved Body
MRA – Mutual Recognition Agreement
MRA Phase I - recognition for product testing
MRA Phase II – recognition for both product testing and certification

1.3. PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065:2012. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-02.pdf

Accredited Product Certification Body

A2LA has accredited

MiCOM LABS

Pleasanton, CA

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC 17065:2012 *Requirements for bodies certifying products, processes and services*. This product certification body also meets the *A2LA R322 – Specific Requirements – Notified Body Accreditation Requirements* and *A2LA R308 - Specific Requirements - ISO-IEC 17065 - Telecommunication Certification Body Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a management system.

Presented this 28th day of February 2024.

Mr. Trace McInturff, Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2025

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

United States of America – Telecommunication Certification Body (TCB)
Industry Canada – Certification Body, CAB Identifier – US0159
Europe – Notified Body (NB), NB Identifier - 2280
UK – Approved Body (AB), AB Identifier - 2280
Japan – Recognized Certification Body (RCB), RCB Identifier - 210

2. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	1st May 2024	Draft report for Client Review.
Rev A	8th May 2024	Initial release.

In the above table the latest report revision will replace all earlier versions.

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3. TEST RESULT CERTIFICATE

Manufacturer:	Pelican Wireless Systems 2655 Collier Canyon Rd Livermore, CA 94551 USA	**Tested By:**	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Model:	915 MHz Module	**Telephone:**	+1 925 462 0304
Type Of Equipment:	Wireless Module	**Fax:**	+1 925 462 0306
S/N's:	Sample #1		
Test Date(s):	18th – 19th April 2024	**Website:**	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC CFR 47 Part 15 Subpart C 15.247 (DTS) **ISED RSS-247 Issue 3**	**EQUIPMENT COMPLIES**

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.

2. Details of test methods used have been recorded and kept on file by the laboratory.

3. Test results apply only to the item(s) tested.

ACCREDITED
TESTING CERT #2381.01

Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

4. REFERENCES AND MEASUREMENT UNCERTAINTY

4.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
I	KDB 558074 D01 v05r02	Apr 2019	Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices operating under section 15.247 of the FCC Rules.
II	A2LA	22nd June 2022	R105 - Requirement's When Making Reference to A2LA Accreditation Status
III	ANSI C63.10	2020	American National Standard for Testing Unlicensed Wireless Devices
IV	ANSI C63.4	2014	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
V	ETSI TR 100 028	2001-12	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
VI	FCC 47 CFR Part 15.247	Apr 2020	Radio Frequency Devices; Subpart C – Intentional Radiators
VII	ICES-003	Issue 7; Oct 2020	Information Technology Equipment (Including Digital Apparatus)
VIII	M 3003	EDITION 5 Sept 2022	Expression of Uncertainty and Confidence in Measurements
IX	RSS-247 Issue 3	Aug 2023	Digital Transmission Systems (DTSs), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices
X	RSS-Gen Issue 5	Amendment 1,2 (Feb 2021)	General Requirements for Compliance of Radio Apparatus. With Amendments 1: March 2019 and 2: Feb 2021.
XI	FCC 47 CFR Part 2.1033	May 2023	FCC requirements and rules regarding photographs and test setup diagrams.
XII	KDB 789033 D02 V02r01	Dec 2017	Guidelines For Compliance Testing Of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E

4.2. Test and Uncertainty Procedure

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

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5. PRODUCT DETAILS AND TEST CONFIGURATIONS

5.1. Technical Details

Details	Description
Purpose:	Test of the Pelican Wireless Systems 915 MHz Module to FCC CFR 47 Part 15 Subpart C 15.247 (DTS) and ISED RSS-247 Issue 3.
Applicant:	Pelican Wireless Systems 2655 Collier Canyon Rd Livermore, CA 94551 United States of America
Manufacturer:	Pelican Wireless Systems
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	PELC01-U2
Date EUT received:	18th April 2024
Standard(s) applied:	FCC CFR 47 Part 15 Subpart C 15.247 (DTS) ISED RSS-247 Issue 3
Dates of test (from - to):	18th to 19th April 2024
No of Units Tested:	1
Product Family Name:	Commercial Energy Management
Model(s):	915 MHz Module
Location for use:	Both
Declared Frequency Range(s):	902 - 928 MHz
Type of Modulation:	OQPSK
EUT Modes of Operation:	802.15.4 (Zigbee)
Declared Nominal Output Power:	+25.0 dBm
Transmit/Receive Operation:	Transceiver
Rated Input Voltage and Current:	3.3 VDC 0.5A
Operating Temperature Range:	0°C to 50°C
ITU Emission Designator:	1M25D1D
Equipment Dimensions:	1.2" x 1.0" x 0.2"
Weight:	0.128 oz
Hardware Rev:	A
Software Rev:	3.17

5.2. Scope Of Test Program

Pelican Wireless Systems 915 MHz Module

The scope of the test program was to test the Pelican Wireless Systems 915 MHz Module for emissions in its 802.15.4 configurations in the frequency range 902 - 928 MHz for compliance against the following specifications:

FCC CFR 47 Part 15 Subpart C 15.247 (DTS)

Radio Frequency Devices; Subpart C – Intentional Radiators

ISED RSS-247 Issue 3

Digital Transmission Systems (DTSs), Frequency Hopping System (FHSs) and License-Exempt Local Area Network (LE-LEN) Devices

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5.3. Equipment Model(s) and Serial Number(s)

Type (EUT/ Support)	Equipment Description	Manufacturer	Model No.	Serial No.
EUT	Wireless Radio Module	Pelican Wireless Systems	45-5105	Sample #1
Support	Wireless Repeater	Pelican Wireless Systems	WR900	N/A
Support	AC/DC Adapter (USB-C)	Kuncan	GA-0502000	N/A
Support	Plant Controller	Pelican Wireless Systems	EPIC-M1	5A3-B7ZF
Support	AC Adapter	Xlaohudui	JY41-240-050-UA	N/A

5.4. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
Integral	World Products	WPANT10174-S1A	FPC	1.0	-	-	-	902-928

BF Gain - Beamforming Gain
Dir BW - Directional BeamWidth
X-Pol - Cross Polarization

5.5. Cabling and I/O Ports

915 MHz Module:

Port Type	Max Cable Length	# of Ports	Screened	Conn Type	Data Type	Bit Rate	Environment
Antenna	<3m	1	No	U.FL	Digital	250 kbps	Indoors

WR900 Wireless Repeater:

Port Type	Max Cable Length	# of Ports	Screened	Conn Type	Data Type	Bit Rate	Environment
USB	<3m	1	No	USB-C	--	--	Indoors

EPIC-M1 Plant Controller:

Port Type	Max Cable Length	# of Ports	Screened	Conn Type	Data Type	Bit Rate	Environment
24V AC	<3m	1	No	Terminal Block	--	--	Indoors
RS485	<3m	1	No	Terminal Block	Packet	38.4 kbps	Indoors

5.6. Test Configurations

Results for the following configurations are provided in this report:

Operational Mode(s)	Data Rate with Highest Power MBit/s	Channel Frequency (MHz)		
		Low	Mid	High
902 - 928 MHz				
802.15.4 (Zigbee)	0.25	906.0	914.0	924.0

5.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:
1. NONE

5.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:
1. NONE

6. TEST SUMMARY

List of Measurements

Test Header	Result	Data Link
Emissions	Complies	-
(1) Radiated Emissions	Complies	-
(2) Conducted Emissions	Complies	-

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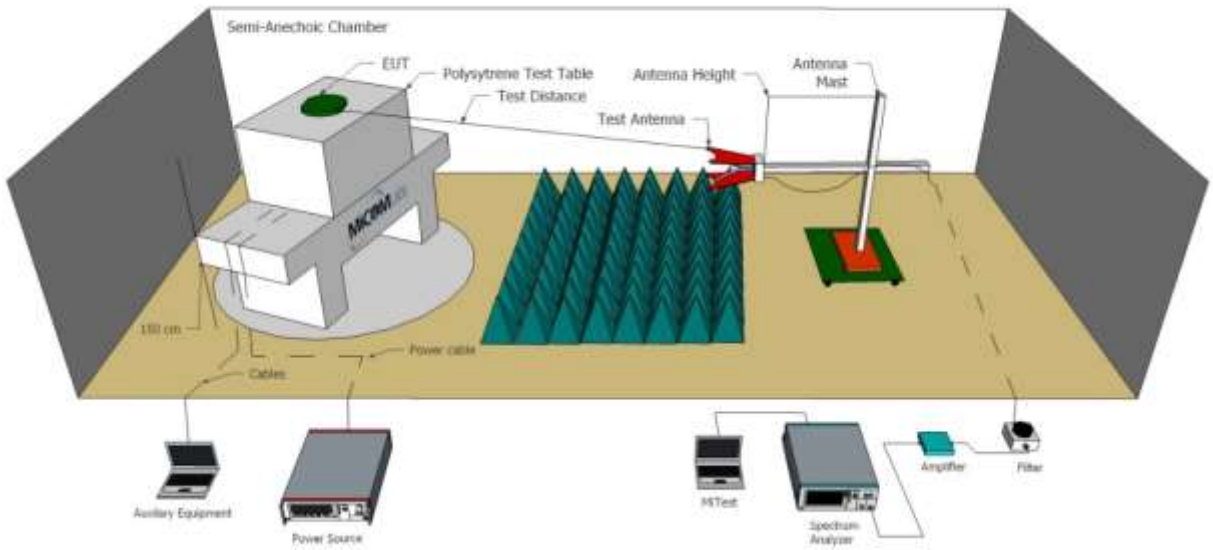
7. TEST EQUIPMENT CONFIGURATION(S)

7.1. Radiated Emissions

The following tests were performed using the radiated test set-up shown in the diagram below. Radiated emissions above and below 1GHz.

Radiated Emissions Above 1GHz Test Setup



Test Equipment Utilized

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
170	Video System Controller for Semi Anechoic Chamber	Panasonic	WV-CU101	04R08507	Not Required
266	10 Hz to 50GHz MXA Signal Analyzer	Keysight	N9020B	MY60110791	25 Jul 2024
285	DC Power Supply	Keysight	E36155A	MY63000156	4 Dec 2024
298	3M Radiated Emissions Chamber Maintenance Check	MiCOM	3M Chamber	298	11 Jul 2024
330	Variac 0-280 Vac	Staco Energy Co	3PN1020B	0546	Cal when used
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	5 Dec 2024
341	900MHz Notch Filter	EWT	EWT-14-0199	H1	13 Sep 2024
373	26III RMS Multimeter	Fluke	Fluke 26 series III	76080720	29 Sep 2024
377	Band Rejection Filter 5150 to 5880MHz	Microtronics	BRM50716	034	13 Sep 2024
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	27 Jul 2024
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	7 Dec 2024
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	2 Nov 2024
410	Desktop Computer	Dell	Inspiron 620	WS38	Not Required
411	Mast/Turntable Controller	Sunol Sciences	SC98V	060199-1D	Not Required
412	USB to GPIB Interface	National Instruments	GPIB-USB HS	11B8DC2	Not Required
413	Mast Controller	Sunol Science	TWR95-4	030801-3	Not Required
414	DC Power Supply 0-60V	HP	6274	1029A01285	Cal when used
415	Turntable Controller	Sunol Sciences	Turntable Controller	None	Not Required
416	Gigabit ethernet filter	ETS-Lingren	Gigafoil 260366	None	Not Required
447	MiTest Rad Emissions Test Software	MiCOM	Rad Emissions Test Software Version 1.0	447	Not Required
462	Schwarzbeck cable from Antenna to Amplifier.	Schwarzbeck	AK 9513	462	18 Sep 2024
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	18 Sep 2024
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	16 Sep 2024
465	Low Pass Filter DC-1000 MHz	Mini-Circuits	NLP-1200+	VUU01901402	14 Sep 2024
480	Cable - Bulkhead to Amp	SRC Haverhill	157-3050360	480	18 Sep 2024
481	Cable - Bulkhead to	SRC Haverhill	151-3050787	481	18 Sep 2024

	Receiver				
510	Barometer/Thermometer	Digi Sense	68000-49	170871375	4 Jan 2026
554	Precision SMA Cable	Fairview Microwave	SCE18060101-400CM	554	18 Sep 2024
555	Rhode & Schwarz Receiver (Firmware Version : 3.10 SP1)	Rhode & Schwarz	ESW 44	101893	28 Jun 2024
87	Uninterruptible Power Supply	Falcon Electric	ED2000-1/2LC	F3471 02/01	Cal when used

7.2 Conducted Emissions

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
127	Power Supply	HP	6674A	US36370530	Cal when used
248	Resistance Thermometer	Thermotronics	GR2105-02	9340 #1	30 Oct 2024
398	MiTest RF Conducted Test Software	MiCOM	MiTest ATS	Version 4.2.3.0	Not Required
420	USB to GPIB Interface	National Instruments	GPIB-USB HS	1346738	Not Required
440	USB Wideband Power Sensor	Boonton	55006	9178	8 Oct 2024
510	Barometer/Thermometer	Digi Sense	68000-49	170871375	4 Jan 2026
515	MiTest Cloud Solutions RF Test Box	MiCOM	2nd Gen	515	26 May 2024
517	USB Wideband Power Sensor	Boonton	RTP5006	10510	8 Oct 2024
555	Rhode & Schwarz Receiver (Firmware Version : 3.10 SP1)	Rhode & Schwarz	ESW 44	101893	28 Jun 2024
74	Environmental Chamber Chamber 3	Tenney	TTC	12808-1	Not Required
RF#2 GPIB#1	GPIB cable to Power Supply	HP	GPIB	None	Not Required
RF#2 SMA#1	EUT to Mitest box port 1	Flexco	SMA Cable port1	None	26 Jul 2024
RF#2 SMA#2	EUT to Mitest box port 2	Flexco	SMA Cable port2	None	26 Jul 2024
RF#2 SMA#3	EUT to Mitest box port 3	Flexco	SMA Cable port3	None	26 Jul 2024
RF#2 SMA#4	EUT to Mitest box port 4	Flexco	SMA Cable port4	None	26 Jul 2024
RF#2 SMA#SA	Mitest box to SA	Flexco	SMA Cable SA	None	26 Jul 2024
RF#2 USB#1	USB Cable to Mitest Box	Dynex	USB Cable	None	Not Required

8. MEASUREMENT AND PRESENTATION OF TEST DATA

The measurement and graphical data presented in this test report was generated automatically using state-of-the-art technology creating an easy to read report structure. Numerical measurement data is separated from supporting graphical data (plots) through hyperlinks. Numerical measurement data can be reviewed without scrolling through numerous graphical pages to arrive at the next data matrix.

Plots have been relegated into the Appendix 'Graphical Data'.

Test and report automation was performed by MiTest. MiTest is an automated test system developed by MiCOM Labs. MiTest is the first cloud based modular test system enabling end-to-end automation of regulatory compliance testing for conducted RF testing.

The MiCOM Labs "MiTest" Automated Test System" (Patent Pending)

9. TEST RESULTS

9.1. Radiated Emissions

Radiated Test Conditions for Radiated Spurious and Band-Edge Emissions (Restricted Bands)			
Standard:	FCC CFR 47 Part 15 Subpart C 15.247 (DTS) ISED RSS-247	**Ambient Temp. (ºC):**	20.0 - 24.5
Test Heading:	Radiated Spurious and Band-Edge Emissions	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.205, 15.209 RSS-247:5.5	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Radiated Spurious and Band-Edge Emissions (Restricted Bands)
Radiated emissions for restricted bands above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter and waveguide filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned. Measurements on any restricted band frequency or frequencies above 1 GHz are based on the use of measurement instrumentation employing peak and average detectors. All measurements were performed using a resolution bandwidth of 1 MHz.

Test configuration and setup for Radiated Spurious and Band-Edge Measurement were per the Radiated Test Set-up specified in this document.

Orientation testing of the EUT was performed and the EUT standing upright was determined to be the worst case for Spurious and Band Edge emissions with the integral antennas attached.

Limits for Restricted Bands
Peak emission: 74 dBuV/m
Average emission: 54 dBuV/m
Average Measurements were performed following ANSI C63.10 section11.12.2.5.2 Trace averaging across on and off times of the EUT transmissions followed by a duty cycle correction.
RMS detector used, DCCF of 10log (1/D) where D is the Duty Cycle.

Field Strength Calculation
The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.
FS = R + AF + CORR - FO

where:
FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

Example:
Given receiver input reading of 51.5 dBmV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength (FS) of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBmV/m

Conversion between dBmV/m (or dBmV) and mV/m (or mV) are as follows:
Level (dBmV/m) = 20 * Log (level (mV/m))
40 dBmV/m = 100 mV/m
48 dBmV/m = 250 mV/m

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Restricted Bands of Operation (15.205)
(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

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

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e) of this section, regardless of the field strength limits specified elsewhere in this subpart, the provisions of this section apply to emissions from any intentional radiator.

(d) The following devices are exempt from the requirements of this section:

(1) Swept frequency field disturbance sensors operating between 1.705 and 37 MHz provided their emissions only sweep through the bands listed in paragraph (a) of this section, the sweep is never stopped with the fundamental emission within the bands listed in paragraph (a) of this section, and the fundamental emission is outside of the bands listed in paragraph (a) of this section more than 99% of the time the device is actively transmitting, without compensation for duty cycle.

(2) Transmitters used to detect buried electronic markers at 101.4 kHz which are employed by telephone companies.

(3) Cable locating equipment operated pursuant to §15.213.

(4) Any equipment operated under the provisions of §15.253, 15.255, and 15.256 in the frequency band 75-85 GHz, or §15.257 of this part.

(5) Biomedical telemetry devices operating under the provisions of §15.242 of this part are not subject to the restricted band 608-614 MHz but are subject to compliance within the other restricted bands.

(6) Transmitters operating under the provisions of subparts D or F of this part.

(7) Devices operated pursuant to §15.225 are exempt from complying with this section for the 13.36-13.41 MHz band only.

(8) Devices operated in the 24.075-24.175 GHz band under §15.245 are exempt from complying with the requirements of this section for the 48.15-48.35 GHz and 72.225-72.525 GHz bands only, and shall not exceed the limits specified in §15.245(b).

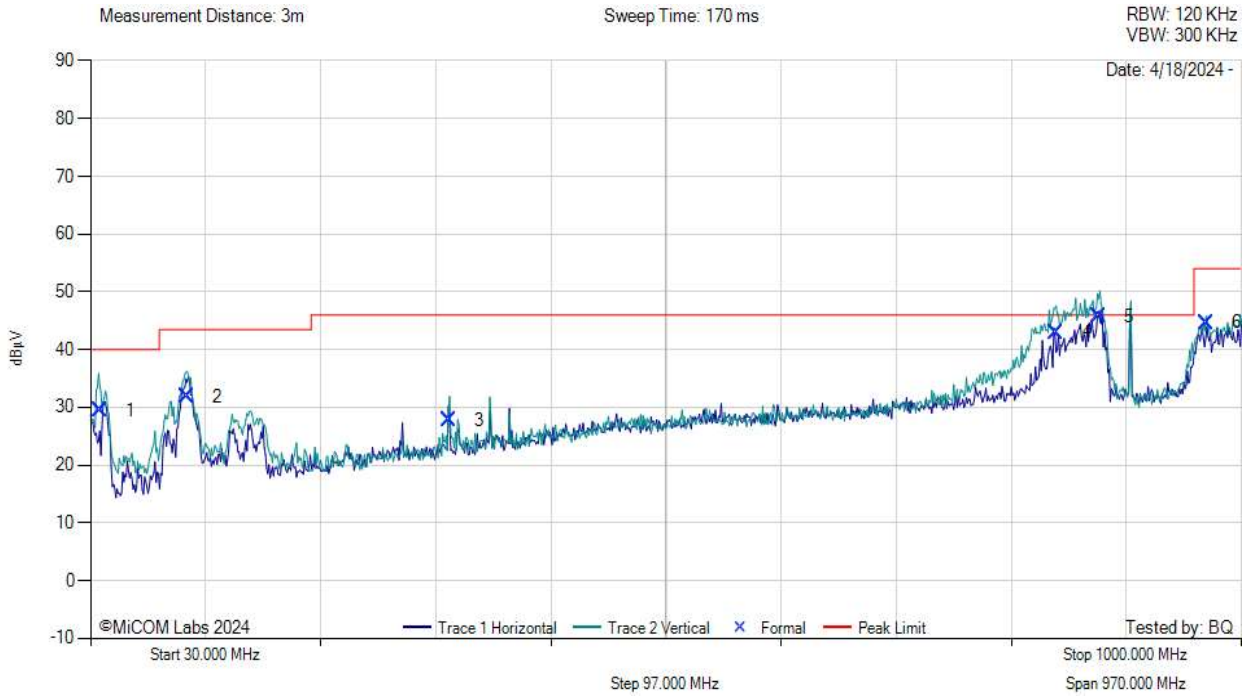
(9) Devices operated in the 24.0-24.25 GHz band under §15.249 are exempt from complying with the requirements of this section for the 48.0-48.5 GHz and 72.0-72.75 GHz bands only, and shall not exceed the limits specified in §15.249(a).

(e) Harmonic emissions appearing in the restricted bands above 17.7 GHz from field disturbance sensors operating under the provisions of §15.245 shall not exceed the limits specified in §15.245(b).

9.1.1. TX Spurious & Restricted Band Emissions

Equipment Configuration for FCC SPURIOUS 30 MHz – 1 GHz			
Antenna:	WPANT10174-S1A	**Variant:**	915 MHz Module
Antenna Gain (dBi):	1	**Modulation:**	OQPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	100%
Channel Frequency (MHz):	906	**Data Rate:**	0.25 Mbps
Power Setting:	25 dBm	**Tested By:**	BQ

Test Measurement Results



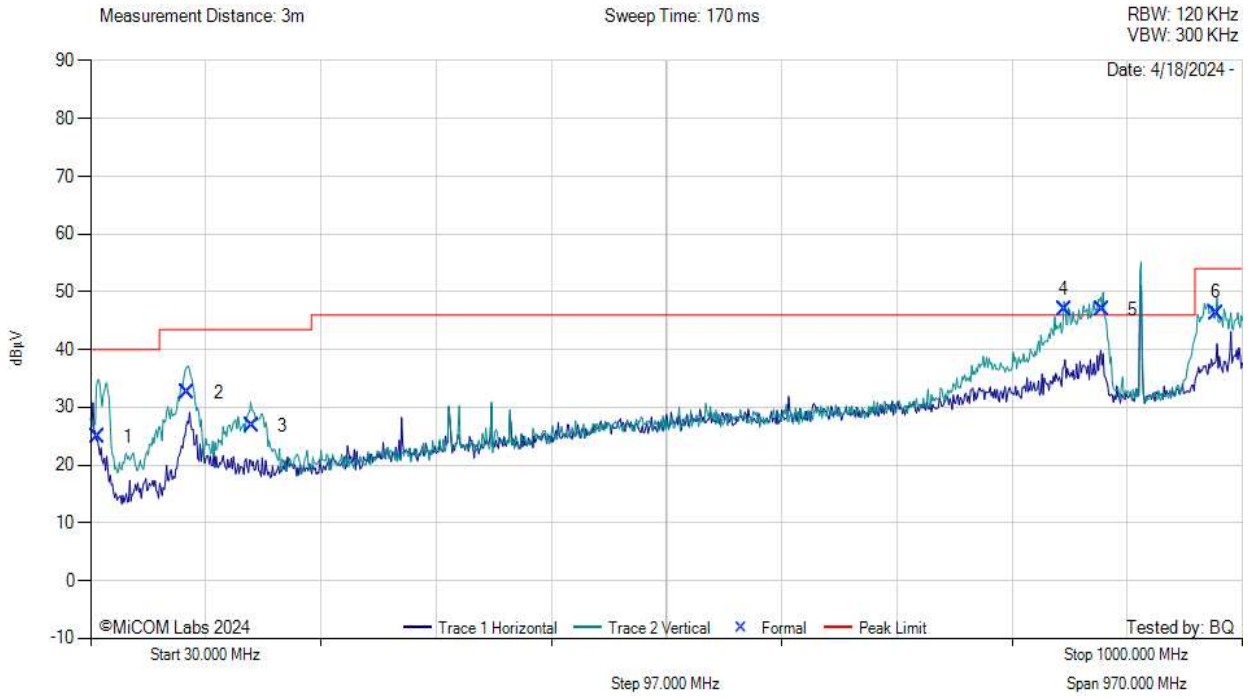
30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	37.66	35.17	3.60	-9.27	29.50	MaxQP	Vertical	100	113	40.0	-10.5	Pass
2	111.65	39.63	4.16	-12.02	31.77	MaxQP	Vertical	101	159	43.5	-11.7	Pass
3	331.71	33.38	5.14	-10.82	27.70	MaxQP	Vertical	99	207	46.0	-18.3	Pass
4	844.23	38.65	6.76	-2.38	43.02	NRB*	Vertical	100	152	46.0	-3.0	Pass
5	879.95	41.03	6.87	-2.20	45.70	NRB*	Vertical	100	130	46.0	-0.3	Pass
6	970.08	38.58	7.15	-1.09	44.64	MaxQP	Vertical	100	29	54.0	-9.4	Pass

NRB* Non-Restricted Band: Does not fall under a restricted band of operation per FCC 15.205 and RSS-Gen Sect 8.10.

Equipment Configuration for FCC SPURIOUS 30 MHz – 1 GHz

Antenna:	WPANT10174-S1A	**Variant:**	915 MHz Module
Antenna Gain (dBi):	1	**Modulation:**	OQPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	100%
Channel Frequency (MHz):	914	**Data Rate:**	0.25 Mbps
Power Setting:	25 dBm	**Tested By:**	BQ

Test Measurement Results

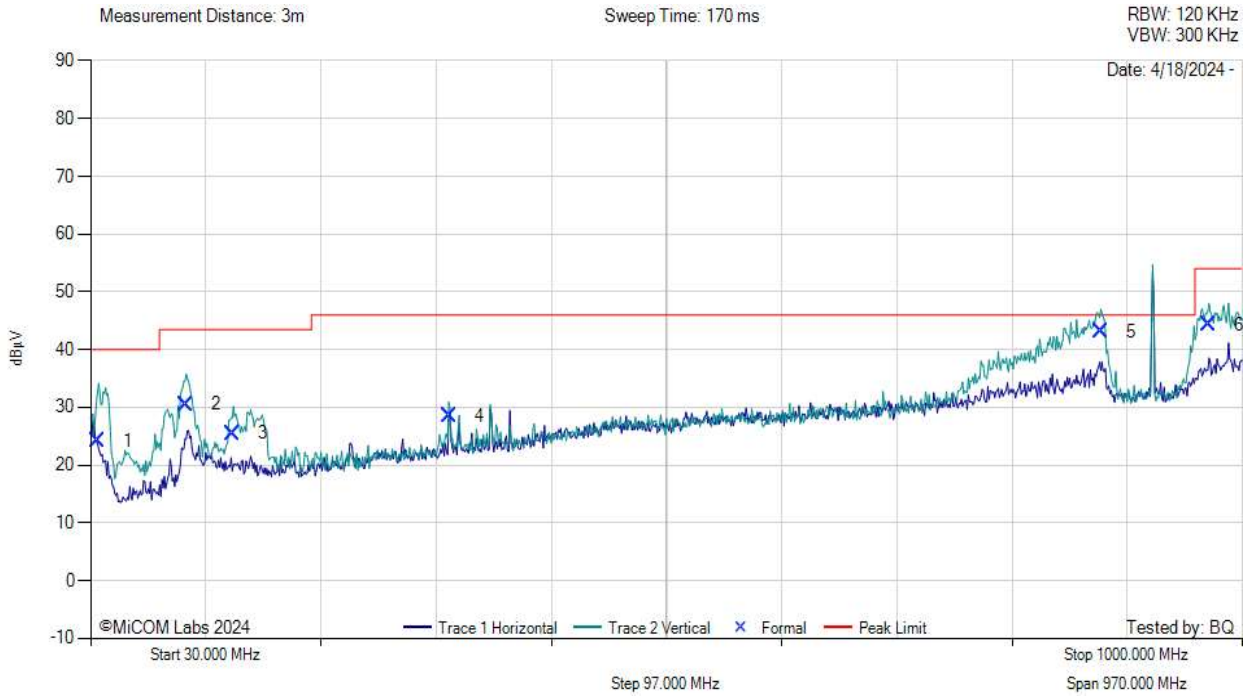


30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	35.83	29.15	3.58	-7.89	24.84	MaxQP	Vertical	117	302	40.0	-15.2	Pass
2	111.86	40.34	4.16	-11.91	32.59	MaxQP	Vertical	100	214	43.5	-10.9	Pass
3	165.52	35.43	4.43	-13.09	26.77	MaxQP	Vertical	100	58	43.5	-16.7	Pass
4	849.93	42.48	6.82	-2.39	46.91	NRB*	Vertical	106	156	46.0	0.9	Pass
5	881.97	42.24	6.88	-2.24	46.88	NRB*	Vertical	99	212	46.0	0.9	Pass
6	977.91	40.18	7.22	-1.09	46.31	MaxQP	Vertical	100	48	54.0	-7.7	Pass

NRB* Non-Restricted Band: Does not fall under a restricted band of operation per FCC 15.205 and RSS-Gen Sect 8.10.

Equipment Configuration for FCC SPURIOUS 30 MHz – 1 GHz			
Antenna:	WPANT10174-S1A	**Variant:**	915 MHz Module
Antenna Gain (dBi):	1	**Modulation:**	OQPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	100%
Channel Frequency (MHz):	924	**Data Rate:**	0.25 Mbps
Power Setting:	25 dBm	**Tested By:**	BQ

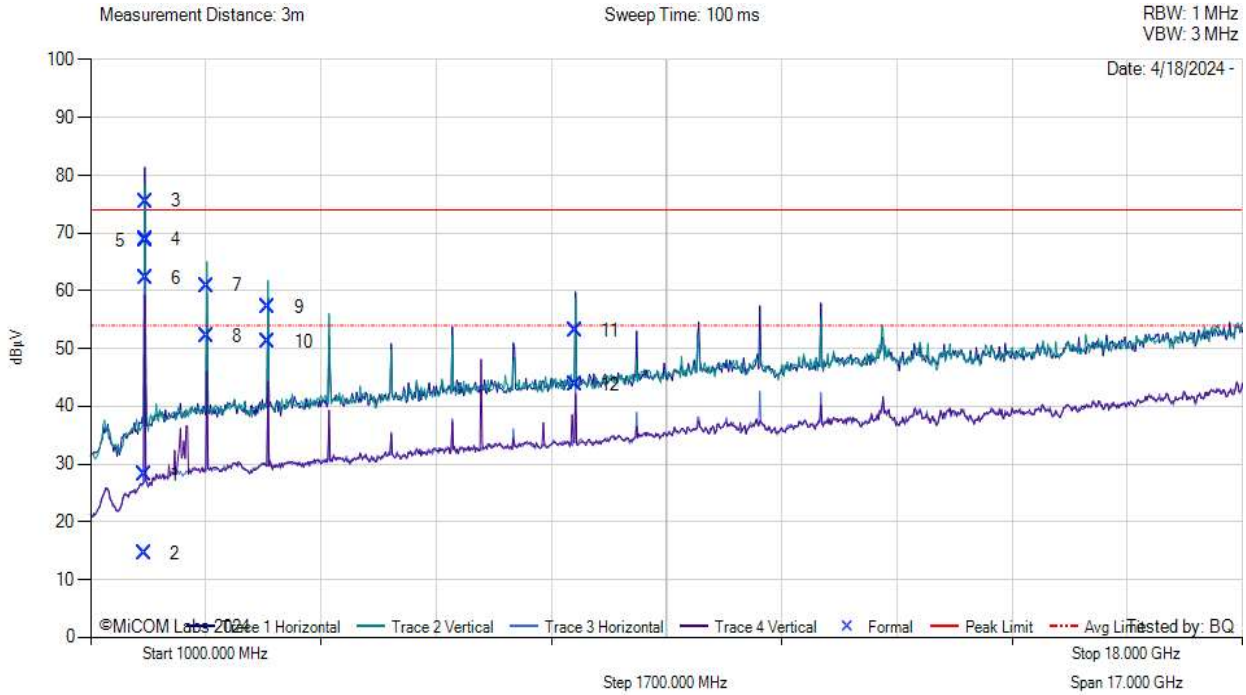
Test Measurement Results



30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	36.08	28.65	3.58	-8.08	24.16	MaxQP	Vertical	109	0	40.0	-15.8	Pass
2	109.82	39.06	4.14	-12.68	30.52	MaxQP	Vertical	110	187	43.5	-13.0	Pass
3	149.51	33.96	4.34	-12.81	25.49	MaxQP	Vertical	101	50	43.5	-18.0	Pass
4	332.46	34.22	5.15	-10.81	28.55	MaxQP	Vertical	101	209	46.0	-17.4	Pass
5	880.56	38.42	6.88	-2.21	43.09	NRB*	Vertical	104	212	46.0	-2.9	Pass
6	971.82	38.26	7.14	-1.08	44.32	MaxQP	Vertical	100	90	54.0	-9.7	Pass

NRB* Non-Restricted Band: Does not fall under a restricted band of operation per FCC 15.205 and RSS-Gen Sect 8.10.

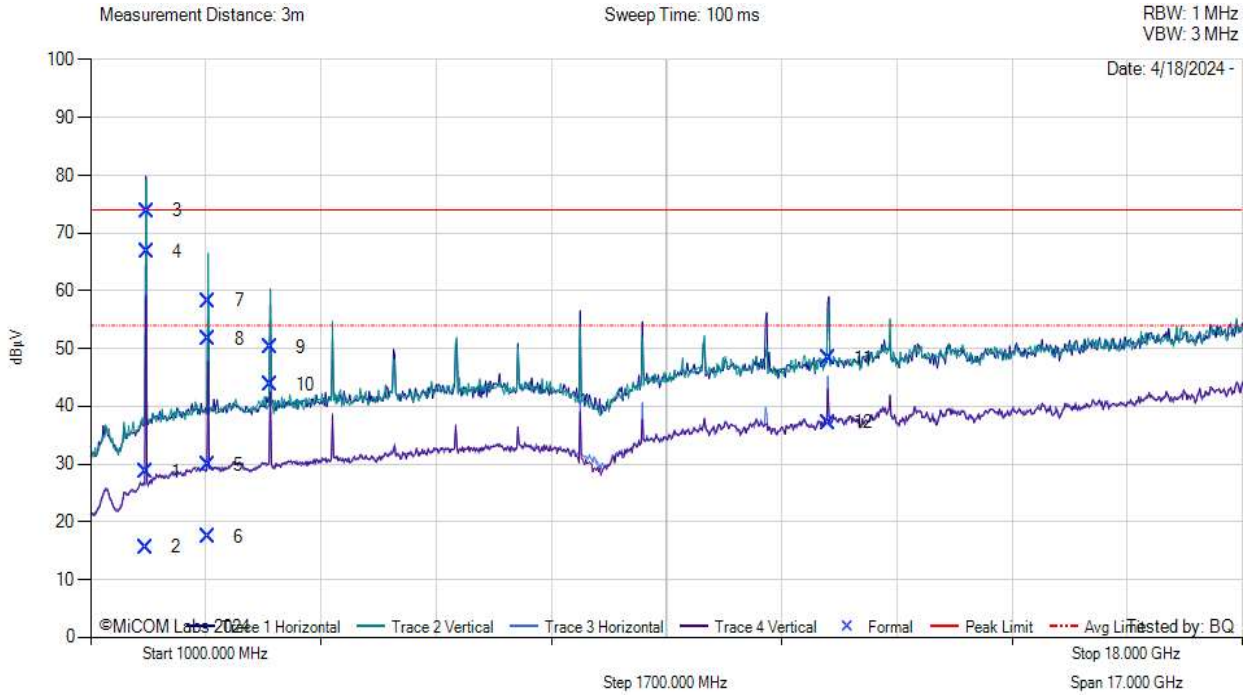
Equipment Configuration for FCC SPURIOUS 1 – 18 GHz			
Antenna:	WPANT10174-S1A	**Variant:**	915 MHz Module
Antenna Gain (dBi):	1	**Modulation:**	OQPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	100%
Channel Frequency (MHz):	906	**Data Rate:**	0.25 Mbps
Power Setting:	25 dBm	**Tested By:**	BQ
Test Measurement Results			



1000.00 - 18000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1797.57	41.04	1.74	-14.58	28.20	NRB*	Horizontal	196	208	74.0	-45.8	Pass
2	1797.57	27.37	1.74	-14.58	14.53	NRB*	Horizontal	196	208	54.0	-39.5	Pass
3	1812.40	88.27	1.72	-14.49	75.50	NRB*	Horizontal	194	203	74.0	1.5	Pass
4	1812.40	81.66	1.72	-14.49	68.89	NRB*	Horizontal	194	203	54.0	14.9	Pass
5	1812.60	81.36	1.72	-14.49	68.60	NRB*	Vertical	159	276	74.0	-5.4	Pass
6	1812.60	74.95	1.72	-14.49	62.19	NRB*	Vertical	159	276	54.0	8.2	Pass
7	2718.74	70.57	2.07	-11.77	60.87	MaxP	Vertical	160	0	74.0	-13.1	Pass
8	2718.74	61.91	2.07	-11.77	52.21	AVG	Vertical	160	0	54.0	-1.8	Pass
9	3623.04	66.50	2.43	-11.83	57.10	MaxP	Vertical	157	180	74.0	-16.9	Pass
10	3623.04	60.59	2.43	-11.83	51.19	AVG	Vertical	157	180	54.0	-2.8	Pass
11	8155.67	57.41	3.86	-8.09	53.17	MaxP	Horizontal	158	207	74.0	-20.8	Pass
12	8155.67	48.00	3.86	-8.09	43.76	AVG	Horizontal	158	207	54.0	-10.2	Pass

NRB* Non-Restricted Band: Does not fall under a restricted band of operation per FCC 15.205 and RSS-Gen Sect 8.10.

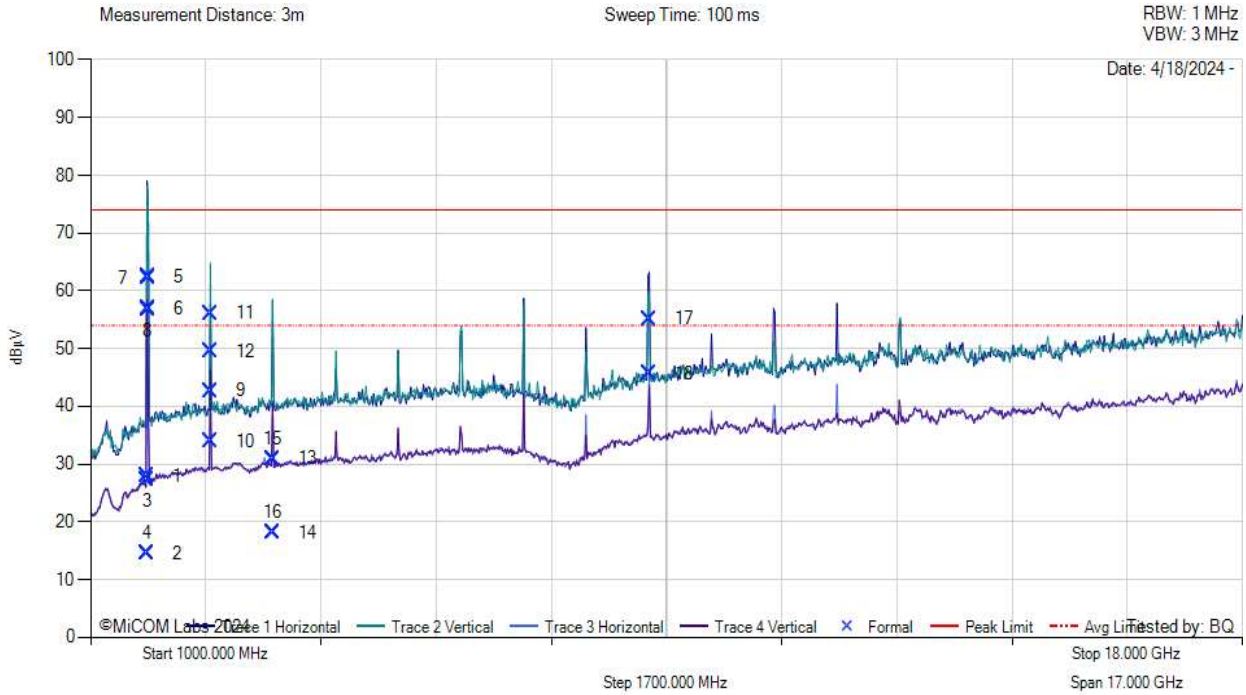
Equipment Configuration for FCC SPURIOUS 1 – 18 GHz			
Antenna:	WPANT10174-S1A	**Variant:**	915 MHz Module
Antenna Gain (dBi):	1	**Modulation:**	OQPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	100%
Channel Frequency (MHz):	914	**Data Rate:**	0.25 Mbps
Power Setting:	25 dBm	**Tested By:**	BQ
Test Measurement Results			



1000.00 - 18000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1814.03	41.35	1.73	-14.47	28.61	NRB*	Horizontal	152	206	74.0	-45.4	Pass
2	1814.03	28.35	1.73	-14.47	15.61	NRB*	Horizontal	152	206	54.0	-38.4	Pass
3	1828.56	86.45	1.75	-14.37	73.83	NRB*	Horizontal	160	204	74.0	-0.2	Pass
4	1828.56	79.37	1.75	-14.37	66.76	NRB*	Horizontal	160	204	54.0	12.8	Pass
5	2735.61	39.44	2.11	-11.74	29.81	MaxP	Vertical	170	0	74.0	-44.2	Pass
6	2735.61	26.97	2.11	-11.74	17.34	AVG	Vertical	170	0	54.0	-36.7	Pass
7	2740.96	67.87	2.11	-11.74	58.24	MaxP	Vertical	187	0	74.0	-15.8	Pass
8	2740.96	61.23	2.11	-11.74	51.60	AVG	Vertical	187	0	54.0	-2.4	Pass
9	3655.35	59.51	2.43	-11.70	50.24	MaxP	Vertical	168	177	74.0	-23.8	Pass
10	3655.35	53.03	2.43	-11.70	43.75	AVG	Vertical	168	177	54.0	-10.2	Pass
11	11880.91	49.66	4.97	-6.27	48.35	MaxP	Horizontal	150	220	74.0	-25.6	Pass
12	11880.91	38.50	4.97	-6.27	37.20	AVG	Horizontal	150	220	54.0	-16.8	Pass

NRB* Non-Restricted Band: Does not fall under a restricted band of operation per FCC 15.205 and RSS-Gen Sect 8.10.

Equipment Configuration for FCC SPURIOUS 1 – 18 GHz			
Antenna:	WPANT10174-S1A	**Variant:**	915 MHz Module
Antenna Gain (dBi):	1	**Modulation:**	OQPSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	100%
Channel Frequency (MHz):	924	**Data Rate:**	0.25 Mbps
Power Setting:	25 dBm	**Tested By:**	BQ
Test Measurement Results			



1000.00 - 18000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1833.61	40.58	1.75	-14.33	27.99	NRB*	Vertical	187	235	74.0	-46.0	Pass
2	1833.61	27.04	1.75	-14.33	14.46	NRB*	Vertical	187	235	54.0	-39.5	Pass
3	1834.93	39.79	1.75	-14.32	27.21	NRB*	Vertical	198	211	74.0	-46.8	Pass
4	1834.93	27.15	1.75	-14.32	14.58	NRB*	Vertical	198	211	54.0	-39.4	Pass
5	1847.23	74.91	1.70	-14.21	62.41	NRB*	Horizontal	160	146	74.0	-11.6	Pass
6	1847.23	69.49	1.70	-14.21	56.98	NRB*	Horizontal	160	146	54.0	3.0	Pass
7	1847.24	74.66	1.70	-14.21	62.16	NRB*	Horizontal	160	146	74.0	-11.8	Pass
8	1847.24	69.26	1.70	-14.21	56.76	NRB*	Horizontal	160	146	54.0	2.8	Pass
9	2770.00	52.26	2.15	32.47	42.66	MaxP	Vertical	198	166	74.0	-31.3	Pass
10	2770.00	43.54	2.15	32.47	33.94	AVG	Vertical	198	166	54.0	-20.1	Pass
11	2771.04	65.70	2.15	-11.76	56.09	MaxP	Vertical	189	167	74.0	-17.9	Pass
12	2771.04	59.06	2.15	-11.76	49.46	AVG	Vertical	189	167	54.0	-4.5	Pass
13	3684.42	40.25	2.42	-11.74	30.93	MaxP	Vertical	166	119	74.0	-43.1	Pass
14	3684.42	27.45	2.42	-11.74	18.13	AVG	Vertical	166	119	54.0	-35.9	Pass
15	3685.24	40.15	2.42	-11.74	30.84	MaxP	Vertical	192	111	74.0	-43.2	Pass

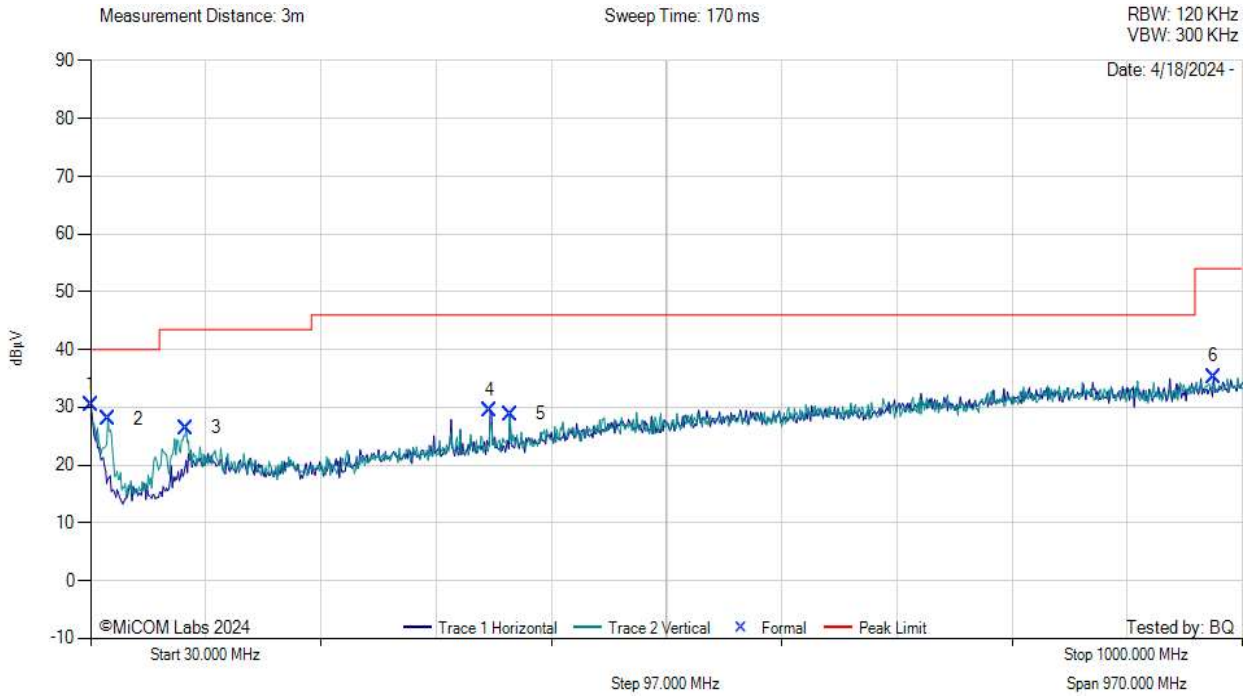
16	3685.24	27.43	2.42	-11.74	18.11	AVG	Vertical	192	111	54.0	-35.9	Pass
17	9243.40	58.14	4.10	-7.14	55.10	MaxP	Horizontal	152	209	74.0	-18.9	Pass
18	9243.40	48.65	4.10	-7.14	45.62	AVG	Horizontal	152	209	54.0	-8.4	Pass

NRB* Non-Restricted Band: Does not fall under a restricted band of operation per FCC 15.205 and RSS-Gen Sect 8.10.

9.1.2 RX Spurious Emissions

Equipment Configuration for FCC SPURIOUS 30 MHz – 1 GHz			
Antenna:	WPANT10174-S1A	**Variant:**	915 MHz Module
Antenna Gain (dBi):	1	**Modulation:**	Not Applicable
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	Not Applicable
Channel Frequency (MHz):	Not Applicable	**Data Rate:**	Not Applicable
Power Setting:	Rx	**Tested By:**	BQ

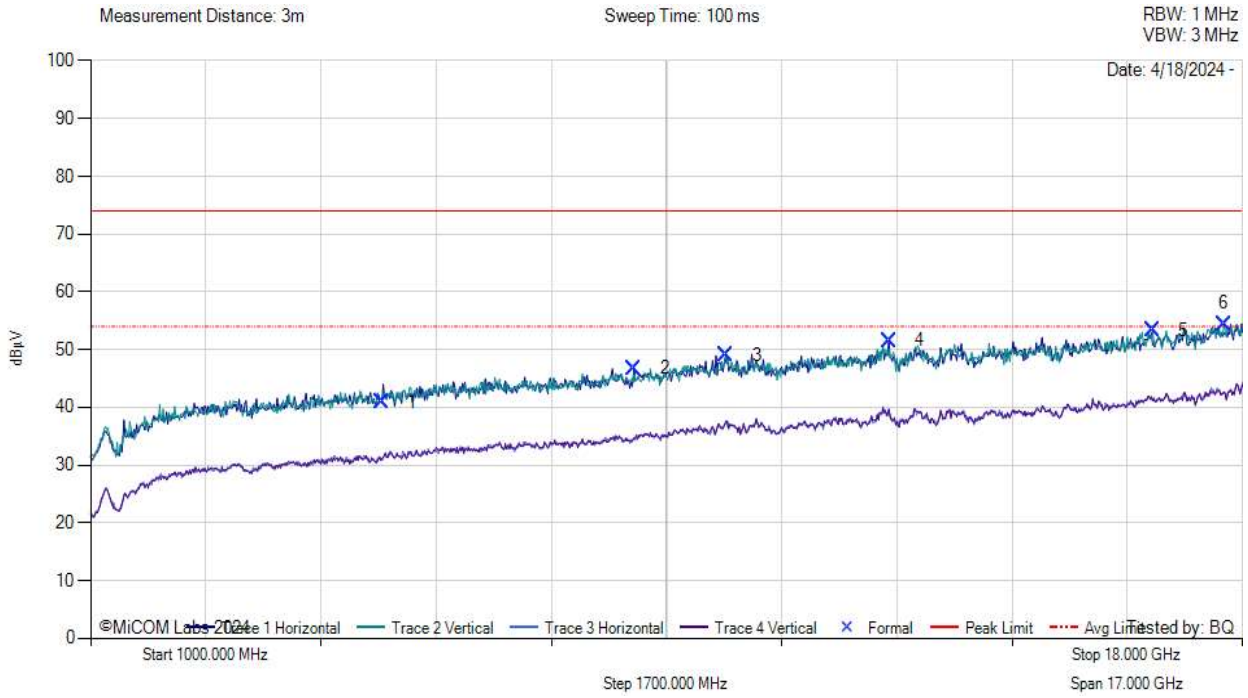
Test Measurement Results



30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	30.00	30.23	3.52	28.41	30.37	MaxP	Horizontal	199	330	40.0	-9.6	Pass
2	44.55	38.45	3.67	-14.10	28.02	MaxP	Vertical	99	29	40.0	-12.0	Pass
3	110.51	34.81	4.15	-12.49	26.47	MaxP	Vertical	99	89	43.5	-17.0	Pass
4	366.59	33.85	5.25	-9.67	29.43	MaxP	Horizontal	99	300	46.0	-16.6	Pass
5	383.08	32.98	5.30	-9.48	28.80	MaxP	Vertical	99	29	46.0	-17.2	Pass
6	975.75	29.26	7.18	-1.08	35.36	MaxP	Horizontal	99	30	54.0	-18.6	Pass

Equipment Configuration for FCC SPURIOUS 1 – 18 GHz			
Antenna:	WPANT10174-S1A	**Variant:**	915 MHz Module
Antenna Gain (dBi):	1	**Modulation:**	Not Applicable
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	Not Applicable
Channel Frequency (MHz):	Not Applicable	**Data Rate:**	Not Applicable
Power Setting:	Rx	**Tested By:**	BQ

Test Measurement Results



1000.00 - 18000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	5301.00	49.90	3.26	34.38	40.95	MaxP	Horizontal	150	300	74.0	-33.1	Pass
2	9024.00	50.44	4.13	36.11	46.77	MaxP	Horizontal	199	330	74.0	-27.2	Pass
3	10384.00	48.89	4.82	37.53	49.10	MaxP	Vertical	199	149	74.0	-24.9	Pass
4	12781.00	54.06	5.29	39.13	51.55	MaxP	Horizontal	199	240	74.0	-22.4	Pass
5	16674.00	47.89	5.97	41.56	53.34	MaxP	Vertical	150	299	74.0	-20.7	Pass
6	17728.00	47.62	6.37	41.67	54.38	MaxP	Vertical	199	299	74.0	-19.6	Pass

9.2 Conducted Emissions

9.2.1 6 dB & 99% Bandwidth

Conducted Test Conditions for 6 dB and 99% Bandwidth			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	6 dB and 99 % Bandwidth	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(2)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for 6 dB and 99% Bandwidth Measurement
The bandwidth at 6 dB and 99 % was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

Testing was performed under ambient conditions at nominal voltage. Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured and reported.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Limits for 6 dB and 99% Bandwidth

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(2) Systems using digital modulation techniques may operate in the 902-928 MHz and 2400-2483.5 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

Equipment Configuration for 6 dB & 99% Bandwidth			
Variant:	915 MHz Module	**Duty Cycle (%):**	100
Data Rate:	0.25 Mbps	**Antenna Gain (dBi):**	Not Applicable
Modulation:	OQPSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	BQ

Test Measurement Results

Test Frequency	Measured 6 dB Bandwidth (MHz)				6 dB Bandwidth (MHz)	
	Port(s)					
MHz	a	b	c	d	Highest	Lowest
906.0	0.782	--	--	--	0.782	0.782
914.0	0.782	--	--	--	0.782	0.782
924.0	0.782	--	--	--	0.782	0.782

Test Frequency	Measured 99% Bandwidth (MHz)				Maximum 99% Bandwidth (MHz)
	Port(s)				
MHz	a	b	c	d	
906.0	1.242	--	--	--	1.242
914.0	1.253	--	--	--	1.253
924.0	1.253	--	--	--	1.253

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

MiCOM Labs, 575 Boulder Court, Pleasanton, California 94566 USA, Phone: +1 (925) 462 0304, Fax: +1 (925) 462 0306, www.micomlabs.com

9.2.2 Conducted Output Power

Conducted Test Conditions for Fundamental Emission Output Power			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Output Power	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (b) & (c)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Fundamental Emission Output Power Measurement
In the case of average power measurements an average power sensor was utilized.

For peak power measurements the spectrum analyzer built-in power function was used to integrate peak power over the 20 dB bandwidth.

Testing was performed under ambient conditions at nominal voltage only. Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured, summed (Σ) and reported.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.
Supporting Information
Calculated Power = A + G + Y+ 10 log (1/x) dBm

A = Total Power [10*Log10 ($10^{a/10}$ + $10^{b/10}$ + $10^{c/10}$ + $10^{d/10}$)]
G = Antenna Gain
Y = Beamforming Gain
x = Duty Cycle (average power measurements only)

Limits for Fundamental Emission Output Power
(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following for non-frequency hopping systems:

(3) For systems using digital modulation in the 902-928 MHz and 2400-2483.5 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

(c) Operation with directional antenna gains greater than 6 dBi.
(1) Fixed point-to-point operation:
(i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

(iii) Fixed, point-to-point operation, as used in paragraphs (c)(1)(i) and (c)(1)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.

(2) In addition to the provisions in paragraphs (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400-2483.5

MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of 10 log (number of array elements or staves) plus the directional gain of the element or stave having the highest gain.

(B) A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beamforming.

(iii) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in paragraph (c)(2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.

(iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

Equipment Configuration for Conducted Output Power			
Variant:	915 MHz Module	**Duty Cycle (%):**	100
Data Rate:	0.25 Mbps	**Antenna Gain (dBi):**	1.00
Modulation:	OQPSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	BQ

Test Measurement Results

Test Frequency	Measured Output Power (dBm) Port(s)				Calculated Total Power Σ Port(s)	Limit	Margin	EUT Power Setting (dBm)
MHz	a	b	c	d	dBm	dBm	dB	
906.0	23.82	--	--	--	23.82	30.00	-6.18	24.00
914.0	23.64	--	--	--	23.64	30.00	-6.36	24.00
924.0	23.29	--	--	--	23.29	30.00	-6.71	24.00

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Measurement Uncertainty:	±1.33 dB

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9.2.3 Power Spectral Density

Conducted Test Conditions for Power Spectral Density			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Power Spectral Density	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (e)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Power Spectral Density
The transmitter output was connected to a spectrum analyzer and the measured made in a 3 kHz resolution bandwidth using the analyzer auto-coupled sweep-time. A peak value was found over the full emission bandwidth and the spectrum downloaded for post processing purposes.

Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured separately. The Peak Power Spectral Density is the highest level found across the emission bandwidth. With multiple antenna port measurements the numerical analyzer data from each port is summed (å) and a link to this additional graphic is provided.

Testing was performed under ambient conditions at nominal voltage only.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Measure and sum the spectra across the outputs. With this technique, spectra are measured at each output of the device at the required resolution bandwidth. The individual spectra are then summed mathematically in linear power units. Unlike in-band power measurements, in which the sum involves a single measured value (output power) from each output, measurements for compliance with PSD limits involve summing entire spectra across corresponding frequency bins on the various outputs. Consistency is maintained for any device with multiple transmitter outputs to be certain the individual outputs are all aligned with the same span and same number of points. In this instance, the linear power spectrum value within the first spectral bin of output 0 is summed with that in the first spectral bin of output 1, and the first spectral bin of output 2, and so on up to the Nth output to obtain the true value for the first frequency bin of the summed spectrum. The summed spectrum value for each frequency bin is computed in this fashion. These summed spectral values were post processed and the resulting numerical and graphical data presented.

NOTE:
It may be observed that the spectrum in some antenna port plots break the limit line however this in itself does NOT constitute a failure. In all cases a spectrum summation plot is provided in order to prove compliance. A failure occurs only after the summation of all spectrum plots have been summed and are found to be greater than the limit line.

Supporting Information
Calculated Power = A + 10 log (1/x) dBm
A = Total Power Spectral Density [10 Log10 ($10^{a/10}$ + $10^{b/10}$ + $10^{c/10}$ + $10^{d/10}$)]
x = Duty Cycle

Limits Power Spectral Density
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than +8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Equipment Configuration for Power Spectral Density			
Variant:	915 MHz Module	**Duty Cycle (%):**	100
Data Rate:	0.25 Mbps	**Antenna Gain (dBi):**	1.00
Modulation:	OQPSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	BQ

Test Measurement Results

Test Frequency	Measured Power Spectral Density Port(s) (dBm/3KHz)				Amplitude Summation + DCCF (+0.04 dB)	Limit	Margin
MHz	**a**	**b**	**c**	**d**	**dBm/3KHz**	**dBm/3KHz**	**dB**
906.0	7.090				7.090	8.0	-0.9
914.0	-2.584				-2.584	8.0	-10.6
924.0	-2.223				-2.223	8.0	-10.2

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

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9.2.4 Conducted Spurious Emissions

Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Max Unwanted Emission Levels	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (d)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Transmitter Conducted Spurious and Band-Edge Emissions Measurement
Transmitter Conducted Spurious and Band-Edge emissions were measured at a limit of 30 dBc (average detector) or 20 dBc (peak detector) below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Measurements were made while EUT was operating in transmit mode of operation at the appropriate centre frequency closest to the band-edge. Emissions were maximized during the measurement and limits derived from the peak spectral power and drawn on each plot.

Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured separately. Testing was performed under ambient conditions at nominal voltage only.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Limits Transmitter Conducted Spurious and Band-Edge Emissions
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Equipment Configuration for Conducted Spurious Emissions			
Variant:	915 MHz Module	**Duty Cycle (%):**	100
Data Rate:	0.25 Mbps	**Antenna Gain (dBi):**	1.00
Modulation:	OQPSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	BQ

Test Measurement Results

Test Frequency	Frequency Range	Conducted Spurious Emissions - Average (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	SE	Limit	SE	Limit	SE	Limit	SE	Limit
906.0	30.0 - 10000.0	-53.890	-42.17	--	--	--	--	--	--
914.0	30.0 - 10000.0	-54.902	-52.56	--	--	--	--	--	--
924.0	30.0 - 10000.0	-55.220	-52.75	--	--	--	--	--	--

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB

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9.2.5 Conducted Band-Edge Emissions

Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Max Unwanted Emission Levels	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (d)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Transmitter Conducted Spurious and Band-Edge Emissions Measurement
Transmitter Conducted Spurious and Band-Edge emissions were measured at a limit of 30 dBc (average detector) or 20 dBc (peak detector) below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Measurements were made while EUT was operating in transmit mode of operation at the appropriate centre frequency closest to the band-edge. Emissions were maximized during the measurement and limits derived from the peak spectral power and drawn on each plot.

Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured separately. Testing was performed under ambient conditions at nominal voltage only.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Limits Transmitter Conducted Spurious and Band-Edge Emissions
(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Equipment Configuration for Conducted Band-Edge

Variant:	915 MHz Module	**Duty Cycle (%):**	100
Data Rate:	0.25 Mbps	**Antenna Gain (dBi):**	1.00
Modulation:	OQPSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	BQ

Test Measurement Results

Channel Frequency:	906.0 MHz
Band-Edge Frequency:	902.0 MHz
Test Frequency Range:	850.0 - 915.0 MHz

Port(s)	Band-Edge Markers and Limit			Revised Limit		Margin
	M3 Amplitude (dBm)	Plot Limit (dBm)	M2 Frequency (MHz)	Amplitude (dBm)	M2A Frequency (MHz)	(MHz)
a	-42.98	-16.21	904.60	--	--	-2.600

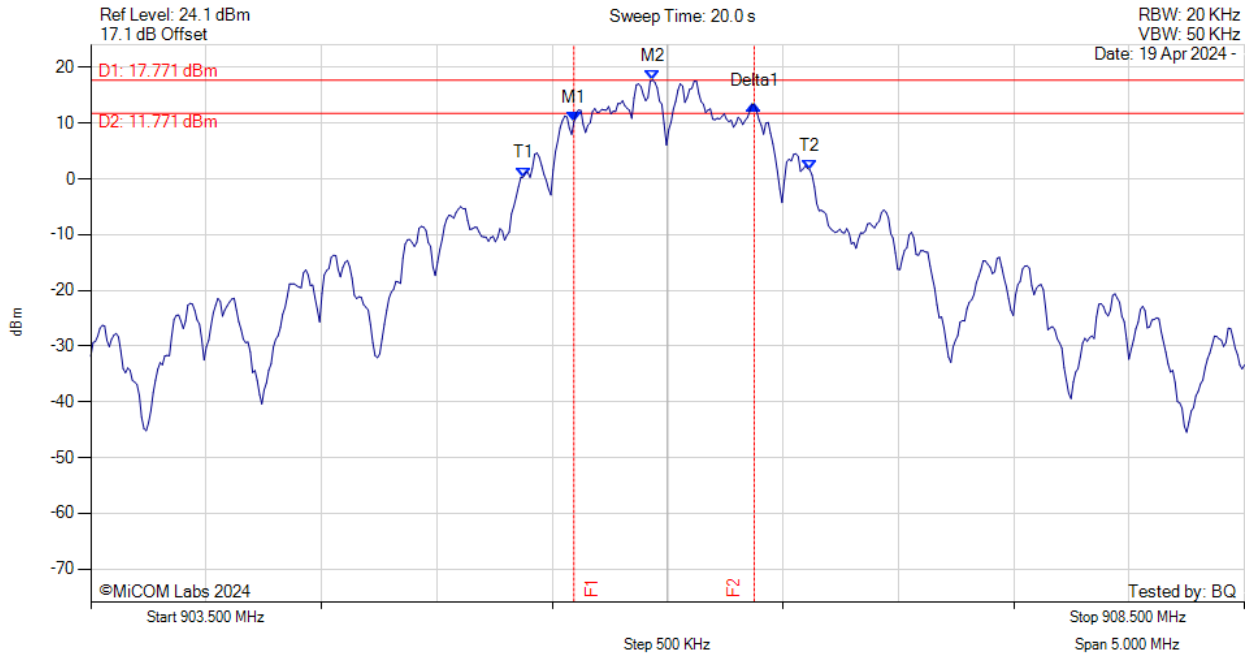
Channel Frequency:	924.0 MHz
Band-Edge Frequency:	928.0 MHz
Test Frequency Range:	915.0 - 978.0 MHz

Port(s)	Band-Edge Markers and Limit			Revised Limit		Margin
	M3 Amplitude (dBm)	Plot Limit (dBm)	M2 Frequency (MHz)	Amplitude (dBm)	M2A Frequency (MHz)	(MHz)
a	-44.84	-32.31	926.50	--	--	-1.500

A. APPENDIX – GRAPHICAL IMAGES

A.1 6dB & 99% Bandwidth

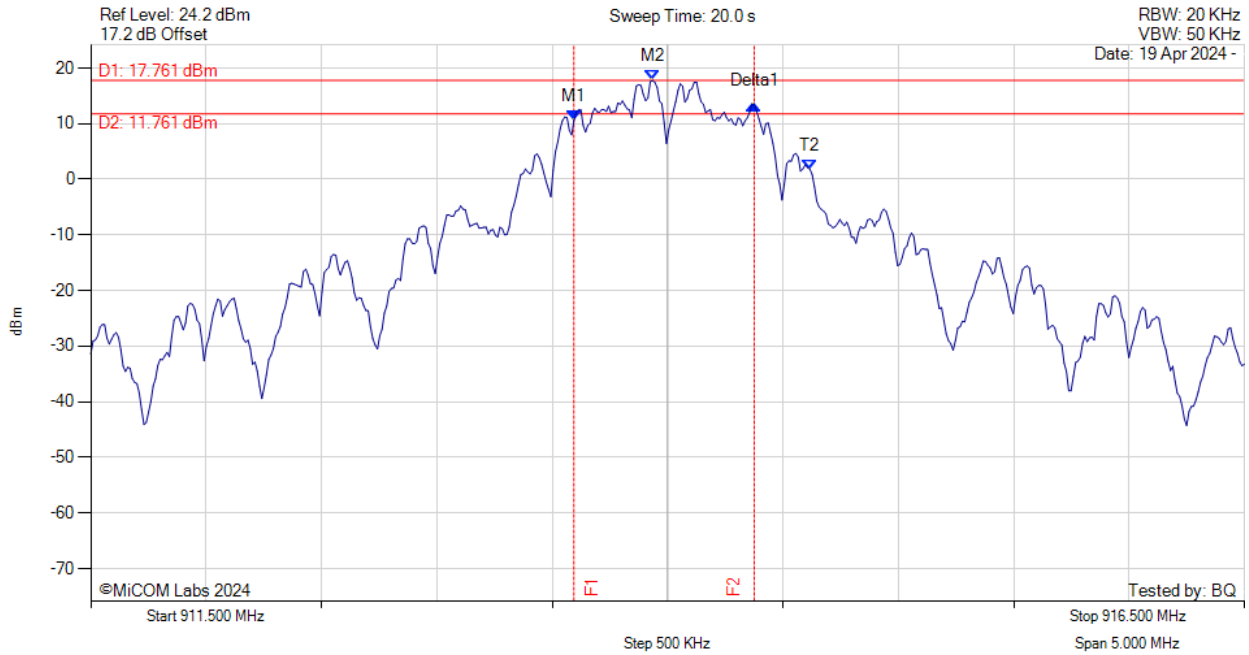
Channel: 906 MHz



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD	M1 : 905.594 MHz : 10.240 dBm M2 : 905.935 MHz : 17.771 dBm Delta1 : 782 KHz : 3.095 dB T1 : 905.374 MHz : 0.360 dBm T2 : 906.616 MHz : 1.639 dBm OBW : 1.242 MHz	Measured 6 dB Bandwidth: 0.782 MHz

back to matrix

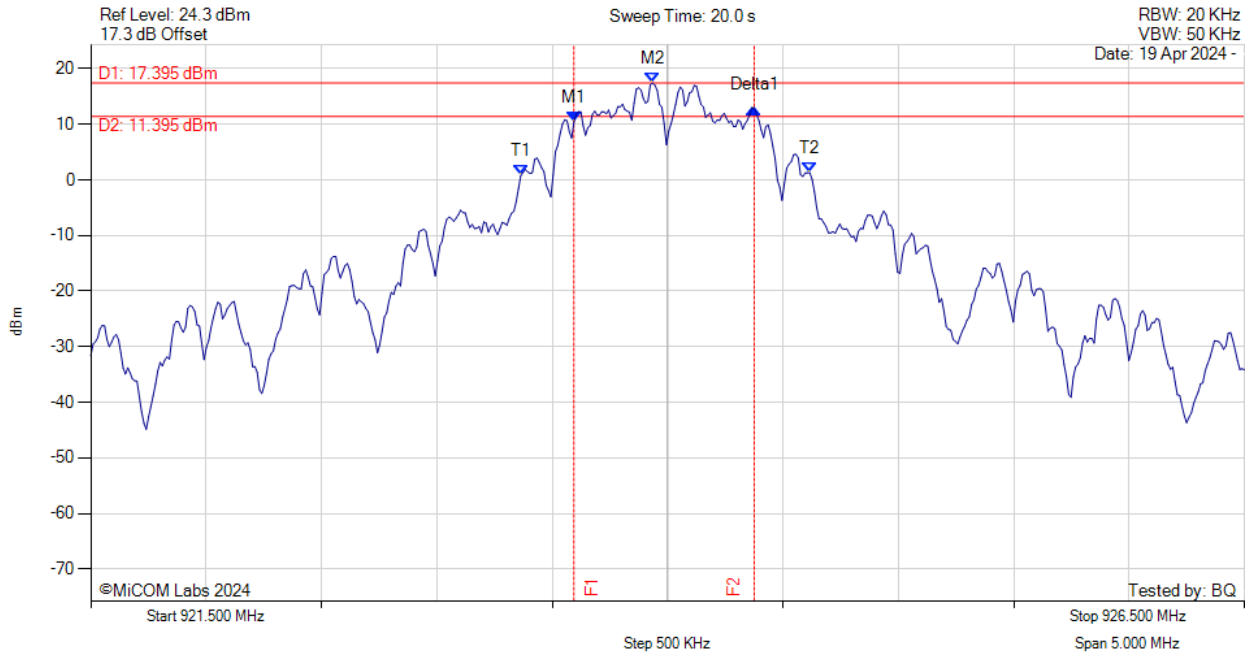
Channel: 914 MHz



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD	M1 : 913.594 MHz : 10.600 dBm M2 : 913.935 MHz : 17.761 dBm Delta1 : 782 KHz : 2.786 dB T1 : 0 Hz : 0.000 dBm T2 : 914.616 MHz : 1.810 dBm OBW : 1.253 MHz	Measured 6 dB Bandwidth: 0.782 MHz

back to matrix

Channel: 924 MHz

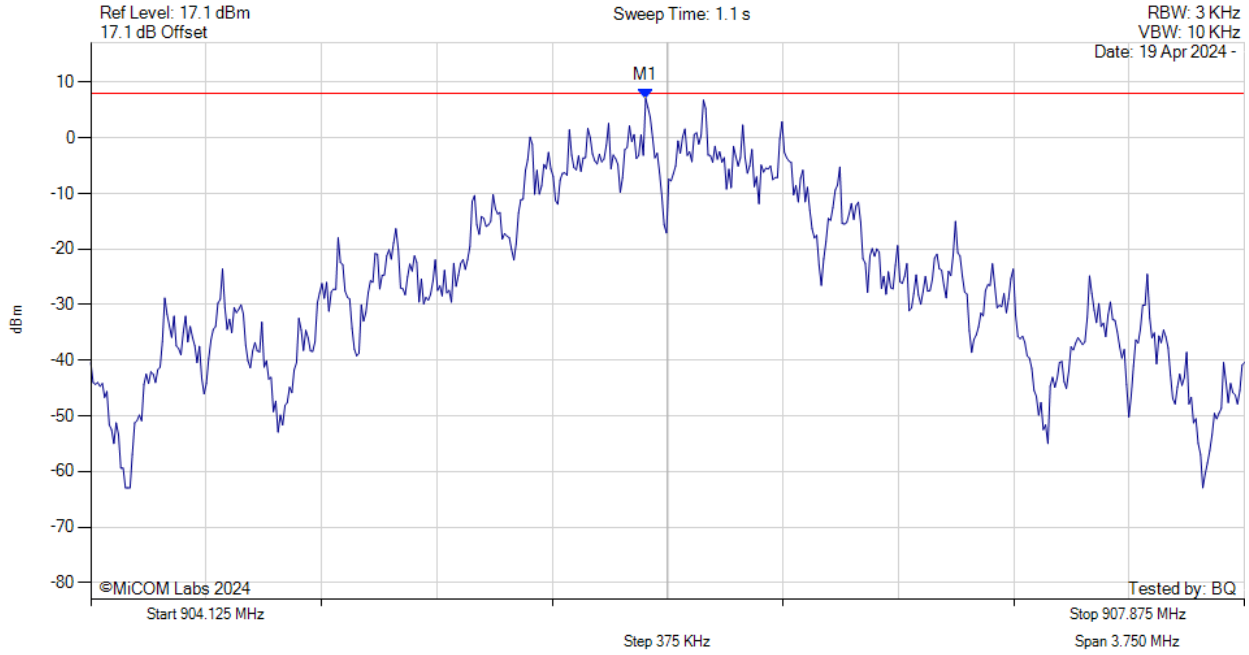


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD	M1 : 923.594 MHz : 10.385 dBm M2 : 923.935 MHz : 17.395 dBm Delta1 : 782 KHz : 2.516 dB T1 : 923.364 MHz : 0.804 dBm T2 : 924.616 MHz : 1.274 dBm OBW : 1.253 MHz	Measured 6 dB Bandwidth: 0.782 MHz

back to matrix

A.2 Power Spectral Density

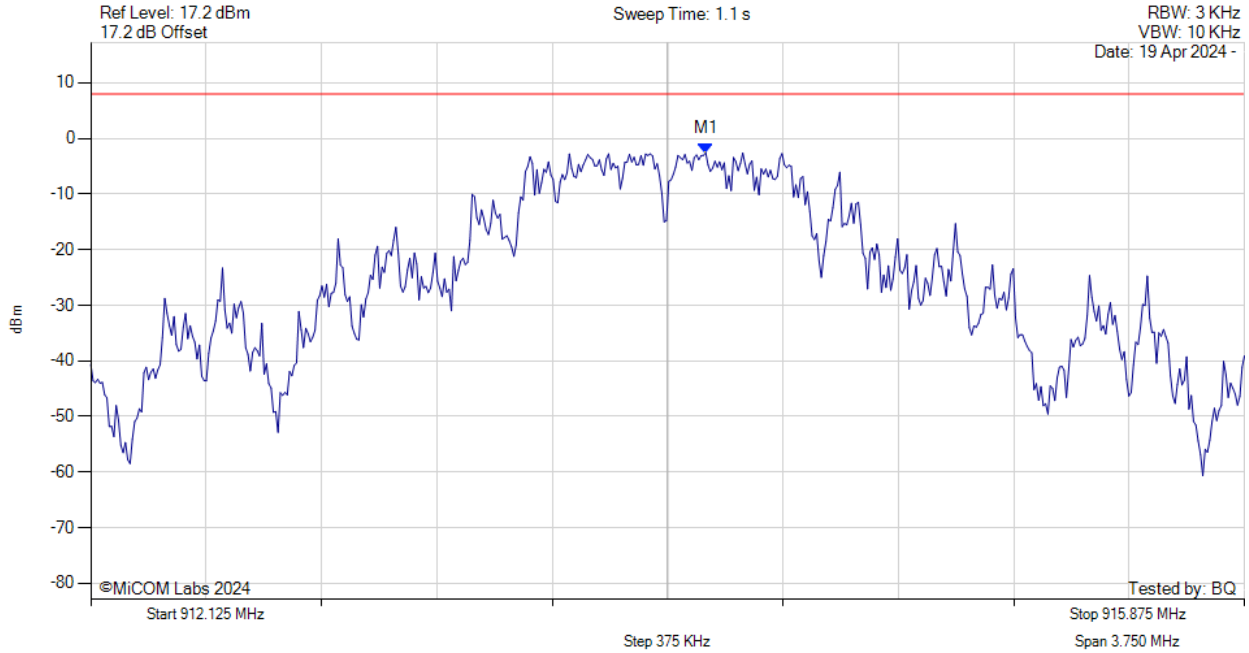
Channel: 906 MHz



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1: 905.929 MHz : 7.090 dBm	Limit: ≤ 8.000 dBm

back to matrix

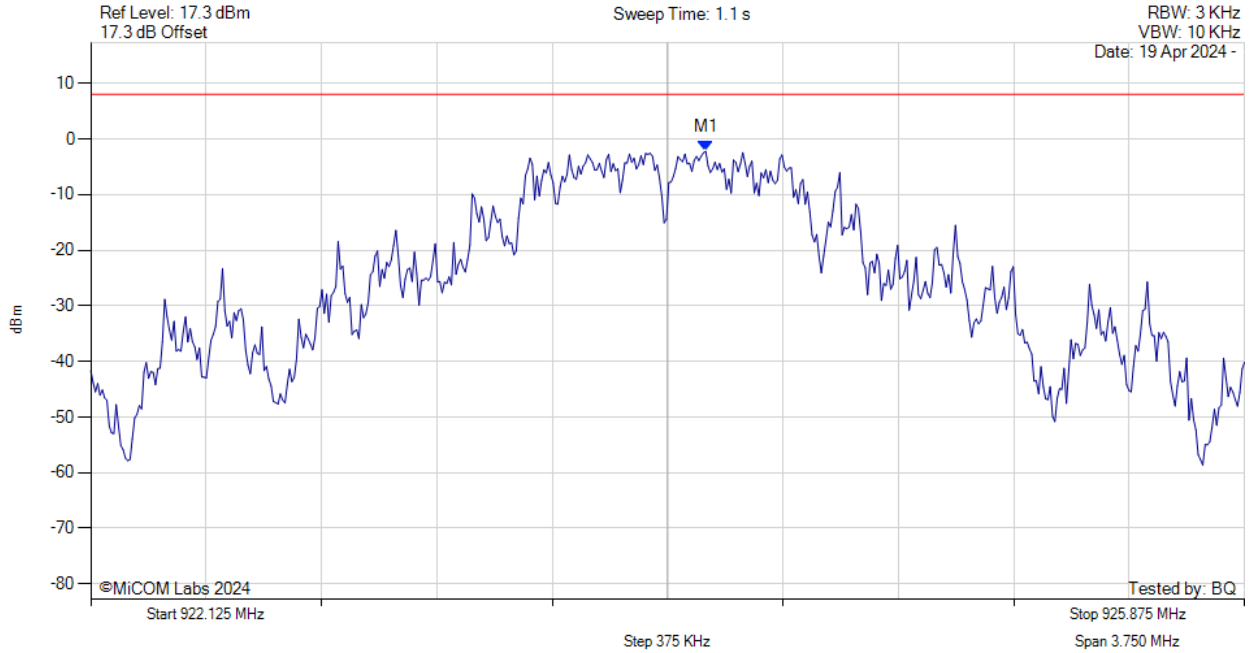
Channel: 914 MHz



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1: 914.100 MHz : -2.584 dBm	Limit: ≤ 8.000 dBm

back to matrix

Channel: 924 MHz

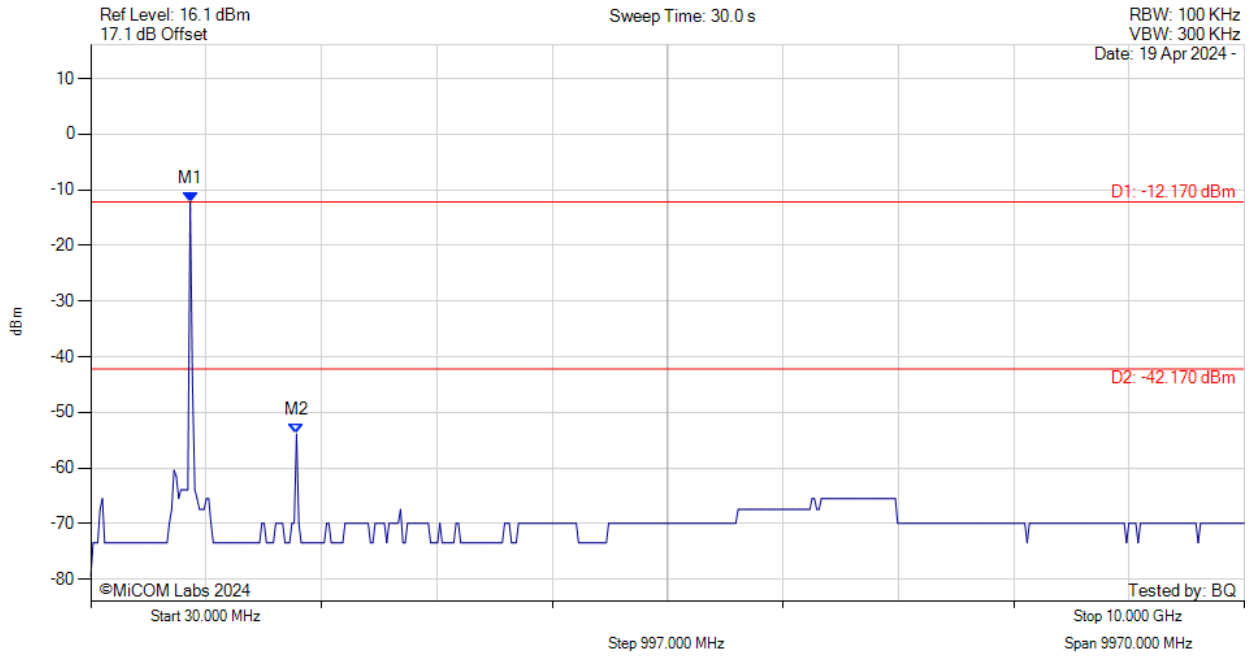


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1: 924.124 MHz : -2.223 dBm	Limit: ≤ 8.000 dBm

back to matrix

A.3 Conducted Spurious Emissions

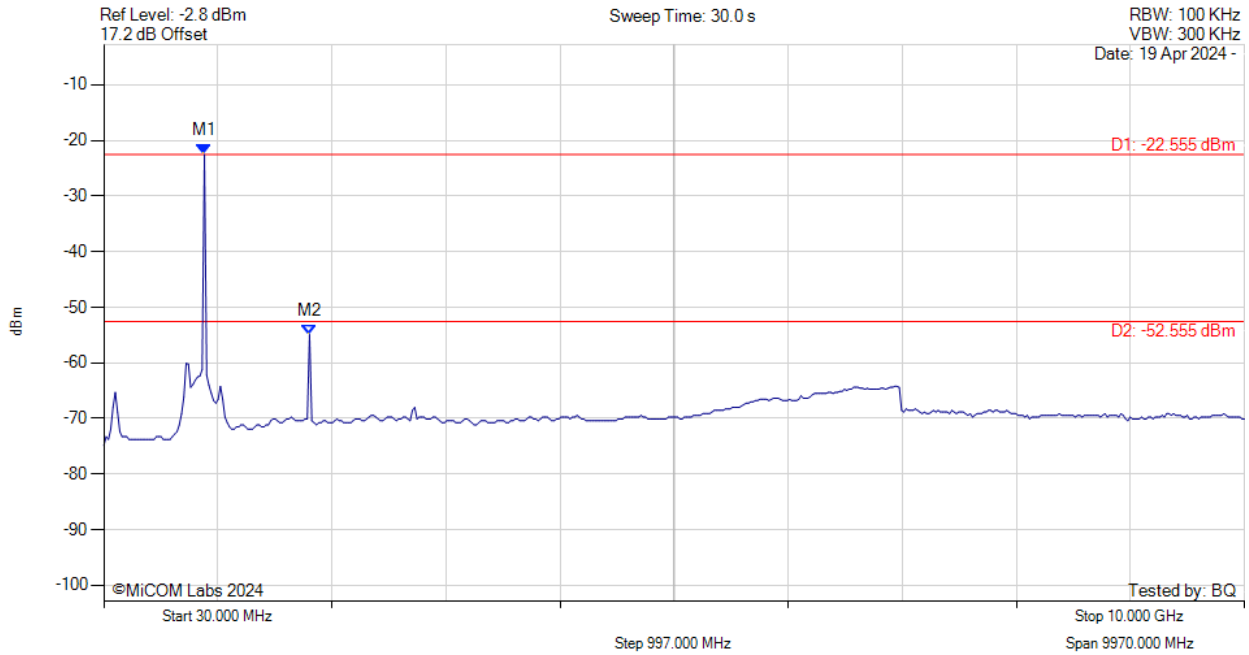
Channel: 906 MHz



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1 : 889.138 MHz : -12.174 dBm M2 : 1808.216 MHz : -53.890 dBm	Limit: -42.17 dBm Margin: -11.72 dB

back to matrix

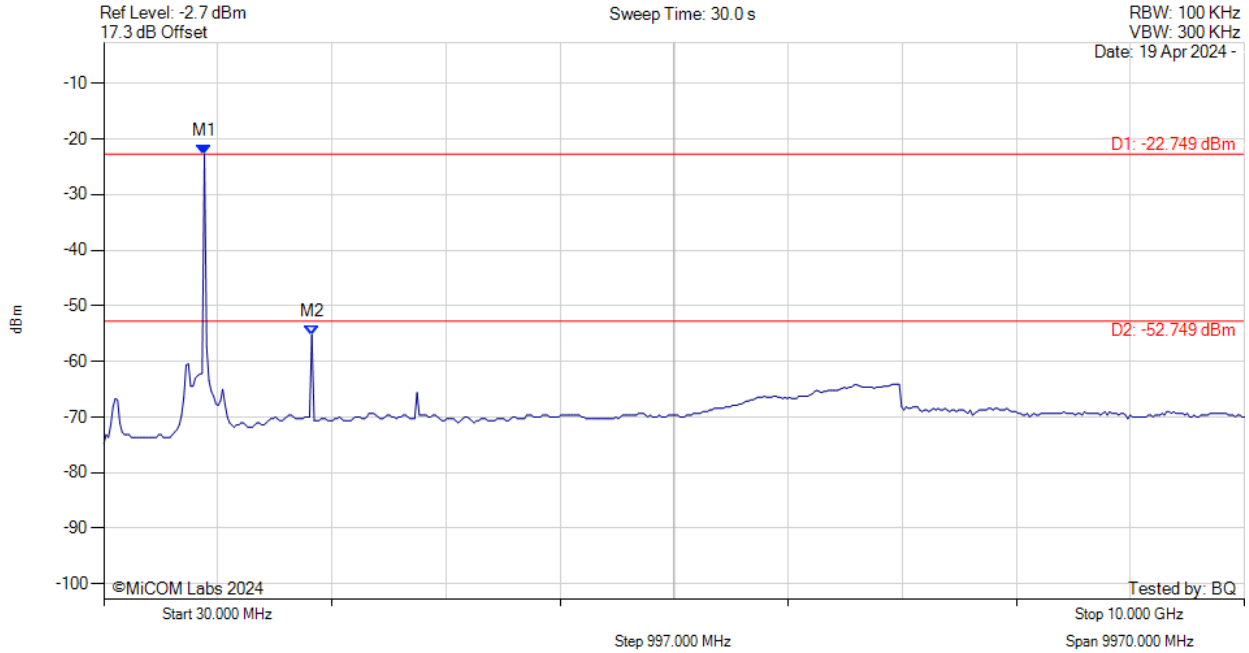
Channel: 914 MHz



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1 : 909.118 MHz : -22.555 dBm M2 : 1828.196 MHz : -54.902 dBm	Limit: -52.56 dBm Margin: -2.34 dB

back to matrix

Channel: 924 MHz

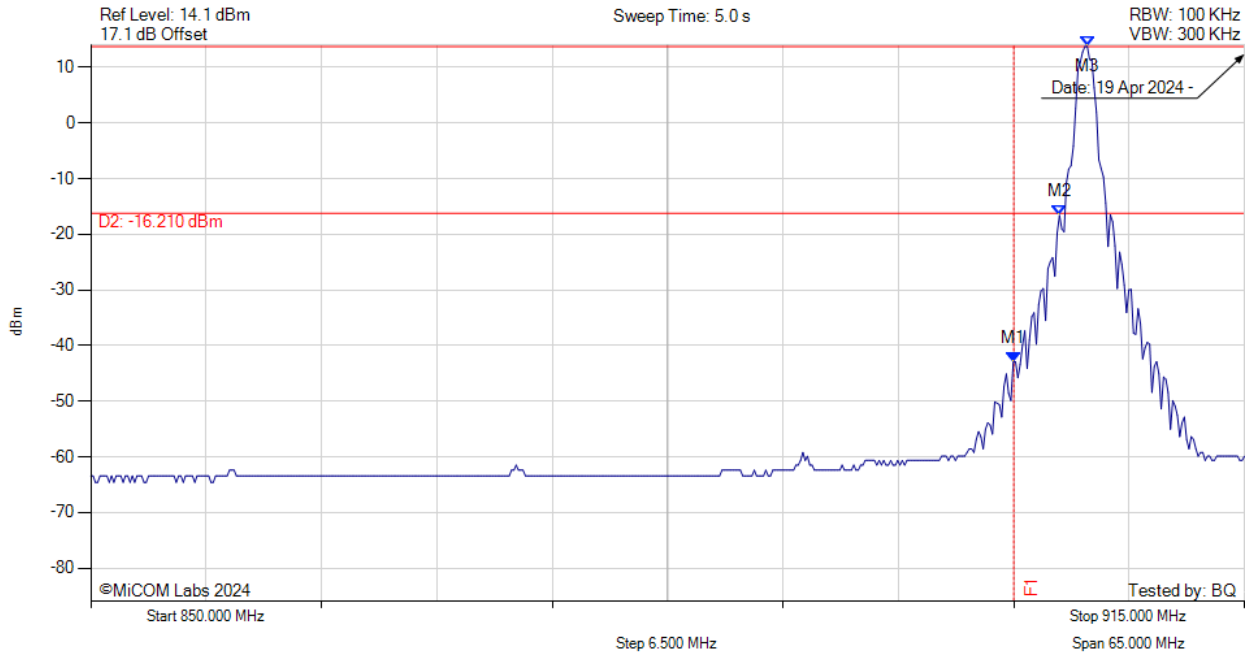


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = CLR/WRITE	M1 : 909.118 MHz : -22.749 dBm M2 : 1848.176 MHz : -55.220 dBm	Limit: -52.75 dBm Margin: -2.47 dB

back to matrix

A.4 Conducted Band-Edge Emissions

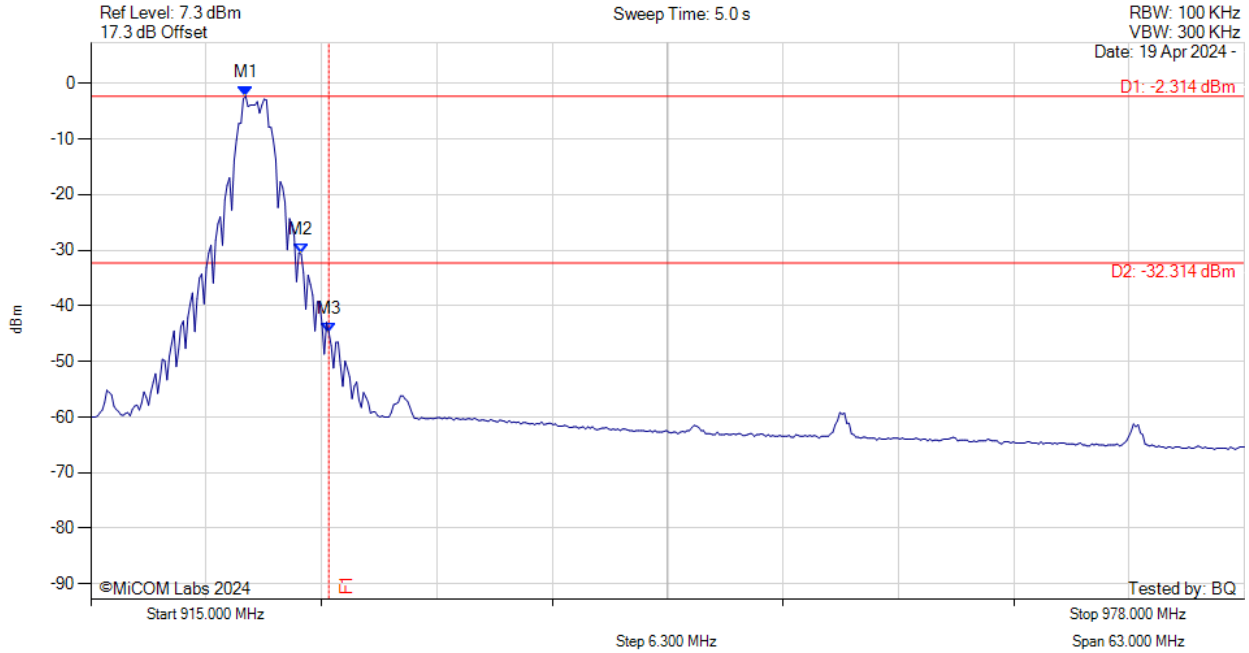
Channel: 906 MHz



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 902.000 MHz : -42.980 dBm M2 : 904.579 MHz : -16.580 dBm M3 : 906.142 MHz : 13.795 dBm	Channel Frequency: 906.00 MHz

back to matrix

Channel: 924 MHz



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 923.459 MHz : -2.314 dBm M2 : 926.489 MHz : -30.676 dBm M3 : 928.000 MHz : -44.842 dBm	Channel Frequency: 924.00 MHz

back to matrix

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