



## **REGULATORY VERIFICATION TEST REPORT**

**FCC CFR 47 Part 15.247, ISSED 15.247 Issue 2**

**Report No.: LYFT15-U5 Rev A (BLE)**

**Company:** Lyft, Inc

**Model Name:** BIT041N

## REGULATORY VERIFICATION TEST REPORT

**Company Name:** Lyft, Inc

**Model Name:** BIT041N

**To:** FCC CFR 47 Part 15 Subpart C 15.247 (DTS), ISSED RSS-247 Issue 2

**Test Report Serial No.:** LYFT15-U5 Rev A (BLE)

**This report supersedes:** NONE

**Applicant:** Lyft, Inc  
185 Berry St #5000  
San Francisco, California 94107  
USA

**Issue Date:** 15<sup>th</sup> August 2022

**This Test Report is Issued Under the Authority of:**

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**MiCOM Labs is an ISO 17025 Accredited Testing Laboratory**

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## 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](http://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>



### Accredited Laboratory

A2LA has accredited

**MICOM LABS**

Pleasanton, CA

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).



Presented this 14<sup>th</sup> day of January 2022.



Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 2381.01  
Valid to November 30, 2023

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](http://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 14<sup>th</sup> day of January 2022



Vice President, Accreditation Services  
For the Accreditation Council  
Certificate Number 2381.02  
Valid to November 30, 2023

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	9 <sup>th</sup> August 2022	Draft report for client review.
Rev A	15 <sup>th</sup> August 2022	Initial Release

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



### 3. TEST RESULT CERTIFICATE

<b>Manufacturer:</b> Lyft, Inc 185 Berry St #5000 San Francisco California 94107 USA	<b>Tested By:</b> MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
<b>Model:</b> BIT041N	<b>Telephone:</b> +1 925 462 0304
<b>Equipment Type:</b> E-Bike Location and Communication Module	<b>Fax:</b> +1 925 462 0306
<b>S/N's:</b> 65-0000029-A	
<b>Test Date(s):</b> 9 <sup>th</sup> August 2022	<b>Website:</b> www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC CFR 47 Part 15 Subpart C 15.247 ISED RSS-247	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.

**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 662911 D01 & D02	Oct 31 2013	Guidance for measurement of output emission of devices that employ single transmitter with multiple outputs or systems with multiple transmitters operating simultaneously in the same frequency band
II	KDB 558074 D01 v05r02	2nd April 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.
III	A2LA	5th October 2020	R105 - Requirement's When Making Reference to A2LA Accreditation Status
IV	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
V	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
VI	CISPR 32	2015	Electromagnetic compatibility of multimedia equipment - Emission requirements
VII	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
VIII	FCC 47 CFR Part 15.247	2020	Radio Frequency Devices; Subpart C – Intentional Radiators
IX	ICES-003	Issue 7; October 15,2020	Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement.
X	M 3003	Edition 3 Nov.2012	Expression of Uncertainty and Confidence in Measurements
XI	RSS-247 Issue 2	Feb 2017	Digital Transmission Systems (DTSSs), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices
XII	RSS-Gen Issue 5	2018	General Requirements for Compliance of Radio Apparatus. With Amendments 1: March 2019 and 2: Feb 2021.
XIII	FCC 47 CFR Part 2.1033	2020	FCC requirements and rules regarding photographs and test setup diagrams.
XIV	KDB 789033 D02 V02r01	14th December, 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.

## 5. PRODUCT DETAILS AND TEST CONFIGURATIONS

### 5.1. Technical Details

Details	Description
Purpose:	Test of the Lyft, Inc BIT041N to FCC CFR 47 Part 15 Subpart C 15.247, ISED RSS-247 Issue 2.
Applicant:	Lyft, Inc 185 Berry St #5000 San Francisco California 94107, USA
Manufacturer:	Lyft, Inc
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	LYFT15-U5
Date EUT received:	4 <sup>th</sup> August 2022
Standard(s) applied:	FCC CFR 47 Part 15 Subpart C 15.247 ISED RSS-247 Issue 2
Dates of test (from - to):	3 <sup>rd</sup> – 4 <sup>th</sup> & 8 <sup>th</sup> August 2022
No of Units Tested:	1
Product Family Name:	Cosmo VCU
Model(s):	BIT041N
Marketing Name:	Cosmo VCU
Location for use:	Indoor / Outdoor
Declared Frequency Range(s):	2400 - 2483.5 MHz
Type of Modulation:	GFSK
EUT Modes of Operation:	2400 - 2483.5 MHz: BLE;
Declared Nominal Output Power (dBm):	+8 dBm
Rated Input Voltage and Current:	50.4VDC / 1A Battery
Operating Temperature Range:	-20°C to +50°C
Equipment Dimensions:	15.75cm x 8.8cm x 5.5cm
Weight:	360 grams
Hardware Rev:	88-0000779-A
Software Rev:	16b00bc1d102c

## **5.2. Scope Of Test Program**

### **Lyft, Inc BIT041N**

The scope of the test program was to verify the Lyft, Inc BIT041N 2.4G BLE radio modifications from previous product release in the frequency range 2400 - 2483.5 MHz; for compliance against the following specifications:

#### **FCC CFR 47 Part 15 Subpart C 15.247 (DTS)**

Radio Frequency Devices; Subpart C – Intentional Radiators

#### **ISSED RSS-247 Issue 2**

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

This verification report was only to verify the continued compliance of the Lyft Inc. BIT041N. As a result of the device modification testing was limited to conducted output power and radiated emissions.

All other tests may be found in the following test report:

The BLE Module used in this equipment was previously tested in MiCOM Labs Report # LYFT06-U5 Rev A, Date 20<sup>th</sup> April 2021.

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

Type (EUT/Support)	Equipment Description (Including Brand Name)	Mfr.	Model No.	Serial No.
EUT	E-Bike Location and Communication Module	Lyft Inc	BIT041N	65-0000029-A

### 5.4. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
integral	Taoglas	WLA.01	Chip	2.5	-	360	-	2400 - 2483.5

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

### 5.5. Cabling and I/O Ports

Port Type	Max Cable Length	Conn Type	Environment
Discrete I/O	<3m	Higo L810 CG	End-User
Analog	<3m	Higo L309 CM	End-User
Analog	<3m	Higo L609 CM	End-User
CAN+DC IN	<3m	Higo L409 CG	End-User
Power + Digital I/O	<3m	Higo L509 CM	End-User

### 5.6. Test Configurations

Results for the following configurations are provided in this report:

Results for the following configurations are provided in this report:				
Operational Mode	Data Rate with Highest Power MBit/s	Channel Frequency (MHz)		
		Low	Mid	High
2400.0 – 2483.5 MHz				
BLE	1	2,402.00	2,440.00	2,480.00

### **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

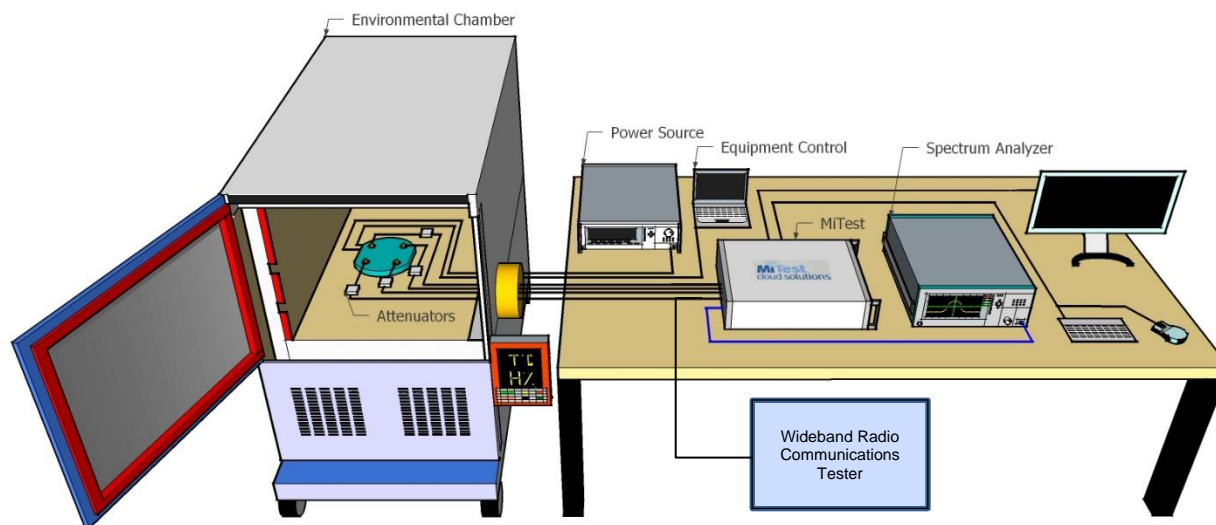
Test Header	Result	Data Link
Conducted Output Power	Complies	<a href="#">View Data</a>
TX Spurious & Restricted Band Emissions	Complies	<a href="#">View Data</a>
Restricted Edge & Band-Edge Emissions	Complies	<a href="#">View Data</a>



## 7. TEST EQUIPMENT CONFIGURATION(S)

### 7.1. Conducted RF

MiTest Automated Test System



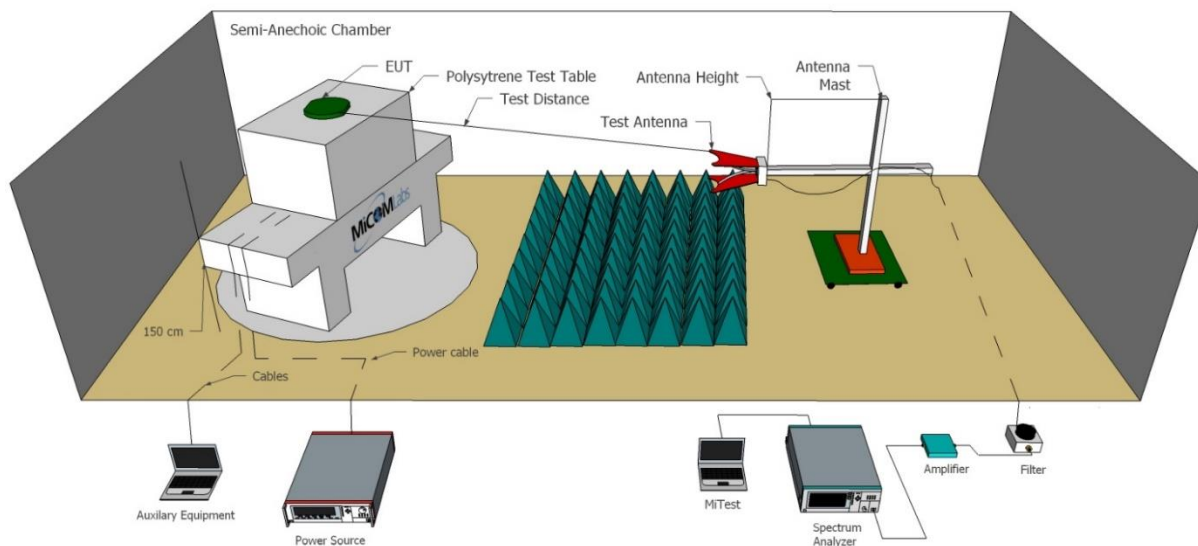
A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
#3 SA	MiTest Box to SA	Fairview Microwave	SCA1814-0101-72	#3 SA	7 Oct 2022
#3P1	EUT to MiTest box port 1	Fairview Microwave	SCA1814-0101-72	#3P1	7 Oct 2022
#3P2	EUT to MiTest box port 2	Fairview Microwave	SCA1814-0101-72	#3P2	7 Oct 2022
#3P3	EUT to MiTest box port 3	Fairview Microwave	SCA1814-0101-72	#3P3	7 Oct 2022
#3P4	EUT to MiTest box port 4	Fairview Microwave	SCA1812-0101-72	#3P4	7 Oct 2022
249	Thermocouple; Resistance Thermometer	Thermotronics	GR2105-02	9340 #2	30 Oct 2022
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	8 Oct 2022
398	MiTest RF Conducted Test Software	MiCOM	MiTest ATS	Version 4.2.3.0	Not Required
405	DC Power Supply 0-60V	Agilent	6654A	MY4001826	Cal when used
408	USB to GPIB interface	National Instruments	GPIB-USB HS	14C0DE9	Not Required
441	USB Wideband Power Sensor	Boonton	55006	9179	20 Sep 2022
442	USB Wideband Power Sensor	Boonton	55006	9181	19 Oct 2022
445	PoE Injector	D-Link	DPE-101GL	QTAH1E2000625	Not Required
461	Spectrum Analyzer	Agilent	E4440A	MY46185537	27 Sep 2023
493	USB Wideband Power Sensor	Boonton	55006	9634	8 Oct 2022
494	USB Wideband Power Sensor	Boonton	55006	9726	19 Oct 2022
510	Barometer/Thermometer	Digi Sense	68000-49	170871375	4 Jan 2023
512	MiTest Cloud Solutions RF Test Box	MiCOM	2nd Gen with DFS	512	29 Jun 2023
555	Rhode & Schwarz Receiver (Firmware Version : 2.00 SP1)	Rhode & Schwarz	ESW 44	101893	28 Jun 2023
75	Environmental Chamber	Thermatron	SE-300-2-2	27946	20 Feb 2023

## 7.2. Radiated Emissions - 3m Chamber

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

A full system calibration was performed on the test station and any resulting system losses (or gains) were considered in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
170	Video System Controller for Semi Anechoic Chamber	Panasonic	WV-CU101	04R08507	Not Required
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	8 Oct 2022
298	3M Radiated Emissions Chamber Maintenance Check	MiCOM	3M Chamber	298	24 Sep 2022
301	5470 to 5725 MHz Notch Filter	Microtronics	RBC50704	001	6 Oct 2022
302	5150 to 5350 MHz Notch Filter	Microtronics	BRC50703	002	6 Oct 2022
303	5725 to 5875 MHz Notch filter	Microtronics	BRC50705	003	6 Oct 2022
330	Variac 0-280 Vac	Staco Energy Co	3PN1020B	0546	Cal when used
336	Active loop Ant 10kHz to 30 MHz	EMCO	EMCO 6502	00060498	29 Nov 2022
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	29 Sep 2023
342	2.4 GHz Notch Filter	EWT	EWT-14-0203	H1	6 Oct 2022
373	26III RMS Multimeter	Fluke	Fluke 26 series III	76080720	29 Sep 2022
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	27 Oct 2022
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	30 Sep 2023
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	2 Nov 2022
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	27 Oct 2022

463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	27 Oct 2022
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	27 Oct 2022
480	Cable - Bulkhead to Amp	SRC Haverhill	157-3050360	480	6 Oct 2022
481	Cable - Bulkhead to Receiver	SRC Haverhill	151-3050787	481	6 Oct 2022
510	Barometer/Thermometer	Digi Sense	68000-49	170871375	4 Jan 2023
554	Precision SMA Cable	Fairview Microwave	SCE18060101-400CM	554	6 Oct 2022
555	Rhode & Schwarz Receiver (Firmware Version : 2.00 SP1)	Rhode & Schwarz	ESW 44	101893	28 Jun 2023
CC05	Confidence Check	MiCOM	CC05	None	27 Feb 2023

## 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. Conducted Output Power

Conducted Test Conditions for Fundamental Emission Output Power			
<b>Standard:</b>	FCC CFR 47:15.247	<b>Ambient Temp. (°C):</b>	24.0 - 27.5
<b>Test Heading:</b>	Output Power	<b>Rel. Humidity (%):</b>	32 - 45
<b>Standard Section(s):</b>	15.247 (b) & (c)	<b>Pressure (mBars):</b>	999 - 1001
<b>Reference Document(s):</b>	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 ( $\Sigma$ ) 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 [ $10^{\log_{10} 10^{a/10} + 10^{b/10} + 10^{c/10} + 10^{d/10}}$ ]

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 Average Output Power

<b>Variant:</b>	BLE	<b>Duty Cycle (%):</b>	99.0
<b>Data Rate:</b>	1.00 MBit/s	<b>Antenna Gain (dBi):</b>	2.50
<b>Modulation:</b>	GFSK	<b>Beam Forming Gain (Y)(dB):</b>	Not Applicable
<b>TPC:</b>	Not Applicable	<b>Tested By:</b>	SB
<b>Engineering Test Notes:</b>			

#### Test Measurement Results

Test Frequency MHz	Measured Output Power (dBm)				Calculated Total Power Σ Port(s) dBm	Limit dBm	Margin dB	EUT Power Setting
	a	b	c	d				
2402.0	6.76	--	--	--	6.76	30.00	-23.24	Max
2440.0	6.63	--	--	--	6.63	30.00	-23.37	Max
2480.0	6.36	--	--	--	6.36	30.00	-23.64	Max

#### Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Measurement Uncertainty:	±1.33 dB

## 9.2. Emissions

### 9.2.1. Radiated Emissions

#### 9.2.1.1. TX Spurious & Restricted Band Emissions

Radiated Test Conditions for Radiated Spurious and Band-Edge Emissions (Restricted Bands)			
<b>Standard:</b>	FCC CFR 47 Part 15.247 ISED RSS-247	<b>Ambient Temp. (°C):</b>	20.0 - 24.5
<b>Test Heading:</b>	Radiated Spurious and Band-Edge Emissions	<b>Rel. Humidity (%):</b>	32 - 45
<b>Standard Section(s):</b>	15.205, 15.209 Sect 5.5	<b>Pressure (mBars):</b>	999 - 1001
<b>Reference Document(s):</b>	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 section 11.12.2.5.2 Trace averaging across on and off times of the EUT transmissions followed by a duty cycle correction.

RMS detector used, DCCF of  $10\log(1/D)$  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:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 \text{ dBmV/m}$$

Conversion between dBmV/m (or dBmV) and mV/m (or mV) are as follows:

$$\text{Level (dBmV/m)} = 20 * \log(\text{level (mV/m)})$$

$$40 \text{ dBmV/m} = 100 \text{ mV/m}$$

$$48 \text{ dBmV/m} = 250 \text{ mV/m}$$

#### 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).

### Equipment Configuration for FCC SPURIOUS 1 GHZ -18 GHZ

<b>Antenna:</b>	Integral	<b>Variant:</b>	BLE
<b>Antenna Gain (dBi):</b>	2.50	<b>Modulation:</b>	GFSK
<b>Beam Forming Gain (Y):</b>	Not Applicable	<b>Duty Cycle (%):</b>	99
<b>Channel Frequency (MHz):</b>	2402	<b>Data Rate:</b>	1Mbit/s
<b>Power Setting:</b>	Max	<b>Tested By:</b>	SB

### Test Measurement Results



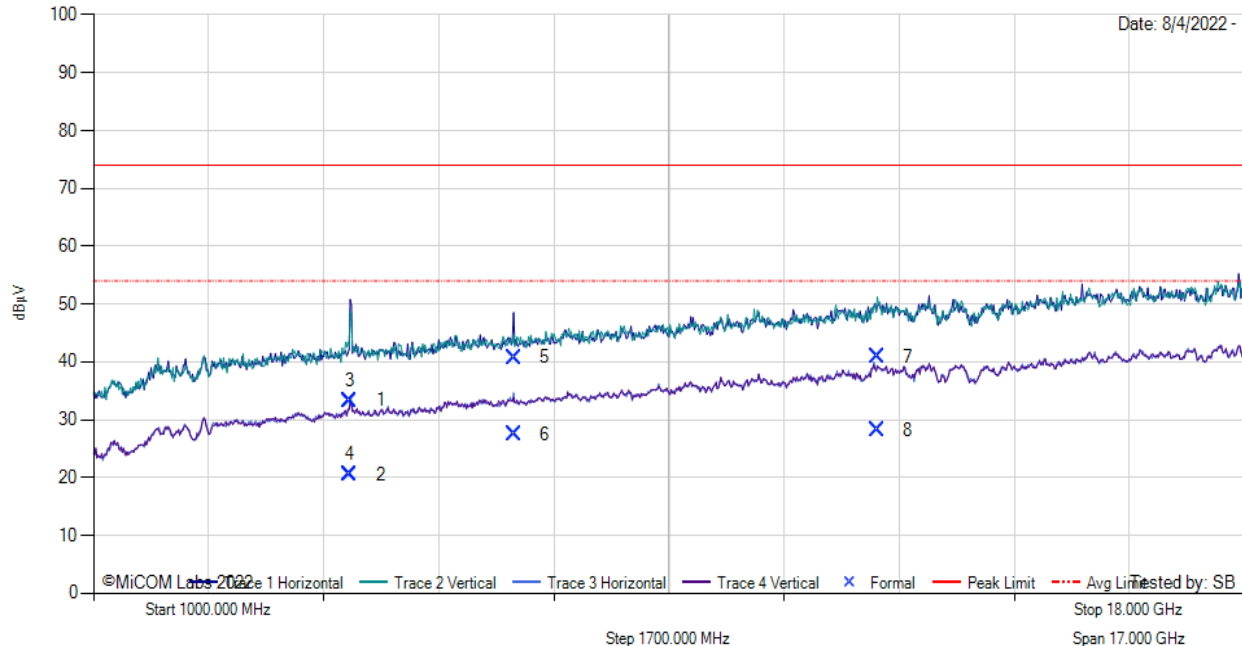
FCC Spurious 1 GHz -18 GHz

Antenna: Integral

Measurement Distance: 3m

Sweep Time: 100 ms

RBW: 1 MHz  
VBW: 3 MHz



### 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	4790.44	42.13	2.93	-11.75	33.32	MaxP	Horizontal	99	0	74.0	-40.7	Pass
2	4790.44	29.38	2.93	-11.75	20.56	AVG	Horizontal	99	0	54.0	-33.4	Pass
3	4792.00	42.08	2.91	34.50	33.24	MaxP	Vertical	148	148	74.0	-40.8	Pass
4	4792.00	29.31	2.91	34.50	20.47	AVG	Vertical	148	148	54.0	-33.5	Pass
5	7206.46	45.27	3.76	-8.29	40.74	MaxP	Horizontal	171	112	74.0	-33.3	Pass
6	7206.46	31.94	3.76	-8.29	27.41	AVG	Horizontal	171	112	54.0	-26.6	Pass
7	12575.16	42.08	5.04	-6.18	40.94	MaxP	Vertical	122	59	74.0	-33.1	Pass
8	12575.16	29.38	5.04	-6.18	28.24	AVG	Vertical	122	59	54.0	-25.8	Pass

Test Notes: BLE 2402 MHz

### Equipment Configuration for FCC SPURIOUS 1 GHZ -18 GHZ

<b>Antenna:</b>	Integral	<b>Variant:</b>	BLE
<b>Antenna Gain (dBi):</b>	2.50	<b>Modulation:</b>	GFSK
<b>Beam Forming Gain (Y):</b>	Not Applicable	<b>Duty Cycle (%):</b>	99
<b>Channel Frequency (MHz):</b>	2440	<b>Data Rate:</b>	1Mbit/s
<b>Power Setting:</b>	Max	<b>Tested By:</b>	SB



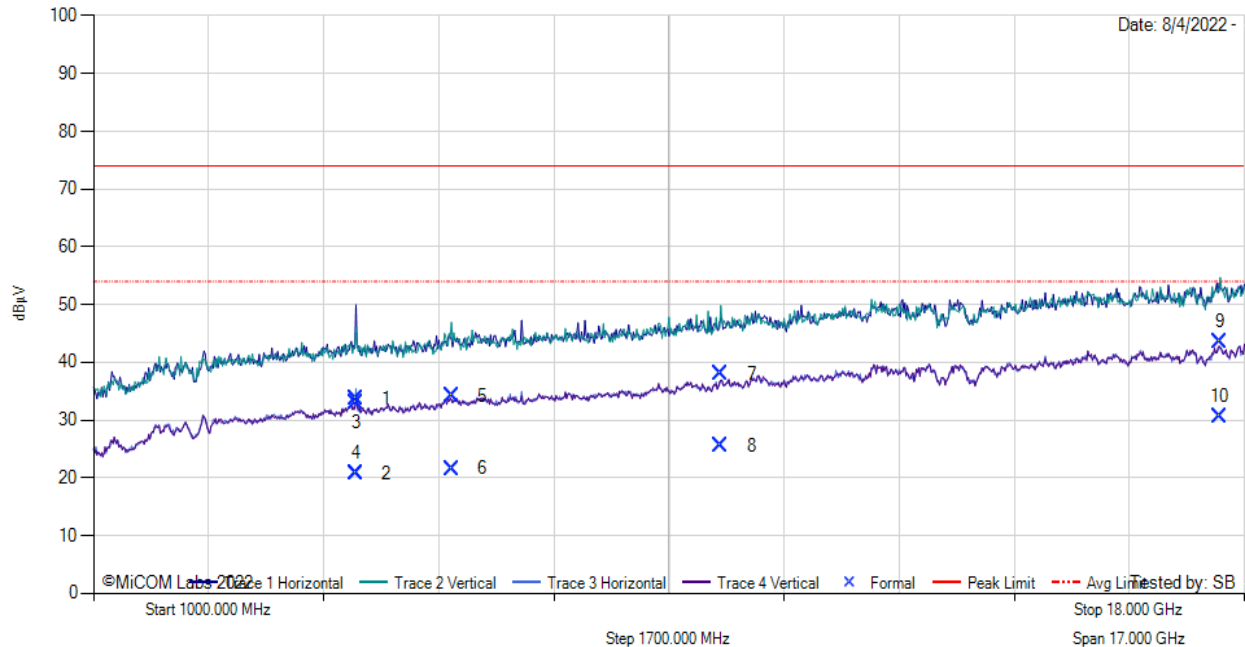
### FCC Spurious 1 GHz -18 GHz

Antenna: Integral

Measurement Distance: 3m

Sweep Time: 100 ms

RBW: 1 MHz  
VBW: 3 MHz



### 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	4875.23	42.62	2.84	-11.84	33.62	MaxP	Vertical	148	192	74.0	-40.4	Pass
2	4875.23	29.76	2.84	-11.84	20.76	AVG	Vertical	148	192	54.0	-33.2	Pass
3	4876.41	42.07	2.84	-11.84	33.07	MaxP	Horizontal	181	116	74.0	-40.9	Pass
4	4876.41	29.69	2.84	-11.84	20.68	AVG	Horizontal	181	116	54.0	-33.3	Pass
5	6287.43	39.82	3.31	-8.92	34.21	MaxP	Vertical	117	296	74.0	-39.8	Pass
6	6287.43	27.24	3.31	-8.92	21.63	AVG	Vertical	117	296	54.0	-32.4	Pass
7	10266.99	38.64	4.73	-5.41	37.96	MaxP	Vertical	148	9	74.0	-36.0	Pass
8	10266.99	26.27	4.73	-5.41	25.59	AVG	Vertical	148	9	54.0	-28.4	Pass
9	17644.58	38.55	6.28	-1.33	43.51	MaxP	Vertical	156	298	74.0	-30.5	Pass
10	17644.58	25.63	6.28	-1.33	30.58	AVG	Vertical	156	298	54.0	-23.4	Pass

Test Notes: BLE 2440 MHz

### Equipment Configuration for FCC SPURIOUS 1 GHZ -18 GHZ

<b>Antenna:</b>	Integral	<b>Variant:</b>	BLE
<b>Antenna Gain (dBi):</b>	2.50	<b>Modulation:</b>	GFSK
<b>Beam Forming Gain (Y):</b>	Not Applicable	<b>Duty Cycle (%):</b>	99
<b>Channel Frequency (MHz):</b>	2480	<b>Data Rate:</b>	1Mbit/s
<b>Power Setting:</b>	Max	<b>Tested By:</b>	SB

### Test Measurement Results



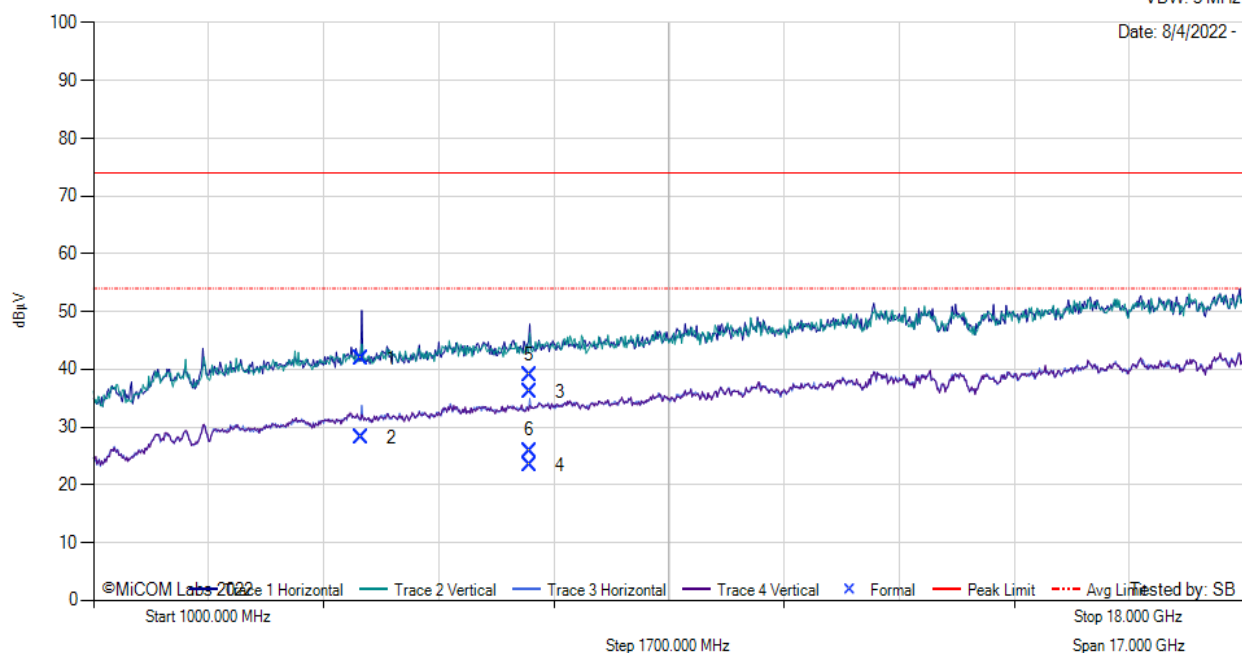
FCC Spurious 1 GHz -18 GHz

Antenna: Integral

Measurement Distance: 3m

Sweep Time: 100 ms

RBW: 1 MHz  
VBW: 3 MHz



### 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	4960.27	50.98	2.90	-12.08	41.79	MaxP	Horizontal	162	118	74.0	-32.2	Pass
2	4960.27	37.44	2.90	-12.08	28.26	AVG	Horizontal	162	118	54.0	-25.7	Pass
3	7441.01	40.49	3.79	-8.17	36.11	MaxP	Vertical	163	227	74.0	-37.9	Pass
4	7441.01	27.73	3.79	-8.17	23.35	AVG	Vertical	163	227	54.0	-30.7	Pass
5	7441.02	43.38	3.79	-8.17	39.00	MaxP	Horizontal	198	119	74.0	-35.0	Pass
6	7441.02	30.31	3.79	-8.17	25.93	AVG	Horizontal	198	119	54.0	-28.1	Pass

**Test Notes:** BLE 2480 MHz





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