



REGULATORY COMPLIANCE TEST REPORT

FCC CFR 47 Part 15 Subpart C 15.247 DTS, ISED RSS-247

Report No.: LYFT27-U5 Rev A

Company: Lyft, Inc.

Model Name: BIT043G

FCC ID: 2ASMP-BIT043G

ISED ID: 24879-BIT043G

REGULATORY COMPLIANCE TEST REPORT

Company Name: Lyft, Inc.

Model Name: BIT043G

To: FCC CFR 47 Part 15 Subpart C 15.247 DTS,
ISED RSS-247 Issue 4 July 2025

Test Report Serial No.: LYFT27-U5 Rev A

This report supersedes: NONE

Applicant: Lyft, Inc.
185 Berry St #400
San Francisco, CA 94107
USA

Issue Date: 19th March 2026

This Test Report is Issued Under the Authority of:

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



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 test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-01.pdf>



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			
Europe	European Commission	NB	EU MRA 2	A-0012 NB 2280
United Kingdom	Department for Business, Energy & Industrial Strategy (BEIS)	AB	UK MRA 2	AB 2280
Indonesia	Minister of Communication and Digital Education Keputusan Menteri Komunikasi Dan Digital	Number 13 List of Overseas Test Labs	--	Lab n°50/2025 of Decree n°13
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 PhasePhase I - recognition for product testing

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>



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	28 th January 2026	Draft for comment
Rev A	19 th March 2026	Initial Release

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

3. TEST RESULT CERTIFICATE

Manufacturer: Lyft, Inc.
185 Berry St #400
San Francisco CA 94107
USA

Tested By: MiCOM Labs, Inc.
575 Boulder Court
Pleasanton California 94566
USA

Model: BIT043G

Telephone: +1 925 462 0304

Equipment Type: Global VCU (Vehicle Control Unit)

Fax: +1 925 462 0306

S/N's: FK2541CVCU2GM0122,
FK2541CVCU2GM0123

Test Date(s): 20th – 21st January 2026

Website: www.micomlabs.com

STANDARD(S)

FCC CFR 47 Part 15 Subpart C 15.247 DTS,
ISED RSS-247

TEST RESULTS

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, D03	D01 Oct 2013, D02 Oct 2011, D03 Oct 2020	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. 662911 D01 Multiple Transmitter Output v02r01, 662911 D02 MIMO with Cross Polarized Antenna v01, 662911 D03 MIMO Antenna Gain Measurement v01, OET 13TR1003 Directional Gain of 802 11 MIMO with CDD 04 05 2013
II	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.
III	A2LA R105	24th February 2025	Requirements When Making Reference to A2LA Accreditation Status.
IV	ANSI C63.10a	2024	American National Standard for Testing Unlicensed Wireless Devices
V	ANSI C63.4	2014 + 2017 Amendment	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	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
VII	FCC 47 CFR Part 15.247	Apr 2020	Radio Frequency Devices; Subpart C – Intentional Radiators
VIII	ICES-003	Issue 7; Oct 2020	Information Technology Equipment (Including Digital Apparatus)
IX	UKAS M3003	Edition 6 March 2024	The Expression of Uncertainty and Confidence in Measurements
X	RSS-247 Issue 4	July 2025	RSS-247 — Digital Transmission Systems, Frequency Hopping Systems and Licence-Exempt Local Area Network Devices in 902-928 MHz, 2400-2483.5 MHz, 5150-5350 MHz, and 5470-5895 MHz bands.
XI	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.
XII	FCC 47 CFR Part 2.1033	Feb 2023	FCC requirements and rules regarding photographs and test setup diagrams.
XIII	KDB 789033 D02 V02r01	Dec 2017	Guidelines For Compliance Testing Of Unlicensed National Information Infrastructure (U-NII) Devices Part 15, Subpart E
XIV	UKAS LAB 12	Edition 5 December 2025	The Expression of Uncertainty in Testing

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. BIT043G to : FCC CFR 47 Part 15 Subpart C, 15.247 DTS, and ISED RSS-247 Issue 4
Applicant:	Lyft, Inc. 185 Berry St #400 San Francisco CA 94107 USA
Manufacturer:	Lyft, Inc.
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	LYFT27-U5
Date EUT received:	20 th Jan 2026
Standard(s) applied:	FCC CFR 47 Part 15 Subpart C 15.247 DTS, ISED RSS 247
Dates of test (from - to):	20 th – 21 st January 2026
No of Units Tested:	2
Product Family Name:	Global VCU (Vehicle Control Unit)
Model(s):	BIT043G
Location for use:	Indoors & Outdoors
Declared Frequency Range(s):	2400 - 2483.5 MHz;
Type of Modulation:	BIT043G
EUT Modes of Operation:	2400 - 2483.5 MHz: BLE-1M;
Declared Nominal Output Power:	+8.0 dBm
Transmit/Receive Operation:	GFSK
Rated Input Voltage and Current:	3.6V / 4A
Operating Temperature Range:	-20C -> +60 C
Equipment Dimensions:	16 cm x 10 cm x 6 cm
Weight:	365 g
Hardware Rev:	88-0001354 Rev 3
Software Rev:	Ae63520d21a0

5.2. Scope Of Test Program

Lyft, Inc. BIT043G

The scope of the test program was to test the Lyft, Inc. BIT043G configurations in the frequency range 2400 - 2483.5 MHz; for compliance against the following specification:

FCC CFR 47 Part 15 Subpart C 15.247 DTS

Radio Frequency Devices; Subpart C – Intentional Radiators

RSS-247 Issue 4 July 2025

RSS-247 — Digital Transmission Systems, Frequency Hopping Systems and License-Exempt Local Area Network Devices in 902-928 MHz, 2400-2483.5 MHz, 5150-5350 MHz, and 5470-5895 MHz bands.

Lyft, Inc. BIT043G



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

Type (EUT/ Support)	Equipment Description	Mfr	Model/Part No.	Serial No.
EUT	Astro Bike VCU (Vehicle Control Unit)	Lyft	BIT043G	FK2541CVCU2GM0122
EUT	Astro Bike VCU (Vehicle Control Unit)	Lyft	BIT043G	FK2541CVCU2GM0123
EUT Support	USB/CAN Adapter	Peak System Technik	GC-CAN-USB	N/A
MiCOM Labs Power Supply Support	System DC Power Supply	Agilent	6654A	MY40001826
Support	CUSTOMER LAPTOP ThinkPad P1 Gen 7	Lenovo	21KWS3J000	PW0F6N9K

5.4. Cabling and I/O Ports

Port Type	Max Cable Length	Conn Type	Environment
Discrete I/O	<3m	Higo 3 Pin	Internal to bike
Discrete I/O	<3m	Higo 5 Pin	Internal to bike
Discrete I/O	<3m	Higo 6 Pin	Internal to bike
Discrete I/O	<3m	Higo 8 Pin	Internal to bike
CAN+DC IN	<3m	Higo 4 Pin	Internal to bike

5.5. Antenna Details

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

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

5.6. Test Configurations

Results for the following configurations are provided in this report:

Operational Mode(s) (DTS)	Data Rate with Highest Power MBit/s	Channel Frequency (MHz)		
		Low	Mid	High
2400 - 2483.5 MHz				
BLE-1M	1	2,402.00	2,440.00	2,480.00

5.7. Operational Modes

Technology	Operating Mode Description
BLE	1 Mbit/s

5.8. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. NONE

5.9. 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
6 dB & 99% Bandwidth	Complies	View Data
Conducted Output Power	Complies	View Data
Power Spectral Density	Complies	View Data
Emissions	Complies	-
(1) Conducted Emissions	Complies	-
(i) Conducted Spurious Emissions	Complies	View Data
(ii) Conducted Band-Edge Emissions	Complies	View Data
(2) Radiated Emissions	Complies	-
(i) TX Spurious & Restricted Band Emissions	Complies	View Data
(ii) Restricted Edge & Band-Edge Emissions	Complies	View Data

7. 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.



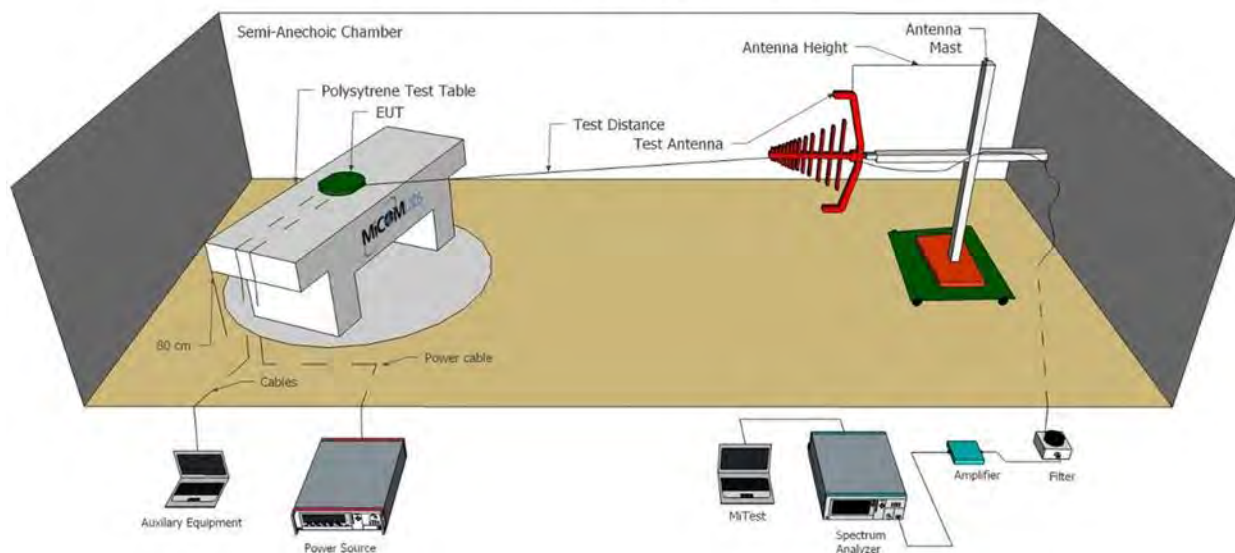
The MiCOM Labs "[MiTest](#)" Automated Test System" (Patent Pending)

8. TEST EQUIPMENT CONFIGURATION(S)

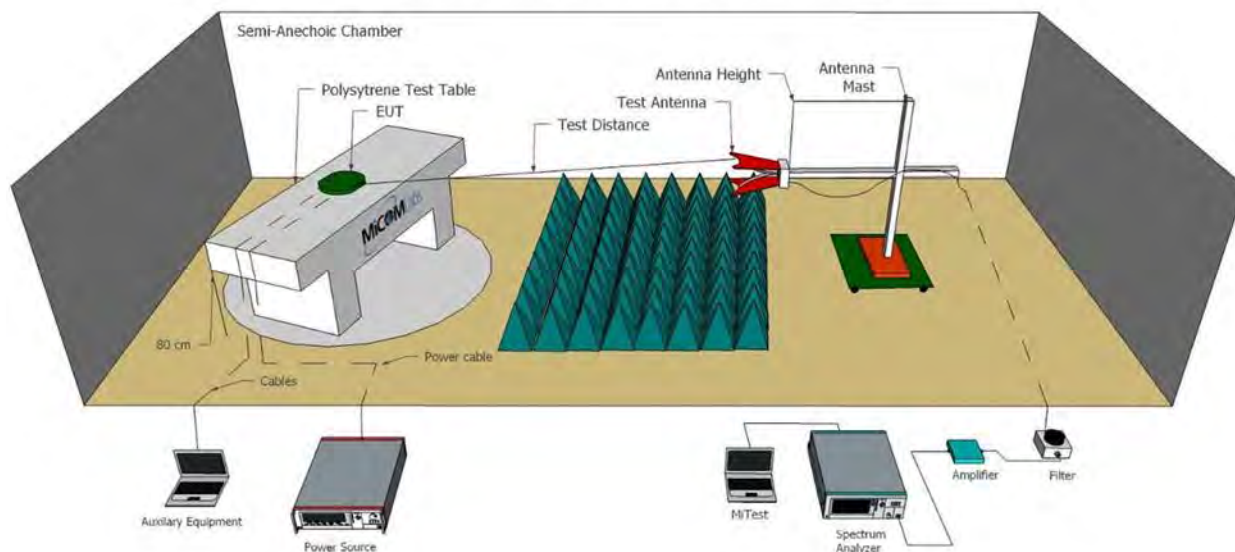
8.1.1. Radiated Test Setup

Test setup diagrams for Radiated Emissions below and above 1 GHz.

Radiated Emissions Below 1GHz Test Setup



Radiated Emissions Above 1GHz Test Setup



Test Equipment Utilized

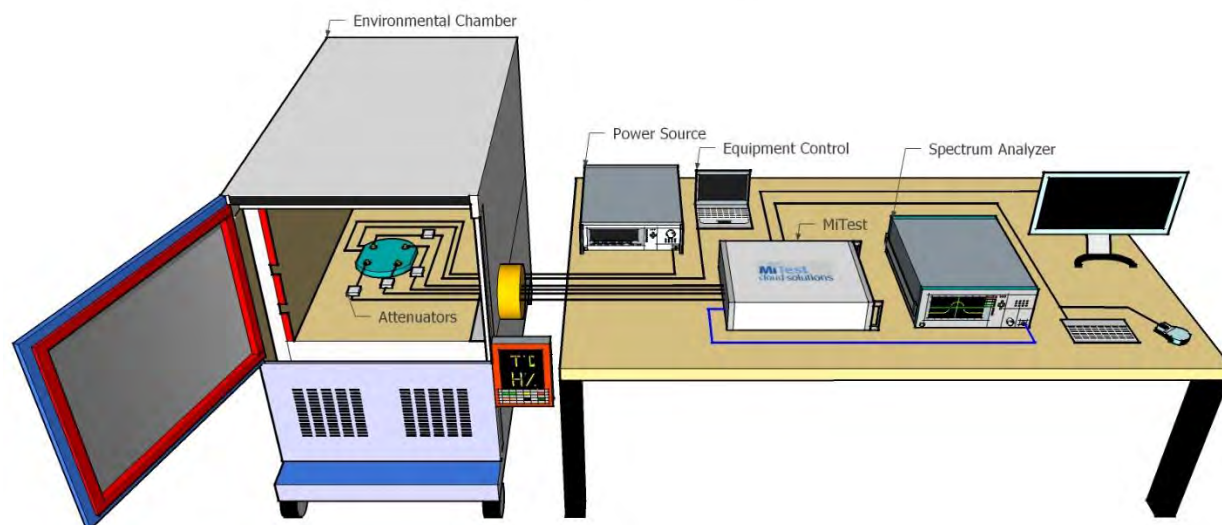
A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
170	Video System Controller for Semi Anechoic Chamber	Panasonic	WV-CU101	04R08507	Not Required
298	3M Radiated Emissions Chamber Maintenance Check	MiCOM	3M Chamber	298	22 Mar 2026
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 2026
342	2.4 GHz Notch Filter	EWT	EWT-14-0203	H1	25 Aug 2026
346	1.6 TO 10GHz High Pass Filter	EWT	EWT-57-0112	H1	25 Aug 2026
382	Tunable Notch Filter	Wainwright Instruments GmbH	WRCT800/960-0.2/40-8EEK	64	Cal when used
396	2.4 GHz Notch Filter	Microtronics	BRM50701	001	25 Aug 2026
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	18 Aug 2026
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	7 Dec 2026
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	18 Aug 2026
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
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 Aug 2026
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	18 Aug 2026
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	18 Aug 2026
465	Low Pass Filter DC-1000 MHz	Mini-Circuits	NLP-1200+	VUU01901402	18 Aug 2026

480	Cable - Bulkhead to Amp	SRC Haverhill	157-3050360	480	18 Aug 2026
481	Cable - Bulkhead to Receiver	SRC Haverhill	151-3050787	481	18 Aug 2026
510	Barometer/Thermometer	Digi Sense	68000-49	170871375	4 Jan 2027
554	Precision SMA Cable	Fairview Microwave	SCE18060 101-400CM	554	18 Aug 2026
555	Rhode & Schwarz Receiver (Firmware Version : 3.10 SP1)	Rhode & Schwarz	ESW 44	101893	14 Aug 2026
578	DC Power Supply 0 - 60 V, 0 - 15 A	HP	6274B	2537A-08192	Not Required
596	DC Power Supply	Keysight	E36155A	MY63001023	17 Jan 2027
87	Uninterruptible Power Supply	Falcon Electric	ED2000-1/2LC	F3471 02/01	Cal when used
145	18 GHz to 26.6 GHz antenna	Millimeter Products Inc	261K/595	145	23 Jun 2026
CC-05	Radiated Emissions Confidence Check	MiCOM	CC-05	None	10 Mar 2026

8.1.2. Conducted Test Setup

MiTest Automated Test System



Test Equipment Utilized

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	8 Mar 2026
#3P1	EUT to MiTest box port 1	Fairview Microwave	SCA1814-0101-72	#3P1	8 Mar 2026
#3P2	EUT to MiTest box port 2	Fairview Microwave	SCA1814-0101-72	#3P2	8 Mar 2026
#3P3	EUT to MiTest box port 3	Fairview Microwave	SCA1814-0101-72	#3P3	8 Mar 2026
#3P4	EUT to MiTest box port 4	Fairview Microwave	SCA1812-0101-72	#3P4	8 Mar 2026
249	Thermocouple; Resistance Thermometer	Thermotronics	GR2105-02	9340 #2	22 Mar 2026
266	10 Hz to 50GHz MXA Signal Analyzer	Keysight	N9020B	MY60110791	25 Jul 2026
382	Tunable Notch Filter	Wainwright Instruments GmbH	WRCT800/960-0.2/40-8EEK	64	Cal when used
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	4 Dec 2026
442	USB Wideband Power Sensor	Boonton	55006	9181	12 Dec 2026
445	PoE Injector	D-Link	DPE-101GL	QTAH1E2000625	Not Required
461	Spectrum Analyzer	Agilent	E4440A	MY46185537	21 Aug 2027
494	USB Wideband Power Sensor	Boonton	55006	9726	12 Dec 2026
510	Barometer/Thermometer	Digi Sense	68000-49	170871375	4 Jan 2027
512	MiTest Cloud Solutions RF Test Box	MiCOM	2nd Gen	512	8 Mar 2026
516	USB Wideband Power Sensor	Boonton	RTP5006	10511	4 Dec 2026
555	Rhode & Schwarz Receiver (Firmware Version : 3.10 SP1)	Rhode & Schwarz	ESW 44	101893	14 Aug 2026
596	DC Power Supply	Keysight	E36155A	MY63001023	17 Jan 2027
75	Environmental Chamber	Theratron	SE-300-2-2	27946	20 Jun 2026

9. TEST RESULTS

9.1. 6 dB & 99% Bandwidth

Conducted Test Conditions for 6 dB and 99% Bandwidth			
Standard:	FCC CFR 47:15.247	Ambient Temp. (°C):	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.			

Equipment Configuration for 6 dB & 99% Bandwidth

Variant:	1M	Duty Cycle (%):	49
Data Rate:	1.00 MBit/s	Antenna Gain (dBi):	2.50
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 6 dB Bandwidth (MHz)				6 dB Bandwidth (MHz)		Limit	Lowest Margin
	Port(s)				Highest	Lowest	KHz	MHz
MHz	a	b	c	d				
2402.0	0.729	--	--	--	0.729	0.729	≥500.0	-0.23
2440.0	0.733	--	--	--	0.733	0.733	≥500.0	-0.23
2480.0	0.733	--	--	--	0.733	0.733	≥500.0	-0.23

Test Frequency	Measured 99% Bandwidth (MHz)				Maximum 99% Bandwidth (MHz)		
	Port(s)						
	MHz	a	b	--		--	
2402.0	1.070	--	--	--	1.070		
2440.0	1.074	--	--	--	1.074		
2480.0	1.078	--	--	--	1.078		

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

Note: click the links in the above matrix to view the graphical image (plot).

9.2. Conducted Output Power

Conducted Test Conditions for Fundamental Emission Output Power			
Standard:	FCC CFR 47:15.247	Ambient Temp. (°C):	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 [$10 \cdot \log_{10}(10^{a/10} + 10^{b/10} + 10^{c/10} + 10^{d/10})$]

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

Variant:	1M	Duty Cycle (%):	49.0
Data Rate:	1.00 MBit/s	Antenna Gain (dBi):	2.50
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm)				Calculated Total Power Σ Port(s)	Limit	Margin	EUT Power Setting
	Port(s)							
MHz	a	b	c	d	dBm	dBm	dB	
2402.0	7.53	--	--	--	7.53	30.00	-22.47	Max
2440.0	7.11	--	--	--	7.11	30.00	-22.89	Max
2480.0	6.83	--	--	--	6.83	30.00	-23.17	Max

Traceability to Industry Recognized Test Methodologies

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

The above measurements are true pulse readings and therefore a Duty Cycling correction factor is not required.

9.3. Power Spectral Density

Conducted Test Conditions for Power Spectral Density			
Standard:	FCC CFR 47:15.247	Ambient Temp. (°C):	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 (â) 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

$A = \text{Total Power Spectral Density } [10 \log_{10} (10^{a/10} + 10^{b/10} + 10^{c/10} + 10^{d/10})]$

$x = \text{Duty Cycle}$

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 - Average

Variant:	1M	Duty Cycle (%):	49.0
Data Rate:	1.00 MBit/s	Antenna Gain (dBi):	2.50
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Power Spectral Density				Amplitude Summation + DCCF (+3.1 dB)	Limit	Margin
	Port(s) (dBm/3KHz)						
MHz	a	b	c	d	dBm/3KHz	dBm/3KHz	dB
2402.0	-14.876	--	--	--	-11.778	8.0	-19.8
2440.0	-15.599	--	--	--	-12.501	8.0	-20.5
2480.0	-14.851	--	--	--	-11.753	8.0	-19.8

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

DCCF - Duty Cycle Correction Factor

Note: click the links in the above matrix to view the graphical image (plot).

9.4. Emissions

9.4.1. Conducted Emissions

9.4.1.1. Conducted Spurious Emissions

Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions			
Standard:	FCC CFR 47:15.247	Ambient Temp. (°C):	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 - Average

Variant:	1M	Duty Cycle (%):	49
Data Rate:	1.00 MBit/s	Antenna Gain (dBi):	2.50
Modulation:	GFSK	Beam Forming Gain (Y):	Not Applicable
TPC:	Not Applicable	Tested By:	CC
Engineering Test Notes:			

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
2402.0	30.0 - 26000.0	-70.290	-66.82	--	--	--	--	--	--
2440.0	30.0 - 26000.0	-70.460	-67.42	--	--	--	--	--	--
2480.0	30.0 - 26000.0	-70.656	-67.16	--	--	--	--	--	--

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

Note: click the links in the above matrix to view the graphical image (plot).

9.4.1.2. Conducted Band-Edge Emissions

Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions			
Standard:	FCC CFR 47:15.247	Ambient Temp. (°C):	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 Low Band-Edge Emissions - Average

Variant:	1M	Duty Cycle (%):	49.0
Data Rate:	1.00 MBit/s	Antenna Gain (dBi):	2.50
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2402.0 MHz					
Band-Edge Frequency:	2400.0 MHz					
Test Frequency Range:	2350.0 - 2422.0 MHz					
Port(s)	Band-Edge Markers and Limit			Revised Limit		Margin
	M1 Amplitude (dBm)	Plot Limit (dBm)	M2 Frequency (MHz)	Amplitude (dBm)	M2A Frequency (MHz)	(MHz)
a	-57.69	-37.82	2400.90	--	--	-0.900

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

Note: click the links in the above matrix to view the graphical image (plot).

Equipment Configuration for Conducted High Band-Edge Emissions - Average

Variant:	1M	Duty Cycle (%):	49.0
Data Rate:	1.00 MBit/s	Antenna Gain (dBi):	2.50
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2480.0 MHz					
Band-Edge Frequency:	2483.5 MHz					
Test Frequency Range:	2452.0 - 2524.0 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	-58.72	-37.04	2481.00	--	--	-2.500

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

Note: click the links in the above matrix to view the graphical image (plot).

9.4.2. Radiated Emissions

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).

9.4.2.3. TX Spurious & Restricted Band Emissions

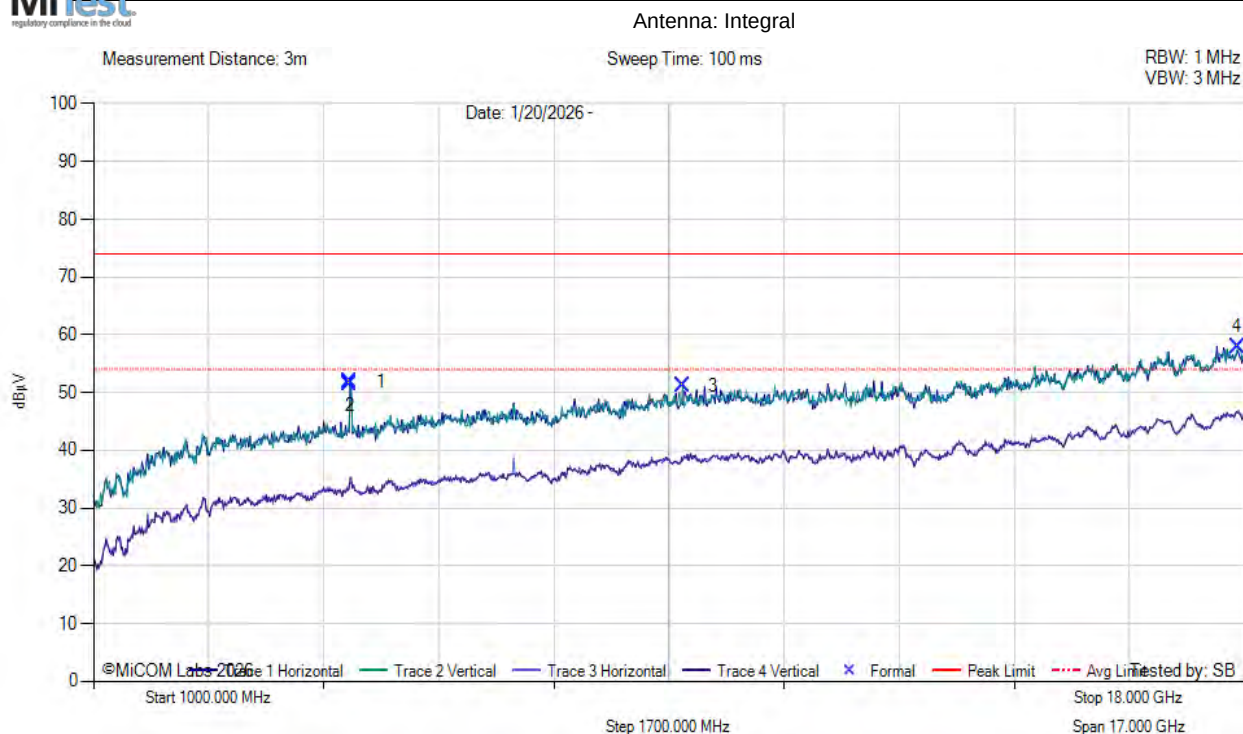
Equipment Configuration for FCC SPURIOUS 1 GHZ -18 GHZ

Antenna:	Integral	Variant:	BLE
Antenna Gain (dBi):	2.5	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2402	Data Rate:	1 Mbps
Power Setting:	Max	Tested By:	SB

Test Measurement Results



FCC Spurious 1 GHz -18 GHz



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	4791.00	60.37	3.84	-12.31	51.90	MaxP	Vertical	149	209	74.0	-22.1	Pass
2	4791.00	59.85	3.84	-12.31	51.37	MaxP	Horizontal	149	210	74.0	-22.6	Pass
3	9704.00	51.87	5.48	-6.12	51.23	MaxP	Vertical	149	89	74.0	-22.8	Pass
4	17898.00	48.55	7.94	1.36	57.85	MaxP	Vertical	149	239	74.0	-16.1	Pass

Test Notes: BLE Active 2402MHz

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;

Equipment Configuration for FCC SPURIOUS 1 - 18 GHZ

Antenna:	Integral	Variant:	BLE
Antenna Gain (dBi):	2.5	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2440	Data Rate:	1 Mbp/s
Power Setting:	Max	Tested By:	SB

Test Measurement Results



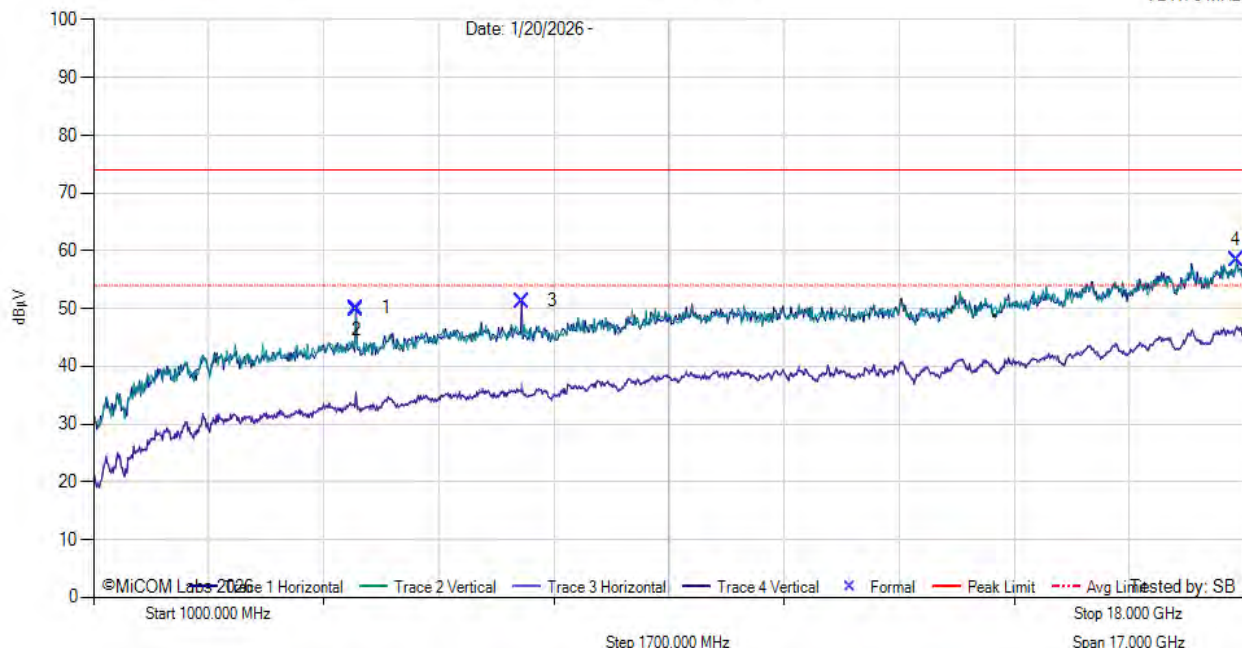
FCC Spurious 1 GHz -18 GHz

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	4876.00	58.69	3.92	-12.48	50.13	MaxP	Vertical	150	29	74.0	-23.9	Pass
2	4876.00	58.39	3.92	-12.48	49.83	MaxP	Horizontal	150	210	74.0	-24.2	Pass
3	7324.00	54.17	4.56	-7.45	51.28	MaxP	Horizontal	199	210	74.0	-22.7	Pass
4	17881.00	48.85	8.07	1.46	58.38	MaxP	Vertical	199	0	74.0	-15.6	Pass

Test Notes: BLE Active 2440MHz

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;

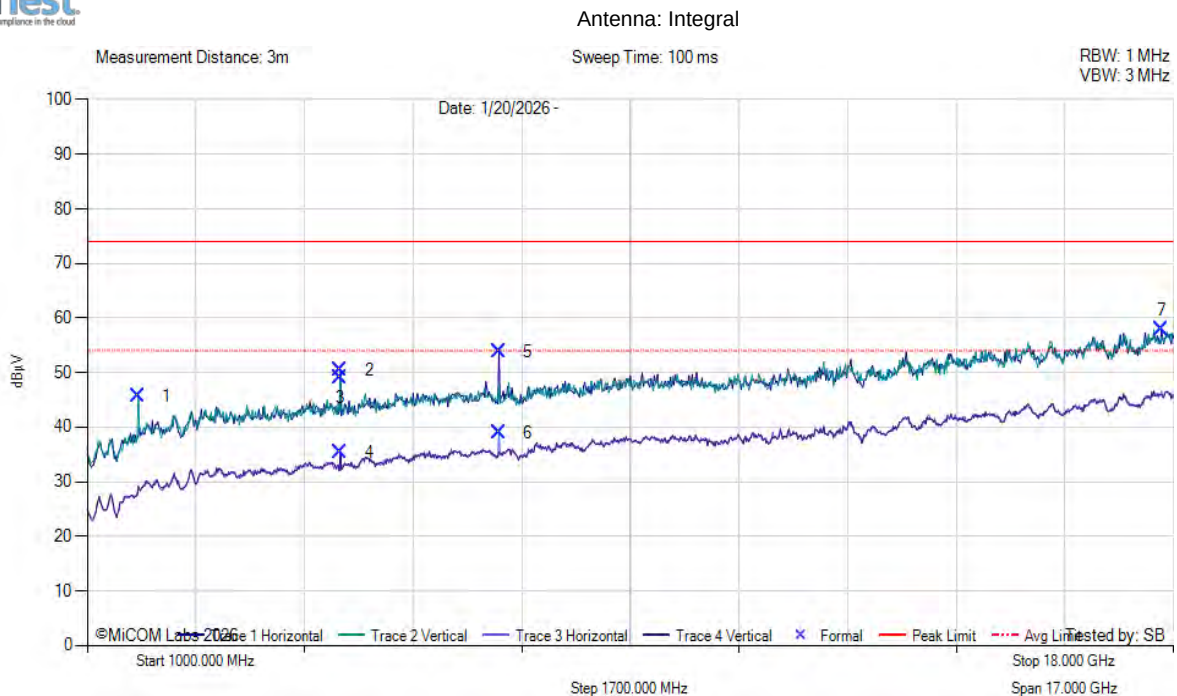
Equipment Configuration for FCC SPURIOUS 1 GHZ -18 GHZ

Antenna:	Integral	Variant:	BLE
Antenna Gain (dBi):	2.5	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2480	Data Rate:	1 Mbp/s
Power Setting:	Max	Tested By:	SB

Test Measurement Results



FCC Spurious 1 GHz -18 GHz



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	1799.00	57.65	2.65	-14.67	45.64	MaxP	Vertical	149	0	74.0	-28.4	Pass
2	4961.00	59.27	3.90	-12.71	50.46	MaxP	Vertical	149	209	74.0	-23.5	Pass
3	4961.00	57.77	3.90	-12.71	48.96	MaxP	Horizontal	149	210	74.0	-25.0	Pass
4	4961.00	44.25	3.90	-12.71	35.44	AVG	Vertical	149	59	54.0	-18.6	Pass
5	7443.00	56.79	4.62	-7.60	53.81	MaxP	Horizontal	199	210	74.0	-20.2	Pass
6	7443.00	41.94	4.62	-7.60	38.96	AVG	Horizontal	199	210	54.0	-15.0	Pass
7	17813.00	48.83	7.83	1.19	57.84	MaxP	Horizontal	149	120	74.0	-16.2	Pass

Test Notes: BLE Active 2480MHz

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;

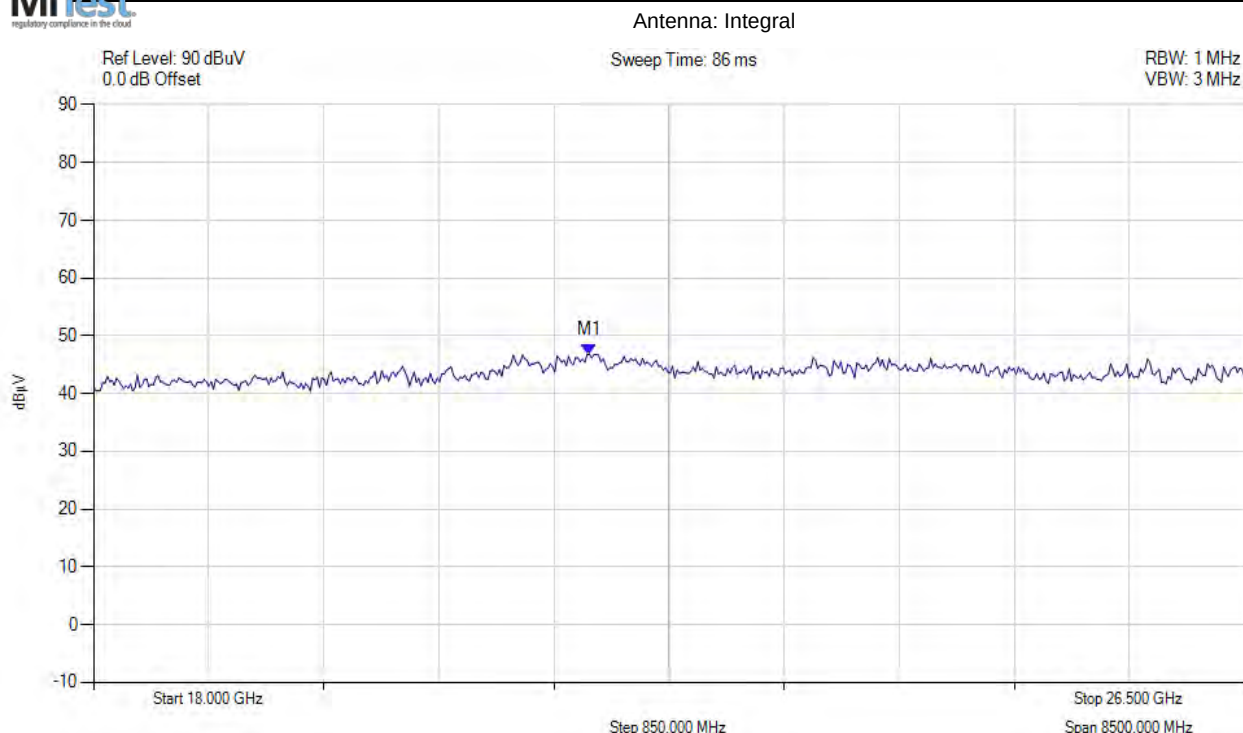
Equipment Configuration for FCC SPURIOUS 18 - 26 GHZ

Antenna:	Integral	Variant:	BLE
Antenna Gain (dBi):	2.5	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2402	Data Rate:	1 Mbps
Power Setting:	Max	Tested By:	SB

Test Measurement Results



FCC Spurious 18 GHz -26 GHz



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 21.662 GHz : 46.825 dBuV	Limit: 54 dBuV Pass

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;

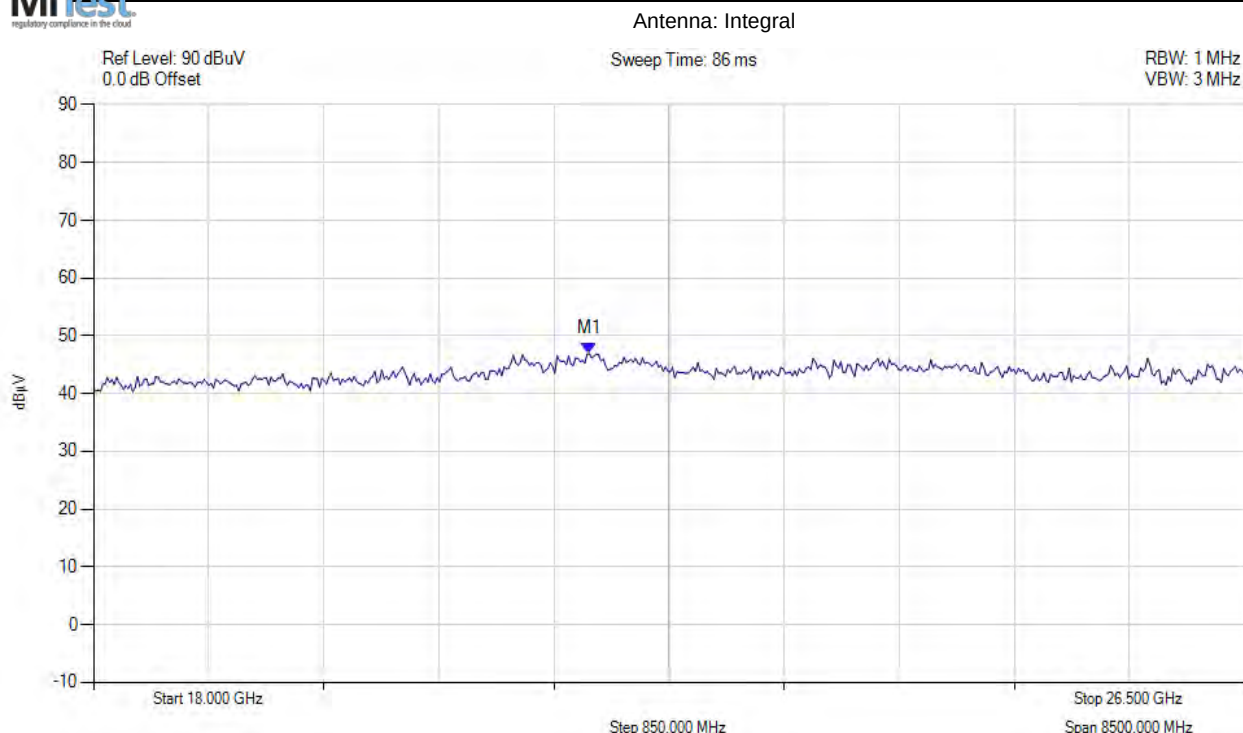
Equipment Configuration for FCC SPURIOUS 18 - 26 GHZ

Antenna:	Integral	Variant:	BLE
Antenna Gain (dBi):	2.5	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2480	Data Rate:	1 Mbps
Power Setting:	Max	Tested By:	SB

Test Measurement Results



FCC Spurious 18 GHz -26 GHz



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 21.662 GHz : 46.887 dBuV	Limit: 54 dBuV Pass

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;

9.4.2.4. Restricted Edge & Band-Edge Emissions

Equipment Configuration for BE 2400 MHz

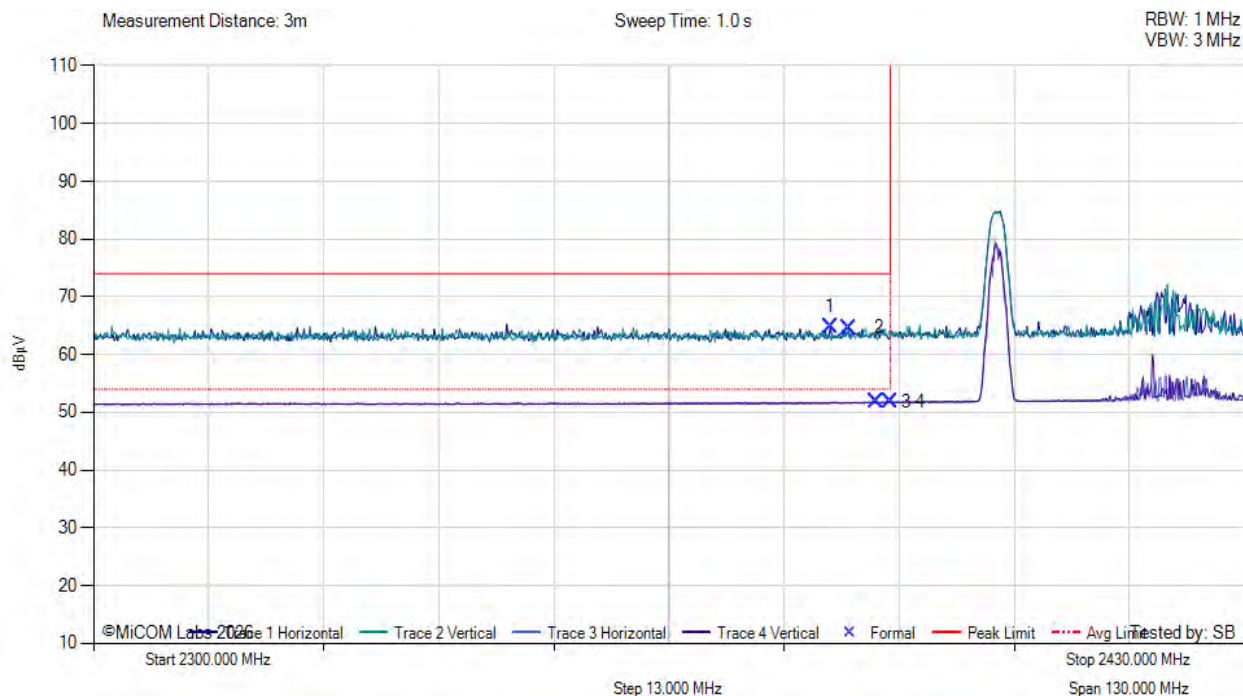
Antenna:	Integral	Variant:	BLE
Antenna Gain (dBi):	2.5	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2402	Data Rate:	1 Mbps
Power Setting:	Max	Tested By:	SB

Test Measurement Results



BE 2400 MHz

Antenna: Integral



2300.00 - 2430.00 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	2383.20	29.66	2.97	32.11	64.74	MaxP	Horizontal	149	90	74.0	-9.3	Pass
2	2385.28	29.54	2.97	32.11	64.62	MaxP	Vertical	99	29	74.0	-9.4	Pass
3	2388.40	16.74	3.00	32.13	51.87	AVG	Vertical	99	29	54.0	-2.1	Pass
4	2389.96	16.71	3.01	32.14	51.86	AVG	Horizontal	149	180	54.0	-2.1	Pass

Test Notes: BLE Active 2402MHz

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;

Equipment Configuration for BE 2483.5 MHz

Antenna:	Integral	Variant:	BLE
Antenna Gain (dBi):	2.5	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2480	Data Rate:	1 Mbps
Power Setting:	Max	Tested By:	SB

Test Measurement Results



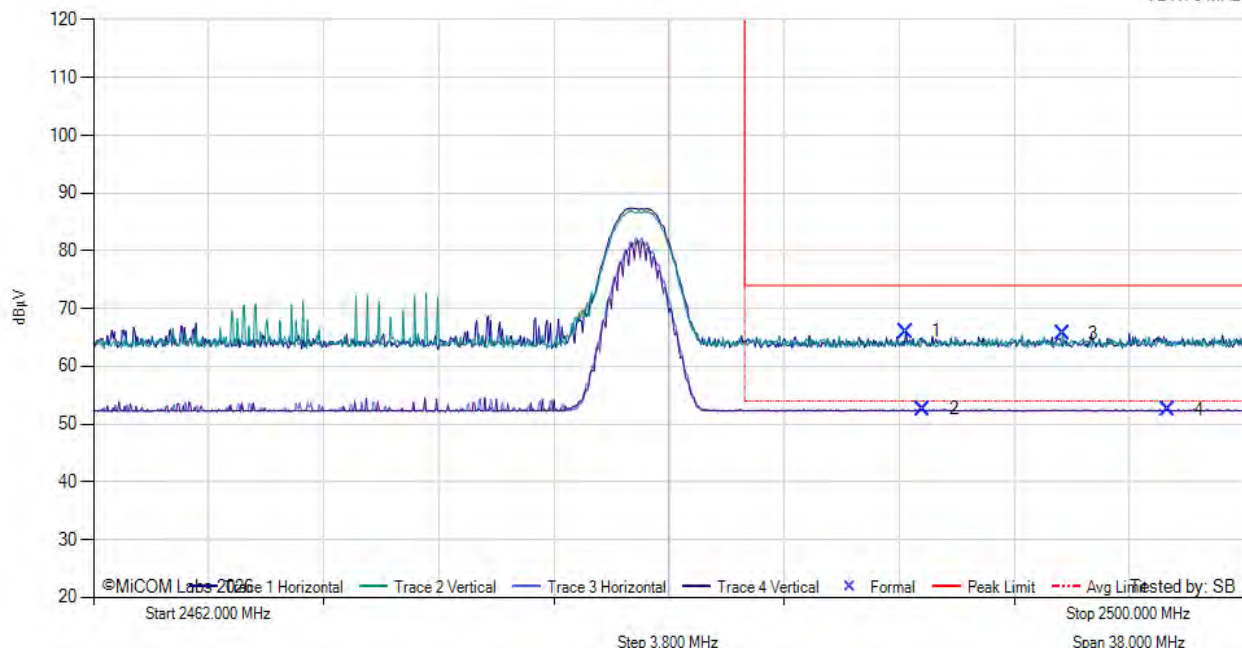
BE 2483.5 MHz

Antenna: Integral

Measurement Distance: 3m

Sweep Time: 1.0 s

RBW: 1 MHz
VBW: 3 MHz



2462.00 - 2500.00 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	2488.83	30.48	3.10	32.42	66.00	MaxP	Horizontal	99	30	74.0	-8.0	Pass
2	2489.40	17.07	3.10	32.43	52.59	AVG	Vertical	99	119	54.0	-1.4	Pass
3	2494.00	30.14	3.08	32.44	65.66	MaxP	Vertical	99	29	74.0	-8.3	Pass
4	2497.49	16.99	3.07	32.44	52.50	AVG	Horizontal	99	180	54.0	-1.5	Pass

Test Notes: BLE Active 2480MHz

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;

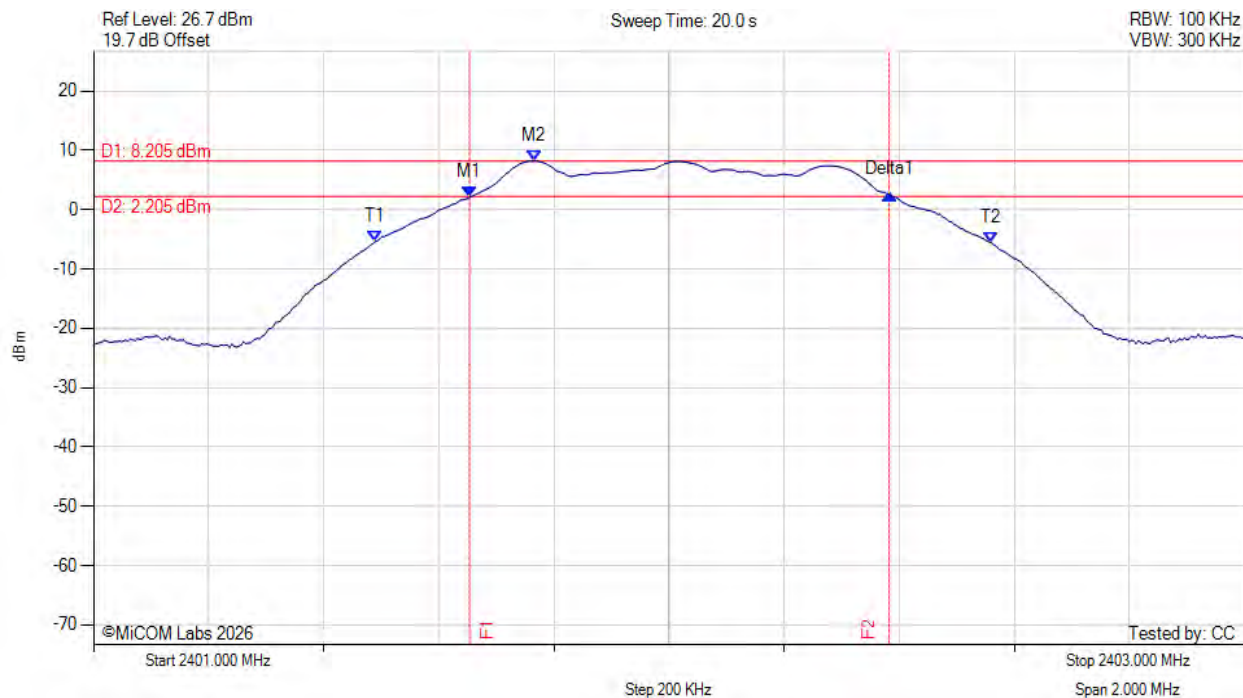
APPENDIX A - GRAPHICAL IMAGES

A.1. 6 dB & 99% Bandwidth



6 dB & 99% Bandwidth

Variant: 1M, Channel: 2402.00 MHz, Chain a, Temp: 20, Voltage: 3.6 Vdc



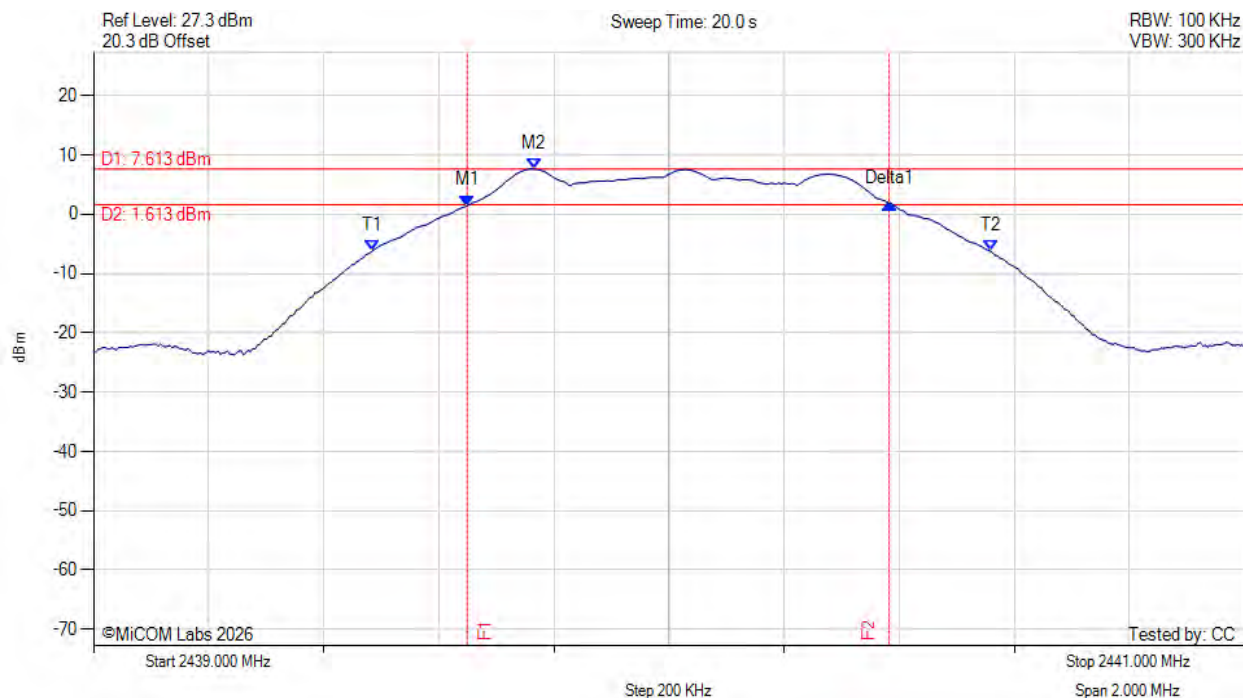
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD	M1 : 2401.653 MHz : 2.106 dBm M2 : 2401.766 MHz : 8.205 dBm Delta1 : 729 KHz : 0.478 dB T1 : 2401.489 MHz : -5.397 dBm T2 : 2402.559 MHz : -5.492 dBm OBW : 1.070 MHz	Channel Frequency: 2402.00 MHz Measured 6 dB Bandwidth: 0.729 MHz Limit: ≥500.0 kHz Margin: -0.23 MHz

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6 dB & 99% Bandwidth



Variant: 1M, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 3.6 Vdc



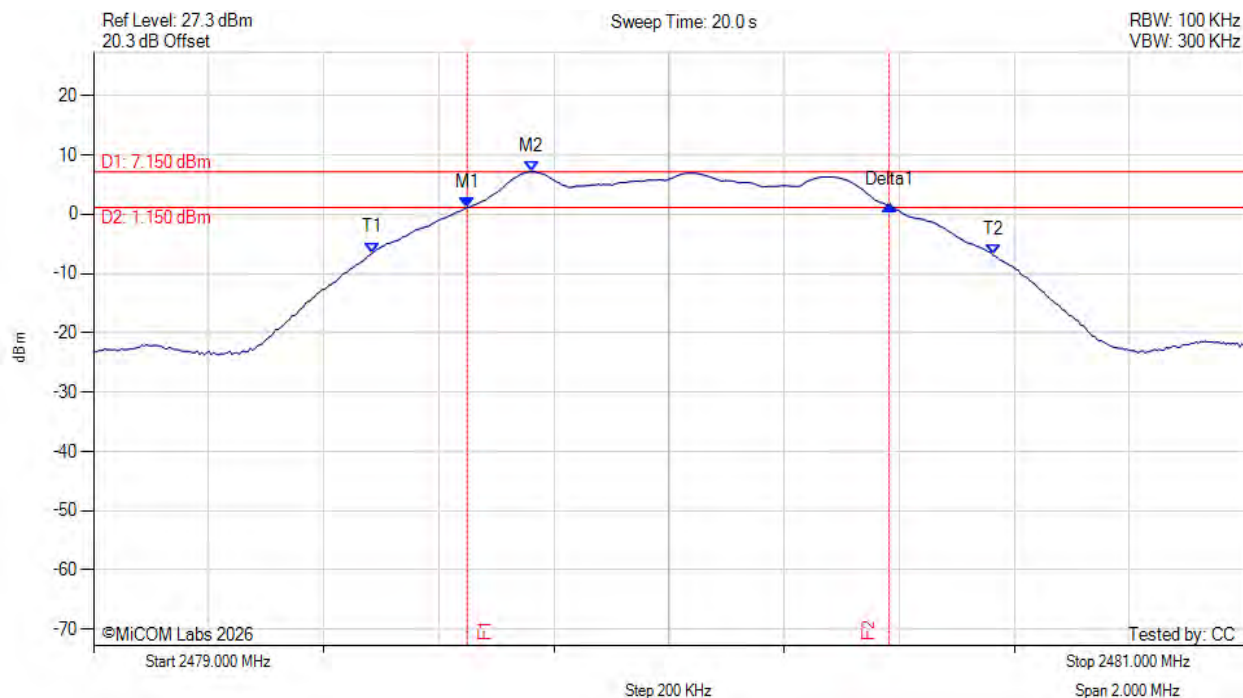
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD	M1 : 2439.649 MHz : 1.439 dBm M2 : 2439.766 MHz : 7.613 dBm Delta1 : 733 KHz : 0.441 dB T1 : 2439.485 MHz : -6.192 dBm T2 : 2440.559 MHz : -6.247 dBm OBW : 1.074 MHz	Channel Frequency: 2440.00 MHz Measured 6 dB Bandwidth: 0.733 MHz Limit: ≥ 500.0 kHz Margin: -0.23 MHz

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6 dB & 99% Bandwidth



Variant: 1M, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 3.6 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD	M1 : 2479.649 MHz : 1.087 dBm M2 : 2479.762 MHz : 7.150 dBm Delta1 : 733 KHz : 0.425 dB T1 : 2479.485 MHz : -6.501 dBm T2 : 2480.563 MHz : -6.895 dBm OBW : 1.078 MHz	Channel Frequency: 2480.00 MHz Measured 6 dB Bandwidth: 0.733 MHz Limit: ≥ 500.0 kHz Margin: -0.23 MHz

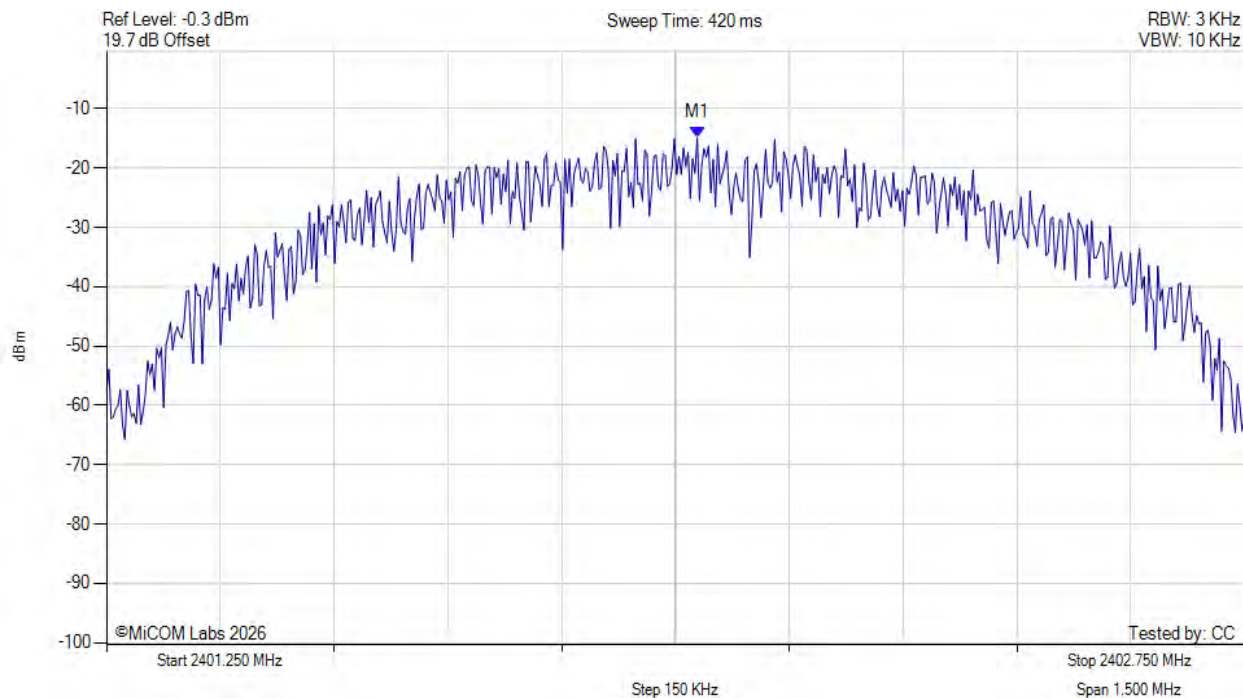
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A.2. Power Spectral Density



POWER SPECTRAL DENSITY - AVERAGE

Variant: 1M, Channel: 2402.00 MHz, Chain a, Temp: 20, Voltage: 3.6 Vdc



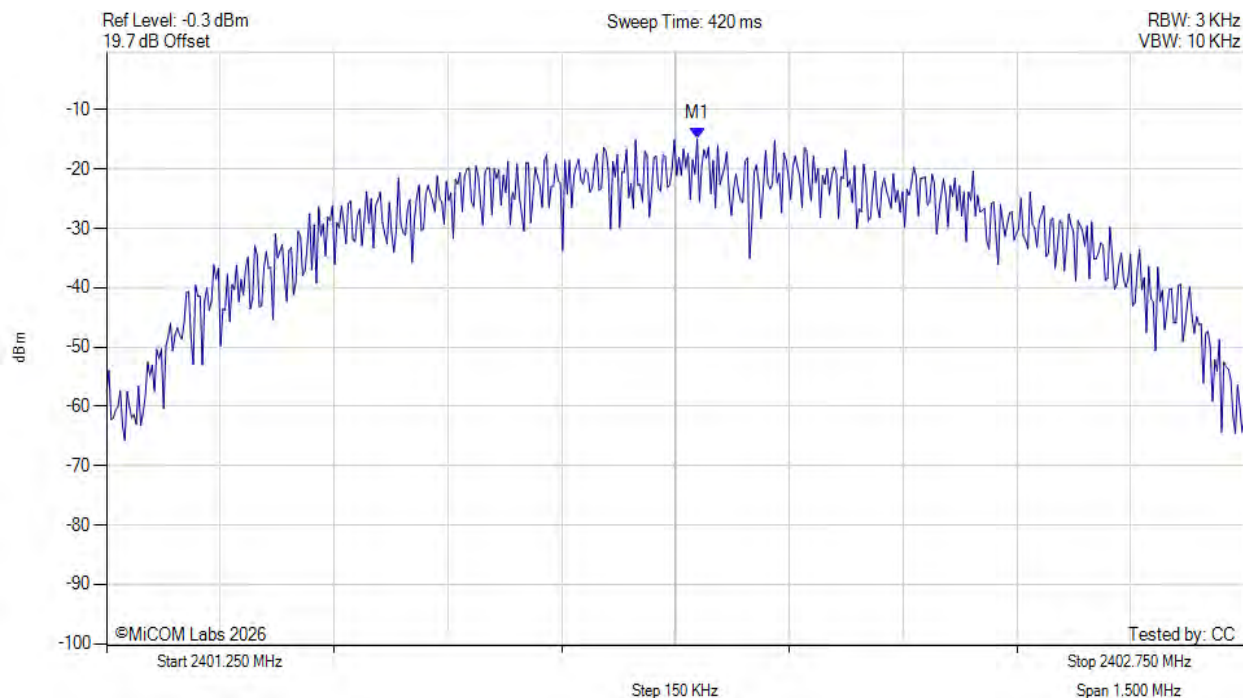
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 2402.029 MHz : -14.876 dBm	Channel Frequency: 2402.00 MHz Limit: ≤ 8.000 dBm

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POWER SPECTRAL DENSITY - AVERAGE



Variant: 1M, Channel: 2402.00 MHz, SUM, Temp: 20, Voltage: 3.6 Vdc



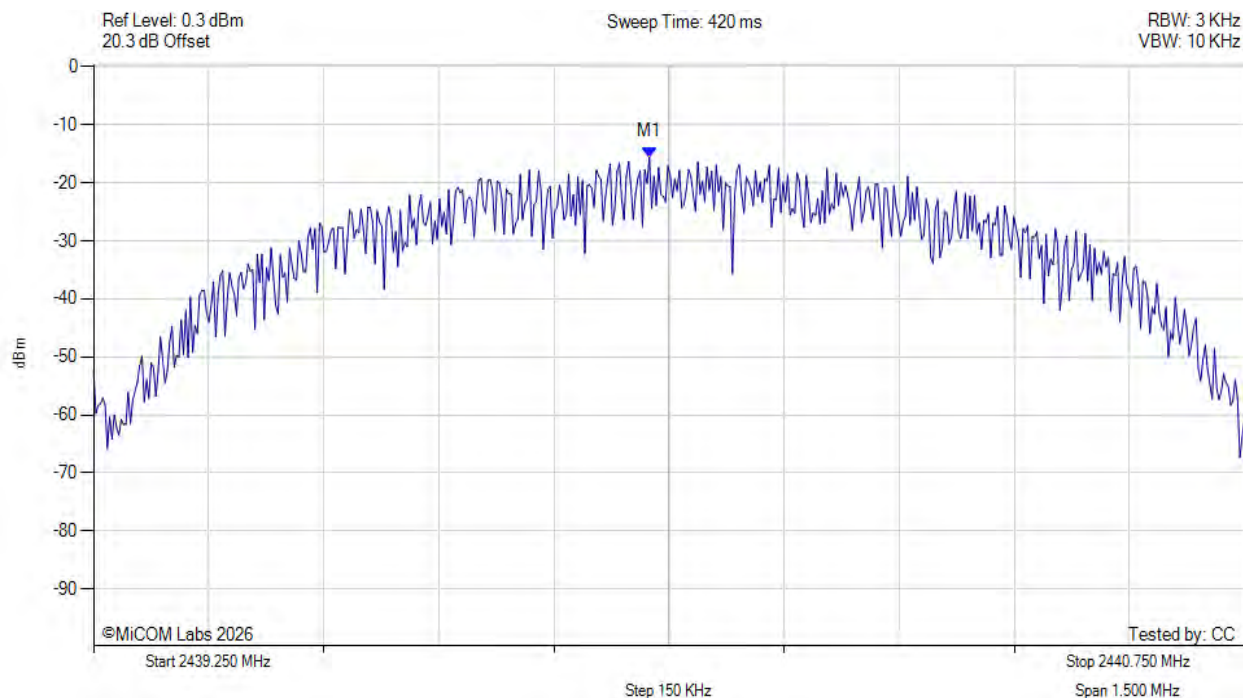
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 2402.029 MHz : -14.876 dBm M1 : 2402.000 MHz : -14.876 dBm M1 + DCCF : 2402.000 MHz : -11.778 dBm Duty Cycle Correction Factor : +3.1 dB	Channel Frequency: 2402.00 MHz Limit: ≤ 8.0 dBm Margin: -19.8 dB

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POWER SPECTRAL DENSITY - AVERAGE



Variant: 1M, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 3.6 Vdc



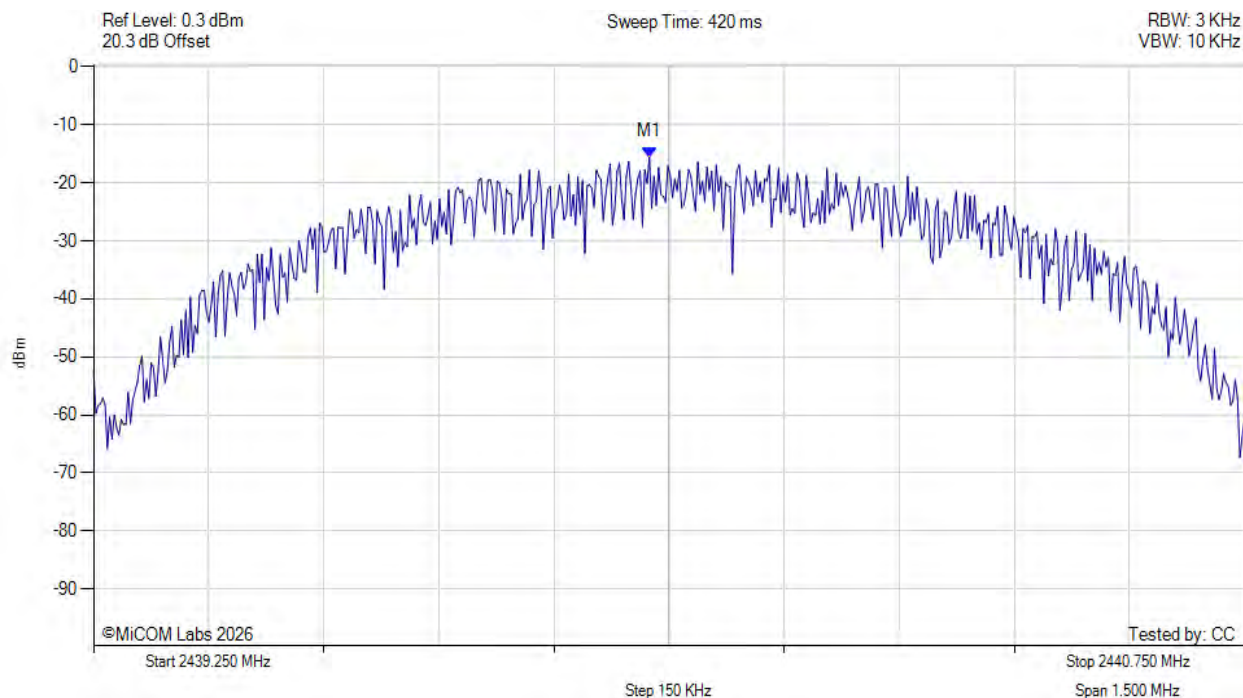
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 2439.974 MHz : -15.599 dBm	Channel Frequency: 2440.00 MHz Limit: ≤ 8.000 dBm

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POWER SPECTRAL DENSITY - AVERAGE



Variant: 1M, Channel: 2440.00 MHz, SUM, Temp: 20, Voltage: 3.6 Vdc



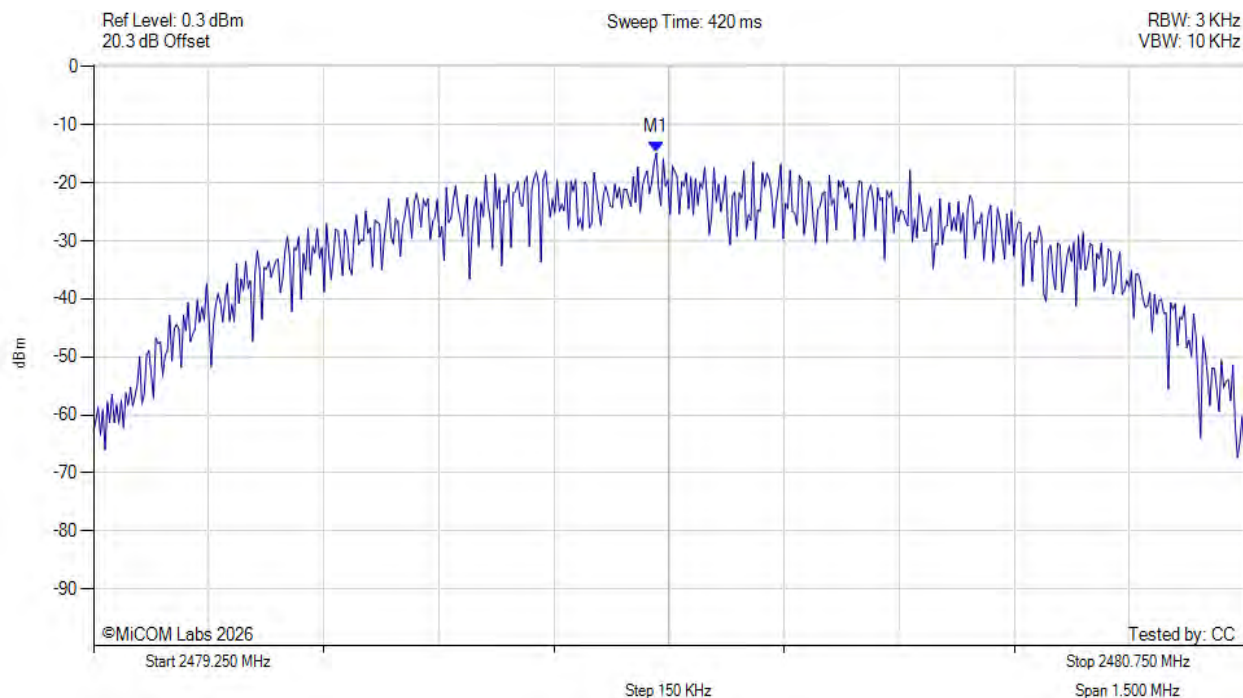
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 2439.974 MHz : -15.599 dBm M1 : 2440.000 MHz : -15.599 dBm M1 + DCCF : 2440.000 MHz : -12.501 dBm Duty Cycle Correction Factor : +3.1 dB	Channel Frequency: 2440.00 MHz Limit: ≤ 8.0 dBm Margin: -20.5 dB

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POWER SPECTRAL DENSITY - AVERAGE



Variant: 1M, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 3.6 Vdc



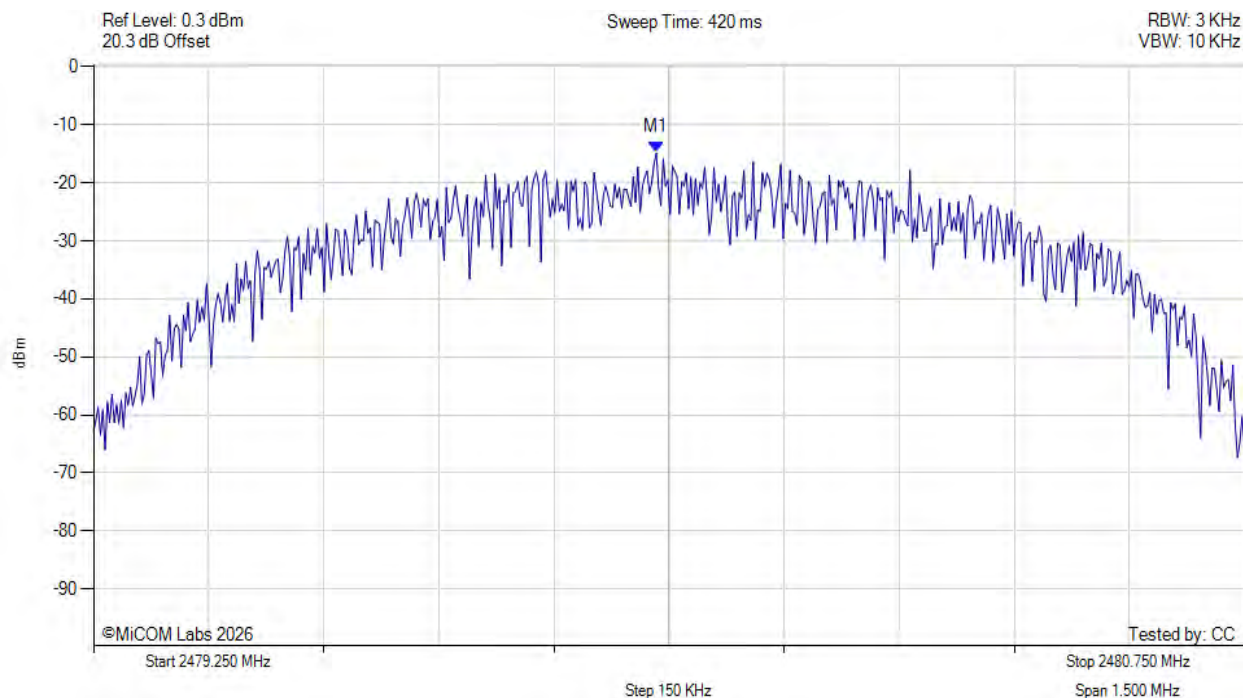
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 2479.983 MHz : -14.851 dBm	Channel Frequency: 2480.00 MHz Limit: ≤ 8.000 dBm

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POWER SPECTRAL DENSITY - AVERAGE



Variant: 1M, Channel: 2480.00 MHz, SUM, Temp: 20, Voltage: 3.6 Vdc



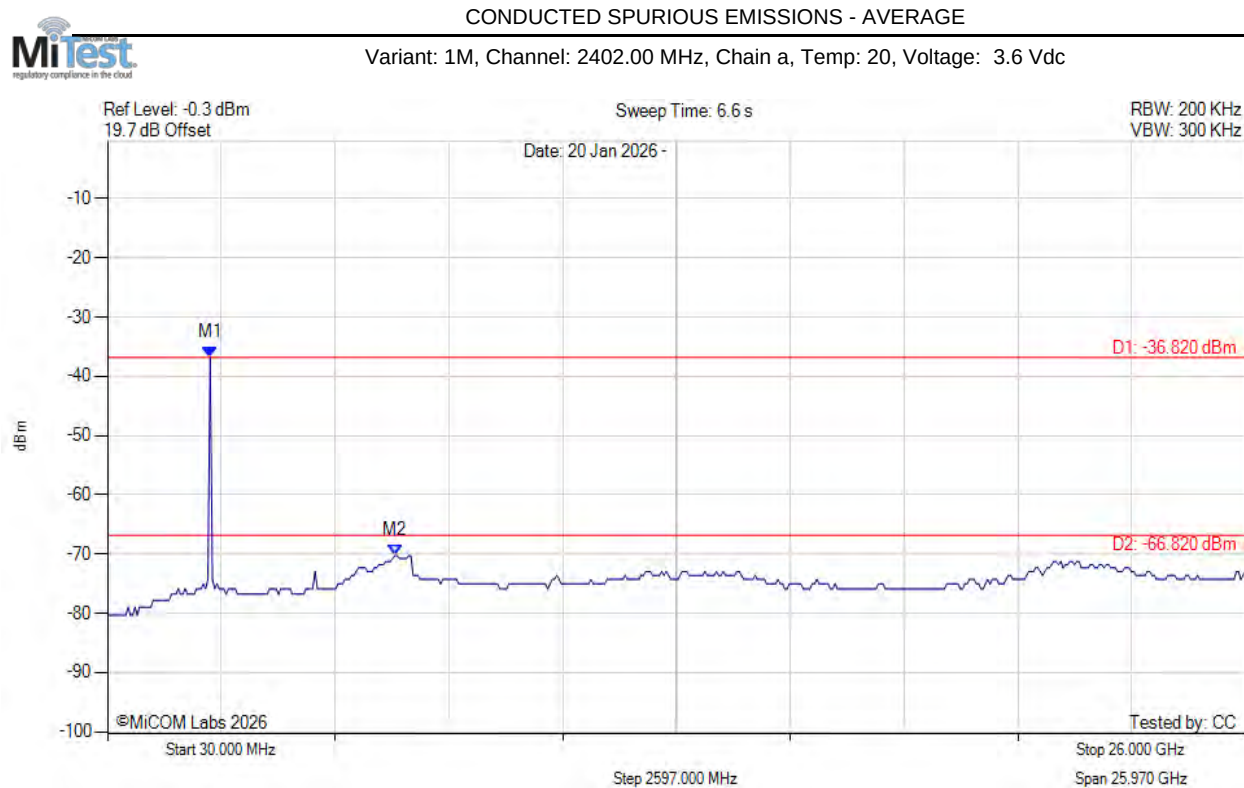
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 2479.983 MHz : -14.851 dBm M1 : 2480.000 MHz : -14.851 dBm M1 + DCCF : 2480.000 MHz : -11.753 dBm Duty Cycle Correction Factor : +3.1 dB	Channel Frequency: 2480.00 MHz Limit: ≤ 8.0 dBm Margin: -19.8 dB

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A.3. Emissions

A.3.1. Conducted Emissions

A.3.1.1. Conducted Spurious Emissions



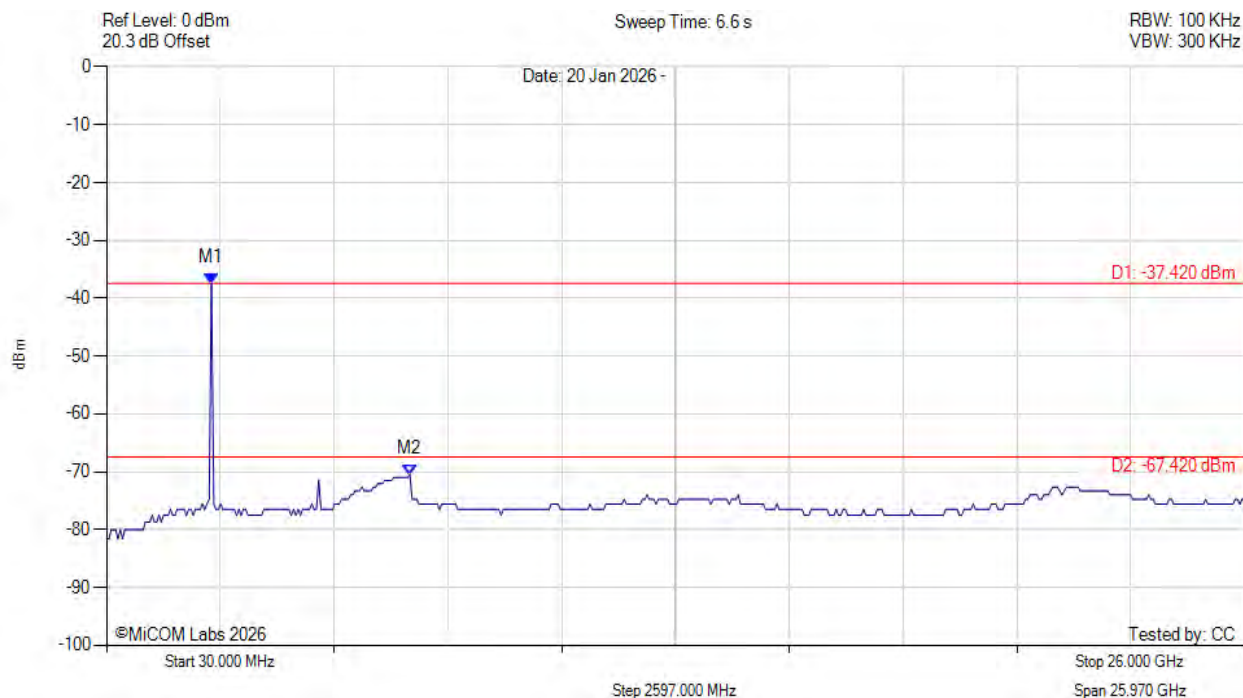
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 0 Trace Mode = CLR/WRITE	M1 : 2371.984 MHz : -36.819 dBm M2 : 6587.555 MHz : -70.290 dBm	Channel Frequency: 2402.00 MHz Limit: -66.82 dBm Margin: -3.47 dB

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CONDUCTED SPURIOUS EMISSIONS - AVERAGE



Variant: 1M, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 3.6 Vdc



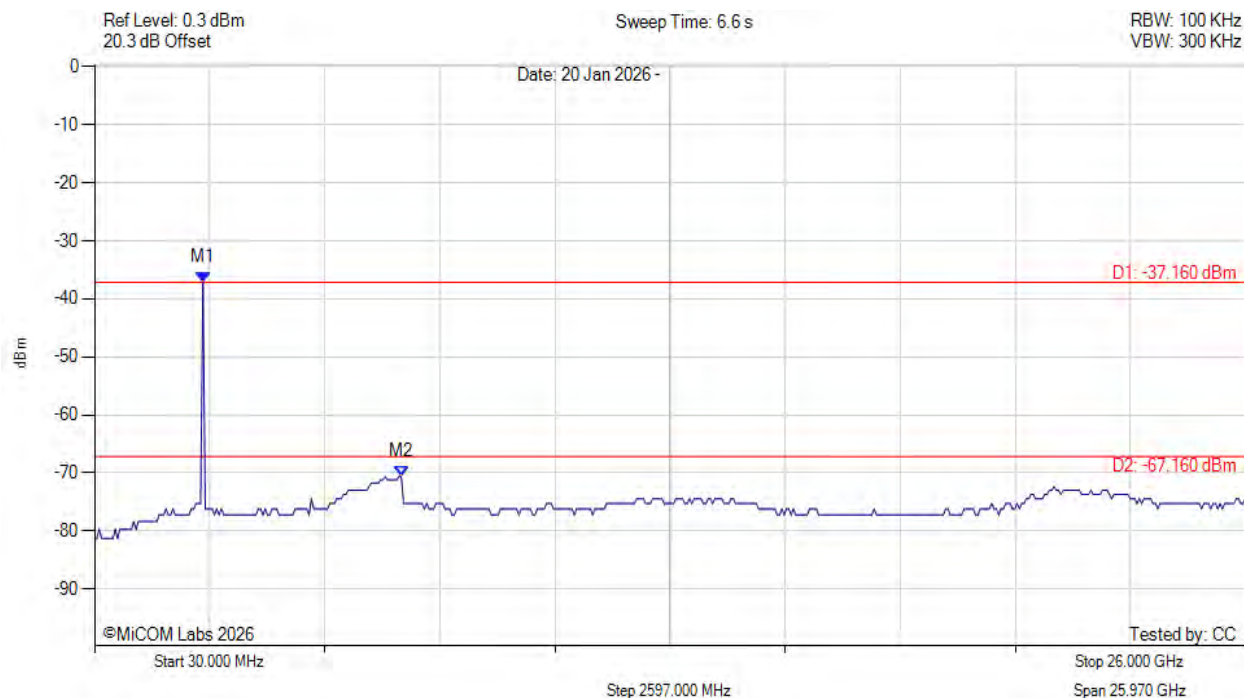
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 0 Trace Mode = CLR/WRITE	M1 : 2424.028 MHz : -37.417 dBm M2 : 6951.864 MHz : -70.460 dBm	Channel Frequency: 2440.00 MHz Limit: -67.42 dBm Margin: -3.04 dB

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CONDUCTED SPURIOUS EMISSIONS - AVERAGE



Variant: 1M, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 3.6 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 0 Trace Mode = CLR/WRITE	M1 : 2476.072 MHz : -37.160 dBm M2 : 6951.864 MHz : -70.656 dBm	Channel Frequency: 2480.00 MHz Limit: -67.16 dBm Margin: -3.50 dB

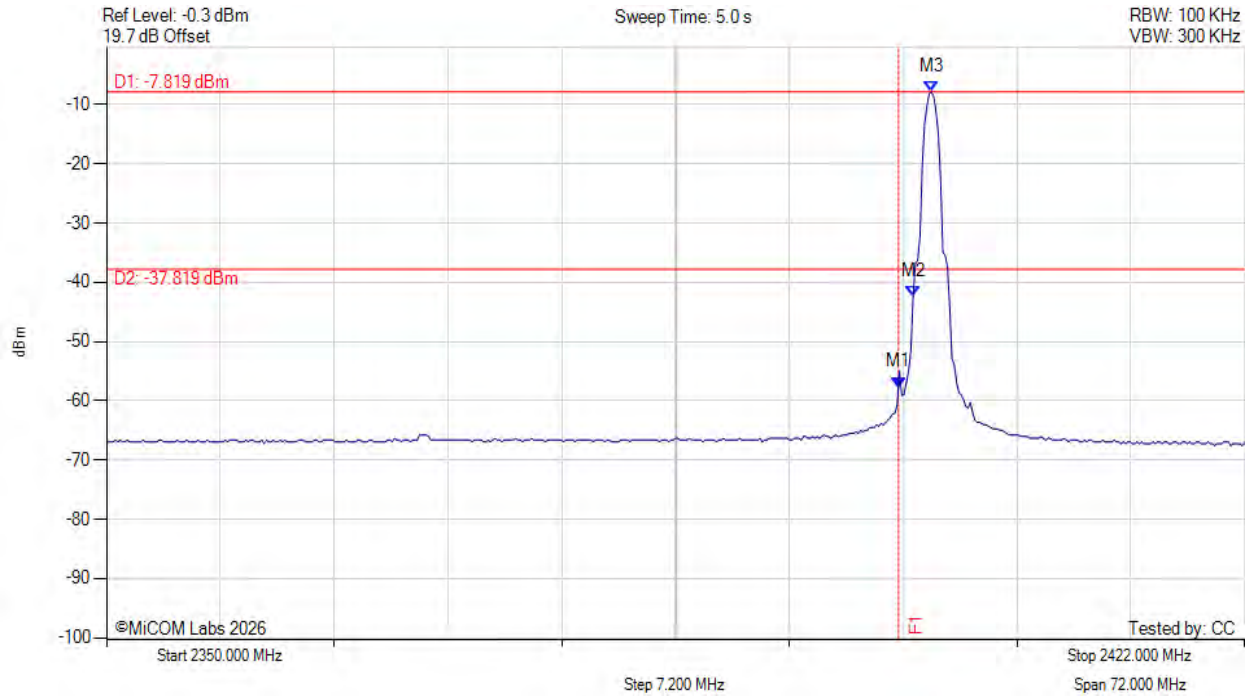
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A.3.1.2. Conducted Band-Edge Emissions



CONDUCTED LOW BAND-EDGE EMISSIONS - AVERAGE

Variant: 1M, Channel: 2402.00 MHz, Chain a, Temp: 20, Voltage: 3.6 Vdc



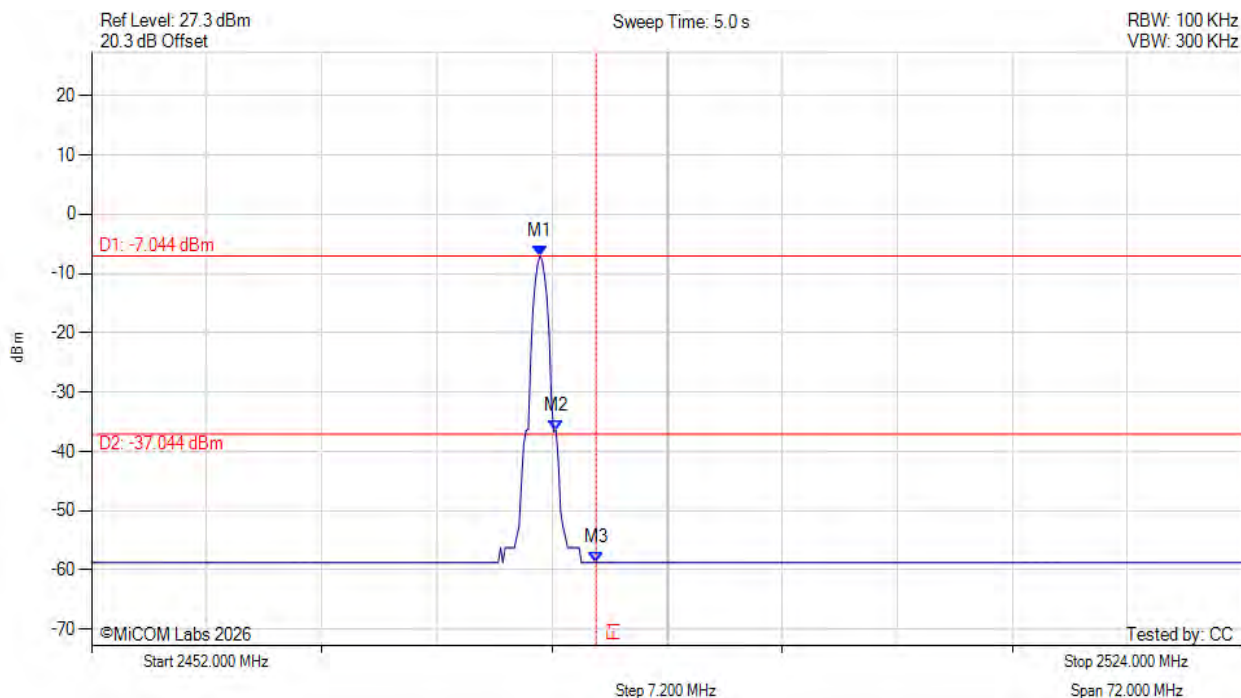
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 2400.000 MHz : -57.693 dBm M2 : 2400.934 MHz : -42.313 dBm M3 : 2402.088 MHz : -7.819 dBm	Channel Frequency: 2402.00 MHz

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CONDUCTED HIGH BAND-EDGE EMISSIONS - AVERAGE



Variant: 1M, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 3.6 Vdc

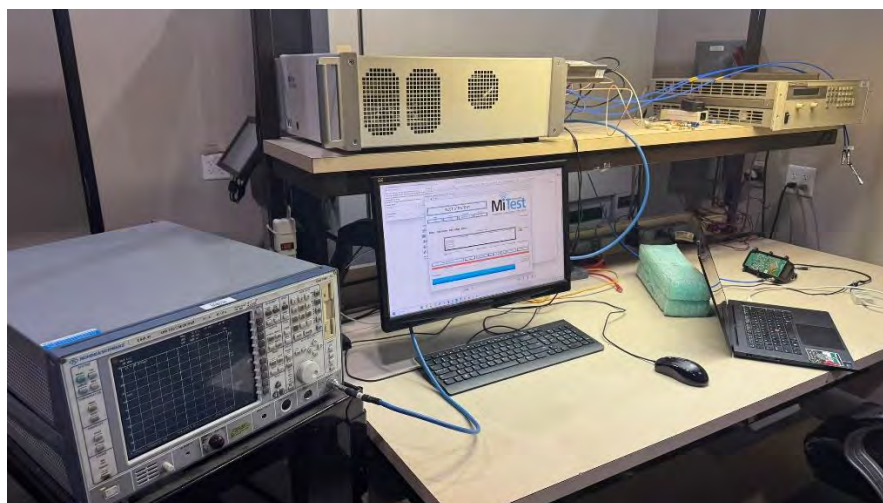


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2479.992 MHz : -7.044 dBm M2 : 2481.002 MHz : -36.444 dBm M3 : 2483.500 MHz : -58.723 dBm	Channel Frequency: 2480.00 MHz

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APPENDIX B – Test Setup Photographs

B.1 Test Setup Conducted Emissions

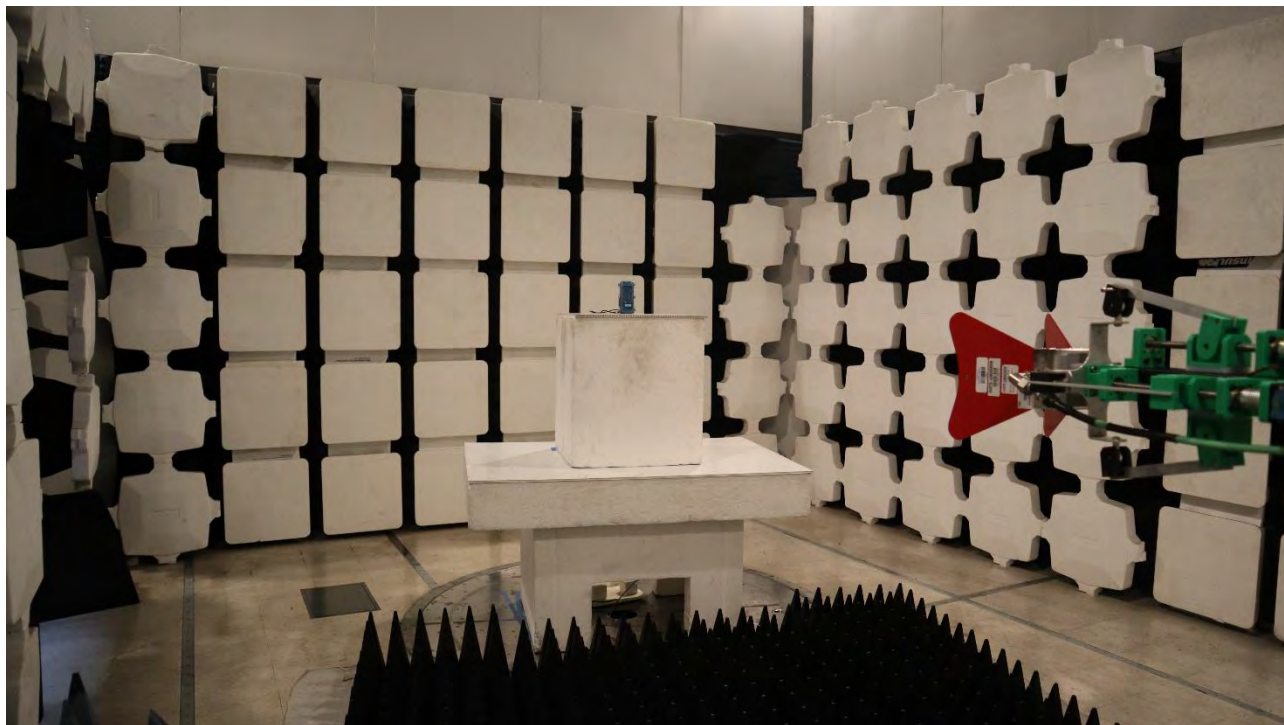


B.2 Test Setup Radiated Emissions

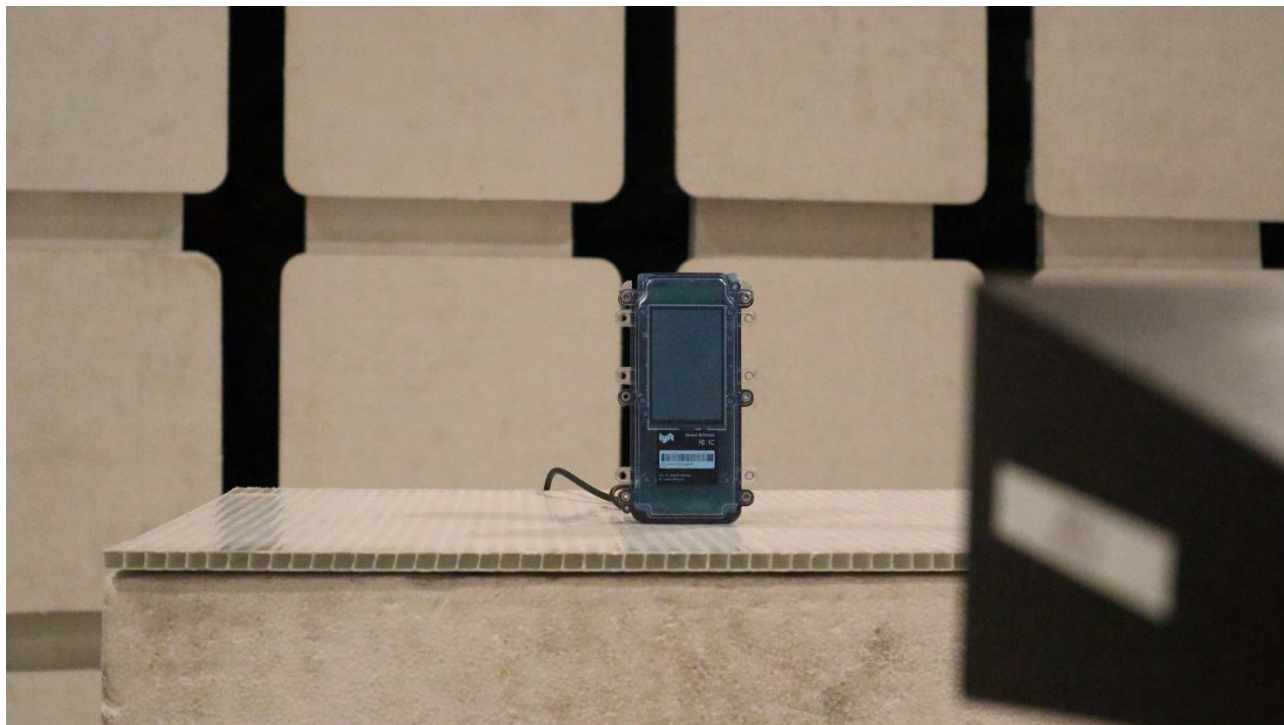
30MHz - 1GHz



1 - 18GHz



18 - 26GHz





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