Test of: Nanit N151Smart Baby Monitor

To: FCC CFR 47 Pt 15.247 (DTS) & ISED RSS-247

Report No.: UDIS01-U4 Rev A

COMPLETE TEST REPORT

TEST REPORT

FROM

MiCOM Labs
opening wireless markets

Test of: Nanit N151 Smart Baby Monitor

To: FCC CFR 47 Pt 15.247 (DTS) & ISED RSS-247

Test Report Serial No.: UDIS01-U4 Rev A

This report supersedes: NONE

Applicant: UdiSense Inc. (DBA: Nanit)
244 Fifth Avenue
Suite # 2702,
New York, NY 10001
USA

Product Function: Wireless Video Baby Monitor

Issue Date: 13th August 2018

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

A2LA ACCREDITED
TESTING CERT #2381.01

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 17025:2005. 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

ilac-MRA A2LA

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 17025:2005 *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*).

American Association for Laboratory Accreditation Corporate Seal 1978 District of Columbia A2LA

Presented this 14th day of May 2018.

President and CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2019

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

1.2. RECOGNITION

MiCOM Labs, Inc has widely recognized wireless testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA countries. MiCOM Labs test reports are accepted globally.

Country	Recognition Body	Status	Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	US0159 Listing #: 102167
Canada	Industry Canada (IC)	FCB	APEC MRA 2	US0159 Listing #: 4143A-2 4143A-3
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	APEC MRA 2	RCB 210
	VCCI	--	--	A-0012
Europe	European Commission	NB	EU MRA	NB 2280
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)	CAB	APEC MRA 1	
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)	CAB	APEC MRA 1	
Singapore	Infocomm Development Authority (IDA)	CAB	APEC MRA 1	
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)	CAB	APEC MRA 1	
Vietnam	Ministry of Communication (MIC)	CAB	APEC MRA 1	

EU MRA – European Union Mutual Recognition Agreement.
NB – Notified Body
APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement. Recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.

Phase 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

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 14th day of May 2018

President and CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2019

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
Japan – Recognized Certification Body (RCB), RCB Identifier - 210

2. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	8th August 2018	Draft report for client review.
Rev A	13th August 2018	Initial release.
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In the above table the latest report revision will replace all earlier versions.

3. TEST RESULT CERTIFICATE

Manufacturer:	UdiSense Inc. (DBA: Nanit) 244 Fifth Avenue Suite # 2702, New York, NY 10001 USA	**Tested By:**	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Model:	N151	**Telephone:**	+1 925 462 0304
Type Of Equipment:	Bluetooth BLE	**Fax:**	+1 925 462 0306
S/N's:	N101AWZ0000005 N101AWZ0000002		
Test Date(s):	24th – 25th July 2018	**Website:**	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC CFR 47 Pt 15.247 (DTS) & 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:

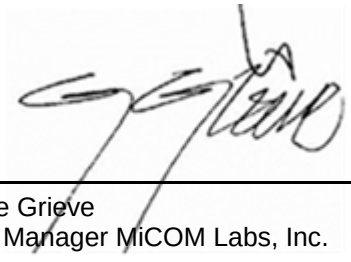
1. This document reports conditions under which testing was conducted and the results of testing performed.

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

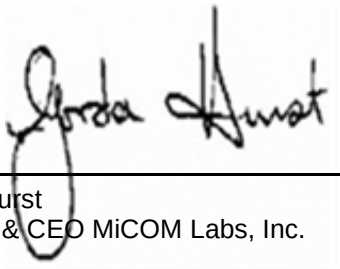
3. Test results apply only to the item(s) tested.

A2LA ACCREDITED
TESTING CERT #2381.01

Approved & Released for MiCOM Labs, Inc. by:



Graeme Grieve
Quality Manager MiCOM Labs, Inc.



Gordon Hurst
President & CEO MiCOM Labs, Inc.

4. REFERENCES AND MEASUREMENT UNCERTAINTY

4.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
I	KDB 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 v04	5th April 2017	Guidance for performing compliance measurements on Digital Transmission Systems (DTS) operating under section 15.247.
III	A2LA	August 2017	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	2016	Radio Frequency Devices; Subpart C – Intentional Radiators
IX	ICES-003	Issue 6 Jan 2016; Updated April 2017	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 (DTSs), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices
XII	RSS-Gen Issue 5	April 2018	General Requirements for Compliance of Radio Apparatus
XIII	FCC 47 CFR Part 2.1033	2016	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 Nanit N151 to FCC CFR 47 Pt 15.247 (DTS) & ISED RSS-247.
Applicant:	UdiSense Inc. (DBA: Nanit) 244 Fifth Avenue Suite # 2702, New York, NY 10001 USA
Manufacturer:	Same as applicant
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	UDIS01-U4 Rev A
Date EUT received:	23rd July 2018
Standard(s) applied:	FCC CFR 47 Pt 15.247 (DTS) & ISED RSS-247
Dates of test (from - to):	24th – 25th July 2018
No of Units Tested:	1
Product Family Name:	Nanit Smart Baby Monitor
Model(s):	N151
Location for use:	Indoors
Declared Frequency Range(s):	2400 - 2483.5 MHz;
Type of Modulation:	BLE -GFSK
EUT Modes of Operation:	2400 - 2483.5 MHz:BLE
Declared Nominal Output Power	10 dBm (BLE)
Transmit/Receive Operation:	1
Rated Input Voltage and Current:	$5V_{DC}$, 2A
Operating Temperature Range:	10 to 40 ^{o}C
ITU Emission Designator:	1M00G1D
Equipment Dimensions:	3 1/8 x 3 1/8 x 1 1/2 inch
Weight:	4 oz.
Hardware Rev:	DV2
Software Rev:	1.1.4.4.2

5.2. Scope Of Test Program

Nanit N151

The scope of the test program was to test the Nanit N151 Smart Baby Monitor configurations in the frequency ranges 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.

ISED RSS-247
Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

The following Product description was provided by the manufacturer:

Nanit smart video baby monitor is a wireless camera that is mounted above a crib and uses machine learning and computer vision algorithms to analyze the baby's sleep, providing parents actionable insights to help them extend and improve the baby's sleep.

Nanit N151

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

Type	Description	Manufacturer	Model	Serial no.	Delivery Date
EUT	Wireless Video Baby Monitor	Nanit	N151	N101AWZ0000005	23rd July 2018
EUT	Wireless Video Baby Monitor	Nanit	N151	N101AWZ0000002	23rd July 2018

1. The EUT samples provided for testing are physically identified as serial numbers;-

   N101AWZ0000005
   N101AWZ0000002

   The manufacturer advised that these serial numbers do not match the Nanit S/N 151AWZYYWWXXX format showing the N151 product code for this product that will be used in manufacturing.

5.4. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
integral	Pulse	SZ0845W	Dipole	5.42	-	360	-	2400 - 2483.5
integral	Pulse	SZ0845W	Dipole	4.69	-	360	-	5150 - 5250
integral	Pulse	SZ0845W	Dipole	4.69	-	360	-	5250 - 5350
integral	Pulse	SZ0845W	Dipole	4.69	-	360	-	5470 - 5725
integral	Pulse	SZ0845W	Dipole	4.69	-	360	-	5725 - 5850

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

5.5. Cabling and I/O Ports

Port Type	Max Cable Length	# of Ports	Screened	Conn Type	Data Type	Environment
USB	10-30m	1	Shielded	USB-C	Digital	End-User |Indoors|

5.6. Test Configurations

Results for the following configurations are provided in this report:

Operational Mode(s) (802.11a/b/g/n/ac)	Data Rate with Highest Power MBit/s	Channel Frequency (MHz)		
		Low	Mid	High
2400 - 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

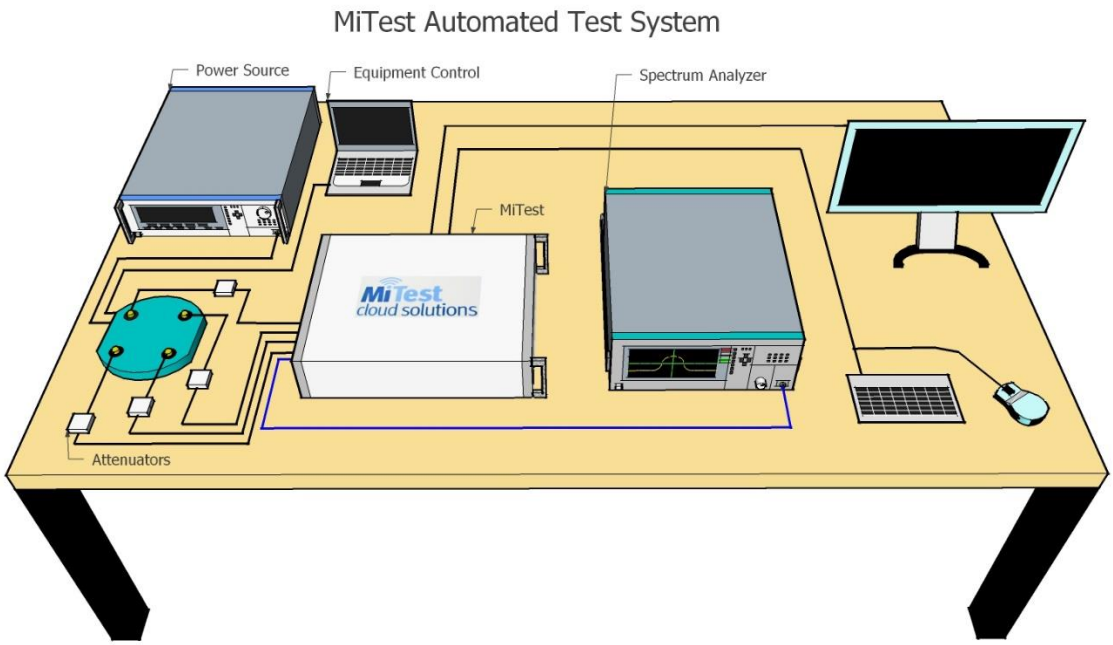
List of Measurements

Test Header	Result	Data Link
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	View Data
(i) TX Spurious & Restricted Band Emissions	Complies	View Data
(ii) Restricted Edge & Band-Edge Emissions	Complies	View Data
(3) Digital Emissions (0.03 - 1 GHz)	Complies	See Test Report UDIS01-U2
(4) AC Wireline Emissions	Complies	See Test Report UDIS01-U2

7. TEST EQUIPMENT CONFIGURATION(S)

7.1. Conducted

Conducted RF Emission Test Set-up(s). The following tests were performed using the conducted test set-up shown in the diagram below.



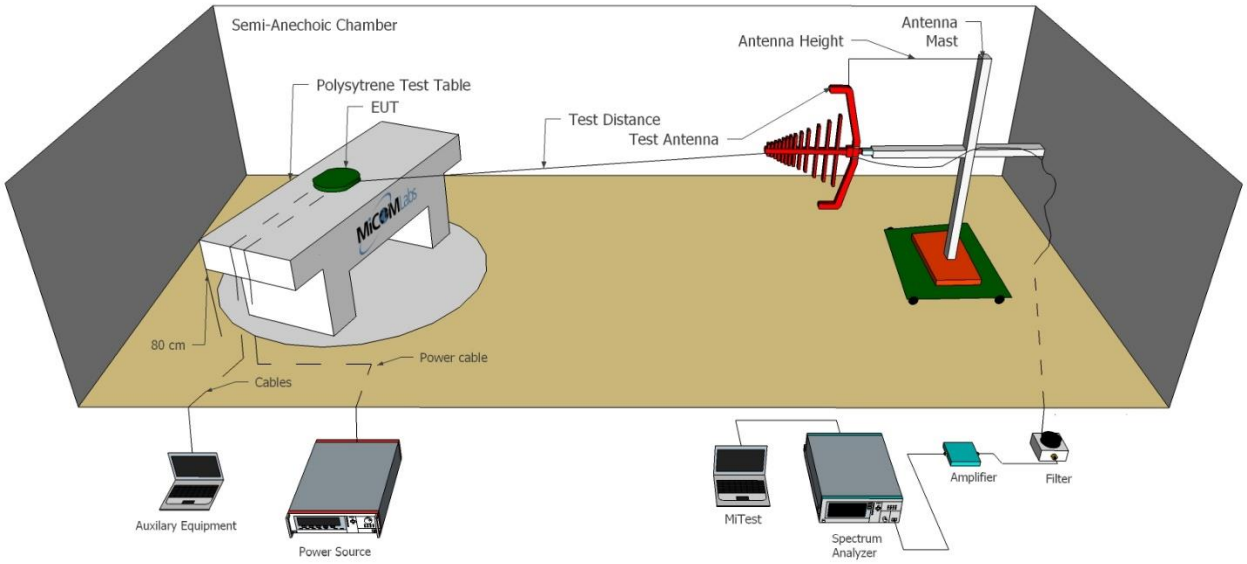
A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
#3 SA	MiTest Box to SA	Fairview Microwave	SCA1814-0101-72	#3 SA	28 Sep 2018
#3P1	EUT to MiTest box port 1	Fairview Microwave	SCA1814-0101-72	#3P1	28 Sep 2018
#3P2	EUT to MiTest box port 2	Fairview Microwave	SCA1814-0101-72	#3P2	28 Sep 2018
#3P3	EUT to MiTest box port 3	Fairview Microwave	SCA1814-0101-72	#3P3	28 Sep 2018
#3P4	EUT to MiTest box port 4	Fairview Microwave	SCA1812-0101-72	#3P4	28 Sep 2018
249	Resistance Thermometer	Thermotronics	GR2105-02	9340 #2	30 Oct 2018
361	Desktop for RF#1, Labview Software installed	Dell	Vostro 220	WS RF#1	Not Required
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	12 Oct 2018
398	MiTest RF Conducted Test Software	MiCOM	MiTest ATS	Version 4.1	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
436	USB Wideband Power Sensor	Boonton	55006	8731	14 Sep 2018
441	USB Wideband Power Sensor	Boonton	55006	9179	20 Sep 2018
445	PoE Injector	D-Link	DPE-101GL	QTAH1E2000625	Not Required
461	Spectrum Analyzer	Agilent	E4440A	MY46185537	20 Sep 2018
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2018
515	MiTest Cloud Solutions RF Test Box	MiCOM	2nd Gen with DFS	515	28 Sep 2018
75	Environmental Chamber	Thermatron	SE-300-2-2	27946	24 Dec 2018

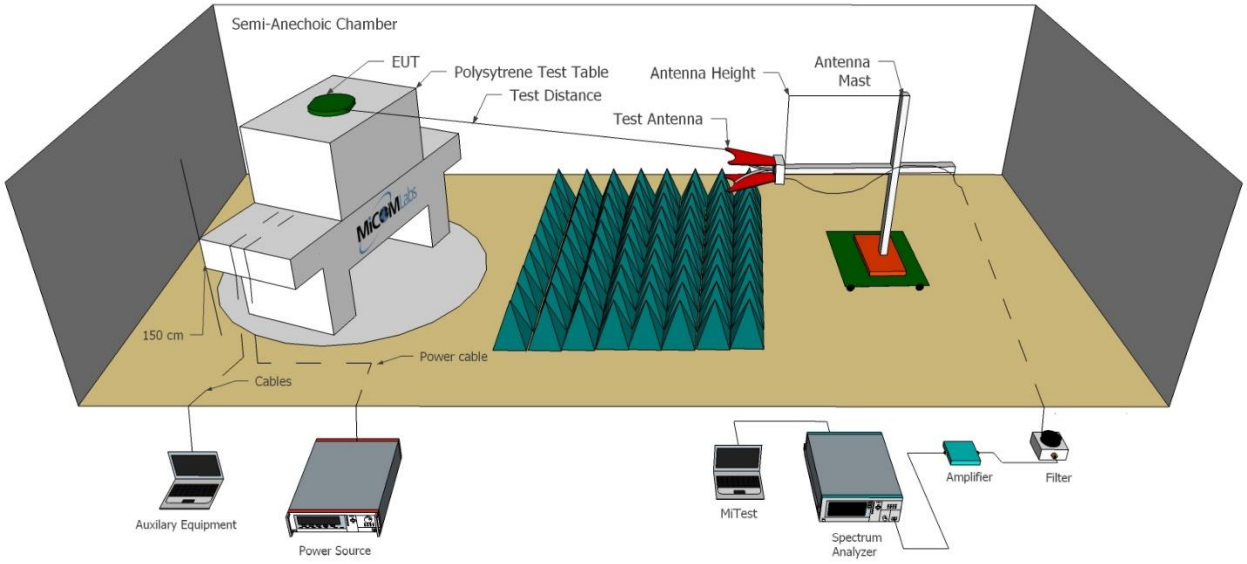
7.2. Radiated Emissions - 3m Chamber

The following tests were performed using the radiated test set-up shown in the diagram below.

Radiated Emissions Below 1GHz Test Setup



Radiated Emissions Above 1GHz Test Setup



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	27 Sep 2018
377	Band Rejection Filter 5150 to 5880MHz	Microtronics	BRM50716	034	6 Oct 2018
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	12 Oct 2018
396	2.4 GHz Notch Filter	Microtronics	BRM50701	001	6 Oct 2018
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	12 Oct 2018
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	12 Oct 2018
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
480	Cable - Bulkhead to Amp	SRC Haverhill	157-3050360	480	6 Oct 2018
481	Cable - Bulkhead to Receiver	SRC Haverhill	151-3050787	481	6 Oct 2018
482	Cable - Amp to Antenna	SRC Haverhill	157-3051574	482	6 Oct 2018
510	Barometer/Thermometer	Control Company	68000-49	170871375	11 Dec 2018

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. 6 dB & 99% Bandwidth

Conducted Test Conditions for 6 dB and 99% Bandwidth			
Standard:	FCC CFR 47: 15.247 (a)(2) IC RSS-247:5.2	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	6 dB and 99 % Bandwidth	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	ANSI C63.10:2013 KDB 558074 D01 Measurement Guidance V04	**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.

KDB 558074 D01 DTS Measurement Guidance v04:
8.0 DTS bandwidth
One of the following procedures may be used to determine the modulated *DTS bandwidth*.
8.1 Option 1
a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 □ RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

8.2 Option 2
The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 × RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.

Equipment Configuration for 6 dB & 99% Bandwidth

Variant:	BLE	**Duty Cycle (%):**	66
Data Rate:	1.00 MBit/s	**Antenna Gain (dBi):**	5.42
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	OC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 6 dB Bandwidth (MHz) Port(s)				6 dB Bandwidth (MHz)		Limit	Lowest Margin
MHz	a	b	c	d	Highest	Lowest	KHz	MHz
2402.0	0.505				0.505	0.505	≥500.0	-0.01
2440.0	0.505				0.505	0.505	≥500.0	-0.01
2480.0	0.505				0.505	0.505	≥500.0	-0.01

Test Frequency	Measured 99% Bandwidth (MHz) Port(s)				Maximum 99% Bandwidth (MHz)		
MHz	a	b	c	d			
2402.0	0.994				0.994		
2440.0	1.002				1.002		
2480.0	0.994				0.994		

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 (b) & (c) IC RSS-247:5.4	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Output Power	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	ANSI C63.10; 11.9.1.3 KDB 558074 D01 Measurement Guidance V04	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

KDB 558074 D01 DTS Measurement Guidance v04:

9.1.3 PKPM1 Peak-reading power meter method
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

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

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

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

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

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

the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

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

(2) In addition to the provisions in paragraphs (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

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

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

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

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

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

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

Equipment Configuration for Peak Output Power			
Variant:	BLE	**Duty Cycle (%):**	66.0
Data Rate:	1.00 MBit/s	**Antenna Gain (dBi):**	5.42
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	OC
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	5.23				5.23	30.00	-24.77	8.00
2440.0	6.50				6.50	30.00	-23.50	8.00
2480.0	7.29				7.29	30.00	-22.71	8.00

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 (e) IC RSS-247:5.2	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Power Spectral Density	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	ANSI C63.10: 11.10.2 KDB 558074 D01 Measurement Guidance V04	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

KDB 558074 D01 DTS Measurement Guidance v04:

10.2 Method PKPSD (peak PSD)

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.
a) Set analyzer center frequency to DTS channel center frequency.

b) Set the span to 1.5 × DTS bandwidth.

c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.

d) Set the VBW ≥ 3 × RBW.
e) Detector = peak.

f) Sweep time = auto couple.
g) Trace mode = max hold.

h) Allow trace to fully stabilize.

i) Use the peak marker function to determine the maximum amplitude level within the RBW.

j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Equipment Configuration for Power Spectral Density - Peak			
Variant:	BLE	**Duty Cycle (%):**	66.0
Data Rate:	1.00 MBit/s	**Antenna Gain (dBi):**	5.42
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	OC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Power Spectral Density Port(s) (dBm/3KHz)				Amplitude Summation	Limit	Margin
MHz	a	b	c	d	dBm/3KHz	dBm/3KHz	dB
2402.0	-5.485				-5.485	8.0	-13.5
2440.0	-5.149				-5.149	8.0	-13.1
2480.0	-5.505				-5.505	8.0	-13.5

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).

9.4. 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 (d) IC RSS-247:5.5	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Max Unwanted Emission Levels	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	ANSI C63.10:2013: Sect 6.10.4, Sect 11.11; 11.12; 11.13 KDB 558074 D01 Measurement Guidance V04; Sect 11; Sect 12.	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Conducted Spurious and Band-Edge Emissions

Conducted Spurious Emissions and Band-edge were measured with a spectrum analyzer connected to the antenna terminal, while the EUT is operating in transmission mode at the appropriate frequency.

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

From ANSI C63.10 sect 11.11 Emissions in non-restricted frequency bands:

11.11.2: Reference Level easurement

The channel found to contain the maximum PSD level can be used to establish the reference level.

11.11.3 Emission level measurement

a) Set the center frequency and span to encompass frequency range to be measured.

b) Set the RBW = 100 kHz.

c) Set the VBW ≥ 3 × RBW.

d) Detector = peak.

e) Sweep time = auto couple.

f) Trace mode = max hold.

g) Allow trace to fully stabilize.

h) Use the peak marker function to determine the maximum amplitude level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b).

6.10.4 Authorized-band band-edge measurements (relative method)
These procedures are applicable for determining compliance at authorized-band band-edges where the requirements are expressed as a value relative to the in-band signal level. Procedures for determining compliance with field strength limits at or close to the band-edges are given in 6.10.6 (see also Table A.2).

For other than frequency-hopping devices, this test sequence shall be performed once. For devices that support frequency hopping, this test sequence shall be performed twice: once with the hopping function turned OFF and then repeated with the hopping function turned ON. The purpose of the test with the hopping function turned on is to confirm that the RF power remains OFF while the device is changing frequencies, and that the oscillator stabilizes at the new frequency before RF power is turned back ON. Overshoot of any oscillator, including phase-lock-loop stabilized oscillators, can cause the device to be temporarily tuned to frequencies outside the authorized band, and it is important that no transmissions occur during such temporary periods. Particular attention to the hopping

sequence requirements specified below is needed in the case of adaptive frequency-hopping devices:

a) Connect the EMI receiver or spectrum analyzer to the EUT using an appropriate RF cable connected to the EUT output. Configure the spectrum analyzer settings as described in step e) (be sure to enter all losses between the unlicensed wireless device output and the spectrum analyzer).

b) Set the EUT to the lowest frequency channel (for the hopping on test, the hopping sequence shall include the lowest frequency channel).

c) Set the EUT to operate at maximum output power and 100% duty cycle, or equivalent “normal mode of operation” as specified in 6.10.3.

d) If using the radiated method, then use the applicable procedure(s) of 6.4, 6.5, or 6.6, and orient the EUT and measurement antenna positions to produce the highest emission level.

e) Perform the test as follows:

1) Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.

2) Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

3) Attenuation: Auto (at least 10 dB preferred).

4) Sweep time: Coupled.

5) Resolution bandwidth: 100 kHz.

6) Video bandwidth: 300 kHz.

7) Detector: Peak.

8) Trace: Max hold.

f) Allow the trace to stabilize. For the test with the hopping function turned ON, this can take several minutes to achieve a reasonable probability of intercepting any emissions due to oscillator overshoot.

Equipment Configuration for Conducted Spurious Emissions - Peak

Variant:	BLE	**Duty Cycle (%):**	66
Data Rate:	1.00 MBit/s	**Antenna Gain (dBi):**	5.42
Modulation:	GFSK	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	OC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Conducted Spurious Emissions - Peak (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	-41.966	-22.13						
2440.0	30.0 - 26000.0	-40.339	-14.05						
2480.0	30.0 - 26000.0	-39.984	-20.73						

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

Equipment Configuration for Conducted Low Band-Edge Emissions - Peak			
Variant:	BLE	**Duty Cycle (%):**	66.0
Data Rate:	1.00 MBit/s	**Antenna Gain (dBi):**	5.42
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	OC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2402.0 MHz					
Band-Edge Frequency:	2400.0 MHz					
Test Frequency Range:	2350.0 - 2403.0 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	-44.38	-15.00	2401.50			-1.500

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).

Equipment Configuration for Conducted High Band-Edge Emissions - Peak			
Variant:	BLE	**Duty Cycle (%):**	66.0
Data Rate:	1.00 MBit/s	**Antenna Gain (dBi):**	5.42
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	OC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2480.0 MHz					
Band-Edge Frequency:	2483.5 MHz					
Test Frequency Range:	2478.8 - 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	-43.79	-14.33	2480.50			-3.000

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

Radiated Test Conditions for Radiated Spurious and Band-Edge Emissions			
Standard:	FCC CFR 47: Part 15.205 ISED RSS-GEN:8.9, 8.10	**Ambient Temp. (ºC):**	20.0 - 24.5
Test Heading:	Radiated Spurious Emissions	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	ANSI C63.10: 6.3, 6.5 & 6.6, 6.10 KDB 558074 D01 Measurement Guidance V04	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Radiated Spurious and Band-Edge Emissions (Restricted Bands)

Testing 30 – 10,000 MHz was performed in an anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver in peak hold mode.

Emissions nearest the limits were chosen for maximization and formal measurement using a CISPR Compliant receiver. Emissions from 30 MHz – 1000 MHz are measured utilizing a CISPR compliant quasi-peak detector with a tuned receiver, using a bandwidth of 120 kHz. Emissions above 1000 MHz are measured utilizing a CISPR compliant average detector with a tuned receiver, using a bandwidth of 1 MHz. Only the highest emissions relative to the limit are listed.

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

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

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

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

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

40 dBmV/m = 100 mV/m
48 dBmV/m = 250 mV/m

Restricted Bands of Operation (15.205)

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

9.4.2.3. TX Spurious & Restricted Band Emissions

Equipment Configuration for TX Spurious & Restricted Band Emissions

Antenna:	Pulse SZ0845W	**Variant:**	BLE
Antenna Gain (dBi):	5.42	**Modulation:**	GFSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	66
Channel Frequency (MHz):	2402.00	**Data Rate:**	1.00 MBit/s
Power Setting:	8	**Tested By:**	JMH

Test Measurement Results
Click here to view measurement data...
Test Notes: Eut powered and controlled by laptop. 2.4 GHz notch in front of amp to prevent overload

Equipment Configuration for TX Spurious & Restricted Band Emissions			
Antenna:	Pulse SZ0845W	**Variant:**	BLE
Antenna Gain (dBi):	5.42	**Modulation:**	GFSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	66
Channel Frequency (MHz):	2440.00	**Data Rate:**	1.00 MBit/s
Power Setting:	8	**Tested By:**	JMH

Test Measurement Results
Click here to view measurement data...
Test Notes: Eut powered and controlled by laptop. 2.4 GHz notch in front of amp to prevent overload

Equipment Configuration for TX Spurious & Restricted Band Emissions			
Antenna:	Pulse SZ0845W	**Variant:**	BLE
Antenna Gain (dBi):	5.42	**Modulation:**	GFSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	66
Channel Frequency (MHz):	2480.00	**Data Rate:**	1.00 MBit/s
Power Setting:	8	**Tested By:**	JMH

Test Measurement Results
Click here to view measurement data...
Test Notes: Eut powered and controlled by laptop. 2.4 GHz notch in front of amp to prevent overload

9.4.2.4. Restricted Edge & Band-Edge Emissions

Pulse SZ0845W		Band-Edge Freq	Limit 74.0dBµV/m	Limit 54.0dBµV/m	Power Setting
Operational Mode	Operating Frequency (MHz)	MHz	dBµV/m	dBµV/m	
BLE	2402.00	2390.00	46.82	33.31	8
BLE	2480.00	2483.50	48.48	34.51	8

Equipment Configuration for Radiated - Lower Restricted Band-Edge Emissions

Antenna:	Pulse SZ0845W	**Variant:**	BLE
Antenna Gain (dBi):	5.42	**Modulation:**	GFSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	66
Channel Frequency (MHz):	2402.00	**Data Rate:**	1.00 MBit/s
Power Setting:	8	**Tested By:**	JMH

Test Measurement Results

2310.00 - 2422.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
#1	2369.70	12.73	2.24	31.85	46.82	Max Peak	Vertical	163	355	74.0	-27.2	Pass
#2	2375.09	-0.82	2.25	31.88	33.31	Max Avg	Vertical	163	355	54.0	-20.7	Pass
#3	2390.00	--	--	--	--	Restricted-Band	--	--	--	--	--	--
Test Notes: Eut powered and controlled by laptop.												

Equipment Configuration for Radiated - Upper Restricted Band-Edge Emissions

Antenna:	Pulse SZ0845W	**Variant:**	BLE
Antenna Gain (dBi):	5.42	**Modulation:**	GFSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	66
Channel Frequency (MHz):	2480.00	**Data Rate:**	1.00 MBit/s
Power Setting:	8	**Tested By:**	JMH

Test Measurement Results

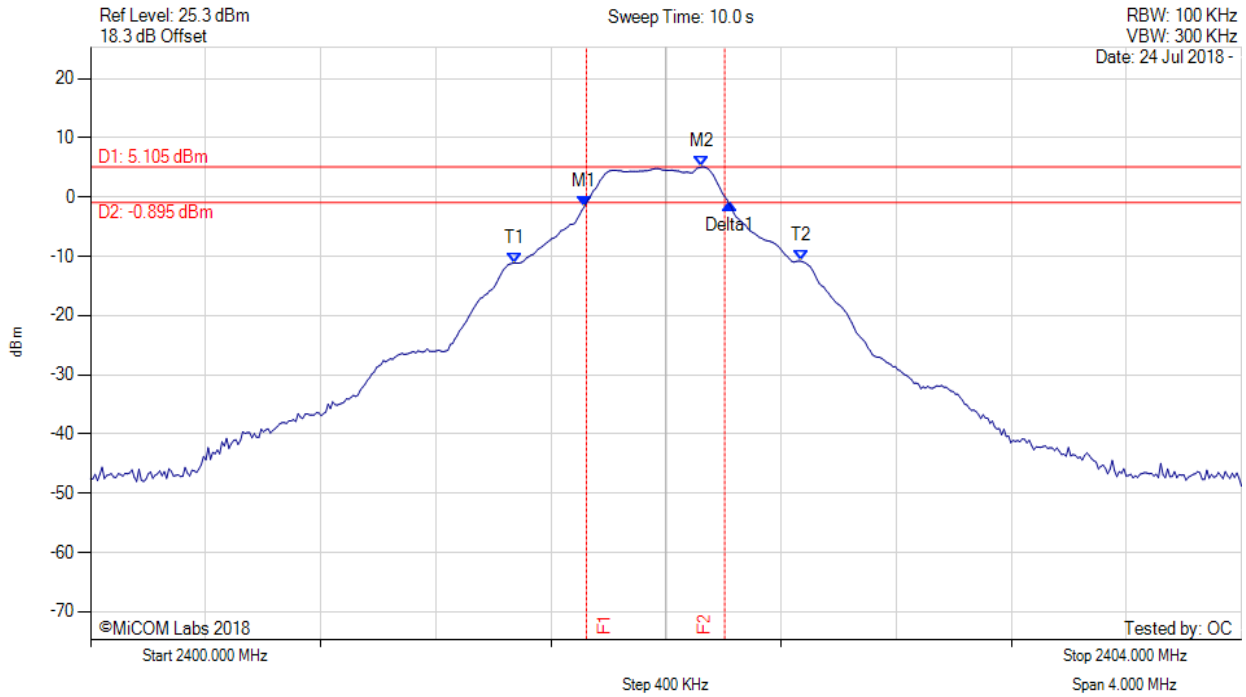
2452.00 - 2520.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
#2	2505.96	13.86	2.30	32.32	48.48	Max Peak	Vertical	163	355	74.0	-25.5	Pass
#3	2509.78	-0.13	2.32	32.32	34.51	Max Avg	Vertical	163	355	54.0	-19.5	Pass
#1	2483.50	--	--	--	--	Restricted-Band	--	--	--	--	--	--
Test Notes: Eut powered and controlled by laptop.												

A. APPENDIX - GRAPHICAL IMAGES

A.1. 6 dB & 99% Bandwidth

6 dB & 99% BANDWIDTH

Variant: BLE, Channel: 2402.00 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

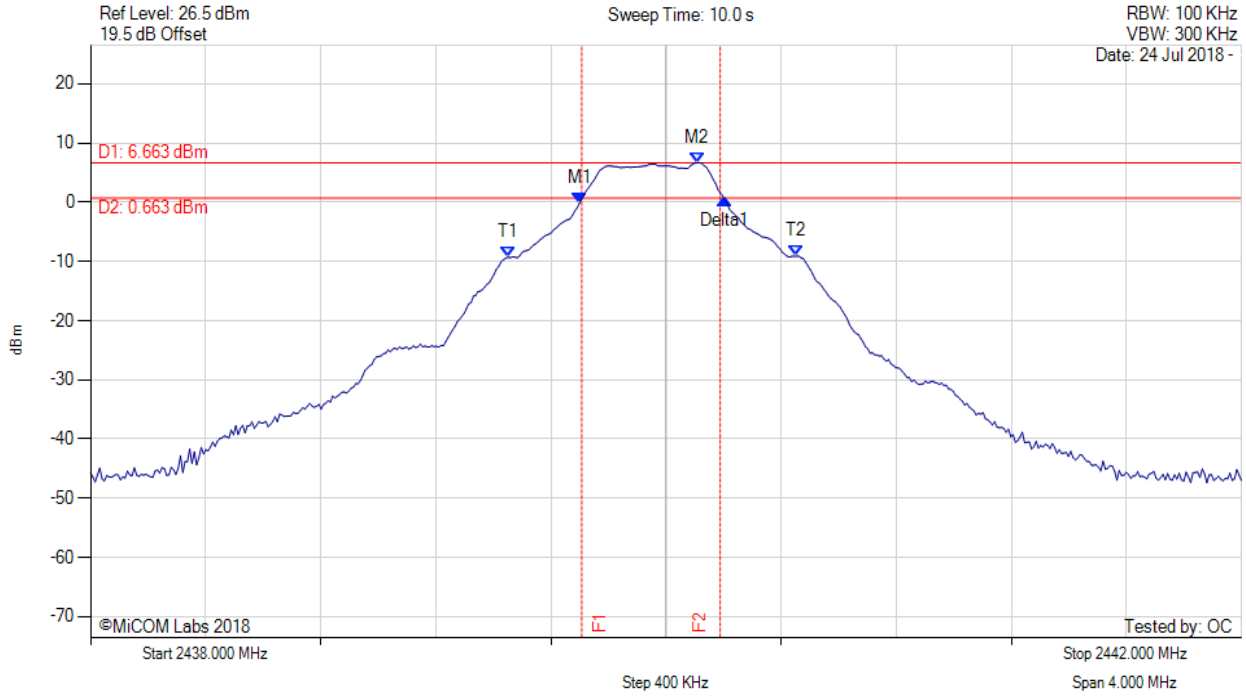


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD	M1 : 2401.715 MHz : -1.678 dBm M2 : 2402.124 MHz : 5.105 dBm Delta1 : 505 KHz : 0.535 dB T1 : 2401.475 MHz : -11.100 dBm T2 : 2402.469 MHz : -10.819 dBm OBW : 994 KHz	Measured 6 dB Bandwidth: 0.505 MHz Limit: ≥500.0 kHz Margin: -0.01 MHz

back to matrix

6 dB & 99% BANDWIDTH

Variant: BLE, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

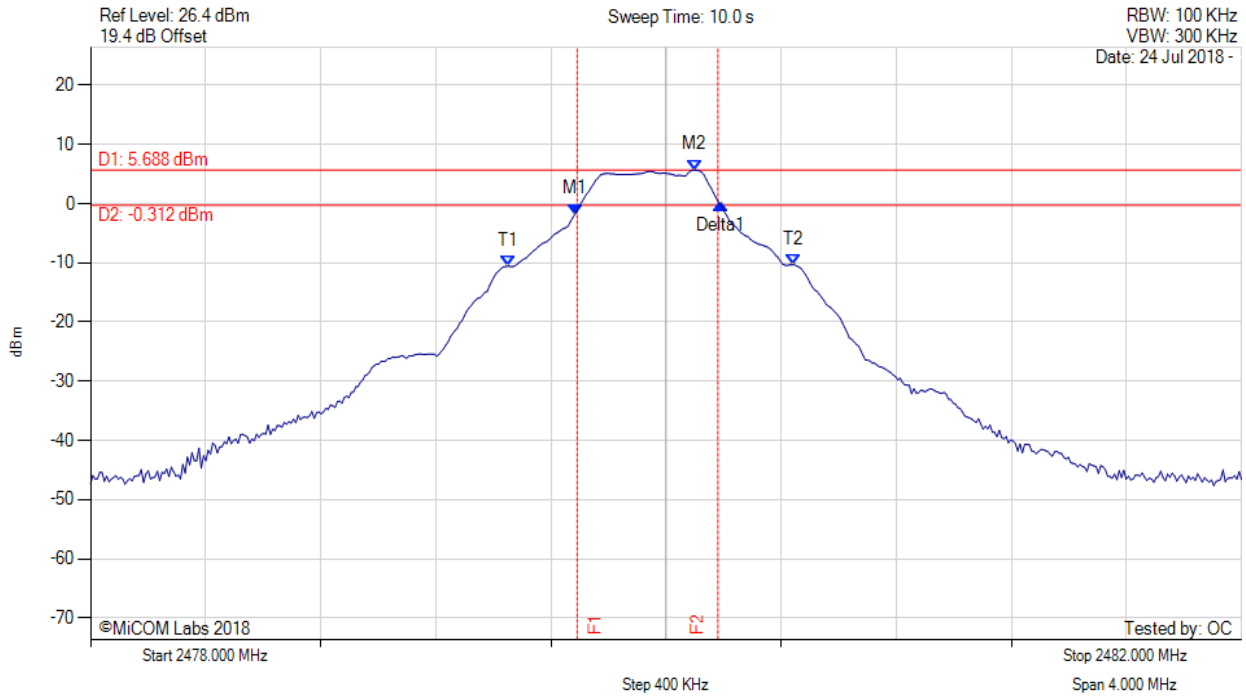


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD	M1 : 2439.699 MHz : -0.124 dBm M2 : 2440.108 MHz : 6.663 dBm Delta1 : 505 KHz : 0.584 dB T1 : 2439.451 MHz : -9.280 dBm T2 : 2440.453 MHz : -9.123 dBm OBW : 1.002 MHz	Measured 6 dB Bandwidth: 0.505 MHz Limit: ≥500.0 kHz Margin: -0.01 MHz

back to matrix

6 dB & 99% BANDWIDTH

Variant: BLE, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



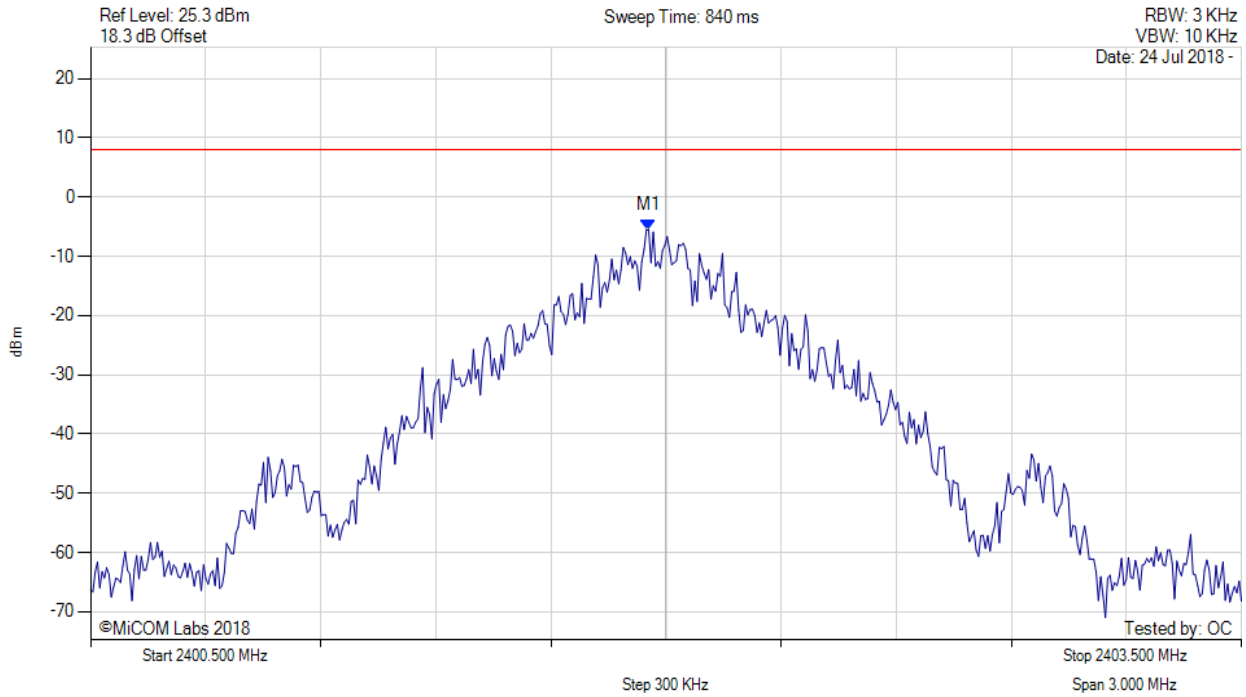
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD	M1 : 2479.683 MHz : -1.778 dBm M2 : 2480.100 MHz : 5.688 dBm Delta1 : 505 KHz : 1.651 dB T1 : 2479.451 MHz : -10.565 dBm T2 : 2480.445 MHz : -10.289 dBm OBW : 994 KHz	Measured 6 dB Bandwidth: 0.505 MHz Limit: ≥500.0 kHz Margin: -0.01 MHz

back to matrix

A.2. Power Spectral Density

POWER SPECTRAL DENSITY - PEAK

Variant: BLE, Channel: 2402.00 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

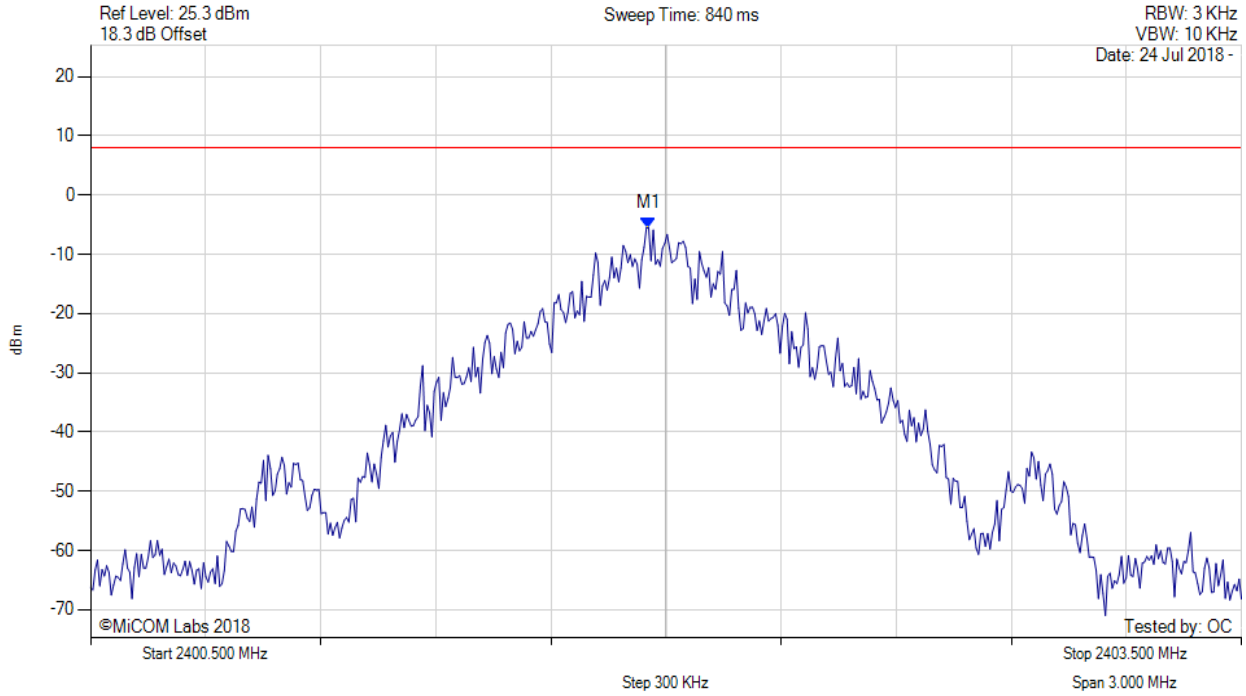


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2401.955 MHz : -5.485 dBm	Limit: ≤ 8.000 dBm Margin: 13.48 dB

back to matrix

POWER SPECTRAL DENSITY - PEAK

Variant: BLE, Channel: 2402.00 MHz, SUM, Temp: 20, Voltage: 5 Vdc

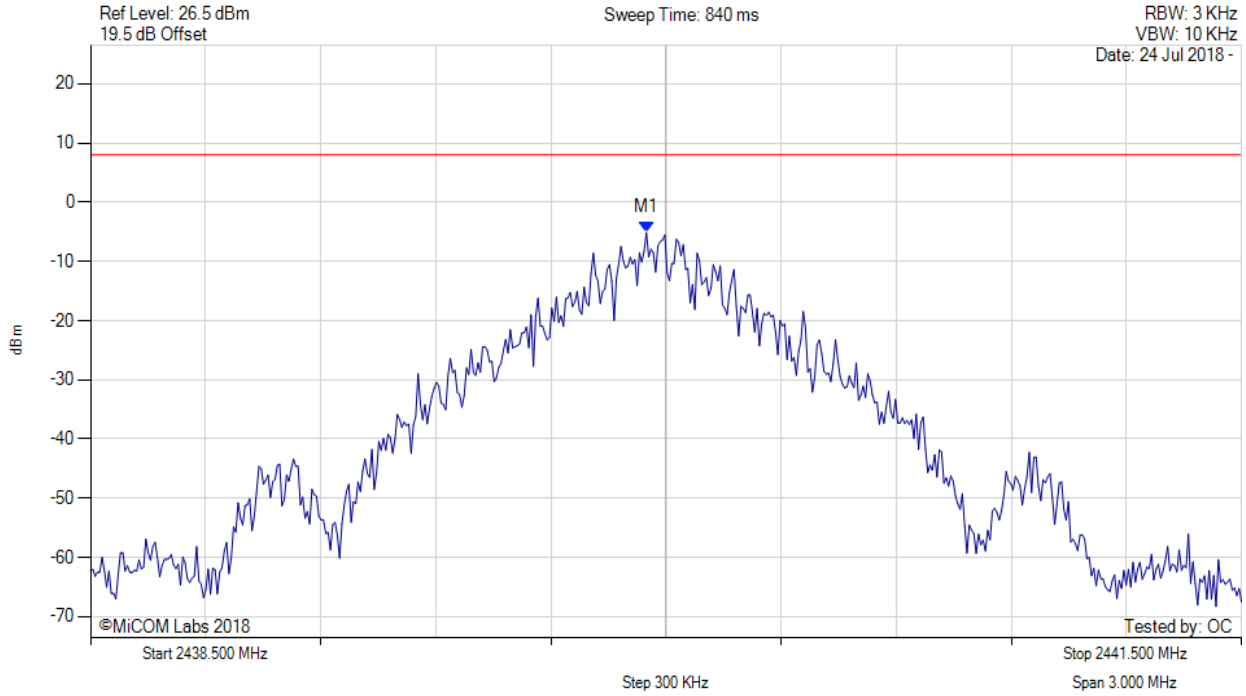


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2401.955 MHz : -5.485 dBm	Limit: ≤ 8.0 dBm Margin: -13.5 dB

back to matrix

POWER SPECTRAL DENSITY - PEAK

Variant: BLE, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

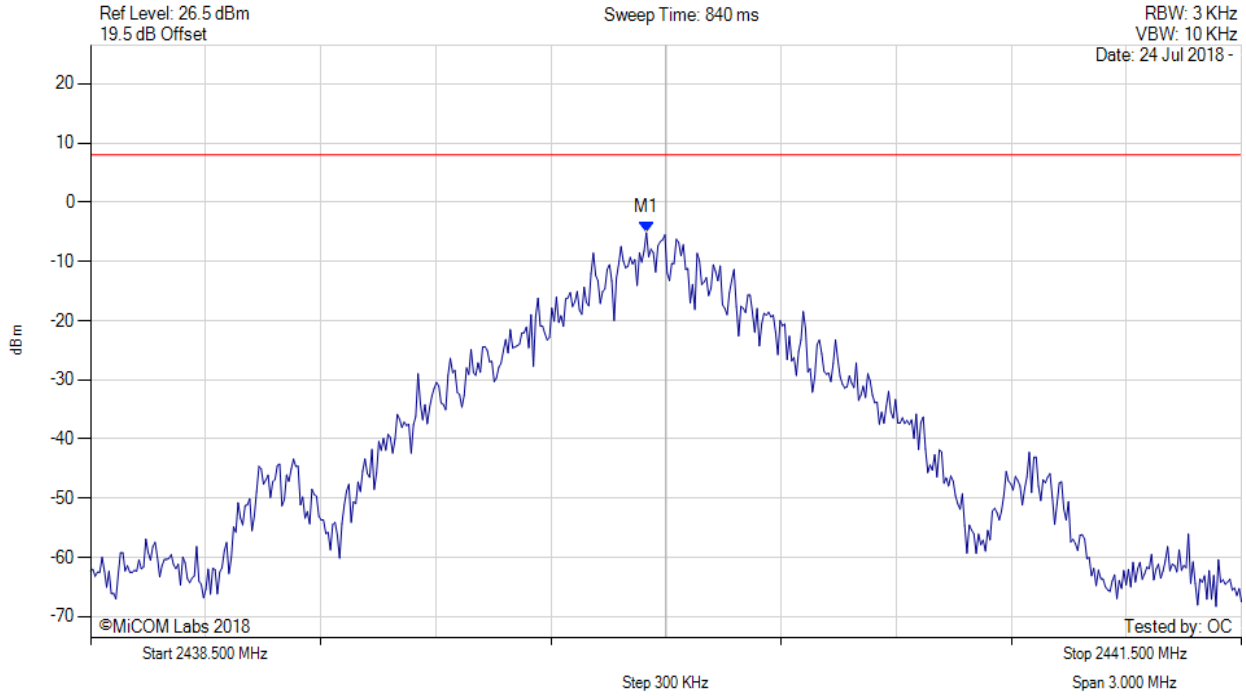


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2439.949 MHz : -5.149 dBm	Limit: ≤ 8.000 dBm Margin: 13.15 dB

back to matrix

POWER SPECTRAL DENSITY - PEAK

Variant: BLE, Channel: 2440.00 MHz, SUM, Temp: 20, Voltage: 5 Vdc

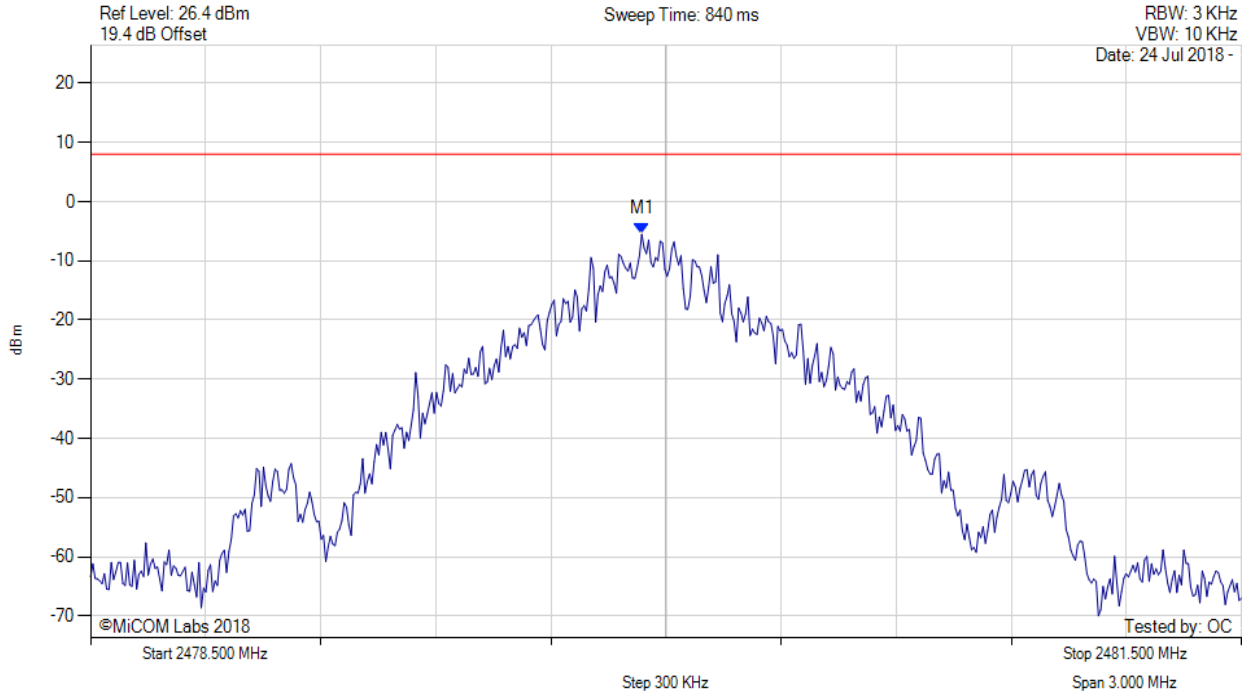


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2439.949 MHz : -5.149 dBm	Limit: ≤ 8.0 dBm Margin: -13.1 dB

back to matrix

POWER SPECTRAL DENSITY - PEAK

Variant: BLE, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

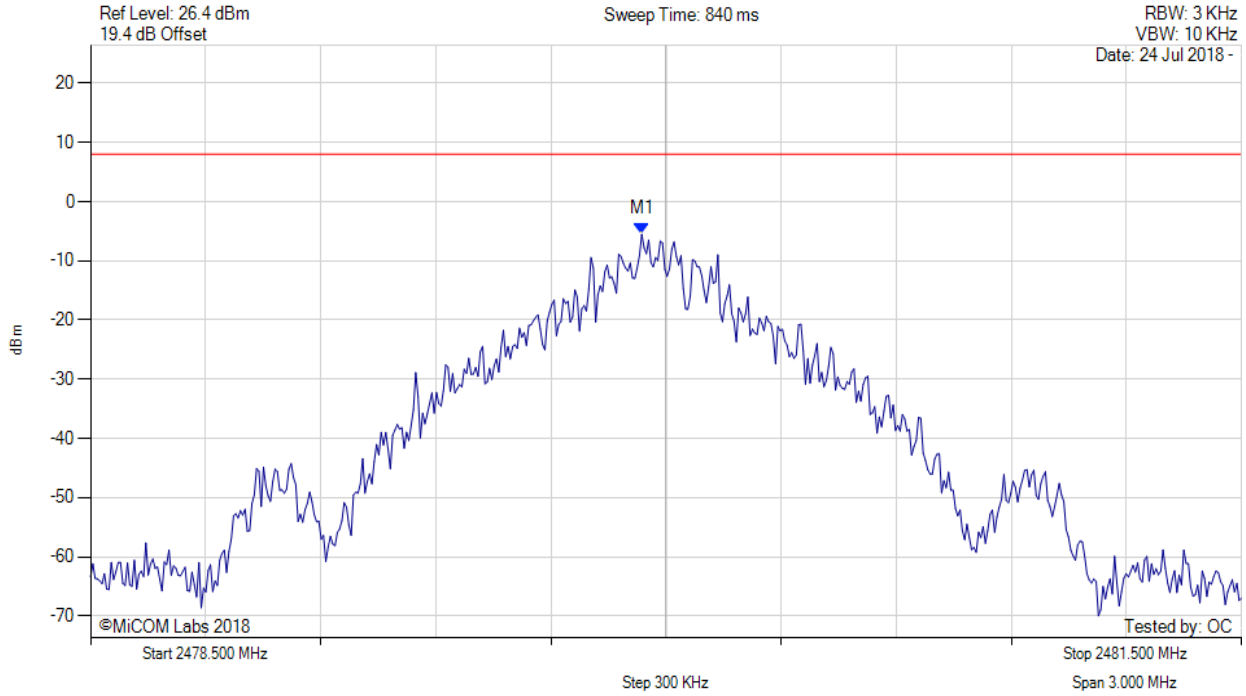


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2479.937 MHz : -5.505 dBm	Limit: ≤ 8.000 dBm Margin: 13.50 dB

back to matrix

POWER SPECTRAL DENSITY - PEAK

Variant: BLE, Channel: 2480.00 MHz, SUM, Temp: 20, Voltage: 5 Vdc



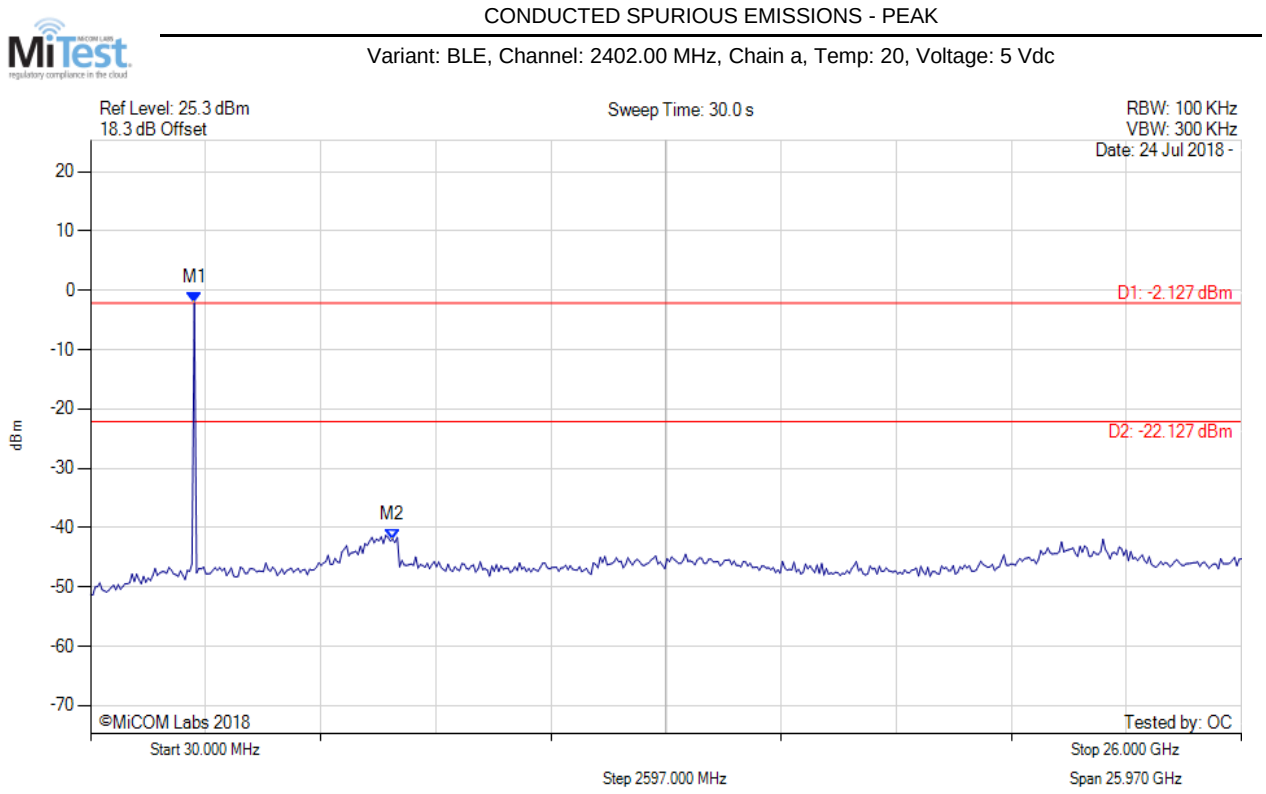
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2479.937 MHz : -5.505 dBm	Limit: ≤ 8.0 dBm Margin: -13.5 dB

back to matrix

A.3. Emissions

A.3.1. Conducted Emissions

A.3.1.1. Conducted Spurious Emissions

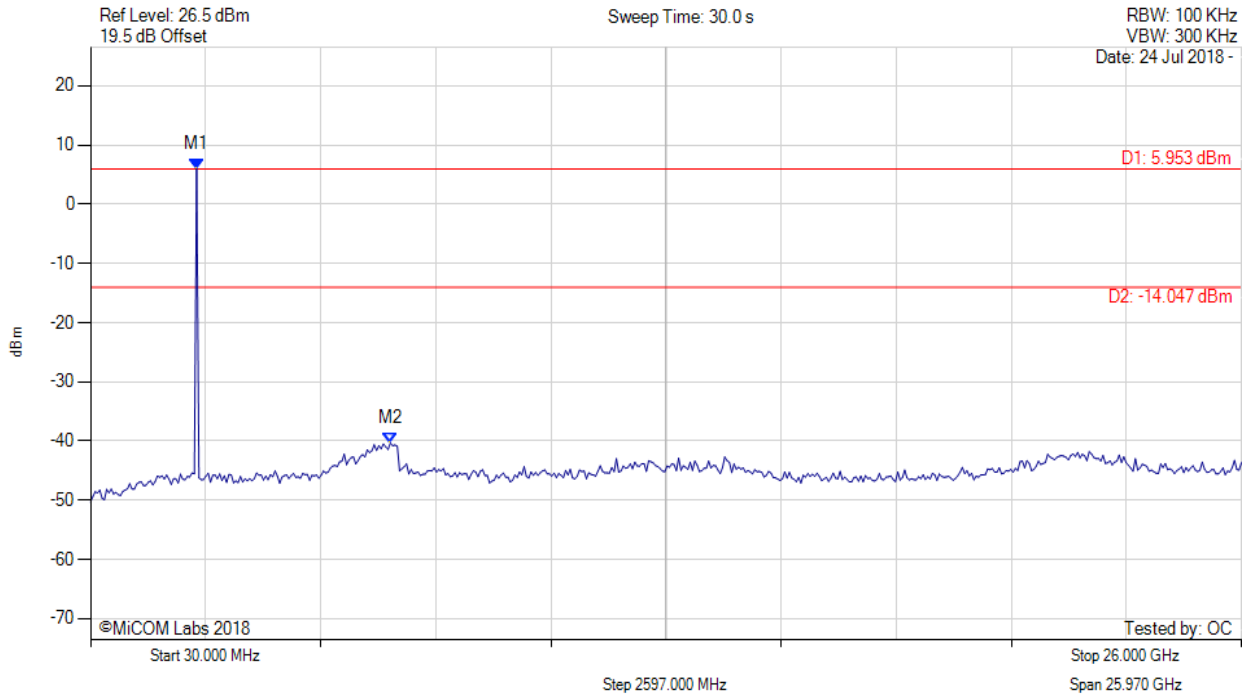


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2371.984 MHz : -2.127 dBm M2 : 6847.776 MHz : -41.966 dBm	Limit: -22.13 dBm Margin: -19.84 dB

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: BLE, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

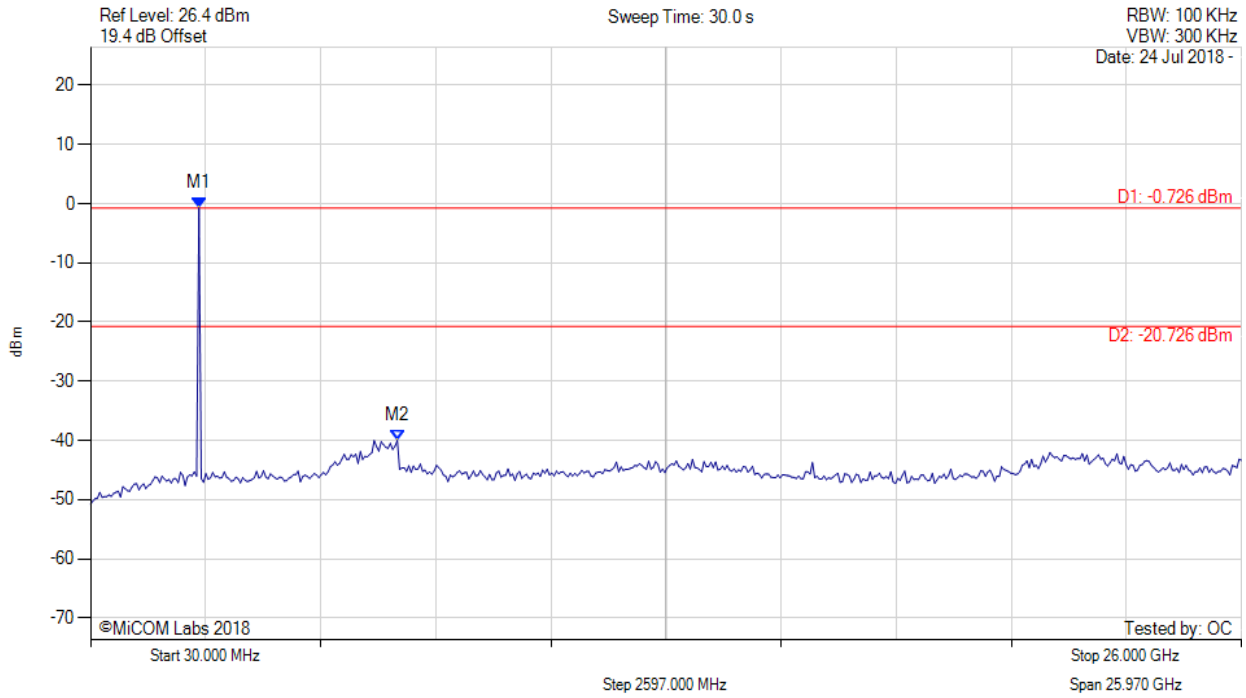


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2424.028 MHz : 5.953 dBm M2 : 6795.731 MHz : -40.339 dBm	Limit: -14.05 dBm Margin: -26.29 dB

back to matrix

CONDUCTED SPURIOUS EMISSIONS - PEAK

Variant: BLE, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



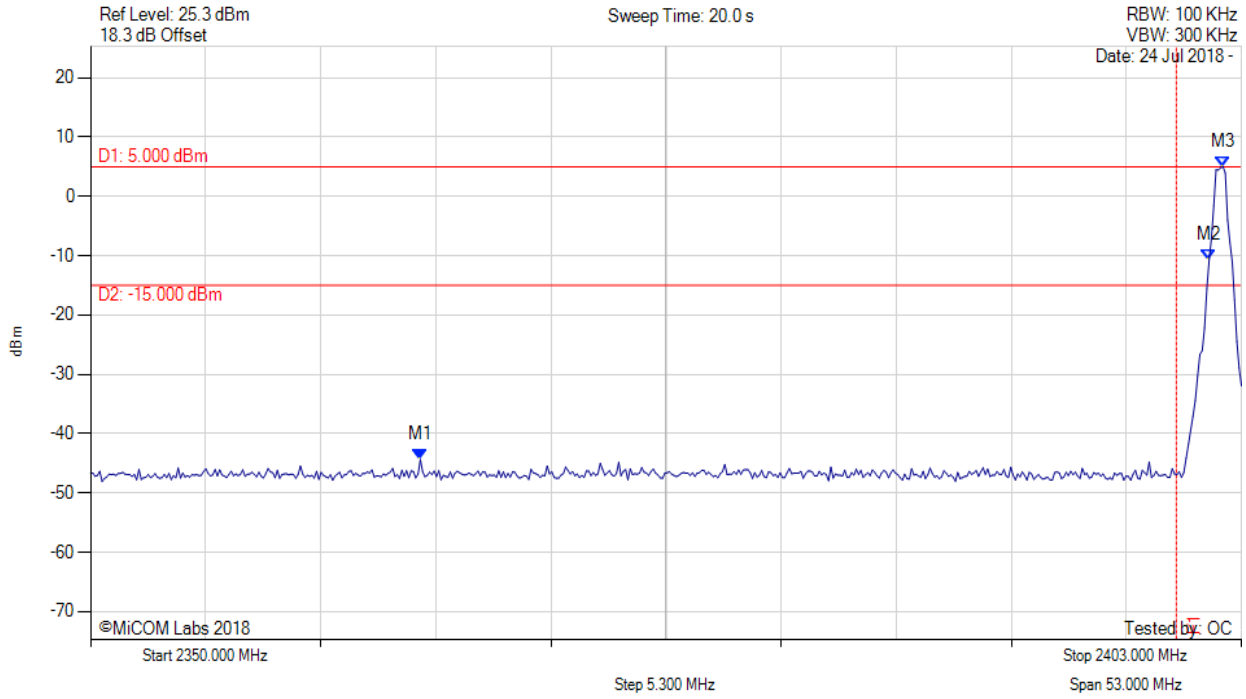
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2476.072 MHz : -0.726 dBm M2 : 6951.864 MHz : -39.984 dBm	Limit: -20.73 dBm Margin: -19.25 dB

back to matrix

A.3.1.2. Conducted Band-Edge Emissions

CONDUCTED LOW BAND-EDGE EMISSION - PEAK

Variant: BLE, Channel: 2402.00 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2365.188 MHz : -44.376 dBm M2 : 2401.487 MHz : -10.744 dBm M3 : 2402.150 MHz : 5.003 dBm	Channel Frequency: 2402.00 MHz

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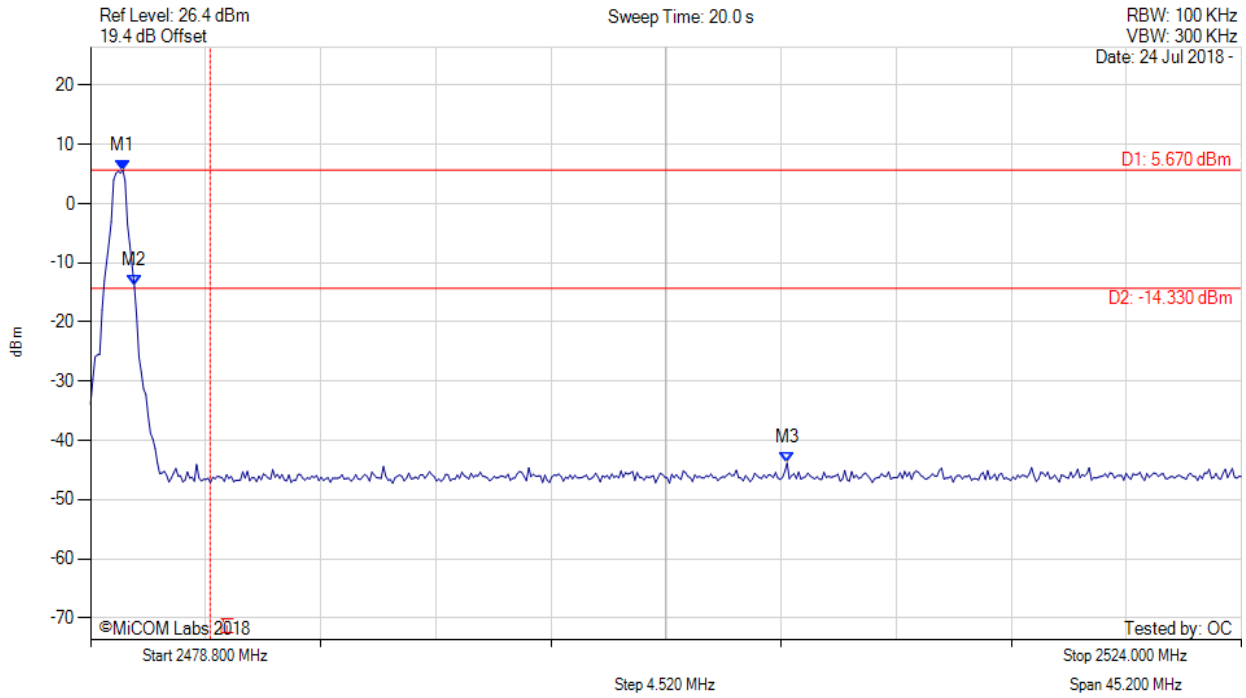
CONDUCTED HIGH BAND-EDGE EMISSION - PEAK

Variant: BLE, Channel: 2480.00 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

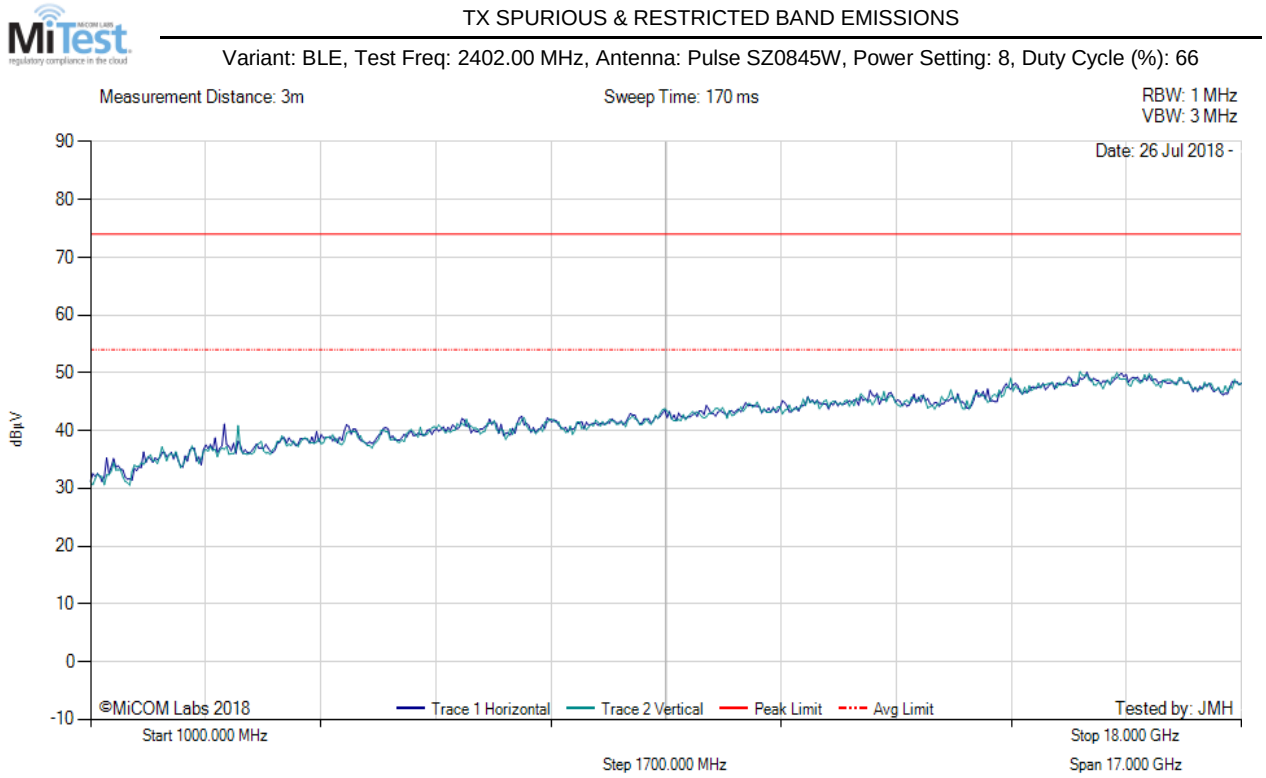


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2480.068 MHz : 5.666 dBm M2 : 2480.521 MHz : -13.915 dBm M3 : 2506.156 MHz : -43.793 dBm	Channel Frequency: 2480.00 MHz

back to matrix

A.3.2. Radiated Emissions

A.3.2.3. TX Spurious & Restricted Band Emissions



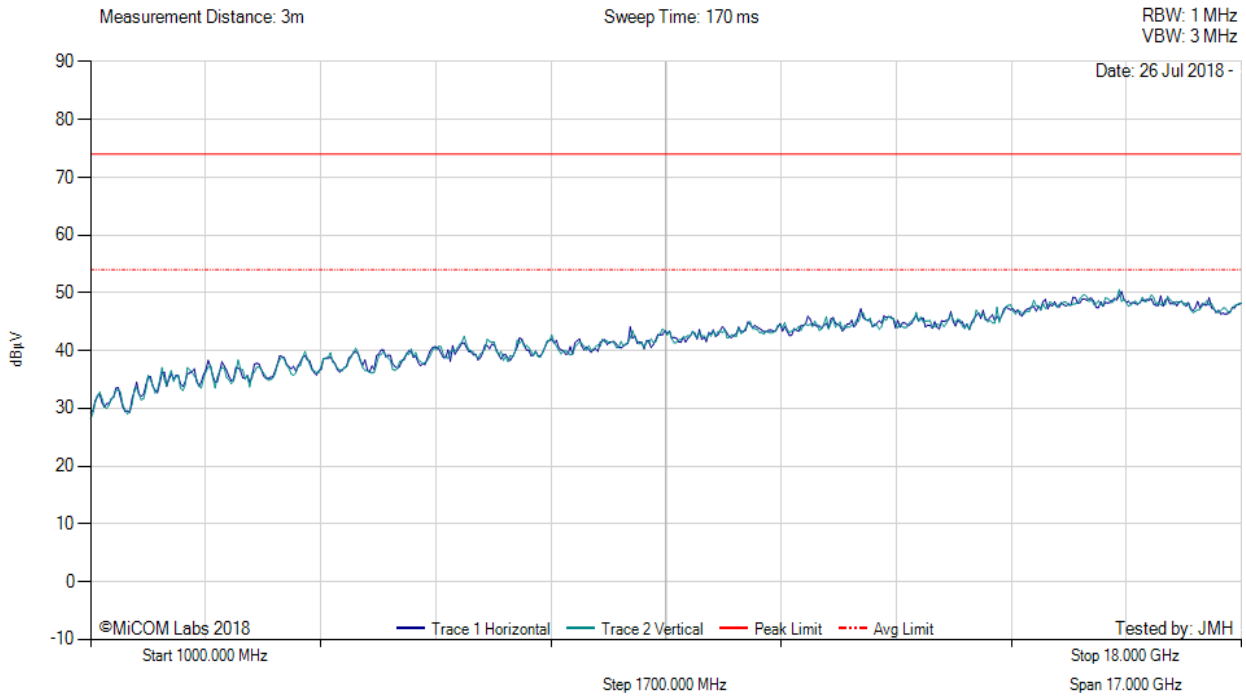
There are no emissions found within 6dB of the limit line.

Test Notes: Eut powered and controlled by laptop. 2.4 GHz notch in front of amp to prevent overload

back to matrix

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: BLE, Test Freq: 2440.00 MHz, Antenna: Pulse SZ0845W, Power Setting: 8, Duty Cycle (%): 66



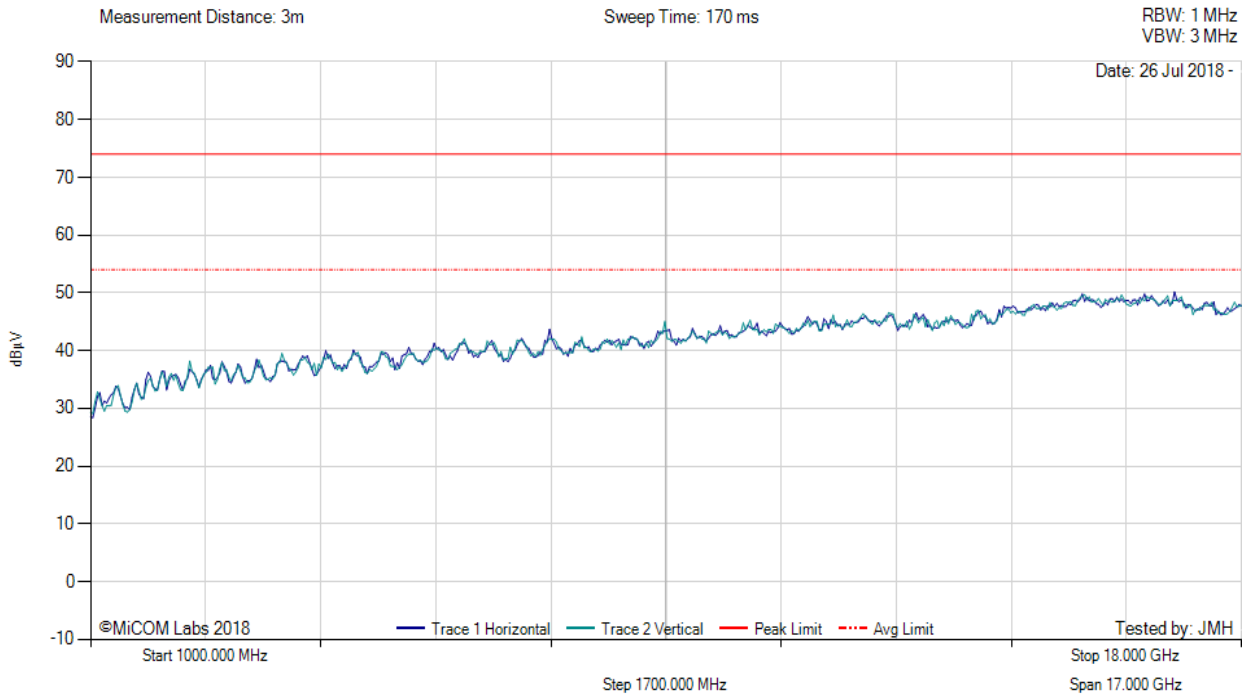
There are no emissions found within 6dB of the limit line.

Test Notes: Eut powered and controlled by laptop. 2.4 GHz notch in front of amp to prevent overload

back to matrix

TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: BLE, Test Freq: 2480.00 MHz, Antenna: Pulse SZ0845W, Power Setting: 8, Duty Cycle (%): 66



There are no emissions found within 6dB of the limit line.

Test Notes: Eut powered and controlled by laptop. 2.4 GHz notch in front of amp to prevent overload

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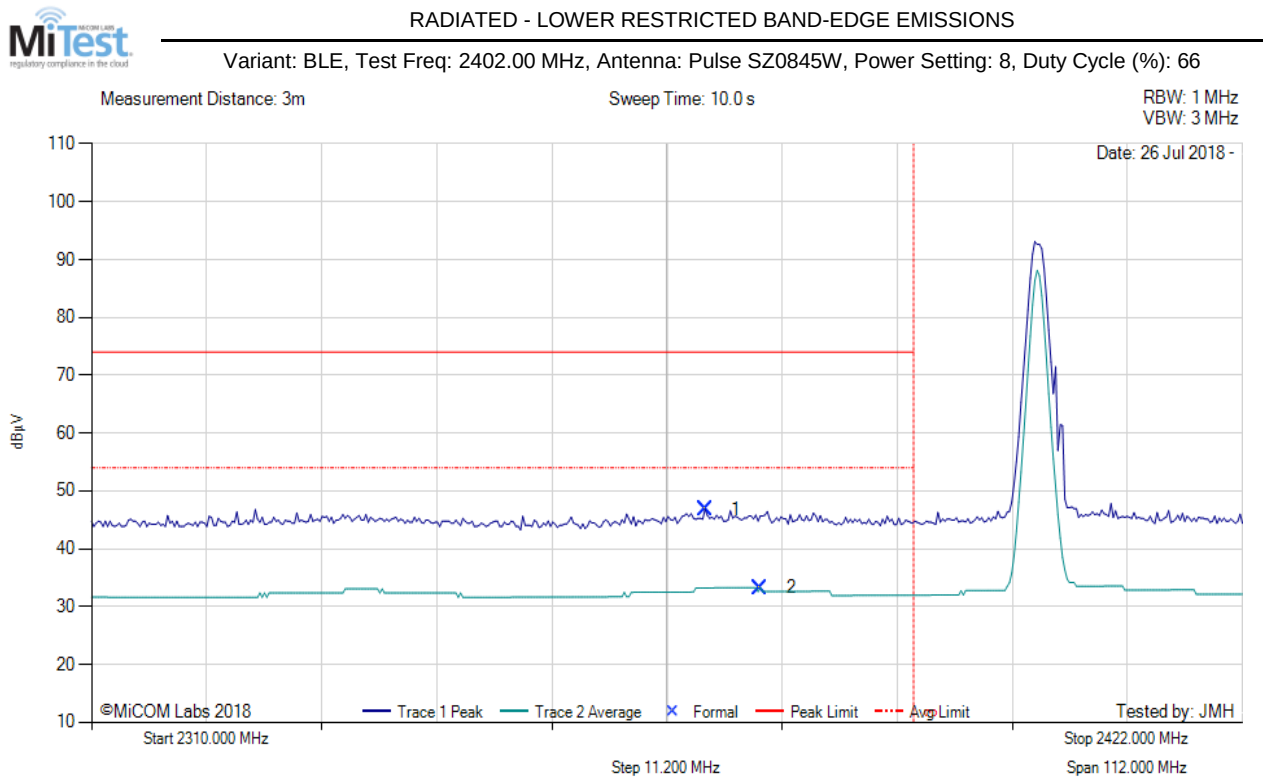
A.3.2.4. Restricted Edge & Band-Edge Emissions



2310.00 - 2422.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	2369.70	12.73	2.24	31.85	46.82	Max Peak	Vertical	163	355	74.0	-27.2	Pass
2	2375.09	-0.82	2.25	31.88	33.31	Max Avg	Vertical	163	355	54.0	-20.7	Pass
3	2390.00	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: Eut powered and controlled by laptop.

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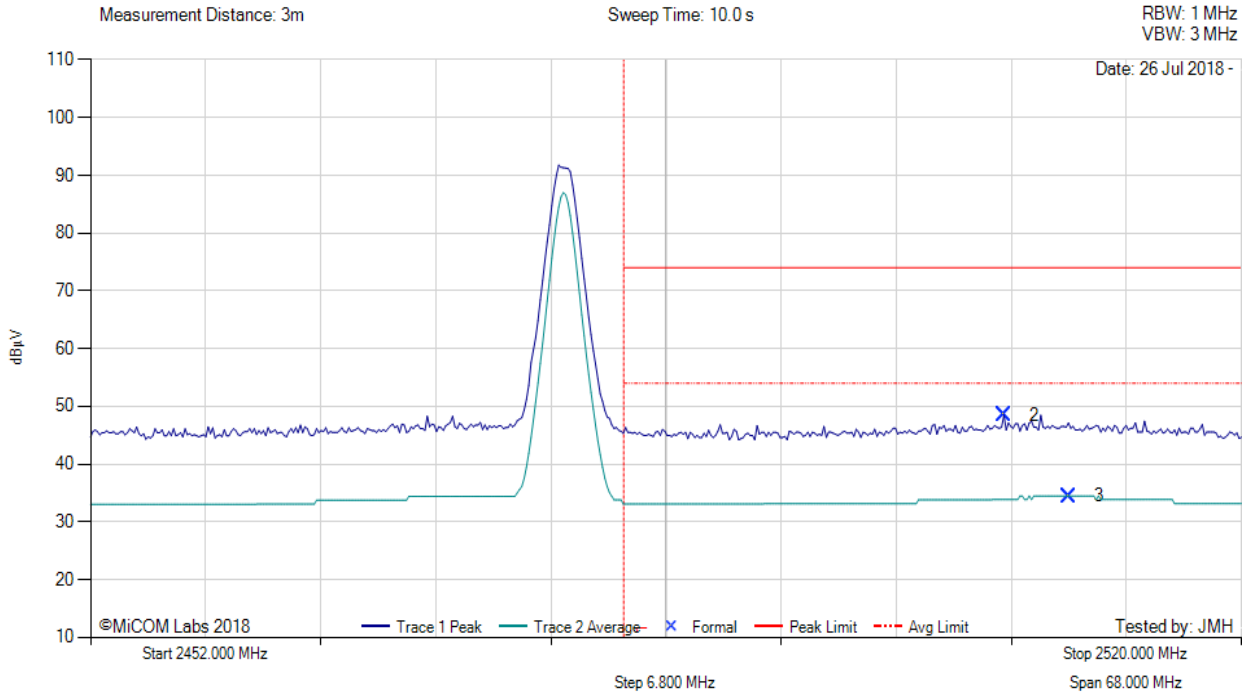
RADIATED - UPPER RESTRICTED BAND-EDGE EMISSIONS

Variant: BLE, Test Freq: 2480.00 MHz, Antenna: Pulse SZ0845W, Power Setting: 8, Duty Cycle (%): 66



2452.00 - 2520.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
2	2505.96	13.86	2.30	32.32	48.48	Max Peak	Vertical	163	355	74.0	-25.5	Pass
3	2509.78	-0.13	2.32	32.32	34.51	Max Avg	Vertical	163	355	54.0	-19.5	Pass
1	2483.50	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: Eut powered and controlled by laptop.

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