

Company: Itron, Inc.

Test of: NIC 510-06

To: FCC CFR 47 Part C 15.247 (FHSS); RSS-247

Report No.: ITRO01-U5 Rev A

COMPLETE TEST REPORT





Test of: Itron, Inc. NIC 510-06

To: FCC CFR 47 Part C 15.247 (FHSS); RSS-247

Test Report Serial No.: ITRO01-U5 Rev A

This report supersedes: NONE

Applicant: Itron, Inc.
230 West Tasman Drive
San Jose, California
95134
USA

Product function: Plug in Radio Device

Issue Date: 9th May 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



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>



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 8 January 2009).



Presented this 4th day of February 2016.



President and CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to May 31, 2018
Revised April 25, 2018

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

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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

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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 4th day of February 2016.



President and CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to May 31, 2018
Revised April 25, 2018

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



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2. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	16th April 2018	Draft report for client review.
Rev A	9th May 2018	Initial release.
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In the above table the latest report revision will replace all earlier versions.

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3. TEST RESULT CERTIFICATE

Manufacturer: Itron, Inc. 230 West Tasman Drive San Jose California 95134 USA	Tested By: MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Model: NIC 511-0603-13	Telephone: +1 925 462 0304
Type Of Equipment: Modular radio device	Fax: +1 925 462 0306
S/N's: 0013500700001592 00135007000013D5	
Test Date(s): 26 March - 03 April 2018	Website: www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC CFR 47 Part C 15.247 (FHSS); RSS-247	EQUIPMENT COMPLIES

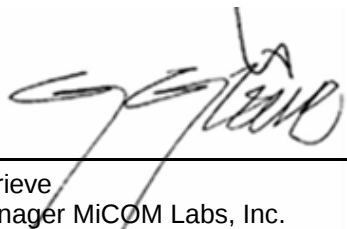
MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

Notes:

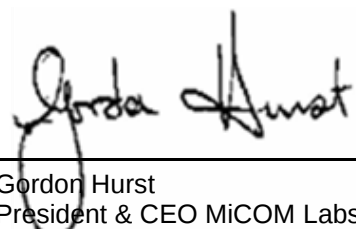
1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:





Graeme Grieve
Quality Manager MiCOM Labs, Inc.



Gordon Hurst
President & CEO MiCOM Labs, Inc.

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4. REFERENCES AND MEASUREMENT UNCERTAINTY

4.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
I	FCC 47 CFR Part 15.247	2016	Radio Frequency Devices; Subpart C – Intentional Radiators
II	FCC Public Notice DA 00-705	March 2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
III	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
IV	ANSI C63.4	2014	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
V	ETSI TR 100 028	2001-12	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
VI	FCC 47 CFR Part 15, Subpart B	2014	Title 47: Telecommunication PART 15—RADIO FREQUENCY DEVICES, SubPart B; Unintentional Radiators
VII	ICES-003	Issue 6 Jan 2016; Updated April 2017	Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement.
VIII	M 3003	Edition 3 Nov.2012	Expression of Uncertainty and Confidence in Measurements
IX	RSS-247 Issue 2	Feb 2017	Digital Transmission Systems (DTSS), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices
X	RSS-Gen Issue 4; Amendment 1	March 2018	General Requirements for Compliance of Radio Apparatus
XI	FCC 47 CFR Part 2.1033	2016	FCC requirements and rules regarding photographs and test setup diagrams.
XII	A2LA	August 2017	R105 - Requirement's When Making Reference to A2LA Accreditation Status



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4.2. Test and Uncertainty Procedure

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

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

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

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5. PRODUCT DETAILS AND TEST CONFIGURATIONS

5.1. Technical Details

Details	Description
Purpose:	Test of the Itron, Inc. NIC 510-06 to FCC CFR 47 Part C 15.247 (FHSS); Radio Frequency Devices; Subpart C – Intentional Radiators; RSS-247.
Applicant:	Itron, Inc. 230 West Tasman Drive San Jose California 95134 USA
Manufacturer:	Itron, Inc.
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	ITRO01-U5 Rev A
Date EUT received:	26th March 2018
Standard(s) applied:	FCC CFR 47 Part C 15.247 (FHSS); RSS-247
Dates of test (from - to):	27 March - 03 April 2018
No of Units Tested:	3
Product Family Name:	NIC 510-06
Model(s):	NIC 511-0603-13; NIC 511-0602-14 (for USB testing)
Location for use:	Indoor/Outdoor
Declared Frequency Range(s):	2400 - 2483.5 MHz;
Type of Modulation:	FHSS
EUT Modes of Operation:	2400 - 2483.5 MHz: 300 kbps/GFSK; 600 kbps/OFDM;
Declared Nominal Output Power	30 dBm
Transmit/Receive Operation:	Transceiver – Half Duplex
Rated Input Voltage and Current:	4VDC
Operating Temperature Range:	-40 to +85 degrees C.
ITU Emission Designator:	800KF1D, 400KF1D
Equipment Dimensions:	110 mm x 45mm x 15mm
Weight:	50g
Hardware Rev:	173-0870-00
Software Rev:	4.4.0

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5.2. Scope Of Test Program

Itron, Inc. NIC 511-0603-13

The scope of the test program was to test the Itron, Inc. NIC 511-0603-13, NIC 510-06 configurations in the frequency ranges 2400 - 2483.5 MHz; for compliance against the following specification:

FCC CFR 47 Part 15.247 (FHSS); Radio Frequency Devices; Subpart C – Intentional Radiators

Industry Canada RSS-247

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

The following product description was provided by Itron Inc.

The NIC 510-06 is a plug-in radio device, will communicate over mesh and HAN networks. May be integrated into host devices (i.e., FSU 5.0, IOTR 5, energy meters, etc.) to be used in Itron Smart Energy Networks (SEN). NIC 510-06 may be configured for host applications on USB or Serial data communications and may support standard or extended last gasp (ELG). The NIC 510-06 family supports basic meter types including single phase meters and three phase meters.

This report is intended to cover the NIC 510-06 family of products which includes the NIC 511-0603-13 and NIC 511-0602-14 and represents a worst case configuration of the product family.

NIC 510-06 products include the following model numbers/configurations:

NIC 511-0603: 900+2.4,INT/EXT ANT, HW1
NIC 511-0602: 900+2.4, EXT ANT,HW1
NIC 511-0601: 900+2.4, INT ANT, HW1
NIC 511-0601-13 : 900+2.4, INT ANT, HW1, 75s ELG
NIC 511-0602-13 : 900+2.4, EXT ANT, HW1, 75s ELG
NIC 511-0602-13 : 900+2.4, INT/EXT ANT,HW1, 75s ELG
NIC 511-0602-14 : 900+2.4, EXT ANT,HW1, USB

Itron, Inc. NIC 511-0603-13





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

Type (EUT)	Equipment Description	Serial Number
EUT	NIC 511-0603-13	0013500700001592
EUT	NIC 511-0602-14	00135007000013D5
Support	IOTR5 SBC	Proto1

5.4. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
integral	Tai Sheng Chen	155-0010-00	f type	5.0	-	360	-	2400 - 2483.5
external	WP	WPANT30017-CA	OMNI	4.5	-	360	-	2400 - 2483.5
external	WP	WPANT40020-SA	Wrap Around	3.5	-	360	-	2400 - 2483.5

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

5.5. Cabling and I/O Ports

Port Type	Max Cable Length	# of Ports	Screened	Conn Type	Data Type
RS232	0 (direct plug)	1	No	12-PIN	Packet Data
USB	0 (direct plug)	1	No	4-PIN	Packet Data

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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				
300 kbps/GFSK	300	2400.8	2440.00	2472.8
600 kbps/OFDM	600	2400.4	2440.00	2454.4

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

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6. TEST SUMMARY

List of Measurements

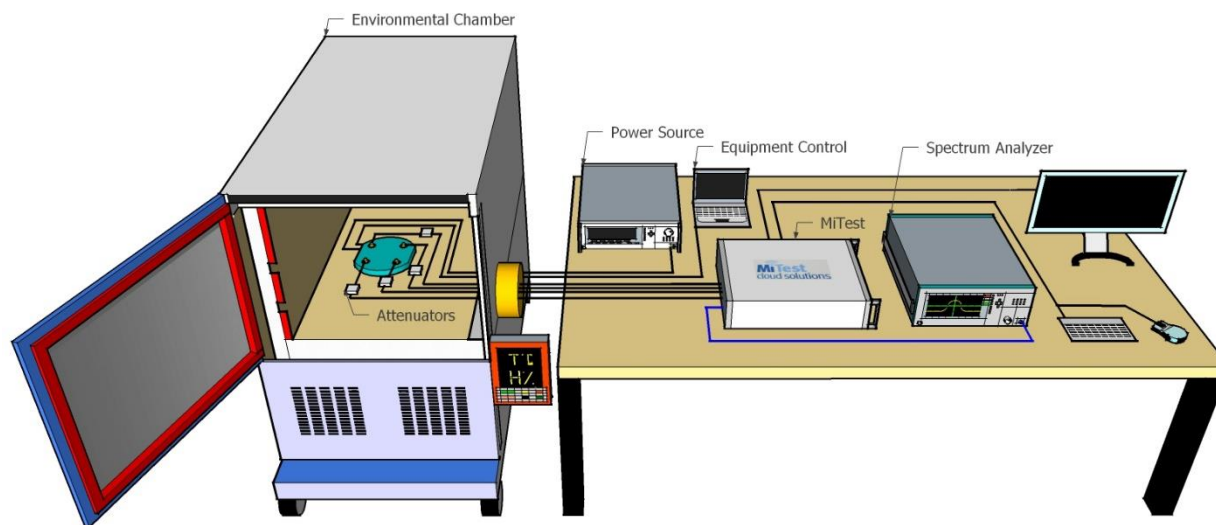
Test Header	Result	Data Link
20 dB & 99% Bandwidth	Complies	View Data
Frequency Hopping Tests	Complies	View Data
Number of Hopping Channels	Complies	View Data
Channel Separation	Complies	View Data
Dwell Time	Complies	View Data
Channel Occupancy	Complies	View Data
Output Power	Complies	View Data
Emissions	Complies	View Data
(1) Conducted Emissions	Complies	View Data
(i) Conducted Unwanted 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	View Data
(4) AC Wireline Emissions	Not Tested	View Data

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7. TEST EQUIPMENT CONFIGURATION(S)

Conducted

MiTest Automated Test System



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



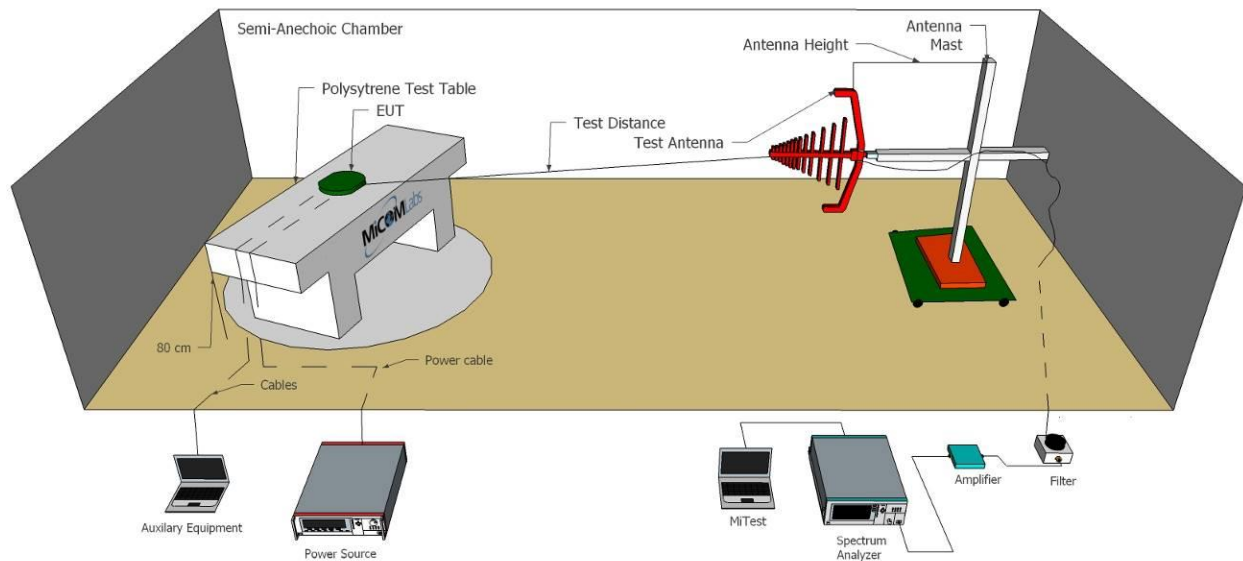
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Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
#3 SA	MiTest Box to SA	Fairview Microwave	SCA1814-0101-72	#3 SA	8 May 2018
#3P1	EUT to MiTest box port 1	Fairview Microwave	SCA1814-0101-72	#3P1	8 May 2018
#3P2	EUT to MiTest box port 2	Fairview Microwave	SCA1814-0101-72	#3P2	8 May 2018
#3P3	EUT to MiTest box port 3	Fairview Microwave	SCA1814-0101-72	#3P3	8 May 2018
#3P4	EUT to MiTest box port 4	Fairview Microwave	SCA1812-0101-72	#3P4	8 May 2018
249	Resistance Thermometer	Thermotronics	GR2105-02	9340 #2	30 Oct 2018
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	2 May 2018
361	Desktop for RF#1, Labview Software installed	Dell	Vostro 220	WS RF#1	Not Required
390	USB Power Head 50MHz - 24GHz -60 to +20dBm	Agilent	U2002A	MY50000103	17 Dec 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
443	4x4 RF Switch Box	MiCOM Labs	MiTest 4X4 RF Switch Box	MIC003	8 May 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
75	Environmental Chamber	Thermatron	SE-300-2-2	27946	24 Dec 2018

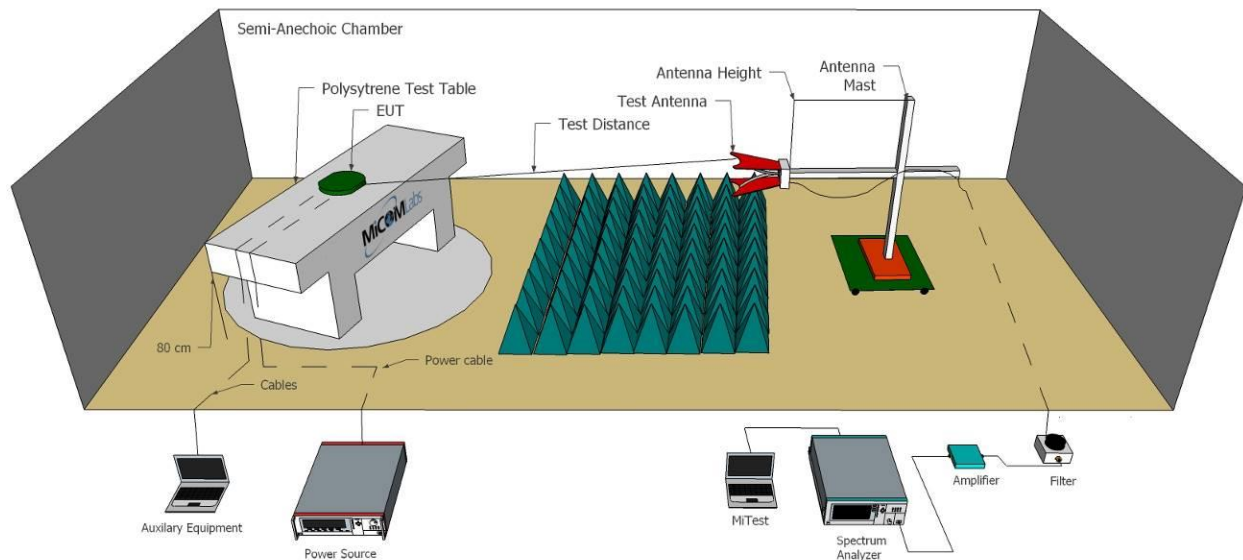
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Radiated Emissions - 3m Chamber

Radiated Emissions Below 1GHz Test Setup



Radiated Emissions Above 1GHz Test Setup



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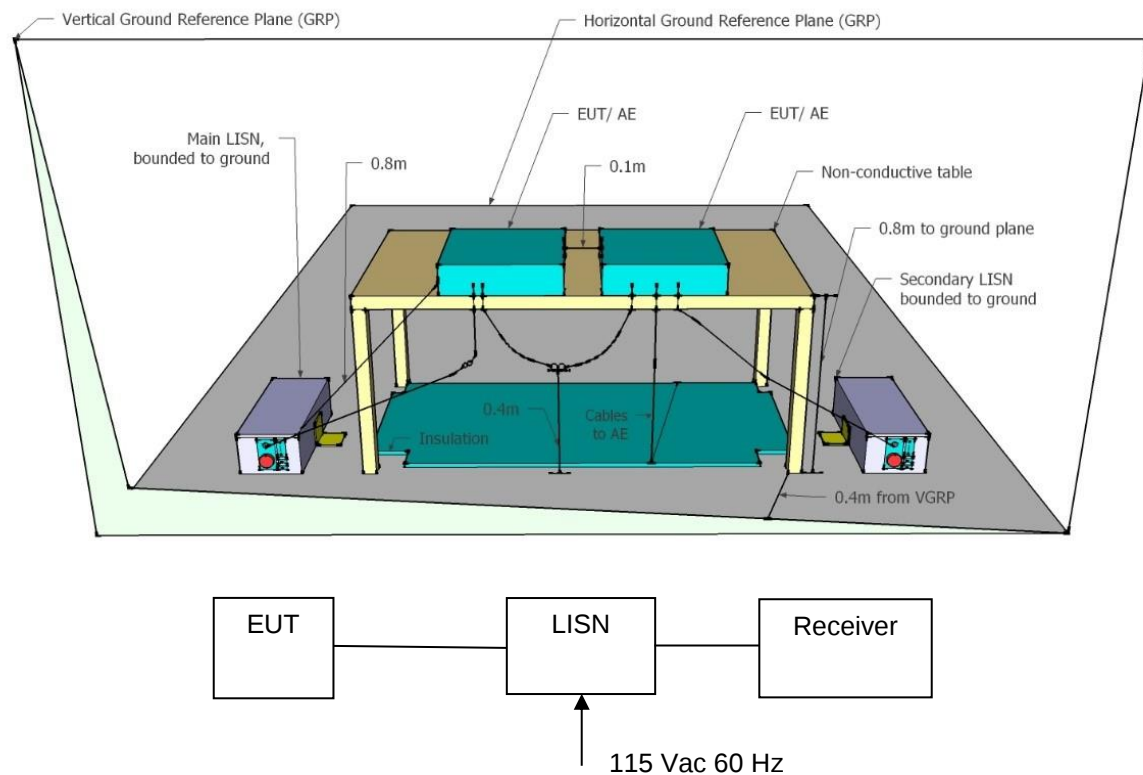
Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
170	Video System Controller for Semi Anechoic Chamber	Panasonic	WV-CU101	04R08507	Not Required
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	2 May 2018
298	3M Radiated Emissions Chamber Maintenance Check	MiCOM	3M Chamber	298	28 Apr 2018
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	5 Oct 2018
342	2.4 GHz Notch Filter	EWT	EWT-14-0203	H1	6 Oct 2018
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	12 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
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	4 Oct 2018
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	4 Oct 2018
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	4 Oct 2018
465	Low Pass Filter DC-1000 MHz	Mini-Circuits	NLP-1200+	VUU01901402	6 Oct 2018
466	Low Pass Filter DC-1500 MHz	Mini-Circuits	NLP-1750+	VUU10401438	6 Oct 2018
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
CC05	Confidence Check	MiCOM	CC05	None	19 Jul 2018
VLF-1700	Low pass filter DC-1700 MHz	Mini Circuits	VLF-1700	None	6 Oct 2018

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AC Wireline Emissions

The ac Wireline Conducted Emissions test was performed using the conducted test set-up shown in the diagram below.

Test Measurement Set up



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Assets Utilized for ac Wireline Emission Testing

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
158	Barometer/Thermometer	Control Company	4196	E2846	30 Nov 2018
184	Pulse Limiter	Rhode & Schwarz	ESH3Z2	357.8810.52	6 Oct 2018
190	LISN (two-line V-network)	Rhode & Schwarz	ESH3Z5	836679/006	18 Oct 2018
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	2 May 2018
307	BNC-CABLE	Megaphase	1689 1GVT4	15F50B002	6 Oct 2018
316	Dell desktop computer workstation	Dell	Desktop	WS04	Not Required
372	AC Variable PS	California Instruments	1251P	L06951	Cal when used
388	LISN (3 Phase) 9kHz - 30MHz	Rohde & Schwarz	ESH2-Z5	892107/022	20 Oct 2018
496	MiTest Conducted Emissions test software.	MiCOM	Conducted Emissions Test Software Version 1.0	496	Not Required
CCEMC01	Confidence Check.	MiCOM	CCEMC01	None	2 Jul 2018

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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)

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9. TEST RESULTS

9.1. 20 dB & 99% Bandwidth

Conducted Test Conditions for 20 dB and 99% Bandwidth			
Rules and Sections:	FCC CFR 47:15.247 ISED RSS-247:5.1	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	20 dB and 99 % Bandwidth	Rel. Humidity (%):	32 - 45
Standard Section(s):	ANSI C63.10:2013: 7.8.7 Public Notice DA 00-705	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for 20 dB and 99% Bandwidth Measurement

The bandwidth at 20 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.

20 dB Bandwidth

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW = 1% of the 20 dB bandwidth

VBW = RBW

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

Occupied bandwidth—Power bandwidth (99%) measurement procedure³⁰

The OBW is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring (99%) power bandwidth:³¹

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be set wide enough to capture all modulation products including the emission skirts (typically a span of $1.5 \times \text{OBW}$ is sufficient).

b) The nominal IF filter 3 dB bandwidth (RBW) shall be in the range of 1% to 5% of the anticipated OBW, and the VBW shall be set $\geq 3 \times \text{RBW}$.

c) Set the reference level of the instrument as required to prevent the signal amplitude from exceeding the maximum spectrum analyzer input mixer level for linear operation. See guidance provided in 4.2.3.

NOTE—Step a), step b), and step c) may require iteration to adjust within the specified tolerances.

d) Set the detection mode to peak, and the trace mode to max-hold.

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e) If the instrument does not have a 99% OBW function, recover the trace data points and sum directly in linear power terms. Place the recovered amplitude data points, beginning at the lowest frequency, in a running sum until 0.5% of the total is reached. Record that frequency as the lower OBW frequency. Repeat the process until 99.5% of the total is reached and record that frequency as the upper OBW frequency. The 99% power OBW can be determined by computing the difference these two frequencies.

f) The OBW shall be reported and plot(s) of the measuring instrument display shall be provided with the test report. The frequency and amplitude axis and scale shall be clearly labeled. Tabular data can be reported in addition to the plot(s).

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Equipment Configuration for 20 dB 99% Bandwidth

Variant:	FHSS	Duty Cycle (%):	99
Data Rate:	300.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 20 dB Bandwidth (MHz)				20 dB Bandwidth (MHz)		Limit	Lowest Margin
	Port(s)				Highest	Lowest		
MHz	a	b	c	d			MHz	MHz
2400.8	0.378				0.378	0.378		
2440.0	0.378				0.378	0.378		
2472.8	0.375				0.375	0.375		

Test Frequency	Measured 99% Bandwidth (MHz)				Maximum 99% Bandwidth (MHz)		
	Port(s)						
	MHz	a	b	c		d	
2400.8	0.330				0.330		
2440.0	0.330				0.330		
2472.8	0.330				0.330		

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).

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Equipment Configuration for 20 dB 99% Bandwidth

Variant:	FHSS	Duty Cycle (%):	99
Data Rate:	600.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	OFDM	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 20 dB Bandwidth (MHz)				20 dB Bandwidth (MHz)		Limit	Lowest Margin
	Port(s)				Highest	Lowest		
MHz	a	b	c	d			MHz	MHz
2400.4	0.372				0.372	0.372		
2440.0	0.396				0.396	0.396		
2472.0	0.407				0.407	0.407		

Test Frequency	Measured 99% Bandwidth (MHz)				Maximum 99% Bandwidth (MHz)		
	Port(s)						
MHz	a	b	c	d			
2400.4	0.317				0.317		
2440.0	0.330				0.330		
2472.0	0.356				0.356		

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).

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9.2. Frequency Hopping Tests

Conducted Test Conditions for Frequency Hopping Measurements			
Rules and Sections:	FCC CFR 47:15.247 (a)(1)(i)/(iii) ISED RSS-247:5.1	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	Frequency Hopping Tests	Rel. Humidity (%):	32 - 45
Standard Section(s):	Public Notice DA 00-705	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References, FCC Public Notice DA 00-705		

Test Procedure for Frequency Hopping Measurements

These tests cover the following measurements:

- i) channel separation
- ii) channel occupancy
- iii) dwell time
- iv) number of hopping frequencies

Frequency hopping testing was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency or hopping mode.

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.

Carrier Frequency Separation

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) ☐ 1% of the span

Video (or Average) Bandwidth (VBW) ☐ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels. The limit is specified in one of the subparagraphs of this Section. Submit this plot.

Number of Hopping Frequencies

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation

RBW = 1% of the span

VBW = RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

Time of Occupancy (Dwell Time)

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = zero span, centered on a hopping channel

RBW = 1 MHz

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VBW = RBW

Sweep = as necessary to capture the entire dwell time per hopping channel

Detector function = peak

Trace = max hold

If possible, use the marker-delta function to determine the dwell time. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section.

Submit this plot(s). An oscilloscope may be used instead of a spectrum analyzer.

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9.2.1. Number of Hopping Channels

Equipment Configuration for Number of Hopping Channels			
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Variant:	FHSS	Antenna:	Not Applicable
Data Rate:	300.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
Duty Cycle (%):	99.0	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Frequency Range (MHz)	Number of Hopping Channels	Limit (Minimum)	Pass / Fail
2400.0-2483.5	91	15	Pass

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).

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Equipment Configuration for Number of Hopping Channels			
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Variant:	FHSS	Antenna:	Not Applicable
Data Rate:	600.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	OFDM	Beam Forming Gain (Y)(dB):	Not Applicable
Duty Cycle (%):	99.0	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Frequency Range (MHz)	Number of Hopping Channels	Limit Limit (Minimum)	Pass / Fail
2400.0-2483.5	136	15	Pass

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).

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9.2.2. Channel Separation

Equipment Configuration for Channel Separation			
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Variant:	FHSS	Antenna:	Not Applicable
Data Rate:	300.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
Duty Cycle (%):	99.0	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Center Frequency (MHz)	Chan Separation (MHz)	Limit (MHz)	Pass / Fail
2440.0	0.800	0.375	Pass

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).

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Equipment Configuration for Channel Separation

Variant:	FHSS	Antenna:	Not Applicable
Data Rate:	600.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	OFDM	Beam Forming Gain (Y)(dB):	Not Applicable
Duty Cycle (%):	99.0	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Center Frequency (MHz)	Chan Separation (MHz)	Limit (MHz)	Pass / Fail
2440.0	0.400	0.372	Pass

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).

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9.2.3. Dwell Time & Channel Occupancy

Equipment Configuration for Dwell Time & Channel Occupancy

Variant:	FHSS	Antenna:	Not Applicable
Data Rate:	300.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
Duty Cycle (%):	99.0	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Channel Frequency(MHz)	Dwell Time (Single Burst) (S)	Channel Occupancy (mS)	Observation Period (S)	Channel Occupancy Limit (mS)	Pass / Fail
2440.0	0.003	33.570	20.00	400.000	Pass

Traceability to Industry Recognized Test Methodologies

Work Instruction:	
Measurement Uncertainty:	

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

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Equipment Configuration for Dwell Time & Channel Occupancy

Variant:	FHSS	Antenna:	Not Applicable
Data Rate:	600.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	OFDM	Beam Forming Gain (Y)(dB):	Not Applicable
Duty Cycle (%):	99.0	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Channel Frequency(MHz)	Dwell Time (Single Burst) (S)	Channel Occupancy (mS)	Observation Period (S)	Channel Occupancy Limit (mS)	Pass / Fail
2440.0	0.003	129.370	20.00	400.000	Pass

Traceability to Industry Recognized Test Methodologies

Work Instruction:	
Measurement Uncertainty:	

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

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9.3. Output Power

Conducted Test Conditions for Fundamental Emission Output Power			
Rules and Sections:	FCC CFR 47: 15.247 (a)(1), (b)(1)/(2)/(3) ISED RSS-247:5.4	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	Output Power	Rel. Humidity (%):	32 - 45
Standard Section(s):	Public Notice DA 00-705	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		
Output power test procedure for frequency-hopping spread-spectrum (FHSS) devices			
<u>Peak Output Power</u>			
Use the following spectrum analyzer settings:			
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel			
RBW > the 20 dB bandwidth of the emission being measured			
VBW ≥ RBW			
Sweep = auto			
Detector function = peak			
Trace = max hold			
Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak output power. The limit is specified in one of the subparagraphs of this Section. Submit this plot. A peak responding power meter may be used instead of a spectrum analyzer			

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Equipment Configuration for Output Power Peak

Variant:	FHSS	Duty Cycle (%):	99.0
Data Rate:	300.00 KBit/s	Antenna Gain (dBi):	3.50
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
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	
2400.8	24.39				24.39	30.00	-5.61	21.00
2440.0	24.17				24.17	30.00	-5.83	21.00
2472.8	24.60				24.60	30.00	-5.40	21.00

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.

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Equipment Configuration for Output Power Peak

Variant:	FHSS	Duty Cycle (%):	99.0
Data Rate:	600.00 KBit/s	Antenna Gain (dBi):	3.50
Modulation:	OFDM	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
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	
2400.4	24.71				24.71	30.00	-5.29	21.00
2440.0	24.33				24.33	30.00	-5.67	21.00
2472.0	24.41				24.41	30.00	-5.59	21.00

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.

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9.4. Emissions

9.4.1. Conducted Emissions

Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions			
Rules and Sections:	FCC CFR 47:15.247 (d) ISED RSS-247:5.5	Ambient Temp. (°C):	24.0 - 27.5
Test Heading:	Transmitter Conducted Spurious and Band-Edge Emissions	Rel. Humidity (%):	32 - 45
Standard Section(s):	Public Notice DA 00-705	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Conducted Spurious and Band-Edge Emissions

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

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

Band-edge Compliance of RF Conducted Emissions

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the bandedge.

RBW $\geq$ 1% of the span

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Set the marker on the emission at the bandedge, or on the highest modulation product outside of the band, if this level is greater than that at the bandedge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section. Submit this plot. Now, using the same instrument settings, enable the hopping function of the EUT. Allow the trace to stabilize. Follow the same procedure listed above to determine if any spurious emissions caused by the hopping function also comply with the specified limit. Submit this plot.

Spurious RF Conducted Emissions

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions.

RBW = 100 kHz

VBW $\geq$ RBW

Sweep = auto

Detector function = peak

Trace = max hold

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Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded. The level displayed must comply with the limit specified in this Section. Submit these plots.

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9.4.1.1. Conducted Unwanted Spurious Emissions

Equipment Configuration for Unwanted Emissions Peak

Variant:	FHSS	Duty Cycle (%):	99
Data Rate:	300.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	GFSK	Beam Forming Gain (Y):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Unwanted Emissions Peak (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	SE	Limit	SE	Limit	SE	Limit	SE	Limit
2400.8	30.0 - 26000.0	-40.289	2.96						
2440.0	30.0 - 26000.0	-40.233	1.83						
2472.8	30.0 - 26000.0	-40.017	1.75						

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ± 2.37 dB, > 40 GHz ± 4.6 dB

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

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Equipment Configuration for Unwanted Emissions Peak

Variant:	FHSS	Duty Cycle (%):	99
Data Rate:	600.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	OFDM	Beam Forming Gain (Y):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Unwanted Emissions Peak (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	SE	Limit	SE	Limit	SE	Limit	SE	Limit
2400.4	30.0 - 26000.0	-39.677	0.03						
2440.0	30.0 - 26000.0	20.048	0.05						
2472.0	30.0 - 26000.0	-40.662	0.29						

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ± 2.37 dB, > 40 GHz ± 4.6 dB

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9.4.1.2. Conducted Band-Edge Emissions

Equipment Configuration for Conducted Low Band-Edge Emissions (Hopping) Peak

Variant:	FHSS	Duty Cycle (%):	99.0
Data Rate:	300.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2400.8 MHz					
Band-Edge Frequency:	2400.0 MHz					
Test Frequency Range:	2350.0 - 2405.0 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	-25.46	3.92	2400.50			-0.500

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).

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Equipment Configuration for Conducted Low Band-Edge Emissions (Hopping) Peak

Variant:	FHSS	Duty Cycle (%):	99.0
Data Rate:	600.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	OFDM	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2400.4 MHz					
Band-Edge Frequency:	2400.0 MHz					
Test Frequency Range:	2350.0 - 2405.0 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	-8.84	1.52	2400.00			0.000

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).

M1 is the highest emission measured with respect to the emissions limit at or below the Band Edge.

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Equipment Configuration for Conducted Low Band-Edge Emissions (Static) Peak

Variant:	FHSS	Duty Cycle (%):	99.0
Data Rate:	300.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2400.8 MHz					
Band-Edge Frequency:	2400.0 MHz					
Test Frequency Range:	2350.0 - 2405.0 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	-28.49	2.82	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).

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Equipment Configuration for Conducted Low Band-Edge Emissions (Static) Peak

Variant:	FHSS	Duty Cycle (%):	99.0
Data Rate:	600.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	OFDM	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2400.4 MHz					
Band-Edge Frequency:	2400.0 MHz					
Test Frequency Range:	2350.0 - 2405.0 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	-2.30	1.53	2400.00			0.000

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).

M1 is the highest emission measured with respect to the emissions limit at or below the Band Edge.

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Equipment Configuration for Conducted Upper Band-Edge Emissions (Hopping) Peak

Variant:	FHSS	Duty Cycle (%):	99.0
Data Rate:	300.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2472.8 MHz					
Band-Edge Frequency:	2483.5 MHz					
Test Frequency Range:	2470.0 - 2534.0 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	-38.51	3.44	2473.10			-10.400

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ± 2.37 dB, > 40 GHz ± 4.6 dB

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Equipment Configuration for Conducted Upper Band-Edge Emissions (Hopping) Peak

Variant:	FHSS	Duty Cycle (%):	99.0
Data Rate:	600.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	OFDM	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2454.4 MHz					
Band-Edge Frequency:	2483.5 MHz					
Test Frequency Range:	2453.0 - 2534.0 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	-45.21	0.59	2454.60			-28.900

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).

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Equipment Configuration for Conducted Upper Band-Edge Emissions (Static) Peak

Variant:	FHSS	Duty Cycle (%):	99.0
Data Rate:	300.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	GFSK	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2472.8 MHz					
Band-Edge Frequency:	2483.5 MHz					
Test Frequency Range:	2470.0 - 2533.0 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	-39.53	2.33	2473.20			-10.300

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ± 2.37 dB, > 40 GHz ± 4.6 dB

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Equipment Configuration for Conducted Upper Band-Edge Emissions (Static) Peak

Variant:	FHSS	Duty Cycle (%):	99.0
Data Rate:	600.00 KBit/s	Antenna Gain (dBi):	Not Applicable
Modulation:	OFDM	Beam Forming Gain (Y)(dB):	Not Applicable
TPC:	Not Applicable	Tested By:	SB
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	2454.4 MHz					
Band-Edge Frequency:	2483.5 MHz					
Test Frequency Range:	2453.0 - 2533.0 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	-45.13	1.97	2454.80			-28.700

Traceability to Industry Recognized Test Methodologies

Work Instruction:	WI-05 MEASUREMENT OF SPURIOUS EMISSIONS
Measurement Uncertainty:	<=40 GHz ± 2.37 dB, > 40 GHz ± 4.6 dB

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9.4.2. Radiated Emissions

Radiated Test Conditions for Radiated Spurious and Band-Edge Emissions (Restricted Bands)			
Rules and Sections:	FCC CFR 47: Part 15.205 ISED RSS-GEN:8.9, 8.10	Ambient Temp. (°C):	20.0 - 24.5
Test Heading:	Radiated Spurious and Band-Edge Emissions	Rel. Humidity (%):	32 - 45
Standard Section(s):	ANSI C63.10: 6.3, 6.5 & 6.6, 6.10	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

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

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

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

Limits for [Restricted Bands](#)
Peak emission: 74 dBuV/m
Average emission: 54 dBuV/m

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:

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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.



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9.4.2.3. TX Spurious & Restricted Band Emissions

Antenna: Tai Sheng Chen 155-0010-00

Equipment Configuration for TX Spurious & Restricted Band Emissions

Antenna:	Tai Sheng Chen 155-0010-00	Variant:	FHSS
Antenna Gain (dBi):	5.00	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2400.80	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

1000.00 - 18000.00 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	2400.82	55.59	2.24	-12.41	45.42	Fundamental	Vertical	100	76	--	--	
#2	7202.23	49.64	3.46	-7.38	45.72	Peak (NRB)	Vertical	200	190	--	--	Pass
#3	12004.01	54.03	4.77	-7.02	51.78	Max Peak	Horizontal	192	115	74.0	-22.2	Pass
#4	12004.01	45.55	4.77	-7.02	43.30	Max Avg	Horizontal	192	115	54.0	-10.7	Pass

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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Equipment Configuration for TX Spurious & Restricted Band Emissions

Antenna:	Tai Sheng Chen 155-0010-00	Variant:	FHSS
Antenna Gain (dBi):	5.00	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2440.00	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

1000.00 - 18000.00 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	2439.96	65.93	2.27	-12.08	56.12	Fundamental	Horizontal	100	0	--	--	
#2	7320.15	53.42	3.49	-7.86	49.05	Max Peak	Vertical	111	177	74.0	-25.0	Pass
#3	7320.15	46.28	3.49	-7.86	41.91	Max Avg	Vertical	111	177	54.0	-12.1	Pass
#4	12200.23	54.01	4.66	-4.76	53.91	Max Peak	Horizontal	182	113	74.0	-20.1	Pass
#5	12200.23	45.88	4.66	-4.76	45.78	Max Avg	Horizontal	182	113	54.0	-8.2	Pass

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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Equipment Configuration for TX Spurious & Restricted Band Emissions

Antenna:	Tai Sheng Chen 155-0010-00	Variant:	FHSS
Antenna Gain (dBi):	5.00	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2472.80	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

1000.00 - 18000.00 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	2472.70	63.31	2.26	-11.92	53.65	Fundamental	Vertical	151	121	--	--	
#2	7418.60	52.97	3.54	-8.00	48.51	Max Peak	Vertical	176	180	74.0	-25.5	Pass
#3	7418.60	45.45	3.54	-8.00	40.99	Max Avg	Vertical	176	180	54.0	-13.0	Pass
#4	12364.36	54.57	4.65	-4.86	54.36	Max Peak	Horizontal	180	84	74.0	-19.6	Pass
#5	12364.36	46.08	4.65	-4.86	45.87	Max Avg	Horizontal	180	84	54.0	-8.1	Pass

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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Equipment Configuration for TX Spurious & Restricted Band Emissions

Antenna:	Tai Sheng Chen 155-0010-00	Variant:	FHSS
Antenna Gain (dBi):	5.00	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	Hopping	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

1000.00 - 18000.00 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	2461.61	63.65	2.29	-11.95	53.99	Fundamental	Horizontal	100	0	--	--	Pass
#2	7421.08	49.06	3.54	-8.05	44.55	Max Peak	Vertical	112	274	74.0	-29.5	Pass
#3	7421.08	35.50	3.54	-8.05	30.99	Max Avg	Vertical	112	274	54.0	-23.0	Pass
#4	12348.38	49.04	4.58	-4.56	49.06	Max Peak	Horizontal	115	247	74.0	-24.9	Pass
#5	12348.38	35.62	4.58	-4.56	35.64	Max Avg	Horizontal	115	247	54.0	-18.4	Pass

Test Notes: EUT powered by 4V DC. 2.4 GHz Notch in front of amp to prevent overload. Hopping

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Antenna: WP WPANT30017-CA

Equipment Configuration for TX Spurious & Restricted Band Emissions

Antenna:	WP WPANT30017-CA	Variant:	FHSS
Antenna Gain (dBi):	4.50	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2400.80	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

1000.00 - 18000.00 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	2400.92	53.14	2.24	-12.41	42.97	Fundamental	Vertical	100	161	--	--	

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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To: FCC CFR 47 Part 15.247 (FHSS); RSS-247
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Equipment Configuration for TX Spurious & Restricted Band Emissions

Antenna:	WP WPANT30017-CA	Variant:	FHSS
Antenna Gain (dBi):	4.50	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2440.00	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

1000.00 - 18000.00 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	2440.01	54.80	2.27	-12.08	44.99	Fundamental	Vertical	100	154	--	--	

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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Equipment Configuration for TX Spurious & Restricted Band Emissions

Antenna:	WP WPANT30017-CA	Variant:	FHSS
Antenna Gain (dBi):	4.50	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2472.80	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

1000.00 - 18000.00 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	2472.92	59.41	2.26	-11.92	49.75	Fundamental	Vertical	100	42	--	--	

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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Equipment Configuration for TX Spurious & Restricted Band Emissions

Antenna:	WP WPANT30017-CA	Variant:	FHSS
Antenna Gain (dBi):	4.50	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	Hopping	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

1000.00 - 18000.00 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	2466.35	59.96	2.27	-11.97	50.26	Fundamental	Vertical	200	0	--	--	Pass
#2	9836.61	49.25	4.45	-6.34	47.36	Peak (NRB)	Vertical	200	86	--	--	Pass
#3	12355.99	48.48	4.61	-4.68	48.41	Max Peak	Vertical	170	92	74.0	-25.6	Pass
#4	12355.99	35.25	4.61	-4.68	35.18	Max Avg	Vertical	170	92	54.0	-18.8	Pass

Test Notes: EUT powered by 4V DC. 2.4 GHz Notch filter in front of amp to prevent overload. Hopping

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Antenna: WP WPANT40020-SA

Equipment Configuration for TX Spurious & Restricted Band Emissions

Antenna:	WP WPANT40020-SA	Variant:	FHSS
Antenna Gain (dBi):	3.50	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2400.80	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

1000.00 - 18000.00 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	2400.70	56.75	2.24	-12.41	46.58	Fundamental	Horizontal	200	95	--	--	
#2	4801.61	58.63	2.96	-12.43	49.16	Max Peak	Vertical	101	214	74.0	-24.8	Pass
#3	4801.61	53.13	2.96	-12.43	43.66	Max Avg	Vertical	101	214	54.0	-10.3	Pass
#4	9603.08	50.22	4.54	-6.67	48.09	Peak (NRB)	Horizontal	200	175	--	--	Pass

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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Equipment Configuration for TX Spurious & Restricted Band Emissions

Antenna:	WP WPANT40020-SA	Variant:	FHSS
Antenna Gain (dBi):	3.50	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2440.00	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

1000.00 - 18000.00 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	2439.94	62.92	2.27	-12.08	53.11	Fundamental	Horizontal	100	60	--	--	
#2	9759.74	51.66	4.37	-5.95	50.08	Peak (NRB)	Horizontal	100	185	--	--	Pass

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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Equipment Configuration for TX Spurious & Restricted Band Emissions

Antenna:	WP WPANT40020-SA	Variant:	FHSS
Antenna Gain (dBi):	3.50	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2472.80	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

1000.00 - 18000.00 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	2472.92	60.09	2.26	-11.92	50.43	Fundamental	Vertical	100	114	--	--	
#2	7418.47	54.77	3.54	-8.00	50.31	Max Peak	Horizontal	151	188	74.0	-23.7	Pass
#3	7418.47	48.20	3.54	-8.00	43.74	Max Avg	Horizontal	151	188	54.0	-10.3	Pass
#4	9891.22	50.89	4.48	-6.76	48.61	Peak (NRB)	Horizontal	100	175	--	--	Pass

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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Equipment Configuration for TX Spurious & Restricted Band Emissions

Antenna:	WP WPANT40020-SA	Variant:	FHSS
Antenna Gain (dBi):	3.50	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	Hopping	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

1000.00 - 18000.00 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	2464.16	65.34	2.28	-11.96	55.66	Peak (NRB)	Horizontal	151	150	--	--	Pass
#2	7365.89	51.31	3.52	-7.81	47.02	Max Peak	Vertical	160	153	74.0	-27.0	Pass
#3	7365.89	35.60	3.52	-7.81	31.31	Max Avg	Vertical	160	153	54.0	-22.7	Pass
#4	9856.23	52.55	4.41	-6.57	50.39	Peak (NRB)	Horizontal	151	279	--	--	Pass
Test Notes: EUT powered by 4V DC. 2.4 GHz Notch in front of amp to prevent overload. Hopping												

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9.4.2.4. Restricted Edge & Band-Edge Emissions

Tai Sheng Chen 155-0010-00		Band-Edge Freq	Limit 74.0dB μ V/m	Limit 54.0dB μ V/m	Power Setting
Operational Mode	Operating Frequency (MHz)	MHz	dB μ V/m	dB μ V/m	
GFSK	2400.80	2390.00	62.30	49.46	21
GFSK	2472.80	2483.5	65.57	53.58	21

Antenna: WP WPANT30017-CA		Band-Edge Freq	Limit 74.0dB μ V/m	Limit 54.0dB μ V/m	Power Setting
Operational Mode	Operating Frequency (MHz)	MHz	dB μ V/m	dB μ V/m	
GFSK	2400.80	2390.00	59.74	46.73	21
GFSK	2472.80	2483.5	61.63	49.14	21

Antenna: WP WPANT40020-SA		Band-Edge Freq	Limit 74.0dB μ V/m	Limit 54.0dB μ V/m	Power Setting
Operational Mode	Operating Frequency (MHz)	MHz	dB μ V/m	dB μ V/m	
GFSK	2400.80	2390.00	60.98	48.01	21
GFSK	2472.80	2483.5	63.13	50.79	21

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Antenna: Tai Sheng Chen 155-0010-00

Equipment Configuration for Radiated - Lower Restricted Band-Edge Emissions

Antenna:	Tai Sheng Chen 155-0010-00	Variant:	FHSS
Antenna Gain (dBi):	Not Applicable	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2400.80	Data Rate:	300.00 KBit/s
Power Setting:	21	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	2389.78	28.08	2.26	31.96	62.30	Max Peak	Horizontal	130	80	74.0	-11.7	Pass
#2	2390.00	15.24	2.26	31.96	49.46	Max Avg	Horizontal	130	80	54.0	-4.5	Pass
#3	2390.00	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: EUT powered by 4 volt DC,

Equipment Configuration for Radiated - Upper Restricted Band-Edge Emissions

Antenna:	Tai Sheng Chen 155-0010-00	Variant:	FHSS
Antenna Gain (dBi):	5.00	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2472.80	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

2470.00 - 2550.00 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	2483.50	19.00	2.25	32.33	53.58	Max Avg	Horizontal	130	80	54.0	-0.4	Pass
#3	2483.66	30.99	2.25	32.33	65.57	Max Peak	Horizontal	130	80	74.0	-8.4	Pass
#2	2483.50	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: EUT powered by 4 volt DC,

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Antenna: WP WPANT30017-CA

Equipment Configuration for Radiated - Lower Restricted Band-Edge Emissions

Antenna:	WP WPANT30017-CA	Variant:	FHSS
Antenna Gain (dBi):	Not Applicable	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2400.80	Data Rate:	300.00 KBit/s
Power Setting:	21	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	2389.01	25.53	2.26	31.95	59.74	Max Peak	Vertical	193	348	74.0	-14.3	Pass
#2	2390.00	12.51	2.26	31.96	46.73	Max Avg	Vertical	193	348	54.0	-7.3	Pass
#3	2390.00	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: EUT powered by 4 volt DC,

Equipment Configuration for Radiated - Upper Restricted Band-Edge Emissions

Antenna:	WP WPANT30017-CA	Variant:	FHSS
Antenna Gain (dBi):	4.50	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2472.80	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

2470.00 - 2550.00 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	2483.50	14.56	2.25	32.33	49.14	Max Avg	Vertical	193	348	54.0	-4.9	Pass
#3	2485.90	27.05	2.25	32.33	61.63	Max Peak	Vertical	193	348	74.0	-12.4	Pass
#2	2483.50	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: EUT powered by 4 volt DC,

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Antenna: WP WPANT40020-SA

Equipment Configuration for Radiated - Lower Restricted Band-Edge Emissions

Antenna:	WP WPANT40020-SA	Variant:	FHSS
Antenna Gain (dBi):	Not Applicable	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2400.80	Data Rate:	300.00 KBit/s
Power Setting:	21	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	2389.33	26.77	2.26	31.95	60.98	Max Peak	Horizontal	200	153	74.0	-13.0	Pass
#2	2390.00	13.79	2.26	31.96	48.01	Max Avg	Horizontal	200	153	54.0	-6.0	Pass
#3	2390.00	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: EUT powered by 4 volt DC

Equipment Configuration for Radiated - Upper Restricted Band-Edge Emissions

Antenna:	WP WPANT40020-SA	Variant:	FHSS
Antenna Gain (dBi):	Not Applicable	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2472.80	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

2470.00 - 2550.00 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	2483.50	16.21	2.25	32.33	50.79	Max Avg	Horizontal	183	159	54.0	-3.2	Pass
#3	2485.74	28.55	2.25	32.33	63.13	Max Peak	Horizontal	183	159	74.0	-10.9	Pass
#2	2483.50	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: EUT powered by 4 volt DC

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9.4.3. Digital Emissions (0.03 - 1 GHz)

Radiated Test Conditions for Radiated Digital and Receiver Emissions (0.03 – 18 GHz)			
Rules and Sections:	FCC CFR 47:15.209, ICES-003: 6.2 RSS-GEN: 7	Ambient Temp. (°C):	20.0 - 24.5
Test Heading:	Digital Emissions,	Rel. Humidity (%):	32 - 45
Standard Section(s):	ANSI C63.4: 8.3	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Radiated Digital Emissions and Receiver Emissions (0.03 – 18 GHz)

Testing 30 – 18,000 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.

Test configuration and setup for Radiated Digital and Receiver Emissions Measurement were per the Radiated Test Set-up specified in this document.

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

$$FS = R + AF + CORR$$

where:

FS = Field Strength

R = Measured Receiver Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss

AG = Amplifier Gain

For example:

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

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

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

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

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

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

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Limits for Radiated Digital Emissions (0.03 – 18 GHz)

(a) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength		Field Strength $\mu\text{V/m}$ (microvolts/meter)
	$\mu\text{V/m}$ (microvolts/meter)	$\mu\text{V/m}$ (microvolts/meter)	
0.009-0.490	2400/F(kHz)	2400/F(kHz)	2400/F(kHz)
0.490-1.705	24000/F(kHz)	24000/F(kHz)	24000/F(kHz)
1.705-30.0	30	30	30
30-88	100**	100**	100**
88-216	150**	150**	150**
216-960	200**	200**	200**
Above 960	500	500	500

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241. (b) In the emission table above, the tighter limit applies at the band edges. (c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency. (d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. (e) The provisions in §§15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part. (f) In accordance with §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in §15.109 that are applicable to the incorporated digital device. (g) Perimeter protection systems may operate in the 54-72 MHz and 76-88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to industrial, business and commercial applications.

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USB Active and Downloading, Connected to SBC Computer

Equipment Configuration for Radiated Digital Emissions

Antenna:	WP WPANT30017-CA	Variant:	OFDM
Antenna Gain (dBi):	3.00	Modulation:	OFDM
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	
Channel Frequency (MHz):	0.00	Data Rate:	
Power Setting:	NA	Tested By:	JMH

Test Measurement Results

30.00 - 1000.00 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	39.02	43.91	3.47	-17.37	30.01	MaxQP	Vertical	104	71	40.0	-10.0	Pass
#2	431.96	49.59	4.99	-14.31	40.27	MaxQP	Horizontal	204	154	46.0	-5.7	Pass
#3	443.99	49.98	5.02	-14.21	40.79	MaxQP	Horizontal	101	356	46.0	-5.2	Pass
#4	456.01	50.18	5.04	-13.93	41.29	MaxQP	Horizontal	282	349	46.0	-4.7	Pass
#5	468.02	47.67	5.07	-13.37	39.37	MaxQP	Horizontal	101	301	46.0	-6.6	Pass
#6	503.99	48.65	5.20	-13.23	40.62	MaxQP	Horizontal	159	160	46.0	-5.4	Pass

Test Notes: Powered by AC/DC PS. Digital Communications over USB. Connected to SBC.

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Equipment Configuration for Radiated Digital Emissions

Antenna:	Tai Sheng Chen 155-0010-00	Variant:	FHSS
Antenna Gain (dBi):	5.00	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	2440.00	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

Click here to view measurement data...
--

Test Notes: EUT powered by 4V DC

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Equipment Configuration for Radiated Digital Emissions			
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Antenna:	Tai Sheng Chen 155-0010-00	Variant:	FHSS
Antenna Gain (dBi):	5.00	Modulation:	GFSK
Beam Forming Gain (Y):	Not Applicable	Duty Cycle (%):	99
Channel Frequency (MHz):	Hopping	Data Rate:	300.00 KBit/s
Power Setting:	21	Tested By:	JMH

Test Measurement Results

Click here to view measurement data...
--

Test Notes: EUT powered by 4V DC. Hopping

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9.4.4. AC Wireline Emissions

Test Conditions for ac Wireline Emissions (0.15 – 30 MHz)			
Rules and Sections:	FCC CFR 47:15.207 ICES-003:6.1	Ambient Temp. (°C):	20.0 - 24.5
Test Heading:	Conducted (ac Wireline Emissions)	Rel. Humidity (%):	32 - 45
Standard Section(s):	ANSI C63.4: 7.3	Pressure (mBars):	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for ac Wireline Emissions (0.15 – 30 MHz)

The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

Test configuration and setup for ac Wireline Emission Measurement were per the ac Wireline Test Set-up specified in this document.

Limits for ac Wireline Emissions

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dBmV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency

The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 µV within the frequency band 535-1705 kHz, as measured using a 50 µH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.205, §15.209, §15.221, §15.223, or §15.227, as appropriate.

Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

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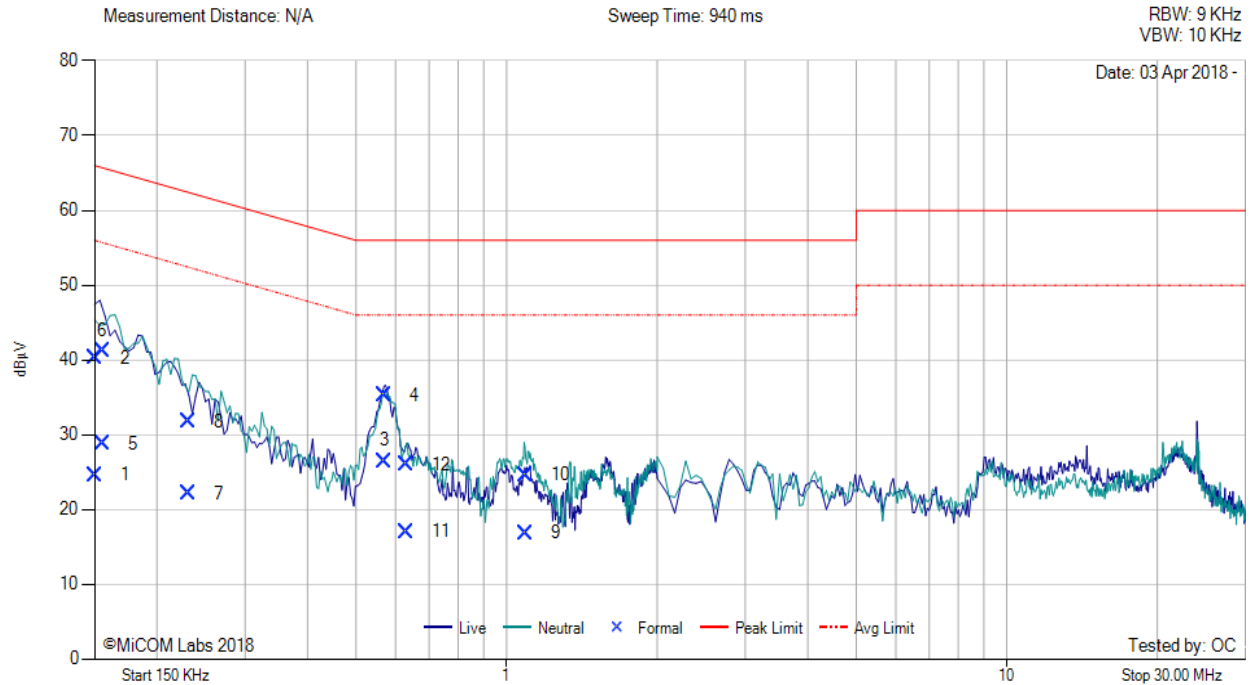
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Measurement Results

Model:	NIC-510-06	Configuration tested:	AC/DC POWERED
Input power:	120V _{AC} /60Hz	Standard:	FCC 15B



Variant: AC Wireline, Test Freq: 0.15 - 30 MHz



Num	Frequency MHz	Raw dBμV	Cable Loss dB	Factor dB	Total Correction dBμV	Corrected Value dBμV	Measurement Type	Line	Limit dBμV/m	Margin dB	Pass /Fail
1	0.150	14.64	0.05	9.92	9.97	24.61	Max Avg	Live	56.0	-31.4	Pass
2	0.150	30.27	0.05	9.92	9.97	40.24	Max Qp	Live	66.0	-25.8	Pass
3	0.570	16.43	0.10	9.92	10.02	26.45	Max Avg	Live	46.0	-19.6	Pass
4	0.570	25.29	0.10	9.92	10.02	35.31	Max Qp	Live	56.0	-20.7	Pass
5	0.156	18.81	0.05	9.92	9.97	28.78	Max Avg	Neutral	55.8	-27.1	Pass
6	0.156	31.21	0.05	9.92	9.97	41.18	Max Qp	Neutral	65.8	-24.7	Pass
7	0.231	12.13	0.07	9.92	9.99	22.12	Max Avg	Live	53.7	-31.6	Pass
8	0.231	21.76	0.07	9.92	9.99	31.75	Max Qp	Live	63.7	-31.9	Pass
9	1.091	6.83	0.08	9.94	10.02	16.85	Max Avg	Neutral	46.0	-29.2	Pass
10	1.091	14.61	0.08	9.94	10.02	24.63	Max Qp	Neutral	56.0	-31.4	Pass
11	0.631	6.98	0.11	9.93	10.04	17.02	Max Avg	Neutral	46.0	-29.0	Pass
12	0.631	15.94	0.11	9.93	10.04	25.98	Max Qp	Neutral	56.0	-30.0	Pass

Test Notes: Model: NIC 510-06-06. AC/DC powered at 120Vac, 60Hz.

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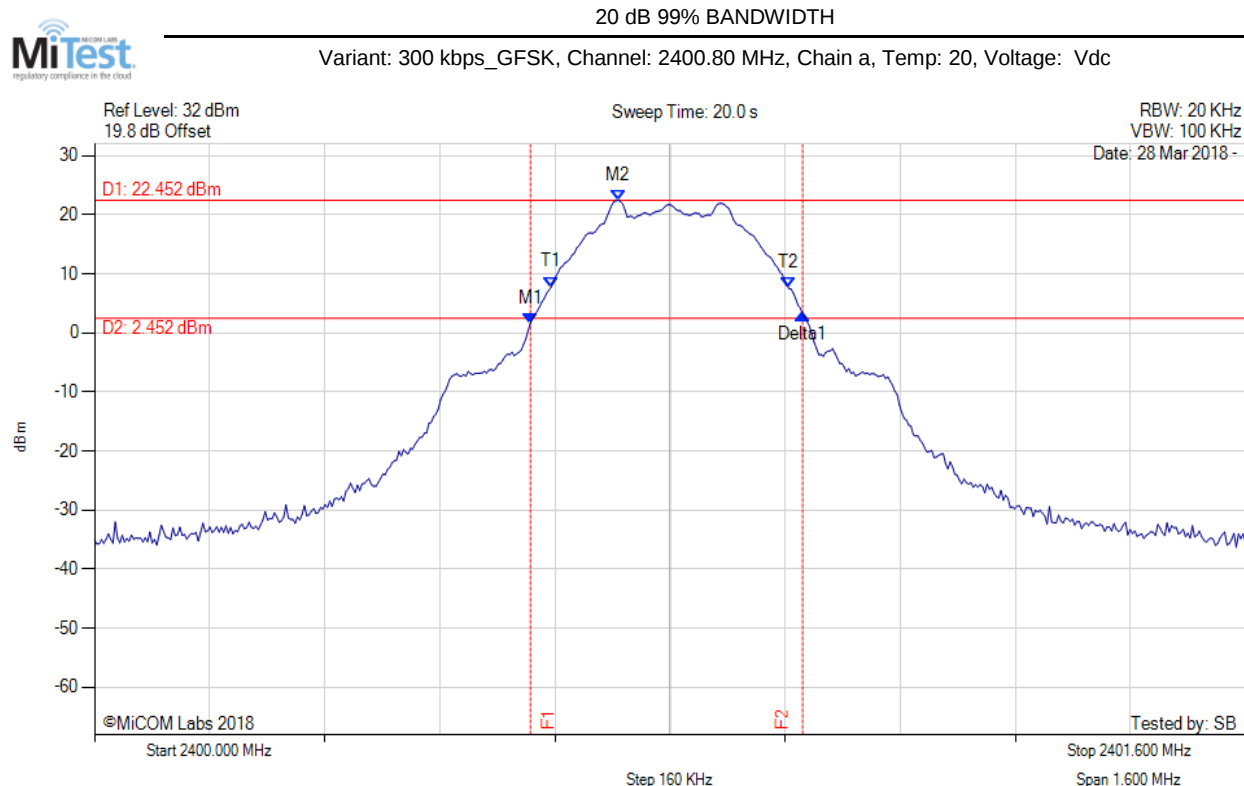
A. APPENDIX - GRAPHICAL IMAGES

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A.1. 20 dB & 99% Bandwidth



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = MAX HOLD	M1 : 2400.606 MHz : 1.616 dBm M2 : 2400.728 MHz : 22.452 dBm Delta1 : 378 KHz : 1.641 dB T1 : 2400.635 MHz : 7.756 dBm T2 : 2400.965 MHz : 7.538 dBm OBW : 330 KHz	Measured 20 dB Bandwidth: 0.378 MHz Margin: #VALUE! MHz

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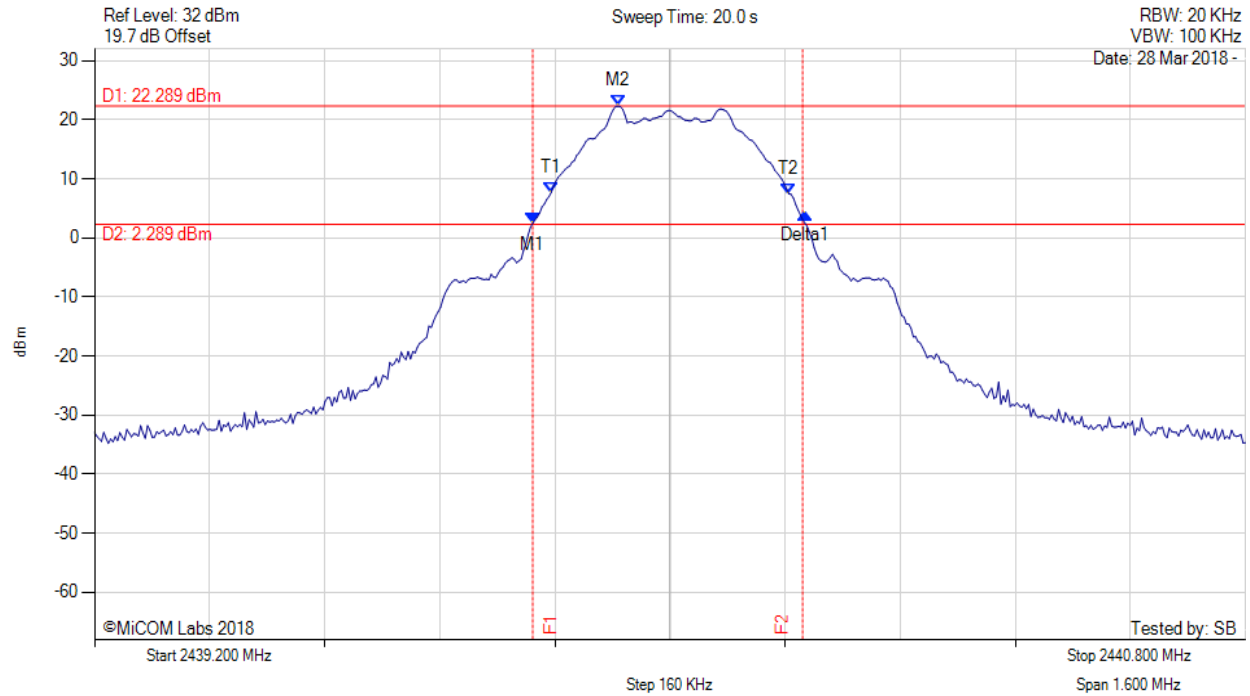


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20 dB 99% BANDWIDTH

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = MAX HOLD	M1 : 2439.809 MHz : 2.480 dBm M2 : 2439.928 MHz : 22.289 dBm Delta1 : 378 KHz : 1.640 dB T1 : 2439.835 MHz : 7.656 dBm T2 : 2440.165 MHz : 7.473 dBm OBW : 330 KHz	Measured 20 dB Bandwidth: 0.378 MHz Margin: #VALUE! MHz

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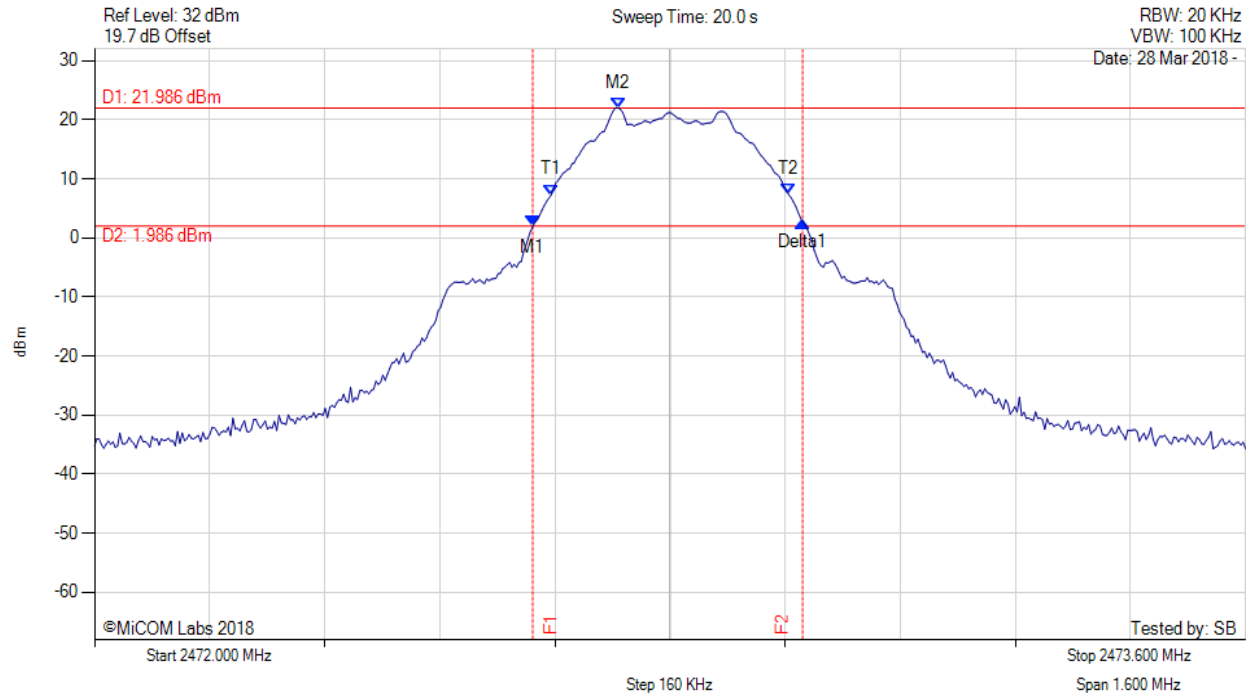


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20 dB 99% BANDWIDTH

Variant: 300 kbps_GFSK, Channel: 2472.80 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = MAX HOLD	M1 : 2472.609 MHz : 1.972 dBm M2 : 2472.728 MHz : 21.986 dBm Delta1 : 375 KHz : 0.775 dB T1 : 2472.635 MHz : 7.274 dBm T2 : 2472.965 MHz : 7.296 dBm OBW : 330 KHz	Measured 20 dB Bandwidth: 0.375 MHz Margin: #VALUE! MHz

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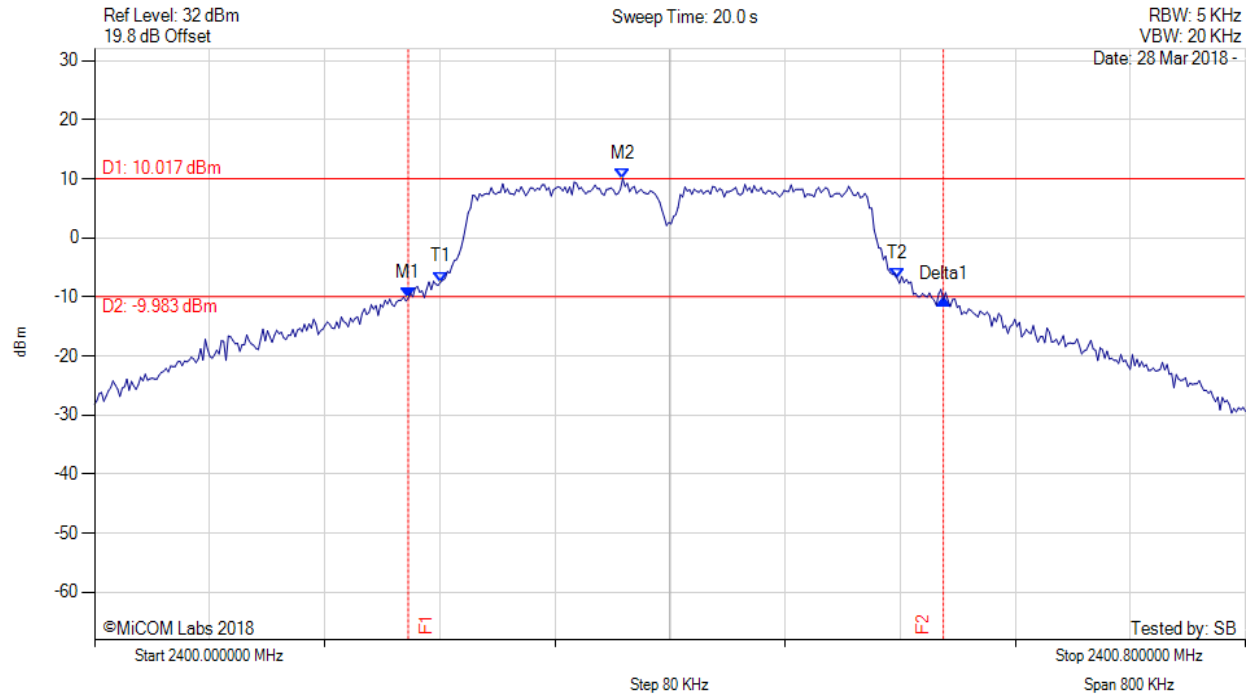


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20 dB 99% BANDWIDTH

Variant: 600 kbps_OFDM, Channel: 2400.40 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = MAX HOLD	M1 : 2400.218 MHz : -10.253 dBm M2 : 2400.367 MHz : 10.017 dBm Delta1 : 372 KHz : -0.209 dB T1 : 2400.240 MHz : -7.475 dBm T2 : 2400.558 MHz : -6.889 dBm OBW : 317 KHz	Measured 20 dB Bandwidth: 0.372 MHz Margin: #VALUE! MHz

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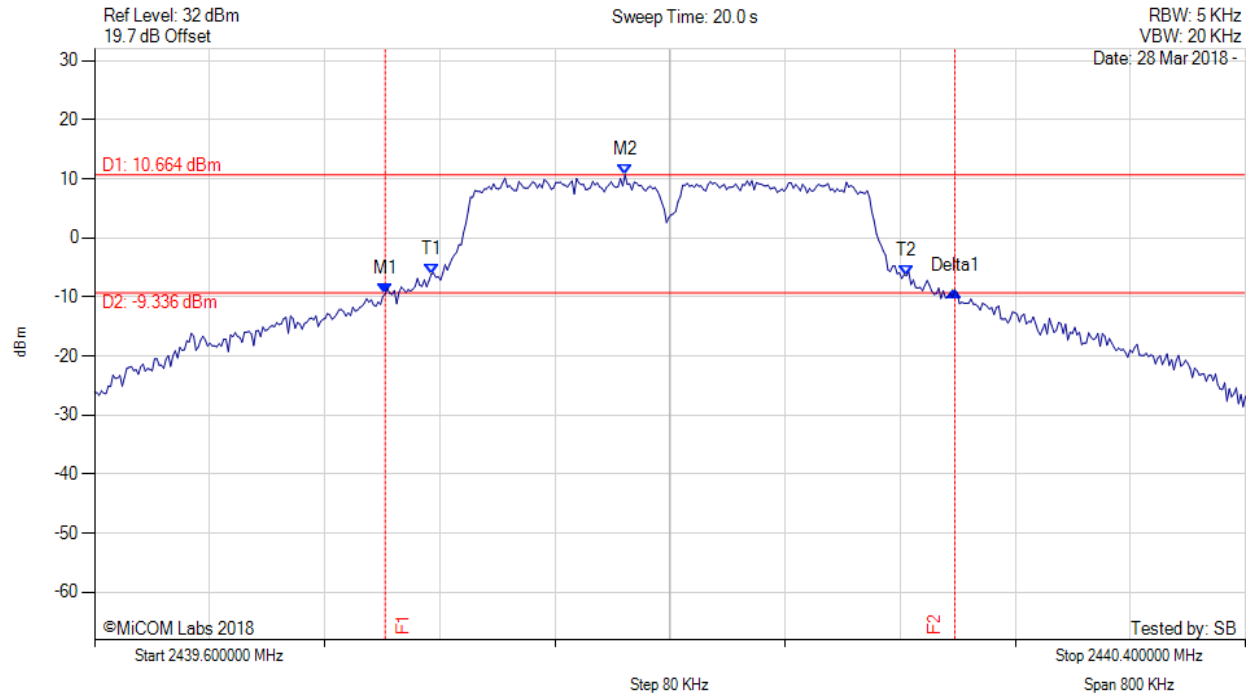


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20 dB 99% BANDWIDTH

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = MAX HOLD	M1 : 2439.802 MHz : -9.486 dBm M2 : 2439.969 MHz : 10.664 dBm Delta1 : 396 KHz : 0.502 dB T1 : 2439.834 MHz : -6.141 dBm T2 : 2440.164 MHz : -6.399 dBm OBW : 330 KHz	Measured 20 dB Bandwidth: 0.396 MHz Margin: #VALUE! MHz

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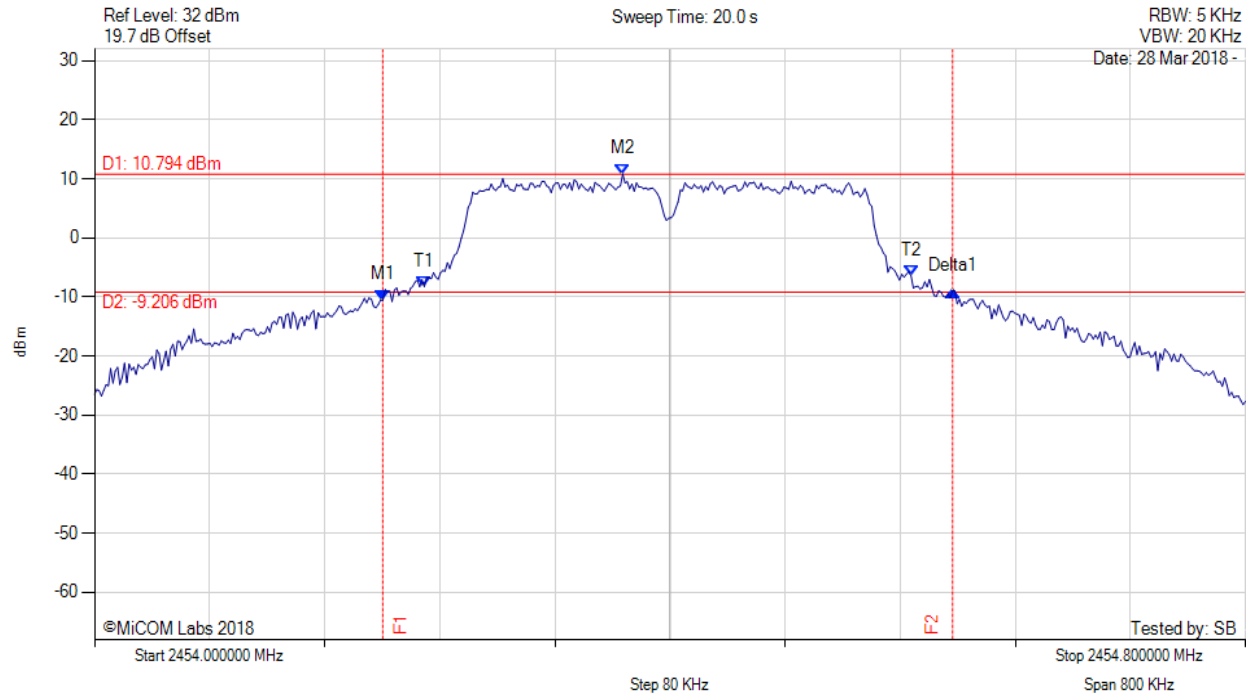


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20 dB 99% BANDWIDTH

Variant: 600 kbps_OFDM, Channel: 2454.40 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = MAX HOLD	M1 : 2454.200 MHz : -10.522 dBm M2 : 2454.367 MHz : 10.794 dBm Delta1 : 396 KHz : 1.550 dB T1 : 2454.229 MHz : -8.250 dBm T2 : 2454.568 MHz : -6.348 dBm OBW : 338 KHz	Channel Frequency: 2454.40 MHz

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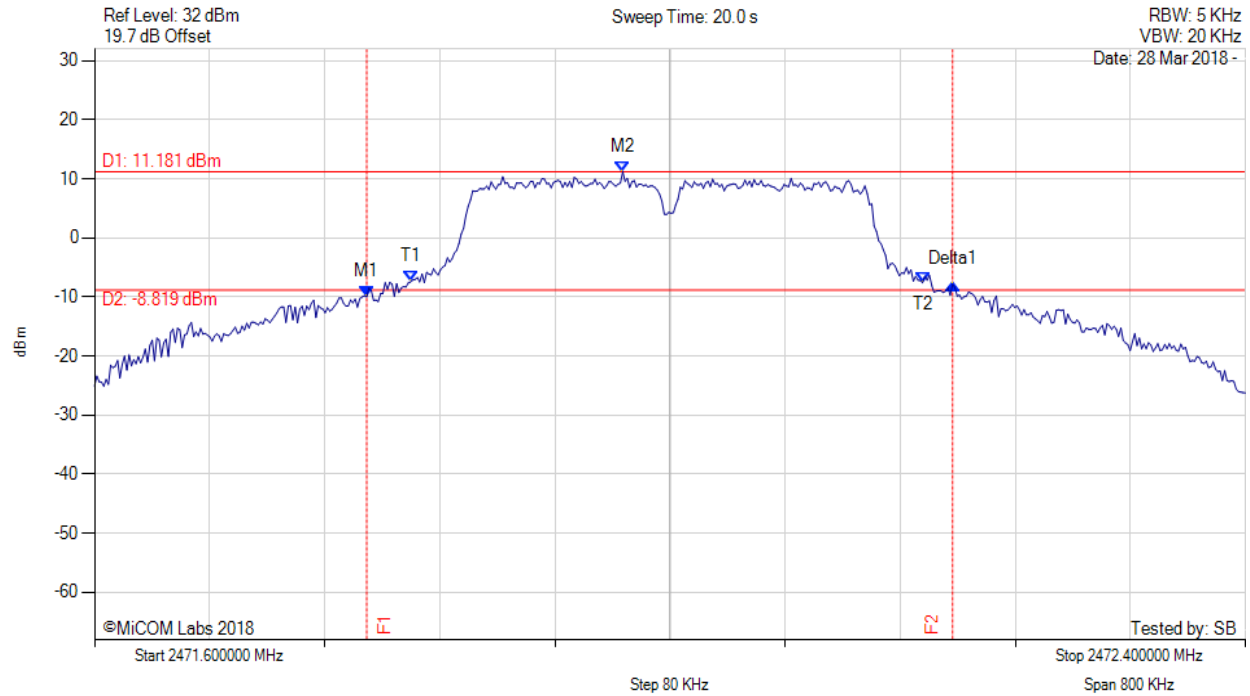


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20 dB 99% BANDWIDTH

Variant: 600 kbps_OFDM, Channel: 2472.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = MAX HOLD	M1 : 2471.789 MHz : -9.977 dBm M2 : 2471.967 MHz : 11.181 dBm Delta1 : 407 KHz : 2.085 dB T1 : 2471.820 MHz : -7.447 dBm T2 : 2472.176 MHz : -7.607 dBm OBW : 356 KHz	Measured 20 dB Bandwidth: 0.407 MHz Limit: kHz Margin: #VALUE! MHz

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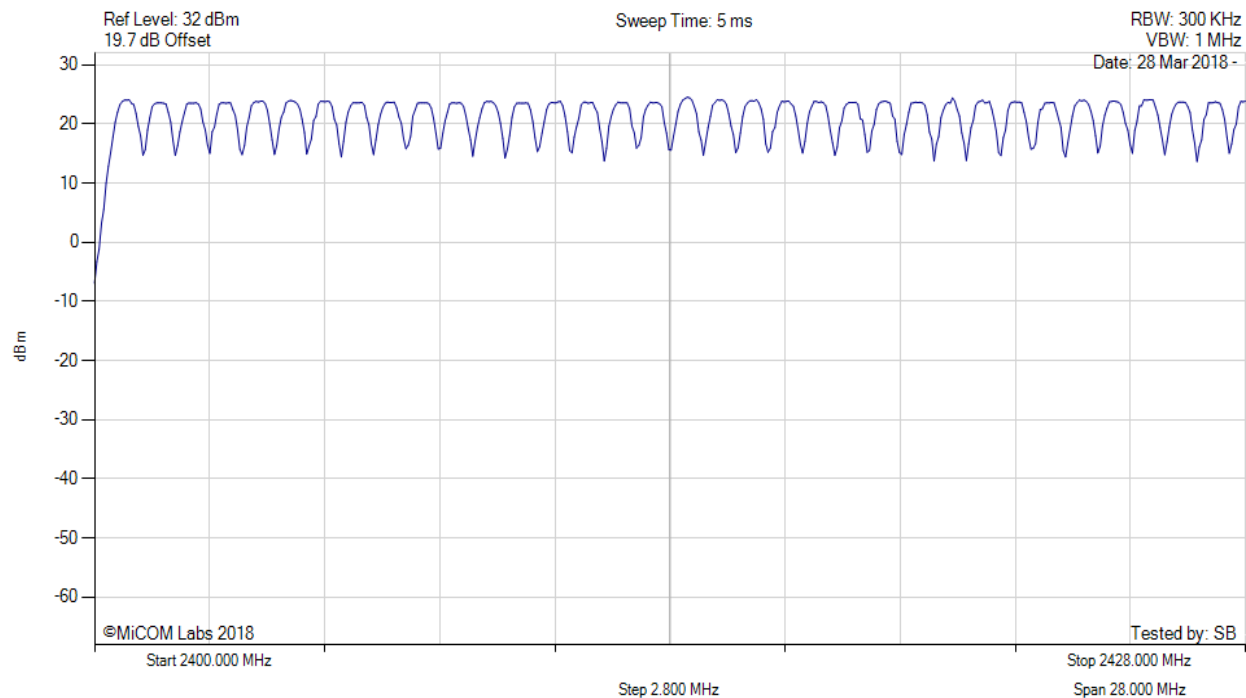
A.2. Frequency Hopping Tests

A.2.1. Number of Hopping Channels



NUMBER OF HOPPING CHANNELS

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW		Channel Frequency: 2440.00 MHz

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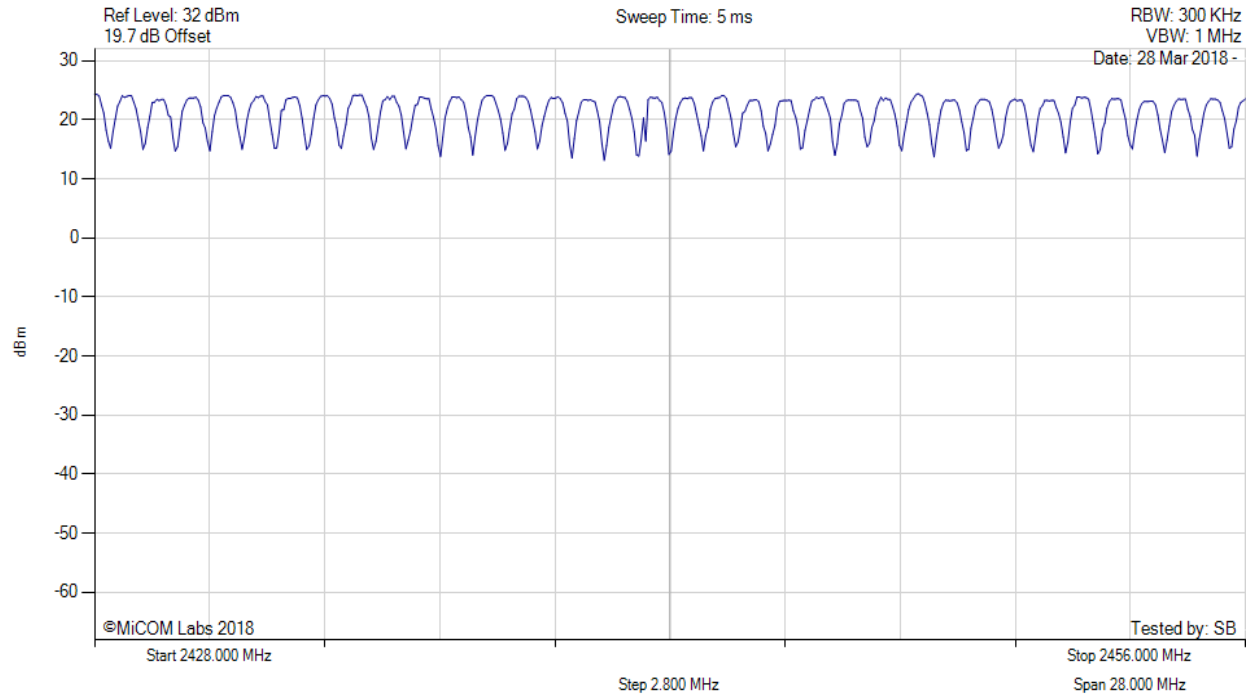


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NUMBER OF HOPPING CHANNELS

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW		Channel Frequency: 2440.00 MHz

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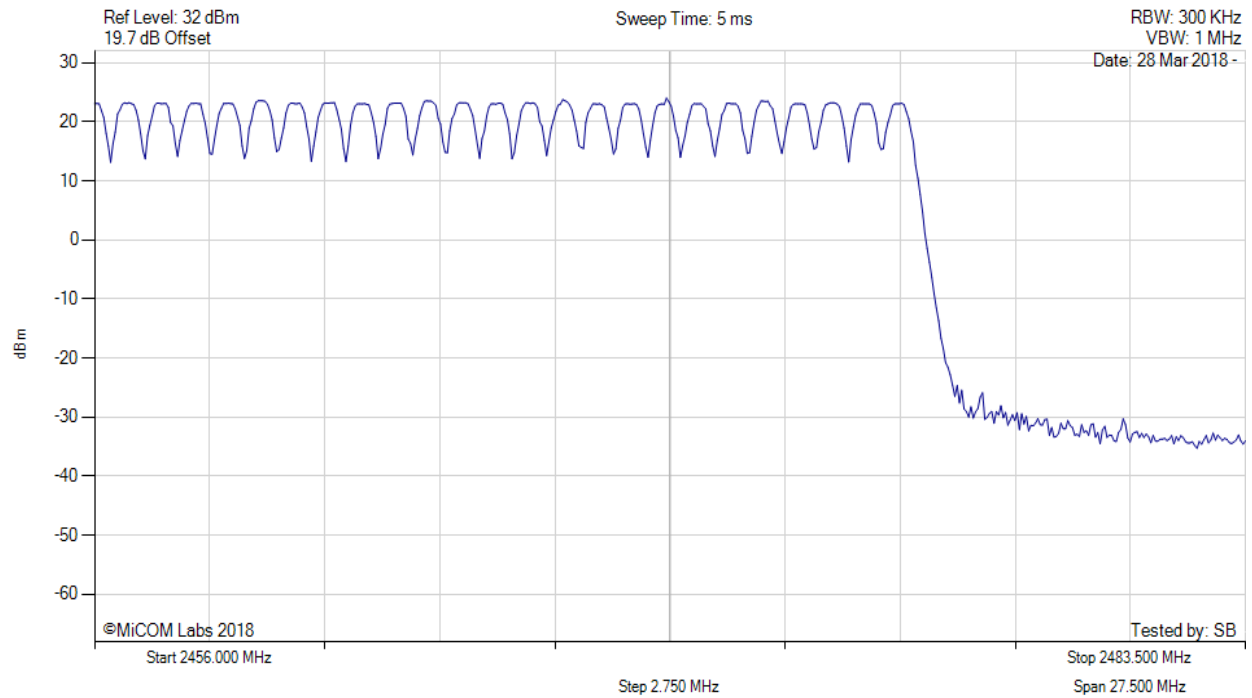


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NUMBER OF HOPPING CHANNELS

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW		Channel Frequency: 2440.00 MHz

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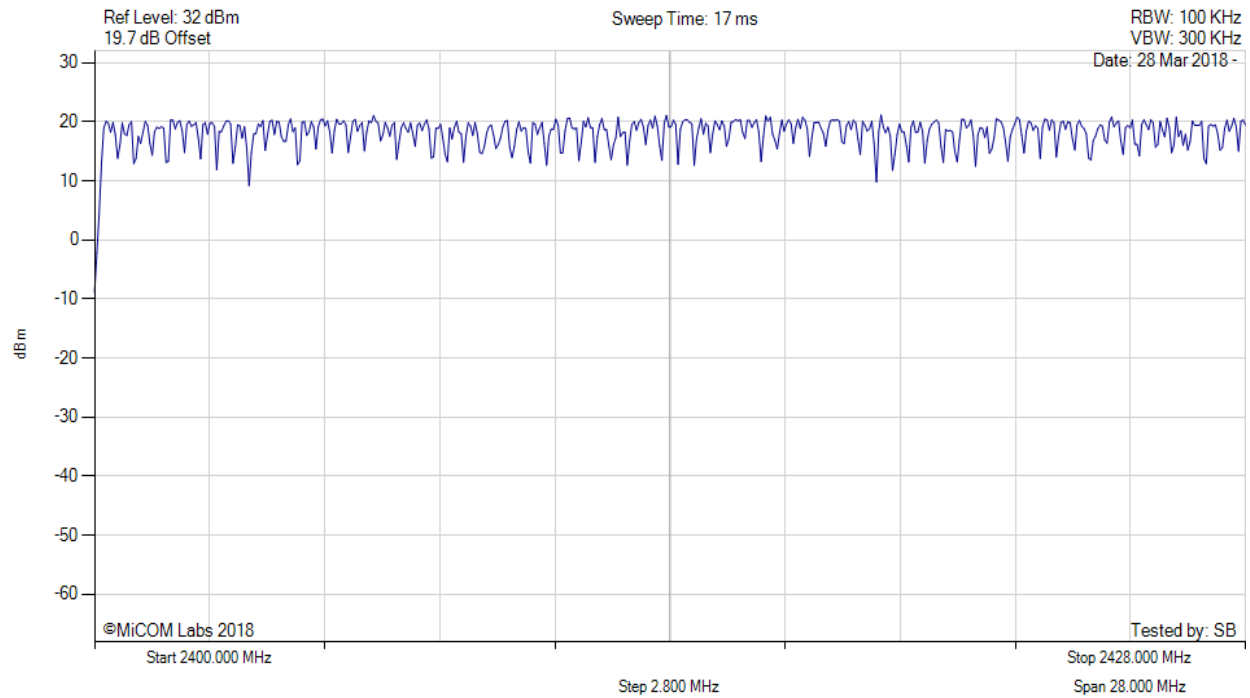


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NUMBER OF HOPPING CHANNELS

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AUTOPEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW		Channel Frequency: 2440.00 MHz

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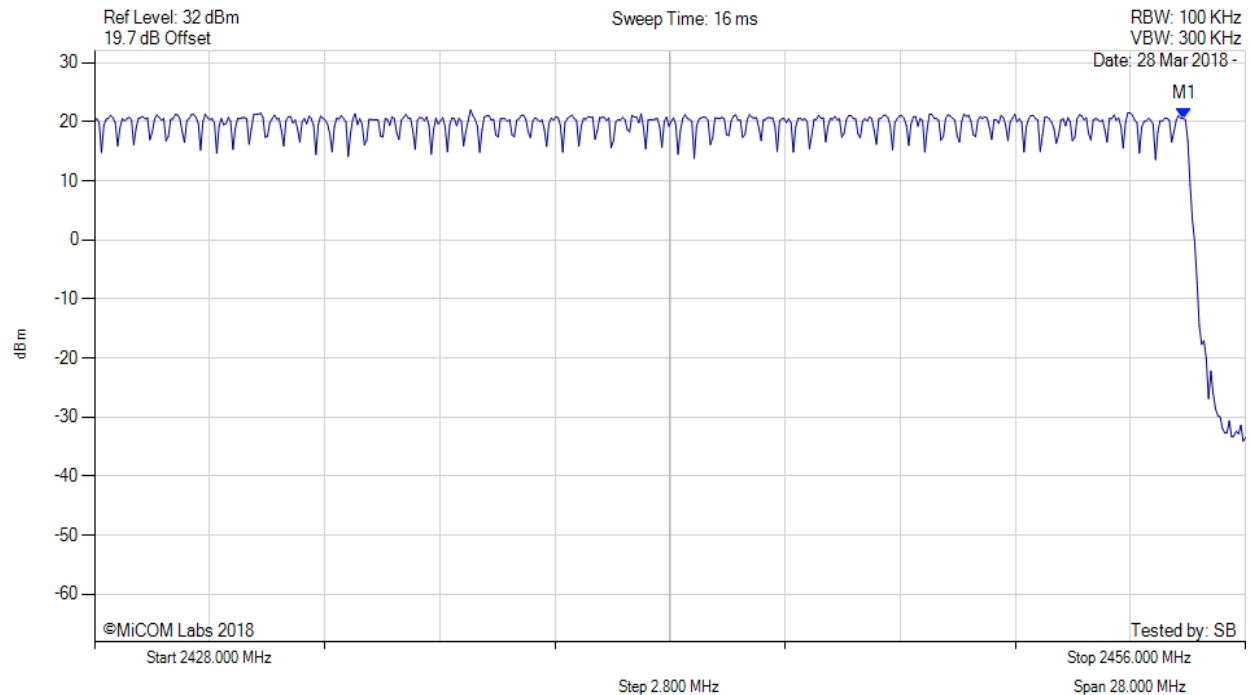


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NUMBER OF HOPPING CHANNELS

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = AUTOPEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 2454.505 MHz : 20.550 dBm	Channel Frequency: 2440.00 MHz

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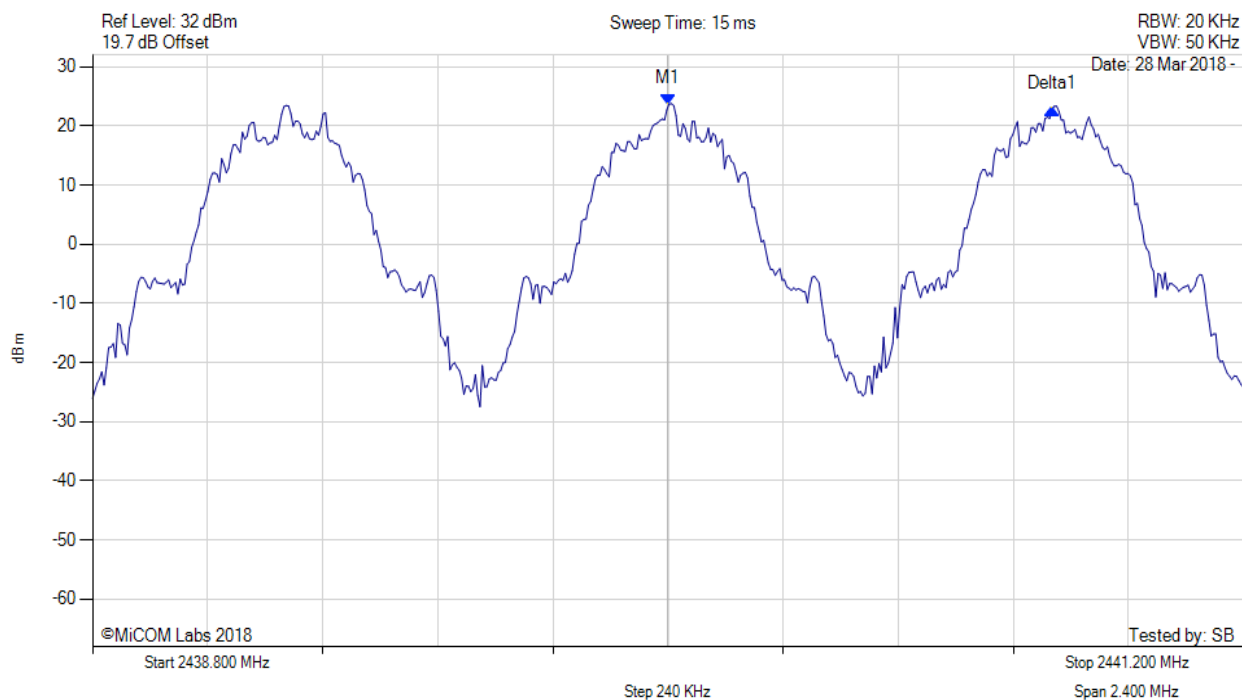
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A.2.2. Channel Separation



CHANNEL SEPARATION

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 2440.000 MHz : 23.686 dBm Delta1 : 800 KHz : -0.915 dB	Channel Frequency: 2440.00 MHz

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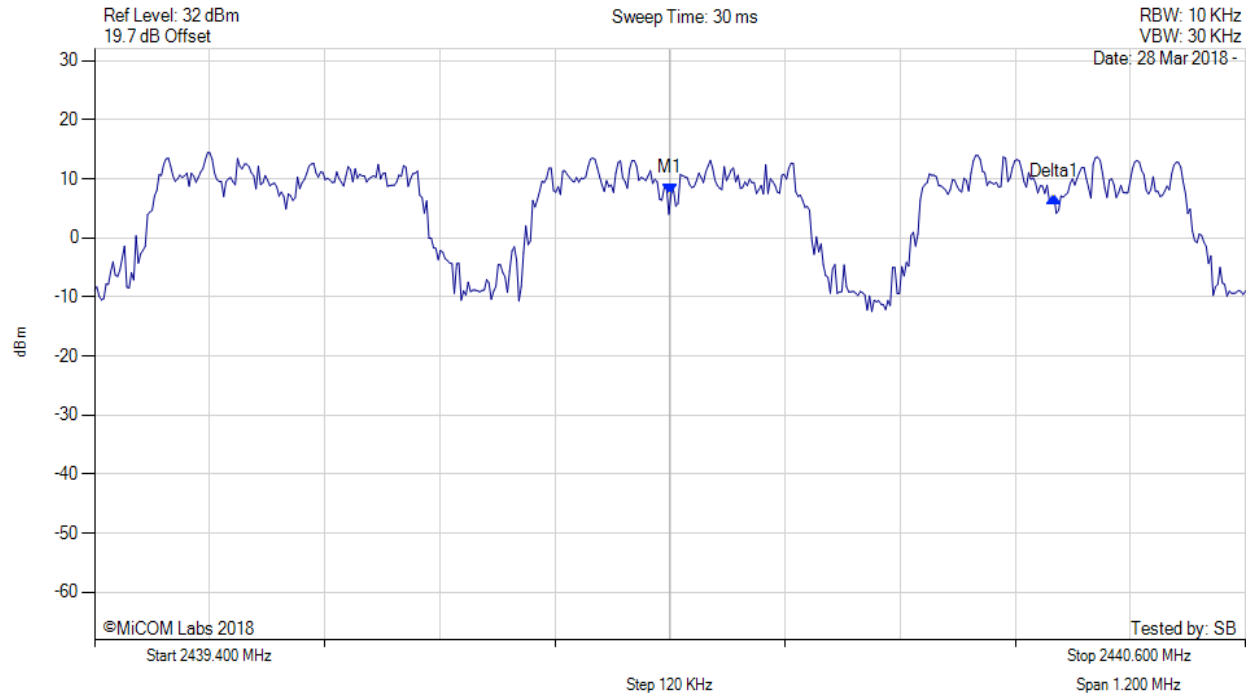


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CHANNEL SEPARATION

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 2440.000 MHz : 7.518 dBm Delta1 : 400 KHz : -0.571 dB	Channel Frequency: 2440.00 MHz

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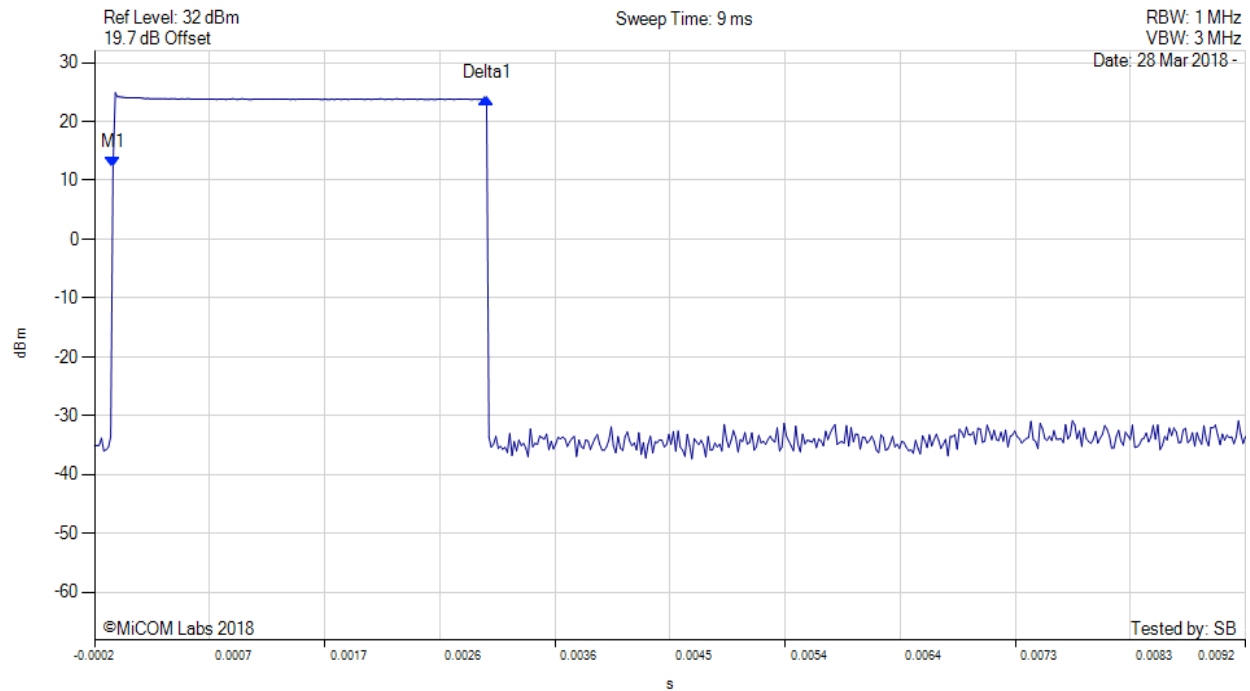
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A.2.3. Dwell Time



DWELL TIME

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Time:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1(2440.00 MHz) : 0.000 s : 12.130 dBm Delta1(2440.00 MHz) : 0.003 s : 11.960 dB	Channel Frequency: 2440.00 MHz

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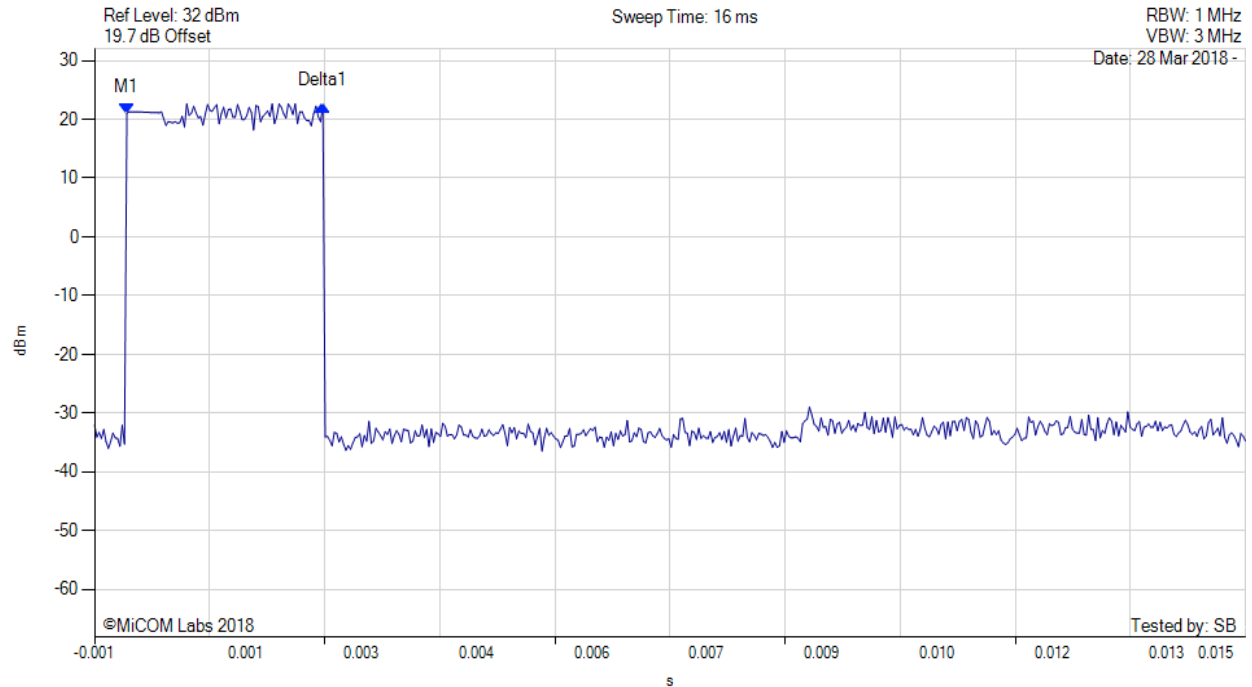


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DWELL TIME

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Time:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1(2440.00 MHz) : 0.000 s : 21.050 dBm Delta1(2440.00 MHz) : 0.003 s : 1.194 dB	Channel Frequency: 2440.00 MHz

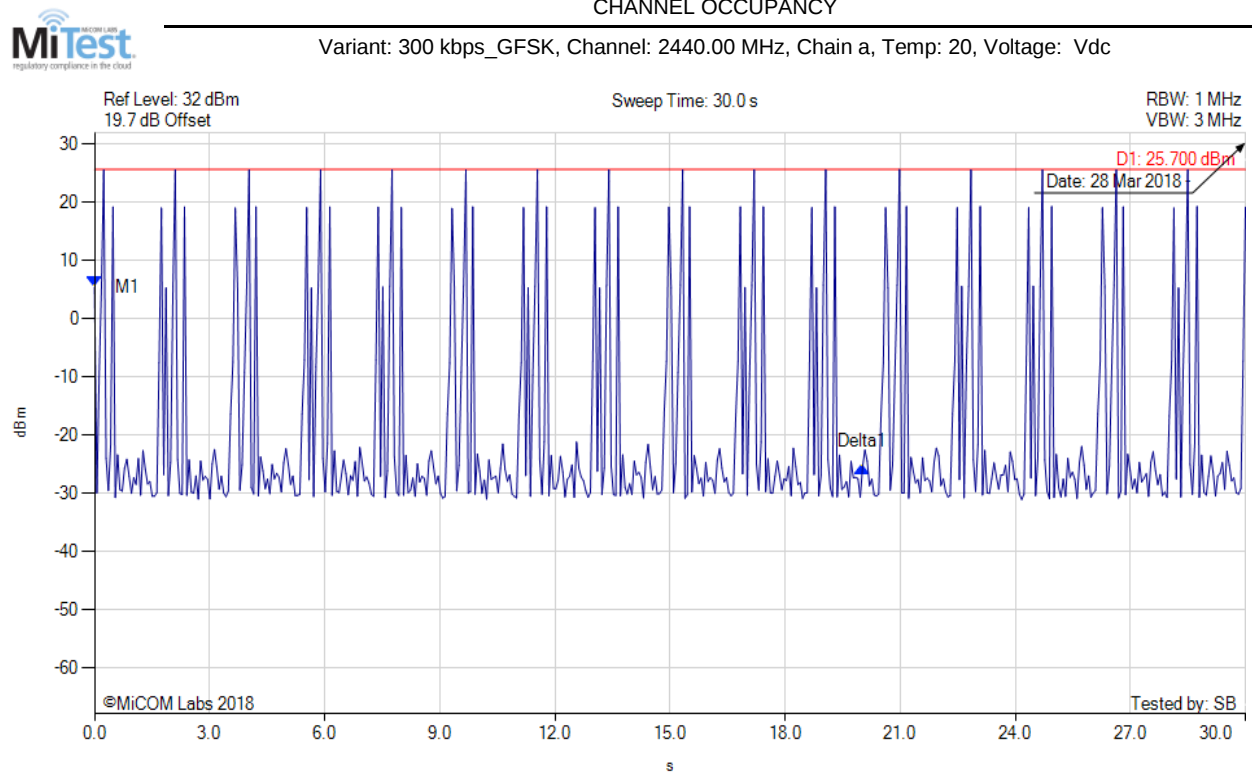
[back to matrix](#)

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A.2.4. Channel Occupancy



Analyzer Setup	Marker:Time:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1(2440.00 MHz) : 0.000 s : 5.494 dBm Delta1(2440.00 MHz) : 20.000 s : -30.972 dB	Channel Frequency: 2440.00 MHz

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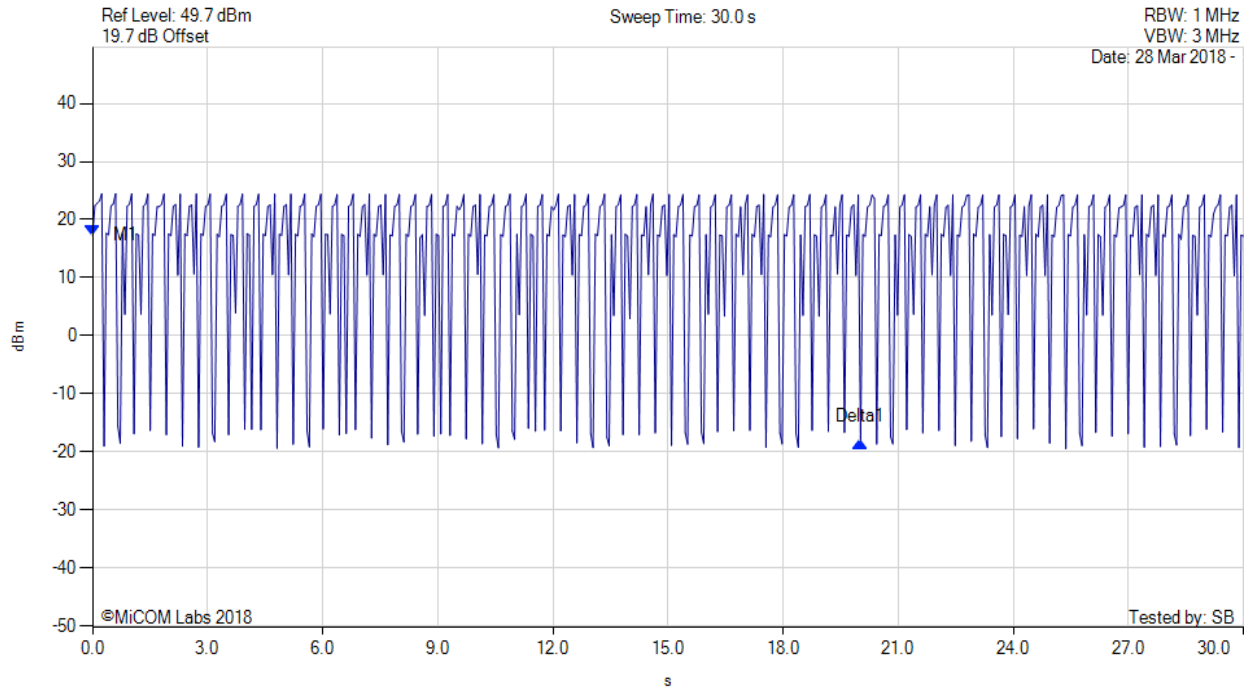


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CHANNEL OCCUPANCY

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Time:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1(2440.00 MHz) : 0.000 s : 17.323 dBm Delta1(2440.00 MHz) : 20.000 s : -35.641 dB	Channel Frequency: 2440.00 MHz

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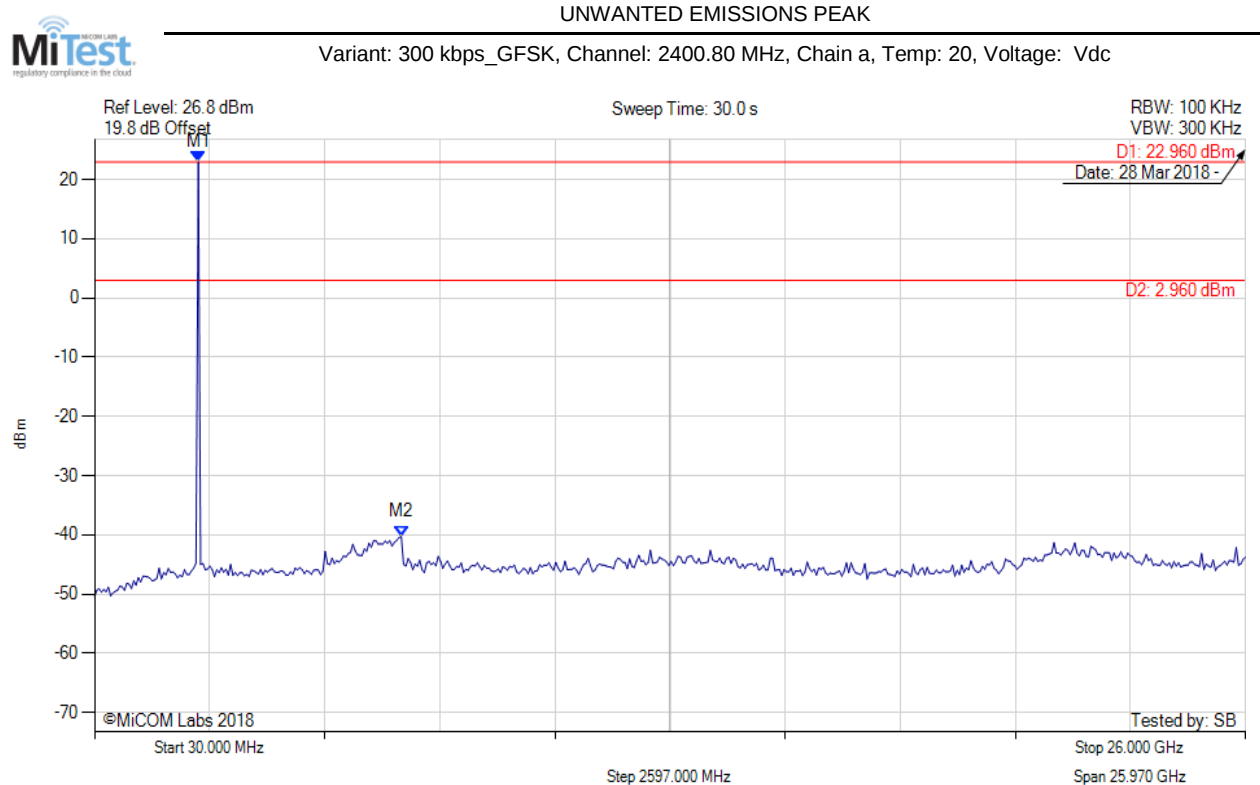


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A.3. Emissions

A.3.1. Conducted Emissions

A.3.1.1. Conducted Unwanted Spurious Emissions



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD	M1 : 2371.984 MHz : 22.958 dBm M2 : 6951.864 MHz : -40.289 dBm	Limit: 2.96 dBm Margin: -43.25 dB

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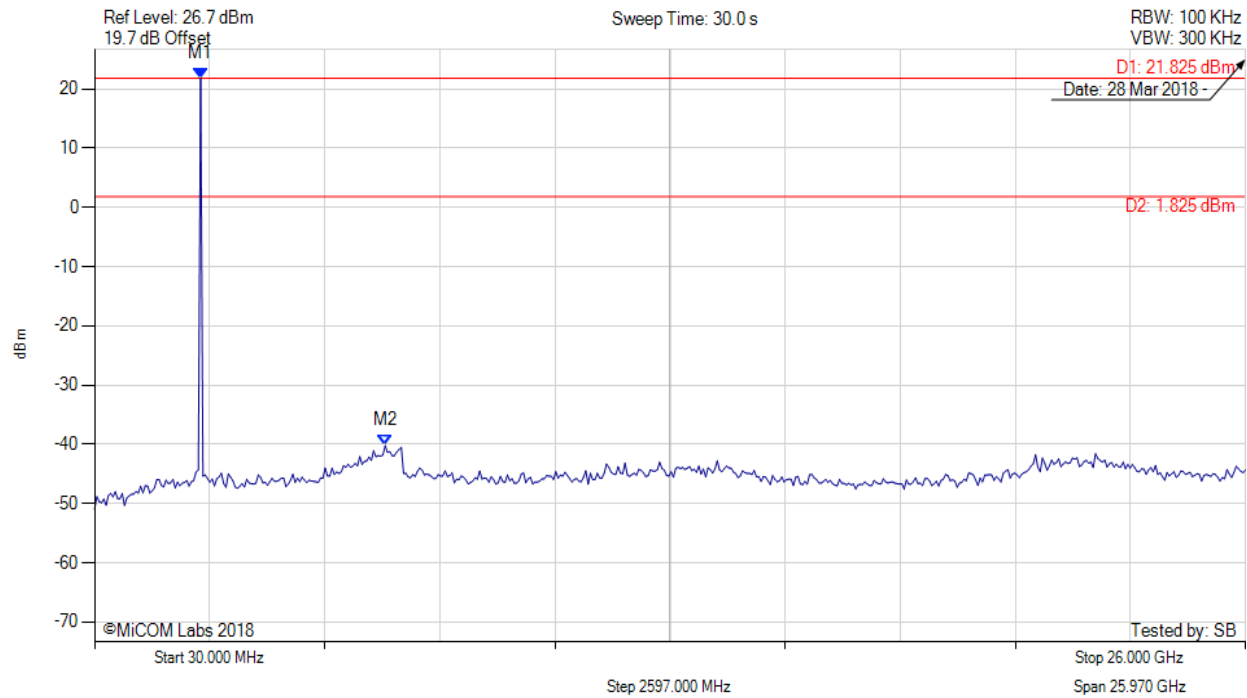


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UNWANTED EMISSIONS PEAK

Variant: 300 kbps_GFSK, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 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 : 21.825 dBm M2 : 6587.555 MHz : -40.233 dBm	Limit: 1.83 dBm Margin: -42.06 dB

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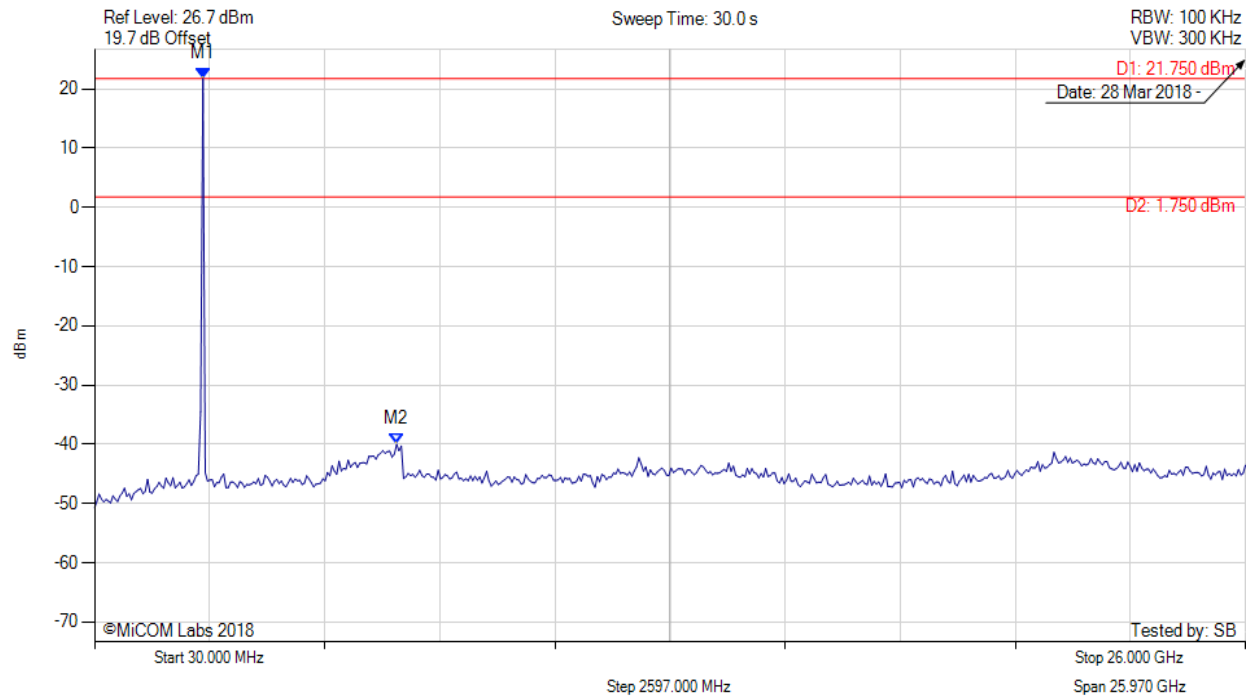


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UNWANTED EMISSIONS PEAK

Variant: 300 kbps_GFSK, Channel: 2472.80 MHz, Chain a, Temp: 20, Voltage: 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 : 21.750 dBm M2 : 6847.776 MHz : -40.017 dBm	Limit: 1.75 dBm Margin: -41.77 dB

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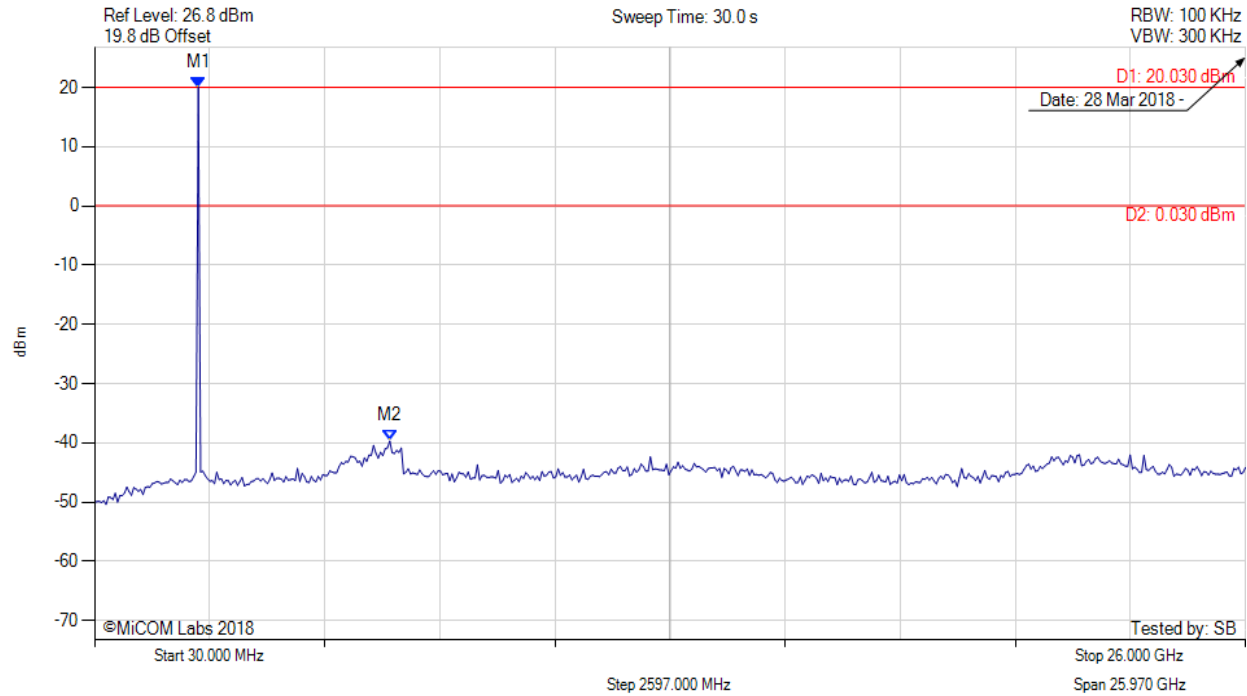


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UNWANTED EMISSIONS PEAK

Variant: 600 kbps_OFDM, Channel: 2400.40 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2371.984 MHz : 20.030 dBm M2 : 6691.643 MHz : -39.677 dBm	Limit: 0.03 dBm Margin: -39.71 dB

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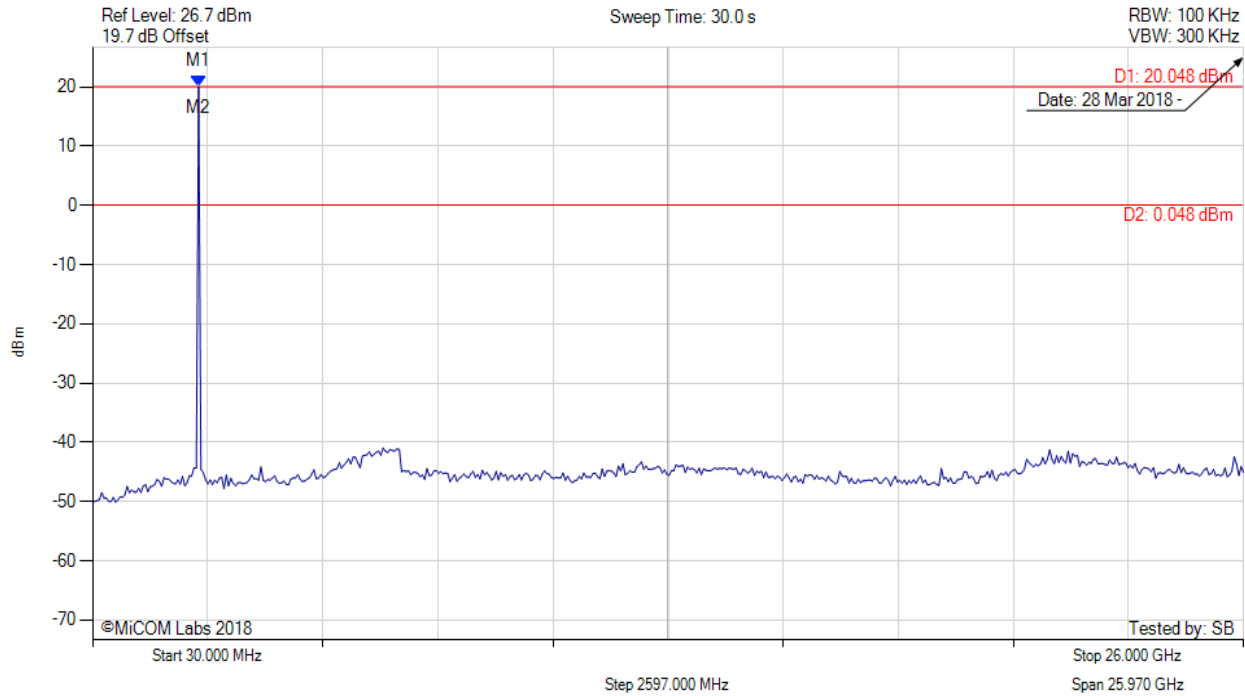


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UNWANTED EMISSIONS PEAK

Variant: 600 kbps_OFDM, Channel: 2440.00 MHz, Chain a, Temp: 20, Voltage: 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 : 20.048 dBm M2 : 2424.028 MHz : 20.048 dBm	Limit: 0.05 dBm Margin: 20.00 dB

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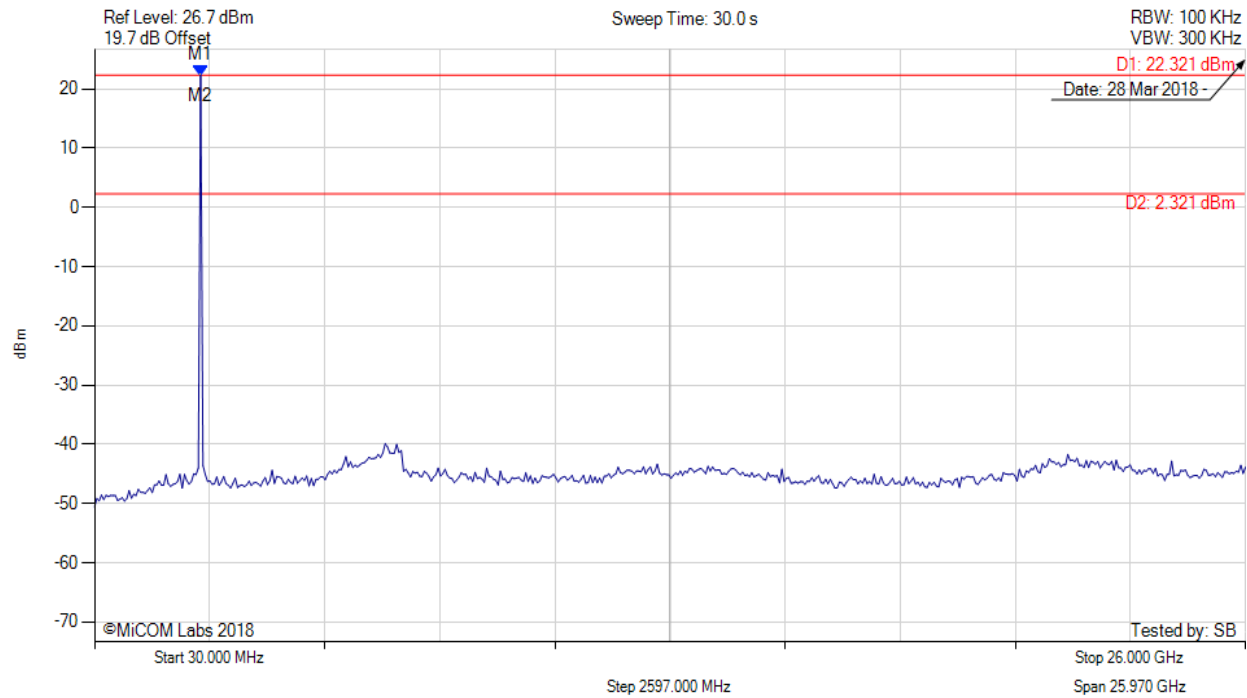


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UNWANTED EMISSIONS PEAK

Variant: 600 kbps_OFDM, Channel: 2454.40 MHz, Chain a, Temp: 20, Voltage: 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 : 22.321 dBm M2 : 2424.028 MHz : 22.321 dBm	Channel Frequency: 2454.40 MHz

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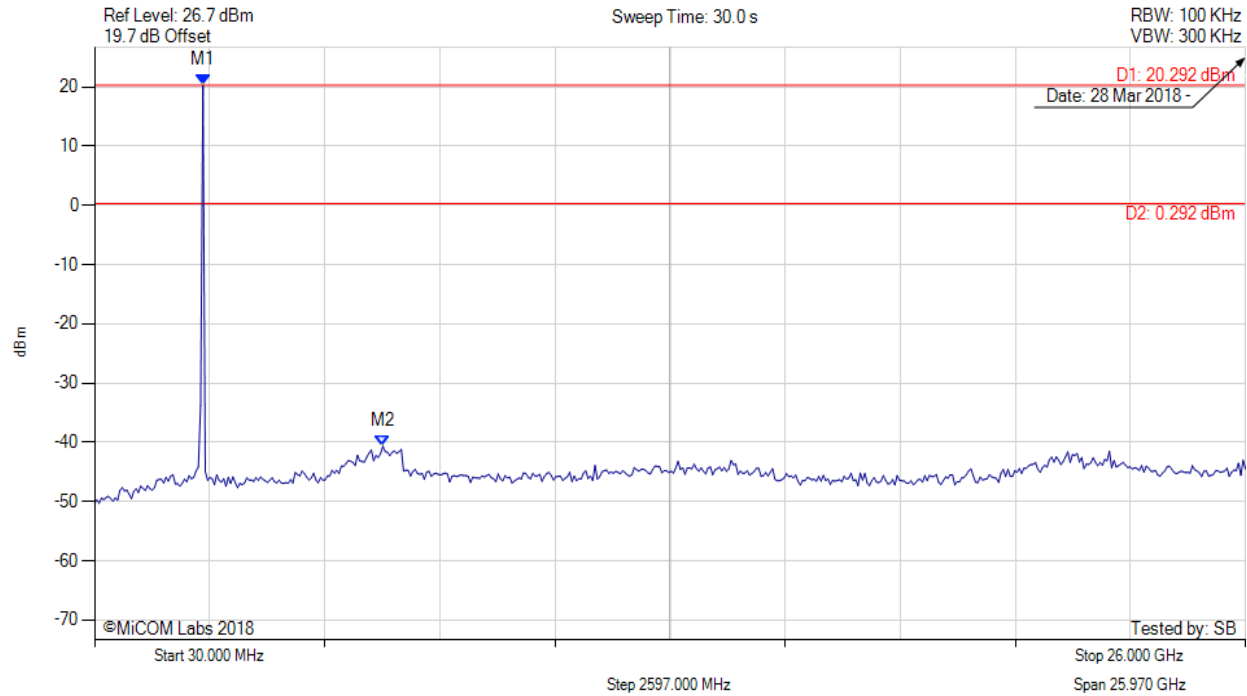


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UNWANTED EMISSIONS PEAK

Variant: 600 kbps_OFDM, Channel: 2472.00 MHz, Chain a, Temp: 20, Voltage: 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 : 20.292 dBm M2 : 6535.511 MHz : -40.662 dBm	Limit: 0.29 dBm Margin: -40.95 dB

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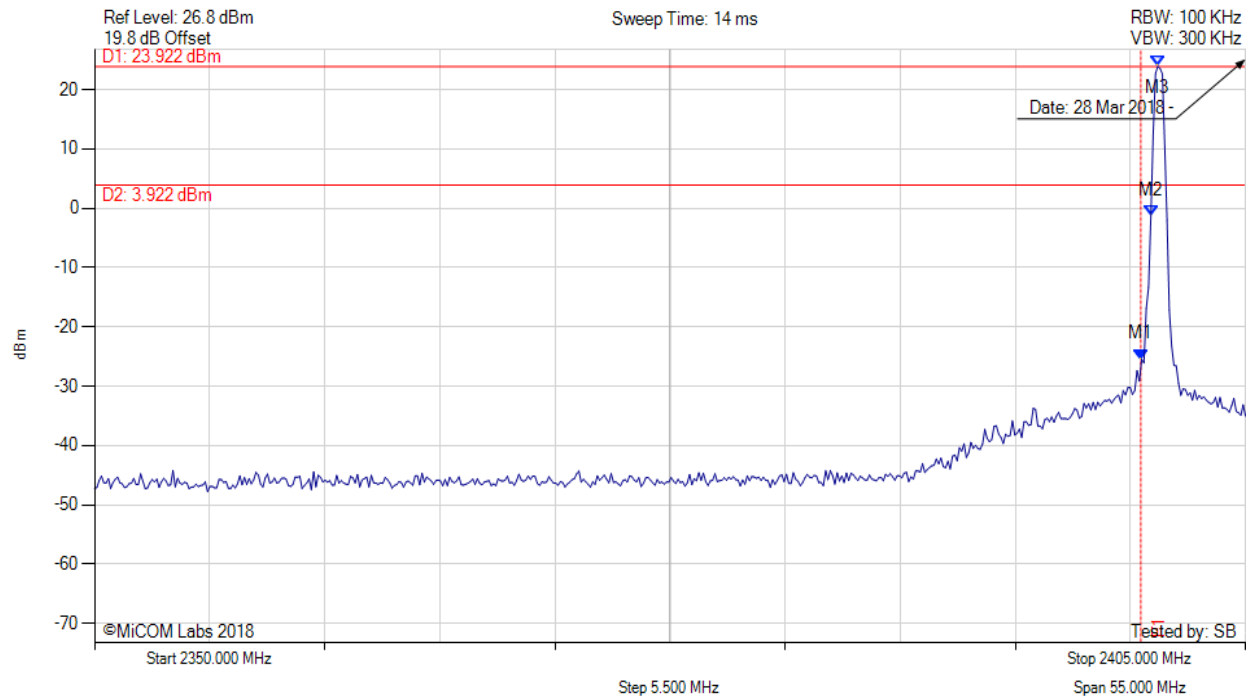
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A.3.1.2. Conducted Band-Edge Emissions



CONDUCTED LOW BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: 300 kbps_GFSK, Channel: 2400.80 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2400.000 MHz : -25.461 dBm M2 : 2400.481 MHz : -1.207 dBm M3 : 2400.812 MHz : 23.922 dBm	Channel Frequency: 2400.80 MHz

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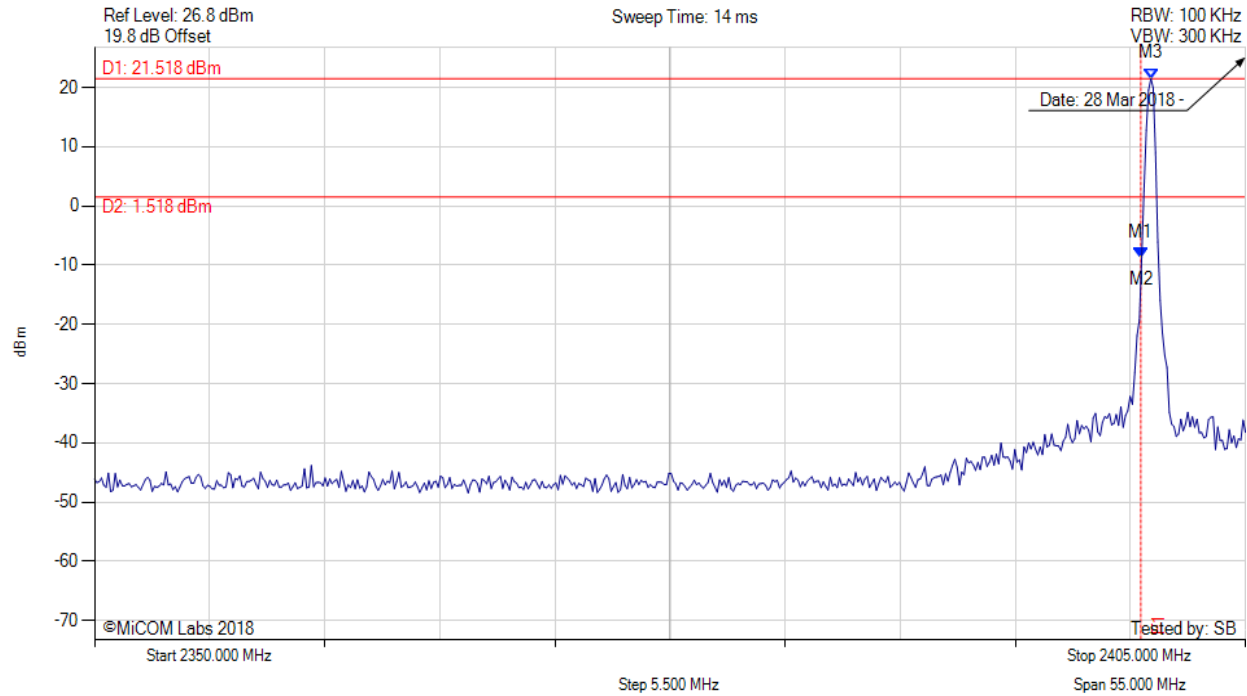


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CONDUCTED LOW BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: 600 kbps_OFDM, Channel: 2400.40 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2400.000 MHz : -8.839 dBm M2 : 2400.040 MHz : -8.839 dBm M3 : 2400.481 MHz : 21.518 dBm	Channel Frequency: 2400.40 MHz

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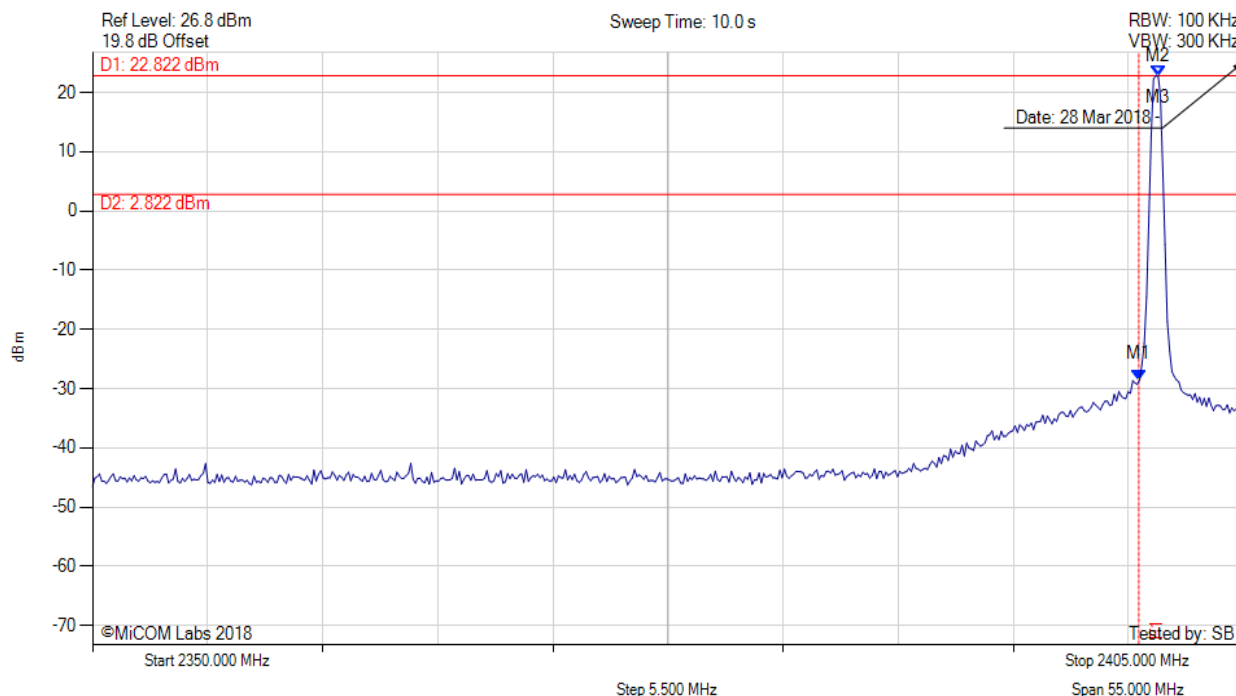


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CONDUCTED LOW BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: 300 kbps_GFSK, Channel: 2400.80 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2400.000 MHz : -28.493 dBm M2 : 2400.922 MHz : 22.822 dBm M3 : 2400.922 MHz : 22.822 dBm	Channel Frequency: 2400.80 MHz

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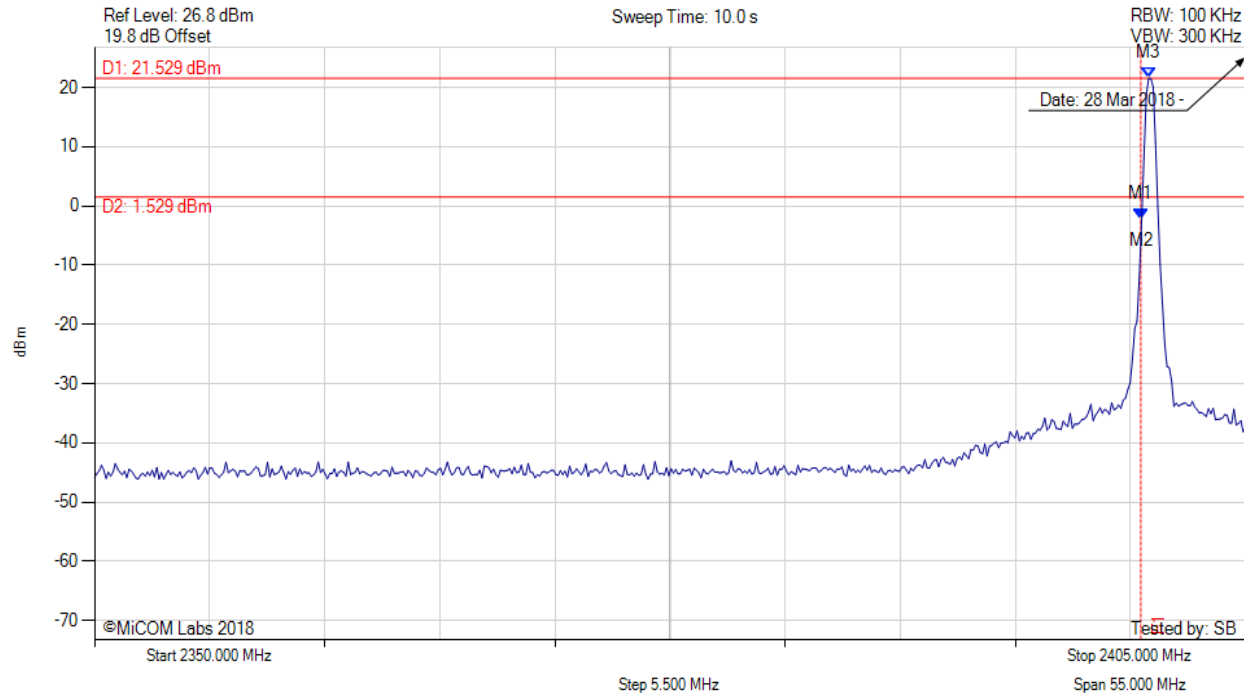


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CONDUCTED LOW BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: 600 kbps_OFDM, Channel: 2400.40 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2400.000 MHz : -2.295 dBm M2 : 2400.040 MHz : -2.295 dBm M3 : 2400.371 MHz : 21.529 dBm	Channel Frequency: 2400.40 MHz

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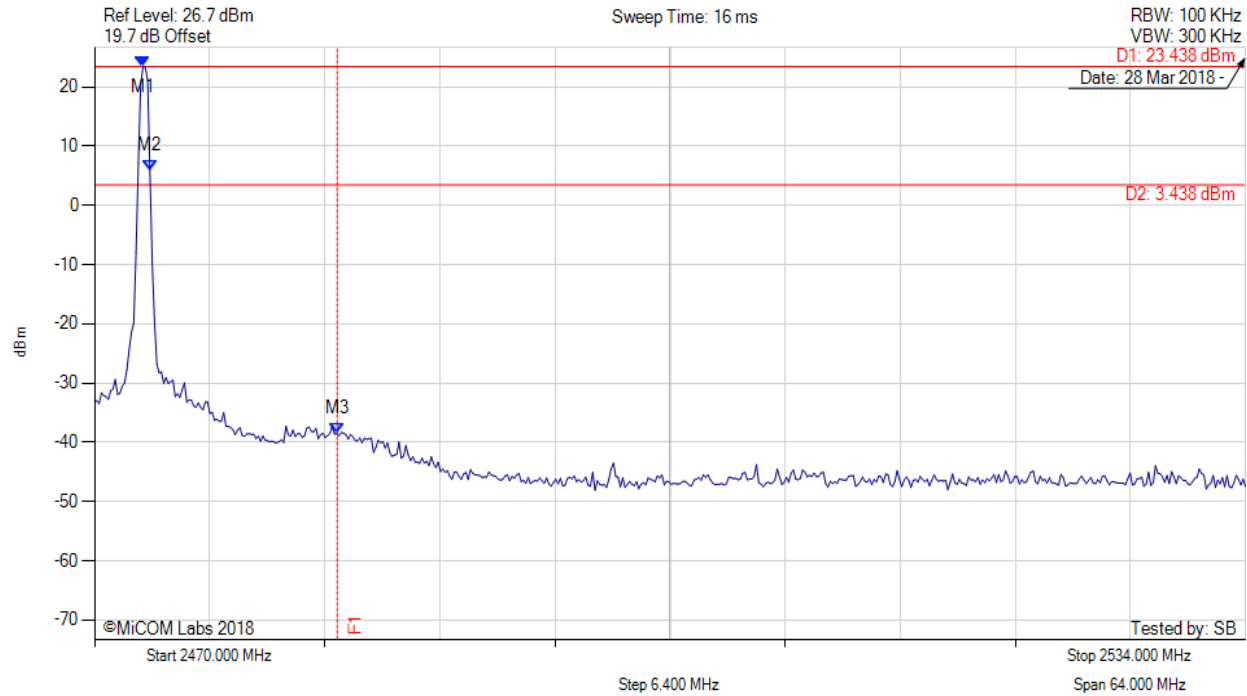


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CONDUCTED UPPER BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: 300 kbps_GFSK, Channel: 2472.80 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2472.693 MHz : 23.438 dBm M2 : 2473.078 MHz : 5.889 dBm M3 : 2483.500 MHz : -38.506 dBm	Channel Frequency: 2472.80 MHz

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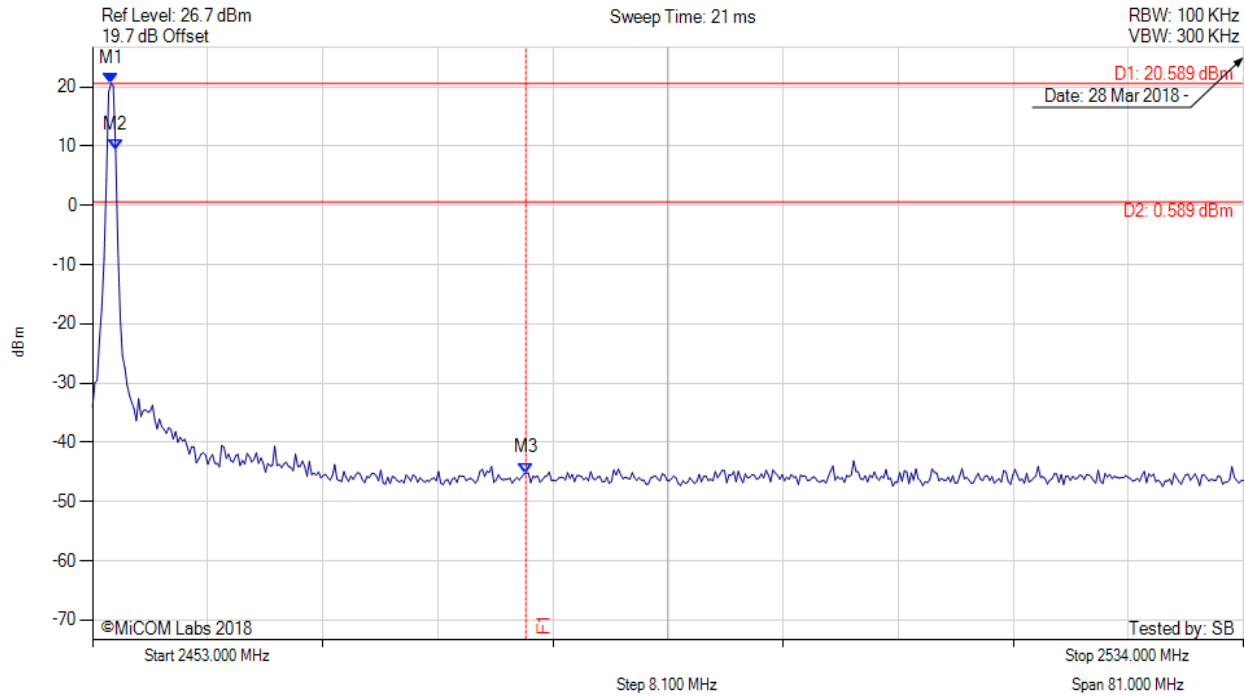


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CONDUCTED UPPER BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: 600 kbps_OFDM, Channel: 2454.40 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2454.299 MHz : 20.589 dBm M2 : 2454.623 MHz : 9.283 dBm M3 : 2483.500 MHz : -45.207 dBm	Channel Frequency: 2454.40 MHz

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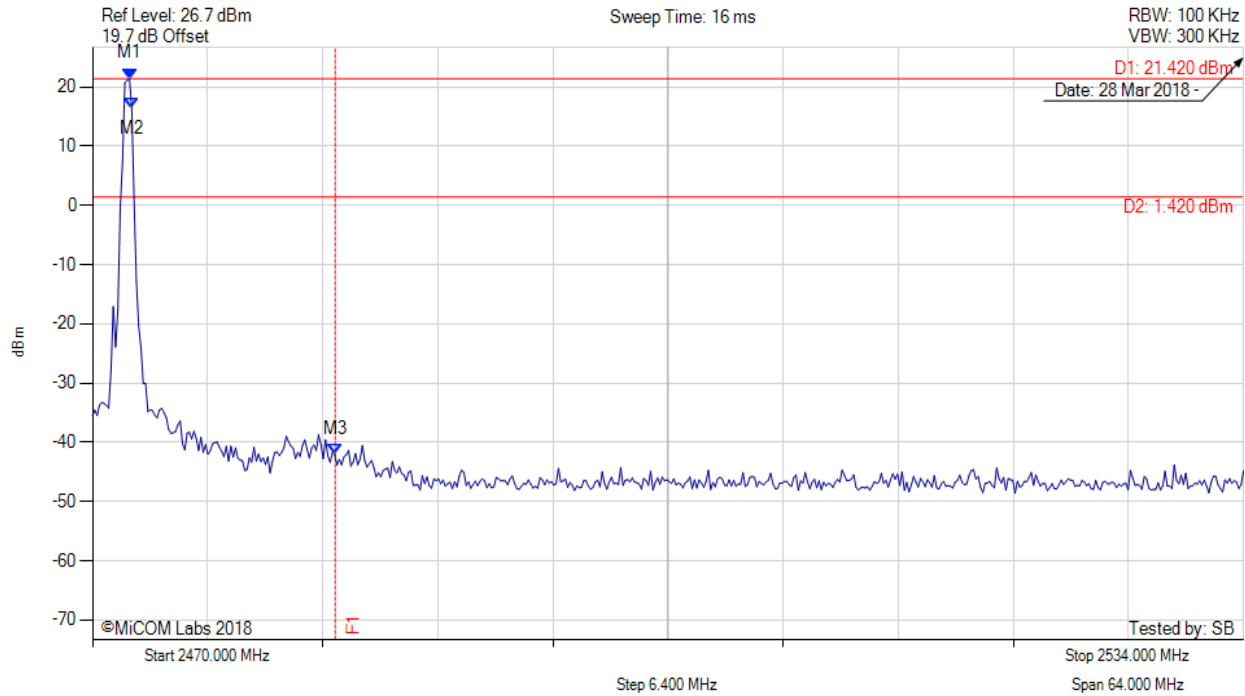


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CONDUCTED UPPER BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: 600 kbps_OFDM, Channel: 2472.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2472.052 MHz : 21.420 dBm M2 : 2472.180 MHz : 16.456 dBm M3 : 2483.500 MHz : -42.091 dBm	Channel Frequency: 2472.00 MHz

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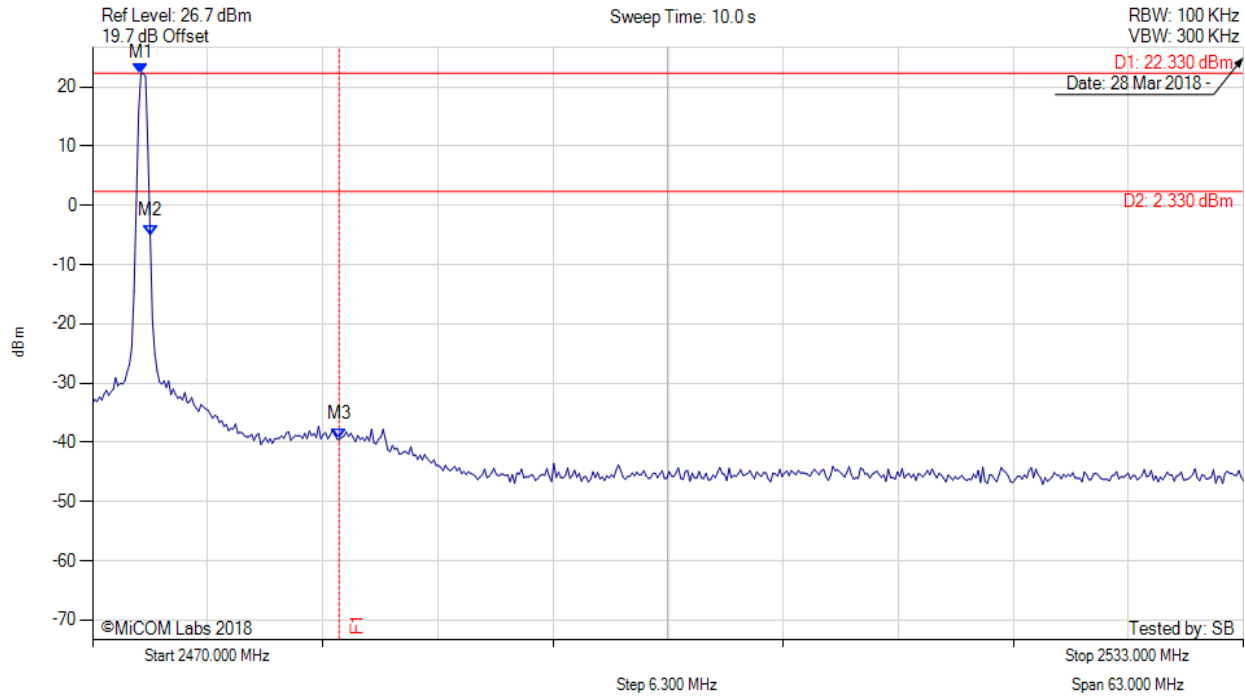


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CONDUCTED UPPER BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: 300 kbps_GFSK, Channel: 2472.80 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 2472.651 MHz : 22.332 dBm M2 : 2473.156 MHz : -5.214 dBm M3 : 2483.500 MHz : -39.531 dBm	Channel Frequency: 2472.80 MHz

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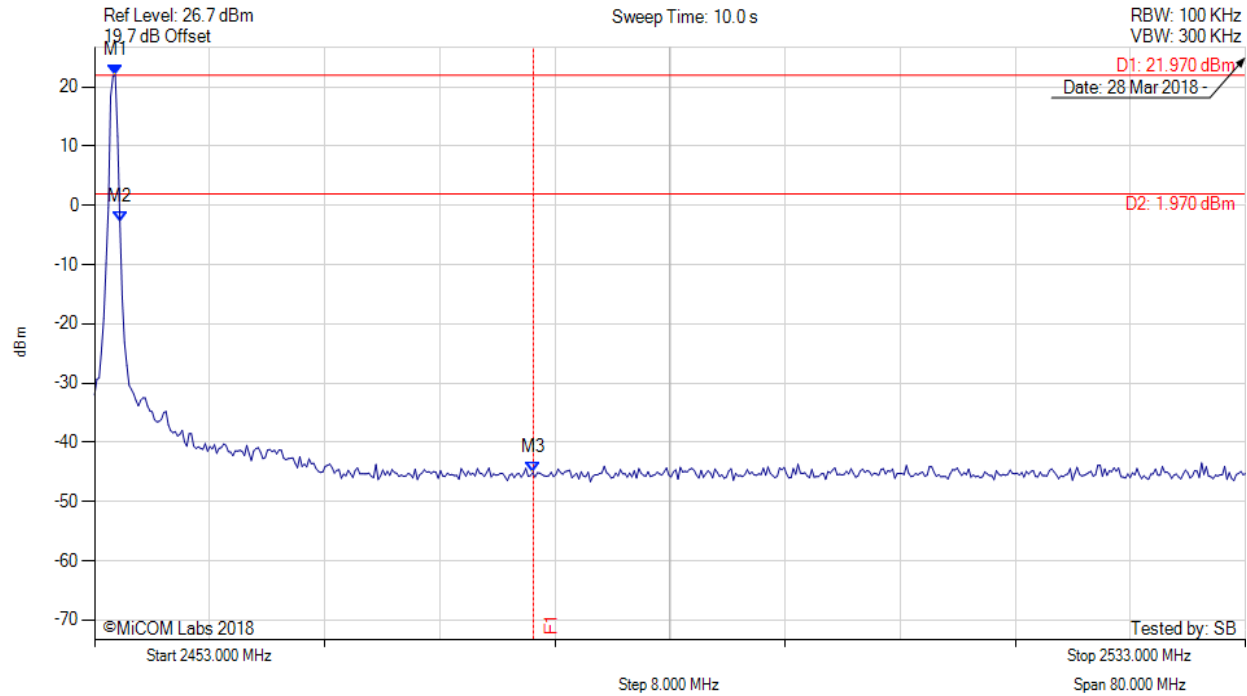


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CONDUCTED UPPER BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: 600 kbps_OFDM, Channel: 2454.40 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD	M1 : 2454.443 MHz : 21.972 dBm M2 : 2454.764 MHz : -2.812 dBm M3 : 2483.500 MHz : -45.132 dBm	Channel Frequency: 2454.40 MHz

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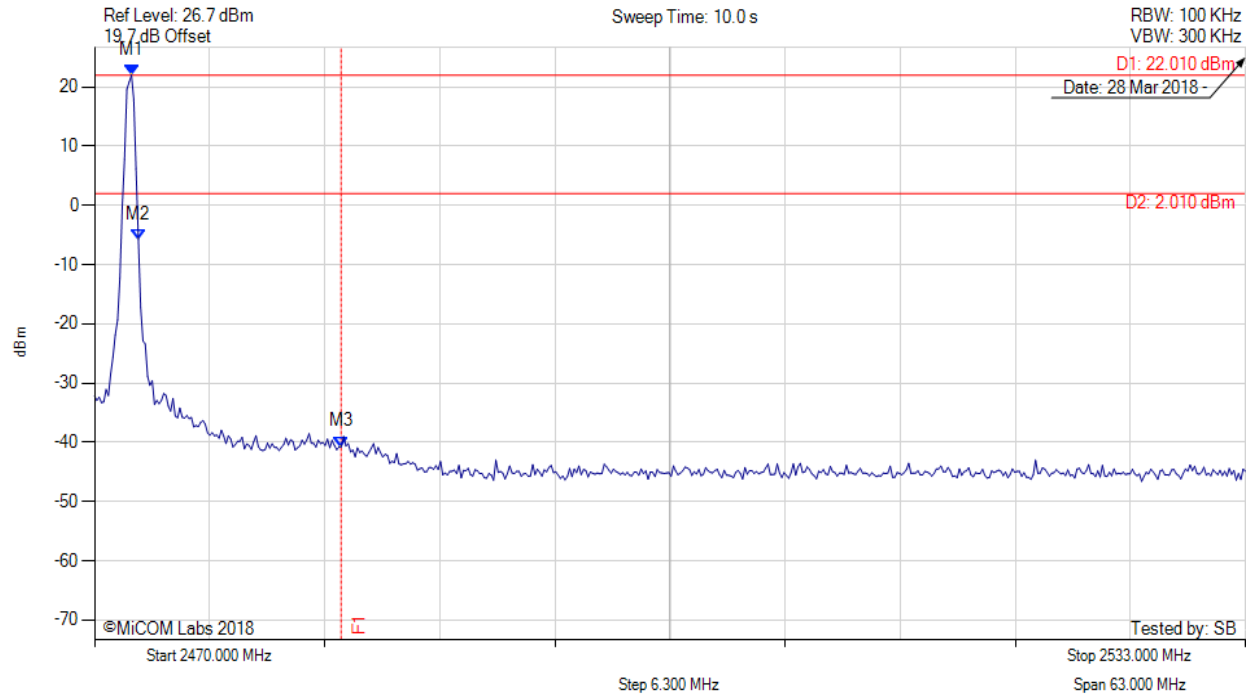


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CONDUCTED UPPER BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: 600 kbps_OFDM, Channel: 2472.00 MHz, Chain a, Temp: 20, Voltage: Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = MAX HOLD	M1 : 2472.020 MHz : 22.008 dBm M2 : 2472.399 MHz : -5.720 dBm M3 : 2483.500 MHz : -40.765 dBm	Channel Frequency: 2472.00 MHz

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A.3.2. Radiated Emissions

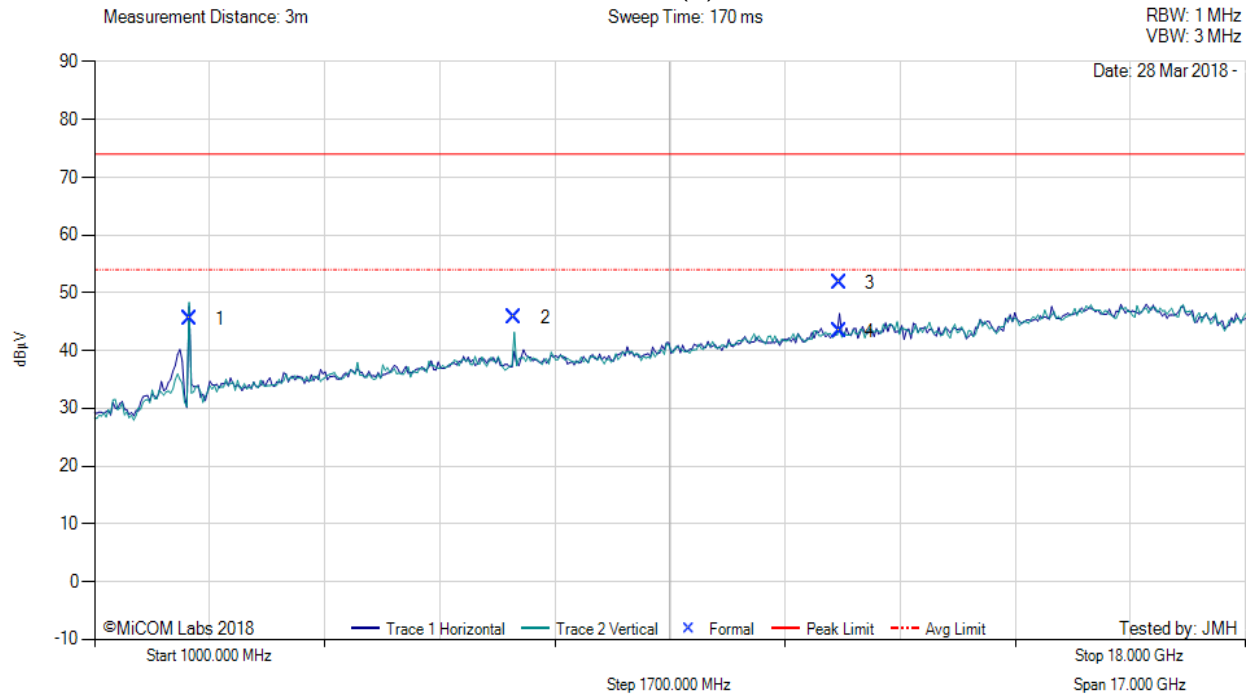
A.3.2.3. TX Spurious & Restricted Band Emissions

Antenna: Tai Sheng Chen 155-0010-00



TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2400.80 MHz, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99



1000.00 - 18000.00 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	2400.82	55.59	2.24	-12.41	45.42	Fundamental	Vertical	100	76	--	--	
2	7202.23	49.64	3.46	-7.38	45.72	Peak (NRB)	Vertical	200	190	--	--	Pass
3	12004.01	54.03	4.77	-7.02	51.78	Max Peak	Horizontal	192	115	74.0	-22.2	Pass
4	12004.01	45.55	4.77	-7.02	43.30	Max Avg	Horizontal	192	115	54.0	-10.7	Pass
Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.												

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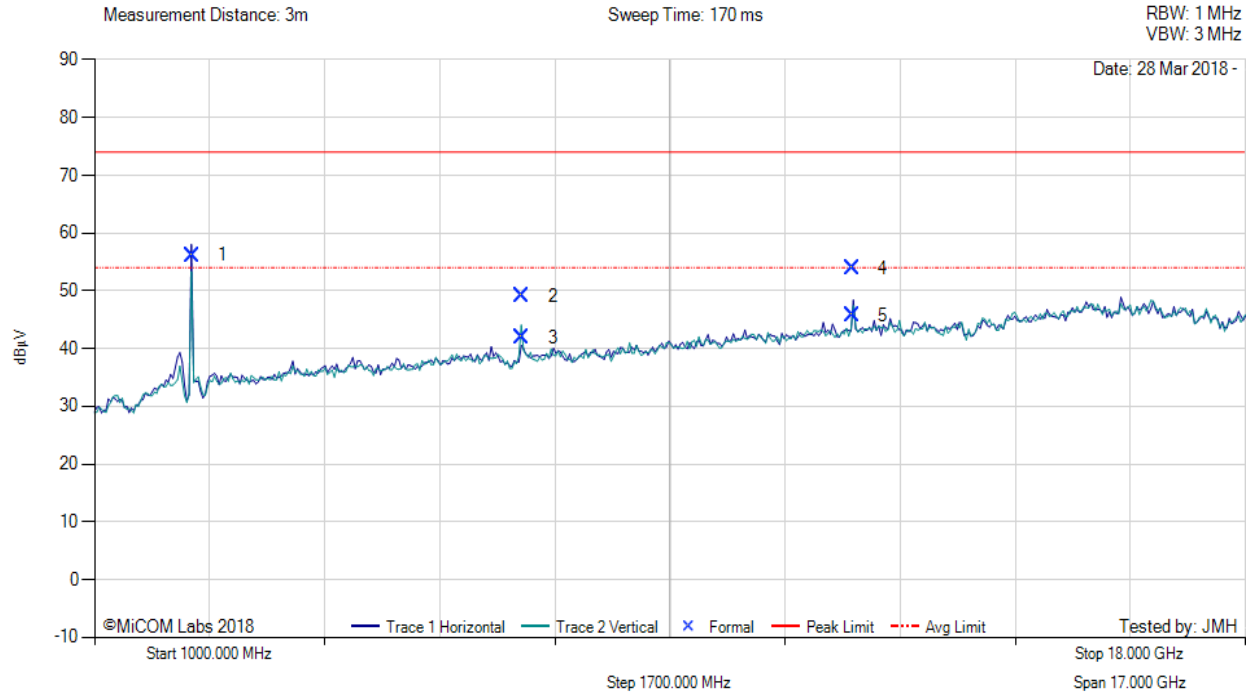


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TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2440.00 MHz, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99



1000.00 - 18000.00 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	2439.96	65.93	2.27	-12.08	56.12	Fundamental	Horizontal	100	0	--	--	
2	7320.15	53.42	3.49	-7.86	49.05	Max Peak	Vertical	111	177	74.0	-25.0	Pass
3	7320.15	46.28	3.49	-7.86	41.91	Max Avg	Vertical	111	177	54.0	-12.1	Pass
4	12200.23	54.01	4.66	-4.76	53.91	Max Peak	Horizontal	182	113	74.0	-20.1	Pass
5	12200.23	45.88	4.66	-4.76	45.78	Max Avg	Horizontal	182	113	54.0	-8.2	Pass

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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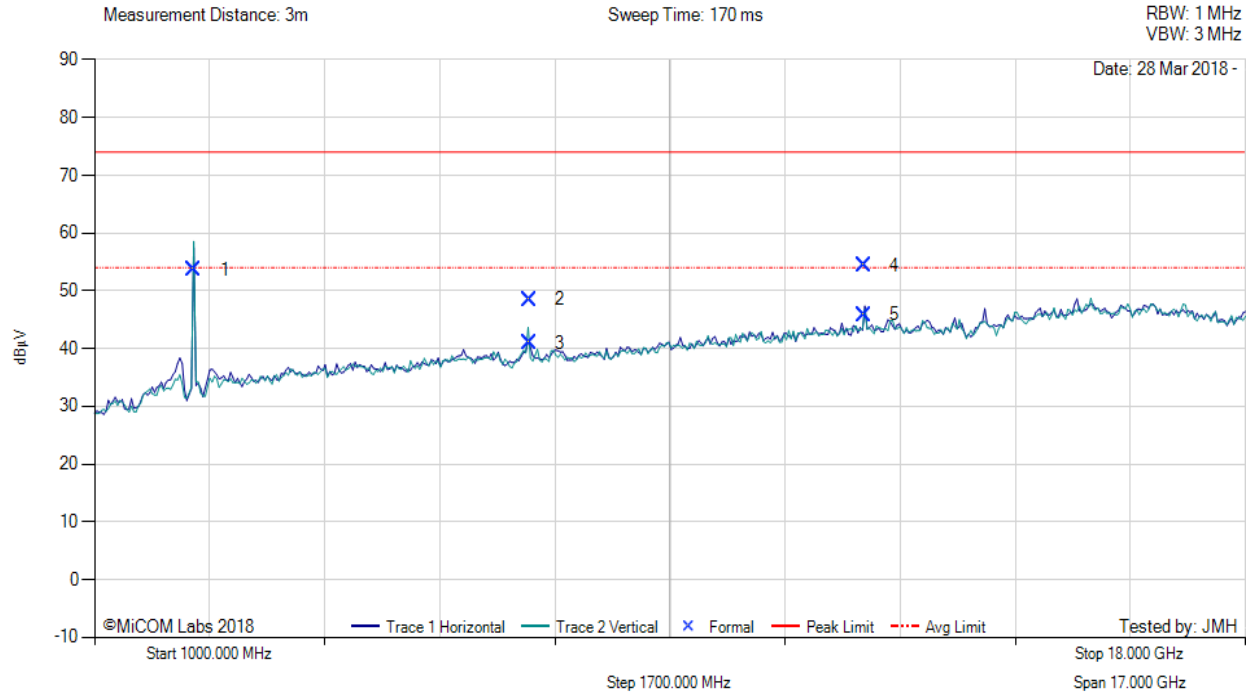


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TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2472.80 MHz, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99



1000.00 - 18000.00 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	2472.70	63.31	2.26	-11.92	53.65	Fundamental	Vertical	151	121	--	--	
2	7418.60	52.97	3.54	-8.00	48.51	Max Peak	Vertical	176	180	74.0	-25.5	Pass
3	7418.60	45.45	3.54	-8.00	40.99	Max Avg	Vertical	176	180	54.0	-13.0	Pass
4	12364.36	54.57	4.65	-4.86	54.36	Max Peak	Horizontal	180	84	74.0	-19.6	Pass
5	12364.36	46.08	4.65	-4.86	45.87	Max Avg	Horizontal	180	84	54.0	-8.1	Pass

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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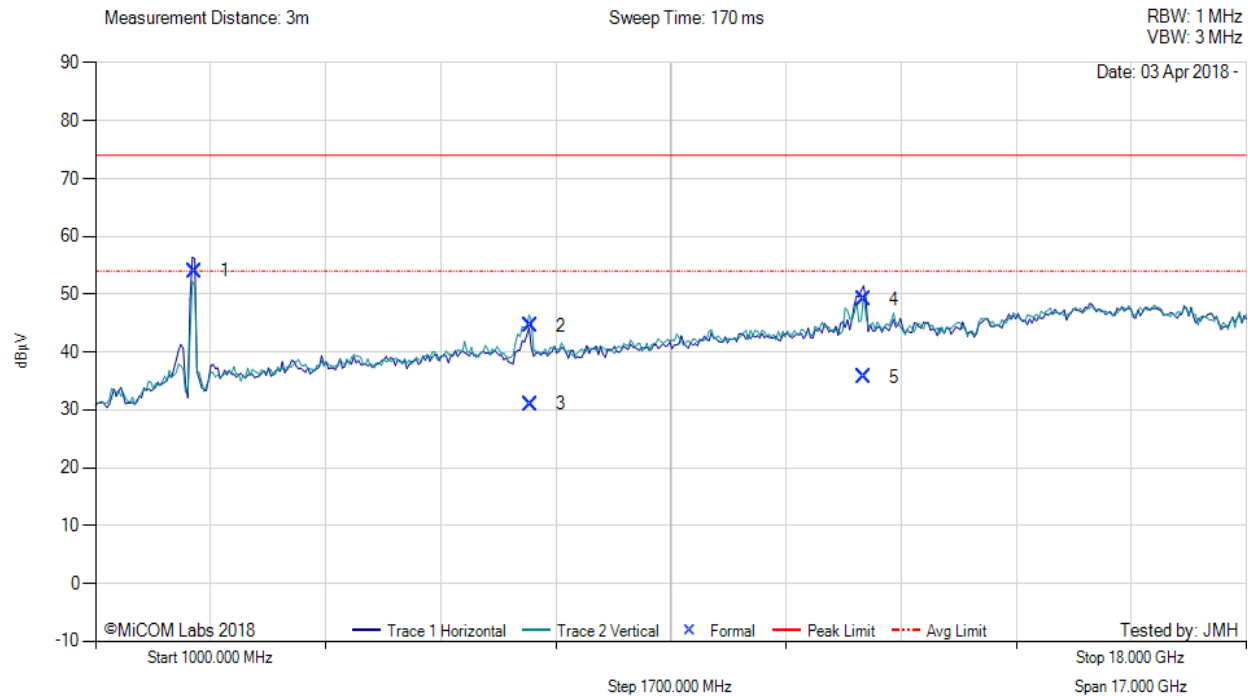


Title: Itron, Inc. NIC 510-06
To: FCC CFR 47 Part 15.247 (FHSS); RSS-247
Serial #: ITRO01-U5 Rev A
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TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: Hopping, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99



1000.00 - 18000.00 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	2461.61	63.65	2.29	-11.95	53.99	Fundamental	Horizontal	100	0	--	--	Pass
2	7421.08	49.06	3.54	-8.05	44.55	Max Peak	Vertical	112	274	74.0	-29.5	Pass
3	7421.08	35.50	3.54	-8.05	30.99	Max Avg	Vertical	112	274	54.0	-23.0	Pass
4	12348.38	49.04	4.58	-4.56	49.06	Max Peak	Horizontal	115	247	74.0	-24.9	Pass
5	12348.38	35.62	4.58	-4.56	35.64	Max Avg	Horizontal	115	247	54.0	-18.4	Pass

Test Notes: EUT powered by 4V DC. 2.4 GHz Notch filter in front of amp to prevent overload. Hopping

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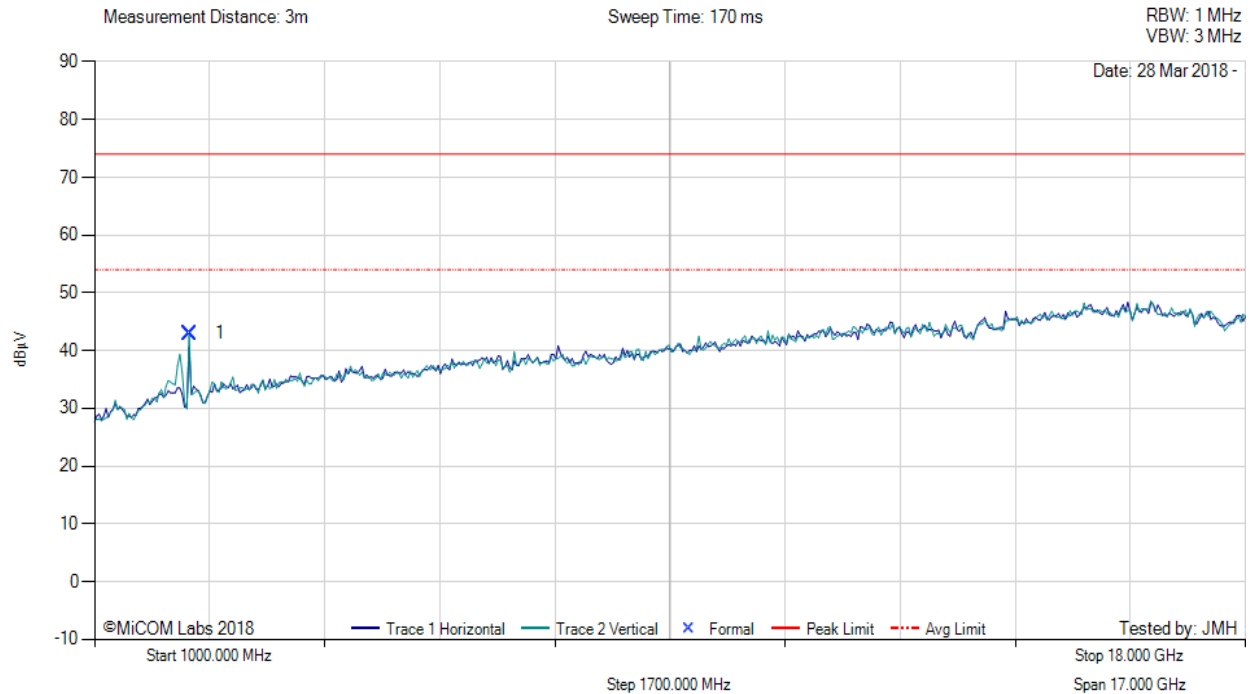
Title: Itron, Inc. NIC 510-06
To: FCC CFR 47 Part 15.247 (FHSS); RSS-247
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Antenna: WP WPANT30017-CA



TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2400.80 MHz, Antenna: WP WPANT30017-CA, Power Setting: 21, Duty Cycle (%): 99



1000.00 - 18000.00 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	2400.92	53.14	2.24	-12.41	42.97	Fundamental	Vertical	100	161	--	--	

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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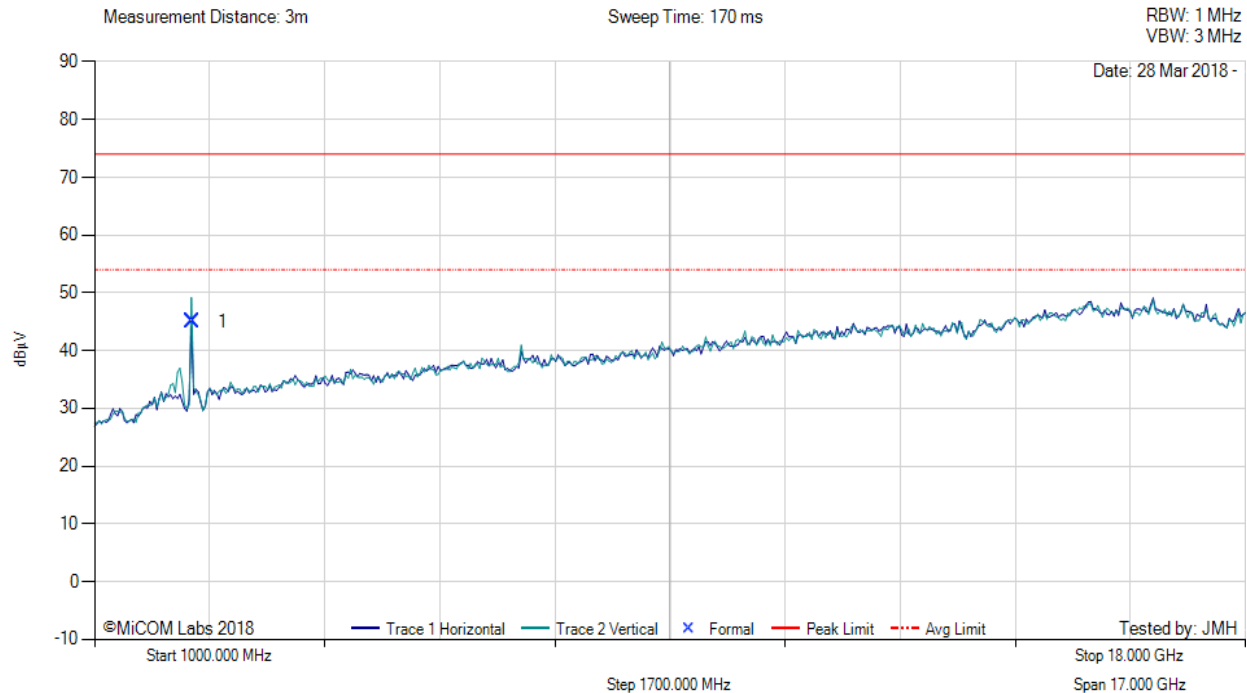


Title: Itron, Inc. NIC 510-06
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TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2440.00 MHz, Antenna: WP WPANT30017-CA, Power Setting: 21, Duty Cycle (%): 99



1000.00 - 18000.00 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	2440.01	54.80	2.27	-12.08	44.99	Fundamental	Vertical	100	154	--	--	
Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.												

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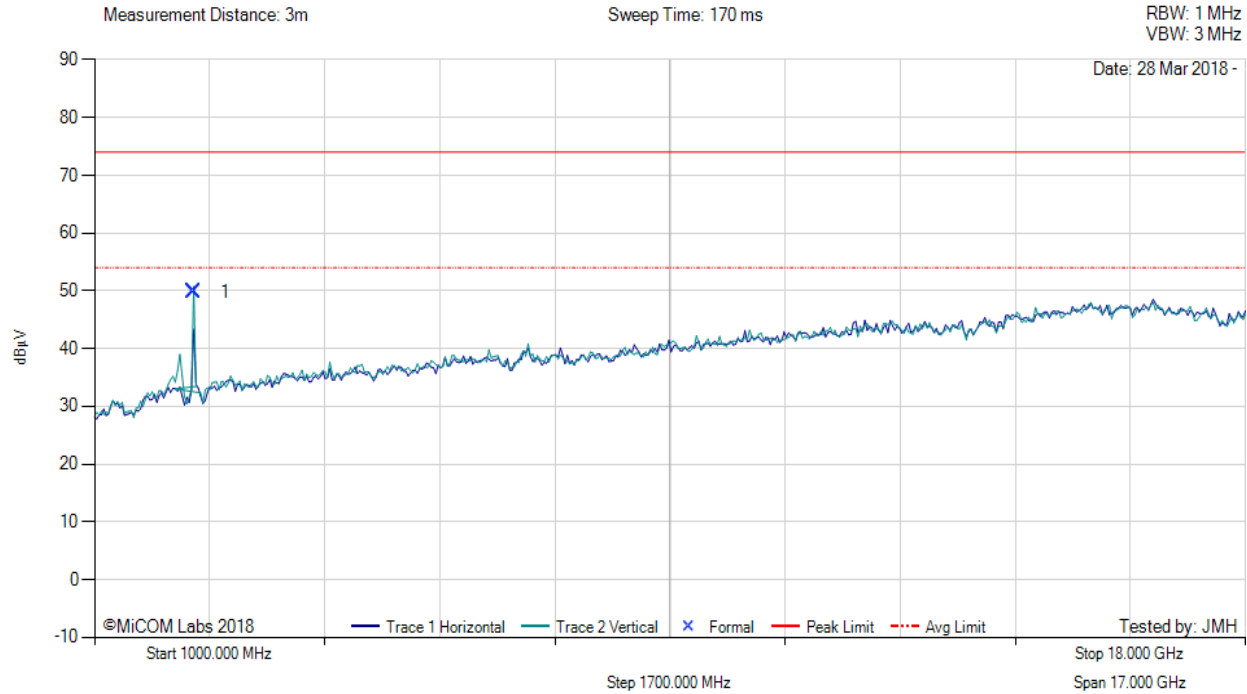


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TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2472.80 MHz, Antenna: WP WPANT30017-CA, Power Setting: 21, Duty Cycle (%): 99



1000.00 - 18000.00 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	2472.92	59.41	2.26	-11.92	49.75	Fundamental	Vertical	100	42	--	--	
Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.												

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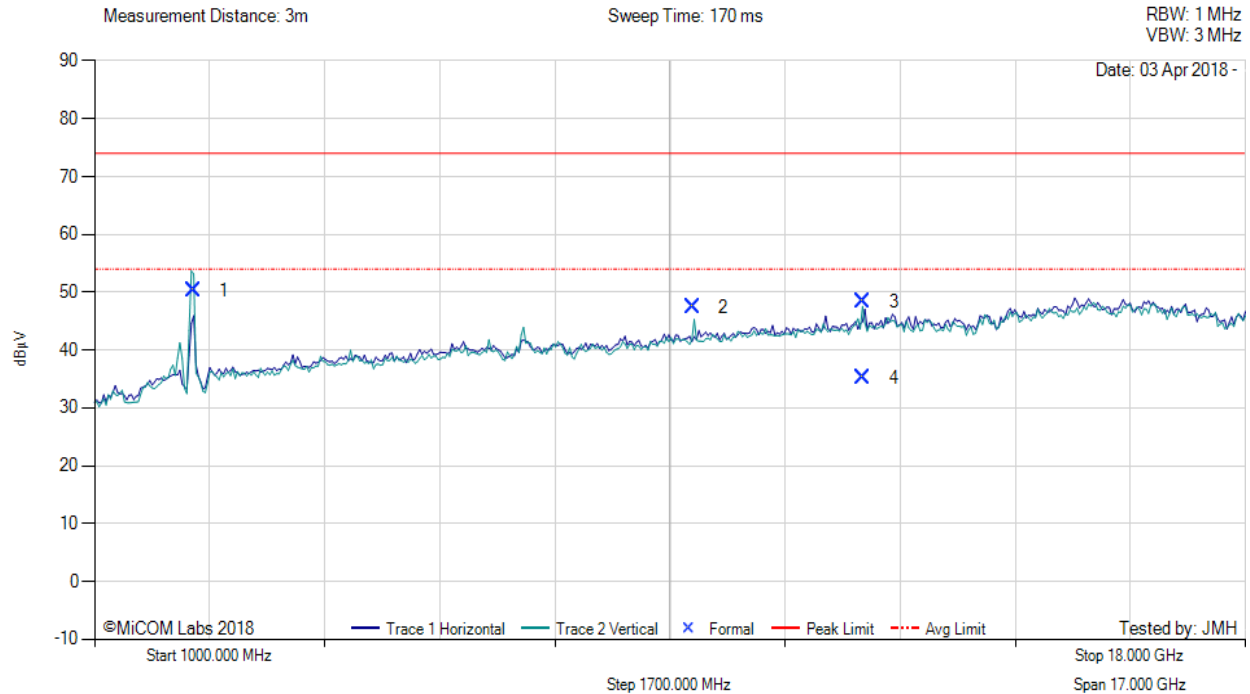


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TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: Hopping, Antenna: WP WPANT30017-CA, Power Setting: 21, Duty Cycle (%): 99



1000.00 - 18000.00 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	2466.35	59.96	2.27	-11.97	50.26	Fundamental	Vertical	200	0	--	--	Pass
2	9836.61	49.25	4.45	-6.34	47.36	Peak (NRB)	Vertical	200	86	--	--	Pass
3	12355.99	48.48	4.61	-4.68	48.41	Max Peak	Vertical	170	92	74.0	-25.6	Pass
4	12355.99	35.25	4.61	-4.68	35.18	Max Avg	Vertical	170	92	54.0	-18.8	Pass

Test Notes: EUT powered by 4V DC. 2.4 GHz Notch filter in front of amp to prevent overload. Hopping

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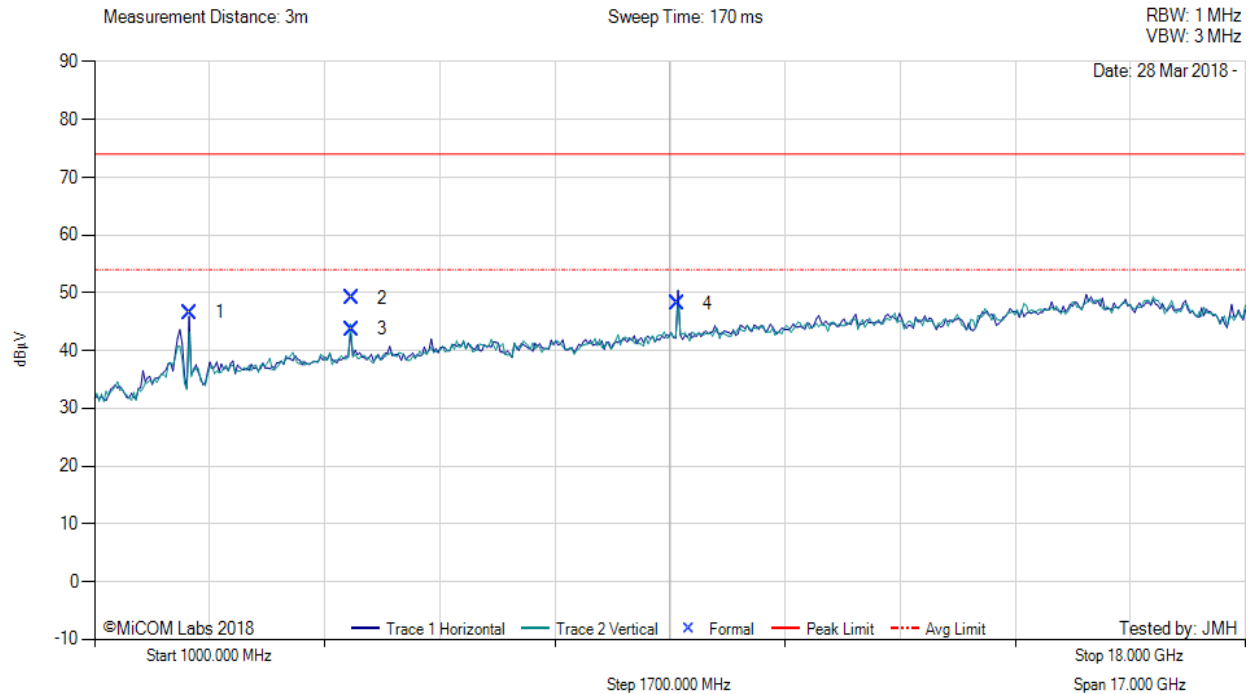
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Antenna: WP WPANT40020-SA



TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2400.80 MHz, Antenna: WP WPANT40020-SA, Power Setting: 21, Duty Cycle (%): 99



1000.00 - 18000.00 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	2400.70	56.75	2.24	-12.41	46.58	Fundamental	Horizontal	200	95	--	--	
2	4801.61	58.63	2.96	-12.43	49.16	Max Peak	Vertical	101	214	74.0	-24.8	Pass
3	4801.61	53.13	2.96	-12.43	43.66	Max Avg	Vertical	101	214	54.0	-10.3	Pass
4	9603.08	50.22	4.54	-6.67	48.09	Peak (NRB)	Horizontal	200	175	--	--	Pass

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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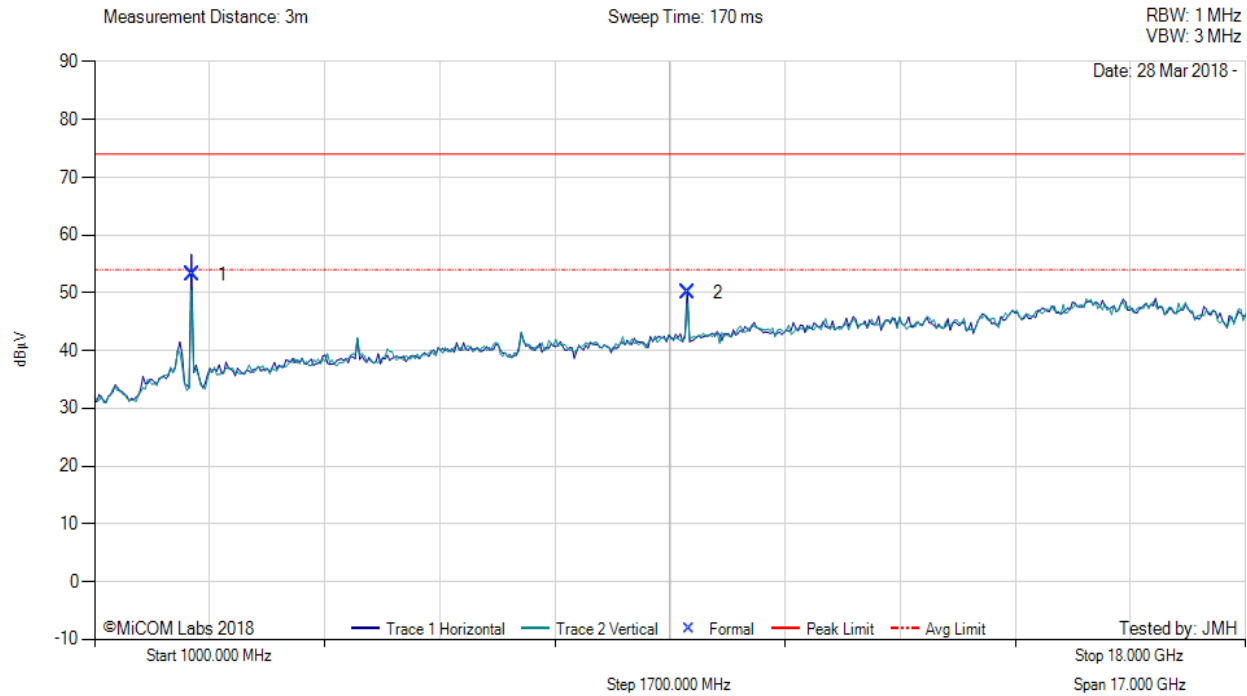


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TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2440.00 MHz, Antenna: WP WPANT40020-SA, Power Setting: 21, Duty Cycle (%): 99



1000.00 - 18000.00 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	2439.94	62.92	2.27	-12.08	53.11	Fundamental	Horizontal	100	60	--	--	
2	9759.74	51.66	4.37	-5.95	50.08	Peak (NRB)	Horizontal	100	185	--	--	Pass

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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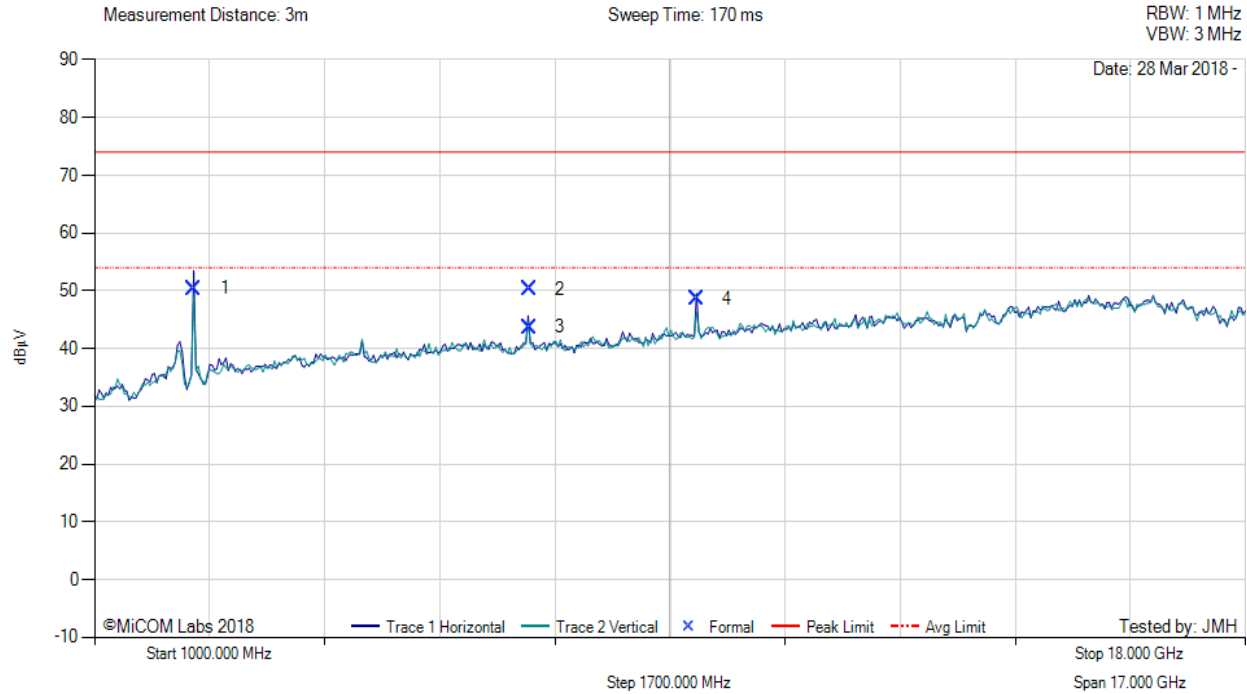


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TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: 2472.80 MHz, Antenna: WP WPANT40020-SA, Power Setting: 21, Duty Cycle (%): 99



1000.00 - 18000.00 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	2472.92	60.09	2.26	-11.92	50.43	Fundamental	Vertical	100	114	--	--	
2	7418.47	54.77	3.54	-8.00	50.31	Max Peak	Horizontal	151	188	74.0	-23.7	Pass
3	7418.47	48.20	3.54	-8.00	43.74	Max Avg	Horizontal	151	188	54.0	-10.3	Pass
4	9891.22	50.89	4.48	-6.76	48.61	Peak (NRB)	Horizontal	100	175	--	--	Pass

Test Notes: EUT powered by 4 volt DC. 2.4 GHz notch placed in front of amp to prevent overload.

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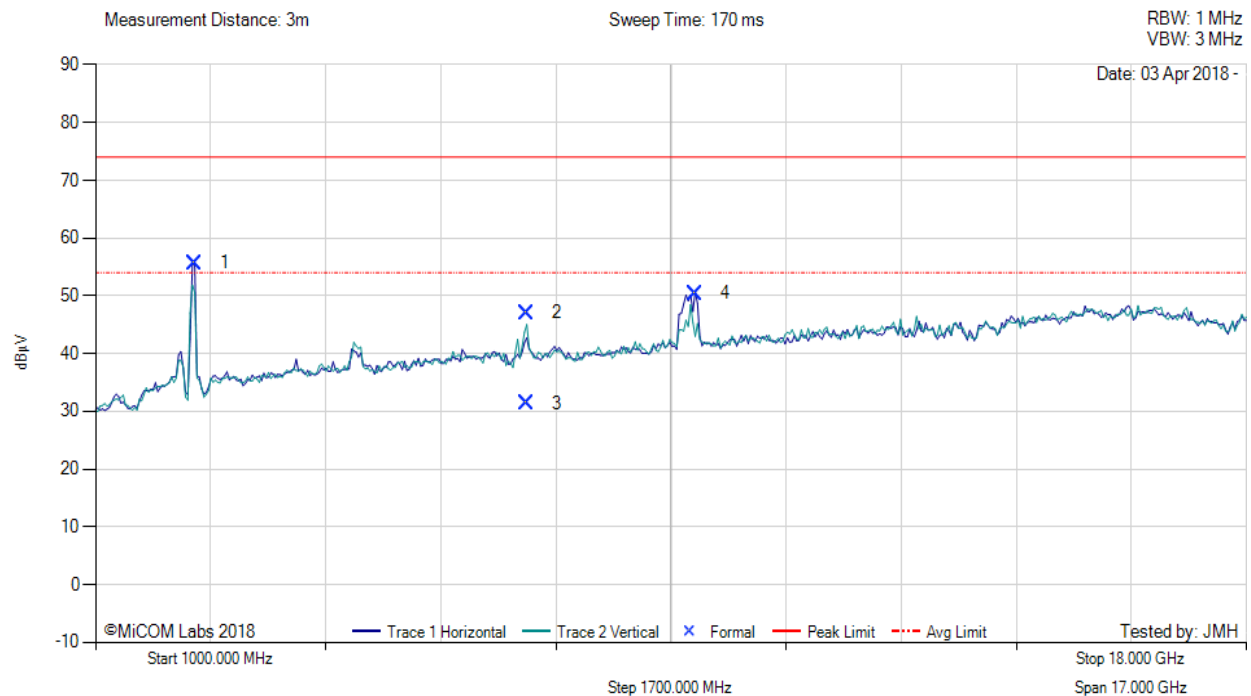


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TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: GFSK, Test Freq: Hopping, Antenna: WP WPANT40020-SA, Power Setting: 21, Duty Cycle (%): 99



1000.00 - 18000.00 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	2464.16	65.34	2.28	-11.96	55.66	Peak (NRB)	Horizontal	151	150	--	--	Pass
2	7365.89	51.31	3.52	-7.81	47.02	Max Peak	Vertical	160	153	74.0	-27.0	Pass
3	7365.89	35.60	3.52	-7.81	31.31	Max Avg	Vertical	160	153	54.0	-22.7	Pass
4	9856.23	52.55	4.41	-6.57	50.39	Peak (NRB)	Horizontal	151	279	--	--	Pass

Test Notes: EUT powered by 4V DC. 2.4 GHz Notch in front of amp to prevent overload. Hopping

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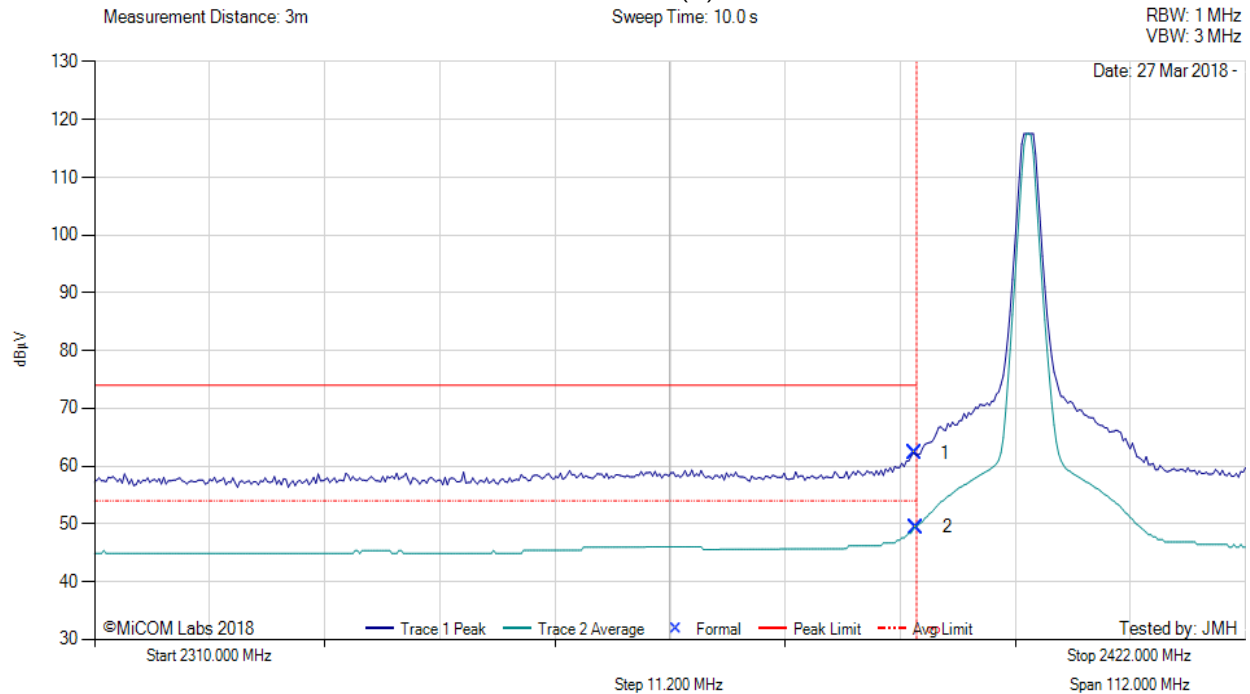
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A.3.2.4. Restricted Edge & Band-Edge Emissions



RADIATED - LOWER RESTRICTED BAND-EDGE EMISSIONS

Variant: GFSK, Test Freq: 2400.80 MHz, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99



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	2389.78	28.08	2.26	31.96	62.30	Max Peak	Horizontal	130	80	74.0	-11.7	Pass
2	2390.00	15.24	2.26	31.96	49.46	Max Avg	Horizontal	130	80	54.0	-4.5	Pass
3	2390.00	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: EUT powered by 4 volt DC,

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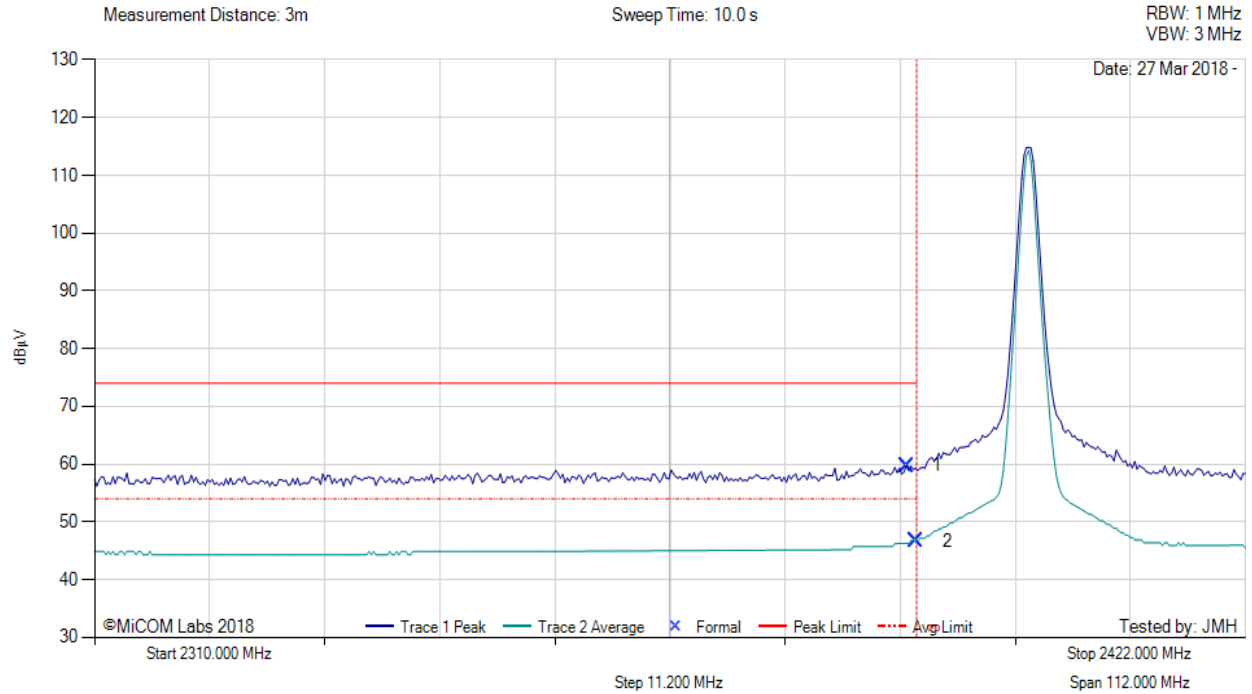


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RADIATED - LOWER RESTRICTED BAND-EDGE EMISSIONS

Variant: GFSK, Test Freq: 2400.80 MHz, Antenna: WP WPANT30017-CA, Power Setting: 21, Duty Cycle (%): 99



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	2389.01	25.53	2.26	31.95	59.74	Max Peak	Vertical	193	348	74.0	-14.3	Pass
2	2390.00	12.51	2.26	31.96	46.73	Max Avg	Vertical	193	348	54.0	-7.3	Pass
3	2390.00	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: EUT powered by 4 volt DC,

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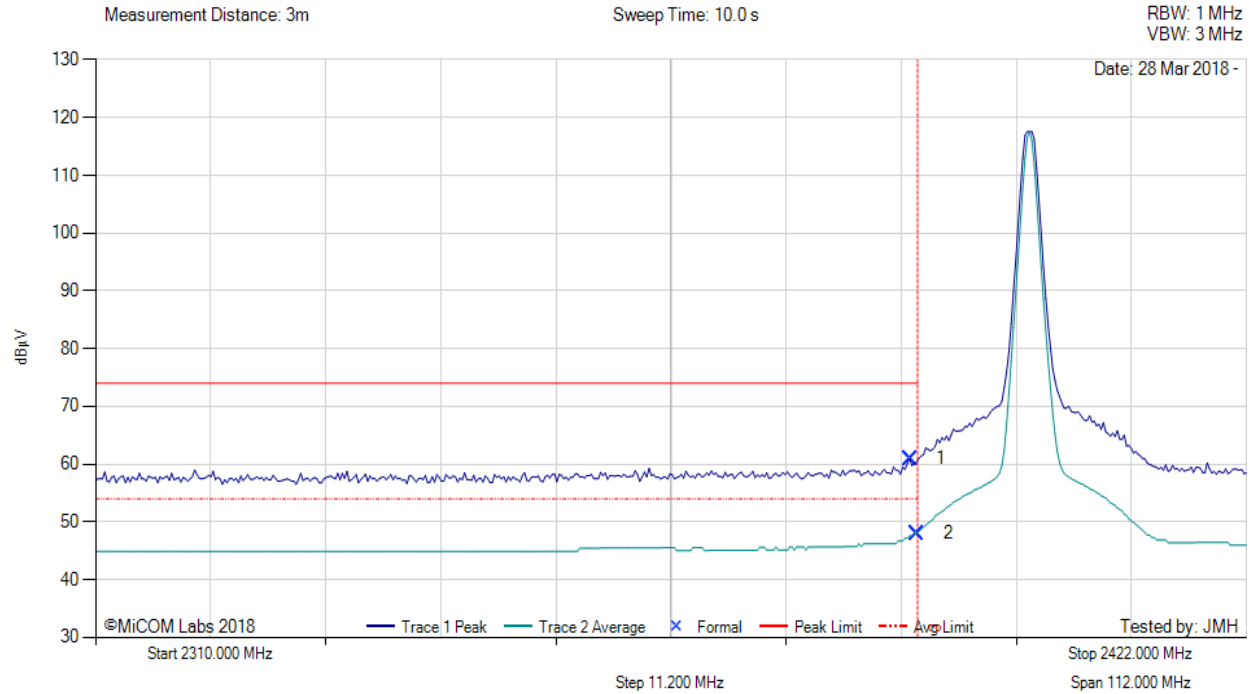


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RADIATED - LOWER RESTRICTED BAND-EDGE EMISSIONS

Variant: GFSK, Test Freq: 2400.80 MHz, Antenna: WP WPANT40020-SA, Power Setting: 21, Duty Cycle (%): 99



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	2389.33	26.77	2.26	31.95	60.98	Max Peak	Horizontal	200	153	74.0	-13.0	Pass
2	2390.00	13.79	2.26	31.96	48.01	Max Avg	Horizontal	200	153	54.0	-6.0	Pass
3	2390.00	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: EUT powered by 4 volt DC

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RADIATED - UPPER RESTRICTED BAND-EDGE EMISSIONS

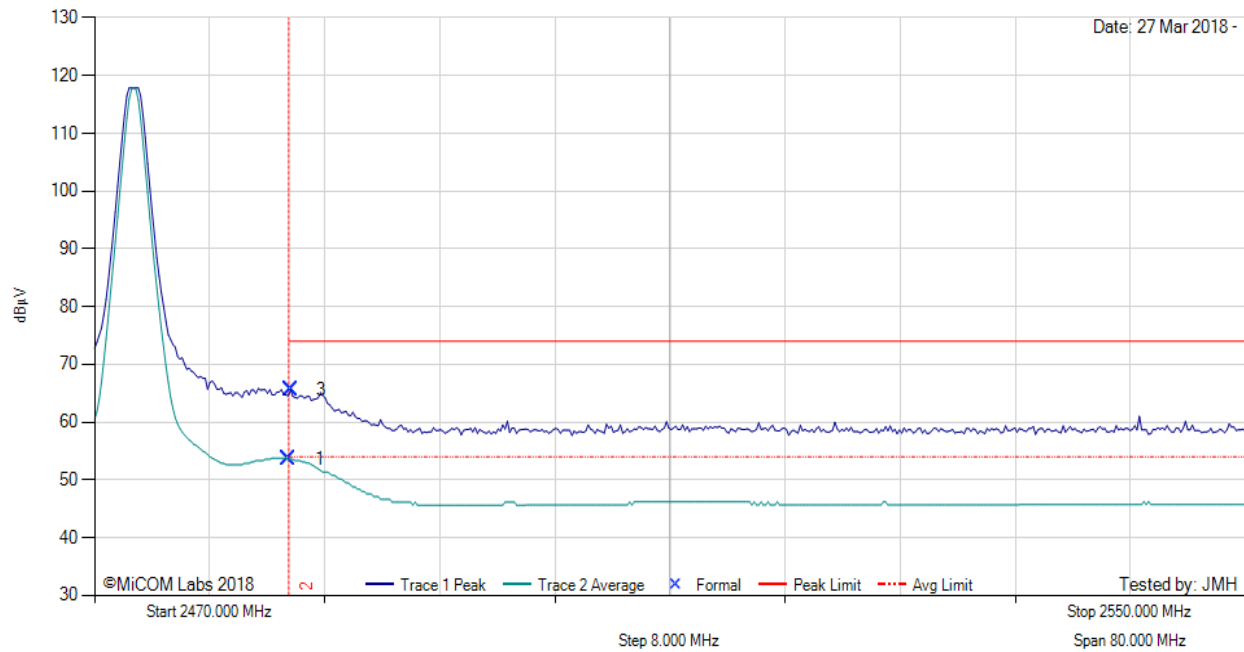
Variant: GFSK, Test Freq: 2472.80 MHz, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99

Measurement Distance: 3m

Sweep Time: 10.0 s

RBW: 1 MHz
 VBW: 3 MHz

Date: 27 Mar 2018 -



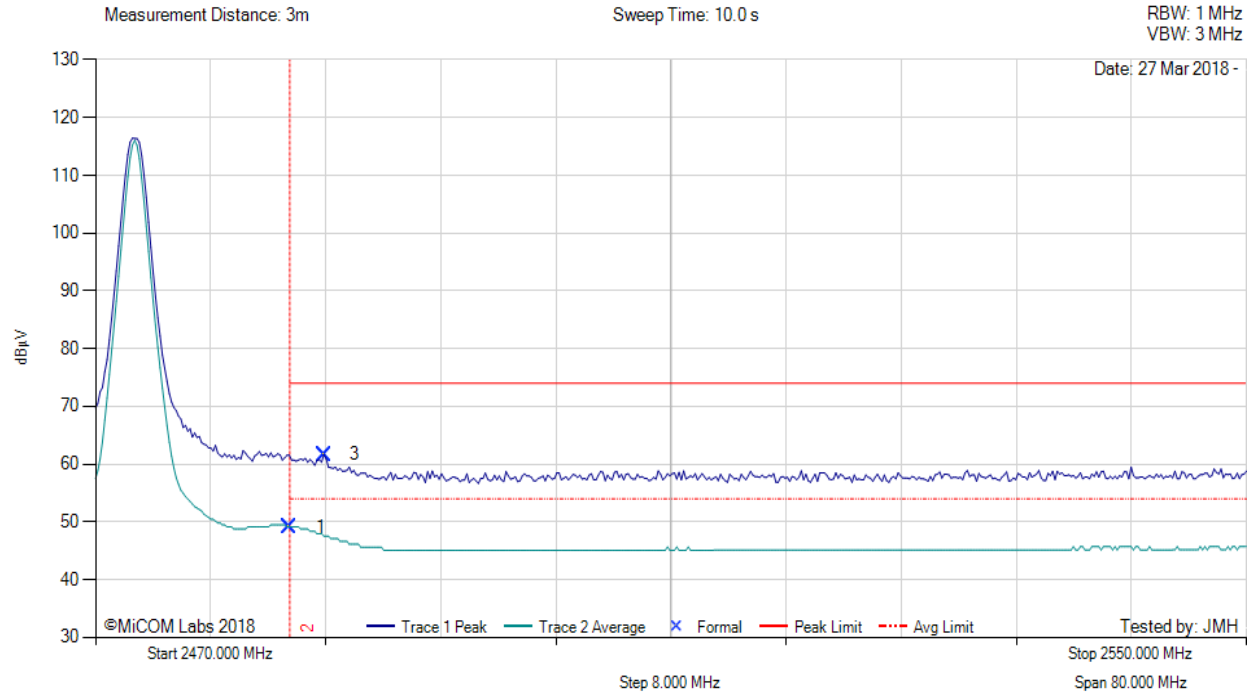
2470.00 - 2550.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	2483.50	19.00	2.25	32.33	53.58	Max Avg	Horizontal	130	80	54.0	-0.4	Pass
3	2483.66	30.99	2.25	32.33	65.57	Max Peak	Horizontal	130	80	74.0	-8.4	Pass
2	2483.50	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: EUT powered by 4 volt DC,

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RADIATED - UPPER RESTRICTED BAND-EDGE EMISSIONS

Variant: GFSK, Test Freq: 2472.80 MHz, Antenna: WP WPANT30017-CA, Power Setting: 21, Duty Cycle (%): 99



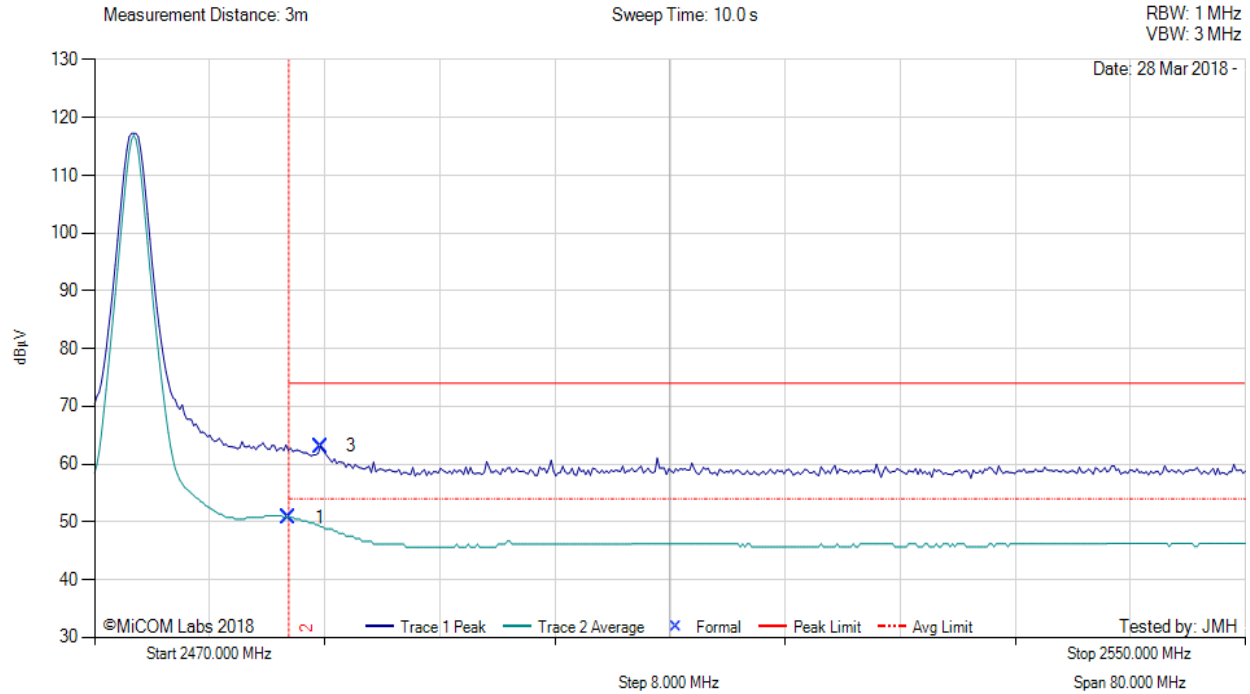
2470.00 - 2550.00 MHz												
Num	Frequency MHz	Raw dBμV	Cable Loss dB	AF dB	Level dBμV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBμV/m	Margin dB	Pass /Fail
1	2483.50	14.56	2.25	32.33	49.14	Max Avg	Vertical	193	348	54.0	-4.9	Pass
3	2485.90	27.05	2.25	32.33	61.63	Max Peak	Vertical	193	348	74.0	-12.4	Pass
2	2483.50	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: EUT powered by 4 volt DC,

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RADIATED - UPPER RESTRICTED BAND-EDGE EMISSIONS

Variant: GFSK, Test Freq: 2472.80 MHz, Antenna: WP WPANT40020-SA, Power Setting: 21, Duty Cycle (%): 99



2470.00 - 2550.00 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	2483.50	16.21	2.25	32.33	50.79	Max Avg	Horizontal	183	159	54.0	-3.2	Pass
3	2485.74	28.55	2.25	32.33	63.13	Max Peak	Horizontal	183	159	74.0	-10.9	Pass
2	2483.50	--	--	--	--	Restricted-Band	--	--	--	--	--	--

Test Notes: EUT powered by 4 volt DC

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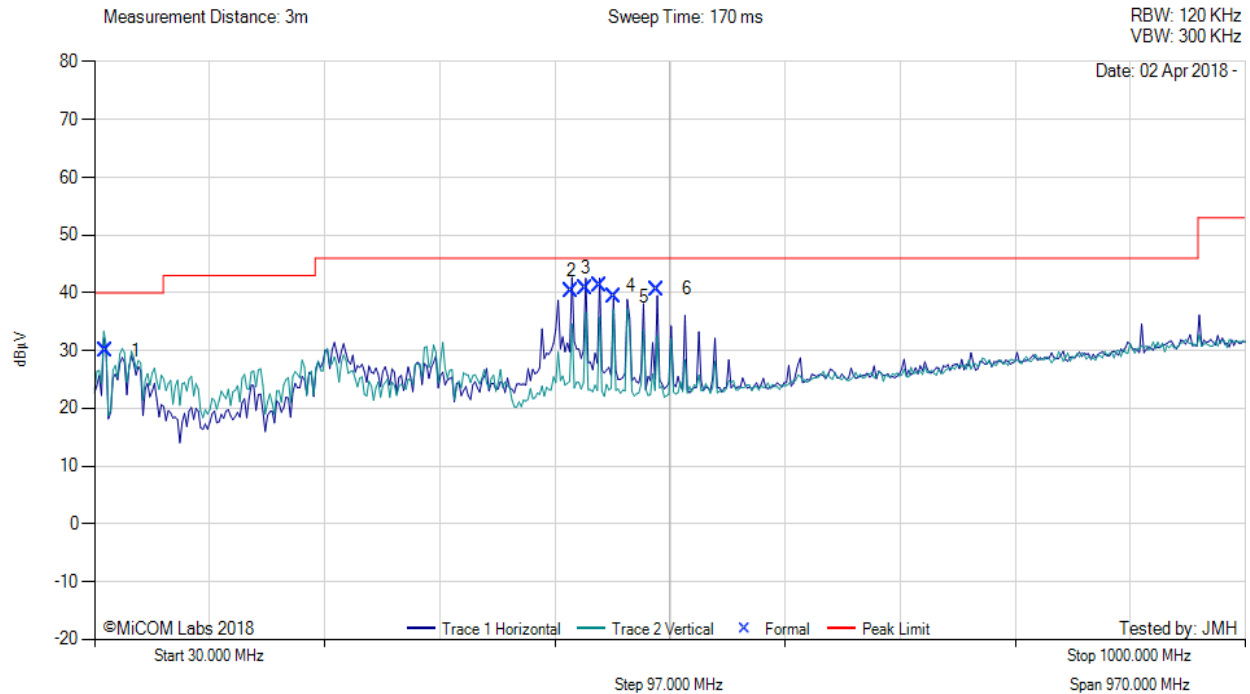
A.3.3. Digital Emissions (0.03 - 1 GHz)

USB Active and downloading, Connected to SBC computer



DIGITAL EMISSIONS (0.03 - 1 GHz)

Variant: OFDM, Test Freq: 0.00 MHz, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: NA



30.00 - 1000.00 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	39.02	43.91	3.47	-17.37	30.01	MaxQP	Vertical	104	71	40.0	-10.0	Pass
2	431.96	49.59	4.99	-14.31	40.27	MaxQP	Horizontal	204	154	46.0	-5.7	Pass
3	443.99	49.98	5.02	-14.21	40.79	MaxQP	Horizontal	101	356	46.0	-5.2	Pass
4	456.01	50.18	5.04	-13.93	41.29	MaxQP	Horizontal	282	349	46.0	-4.7	Pass
5	468.02	47.67	5.07	-13.37	39.37	MaxQP	Horizontal	101	301	46.0	-6.6	Pass
6	503.99	48.65	5.20	-13.23	40.62	MaxQP	Horizontal	159	160	46.0	-5.4	Pass

Test Notes: Powered by AC/DC PS. Digital Communications over USB. Connected to SBC.

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RADIATED DIGITAL EMISSIONS

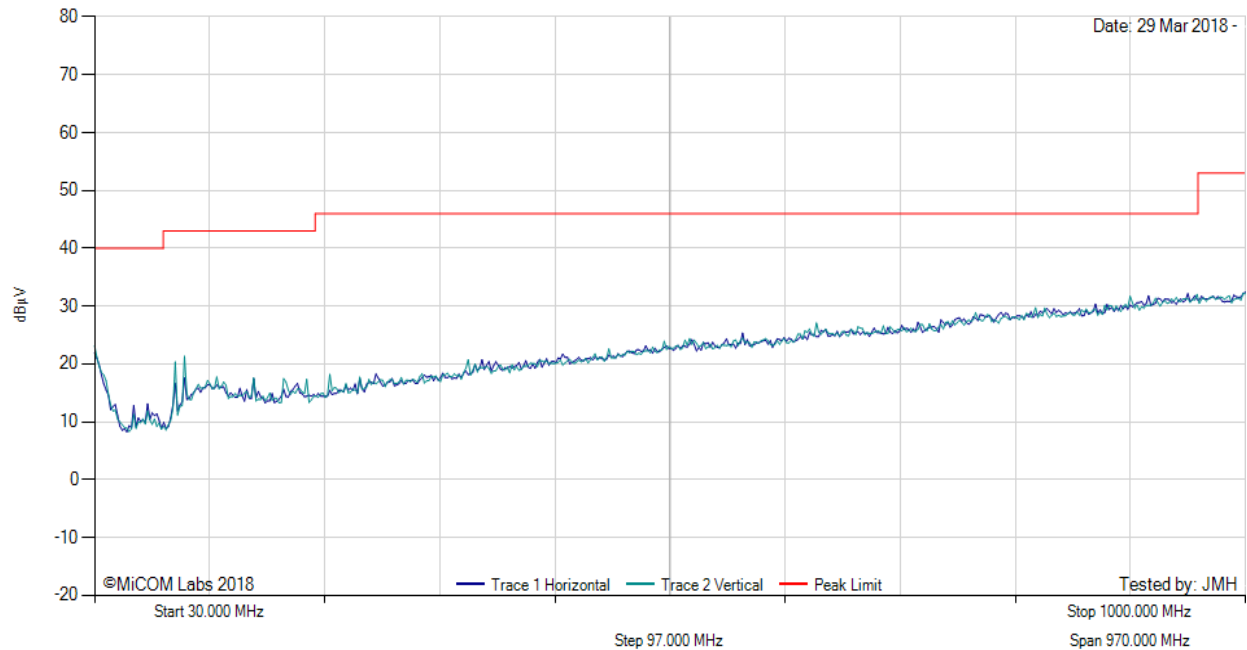
Variant: GFSK, Test Freq: 2440.00 MHz, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99

Measurement Distance: 3m

Sweep Time: 170 ms

RBW: 120 KHz
VBW: 300 KHz

Date: 29 Mar 2018 -



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

Test Notes: EUT powered by 4V DC

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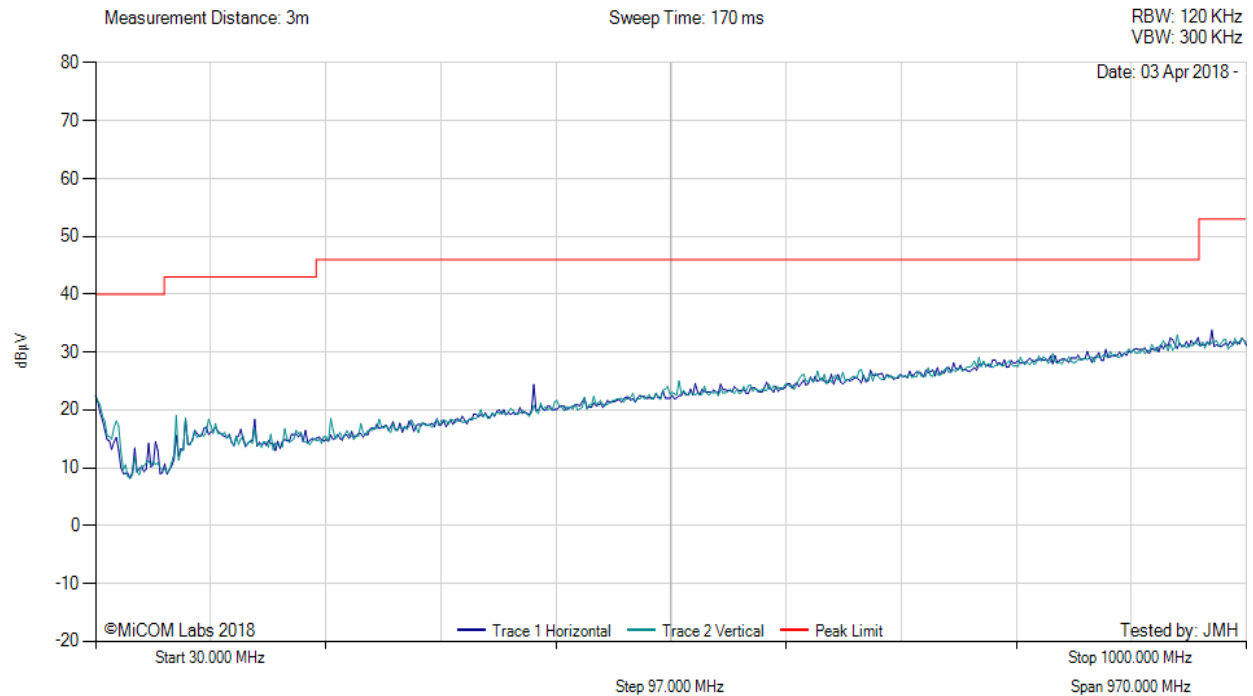


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RADIATED DIGITAL EMISSIONS

Variant: GFSK, Test Freq: Hopping, Antenna: Tai Sheng Chen 155-0010-00, Power Setting: 21, Duty Cycle (%): 99



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

Test Notes: EUT powered by 4V DC. Hopping

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