Company: Alien Technology, LLC

Test of: ALR-H450

To: FCC CFR 47 Part 15 Subpart C 15.247 (FHSS)
Industry Canada RSS-247 Issue 2

Report No.: ALNT83-U2 Rev A

COMPLETE TEST REPORT

COMPLETE TEST REPORT

FROM

Test of: Alien Technology, LLC ALR-H450

to

To: FCC CFR 47 Part 15 Subpart C 15.247 (FHSS)
Industry Canada RSS-247 Issue 2

Test Report Serial No.: ALNT83-U2 Rev A

This report supersedes: NONE

Applicant:	Alien Technology, LLC 845 Embedded Way San Jose, California 95138 USA
Product Function:	Handheld RFID Reader
Issue Date:	29th March 2017

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

ACCREDITED
TESTING CERT #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

Contents

1. ACCREDITATION, LISTINGS & RECOGNITION

1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2005. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-01.pdf

ilac-MRA A2LA

Accredited Laboratory

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 4th day of February 2016.

Senior Director of Quality & Communications
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2017

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

1.2. RECOGNITION

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

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

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

Phase I - recognition for product testing
Phase II – recognition for both product testing and certification

1.3. PRODUCT CERTIFICATION

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

Accredited Product Certification Body

A2LA has accredited

MICOM LABS

Pleasanton, CA

This product certification body is accredited in accordance with the recognized International Standard ISO/IEC 17065:2012 *Requirements for bodies certifying products, processes and services*. This accreditation demonstrates technical competence for a defined scope and the operation of a management system.

Presented this 4th day of February 2016.

Senior Director of Quality & Communications
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2017

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

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

2. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	22nd March 2017	
Rev A	29th March 2017	Initial Release
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In the above table the latest report revision will replace all earlier versions.

3. TEST RESULT CERTIFICATE

Manufacturer:	Alien Technology, LLC 845 Embedded Way San Jose, California 95138 USA	**Tested By:**	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Model:	ALR-H450	**Telephone:** **Fax:**	+1 925 462 0304 +1 925 462 0306
Type Of Equipment:	Handheld RFID Reader		
S/N's:	CW1607010054, CW1607010170 (Digital Emissions)		
Test Date(s):	16th – 17th March 2017	**Website:**	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC CFR 47 Part 15 Subpart C 15.247 (FHSS) **Industry Canada RSS-247 Issue 2 (FHSS)**	**EQUIPMENT COMPLIES**

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

Notes:

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

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

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

A2LA ACCREDITED
TESTING CERT #2381.01

Approved & Released for MiCOM Labs, Inc. by:

Graeme Grieve
Quality Manager MiCOM Labs, Inc.

Gordon Hurst
President & CEO MiCOM Labs, Inc.

4. REFERENCES AND MEASUREMENT UNCERTAINTY

4.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
I	A2LA	June 2015	R105 - Requirement's When Making Reference to A2LA Accreditation Status
II	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
III	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
IV	CISPR 32	2012	Electromagnetic compatibility of multimedia equipment - Emission requirements
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	FCC 47 CFR Part 15.247	2016	Radio Frequency Devices; Subpart C – Intentional Radiators
VIII	FCC Public Notice DA 00-705	March 2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
IX	ICES-003	Issue 6 Jan 2016	Spectrum Management and Telecommunications; Interference-Causing Equipment Standard. Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement.
X	M 3003	Edition 3 Nov.2012	Expression of Uncertainty and Confidence in Measurements
XI	RSS-247 Issue 1	May 2015	Digital Transmission Systems (DTSs), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices
XII	RSS-Gen Issue 4	November 2014	General Requirements and Information for the Certification of Radiocommunication Equipment
XIII	FCC 47 CFR Part 2.1033	2016	FCC requirements and rules regarding photographs and test setup diagrams.

4.2. Test and Uncertainty Procedure

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

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

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

5. PRODUCT DETAILS AND TEST CONFIGURATIONS

5.1. Technical Details

Details	Description
Purpose:	Test of the Alien Technology, LLC ALR-H450 to FCC CFR 47 Part 15 Subpart C 15.247 (FHSS) & IC RSS-247.
Applicant:	Alien Technology, LLC 845 Embedded Way San Jose, California 95138 USA
Manufacturer:	As Applicant
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	ALNT83-U2
Date EUT received:	16th March 2017
Standard(s) applied:	[FCC CFR 47 Part 15 Subpart C 15.247 (FHSS) Industry Canada RSS-247 Issue 2
Dates of test (from - to):	16th – 17th March 2017
No of Units Tested:	2
Model(s):	ALR-H450
Location for use:	Indoor
Declared Frequency Range(s):	902 - 928 MHz;
Type of Modulation:	PR-ASK
EUT Modes of Operation:	902 - 928 MHz: Mode 1 (PR-ASK)
Declared Nominal Output Power (dBm):	Mode 1: +30 dBm
Transmit/Receive Operation:	Transceiver - Full Duplex
Rated Input Voltage and Current:	DC only (Battery operated / external supply) 3.7Vdc
Operating Temperature Range:	Declared Range -10°C to 50°C
ITU Emission Designator:	67K0A1D
Equipment Dimensions:	L: 7.28”, W: 3.35”, H 4.13”,
Weight:	1.375 Lb
Hardware Rev:	Rev B
Software Rev:	3.4.4

5.2. Scope Of Test Program

Alien Technology, LLC ALR-H450

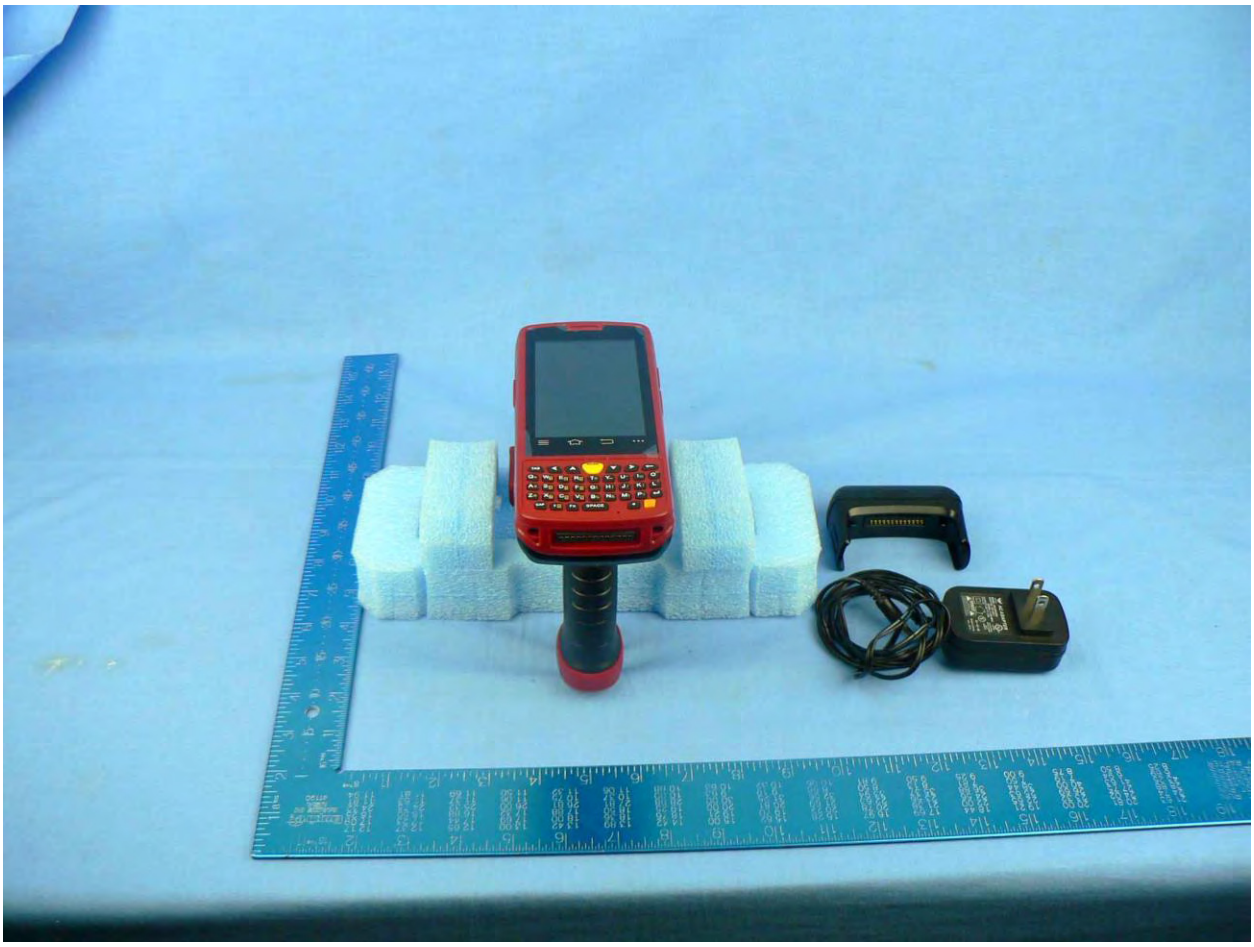
The scope of the test program was to test the Alien Technology, LLC ALR-H450, Handheld RFID Reader configurations in the frequency ranges 902 - 928 MHz; for compliance against the following specification:

FCC CFR 47 Part 15 Subpart C 15.247 (FHSS)
Radio Frequency Devices; Subpart C – Intentional Radiators

Industry Canada RSS-247 Issue 2
Digital Transmission Systems (DTSs), Frequency Hopping System (FHSs) and License-Exempt Local Area Network (LE-LEN) Devices

Alien Technology, LLC ALR-H450 Top View

Alien Technology, LLC ALR-H450 Back View



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

6. Type	Description	Manufacturer	Model	Serial no.	Delivery Date
EUT	Handheld RFID Reader	Alien Technology LLC	ALR-H450	CW1607010054	16th Mar 2017
EUT	Handheld RFID Reader	Alien Technology LLC	ALR-H450	CW1607010170	16th Mar 2017
Support	AC/DC Adapter	Huoniu	HNBM050200WU	--	--

6.1. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
integral	Broad Radio	NA	Omni	1.8	-	360	-	902 - 928

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

6.2. Cabling and I/O Ports

Port Type	Max Cable Length	# Of Ports	Screened	Conn Type	Data Type
USB	15m	1	Y	USB	Data
DC Jack	< 3m	1	Yes		

6.3. Test Configurations

Results for the following configurations are provided in this report:

Operational Mode(s) (PR-ASK)	Data Rate with Highest Power MBit/s	Channel Frequency (MHz)		
		Low	Mid	High
902 - 928 MHz				
Mode 1	40	902.75	915.25	927.25

6.4. Equipment Modifications

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

6.5. Deviations from the Test Standard

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

7. TEST SUMMARY

List of Measurements

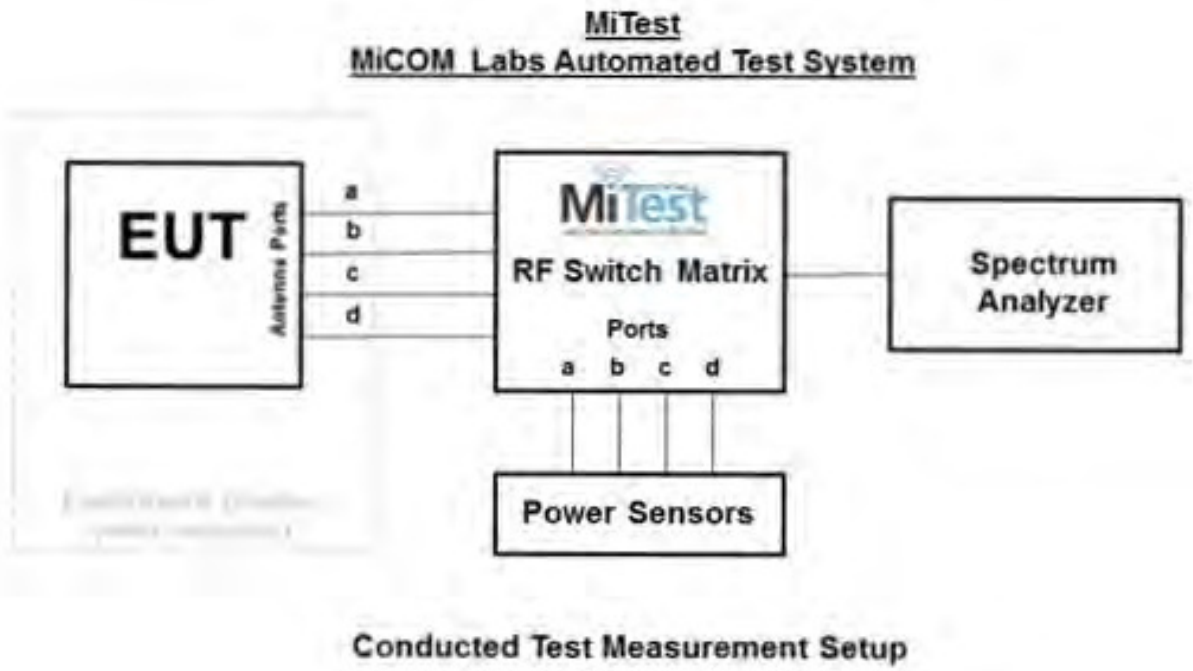
Test Header	Result	Data Link
20 dB & 99% Bandwidth	Complies	View Data
Frequency Hopping Tests	Complies	-
Number of Hopping Channels	Complies	View Data
Channel Separation	Complies	View Data
Dwell Time	Complies	View Data
Channel Occupancy	Complies	View Data
Output Power	Complies	View Data
Emissions	Complies	-
(1) Conducted Emissions	Complies	-
(i) Conducted Unwanted Spurious Emissions	Complies	View Data
(ii) Conducted Band-Edge Emissions	Complies	View Data
(2) Radiated Emissions	Complies	-
(i) TX Spurious & Restricted Band Emissions	Complies	View Data
(ii) Restricted Edge & Band-Edge Emissions	Complies	View Data
(3) Digital Emissions (0.03 - 1 GHz)	Complies	View Data
(4) AC Wireline Emissions	Complies	View Data

8. TEST EQUIPMENT CONFIGURATION(S)

8.1. Conducted

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

1. Section 9.1 20 dB & 99% Bandwidth
2. Section 9.2 Number of Channels
3. Section 9.3 Channel Spacing
4. Section 9.4 Dwell Time & Channel Occupancy
5. Section 9.5 Conducted Output Power
6. Section 9.6.1.1 Conducted Spurious Emissions
7. Section 9.6.1.2 Conducted Spurious Band-Edge Emissions



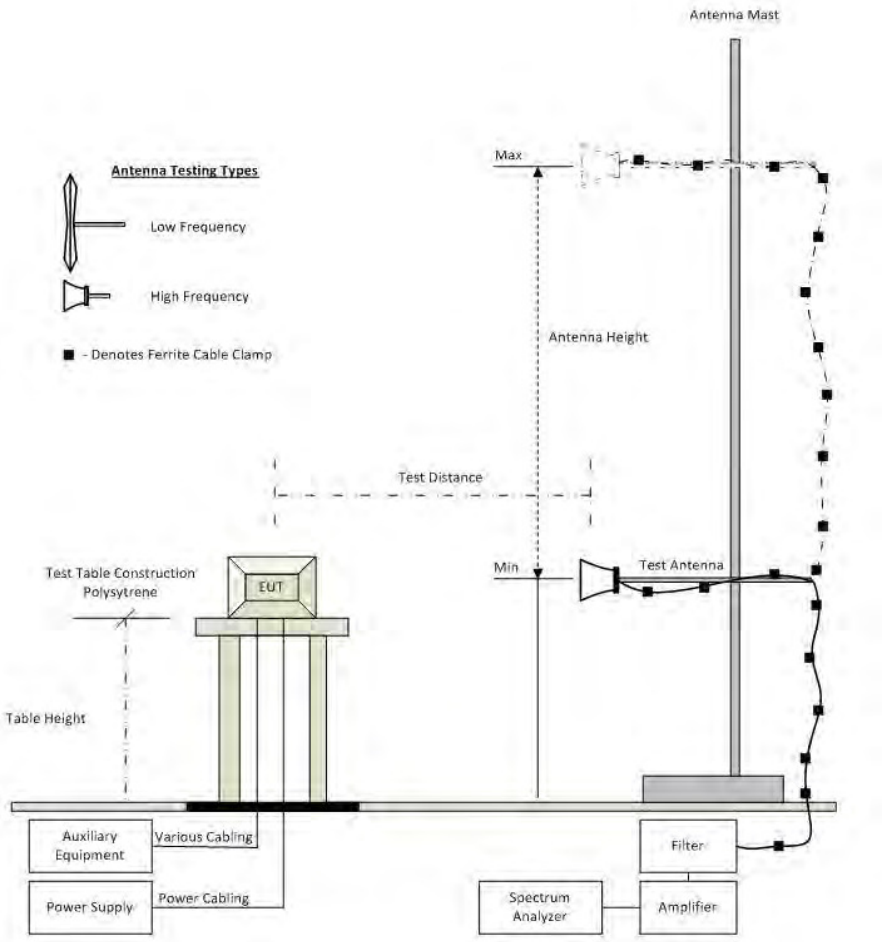
Conducted Test Measurement Setup

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

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
158	Barometer/Thermometer	Control Company	4196	E2846	30 Nov 2017
248	Resistance Thermometer	Thermotronics	GR2105-02	9340 #1	21 Oct 2017
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	4 Aug 2017
381	4x4 RF Switch Box	MiCOM Labs	MiTest RF Switch Box	MIC002	2 Jun 2017
398	Test Software	MiCOM	MiTest ATS	Version 4.1.0.76	Not Required
419	Laptop with Labview Software	Lenova	W520	TS02	Not Required
420	USB to GPIB Interface	National Instruments	GPIB-USB HS	1346738	Not Required
440	USB Wideband Power Sensor	Boonton	55006	9178	25 Sep 2017
442	USB Wideband Power Sensor	Boonton	55006	9181	6 Oct 2017
445	PoE Injector	D-Link	DPE-101GL	QTAH1E2000625	Not Required
460	Dell Computer	Dell	Optiplex330	BC944G1	Not Required
461	Spectrum Analyzer	Agilent	E4440A	MY46185537	13 Aug 2017
493	USB Wideband Power Sensor	Boonton	55006	9634	10 Mar 2018
494	USB Wideband Power Sensor	Boonton	55006	9726	10 Mar 2018
74	Environmental Chamber Chamber 3	Tenney	TTC	12808-1	29 Sep 2017
RF#2 GPIB#1	GPIB cable to Power Supply	HP	GPIB	None	Not Required
RF#2 SMA#1	EUT to Mitest box port 1	Flexco	SMA Cable port1	None	2 Jun 2017
RF#2 SMA#2	EUT to Mitest box port 2	Flexco	SMA Cable port2	None	2 Jun 2017
RF#2 SMA#3	EUT to Mitest box port 3	Flexco	SMA Cable port3	None	2 Jun 2017
RF#2 SMA#4	EUT to Mitest box port 4	Flexco	SMA Cable port4	None	2 Jun 2017
RF#2 SMA#SA	Mitest box to SA	Flexco	SMA Cable SA	None	2 Jun 2017
RF#2 USB#1	USB Cable to Mitest Box	Dynex	USB Cable	None	Not Required

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

1. Spurious Emissions
2. Radiated Digital Emissions



Radiated Emission Test Setup

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

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
158	Barometer/Thermometer	Control Company	4196	E2846	30 Nov 2017
170	Video System Controller for Semi Anechoic Chamber	Panasonic	WV-CU101	04R08507	Not Required
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	15 Aug 2017
341	900MHz Notch Filter	EWT	EWT-14-0199	H1	16 Aug 2017
346	1.6 TO 10GHz High Pass Filter	EWT	EWT-57-0112	H1	16 Aug 2017
373	26III RMS Multimeter	Fluke	Fluke 26 series III	76080720	26 Oct 2017
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	4 Aug 2017
393	DC - 1050 MHz Low Pass Filter	Microcircuits	VLFX-1050	N/A	16 Aug 2017
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	9 Jun 2017
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	10 Apr 2017
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	9 Jun 2017
410	Desktop Computer	Dell	Inspiron 620	WS38	Not Required
411	Mast/Turntable Controller	Sunol Sciences	SC98V	060199-1D	Not Required
412	USB to GPIB Interface	National Instruments	GPIB-USB HS	11B8DC2	Not Required
413	Mast Controller	Sunol Science	TWR95-4	030801-3	Not Required
415	Turntable Controller	Sunol Sciences	Turntable Controller	None	Not Required
416	Gigabit ethernet filter	ETS-Lingren	Gigafoil 260366	None	Not Required
447	Rad Emissions Test Software	MiCOM	Rad Emissions Test Software Version 1.0.109	447	Not Required
462	Schwarzbeck cable from Antenna to Amplifier.	Schwarzbeck	AK 9513	462	31 May 2017
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	31 May 2017
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	31 May 2017
465	Low Pass Filter DC-1000 MHz	Mini-Circuits	NLP-1200+	VUU01901402	2 Jun 2017

466	Low Pass Filter DC-1500 MHz	Mini-Circuits	NLP-1750+	VUU10401438	2 Jun 2017
467	2495 to 2650 MHz notch filter	MicroTronics	BRM50709	011	16 Aug 2017
480	Cable - Bulkhead to Amp	SRC Haverhill	157-157-3050360	480	2 Jun 2017
481	Cable - Bulkhead to Receiver	SRC Haverhill	151-151-3050787	481	2 Jun 2017
482	Cable - Amp to Antenna	SRC Haverhill	157-157-3051574	482	2 Jun 2017
502	Test Software for Radiated Emissions	EMISoft	Vasona	Version 5 Build 59	Not Required
CC05	Confidence Check	MiCOM	CC05	None	26 Apr 2017
VLF-1700	Low pass filter DC-1700 MHz	Mini Circuits	VLF-1700	None	31 May 2017

9. 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)

10. TEST RESULTS

10.1. 20 dB & 99% Bandwidth

Conducted Test Conditions for 20 dB and 99% Bandwidth			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	20 dB and 99 % Bandwidth	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(1)(i)/(ii)	**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.

Limits for 20 dB and 99% Bandwidth

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

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(ii) Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

Equipment Configuration for 20 dB 99% Bandwidth			
Variant:	Mode 1	**Duty Cycle (%):**	65
Data Rate:	40.00 KBit/s	**Antenna Gain (dBi):**	1.88
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	JMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 20 dB Bandwidth (MHz) Port(s)				20 dB Bandwidth (MHz)		Limit	Lowest Margin
MHz	a	b	c	d	Highest	Lowest	MHz	MHz
902.8	0.043	--	--	--	0.043	0.043	0.5	-0.46
915.3	0.039	--	--	--	0.039	0.039	0.5	-0.46
927.3	0.039	--	--	--	0.039	0.039	0.5	-0.46

Test Frequency	Measured 99% Bandwidth (MHz) Port(s)				Maximum 99% Bandwidth (MHz)		
MHz	a	b	c	d			
902.8	0.065	--	--	--	0.065		
915.3	0.067	--	--	--	0.067		
927.3	0.062	--	--	--	0.062		

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).

10.2. Frequency Hopping Tests

Conducted Test Conditions for Frequency Hopping Measurements			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Frequency Hopping Tests	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(1)(i)/(ii)	**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.

Limits for Frequency Hopping Measurements

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

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

(ii) Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

10.2.1. Number of Hopping Channels

Equipment Configuration for Number of Hopping Channels

Variant:	Mode 1	**Antenna:**	Integral
Data Rate:	40.00 KBit/s	**Antenna Gain (dBi):**	1.8
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
Duty Cycle (%):	65.0	**Tested By:**	JMH
Engineering Test Notes:			

Test Measurement Results

Frequency Range (MHz)	Number of Hopping Channels	Limit	Pass / Fail
902.0-910.0	15	--	--
910.0-920.0	20	--	--
920.0-928.0	15	--	--
Total number of Hops	**50**	**50**	**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).

10.2.2. Channel Separation

Equipment Configuration for Channel Separation

Variant:	Mode 1	**Antenna:**	Integral
Data Rate:	40.00 KBit/s	**Antenna Gain (dBi):**	1.8
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
Duty Cycle (%):	65.0	**Tested By:**	JMH
Engineering Test Notes:			

Test Measurement Results

Center Frequency (MHz)	Chan Separation (MHz)	Limit (MHz)	Pass / Fail
915.3	0.499	0.043	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).

10.2.3. Dwell Time & Channel Occupancy

Variant:	Mode 1	**Antenna:**	Integral
Data Rate:	40.00 KBit/s	**Antenna Gain (dBi):**	1.8
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
Duty Cycle (%):	65.0	**Tested By:**	JMH
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
915.25	0.015	30	20	400.000	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).

10.3. Output Power

Conducted Test Conditions for Fundamental Emission Output Power			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Output Power	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(1), (b)(1)/(2)/(3)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Fundamental Emission Output Power Measurement

In the case of average power measurements an average power sensor was utilized.

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

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

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

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

Limits for Fundamental Emission Output Power

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

(1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following for frequency hopping systems:

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum

conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Equipment Configuration for Output Power Peak

Variant:	Mode 1	**Duty Cycle (%):**	65.0
Data Rate:	40.00 KBit/s	**Antenna Gain (dBi):**	1.80
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	JMH
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm) Port(s)				Calculated Total Power Σ Port(s)	Limit	Margin	EUT Power Setting
MHz	a	b	c	d	dBm	dBm	dB	
902.75	29.01	--	--	--	29.01	30.00	-0.99	30.00
915.25	28.93	--	--	--	28.93	30.00	-1.07	30.00
927.25	28.71	--	--	--	28.71	30.00	-1.29	30.00

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.

10.4. Emissions

10.4.1. Conducted Emissions

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

Test Procedure for Transmitter Conducted Spurious and Band-Edge Emissions Measurement

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

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

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

Limits Transmitter Conducted Spurious and Band-Edge Emissions

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

10.4.1.1. Conducted Unwanted Spurious Emissions

Equipment Configuration for Unwanted Emissions Peak			
Variant:	Mode 1	**Antenna:**	Integral
Data Rate:	40.00 KBit/s	**Antenna Gain (dBi):**	1.8
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	JMH
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
902.8	30.0 - 10000.0	-44.090	8.04	--	--	--	--	--	--
915.3	30.0 - 10000.0	-23.183	8.49	--	--	--	--	--	--
927.3	30.0 - 10000.0	-23.413	7.99	--	--	--	--	--	--

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).

10.4.1.2. Conducted Band-Edge Emissions

Equipment Configuration for Conducted Low Band-Edge Emissions (Hopping) Peak			
Variant:	Mode 1	**Antenna:**	Integral
Data Rate:	40.00 KBit/s	**Antenna Gain (dBi):**	1.8
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	65.0	**Tested By:**	JMH
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	902.8 MHz					
Band-Edge Frequency:	902.0 MHz					
Test Frequency Range:	875.0 - 905.0 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	-28.54	8.72	902.50			-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).

Equipment Configuration for Conducted Low Band-Edge Emissions (Static) Peak			
Variant:	Mode 1	**Antenna:**	Integral
Data Rate:	40.00 KBit/s	**Antenna Gain (dBi):**	1.8
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	65.0	**Tested By:**	JMH
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	902.8 MHz					
Band-Edge Frequency:	902.0 MHz					
Test Frequency Range:	875.0 - 905.0 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	-24.76	8.80	902.50			-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).

Equipment Configuration for Conducted Upper Band-Edge Emissions (Hopping) Peak			
Variant:	Mode 1	**Antenna:**	Integral
Data Rate:	40.00 KBit/s	**Antenna Gain (dBi):**	1.8
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	65.0	**Tested By:**	JMH
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	927.3 MHz					
Band-Edge Frequency:	928.0 MHz					
Test Frequency Range:	925.0 - 950.0 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	-32.96	8.47	927.40			-0.600

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

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

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

Variant:	Mode 1	**Antenna:**	Integral
Data Rate:	40.00 KBit/s	**Antenna Gain (dBi):**	1.8
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	65.0	**Tested By:**	JMH
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	927.3 MHz					
Band-Edge Frequency:	928.0 MHz					
Test Frequency Range:	925.0 - 950.0 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	-29.09	8.49	927.40			-0.600

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).

10.4.2. Radiated Emissions

Radiated Test Conditions for Radiated Spurious and Band-Edge Emissions (Restricted Bands)			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	20.0 - 24.5
Test Heading:	Radiated Spurious and Band-Edge Emissions	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.205, 15.209	**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:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

10.4.2.3. TX Spurious & Restricted Band Emissions

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	Integral	**Variant:**	FHSS
Antenna Gain (dBi):	1.8	**Modulation:**	PR-ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	65
Channel Frequency (MHz):	902.75	**Data Rate:**	40.00 Kbit/s
Power Setting:	Default	**Tested By:**	JMH

Test Measurement Results

1000.00 - 10000.00 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	1805.43	59.49	2.45	-13.63	48.31	Peak (NRB)	Horizontal	100	26	--	--	Pass
#2	2708.32	54.69	2.86	-11.37	46.18	Max Peak	Horizontal	132	342	74.0	-27.8	Pass
#3	2708.32	40.99	2.86	-11.37	32.48	Max Avg	Horizontal	132	342	54.0	-21.5	Pass
#4	3610.99	64.67	3.13	-11.14	56.66	Max Peak	Horizontal	98	321	74.0	-17.3	Pass
#5	3610.99	52.24	3.13	-11.14	44.23	Max Avg	Horizontal	98	321	54.0	-9.8	Pass
#6	5416.58	58.51	3.73	-11.18	51.06	Max Peak	Vertical	151	12	74.0	-22.9	Pass
#7	5416.58	44.51	3.73	-11.18	37.06	Max Avg	Vertical	151	12	54.0	-16.9	Pass
#8	6319.26	62.94	3.94	-8.33	58.55	Peak (NRB)	Horizontal	100	0	--	--	Pass
#9	7221.95	49.79	4.30	-7.35	46.74	Peak (NRB)	Horizontal	100	158	--	--	Pass

Test Notes: EUT ALR-H450 SN: 170 on 150cm table battery powered

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

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	Integral	**Variant:**	FHSS
Antenna Gain (dBi):	1.8	**Modulation:**	PR-ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	65
Channel Frequency (MHz):	915.25	**Data Rate:**	40.00 Kbit/s
Power Setting:	Default	**Tested By:**	JMH

Test Measurement Results

1000.00 - 10000.00 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	2745.76	56.62	2.84	-11.35	48.11	Max Peak	Horizontal	108	331	74.0	-25.9	Pass
#2	2745.76	43.10	2.84	-11.35	34.59	Max Avg	Horizontal	108	331	54.0	-19.4	Pass
#3	3661.00	57.14	3.17	-11.04	49.27	Max Peak	Vertical	101	251	74.0	-24.7	Pass
#4	3661.00	43.96	3.17	-11.04	36.09	Max Avg	Vertical	101	251	54.0	-17.9	Pass
#5	4576.25	59.87	3.48	-11.39	51.96	Max Peak	Horizontal	115	41	74.0	-22.0	Pass
#6	4576.25	45.98	3.48	-11.39	38.07	Max Avg	Horizontal	115	41	54.0	-15.9	Pass
#7	5491.55	54.22	3.71	-11.18	46.75	Peak (NRB)	Vertical	100	222	--	--	Pass
#8	6406.80	56.99	3.97	-8.03	52.93	Peak (NRB)	Horizontal	100	222	--	--	Pass
#9	8237.21	55.33	4.55	-7.24	52.64	Max Peak	Horizontal	139	25	74.0	-21.4	Pass
#10	8237.21	40.62	4.55	-7.24	37.93	Max Avg	Horizontal	139	25	54.0	-16.1	Pass

Test Notes: EUT ALR-H450 SN: 170 on 150cm table battery powered

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

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	Integral	**Variant:**	FHSS
Antenna Gain (dBi):	1.8	**Modulation:**	PR-ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	65
Channel Frequency (MHz):	927.25	**Data Rate:**	40.00 Kbit/s
Power Setting:	Default	**Tested By:**	JMH

Test Measurement Results

1000.00 - 10000.00 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	2781.79	60.26	2.85	-11.33	51.78	Max Peak	Horizontal	118	342	74.0	-22.2	Pass
#2	2781.79	47.39	2.85	-11.33	38.91	Max Avg	Horizontal	118	342	54.0	-15.1	Pass
#3	3708.99	59.32	3.19	-10.93	51.58	Max Peak	Horizontal	108	323	74.0	-22.4	Pass
#4	3708.99	44.67	3.19	-10.93	36.93	Max Avg	Horizontal	108	323	54.0	-17.1	Pass
#5	4636.27	59.03	3.57	-11.30	51.30	Max Peak	Horizontal	152	18	74.0	-22.7	Pass
#6	4636.27	46.58	3.57	-11.30	38.85	Max Avg	Horizontal	152	18	54.0	-15.2	Pass
#7	6490.77	62.67	4.00	-7.92	58.75	Peak (NRB)	Horizontal	100	0	--	--	Pass

Test Notes: EUT ALR-H450 SN: 170 on 150cm table battery powered

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

Equipment Configuration for Restricted Band Spurious Emissions (0.03 - 1 GHz)			
Antenna:	Integral	**Variant:**	FHSS
Antenna Gain (dBi):	1.8	**Modulation:**	PR-ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	65
Channel Frequency (MHz):	902.75	**Data Rate:**	40.00 Kbit/s
Power Setting:	Default	**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	204.27	49.00	4.36	-19.60	33.76	MaxQP	Horizontal	150	286	43.0	-9.2	Pass
#2	408.43	47.77	5.06	-14.45	38.38	MaxQP	Vertical	115	266	46.0	-7.6	Pass
#3	840.92	37.90	6.23	-8.47	35.66	MaxQP	Vertical	110	27	46.0	-10.3	Pass
#4	902.74	65.59	6.34	-7.75	64.18	Fundamental	Vertical	100	0	--	--	

Test Notes: EUT ALR-H450 SN: 170 on 80cm table battery powered, 900 MHz notch placed in front of amp to prevent overload

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

Equipment Configuration for Restricted Band Spurious Emissions (0.03 - 1 GHz)

Antenna:	Integral	**Variant:**	FHSS
Antenna Gain (dBi):	1.8	**Modulation:**	PR-ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	65
Channel Frequency (MHz):	915.25	**Data Rate:**	40.00 Kbit/s
Power Setting:	Default	**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	204.23	54.89	4.36	-19.60	39.65	MaxQP	Horizontal	102	95	43.0	-3.4	Pass
#2	408.42	47.79	5.06	-14.45	38.40	MaxQP	Vertical	108	269	46.0	-7.6	Pass
#3	915.25					Fundamental						
#4	961.04	38.69	6.48	-7.11	38.06	Peak (Scan)	Vertical	100	63	53.0	-14.9	Pass

Test Notes: EUT ALR-H450 SN: 170 on 80cm table battery powered, 900 MHz notch placed in front of amp to prevent overload

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

Equipment Configuration for Restricted Band Spurious Emissions (0.03 - 1 GHz)

Antenna:	Integral	**Variant:**	FHSS
Antenna Gain (dBi):	1.8	**Modulation:**	PR-ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	65
Channel Frequency (MHz):	927.25	**Data Rate:**	40.00 Kbit/s
Power Setting:	Default	**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	204.21	55.62	4.36	-19.60	40.38	MaxQP	Horizontal	114	87	43.0	-2.6	Pass
#2	408.43	47.87	5.06	-14.45	38.48	MaxQP	Vertical	109	267	46.0	-7.5	Pass
#3	927.24					Fundamental						
#4	963.27	40.55	6.48	-7.07	39.96	MaxQP	Horizontal	145	286	53.0	-13.0	Pass

Test Notes: EUT ALR-H450 SN: 170 on 80cm table battery powered, 900 MHz notch placed in front of amp to prevent overload

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

10.4.3. Digital Emissions (0.03 - 1 GHz)

Radiated Test Conditions for Radiated Digital Emissions (0.03 – 1 GHz)			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	20.0 - 24.5
Test Heading:	Digital Emissions	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.209	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Radiated Digital Emissions (0.03 – 1 GHz)

Testing 30M-1 GHz was performed in a 3-meter 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 closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed.

Test configuration and setup for Radiated Spurious and Band-Edge 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 = 36.3dBmV/m

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

Level (dBmV/m) = 20 * Log (level (mV/m))

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

Limits for Radiated Digital Emissions (0.03 – 1 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:

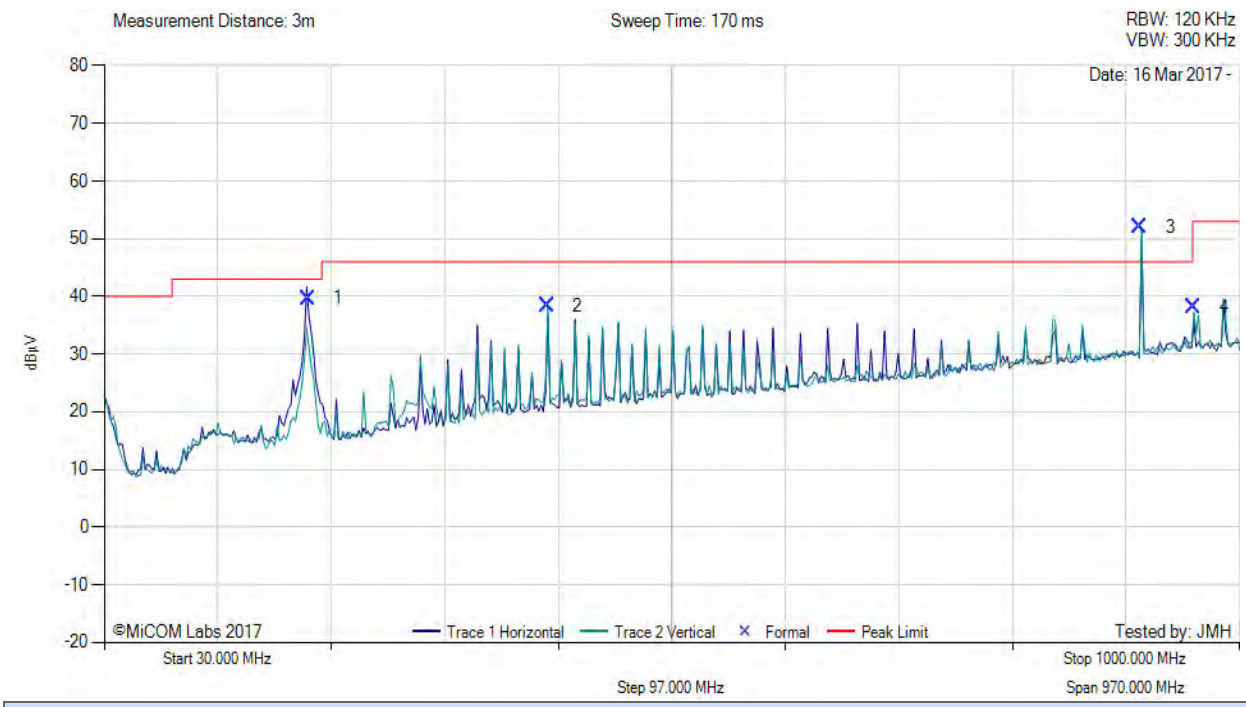
Frequency (MHz)	Field Strength		Measurement Distance (m)
	µV/m (microvolts/meter)	dBµV/m (dB microvolts/meter)	
0.009-0.490	2400/F(kHz)	--	300
0.490-1.705	24000/F(kHz)	--	30
1.705-30.0	30	29.5	30
30-88	100**	40	3
88-216	150**	43.5	3
216-960	200**	46.0	3
Above 960	500	54.0	3

**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.

Equipment Configuration for Radiated Digital Emissions			
Antenna:	Integral	**Variant:**	FHSS
Antenna Gain (dBi):	1.8	**Modulation:**	PR-ASK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	65
Channel Frequency (MHz):	915.25	**Data Rate:**	40.00 Kbit/s
Power Setting:	Default	**Tested By:**	JMH

Test Measurement Results

Variant: FHSS, Test Freq: 915.25 MHz, Power Setting: Default



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	204.23	54.89	4.36	-19.60	39.65	MaxQP	Horizontal	102	95	43.0	-3.4	Pass
2	408.42	47.79	5.06	-14.45	38.40	MaxQP	Vertical	108	269	46.0	-7.6	Pass
3	915.25					Fundamental						
4	961.04	38.69	6.48	-7.11	38.06	Peak (Scan)	Vertical	100	63	53.0	-14.9	Pass

Test Notes: EUT ALR-H450 SN: 170 on 80cm table battery powered, EUT transmitting at 915.25 MHz. 900 MHz notch placed in front of amp to prevent overload

10.4.4. AC Wireline Emissions

Test Conditions for ac Wireline Emissions (0.15 – 30 MHz)			
Standard:	FCC CFR 47:15.247	Ambient Temp. (ºC):	20.0 - 24.5
Test Heading:	Conducted (ac Wireline Emissions)	Rel. Humidity (%):	32 - 45
Standard Section(s):	15.207	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:

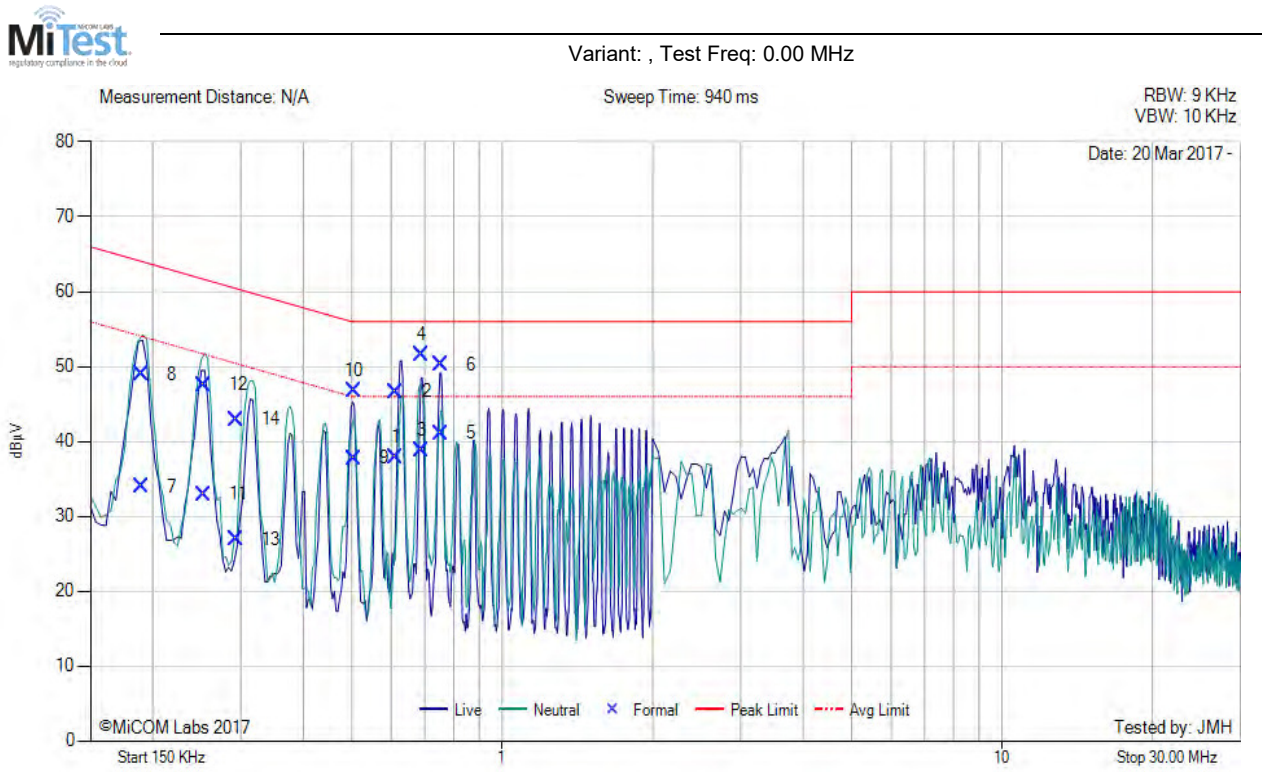
(1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(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.

AC Mains 120V 60 Hz



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	0.613	27.87	0.10	9.93	10.03	37.90	Max Avg	Live	46.0	-8.1	Pass
2	0.613	36.60	0.10	9.93	10.03	46.63	Max Qp	Live	56.0	-9.4	Pass
3	0.690	28.79	0.11	9.93	10.04	38.83	Max Avg	Live	46.0	-7.2	Pass
4	0.690	41.49	0.11	9.93	10.04	51.53	Max Qp	Live	56.0	-4.5	Pass
5	0.754	31.07	0.12	9.93	10.05	41.12	Max Avg	Neutral	46.0	-4.9	Pass
6	0.754	40.23	0.12	9.93	10.05	50.28	Max Qp	Neutral	56.0	-5.7	Pass
7	0.190	24.01	0.06	9.92	9.98	33.99	Max Avg	Neutral	54.9	-20.9	Pass
8	0.190	38.94	0.06	9.92	9.98	48.92	Max Qp	Neutral	64.9	-15.9	Pass
9	0.506	27.78	0.09	9.92	10.01	37.79	Max Avg	Live	46.0	-8.2	Pass
10	0.506	36.70	0.09	9.92	10.01	46.71	Max Qp	Live	56.0	-9.3	Pass
11	0.253	22.98	0.07	9.92	9.99	32.97	Max Avg	Neutral	53.1	-20.1	Pass
12	0.253	37.55	0.07	9.92	9.99	47.54	Max Qp	Neutral	63.1	-15.5	Pass
13	0.293	16.98	0.05	9.92	9.97	26.95	Max Avg	Neutral	51.9	-25.0	Pass
14	0.293	32.98	0.05	9.92	9.97	42.95	Max Qp	Neutral	61.9	-19.0	Pass

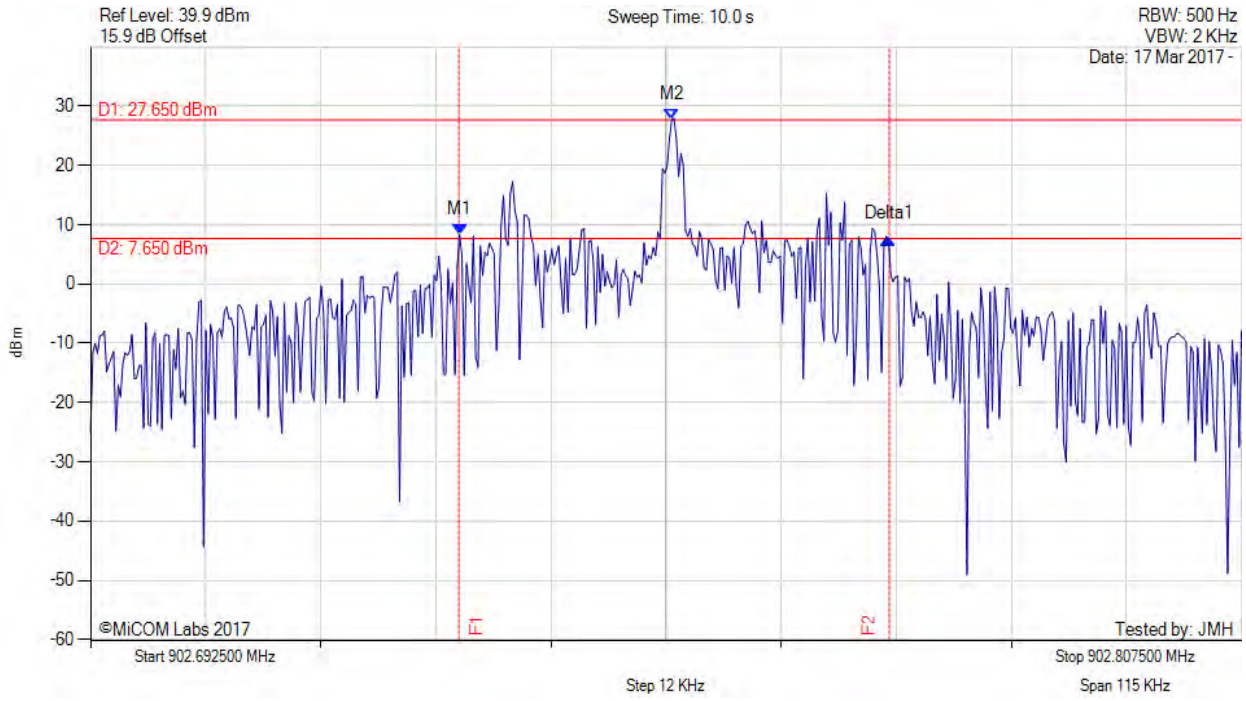
Test Notes: EUT on Table connected to AC/DC adapter charing battery

A. APPENDIX - GRAPHICAL IMAGES

A.1. 20 dB & 99% Bandwidth

20 dB 99% BANDWIDTH

Variant: Mode 1, Channel: 902.75 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

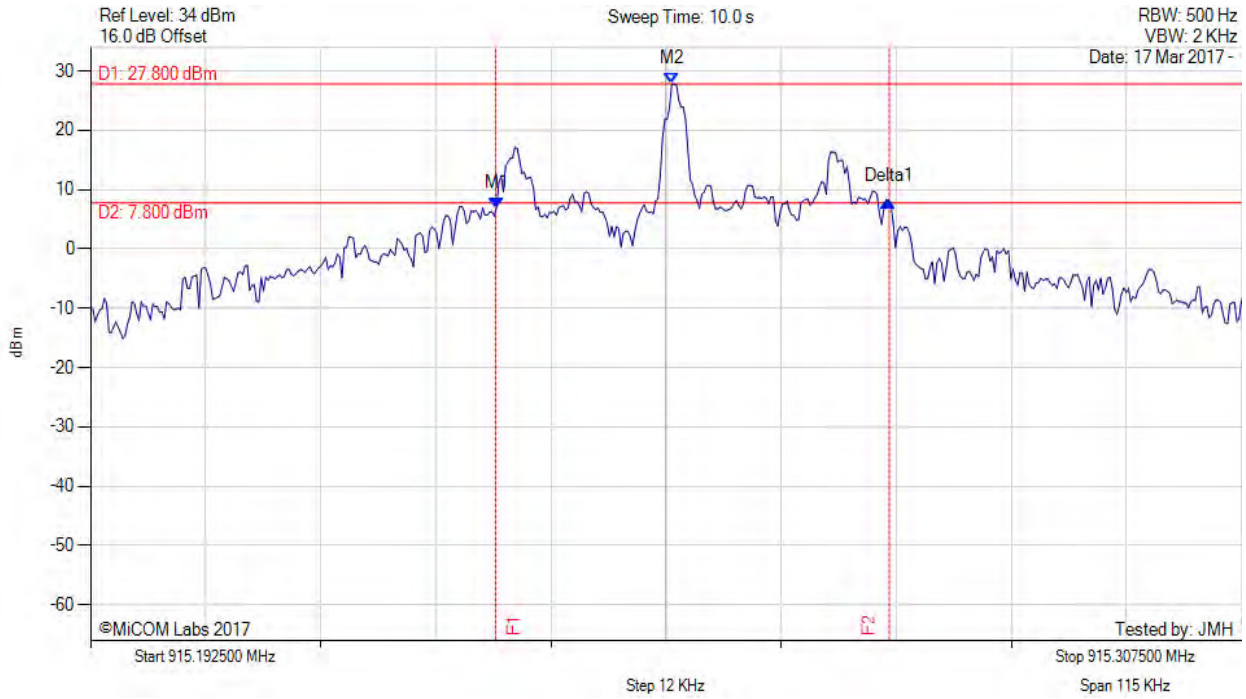


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 50 Trace Mode = VIEW	M1 : 902.729 MHz : 8.294 dBm M2 : 902.751 MHz : 27.655 dBm Delta1 : 43 KHz : -0.704 dB T1 : 902.580 MHz : 11.857 dBm T2 : 902.892 MHz : 12.355 dBm OBW : 65 KHz	Measured 20 dB Bandwidth: 0.043 MHz Limit: 0.5 kHz Margin: 0.46 MHz

back to matrix

20 dB 99% BANDWIDTH

Variant: Mode 1, Channel: 915.25 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

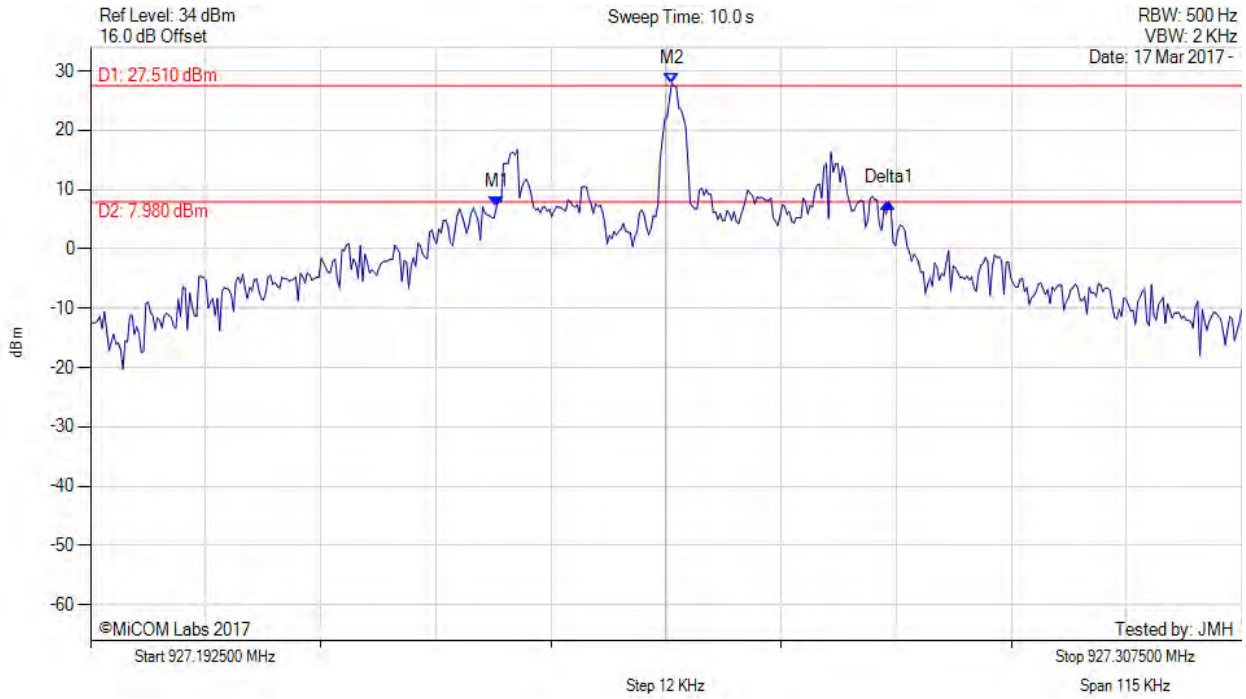


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1 : 915.233 MHz : 6.929 dBm M2 : 915.251 MHz : 27.803 dBm Delta1 : 39 KHz : 1.161 dB T1 : 915.081 MHz : 12.193 dBm T2 : 915.385 MHz : 12.638 dBm OBW : 67 KHz	Measured 20 dB Bandwidth: 0.039 MHz Limit: 0.5 kHz Margin: 0.46 MHz

back to matrix

20 dB 99% BANDWIDTH

Variant: Mode 1, Channel: 927.25 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

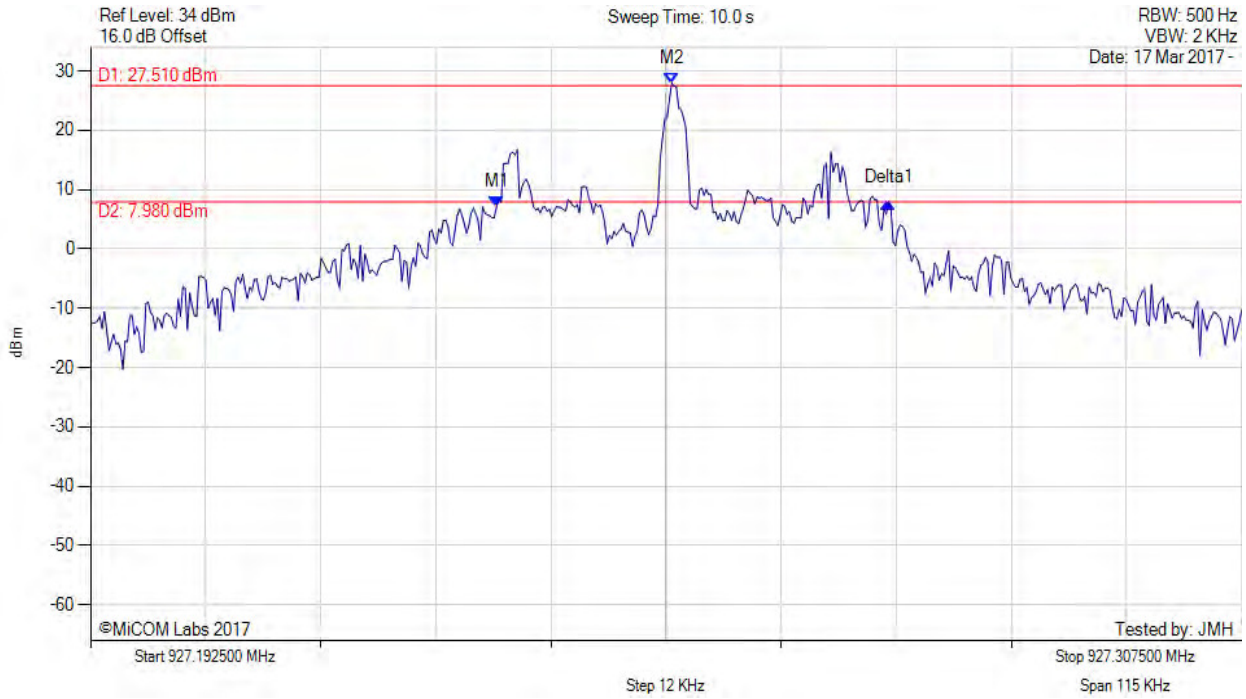


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1 : 927.233 MHz : 7.035 dBm M2 : 927.251 MHz : 27.978 dBm Delta1 : 39 KHz : 0.669 dB T1 : 927.086 MHz : 12.018 dBm T2 : 927.388 MHz : 11.581 dBm OBW : 62 KHz	Measured 20 dB Bandwidth: 0.039 MHz Limit: 0.5 kHz Margin: 0.46 MHz

back to matrix

20 dB 99% BANDWIDTH

Variant: Mode 1, Channel: 927.25 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1 : 927.233 MHz : 7.035 dBm M2 : 927.251 MHz : 27.978 dBm Delta1 : 39 KHz : 0.669 dB T1 : 927.086 MHz : 12.018 dBm T2 : 927.388 MHz : 11.581 dBm OBW : 62 KHz	Measured 20 dB Bandwidth: 0.039 MHz Limit: 0.5 kHz Margin: 0.46 MHz

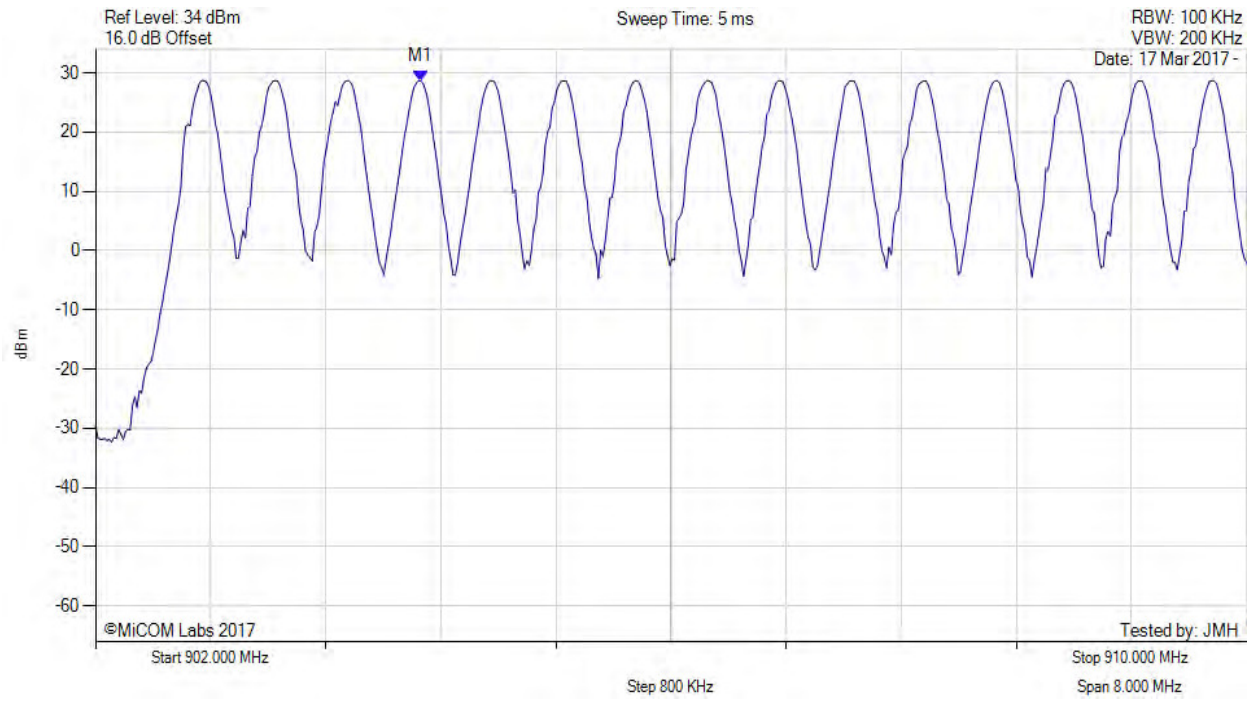
back to matrix

A.2. Frequency Hopping Tests

A.2.1. Number of Hopping Channels

NUMBER OF HOPPING CHANNELS

Variant: Mode 1, Channel: 915.25 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

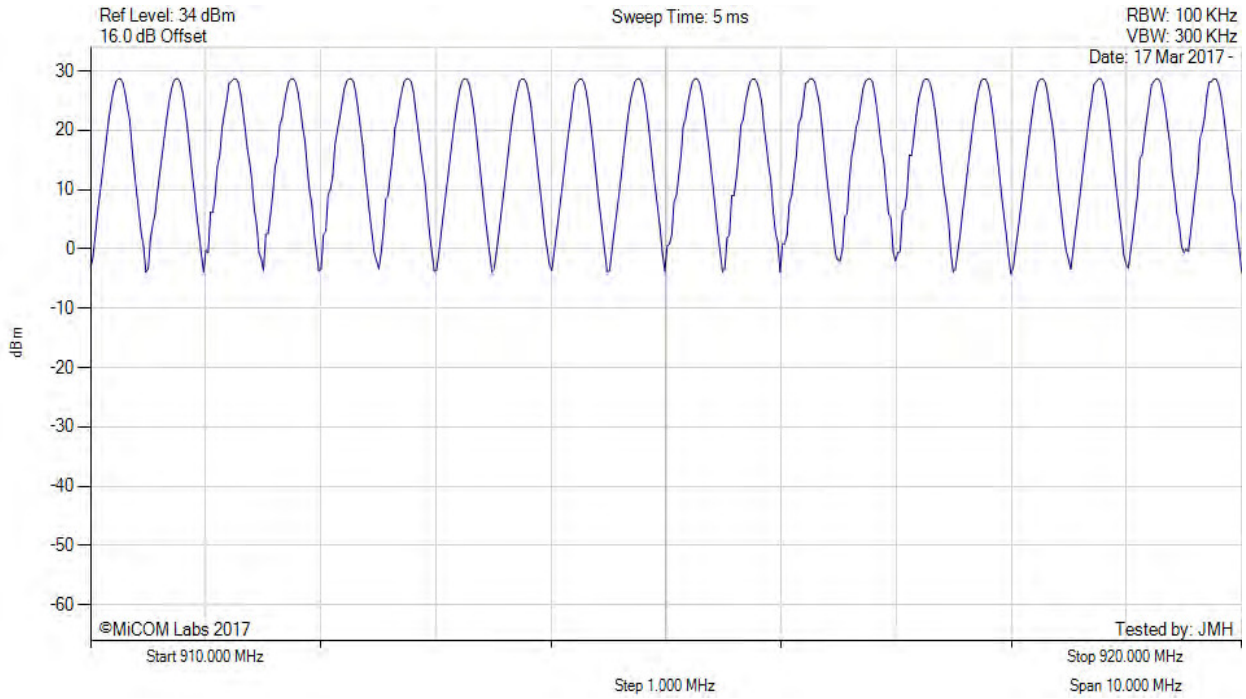


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1 : 904.261 MHz : 28.672 dBm	Channel Frequency: 915.25 MHz

back to matrix

NUMBER OF HOPPING CHANNELS

Variant: Mode 1, Channel: 915.25 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

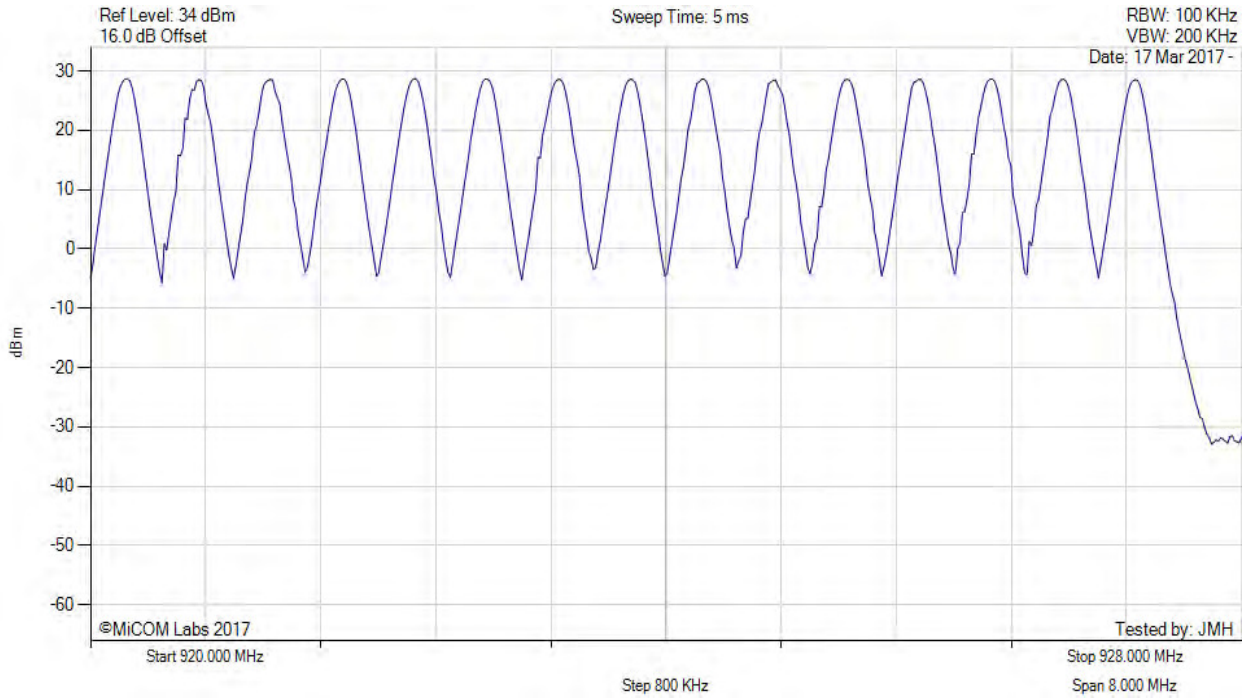


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW		Channel Frequency: 915.25 MHz

back to matrix

NUMBER OF HOPPING CHANNELS

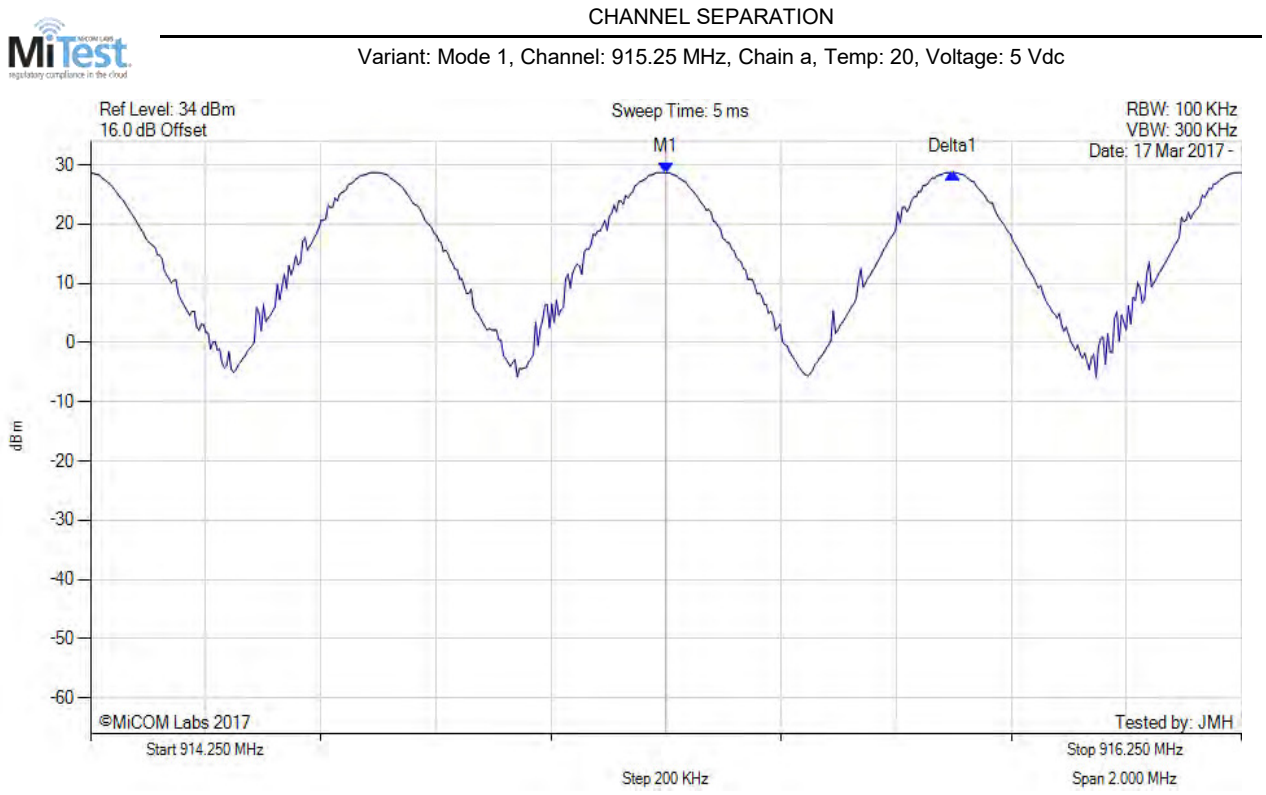
Variant: Mode 1, Channel: 915.25 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW		Channel Frequency: 915.25 MHz

back to matrix

A.2.2. Channel Separation



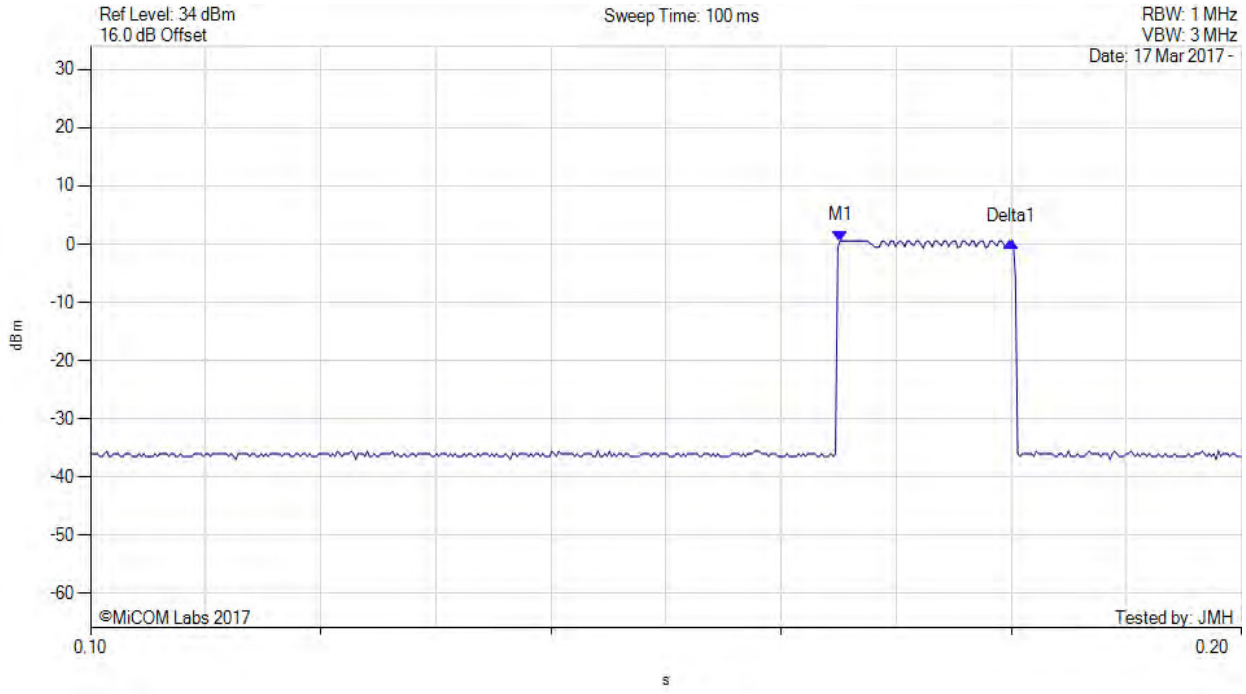
Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1 : 915.250 MHz : 28.706 dBm Delta1 : 499 KHz : 0.012 dB	Channel Frequency: 915.25 MHz

back to matrix

A.2.3. Dwell Time

DWELL TIME

Variant: Mode 1, Channel: 915.25 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



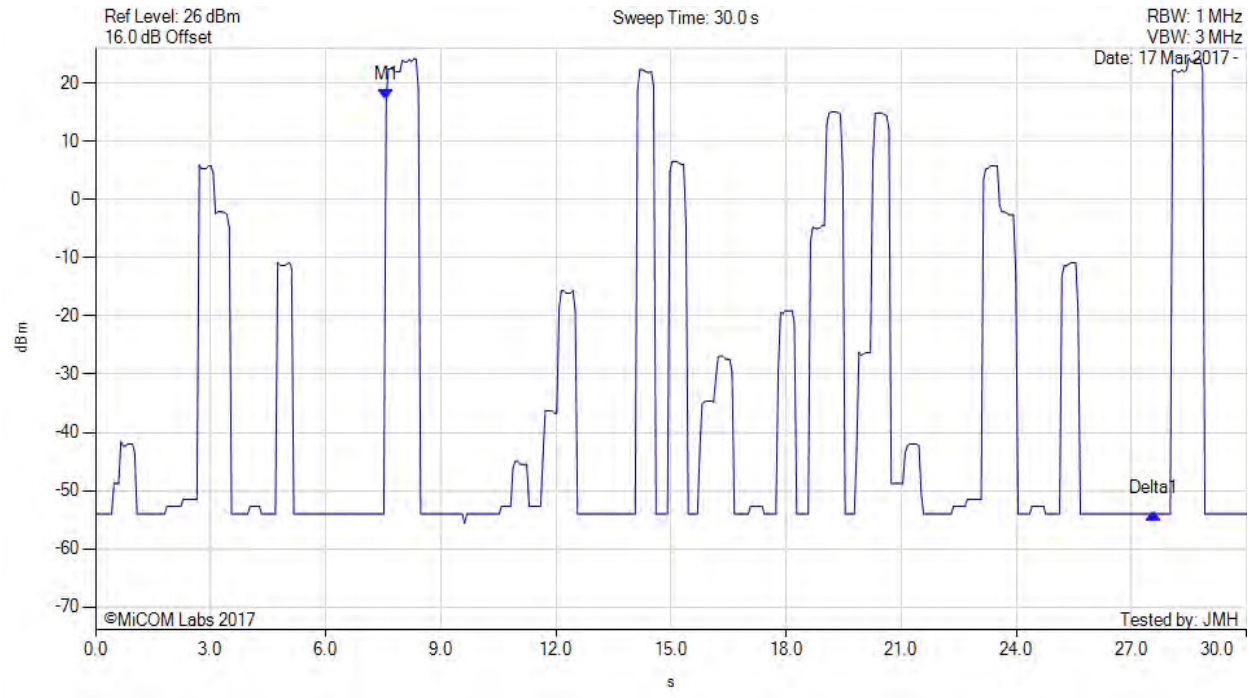
Analyzer Setup	Marker:Time:Amplitude	Test Results
Detector = RMS Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1(915.25 MHz) : 0.164 s : 0.565 dBm Delta1(915.25 MHz) : 0.015 s : -0.027 dB	Channel Frequency: 915.25 MHz

back to matrix

A.2.4. Channel Occupancy

CHANNEL OCCUPANCY

Variant: Mode 1, Channel: 915.25 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Analyzer Setup	Marker:Time:Amplitude	Test Results
Detector = RMS Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1(915.25 MHz) : 7.575 s : 17.077 dBm Delta1(915.25 MHz) : 20.000 s : -71.002 dB	Channel Frequency: 915.25 MHz

back to matrix

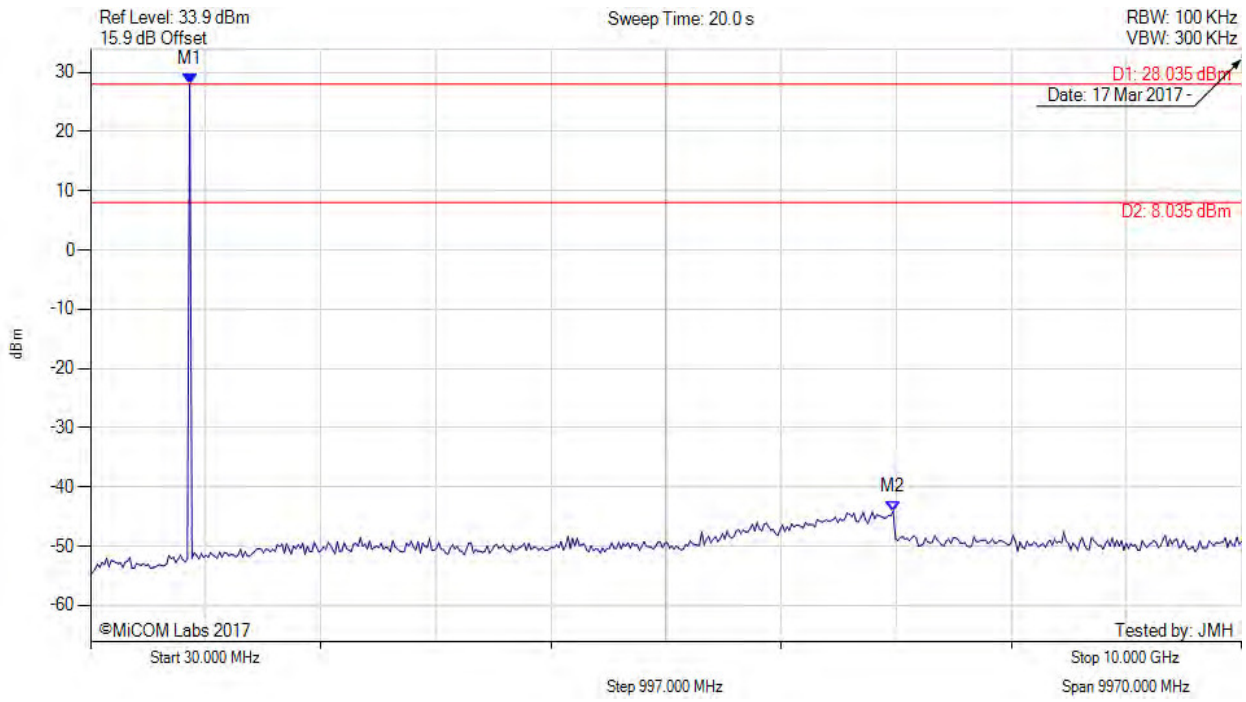
A.3. Emissions

A.3.1. Conducted Emissions

A.3.1.1. Conducted Unwanted Spurious Emissions

UNWANTED EMISSIONS PEAK

Variant: Mode 1, Channel: 902.75 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

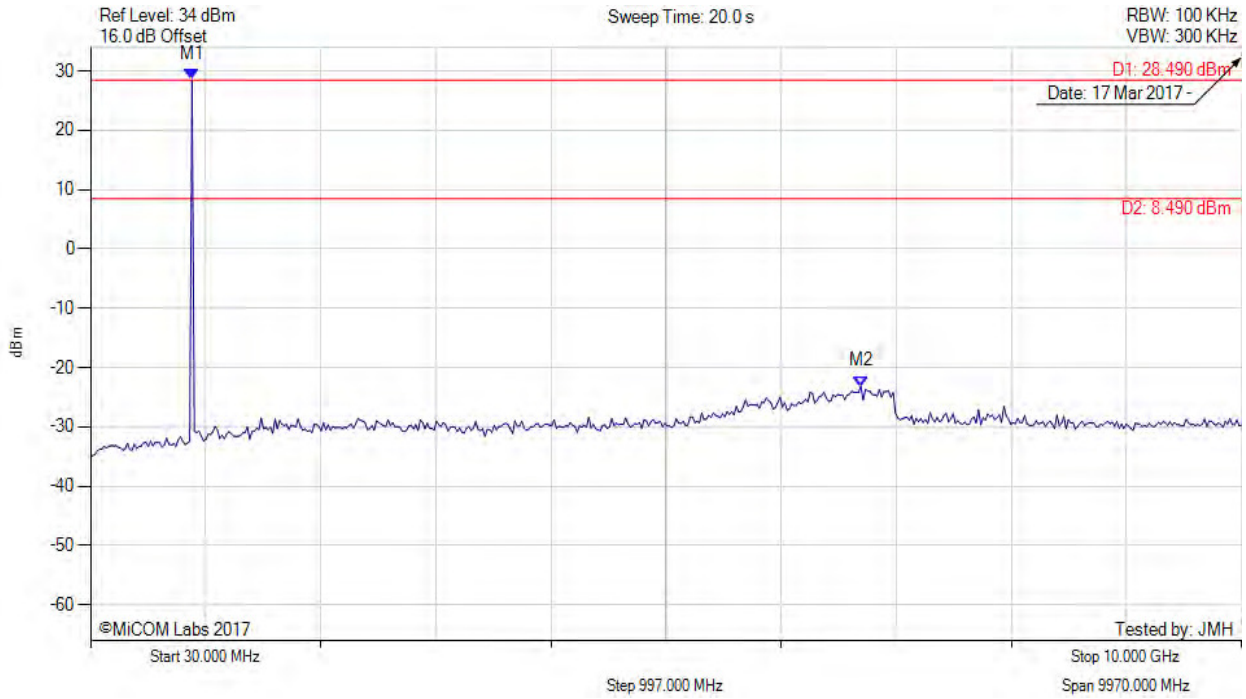


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 889.138 MHz : 28.035 dBm M2 : 6983.026 MHz : -44.090 dBm	Limit: 8.04 dBm Margin: -52.13 dB

back to matrix

UNWANTED EMISSIONS PEAK

Variant: Mode 1, Channel: 915.25 MHz, Chain a, Temp: 20, Voltage: 5 Vdc

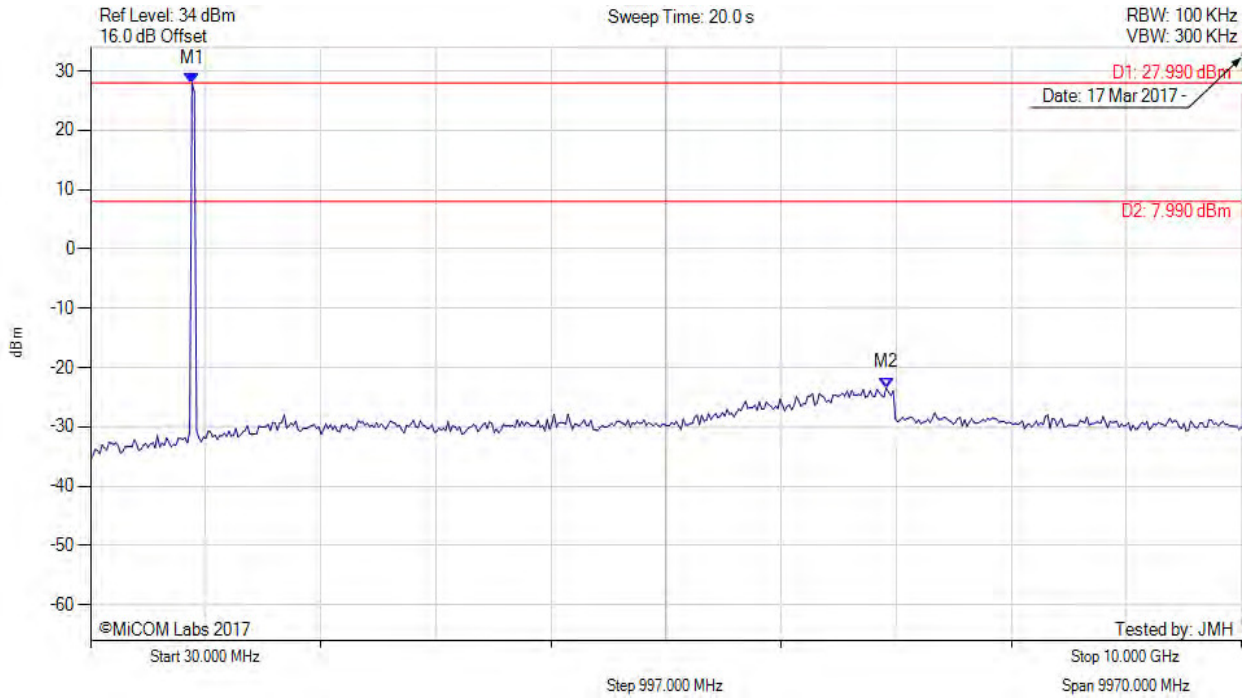


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = MAX HOLD	M1 : 909.118 MHz : 28.495 dBm M2 : 6703.307 MHz : -23.183 dBm	Limit: 8.49 dBm Margin: -31.67 dB

back to matrix

UNWANTED EMISSIONS PEAK

Variant: Mode 1, Channel: 927.25 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = MAX HOLD	M1 : 909.118 MHz : 27.990 dBm M2 : 6923.086 MHz : -23.413 dBm	Limit: 7.99 dBm Margin: -31.40 dB

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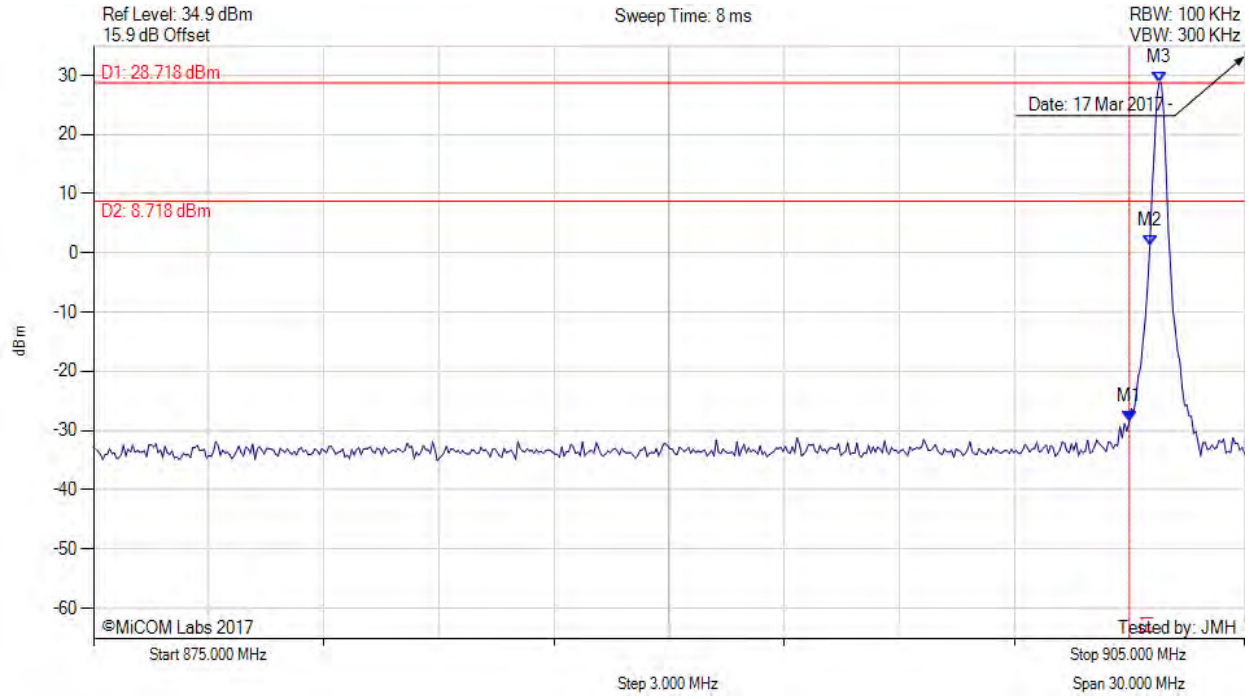
A.3.1.2. Conducted Band-Edge Emissions

CONDUCTED LOW BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: Mode 1, Channel: 902.75 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1 : 902.000 MHz : -28.536 dBm M2 : 902.535 MHz : 1.308 dBm M3 : 902.776 MHz : 28.718 dBm	Channel Frequency: 902.75 MHz

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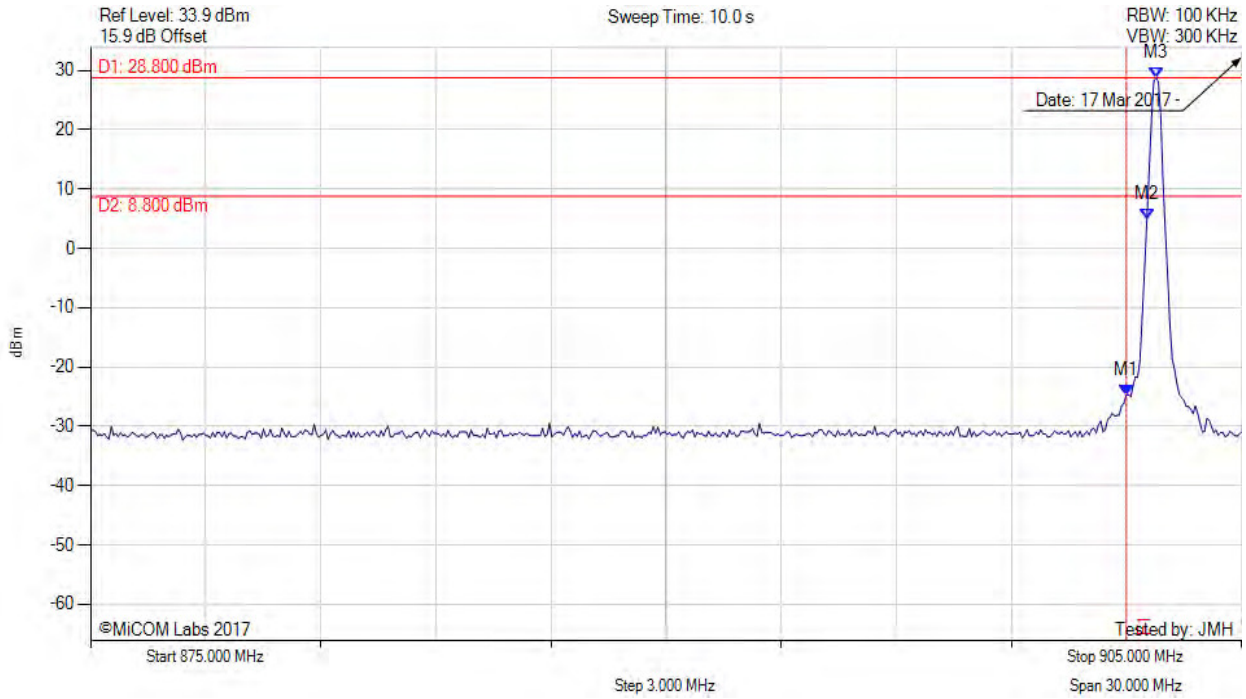
CONDUCTED LOW BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: Mode 1, Channel: 902.75 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1 : 902.000 MHz : -24.759 dBm M2 : 902.535 MHz : 4.840 dBm M3 : 902.776 MHz : 28.801 dBm	Channel Frequency: 902.75 MHz

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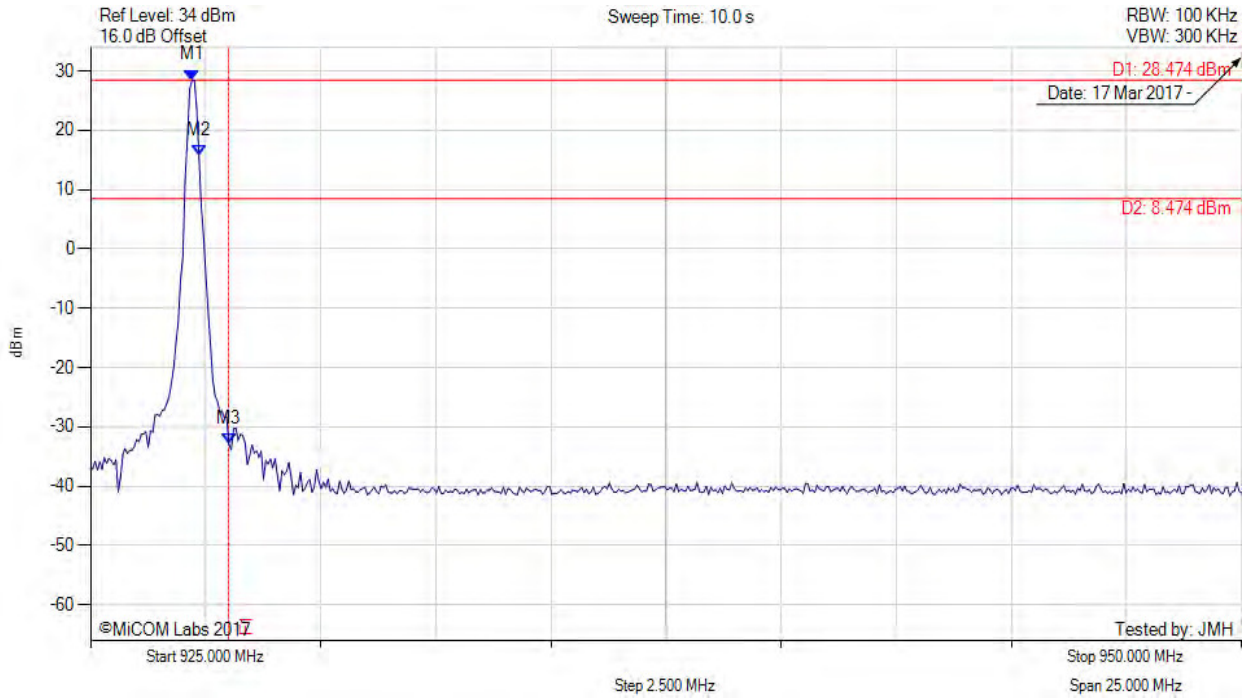
CONDUCTED UPPER BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: Mode 1, Channel: 927.25 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 927.204 MHz : 28.474 dBm M2 : 927.355 MHz : 15.691 dBm M3 : 928.000 MHz : -32.955 dBm	Channel Frequency: 927.25 MHz

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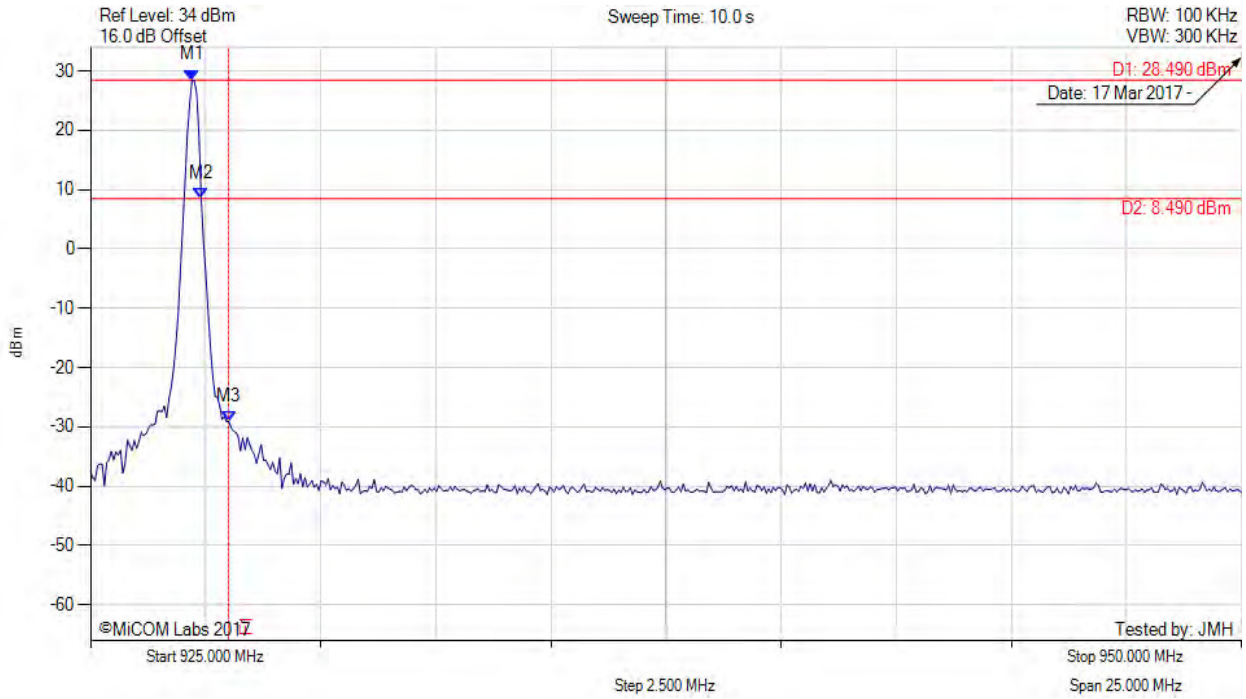
CONDUCTED UPPER BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: Mode 1, Channel: 927.25 MHz, Chain a, Temp: 20, Voltage: 5 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 927.204 MHz : 28.487 dBm M2 : 927.405 MHz : 8.468 dBm M3 : 928.000 MHz : -29.087 dBm	Channel Frequency: 927.25 MHz

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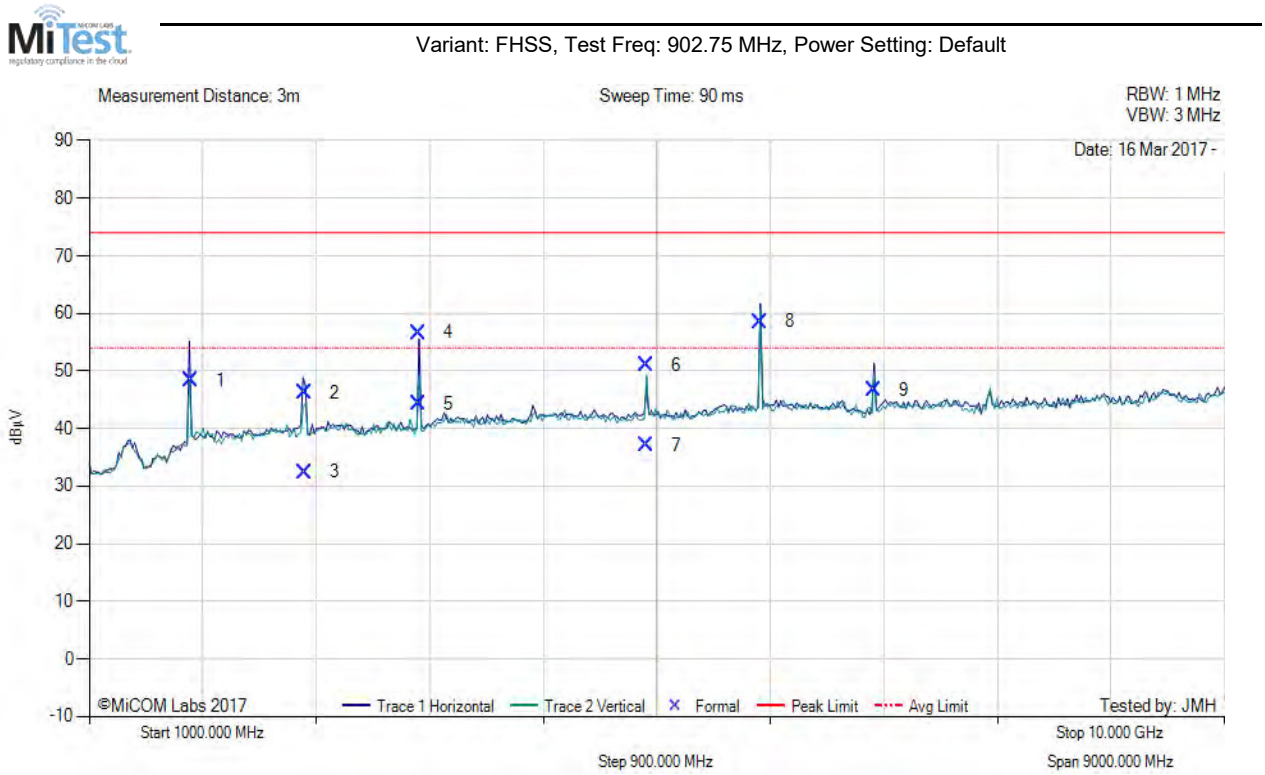
A.3.2. Radiated Emissions

A.3.2.3. TX Spurious & Restricted Band Emissions

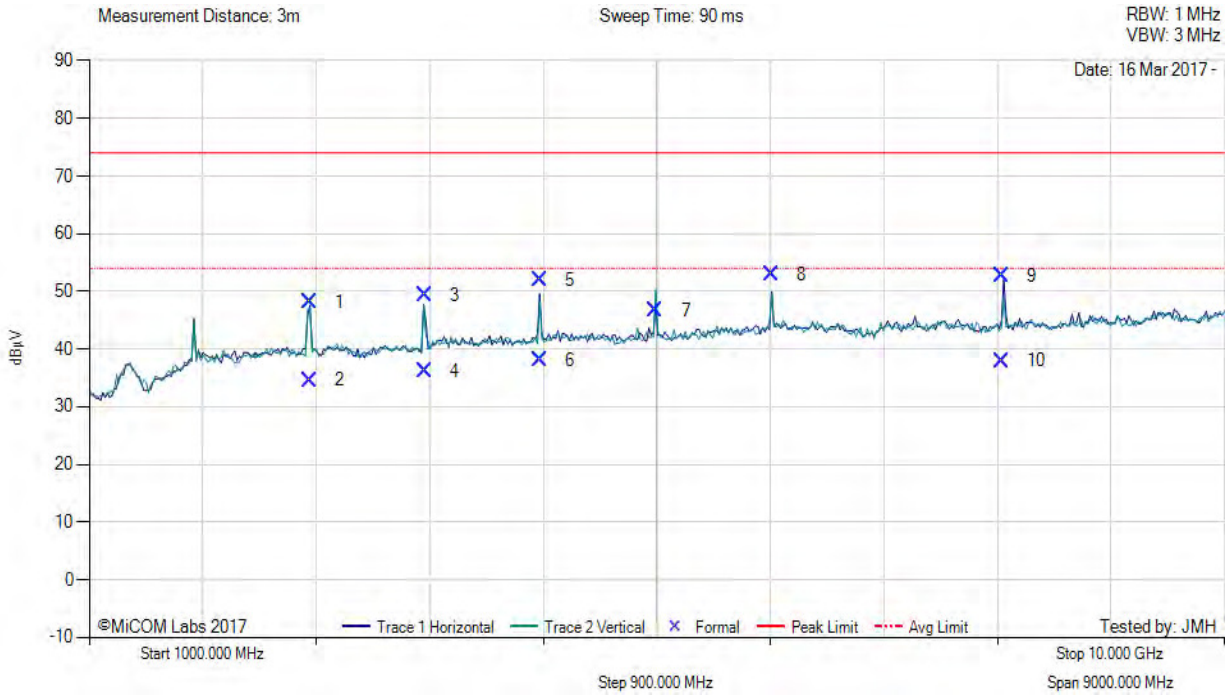


1000.00 - 10000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1805.43	59.49	2.45	-13.63	48.31	Peak (NRB)	Horizontal	100	26	--	--	Pass
2	2708.32	54.69	2.86	-11.37	46.18	Max Peak	Horizontal	132	342	74.0	-27.8	Pass
3	2708.32	40.99	2.86	-11.37	32.48	Max Avg	Horizontal	132	342	54.0	-21.5	Pass
4	3610.99	64.67	3.13	-11.14	56.66	Max Peak	Horizontal	98	321	74.0	-17.3	Pass
5	3610.99	52.24	3.13	-11.14	44.23	Max Avg	Horizontal	98	321	54.0	-9.8	Pass
6	5416.58	58.51	3.73	-11.18	51.06	Max Peak	Vertical	151	12	74.0	-22.9	Pass
7	5416.58	44.51	3.73	-11.18	37.06	Max Avg	Vertical	151	12	54.0	-16.9	Pass
8	6319.26	62.94	3.94	-8.33	58.55	Peak (NRB)	Horizontal	100	0	--	--	Pass
9	7221.95	49.79	4.30	-7.35	46.74	Peak (NRB)	Horizontal	100	158	--	--	Pass

Test Notes: EUT ALR-H450 SN: 170 on 150cm table battery powered

back to matrix

Variant: FHSS, Test Freq: 915.25 MHz, Power Setting: Default

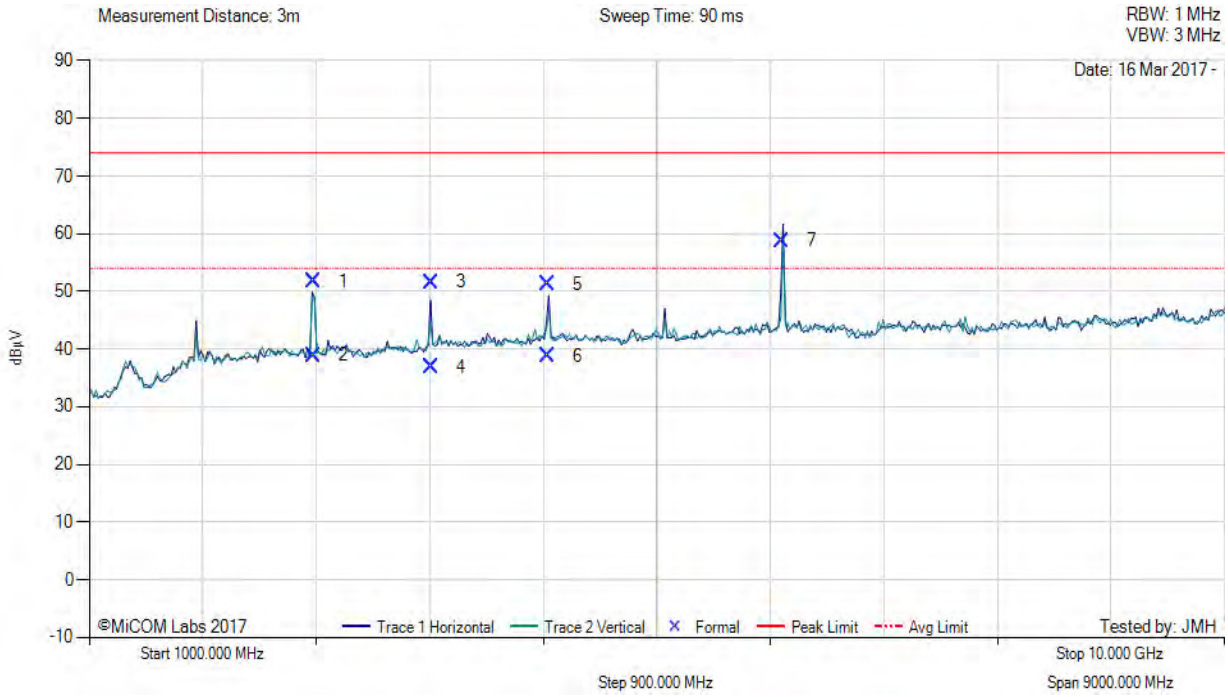


1000.00 - 10000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	2745.76	56.62	2.84	-11.35	48.11	Max Peak	Horizontal	108	331	74.0	-25.9	Pass
2	2745.76	43.10	2.84	-11.35	34.59	Max Avg	Horizontal	108	331	54.0	-19.4	Pass
3	3661.00	57.14	3.17	-11.04	49.27	Max Peak	Vertical	101	251	74.0	-24.7	Pass
4	3661.00	43.96	3.17	-11.04	36.09	Max Avg	Vertical	101	251	54.0	-17.9	Pass
5	4576.25	59.87	3.48	-11.39	51.96	Max Peak	Horizontal	115	41	74.0	-22.0	Pass
6	4576.25	45.98	3.48	-11.39	38.07	Max Avg	Horizontal	115	41	54.0	-15.9	Pass
7	5491.55	54.22	3.71	-11.18	46.75	Peak (NRB)	Vertical	100	222	--	--	Pass
8	6406.80	56.99	3.97	-8.03	52.93	Peak (NRB)	Horizontal	100	222	--	--	Pass
9	8237.21	55.33	4.55	-7.24	52.64	Max Peak	Horizontal	139	25	74.0	-21.4	Pass
10	8237.21	40.62	4.55	-7.24	37.93	Max Avg	Horizontal	139	25	54.0	-16.1	Pass

Test Notes: EUT ALR-H450 SN: 170 on 150cm table battery powered

back to matrix

Variant: FHSS, Test Freq: 927.25 MHz, Power Setting: Default



1000.00 - 10000.00 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	2781.79	60.26	2.85	-11.33	51.78	Max Peak	Horizontal	118	342	74.0	-22.2	Pass
2	2781.79	47.39	2.85	-11.33	38.91	Max Avg	Horizontal	118	342	54.0	-15.1	Pass
3	3708.99	59.32	3.19	-10.93	51.58	Max Peak	Horizontal	108	323	74.0	-22.4	Pass
4	3708.99	44.67	3.19	-10.93	36.93	Max Avg	Horizontal	108	323	54.0	-17.1	Pass
5	4636.27	59.03	3.57	-11.30	51.30	Max Peak	Horizontal	152	18	74.0	-22.7	Pass
6	4636.27	46.58	3.57	-11.30	38.85	Max Avg	Horizontal	152	18	54.0	-15.2	Pass
7	6490.77	62.67	4.00	-7.92	58.75	Peak (NRB)	Horizontal	100	0	--	--	Pass

Test Notes: EUT ALR-H450 SN: 170 on 150cm table battery powered

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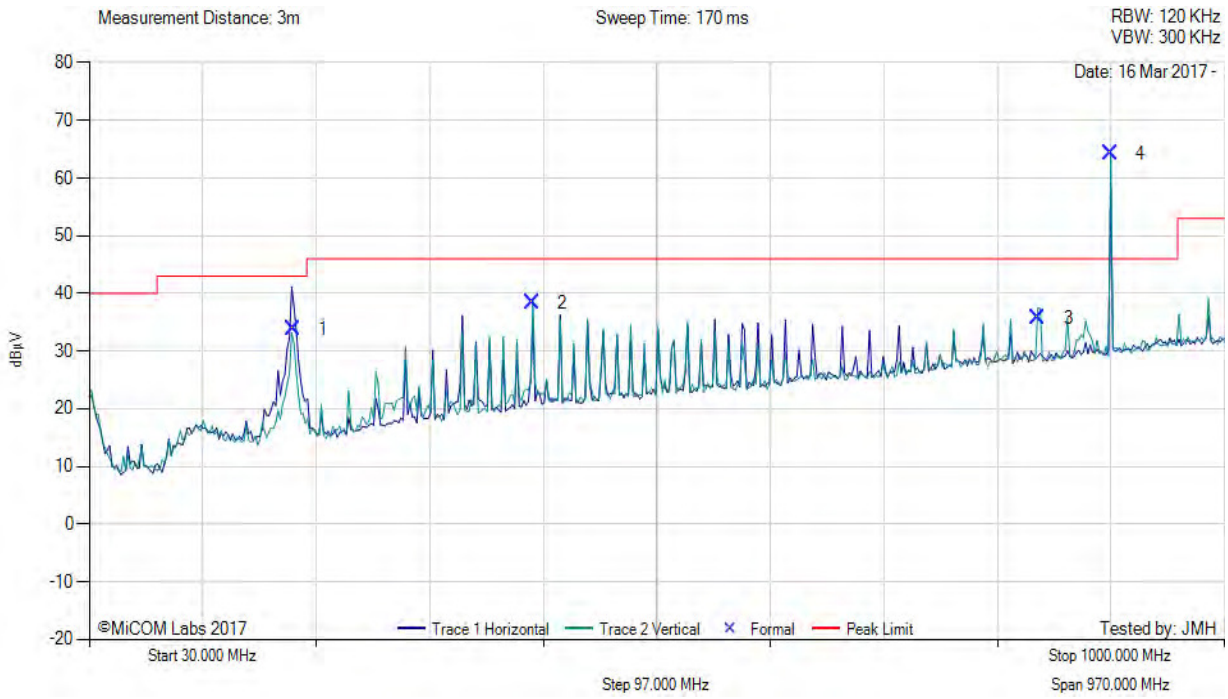
Variant: FHSS, Test Freq: 902.75 MHz, Power Setting: Default



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	204.27	49.00	4.36	-19.60	33.76	MaxQP	Horizontal	150	286	43.0	-9.2	Pass
2	408.43	47.77	5.06	-14.45	38.38	MaxQP	Vertical	115	266	46.0	-7.6	Pass
3	840.92	37.90	6.23	-8.47	35.66	MaxQP	Vertical	110	27	46.0	-10.3	Pass
4	902.74	65.59	6.34	-7.75	64.18	Fundamental	Vertical	100	0	--	--	

Test Notes: EUT ALR-H450 SN: 170 on 150cm table battery powered. 900 MHz filter in front of amp to prevent overloads

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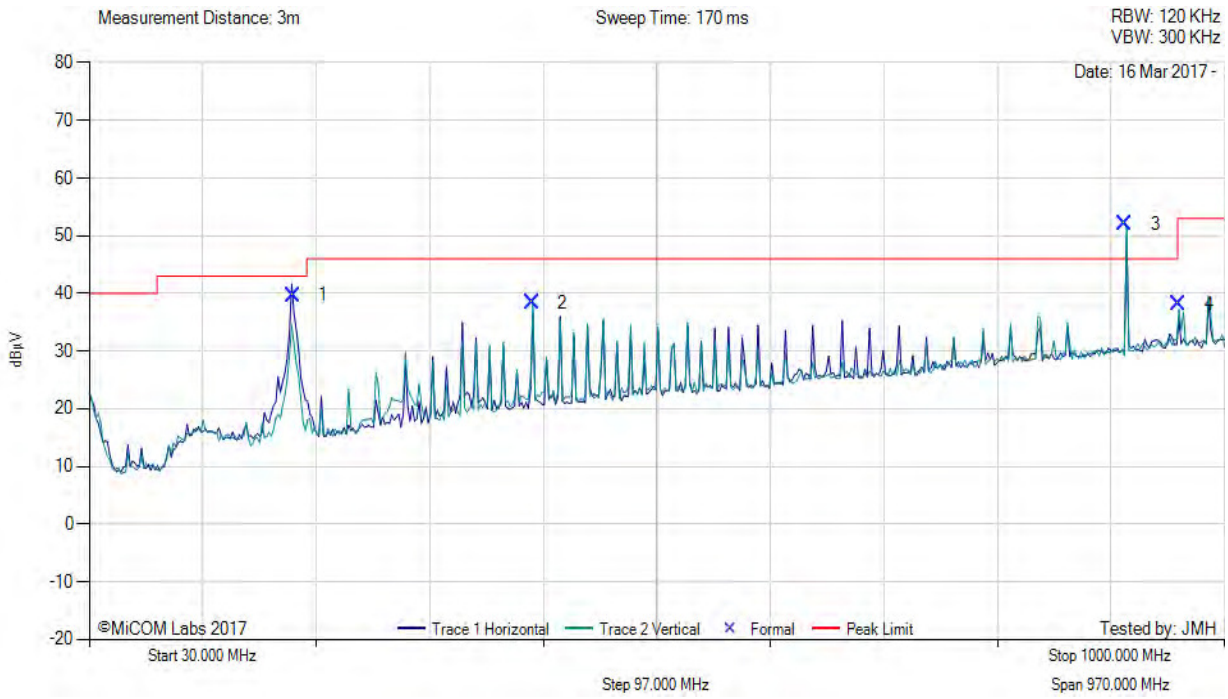
Variant: FHSS, Test Freq: 915.25 MHz, Power Setting: Default



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	204.23	54.89	4.36	-19.60	39.65	MaxQP	Horizontal	102	95	43.0	-3.4	Pass
2	408.42	47.79	5.06	-14.45	38.40	MaxQP	Vertical	108	269	46.0	-7.6	Pass
3	915.25	53.30	6.40	-7.74	51.96	Peak Fundamental	Vertical	100	0	--	--	Pass
4	961.04	38.69	6.48	-7.11	38.06	Peak (Scan)	Vertical	100	63	53.0	-14.9	Pass

Test Notes: EUT ALR-H450 SN: 170 on 150cm table battery powered

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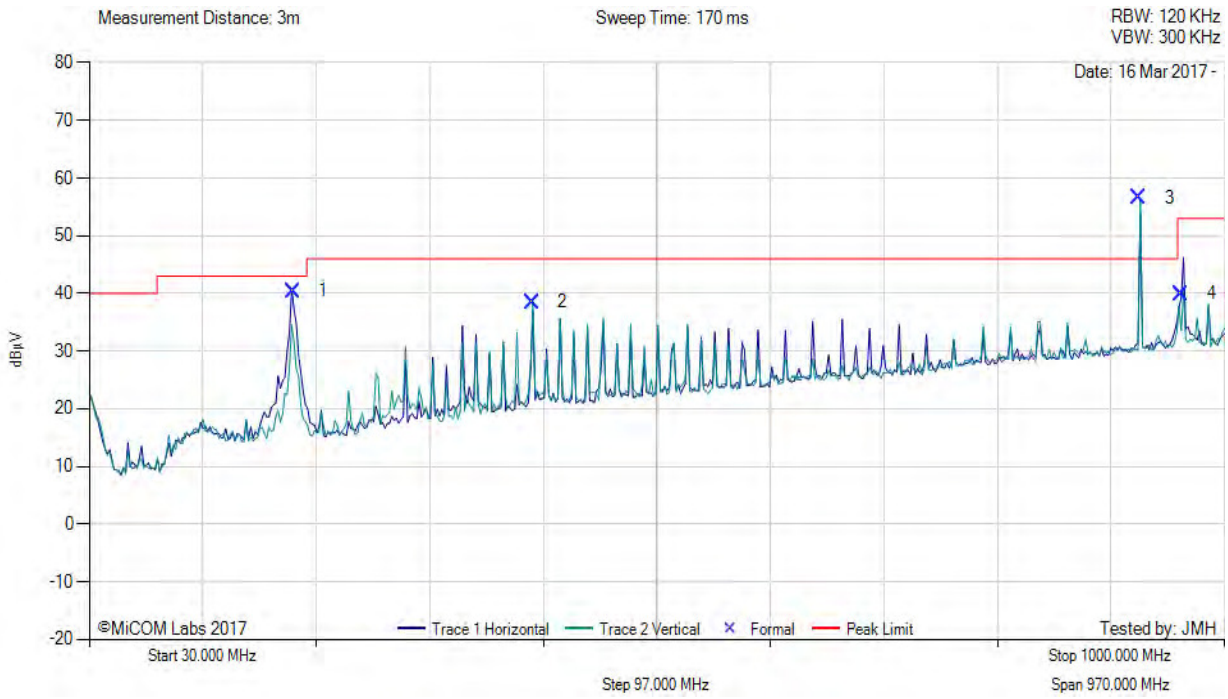
Variant: FHSS, Test Freq: 927.25 MHz, Power Setting: Default



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	204.21	55.62	4.36	-19.60	40.38	MaxQP	Horizontal	114	87	43.0	-2.6	Pass
2	408.43	47.87	5.06	-14.45	38.48	MaxQP	Vertical	109	267	46.0	-7.5	Pass
3	927.24	57.54	6.43	-7.44	56.53	Fundamental	Vertical	100	0	--	--	Pass
4	963.27	40.55	6.48	-7.07	39.96	MaxQP	Horizontal	145	286	53.0	-13.0	Pass

Test Notes: EUT ALR-H450 SN: 170 on 150cm table battery powered

back to matrix

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