Company: Alien Technology, LLC

Test of: ALH-9011
To: FCC CFR 47 Part 15 Subpart C 15.247 (FHSS)
Industry Canada RSS-247 Issue 1

Report No.: ALNT64-U2 Rev A

CONDUCTED, RADIATED TEST REPORT

CONDUCTED, RADIATED TEST REPORT

FROM

Test of: Alien Technology, LLC ALH-9011
to

To: FCC CFR 47 Part 15 Subpart C 15.247 (FHSS)
Industry Canada RSS-247 Issue 1

Test Report Serial No.: ALNT64–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:	14th December 2015

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 28th day of February 2014.

President & CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to December 31, 2015
Revised November 18, 2015

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

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	6th November 2015	
Draft #2	4th December 2015	
Draft #3	10th December 2015	
Rev A	14th December 2015	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:	ALH-9011	**Telephone:**	+1 925 462 0304
Type Of Equipment:	Handheld RFID Reader	**Fax:**	+1 925 462 0306
S/N's:	9011-01-1520258		
Test Date(s):	26th – 28th October 2015	**Website:**	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC CFR 47 Part 15 Subpart C 15.247 (FHSS) **Industry Canada RSS-247 Issue 1 (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	KDB 662911	Oct 31 2013	Guidance for measurement of output emission of devices that employ single transmitter with multiple outputs or systems with multiple transmitters operating simultaneously in the same frequency band
II	KDB 558074 D01 v03r03	9th June 2015	Guidance for performing compliance measurements on Digital Transmission Systems (DTS) operating under section 15.247.
III	A2LA	June 2015	R105 - Requirement's When Making Reference to A2LA Accreditation Status
IV	ANSI C63.10	2013	American National Standard for Testing Unlicensed Wireless Devices
V	ANSI C63.4	2009	American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
VI	CISPR 22	2008	Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement
VII	ETSI TR 100 028	2001-12	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
VIII	FCC 47 CFR Part 15.247	2014	Radio Frequency Devices; Subpart C – Intentional Radiators
IX	ICES-003	Issue 5 2012	Spectrum Management and Telecommunications; Interference-Causing Equipment Standard. Information Technology Equipment (ITE) – 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	KDB 644545 D03 v01	August 14th 2014	Guidance for IEEE 802.11ac New Rules
XIV	FCC 47 CFR Part 2.1033	2014	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 ALH-9011 to FCC CFR 47 Part 15 Subpart C 15.247 (FHSS) and Industry Canada RSS-247 Issue 1
Applicant:	Alien Technology, LLC 845 Embedded Way San Jose California 95138 United States Of America
Manufacturer:	As Applicant
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Test report reference number:	ALNT64-U2
Date EUT received:	14th October 2015
Standard(s) applied:	FCC CFR 47 Part 15 Subpart C 15.247 (FHSS) Industry Canada RSS-247 Issue 1
Dates of test (from - to):	26th – 28th October 2015
No of Units Tested:	1
Type of Equipment:	Handheld RFID Reader
Model(s):	See Section 3.2 Scope of Test Program ALH-90xx Family of Products ALH-9011 (fully loaded, worst case model tested) ALH-9000 ALH-9001 ALH-9010
Location for use:	Indoor and Outdoor
Declared Frequency Range(s):	902 - 928 MHz;
Primary function of equipment:	Handheld RFID Reader
Secondary function of equipment:	None Provided
Type of Modulation:	PR-ASK
EUT Modes of Operation:	902 - 928 MHz: RFID UHF Gen2
Declared Nominal Output Power (Ave):	902 - 928 MHz: +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:	56K0A1D
Equipment Dimensions:	159mm (L) x 79mm (W) x 135mm (H)
Weight:	0.65 Kg
Hardware Rev:	R2000
Software Rev:	R2000Test

5.2. Scope Of Test Program

Alien Technology, LLC ALH-9011

The scope of the test program was to test the Alien Technology, LLC ALH-9011, 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 1
Digital Transmission Systems (DTSs), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices

ALH-90xx Family of Products

	Model			
Feature	**ALH-9000**	**ALH-9001**	**ALH-9010**	**ALH-9011**
Operating System	Win CE	Win CE	Win Mobile	Win Mobile
RFID	Yes	Yes	Yes	Yes
Wi-Fi	Yes	Yes	Yes	Yes
Cellular (HSPDA)	No	Yes	No	Yes
Bluetooth v2.0	No	Yes	No	Yes
GPS	No	Yes	No	Yes

Alien Technology, LLC ALH-9011

Front View

Alien Technology, LLC ALH-9011

Right View

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

Type	Description	Manufacturer	Model	Serial no.	Delivery Date
EUT	Handheld RFID Reader	Alien Technology LLC	ALH-9011	9011-01-1520258	14th Oct 2015

5.4. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
integral	Alien		OMNI	1.2	-	360	-	902- 928.0

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
USB	15m	1	Y	USB	

5.6. Test Configurations

Results for the following configurations are provided in this report:

Operational Mode(s) (PR-ASK)	Data Rate with Highest Power kbps	Channel Frequency (MHz)		
		Low	Mid	High
900 - 928 MHz				
RFID UHF Gen 2	40	902.75	915.25	927.25

5.7. Equipment Modifications

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

5.8. Deviations from the Test Standard

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

6. TEST SUMMARY

List of Measurements

Test Header	Result	Data Link
Conducted Test Results		
15.247(a)(2) 20 dB & 99% Bandwidth **[5.1 (2)]**	Complies	View Data
15.247(b), 15.31(e) Conducted Output Power **[5.4 (4)]**	Complies	View Data
15.247(d) Emissions **[5.5]**	Complies	-
(1) Conducted Emissions	Complies	-
(i) Conducted Spurious Emissions	Complies	View Data
(ii) Conducted Band-Edge Emissions	Complies	View Data
15.247(e) Power Spectral Density [N/A]	Not Tested*	-
Radiated Test Results		
15.205 Restricted Band Spurious Emissions **[RSS-Gen 8.9]**	Complies	View Data
15.209 Digital Emissions (0.03 - 1 GHz) **[RSS-Gen 8.9]**	Complies	View Data
ac Wireline Emissions		
15.207 ac Wireline Emissions **[RSS-Gen 8.8]**	Complies	View Data

* no requirement to test PPSD for FHSS devices

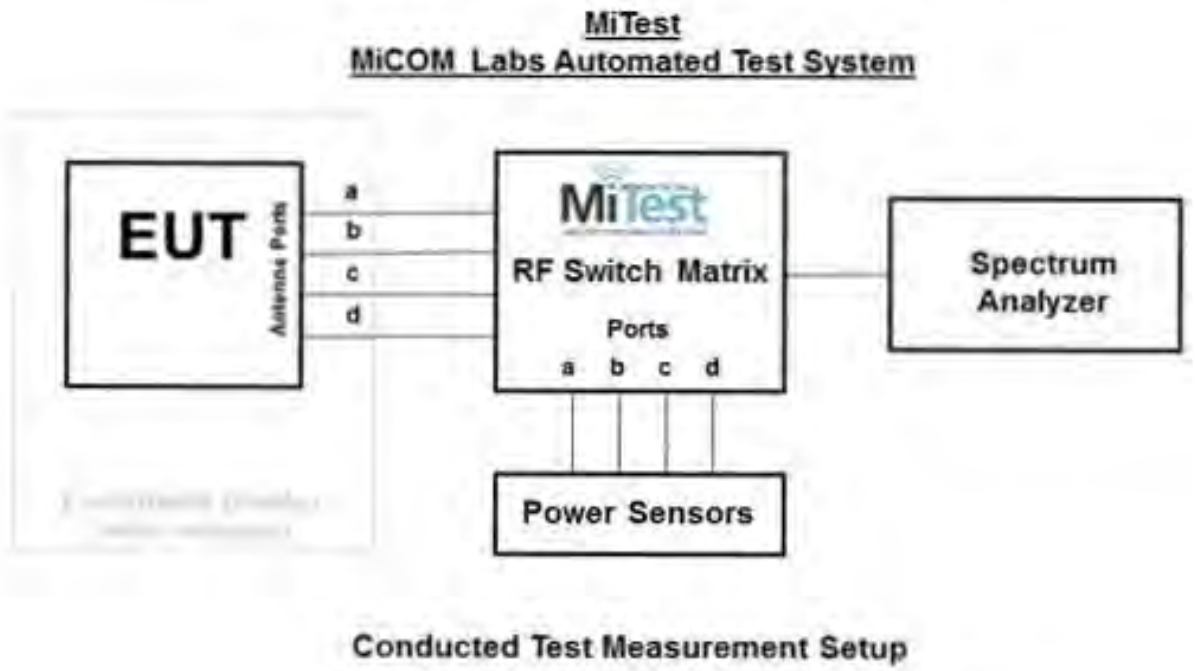
Reference - **Industry Canada RSS-247 or RSS-Gen**

7. TEST EQUIPMENT CONFIGURATION(S)

7.1. Conducted

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

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

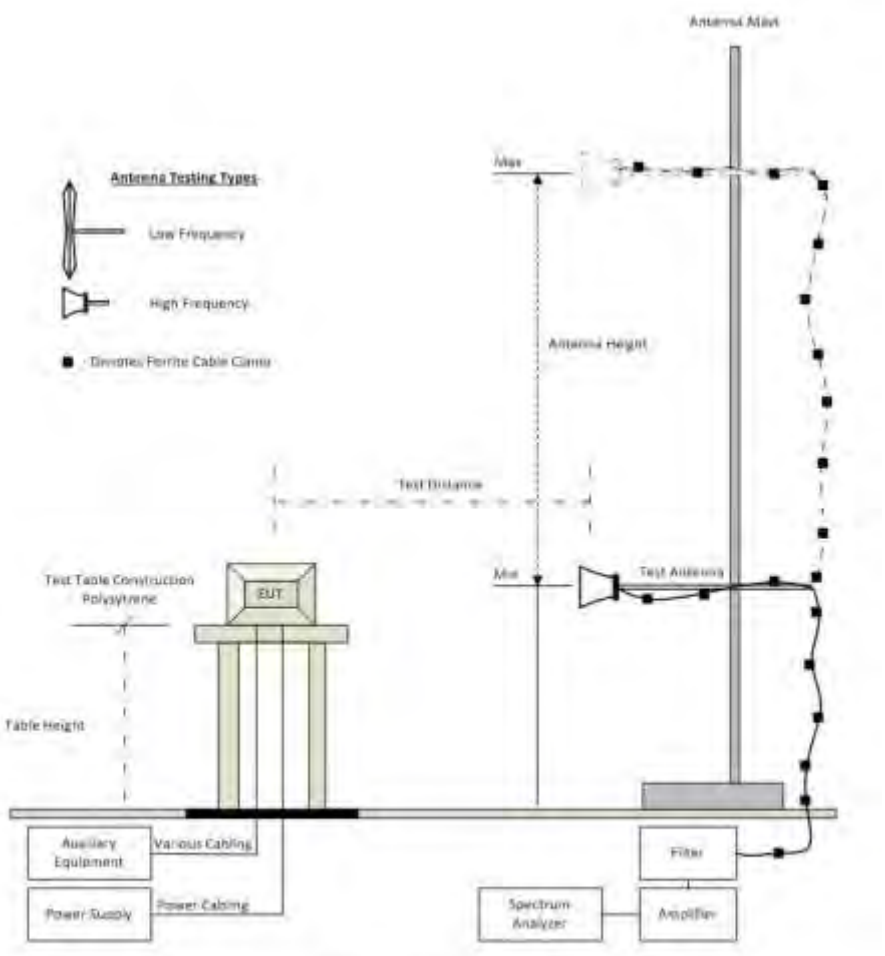
A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
127	Power Supply	HP	6674A	US36370530	Cal when used
158	Barometer/Thermometer	Control Company	4196	E2846	04 Dec 2015
193	Receiver 20 Hz to 7 GHz	Rhode & Schwarz	ESI 7	838496/007	14 Jan 2016
248	Resistance Thermometer	Thermotronics	GR2105-02	9340 #1	21 Oct 2016
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	27 Aug 2016
376	USB 10MHz - 18GHz Average Power Sensor	Agilent	U2000A	MY51440005	23 Oct 2016
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	04 Aug 2016
381	4x4 RF Switch Box	MiCOM Labs	MiTest RF Switch Box	MIC002	20 Dec 2015
419	Laptop	Lenova	W520	TS02	Not Required
420	USB to GPIB Interface	National Instruments	GPIB-USB HS	1346738	Not Required
435	USB Wideband Power Sensor	Boonton	55006	8730	31 Jul 2016
440	USB Wideband Power Sensor	Boonton	55006	9178	25 Sep 2016
441	USB Wideband Power Sensor	Boonton	55006	9179	25 Sep 2016
442	USB Wideband Power Sensor	Boonton	55006	9181	25 Sep 2016
445	PoE Injector	D-Link	DPE-101GL	QTAH1E2000625	Not Required
460	Dell Computer	Dell	Optiplex330	BC944G1	Not Required
74	Environmental Chamber Chamber 3	Tenney	TTC	12808-1	30 Sep 2016
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	20 Dec 2015
RF#2 SMA#2	EUT to Mitest box port 2	Flexco	SMA Cable port2	None	20 Dec 2015
RF#2 SMA#3	EUT to Mitest box port 3	Flexco	SMA Cable port3	None	20 Dec 2015
RF#2 SMA#4	EUT to Mitest box port 4	Flexco	SMA Cable port4	None	20 Dec 2015
RF#2 SMA#SA	Mitest box to SA	Flexco	SMA Cable SA	None	20 Dec 2015
RF#2 USB#1	USB Cable to Mitest Box	Dynex	USB Cable	None	Not Required

7.2. Radiated Emissions

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

1. Section 9.6.2 Radiated Spurious Emissions
2. Section 9.6.3 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.

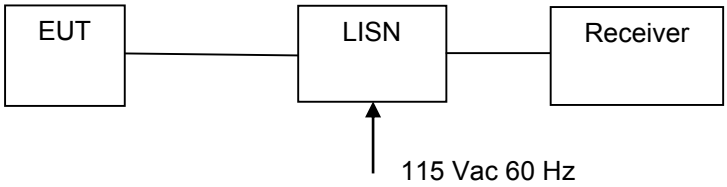
Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
158	Barometer/Thermometer	Control Company	4196	E2846	04 Dec 2015
170	Video System Controller for Semi Anechoic Chamber	Panasonic	WV-CY101	04R08507	Not Required
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	31 Jul 2016
310	SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001	30 Oct 2015
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	14 Aug 2015
393	DC - 1050 MHz Low Pass Filter	Microcircuits	VLFX-1050	N/A	08 Oct 2015
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	23 Oct 2015
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	10 Oct 2015
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	28 May 2016
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
462	Schwarzbeck cable from Antenna to Amplifier.	Schwarzbeck	AK 9513	462	25 Aug 2015
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	25 Aug 2015
464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	25 Aug 2015
465	Low Pass Filter DC-1000 MHz	Mini-Circuits	NLP-1200+	VUU01901402	25 Aug 2015
468	Low pass filter	Mini Circuits	SLP-550	None	30 Sep 2015
469	Low pass filter	Mini Circuit	SLP-1000	None	30 Sep 2015
470	High Pass filter	Mini Circuits	SHP-700	None	30 Sep 2015
CC05	Confidence Check	MiCOM	CC05	None	1 Aug 2015

7.3. ac Wireline Emission

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

1. Section 9.7 ac Wireline Conducted Emissions

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

Traceability of Test Equipment Utilized for ac Wireline Emission Testing

Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
158	Barometer/Thermometer	Control Company	4196	E2846	04 Dec 2015
184	Pulse Limiter	Rhode & Schwarz	ESH3Z2	357.8810.52	Cal when used
190	LISN (two-line V-network)	Rhode & Schwarz	ESH3Z5	836679/006	12 Sep 2016
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	31 Jul 2016
316	Dell desktop computer workstation with Vasona	Dell	Desktop	WS04	Not Required

8. MEASUREMENT AND PRESENTATION OF TEST DATA

The measurement and graphical data presented in this test report was generated automatically using state-of-the-art technology creating an easy to read report structure. Numerical measurement data is separated from supporting graphical data (plots) through hyperlinks. Numerical measurement data can be reviewed without scrolling through numerous graphical pages to arrive at the next data matrix.

Plots have been relegated into the Appendix 'Graphical Data'.

Test and report automation was performed by MiTest. MiTest is an automated test system developed by MiCOM Labs. MiTest is the first cloud based modular test system enabling end-to-end automation of regulatory compliance testing for conducted RF testing.

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

9. TEST RESULTS

9.1. 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)(2)	**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:

(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.

Equipment Configuration for 20 dB & 99% Bandwidth			
Variant:	RFID UHF Gen 2	**Duty Cycle (%):**	99
Data Rate:	Tari 25	**Antenna Gain (dBi):**	Not Applicable
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 6 dB Bandwidth (MHz) Port(s)				6 dB Bandwidth (MHz)		Limit	Lowest Margin
MHz	a	b	c	d	Highest	Lowest	KHz	MHz
902.8	0.047	--	--	--	0.047	0.047	≤500.0	-0.45
915.3	0.044	--	--	--	0.044	0.044	≤500.0	-0.46
927.3	0.051	--	--	--	0.051	0.051	≤500.0	-0.45

Test Frequency	Measured 99% Bandwidth (MHz) Port(s)				Maximum 99% Bandwidth (MHz)		
MHz	a	b	c	d			
902.8	0.056	--	--	--	0.056		
915.3	0.055	--	--	--	0.055		
927.3	0.055	--	--	--	0.055		

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-03 MEASURING RF SPECTRUM MASK
Measurement Uncertainty:	±2.81 dB

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

9.2. Number Of Channels

Conducted Test Conditions for Number Of Channels			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Number of Channels	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(2)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure
The number of channels and channel occupancy is measured with a spectrum analyzer connected to the antenna terminal, while the EUT is operating in transmission mode at the appropriate center frequency and modulation.

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.

Limit
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; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

Equipment Configuration for Hopping Sequence			
Variant:	RFID UHF Gen 2	**Duty Cycle (%):**	Not Applicable
Data Rate:	Tari 25	**Antenna Gain (dBi):**	Not Applicable
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Modulation	Frequeny Range (MHz)	Number of Hopping Channels	Limit	Total Number of Hops	Results
			No of Hopping Channels		
PR-ASK	900.00 – 915.00	25			Pass
PR-ASK	915.00 – 928.00	25			Pass
Total No. of Hopping Channels:		**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).

9.3. Channel Spacing

Conducted Test Channel Separation			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Channel Spacing	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(2)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure
The number of channels and channel occupancy is measured with a spectrum analyzer connected to the antenna terminal, while the EUT is operating in transmission mode at the appropriate center frequency and modulation.

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.

Limit
(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.

Equipment Configuration for Channel Separation			
Variant:	RFID UHF Gen 2	**Duty Cycle (%):**	Not Applicable
Data Rate:	Tari 25	**Antenna Gain (dBi):**	Not Applicable
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Center Frequency	Modulation	Chan Separation	Limit (20 dB Occ. BW)	Result
MHz		MHz	MHz	
902.75	PR-ASK	0.501	≥ 0.047	Pass
915.25	PR-ASK	0.501	≥ 0.044	Pass
927.25	PR-ASK	0.501	≥ 0.051	Pass
Traceability to Industry Recognized Test Methodologies				
Measurement Uncertainty:	±2.81 dB (Spectrum/Amplitude), ±0.86 ppm (Frequency)			

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

9.4. Dwell Time & Channel Occupancy

Conducted Test Conditions for Dwell Time and Channel Occupancy			
Standard:	FCC CFR 47:15.247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Dwell Time & Channel Occupancy	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(2)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure
The number of channels and channel occupancy is measured with a spectrum analyzer connected to the antenna terminal, while the EUT is operating in transmission mode at the appropriate center frequency and modulation.

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.

Limit
(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 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 average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

Equipment Configuration for Dwell Time & Channel Occupancy			
Variant:	RFID UHF Gen 2	**Duty Cycle (%):**	Not Applicable
Data Rate:	Tari 25	**Antenna Gain (dBi):**	Not Applicable
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

		Test Measurement Results			
Center Frequency	**Modulation Type**	**Dwell Time (Single Channel)**	**Channel Occupancy**	**Channel Occupancy Limit**	**Result**
MHz		**mS**	**ms**	**ms**	
902.75	FHSS	196.00	398.00	400.00	Pass
915.25	FHSS	196.00	398.00	400.00	Pass
927.25	FHSS	196.00	398.00	400.00	Pass

Traceability to Industry Recognized Test Methodologies	
Measurement Uncertainty:	±2.81 dB (Spectrum/Amplitude), ±0.86 ppm (Frequency)

Note: click the links in the above matrix

9.5. Conducted 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 (b) & (c)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Fundamental Emission Output Power Measurement
In the case of average power measurements an average power sensor was utilized.

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

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

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

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

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

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

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

(c) Operation with directional antenna gains greater than 6 dBi.
(1) Fixed point-to-point operation:
(i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

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

instructions informing the operator and the installer of this responsibility.

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

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

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

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

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

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

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

Equipment Configuration for Average Output Power

Variant:	RFID UHF Gen 2	**Duty Cycle (%):**	99.0
Data Rate:	Tari 25	**Antenna Gain (dBi):**	Not Applicable
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power + DCCF (+0.04 dB) (dBm)				Calculated Total Power Σ Port(s)	Limit	Margin	EUT Power Setting
	Port(s)							
MHz	a	b	c	d	dBm	dBm	dB	
902.8	29.04	--	--	--	29.04	30.00	-0.96	30.00
915.3	28.95	--	--	--	28.95	30.00	-1.05	30.00
927.3	28.14	--	--	--	28.14	30.00	-1.86	30.00

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Measurement Uncertainty:	±1.33 dB

DCCF - Duty Cycle Correction Factor

9.6. Conducted and Radiated Emissions

9.6.1. Conducted Emissions

9.6.1.1. Conducted Spurious 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:	Max Unwanted Emission Levels	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (d)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

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

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

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

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

Equipment Configuration for Transmitter Conducted Spurious Emissions			
Variant:	RFID UHF Gen 2	**Duty Cycle (%):**	99
Data Rate:	Tari 25	**Antenna Gain (dBi):**	Not Applicable
Modulation:	PR-ASK	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Transmitter Conducted Spurious Emissions (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	SE	Limit	SE	Limit	SE	Limit	SE	Limit
902.8	30.0 - 26000.0	-59.023	-50.00	--	--	--	--	--	--
915.3	30.0 - 26000.0	-59.023	-51.41	--	--	--	--	--	--
927.3	30.0 - 26000.0	-58.923	-50.00	--	--	--	--	--	--

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

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

9.6.1.2. Conducted Band-Edge Emissions

Equipment Configuration for Conducted Low Band-Edge Emissions - Average			
Variant:	RFID UHF Gen 2	**Duty Cycle (%):**	99.0
Data Rate:	Tari 25	**Antenna Gain (dBi):**	Not Applicable
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	902.8 MHz					
Band-Edge Frequency:	902.0 MHz					
Test Frequency Range:	880.0 - 904.0 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	-48.66	-3.00	902.50	--	--	-0.50

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

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

Equipment Configuration for Conducted High Band-Edge Emissions - Average			
Variant:	RFID UHF Gen 2	**Duty Cycle (%):**	99.0
Data Rate:	Tari 25	**Antenna Gain (dBi):**	Not Applicable
Modulation:	PR-ASK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	927.3 MHz					
Band-Edge Frequency:	928.0 MHz					
Test Frequency Range:	925.0 - 940.0 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	-48.92	-1.40	927.50	--	--	-0.50

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

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

9.6.2. Radiated Spurious Emissions

Transmitter Radiated Spurious Emissions (above 1 GHz); Peak Field Strength Measurements; and Radiated Band Edge Measurements – Restricted Bands

FCC, Part 15 Subpart C §15.247(d) 15.205; 15.209
Industry Canada RSS-210 §A8.5, §2.2, §2.6
Industry Canada RSS-Gen §4.7

Test Procedure

Radiated emissions 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.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

Operational Modes

Operational mode(s) tested for spurious emissions were the modes which delivered maximum spectral density

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

For example:
Given receiver input reading of 51.5 dBμV; 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 of the measured emission is:

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

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

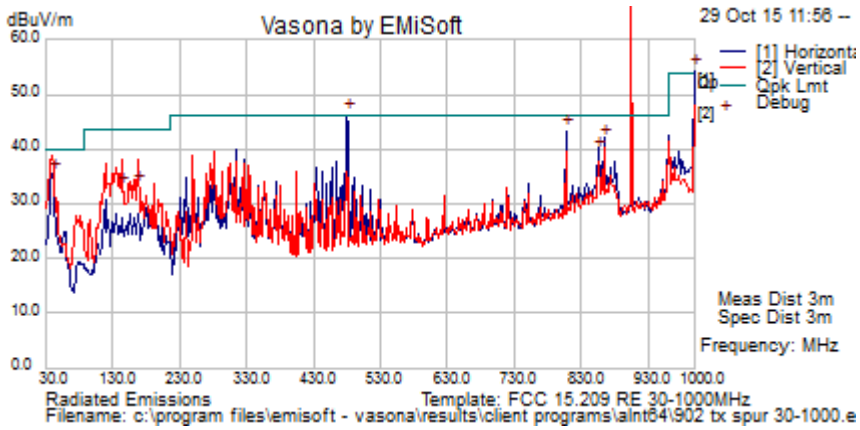
Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

NOTE: KDB 662911 was implemented for Out-of-Band measurements. Where necessary Option (2) Measure and add 10 log (N) dB was implemented

Restricted Band Spurious Emissions

Test Freq.	CH0 (902.75 MHz)	**Engineer**	JMH
Variant	TX Spur	**Temp (ºC)**	20
Freq. Range	30-1000 MHz	**Rel. Hum.(%)**	45
Power Setting	30	**Press. (mBars)**	1004
Antenna	Integral	**Duty Cycle (%)**	100
	ALH-9011 (SN: 9011-01-152256) powered in charger ITE PS (BP1020S05N03)		
Test Notes 2			

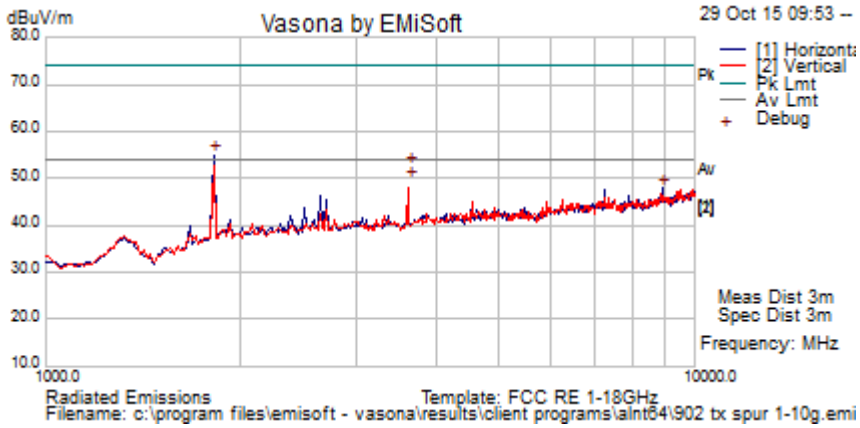


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
904.749	69.5	6.3	-7.8	68.0	Peak [Scan]	V						FUND
479.991	54.8	5.3	-13.3	46.8	Quasi Max	H	243	82	46.0	--	Pass	TX Related NRB 30 dBc
999.260	54.8	6.6	-6.7	54.7	Quasi Peak	H	127	160	54	--	Pass	
807.250	46.5	6.1	-9.0	43.6	Quasi Max	H	101	231	46	-2.4	Pass	
864.003	44.4	6.3	-8.6	42.1	Quasi Max	H	163	232	46	-3.9	Pass	
41.107	50.6	3.5	-18.4	35.7	Quasi Max	V	386	116	40	-4.3	Pass	
855.258	42.2	6.2	-8.6	39.9	Quasi Max	H	99	221	46	-6.1	Pass	
168.091	48.5	4.2	-19.4	33.3	Quasi Max	V	99	346	43.5	-10.2	Pass	
143.953	47.8	4.1	-18.6	33.3	Quasi Max	V	99	253	43.5	-10.2	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

Test Freq.	CH0 (902.75 MHz)	**Engineer**	JMH
Variant	TX Spur	**Temp (ºC)**	20
Freq. Range	1000 MHz - 10000 MHz	**Rel. Hum.(%)**	45
Power Setting	30	**Press. (mBars)**	1004
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	ALH-9011 (SN: 9011-01-152256) powered in charger ITE PS (BP1020S05N03)		
Test Notes 2			

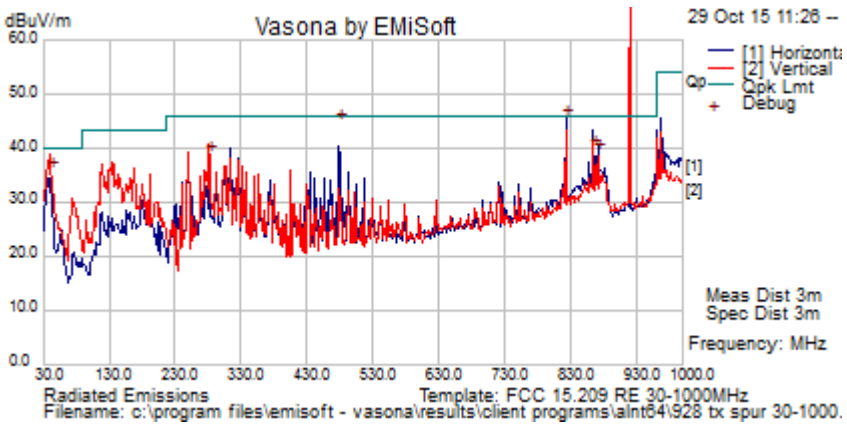


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
1811.623	66.2	2.4	-13.6	55.0	Peak [Scan]	H						NRB
3625.031	60.6	3.2	-11.1	52.7	Peak Max	V	128	278	74.0	-21.3	Pass	RB
3625.031	57.4	3.2	-11.1	49.4	Average Max	V	128	278	54	-4.6	Pass	RB
8899.800	50.0	4.9	-6.9	48.0	Peak [Scan]	H						NRB

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

Test Freq.	CH25 (915.25 MHz)	**Engineer**	JMH
Variant	TX Spur	**Temp (ºC)**	20
Freq. Range	30-1000 MHz	**Rel. Hum.(%)**	45
Power Setting	30	**Press. (mBars)**	1004
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	ALH-9011 (SN: 9011-01-152256) powered in charger ITE PS (BP1020S05N03)		
Test Notes 2			

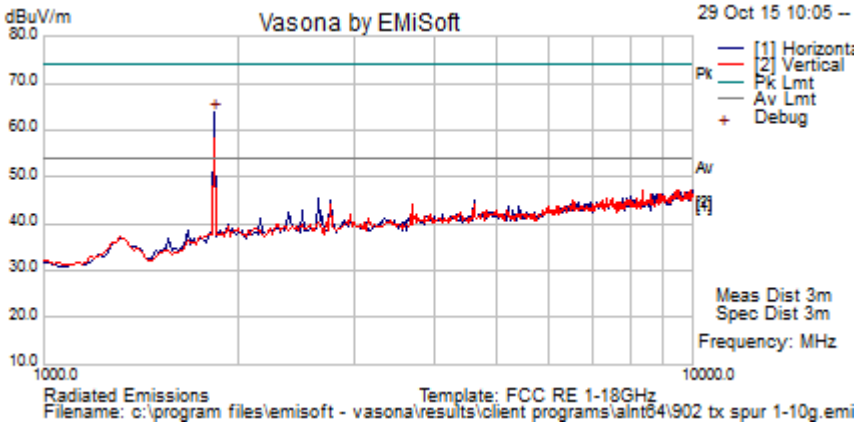


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
920.301	77.6	6.4	-7.3	76.7	Peak [Scan]	V	100					FUND
822.747	48.0	6.2	-8.7	45.5	Quasi Max	H	99	234	46.0	-0.5	Pass	
40.877	50.5	3.5	-18.3	35.7	Quasi Max	V	394	22	40	-4.3	Pass	
864.006	42.3	6.3	-8.6	40.0	Quasi Max	H	154	15	46	-6.0	Pass	
281.067	51.9	4.6	-17.8	38.8	Quasi Max	V	105	16	46	-7.2	Pass	
870.747	41.6	6.3	-8.5	39.3	Quasi Max	H	161	183	46	-6.7	Pass	
479.993	52.8	5.3	-13.3	44.8	Quasi Max	H	200	13	46	-1.2	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

Test Freq.	CH25 (915.25 MHz)	**Engineer**	JMH
Variant	TX Spur	**Temp (ºC)**	20
Freq. Range	1000 MHz - 10000 MHz	**Rel. Hum.(%)**	45
Power Setting	30	**Press. (mBars)**	1004
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	ALH-9011 (SN: 9011-01-152256) powered in charger ITE PS (BP1020S05N03)		
Test Notes 2			

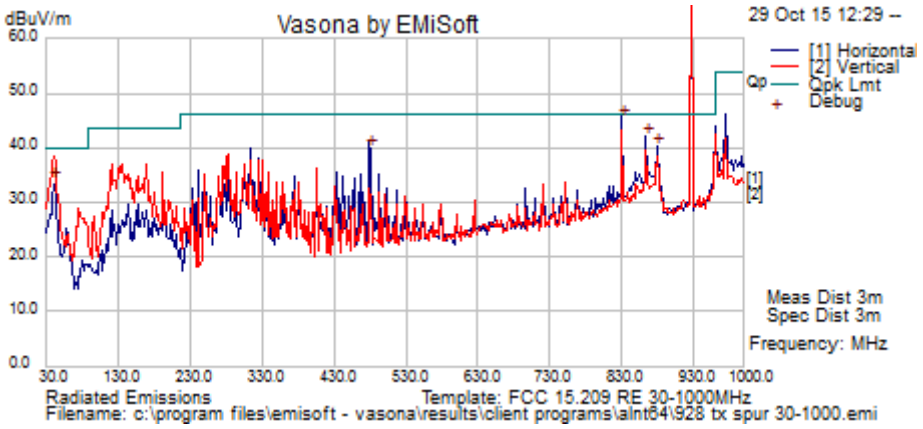


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
1829.659	74.8	2.5	-13.5	63.7	Peak [Scan]	H	150					NRB

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

Test Freq.	CH49 (927.25 MHz)	**Engineer**	JMH
Variant	TX Spur	**Temp (ºC)**	20
Freq. Range	30-1000 MHz	**Rel. Hum.(%)**	45
Power Setting	30	**Press. (mBars)**	1004
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	ALH-9011 (SN: 9011-01-152256) powered in charger ITE PS (BP1020S05N03)		
Test Notes 2			

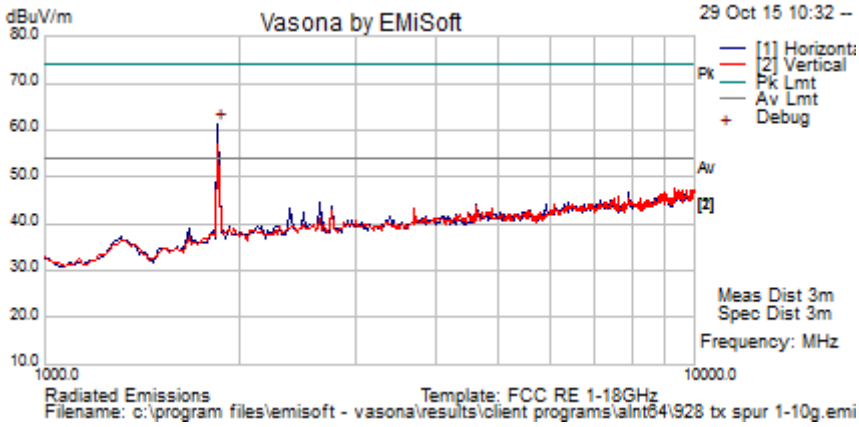


Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
928.020	77.9	6.4	-7.4	76.9	Peak [Scan]	H	200					FUND
830.25	47.9	6.2	-8.7	45.3	Quasi Max	H	99	245	46.0	-0.7	Pass	
39.719	47.8	3.5	-17.6	33.7	Quasi Max	V	99	269	40	-6.3	Pass	
864.002	44.1	6.3	-8.6	41.8	Quasi Max	H	152	238	46	-4.2	Pass	
479.995	47.6	5.3	-13.3	39.6	Quasi Max	H	296	361	46	-6.4	Pass	
878.255	42.3	6.3	-8.4	40.2	Quasi Max	H	152	222	46	-5.8	Pass	

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

Test Freq.	CH49 (927.25 MHz)	**Engineer**	JMH
Variant	TX Spur	**Temp (ºC)**	20
Freq. Range	1000 MHz - 10000 MHz	**Rel. Hum.(%)**	45
Power Setting	30	**Press. (mBars)**	1004
Antenna	Integral	**Duty Cycle (%)**	100
Test Notes 1	ALH-9011 (SN: 9011-01-152256) powered in charger ITE PS (BP1020S05N03)		
Test Notes 2			



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
1847.695	72.4	2.5	-13.5	61.4	Peak [Scan]	H	150					NRB

Legend:	TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
	NRB = Non-Restricted Band. Limit = 68.23 dBuV/m; RB = Restricted Band. Limits per 15.205

9.6.3. Digital Emissions (0.03 - 1 GHz)

Test Procedure

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. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

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 51.5dBμV; 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:

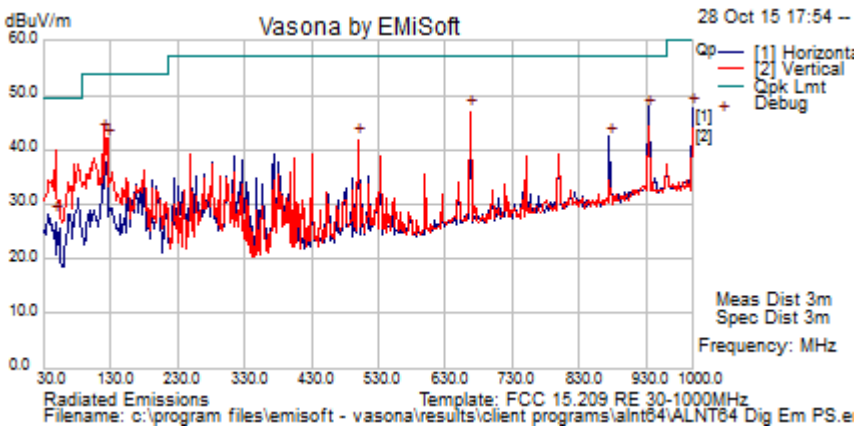
$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 dB\mu V/m$$

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

$$Level\ (dB\mu V/m) = 20 * Log\ (level\ (\mu V/m))$$

40 dBμV/m = 100μV/m
48 dBμV/m = 250μV/m

EUT	ALH-9011	**Engineer**	JMH
Variant	Digital Emissions	**Temp (ºC)**	22
Freq. Range	30 MHz - 1000 MHz	**Rel. Hum.(%)**	44
Standard Limit	FCC Class A	**Press. (mBars)**	1004
Support Equip	None		
Test Notes	EUT in charger base (PS ITE BP1020S05N03), Lan connected to hub below turntable		



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail	Comments
666.658	52.6	5.8	-10.8	47.57	Quasi Max	V	104	361	57.0	-9.4	Pass	
933.328	48.5	6.4	-7.4	47.5	Quasi Max	H	252	32	57.0	-9.5	Pass	
119.991	56.4	4.0	-17.2	43.21	Quasi Max	V	118	45	54.0	-10.8	Pass	
125.006	55.4	4.0	-17.3	42.1	Quasi Max	V	105	131	54.0	-11.9	Pass	
499.987	50.2	5.3	-13.1	42.38	Quasi Max	V	131	263	57.0	-14.6	Pass	
874.975	44.5	6.3	-8.5	42.3	Quasi Max	H	98	10	57.0	-14.7	Pass	
48.051	46.6	3.6	-22.3	27.83	Quasi Max	V	123	121	49.5	-21.7	Pass	
1000.000	48.1	6.6	-6.7	48.0	Peak [Scan]	H	100	0	60.0	-12.0	Pass	

Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	TRNS= Transient Emission, Brbnd= Broadband emission

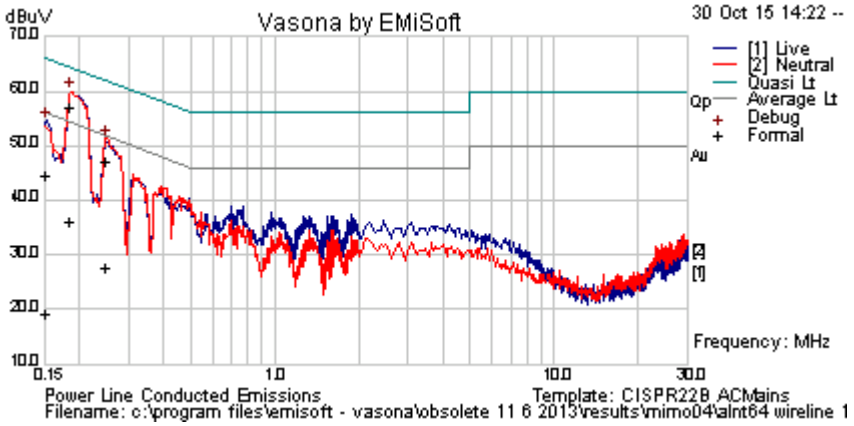
9.7. ac Wireline Emissions

FCC, Part 15 Subpart C §15.207
Industry Canada RSS-Gen §7.2.2

Test Procedure
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.

Measurement Results for ac Wireline Conducted Emissions (150 kHz – 30 MHz)

Test Freq.	Not Applicable	**Engineer**	SB
Variant	AC Line Emissions	**Temp (ºC)**	25
Freq. Range	0.150 MHz - 30 MHz	**Rel. Hum.(%)**	22
Power Setting	Max	**Press. (mBars)**	1009
Antenna	Integral		
Test Notes 1	Battery charging in stand; EUT powered by stand; Transmitter On;		
Test Notes 2			



Formally measured emission peaks

Frequency MHz	Raw dBuV	Cable Loss	Factors dB	Level dBuV	Measurement Type	Line	Limit dBuV	Margin dB	Pass /Fail	Comments
0.154	34.6	9.8	0.1	44.5	Quasi Peak	Live	65.8	-21.3	Pass	
0.187	47.0	9.8	0.1	56.9	Quasi Peak	Live	64.17	-7.2	Pass	
0.250	37.4	9.8	0.1	47.3	Quasi Peak	Neutral	61.75	-14.4	Pass	
0.154	9.4	9.8	0.1	19.3	Average	Live	55.8	-36.5	Pass	
0.187	26.2	9.8	0.1	36.0	Average	Live	54.17	-18.1	Pass	
0.250	17.8	9.8	0.1	27.7	Average	Neutral	51.75	-24.1	Pass	
1.649	25.3	9.8	0.1	35.2	Peak [Scan]	Live	46	-10.8	Pass	
4.027	24.8	9.7	0.2	34.8	Peak [Scan]	Live	46	-11.2	Pass	
0.677	27.3	9.8	0.1	37.2	Peak [Scan]	Live	46	-8.8	Pass	

Legend:	DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency
	NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band

Specification

Limits

§15.207 (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 μΩ line impedance stabilization network (LISN), see §15.207 (a) matrix below. 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.

§15.207 (a) Limit Matrix
The lower limit applies at the boundary between frequency ranges

Frequency of Emission (MHz)	Conducted Limit (dBμV)	
	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

Laboratory Measurement Uncertainty for Conducted Emissions

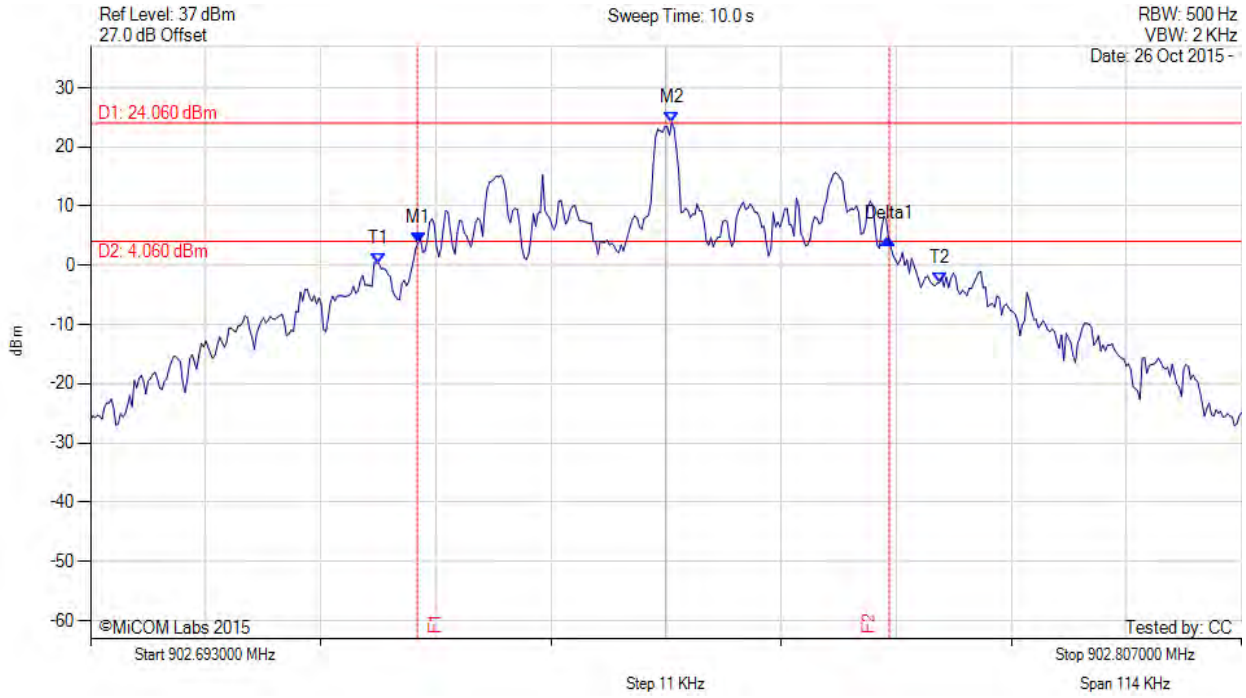
Measurement uncertainty	±2.64 dB

A. APPENDIX - GRAPHICAL IMAGES

A.1. 20 dB & 99% Bandwidth

20 dB & 99% BANDWIDTH

Variant: FHSS, Channel: 902.75 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

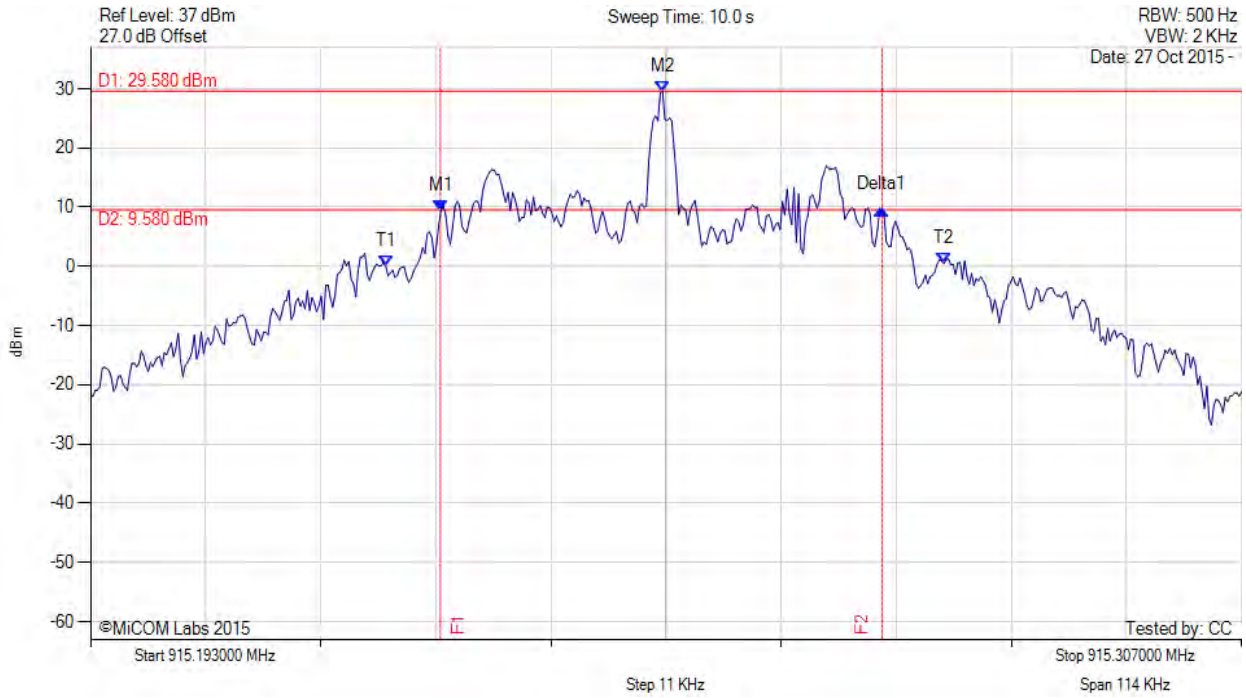


Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 902.725 MHz : 3.736 dBm M2 : 902.751 MHz : 24.061 dBm Delta1 : 47 KHz : 0.801 dB T1 : 902.722 MHz : 0.357 dBm T2 : 902.777 MHz : -2.945 dBm OBW : 56 KHz	Measured 6 dB Bandwidth: 0.047 MHz Limit: ≥500.0 kHz Margin: 0.45 MHz

back to matrix

20 dB & 99% BANDWIDTH

Variant: FHSS, Channel: 915.25 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

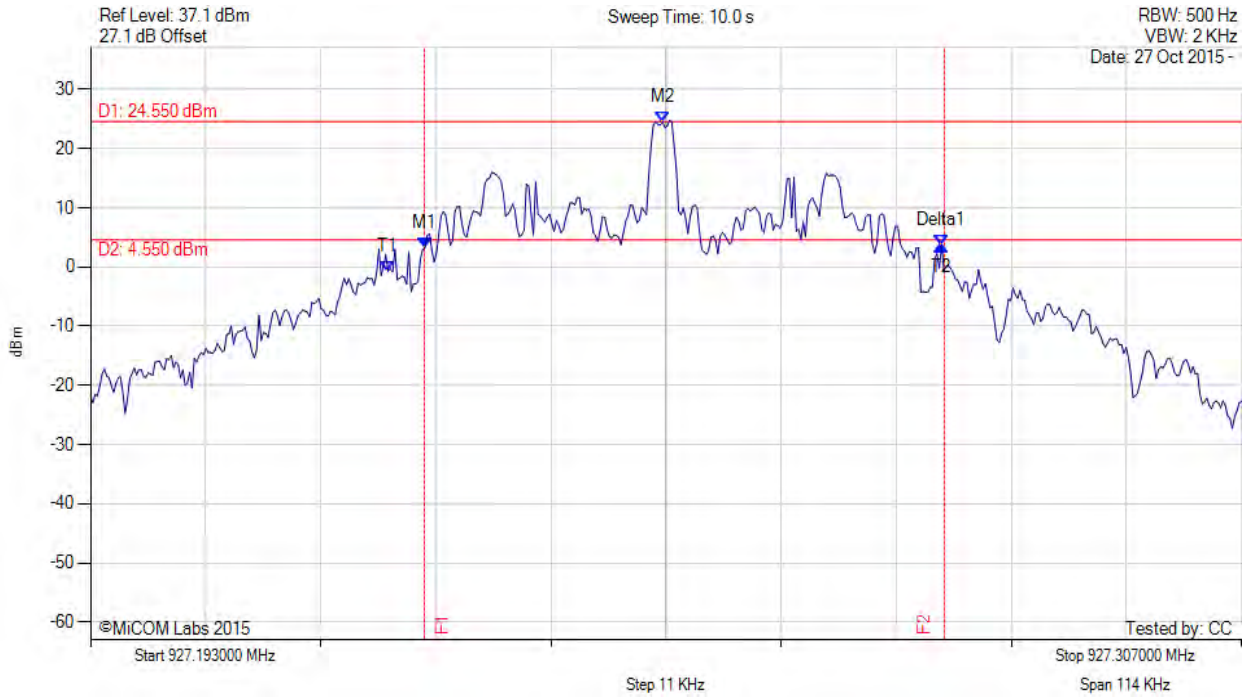


Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 915.228 MHz : 9.390 dBm M2 : 915.250 MHz : 29.577 dBm Delta1 : 44 KHz : 0.136 dB T1 : 915.222 MHz : 0.035 dBm T2 : 915.278 MHz : 0.469 dBm OBW : 55 KHz	Measured 6 dB Bandwidth: 0.044 MHz Limit: ≥500.0 kHz Margin: 0.46 MHz

back to matrix

20 dB & 99% BANDWIDTH

Variant: FHSS, Channel: 927.25 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc



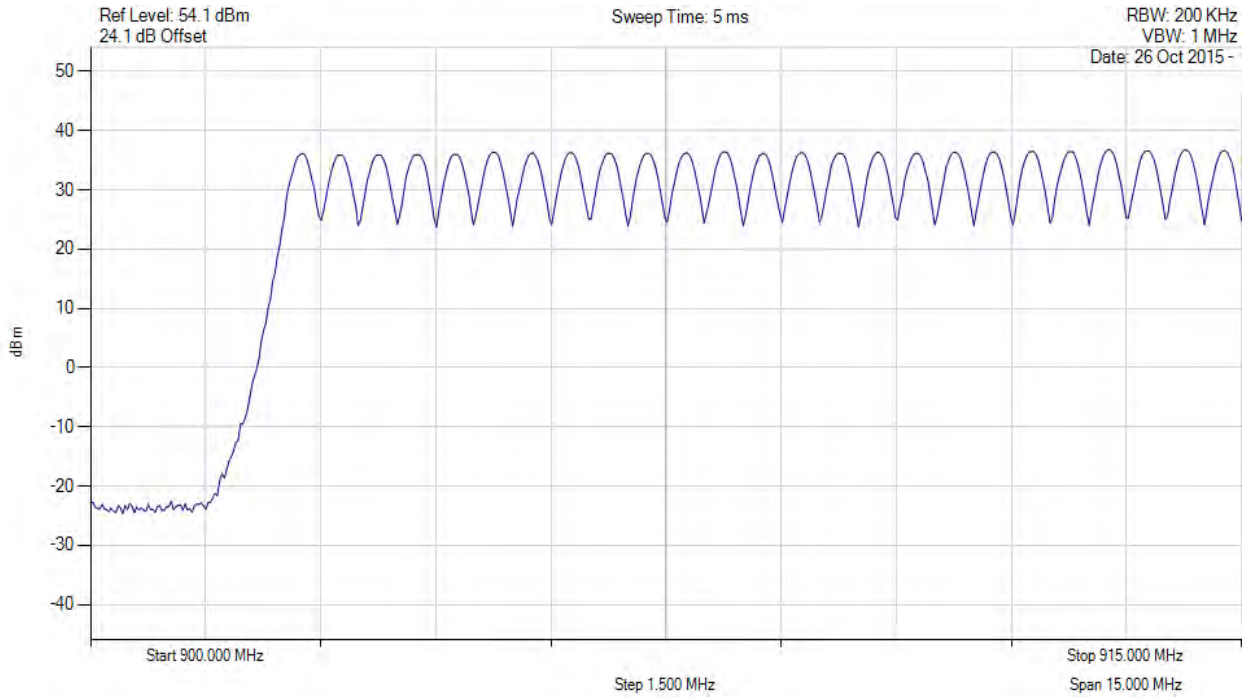
Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 927.226 MHz : 3.269 dBm M2 : 927.250 MHz : 24.548 dBm Delta1 : 51 KHz : 0.384 dB T1 : 927.222 MHz : -0.723 dBm T2 : 927.277 MHz : 3.656 dBm OBW : 55 KHz	Measured 6 dB Bandwidth: 0.051 MHz Limit: ≥500.0 kHz Margin: 0.45 MHz

back to matrix

A.2. Number of Channels

Hopping 902-915MHz

Variant: FHSS, Channel: Hopping, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

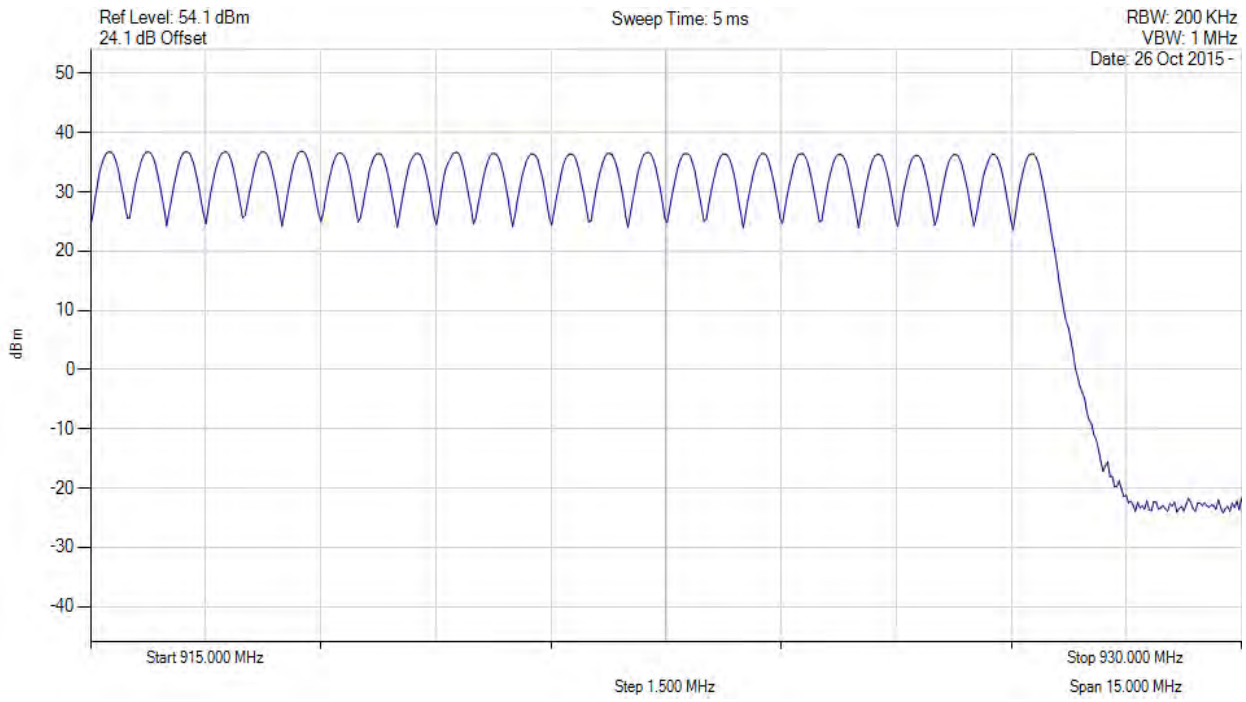


Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW		Channel Frequency: Hopping Number of Hops: 25

back to matrix

Hopping 915-930MHz

Variant: FHSS, Channel: Hopping, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

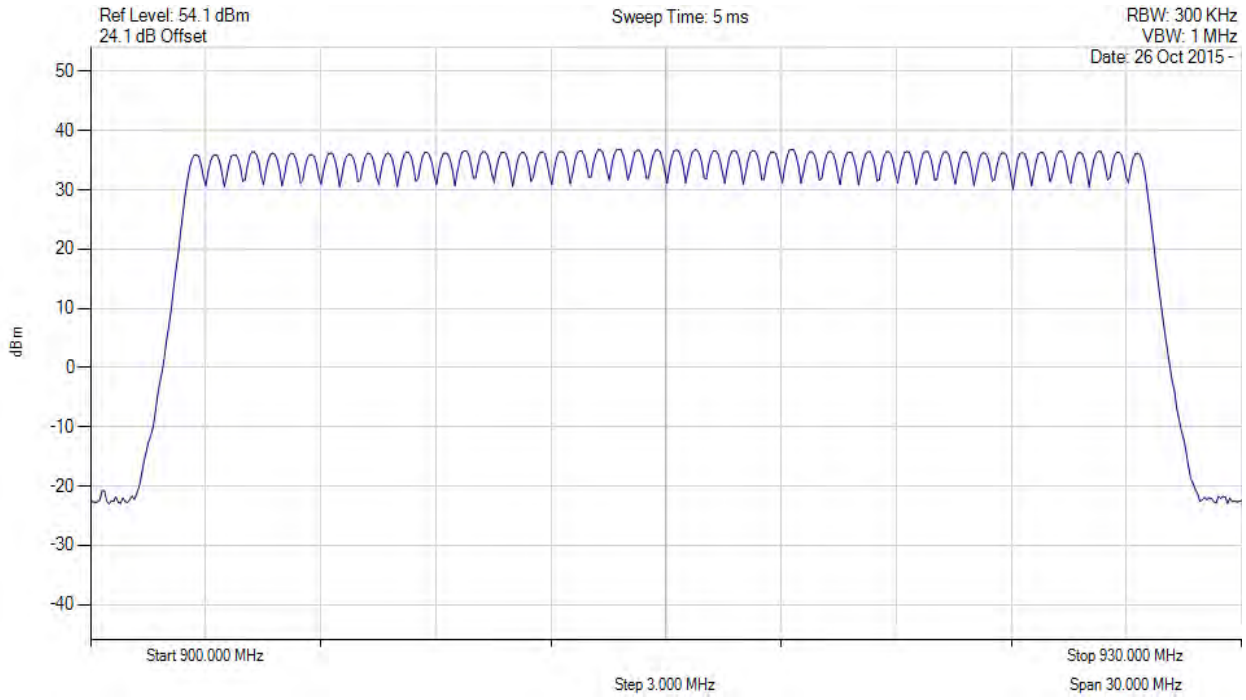


Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW		Channel Frequency: Hopping Number of Hops: 25

back to matrix

Number of Hopping Channels

Variant: FHSS, Channel: Hopping, Chain a, Temp: Ambient, Voltage: 3.7 Vdc



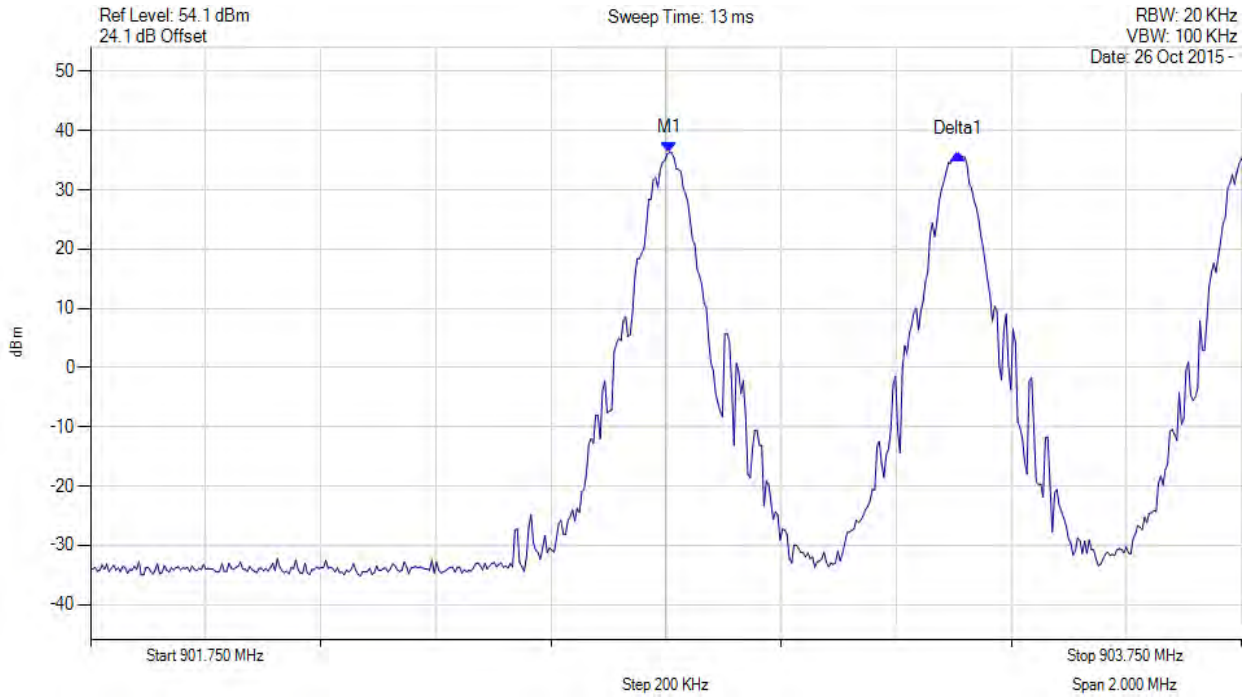
Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW		Channel Frequency: Hopping Number of Hops: 50

back to matrix

A.3. Channel Spacing

Channel Separation

Variant: FHSS, Channel: 902.75 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

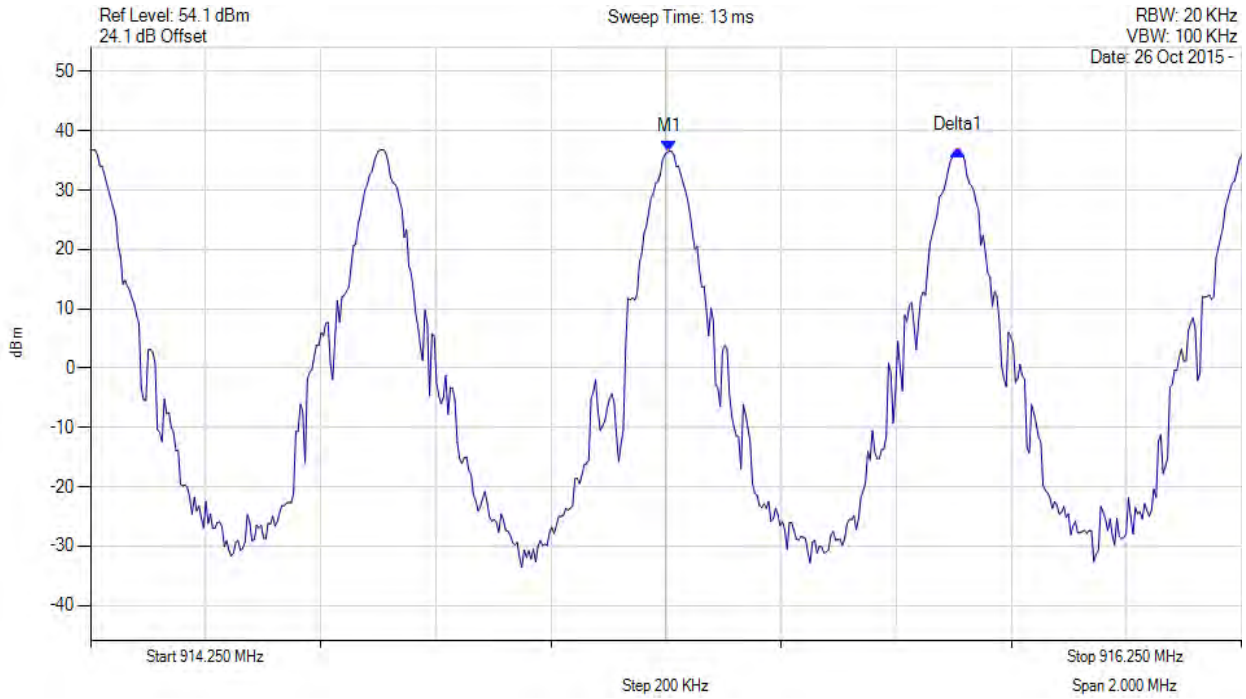


Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1 : 902.756 MHz : 36.309 dBm Delta1 : 501 KHz : -0.325 dB	Channel Frequency: 902.75 MHz Channel Separation: 0.5MHz

back to matrix

Channel Separation

Variant: FHSS, Channel: 915.25 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

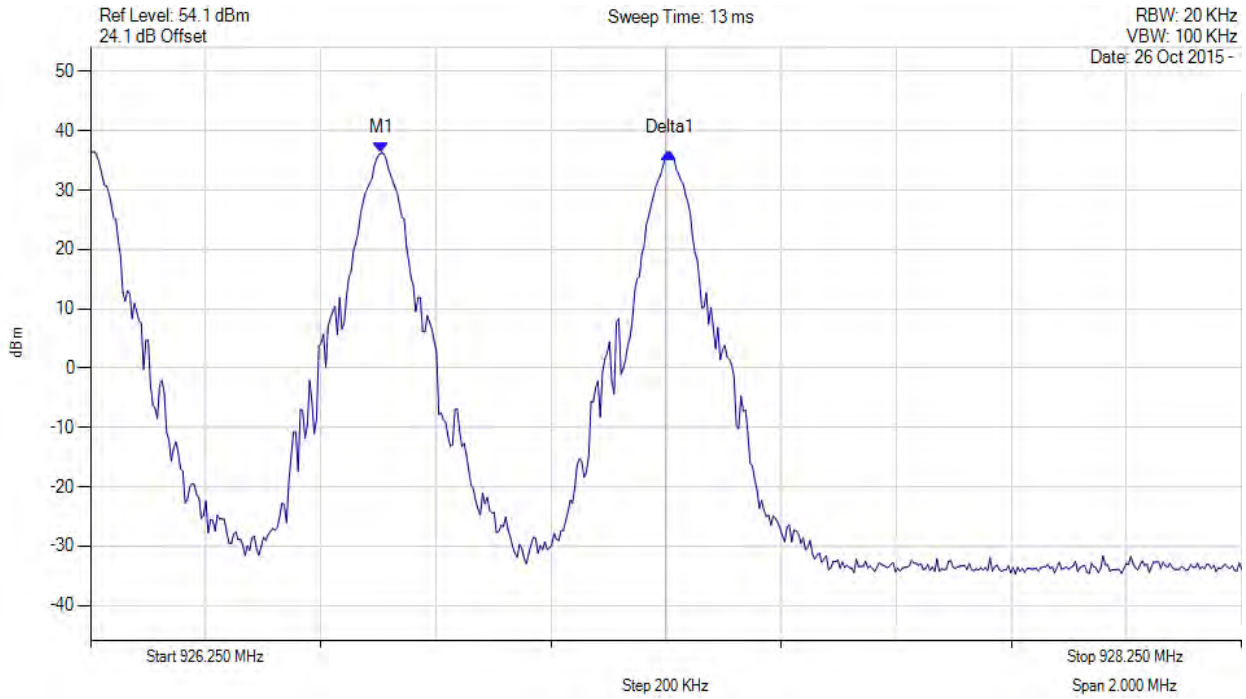


Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1 : 915.256 MHz : 36.557 dBm Delta1 : 501 KHz : 0.185 dB	Channel Frequency: 915.25 MHz Channel Separation: 0.5MHz

back to matrix

Channel Separation

Variant: FHSS, Channel: 927.25 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc



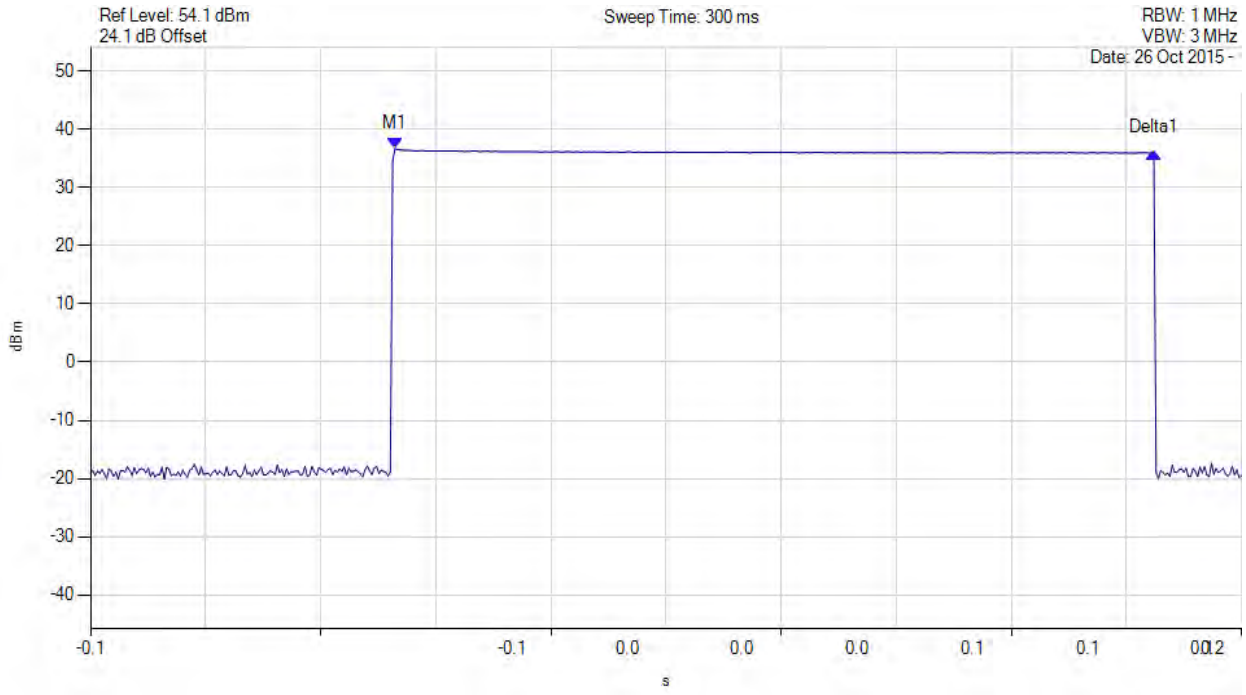
Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1 : 926.755 MHz : 36.290 dBm Delta1 : 501 KHz : -0.004 dB	Channel Frequency: 927.25 MHz Channel Separation: 0.5MHz

back to matrix

A.4. Dwell Time & Channel Occupancy

Dwell Time

Variant: FHSS, Channel: 902.75 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

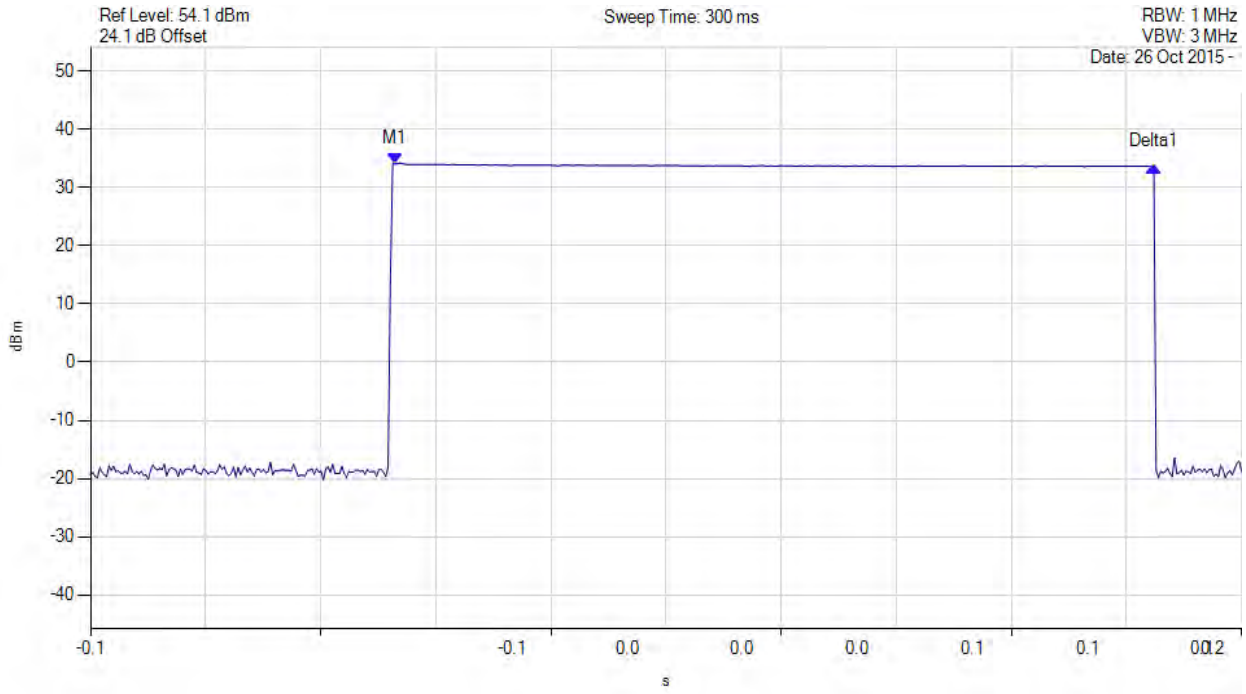


Analyser Setup	Marker:Time:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1(902.75 MHz) : -0.001 s : 36.687 dBm Delta1(902.75 MHz) : 0.198 s : -0.781 dB	Channel Frequency: 902.75 MHz Dwell Time: 0.198 s

back to matrix

Dwell Time

Variant: FHSS, Channel: 915.25 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

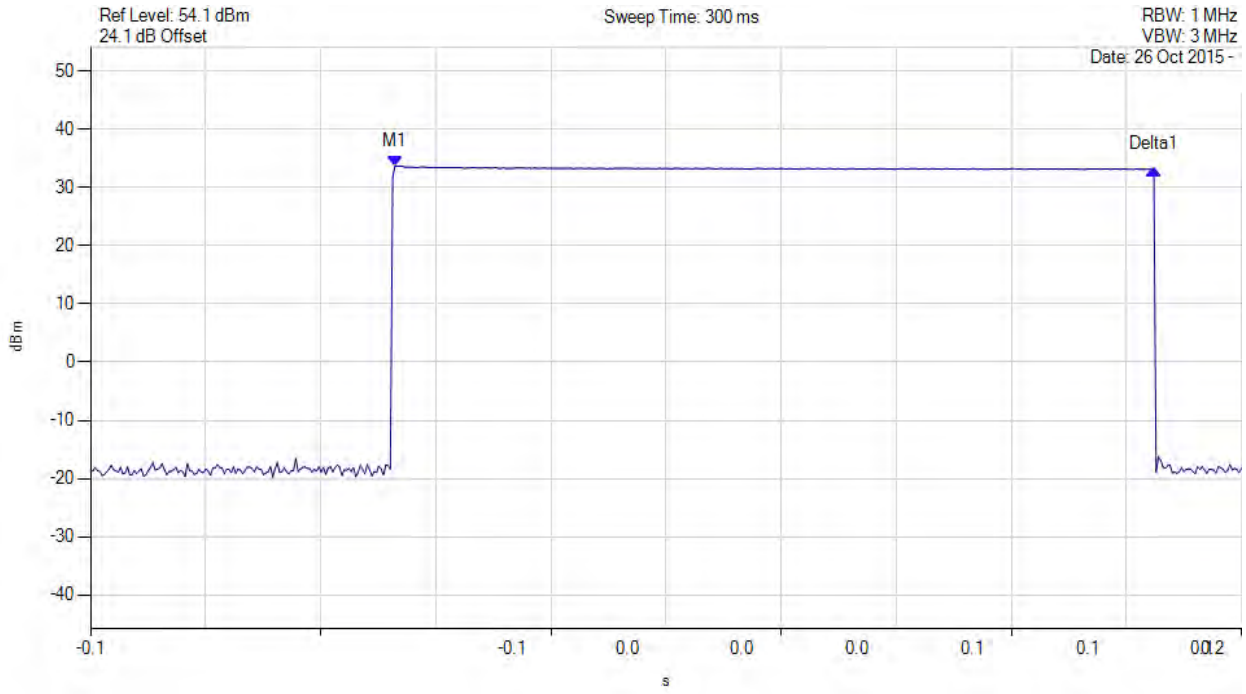


Analyser Setup	Marker:Time:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1(915.25 MHz) : -0.001 s : 34.090 dBm Delta1(915.25 MHz) : 0.198 s : -0.405 dB	Channel Frequency: 915.25 MHz Dwell Time: 0.198 s

back to matrix

Dwell Time

Variant: FHSS, Channel: 927.25 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

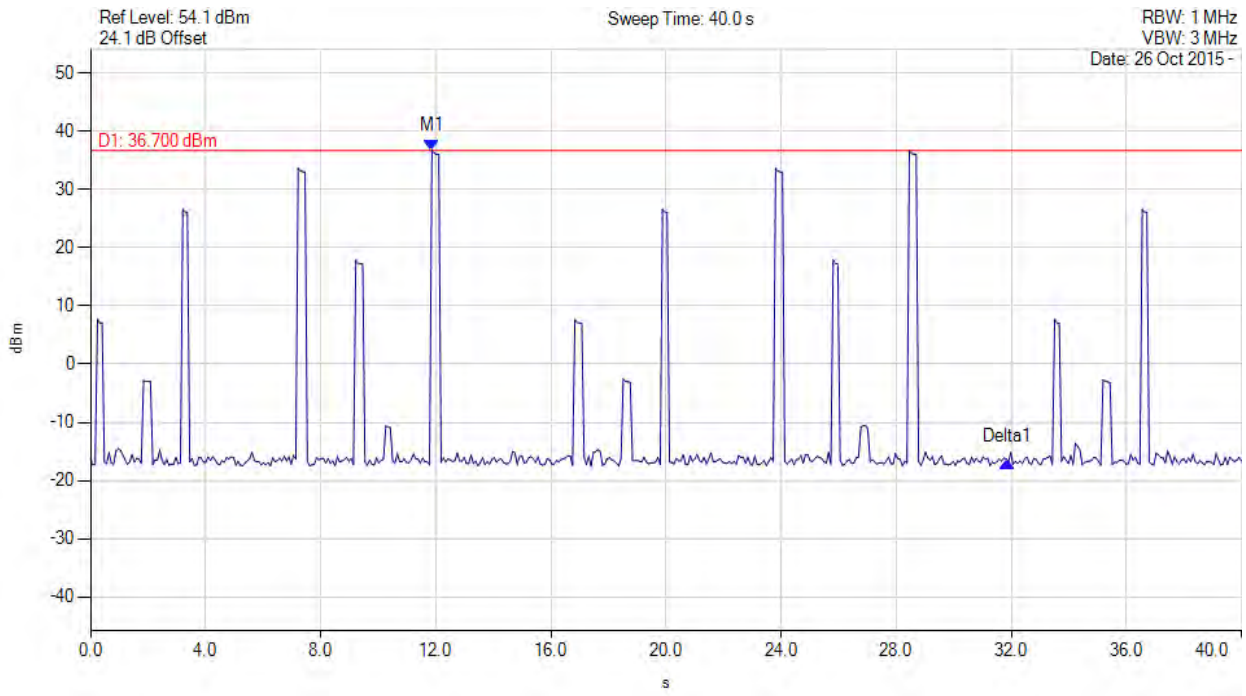


Analyser Setup	Marker:Time:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1(927.25 MHz) : -0.001 s : 33.691 dBm Delta1(927.25 MHz) : 0.198 s : -0.553 dB	Channel Frequency: 927.25 MHz Dwell Time: 0.198 s

back to matrix

Channel Occupancy

Variant: FHSS, Channel: 902.75 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

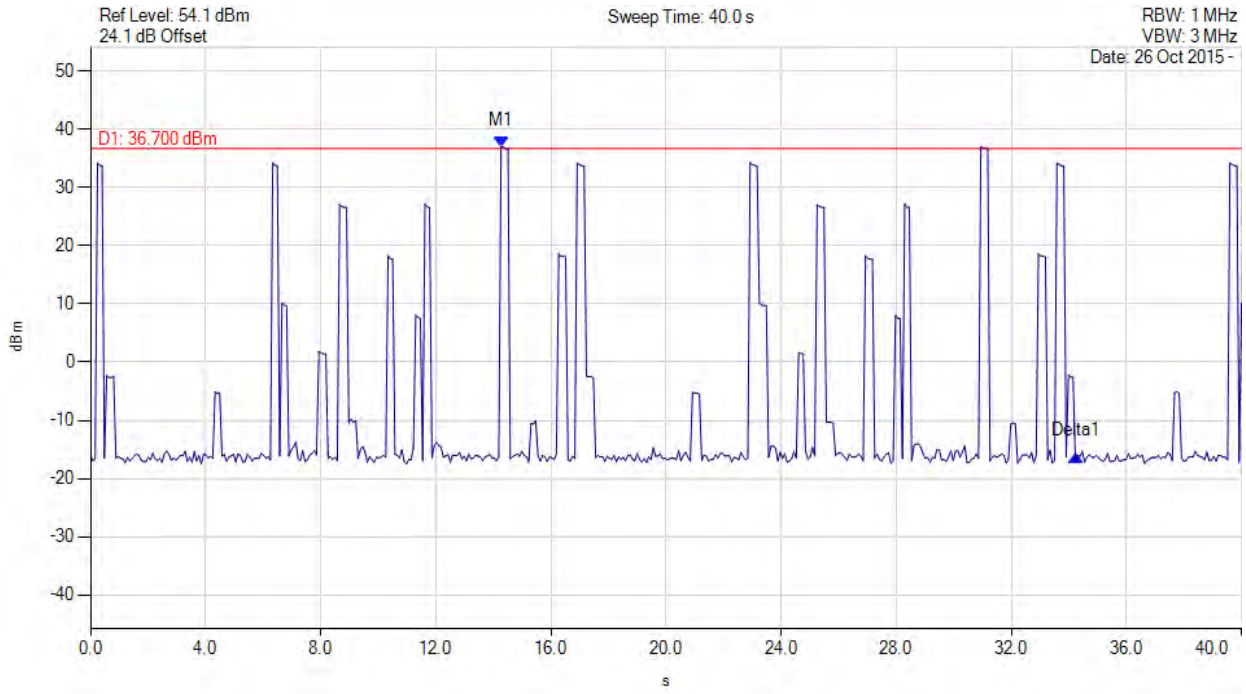


Analyser Setup	Marker:Time:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1(902.75 MHz) : 11.864 s : 36.687 dBm Delta1(902.75 MHz) : 20.000 s : -53.414 dB	Channel Frequency: 902.75 MHz Occupancy: 398.00 ms

back to matrix

Channel Occupancy

Variant: FHSS, Channel: 915.25 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

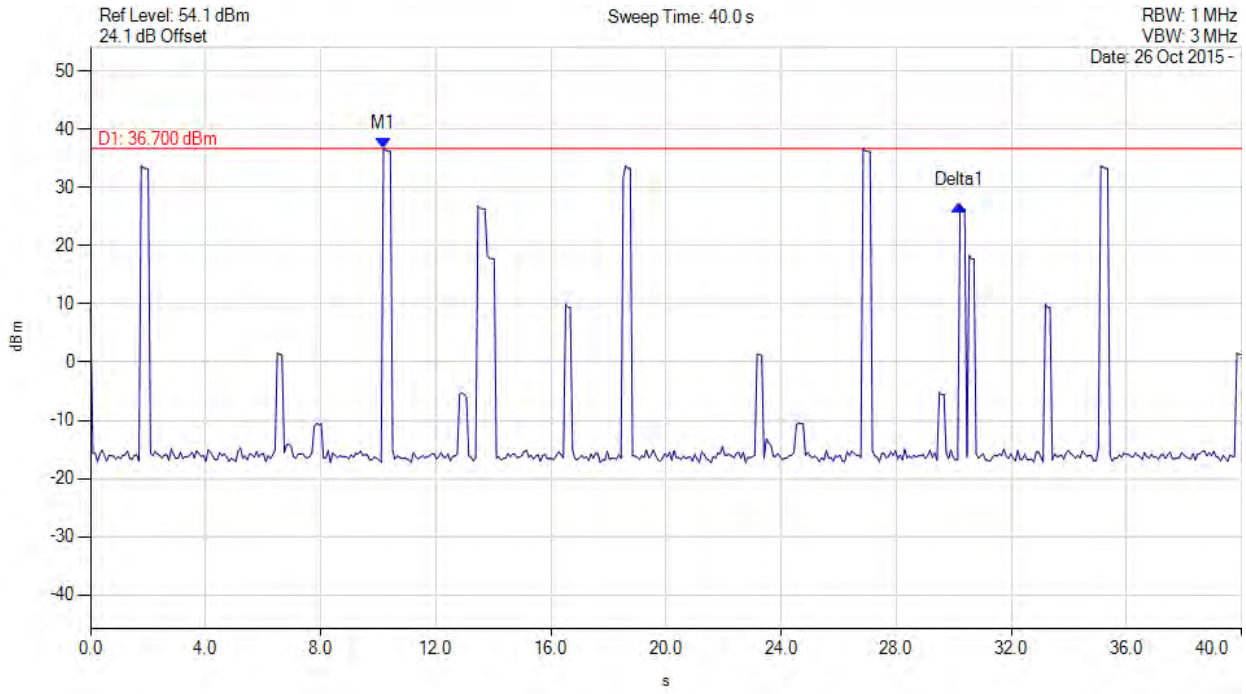


Analyser Setup	Marker:Time:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1(915.25 MHz) : 14.269 s : 37.071 dBm Delta1(915.25 MHz) : 20.000 s : -53.089 dB	Channel Frequency: 915.25 MHz Occupancy: 398.00 ms

back to matrix

Channel Occupancy

Variant: FHSS, Channel: 927.25 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc



Analyser Setup	Marker:Time:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1(927.25 MHz) : 10.180 s : 36.754 dBm Delta1(927.25 MHz) : 20.000 s : -9.854 dB	Channel Frequency: 927.25 MHz Occupancy: 398.00 ms

back to matrix

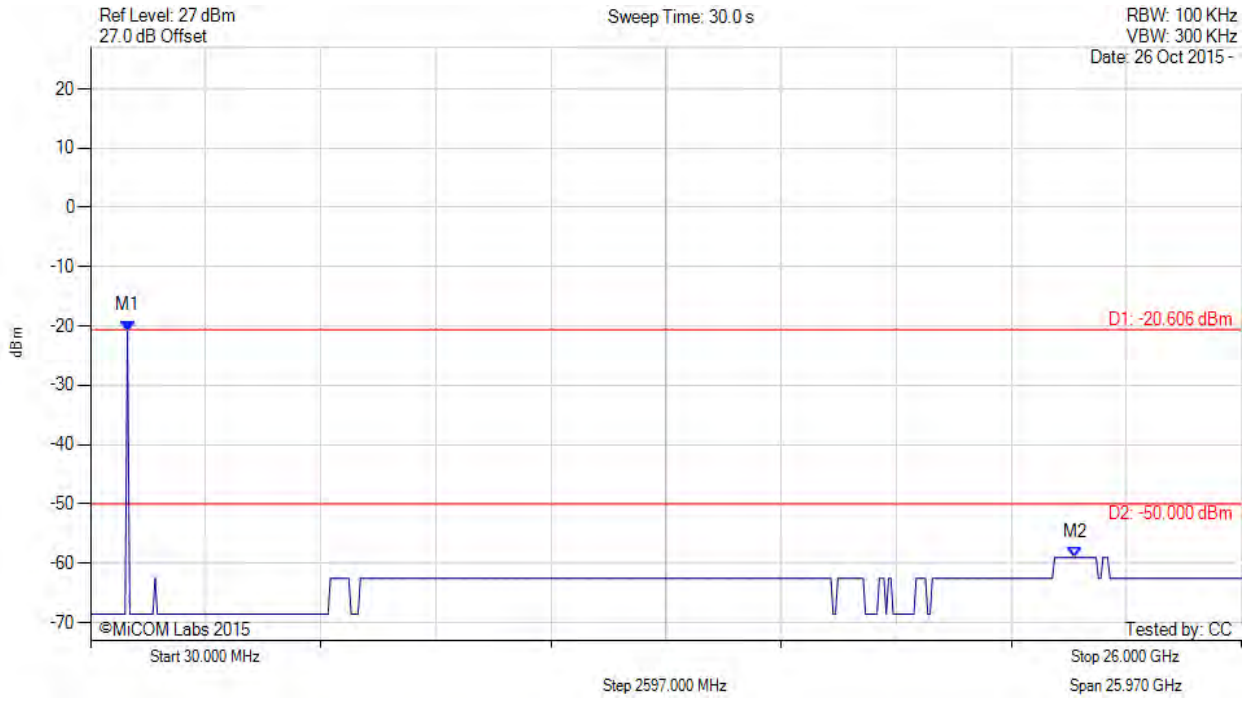
A.5. Emissions

A.5.1. Conducted Emissions

A.5.1.1. Conducted Spurious Emissions

CONDUCTED SPURIOUS EMISSIONS - AVERAGE

Variant: FHSS, Channel: 902.75 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

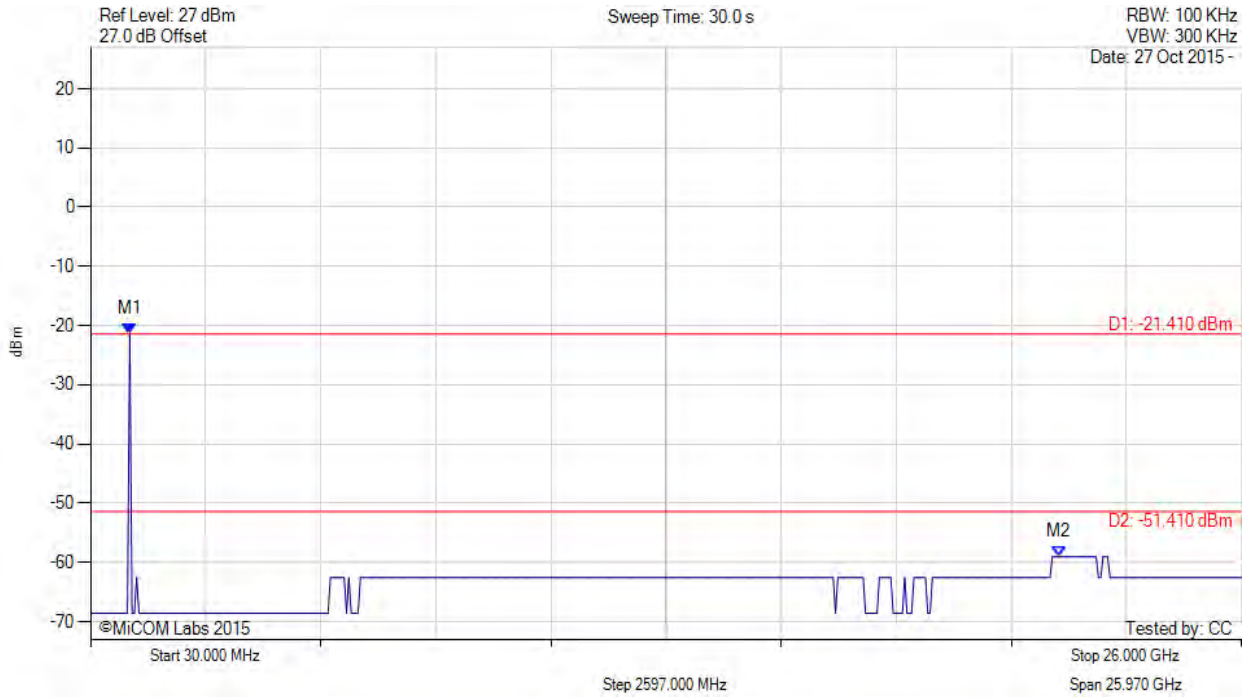


Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 862.705 MHz : -20.818 dBm M2 : 22.253 GHz : -59.023 dBm	Limit: -50.00 dBm Margin: -9.02 dB

back to matrix

CONDUCTED SPURIOUS EMISSIONS - AVERAGE

Variant: FHSS, Channel: 915.25 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

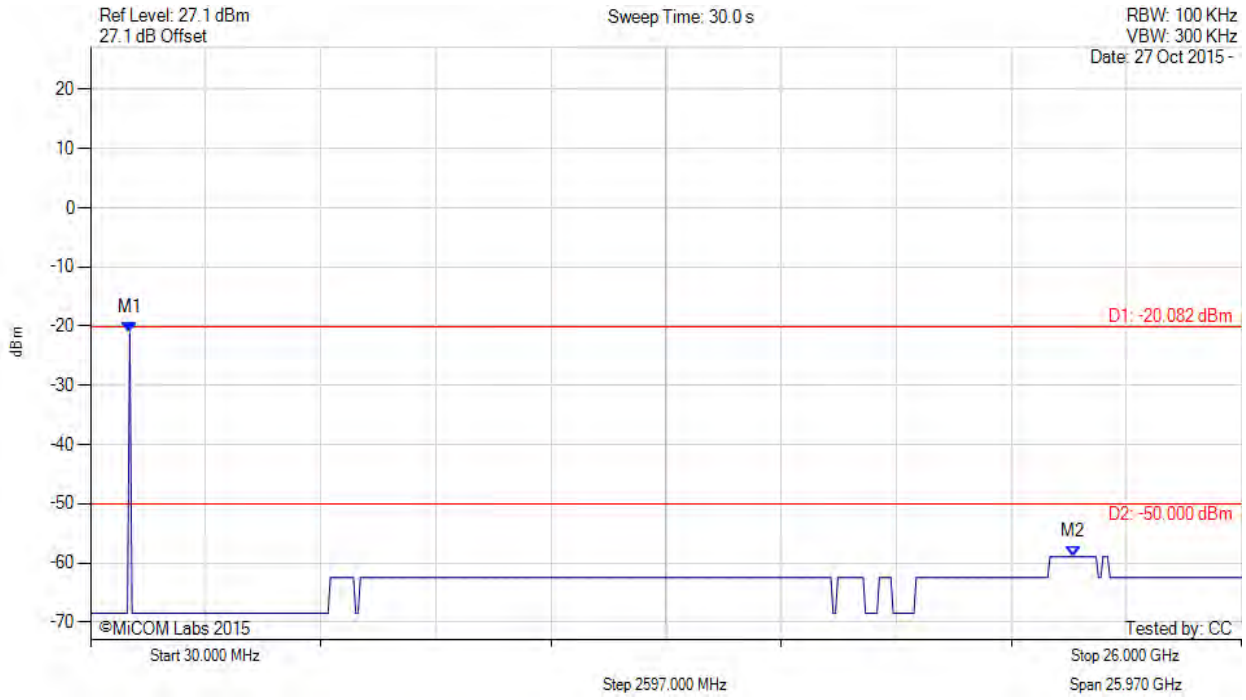


Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 914.749 MHz : -21.407 dBm M2 : 21.889 GHz : -59.023 dBm	Limit: -51.41 dBm Margin: -7.61 dB

back to matrix

CONDUCTED SPURIOUS EMISSIONS - AVERAGE

Variant: FHSS, Channel: 927.25 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc



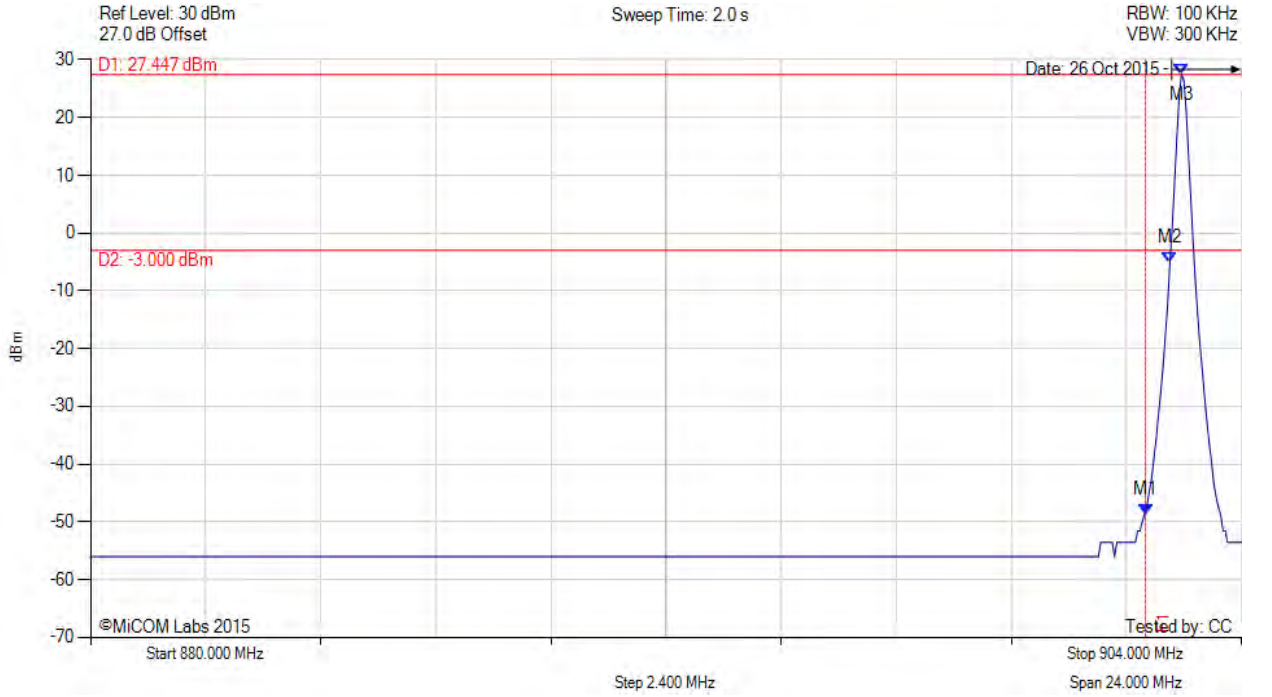
Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW	M1 : 914.749 MHz : -21.118 dBm M2 : 22.201 GHz : -58.923 dBm	Limit: -50.00 dBm Margin: -8.92 dB

back to matrix

A.5.1.2. Conducted Band-Edge Emissions

CONDUCTED LOW BAND-EDGE EMISSIONS - AVERAGE

Variant: FHSS, Channel: 902.75 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 902.000 MHz : -48.663 dBm M2 : 902.509 MHz : -5.158 dBm M3 : 902.749 MHz : 27.534 dBm	Channel Frequency: 902.75 MHz

back to matrix

CONDUCTED HIGH BAND-EDGE EMISSIONS - AVERAGE

Variant: FHSS, Channel: 927.25 MHz, Chain a, Temp: Ambient, Voltage: 3.7 Vdc

Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW	M1 : 927.224 MHz : 28.401 dBm M2 : 927.495 MHz : -5.191 dBm M3 : 928.000 MHz : -48.923 dBm	Channel Frequency: 927.25 MHz

back to matrix

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