

Test of: Thinkify LLC UHF RFID 915 MHz Module

To: FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: THNK10-U2 Rev A



TEST REPORT

FROM



Test of: Thinkify LLC UHF RFID 915 MHz Module

to

To: FCC 47 CFR Part 15.247 & IC RSS-210

Test Report Serial No.: THNK10-U2 Rev A

This report supersedes: NONE

Applicant: Thinkify LLC
18450 Technology Drive, Suite E1
Morgan Hill, California 95037
USA

Product Function: UHF RFID 915 MHz Module

Copy No: pdf Issue Date: 10th September 2014

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.

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



TESTING CERT #2381.01

MiCOM Labs is an ISO 17025 Accredited Testing Laboratory



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ACCREDITATION, LISTINGS & RECOGNITION

TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard EN ISO/IEC 17025. 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>



American Association for Laboratory Accreditation

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 November 30, 2015



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

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RECOGNITION

MiCOM Labs, Inc has widely recognized Electrical testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA** countries. Our test reports are widely accepted for global type approvals.

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	

**APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.

Is a 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

N/A – Not Applicable

**EU MRA – European Union Mutual Recognition Agreement.

Is a recognition agreement under which test lab is accredited to regulatory standards of the EU member countries.

**NB – Notified Body

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PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard EN ISO/IEC 17065. 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>



American Association for Laboratory Accreditation

Accredited Product Certification Body

A2LA has accredited

MICOM LABS

Pleasanton, CA

for technical competence as a

Product Certification Body

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 quality management system.

Presented this 28th day of February 2014.



Peter Nguyen

President & CEO
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2015

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)

TCB Identifier – US0159

Industry Canada – Certification Body

CAB Identifier – US0159

Europe – Notified Body

Notified Body Identifier - 2280

Japan – Recognized Certification Body (RCB)

RCB Identifier - 210

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DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft		
Rev A	10 th September 2014	Initial Release

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1. TEST RESULT CERTIFICATE

Manufacturer:	Thinkify LLC 18450 Technology Drive, Suite E1 Morgan Hill, California 95037 USA	Tested By:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California, 94566, USA
EUT:	UHF RFID 915 MHz Module	Telephone:	+1 925 462 0304
Model:	TR-65	Fax:	+1 925 462 0306
S/N's:	#1		
Test Date(s):	11th - 20th August 2014	Website:	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC 47 CFR Part 15.247 & IC RSS-210 (Bluetooth Functionality Only)	EQUIPMENT COMPLIES

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

Notes:

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

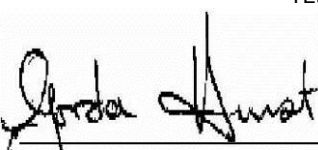
Approved & Released for MiCOM Labs, Inc. by:



TESTING CERT #2381.01



Graeme Grieve
Quality Manager MiCOM Labs,



Gordon Hurst
President & CEO MiCOM Labs, Inc.

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2. REFERENCES AND MEASUREMENT UNCERTAINTY

2.1. Normative References

REF.	PUBLICATION	YEAR	TITLE
i.	FCC 47 CFR Part 15, Subpart C	2012	Title 47: Telecommunication PART 15 — Radio Frequency Devices Subpart C—Intentional Radiators
ii.	RSS-210 Annex 8	2010	Radio Standards Specification 210, Issue 8, Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment
iii.	FCC OET KDB 662911	4 th April 2011	Emissions Testing of Transmitters with Multiple Outputs in the Same Band
iv.	DA 00-705	2000	FCC DA 00-705 “Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems” released March 30, 2000
v.	RSS-GEN	2010	Radio Standards Specification-Gen, Issue 3, General Requirements and Information for the Certification of Radiocommunication Equipment
vi.	FCC 47 CFR Part 15, Subpart B	2010	47 CFR Part 15, SubPart B; Unintentional Radiators
vii.	ICES-003	2004	Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard Digital Apparatus; Issue 4
viii.	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
ix.	CISPR 22/ EN 55022	2008 2006 +A1:2007	Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment
x.	M 3003	Edition 2 Jan. 2007	Expression of Uncertainty and Confidence in Measurements
xi.	LAB34	Edition 1 Aug 2002	The expression of uncertainty in EMC Testing
xii.	ETSI TR 100 028	2001	Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics
xiii.	A2LA	April 2014	Reference to A2LA Accreditation Status – A2LA Advertising Policy



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2.2. Test and Uncertainty Procedures

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

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

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

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3. PRODUCT DETAILS AND TEST CONFIGURATIONS

3.1. Technical Details

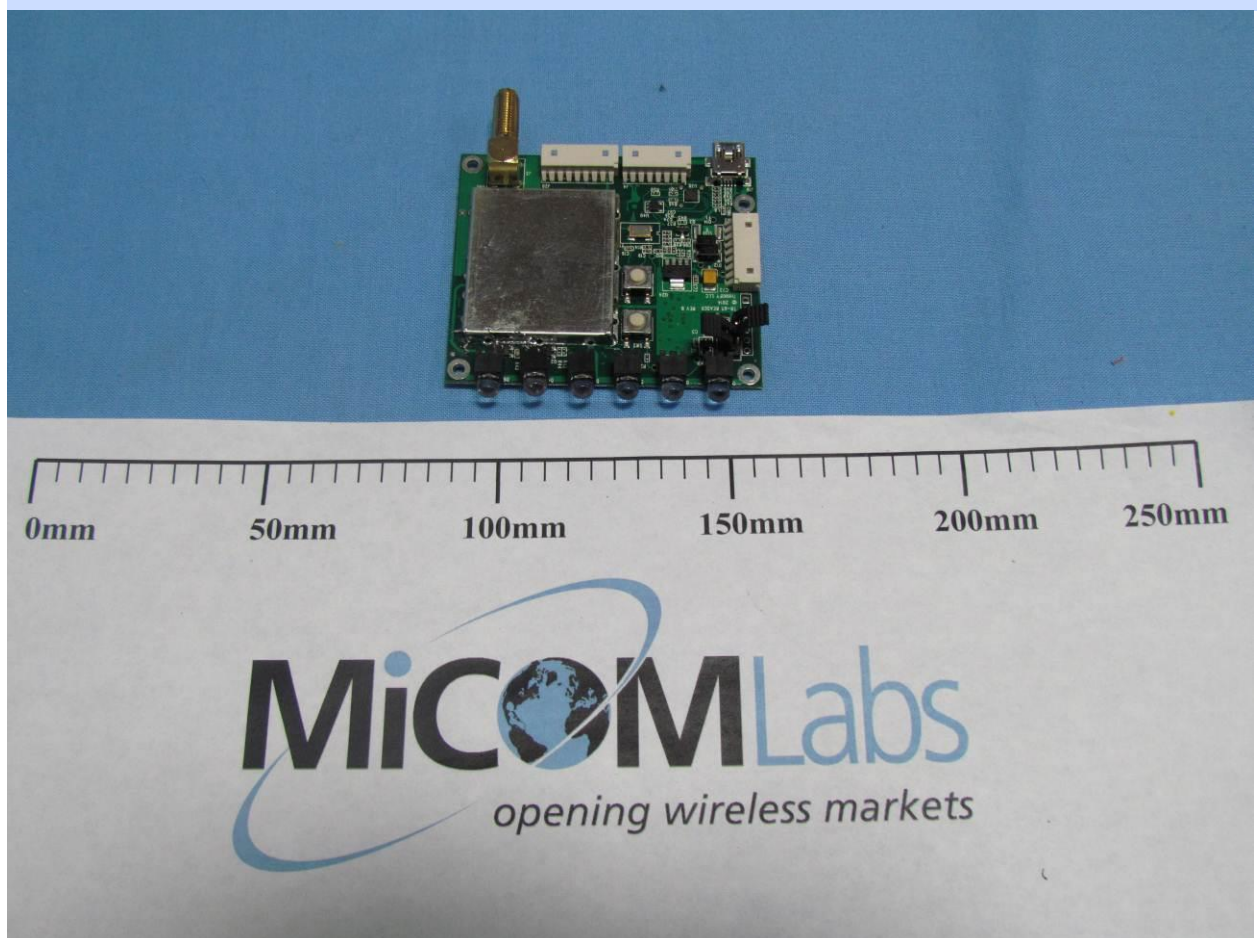
Details	Description
Purpose:	Test of Thinkify LLC UHF 915 MHz RFID Module to FCC Part 15.247 and Industry Canada RSS-210 regulations.
Applicant:	Thinkify LLC 18450 Technology Drive, Suite E1 Morgan Hill, California 95037 USA
Manufacturer:	As applicant.
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton, California 94566 USA
Test report reference number:	THNK10-U2 Rev A
Date EUT received:	11 th August 2014
Standard(s) applied:	FCC 47 CFR Part 15.247 & IC RSS-210
Dates of test (from - to):	11th - 20th August 2014
No of Units Tested:	One
Type of Equipment:	915 MHz RFID Module
Manufacturers Trade Name:	Thinkify LLC
Model(s):	TR-65
Location for use:	Outdoor
Declared Frequency Range(s):	900 - 928 MHz
Software Release	3.2.1
Type of Modulation:	ASK
EUT Modes of Operation:	Single Mode Frequency Hopping
Transmit/Receive Operation:	Simplex
Output Power Type:	Variable
Rated Input Voltage and Current:	5 Vdc 800 mA
Operating Temperature Range:	Declared range -40° to +70°C
Equipment Dimensions:	60 x 70 x 10 mm
Weight:	1.5 oz
Primary function of equipment:	Radio Frequency Identification
Equipment Secondary Function(s):	None

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3.2. Scope of Test Program

The scope of the test program was to test the Thinkify LLC UHF RFID 915 MHz RFID Module configuration in the frequency range 900 - 928 MHz for compliance against FCC 47 CFR Part 15.247 and Industry Canada RSS-210 specifications.

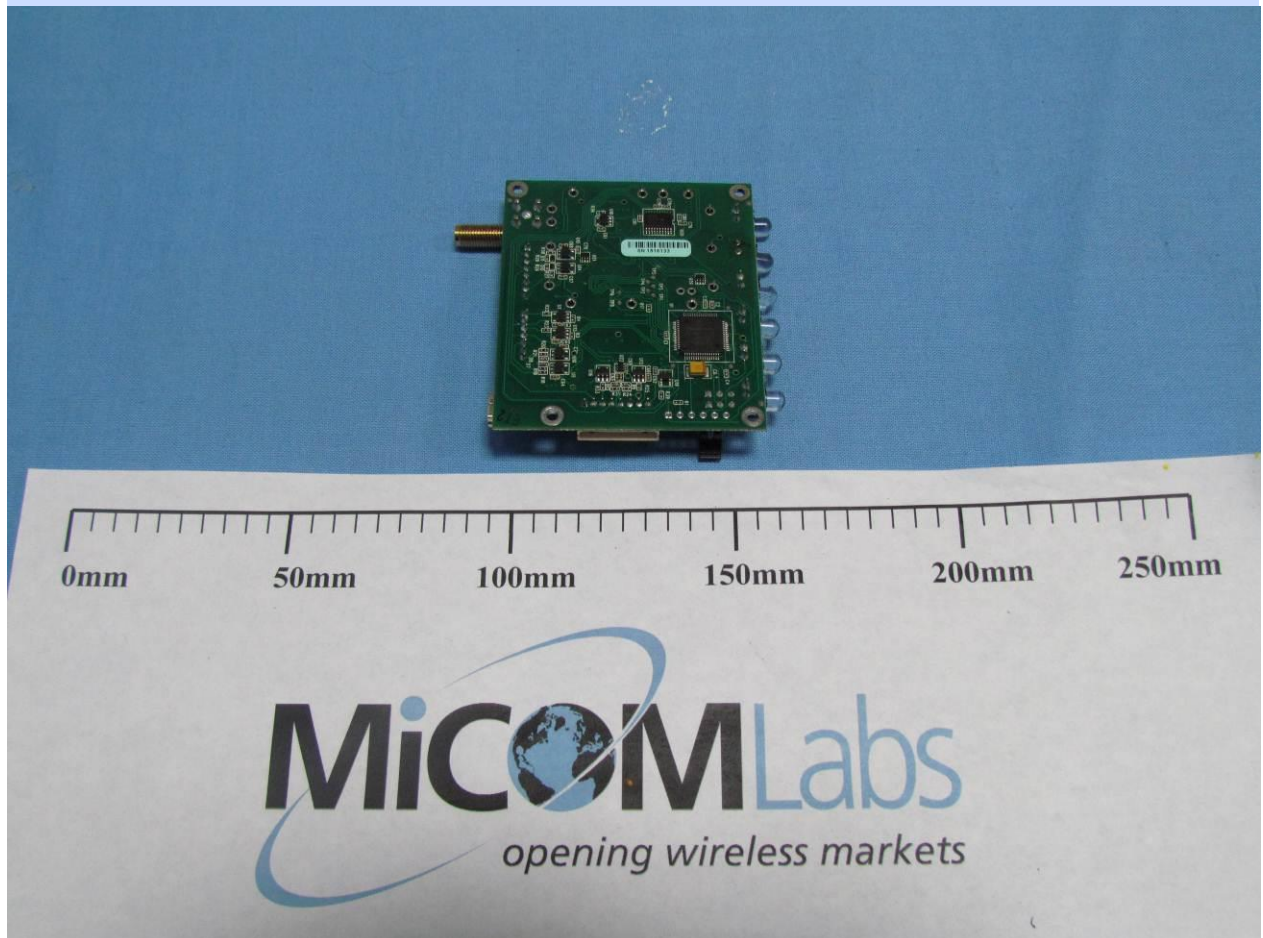
TR-65 915 MHz RFID





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TR-65 915 MHz RFID



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

Equipment Type	Equipment Description (Including Brand Name)	Mfr	Model No.	Serial No.
EUT	915 MHz RFID Module	Thinkify LLC	TR-65	#1
Support	Laptop PC	IBM	Thinkpad	None

3.4. Antenna Details

Antenna Type	Manufacturer	Model Number	Antenna Gain (dBi)
Dipole	Linx	ANT-916-CW-HWR-RPS	2.0
Patch (Circular)	Thinkify LLC	TAC-060	6.0
Patch (Linear)	Thinkify LLC	TAL-060	6.0

3.5. Cabling and I/O Ports

The following is a description of the cable and input, output ports available on the EUT.

Type of I/O Ports	Description	Screened (y/n)	Description	Qty
TTL RS 232	Digital Data	Yes	2 meters	2
GPIO	I/O	Yes	2 meters	1
USB	I/O	Yes	2 meters	1

3.6. EUT Configurations

Band (MHz)	Mode	Freq Band (MHz)	Freq Range (MHz)	Low ch	Mid ch	High ch
900	RFID	900 - 928	902.75 – 927.25	902.75	915.25	927.25

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3.7. Test Configurations

Operational Mode(s)	Variant	Data Rate with Highest Power	Frequencies (MHz)
TR65, P232	N/A	N/A	902.75 915.25 927.25

Results for the above configurations are provided in this report.

3.8. Equipment Modifications

The following modifications were required to bring the equipment into compliance

1).. NONE

3.9. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

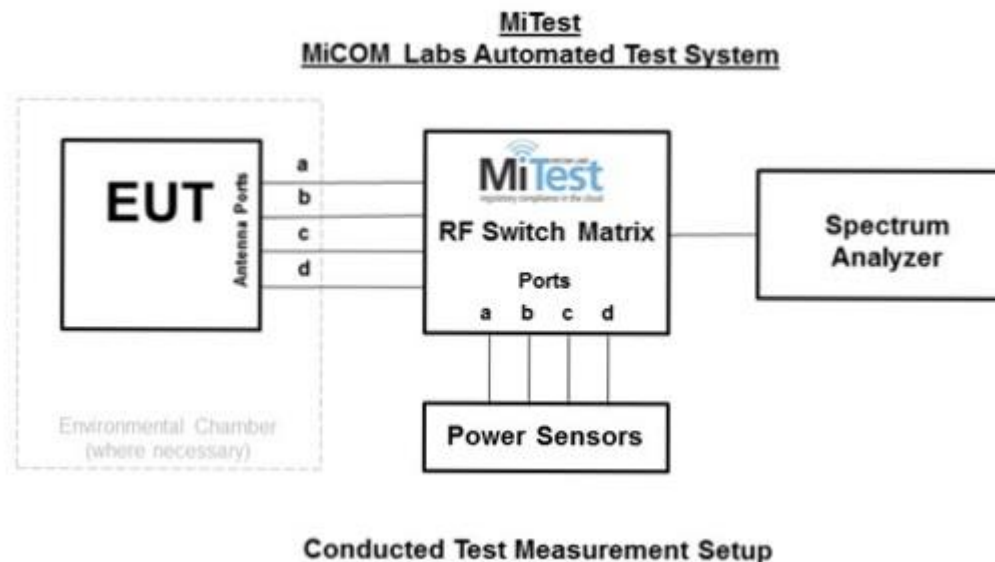
1. NONE

4. TESTING CONFIGURATION(S)

4.1. Conducted RF Emission Test Set-up

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

1. Section 6.1.1.1. 20 dB and 99% Bandwidth
2. Section 6.1.1.2. Peak Output Power
3. Section 6.1.1.3. Transmitter Channel Spacing, Occupancy etc.
4. Section 6.1.1.4. Conducted Spurious Emissions including band-edge



Traceability

Test Equipment Utilized for Conducted Testing

075, 117, 158, 223, 376, 378, 380, 390, 398, 405, RF#1 SMA#SA, RF#1 SMA#1, RF#1 SMA#2, RF#1 SMA#3, RF#1 SMA#4

Measurement and Presentation of Test Data

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

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

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



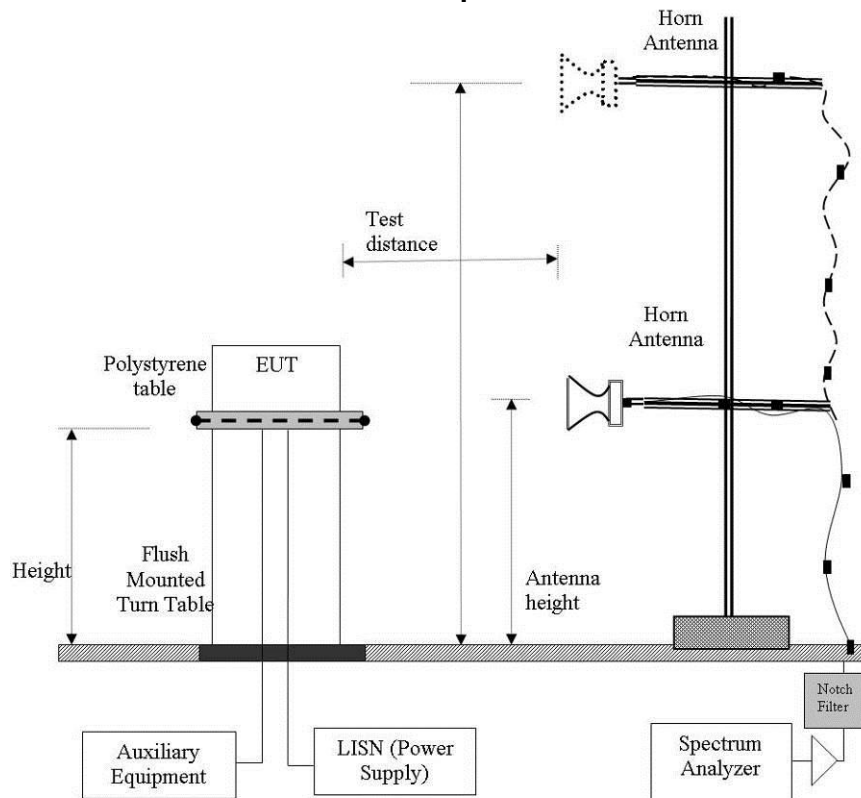
The MiCOM Labs “**MiTest**” Automated Test System“ (Patent Pending)

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4.2. Radiated Spurious Emission Test Set-up > 1 GHz

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

Radiated Emission Measurement Setup – Above 1 GHz



Traceability

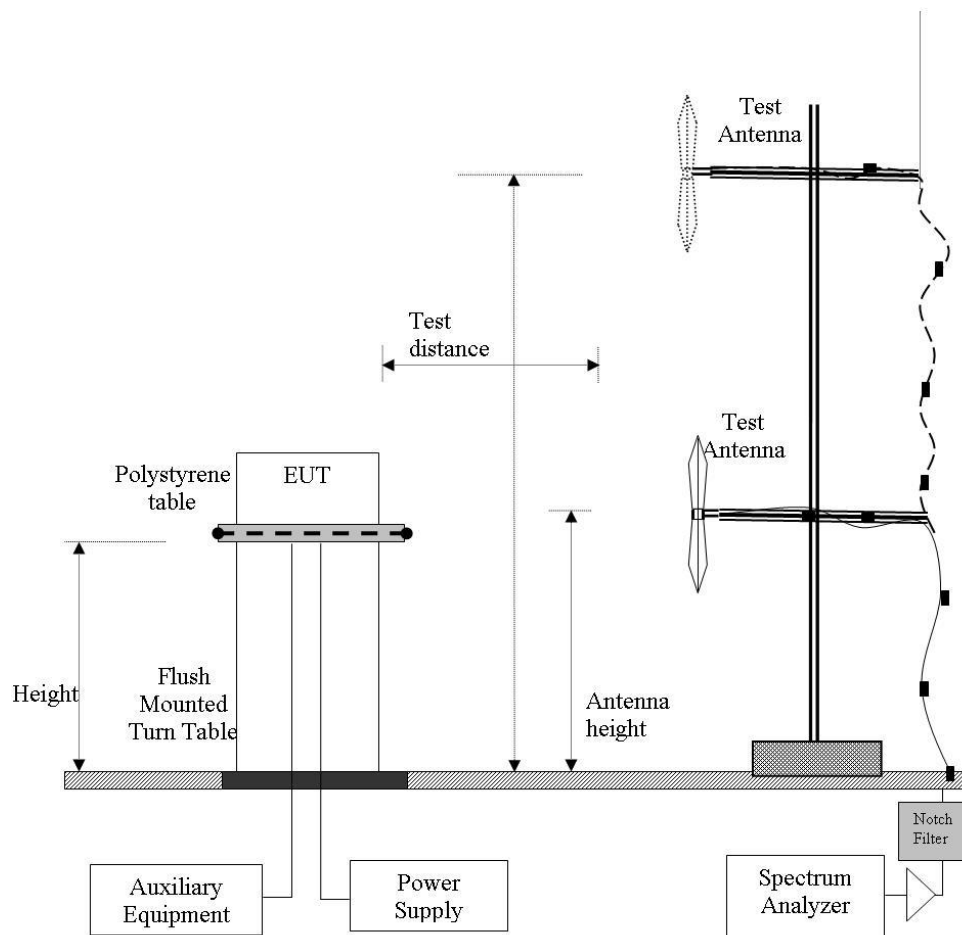
Test Equipment Utilized for Radiated Emission Testing > 1GHz

158, 252, 310, 312, 377, 393, 396, 399, 406, 411, 413, 4165, 416, 502, 503

4.3. Digital Emissions Test Set-up (0.03 – 1 GHz)

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

Digital Emission Measurement Setup ≤ 1 GHz



EUT Table Top Height = Fixed Test Antenna Height = 1.5 m

Traceability

Test Equipment Utilized for Radiated Emission Testing 0.03 - 1GHz

158, 252, 310, 312, 338, 377, 393, 396, 397, 411, 413, 4165, 416, 502, 503



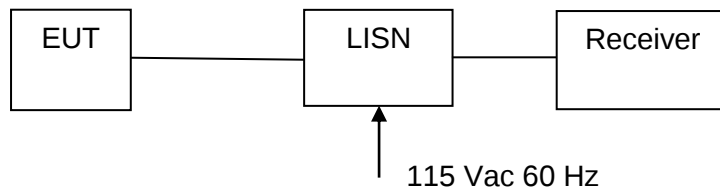
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4.4. ac Wireline Emission Test Set-up

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

1. Section 5.1.3 ac Wireline Conducted Emissions

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

Test Equipment Utilized for ac Wireline Emissions
158, 193, 190, 307



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5. TEST SUMMARY

List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247** and **Industry Canada RSS-210** and **Industry Canada RSS-Gen**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(a)(1) A8.1	20 dB BW	20 dB Bandwidth	Conducted	Complies	6.1.1.1
15.247(b)(2) A8.4	Output Power	Transmit Power	Conducted	Complies	6.1.1.2
15.247(a)(1) A8.1	Transmitter Channels	Channel Spacing	Conducted	Complies	6.1.1.3
15.247(a)(1) A8.1	Transmitter Channels	Number of Hopping Frequencies	Conducted	Complies	6.1.1.4 6.1.1.5
		Channel Occupancy	Conducted	Complies	6.1.1.6
15.247(d) A8.5	Conducted Spurious Emissions	Band Edge	Conducted	Complies	6.1.1.7 6.1.1.8
		Spurious Emissions Transmitter	Conducted	Complies	

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List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.247**, **Industry Canada RSS-210** and **Industry Canada RSS-Gen**.

Section(s)	Test Items	Description	Condition	Result	Test Report Section
15.247(d) 15.205 15.209 A8.5 2.2 2.6 4.9	Radiated Emissions above 1 GHz	Transmitter	Radiated	Complies	6.1.2.1
4.10		Receiver	Radiated	Complies	
15.247(d) 15.205 15.209 A8.5 2.2 2.6	Radiated Emissions below 1 GHz		Radiated	Complies	6.1.2.2
15.207 7.2.2	Conducted	AC Wireline Conducted Emissions	Conducted	Not Applicable EUT dc Powered	N/A

Note 1: Test results reported in this document relate only to the items tested

Note 2: The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria

Note 3: Section 3.7 - Equipment Modifications highlights the equipment modifications that were required to bring the product into compliance with the above test matrix

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6. TEST RESULTS

6.1. Device Characteristics

6.1.1. Conducted Testing

6.1.1.1. 20 dB Bandwidth

Test Procedure

The 20 dB bandwidth 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.

Test Results for 20 dB & 99% Bandwidth

Equipment Configuration for 20 dB Bandwidth			
Variant:		Duty Cycle (%):	95
Data Rate:	250 KHz	Antenna Gain (dBi):	Not Applicable
Modulation:		Beam Forming Gain (Y):	Not Applicable
TPC:	Not Applicable	Tested By:	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 20 dB & 99% Bandwidth (kHz)				20 dB Bandwidth (MHz)		Limit	Lowest Margin
	Port(s)				Highest	Lowest		
MHz	a	b	c	d			KHz	kHz
902.8	155.131	--	--	--	155.131	155.131	≤250.0	-98.869
915.3	106.212	--	--	--	106.212	106.212	≤250.0	-143.788
927.3	147.295	--	--	--	147.295	147.295	≤250.0	-102.705

Test Frequency	Measured 99% Bandwidth (kHz)							
	Port(s)							
MHz	a	b	c	d				
902.8	165.331	--	--	--				
915.3	118.236	--	--	--				
927.3	150.301	--	--	--				

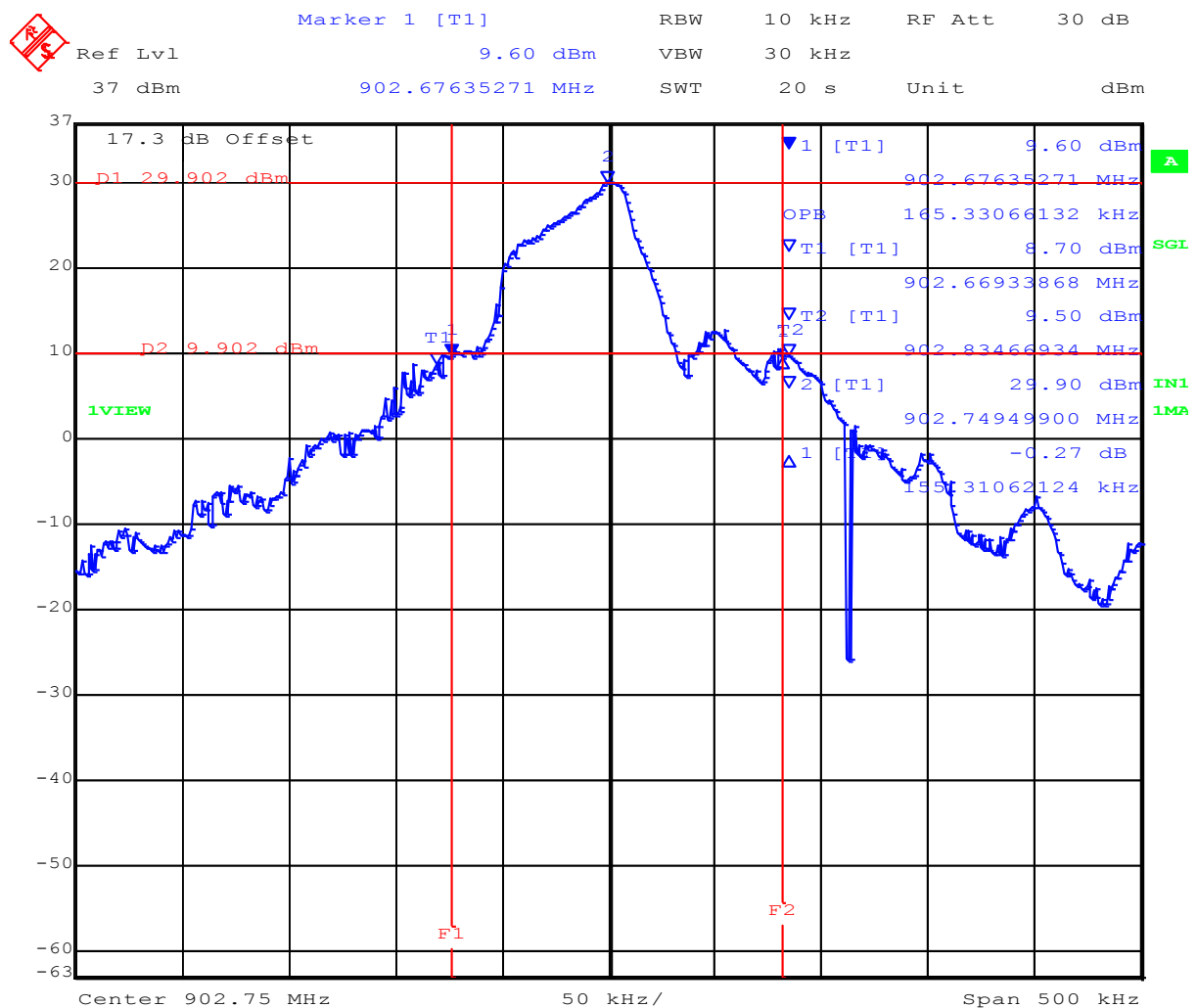
Traceability to Industry Recognized Test Methodologies

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

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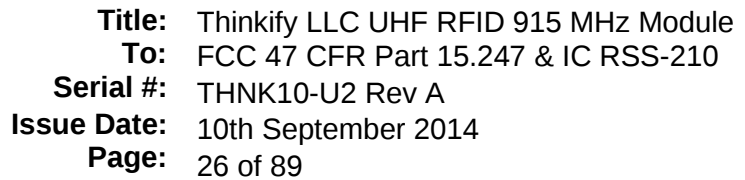


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Date: 11.AUG.2014 11:01:22

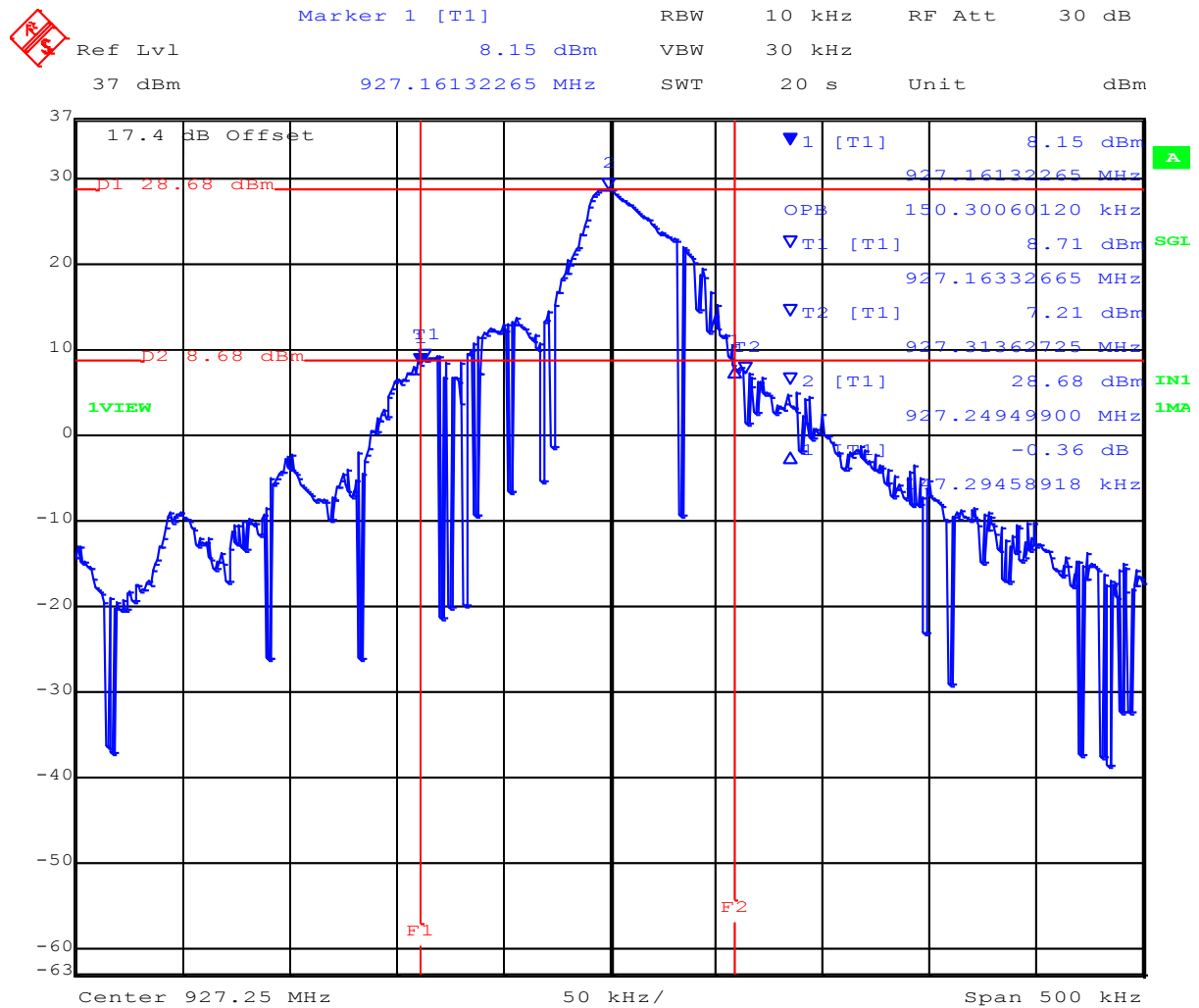
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MiCOM Labs, 575 Boulder Court, Pleasanton, CA 94566 USA, Phone: 925.462.0304, Fax: 925.462.0306, www.micomlabs.com



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Specification

Limits

FCC §15.247 (a)(1)
Industry Canada RSS-210 §8.1

(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) (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



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6.1.1.2. Peak Output Power

FCC, Part 15 Subpart C §15.247(b)(2)
Industry Canada RSS-210 §A8.4

Test Procedure

The transmitter terminal of EUT was set for the channel of interest and connected to the input of the power meter which was calibrated to measure power. The value of measured power including antenna cable loss was reported.

Equipment Configuration for Average Output Power			
Variant:	802.11b	Duty Cycle (%):	95.0
Data Rate:	250 KHz	Antenna Gain (dBi):	2.0
Modulation:	CCK	Beam Forming Gain (Y):	Not Applicable
TPC:	Not Applicable	Tested By:	CC
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm)				Calculated Total Power Σ Port(s) + DCCF Duty Cycle Correction Factor : +0.22 dB	Limit	Margin	EUT Power Setting
	Port(s)							
MHz	a	b	c	d	dBm	dBm	dB	
902.8	26.22	--	--	--	26.44	30.00	-3.56	RA7
915.3	25.34	--	--	--	25.56	30.00	-4.44	RA7
927.3	24.57	--	--	--	24.79	30.00	-5.21	RA7

Traceability to Industry Recognized Test Methodologies

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

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Specification

Limits

FCC Part 15 Subpart C §15.247 (b)(1)

(b) (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



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6.1.1.3. Carrier Frequency Separation

Test Procedure

The EUT must have its hopping function enabled.

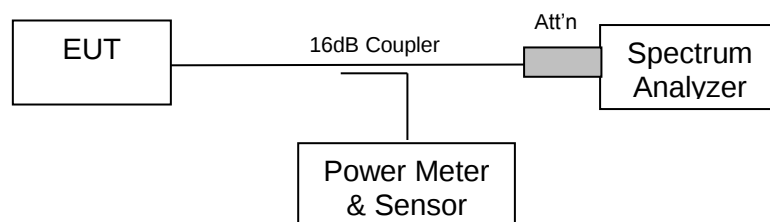
The following spectrum analyzer settings were used:

Span = wide enough to capture the peaks of two adjacent channels
Resolution (or IF) Bandwidth (RBW) $\geq 1\%$ of the span
Video (or Average) Bandwidth (VBW) $\geq$ RBW
Sweep = auto
Detector function = peak
Trace = max hold

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

Reference: FCC DA 00-705 "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems"

Test Setup



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Specification for Carrier Frequency Separation Limits

FCC §15.247

(a) (1) (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

Laboratory Measurement Uncertainty

Measurement Uncertainty (Spectrum/Amplitude)	±2.81 dB
---	----------

Traceability

Method
FCC DA 00-705

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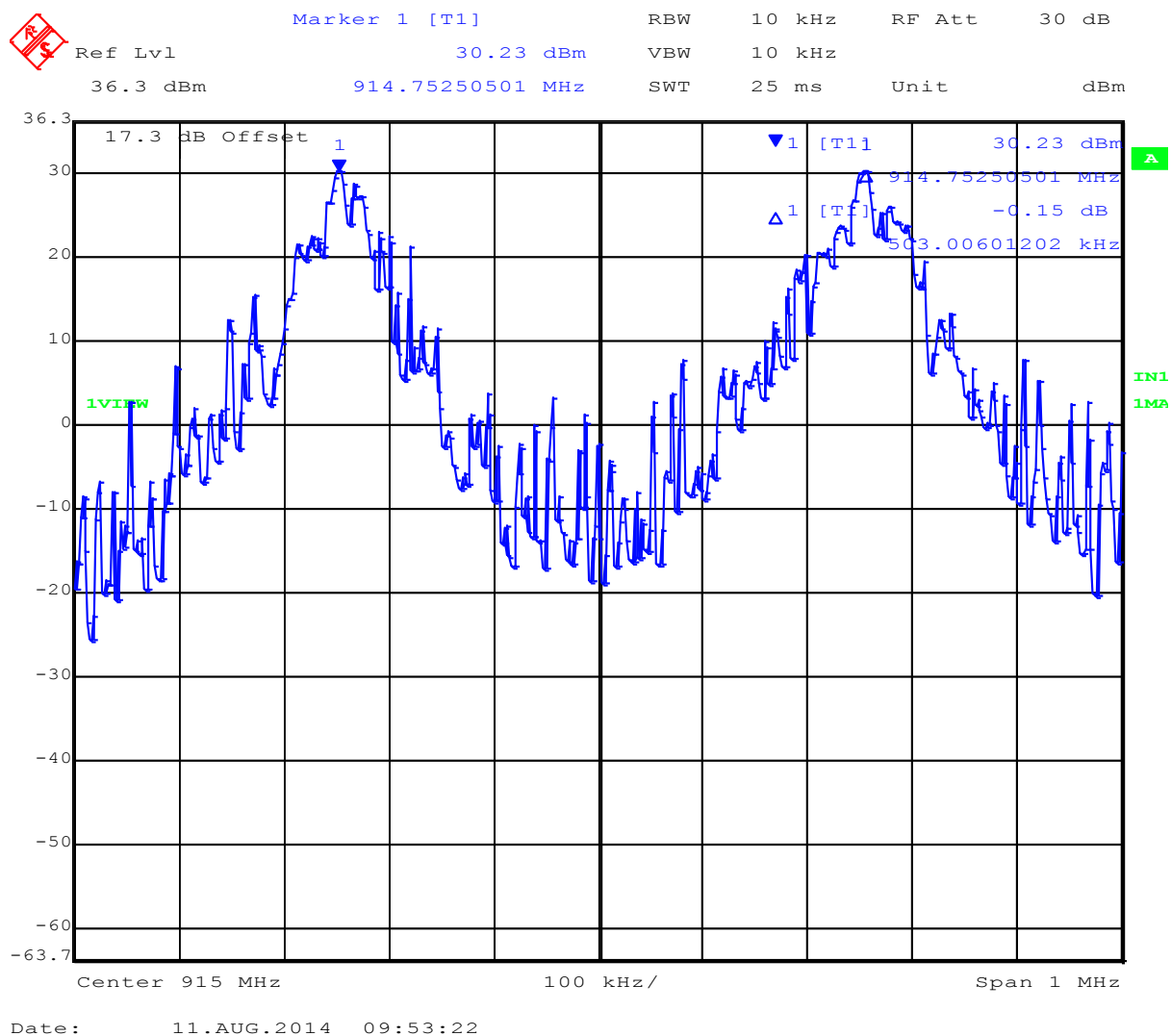
Test Results for Carrier Frequency Separation

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Channel Spacing (kHz)	Maximum 20 dB Bandwidth (kHz)
503.01	155.131

Carrier Frequency Separation; Hopping On = 1.004 MHz



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6.1.1.4. Number of Hopping Frequencies

Test Procedure

The EUT must have its hopping function enabled.

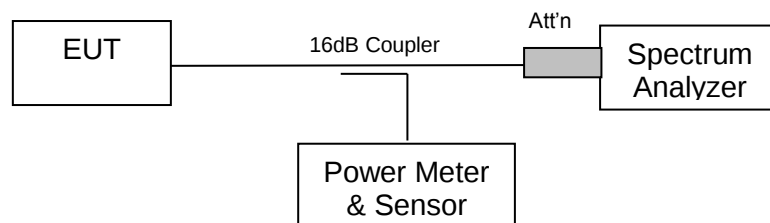
The following spectrum analyzer settings were used:

Span = the frequency band of operation
RBW $\geq$ 1% of the span
VBW $\geq$ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Allow the trace to stabilize. It may prove necessary to break the span up to sections, in order to clearly show all of the hopping frequencies. The limit is specified in one of the sub-paragraphs of this Section.

Reference: FCC DA 00-705 "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems"

Test Setup



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Specification for Number of Hopping Frequencies Limits

FCC §15.247

(a) (1) (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

Laboratory Measurement Uncertainty

Measurement Uncertainty Spectrum/Amplitude)	±2.81 dB
Measurement Uncertainty (Frequency)	±0.86 ppm

Traceability

Method
FCC DA 00-705

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Test Results for Number of Hopping Frequencies

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Number of Channels	Specification
50	1 Watt Output Power - Minimum 50 hopping channels

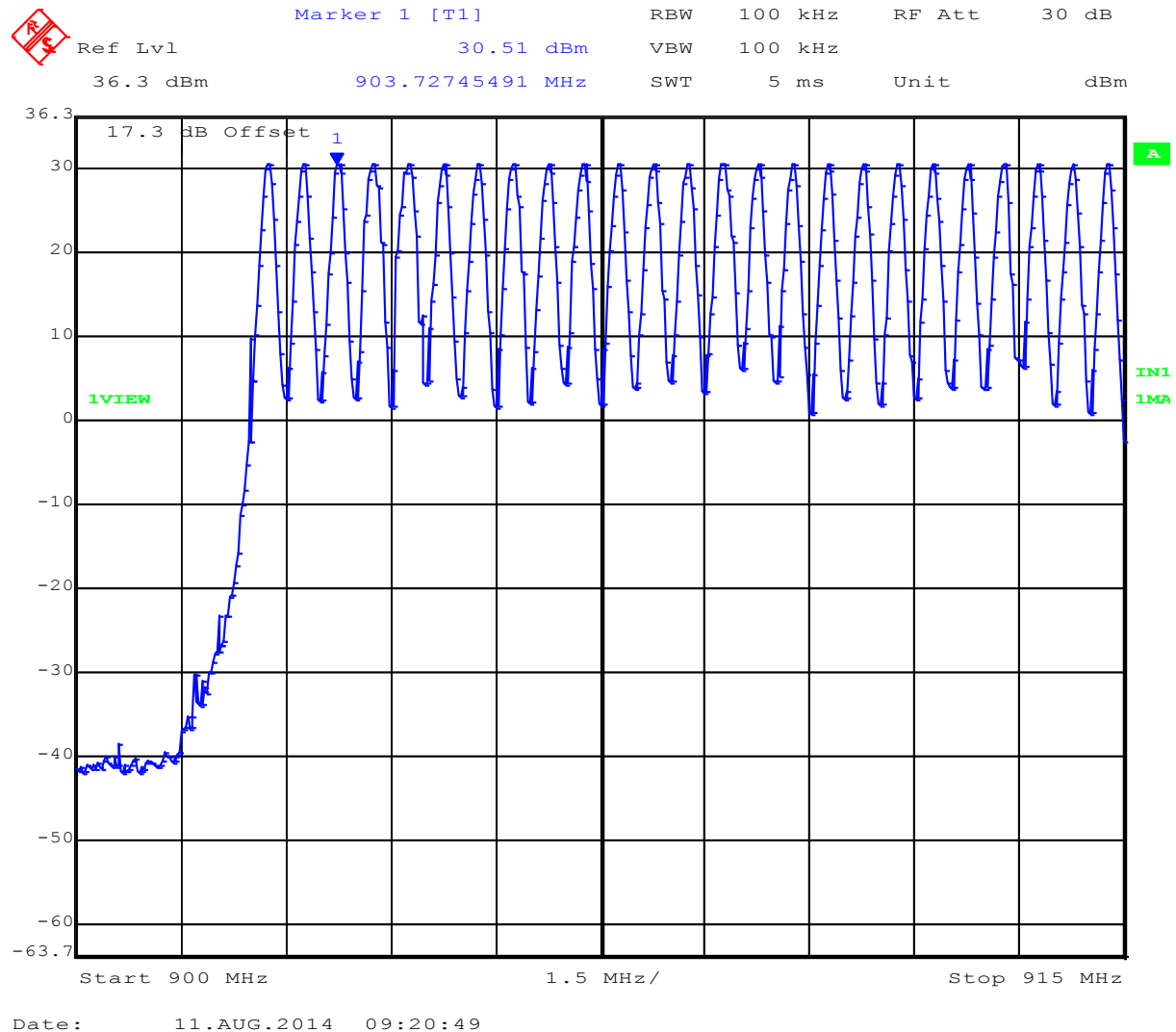
EUT operates at a peak output power less than 1 Watt

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Number of Hopping Frequencies; Hopping On; 902 - 915 MHz

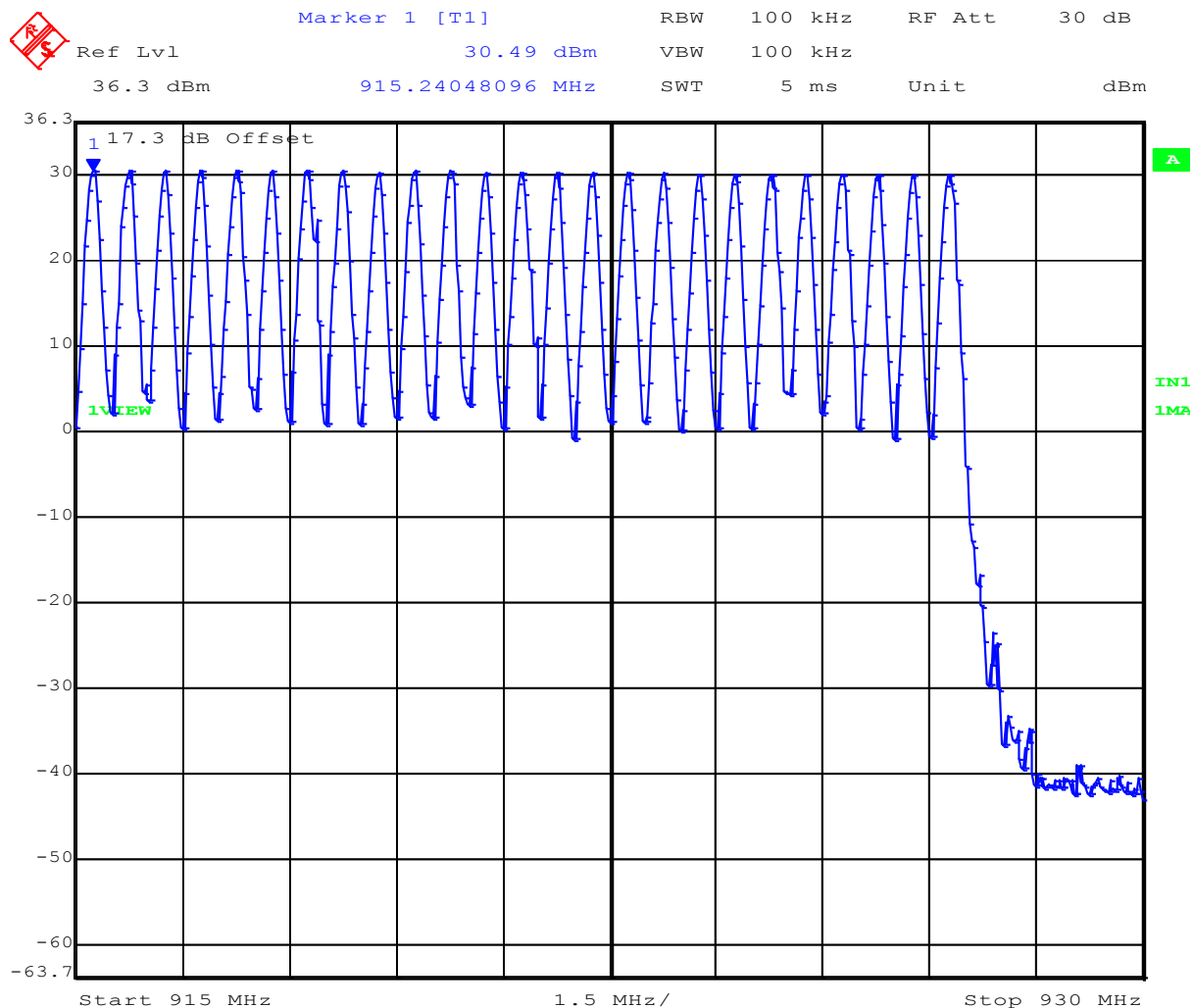


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Number of Hopping Frequencies; Hopping On; 915 – 928 MHz



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6.1.1.5. Time of Occupancy (Dwell Time)

Test Procedure

The EUT must have its hopping function enabled.

The following spectrum analyzer settings were used:

Span = zero span, centered on a hopping channel

RBW = 1MHz

VBW $\geq$ RBW

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

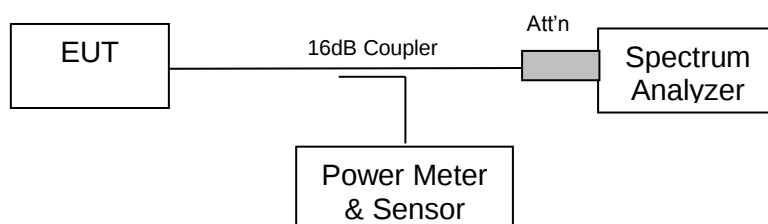
Detector function = peak

Trace = max hold

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

Reference: FCC DA 00-705 "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems"

Test Setup





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Specification for Time of Occupancy (Dwell Time) Limits

FCC §15.247

(a)(1)(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

Laboratory Measurement Uncertainty

Measurement Uncertainty (Spectrum/Amplitude)	±2.81 dB
Measurement Uncertainty (Frequency)	±0.86 ppm

Traceability

Method
FCC DA 00-705

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Test Results for Time of Occupancy (Dwell Time)

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

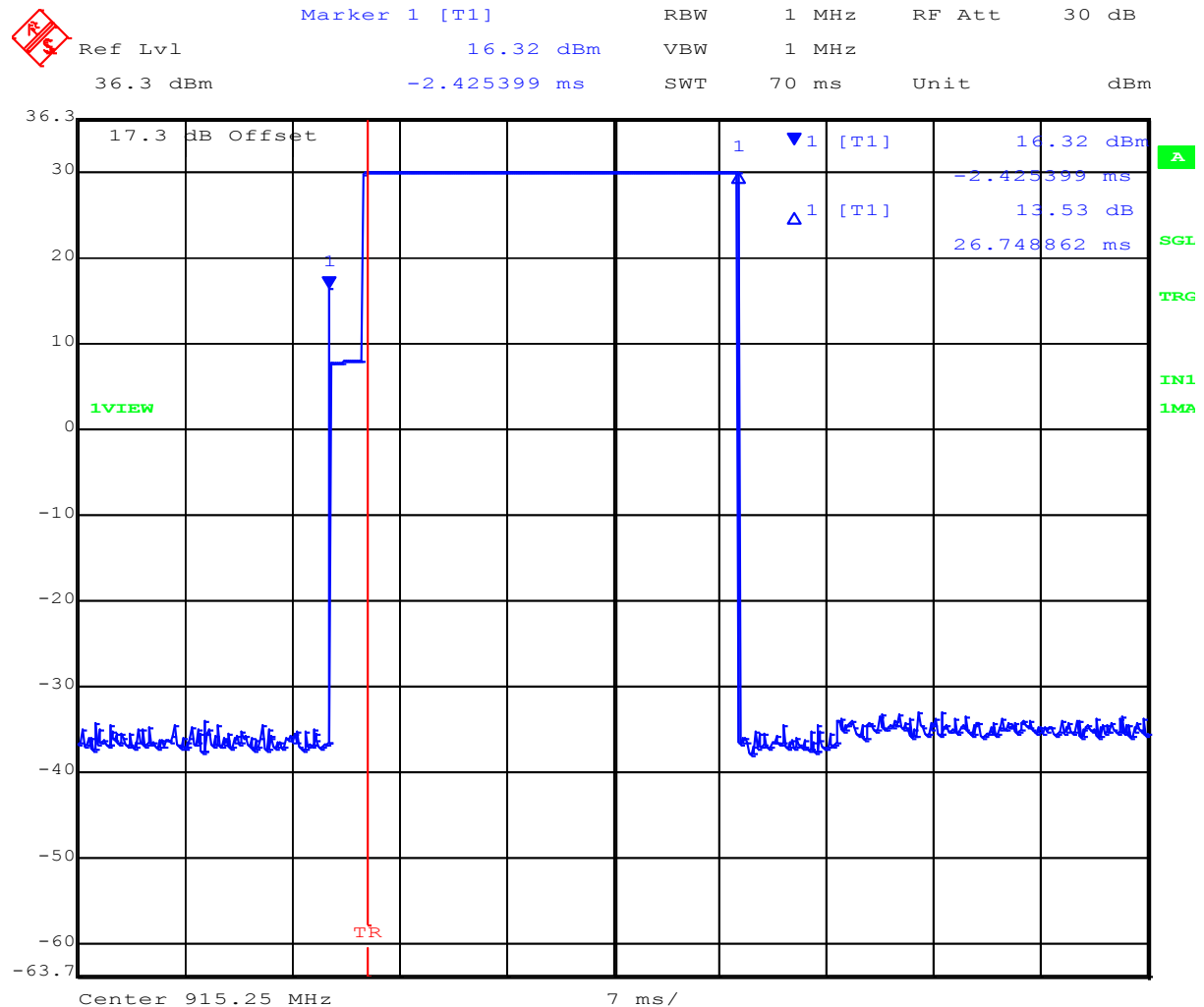
Centered on Channel	Center Frequency (MHz)	Channel Dwell Time (single channel) (ms)
--	915.25	26.749

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Time of Occupancy; Hopping On; 915.25 MHz; 26.749 ms



Date: 11.AUG.2014 09:37:18

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6.1.1.6. Channel Occupancy

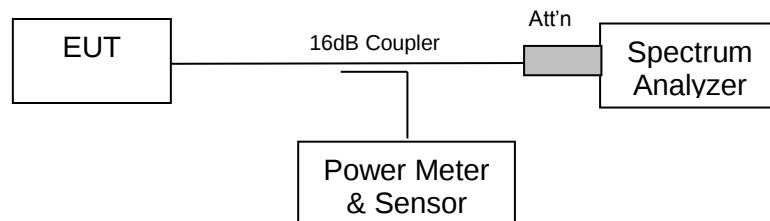
Test Procedure

The EUT must have its hopping function enabled.

The following spectrum analyzer settings were used:

Span = zero span, centered on a hopping channel
RBW = 1MHz (or appropriate RBW to distinguish center channel from adjacent channels)
VBW $\geq$ RBW
Sweep = Dwell time x Number of Hopping Frequencies
Detector function = peak
Trace = max hold

Test Setup





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Specification for Number of Channels and Channel Occupancy Limits

FCC §15.247 (a)(1)(iii)

(a)(1)(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

Laboratory Measurement Uncertainty

Measurement Uncertainty (Spectrum/Amplitude)	±2.81 dB
Measurement Uncertainty (Frequency)	±0.86 ppm

Traceability

Method
FCC DA 00-705

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Test Results for Channel Occupancy

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Channel #	Center Frequency (MHz)	Channel Dwell Time (single channel) (ms)	Number of Hops	Channel Occupancy (ms)	Limit (ms)	Result
--	915.25	26.749	9	240.741	400	PASS

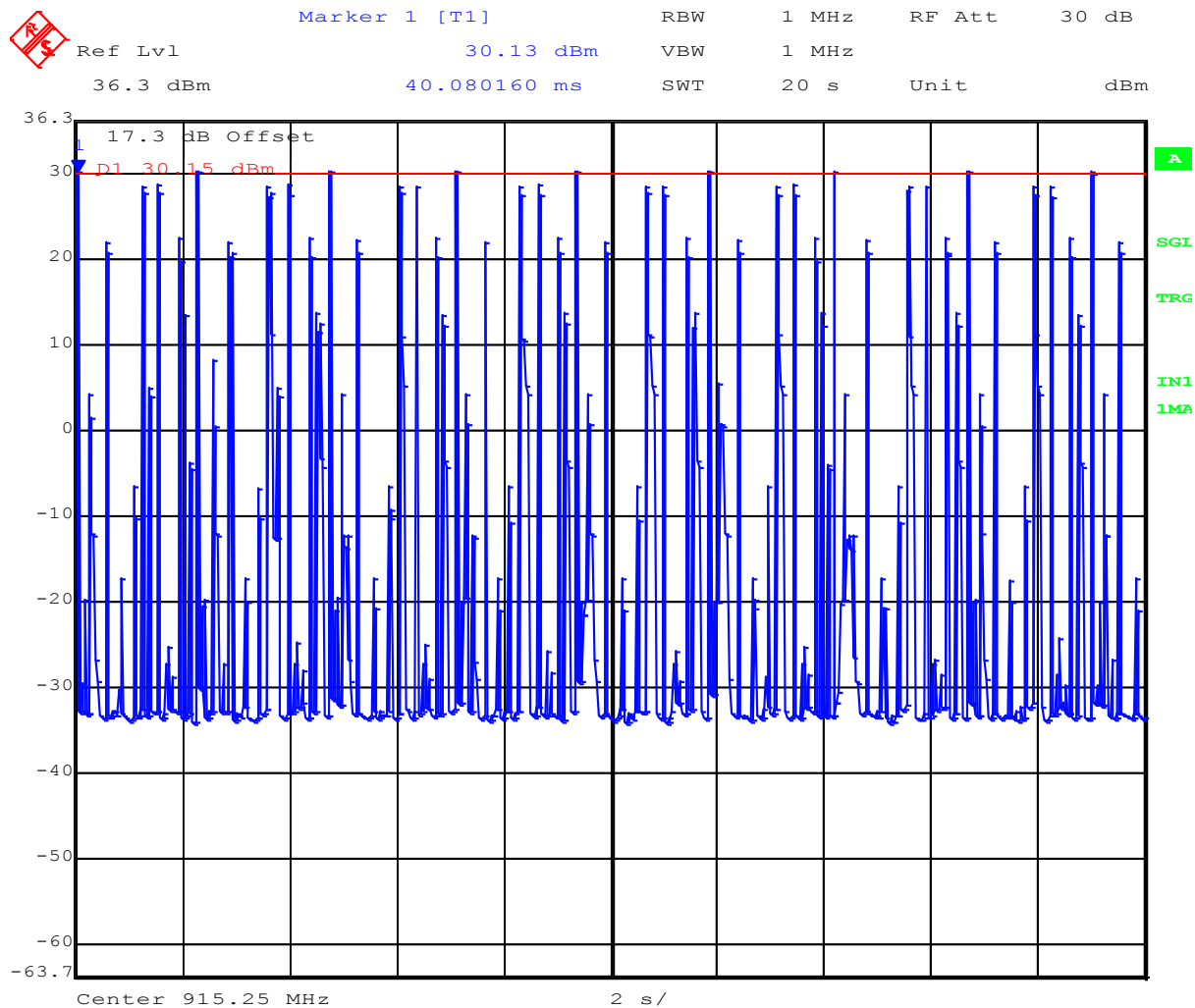
Channel occupancy was performed using a sweep time of 20 seconds

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Channel Occupancy; 915.25 MHz; Sweep Time 20 s



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6.1.1.7. Band-Edge Compliance of RF Conducted Emissions

Test Procedure

The following spectrum analyzer settings were used:

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation
RBW $\geq$ 1% of the span
VBW $\geq$ RBW
Sweep = auto
Detector function = peak
Trace = max hold

Allow the trace to stabilize. Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge. Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission. The marker-delta value now displayed must comply with the limit specified in this Section.



Specification for Band-edge Limits

FCC Part 15 Subpart C §15.247(d)

(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)).

Industry Canada RSS-210 §A8.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

RSS-GEN 6.2

If the receiver has a detachable antenna of known impedance, antenna conducted spurious emissions measurement is permitted as an alternative to radiated measurement. However, the radiated method of Section 6.1 is recommended:

The antenna conducted test shall be performed with the antenna disconnected and the receiver antenna terminals connected to a measuring instrument having equal impedance to that specified for the antenna

The receiver spurious emissions measured at the antenna terminals by the antenna conducted method shall then comply with the following limits:

Receiver spurious emissions at any discrete frequency shall not exceed 2 nanowatts in the band 30-1000 MHz, and 5 nanowatts above 1000 MHz.



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Equipment Configuration for Conducted Low Band-Edge Emissions - Average

Variant:	--	Duty Cycle (%):	100
Data Rate:	250 kHz	Antenna Gain (dBi):	Not Applicable
Modulation:	--	Beam Forming Gain (Y):	Not Applicable
TPC:	Not Applicable	Tested By:	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	902.75 MHz					
Band-Edge Frequency:	902.0 MHz					
Test Frequency Range:	886 – 903.5 MHz					
Port(s)	Band-Edge Markers and Limit			Amended Limit		Margin (MHz)
	M1 Amplitude (dBm)	Plot Limit (dBm)	M2 Frequency (MHz)	Amplitude (dBm)	M2A Frequency (MHz)	
a	-46.96	-0.336	902.518	--	--	-0.518

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:	--	Duty Cycle (%):	100
Data Rate:	250 kHz	Antenna Gain (dBi):	Not Applicable
Modulation:	--	Beam Forming Gain (Y):	Not Applicable
TPC:	Not Applicable	Tested By:	CC
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	927.25 MHz					
Band-Edge Frequency:	928.0 MHz					
Test Frequency Range:	926.5 – 935 MHz					
Port(s)	Band-Edge Markers and Limit			Amended Limit		Margin (MHz)
	M3 Amplitude (dBm)	Plot Limit (dBm)	M2 Frequency (MHz)	Amplitude (dBm)	M2A Frequency (MHz)	
a	-46.86	-1.901	927.471	--	--	-0.518

Traceability to Industry Recognized Test Methodologies

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

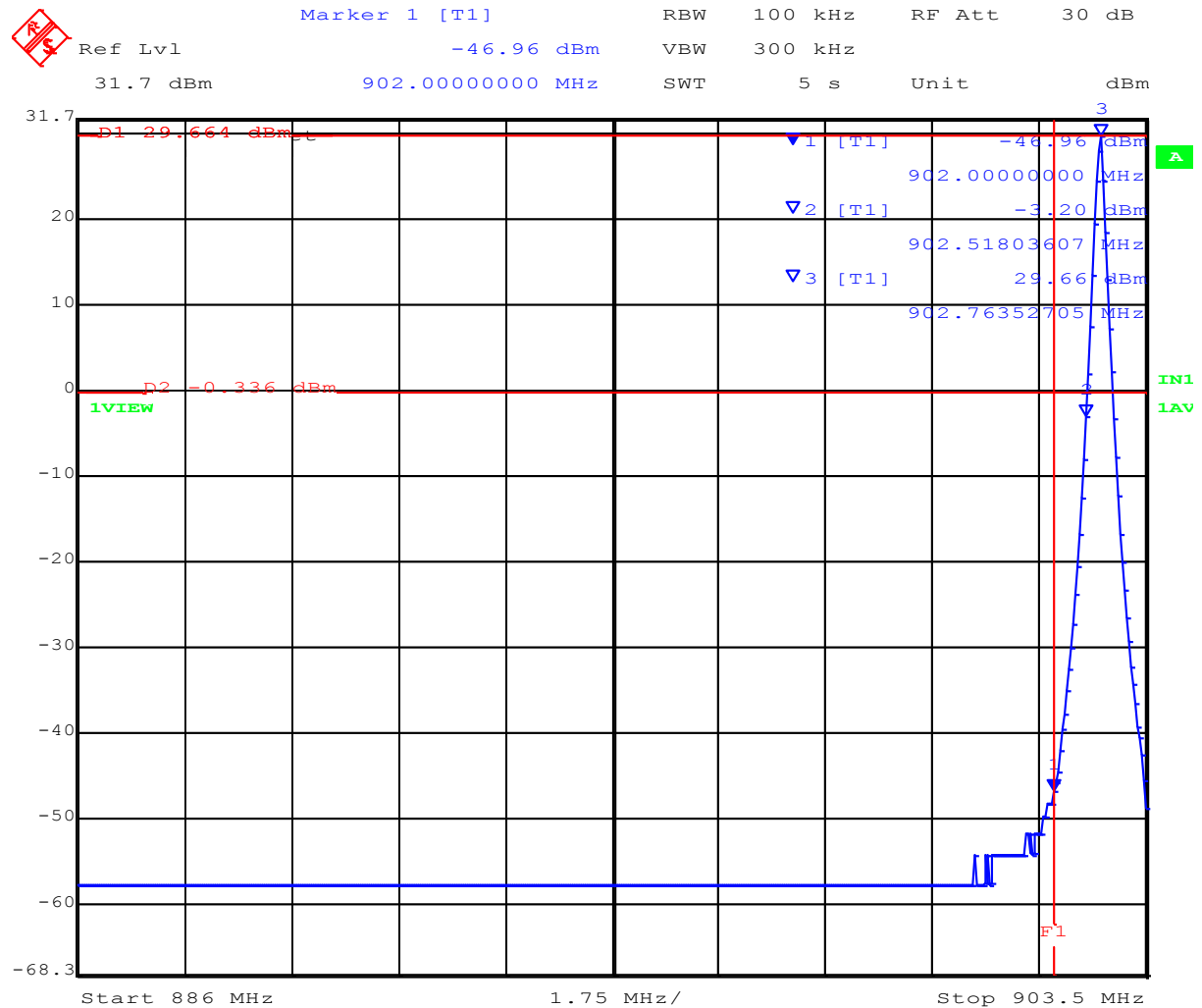
Note: click the links in the above matrix to view the graphical image (plot).

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Low Conducted Band-Edge (902 MHz)



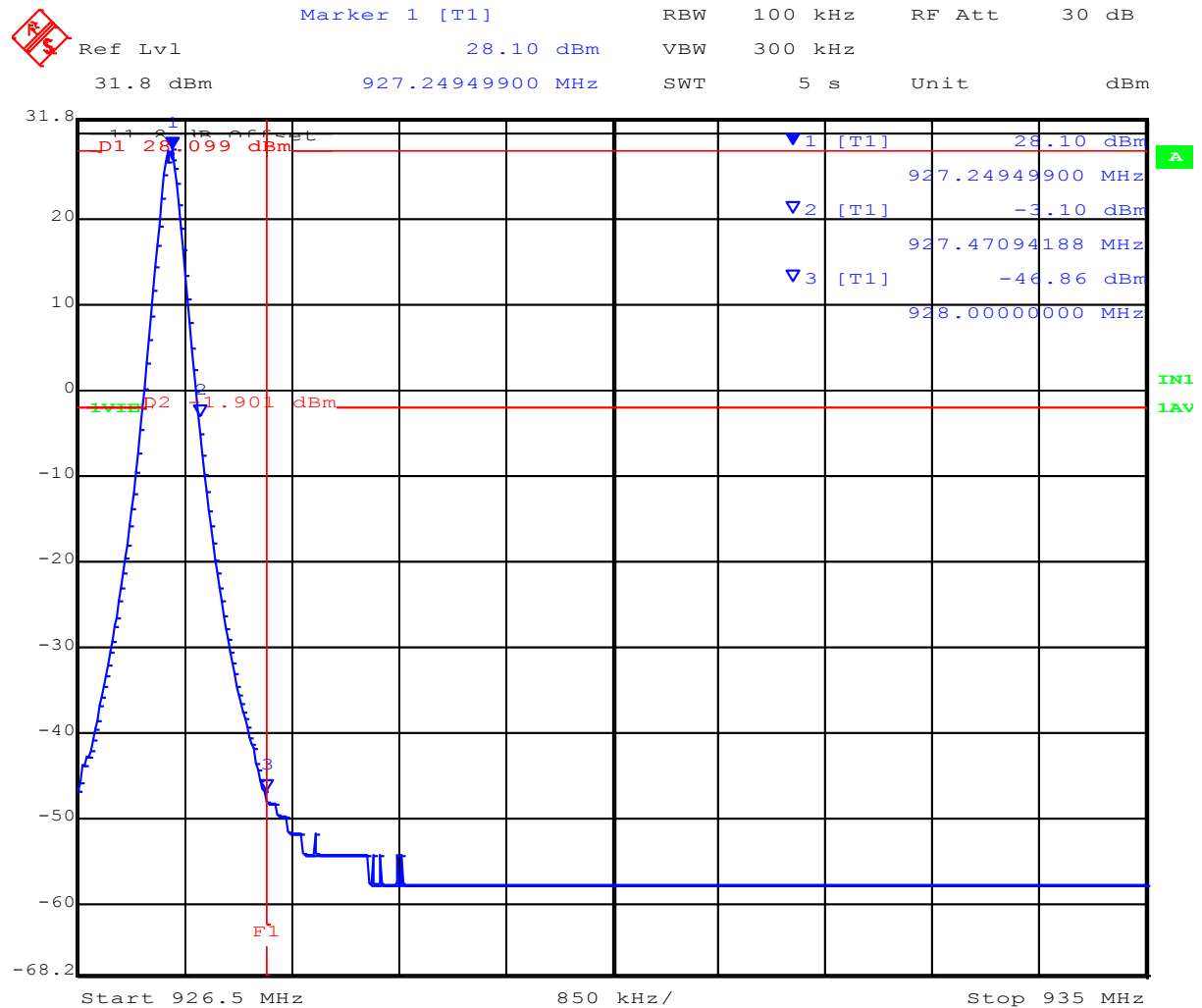
Date: 11.AUG.2014 11:02:14

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High Conducted Band-Edge (928 MHz)



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6.1.1.8. Spurious RF Conducted Emissions - Transmitter

Test Procedure

The following spectrum analyzer settings were used:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic.
RBW = 100 kHz
VBW $\geq$ RBW
Sweep = auto
Detector function = peak
Trace = max hold

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

Reference: FCC DA 00-705 "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems"



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Specification for Spurious RF Conducted Emissions

FCC Part 15 Subpart C §15.247(d)

(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)).

Industry Canada RSS-210 §A8.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under Section A8.4 (4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.



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Equipment Configuration for Transmitter Conducted Spurious Emissions

Variant:	--	Duty Cycle (%):	100
Data Rate:	250 kHz	Antenna Gain (dBi):	Not Applicable
Modulation:	--	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
902.75	30 – 10000	-51.586	-49.46	--	--	--	--	--	--
915.25	30 – 10000	-50.002	-49.04	--	--	--	--	--	--
927.25	30 – 10000	-51.586	-50.86	--	--	--	--	--	--

Traceability to Industry Recognized Test Methodologies

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

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CONDUCTED SPURIOUS EMISSIONS - AVERAGE

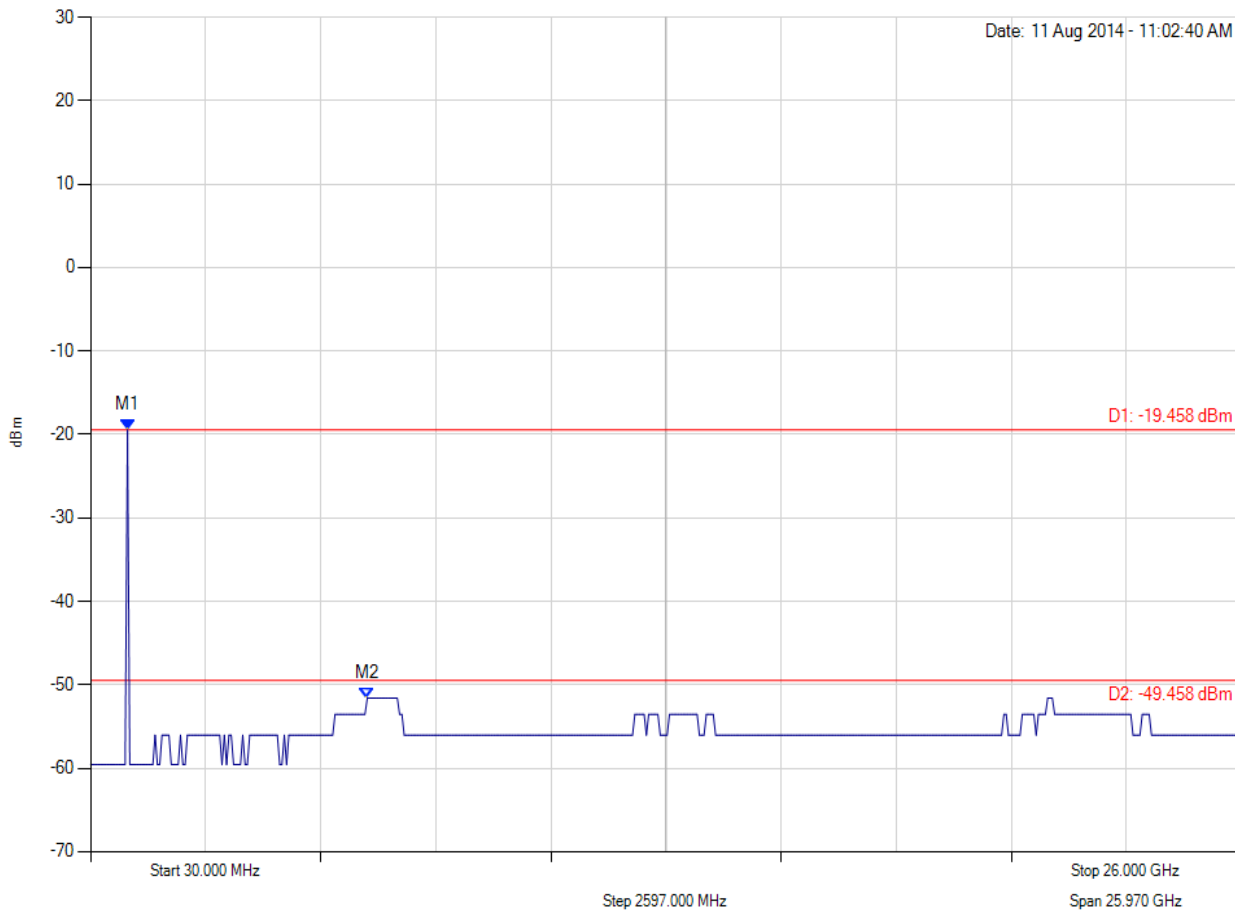


Variant: 802.11b, Channel: 902.75 MHz, Chain a, Temp: Ambient, Voltage: 5 Vdc

Ref Level: 30 dBm
11.7 dB Offset

Sweep Time: 30.0 s

RBW: 100 KHz
VBW: 300 KHz



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 862.705 MHz : -19.458 dBm M2 : 6275.291 MHz : -51.586 dBm	Limit: -49.46 dBm Margin: -2.13 dB

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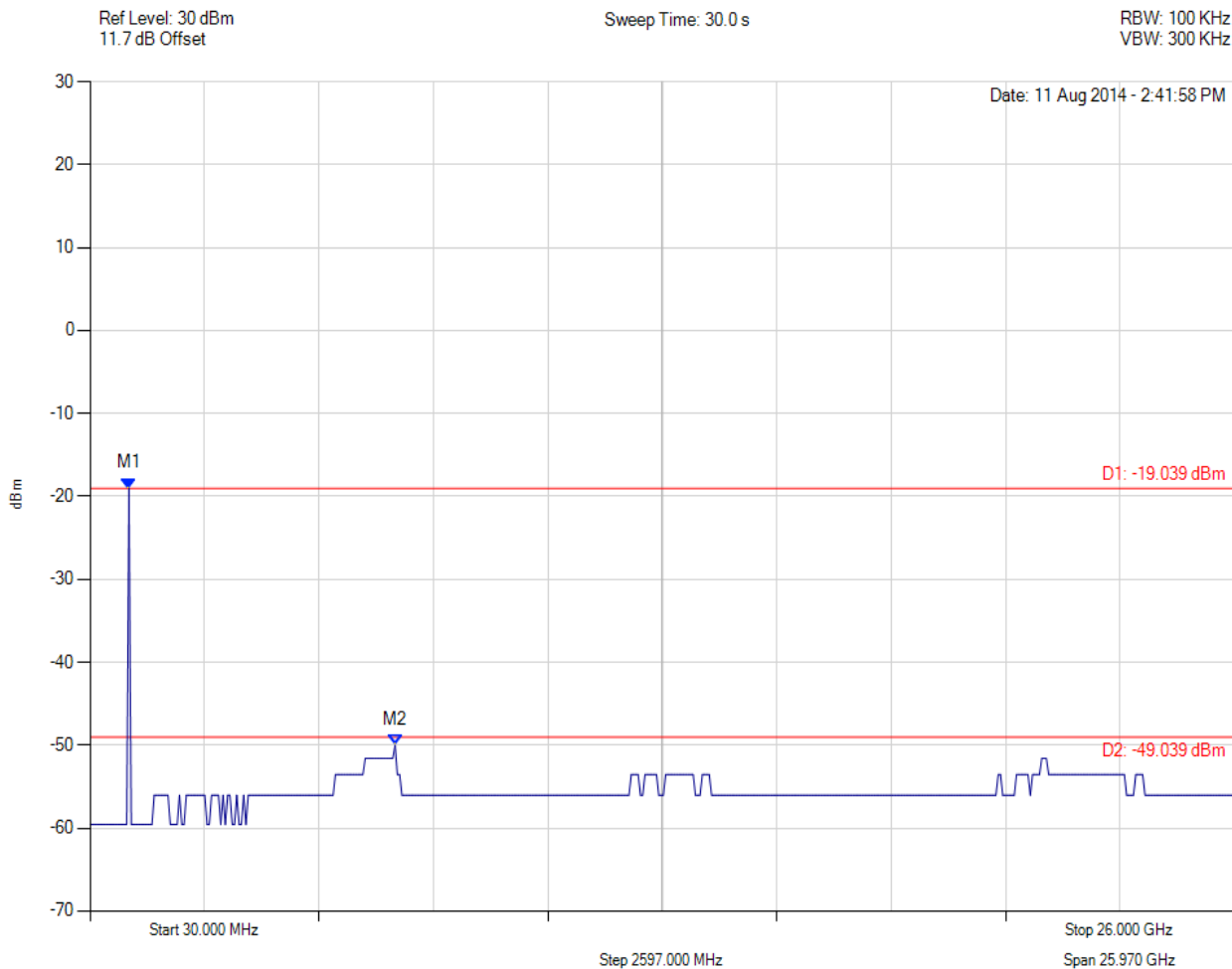


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CONDUCTED SPURIOUS EMISSIONS - AVERAGE



Variant: 802.11b, Channel: 915.25 MHz, Chain a, Temp: Ambient, Voltage: 5 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 914.749 MHz : -19.039 dBm M2 : 6951.864 MHz : -50.002 dBm	Limit: -49.04 dBm Margin: -0.96 dB

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CONDUCTED SPURIOUS EMISSIONS - AVERAGE



Variant: 802.11b, Channel: 927.25 MHz, Chain a, Temp: Ambient, Voltage: 5 Vdc



Analyser Setup	Marker:Frequency:Amplitude	Test Results
Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 914.749 MHz : -20.855 dBm M2 : 6483.467 MHz : -51.586 dBm	Limit: -50.86 dBm Margin: -0.73 dB

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6.1.1.9. Pseudorandom Frequency Hopping Sequence

Description

Describe how the hopping sequence is generated. Provide an example of the hopping sequence channels, in order to demonstrate that the sequence meets the requirement specified in the definition of a frequency hopping spread spectrum system, found in Section 2.1.

Reference: FCC DA 00-705 "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems"

Declaration from the Manufacturer

The hopping sequence for channels 1 through 50 are as follows (ordered 1 to 50, start top to bottom left hand column progressing to column 2 etc.):

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (MHz)
923.25	915.75	907.75	921.75	903.25
922.75	924.75	913.75	917.25	904.25
921.25	927.25	925.75	907.25	906.25
914.75	911.25	912.75	912.25	910.25
916.75	920.25	923.75	922.25	918.25
920.75	910.75	925.25	918.75	902.75
913.25	919.75	915.25	905.25	903.75
924.25	909.25	919.25	908.25	905.75
926.75	916.25	906.75	914.25	909.75
908.75	904.75	911.75	926.25	917.75

6.1.1.10. Equal Hopping Frequency Use

Description

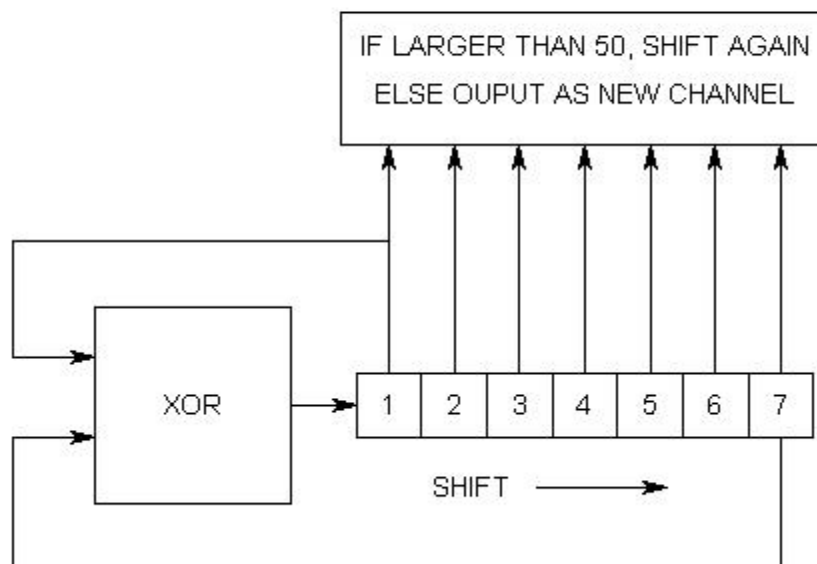
Describe how each individual EUT meets the requirement that each of its hopping channels is used equally on average (e.g., that each new transmission event begins on the next channel in the hopping sequence after the final channel used in the previous transmission event).

Reference: FCC DA 00-705 "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems"

Declaration from the Manufacturer

The 915 MHz UHF RFID device uses a **pseudo random sequence**, so all **50** frequencies in the hopping sequence get used equally.

PN SEQUENCER TO DEVELOP HOP CHANNEL TABLE



The EUT hops from each channel to the next based on the table, above, devised from this sequencer. A system clock insures that we dwell a maximum of 380 mS maximum on each frequency before commencing to the next hop frequency.



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6.1.1.11. System Receiver Input Bandwidth

Description

Describe how the associated receiver(s) complies with the requirement that its input bandwidth (either RF or IF) matches the bandwidth of the transmitted signal.

Reference: FCC DA 00-705 "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems"

Declaration from the Manufacturer

The 20dB bandwidth of the received signal is less than 250 KHz in all operational modes and matches the bandwidth of the transmitted signal

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6.1.1.12. System Receiver Hopping Capability

Description

Describe how the associated receiver(s) has the ability to shift frequencies in synchronization with the transmitted signals.

Reference: FCC DA 00-705 "Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems"

Declaration from the Manufacturer

A tag device follows the reader device's hopping sequence by **"obtaining power from the transmitter."** It then uses information in that packet and the same algorithmic process described in the standard to determine what the hopping sequence is that the master is using.



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6.1.2. Radiated Emission Testing

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.

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 dB μ V; 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:

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

Conversion between dB μ V/m (or dB μ V) and μ V/m (or μ V) are done as:

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

$$40 \text{ dB}\mu\text{V/m} = 100 \mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250 \mu\text{V/m}$$

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6.1.2.1. Transmitter Radiated Spurious Emissions (>1 GHz)

The EUT was evaluated to determine orientation where maximum emissions were observed (i.e. horizontal or vertical). The EUT + antenna was positioned on the test table during radiated emissions testing. Emission scans are generated using a peak detector.

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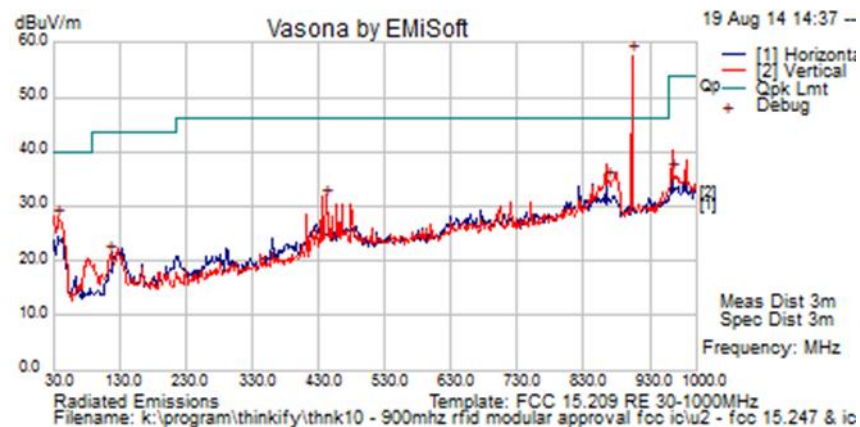


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Antenna ANT-916-CW-HWR-RPS Test Results

Operational Mode - Continuous Transmit

Test Freq.	902.75 MHz	Engineer	SB
Variant	Cont TX	Temp (°C)	21
Freq. Range	30 MHz - 1000 MHz	Rel. Hum.(%)	38
Power Setting	RA7	Press. (mBars)	998
Antenna	ANT-916	Duty Cycle (%)	100
Test Notes 1	Unit:#2;5VDC external PSU; No LEDs;		
Test Notes 2	IP=0;		



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
902.806	58.3	7.1	-7.8	57.6	Peak [Scan]	V	100	0				FUND
441.919	39.8	5.6	-14.1	31.3	Peak [Scan]	V	98	-1	46.0	-14.7	Pass	
37.275	39.5	3.6	-15.4	27.7	Peak [Scan]	V	98	-1	40.0	-12.3	Pass	
868.080	35.7	7.1	-8.2	34.6	Peak [Scan]	V	98	-1	46.0	-11.4	Pass	
964.595	36.0	7.3	-7.1	36.3	Peak [Scan]	V	98	-1	54.0	-17.7	Pass	
115.360	34.6	4.2	-18.0	20.8	Peak [Scan]	V	98	-1	43.5	-22.7	Pass	

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

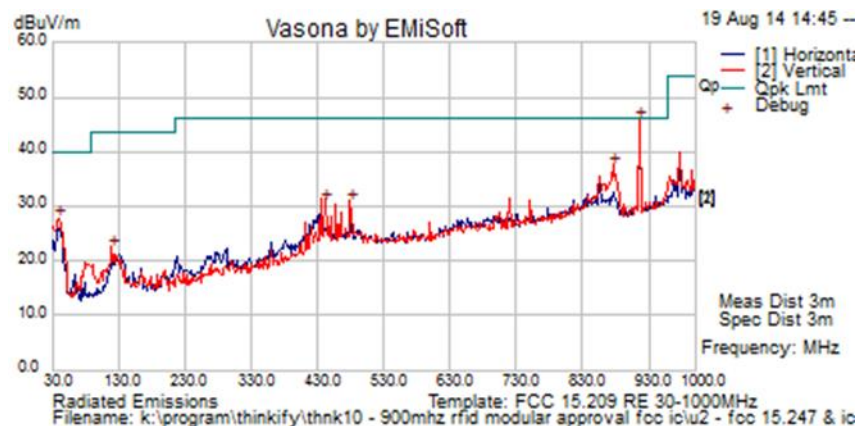
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Operational Mode - Continuous Transmit

Test Freq.	915.25 MHz	Engineer	SB
Variant	Cont TX	Temp (°C)	21
Freq. Range	1000 MHz - 10000 MHz	Rel. Hum.(%)	38
Power Setting	RA7	Press. (mBars)	998
Antenna	ANT-916	Duty Cycle (%)	100
Test Notes 1	Unit:#2;5VDC external PSU; No LEDs;		
Test Notes 2	IP=0;		



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
916.413	46.3	7.2	-7.7	45.7	Peak [Scan]	V	100	0				FUND
119.157	35.5	4.2	-17.5	22.2	Peak [Scan]	V	98	-1	43.5	-21.3	Pass	
876.132	38.1	7.1	-8.1	37.1	Peak [Scan]	V	98	-1	46.0	-8.9	Pass	
40.185	41.6	3.6	-17.7	27.5	Peak [Scan]	V	98	-1	40.0	-12.5	Pass	
479.688	37.4	5.8	-12.8	30.4	Peak [Scan]	V	98	-1	46.0	-15.6	Pass	
441.802	39.1	5.6	-14.1	30.5	Peak [Scan]	V	98	-1	46.0	-15.5	Pass	

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

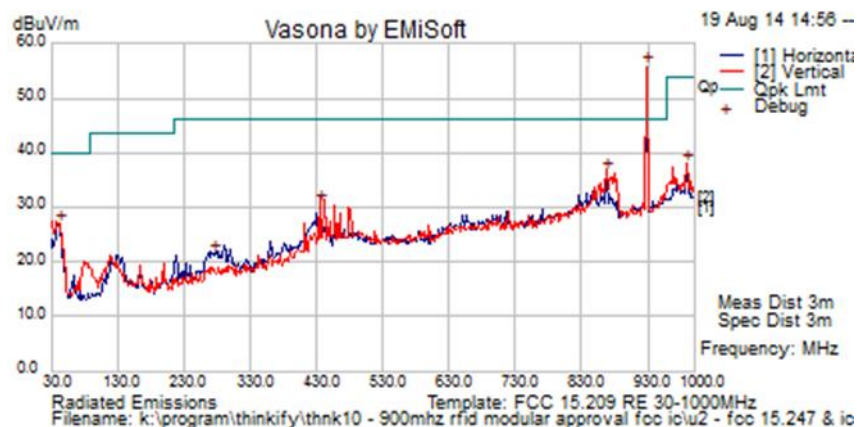
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Operational Mode - Continuous Transmit

Test Freq.	927.25 MHz	Engineer	SB
Variant	Cont TX	Temp (°C)	21
Freq. Range	1000 MHz - 10000 MHz	Rel. Hum.(%)	38
Power Setting	RA7	Press. (mBars)	998
Antenna	ANT-916	Duty Cycle (%)	100
Test Notes 1	Unit:#2;5VDC external PSU; No LEDs;		
Test Notes 2	IP=0;		



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
928.076	56.0	7.2	-7.5	55.8	Peak [Scan]	V	100	0				FUND
434.738	39.0	5.6	-14.2	30.5	Peak [Scan]	V	98	-1	46.0	-15.5	Pass	
868.060	37.7	7.1	-8.2	36.6	Peak [Scan]	V	98	-1	46.0	-9.4	Pass	
43.095	42.8	3.6	-19.6	26.8	Peak [Scan]	V	98	-1	40.0	-13.2	Pass	
988.382	37.4	7.3	-6.7	38.0	Peak [Scan]	V	98	-1	54.0	-16.0	Pass	
275.895	33.8	5.0	-17.4	21.4	Peak [Scan]	H	98	-1	46.0	-24.6	Pass	
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

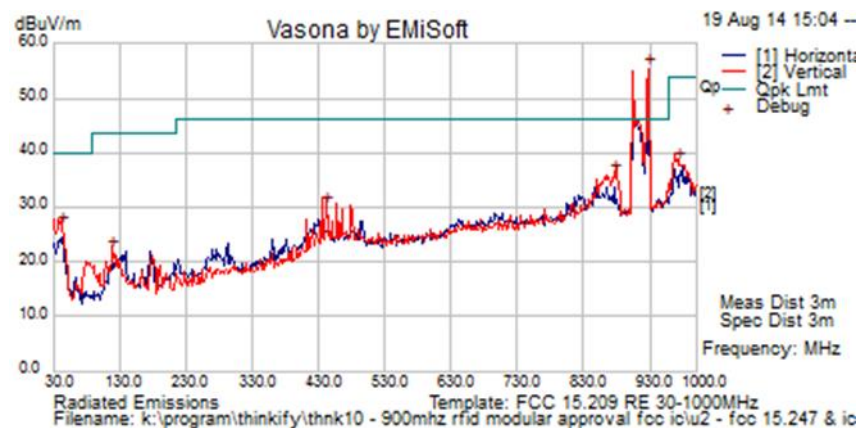
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Operational Mode - Frequency Hopping

Test Freq.	902.75-927.25 MHz	Engineer	SB
Variant	FHSS	Temp (°C)	21
Freq. Range	1000 MHz - 10000 MHz	Rel. Hum.(%)	38
Power Setting	RA7	Press. (mBars)	998
Antenna	ANT-916	Duty Cycle (%)	100
Test Notes 1	Unit:#2;5VDC external PSU; No LEDs;		
Test Notes 2	IP=0;		



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
928.076	55.7	7.2	-7.5	55.5	Peak [Scan]	V	100	0	46.0	9.5	Fail	
876.810	36.9	7.1	-8.1	35.9	Peak [Scan]	V	99	-1	46.0	-10.1	Pass	
973.810	37.9	7.3	-7.0	38.2	Peak [Scan]	V	99	-1	54.0	-15.8	Pass	
441.765	38.9	5.6	-14.1	30.4	Peak [Scan]	V	99	-1	46.0	-15.6	Pass	
118.755	35.6	4.2	-17.5	22.3	Peak [Scan]	V	99	-1	43.5	-21.2	Pass	
43.095	42.7	3.6	-19.6	26.7	Peak [Scan]	V	99	-1	40.0	-13.4	Pass	

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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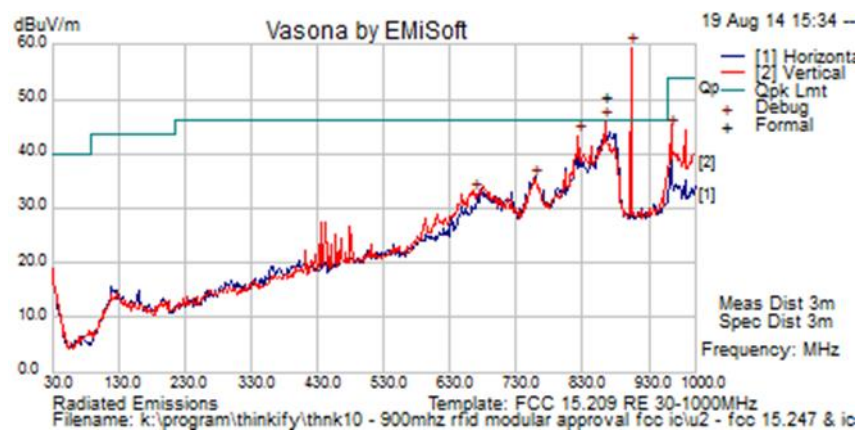


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Antenna TAC-060 Test Results

Operational Mode - Continuous Transmit

Test Freq.	902.75 MHz	Engineer	SB
Variant	Cont TX	Temp (°C)	21
Freq. Range	30 MHz - 1000 MHz	Rel. Hum.(%)	38
Power Setting	RA7	Press. (mBars)	998
Antenna	TAC-060	Duty Cycle (%)	100
Test Notes 1	Unit:#2;5VDC external PSU; LEDs;		
Test Notes 2	IP=0;		



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
902.806	60.2	7.1	-7.8	59.5	Peak [Scan]	V	100	0				FUND
862.771	47.1	7.0	-8.2	45.9	Peak [Scan]	V	100	0				NRB
666.428	37.0	6.4	-10.7	32.8	Peak [Scan]	V	99	328				NRB
756.579	37.9	6.7	-9.3	35.3	Peak [Scan]	V	99	328				NRB
823.125	44.7	6.9	-8.4	43.3	Peak [Scan]	V	99	328				NRB
962.760	44.2	7.3	-7.1	44.4	Peak [Scan]	V	99	328	54.0	-9.6	Pass	RB

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
 RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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Operational Mode - Continuous Transmit

Test Freq.	915.25 MHz	Engineer	SB
Variant	Cont TX	Temp (°C)	21
Freq. Range	1000 MHz - 10000 MHz	Rel. Hum.(%)	38
Power Setting	RA7	Press. (mBars)	998
Antenna	TAC-060	Duty Cycle (%)	100
Test Notes 1	Unit:#2;5VDC external PSU; LEDs;		
Test Notes 2	IP=0;		



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
916.413	48.2	7.2	-7.7	47.6	Peak [Scan]	H	100	0				FUND
856.152	47.4	7.0	-8.3	46.1	Peak [Scan]	H	100	0				NRB
434.254	35.1	5.6	-14.2	26.5	Peak [Scan]	V	98	361				NRB
656.620	36.3	6.4	-10.6	32.1	Peak [Scan]	V	98	361				NRB
976.720	45.8	7.3	-6.9	46.2	Peak [Scan]	V	98	361	54.0	-7.9	Pass	RB
30.000	24.1	3.5	-9.7	17.9	Peak [Scan]	V	98	361	40.0	-22.1	Pass	RB
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

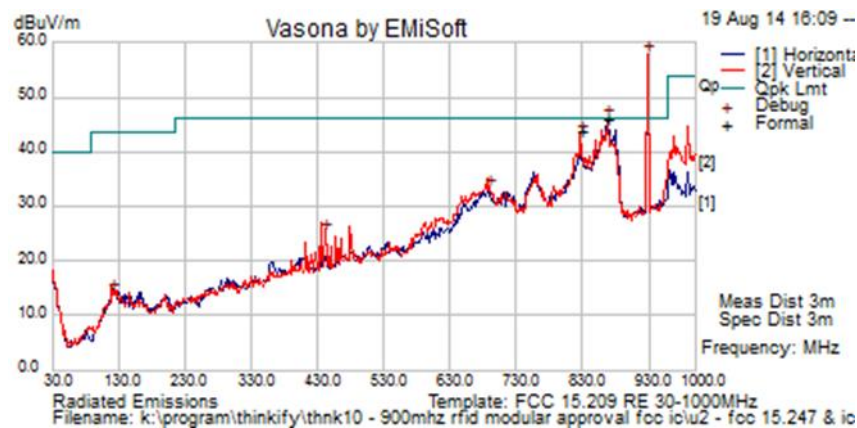
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Operational Mode - Continuous Transmit

Test Freq.	927.25 MHz	Engineer	SB
Variant	Cont TX	Temp (°C)	21
Freq. Range	1000 MHz - 10000 MHz	Rel. Hum.(%)	38
Power Setting	RA7	Press. (mBars)	998
Antenna	TAC-060	Duty Cycle (%)	100
Test Notes 1	Unit:#2;5VDC external PSU; LEDs;		
Test Notes 2	IP=0;		



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
928.076	58.2	7.2	-7.5	57.9	Peak [Scan]	V	100	0				FUND
867.249	47.0	7.1	-8.2	45.9	Peak [Scan]	H	100	0				NRB
827.219	44.6	6.9	-8.3	43.2	Peak [Scan]	V	200	0				NRB
441.765	33.5	5.6	-14.1	24.9	Peak [Scan]	V	129	345				NRB
689.600	37.1	6.5	-10.4	33.2	Peak [Scan]	V	129	345				NRB
121.665	27.0	4.2	-17.4	13.9	Peak [Scan]	V	129	345	43.5	-29.6	Pass	RB
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission												
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

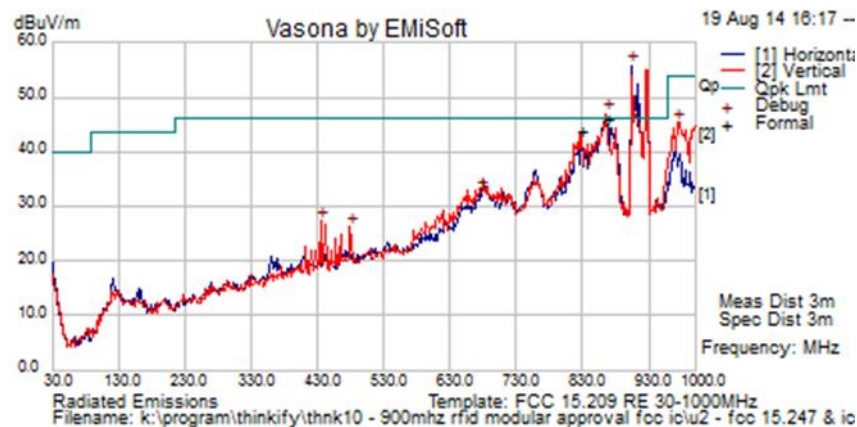
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Operational Mode - Frequency Hopping

Test Freq.	902.75-927.25 MHz	Engineer	SB
Variant	FHSS	Temp (°C)	21
Freq. Range	1000 MHz - 10000 MHz	Rel. Hum.(%)	38
Power Setting	RA7	Press. (mBars)	998
Antenna	TAC-060	Duty Cycle (%)	100
Test Notes 1	Unit:#2;5VDC external PSU; LEDs;		
Test Notes 2	IP=0;		



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
902.806	56.4	7.1	-7.8	55.8	Peak [Scan]	H	200	0				FUND
865.872	48.2	7.0	-8.2	47.0	Peak [Scan]	V	200	0				NRB
434.325	36.0	5.6	-14.2	27.4	Peak [Scan]	V	98	361				NRB
479.159	33.2	5.8	-12.9	26.1	Peak [Scan]	V	98	361				NRB
677.475	36.7	6.5	-10.5	32.7	Peak [Scan]	V	98	361				NRB
973.810	45.0	7.3	-7.0	45.4	Peak [Scan]	V	98	361	54.0	-8.6	Pass	RB
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

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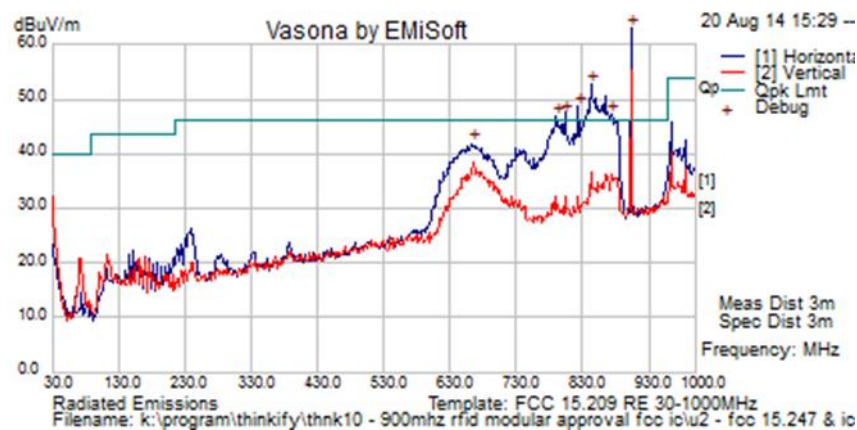


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Antenna TAL-060 Test Results

Operational Mode - Continuous Transmit

Test Freq.	902.75 MHz	Engineer	SB
Variant	Cont TX	Temp (°C)	21
Freq. Range	30 MHz - 1000 MHz	Rel. Hum.(%)	38
Power Setting	RA7	Press. (mBars)	998
Antenna	TAL-060	Duty Cycle (%)	100
Test Notes 1	Unit:#2;5VDC external PSU; LEDs;		
Test Notes 2	IP=0;		



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
902.806	63.7	7.1	-7.8	63.1	Peak [Scan]	H	100	0				FUND
842.545	54.0	7.0	-8.4	52.6	Peak [Scan]	H	100	0				NRB
873.647	48.1	7.1	-8.1	47.1	Peak [Scan]	H	100	0				NRB
663.707	46.1	6.4	-10.7	41.9	Peak [Scan]	H	200	0				NRB
823.227	49.9	6.9	-8.4	48.4	Peak [Scan]	H	99	360				NRB
803.475	49.0	7.0	-8.9	47.1	Peak [Scan]	H	99	360				NRB

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

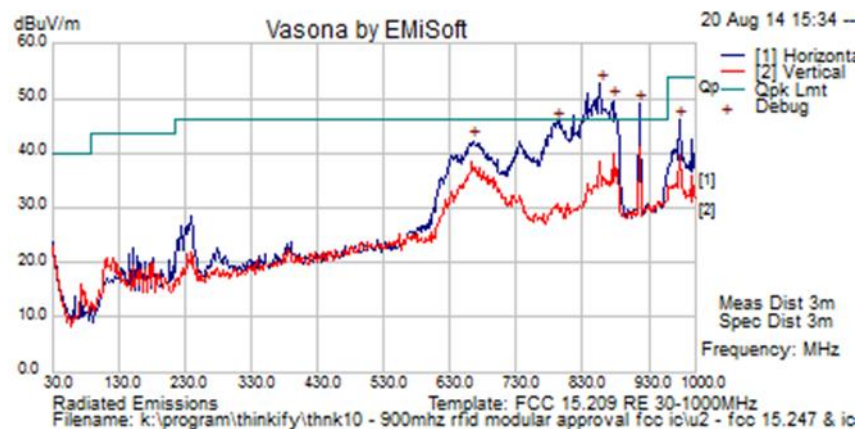
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Operational Mode - Continuous Transmit

Test Freq.	915.25 MHz	Engineer	SB
Variant	Cont TX	Temp (°C)	21
Freq. Range	30 MHz - 1000 MHz	Rel. Hum.(%)	38
Power Setting	RA7	Press. (mBars)	998
Antenna	TAL-060	Duty Cycle (%)	100
Test Notes 1	Unit:#2;5VDC external PSU; LEDs;		
Test Notes 2	IP=0;		



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
856.152	54.0	7.0	-8.3	52.7	Peak [Scan]	H	100	0				NRB
875.591	50.6	7.1	-8.1	49.6	Peak [Scan]	H	100	0				NRB
916.413	49.5	7.2	-7.7	48.9	Peak [Scan]	H	100	0				FUND
792.420	47.9	6.8	-9.0	45.8	Peak [Scan]	H	98	361				NRB
665.651	46.4	6.4	-10.7	42.2	Peak [Scan]	H	200	0				NRB
976.720	45.6	7.3	-6.9	45.9	Peak [Scan]	H	98	361				NRB

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
 RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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Operational Mode - Continuous Transmit

Test Freq.	927.25 MHz	Engineer	SB
Variant	Cont TX	Temp (°C)	21
Freq. Range	30 MHz - 1000 MHz	Rel. Hum.(%)	38
Power Setting	RA7	Press. (mBars)	998
Antenna	TAL-060	Duty Cycle (%)	100
Test Notes 1	Unit:#2;5VDC external PSU; LEDs;		
Test Notes 2	IP=0;		



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
928.076	58.9	7.2	-7.5	58.7	Peak [Scan]	H	100	0				FUND
848.377	53.2	6.9	-8.3	51.8	Peak [Scan]	H	100	0				NRB
667.595	46.5	6.4	-10.7	42.2	Peak [Scan]	H	200	0				NRB
786.115	47.4	6.8	-9.1	45.1	Peak [Scan]	H	98	361				NRB
988.845	41.7	7.3	-6.7	42.3	Peak [Scan]	H	98	361				NRB
233.215	39.6	4.8	-19.2	25.2	Peak [Scan]	H	98	361	46.0	-20.8	Pass	
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission												
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

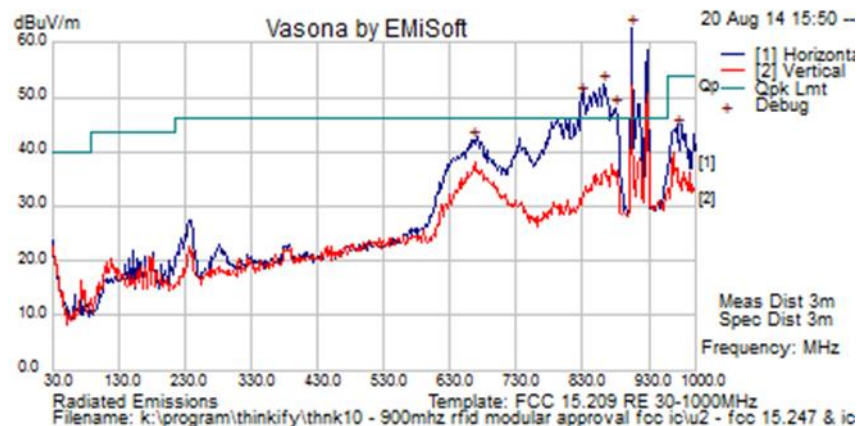
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Operational Mode - Frequency Hopping

Test Freq.	902.75-927.25 MHz	Engineer	SB
Variant	FHSS	Temp (°C)	21
Freq. Range	30 MHz - 1000 MHz	Rel. Hum.(%)	38
Power Setting	RA7	Press. (mBars)	998
Antenna	ANT-916	Duty Cycle (%)	100
Test Notes 1	Unit:#2;5VDC external PSU; LEDs;		
Test Notes 2	IP=0;		



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
902.806	63.2	7.1	-7.8	62.5	Peak [Scan]	H	100	0				FUND
861.984	53.6	7.0	-8.2	52.4	Peak [Scan]	H	100	0				NRB
828.795	51.4	6.9	-8.3	50.0	Peak [Scan]	H	98	361				NRB
879.479	49.0	7.1	-8.2	47.9	Peak [Scan]	H	100	0				NRB
665.350	46.3	6.4	-10.7	42.1	Peak [Scan]	H	98	361				NRB
973.810	43.7	7.3	-7.0	44.1	Peak [Scan]	H	98	361				NRB

Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission
RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak

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Specification Limits

FCC §15.247(d) and RSS-210 §A8.5 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 radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits.

FCC §15.247(d)

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 §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section §15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(a)).

IC RSS-210 §A8.5 If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in Tables 2 and 3 is not required. In addition, radiated emissions which fall in the restricted bands of Table 1 must also comply with the radiated emission limits specified in Tables 2 and 3.

IC RSS-Gen §4.7

The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz , whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated without exceeding 40 GHz.

FCC §15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

FCC §15.205 (a) Except as shown 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 Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

FCC §15.209 (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.



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§15.209 (a) Limit Matrix

Frequency(MHz)	Field Strength (μ V/m)	Field Strength (dB μ V/m)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
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Traceability

Method
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'

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6.1.2.2. Digital Emissions (0.03-1 GHz)

FCC, Part 15 Subpart C §15.205/ §15.209
Industry Canada RSS-210 §2.2

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.

The EUT had two methods of powering on ac/dc converter and Power over Ethernet (POE). Both modes were tested for emissions below 1GHz.

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.

$$\text{FS} = \text{R} + \text{AF} + \text{CORR}$$

where:

$$\begin{aligned}\text{FS} &= \text{Field Strength} \\ \text{R} &= \text{Measured Receiver Input Amplitude} \\ \text{AF} &= \text{Antenna Factor} \\ \text{CORR} &= \text{Correction Factor} = \text{CL} - \text{AG} + \text{NFL} \\ \text{CL} &= \text{Cable Loss} \\ \text{AG} &= \text{Amplifier Gain}\end{aligned}$$

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:

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

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

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

$$40 \text{ dB}\mu\text{V/m} = 100\mu\text{V/m}$$

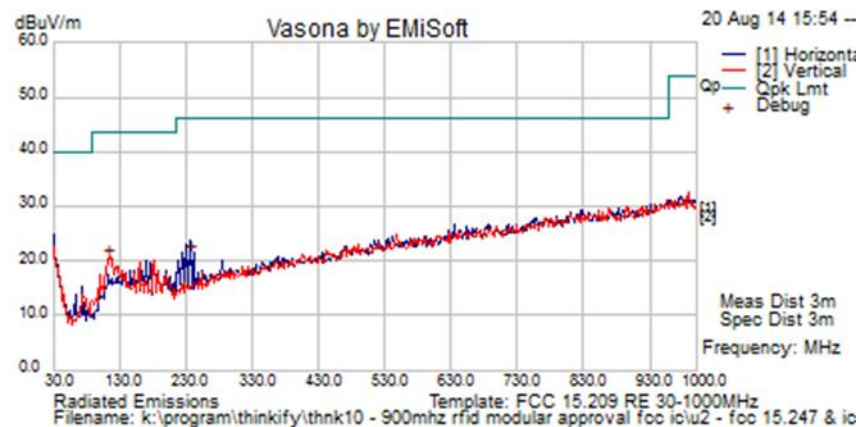
$$48 \text{ dB}\mu\text{V/m} = 250\mu\text{V/m}$$



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The EUT was evaluated to determine orientation where maximum emissions were observed (i.e. horizontal or vertical). The EUT + antenna was positioned on the test table during radiated emissions testing. Emission scans are generated using a peak detector.

Test Freq.	902.75-927.25 MHz	Engineer	SB
Variant	FHSS	Temp (°C)	21
Freq. Range	30 MHz - 1000 MHz	Rel. Hum.(%)	38
Power Setting	RA7	Press. (mBars)	998
Antenna	ANT-916	Duty Cycle (%)	100
Test Notes 1	Unit:#2;5VDC external PSU; LEDs; TX Off EUT Off;		
Test Notes 2	IP=0;		



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
236.610	35.4	4.8	-19.1	21.1	Peak [Scan]	H	98	361	46	-24.9	Pass	
112.450	34.3	4.2	-18.4	20.2	Peak [Scan]	H	98	361	44	-23.8	Pass	
Legend: TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak												

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Specification

Limits

§15.205 (a) Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

§15.205 (a) Except as shown 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 Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (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.

§15.209 (a) and RSS-Gen §2.2 Limit Matrix

Frequency(MHz)	Field Strength ($\mu\text{V/m}$)	Field Strength ($\text{dB}\mu\text{V/m}$)	Measurement Distance (meters)
30-88	100	40.0	3
88-216	150	43.5	3
216-960	200	46.0	3
Above 960	500	54.0	3

Laboratory Measurement Uncertainty for Radiated Emissions

Measurement uncertainty	+5.6/ -4.5 dB
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Traceability

Method
Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions'

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6.1.3. AC Wireline Conducted Emissions (150 kHz – 30 MHz)

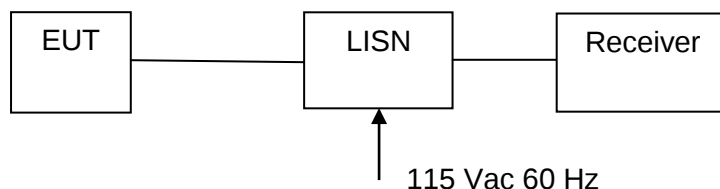
FCC, Part 15 Subpart C §15.207

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.

Test Measurement Set up



Measurement set up for AC Wireline Conducted Emissions Test

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

Ambient conditions.

Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Not required - EUT is power by DC only



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Specification

Limit

§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 $\mu\Omega$ 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.

RSS-Gen §7.2.2

The radio frequency voltage that is conducted back into the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table below. The tighter limit applies at the frequency range boundaries.

§15.207 (a) and **RSS-Gen §7.2.2** Limit Matrix

The lower limit applies at the boundary between frequency ranges

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	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
-------------------------	---------------

Traceability

Method
Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions'

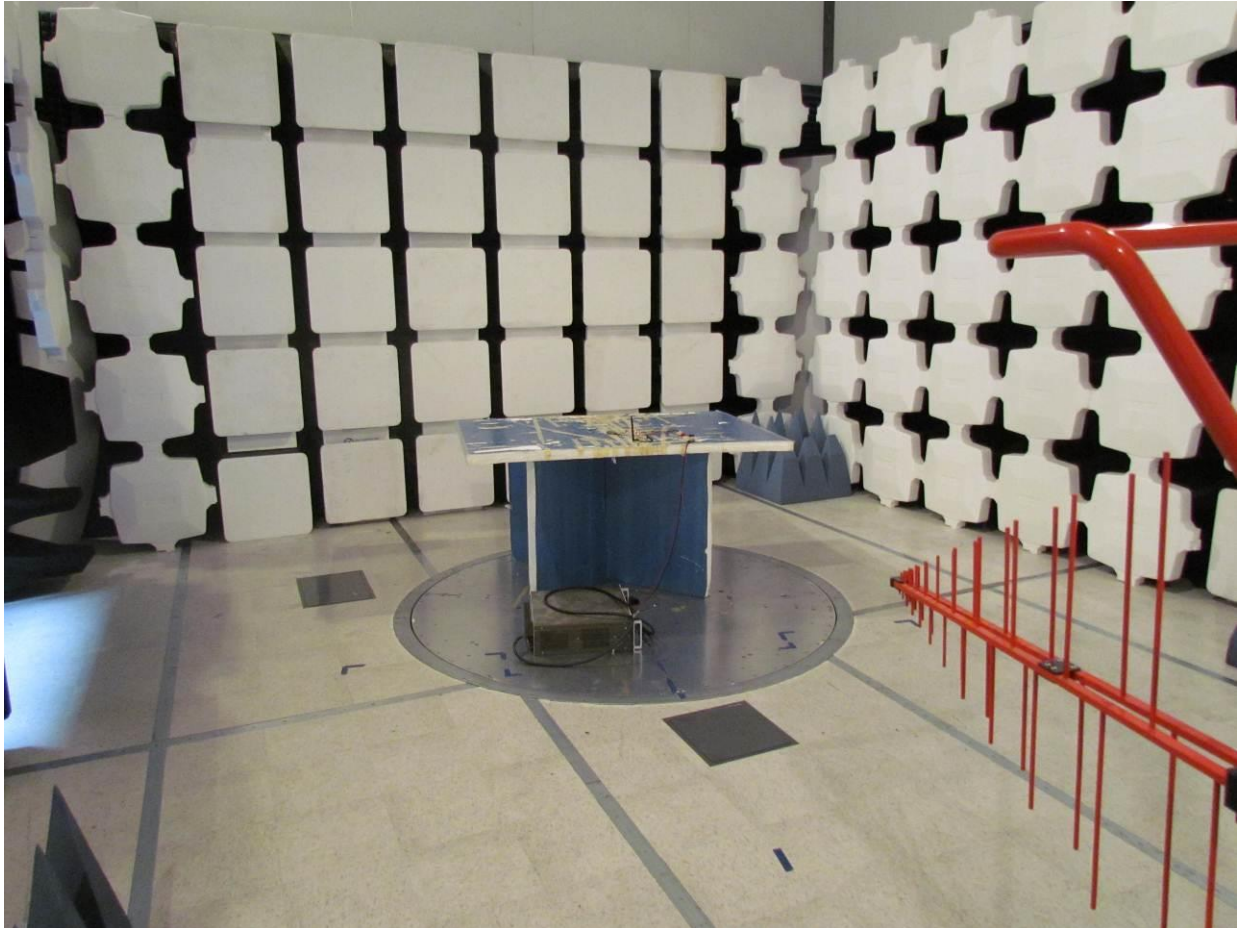
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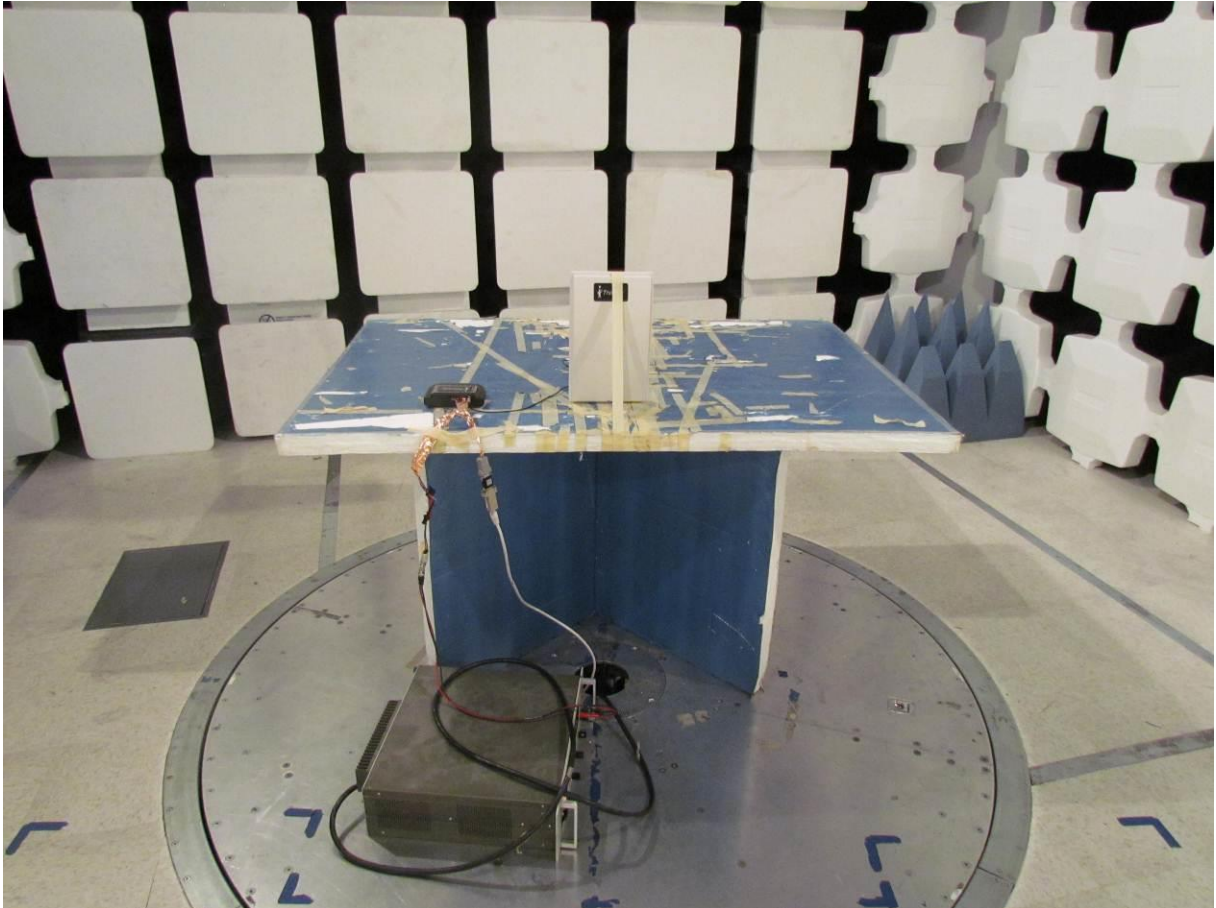
7. PHOTOGRAPHS

7.1. Test Setup - Conducted

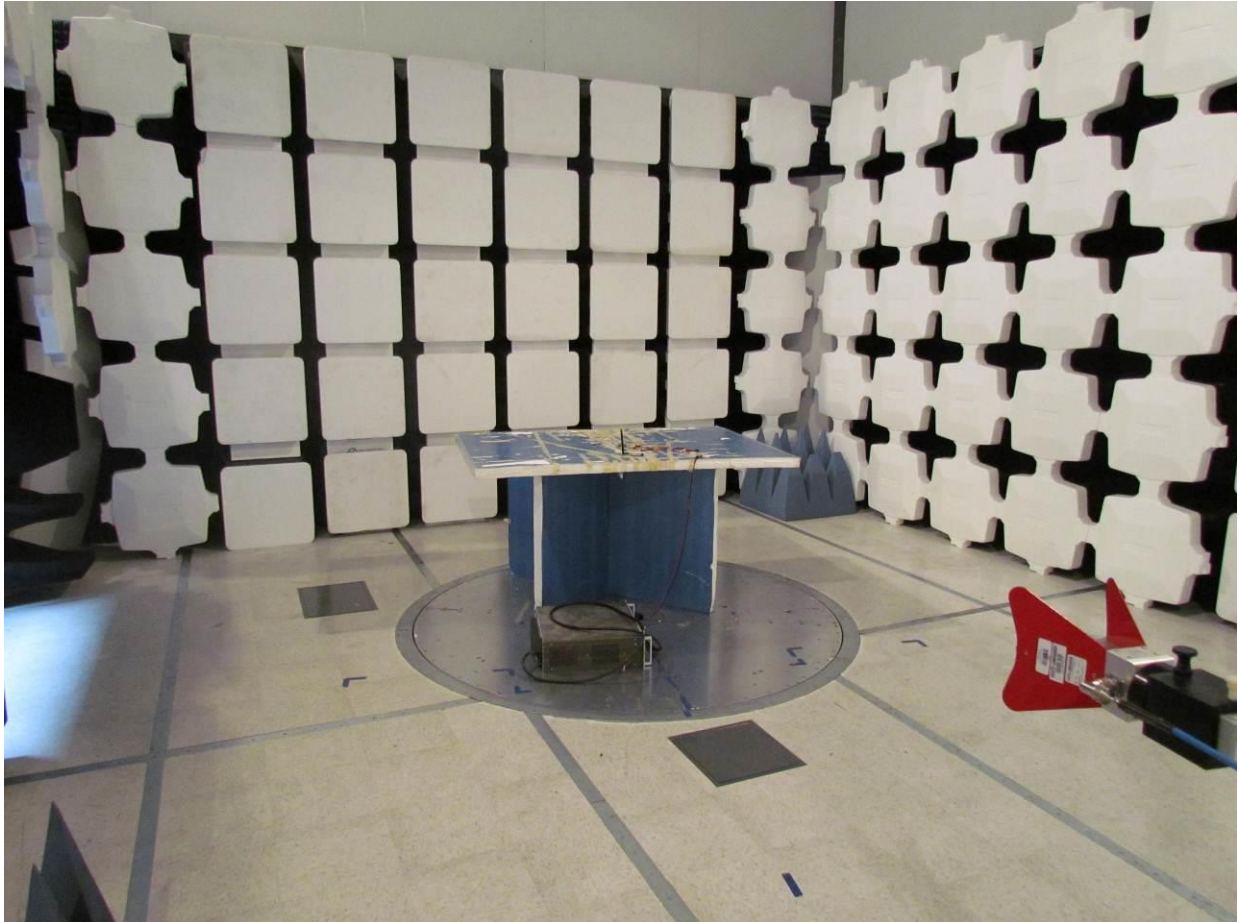


7.2. Test Setup - Digital Emissions below 1 GHz





7.3. Test Setup - Spurious Emissions Above 1 GHz





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8. TEST EQUIPMENT

Asset #	Instrument	Manufacturer	Part #	Serial #	Calibration Due Date
075	Environmental Chamber	Thermatron	SE-300-2-2	27946	N/A
091	Synthesized Sweeper	Hewlett Packard	HP 83640L	3722A00249	N/A
117	Power Sensor	Hewlett Packard	8487D	3318A00371	18 th Oct 14
158	Barometer /Thermometer	Control Co.	4196	E2846	6 th Dec 14
223	Power Meter	Hewlett Packard	EPM-442A	US37480256	18 th Oct 14
252	SMA Cable	Megaphase	Sucoflex 104	None	N/A
310	2m SMA Cable	Micro-Coax	UFA210A-0-0787-3G03G0	209089-001	N/A
312	3m SMA Cable	Micro-Coax	UFA210A-1-1181-3G0300	209092-001	N/A
338	30 - 3000 MHz Antenna	Sunol	JB3	A052907	14 th Aug 15
376	Power Sensor	Agilent	U2000A	MY51440005	28 th Oct 14
377	Notch Filter 5G	Microtronics	BRM50716	034	N/A
378	EMI Receiver	Rhode & Schwartz	ESIB40	100107/040	17 th Jul 15
380	RF Switch	MiCOM Labs	MIC001	MIC001	20 th Dec 14
390	Power Sensor	Agilent	U2002A	MY50000103	17 th Oct 14
393	Low Pass Filter 1050MHz	Minicircuits	WLFX-1050		N/A
396	Notch Filter 2.4G	Microtronics	BRM50701		N/A
397	Preamp 10-2500 MHz	MiCOM Labs		0397	23 Oct '14
398	RF Conducted Test Software	MiCOM Labs ATS	--	Version 1.8	N/A

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Asset #	Instrument	Manufacturer	Part #	Serial #	Calibration Due Date
399	Horn Antenna 1-18G	ETS	3117	00154575	10 Oct '14
405	Power Supply 0 -60 Vdc	Agilent	6654A	MY4001826	N/A
406	Preamplifier 1-18 GHz	MiCOM Labs		0406	30 May '15
411	Mast/Turntable Control	Sunol Sciences	SC98V	060199-1D	N/A
413	Mast Controller	Sunol Sciences	TWR95-4	030801-3	N/A
415	Turntable Controller	Sunol Sciences		0415	N/A
416	Gigabit Ethernet Filter	ETS	260366	0416	N/A
502	EMC Test Software	EMISoft	Vasona	5.0051	N/A
503	RF Conducted Test Software	National Instruments	Labview	Version 8.2	N/A
RF#1SMA #SA	SMA Cable	Flexco	--	--	20 th Dec 14
RF#1SMA #1	SMA Cable	Flexco	--	--	20 th Dec 14
RF#1SMA #2	SMA Cable	Flexco	--	--	20 th Dec 14
RF#1SMA #3	SMA Cable	Flexco	--	--	20 th Dec 14
RF#1SMA #4	SMA Cable	Flexco	--	--	20 th Dec 14

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