849 NW State Road 45
Newberry, FL 32669 USA
Ph.: 888.472.2424 or
352.472.5500
Fax: 352.472.2030
Email: info@timcoengr.com
Website: www.timcoengr.com

FCC PART 15.247 & IC RSS-247

900MHz FHSS

TEST REPORT

Applicant	**ELK PRODUCTS, INC.**
Address	**3266 US Highway 70 West**
	Hildebran NC 28637 USA
FCC ID	**TMAELK-M1XRFTWM**
IC:	**4353A-ELKM1XRFTWM**
Model Number	ELK-M1XRFTWM
Product Description	INTERFACE TRANSCEIVER
Date Sample Received	3/29/2016
Final Test Date	8/1/2016
Tested By	Tim Royer
Approved By	Cory Leverett

Report Number	Version Number	Description	Issue Date
576AUT16TestReport	Rev1	Initial Issue	5/17/2016
	Rev2	Statement added regarding radiated emissions – page 33	5/20/2016
	Rev3	Updated antenna gain on page 17	7/20/2016
	Rev4	Added new Bandedge plots Page 23, 25	8/01/2016

TABLE OF CONTENTS

GENERAL REMARKS

The attached report shall not be reproduced except in full without the written permission of Timco Engineering Inc.

The test results relate only to the items tested.

Summary

The device under test does:
☒ Fulfill the general approval requirements as identified in this test report and selected by the applicant.
☐ Not fulfill the general approval requirements as identified in this test report

Attestations

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report.

All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025: 2005 requirements.

I attest that the necessary measurements were made at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669

Tested by: 

Tim Royer, Engineering Project Manager

Date: 8/1/2015

Report Reviewed and Approved by 

Cory Leverett, Engineering Project Manager

Date: 8/1/2016

GENERAL INFORMATION

EUT Specification

Regulatory Standards	FCC Title 47 CFR Part 15.247 IC RSS-247 Issue 1 IC RSS-GEN Issue 4		
FCC ID	**TMAELK-M1XRFTWM**		
IC	**4353A-ELKM1XRFTWM**		
Model	ELK-M1XRFTWM		
EUT Description	INTERFACE TRANSCEIVER		
Modulation Type	GFSK		
Operating Frequency	TX: 902 - 928MHz	RX: 902 - 928MHz MHz	
EUT Power Source	☐ 110–120Vac/50– 60Hz		
	☒ DC Power		
	☐ Battery Operated Exclusively		
Test Item	☐ Prototype	☐ Pre-Production	☒ Production
Type of Equipment	☒ Fixed	☐ Mobile	☐ Portable
Antenna Connector	None (Temporary antenna connector for testing only)		
Antenna	Integrated antenna		
Test Conditions	Temperature: 24-26ºC Relative humidity: 50-65%		
Measurement Standard	ANSI C63.10-2013 (Measurement Procedures) ANSI C63.4-2014 (Radiated Site Validation)		
Test Exercise	The EUT was tuned to 3 places in the band and operated in normal operation		

Test Supporting Equipment

Device	Manufacturer	Model	S/N	Supplied By	Used For
N/A	N/A	N/A	N/A	N/A	N/A

RESULTS SUMMARY

FCC Rule Part No.	IC Standard Ref.	Requirement	Test Item	Result
15.215 (c)	RSS-GEN 6.6	Occupied Bandwidth	20 dB Bandwidth	Pass
15.247(a,1)	RSS-247 § 5.1	FHSS Requirements	Channel Separation	Pass
			Hopping Sequence	Pass
			System Receiver Bandwidth	Pass
			Number of Hopping Channels	Pass
			Hopping Channel Occupancy Time	Pass
15.247(b,1) & (b,4)	RSS-247 § 5.4.2	Peak Power Output	Peak Power Output (ERP)	Pass
			Antenna Gain (EIRP)	Pass
15.247(d)	RSS-247 § 5.5	Unwanted Emissions	Bandedge	Pass
			Radiated Spurious	Pass

Notes:

OCCUPIED BANDWIDTH

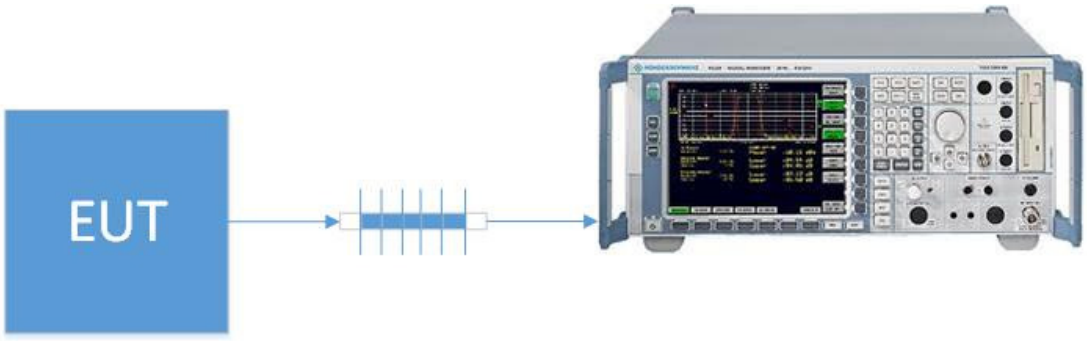
Rules Part No.: FCC 15.215(C), IC RSS 247 § 5.1.1, 5.1.1.3

FCC Requirements: The 20 dB bandwidth of the emission shall be contained within the frequency band designated in the rule section under which the equipment is operated.

IC Requirements: The maximum 20 dB bandwidth shall be 500 KHz

Test Method: ANSI C63.10 § 6.9.2 Occupied bandwidth-20dB Relative procedure

Setup:



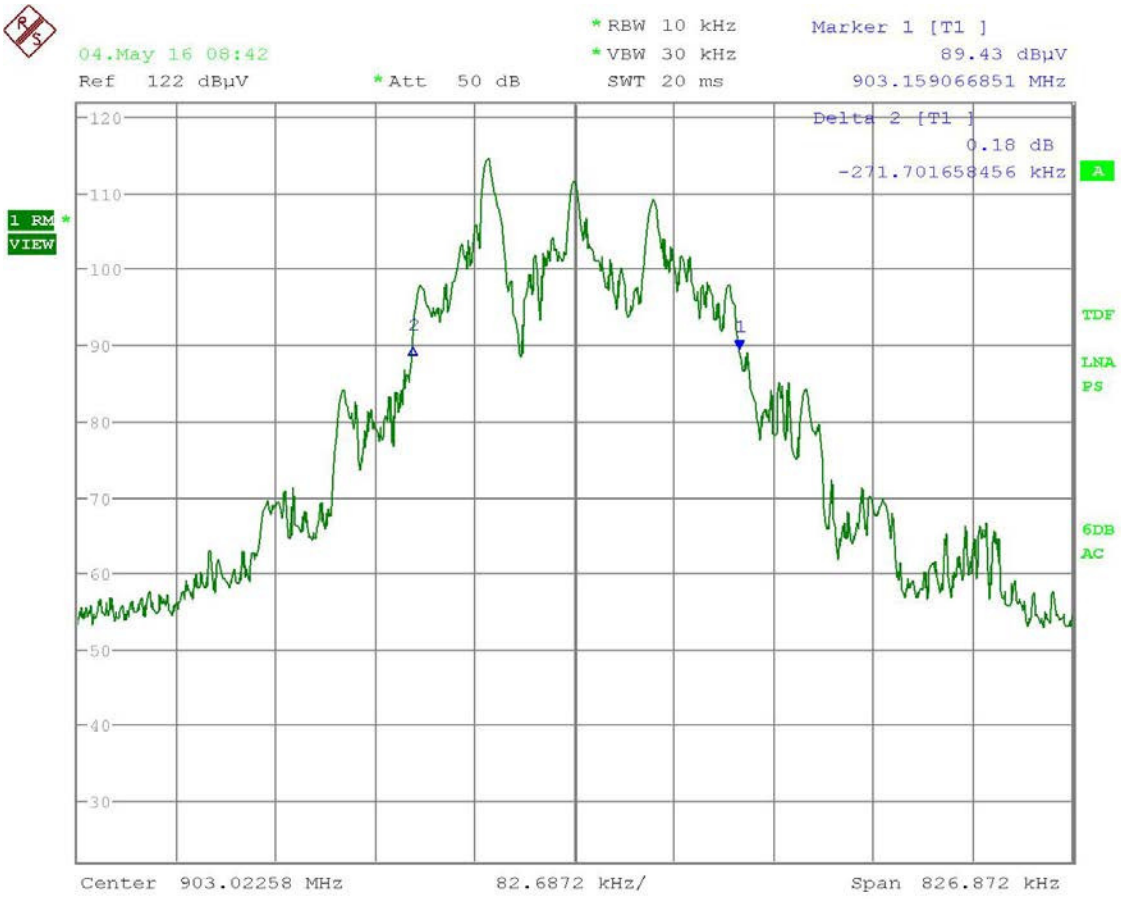
Test Data: **Mode 1 20 dB Occupied Bandwidth Measurement Table**

Tuned Frequency (MHz)	20 dB BW (KHz)	Limit (KHz)	Margin (KHz)
903	271.7	≤ 500	228.3
915	253.09	≤ 500	246.91
927	250.44	≤ 500	249.56

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: **20 dB OBW Low End of Band Plot**

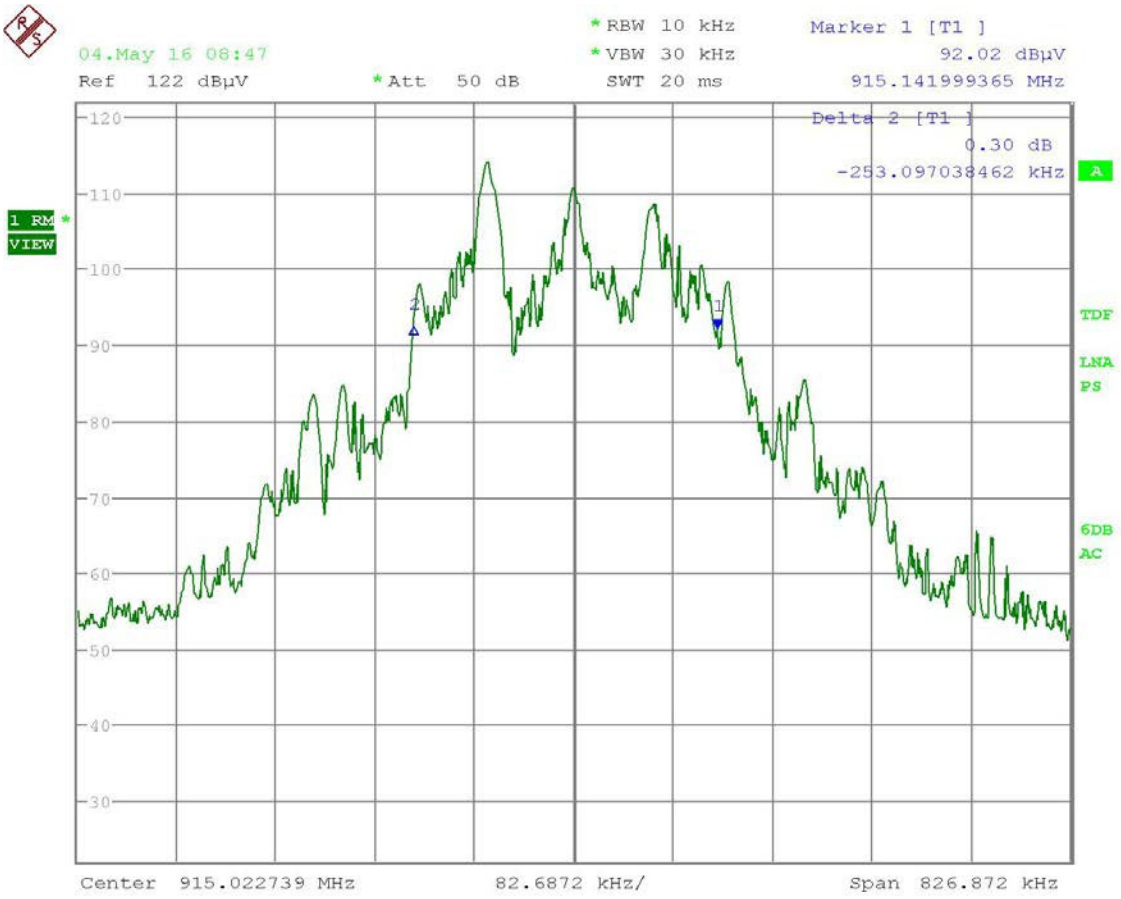


Date: 4.MAY.2016 08:42:48

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: **20 dB OBW Middle of Band Plot**

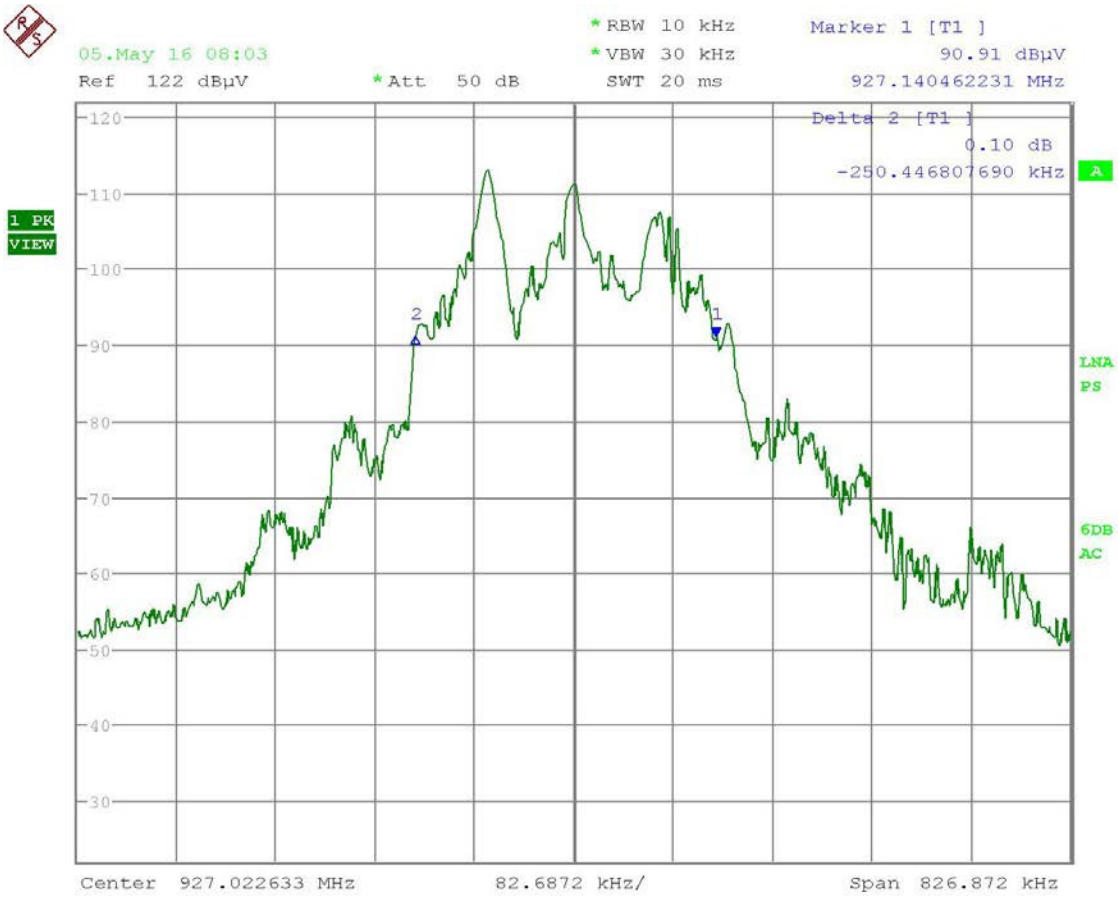


Date: 4.MAY.2016 08:47:23

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: **20 dB OBW High end of Band Plot**



Date: 5.MAY.2016 08:03:08

RESULTS: Meets Requirements

FHSS REQUIREMENTS

Rules Part No.: FCC 15.247(a)(1), IC RSS 247 § 5.1.1, 5.1.2, 5.1.3

Requirements:

Maximum 20 dB Bandwidth
The bandwidth of a frequency hopping channel is the -20 dB emission bandwidth, measured with the hopping stopped. The maximum 20 dB bandwidth of the hopping channel shall be 500 kHz.

Channel Separation
FHSs 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.

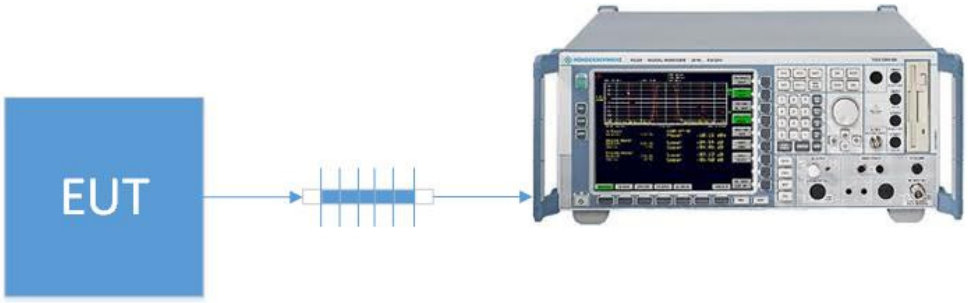
Dwell Time and Number of Hopping Channels
If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping channels 0.4 seconds within a 10-second period.

Hopping Sequence
The hopset shall be such that the near-term distribution of frequencies appears random, with sequential hops randomly distributed in both direction and magnitude of change in the hopset, whereas the long-term distribution appears evenly distributed.

Receiver Input Bandwidth
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.

Test Method:
ANSI C63.10 § 7.8.2 Carrier frequency separation
ANSI C63.10 § 7.8.3 Number of hopping frequencies
ANSI C63.10 § 7.8.3 Time of Occupancy
DA 00-705 § Pseudorandom Frequency Hopping Sequence
DA 00-705 § Equal Hopping Frequency Use
DA 00-705 § System Receiver Input Bandwidth

Setup:



FHSS REQUIREMENTS

Test Data: **FHSS Channel Separation Measurement Table**

Mode	Separation (KHz)	Limit (KHz)	Pass / Fail
1	1001.6	>250.44	Pass

Test Data: **Number of Hopping Channels Measurement Table**

Mode	Number of channels	Limit	Pass / Fail
1	25	≥25	Pass

Test Data: **Hopping Channel Occupancy Time Measurement Table**

Mode	Number of Tx in Period	Burst Length (Sec)	Occupancy Time (Sec)	Limit (sec)	Pass / Fail
1	1	0.01193	0.01	≤ 0.4	Pass

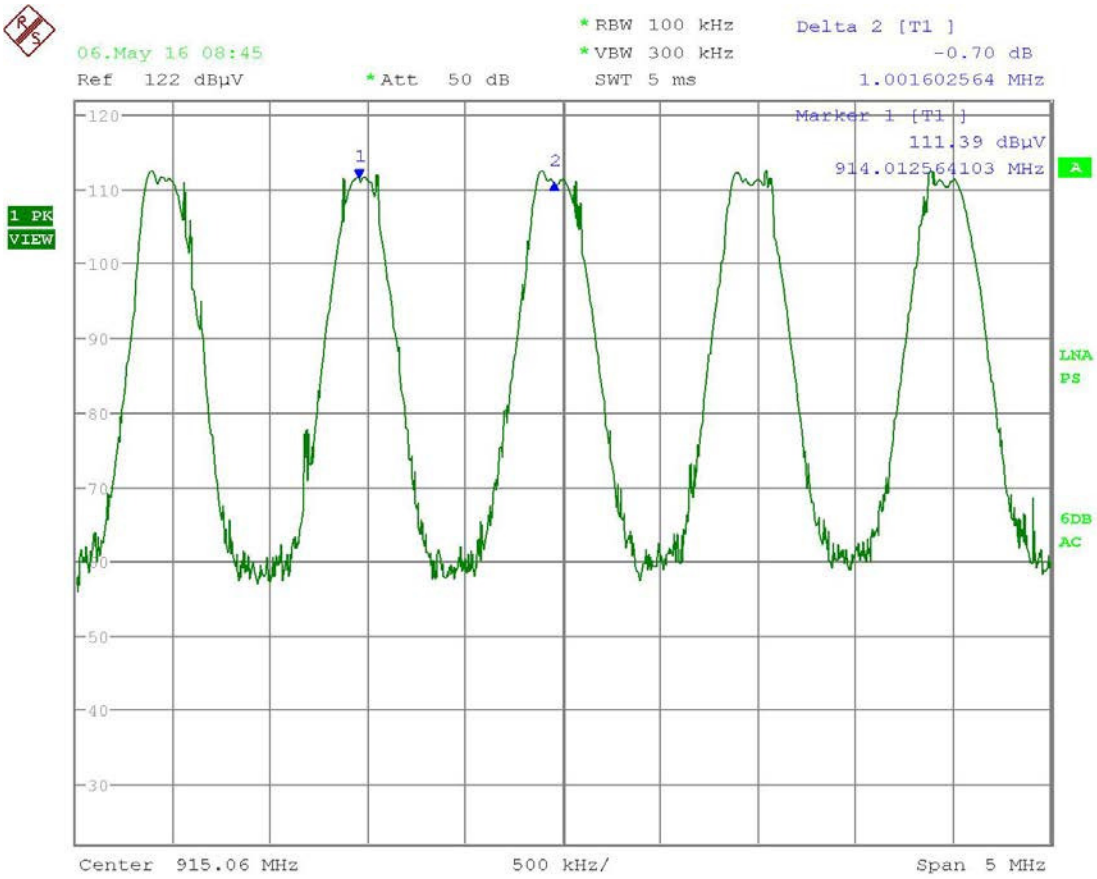
Test Data: **FHSS Hopping Sequence and Receiver Bandwidth Verification**

Requirement	Supporting Documentation	Pass / Fail
Pseudorandom Hopping Sequence	Operational Description provided by applicant	Pass
Equal Frequency Use		Pass
Receiver Input Bandwidth		Pass

RESULTS: Meets Requirements

FHSS REQUIREMENTS

Test Data: **Mode 1 Channel Separation Plot**

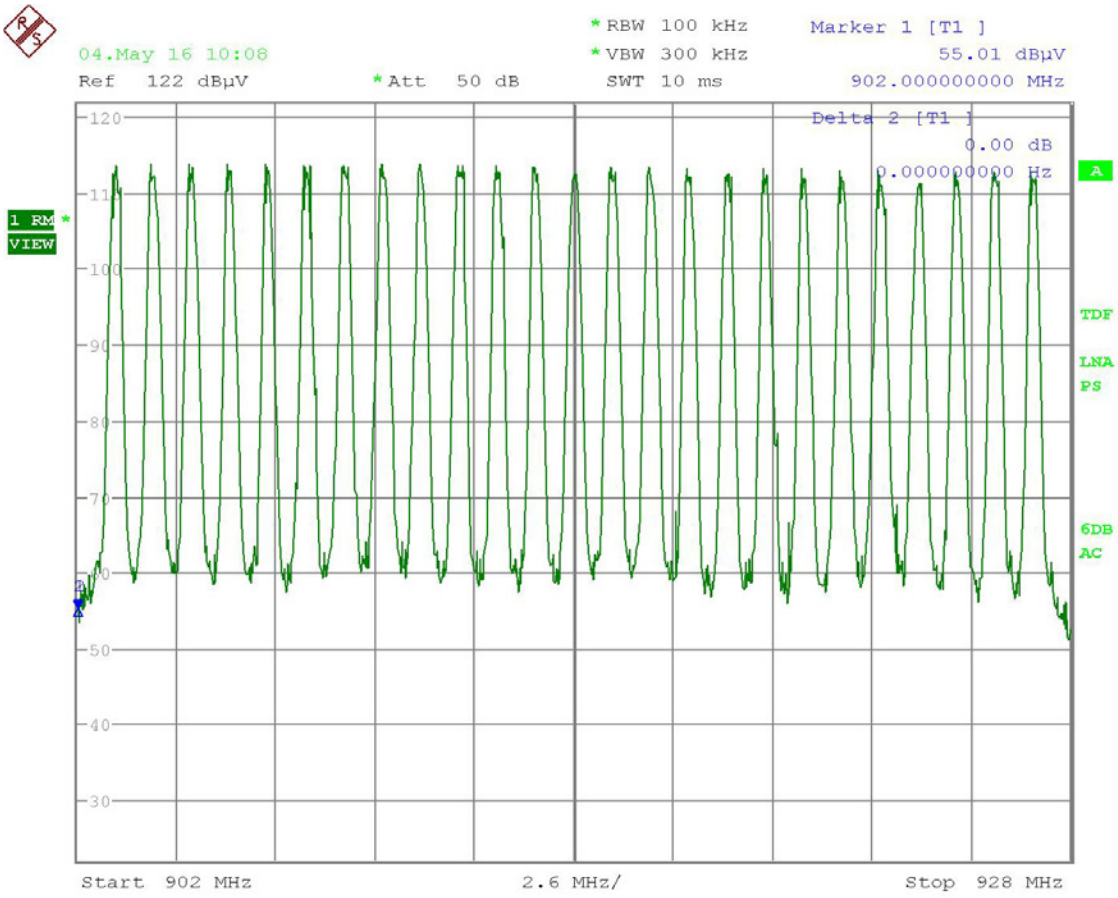


Date: 6.MAY.2016 08:45:09

RESULTS: Meets Requirements

FHSS REQUIREMENTS

Test Data: **Mode 1 Number of Hopping Channels Plot**

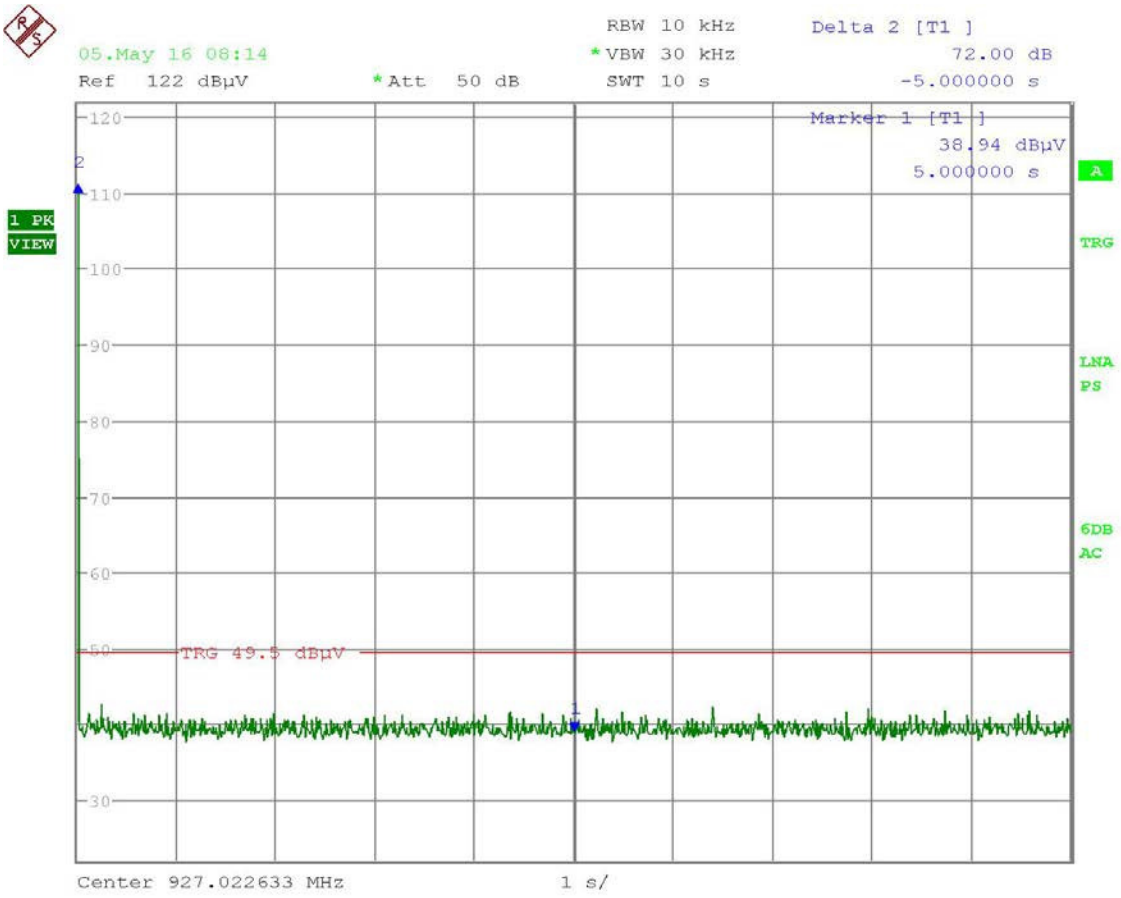


Date: 4.MAY.2016 10:08:26

RESULTS: Meets Requirements

FHSS REQUIREMENTS

Test Data: **Mode 1 Channel Occupancy Time Plot**



Date: 5.MAY.2016 08:14:06

RESULTS: Meets Requirements

FHSS REQUIREMENTS

Test Data: **Mode 1 Burst Length Plot**

Date: 5.MAY.2016 08:04:24

RESULTS: Meets Requirements

PEAK POWER OUTPUT

Rules Part No.: FCC 15.247(b) (2) (4), IC RSS 247 § 5.4.1

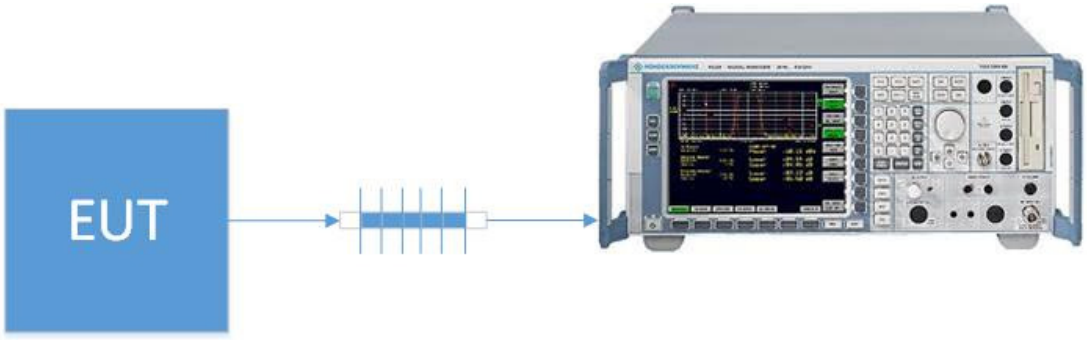
Requirements:

FHSS Using Hopset ≥ 50 Channels

The maximum peak conducted output power shall not exceed 1.0 W, and the e.i.r.p. shall not exceed 4 W if the hopset uses 25 or more hopping channels.

Test Method: ANSI C63.10 § 7.8.5 Output Power test procedure for FHSS

Setup:



PEAK POWER OUTPUT

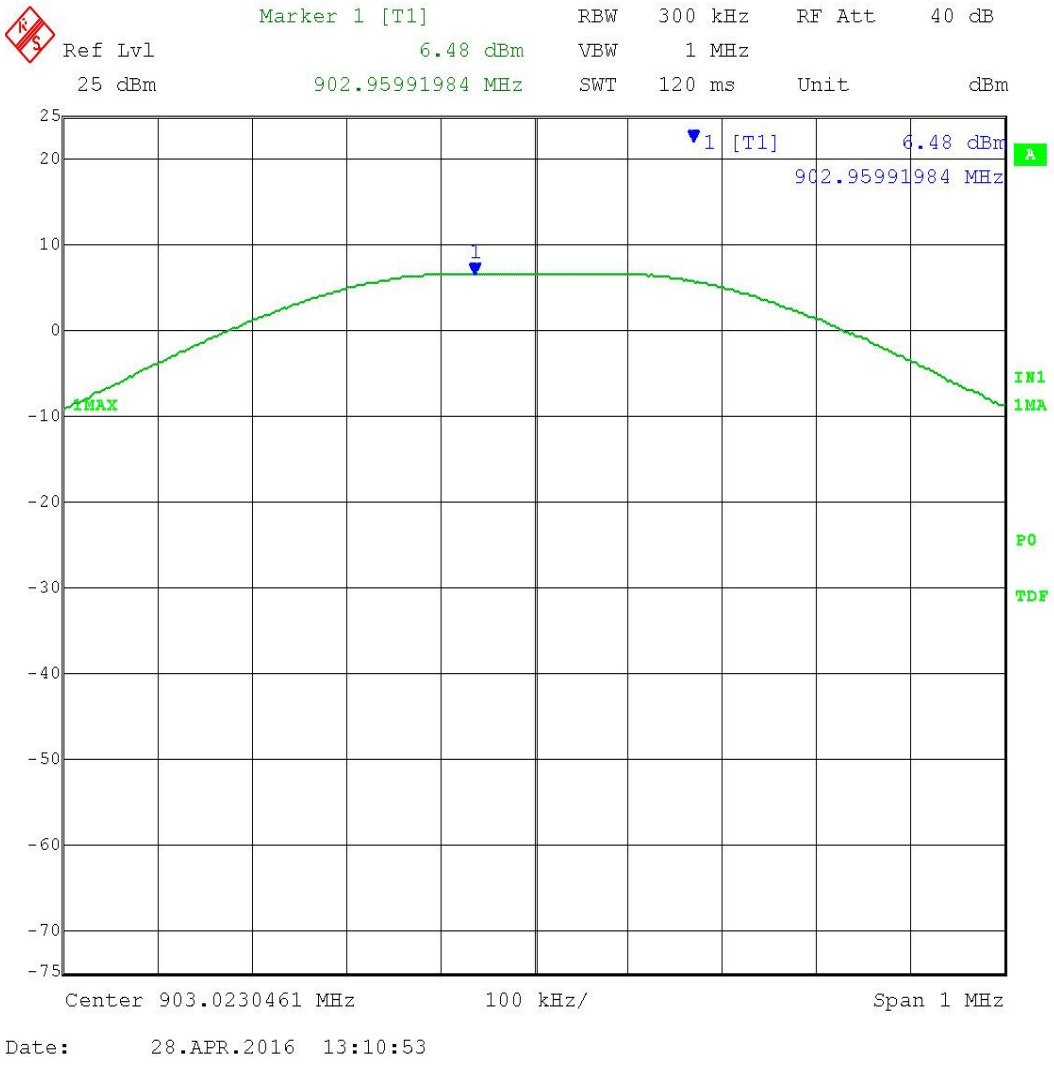
Test Data: **Peak Power Output Measurement Table**

Peak Conducted Power Output Measurement				
Tuned Frequency (MHz)	Level (dBm)	Level (W)	Limit (W)	Margin (W)
903	6.48	0.00445	1.00	0.99555
915	5.95	0.00394	1.00	0.99606
927	5.95	0.00394	1.00	0.99606
EIRP Conversion formula: EIRP = Pcond + Gain Ant (dBi)				
Antenna Gain (dBi)		-1		
Tuned Frequency (MHz)	Pcond (dBm)	EIRP (W)	Limit (W)	Margin (W)
903	6.48	0.00353	4.00	3.99647
915	5.95	0.00313	4.00	3.99687
927	5.95	0.00313	4.00	3.99687

RESULTS: Meets Requirements

PEAK POWER OUTPUT

Test Data: **Mode 1 Low End of Band Peak Conducted Power Plot**



RESULTS: Meets Requirements

PEAK POWER OUTPUT

Test Data: **Mode 1 Peak Power Output Plot Middle of Band**

RESULTS: Meets Requirements

PEAK POWER OUTPUT

Test Data: **Mode 1 Peak Power Output High End of Band**

RESULTS: Meets Requirements

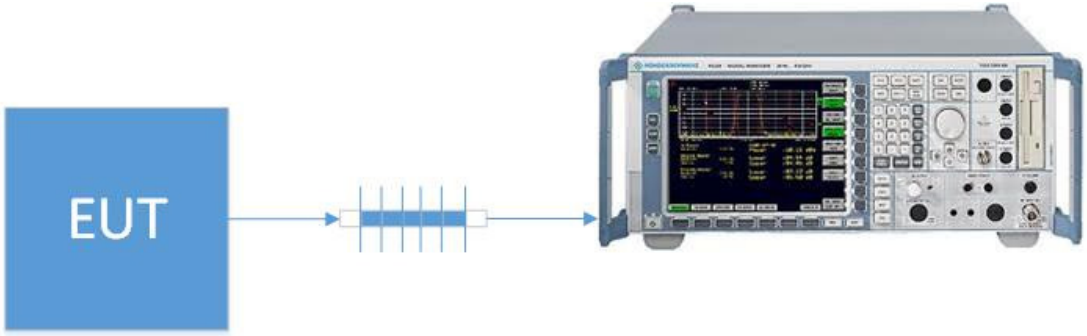
BANDEDGE

Rule Part No.: FCC 15.247(d) & 15.209, IC RSS 247 § 5.5 & RSS GEN § 8.9

Requirements: Emissions must be at least 20dB down from the highest emission level Within the authorized band as measured with a 100 kHz RBW, additionally adjacent restricted band edge emissions must comply with 15.209 and RSS-GEN 8.9 limits.

Test Method: ANSI C63.10 § 6.10.4 Authorized band-edge relative method

Setup:



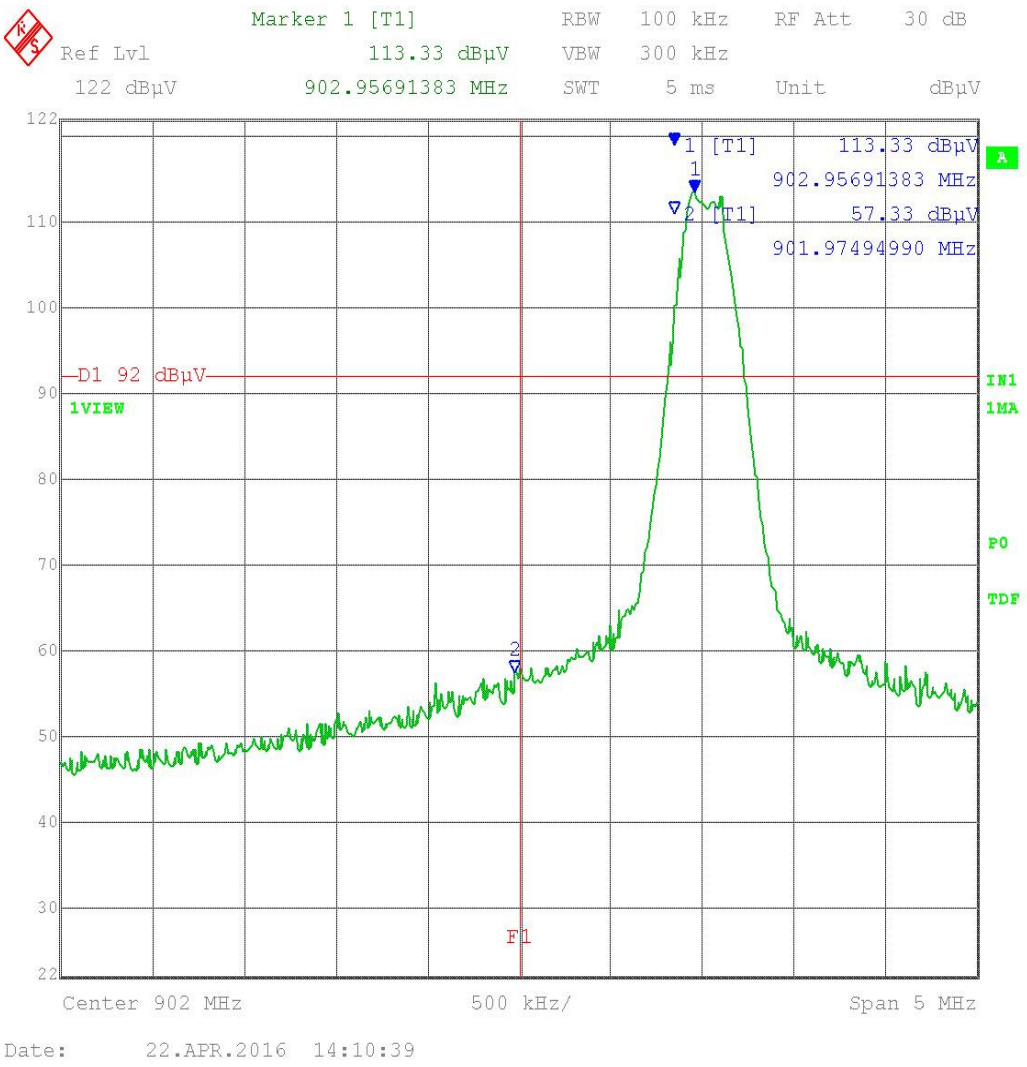
Test Data: **Bandedge Measurement Table**

Bandedge	Tuned Frequency (MHz)	Measured Level (dBc)	Limit (dBc)	Margin (dB)
Lower	903	56	20	36
	Hopping	55.01	20	35.01
Upper	927	57.83	20	37.83
	Hopping	55.11	20	35.11

Results Meet Requirements

BANDEDGE

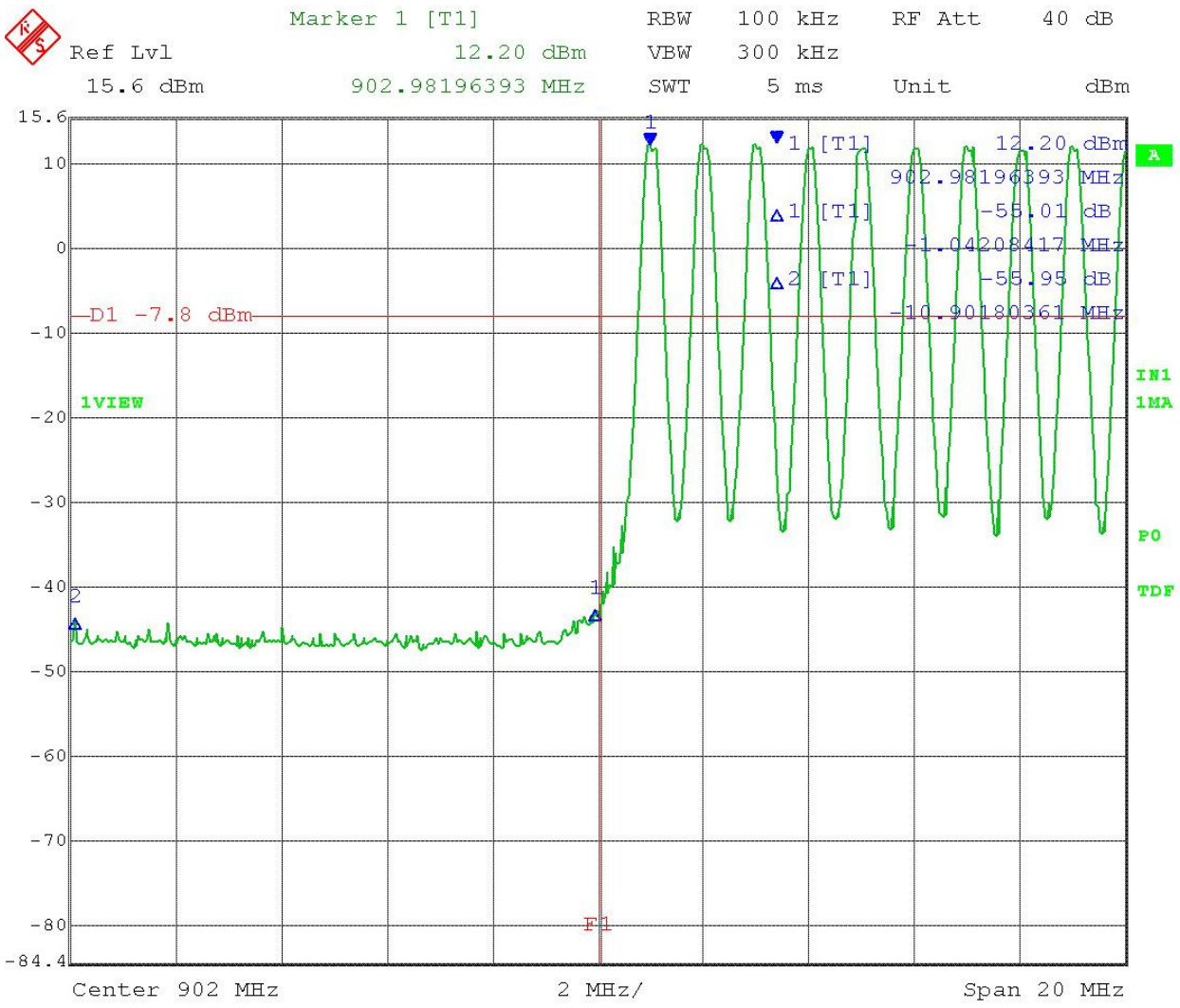
Data: **Mode 1 Low End of Band Lower Band Edge Plot**



RESULTS: Meets Requirements

BANDEDGE

Data: **Mode 1 Hopping Lower Band Edge Plot**

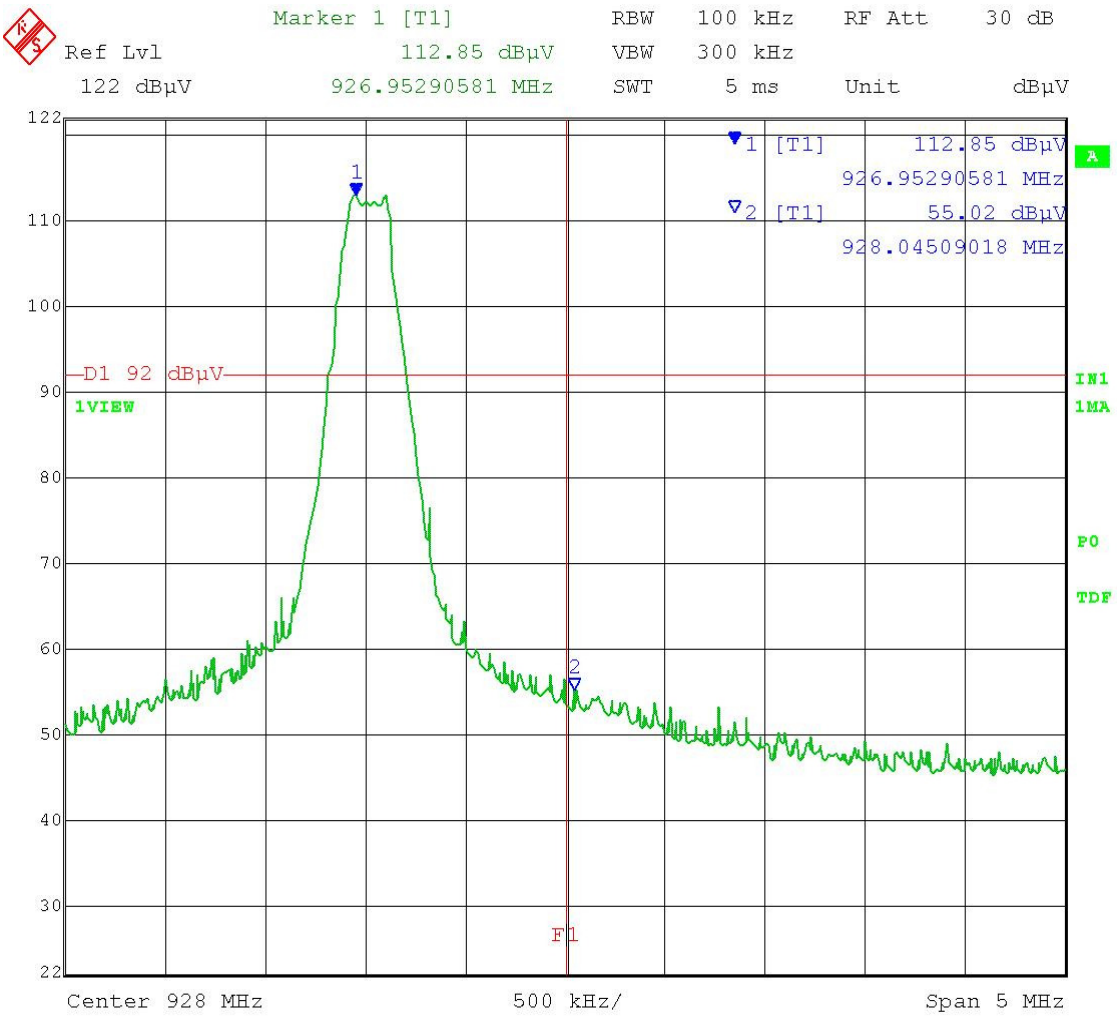


Date: 1.AUG.2016 10:49:42

RESULTS: Meets Requirements

BANDEDGE

Data: **Mode 1 High End of Band Upper Band Edge Plot**

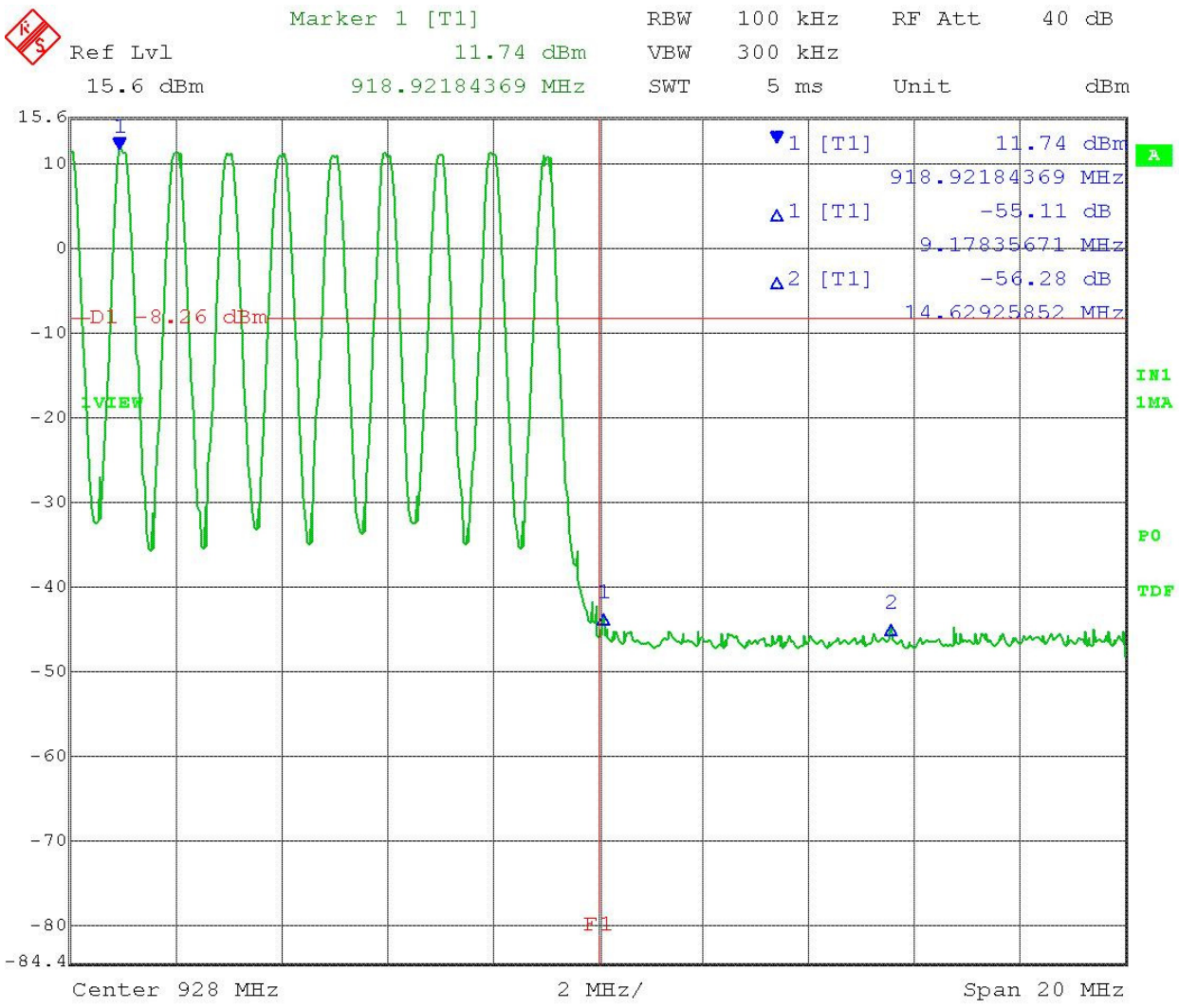


Date: 22.APR.2016 14:08:43

RESULTS: Meets Requirements

BANDEDGE

Data: **Mode 1 Hopping Upper Band Edge Plot**



Date: 1.AUG.2016 10:56:23

RESULTS: Meets Requirements

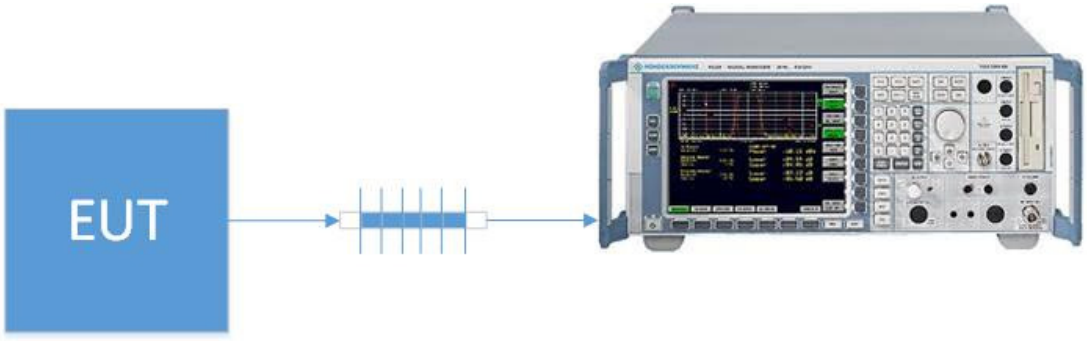
ANTENNA CONDUCTED SPURIOUS EMISSIONS

Rules Part No.: FCC part 15.247 (d), IC RSS 247 § 5.5

Requirements: 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

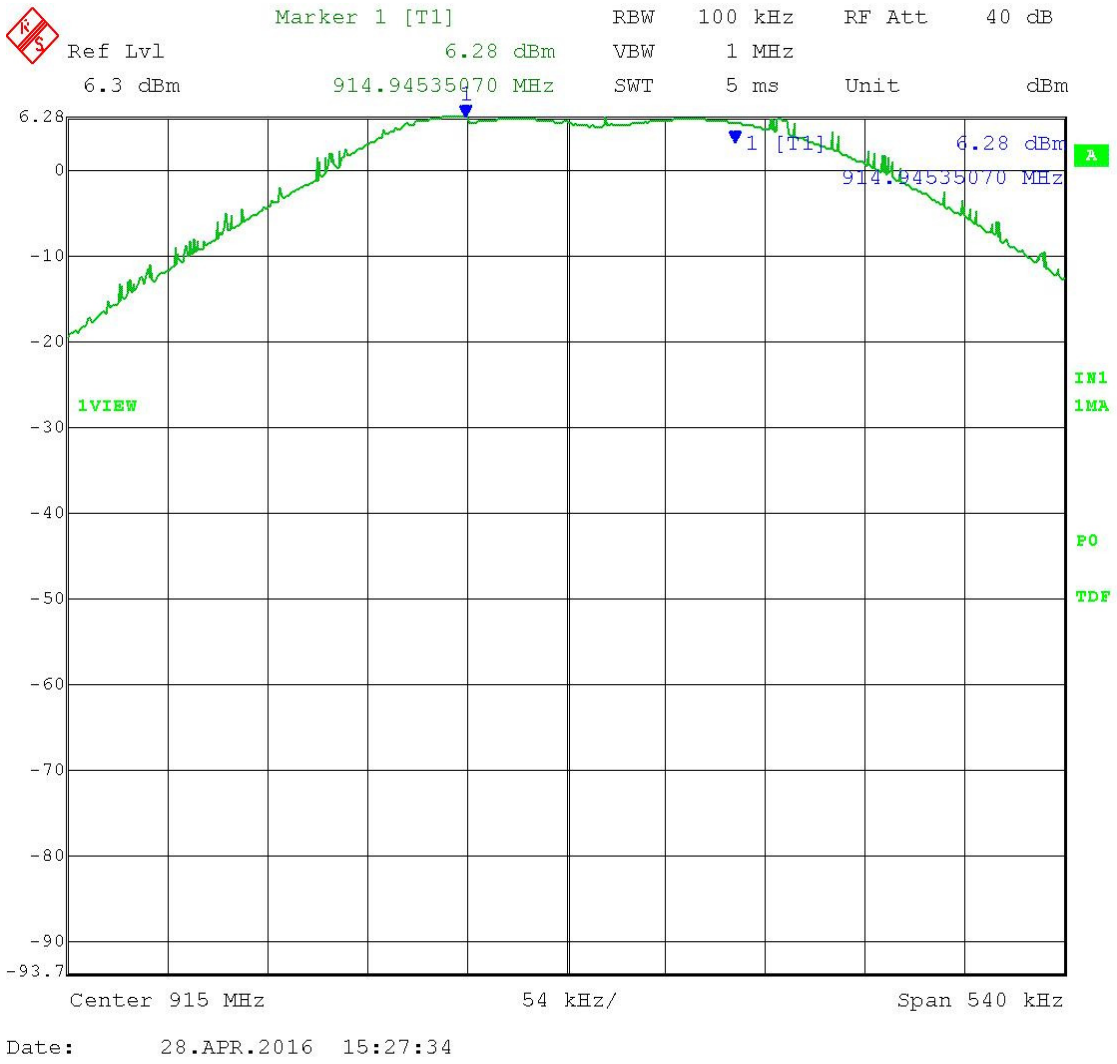
Test Method: ANSI C63.10 § 7.8.1 FHSS Device Parameters Test Setup
ANSI C63.10 § 7.8.8 Conducted spurious emissions test methodology

Setup:



ANTENNA CONDUCTED SPURIOUS EMISSIONS

Test Data: **100 KHz Reference Level Plot**



RESULTS: Meets Requirements

ANTENNA CONDUCTED SPURIOUS EMISSIONS

Test Data: **Mode 1 Low End of Band 30 MHz – 10 GHz Plot**

RESULTS: Meets Requirements

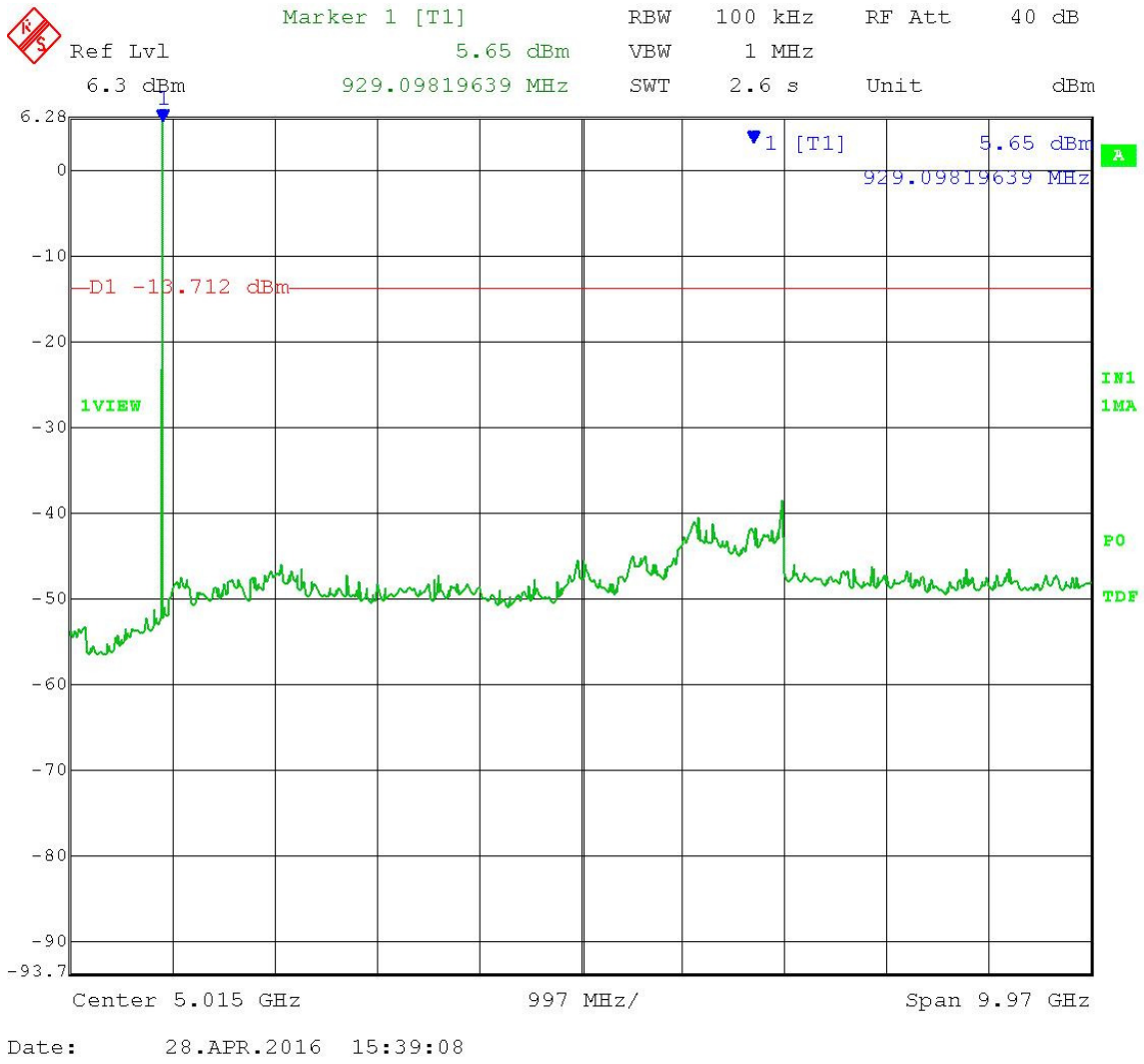
ANTENNA CONDUCTED SPURIOUS EMISSIONS

Test Data: **Mode 1 Middle of Band 30 MHz – 10 GHz Plot**

RESULTS: Meets Requirements

ANTENNA CONDUCTED SPURIOUS EMISSIONS

Test Data: **Mode 1 High End of Band 30 MHz – 10 GHz Plot**



RESULTS: Meets Requirements

RADIATED SPURIOUS EMISSIONS

Rules Part No.: FCC part 15.247 (d) & 15.209, IC RSS 247 § 5.5 & RSS GEN § 8.9

Requirements: Emissions found in restricted bands the levels must comply with the general limits found in FCC part 15.209

Frequency	Limits
FCC Part 15.209, IC RSS-GEN 8.9	
9 to 490 kHz	2400/F (kHz) µV/m @ 300 meters
490 to 1705 kHz	24000/F (kHz) µV/m @ 30 meters
1705 kHz to 30 MHz	29.54 dBµV/m @ 30 meters
30 – 88	40.0 dBµV/m @ 3 meters
80 – 216	43.5 dBµV/m @ 3 meters
216 – 960	46.0 dBµV/m @ 3 meters
Above 960	54.0 dBµV/m @ 3 meters

Test Method: ANSI C63.4 § Annex D Validation of radiated emissions standard test sites
ANSI C63.10 § 6.3 Common requirements radiated emissions
ANSI C63.10 § 6.4 Emissions below 30 MHz
ANSI C63.10 § 6.5 Emissions between 30 & 1000 MHz
ANSI C63.10 § 6.6 Emissions above 1 GHz

Field Strength Calculation:

The field strength at 3m was established by adding the meter reading of the spectrum analyzer (which is set to read in units of dBµV) to the antenna correction factor supplied by the antenna manufacturer plus the coax loss. The antenna correction factors are stated in terms of dB. The gain of the preselector was accounted for in the spectrum analyzer meter reading.

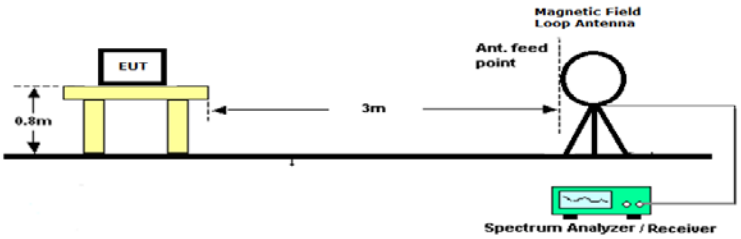
Example:

Freq (MHz)	Meter Reading	+ ACF	+ CL = FS
33	20 dBµV	+ 10.36 dB	+ 0.5 = 30.86 dBµV/m @ 3m

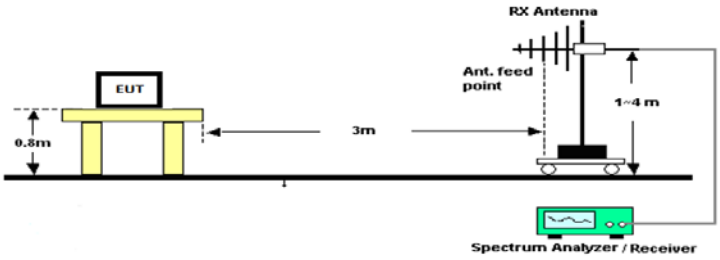
RADIATED SPURIOUS EMISSIONS

Setup:

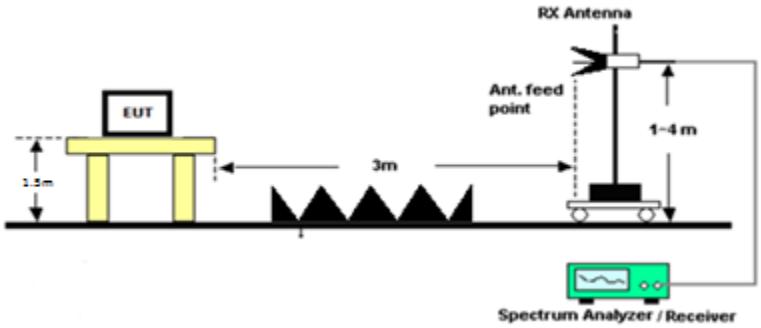
Emissions below 30 MHz



Emissions 30 – 1000 MHz



Emissions above 1 GHz



RADIATED SPURIOUS EMISSIONS

Notes: The EUT was checked in three orthogonal planes as required, a setup photo is provided to show the orientation of the worst case position.

Only the worst case data rate and Output Power which produced emissions within 20dB of the limit are reported.

The spectrum was measured from 9 KHz to 9.28 GHz

Test Data: **Restricted Band Emissions Field Strength Measurement Table**

Tuned Frequency MHz	Emission Frequency MHz	Detector	Meter Reading dBuV	Ant. Polarity	Coax Loss dB	Correction Factor dB/m	Field Strength dBuV/m	Margin dB
903.0	2,708.90	Peak	2.25	V	6.04	32.66	40.95	13.05
903.0	2,708.90	Peak	3.67	H	6.04	32.66	42.37	11.63
903.0	3,611.90	Peak	2.7	H	6.96	33.52	43.18	10.82
903.0	3,611.95	Peak	3.7	V	6.96	33.52	44.18	9.82
903.0	4,515.10	Peak	3.9	H	7.81	33.82	45.53	8.47
903.0	4,515.43	Peak	2.25	V	7.81	33.82	43.88	10.12
903.0	5,417.60	Peak	0.47	H	8.60	34.40	43.47	10.53
903.0	8,126.40	Peak	3.67	V	10.53	35.73	49.93	4.07
915.0	2,744.90	Peak	1.6	H	6.07	32.48	40.15	13.85
915.0	2,745.00	Peak	4.9	V	6.08	32.48	43.46	10.54
915.0	3,659.90	Peak	3.8	H	7.01	33.62	44.43	9.57
915.0	3,660.20	Peak	3.6	V	7.01	33.62	44.23	9.77
915.0	4,575.15	Peak	2.7	V	7.87	33.88	44.45	9.55
915.0	4,595.30	Peak	3.8	H	7.88	33.90	45.58	8.42
927.0	2,780.80	Peak	5.2	H	6.11	32.30	43.61	10.39
927.0	3,707.62	Peak	2.3	H	7.06	33.70	43.06	10.94
927.0	4,632.00	Peak	3.75	V	7.92	33.93	45.6	8.4
927.0	4,632.00	Peak	4.1	H	7.92	33.93	45.95	8.05

Results Meet Requirements

AC POWER LINE CONDUCTED EMISSIONS

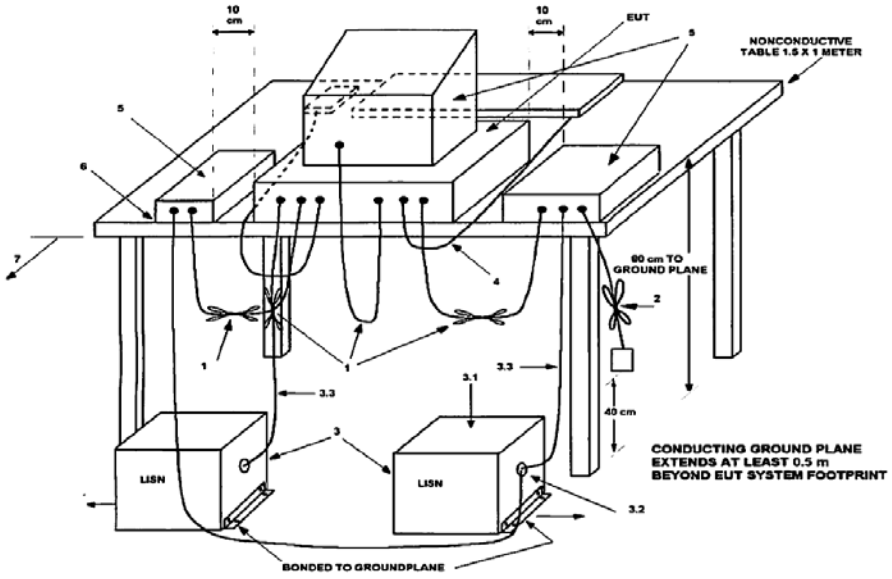
Rules Part No.: FCC 15.207(a)

Requirements:

Frequency (MHz)	Quasi Peak Limits (dBµV)	Average Limits (dBµV)
0.15 – 0.5	66 – 56 *	56 – 46 *
0.5 – 5.0	56	46
5.0 – 30	60	50
* Decrease with logarithm of frequency		

Test Method: ANSI C63.10 § 6.2 Test Method for AC power-line conducted emissions

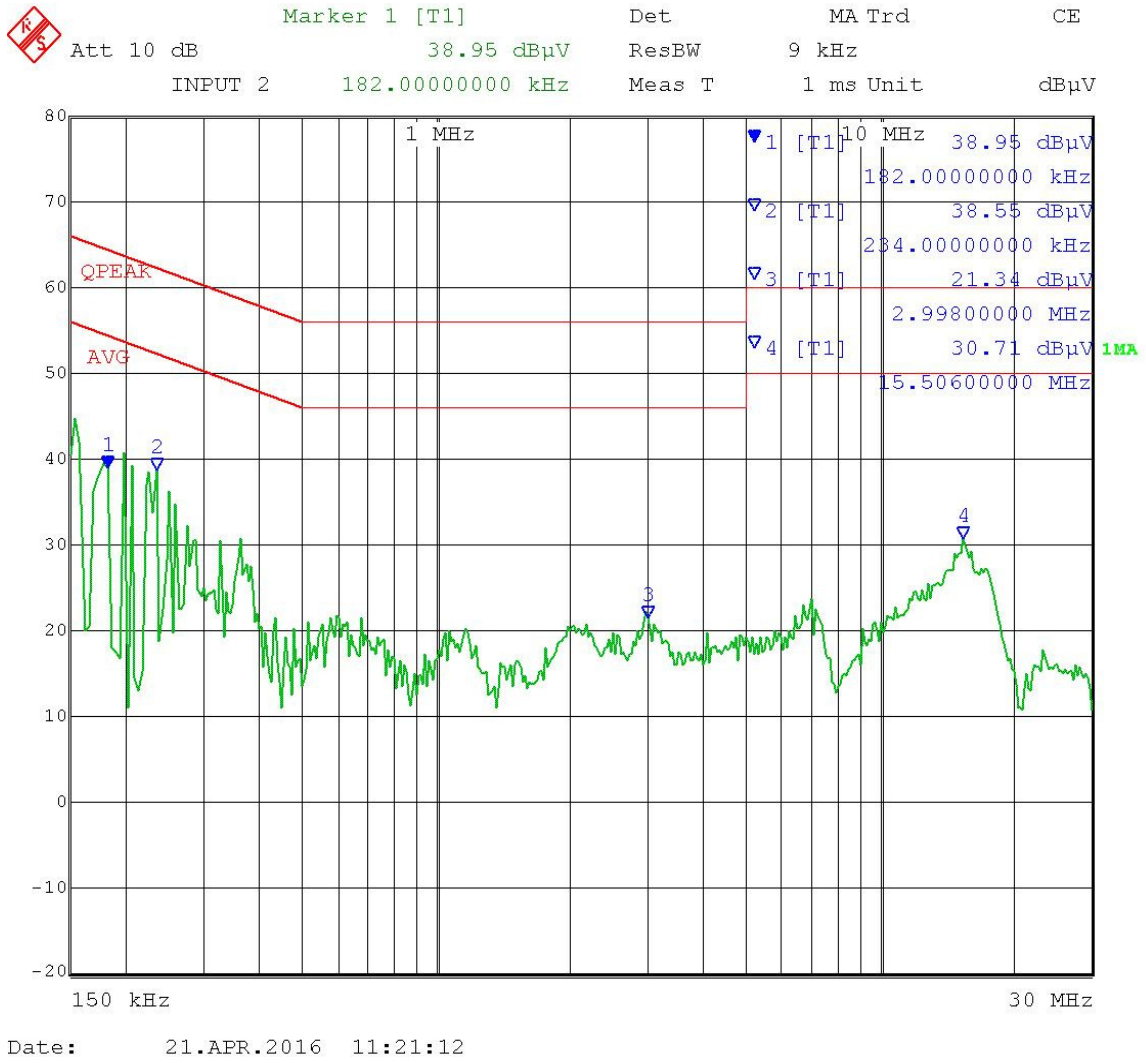
Setup:



AC POWER LINE CONDUCTED EMISSIONS

Test Data: The following plots represent the emissions read for power line Conducted. Both lines were observed.

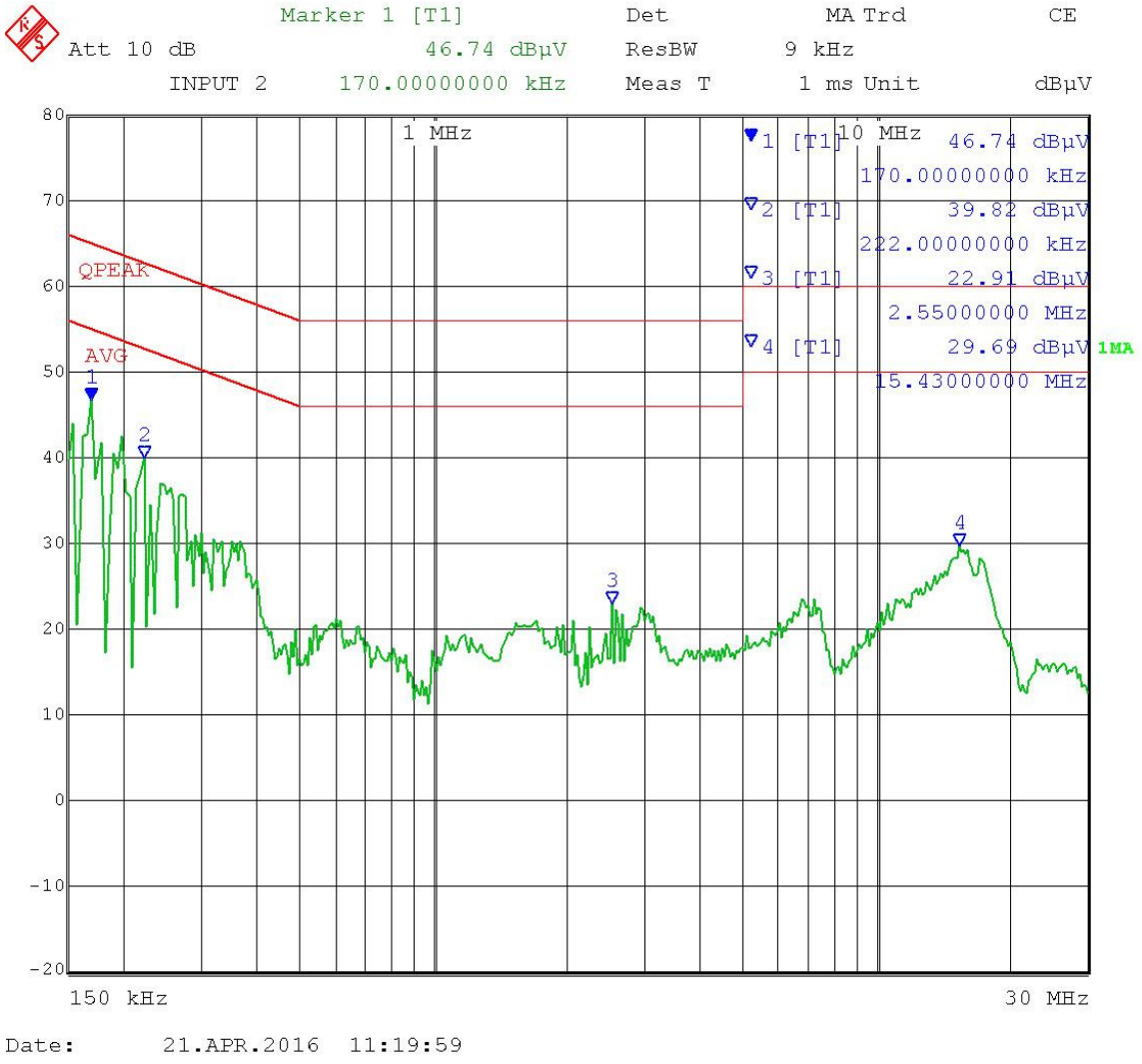
Test Exercise : The EUT was operated normally in a hopping mode for this test.



RESULTS: Meets Requirements

POWER LINE CONDUCTED INTERFERENCE

Test Data:



Date: 21.APR.2016 11:19:59

RESULTS: Meets Requirements

EMC EQUIPMENT LIST

Device	Manufacturer	Model	Serial Number	Cal/Char Date	Due Date
Antenna: Biconnical 1096	Eaton	94455-1	1096	07/14/15	07/14/17
Antenna: Log-Periodic 1122	Electro-Metrics	LPA-25	1122	07/14/15	07/14/17
LISN (Primary)	Electro-Metrics	EM-7820	2682	05/08/15	05/08/17
CHAMBER	Panashield	3M	N/A	04/25/16	12/13/17
Antenna: Double-Ridged Horn/ETS Horn 2	ETS-Lindgren Chamber	3117	00041534	02/25/15	02/25/17
EMI Test Receiver R & S ESIB 40 Screen Room	Rohde & Schwarz	ESIB 40	100274	08/12/14	08/12/16
Software: Field Strength Program	Timco	N/A	Version 4.0	N/A	N/A
Antenna: Active Loop	ETS-Lindgren	6502	00062529	11/18/15	11/18/17
Coaxial Cable #103 - K MS MS 180cm Aqua	Micro-Coax	UFB142A-0-0720-200200	225363-002 (#103)	08/05/15	08/05/17
EMI Test Receiver R & S ESU 40 Chamber	Rohde & Schwarz	ESU 40	100320	04/01/16	04/01/18
LISN CABLE	TIMCO LISN	17		01/05/16	01/04/17
Coaxial Cable - Chamber 3 cable set (Primary)	Micro-Coax		Chamber 3 cable set (Primary)	12/05/15	12/05/17

*** EMI RECEIVER SOFTWARE VERSION**

The receiver firmware used was version 4.43 Service Pack 3