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	**DIGITAL MONITORING PRODUCTS INC.**
Address	**2500 N. PARTNERSHIP BLVD.**
	SPRINGFIELD MISSOURI 65802 USA
FCC ID	**CCKPC0181**
IC	**5251A-PC0181**
Model Number	XTLplus
Product Description	Control Panel
Date Sample Received	5/6/2016
Final Test Date	5/19/2016
Tested By	Tim Royer
Approved By	Cory Leverett

Report Number	Version Number	Description	Issue Date
760BUT16TestReport_	Rev1	Initial Issue	5/19/2016
760BUT16TestReport_	Rev2	Added test site reg# to page 3, Added Statement to radiated emissions on page 16 & 17	5/23/2016

THE ATTACHED REPORT SHALL NOT BE REPRODUCED EXCEPT IN FULL WITHOUT THE WRITTEN APPROVAL OF TIMCO ENGINEERING, INC.

TABLE OF CONTENTS

GENERAL INFORMATION 4
EUT Specification 4
Test Supporting Equipment 4
RESULTS SUMMARY 5
OCCUPIED BANDWIDTH 6
Test Data: Mode 1 20 dB Occupied Bandwidth Measurement Table 6
Test Data: 20 dB OBW Mode 1 Low End of Band Plot 7
Test Data: 20 dB OBW Mode 1 Middle of Band Plot 8
Test Data: 20 dB OBW Mode 1 High end of Band Plot 9
FHSS REQUIREMENTS 10
Test Data: FHSS Channel Separation Measurement Table 11
Test Data: Number of Hopping Channels Measurement Table 11
Test Data: Hopping Channel Occupancy Time Measurement Table 11
Test Data: FHSS Hopping Sequence and Receiver Bandwidth Verification 11
Test Data: Mode 1 Channel Separation Plot 12
Test Data: Mode 1 Number of Hopping Channels Plot 13
Test Data: Mode 1 Channel Occupancy Time Plot 14
Test Data: Mode 1 Burst Length Plot 15
PEAK POWER OUTPUT 16
Test Data: Mode 1 Peak Power Output Measurement Table 17
Test Data: Mode 1 Low End of Band Peak Conducted Power Plot 18
Test Data: Mode 1 Middle of Band Peak Conducted Power Plot 19
Test Data: Mode 1 High of Band Peak Conducted Power Plot 20
BANDEDGE 21
Test Data: Mode 1 Bandedge Measurement Table 21
Data: Mode 1 Low End of Band Lower Band Edge Plot 22
Data: Mode 1 Hopping Lower Band Edge Plot 23
Data: Mode 1 High End of Band Upper Band Edge Plot 24
Data: Mode 1 Hopping Upper Band Edge Plot 25
ANTENNA CONDUCTED SPURIOUS EMISSIONS 26
Test Data: Mode 1 Low End of Band 30 MHz – 10 GHz Plot 27
Test Data: Mode 1 Middle of Band 30 MHz – 10 GHz Plot 28
Test Data: Mode 1 High End of Band 30 MHz – 10 GHz Plot 29
RADIATED SPURIOUS EMISSIONS 30
Test Data: Calculation of Duty Cycle Correction for Average Value of Emissions 32
Test Data: Mode 1 Hopping Duty Cycle Pulse Repetition Rate Plot 33
Test Data: Mode 1 Hopping Duty Cycle Pulse Width Plot 34
Test Data: Mode 1 Restricted Band Emissions Field Strength Measurement Table 35
AC POWER LINE CONDUCTED EMISSIONS 36
Test Data: Mode 1 Hopping Line 1 Peak Plot 37
Test Data: Mode 1 Hopping Line 2 Peak Plot 38
EMC EQUIPMENT LIST 39

GENERAL REMARKS

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

Summary

The device under test does:

☒ Fulfill the general approval requirements as identified in this test report and was selected by the customer.

☐ 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 requirements.

I attest that the necessary measurements were made at:

Timco Engineering Inc.
849 NW State Road 45
Newberry, FL 32669
IC Test Site Registration #: 2056A-3

Tested by: _____

Tim Royer
Project Manager/Testing Technician

Date: 5/19/2016

Reviewed and approved by:

Cory Leverett_____
Project Manager/Testing Technician

Date: 5/19/2016

GENERAL INFORMATION

EUT Specification

Regulatory Standards	FCC Title 47 CFR Part 15.247 IC RSS-247 Issue 1 & RSS-GEN Issue 4		
FCC ID	**CCKPC0181**		
IC	**5251A-PC0181**		
Model	XTLplus		
EUT Description	Control Panel		
Modulation Types	Mode 1: FHSS (GFSK)		
	Mode 2: NA		
Operating Frequency	TX: 905.6 – 924.4 MHz	RX: 905.6 – 924.4 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 Connector Provided for Testing)		
Antenna	PCB Trace		
Test Conditions	Temperature: 24-26ºC Relative humidity: 50-65%		
Measurement Standard	ANSI C63.10-2013 FCC DA 00-705 ANSI C63.4-2009 (Radiated Site Validation)		

Test Supporting Equipment

Device	Manufacturer	Model	S/N	Supplied By	Used For
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 Occupied 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

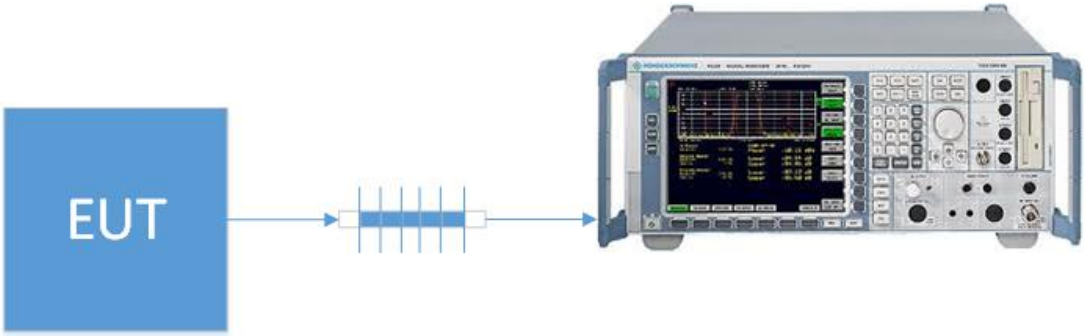
Rules Part No.: FCC 15.215(C), IC RSS 247 § 5.1.1, 5.1.1.3

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:



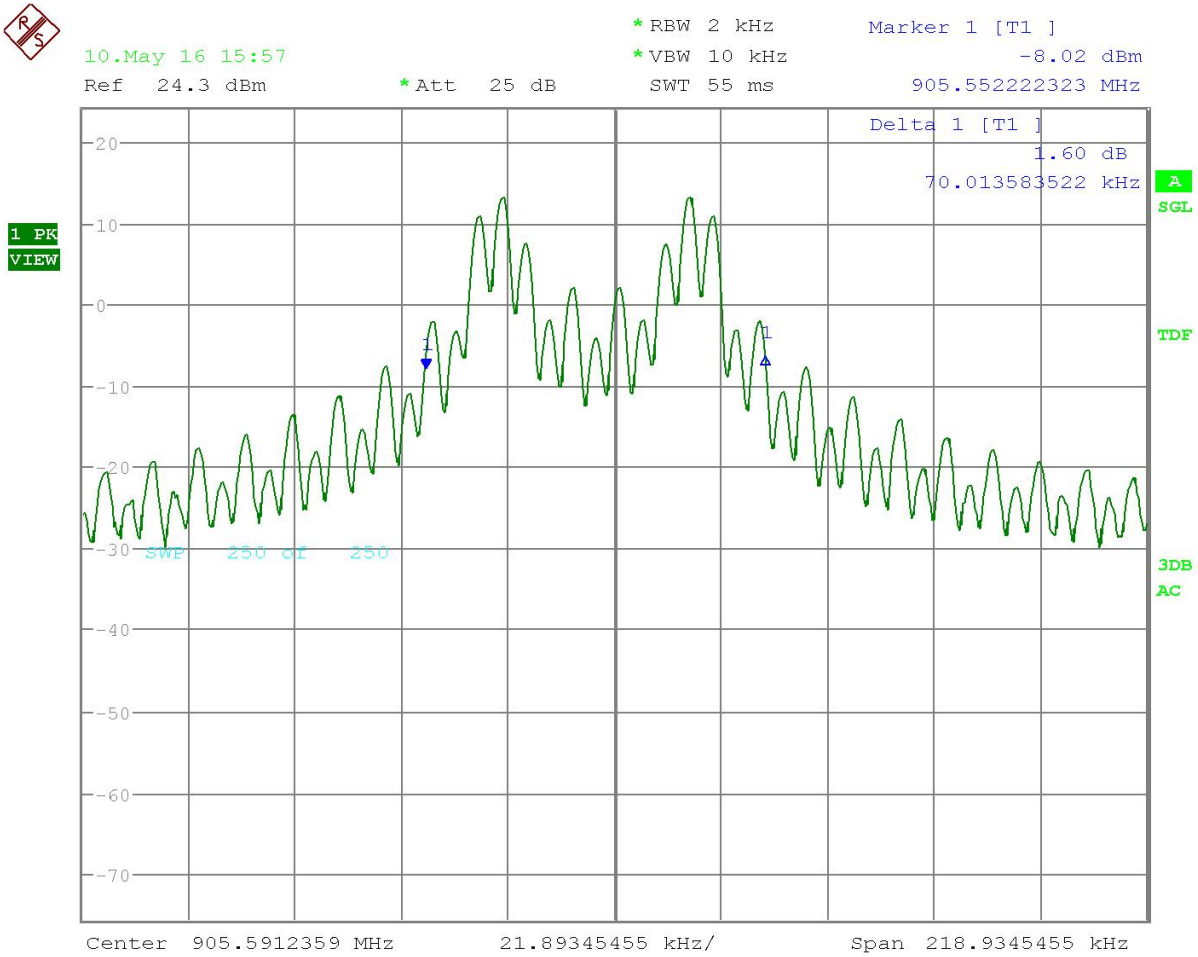
Test Data: **Mode 1 20 dB Occupied Bandwidth Measurement Table**

Tuned Frequency (MHz)	20 dB BW (KHz)	Limit (KHz)	Margin (KHz)
905.4	70.013	≤ 500	429.987
915	70.15	≤ 500	429.85
924.36	70.17	≤ 500	429.83

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: **20 dB OBW Mode 1 Low End of Band Plot**

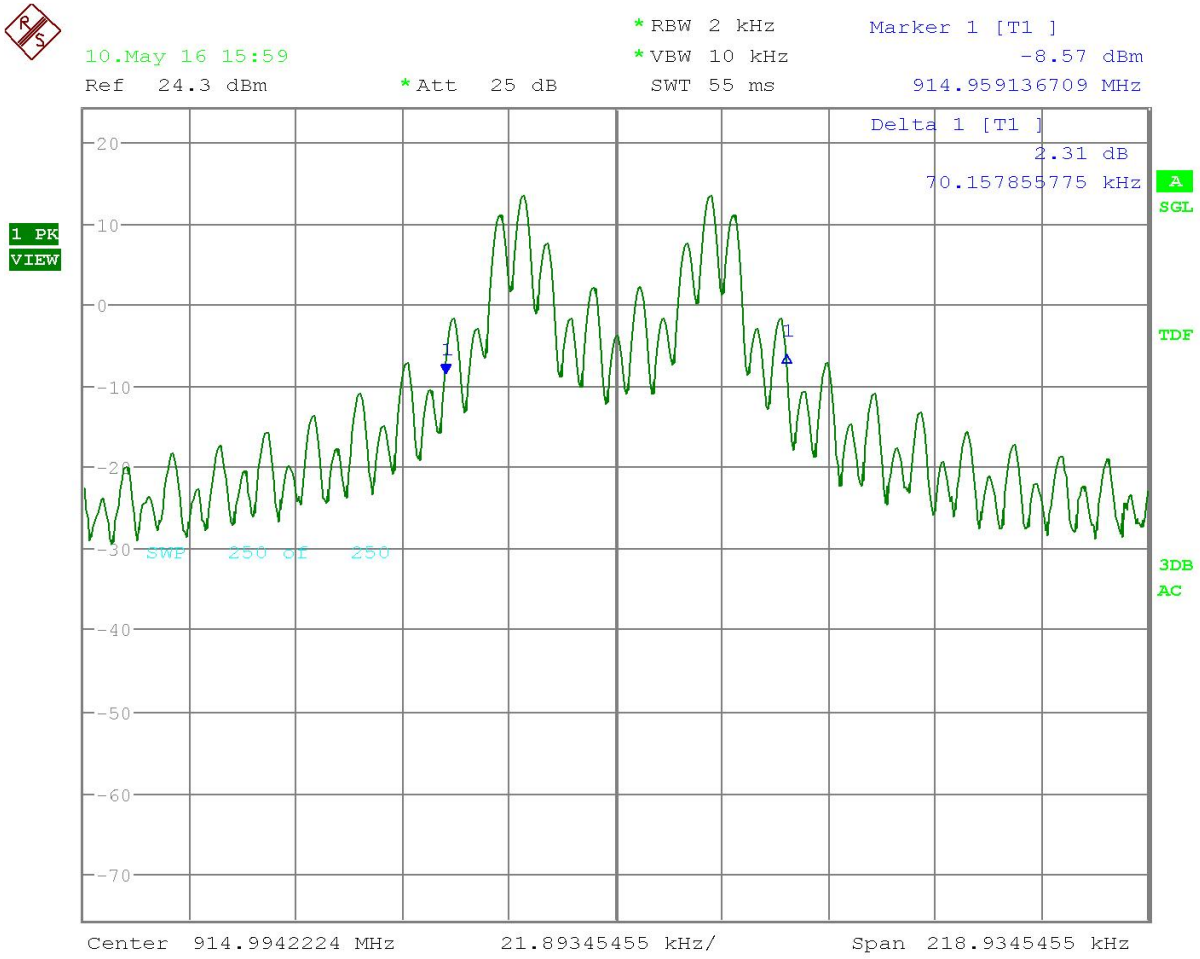


Date: 10.MAY.2016 15:57:13

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: **20 dB OBW Mode 1 Middle of Band Plot**

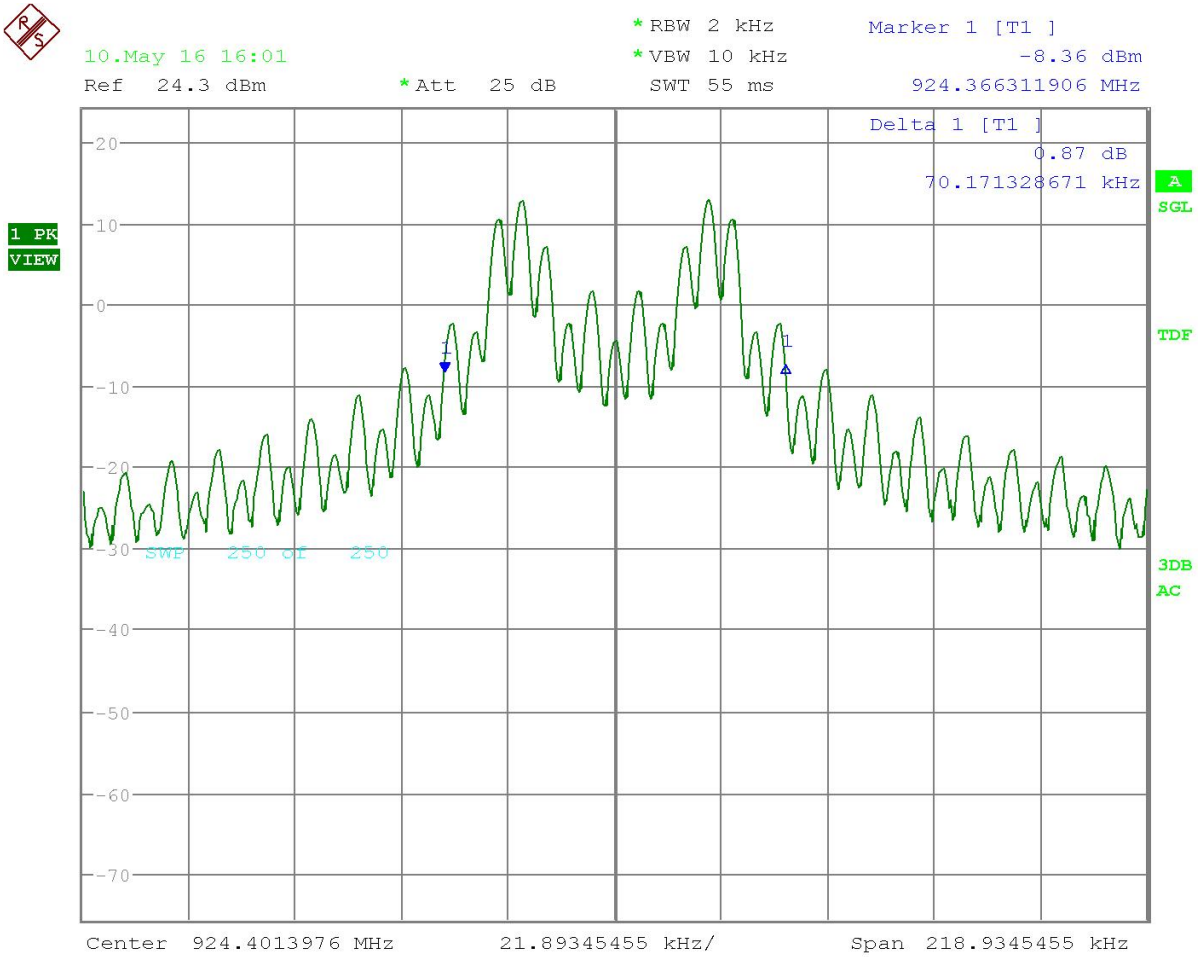


Date: 10.MAY.2016 15:59:11

RESULTS: Meets Requirements

OCCUPIED BANDWIDTH

Test Data: **20 dB OBW Mode 1 High end of Band Plot**



Date: 10.MAY.2016 16:01:17

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.

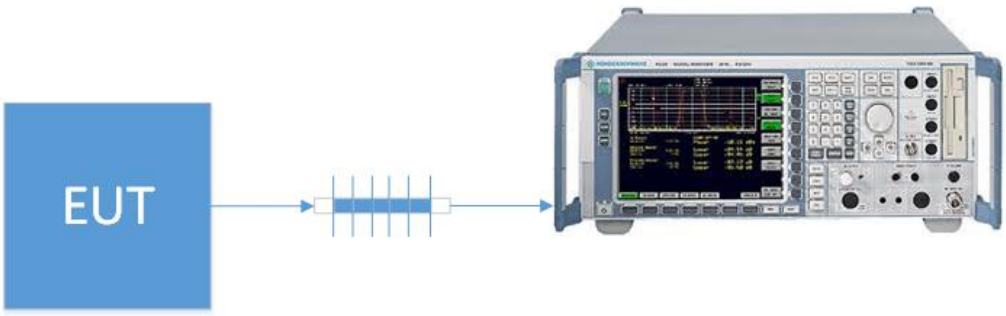
Dwell Time and Number of Hopping Channels
If the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping channels and the average time of occupancy on any channel shall not be greater than 0.4 seconds within a 20-second period. If the 20 dB bandwidth of the 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	364.1	≥70.14	Pass

Test Data: Number of Hopping Channels Measurement Table

Mode	Number of channels	Limit	Pass / Fail
1	53	≥50	Pass

Test Data: Hopping Channel Occupancy Time Measurement Table

Mode	Number of Tx in Period	Burst Length (ms)	Occupancy Time (Sec)	Limit (sec)	Pass / Fail
1	7	11.96	0.08	≤ 0.4	Pass

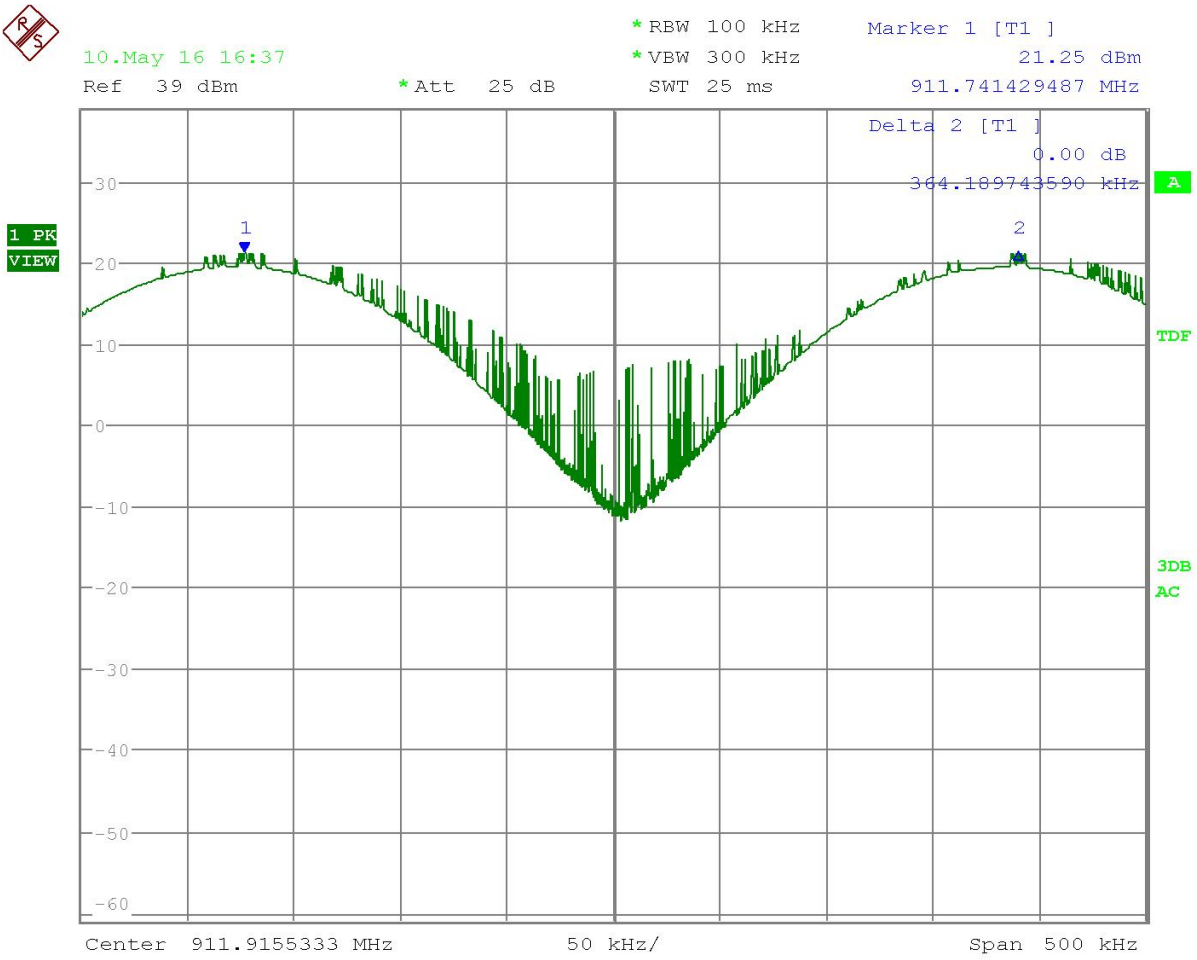
Test Data: FHSS Hopping Sequence and Receiver Bandwidth Verification

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**

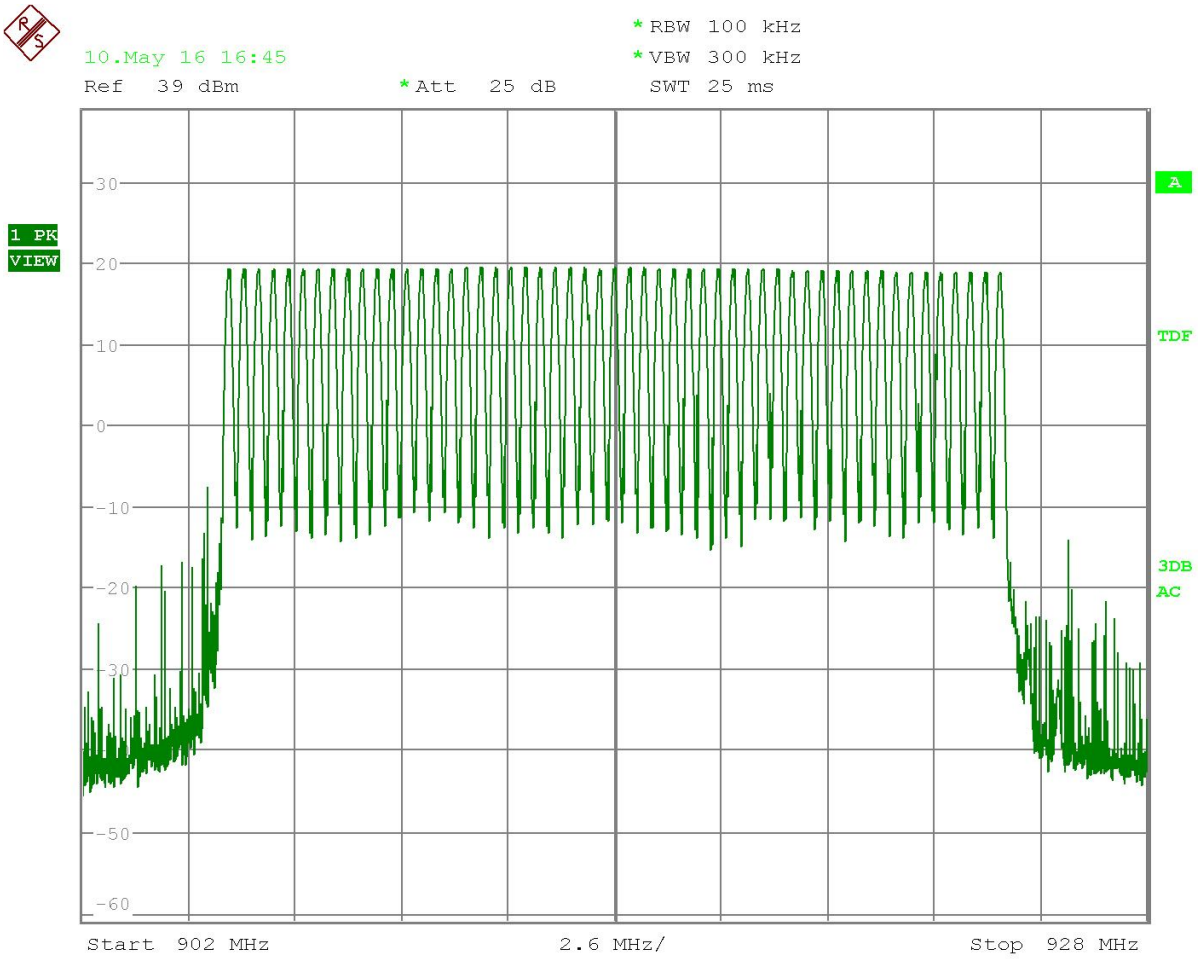


Date: 10.MAY.2016 16:37:40

RESULTS: Meets Requirements

FHSS REQUIREMENTS

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

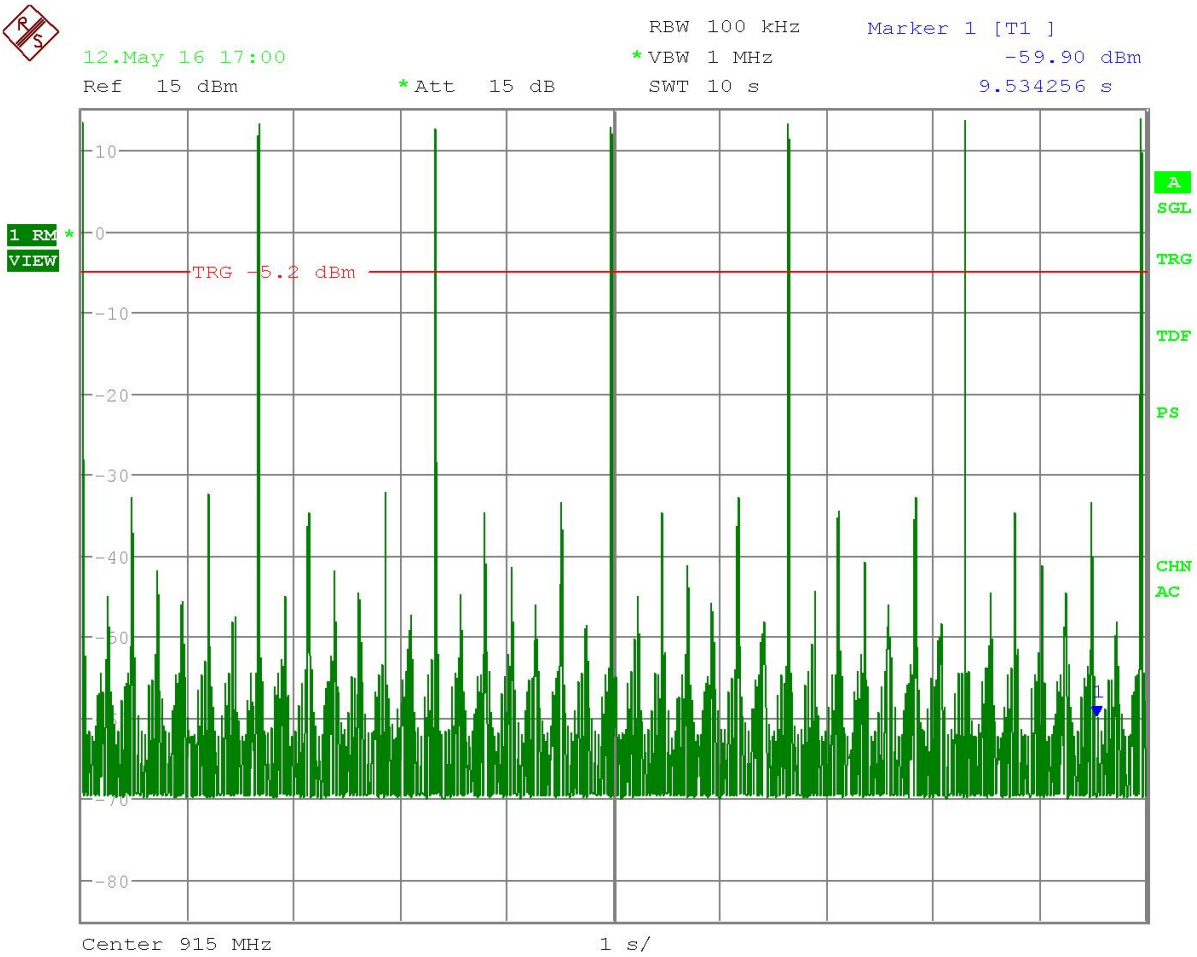


Date: 10.MAY.2016 16:45:13

RESULTS: Meets Requirements

FHSS REQUIREMENTS

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

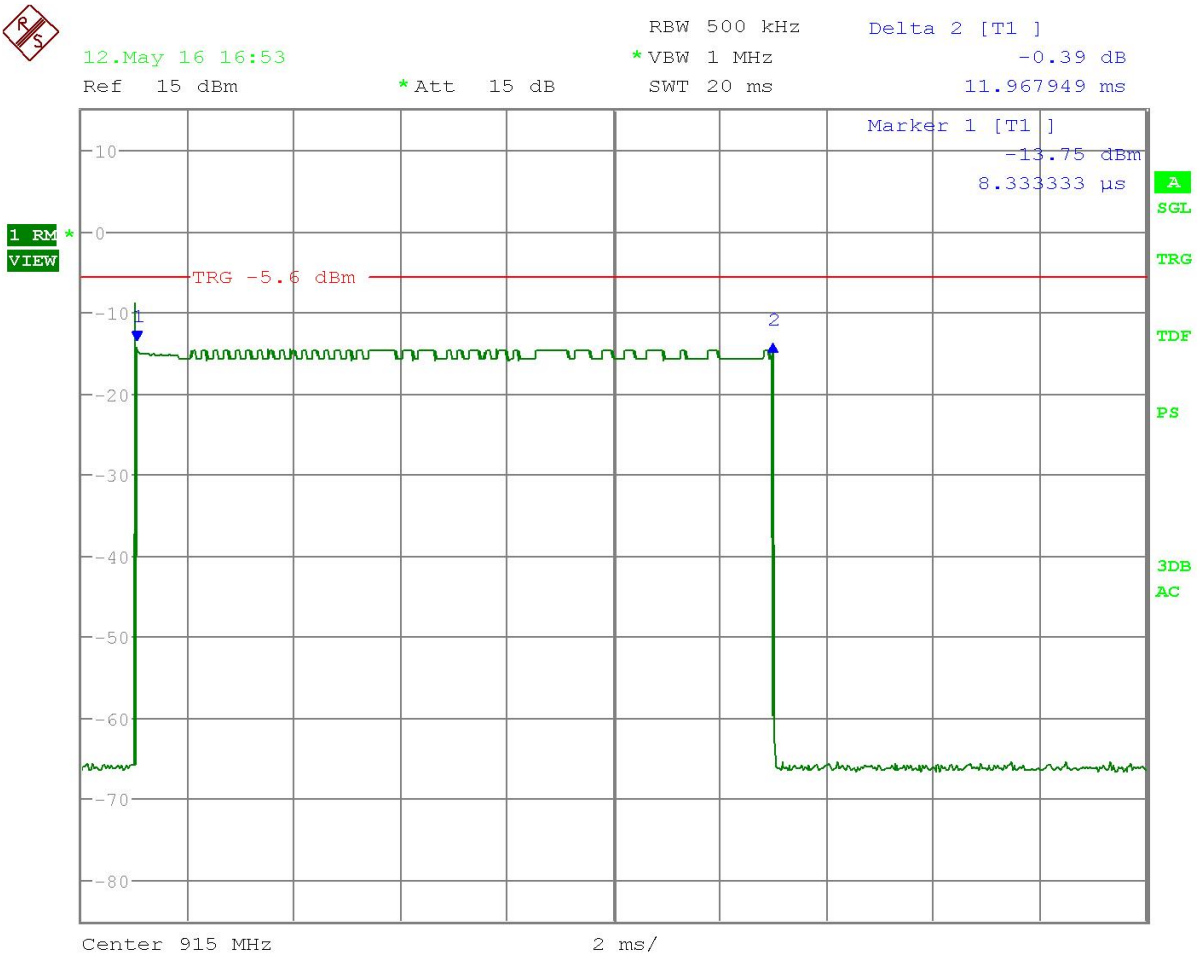


Date: 12.MAY.2016 17:00:14

RESULTS: Meets Requirements

FHSS REQUIREMENTS

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



Date: 12.MAY.2016 16:53:43

RESULTS: Meets Requirements

PEAK POWER OUTPUT

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

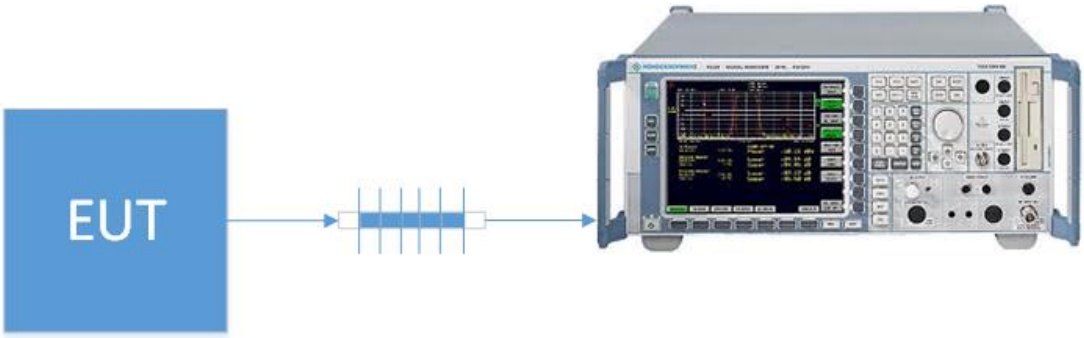
Requirements:

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 50 or more hopping channels.

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

Setup:



PEAK POWER OUTPUT

Test Data: **Mode 1 Peak Power Output Measurement Table**

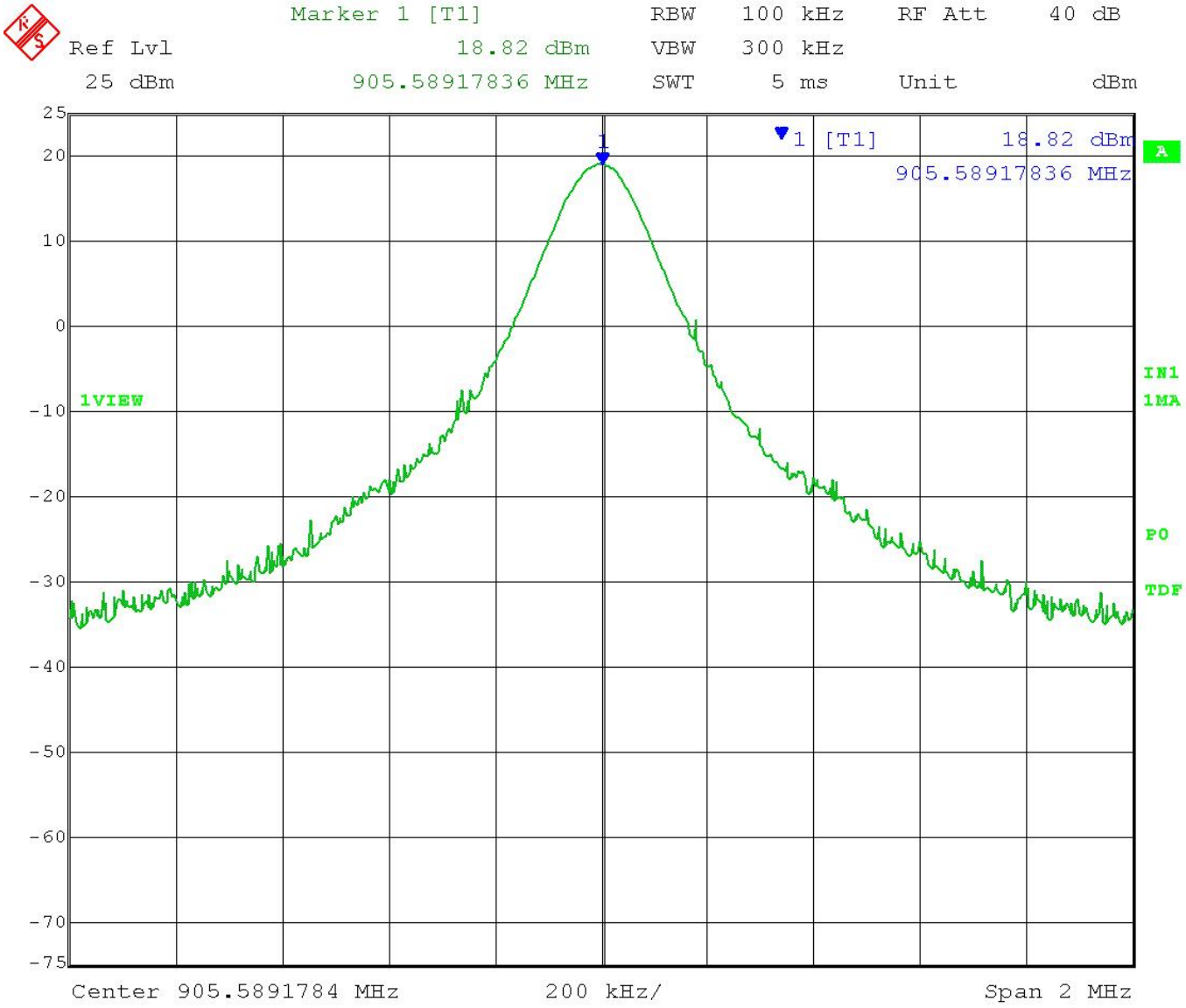
Peak Conducted Power Output Measurement				
Tuned Frequency (MHz)	PConducted (dBm)	PConducted (W)	Limit (W)	Margin (W)
905.6	18.62	0.073	1.00	0.927
915	19.01	0.080	1.00	0.920
924.4	18.45	0.070	1.00	0.930

Peak EIRP Power Output Calculation				
Tuned Frequency (MHz)	PConducted (dBm)	EIRP (W)	Limit (W)	Margin (W)
905.6	18.62	0.119	4.00	3.881
915	19.01	0.131	4.00	3.869
924.4	18.45	0.115	4.00	3.885

RESULTS: Meets Requirements

PEAK POWER OUTPUT

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

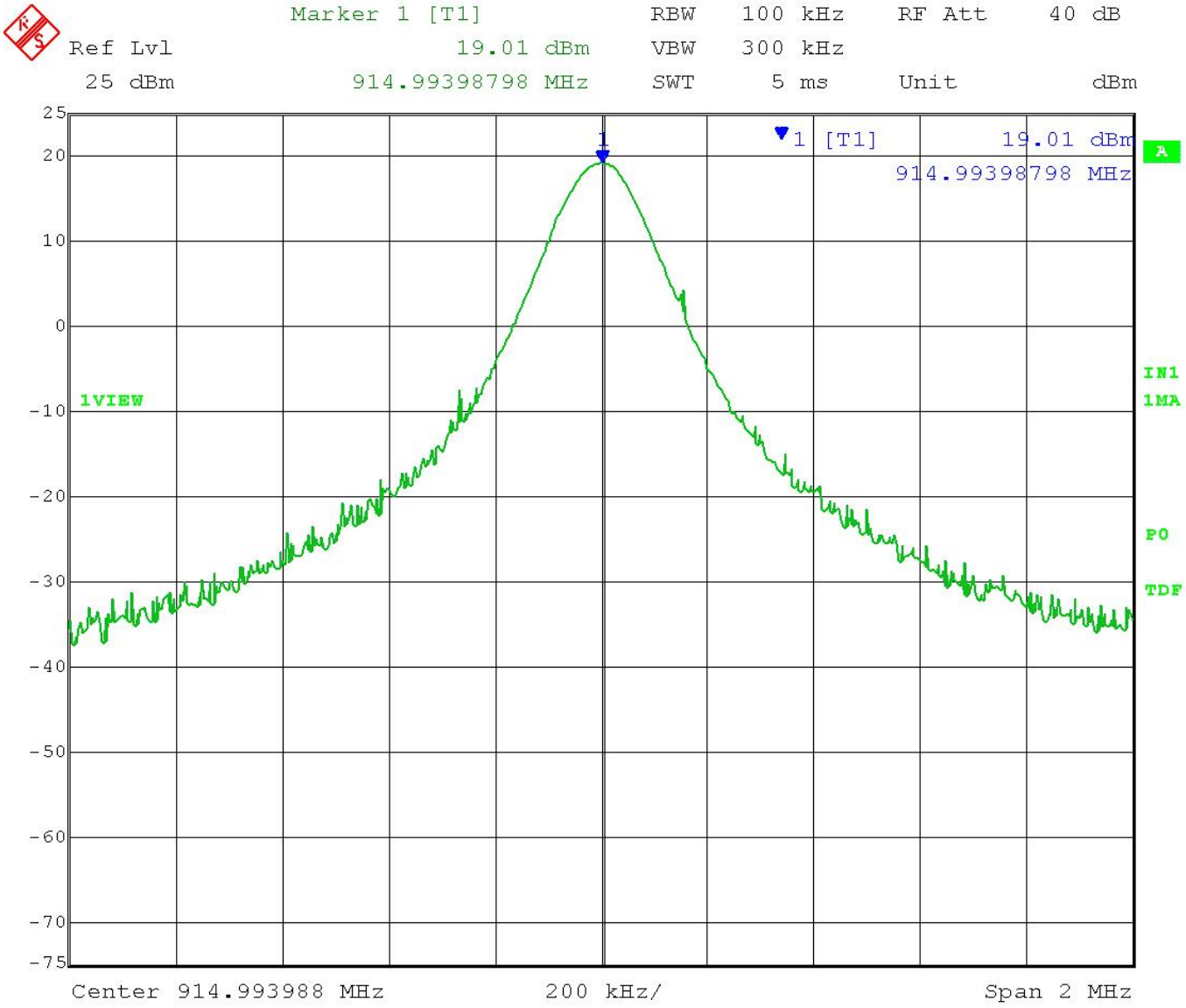


Date: 16.MAY.2016 15:05:09

RESULTS: Meets Requirements

PEAK POWER OUTPUT

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

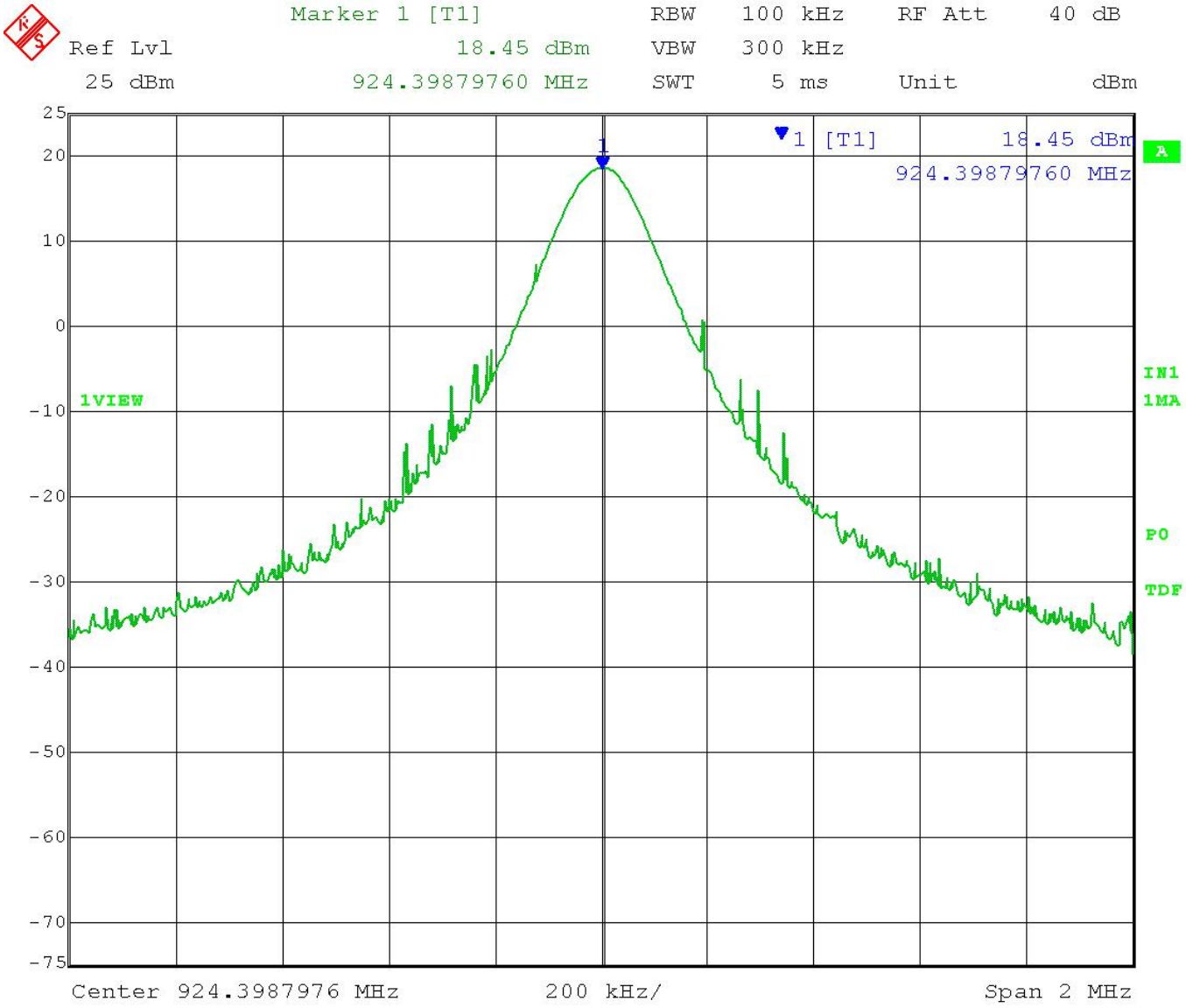


Date: 16.MAY.2016 15:06:03

RESULTS: Meets Requirements

PEAK POWER OUTPUT

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



Date: 16.MAY.2016 15:06:45

RESULTS: Meets Requirements

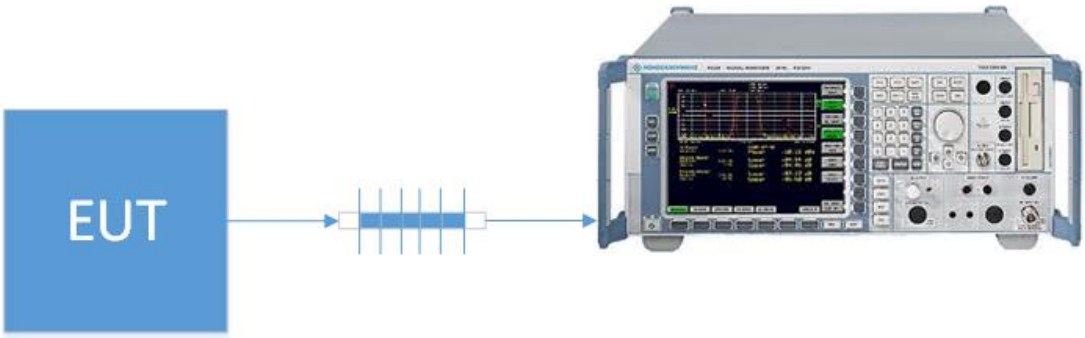
BANDEDGE

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:



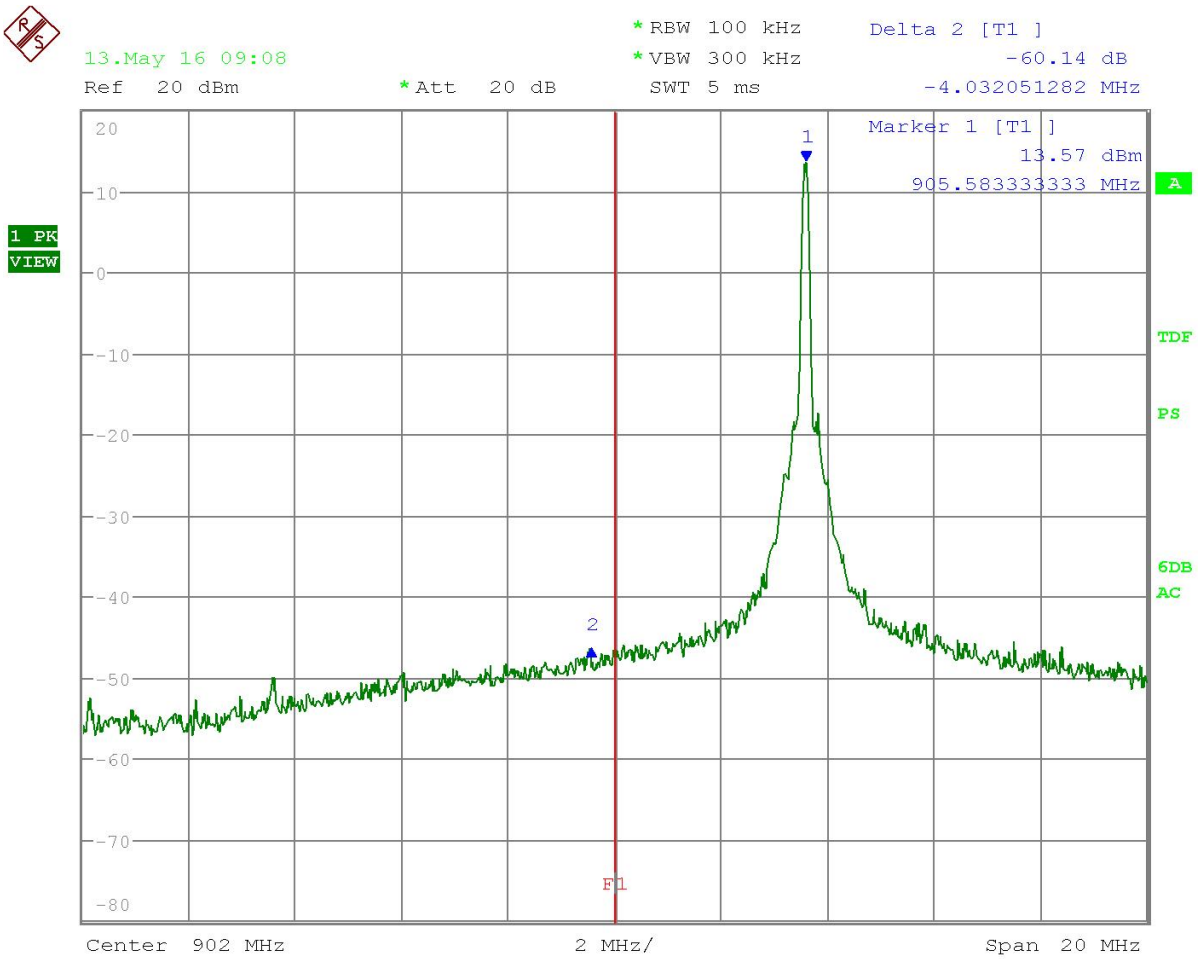
Test Data: **Mode 1 Bandedge Measurement Table**

Bandedge	Tuned Frequency (MHz)	Measured Level (dBc)	Limit (dBc)	Margin (dB)
Lower	905.58	60.14	20	40.14
	Hopping	49.83	20	29.83
Upper	924.4	62.04	20	42.04
	Hopping	47.49	20	27.49

Results Meet Requirements

BANDEDGE

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

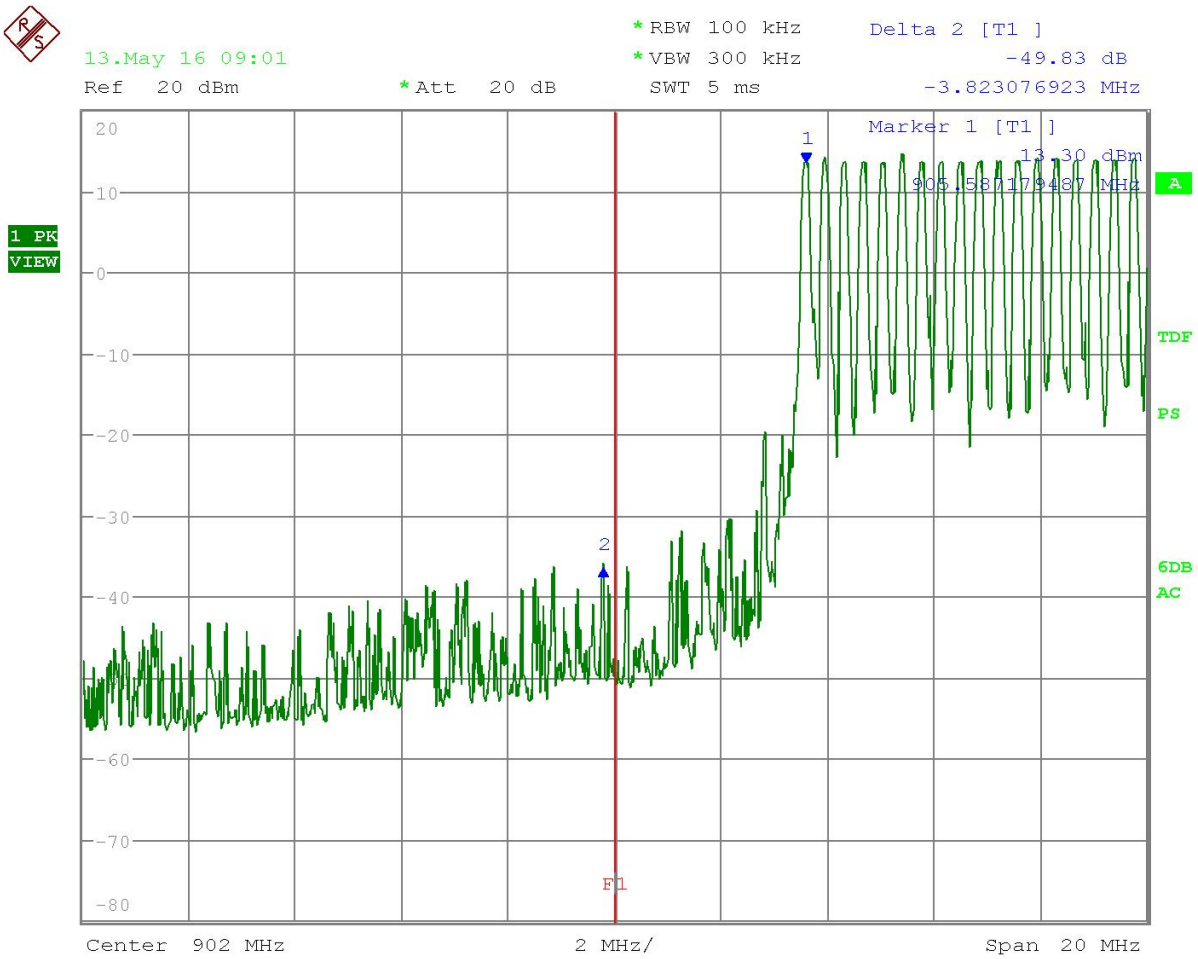


Date: 13.MAY.2016 09:08:42

RESULTS: Meets Requirements

BANDEDGE

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

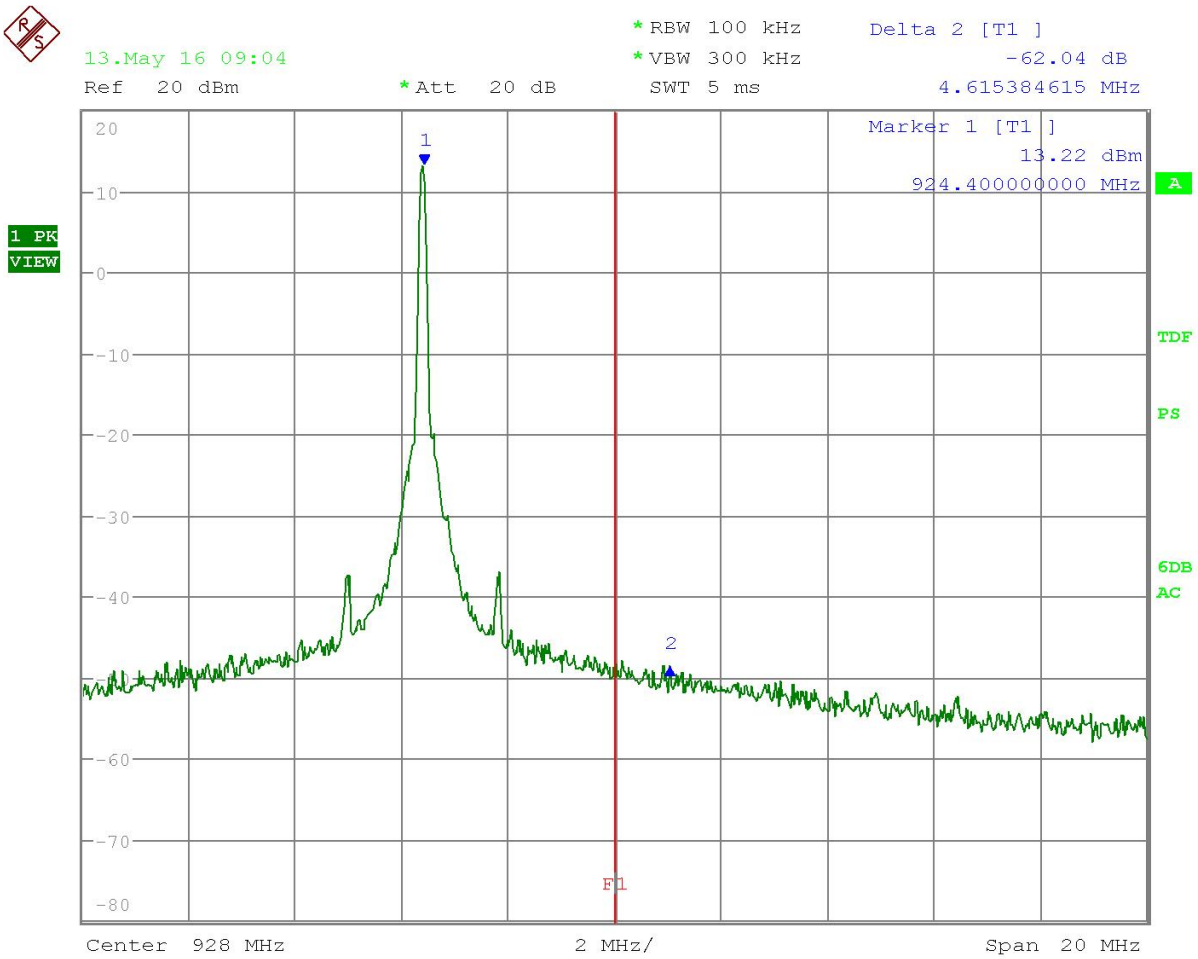


Date: 13.MAY.2016 09:01:52

RESULTS: Meets Requirements

BANDEDGE

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

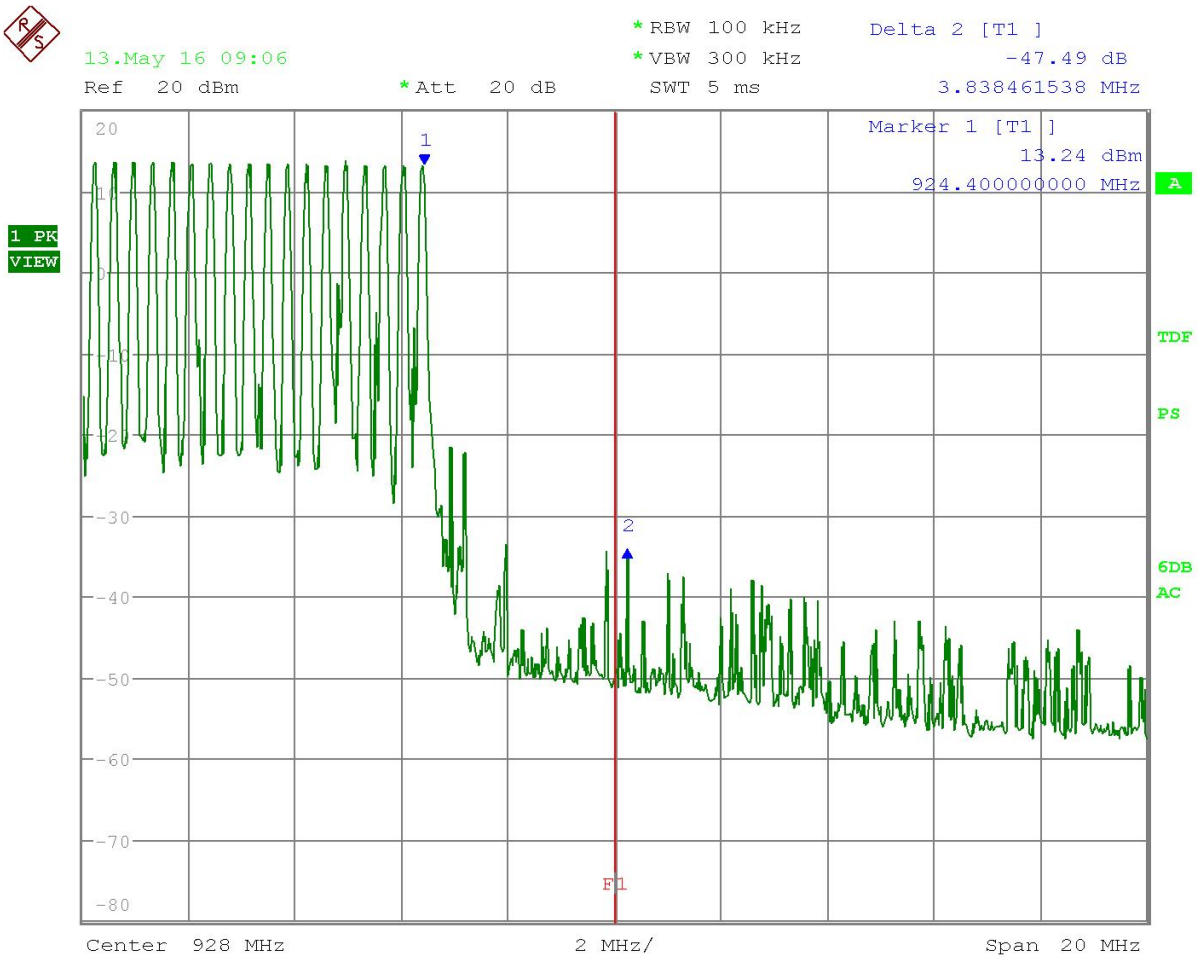


Date: 13.MAY.2016 09:04:26

RESULTS: Meets Requirements

BANDEDGE

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



Date: 13.MAY.2016 09:06:50

RESULTS: Meets Requirements

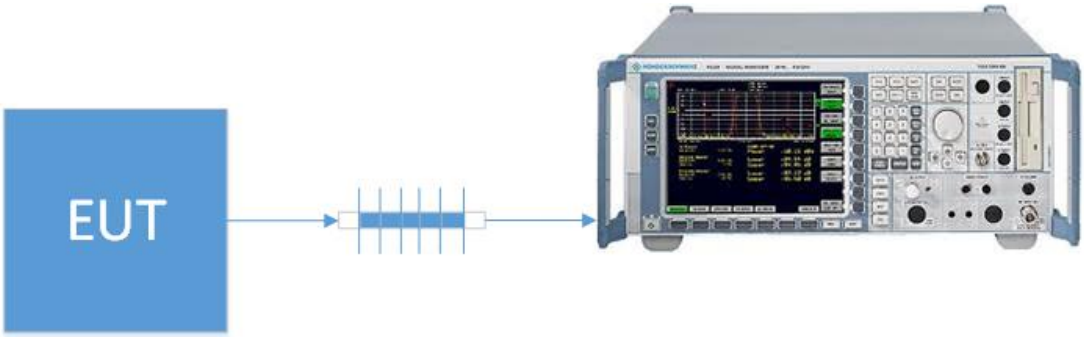
ANTENNA CONDUCTED SPURIOUS EMISSIONS

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

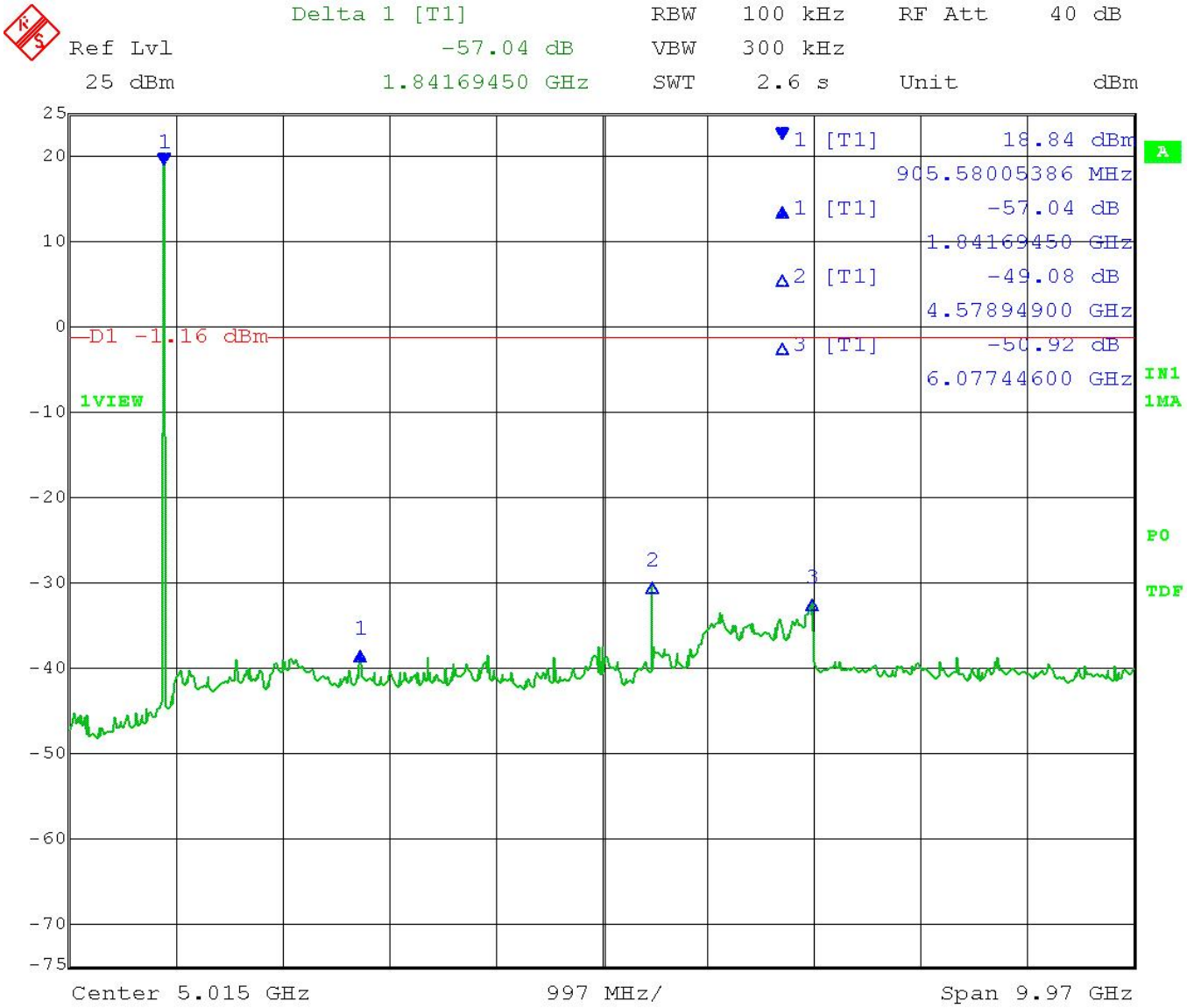
Test Method: ANSI C63.10 § 7.8.1 FHSS Device Parameters Test Setup
ANSI C63.10 § 7.8.8 Conducted spurious emissions test methodology

Setup:



ANTENNA CONDUCTED SPURIOUS EMISSIONS

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

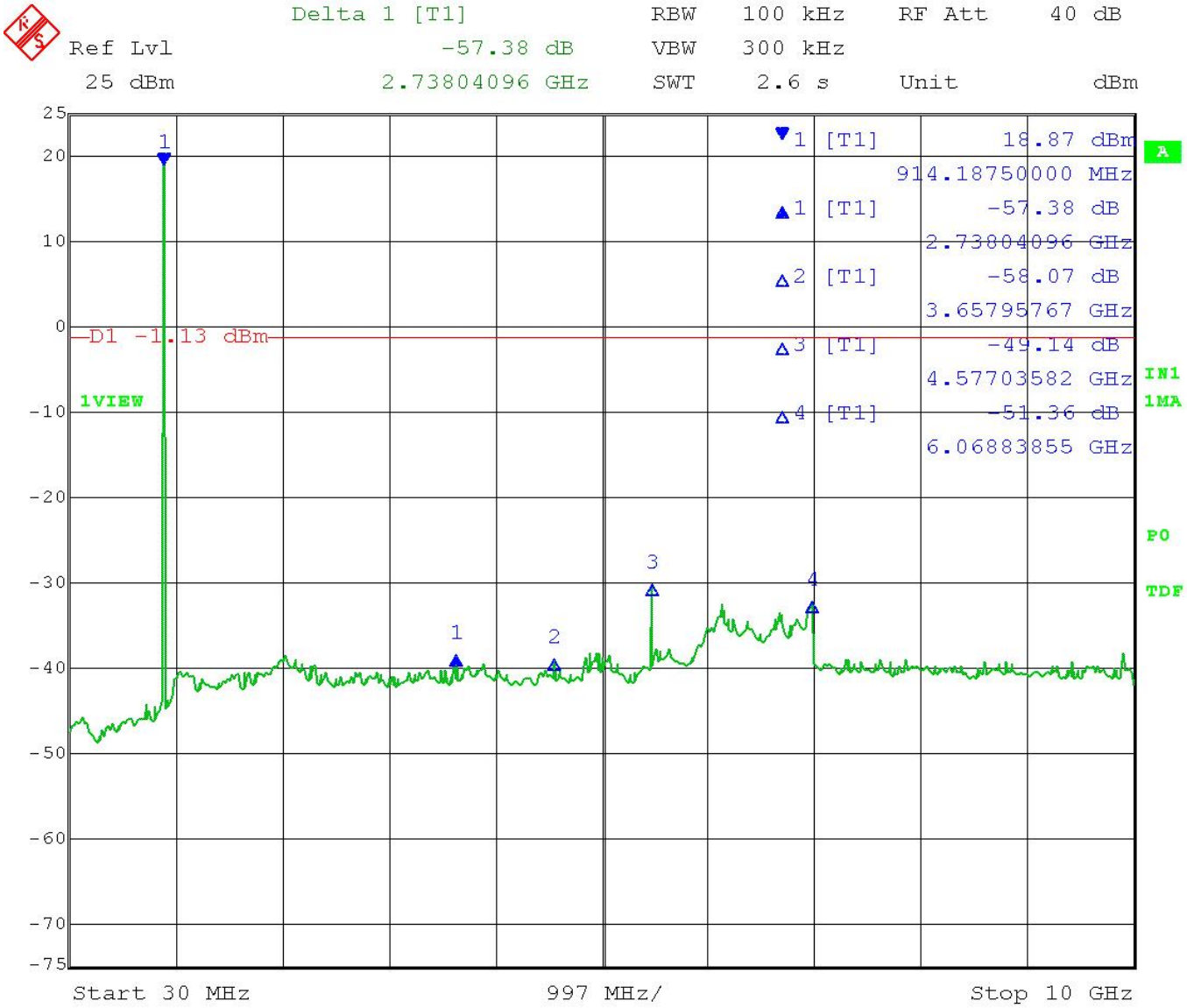


Date: 19.MAY.2016 15:36:26

RESULTS: Meets Requirements

ANTENNA CONDUCTED SPURIOUS EMISSIONS

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

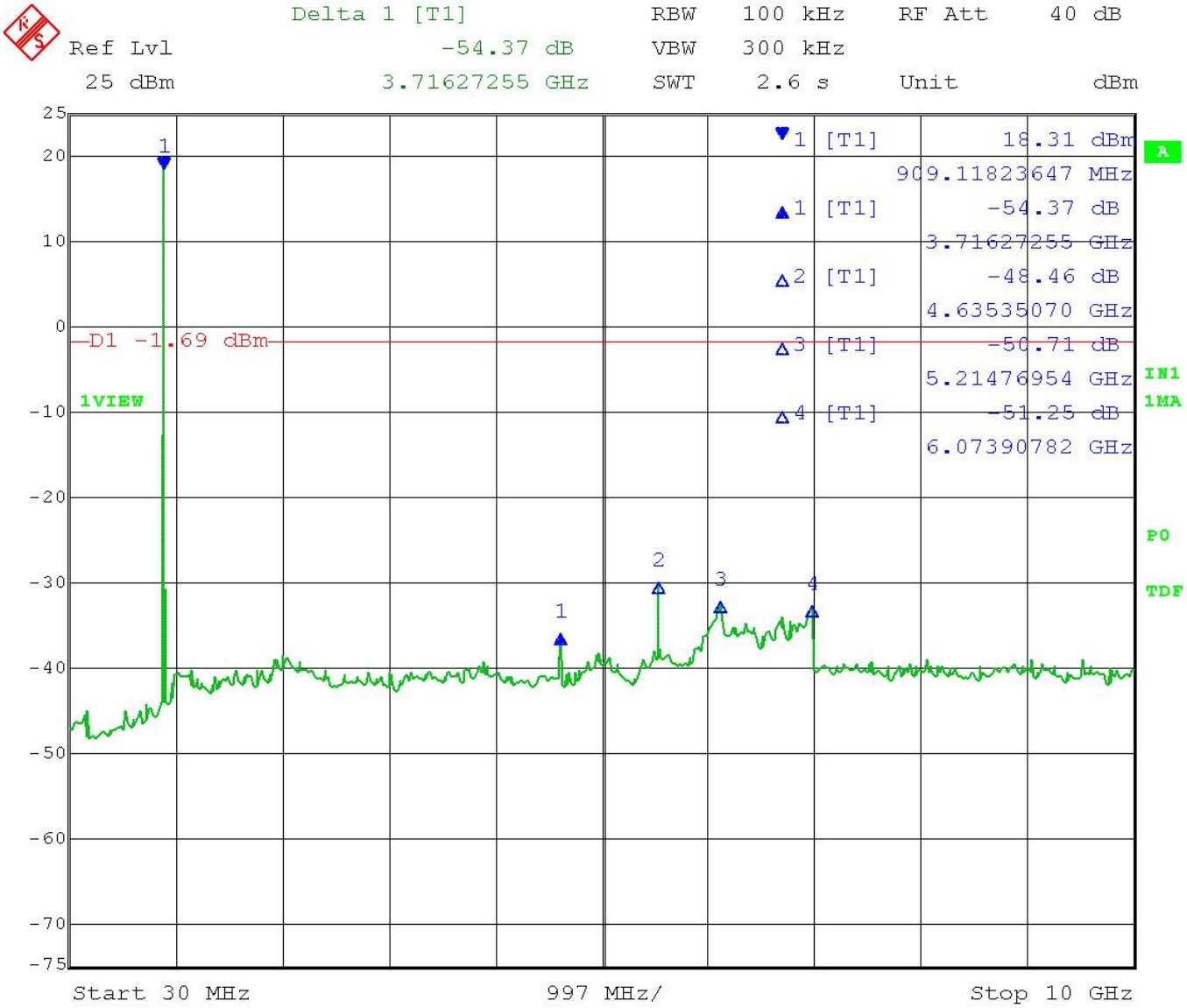


Date: 19.MAY.2016 15:39:15

RESULTS: Meets Requirements

ANTENNA CONDUCTED SPURIOUS EMISSIONS

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



Date: 19.MAY.2016 15:41:43

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.

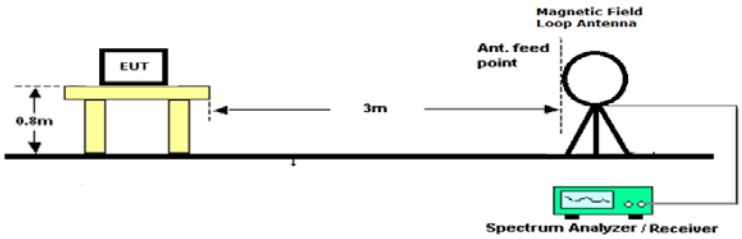
Example:

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

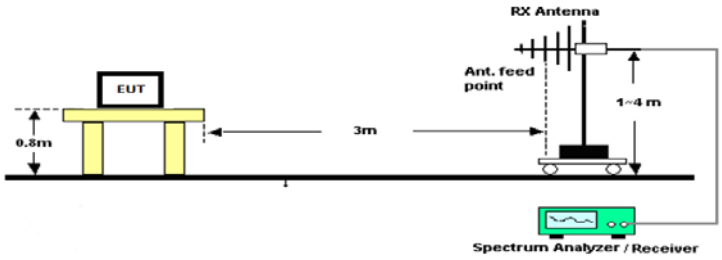
RADIATED SPURIOUS EMISSIONS

Setup:

Emissions below 30 MHz



Emissions 30 – 1000 MHz



Emissions above 1 GHz

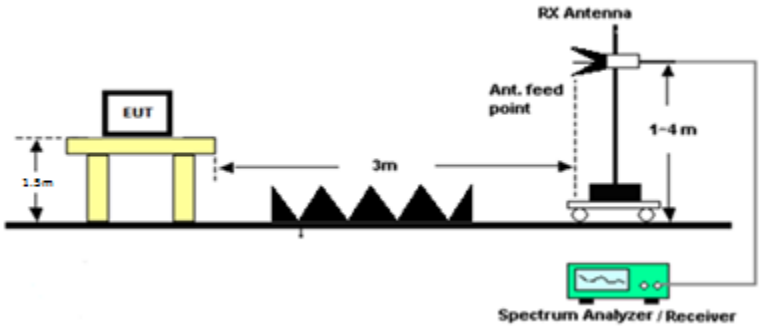


Table of Contents

RADIATED SPURIOUS EMISSIONS

Duty Cycle Formula:

$$\delta\ (dB) = 20 \log (n_1 t_1 + n_2 t_2 + n_3 t_3) / T$$

Where:

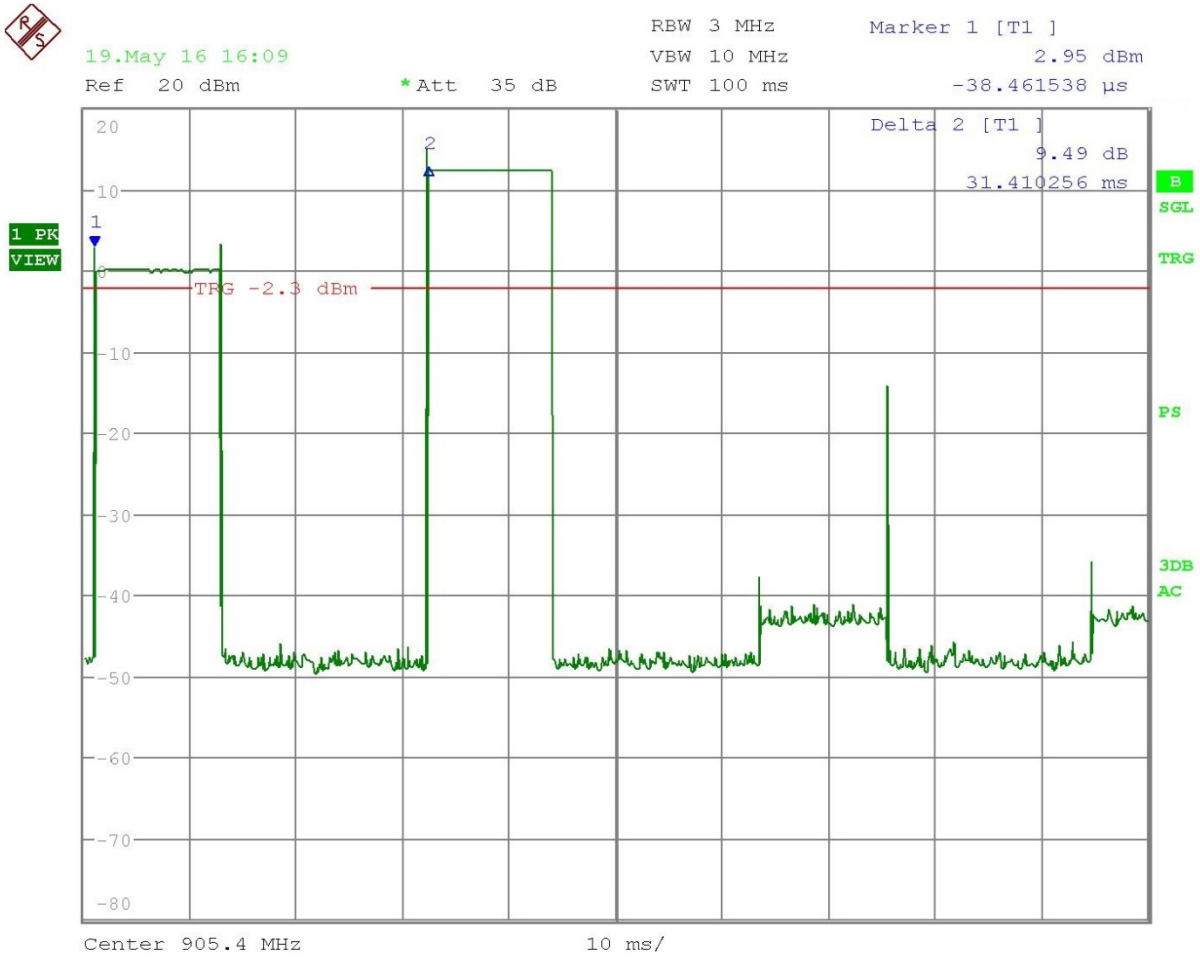
δ is the duty cycle correction factor (dB)
T is the pulse width (100 ms period)
t_1 is the pulse width of subpulse 1
t_2 is the pulse width of subpulse 2
t_3 is the pulse width of subpulse 3
n_1 is the number of t_1 pulses
n_2 is the number of t_2 pulses
n_3 is the number of t_3 pulses

Test Data: Calculation of Duty Cycle Correction for Average Value of Emissions

Sub Pulse	Duration (ms)	Number (n)	On Time (ms)
1	11.85	2	23.7
		Total On Time (ms)	23.7
		Period (ms)	100
		Duty Cycle (%)	24%
		Cor Factor (dB)	-12.51

RADIATED SPURIOUS EMISSIONS

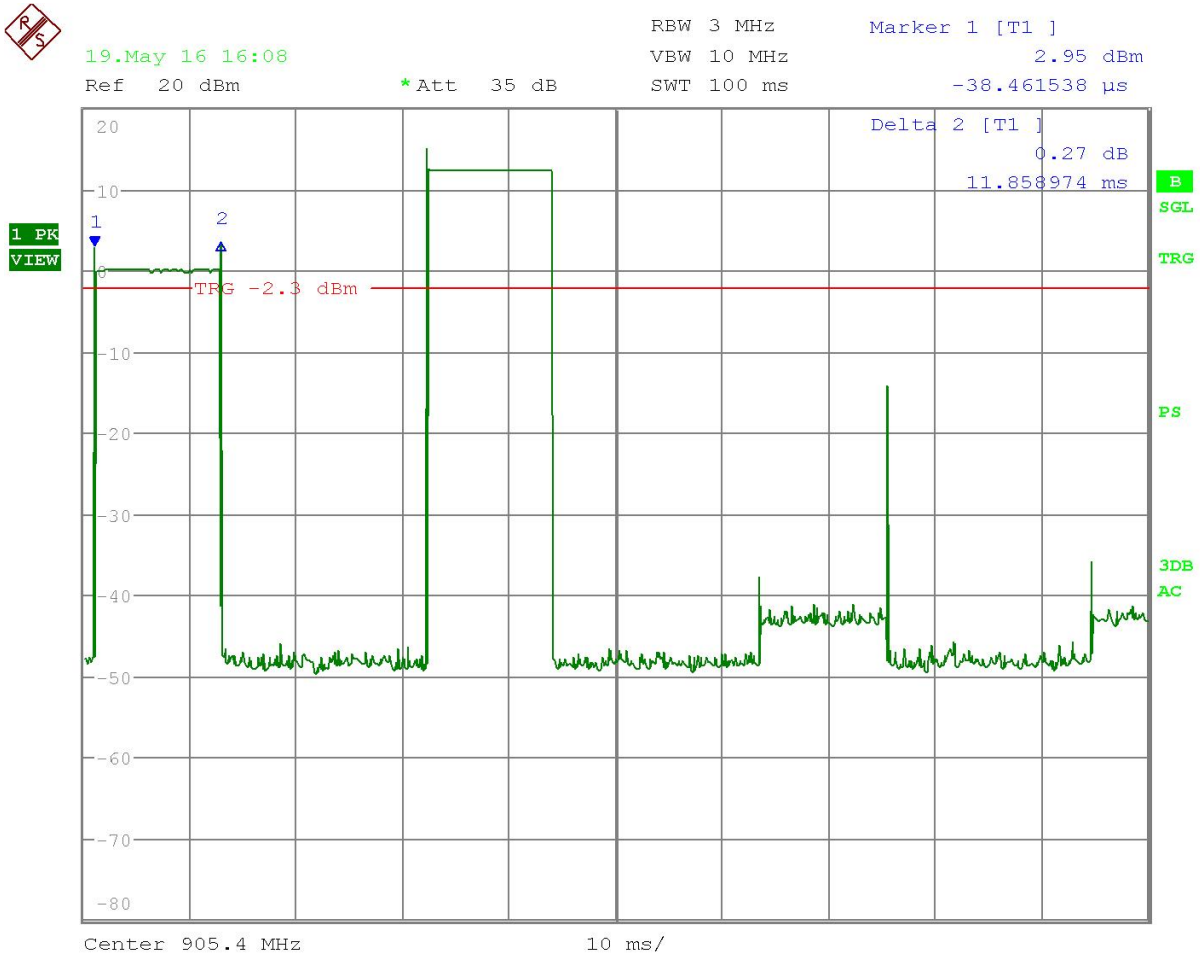
Test Data: Mode 1 Hopping Duty Cycle Pulse Repetition Rate Plot



Date: 19.MAY.2016 16:09:17

RADIATED SPURIOUS EMISSIONS

Test Data: Mode 1 Hopping Duty Cycle Pulse Width Plot



Date: 19.MAY.2016 16:08:57

RADIATED SPURIOUS EMISSIONS

Notes: Only emissions found within 20dB of the limit are reported from 9 KHz to the 10th harmonic of the fundamental

The EUT's duty cycle was calculated and used to determine compliance with the average limit of emissions above 1 GHz

Test Data: **Mode 1 Restricted Band Emissions Field Strength Measurement Table**

Tuned Frequency (MHz)	Emission Frequency (MHz)	Detector (PK/QP/AV)	Meter Reading (dBuV)	Ant. Polarity (H/V)	Coax Loss (dB)	Correction Factor (dB)	Field Strength (dBuV/m)	Margin (dB)
905.60	162.40	PK	14.80	V	1.46	16.40	32.66	10.84
905.60	190.73	PK	23.26	V	1.56	13.97	38.79	4.71
905.60	191.80	PK	20.26	H	1.57	14.24	36.07	7.43
905.60	256.89	PK	19.22	V	1.87	12.31	33.40	12.60
905.60	258.16	PK	18.85	H	1.88	12.39	33.12	12.88
905.60	404.31	PK	15.73	H	2.29	15.31	33.33	12.67
905.60	2716.80	PK	17.97	H	6.04	32.64	56.65	17.35
905.60	2716.80	AV	5.46	H	6.04	32.64	44.14	9.86
905.60	5433.60	PK	-2.25	H	8.61	34.40	40.76	13.24
915.00	73.31	PK	21.90	V	1.02	6.56	29.48	10.52
915.00	127.80	PK	18.56	V	1.30	12.36	32.22	11.28
915.00	241.89	PK	15.98	H	1.81	11.35	29.14	16.86
915.00	2745.00	PK	24.88	H	6.07	32.48	63.43	10.57
915.00	2745.00	AV	12.37	H	6.07	32.48	50.92	3.08
915.00	3660.00	PK	-6.28	H	7.01	33.62	34.35	19.65
915.00	4575.00	PK	-3.50	H	7.87	33.87	38.24	15.76
915.00	5490.00	PK	1.66	H	8.66	34.40	44.72	9.28
915.00	7320.00	PK	-9.03	H	10.00	35.60	36.57	17.43
915.00	8235.00	PK	-11.51	V	10.59	35.77	34.85	19.15
924.40	73.31	PK	20.53	V	1.02	6.56	28.11	11.89
924.40	127.80	PK	18.84	V	1.30	12.36	32.50	11.00
924.40	132.16	PK	18.19	V	1.32	13.43	32.94	10.56
924.40	257.60	PK	18.30	H	1.88	12.36	32.54	13.46
924.40	407.00	PK	14.17	V	2.30	15.30	31.77	14.23
924.40	2773.20	PK	23.96	H	6.10	32.33	62.39	11.61
924.40	2773.20	AV	11.45	H	6.10	32.33	49.88	4.12

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:

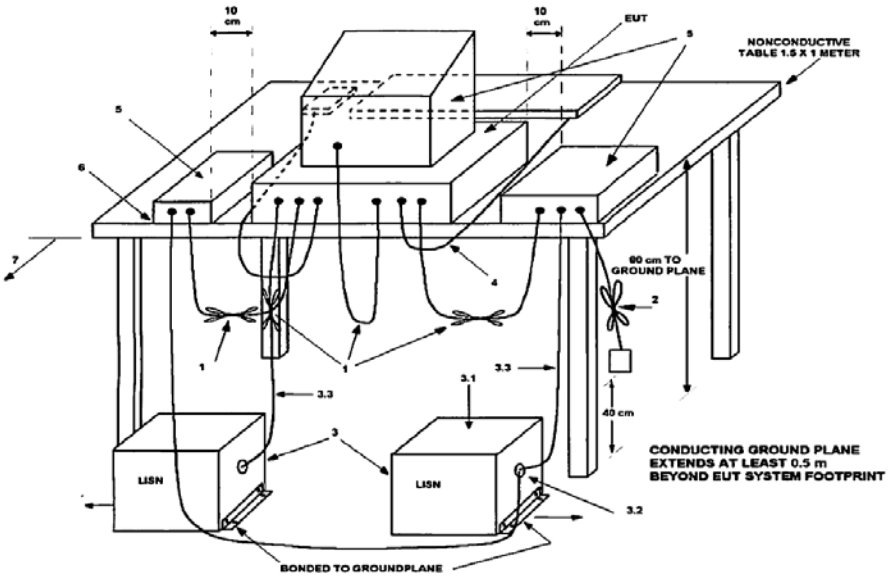
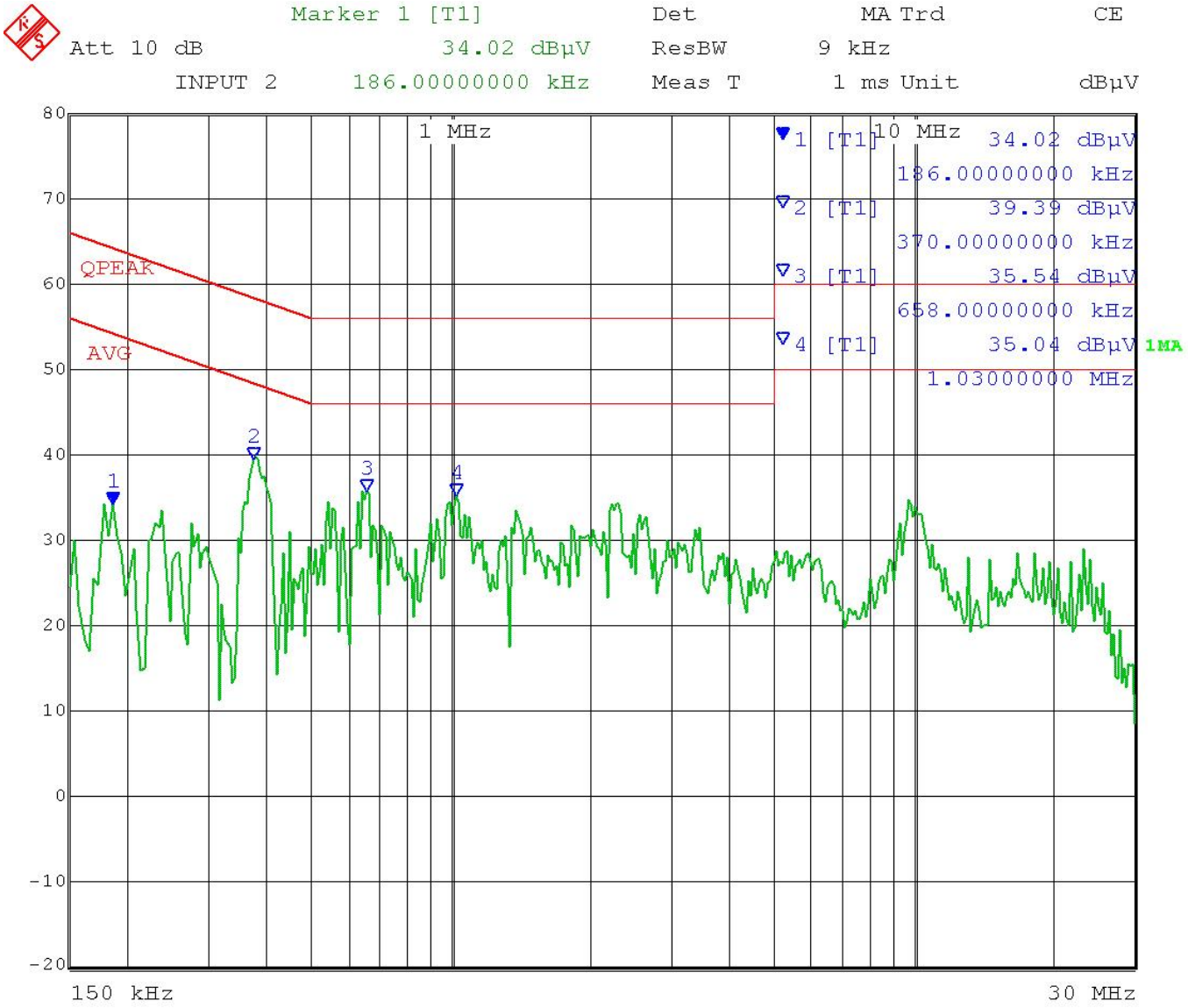


Table of Contents

AC POWER LINE CONDUCTED EMISSIONS

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

Test Data: Mode 1 Hopping Line 1 Peak Plot

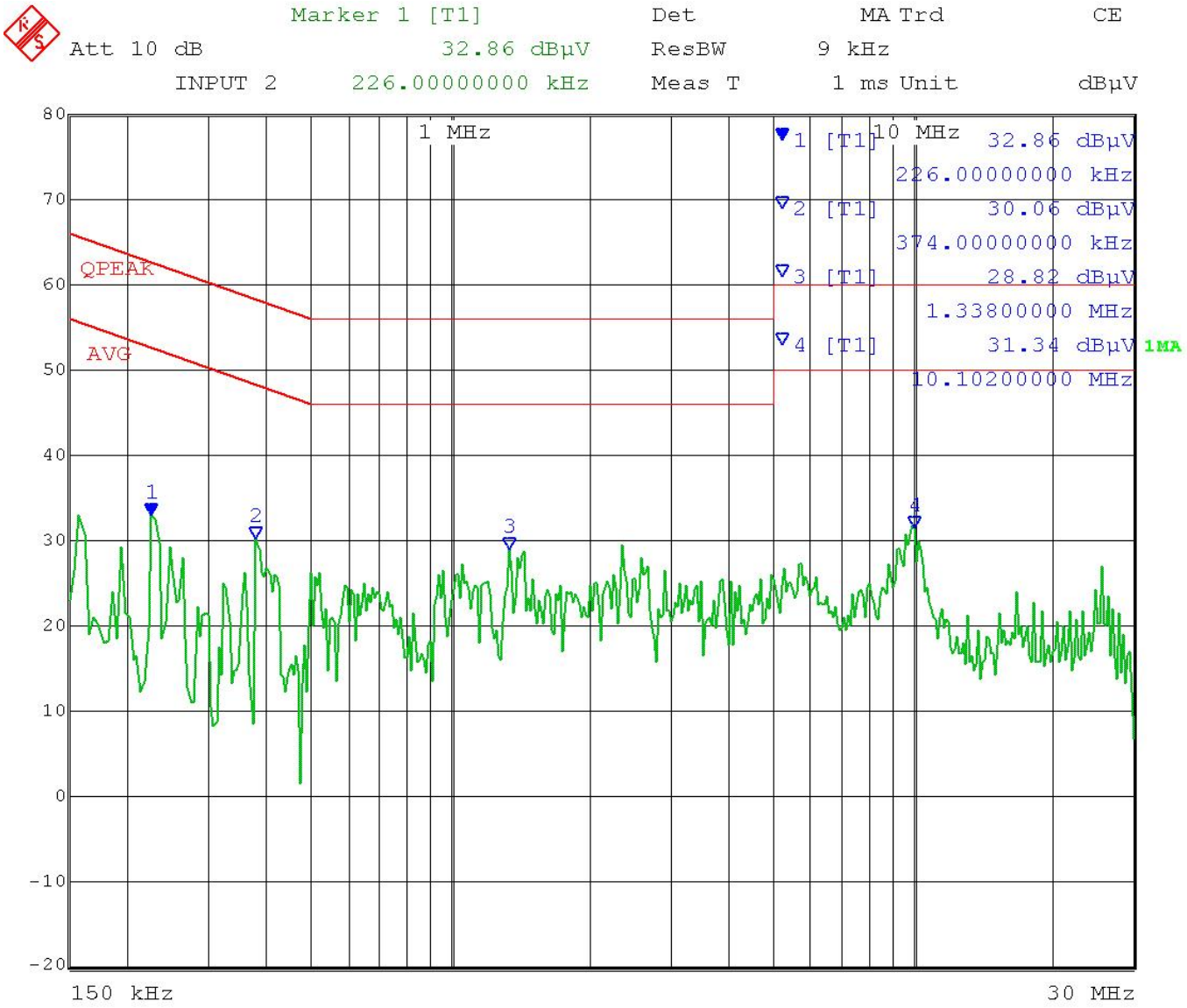


Date: 18.MAY.2016 11:20:27

RESULTS: Meets Requirements

POWER LINE CONDUCTED INTERFERENCE

Test Data: **Mode 1 Hopping Line 2 Peak Plot**



Date: 18.MAY.2016 11:23:00

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	01/05/16	12/31/17
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	Rohde & Schwarz	ESIB 40	100274	08/12/14	08/12/16
Software: Field Strength Program	Timco	N/A	Version 4.0	NA	NA
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
Attenuator #27 - K 6dB 2W DC-40	Narda	4768-6	1044-3 (#27)	06/25/15	06/25/17
EMI Test Receiver R & S ESU 40	Rohde & Schwarz	ESU 40	100320	04/01/16	04/01/18
Coaxial Cable for LISN	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
High Pass Filter	Microlab	HA-20N		6/17/15	6/17/17
Band Reject Filter – 900 MHz	Micro-Tronics	BRC50722-02	G002	5/3/16	5/3/18
Pre-Amp	RF-Lambda	RNLA00M45GA		1/4/16	1/4/18

*EMI RECEIVER SOFTWARE VERSION

The receiver firmware used was version 4.43 Service Pack 3