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Electromagnetic Compatibility
Test Report
IC RSS-210 & FCC CFR47 Part 15/C 15.247

Report Reference No. .....: E10671-1401-FCC-IC Rev 2.0
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Testing Laboratory…….. : Quality Auditing Institute
Address……: 16 – 211 Schoolhouse Street, Coquitlam, BC, V3K 4X9, Canada

Accreditations (ISO 17025):

SCC Accredited LAB / LAB Accrédité CCN

IAS ACCREDITED

ilac-MRA

Standard Council of Canada: Accredited Laboratory No. 743
International Accreditation Service Inc: Accredited Laboratory: No. TL-239

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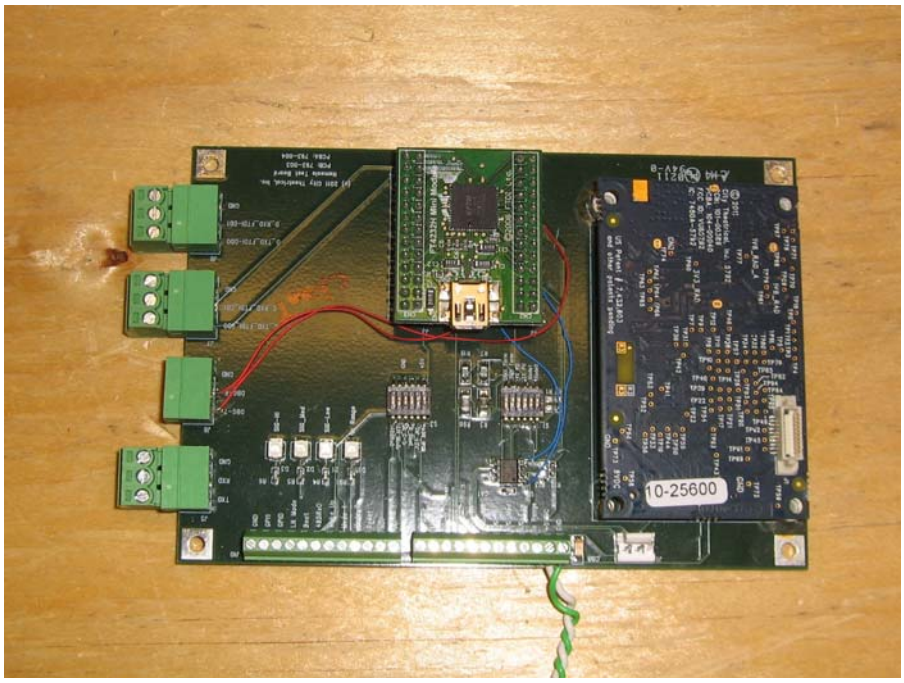
Applicant's name .....: City Theatrical Inc.
Address……...……...: 475 Barell Ave. Carlstadt, NJ, USA, 07072
Contact……...……..: Mr Paul Kleissler
Email.....: Pkleissler@citytheatrical.com
Phone……....……..: (201)549-1160
Fax.....: (201) 549-1161

Test Standards…..... : IC RSS-210 Issue 8
IC RSS-Gen Issue 4
FCC CFR47 Part 15/C 15.247

Test item description..... : Modular Wireless Transceiver
Model Number.....: 5792
Manufacturer.....: City Theatrical Inc.
FCC ID……: VU65792M
IC ……: 7480A-5792M

CITY THEATRICAL
NEW YORK · LONDON

Top side of Module



Module installed onto Test Fixture PCB

Revision History

Date	Report Number	Rev #	Details	Authors Initials
Nov-25- 2014	E10671-1401-FCC-IC	0.0	Draft Test Report	JQ
Dec-10-2014	E10671-1401-FCC-IC	0.1	Revised Draft and released to client	DJ
Dec-16-2014	E10671-1401-FCC-IC	1.0	Released version with clients comments	DJ
Dec-17-2014	E10671-1401-FCC-IC	2.0	Revised reference document dates On multiple pages	DJ
All previous versions of this Report have been superseded by the latest dated Revision as listed in the above table. Please dispose of all previous electronic and paper printed revisions accordingly.				

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The following tests demonstrate the testimony to “IC and FCC” Mark Electromagnetic compatibility testing for “CTI 5792” manufactured by City Theatrical Inc. The testing was performed pursuant to RSS-210 Issue 8 & FCC CFR47, PART 15/C 15.247

Test	Applicable Standard	Description	Result
Radiated Emissions (Receive Mode)	ICES-003 Issue 5, RSS-Gen Issue 4, FCC Part 15/B Class B	The radiated emissions are measured in the 9kHz-26GHz range	Complies
Channel Bandwidth	RSS-210 Iss.8 A8.1 FCC Part 15/C 15.247	The channel bandwidth is measured at -20dB. Minimum 500kHz for DTS	Complies
Channel Separation	RSS-210 Iss.8 A8.1 FCC Part 15/C 15.247	The channel separation should be greater than the channel BW or 25kHz , whichever is greater	Complies
Number of Hopping Channels	RSS-210 Iss.8 A8.1 FCC Part 15/C 15.247	At least 15 hopping channels	Complies
Occupancy Time	RSS-210 Iss.8 A8.1 FCC Part 15/C 15.247	less than 0.4seconds during a period of 0.4 multiplied by the number of hopping channels	Complies
Output Power	RSS-210 Iss.8 A8.4 FCC Part 15/C 15.247	Maximum Peak Conducted Output power will not exceed 0.125W (21dBm)	Complies
EIRP Emissions	RSS-210 Iss.8 A8.4 FCC Part 15/C 15.247(c)(1)(i)	E.I.R.P. will not exceed: IC: 4W(36dBm) FCC: 0.5W (27dBm)	Complies
Out-of-band Emissions	RSS-210 Iss.8 A8.5 FCC Part 15/C 15.247	At least 20 dB below the highest level of the desired power	Complies
Restricted Frequency Bands	RSS-Gen Issue 4 FCC Part 15/C 15.205	Spurious emissions frequency shall not fall within the restricted bands	Complies
Antenna Requirement	FCC Part 15/C 15.203	Antenna with a unique coupling or professionally installed	Complies
RF Exposure Evaluation	FCC 1.1310	General Population Exposure Levels or lower	Complies

All the tests were conducted on a sample of the equipment as requested by City Theatrical Inc. for the purpose of demonstrating compliance with IC RSS-210 Annex8 and FCC CFR47 PART 15/C 15.247. City Theatrical Inc. is responsible for the tested product configuration, continued product compliance with these standards listed, and for the appropriate auditing of subsequent products, as required. Please note that this list of tests may only comprise a partial list of the tests that are required before a FCC or IC label can be produced by the manufacturer.

This is to certify that the following report is true and correct to the best of our knowledge.

X

Tested By David Johanson,
RF/EMC Test Engineer

X

Reviewed By Aman Jathaul,
EMC Project Manager

Section I: GENERAL INFORMATION

PRODUCT DESCRIPTION

Applicant:	City Theatrical Inc.
Equipment Under Test:	Wireless Module 2.4GHz
Model Number:	5792
Serial Number:	ENG-001 Client and ENG-002 Server

Introduction:

The CTI 5792 Wireless Module (EUT) is used in multiple City Theatrical products. It is installed by the Manufacturer and is setup by professional operators on-site for the final configuration.

The EUT requires +3.3VDC nominal to operate, which it receives from a regulated power supply in the application board.

EUT Test Configuration:

The EUT was provided preprogrammed with custom firmware for EMC compliance testing. It was programmable by the lab to test the various modulation options and power levels.

The EUT was mounted to Test PCB that is used to provide communications with a PC via USB port; power from an Auxiliary +5Vdc power port and a UFL flexible cable for the antenna port.

The EUT was powered directly by +5Vdc. A ferrite was added to the power cable to isolate the emissions as this cable is not part of the normal system.

The EUT was programmed by a PC running Hyperterminal using the USB port. The PC and USB cable were removed after programming.

The Antenna port was connected directly to a Spectrum Analyzer or Antenna or Terminated as required by the test.

The EUT has 14 modes (A thru L) of modulation for use by client products, 6 test modes (1-6). All modes (A thru L) are Frequency Hopping spread spectrum (FHSS). Modes K and L were also tested as DTS Hybrid as per 15.247(f) due to only having 5 channels.

Mode of Operation	Description	Channels	Frequency Range
A Address: 0	Even channels Full Band FHSS	36	2406MHz to 2476MHz
A Address: 16	Even channels Full Band FHSS	37	2408MHz to 2480MHz
B Address: 0	Odd channels Full Band FHSS	36	2407MHz to 2477MHz
B Address: 16	Odd channels Full Band FHSS	36	2409MHz to 2479MHz
C	Even channels Low Sub Band FHSS	15	2406MHz to 2434MHz
D	Odd channels Low Sub Band FHSS	15	2407MHz to 2435MHz
E	Even channels Mid Sub Band FHSS	15	2428MHz to 2456MHz
F	Odd channels Mid Sub Band FHSS	15	2429MHz to 2457MHz
G	Even channels High Sub Band FHSS	15	2448MHz to 2476MHz
H	Odd channels High Sub Band FHSS	15	2449MHz to 2477MHz
I	Adaptive Odd Channels Full Band FHSS	20	2407MHz to 2477MHz
J	Adaptive Even Channels Full Band FHSS	20	2406MHz to 2476MHz
K	Odd channels High Sub Band FHSS	5	2471MHz to 2479MHz
L	Even channels High Sub Band FHSS	5	2472MHz to 2480MHz
1	Continuous CW test mode	1	2406
2	Continuous Modulated test mode	1	2406
3	Continuous CW test mode	1	2440
4	Continuous Modulated test mode	1	2440
5	Continuous CW test mode	1	2480
6	Continuous Modulated test mode	1	2480

Firmware Rev. Number	1.0
Received Date	21 Oct 2014
Received By	David Johanson
Sample Log	QM1301

Auxiliary Equipment

Manufacturer	Dell
Product Description	Laptop
Operating System	XP
Software	Hyperterminal
Manufacturer	Samlex
Product Description	Variable DC Power Supply
Model Number	PSA-302

Cables Description

Description	Connector	Length	Shielding	Ferrites
Power Supply	Terminal	1m	No	yes

FACILITIES AND ACCREDITATION

Main Laboratory Headquarters: Quality Auditing Institute

Headquarters Location/Address: 16 – 211 Schoolhouse Street, Coquitlam, BC, 3K 4X9, Canada

Associated Laboratory: Quality Auditing Institute (Remote Location)

EMC Laboratory Address: 19473 Fraser Way, Pitt Meadows, BC, V3Y 2V4, Canada

FCC Test Site Registration Number: (3 m /10 m Open Area Test Site [OATS] and 3 m Semi-Anechoic Chamber [SAC]): 226383
FCC Designation Number: CA9543
Industry Canada Test Site Registration Number (3m SAC): 9543B-1

Standard Council of Canada: ISO/IEC 17025:2005 Accredited Laboratory No. 743

International Accreditation Service Inc.: ISO/IEC 17025:2005 Accredited Laboratory: No. TL-239

ENVIROMENTAL CONDITIONS:

INDOORS, Temperature: 22-28ºC, R.H.: 39.7 - 54.4%

MEASUREMENT UNCERTAINTY

Parameter	Uncertainty
Radio Frequency	±1 x 10-5 MHz
Total RF power, conducted	±1 dB
RF power density, conducted	±2.75 dB
Spurious emissions, conducted	±3 dB
Radiated Emissions	±3 dB
Temperature	±1°C
Humidity	±5 %
DC and low frequency voltages	±3 %

TEST EQUIPMENT LIST

Test Bench Equipment List

Manufacturer	Model	Description	Serial No.	Last Cal	Cal Due Date
Tektronix	TDS754C	Oscilloscope	B012403	10-Oct-2013	10-Oct-2016
HP	8648C	Signal Generator	3623A03622	30-Oct-2012	30-Oct-2015
Boonton	4200-S/17	RF MicroWattmeter	430519 BG	13-Mar-2013	13-Mar-2016
Boonton	51033-6E	Power Sensor 100kHz-18GHz	15779	18-Mar-2013	18-Mar-2016
Rohde & Schwarz	ESU40	EMI Receiver	100011	20-Nov-2014	20-Nov-2017
Rohde & Schwarz	ESCI	EMI Receiver	1000123	27-Aug-2014	27-Aug-2017

Emmission Testing Equipment

Manufacturer	Model	Description	Serial No.	Last Cal	Cal Due Date
ETS Lindgren	2165	Turntable	00043677	N/A	N/A
ETS Lindgren	2125	Mast	00077487	N/A	N/A
FCC	FCC-LISN-50-25-2	LISN	9927	30-Nov-2012	30-Nov-2015
EMCO	6502	60cm Active Loop Antenna 9kHz to 30MHz	2178	14-Jun-2013	10-Jun-2015
Sunol Sciences	JB3	Biconilog Antenna 30MHz – 3GHz	A042004	31-Oct-2012	31-Oct-2015
AILTECH/Eaton	94455-1	Biconical Antenna 20-200MHz	0931	14-Jun-2013	14-Jun-2016
EMCO	93146	Log Periodical Antenna 200-1000MHz	9811-5136	14-Jun-2013	10-Jun-2016
ETS-LINDGREN	3117	Dual Ridge Horn Antenna 1-18GHz	75944	29Aug-13	29-Aug-2015
EMCO	3160-09	Pyramidal Horn Antenna 18-26GHz	9701-1071	30-Aug-2013	30-Aug-2016
EMCO	3160-10	Pyramidal Horn Antenna 26-40GHz	9708-1055	30-Aug-2013	30-Aug-2016
ETS Lindgren	S201	3 meter Semi-Anechoic Chamber	1030	N/A	N/A

Measurement Software List

Manufacturer	Model	Version	Description
Rhode & Schwarz	EMC 32	6.20.0	Emissions Pre-scan Test Software

Section II: Test Information

Markings

According to FCC 47 CFR Part 15 Section 15.19 and ICES 003, a statement similar to the following must be included on an identification label, which also uniquely identifies the manufactured date, either explicitly or through a Serial number etc.:

> "This equipment complies with FCC Rules, Part 15 and Industry Canada's ICES 003 for a Class B Digital Device. Operation is subject to two conditions:
>
> 1) This device may not cause harmful interference, and
>
> 2) This device must accept any interference that may cause any undesired operation"

Additionally, if the manufacturer markets product to Canada, the following information must be added to the label:

> "Cet Apparreil numerique de la Classe B respecte toutes les exigences du Reglement sur le material brouilleur du Canada."

User Manual Statements

According to FCC 47 CFR Part 15 Subpart C Section 15.105, and ICES 003, the following statement must be included in a prominent location in your User's Manual:

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy, and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

It is also required according to FCC 47 CFR Part 15 Subpart B Section 15.21 that a caution is included such as:

> Caution: Changes or modifications to this equipment, not expressly approved by the manufacturer could void the user's authority to operate the equipment.

This product is License Exempt for FCC and IC. There is a requirement for this product to be submitted for certification and requires both an FCC ID and an IC ID number to be added to the labels in accordance with FCC 47 CFR Part 2 Subpart J (2.901 to 2.956) as well as IC Self-Marking standards.

Additionally, your user manual will require the following statements:

> "Cet Apparreil numerique de la Classe B respecte toutes les exigences du Reglement sur le material brouilleur du Canada."
>
> Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
>
> (1) l'appareil ne doit pas produire de brouillage, et
>
> (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Part 1 - Radiated Emissions Testing (Receive Mode)

DATE: Nov-11-2014

TEST STANDARD: ICES-003 Issue 5, RSS-Gen Issue 4, FCC Part 15/B

TEST PROCEDURES: ANSI 63.4-2014, ANSI 63.10-2013, FCC Public Notice DA 00-705 March 30,2000, FCC KDB 996369 v01r04, FCC KDB 55807 4v03r02

TEST SETUP: The EUT was operated in receive mode for these tests.

MINIMUM STANDARD: When the EUT is operating in Receive mode FCC Part 15 Subpart B Unintentional Radiators Limits for a Class B product:

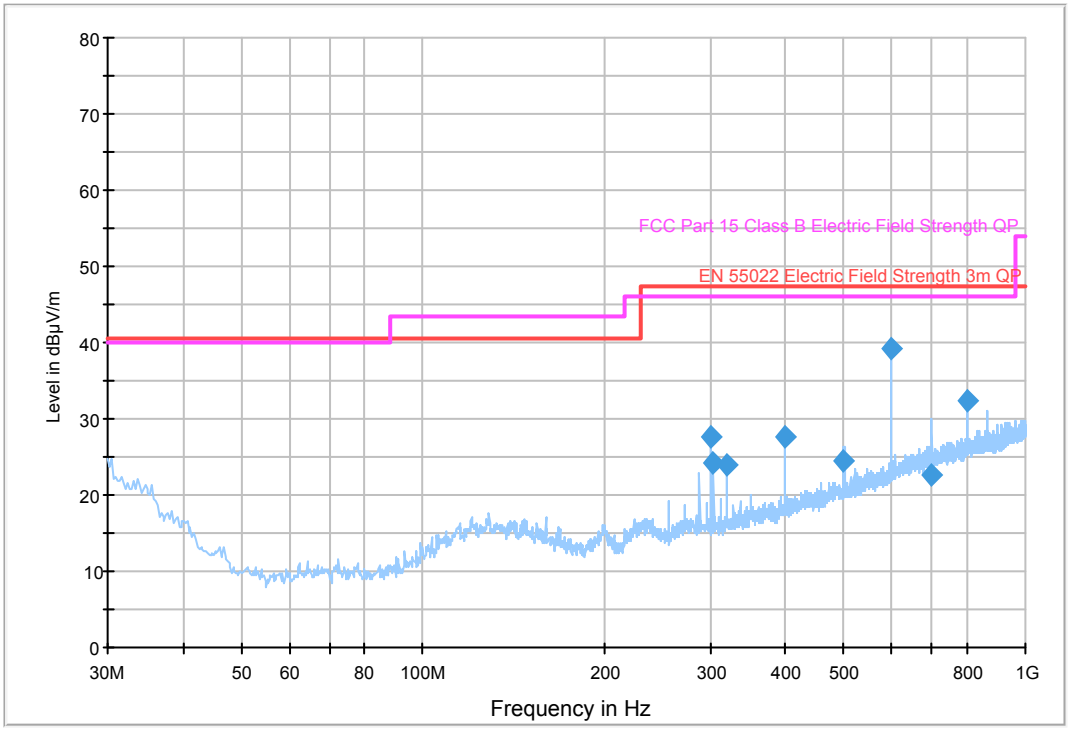
Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

Note: In the above emission table, the tighter limit applies at the band edges.

METHOD OF MEASUREMENT: The equipment was set up in a 3-meter Semi Anechoic Chamber for preliminary measurements and finals were completed in the 3-Meter SAC due to the low emissions. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable to maximize the emissions signal strength.

PERFORMANCE: Complies with standard.

MEASUREMENT DATA:



Plot 1: Radiated Emissions, IC/FCC Class B, Receive Mode -3m

Table1: Radiated Emissions, 9KHz-25GHz, IC/FCC Class B, Receive Mode -3m

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
300.020700	27.8	1000.000	120.000	100.0	H	160.0	15.5	18.2	46
304.007000	24.2	1000.000	120.000	100.0	H	349.0	15.5	21.8	46
320.006600	24.0	1000.000	120.000	100.0	H	346.0	16.1	22	46
400.026200	27.5	1000.000	120.000	241.0	H	160.0	18.1	18.5	46
500.013600	24.5	1000.000	120.000	186.0	H	347.0	20.1	21.5	46
600.049400	39.1	1000.000	120.000	135.0	H	170.0	21.7	6.9	46
700.029700	22.6	1000.000	120.000	100.0	H	66.0	23.2	23.4	46
700.042000	29.3	1000.000	120.000	100.0	H	178.5	23.2	16.7	46
800.044100	32.3	1000.000	120.000	100.0	H	171.0	24.5	13.7	46

No emissions were detectable from 0.009MHz to 30MHz so no results were measured. All other emissions that were attenuated by more than 20dB from the permissible value are not reported in accordance with 15.31(o).

Part 2 - Intentional Radiated Emissions Testing (Transmit Mode)

DATE: Nov-11-2014

TEST STANDARD: RSS-Gen Issue 4, FCC Part 15 Subpart C -15.209

TEST PROCEDURES: ANSI 63.4-2014, ANSI 63.10-2013, FCC Public Notice DA 00-705 March 30,2000, FCC KDB 996369 v01r04, FCC KDB 55807 4v03r02

MINIMUM STANDARD: Spurious Emission Limits

Frequency (MHz)	Field Strength (µV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

Note: In the above emission table, the tighter limit applies at the band edges.

METHOD OF MEASUREMENT: The equipment was set up in a 3-meter Semi Anechoic Chamber for preliminary measurements and final emission measurements. Emissions in both horizontal and vertical polarizations were measured while rotating the EUT on a turntable to maximize the emissions signal strength.

The EUT was tested using the highest power pulsing modulated and Lowest, middle and highest frequency CW signals.

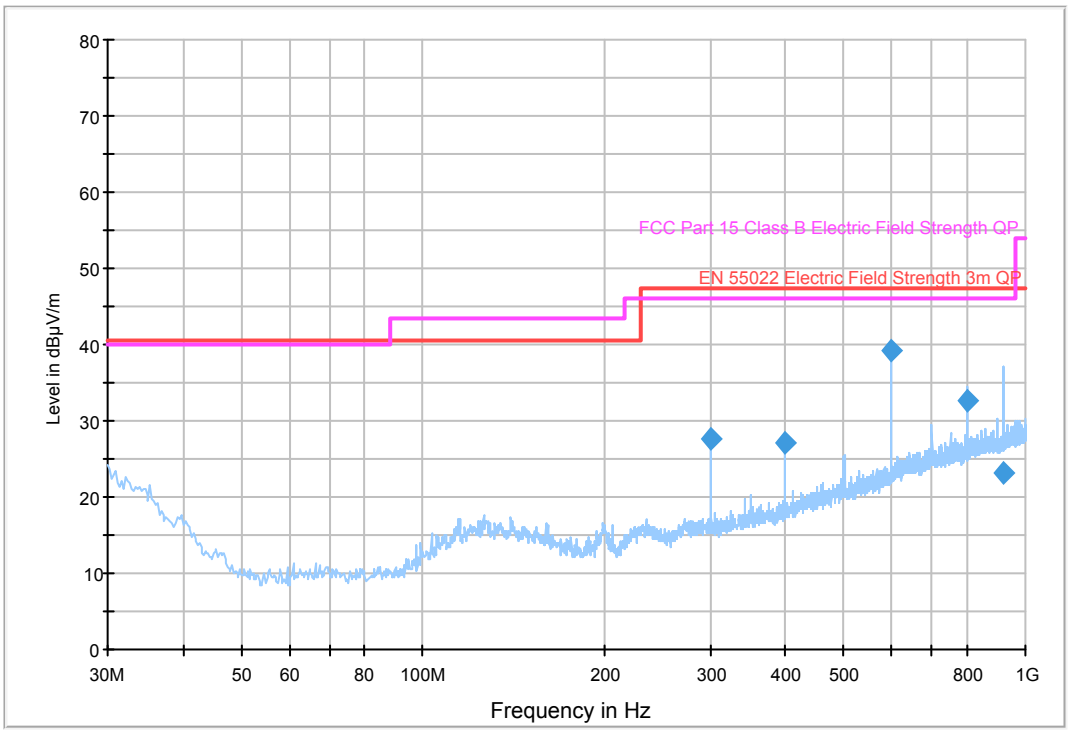
MODIFICATIONS: No modification is required to comply for this test.

PERFORMANCE: Complies with standard.

MEASUREMENT DATA:

A conducted emissions prescan was performed 9kHz to 40GHz.

A radiated emissions prescan for spurious emissions was performed using the various antenna's as outlined in Part 11. No additional spurious emissions were detected.

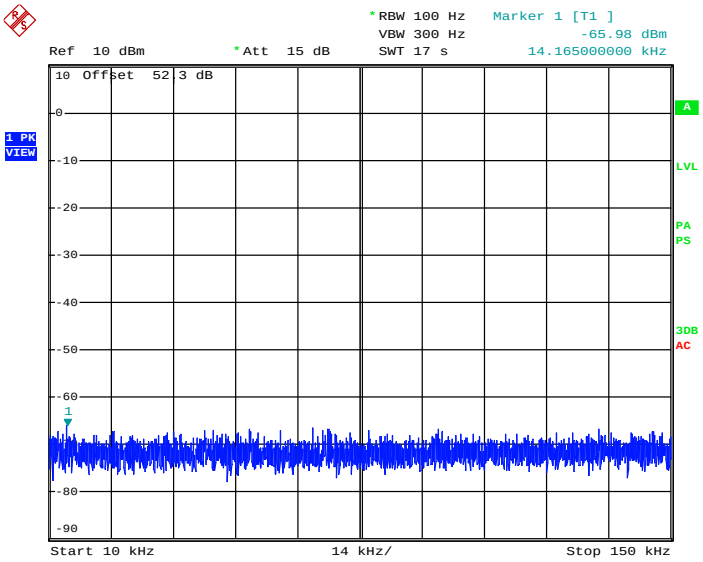


Plot 2: Intentional Radiated Emissions, 30MHz-1GHz, IC/FCC Class B, Tx Mode -3m

Table2: Intentional Radiated Emissions, 9kHz-25GHz, IC/FCC Class B, Tx Mode -3m

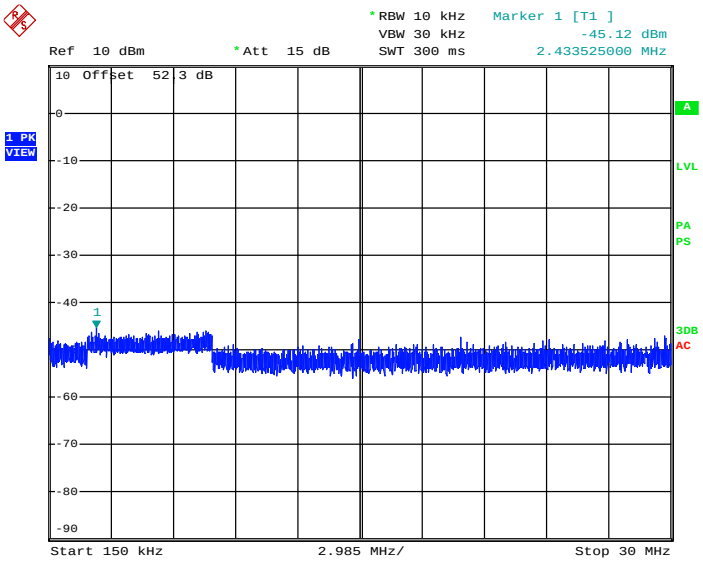
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
300.012000	27.7	1000.000	120.000	100.0	H	160.0	15.5	18.3	46
400.004600	27.0	1000.000	120.000	236.0	H	160.0	18.1	19	46
600.036500	39.3	1000.000	120.000	134.0	H	172.0	21.7	6.7	46
800.034500	32.7	1000.000	120.000	100.0	H	188.0	24.5	13.3	46
916.967500	23.2	1000.000	120.000	242.0	H	312.0	25.8	22.8	46

No emissions were detectable from 9 kHz to 30 MHz and above 2.5GHz so no results were measured. All other emissions that were attenuated by more than 20dB from the permissible value are not reported in accordance with 15.31(o).



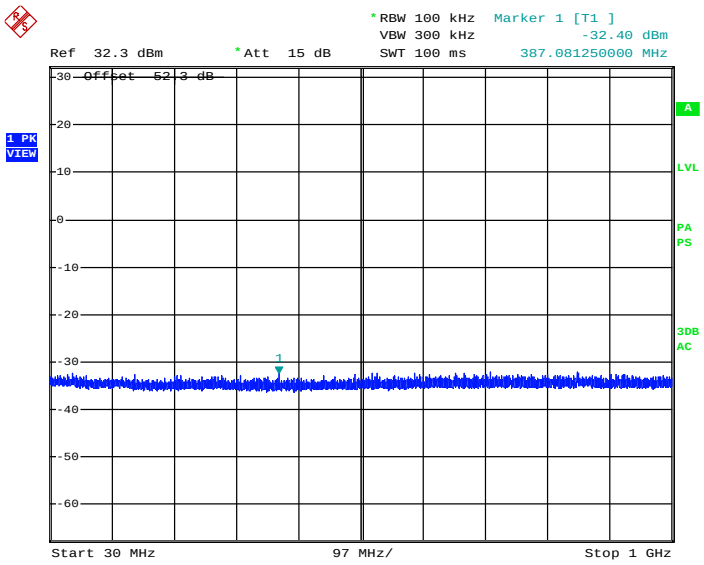
Date: 5.NOV.2014 21:26:55

Conducted emissions 10kHz to 150kHz – prescan for reference use only



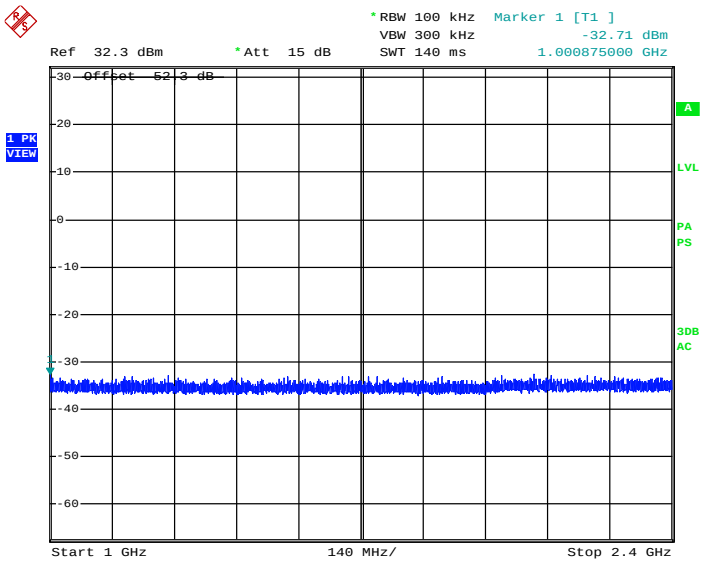
Date: 5.NOV.2014 21:28:58

Conducted emissions 150kHz to 30MHz – prescan for reference use only



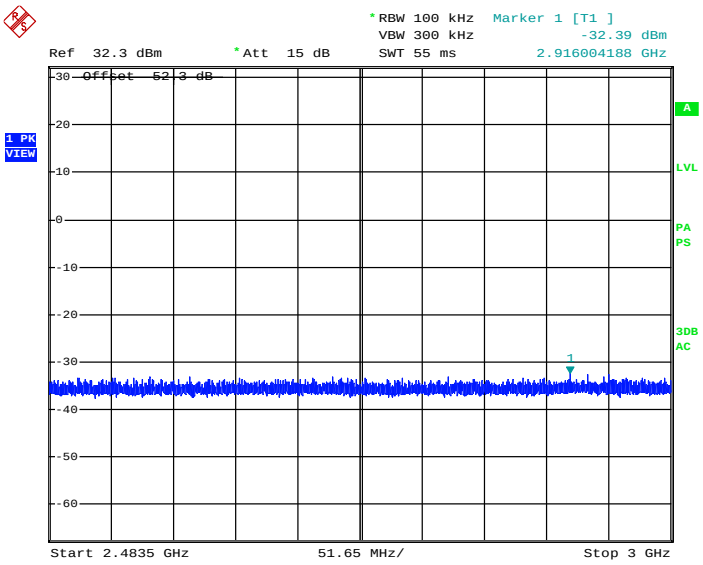
Date: 5.NOV.2014 21:52:01

Conducted emissions 30MHzHz to 1GHz – prescan for reference use only



Date: 5.NOV.2014 22:00:24

Conducted emissions 1GHzHz to 2.4GHz – prescan for reference use only



Date: 5.NOV.2014 22:10:14

Conducted emissions 2.4835GHz to 3GHz – prescan for reference use only

Part 3 - Restricted Frequency Bands

DATE: Nov-11-2014

TEST STANDARD: RSS-Gen Issue 4, FCC Part 15 Subpart C -15.205

TEST PROCEDURES: ANSI 63.4-2014, ANSI 63.10-2013, FCC Public Notice DA 00-705 March 30,2000, FCC KDB 996369 v01r04, FCC KDB 55807 4v03r02

MINIMUM STANDARD: Emissions falling into restricted bands shall comply with the limits specified in the applicable RSS-Gen and FCC Part 15/ C

Restricted Bands specified in RSS-Gen

MHz
0.090-0.110
2.1735-2.1905
3.020-3.026
4.125-4.128
4.17725-4.17775
4.20725-4.20775
5.677-5.683
6.215-6.218
6.26775-6.26825
6.31175-6.31225
8.291-8.294
8.362-8.366
8.37625-8.38675
8.41425-8.41475
12.29-12.293
12.51975-12.52025
12.57675-12.57725
13.36-13.41
16.42-16.423
16.69475-16.69525
16.80425-16.80475
25.5-25.67
37.5-38.25
73-74.6
74.8-75.2
108-138
156.52475-156.52525
156.7-156.9

MHz
240-285
322-335.4
399.9-410
608-614
960-1427
1435-1626.5
1645.5-1646.5
1660-1710
1718.8-1722.2
2200-2300
2310-2390
2655-2900
3260-3267
3332-3339
3345.8-3358
3500-4400
4500-5150
5350-5460
7250-7750
8025-8500

GHz
9.0-9.2
9.3-9.5
10.6-12.7
13.25-13.4
14.47-14.5
15.35-16.2
17.7-21.4
22.01-23.12
23.6-24.0
31.2-31.8
36.43-36.5
Above 38.6

Note: Certain frequency bands listed in Table 3 and in bands above 38.6 GHz are designated for licence-exempt applications. These frequency bands and the requirements that apply to the devices are set out in the 200– and 300– series RSSs, such as RSS-210 and RSS-310, which contain the requirements that apply to licence-exempt radio apparatus.

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Restricted Bands specified in FCC Part 15 Subpart C -15.205

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1] 0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	([2])
13.36–13.41.			

[1] Until February 1, 1999, this restricted band shall be 0.490–0.510 MHz.
[2] Above 38.6

MEASUREMENT DATA: No detectable radiated emission above 2.480GHz. All approved antennas were investigated. See the Plots and the tables in Part 2

PERFORMANCE: Complies with standard.

Part 4 - Channel Bandwidth

DATE: Nov-04-2014

TEST STANDARD: RSS-210 Iss.8 A8.1, FCC Part 15/C 15.247

TEST PROCEDURES: ANSI 63.4-2014, ANSI 63.10-2013, FCC Public Notice DA 00-705 March 30,2000, FCC KDB 996369 v01r04, FCC KDB 55807 4v03r02

MINIMUM STANDARD: The bandwidth of a frequency hopping channel is the -20 dB emission bandwidth, measured with the hopping stopped. 20dB Bandwidth measurement required to verify the correct channel spacing for Hopping frequencies.

MODIFICATIONS: No modification is required to comply for this test.

PERFORMANCE: Complies with standard.

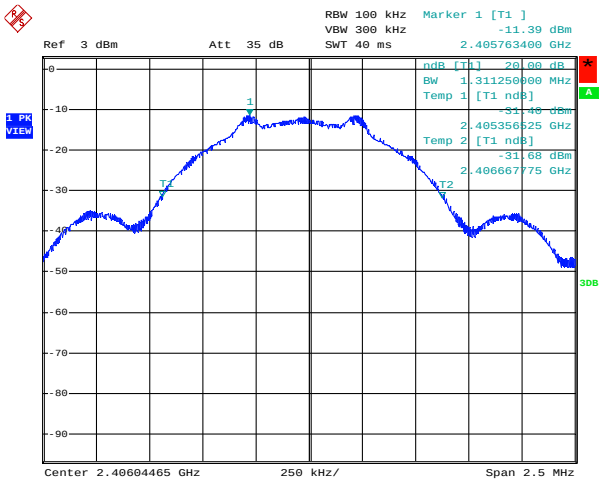
MEASUREMENT DATA:

Mode	Frequency(GHz)	20dB Channel Bandwidth (MHz)
Mode 2	2.40604465	1.31125
Mode 4	2.44	1.3128125
Mode 6	2.48	1.3053125
Mode A0	2.474004	1.228
Mode A16	2.474004	1.228
Mode J	2.450016	1.236
Mode L	2.474004	1.23

Notes:

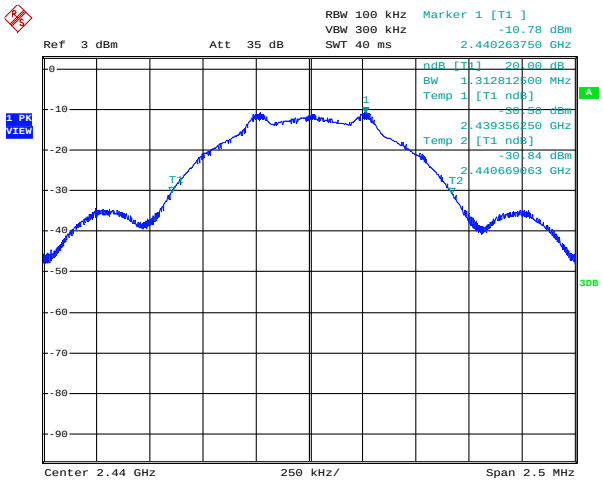
- Modes A thru H are the same modulation
- Modes 2, 4, 6 represent the worst case modulation for this transmitter
- Modes I and J are the same modulation
- Modes K and L are the same modulation
- Frequencies and Modes chosen are the worst case representation for this product.

Mode 2



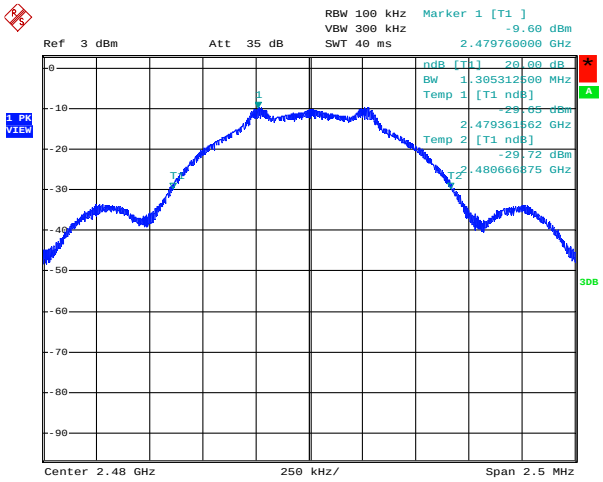
Date: 21.OCT.2014 21:22:07

Mode 4



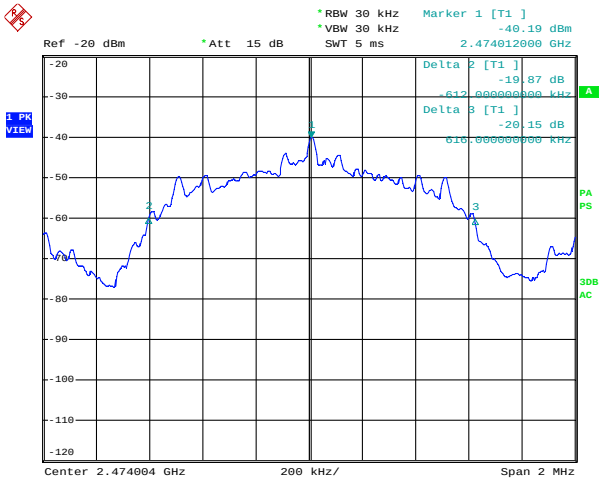
Date: 21.OCT.2014 21:27:30

Mode 6



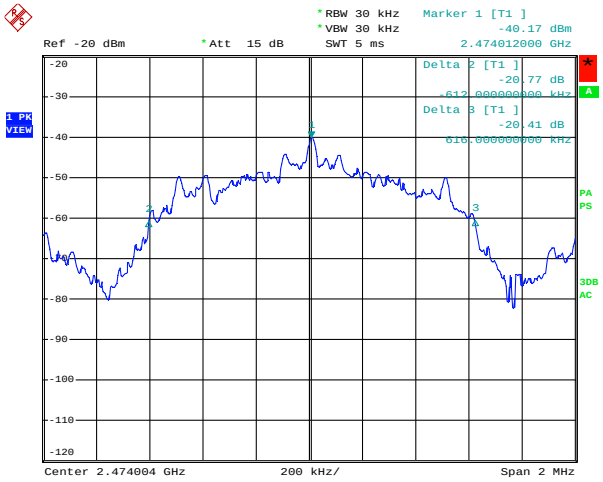
Date: 21.OCT.2014 21:31:40

Mode A0



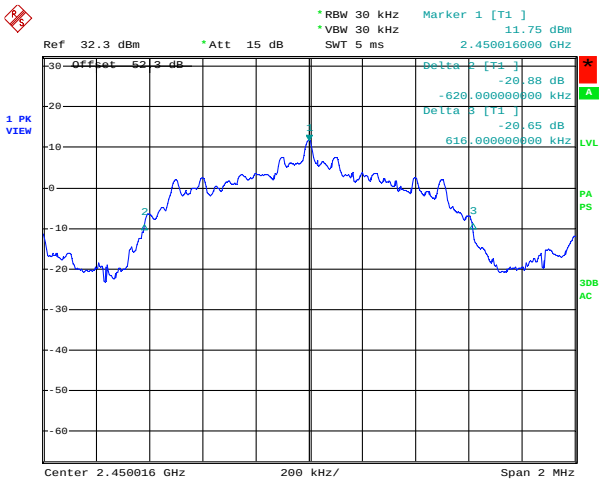
Date: 3.NOV.2014 22:47:27

Mode A16



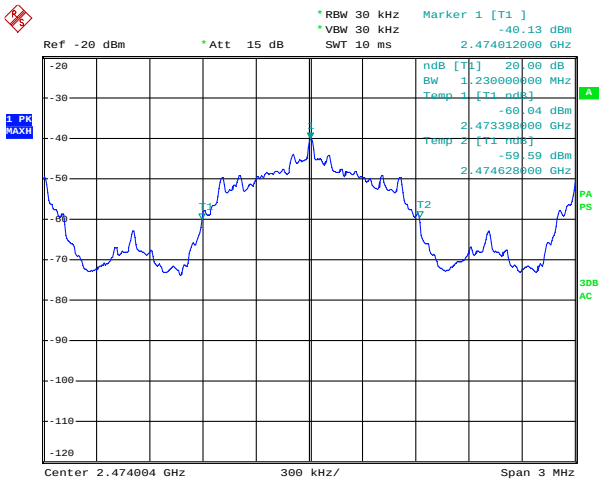
Date: 3.NOV.2014 22:36:25

Mode J



Date: 4.NOV.2014 20:52:41

Mode L



Date: 3.NOV.2014 21:59:14

Part 5 - Channel Separation

DATE: Nov-03-2014

TEST STANDARD: RSS-210 Iss.8 A8.1, FCC Part 15/C 15.247

TEST PROCEDURES: ANSI 63.4-2014, ANSI 63.10-2013, FCC Public Notice DA 00-705 March 30,2000, FCC KDB 996369 v01r04, FCC KDB 55807 4v03r02

MINIMUM STANDARD: Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the -20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the -20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W. (21dBm)

MODIFICATIONS: No modification is required to comply for this test.

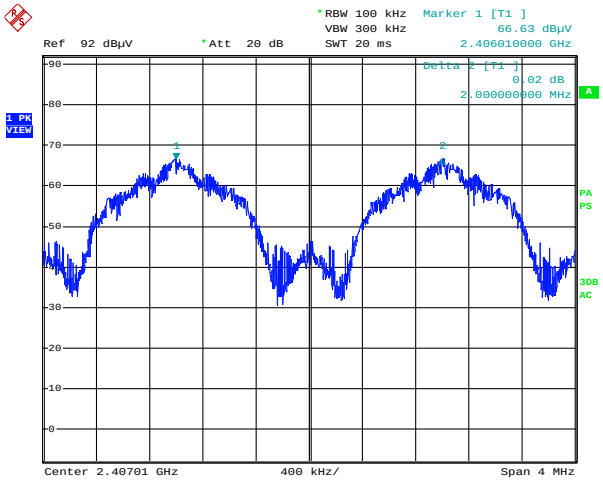
PERFORMANCE: Complies with standard.

MEASUREMENT DATA:

Worst case 20dB Occupied Bandwidth = Mode 4 = 1.31MHz

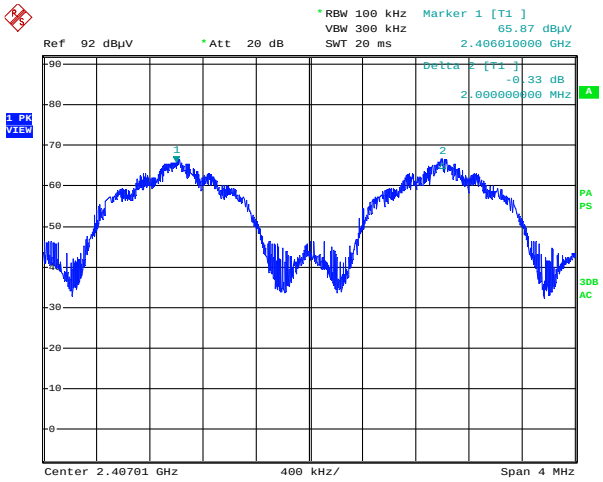
Mode	Channel Separation(MHz)
Mode A0	2
Mode A16	2
Mode B0	2
Mode B16	2
Mode C	2
Mode E	2
Mode F	2
Mode G	2
Mode H	2
Mode I	2
Mode J	2
Mode K	2
Mode L	2

Mode A0



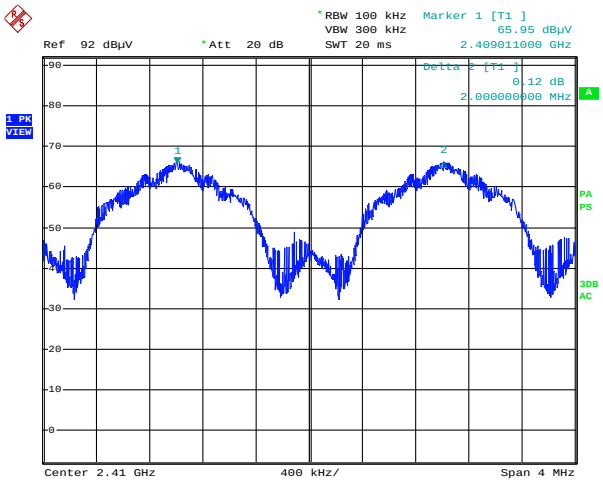
Date: 31.OCT.2014 21:08:12

Mode A16



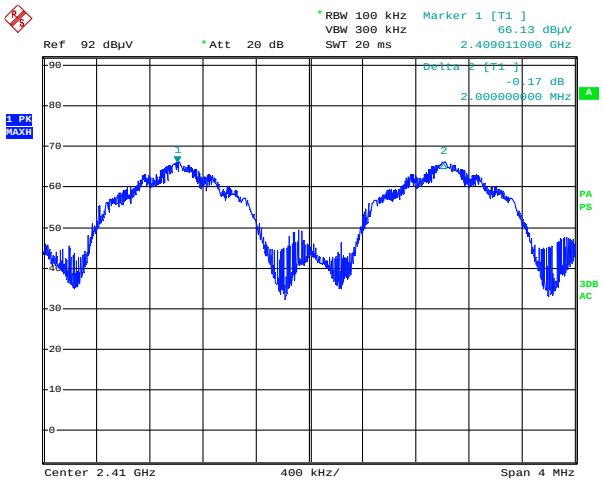
Date: 31.OCT.2014 21:06:18

Mode B0



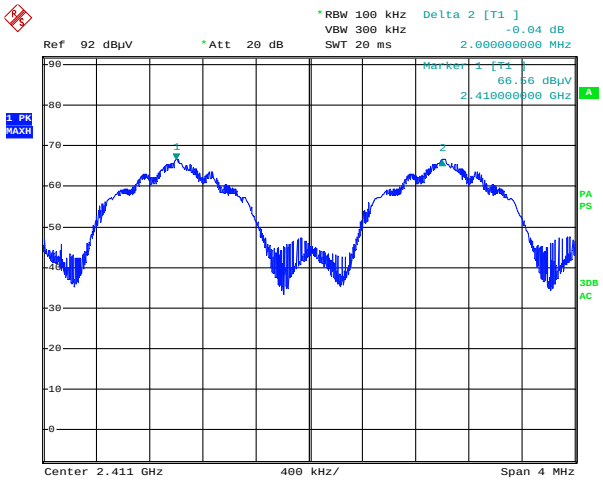
Date: 31.OCT.2014 21:15:39

Mode B16



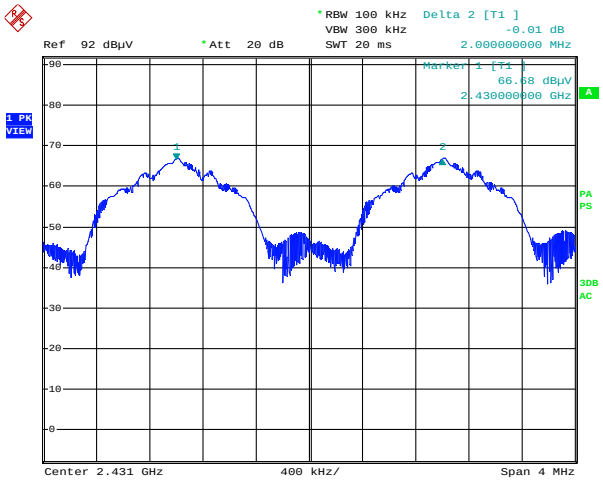
Date: 31.OCT.2014 21:12:50

Mode C



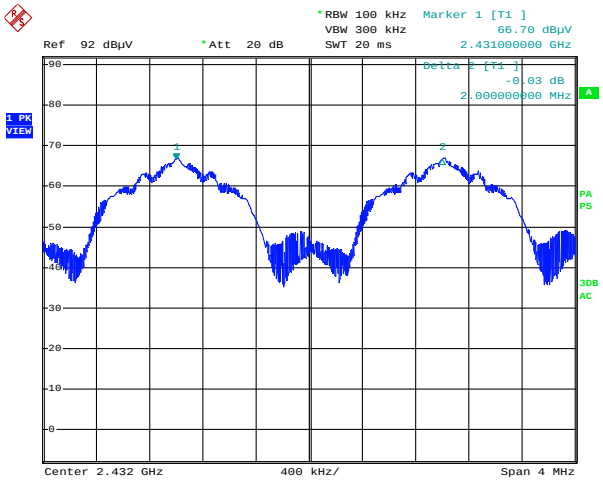
Date: 31.OCT.2014 21:25:58

Mode E



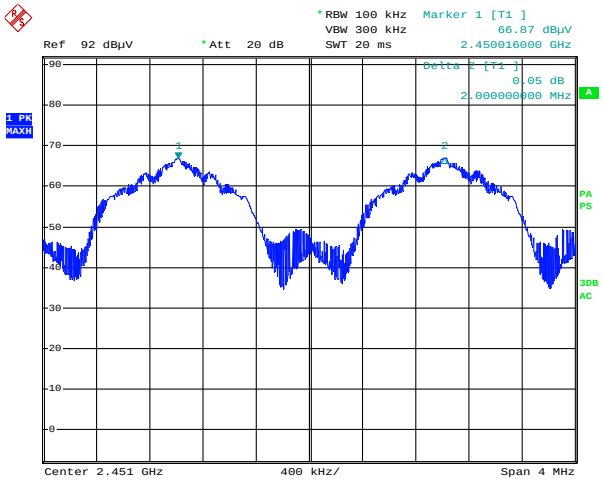
Date: 31.OCT.2014 21:41:48

Mode F



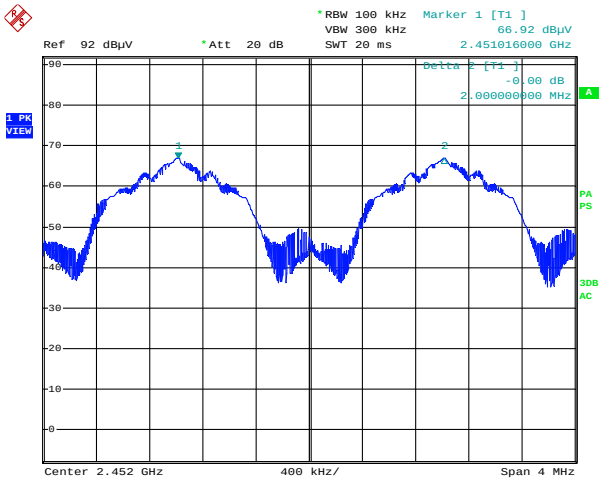
Date: 31.OCT.2014 21:48:15

Mode G



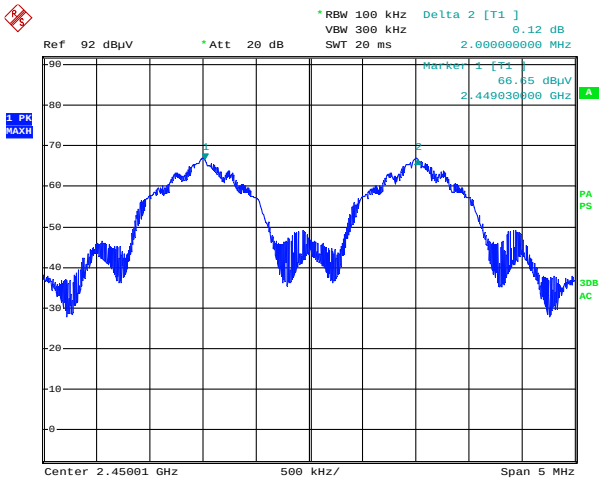
Date: 31.OCT.2014 21:57:09

Mode H



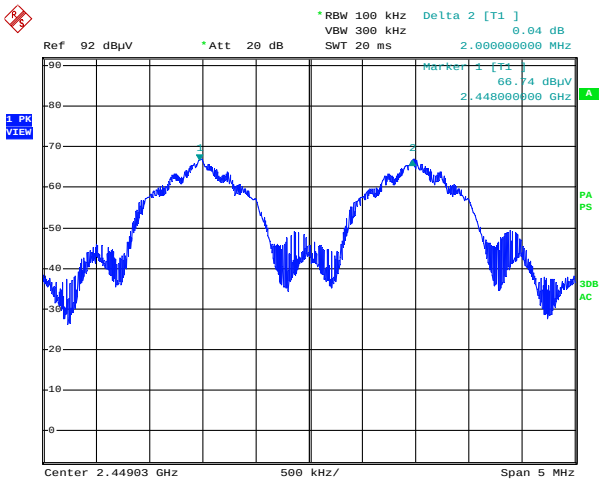
Date: 31.OCT.2014 22:08:17

Mode I



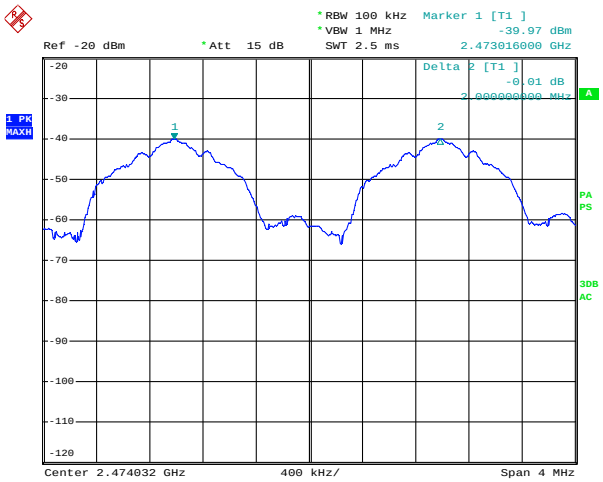
Date: 31.OCT.2014 22:25:18

Mode J

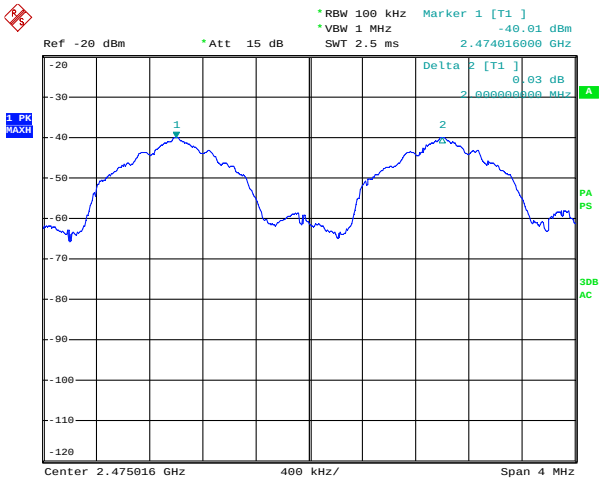


Date: 31.OCT.2014 22:29:39

Mode K



Date: 3.NOV.2014 19:12:31

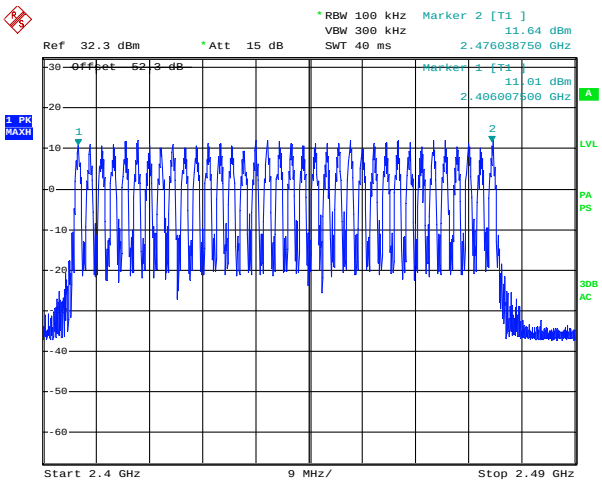
Mode L	
 Date: 3.NOV.2014 19:16:57	

Part 6 - Hopping Channels

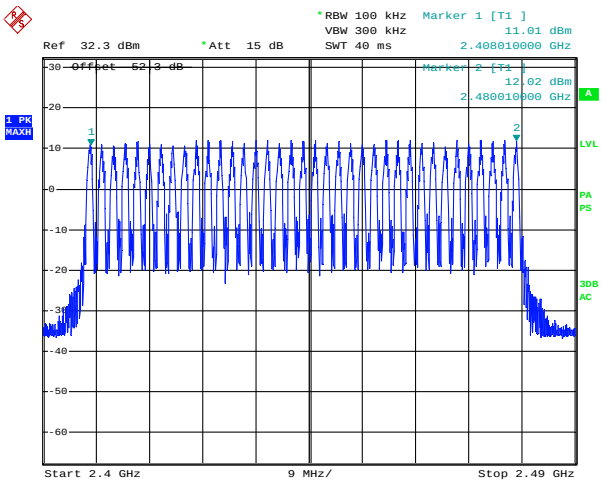
DATE:	Nov-04-2014
TEST STANDARD:	RSS-210 Iss.8 A8.1, FCC Part 15 Subpart C -15.247
TEST PROCEDURES:	ANSI 63.4-2014, ANSI 63.10-2013, FCC Public Notice DA 00-705 March 30,2000, FCC KDB 996369 v01r04, FCC KDB 55807 4v03r02
MINIMUM STANDARD:	At least 15 channels for Frequency Hopping Spread Spectrum systems (FHSS) in the band 2400-2483.5 MHz
MODIFICATIONS:	No modification is required to comply for this test.
PERFORMANCE:	Complies with standard

MEASUREMENT DATA:

Mode	A0	Mode	A16
Number of Channels	36	Number of Channels	37

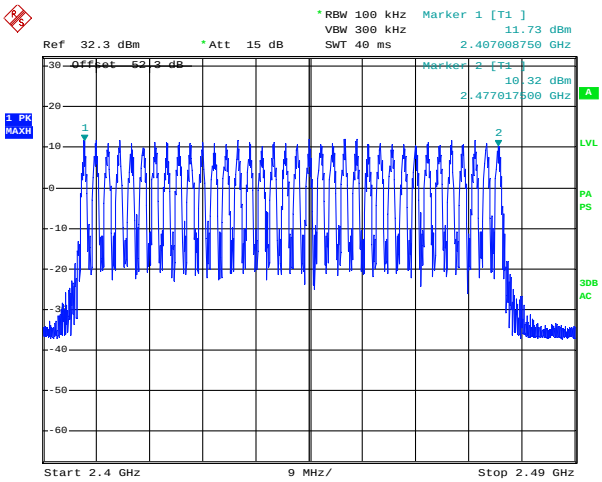


Date: 4.NOV.2014 22:53:16

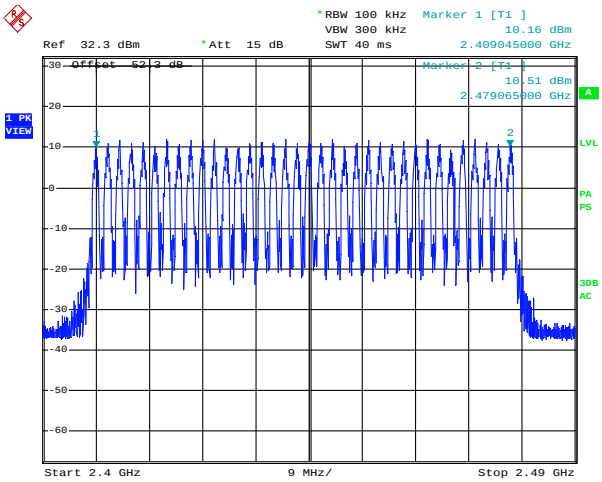


Date: 4.NOV.2014 23:00:07

Mode	B0	Mode	B16
Number of Channels	36	Number of Channels	36

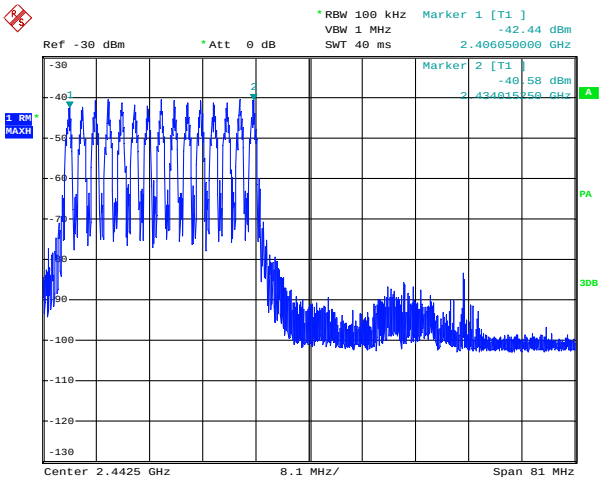


Date: 4.NOV.2014 22:46:57

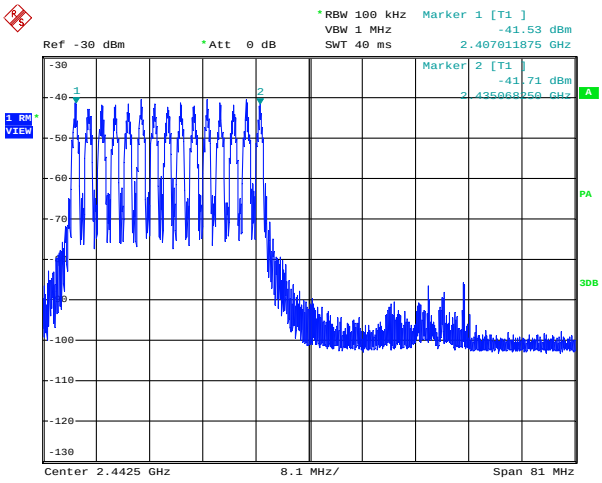


Date: 4.NOV.2014 22:50:22

Mode	C	Mode	D
Number of Channels	15	Number of Channels	15

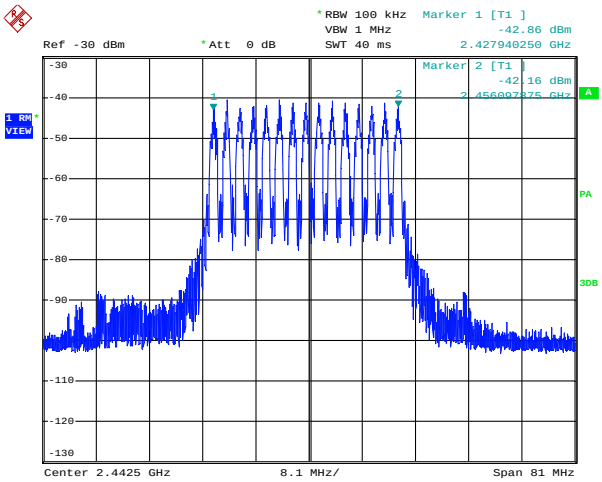


Date: 28.OCT.2014 00:10:44

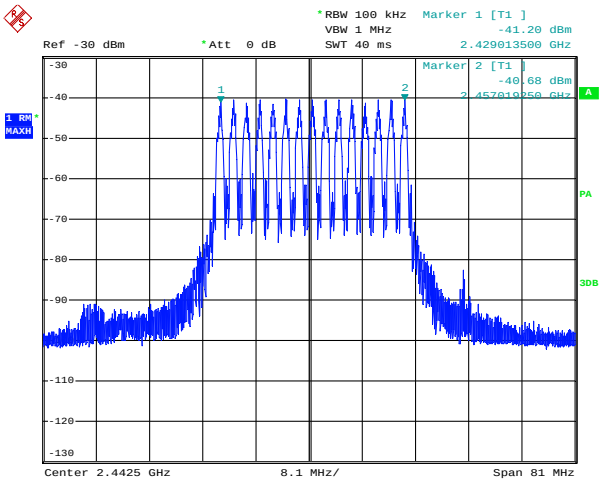


Date: 28.OCT.2014 00:13:34

Mode	E	Mode	F
Number of Channels	15	Number of Channels	15

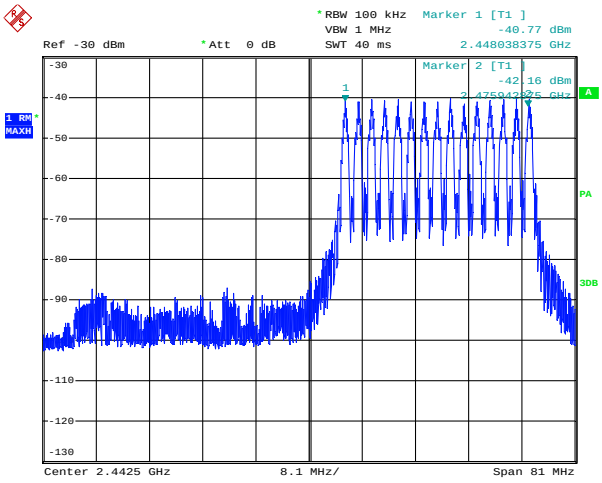


Date: 28.OCT.2014 00:16:04

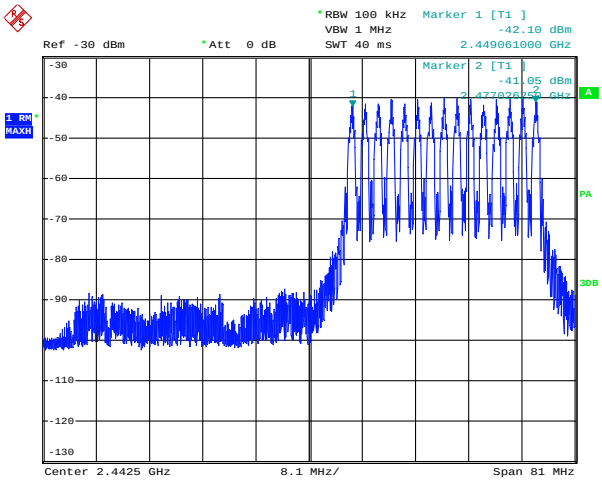


Date: 28.OCT.2014 00:21:35

Mode	G	Mode	H
Number of Channels	15	Number of Channels	15

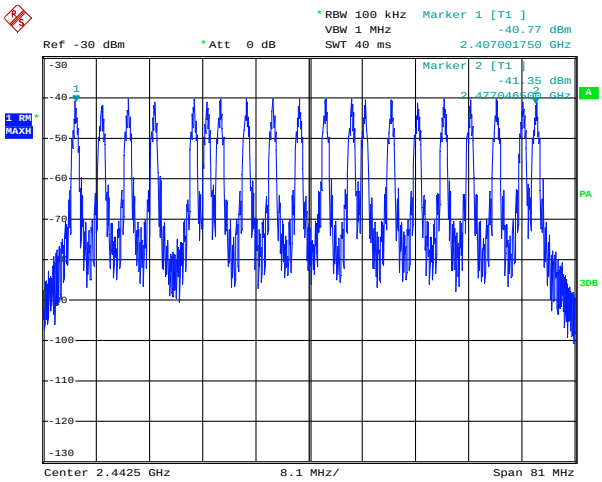


Date: 28.OCT.2014 00:24:42

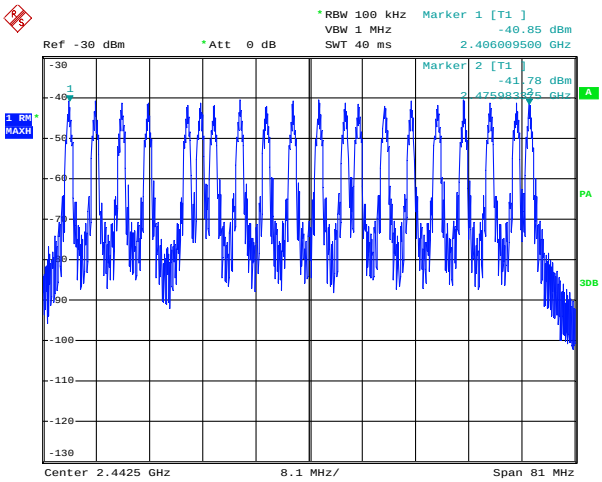


Date: 28.OCT.2014 00:28:24

Mode	I	Mode	J
Number of Channels	20	Number of Channels	20

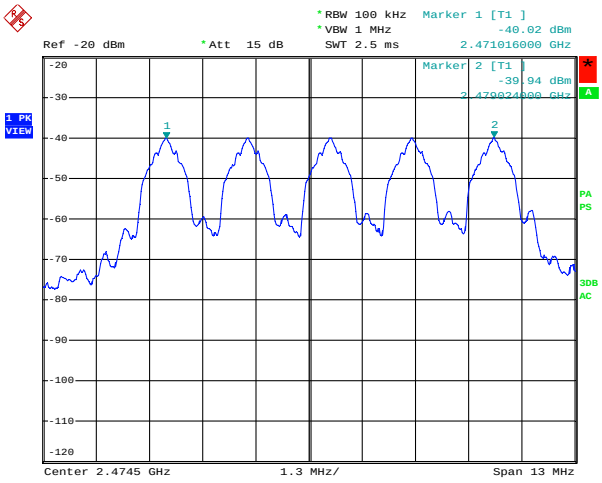


Date: 28.OCT.2014 00:32:47

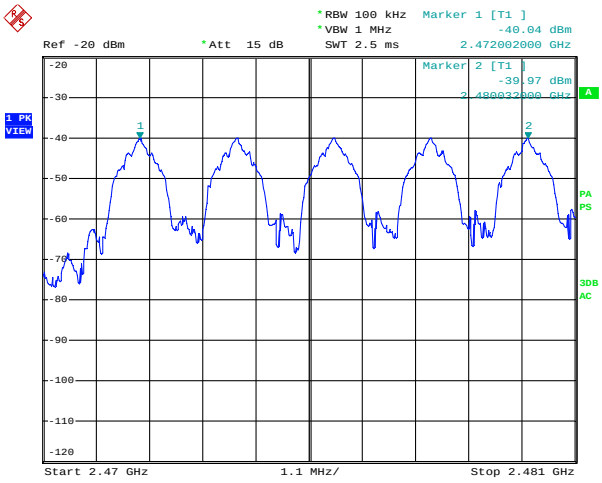


Date: 28.OCT.2014 00:40:51

Mode	K	Mode	L
Number of Channels	5	Number of Channels	5



Date: 3.NOV.2014 19:08:17



Date: 3.NOV.2014 19:19:29

Part 7 - Occupancy Time

DATE: Nov-03-2014

TEST STANDARD: RSS-210 Iss.8 A8.1, FCC Part 15 Subpart C -15.247

TEST PROCEDURES: ANSI 63.4-2014, ANSI 63.10-2013, FCC Public Notice DA 00-705 March 30,2000, FCC KDB 996369 v01r04, FCC KDB 55807 4v03r02

MINIMUM STANDARD: Occupancy Time on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed.

MODIFICATIONS: No modification is required to comply for this test.

PERFORMANCE: Complies with standard,

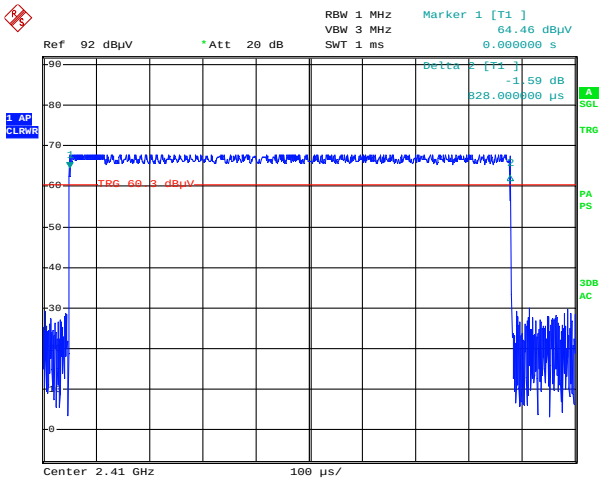
MEASUREMENT DATA:

Mode	Occupancy time per pulse (ms)	Interval time (ms)	Number of Channels	Pulses per 100ms	Duration period (400msXnumber Channel)	measurement per duration period (ms)	Limit (ms)	Result
A0	0.828	81	36	2	14400	238.464	400	Pass
A16	0.828	81	37	2	14800	245.088	400	Pass
B0	0.828	81	36	2	14400	238.464	400	Pass
B16	0.828	81	36	2	14400	238.464	400	Pass
C	0.828	33.24	15	3	6000	149.04	400	Pass
D	0.828	33.27	15	3	6000	149.04	400	Pass
E	0.828	33.27	15	3	6000	149.04	400	Pass
F	0.828	33.27	15	3	6000	149.04	400	Pass
G	0.828	33.27	15	3	6000	149.04	400	Pass
H	0.828	33.27	15	3	6000	149.04	400	Pass
I	0.828	44.67	20	3	8000	198.72	400	Pass
J	0.828	44.61	20	3	8000	198.72	400	Pass
K	0.829	10.75	5	9	2000	149.22	400	Pass
L	0.829	11.75	5	9	2000	149.22	400	Pass

Calculation method:
On time measurement per duration period =((Duration Period) x (pulses per 100ms) x (Occupancy time)) ÷ 100

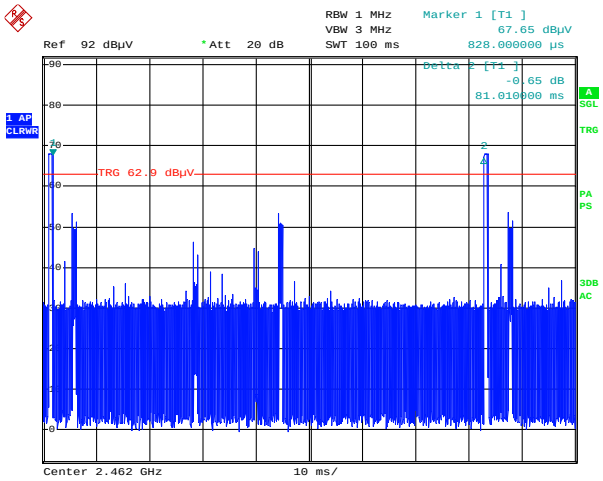
Mode A0

Occupancy time per pulse



Date: 31.OCT.2014 22:44:58

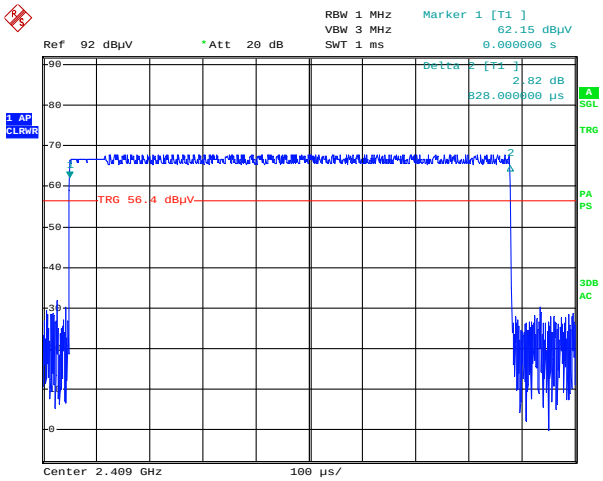
Interval time



Date: 31.OCT.2014 23:22:17

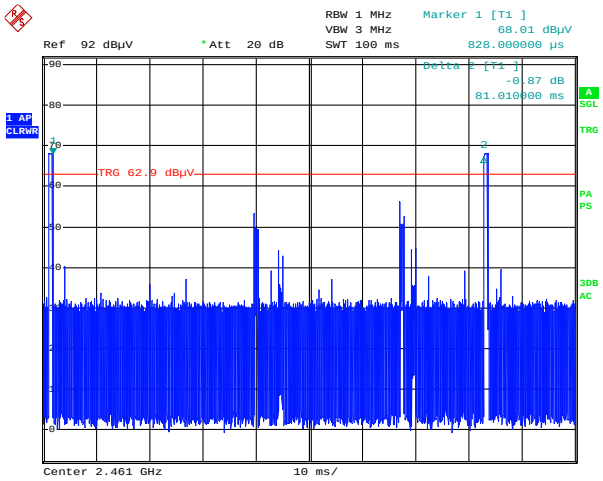
Mode B0

Occupancy time per pulse



Date: 31.OCT.2014 22:53:27

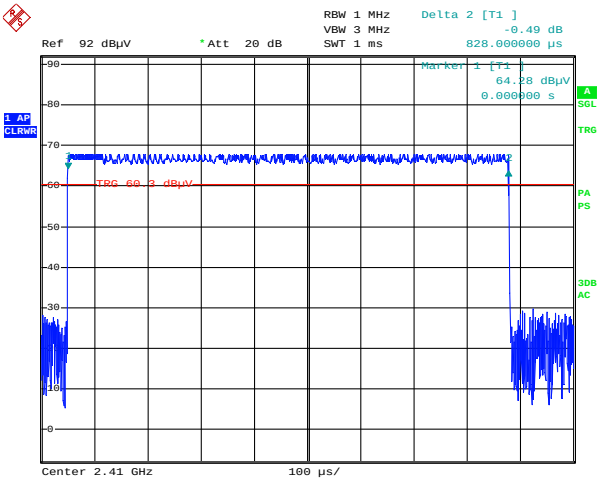
Interval time



Date: 31.OCT.2014 23:24:16

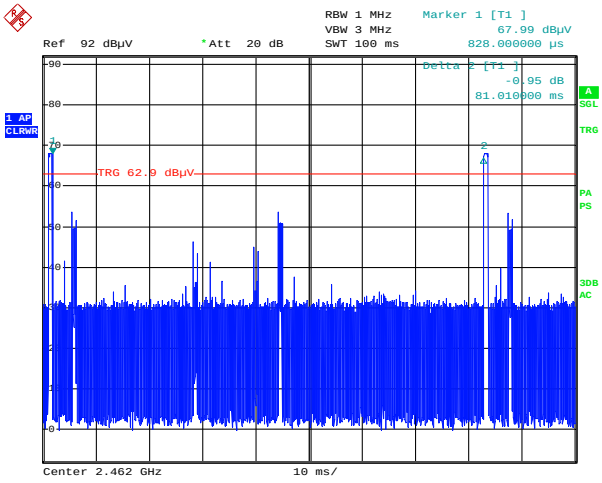
Mode A16

Occupancy time per pulse



Date: 31.OCT.2014 22:44:02

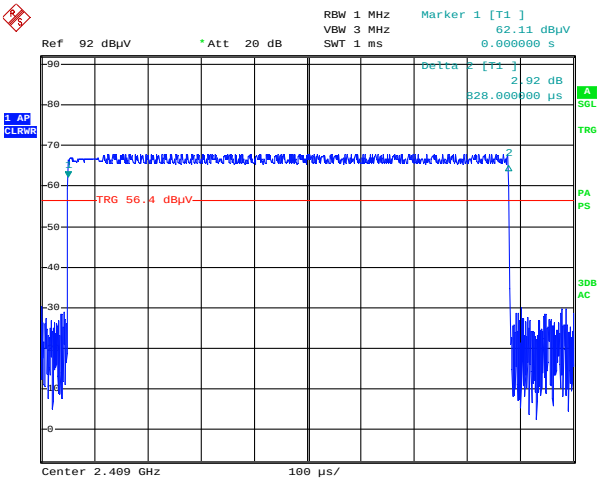
Interval time



Date: 31.OCT.2014 23:21:32

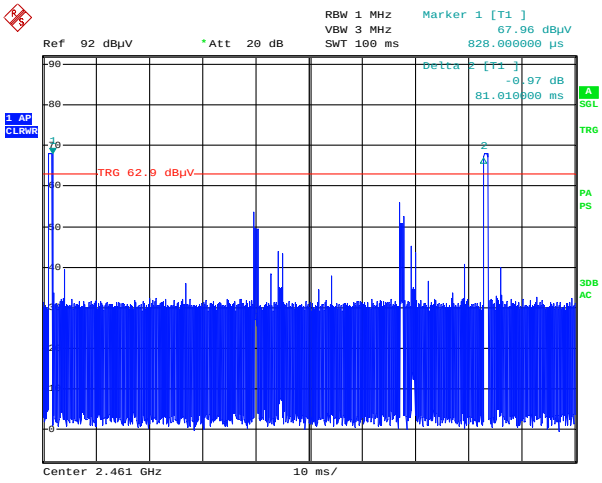
Mode B16

Occupancy time per pulse



Date: 31.OCT.2014 22:52:52

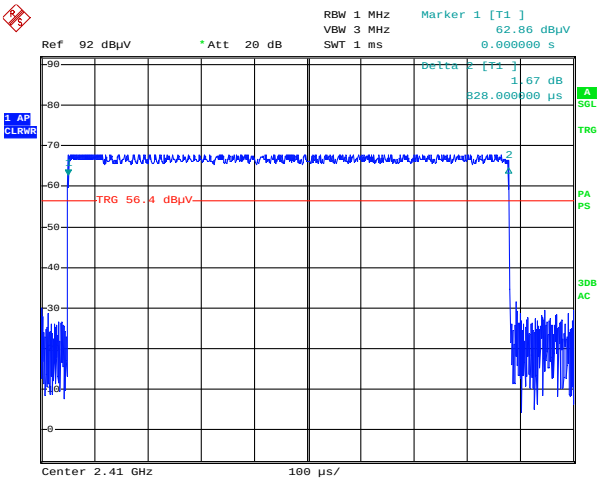
Interval time



Date: 31.OCT.2014 23:23:29

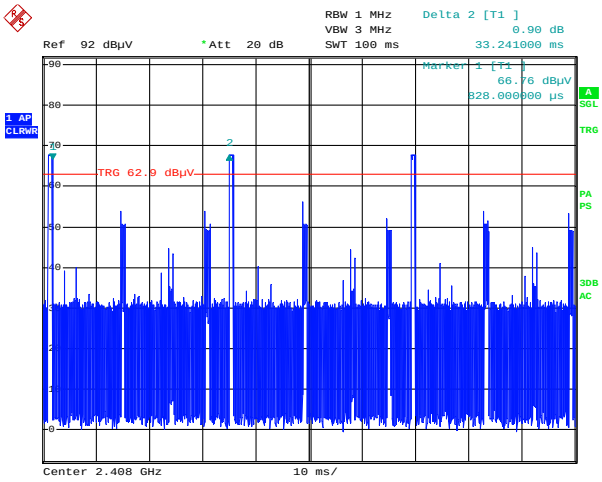
Mode C

Occupancy time per pulse



Date: 31.OCT.2014 22:54:18

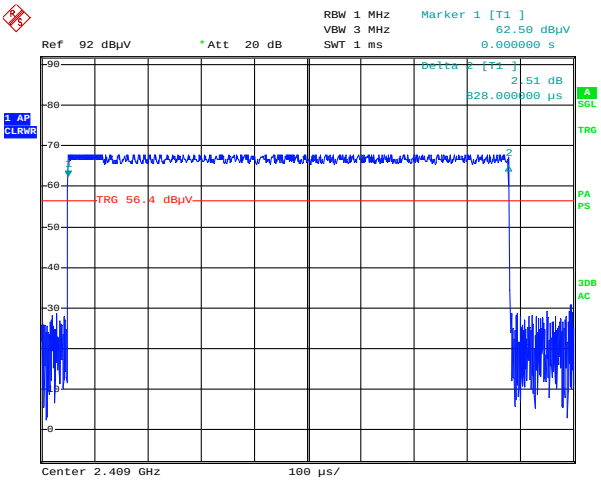
Interval time



Date: 31.OCT.2014 23:28:14

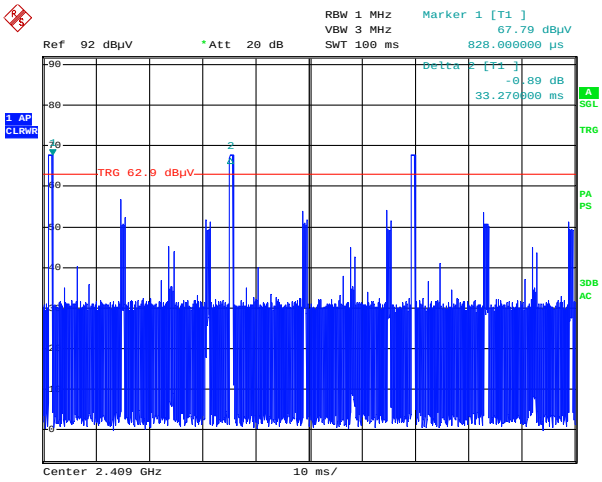
Mode D

Occupancy time per pulse



Date: 31.OCT.2014 22:51:47

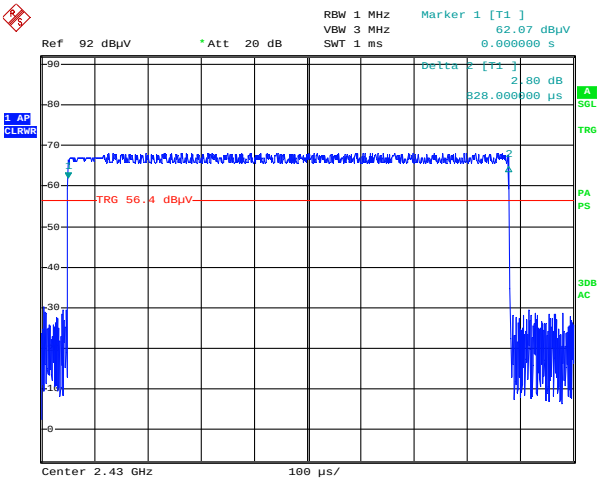
Interval time



Date: 31.OCT.2014 23:30:39

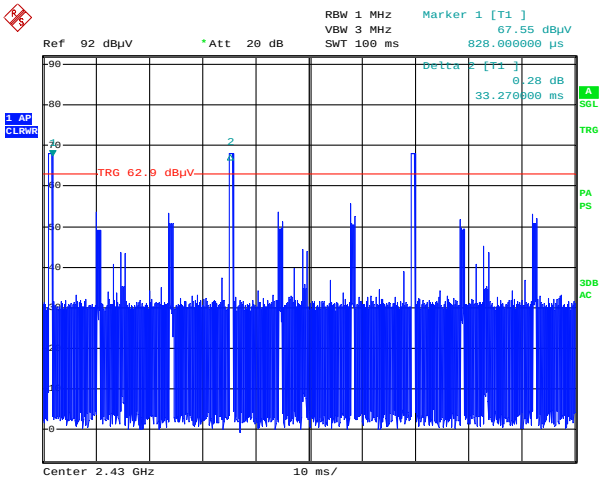
Mode E

Occupancy time per pulse



Date: 31.OCT.2014 22:55:16

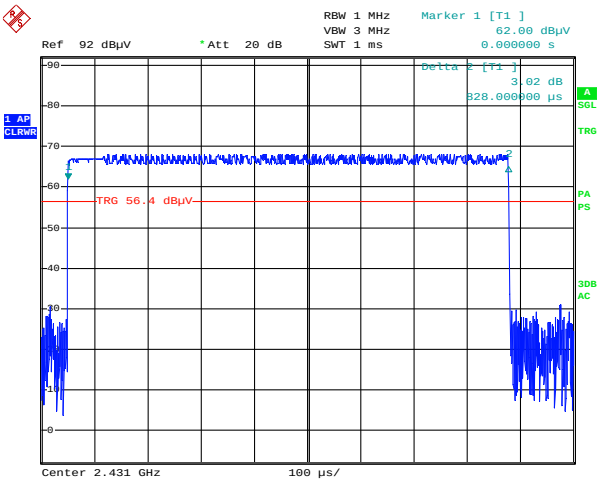
Interval time



Date: 31.OCT.2014 23:31:46

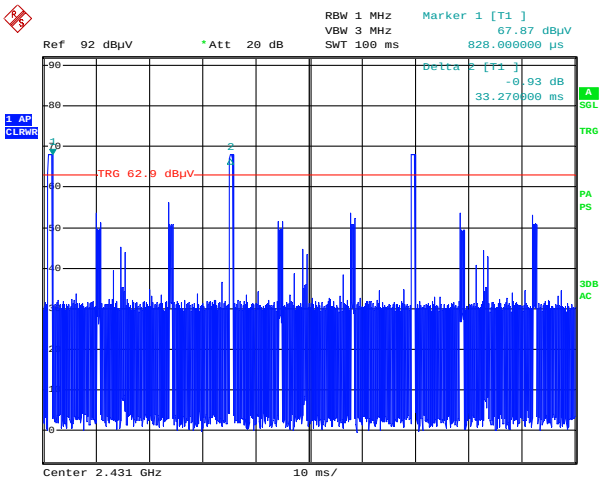
Mode F

Occupancy time per pulse



Date: 31.OCT.2014 22:56:37

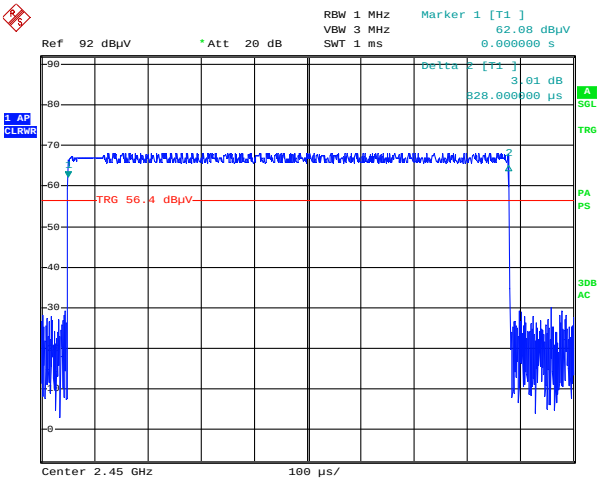
Interval time



Date: 31.OCT.2014 23:32:50

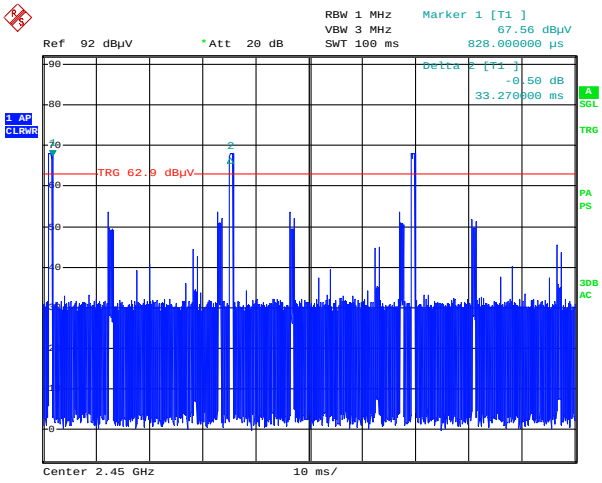
Mode G

Occupancy time per pulse



Date: 31.OCT.2014 22:57:43

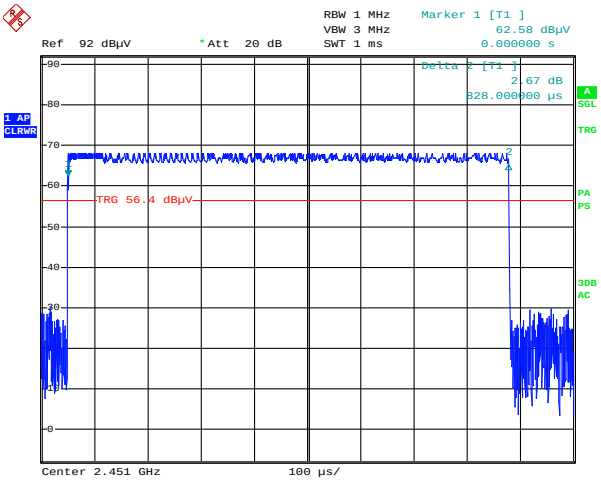
Interval time



Date: 31.OCT.2014 23:33:47

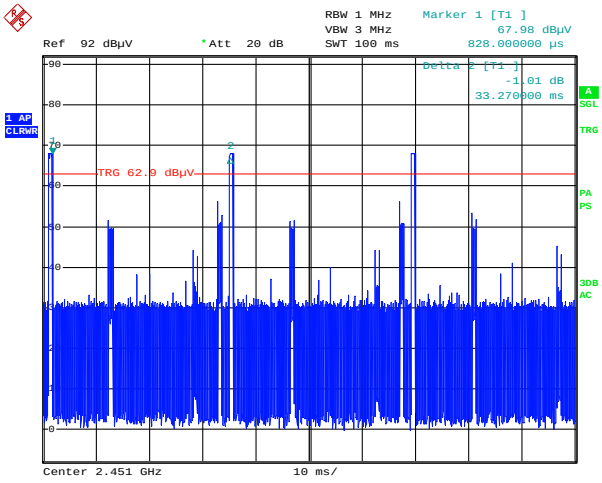
Mode H

Occupancy time per pulse



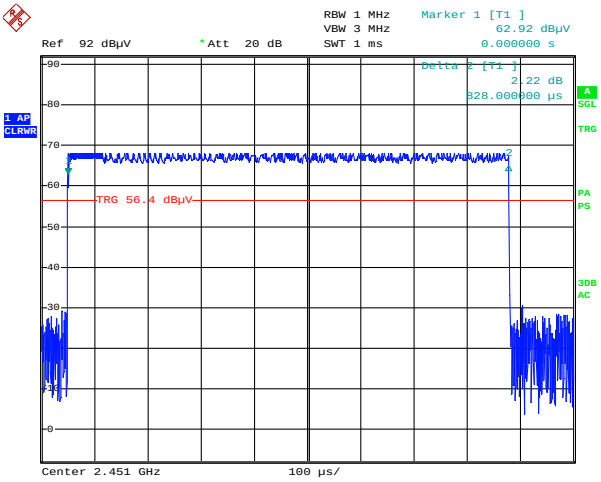
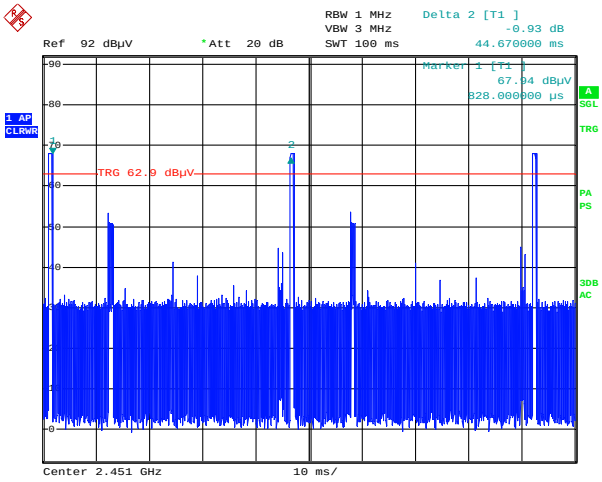
Date: 31.OCT.2014 22:58:56

Interval time

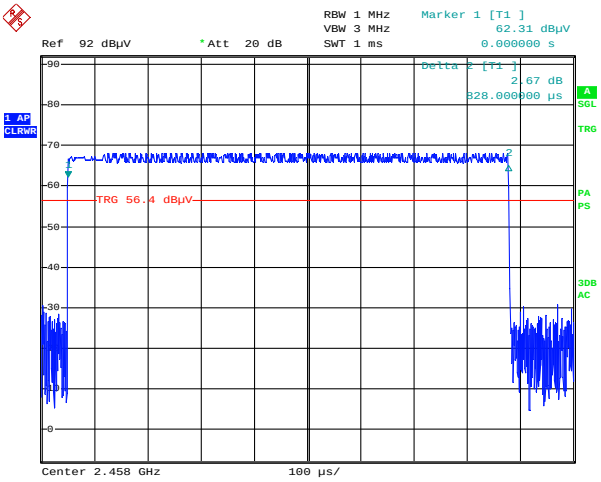
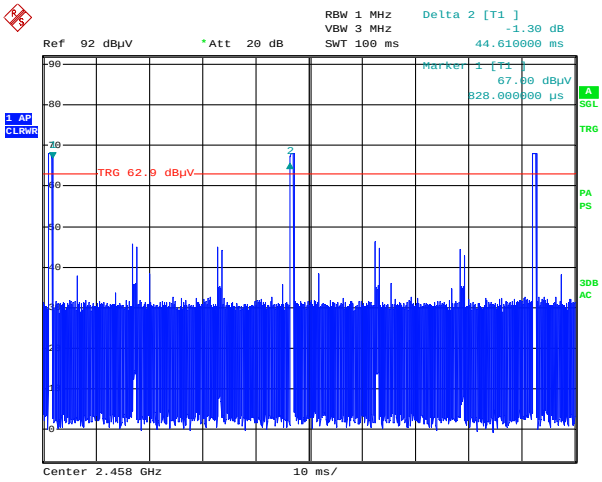


Date: 31.OCT.2014 23:34:44

Mode I

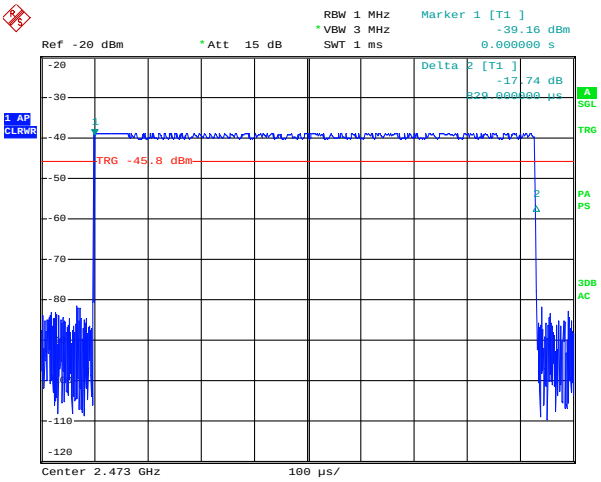
Occupancy time per pulse	Interval time
 Date: 31.OCT.2014 22:59:47	 Date: 31.OCT.2014 23:36:37

Mode J

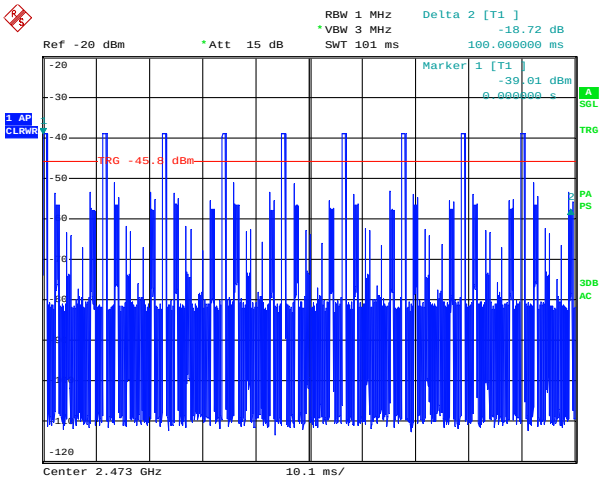
Occupancy time per pulse	Interval time
 Date: 31.OCT.2014 23:02:16	 Date: 31.OCT.2014 23:17:59

Mode K

Occupancy time per pulse	Interval time



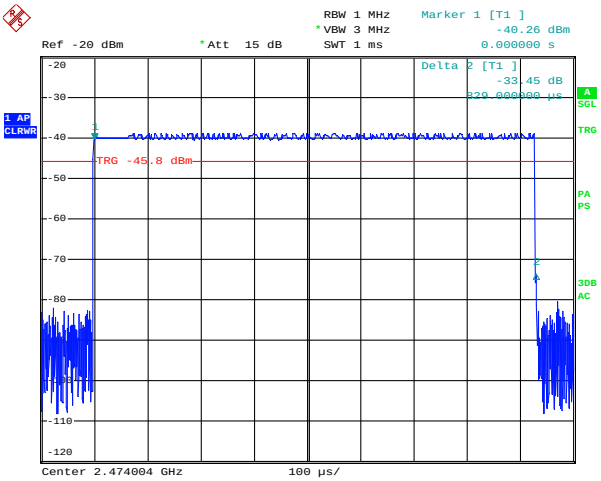
Date: 3.NOV.2014 19:34:04



Date: 3.NOV.2014 19:37:23

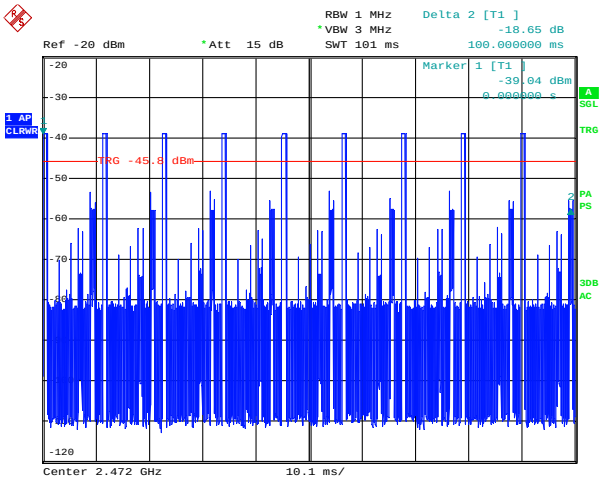
Mode L

Occupancy time per pulse



Date: 3.NOV.2014 19:27:38

Interval time



Date: 3.NOV.2014 19:38:48

Part 8 - Conducted Output Power

DATE: Nov-05-2014

TEST STANDARD: RSS-210 Iss.8 A8.4, FCC Part 15 Subpart C -15.247

TEST PROCEDURES: ANSI 63.4-2014, ANSI 63.10-2013, FCC Public Notice DA 00-705 March 30,2000, FCC KDB 996369 v01r04, FCC KDB 55807 4v03r02

MINIMUM STANDARD: For frequency hopping systems operating in the band 2400-2483.5 MHz and employing at least 75 hopping channels, the maximum peak conducted output power shall not exceed 1 W; for all other frequency hopping systems in the band, the maximum peak conducted output power shall not exceed 0.125 W (21dBm).

METHOD OF MEASUREMENT: The Spectrum Analyzer is connected directly to the PCB antenna port; the conducted output power was measured at this point. A 50dB attenuator with 2.2dB cable loss was used to protect the instrumentation. The 52.2dB correction was added as the offset for the instrumentation and is included in the plot.

MODIFICATIONS: No modification is required to comply for this test.

PERFORMANCE: Complies with standard.

MEASUREMENT DATA:

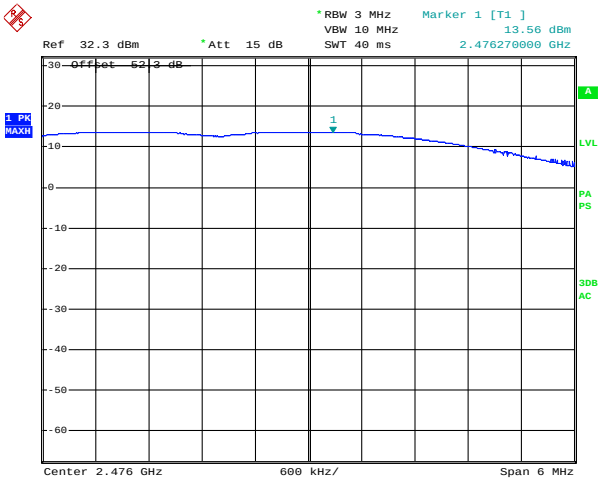
Conducted Output Power measurements
Summary of Highest Measurements per Frequency

Mode	Freq	Meas. Output Power
	(MHz)	(dBm)
C	2406	13.29
B0	2440	13.35
A16	2480	13.65

Mode		A0	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2476	13.56	21
MID	2440	13.35	21
LOW	2406	13.22	21

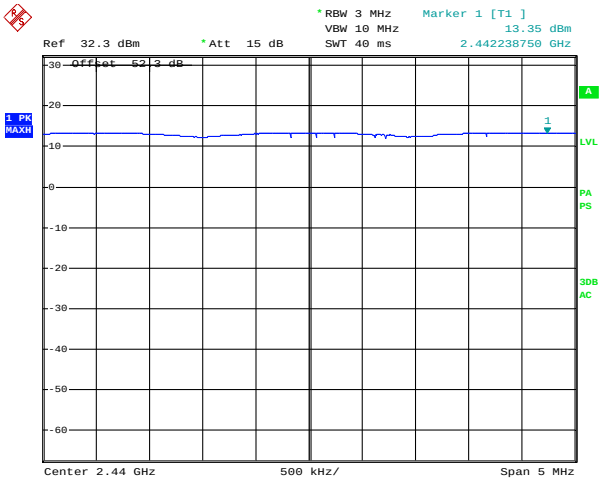
Result: Pass

HI



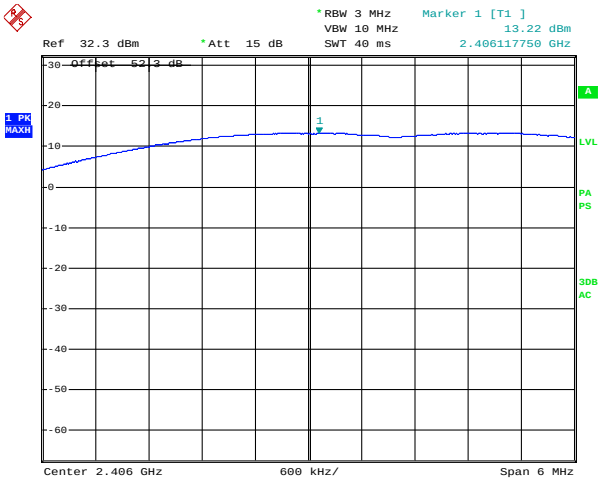
Date: 4.NOV.2014 23:50:39

MID



Date: 5.NOV.2014 18:13:03

LOW

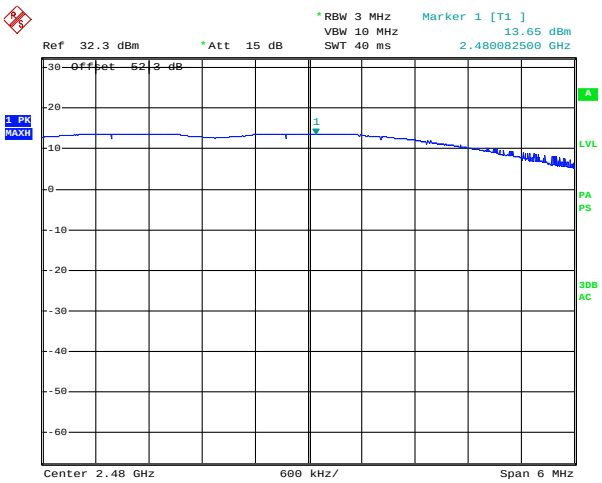


Date: 4.NOV.2014 22:17:51

Mode		A16	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2480	13.65	21
MID	2442	13.38	21
LOW	2408	13.26	21

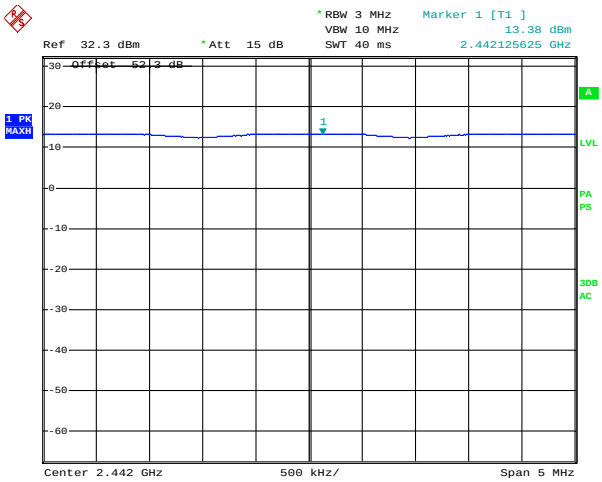
Result: Pass

HI



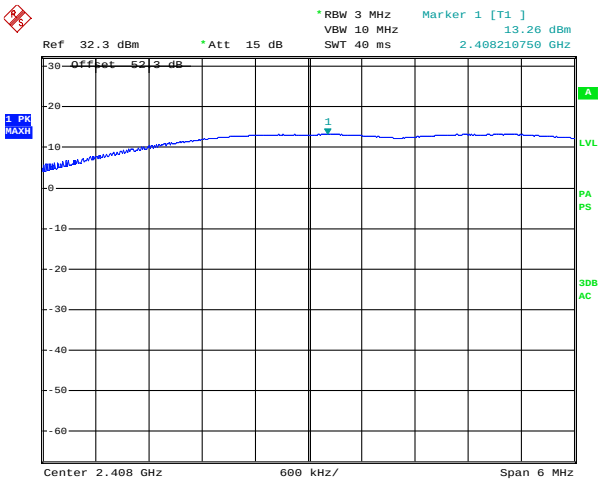
Date: 4.NOV.2014 23:53:58

MID



Date: 5.NOV.2014 18:17:03

LOW

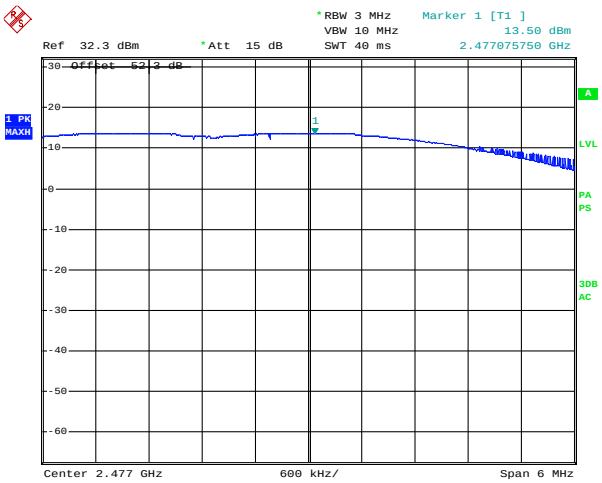


Date: 4.NOV.2014 22:23:52

Mode		B0	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2477	13.5	21
MID	2441	13.35	21
LOW	2407	13.13	21

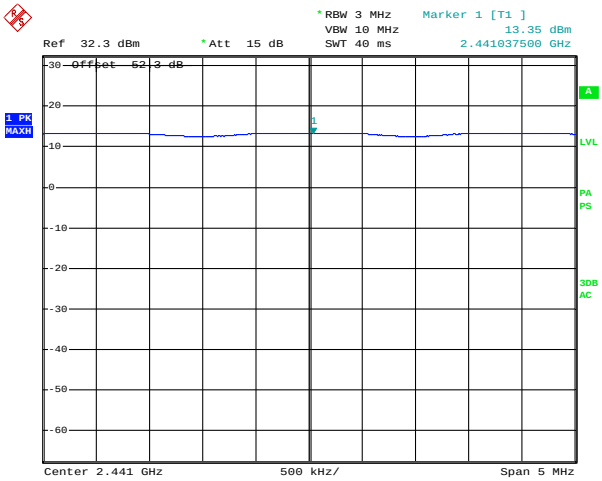
Result: Pass

HI



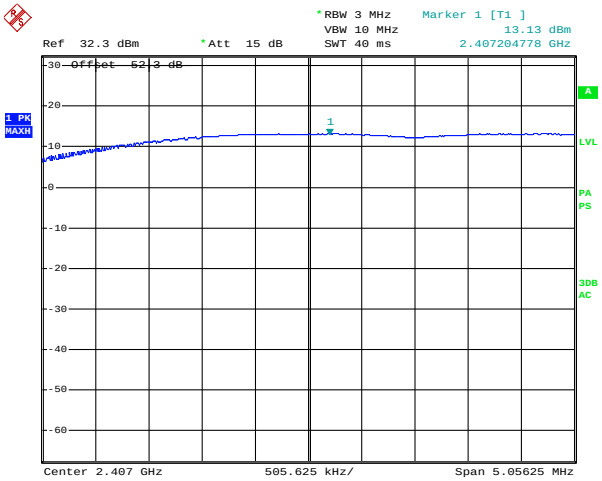
Date: 4.NOV.2014 23:59:52

MID



Date: 5.NOV.2014 18:22:44

LOW

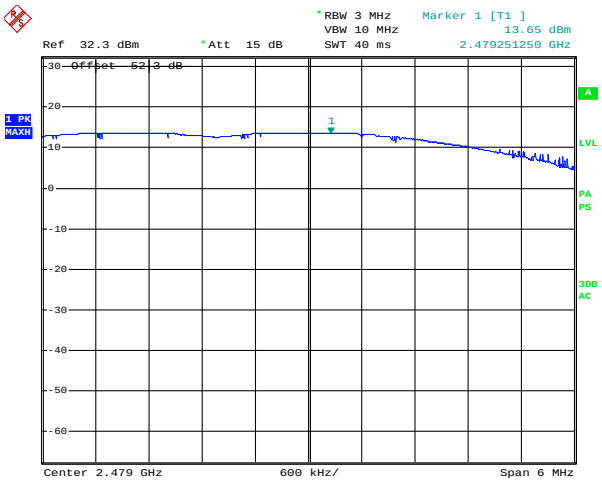


Date: 4.NOV.2014 22:43:40

Mode		B16	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2479	13.65	21
MID	2443	13.38	21
LOW	2409	13.29	21

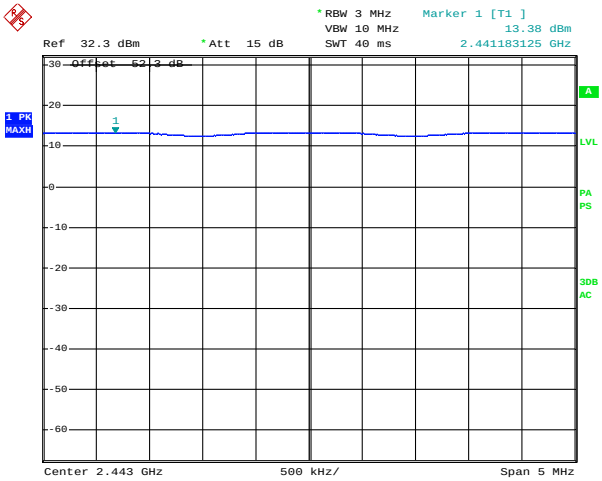
Result: Pass

HI



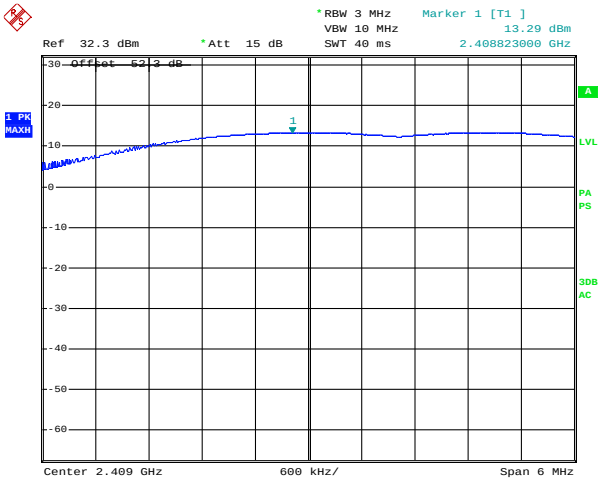
Date: 4.NOV.2014 23:56:21

MID



Date: 5.NOV.2014 18:29:29

LOW

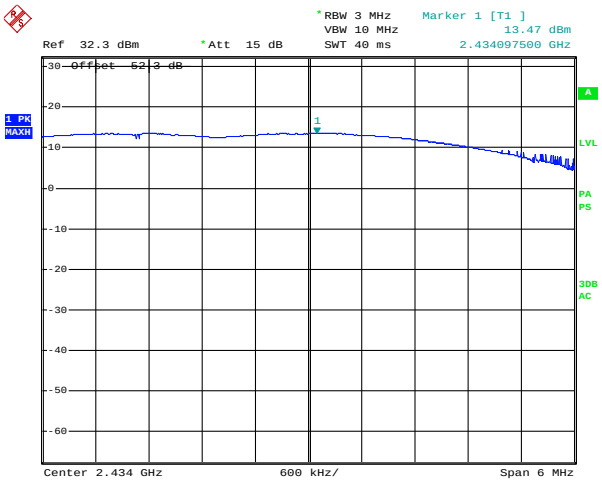


Date: 4.NOV.2014 23:09:01

Mode		C	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2434	13.47	21
MID	2420	13.35	21
LOW	2406	13.29	21

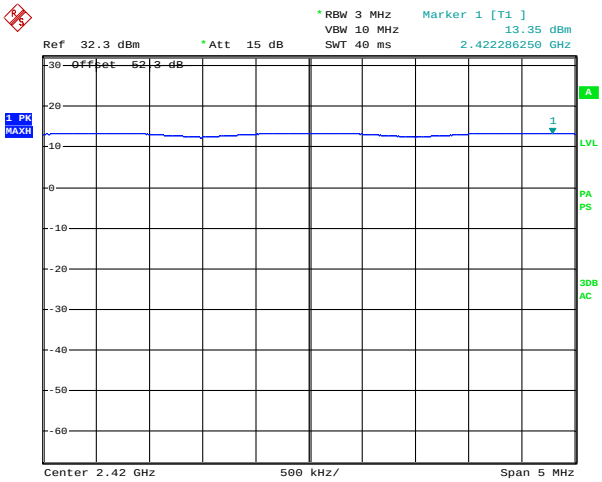
Result: Pass

HI



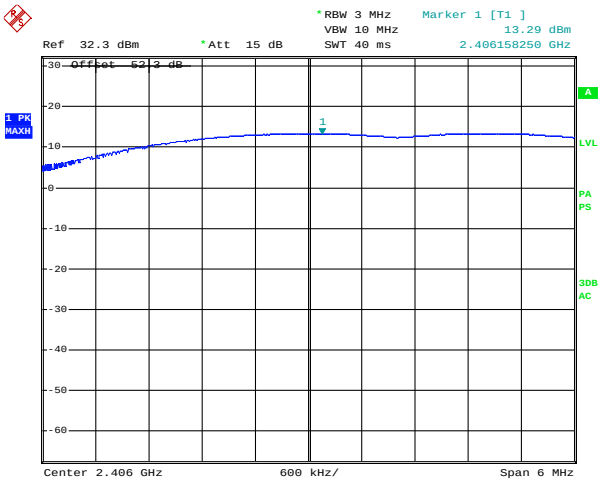
Date: 5.NOV.2014 00:01:34

MID



Date: 5.NOV.2014 18:33:12

LOW

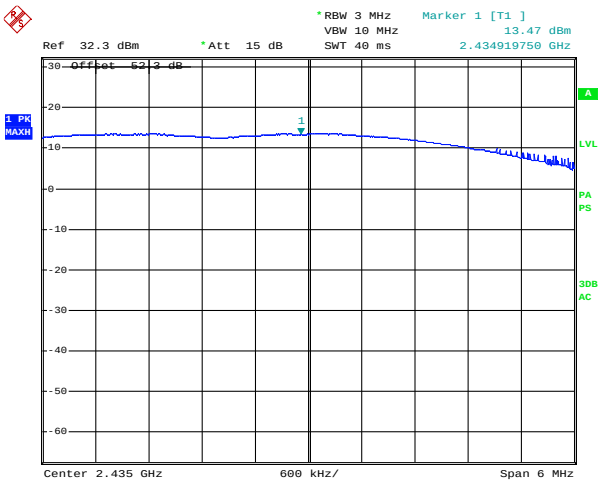


Date: 4.NOV.2014 23:12:13

Mode		D	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2435	13.47	21
MID	2421	13.35	21
LOW	2407	13.26	21

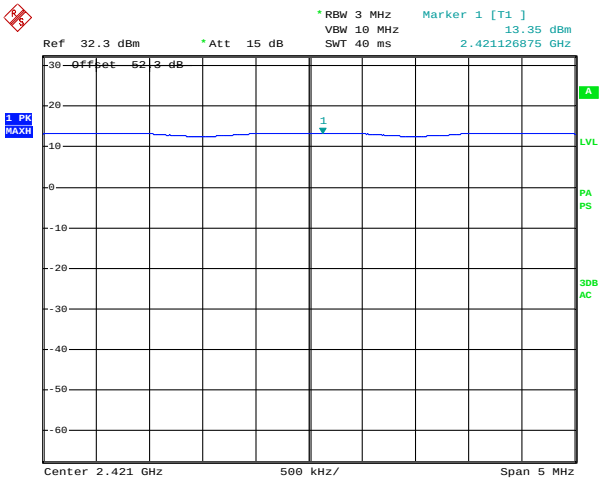
Result: Pass

HI



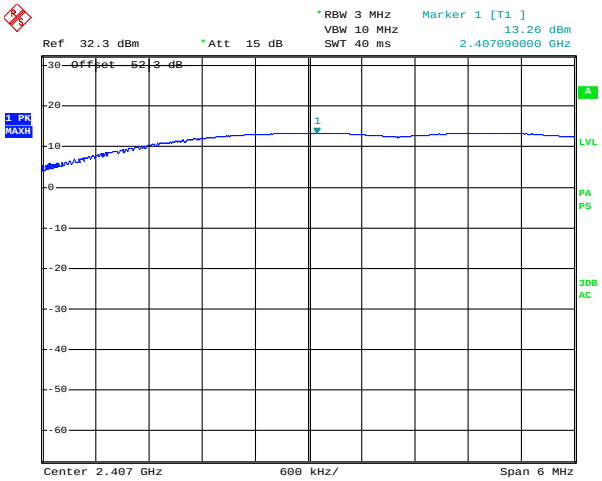
Date: 5.NOV.2014 00:03:10

MID



Date: 5.NOV.2014 18:36:18

LOW

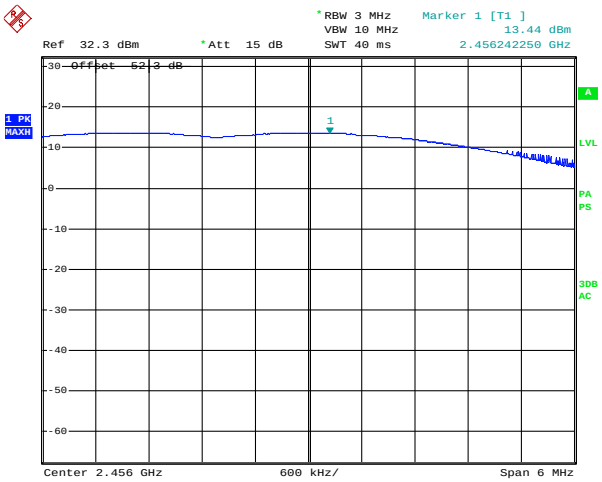


Date: 4.NOV.2014 23:15:25

Mode		E	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2456	13.44	21
MID	2442	13.41	21
LOW	2420	13.41	21

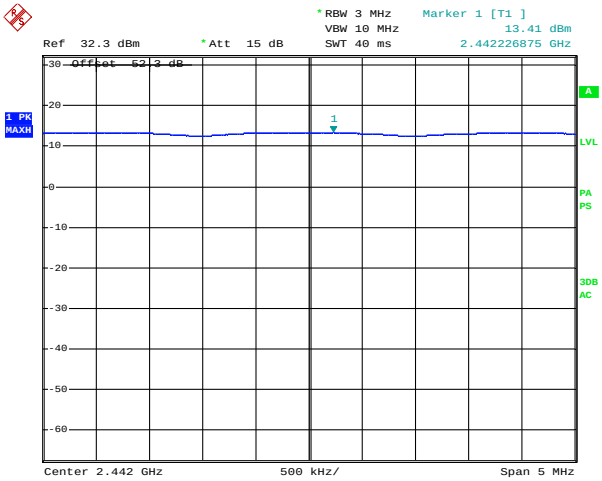
Result: Pass

HI



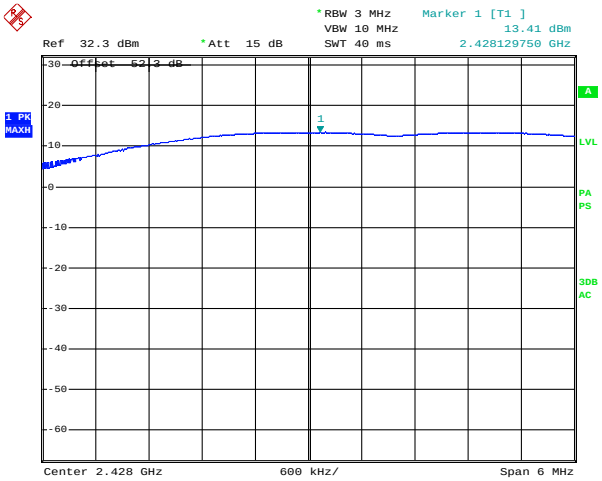
Date: 5.NOV.2014 00:05:14

MID



Date: 5.NOV.2014 18:44:38

LOW

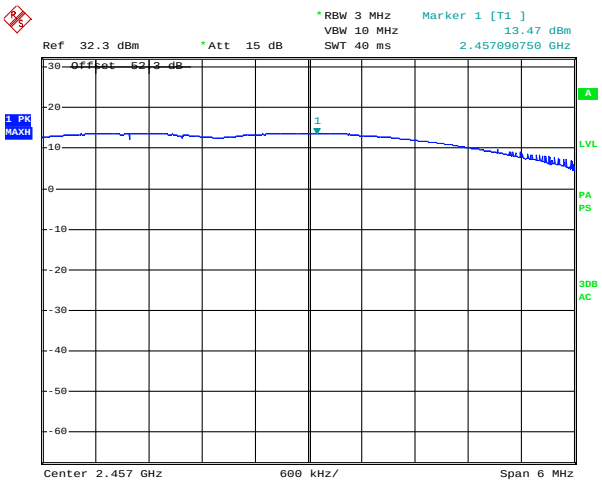


Date: 4.NOV.2014 23:19:35

Mode		F	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2457	13.47	21
MID	2443	13.41	21
LOW	2429	13.41	21

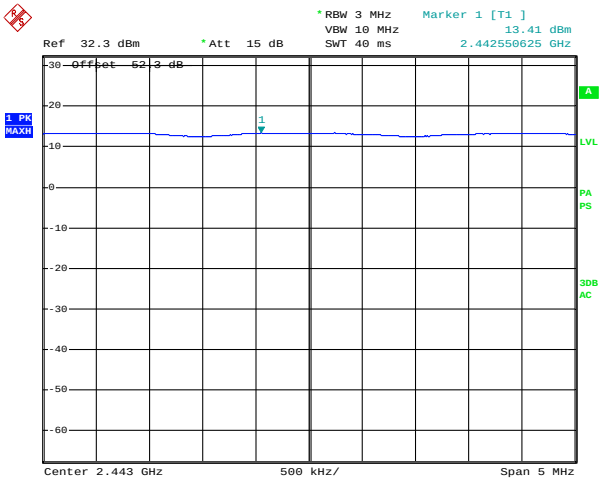
Result: Pass

HI



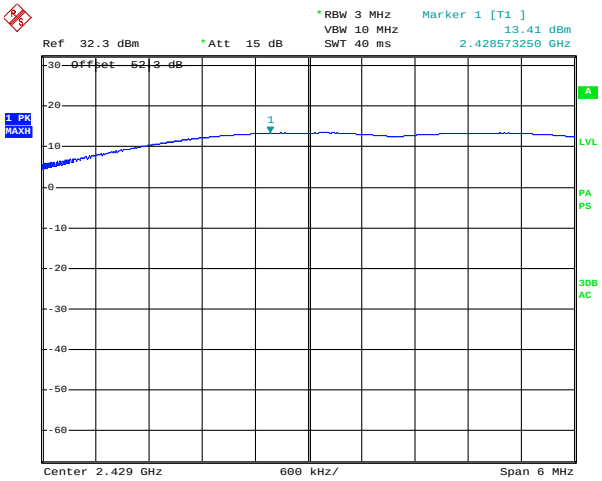
Date: 5.NOV.2014 00:06:59

MID



Date: 5.NOV.2014 18:48:39

LOW

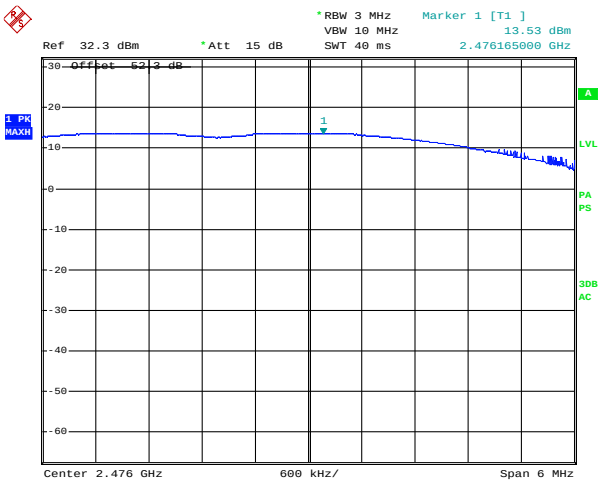


Date: 4.NOV.2014 23:26:44

Mode		G	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2476	13.53	21
MID	2462	13.44	21
LOW	2440	13.47	21

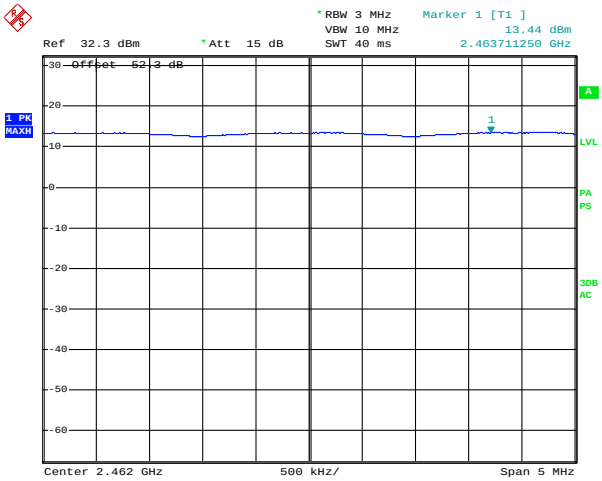
Result: Pass

HI



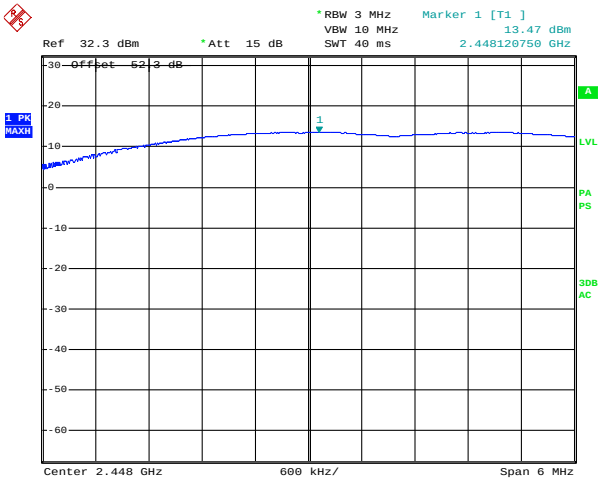
Date: 5.NOV.2014 00:08:44

MID



Date: 5.NOV.2014 18:53:38

LOW

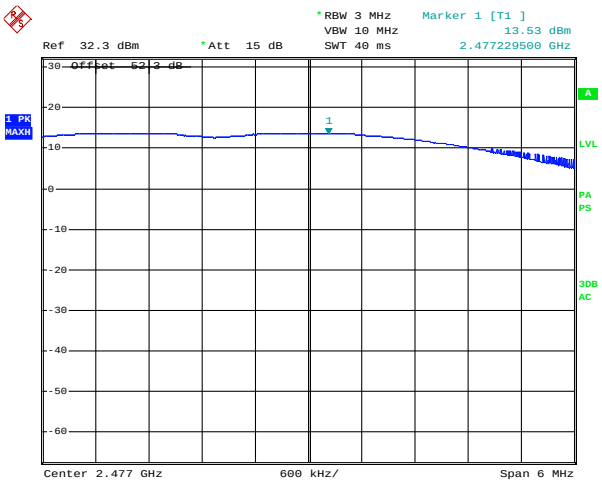


Date: 4.NOV.2014 23:29:22

Mode		H	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2477	13.53	21
MID	2463	13.44	21
LOW	2449	13.5	21

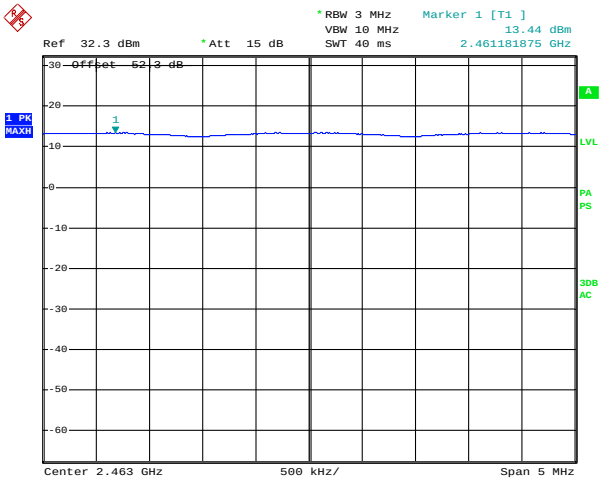
Result: Pass

HI



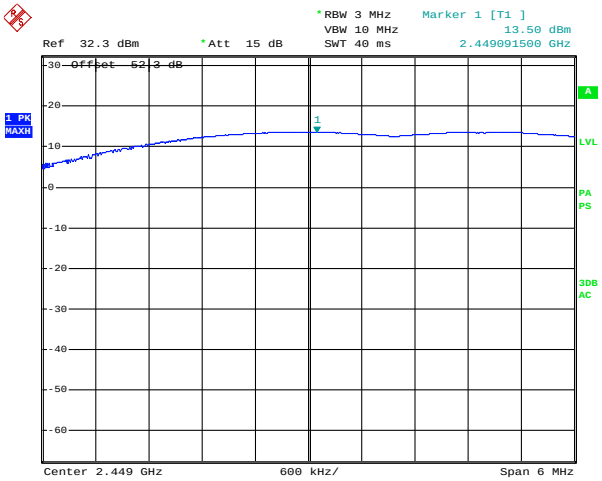
Date: 5.NOV.2014 00:11:09

MID



Date: 5.NOV.2014 18:55:55

LOW

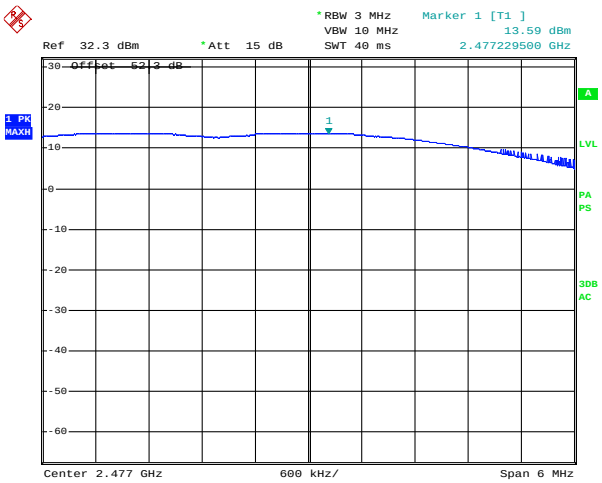


Date: 4.NOV.2014 23:36:44

Mode		I	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2477	13.59	21
MID	2441	13.38	21
LOW	2407	13.29	21

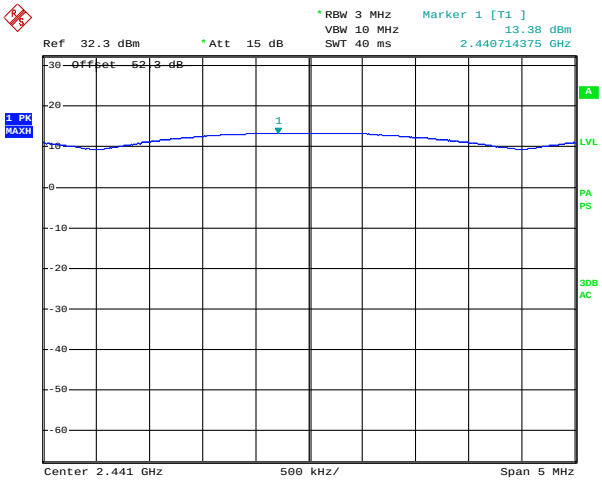
Result: Pass

HI



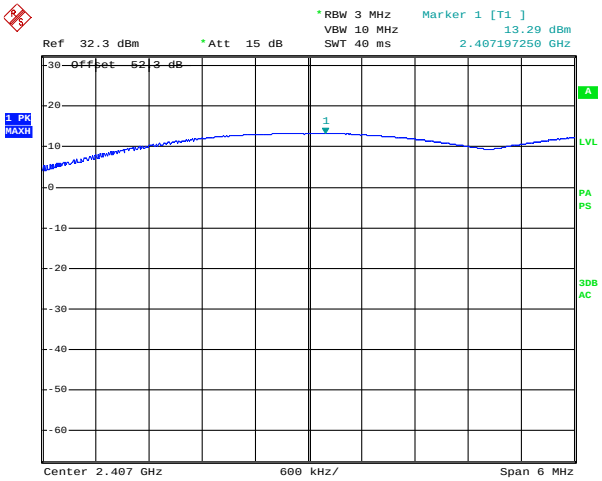
Date: 5.NOV.2014 00:13:37

MID



Date: 5.NOV.2014 18:58:09

LOW

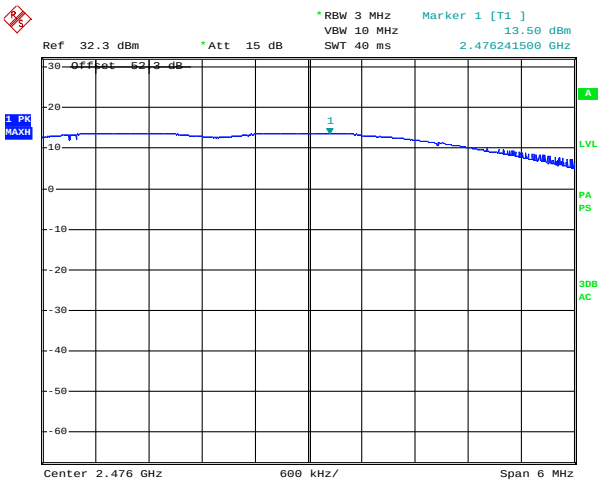


Date: 4.NOV.2014 23:40:03

Mode		J	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2476	13.5	21
MID	2440	13.35	21
LOW	2406	13.26	21

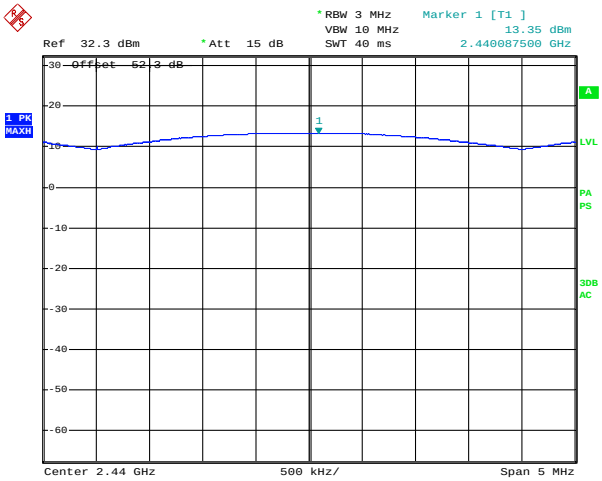
Result: Pass

HI



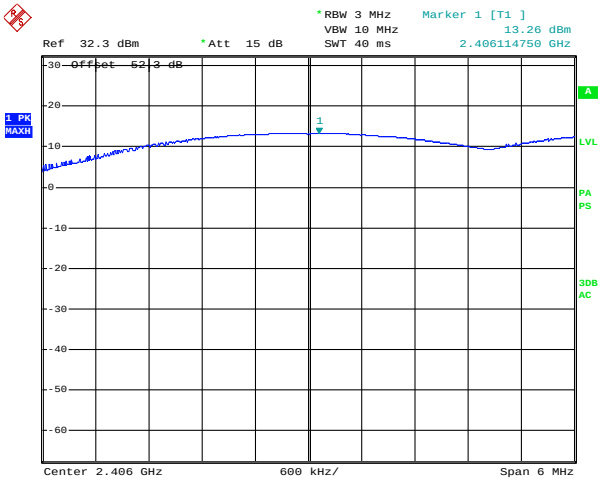
Date: 5.NOV.2014 00:15:56

MID



Date: 5.NOV.2014 19:15:11

LOW

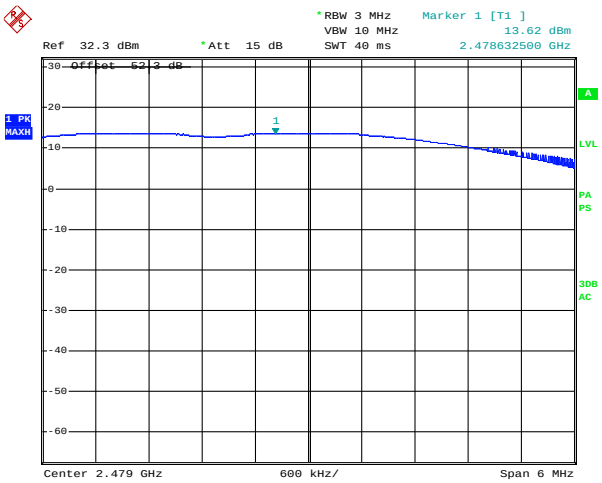


Date: 4.NOV.2014 23:43:49

Mode		K	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2479	13.62	21
MID	2475	13.59	21
LOW	2471	13.56	21

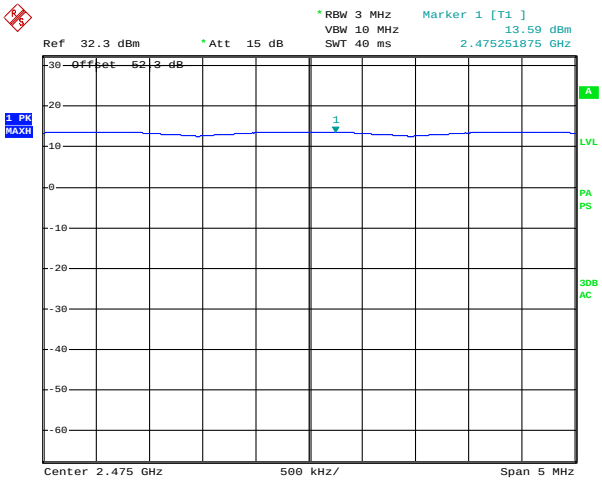
Result: Pass

HI



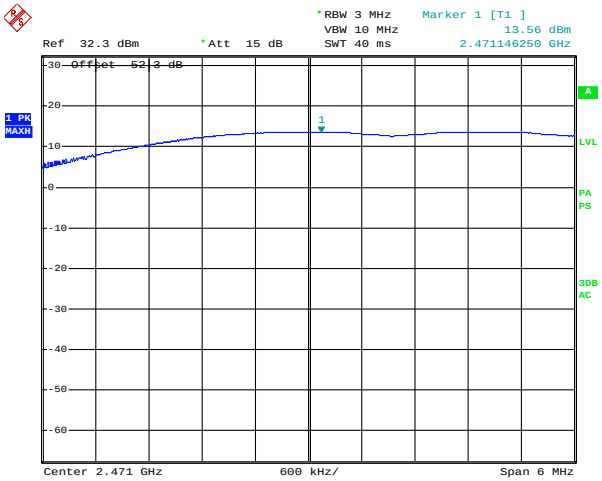
Date: 5.NOV.2014 00:17:18

MID



Date: 5.NOV.2014 19:28:18

LOW

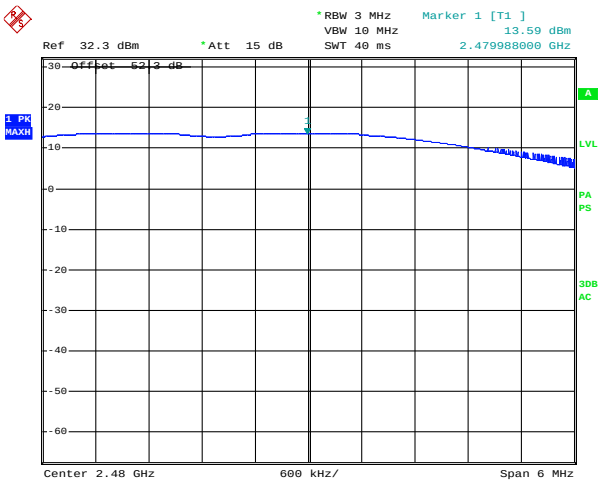


Date: 4.NOV.2014 23:44:59

Mode		L	
Freq (MHz)		Conducted Output Power (dBm)	Limit (dBm)
HI	2480	13.59	21
MID	2476	13.47	21
LOW	2472	13.59	21

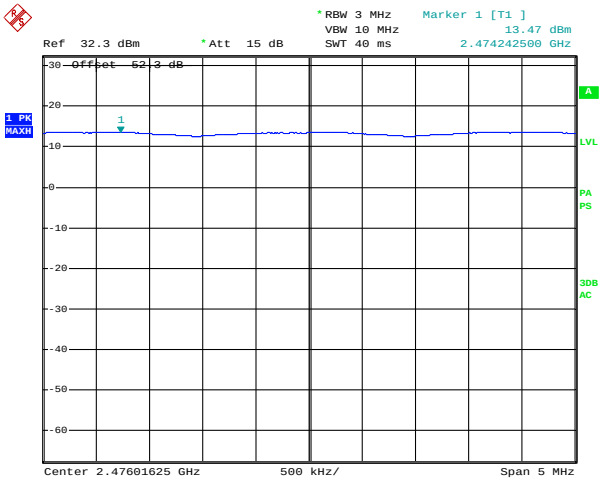
Result: Pass

HI



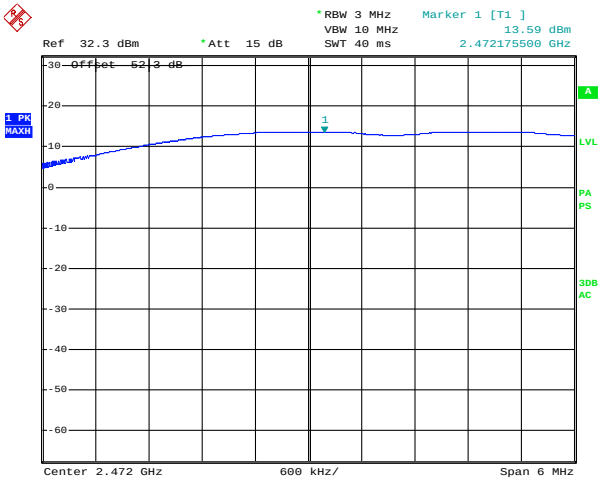
Date: 5.NOV.2014 00:18:33

MID



Date: 5.NOV.2014 18:09:43

LOW



Date: 4.NOV.2014 23:47:47

Part 9 - EIRP Emissions

DATE: Nov-27-2014

TEST STANDARD: RSS-210 Iss.8 A8.4, FCC Part 15 Subpart C -15.247

TEST PROCEDURES: ANSI 63.4-2014, ANSI 63.10-2013, FCC Public Notice DA 00-705 March 30,2000, FCC KDB 996369 v01r04, FCC KDB 55807 4v03r02

MINIMUM STANDARD: EIRP shall not exceed 4 W (36dBm) for IC

500mW (27dBm) for FCC (section 15.247(b)(4)) with a maximum 6dBi antenna

15.247(b)(4)(i) Systems operating in the 2400–2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

METHOD OF MEASUREMENT: The Spectrum Analyzer is connected directly to the PCB antenna port; the conducted output power was measured at this point. A 50dB attenuator with 2.2dB cable loss was used to protect the instrumentation. The 52.2dB correction was added as the offset for the instrumentation and is included in the plot

MEASUREMENT DATA:

EIRP for IC using tested antenna's

Mode	Frequency(MHz)	Output Power (dBm)	Maximum Antenna Gain(dBi)	EIRP (dBm)	IC Limit (dBm)	Result
C	2406	13.29	14	27.29	36	Pass
B0	2440	13.35	14	27.35	36	Pass
A16	2480	13.65	14	27.65	36	Pass

EIRP for FCC using tested antenna's

Mode	Frequency(MHz)	Output Power (dBm)	Maximum Antenna Gain(dBi)	EIRP (dBm)	IC Limit (dBm)	Result
C	2406	13.29	14	27.29	36	Pass
B0	2440	13.35	14	27.35	36	Pass
A16	2480	13.65	14	27.65	36	Pass

MODIFICATIONS: No modification is required to comply for this test.

PERFORMANCE: Complies with standard.

Part 10 - Out of Band Emissions

DATE: Nov-26-2014

TEST STANDARD: RSS-210 A8.5, FCC Part 15/C 15.247

TEST PROCEDURES: ANSI 63.4-2014, ANSI 63.10-2013, FCC Public Notice DA 00-705 March 30,2000, FCC KDB 996369 v01r04, FCC KDB 55807 4v03r02

MINIMUM STANDARD: In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the radio frequency 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 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 Section A8.4(4), the attenuation required shall be 30 dB instead of 20 dB

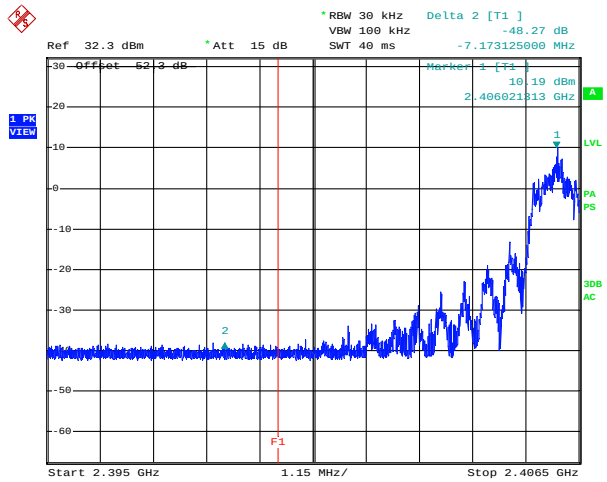
METHOD OF MEASUREMENT: Measurements were made with the antenna port connected directly into a spectrum analyzer using the appropriate attenuators. Only the modes of operation that had frequencies near the band edges were measured in Hopping Mode. Modes 2 and 6 were used to show the non-hopping band edge emissions.

MODIFICATIONS: No modification is required to comply for this test.

PERFORMANCE: Complies with standard.

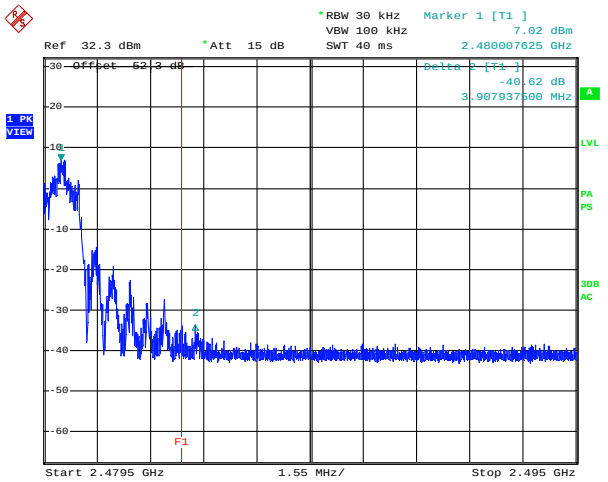
MEASUREMENT DATA:

Mode A0 Low Channel Band edge hopping



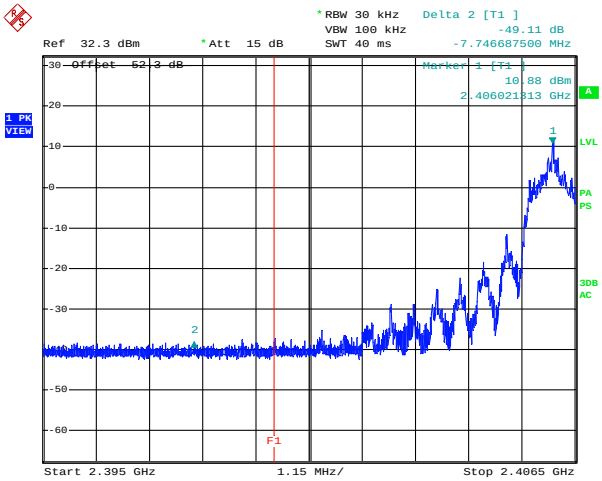
Date: 5.NOV.2014 19:57:47

Mode A16 Hi channel Band Edge hopping



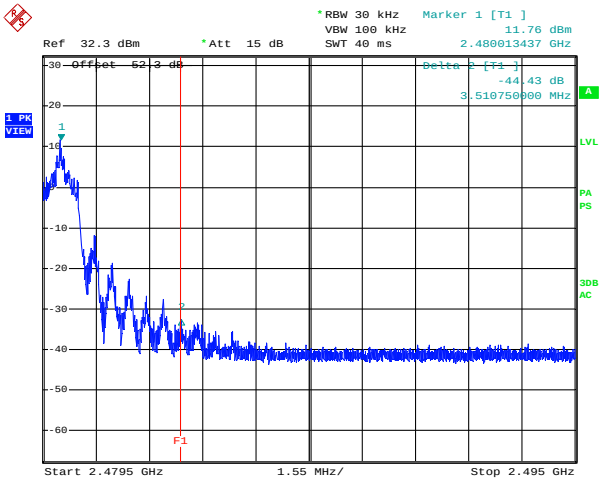
Date: 5.NOV.2014 20:38:38

Mode C 15Channel Low Channel Band Edge Hopping



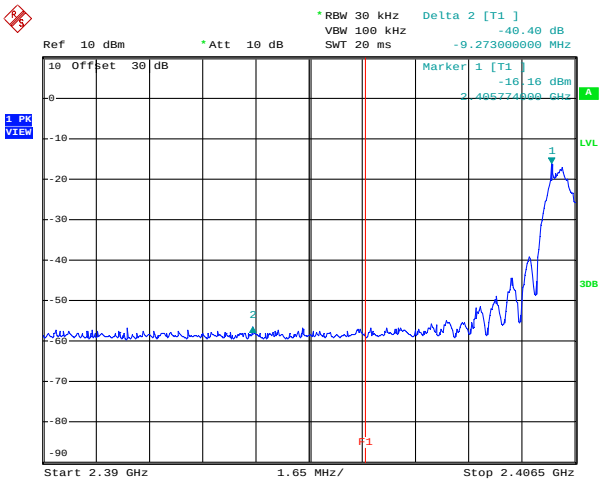
Date: 5.NOV.2014 20:05:13

Mode L Adaptive High Channel Band Edge Hopping



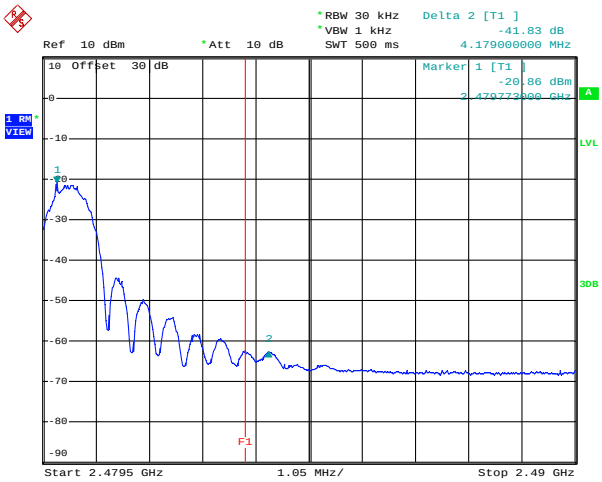
Date: 5.NOV.2014 20:42:07

Mode 2 Low Channel Band edge Non-Hopping



Date: 8.NOV.2014 00:00:05

Mode 6 High Channel band edge Non-Hopping



Date: 7.NOV.2014 23:36:45

Part 11 - Antenna Requirement

TEST STANDARD: FCC Part 15/C 15.203

APPLICABLE REGULATIONS: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

RESULTS: The antennas listed below comply with the standard and maximum EIRP requirements on Part 9.

This product is only sold as an installed part of an OEM final product and is not sold to the general public.

These antennas are only used and installed by trained professional installers and are not available to the general public.

The radio module can be configured with any one of the approved antennas listed below for fixed, point-to-point, one server and one client configuration. When the radio module is configured for point-to-multipoint one server and multiple clients' configuration (client's talk to server only one at a time), the client can use any of the approved antennas and server can use any approved antenna listed below except the 14dBi Yagi directional antenna

Approved and verified antennas for this product

Antenna #	Manufacturer	Model	Type	Connector	Gain (dBi)	Results
1	Nearson	S151AH-2450S	Omni whip	SMA plug reverse polarity	5	Pass
2	Nearson	DG102N-2.4/5.25	Omni whip	SMA plug reverse polarity via provided antenna cable	5	Pass
3	Tekfun	F40-N	Omni whip	SMA plug reverse polarity via provided antenna cable	4.5	Pass
4	Nearson	S152AH-2450S	Omni whip	SMA plug reverse polarity	4	Pass
5	Nearson	S141AH-2450	Omni whip	SMA plug reverse polarity	2	Pass
6	Nearson	S131AH-2450S	Omni whip	SMA plug reverse polarity	2	Pass
7	Centurion	WCP2400-MMCX4	Omni whip	MMCX jack on 4” coax pigtail	2.5	Pass
8	Nearson	SPCB07257	Omni Printed Trace	MMCX jack on 4” coax pigtail	2	Pass
9	PCTEL Maxrad	MP24008XFPT	Panel	SMA plug reverse polarity via provided antenna cable	8	Pass
10	PCTEL Maxrad	MYP24010PT	Yagi	SMA plug reverse polarity via provided antenna cable	10	Pass
11	PCTEL Maxrad	MYP24014PT	Yagi	SMA plug reverse polarity via provided antenna cable	14	Pass

Part 12 - RF Exposure Evaluation

TEST STANDARD: FCC 1.1310

APPLICABLE REGULATIONS: RF Exposure must comply with General Population RF Safety requirements FCC 1.1310 states the criteria listed in the table below shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Section 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Section 2.1093. Further information on evaluating compliance with these limits can be found in the FCC's OST/OET Bulletin Number 65, "Evaluating Compliance with FCC-Specified Guidelines for Human Exposure to Radiofrequency Radiation".

POWER DENSITY LIMITS:

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (s)
(A) Limits for Occupational/Control Exposures				
300-1500	-	-	F/300	6
1500-100,000	-	-	5	6
(B) Limits for General Population/Uncontrolled Exposures				
300-1500	-	-	F/1500	6
1500-100,000	-	-	1	30

1.1 EUT OPERATING CONDITION

- The antenna used for this product is connected to a Flexible antenna cable that connects to the module PCB using a UFL Connector and is designed for a Peak antenna gain of 14 dBi (peak)
- Highest measured conducted output level = 13.6dBm
- From Table 1, the Maximum Power Density safe exposure level for General Population Uncontrolled Exposure of 30 Seconds for the frequency range of 2.4 to 2.4835GHz is $1mW/cm^2$.
-

Conducted Output Power (dBm)	Max Antenna Gain (dBi)	Max EIRP (dBm)	Max EIRP (mW)	Power Density Limit Allowed (mW/cm^2)	Safe distance (cm)
13.6	14	27.6	576	1	6.8

1.2 RF EXPOSURE EVALUATION DISTANCE CALCULATION

$$d = \sqrt{\left(\frac{EIRP}{4\pi S}\right)}$$

where: d = Distance to the center of radiation of the antenna (cm) for the allowable Power Density

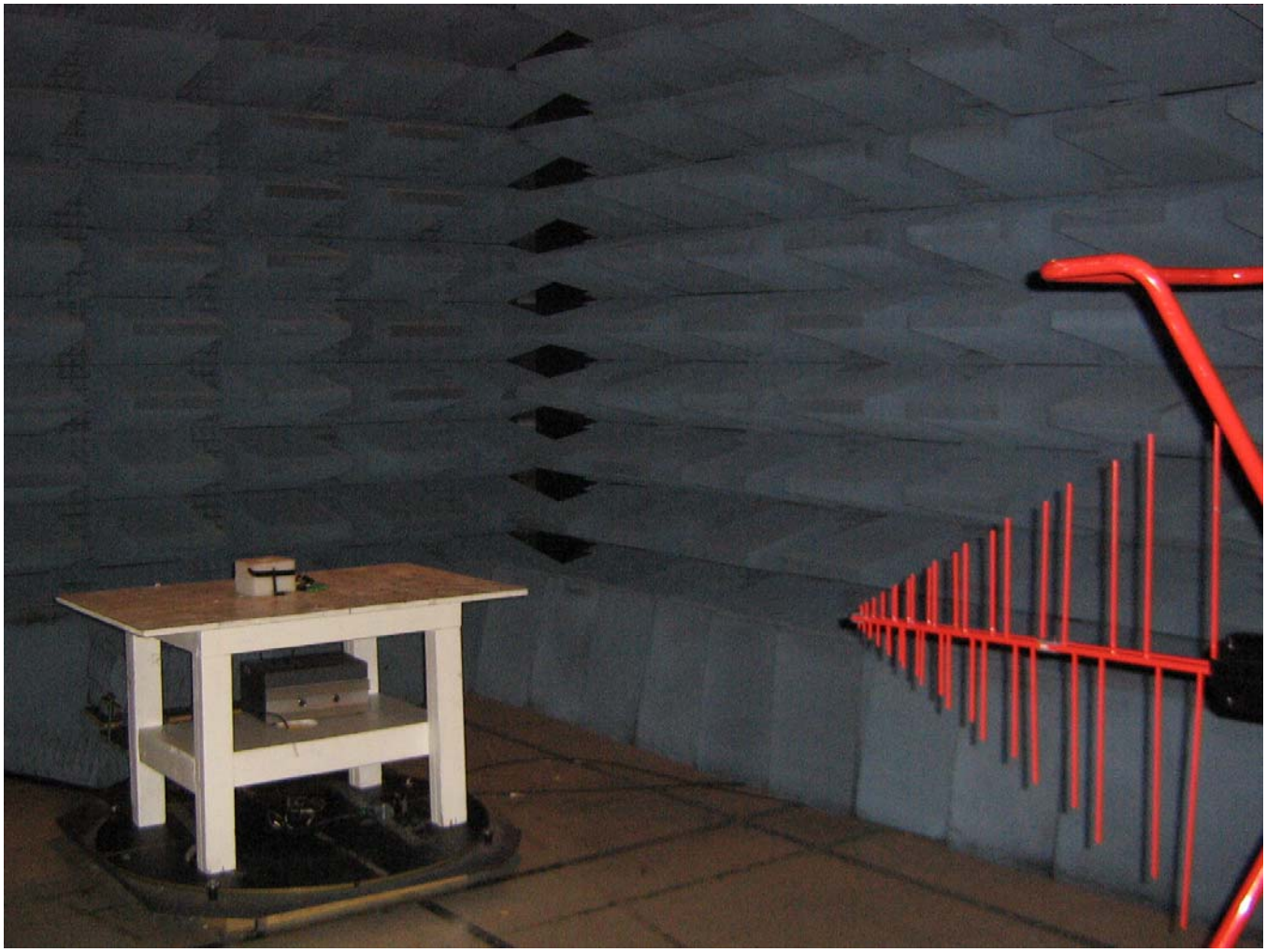
S = Allowable Power density Limit (mW/cm^2)

EIRP = Equivalent isotropically radiated power (mW) = $10^{[TX\ Power\ (dBm) + Ant\ Gain\ (dBi)/10]}$

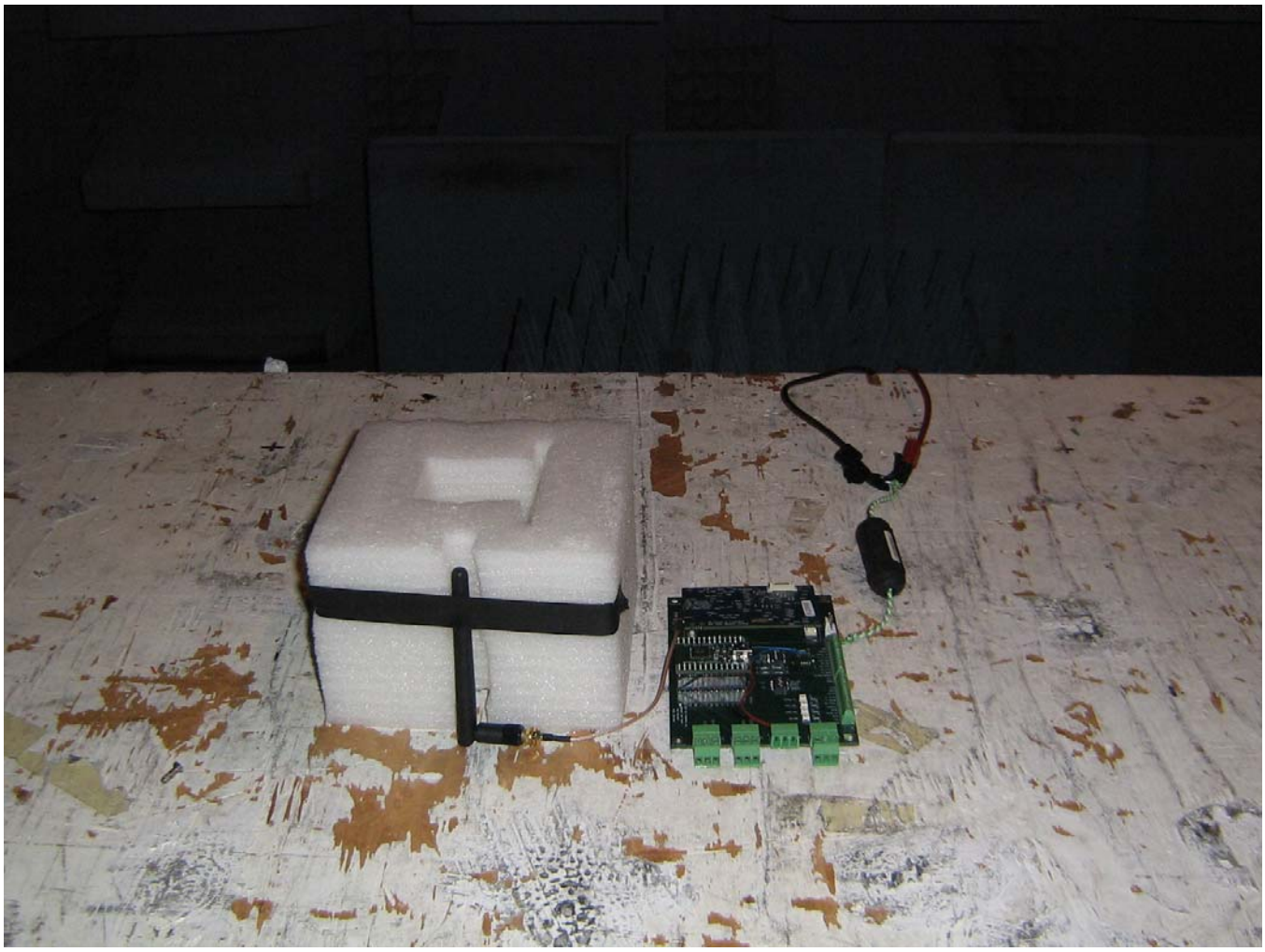
As shown above, the minimum distance where the MPE limit is reached at 6.8 cm from the EUT with the 14.0dBi antenna.

It is recommended that the unit is positioned so that the typical distance from the antenna to the end user is 20cm or greater.

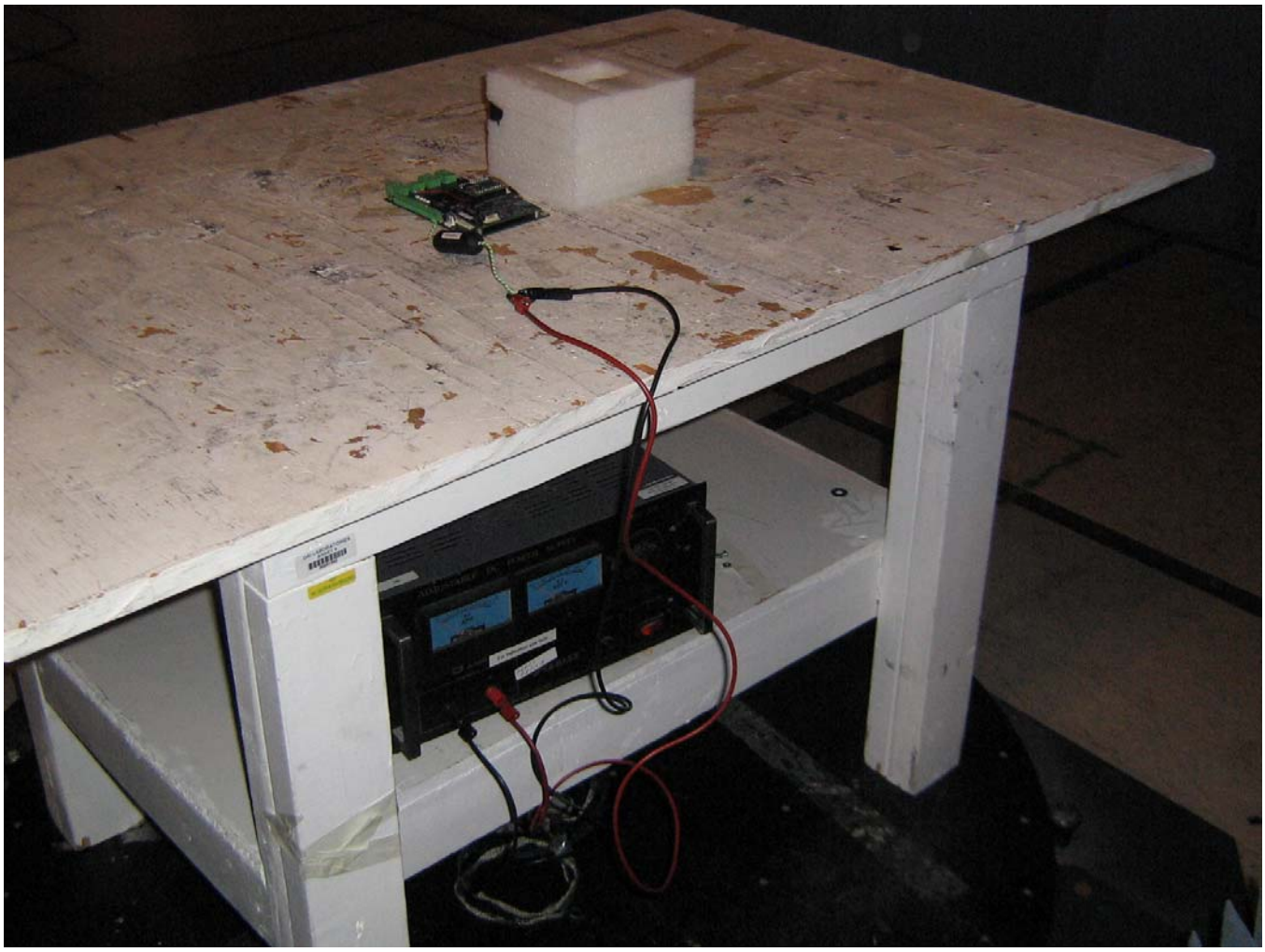
Appendix A: Test Setup Pictures



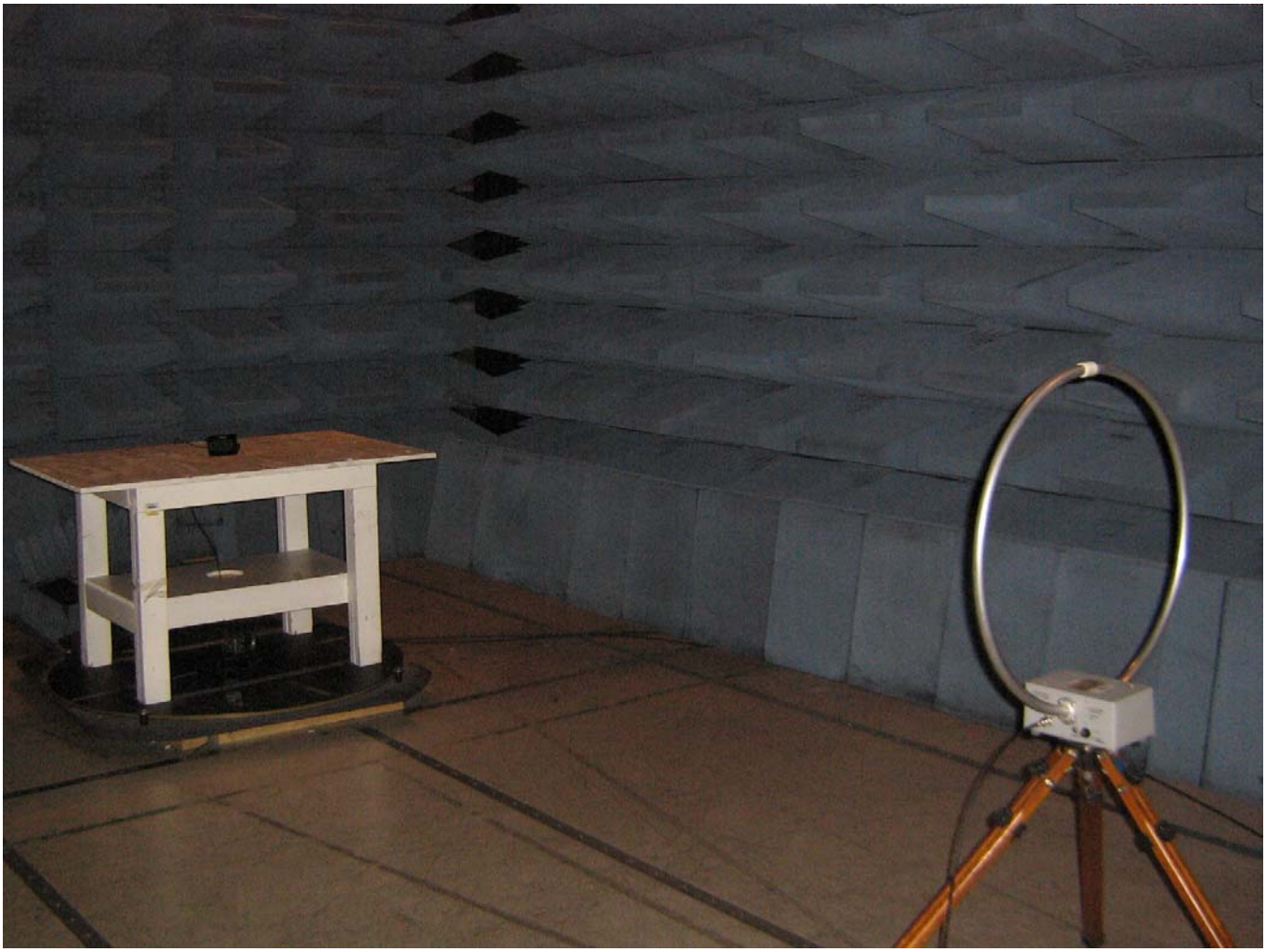
Setup for Radiated emissions when using EUT is using typical Antenna



Close-up of EUT with typical antenna



Auxilliary power supply used with EUT



Typical Low frequency measurement test setup