Report No. 255897-1

Test Report

Product	Zigbee Transceiver in Digital Room Thermostat
Name and address of the applicant	Vingcard Elsafe Anolitveien 1-3 NO-1400 Ski, Norway
Name and address of the manufacturer	Same as above
Model	4824499 Thermostat-Zen-HV
Rating	120V AC (Mains)
Trademark	VingCard Elsafe
Serial number	/
Additional information	2.4GHz Zigbee
Tested according to	**FCC Part 15.249** Digital Transmission Systems **Industry Canada RSS-210, Issue 8** Low Power Licence-Exempt Radiocommunications Devices
Order number	255897
Tested in period	2014.03.17 – 2014.03.18
Issue date	2014.06.27
Name and address of the testing laboratory	Nemko Instituttveien 6 Kjeller, Norway FCC No: 994405 IC OATS: 2040D-1 TEL: (+47) 22 96 03 30 FAX: (+47) 22 96 05 50

Prepared by [G.Suhanthakumar]	Approved by [Frode Sveinsen]

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ENTERPRISE NUMBER NO974404532

CONTENTS

1 TEST INFORMATION

1.1 Test item

Name :	Vingcard Elsafe
Model/version :	4824499 Thermostat-Zen-HV
FCC ID:	Y7V-TZENHV
IC ID:	9514A-TZENHV
Serial number :	-
Hardware identity and/or version:	-
Software identity and/or version :	-
Frequency Range :	2405 - 2480 MHz
Number of Channels :	16
Operating Modes :	TX and RX
Type of Modulation :	Q-PSK
Data rate:	250 kbit/s
User Frequency Adjustment :	None, Software controlled
Conducted Output Power :	1.39 mW
Type of Power Supply :	120 V AC (Mains)
Antenna Connector :	None
Antenna type:	PCB antenna
Number of Antennas :	1

Description of test item

Orion Thermostat Zen HV is a digital room thermostat with a ZigBee transceiver for radio communication. It can be installed as standalone and communicate with the other ZigBee devices to control the climatic comfort in the hotel guestroom, or it can be connected to the hotel LAN and communicate via Gateway or Router with the VingCard wireless online EMS.

Exposure Evaluation

The EUT is exempted from RF Exposure Evaluation.

1.2 Test environment

1.2.1 Normal test condition

Temperature:	20.6 - 20.9 °C
Relative humidity:	24 - 38 %
Normal test voltage:	120V AC (Mains)

The values are the limit registered during the test period.

1.3 Test period

Item received date: 2014-03-17

Test period : from 2014-03-17 to 2014-03-18

2 TEST REPORT SUMMARY

2.1 General

All measurements are traceable to national standards.

The tests were conducted for the purpose of demonstrating compliance with FCC CFR 47 Part 15.249 and Industry Canada RSS-210, Issue 8 and RSS-GEN, Issue 3.

Radiated tests were conducted in accordance with ANSI C63.4-2003 and ANSI C63.10-2009.The radiated tests were made in a semi-anechoic chamber at measuring distances of 3 and 10 meters.

☒ New Submission	☐ Production Unit
☐ Class II Permissive Change	☒ Pre-production Unit
DXX Equipment Code	☐ Family Listing

THIS TEST REPORT APPLIES ONLY TO THE ITEM(S) AND CONFIGURATIONS TESTED.

Deviations from, additions to, or exclusions from the test specifications are described in “Summary of Test Data”.

2.2 Test summary

Name of test	FCC Part 15 reference	RSS-210 Issue 8 & RSS-GEN Issue 3	Result
Supply Voltage Variations	15.31(e)	N/A	Complies [1]
Antenna Requirement	15.203	7.1.4 (RSS-GEN)	Complies [2]
Power-line Conducted Emission	15.207(c)	7.2.2 (RSS-GEN)	Complies
Occupied Bandwidth	N/A	4.6.1 (RSS-GEN)	-
Peak Power Output	15.249(a)(c)	A2.9	Complies
Band edge Emissions	15.249(d)	A.2.9	Complies
Spurious Emissions (Radiated)	15.249 (e) 15.209	A2.9 4.9 (RSS-GEN)	Complies

[1] Varried 85% to 115%.

[2] PCB antenna

RSS Gen issue 3 covers section 7 & 6

RSS 210 issue 8 covers section A2.9

2.3 Description of modification for modification filing

Not applicable.

2.4 Comments

The channels are selected with the use of dedicated test software from the manufacturer.

The power level in the software was set to maximum.

During the test all ports were populated and terminated with load.

The radiated measurements are tested on three axis.

2.5 Family list rationale

Not Applicable.

3 TEST RESULTS

3.1 Power Line Conducted Emissions

Para. No.: 15.207 (a)

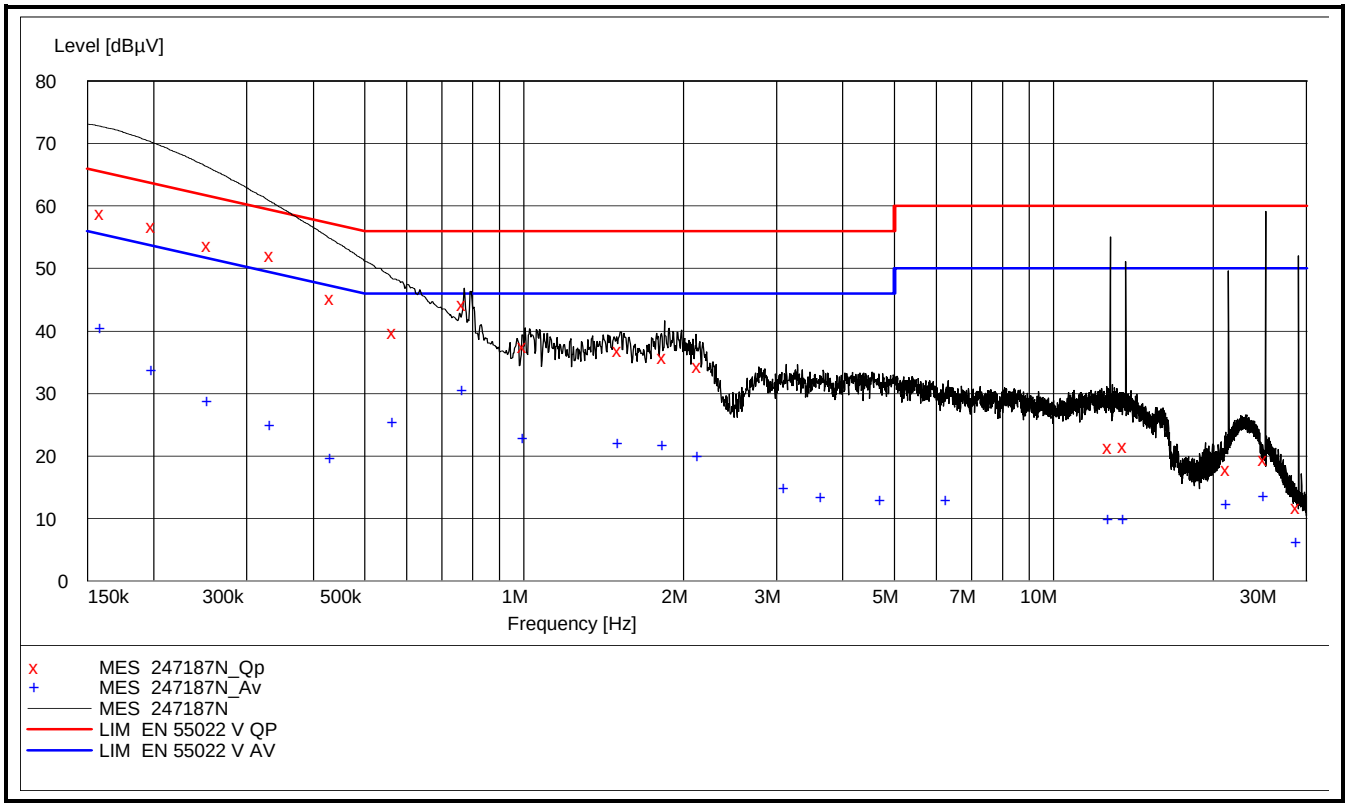
The test is not applicable since the device is battery powered.

Test Performed By: G.Suhanthakumar	**Date of Test: 2014.03.17**

Measurement procedure: **ANSI C63.4-2003 using 50 µH/50 ohms LISN.**

Test Results: **Complies**

Measurement Data: **120V AC, 60Hz**



Plot shows maximum of phase N and L1

Measured Values:

Frequency [MHz]	Level [dBuV]	Af [dB]	Limit [dBuV]	Margin [dB]	Detector	Position	Verdict [Pass/Fail]
0.160000	58.90	10.10	65.50	6.60	QP	L1	Pass
0.200000	56.70	10.10	63.60	6.90	QP	L1	Pass
0.255000	53.70	10.10	61.60	7.90	QP	L1	Pass
0.335000	52.20	10.20	59.30	7.10	QP	L1	Pass
0.435000	45.20	10.20	57.20	12.00	QP	L1	Pass
0.570000	39.80	10.20	56.00	16.20	QP	N	Pass
0.770000	44.40	10.20	56.00	11.60	QP	N	Pass
1.005000	37.60	10.20	56.00	18.40	QP	N	Pass
1.520000	37.00	10.20	56.00	19.00	QP	N	Pass
1.840000	35.90	10.20	56.00	20.10	QP	N	Pass
2.150000	34.50	10.30	56.00	21.50	QP	N	Pass
12.810000	21.40	10.70	60.00	38.60	QP	N	Pass
13.680000	21.60	10.80	60.00	38.40	QP	N	Pass
21.405000	17.90	11.30	60.00	42.10	QP	N	Pass
25.155000	19.50	11.40	60.00	40.50	QP	L1	Pass
29.015000	11.80	11.40	60.00	48.20	QP	N	Pass
0.160000	40.50	10.10	55.50	15.00	AV	L1	Pass
0.200000	33.70	10.10	53.60	19.90	AV	L1	Pass
0.255000	28.70	10.10	51.60	22.90	AV	L1	Pass
0.335000	24.90	10.20	49.30	24.40	AV	L1	Pass
0.435000	19.60	10.20	47.20	27.60	AV	L1	Pass
0.570000	25.40	10.20	46.00	20.60	AV	N	Pass
0.770000	30.60	10.20	46.00	15.40	AV	N	Pass
1.005000	22.80	10.20	46.00	23.20	AV	N	Pass
1.520000	22.10	10.20	46.00	23.90	AV	N	Pass
1.840000	21.70	10.20	46.00	24.30	AV	N	Pass
2.150000	20.00	10.30	46.00	26.00	AV	N	Pass
3.125000	14.90	10.30	46.00	31.10	AV	N	Pass
3.670000	13.40	10.30	46.00	32.60	AV	N	Pass
4.760000	13.00	10.40	46.00	33.00	AV	L1	Pass
6.325000	13.00	10.50	50.00	37.00	AV	L1	Pass
12.810000	9.90	10.70	50.00	40.10	AV	N	Pass
13.680000	9.90	10.80	50.00	40.10	AV	N	Pass
21.405000	12.30	11.30	50.00	37.70	AV	N	Pass
25.155000	13.70	11.40	50.00	36.30	AV	L1	Pass
29.015000	6.20	11.40	50.00	43.80	AV	N	Pass

3.2 Transmitter Frequency Stability

Para. No.: 15.31(m)/7.2.4

Test Performed By: G.Suhanthakumar	Date of Test: 2014.03.18

Measurement Data:

Temperature	Channel nr.	Given Frequency (MHz)	Measured value (MHz)	Deviation (kHz)
20 ° C	-	2405	2404.876	124
	-	2435	2434.875	125
	-	2480	2479.872	128

Comment: Reported for information only. There are no requirements to frequency tolerance for low power devices in the 2400-2483.5 MHz band certified to 15.249 or RSS 210

3.3 20 dB Bandwidth

Para. No.: RSS-Gen

Test Performed By: G.Suhanthakumar	**Date of Test: 2014.03.17**

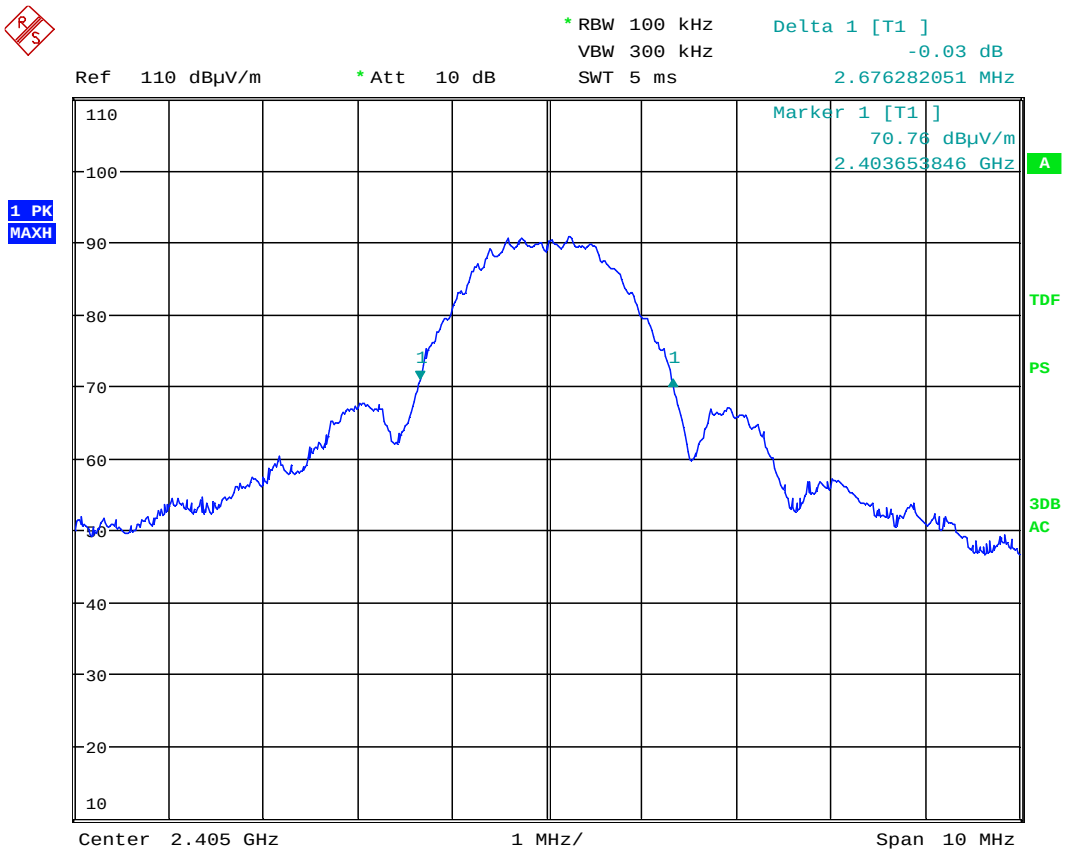
Test Results: Complies

Measurement Data:

Data Rate	20 dB Bandwidth (MHz)		
	2405MHz	**2435MHz**	**2480MHz**
250kbps	2.67	2.74	2.64

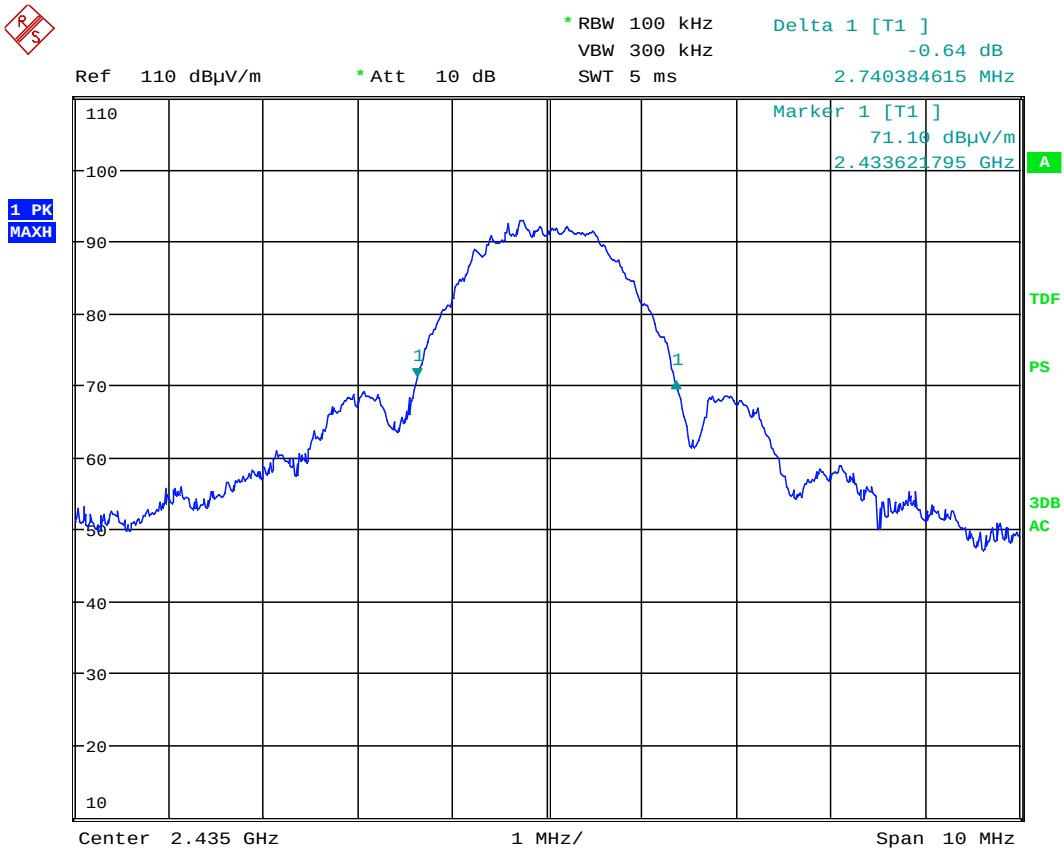
Requirements:

For information only



Date: 17.MAR.2014 09:51:01

2405MHz – 20 dB bandwidth – 2.67MHz



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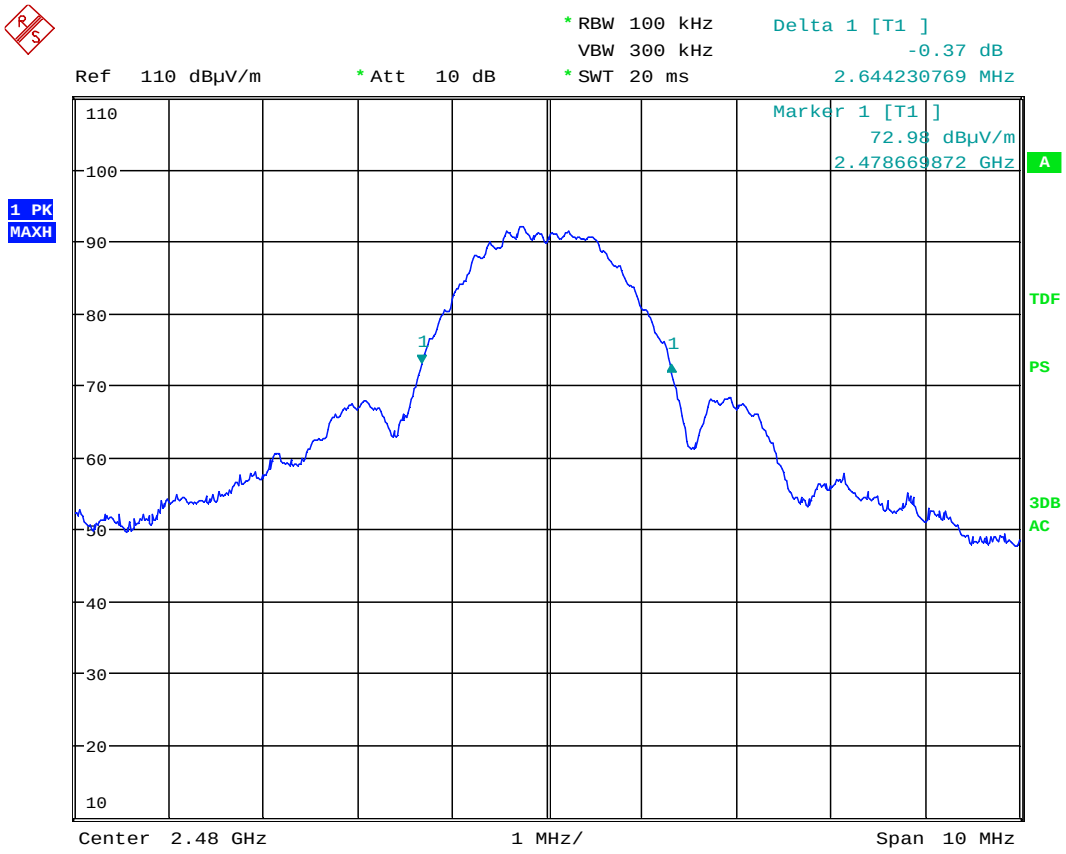
2435MHz – 20 dB bandwidth – 2.74MHz



Date: 17.MAR.2014 10:33:59

2480MHz – 20 dB bandwidth – 2.64MHz

3.4 Peak power output

Para. No.: 15.249 (a) / A2.9

Test Performed By: G.Suhanthakumar	**Date of Test: 2014.03.17 – 2014.03.18**

Test Results: Complies

Measurement data:

Maximum conducted peak output power

RF channel	**2405MHz**	**2435MHz**	**2480MHz**
@ 250kbps, Measured value (dBm)	1.4	0.8	-0.4
@ 250kbps, Measured value (mW)	1.38	1.20	0.91

Maximum field strength - Peak

RF channel	**2405MHz**	**2435MHz**	**2480MHz**
VP: Measured value (dBµV/m)	94.68	96.44	95.66
HP: Measured value (dBµV/m)	92.45	92.60	91.74

Maximum field strength - Average

RF channel	**2405MHz**	**2435MHz**	**2480MHz**
VP: Measured value (dBµV/m)	74.68	76.44	75.66
HP: Measured value (dBµV/m)	72.45	72.60	71.74

Calculated Peak eirp & antenna gain

RF channel	**2405MHz**	**2435MHz**	**2480MHz**
Radiated power e.i.r.p (mW)	0.86	1.31	1.09
Radiated Power e.i.r.p. (dBm)	-0.7	1.2	0.4
Antenna gain dBi	-2.1	0.4	0.8

Duty Cycle Correction Factor is 20 dB

Radiated measurements were performed at 3 m distance.

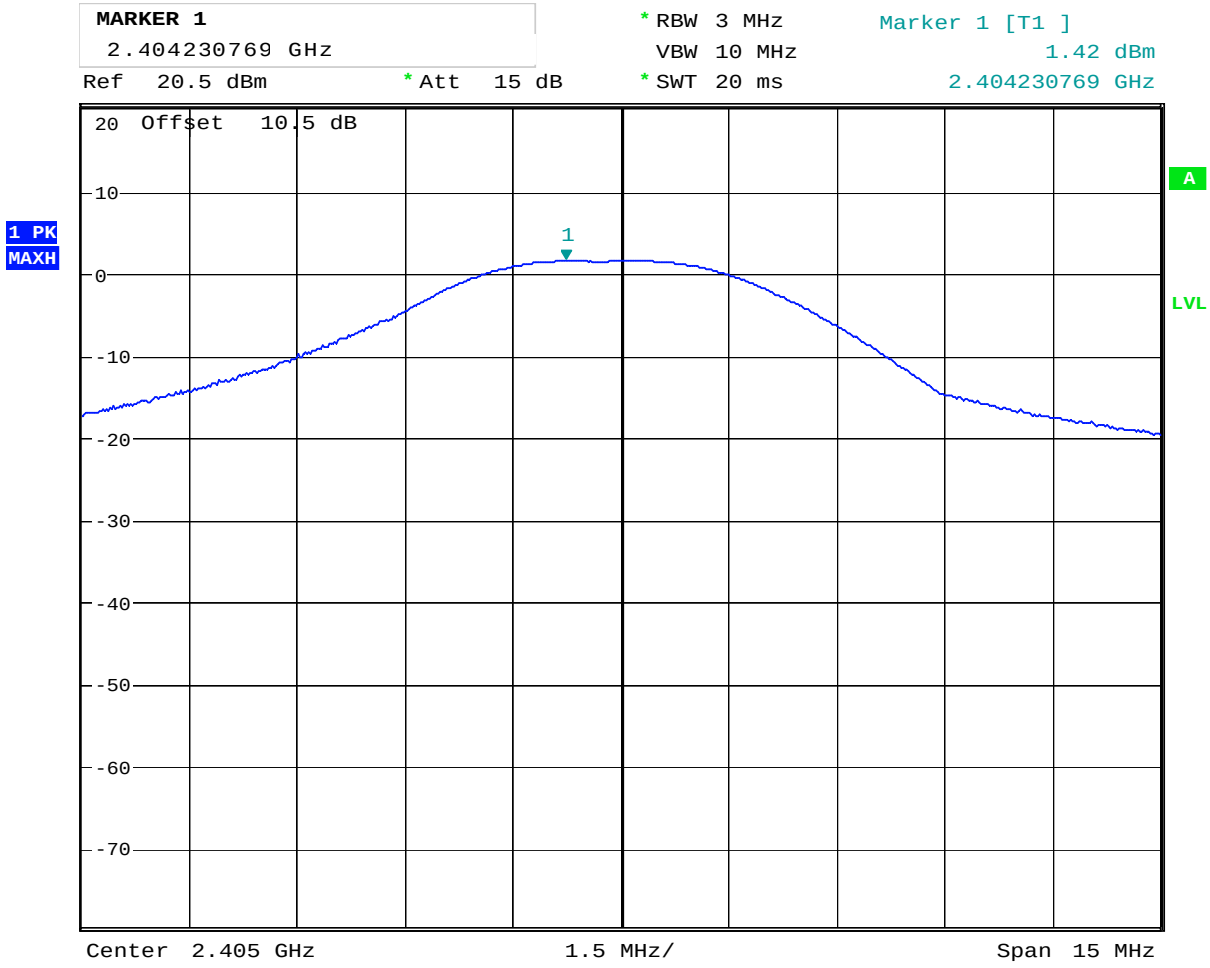
Radiated Power is calculated from measured field strength by the formulas in KDB 412172 D01 Determining ERP and EIRP v01.

Detachable antenna?	☐ Yes	☒ No
If detachable, is the antenna connector non-standard?	☐ Yes	☐ No

Voltage was varied from 85% to 115%

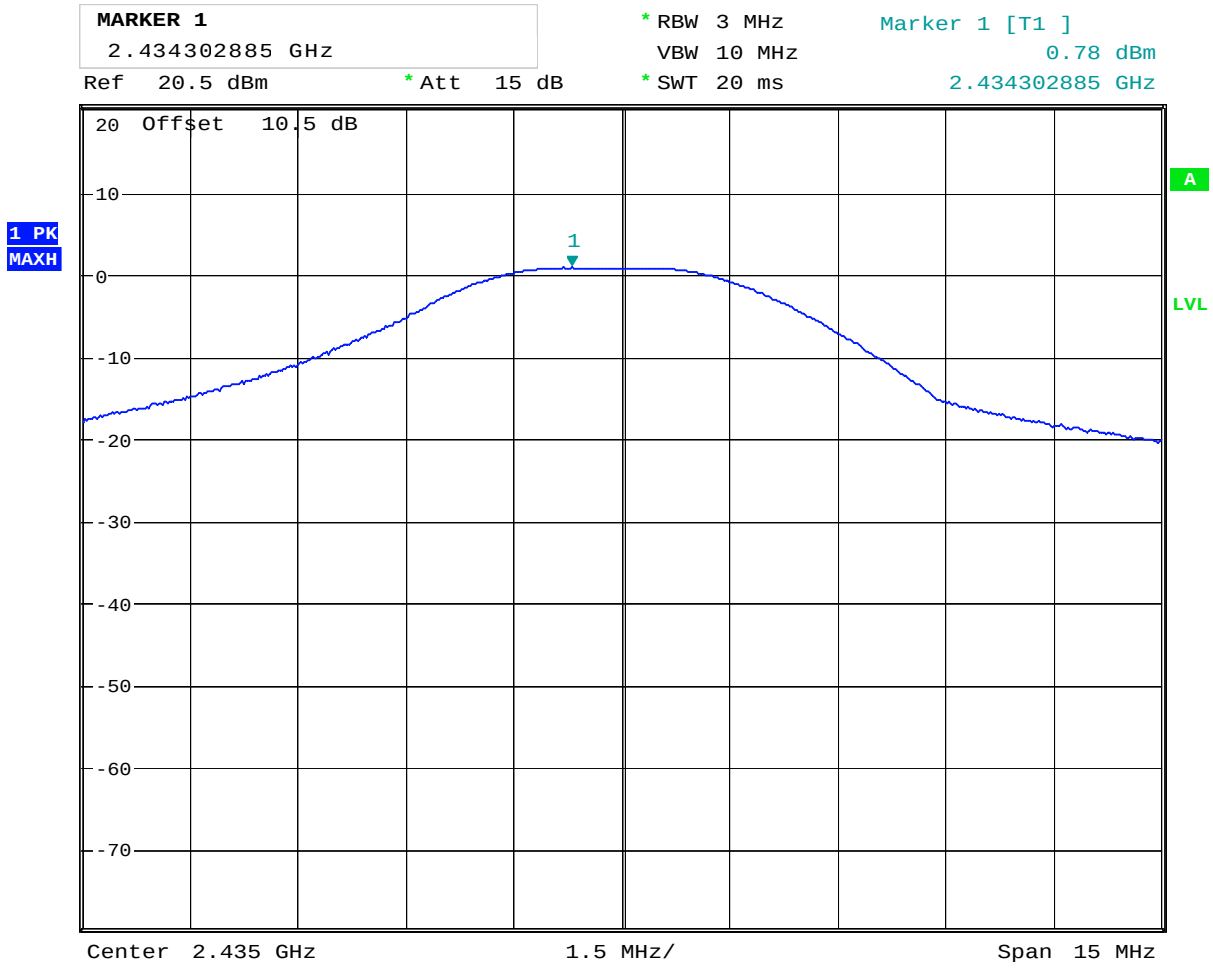
Requirements:

The maximum Average Output Power shall be less than or equal to 94dBµV/m

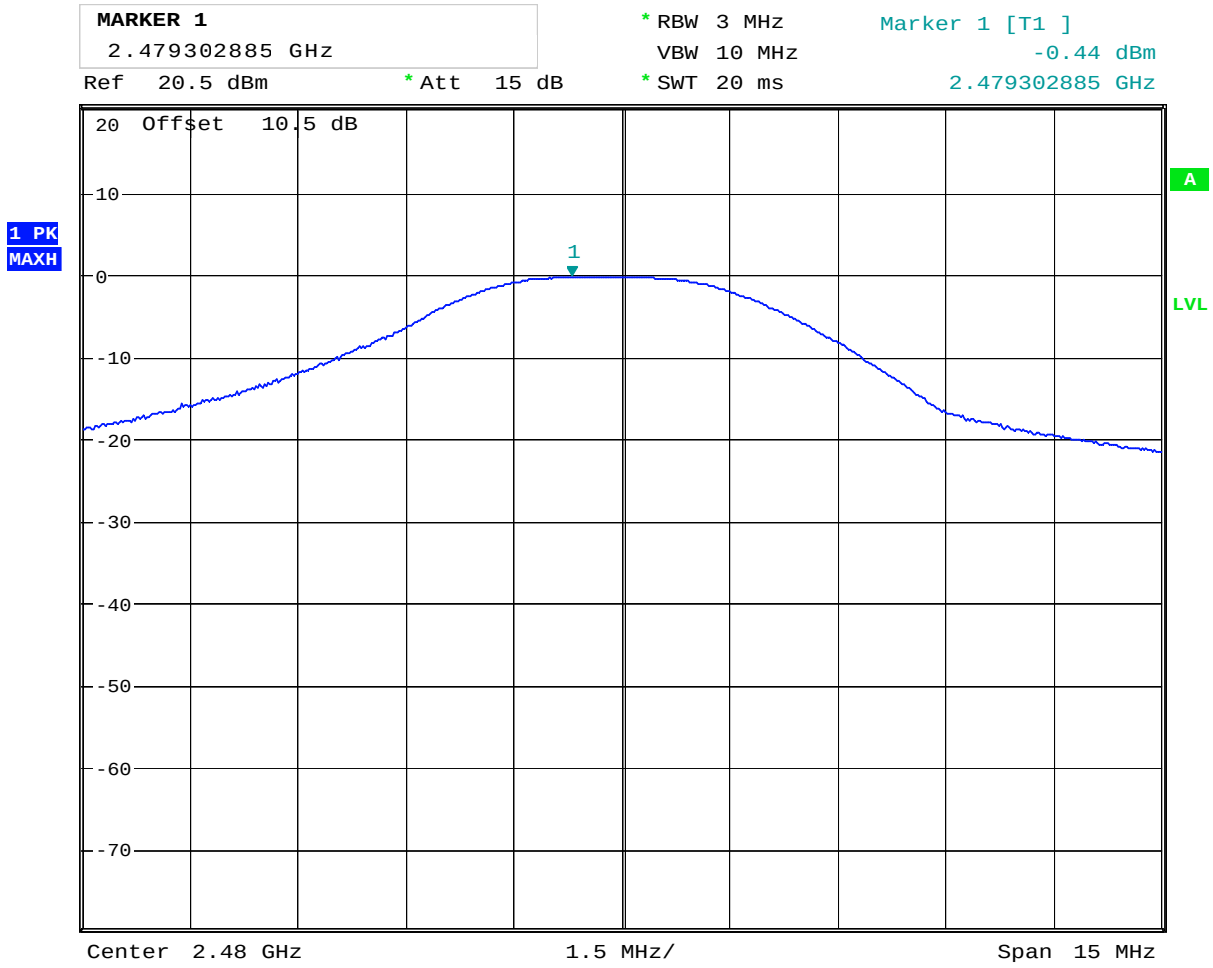


Date: 18.MAR.2014 09:25:19

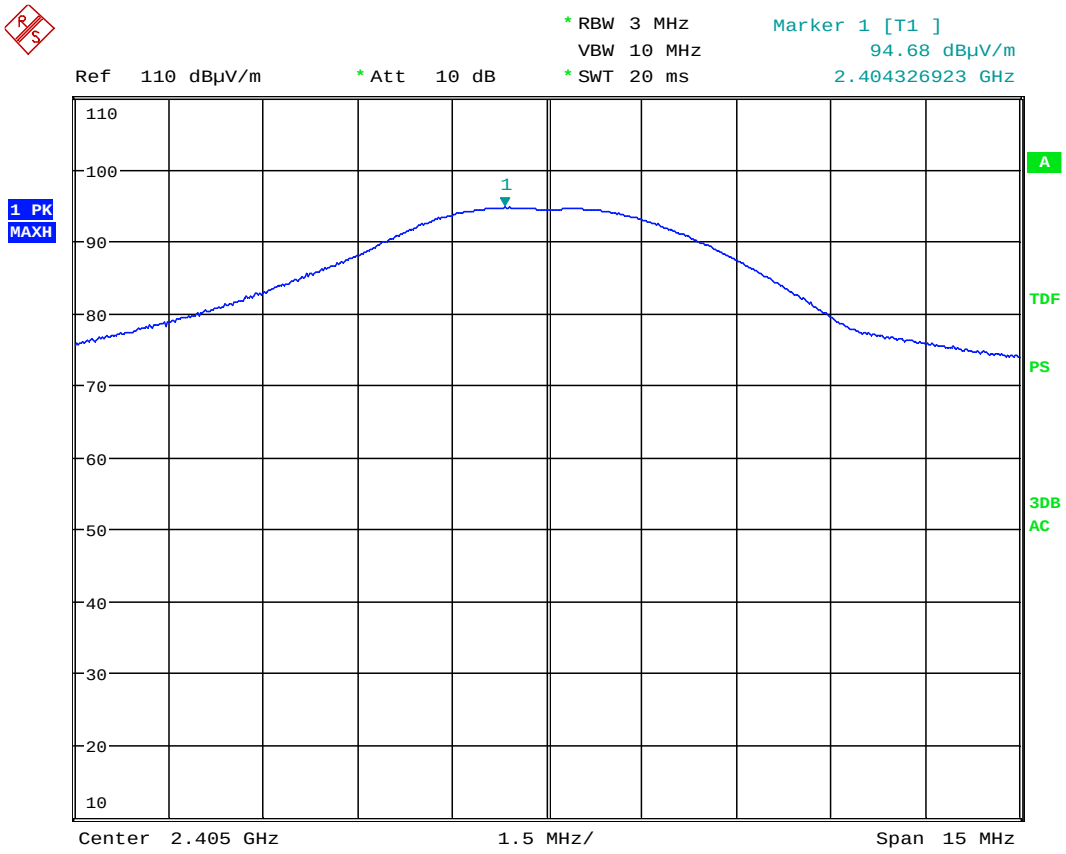
Peak Conducted power – 2405MHz



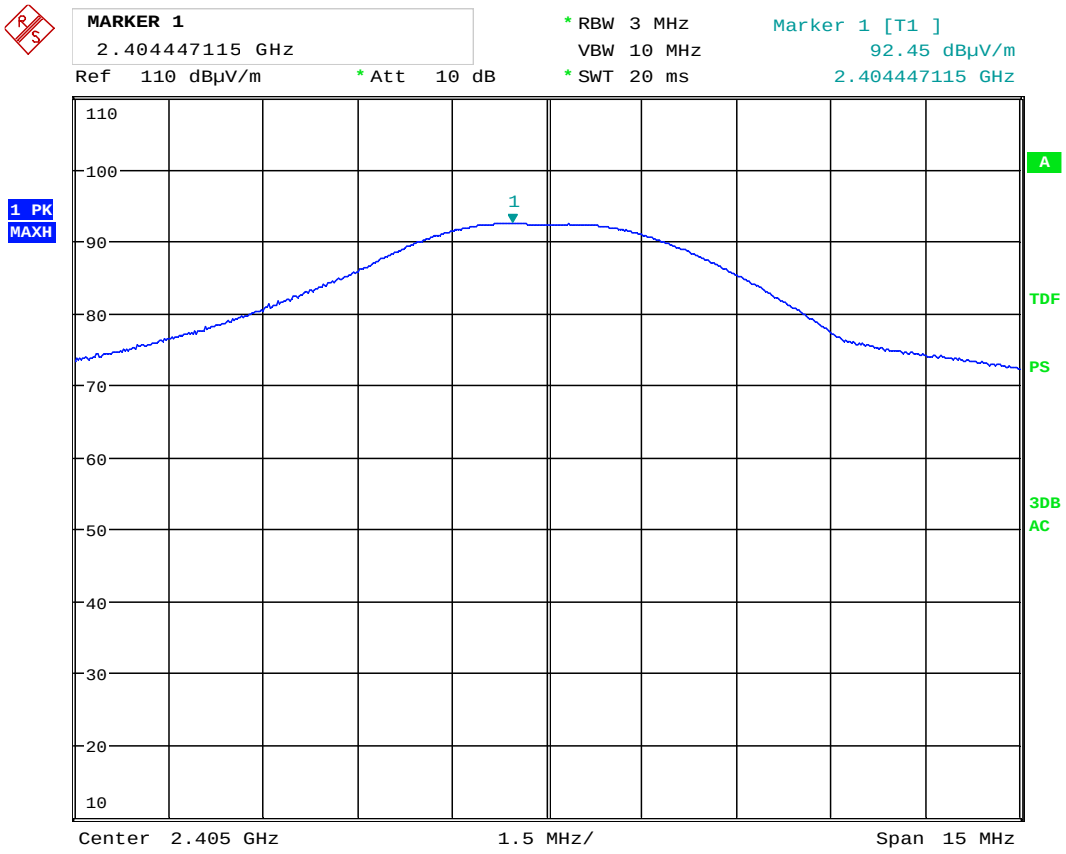
Peak Conducted power – 2435MHz



Peak Conducted power – 2480MHz



VP: 2405MHz – Peak Field strength



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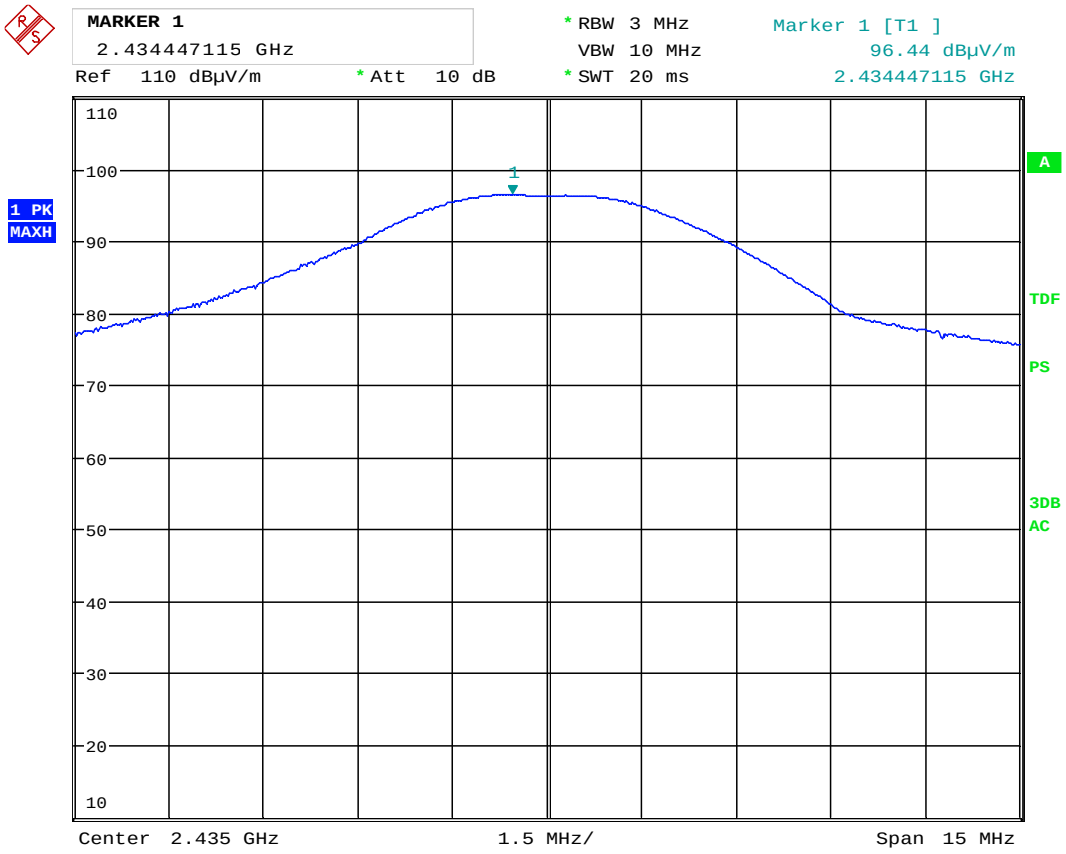
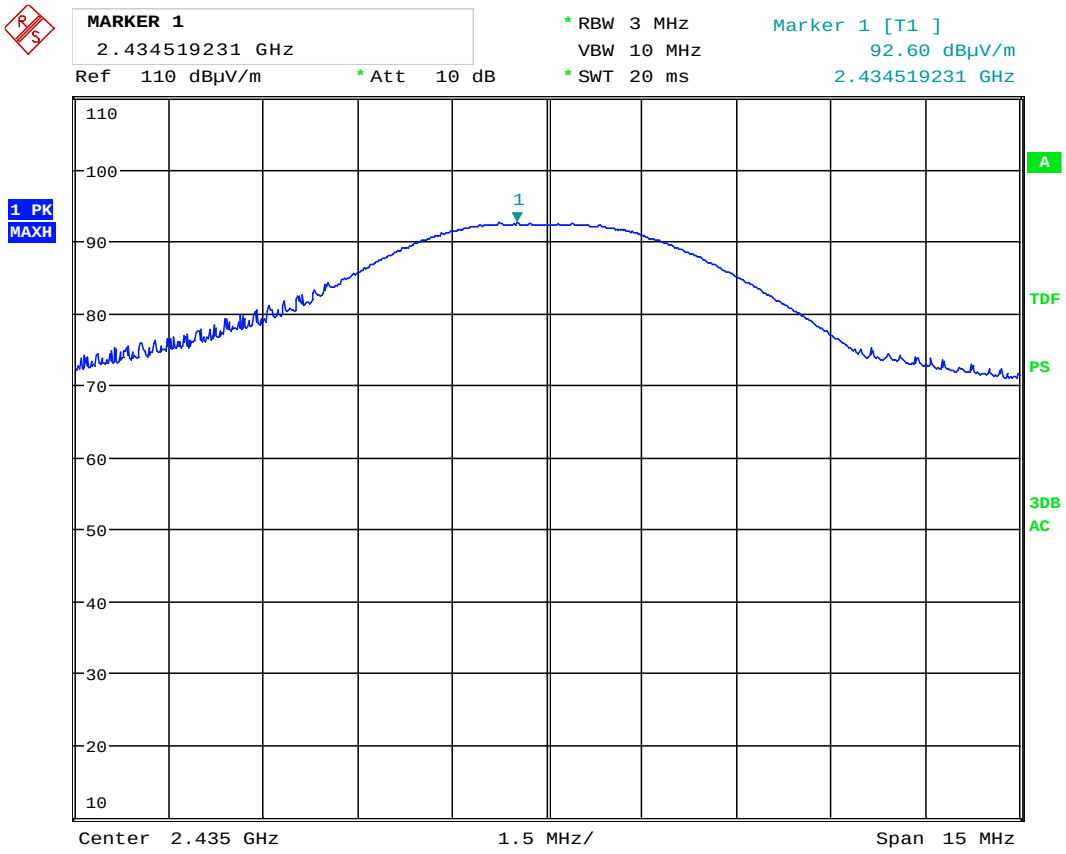
HP: 2405MHz – Peak Field strength



VP: 2435MHz – Peak Field strength



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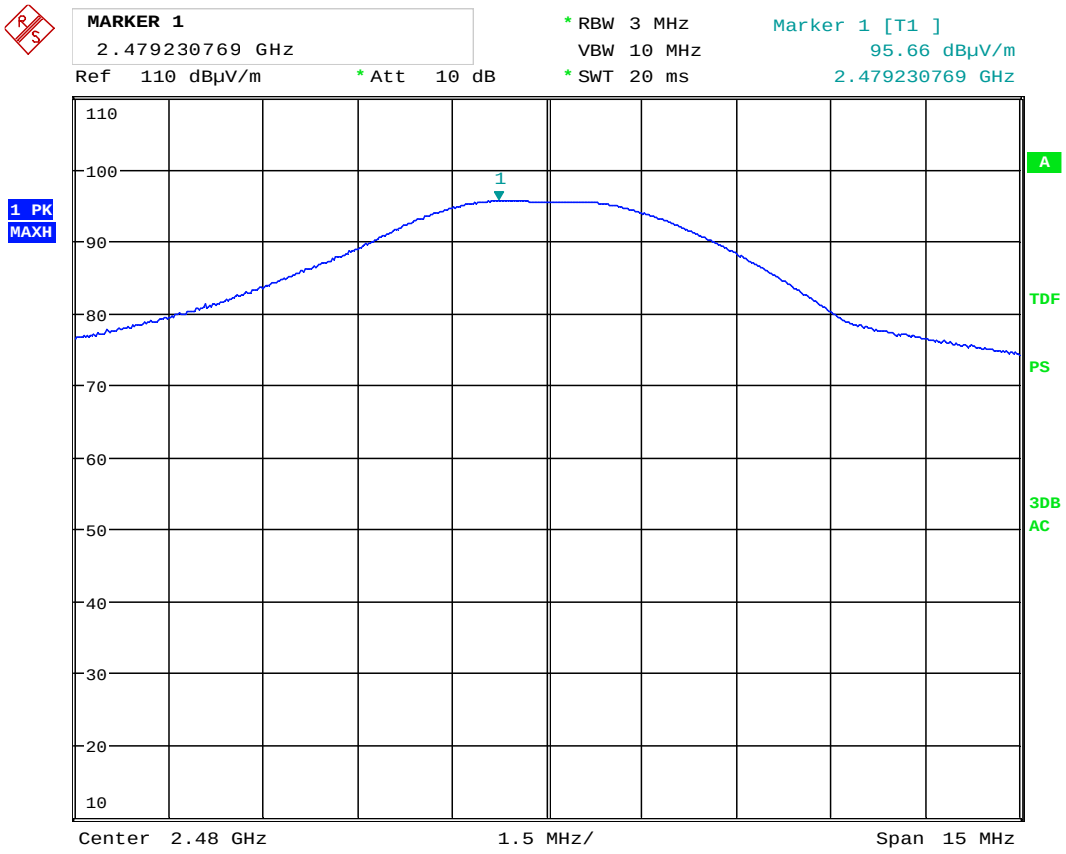
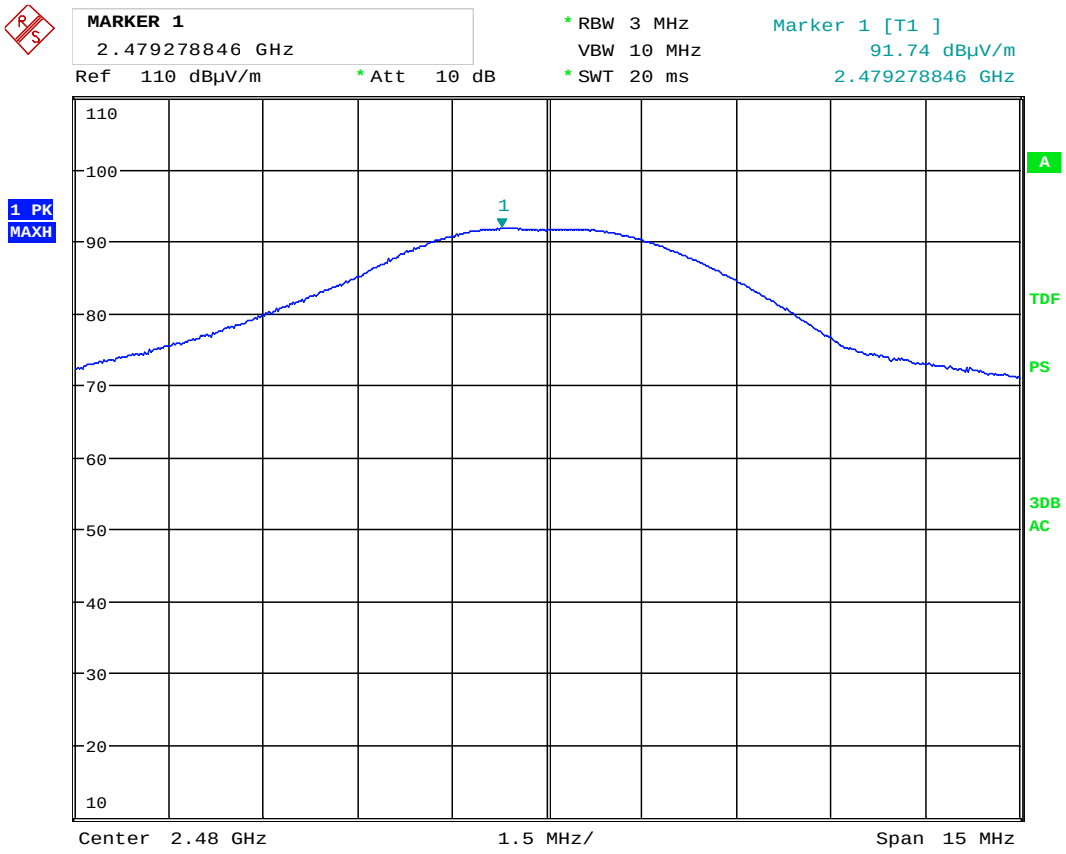
HP: 2435MHz – Peak Field strength



VP: 2480MHz – Peak Field strength



HP: 2480MHz – Peak Field strength

3.5 Spurious emissions (radiated)

Para. No.: 15.209 / 15.249 (e) / A2.9 / 4.9

Test Performed By: G.Suhanthakumar	**Date of Test: 2014.03.17**

Test Results: Complies

Measurement Data:

Radiated - Band-edge, @3m

Frequency	Measured Field Strength @3m, dBµV/m	Detector	Duty Cycle Correction (dB)	Limit dBµV/m	Margin dB
2.39 GHz	59.09	PK	-	74	14.91
	39.09	AV	20	54	14.91
2.4GHz	69.30	PK	-	74	4.97
	49.03	AV	20	54	4.97
2.4835 GHz	73.21	PK	-	74	0.79
	53.21	AV	20	54	0.79

Duty Cycle Calculation:

Pollperiod: 20s

CSMA/CA frame transmission 2.368 ms (default random back-off exponent of 3)

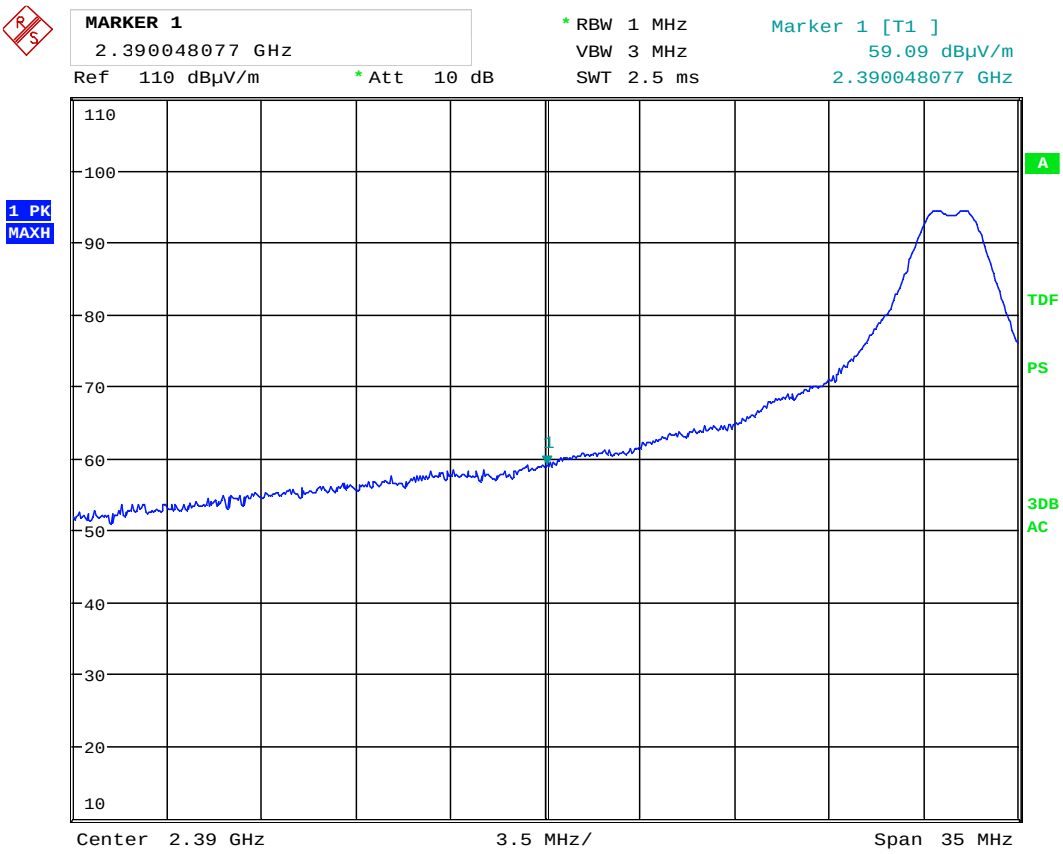
Data Frame transmission 4.256 ms (full frame)

Maximum transmission is one CSMA/CA and one Data Frame per poll period.

Duty Cycle Calculation: (2.368ms+4.256ms)/100ms = 6.624%

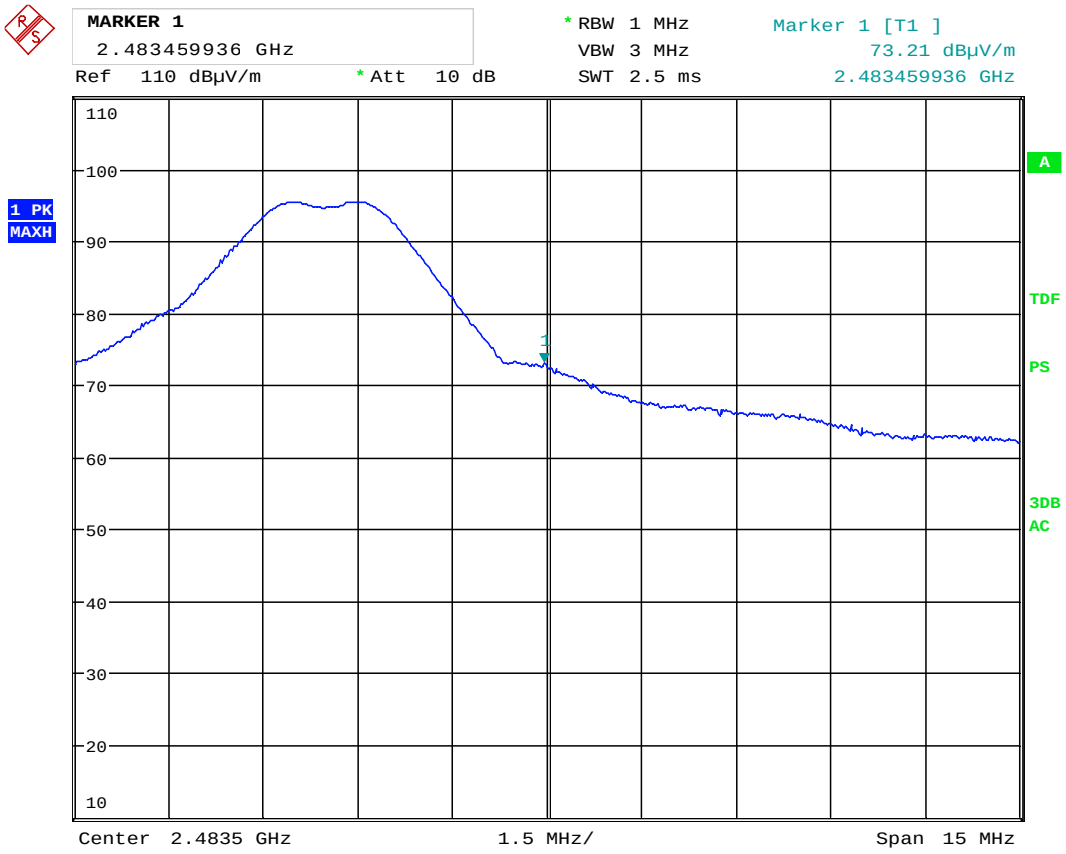
Duty Cycle Correction Factor Calculation: -20x $\log_{10}$(0.06624) dB = 23.6 dB

Duty Cycle Correction Factor is 20 dB



Date: 17.MAR.2014 09:55:47

Lower Band edge – PK ; ch2405MHz



Date: 17.MAR.2014 10:36:02

Upper Band edge – PK ; ch2480MHz

Radiated Emissions with antenna, 1-25 GHz

1-8.5 GHz measured @3m, 8.5 - 25GHz measured @1m.

Measured with Peak Detector:

Frequency	Dist. corr. factor	Field strength, Peak	Duty cycle corr. factor	Limit	Margin
GHz	dB	dBµV/m	dB	dBµV/m	dB
1 – 8.5	0	None detected	-	74	-
8.5 -25	9.5	None detected	-	74	-

Average Detector:

Frequency	Dist. corr. factor	Field strength, AV	Duty cycle corr. factor	Limit	Margin
GHz	dB	dBµV/m	dB	dBµV/m	dB
1 – 8.5	0	-	20	54	-
8.5 – 25	9.5	-	20	54	-

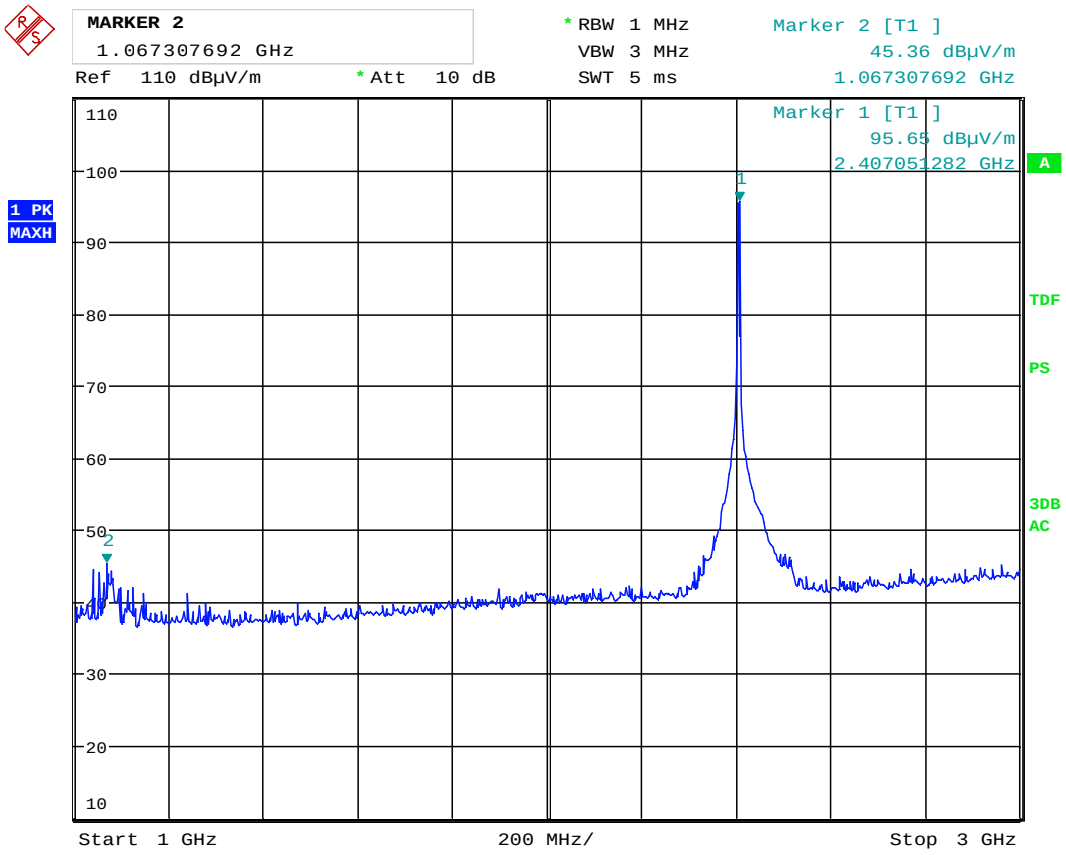
The lowest, middle & higest channels were tested.

The test sample was transmitting with 0.0238% duty cycle for all tests.

Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor".

Requirement:

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.



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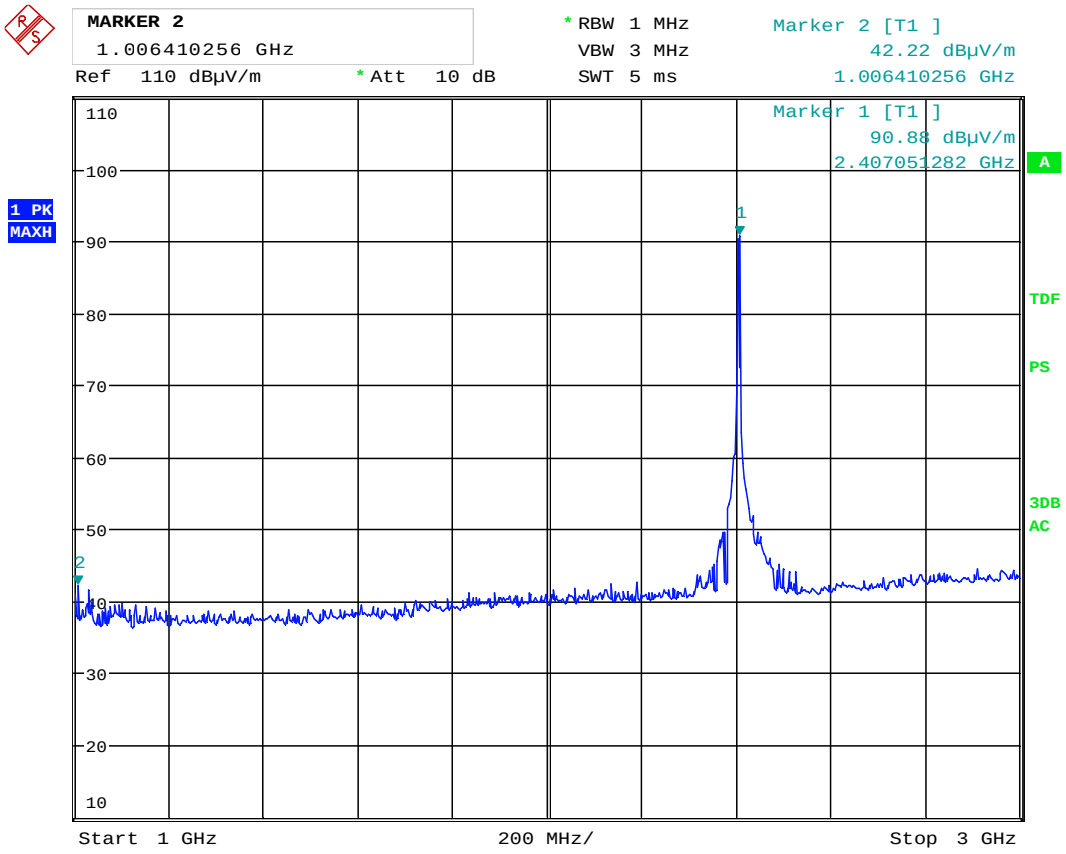
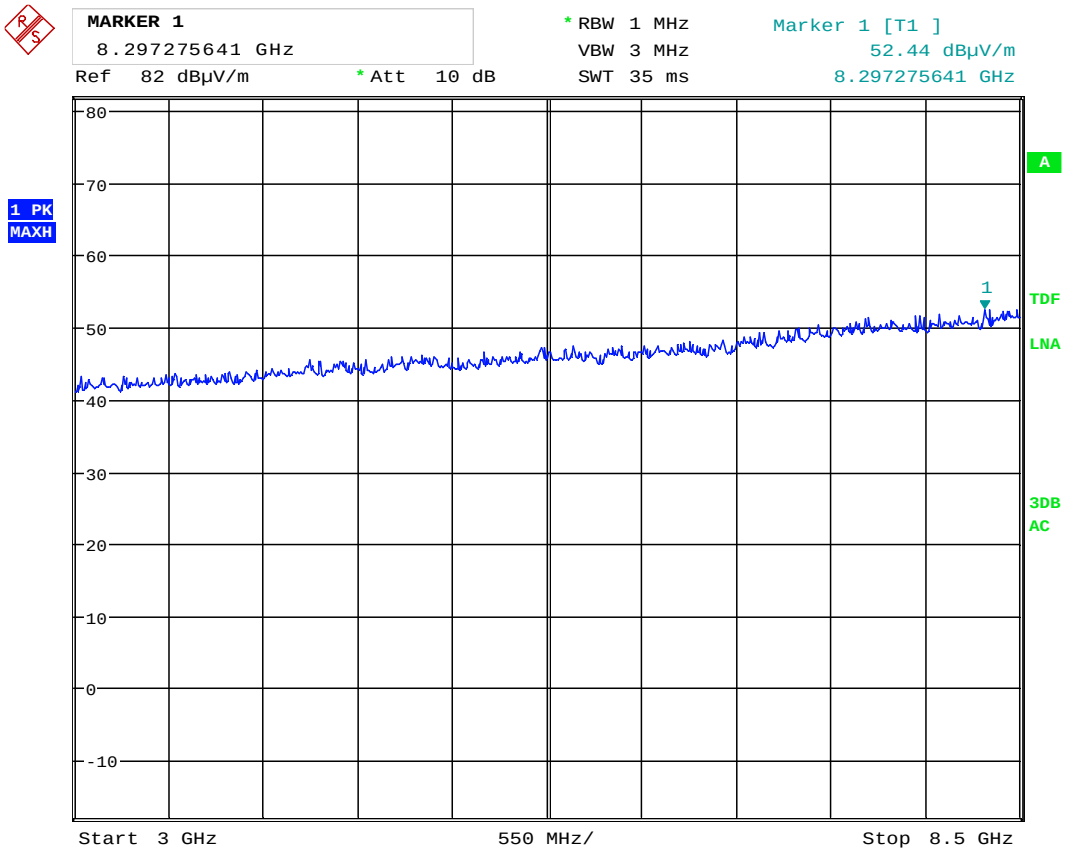
VP: preview scan 1 - 3 GHz –Pk – 2405MHz



Date: 17.MAR.2014 11:35:43

HP: preview scan 1 - 3 GHz –Pk – 2405MHz



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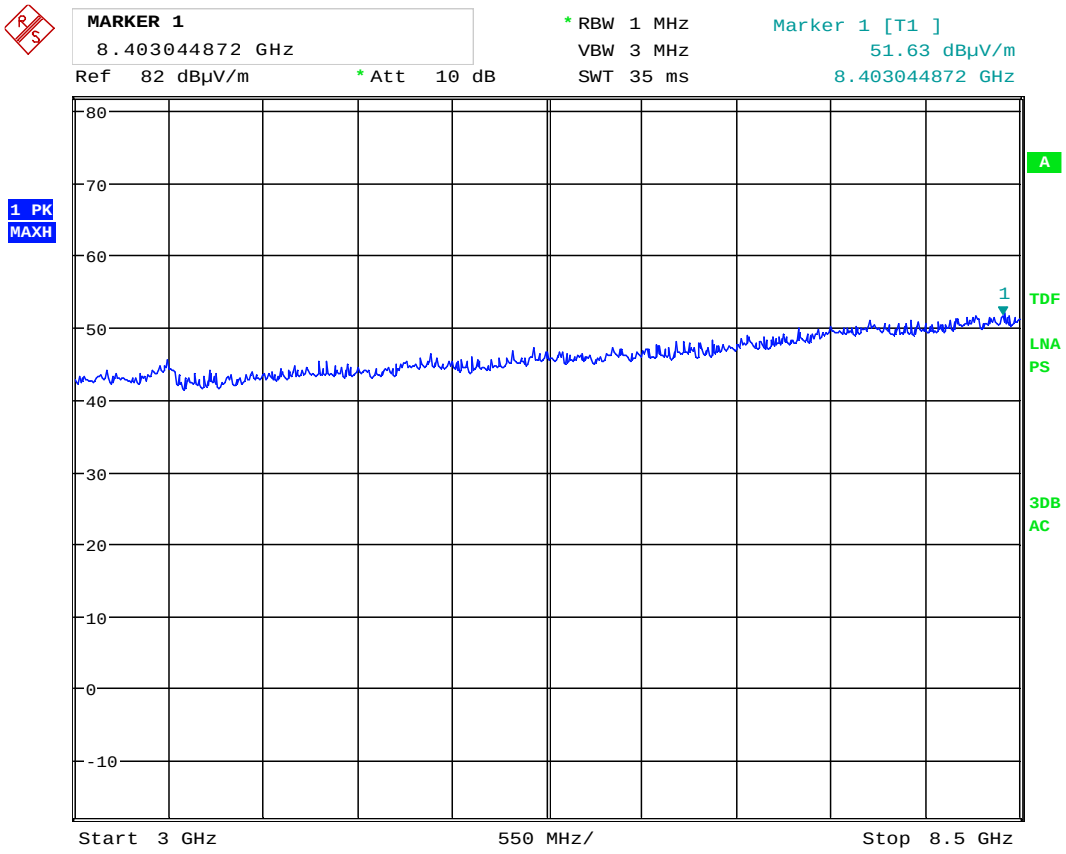
VP: preview scan 3 - 8.5 GHz –Pk with HP-filter – 2405MHz



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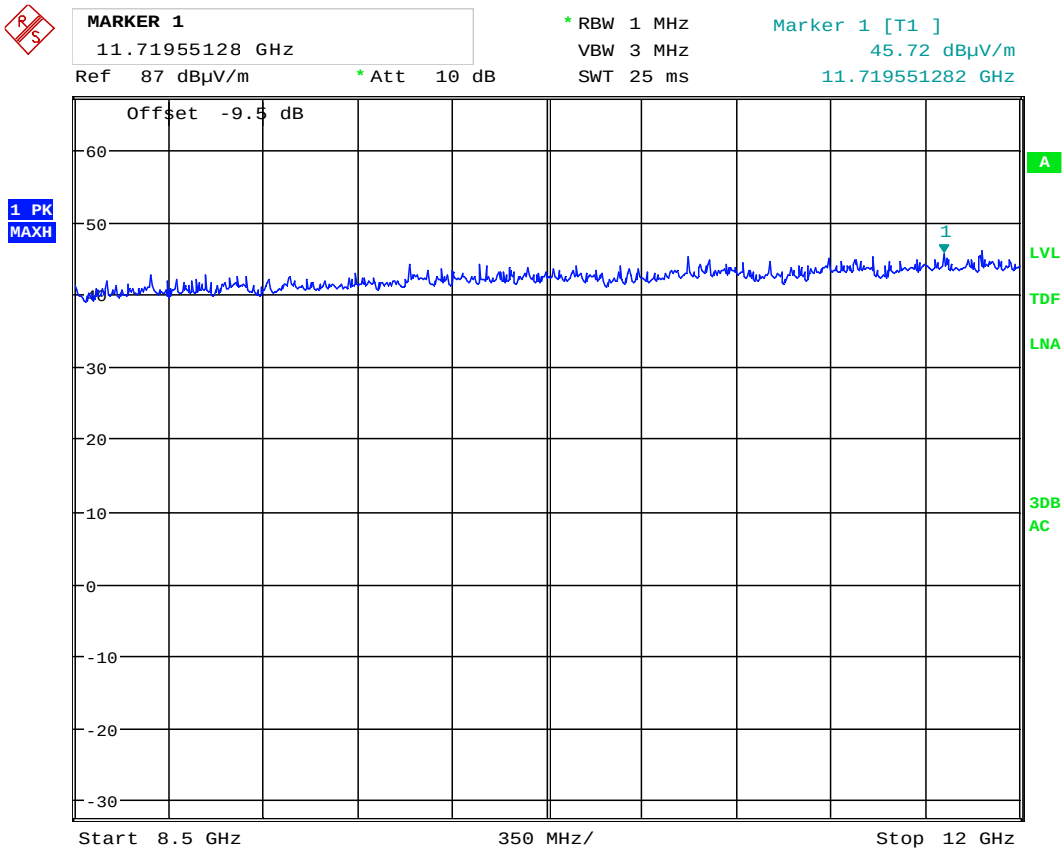
HP: preview scan 3 - 8.5 GHz –Pk with HP-filter – 2405MHz



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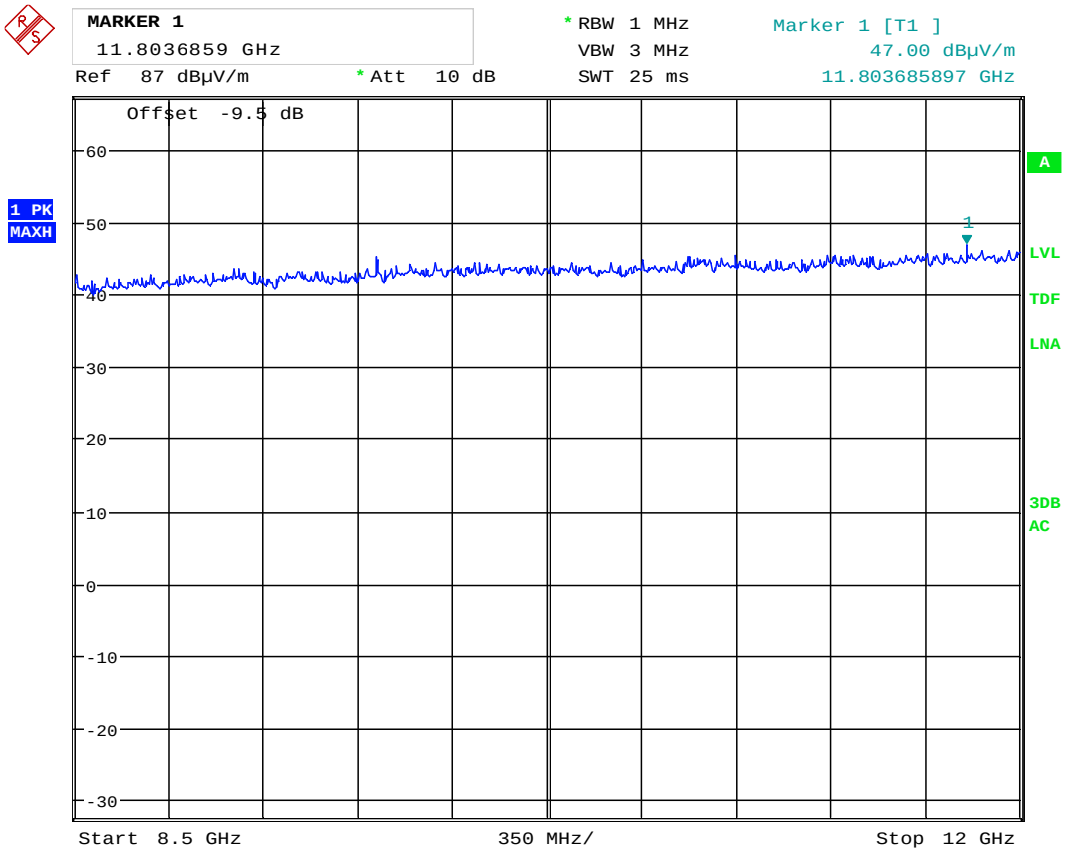
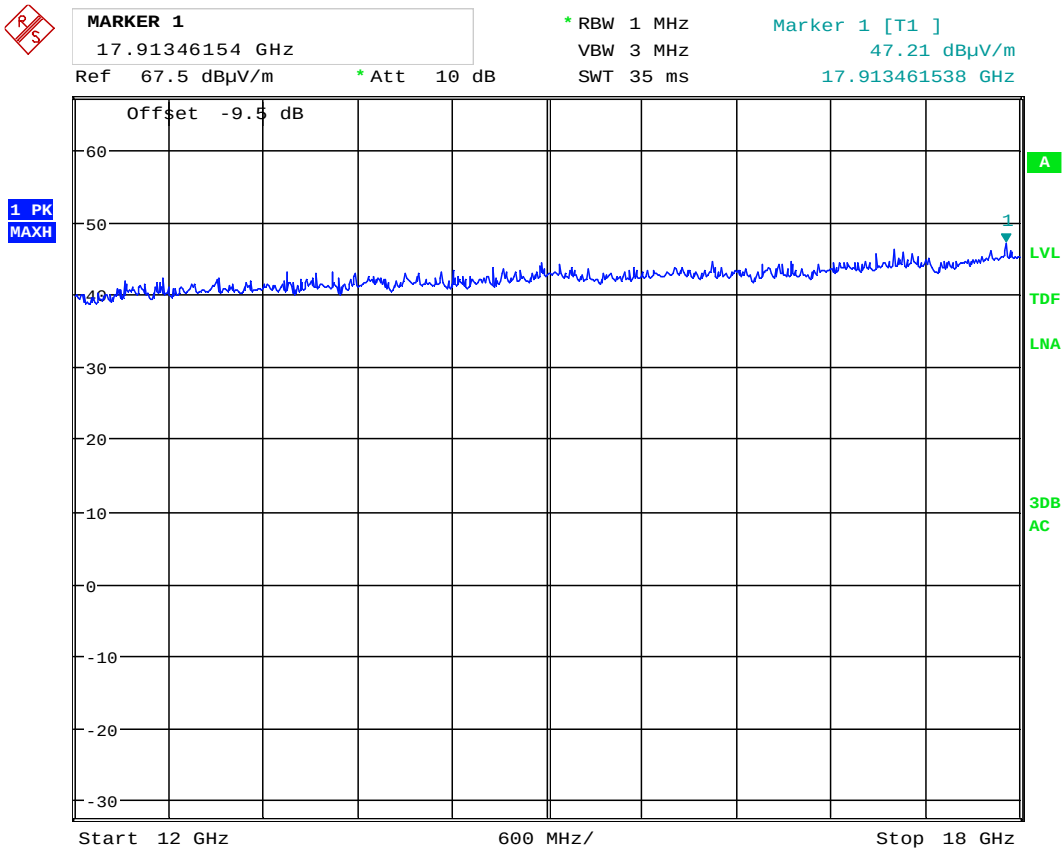
VP: preview scan 8.5 - 12 GHz –Pk– 2405MHz



Date: 17.MAR.2014 13:25:28

HP: preview scan 8.5 - 12 GHz –Pk– 2405MHz



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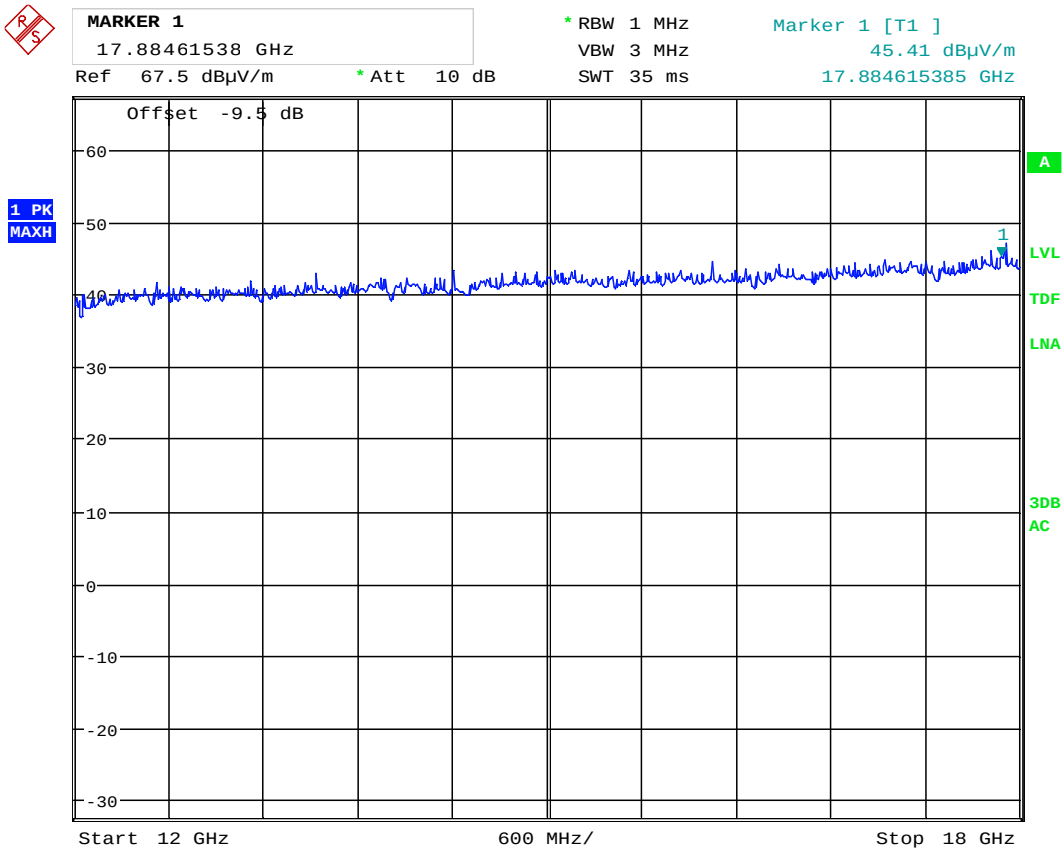
VP: preview scan 12 - 18 GHz –Pk– 2405MHz



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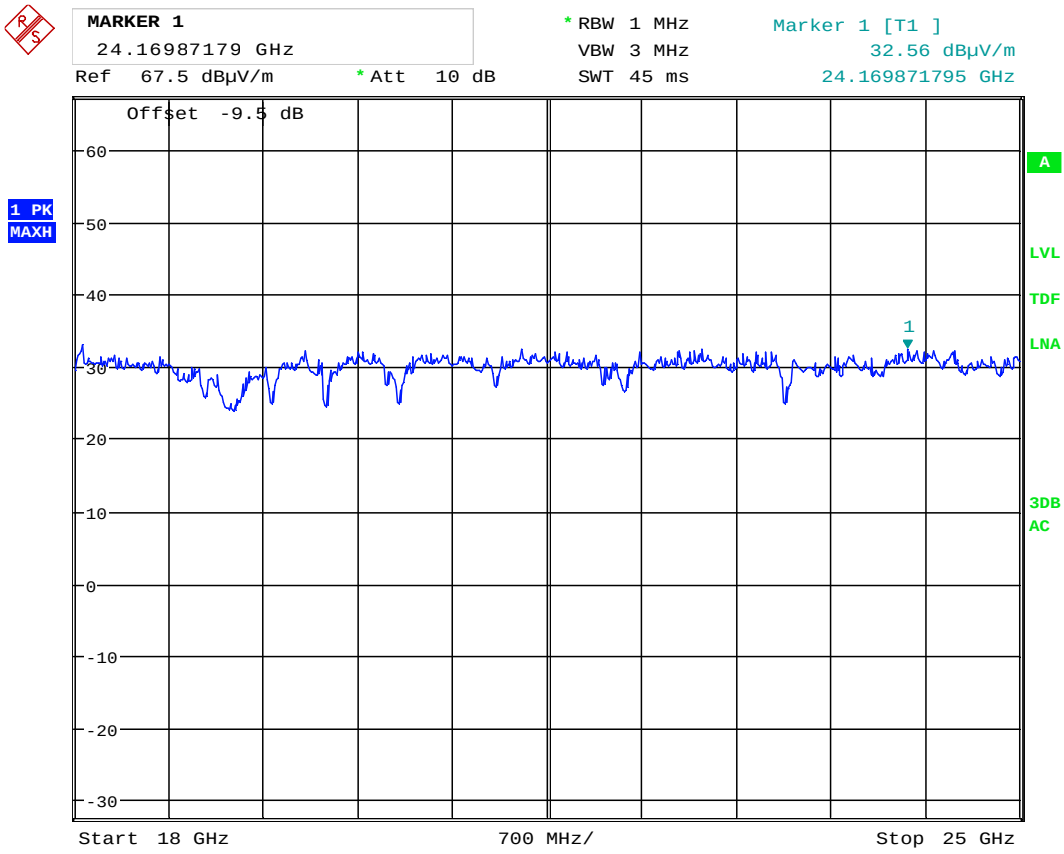
HP: preview scan 12 - 18 GHz –Pk– 2405MHz



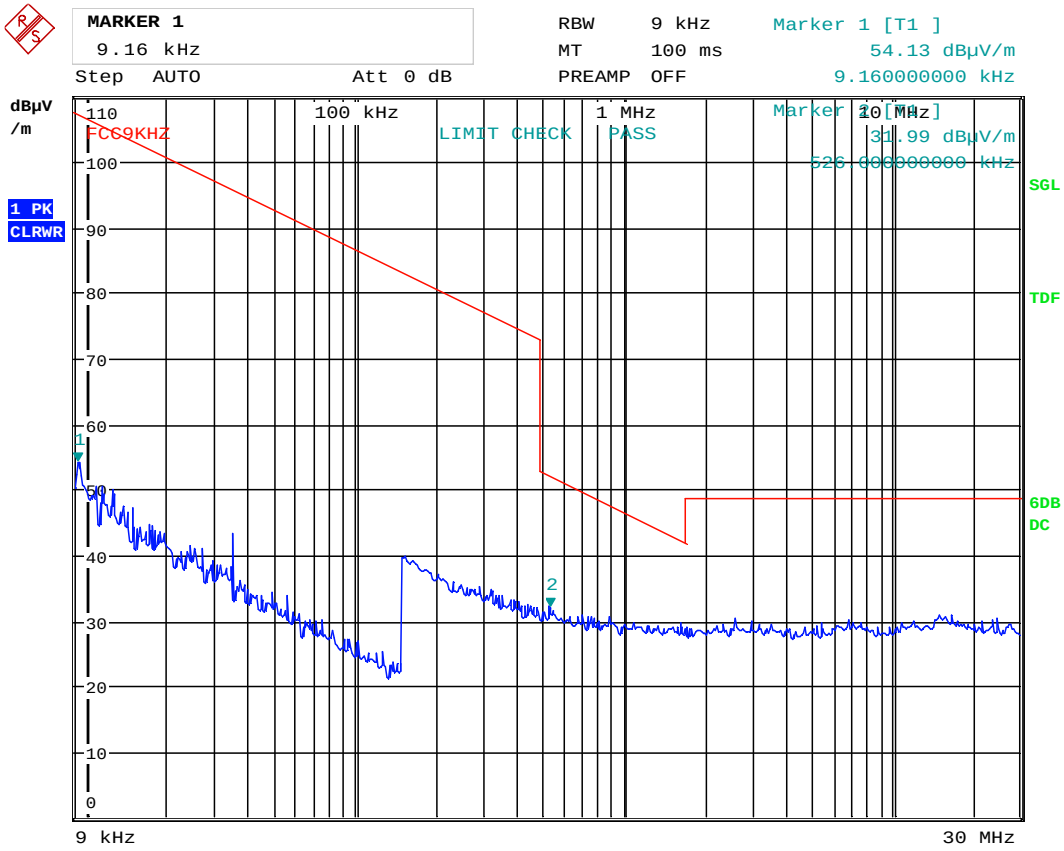
Date: 17.MAR.2014 13:37:58

VP/HP: preview scan 18 - 25 GHz –Pk– 2405MHz

Radiated emissions 9kHz – 30 MHz.

Detector: Peak

Measuring distance 10 m.



Date: 17.MAR.2014 15:37:38

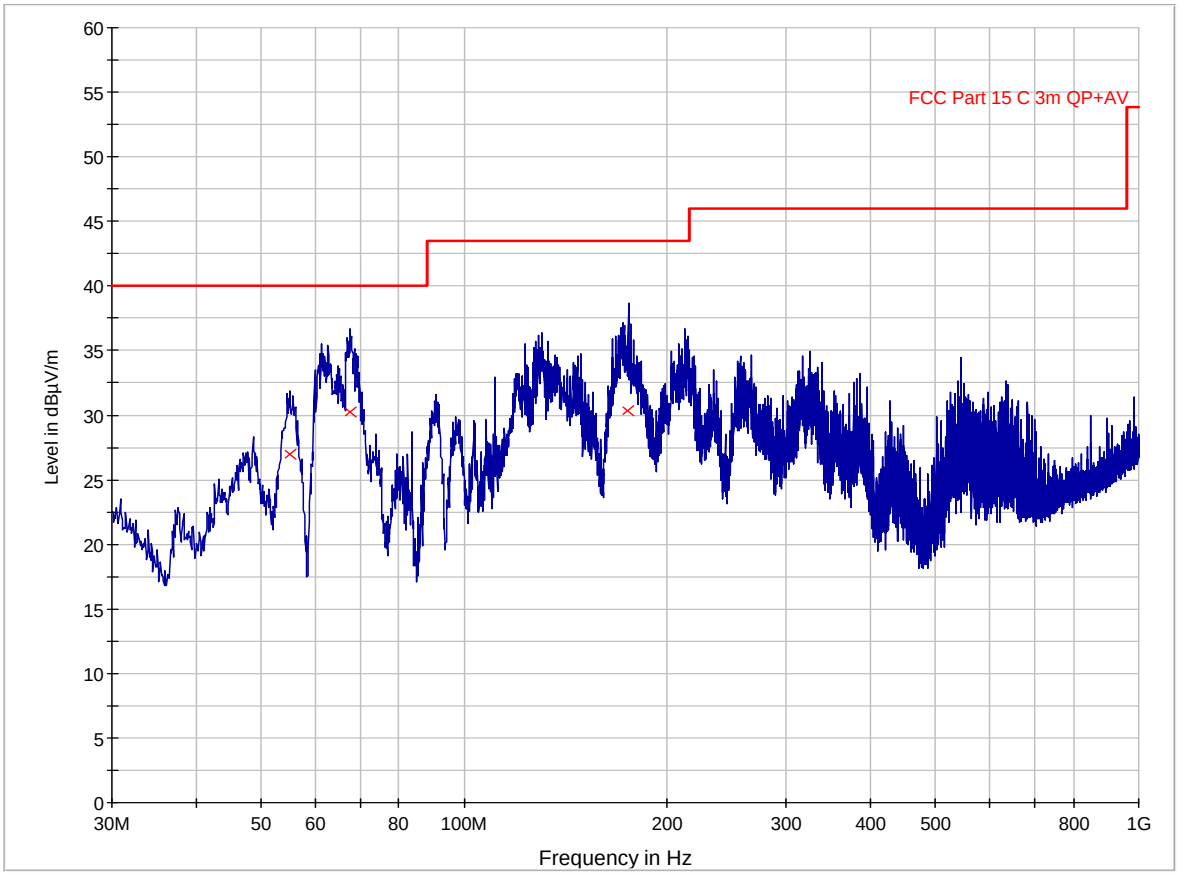
Radiated emissions 30 – 1000 MHz.

Detector: Peak

Measuring distance 3 m.

The graph shows peak scan and highest values.

FCC Pt15 Class C 30-1000 MHz 3m



30 - 1000MHz

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Polarization	Margin (dB)	Limit (dBµV/m)	Comment
55.136194	26.9	120.000	V	13.1	40.0	
67.775291	30.2	120.000	V	9.8	40.0	
174.993436	30.4	120.000	V	13.1	43.5	

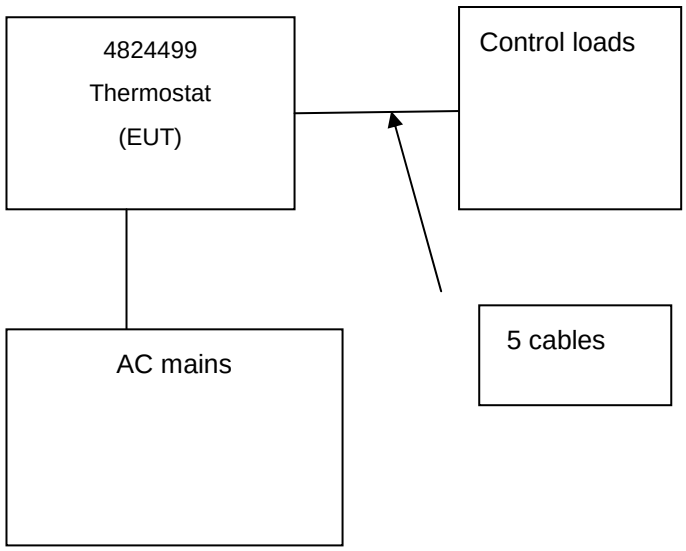
4 LIST OF TEST EQUIPMENT

To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

No.	Model number	Description	Manufacturer	Ref. no.	Cal. date	Cal. Due
1	ESU40	Spectrum Analyzer	Rohde & Schwarz	LR 1639	2013.09.24	2014.09.24
2	4768-10	Attenuator	Narda	LR1647	Calb4 use	
3	ESHS10	EMI receiver	Rohde & Schwarz	N3528	2013.09.09	2014.09.09
4	ESH3-Z5	Two Line V-Network	Rohde & Schwarz	LR 1076	Cal b4 use	
5	80S	Signal Generator	Powertron	LT 502	Cal b4 use	
6	6812B	AC Power Source	Agilent	LR 1515	2013.10.28	2014.10.28
7	ESH3-Z2	Pulse Limiter	Rohde & Schwarz	LR 1074	Cal b4 use	
8	ESCI	Measuring Receiver	Rohde & Schwarz	N-4259	2013.03.21	2015.03.21
9	JB3	BiLog Antenna	Sunol Sciences	N-4525	2011.09.07	2014.09.07
10	LNA6900	Preamplifier	Teseq	LR 1593	Cal b4 use	
11	3115	Horn Antenna	EMCO	LR 1226	2013.12.08	2015.12.08
12	8449B	Pre-amplifier	Hewlett Packard	LR 1322	2013.09	2014.09
13	HFH2-Z2	Loop Antenna	Rohde & Schwarz	LR 285	2013.12	2015.12
14	PM7320X	Standard Gain Horn	Siverts lab	LR 103	N/A	
15	DBF-520-20	Standard Gain Horn	Systron Donner	LR 101	N/A	
16	638	Standard Gain Horn	Narda	LR 1480	N/A	
18	Model 87 V	Multimeter	Fluke	LR 1599	2012.10.29	2014.10.29
19	6HC3000/18000	Highpass Filter	Trilithic	LR 1614	Cal b4 use	
20	FSW26	Spectrum Analyzer	Rohde & Schwarz	LR 1640	2013.08.30	2014.08.30
21	NRP-Z81	Wideband Power Sensor	Rohde & Schwarz	LR 1644	2014.04.05	2015.04.05

5 BLOCK DIAGRAM

5.1 System set up for radiated measurements



Test equipment: 1- 12

5.2 Test site radiated emission