

Test report no.: 162680-2

Item tested: RF module

Type of equipment: IEEE 802.15.4,

2.4 GHz Module

FCC ID: Y7VPCBA9002

Client: VingCard Elsafe AS

FCC Part 15.247

Digital Transmission System

RSS-210 Issue 8 & RSS Gen Issue 3

Low Power Licence-Exempt Radio communication Devices

19 March 2012

Authorized by:

Frode Sveinsen Technical Verificator



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1 GENERAL INFORMATION

1.1 Testhouse Info

Name: Nemko AS
Address: Nemko Kjeller

Instituttveien 6, Box 96 NO-2027 Kjeller, NORWAY

Telephone: +47 64 84 57 00
Fax: +47 64 84 57 05
Email: comlab@nemko.no

FCC test firm : 994405 IC OATS : 2040D-1

Total Number of Pages: 62

1.2 Client Information

Name : VingCard Elsafe AS

Address: Hammerberget,

7120 Leksvik, Norway

Telephone: +47 74 85 35 33

Fax: --

Contact:

Name : Siri S. Grande
Telephone : +47 74 85 35 33

E-mail: sgrande@vcegroup.com

1.3 Manufacturer

Same as client



2 Test Information

2.1 Test Item

Name :	RF module
Name:	Rr module
Model/version :	PCB Assembly 9002
Serial number :	1005 HA
Hardware identity and/or version:	4821930 Rev. B
Software identity and/or version :	4822287 Rev. B
Frequency Range :	2405 – 2475 MHz
Number of Channels :	15
Operating Modes :	TX & RX
Type of Modulation :	DSSS/O-QPSK
Emissions Designator :	G1D
User Frequency Adjustment :	None, Software controlled
Type of Power Supply :	Battery (7.5 V DC)
Antenna Connector :	None
Antenna type:	Integral
Antenna Diversity Supported :	None

Theory of Operation

This designed for wireless applications, such as IEEE 802.15.4 and ZigBee.



2.2 Test Environment

2.2.1 Normal test condition

Temperature: 20 - 22 °C Relative humidity: 20 - 40 % Normal test voltage: 7.5 V DC

The values are the limit registered during the test period.

2.3 Test Period

Item received date: 2010.12.07

Test period: from 2010.12.15 to 2011.01.04 and 2012.03.16



☐ Class II Permissive Change

DTS Equipment Code

TEST REPORT FCC part 15C Project no.: 162680-2 FCC ID: Y7VPCBA9002

3 TEST REPORT SUMMARY

3.1 General	
Manufacturer:	VingCard Elsafe AS
Model No.:	PCB Assembly 9002
Serial No.:	1005 HA
All measurements are tra	aceable to national standards.
The tests were performe	ed for the purpose of demonstrating compliance with FCC CFR 47 Part 15.247.
•	formed in accordance with ANSI C63.4-2009 and ANSI C63.10-2009. The e in a semi-anechoic chamber at measuring distances of 3 and 10 meters.
New Submission ■	□ Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM (S) TESTED.

☐ Pre-production Unit

☐ Family Listing

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



TEST REPORT #: 162820-2

TESTED BY: DATE: 2012-03-16

G.Suhanthakumar, Test engineer

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This test report applies only to the items and configurations tested.

FCC ID: Y7VPCBA9002

3.2 **Test Summary**

Name of test	FCC Part 15 reference	RSS210 Issue 7 & RSS Gen Issue 3	Result
Supply voltage variations	15.31 (e)	8 (RSS-GEN)	Complies
Number of operating frequencies	15.31 (m)	A8.1	Complies
Power-line Conducted Emissions (Receiver)	15.107(a)	7.2.2 (RSS-GEN)	N/A ²
Radiated Emissions limits (receiver)	15.109(a)	6 (RSS-GEN)	ref. 15.209(a)
Antenna requirement	15.203	7.1.4 (RSS-GEN)	N/A ¹
Radiated emissions limits for restricted bands	15.205(a)		Complies
Power Line Conducted Emissions	15.207(a)	7.2.2 (RSS-GEN)	N/A ²
Radiated emission limits	15.209(a)	A8.5	Complies
Bandwidth	15.247(a)(2)	A8.2	Complies
Peak Power Output	15.247(b)(3)	A8.4	Complies
Power Spectral Density	15.247(d)	A8.2	Complies
Out-of-band emissions (Antenna Conducted)	15.247(c)	A8.5	Complies ¹
Out-of-band emissions (Radiated)	15.247(c)	A8.5	Complies
Lower band edge radiated emission	15.247(c)	A8.5	Complies
Upper band edge radiated emission	15.247(c)	A8.5	Complies

¹ standard SMA connector (for laboratory use).

3.3 **Description of modification for Modification Filing**

Not applicable.

3.4 **Comments**

The channels are selected with controller connected to the EUT. The measurements are performed at channels near top Ch 14, near middle Ch 7 and near bottom Ch 0. And the output level is set to maximum in the software. The EUT complies at these channels.

The radiated measurements are tested on three axis.

Power supply variation within manufacturer specified range 4.5 – 9.5V DC has no influence on measured values in this test report.

A temporary antenna connector was used only for making conducted RF measurements for evaluation purposes.

3.5 **Family List Rationale**

Not Applicable.

² Battery operated.



4 TEST RESULTS

4.1 Minimum 6 dB Bandwidth

Para. No.: 15.247 (a)(2)

Test Performed By: G.Suhanthakumar

Date of Test: 15-Dec-2010 & 16-Mar-2012

Test Results: Complies

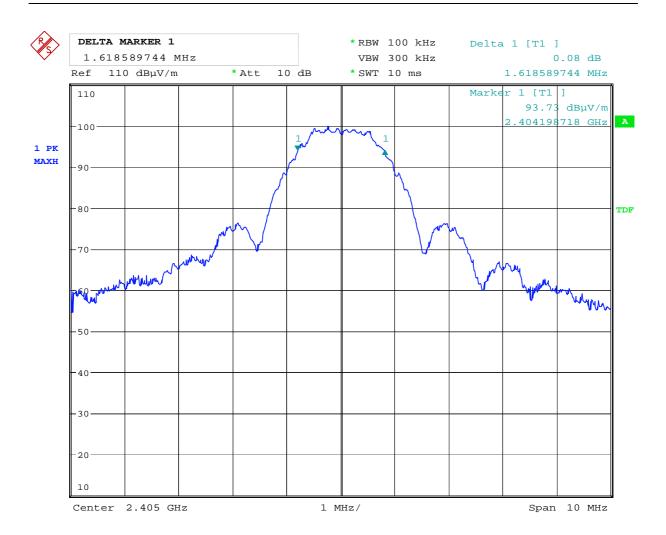
Measurement Data:

6 dB Bandwidth (MHz)				
Ch 0 Ch 7 Ch 14				
2405MHz	2440MHz	2475MHz		
1.62	1.63	1.62		

Requirements:

For Digital Transmission Systems in the 2400-2483.5 MHz band the minimum 6 dB bandwidth shall be at least 500 KHz.

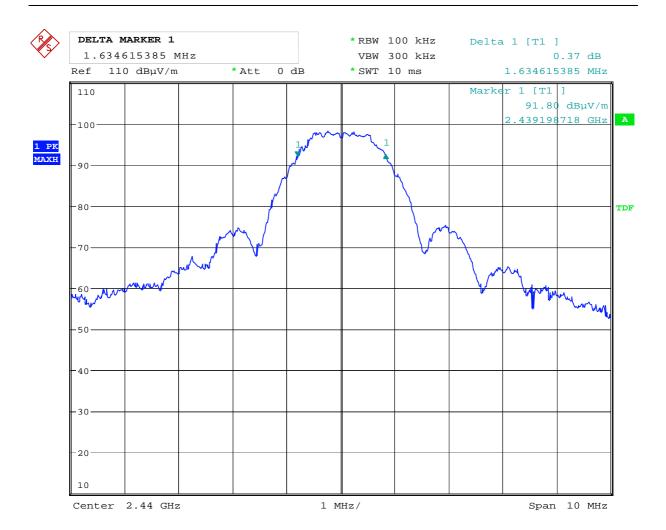




Date: 15.DEC.2010 10:29:13

Ch0 - 6 dB bandwidth - 1.62MHz

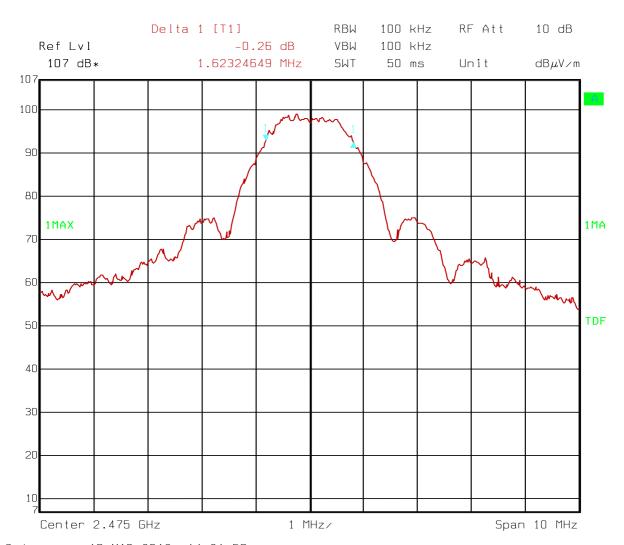




Date: 15.DEC.2010 11:06:09

Ch7 - 6 dB bandwidth - 1.63MHz





Date: 16.MAR.2012 14:21:56

CH14 - 6 dB bandwidth - 1.62MHz



4.2 20 dB Bandwidth

Para. No.: RSS210

Test Performed By: G.Suhanthakumar Date of Test: 15-03-2011 &

16-03-2012

Measurement Data:

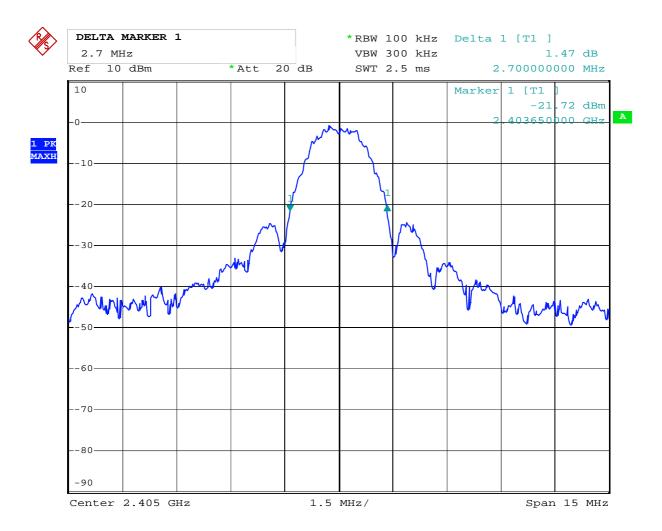
20 dB Bandwidth (MHz)				
Ch 0 Ch 7 Ch 14				
2405MHz	2440MHz	2475MHz		
2.70	2.67	2.71		

Requirements:

For information only



FCC part 15C Project no.: 162680-2 FCC ID: Y7VPCBA9002

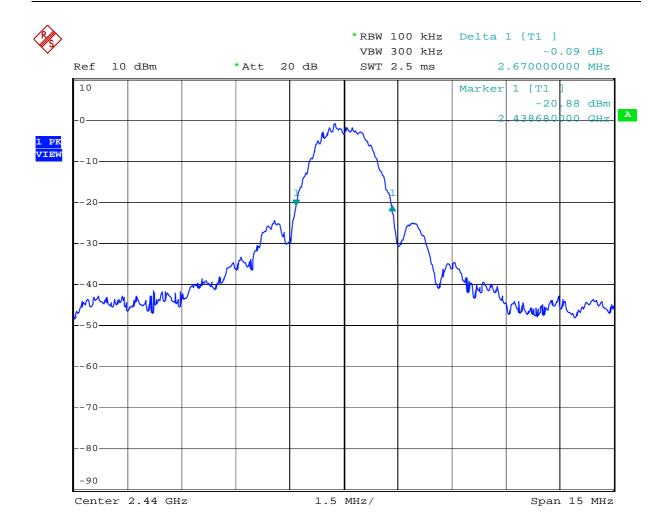


15.MAR.2011 13:38:55 Date:

20 dB BW - CH 2405MHz

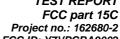


Project no.: 162680-2 FCC ID: Y7VPCBA9002

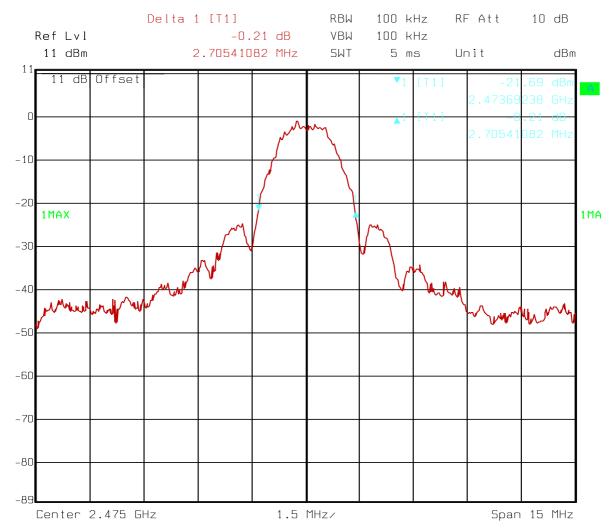


Date: 15.MAR.2011 13:40:35

20 dB BW - CH 2440MHz







Date: 16.MAR.2012 15:25:58

20 dB BW - CH 2475MHz



FCC ID: Y7VPCBA9002

4.3 **Peak Power Output**

Para. No.: 15.247 (b)

Test Performed By: G.Suhanthakumar Date of Test: 15-Dec-2010 & 16-Mar-2012

Test Results: Complies Measurement Data:

Maximum Conducted Peak Output Power

RF channel	Ch 0	Ch 7	Ch 14
Measured value (dBm)	3.51	3.06	2.29
Measured value (Watt)	0.0022	0.0020	0.0017

RBW=3MHz, VBW=10MHz, Peak detector

Maximum Field strength

RF channel	Ch 0	Ch 7	Ch 14
HP: Measured value (dBμV/m)	103.55	102.99	102.43
VP: Measured value (dBμV/m)	92.14	93.79	93.69

Maximum EIRP

RF channel	Ch 0	Ch 7	Ch 14
Measured EIRP (dBm)	4.00	4.25	4.55
Antenna gain dBi	0.49	1.19	2.29

Substitution:

Frequency MHz	Measured value dBm	Subst. Gen. dBm	Attenuator and Cable dB	Gain Subst. Antenna dB	Result dBm
2405	-38.55	9.24	-13.64	8.4	4.00
2440	-38.53	9.45	-13.80	8.6	4.25
2475	-39.99	9.51	-13.96	9.0	4.55

Correction factor = (Subst.Gen. + Attenuator + Cable + Antenna Gain)

Result(eirp) = (Correction factor + Measured value)

Antenna gain = (EIRP -Conducted Power) dBi

The EIRP is measured using substitution method. The maximum eirp is obtained at horizontal polarization.

Power supply variation within manufacturer specified range 4.5 – 9.5V DC has no influence on measured values



TEST REPORT FCC part 15C Project no.: 162680-2 FCC ID: Y7VPCBA9002

Detachable antenna?	Yes No
If detachable, is the antenna connector non-standard?	Yes No
Comment: /	

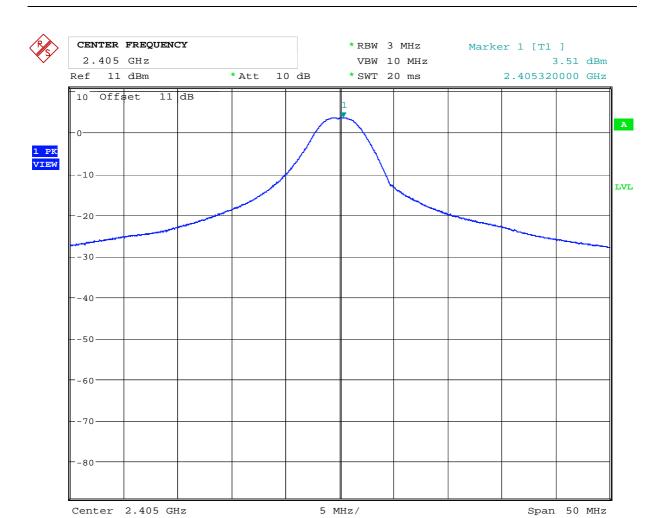
Requirements:

The maximum peak output power shall not exceed the following limits:

For Digital Transmission Systems in the 2400 - 2483.5 MHz band: 1 Watt

If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power from the intentional radiator shall be reduced below the stated value above by the amount in dB that the directional gain of the antenna exceeds 6 dBi.



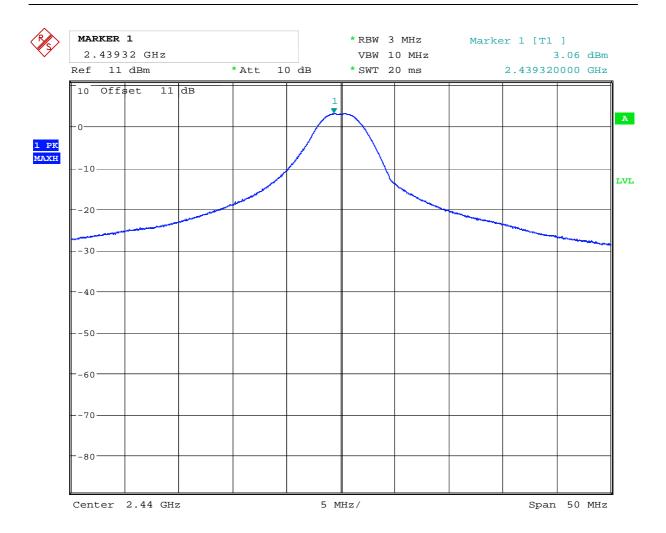


Date: 15.DEC.2010 14:51:59

Conducted power - ch0



FCC part 15C Project no.: 162680-2 FCC ID: Y7VPCBA9002

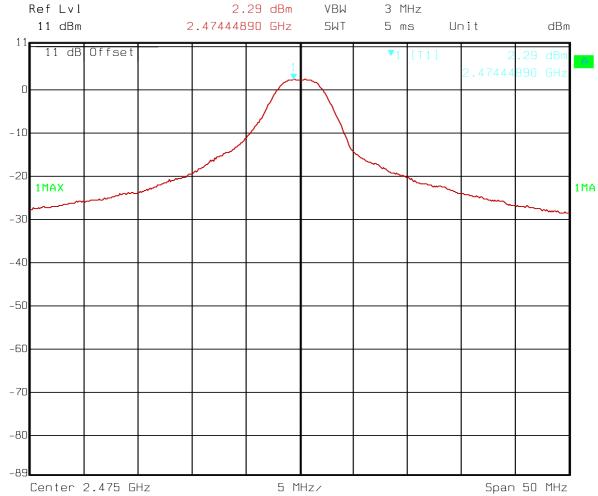


Date: 15.DEC.2010 14:54:13

Conducted power - ch 7



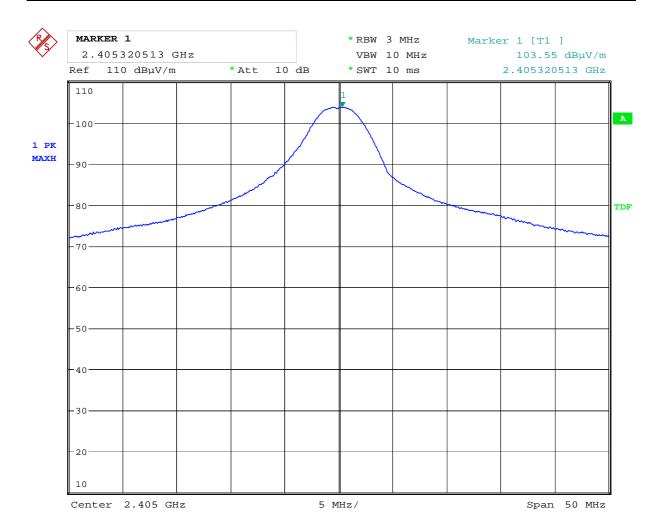
3 MHz Marker 1 [T1] RBWRF Att 10 dB 2.29 dBm VBW3 MHz 2.47444890 GHz SWT 5 ms Unit



Date: 16.MAR.2012 15:15:40

Conducted power -ch14

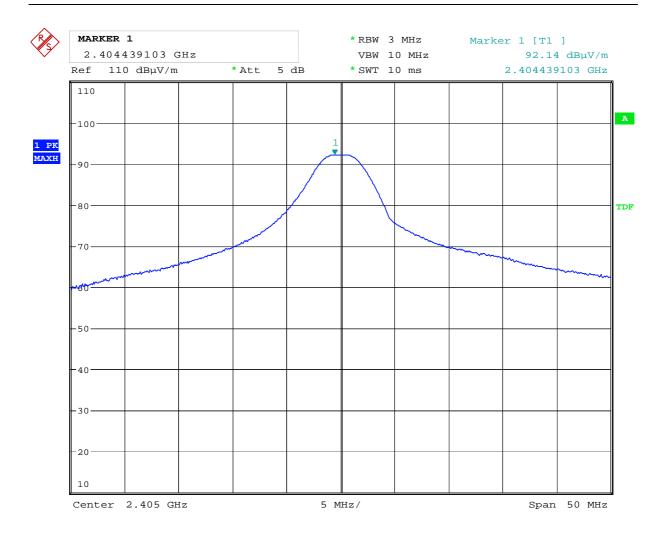




Date: 15.DEC.2010 10:27:59

HP: Ch0 - Field strength

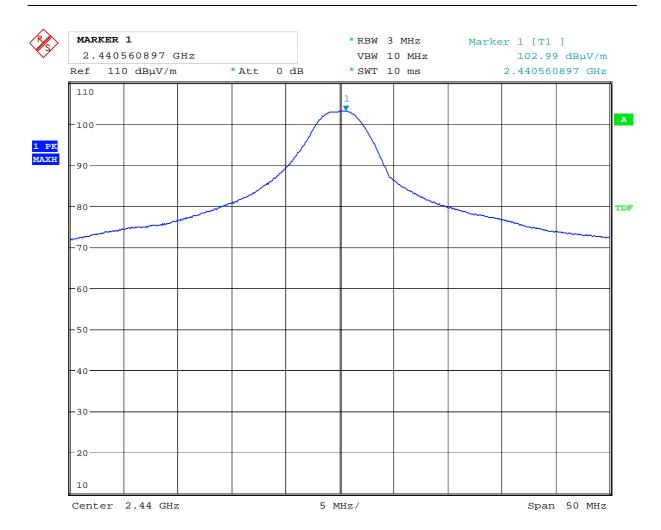




Date: 15.DEC.2010 10:39:47

VP: Ch0 - Field strength

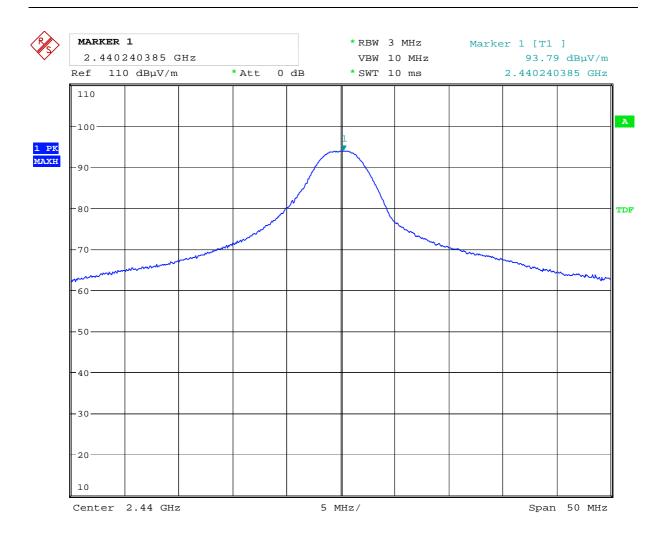




Date: 15.DEC.2010 11:03:07

HP: Ch7 - Field strength



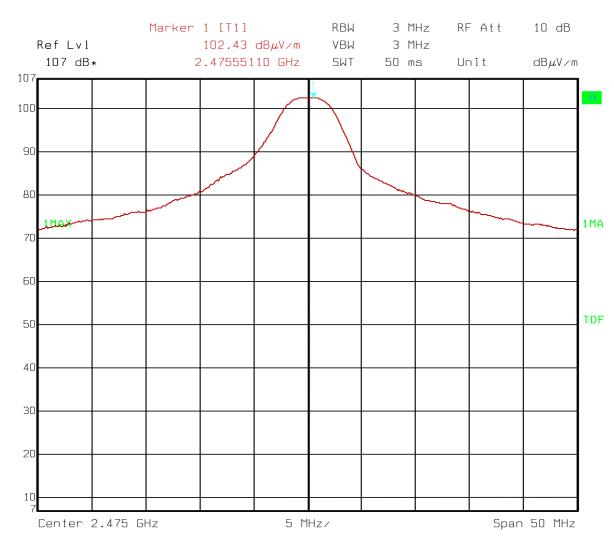


Date: 15.DEC.2010 11:04:50

VP: Ch7 - Field strength



Project no.: 162680-2 FCC ID: Y7VPCBA9002

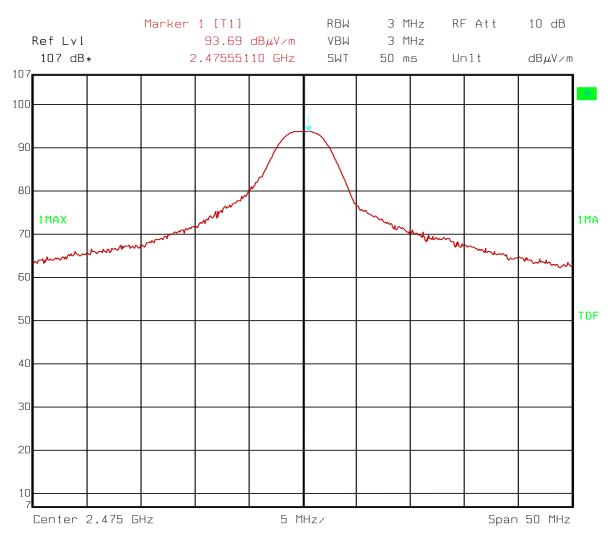


Date: 16.MAR.2012 13:51:49

HP: Ch14 - Field strength



Project no.: 162680-2 FCC ID: Y7VPCBA9002



16.MAR.2012 13:45:25 Date:

VP: Ch14 - Field strength



4.4 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Performed By: G.Suhanthakumar Date of Test: 15.12.2010 and 16.03.2012

Test Results: Complies

Measurement Data:

Frequency	Field Strength at Band Edge	Detector	Limit	Margin
GHz	dBμV/m		dBµV/m	dB
2.39	52.1	Pk	74	21.9
2.4835	52.45	Pk	74	21.6

Band-edge field strength 2.4 GHz:

Marker Delta 100kHz RBW: 50.97dB

Peak Field Strength 103,05–50.97 = 52.08 dB μ V/m

Band-edge field strength 2.4835 GHz:

Marker Delta 100kHz RBW: 49.6 dB

Peak Field Strength: $102.05-49.6 = 52.45 \text{ dB}\mu\text{V/m}$

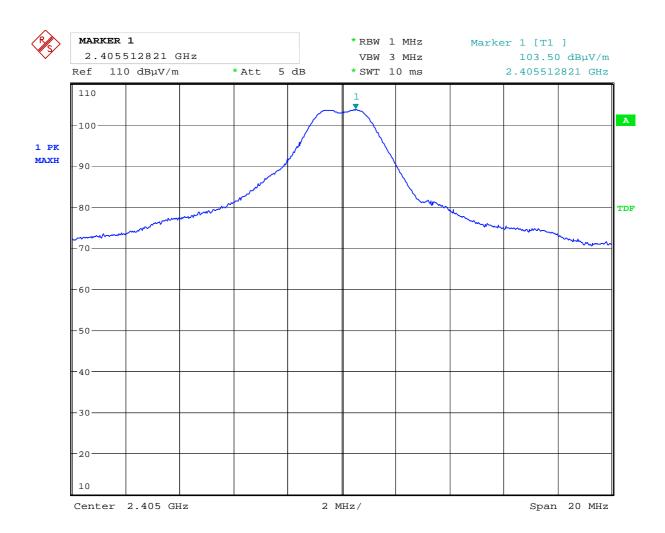
RF conducted emissions to 25 GHz

Maximum RF level outside operating band:

RF ch 0: 34,44 dBC, margin > 20 dB RF ch 7: 35,16 dBC, margin > 20 dB RF ch 15: 37,91 dBC, margin > 20 dB

^{*} duty cycle correction=0

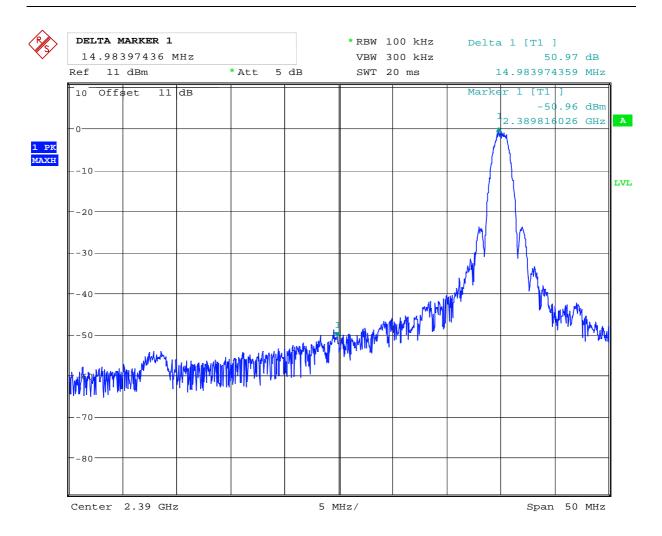




Date: 15.DEC.2010 10:32:16

Ch0- Lower channel power

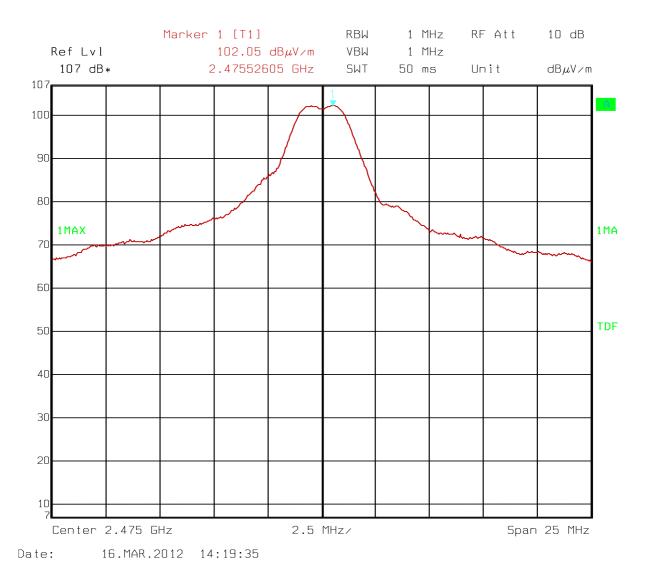




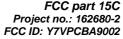
Date: 15.DEC.2010 14:39:42

Ch0 - Lower-band-edge - Delta-marker

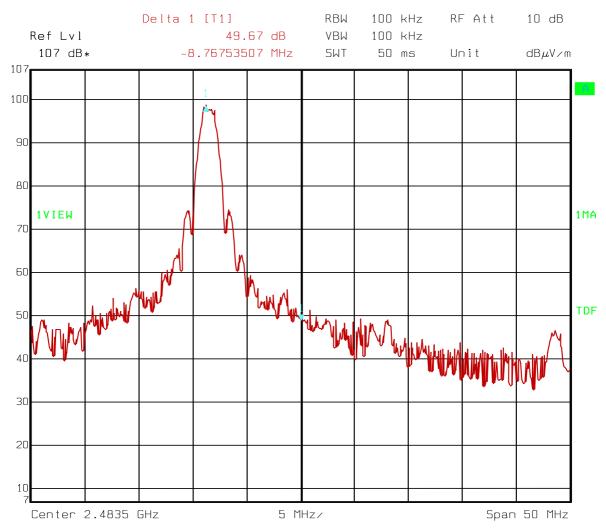




CH14 – upper channel power



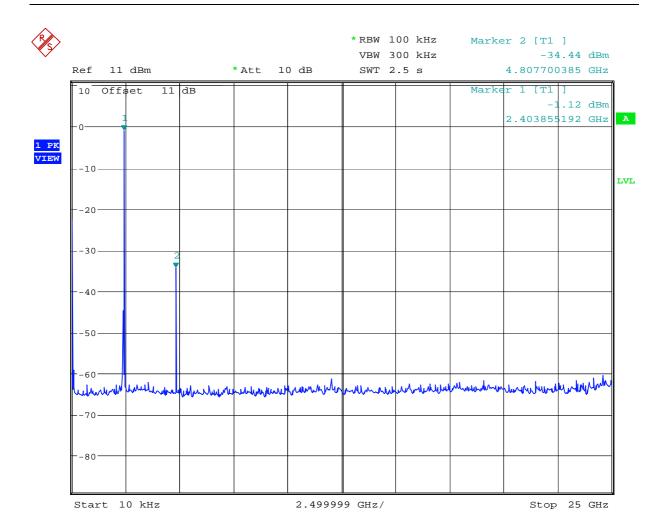




Date: 16.MAR.2012 14:17:50

Ch14 - Upper-band-edge - Delta-Marker

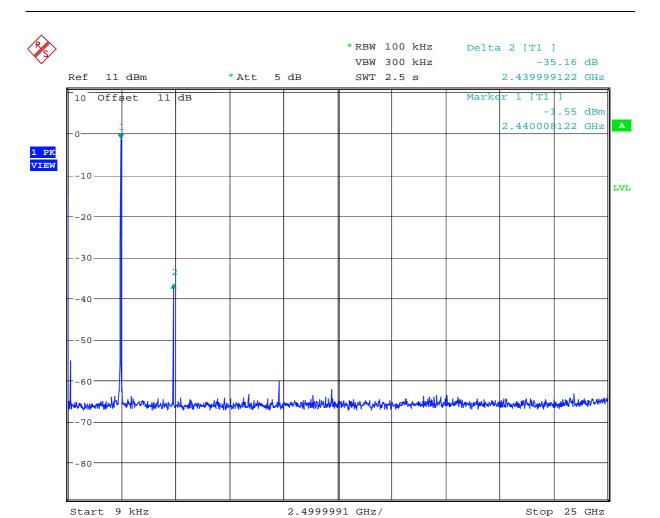




Date: 15.DEC.2010 14:03:06

Ch0 - Conducted Spurious - 9kHz - 25GHz

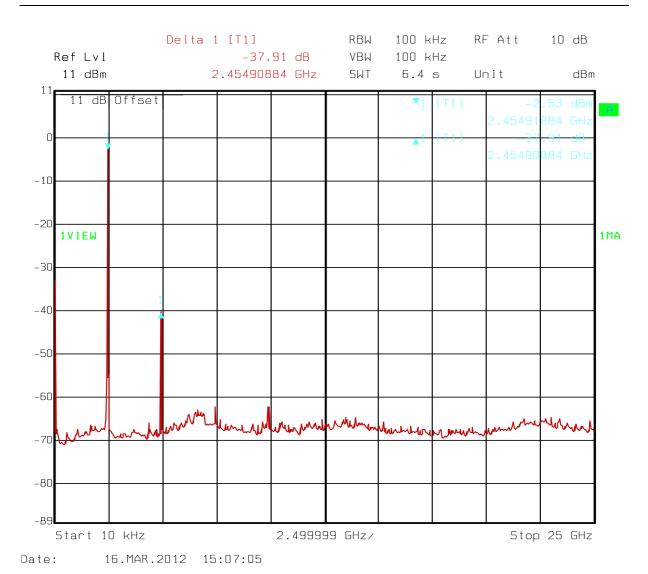




Date: 15.DEC.2010 14:44:27

Ch7 - Conducted Spurious - 9kHz - 25GHz





Ch14 - Conducted Spurious - 9kHz - 25GHz



Project no.: 162680-2 FCC ID: Y7VPCBA9002

Duty Cycle Calculation:

RF duty cycle: Calculation according to RF burst Para 15.35 (c)

 $-20*\log(4.256/4.256) = 0$ dB

Maximum duty cycle according to Para 15.35 (b): 20 dB

This value is used to calculate Average field strength above 1 GHz from measured Peak value.

Manufacturer statement:

The MAC-frame is as follows:

Octets: 2	1	0/2	0/2/8	0/2	0/2/8	variable	2
Frame control	Sequence number	Destination PAN identifier	Destination address	Source PAN identifier	Source address	Frame payload	FCS
		Addressing fields				15 E	
MHR					MAC payload	MFR	

Figure 34—General MAC frame format

This will give a frame size of 127 bytes (payload 102 bytes of those) + the MAC overhead of six bytes => 133 bytes maximum.

With an effective transfer rate of 250kbit this equals a total transmission time of 133x8/250k=4.256ms. This equals 4.256% duty-cycle for a 100ms window.

This module will transmit very seldom and never use the full payload, the effective duty-cycle will be much less.



Radiated Emissions with antenna, 1-25 GHz, peak

1-18 GHz measured at a distance of 3m, 18-25 GHz measured at 1m.

Measured with Peak Detector

Frequency	RF channel	Dist. corr. factor	Field strength, Peak, 3m	Duty cycle corr. factor	Limit	Margin
GHz	0-14	dB	dBμV/m	dB	dBμV/m	dB
4.811	0	0	50.29	-	74	23.71
4.881	7	0	50.11	-	74	23.89
4.950	14	0	48.42	-	74	25.58
7.213	0	0	49.97	-	74	24.03
7.320	7	0	50.24	-	74	23.76
7.425	14	0	49.61	-	74	24.39
8 - 25	0,7,14	0	None detected	-	-	-

Radiated emissions with antenna,1- 25 GHz, Average

Calculated value from Peak Detector

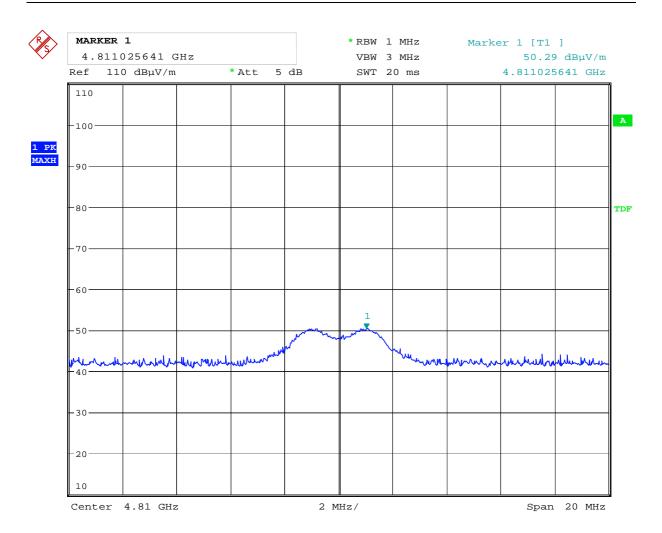
Frequency	RF channel	Dist. corr. factor	Field strength, Peak, 3 meters	Duty Cycle correction factor	Limit	Margin
GHz	0-14	dB	dBμV/m	dB	dBμV/m	dB
4.809	0	0	50.29	0	54	3.71
4.889	7	0	50.11	0	54	3.89
4.950	14	0	48.42	0	54	5.58
7.213	0	0	49.97	0	54	4.03
7.320	7	0	50.24	0	54	3.76
7.425	14	0	49.61	0	54	4.39
8 - 25	0,7,14	0	None detected	-	-	-

The maximum is observed in vertical polarization

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

Also radiated spurious emissions are checked with 50 ohm load and no spurious emissions detected.



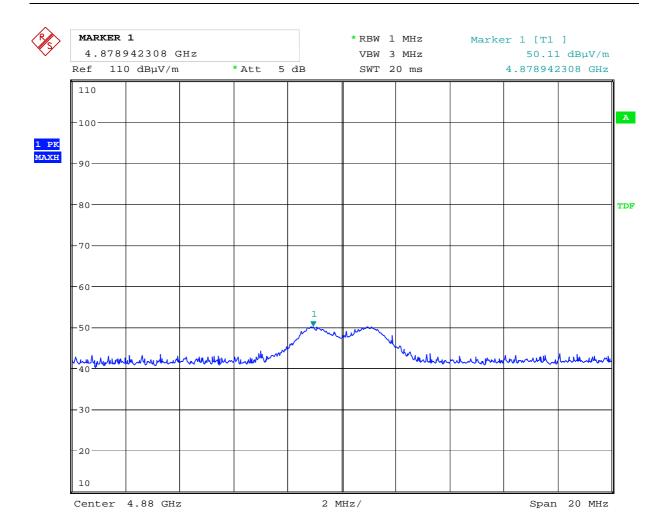


Date: 15.DEC.2010 12:56:38

Ch0 - 2nd harmonic



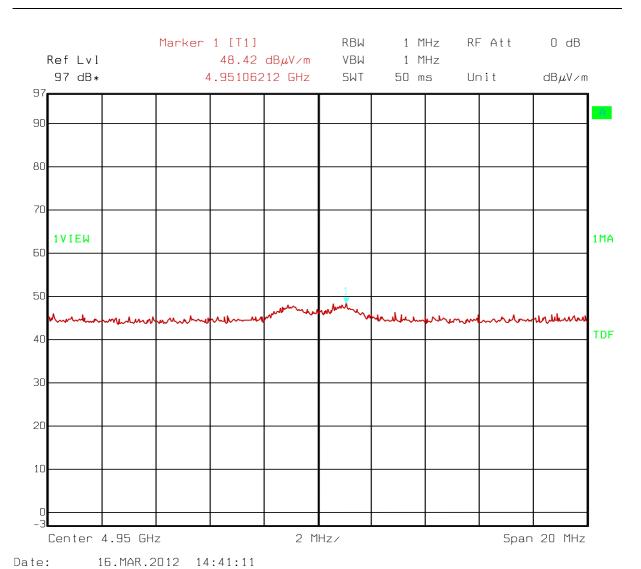
Project no.: 162680-2 FCC ID: Y7VPCBA9002



Date: 15.DEC.2010 12:51:14

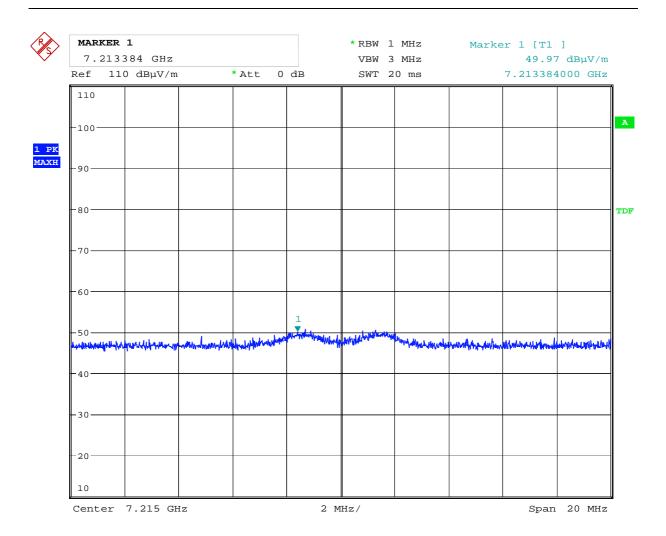
Ch7 – 2nd Harmonic





Ch14 – 2nd Harmonic

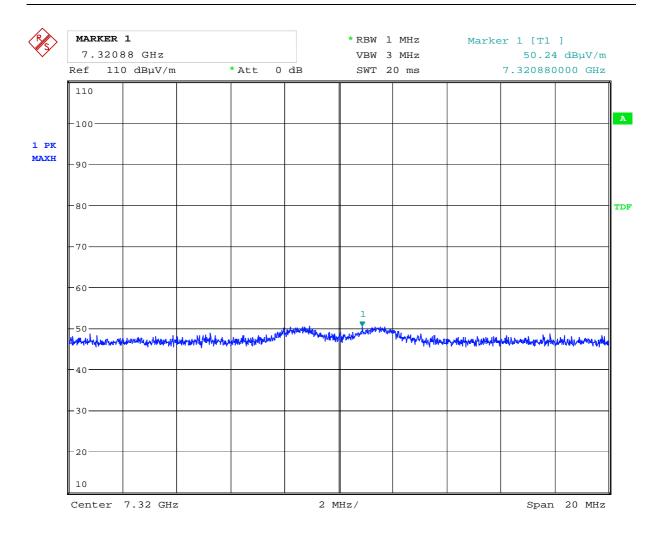




Date: 15.DEC.2010 13:04:19

Ch0 3rd harmonic



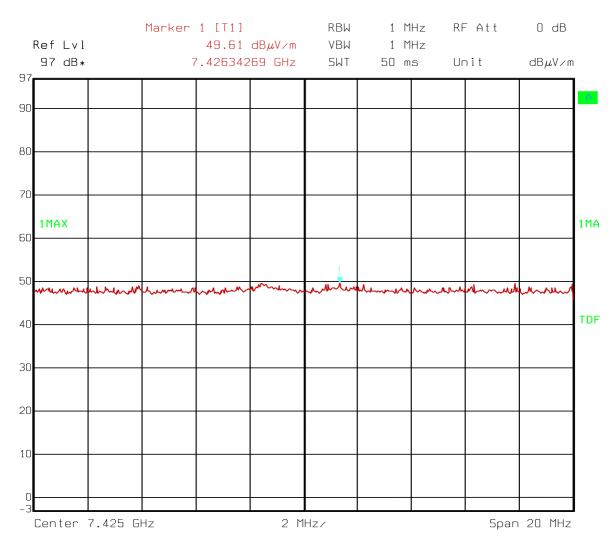


Date: 15.DEC.2010 13:10:39

Ch7 3rd harmonic



FCC part 15C Project no.: 162680-2 FCC ID: Y7VPCBA9002



16.MAR.2012 14:44:42 Date:

Ch14 3rd harmonic

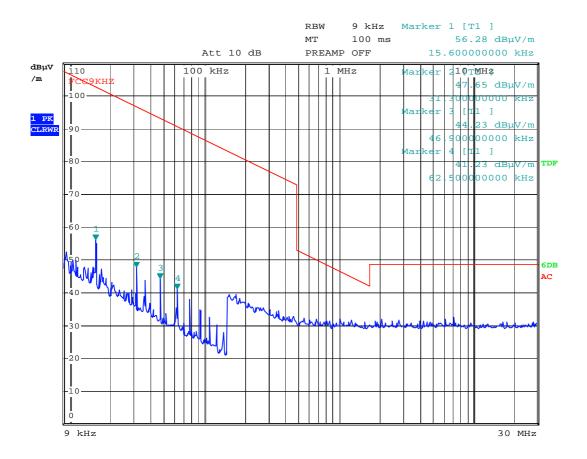


Radiated emissions 30 - 1000 MHz.

Detector: Quasi-Peak Measuring distance 3 m.

Frequency	•	Field	Measuring	Polarization	Limit	Margin
	condition	strength	distance		FCC15.209	
MHz		dBμV/m	m	-	dBμV/m	dB
49.32	TX ON	16.86	3	VP	40	23.14
160	TX ON	24.30	3	VP	43	18.70
207	TX ON	19.54	3	HP	46	26.46

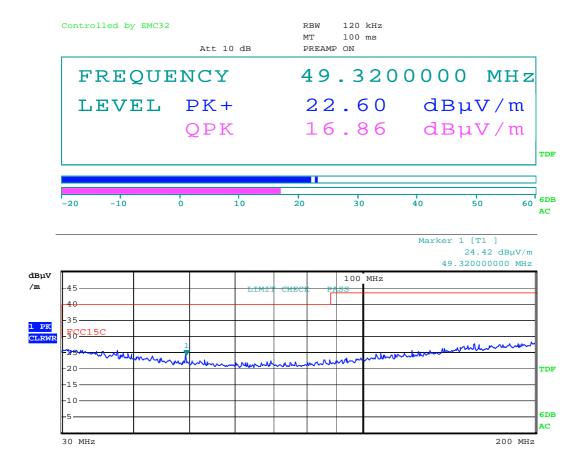




Date: 15.DEC.2010 13:07:36

9kHz - 30MHz

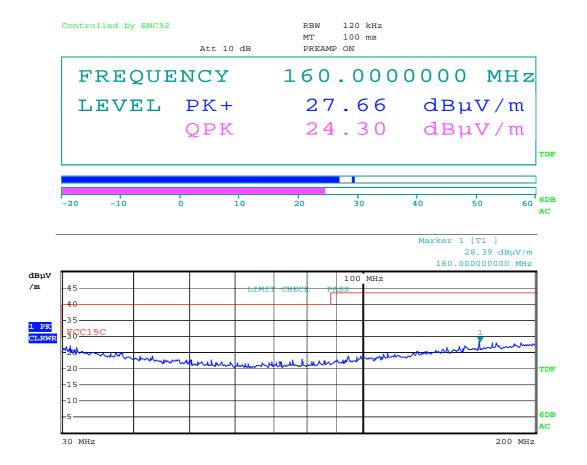




Date: 15.DEC.2010 08:46:37

VP - 30 - 200 MHz

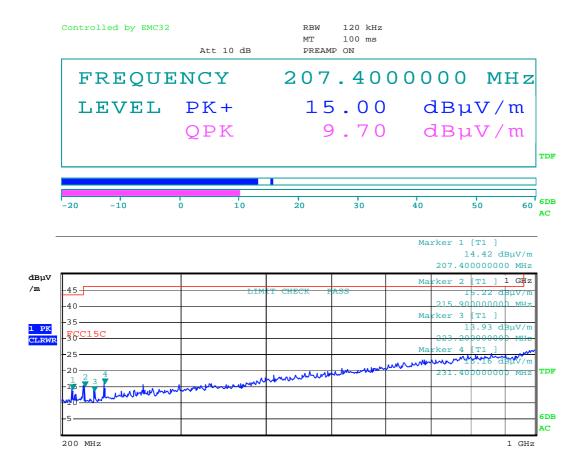




Date: 15.DEC.2010 08:41:48

HP - 30 - 200MHz

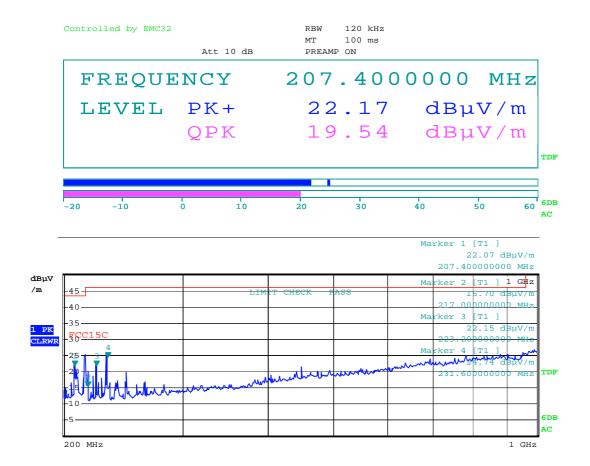




Date: 15.DEC.2010 08:55:45

VP - 200 - 1000GHz





Date: 15.DEC.2010 09:04:05

HP 200 - 1000MHz



4.5 Receiver Spurious Emissions (radiated)

Para. No.: RSS-Gen (6)

Test Performed By: G.Suhanthakumar Date of Test: 15.03.2011 and 16.03.2012

Test Results: Complies

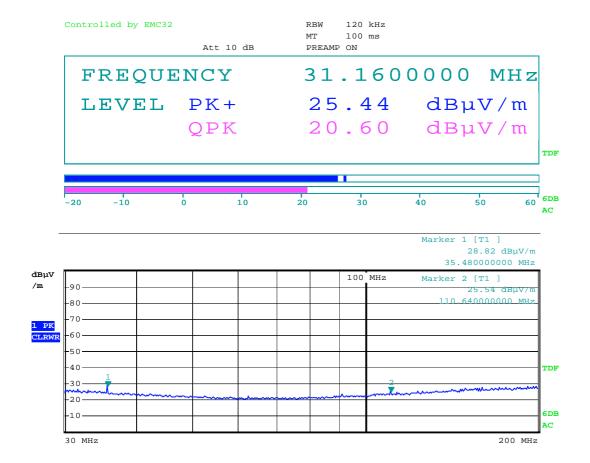
Radiated Emissions with antenna, 30MHz - 25 GHz, peak

30 - 1000MHz measured at 10m, 1-25 GHz measured at 1m (only pre-view).

Measured with Peak Detector

Frequency	RF channel	Dist. corr. factor	Field strength, Peak, 3m	Duty cycle corr. factor	Limit	Margin
GHz	0-15	dB	dBμV/m	dB	dBμV/m	dB
0.030 - 0.088	7	0	< 30	-	40	> 10
0.088 - 0.216	7	0	< 30	-	43	> 10
0.216 - 0.960	7	0	< 30	-	46	> 16
0.960 - 25	7	0	None detected	-	54	-

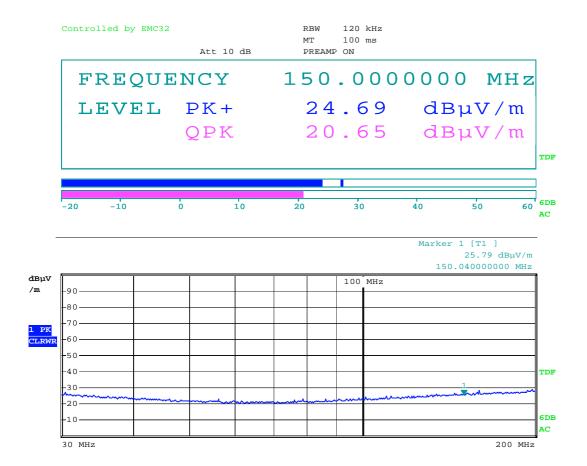




Date: 15.DEC.2010 08:33:31

RX: HP- 30 - 200MHz

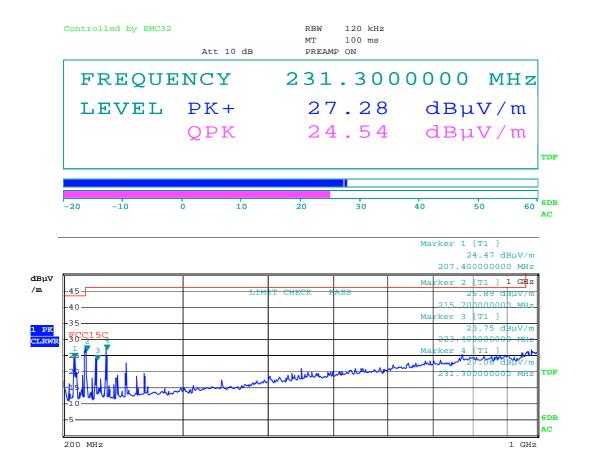




Date: 15.DEC.2010 08:28:13

RX: VP, 30 - 200MHz

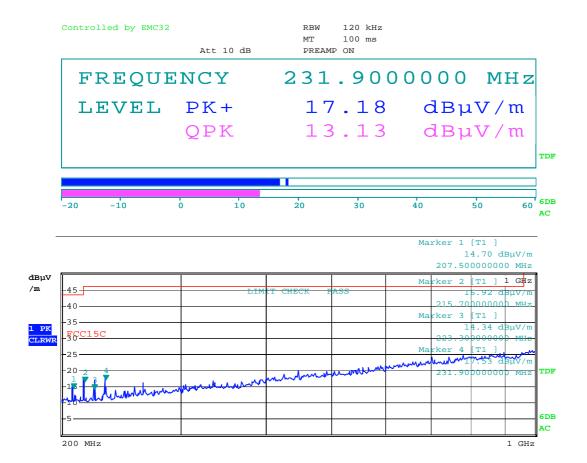




Date: 15.DEC.2010 09:10:08

RX: HP, 200 - 1000MHz

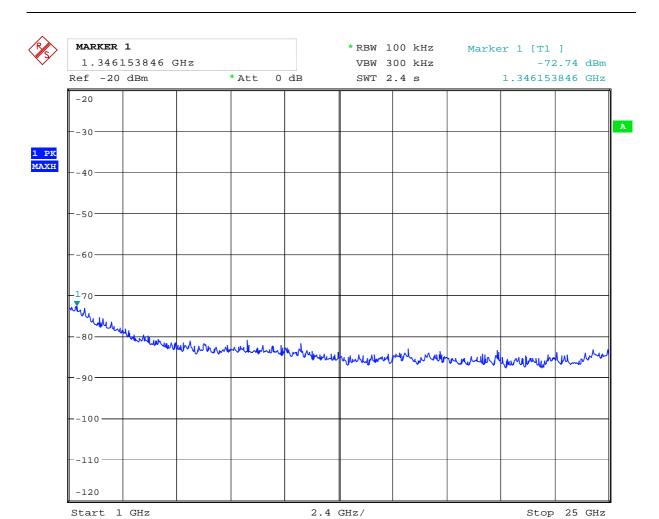




Date: 15.DEC.2010 09:18:00

RX: VP, 200 - 1000MHz





Date: 15.DEC.2010 10:20:26

RX: HP, 1 - 25 GHz (only a pre-view scan at 1 m distance)

Stop 25 GHz



1 PK MAXH

-80-

-90

-100-

-110

-120

Start 1 GHz

MARKER 1

1.307692308 GHz

Ref -20 dBm * Att 0 dB SWT 2.4 s 1.307692308 GHz

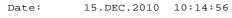
-20

-30

-50

-60

170



RX: VP, 1 - 25 GHz (only a pre-view scan at 1 m distance)

2.4 GHz/

TEST REPORT FCC part 15C Project no.: 162680-2 FCC ID: Y7VPCBA9002

4.6 Power Spectral Density (PSD)

Para. No.: 15.247 (d)

Test Performed By: G.Suhanthakumar Date of Test: 15-Dec-2010

Test Results: Passed

Measured and Calculated Data:

Measured Conducted Values:

Ch0 - Lower Channel:

 $PSD = 35 - 57.86 \, dBm/Hz = -22.86 \, dBm$

Ch7 - Middle Channel:

PSD = 35 - 56.96 dBm/Hz = -21.96 dBm

Ch14 - Upper Channel:

PSD = 35 - 58.35 dBm/Hz = -23.35 dBm

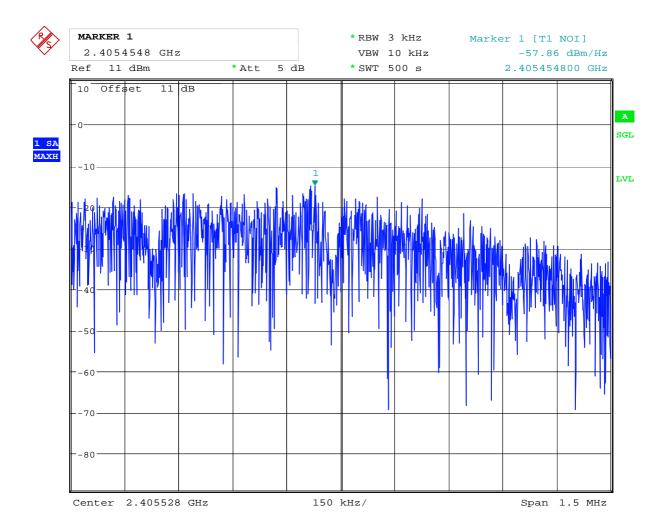
The spectrum line spacing is less than 3kHz, therefore used noise power density and corrected with 35 dB for 3kHz

Requirements:

The Power Spectral Density of a Digital Transmission System shall be no greater than +8 dBm in any 3 kHz band

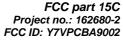
No requirements for Frequency Hopping Systems.



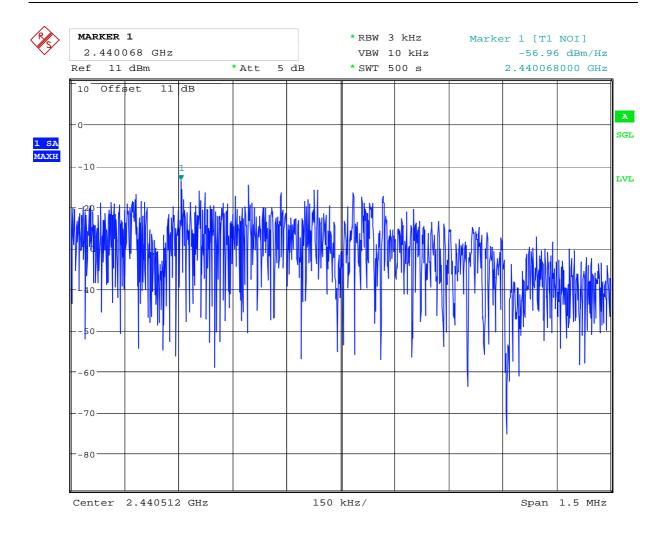


15.DEC.2010 14:38:35 Date:

Ch0 - Power Density - Conducted measurement



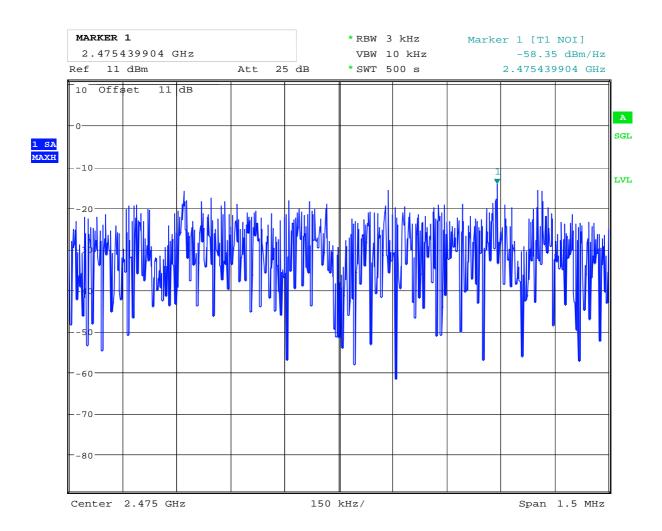




Date: 15.DEC.2010 14:28:56

Ch7 - Power Density - Conducted measurement





Date: 16.MAR.2012 15:26:53

Ch14 - Power Density - Conducted measurement



5 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.	FSU26	Spectrum Analyzer	Rohde & Schwarz	LR 1504	28.09.2010	28.09.2011
2.	ESCI	EMI Receiver	Rohde & Schwarz	N 4259	09.09.2010	09.09.2011
3.	FSEK 1088,3494,30	Spectrum Analyzer	R&S	1337	15.12.2010	15.12.2012
4.	3115	Antenna horn	EMCO	LR 1330	05.08.2010	05.08.2013
5.	643	Antenna horn	Narda	LR 093	26.01.2009	26.01.2012
6.	642	Antenna horn	Narda	LR 220	26.01.2009	26.01.2012
7.	PM7320X	Antenna horn	Sivers lab	LR 103	26.01.2009	26.01.2012
8.	DBF-520-20	Antenna horn	Systron Donner	LR 101	26.01.2009	26.01.2012
9.	638	Antenna horn	Narda	LR 098	26.01.2009	26.01.2012
10.	Sucoflex 102E	Cable microwave	Suhner	LR 1370	-	-
11.	6032A	Power supply	HP	LR 1062	-	-
12.	77	Multimeter, Digital	Fluke	LR155	03.11.2010	03.11.2011
13.	8449B	Amplifier	Hewlett Packard	LR 1322	04.08.2009	04.08.2011
14.	HFH2-Z2	Antenna loop	Rohde and Schwarz	LR 285	08.10.2010	08.10.2013
15.	10855A	Amplifier	Hewlett Packard	LR 1445	04.08.2010	04.08.2011
16.	HL223	Antenna log.per	Rohde & Schwarz	LR 1261	19.05.2010	09.05.2013
17.	HK116	Antenna biconic	Rohde & Schwarz	LR 1260	19.05.2010	09.05.2013
18.	ESN	Test Receiver	Rohde & Schwarz	LR 1237	16.09.2010	06.09.2011
19.	ESH3-Z3	LISN	Rohde & Schwarz	LR 1076	22.10.2009	22.10.2011
20.	B32-10R	Power supply	Oltronix	LR 126	-	-
21.	ESAI	EMI Receiver	Rohde & Schwarz	LR 1090/1089	04.03.2010	04.03.2011
22.	ESH3-Z2	Pulse Limiter	Rohde & Schwarz	LR 1074	03.03.2010	03.03.2012
15.03.2012						
1.	FSU26	Spectrum Analyzer	Rohde & Schwarz	LR 1504	28.09.2011	28.09.2012
2.	FSEK 1088,3494,30	Spectrum Analyzer	R&S	1337	15.12.2010	15.12.2012
3.	3115	Antenna horn	EMCO	LR 1330	05.08.2010	05.08.2013
	0.4.40D	D 116		LD 4000	0044 00 07	0040 00 07

Hewlett Packard

Rosenberger

Suhner

LR 1322

LR 1143

LR1566

2011-09-27

2010.09.15

Cal b4 use

8449B

6810.17A

003030

FA210A1010

5.

6.

Pre-amplifier

10 attenuator

Microwave cable

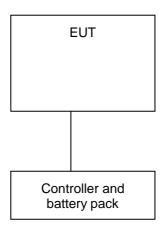
2012-09-27

2012.09.15



6 BLOCK DIAGRAM

6.1 System set up for radiated measurements



Test equipment: 1, 2, 3, 4, 6, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18



6.2 Test Site Radiated Emission

