

# Test Report

<b>Product</b>	Bluetooth Low Energy Transceiver	
<b>Name and address of the applicant</b>	LEGO System A/S Åstvej 1, 7190 Billund, Denmark	
<b>Name and address of the manufacturer</b>	LEGO System A/S Åstvej 1, 7190 Billund, Denmark	
<b>Model</b>	LPF2 Smart Hub	
<b>Rating</b>	3.0V DC	
<b>Trademark</b>	LEGO	
<b>Serial number</b>	/	
<b>Additional information</b>	Bluetooth 4.0 LE	
<b>Tested according to</b>	<b>FCC Part 15.247</b> Digital Transmission Systems <b>Industry Canada RSS-247, Issue 1</b> Low Power Licence-Exempt Radiocommunications Devices	
<b>Order number</b>	280471	
<b>Tested in period</b>	2015.07.20 – 2015.07.29	
<b>Issue date</b>	2015.12.08	
<b>Name and address of the testing laboratory</b>	 <div style="display: inline-block; vertical-align: top; margin-left: 20px;">           FCC No: 994405            IC OATS: 2040D-1             TEL: +47 22 96 03 30            FAX: +47 22 96 05 50         </div> <div style="display: inline-block; vertical-align: top; margin-left: 20px;">           Instituttveien 6            Kjeller, Norway         </div>	
	 Prepared by [G.Suhanthakumar]	 Approved by [Frode Sveinsen]
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## CONTENTS

<b>1</b>	<b>INFORMATION .....</b>	<b>3</b>
1.1	Test Item.....	3
1.2	Test Environment.....	4
1.2.1	Normal test condition .....	4
1.3	Test Engineer(s).....	4
1.4	Test Equipment.....	4
<b>2</b>	<b>TEST REPORT SUMMARY .....</b>	<b>5</b>
2.1	General.....	5
2.2	Test Summary .....	6
2.3	Description of modification for Modification Filing.....	6
2.4	Comments .....	6
2.5	Family List Rational .....	6
<b>3</b>	<b>TEST RESULTS.....</b>	<b>7</b>
3.1	Power Line Conducted Emissions .....	7
3.2	Minimum 6 dB Bandwidth .....	9
3.3	20 dB Bandwidth.....	13
3.4	Peak Power Output.....	15
3.5	Spurious Emissions (Radiated).....	25
3.6	Power Spectral Density (PSD).....	53
<b>4</b>	<b>Measurement Uncertainty.....</b>	<b>57</b>
<b>5</b>	<b>LIST OF TEST EQUIPMENT.....</b>	<b>58</b>
<b>6</b>	<b>BLOCK DIAGRAM.....</b>	<b>59</b>
6.1	Power Line Conducted Emission.....	59
6.2	Test Site Radiated Emission.....	59

# 1 INFORMATION

## 1.1 Test Item

<b>Name :</b>	LEGO
<b>FCC ID :</b>	NPI19071
<b>Industry Canada ID :</b>	3072A-19071
<b>Model/version :</b>	LPF2 Smart Hub
<b>Serial number :</b>	N/A
<b>Hardware identity and/or version:</b>	18884_20J
<b>Software identity and/or version :</b>	1.0.06.0000
<b>Frequency Range :</b>	2402 – 2480 MHz
<b>Tunable Bands :</b>	None
<b>Number of Channels :</b>	40
<b>Operating Modes :</b>	TX/RX
<b>Type of Modulation :</b>	GFSK
<b>User Frequency Adjustment :</b>	None
<b>Rated Output Power :</b>	0.00095 W
<b>Type of Power Supply :</b>	Primary batteries (AA 2x1.5V) or rechargeable Lithium ION polymer 3.7V
<b>Antenna Connector :</b>	N/A (only integra antenna)
<b>Antenna Diversity Supported :</b>	None
<b>Desktop Charger :</b>	N/A (Any DC power supply voltage of 10.4V can used for charging)

### Description of Test Item

The items tested are a system concentrated around a central unit which contains the radio functionality. To this central unit various accessories can be attached, featuring 2 different sensors, a motor and optionally a rechargeable battery.

When used for building models there are no single setup of the system, but it can vary depending on the demands.

### Theory of Operation

The system is built up around a device (iPad or other tablet) with a dedicated program which is connected to the central unit using BLE. This smart device is able to execute a programmed sequence to control the system.

### Exposure Evaluation

The user manual contains text that it shall be mounted with a separation distance of at least 20 cm from any humans. For the purposes of exposure evaluation this EUT is a portable device. MPE Calculation at 20 cm satisfying FCC requirements is submitted as a separate document.

The EUT is exempted from RF Exposure Evaluation to Industry Canada requirements since the output power complies with the power levels of section 2.5.2 of RSS-102 Issue 5.

## 1.2 Test Environment

### 1.2.1 Normal test condition

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	3.0 V DC

The values are the limit registered during the test period.

## 1.3 Test Engineer(s)

G.Suhandhakumar

## 1.4 Test Equipment

See list of test equipment in clause 5.

## 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, paragraph 15.247 and Industry Canada RSS-247 Issue 1.

Tests were performed in accordance with ANSI C63.4-2014 and KDB 55074 D01 DTS Measurement Guidance v03r02.

Radiated tests were made in a semi-anechoic chamber at measuring distances of 1m, 3m and 10m.

A description of the test facility is on file with the FCC and Industry Canada.

New Submission

Production Unit

Class II Permissive Change

Pre-production Unit

**DTS** 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".

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## 2.2 Test Summary

Name of test	FCC Part 15 reference	RSS-247 Issue 1 reference	Result
Supply Voltage Variations	15.31(e)	8 (RSS-GEN)	N/A <sup>1</sup>
Antenna Requirement	15.203	7.1.4 (RSS-GEN)	N/A <sup>2</sup>
Power Line Conducted Emission	15.107(a) 15.207(a)	7.2.2 (RSS-GEN)	Complies <sup>3</sup>
Occupied Bandwidth	15.247(a)(1)	8.1	Complies
Minimum 6 dB Bandwidth	15.247(a)(2)	5.2(1)	Complies
Peak Power Output	15.247(b)	5.4(4)	Complies
Power Spectral Density	15.247(d)	5.2(2)	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	5.5	N/A <sup>2</sup>
Spurious Emissions (Radiated)	15.247(c) 15.109(a) 15.209(a)	5.5	Complies

<sup>1</sup> The tested equipment only operates with battery.

<sup>2</sup> The tested equipment has integrated antennas only.

<sup>3</sup> During charging of rechargeable battery with any external DC power supply.

## 2.3 Description of modification for Modification Filing

Not applicable.

## 2.4 Comments

The measurements were done with fully charged batteries.

All ports were populated during spurious emission measurements.

The following LEGO parts were connected during the measurements

- 1x 10019071 LPF2 Smart Hub 2 IO
- 1x 10019104 LPF2 Smart Hub 2AA BatteryBox
- 1x 10019106 LPF2 Rechargeable Battery
- 1x 10020841 LPF2 Tilt Sensor
- 1x 10020844 LPF2 Detect Sensor
- 1x 10021980 LPF2 Medium Motor
- 1x 2 Wire DC power supply cable for the rechargeable battery (10.4V)

## 2.5 Family List Rational

Not Applicable.

### 3 TEST RESULTS

#### 3.1 Power Line Conducted Emissions

Para. No.: 15.207 (a)

Test Performed By: G.Suhanthakumar	Date of Test: 2015.07.20
------------------------------------	--------------------------

Measurement procedure: ANSI C63.4-2009 using 50 µH/50 ohms LISN.

Test Results: Complies.

Measurement Data: See attached graph, (Peak detector).

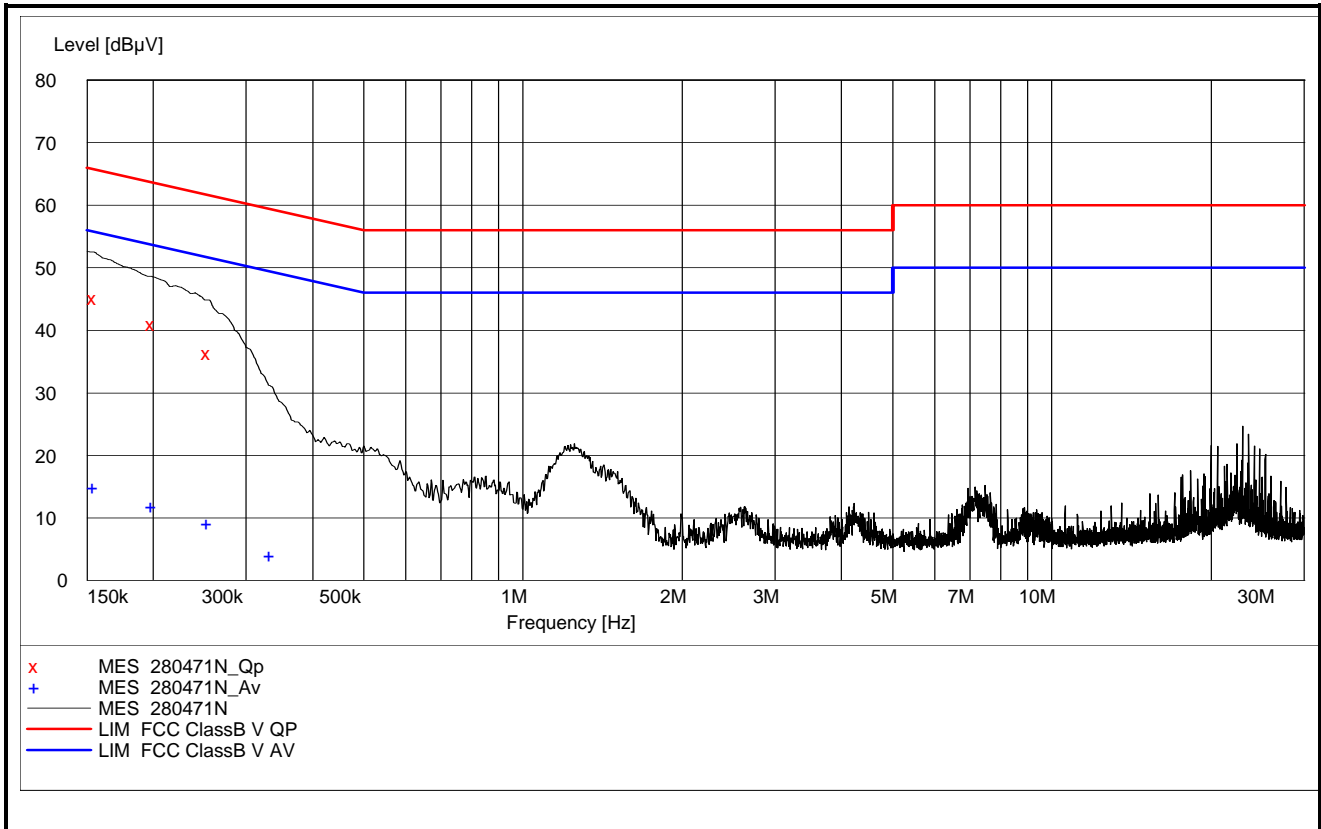
Øltronix DC power supply type B603D is used for charging the battery.  
 120Vac/60Hz

QP Detector:

Frequency [MHz]	Level [dBuV]	Af [dB]	Limit [dBuV]	Margin [dB]	Det	Position	Verdict [Pass/Fail]
0.155000	45.10	10.70	65.70	20.60	QP	N	Pass
0.200000	41.00	10.70	63.60	22.60	QP	N	Pass
0.255000	36.30	10.60	61.60	25.30	QP	N	Pass

AV detector:

Frequency [MHz]	Level [dBuV]	Af [dB]	Limit [dBuV]	Margin [dB]	Det	Position	Verdict [Pass/Fail]
0.155000	15.00	10.70	55.70	40.70	AV	N	Pass
0.200000	12.00	10.70	53.60	41.60	AV	N	Pass
0.255000	9.10	10.60	51.60	42.50	AV	N	Pass
0.335000	4.00	10.50	49.30	45.30	AV	N	Pass





### 3.2 Minimum 6 dB Bandwidth

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

Test Performed By: G.Suhanthakumar	Date of Test: 2015.07.20
------------------------------------	--------------------------

Test Results: **Complies**

Measurement Data:

Measured 6 dB Bandwidth (kHz)		
2402 MHz	2440 MHz	2480 MHz
711.5	737.2	753.2

Duty cycle: 100%

Tested according to KDB 558074 D01 DTS Meas Guidance v03r02, Section 8.1.

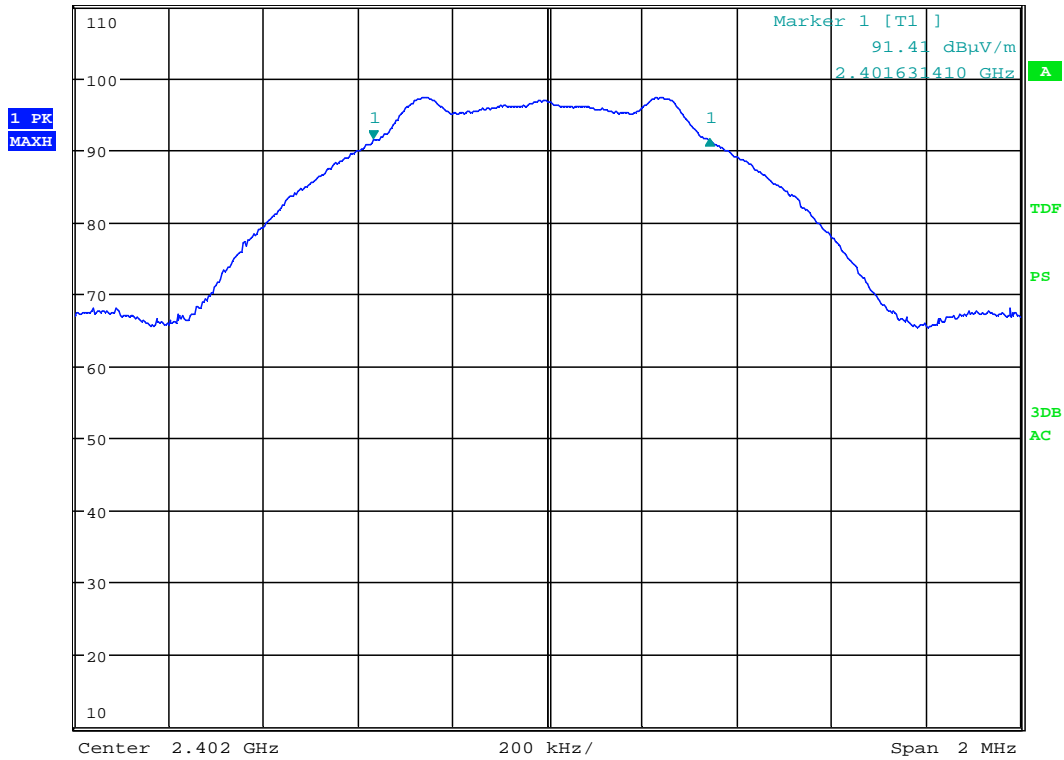
**Requirements:**

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



\*RBW 100 kHz      Delta 1 [T1 ]  
 VBW 300 kHz      -0.02 dB  
 SWT 2.5 ms      711.538461553 kHz

Ref 110 dBuV/m      \*Att 15 dB



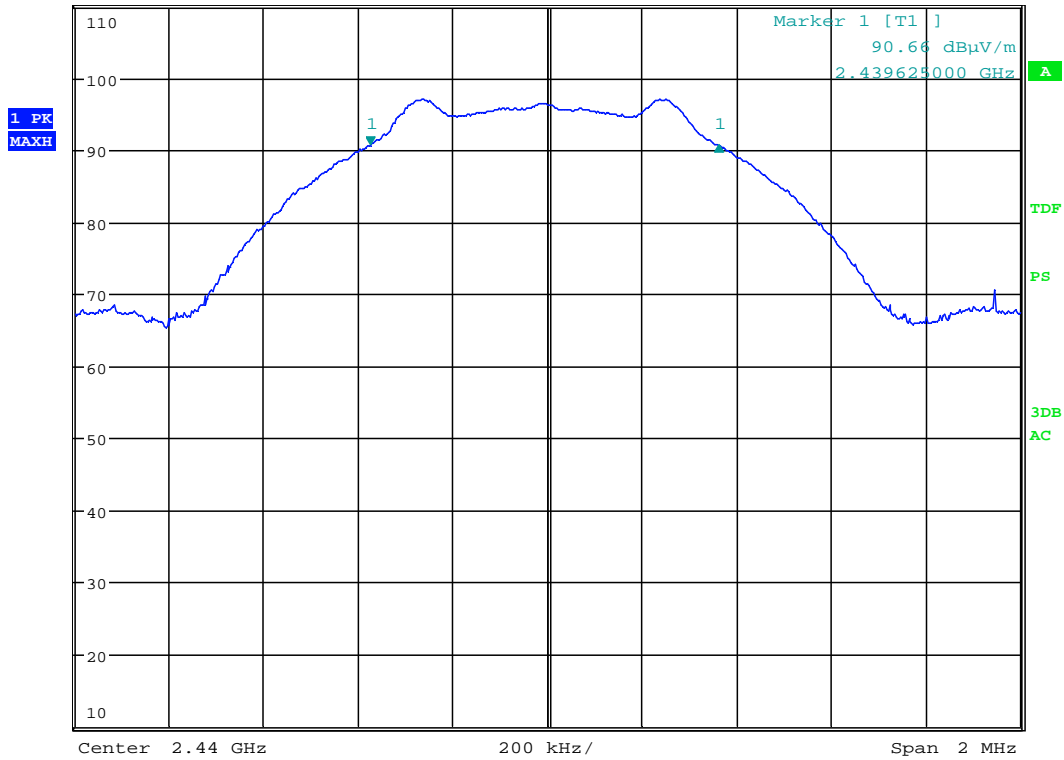
Date: 20.JUL.2015 12:55:10

**6 dB Bandwidth at 2402 MHz**



\*RBW 100 kHz      Delta 1 [T1 ]  
 VBW 300 kHz      -0.10 dB  
 SWT 2.5 ms      737.179487205 kHz

Ref 110 dBuV/m      \*Att 15 dB

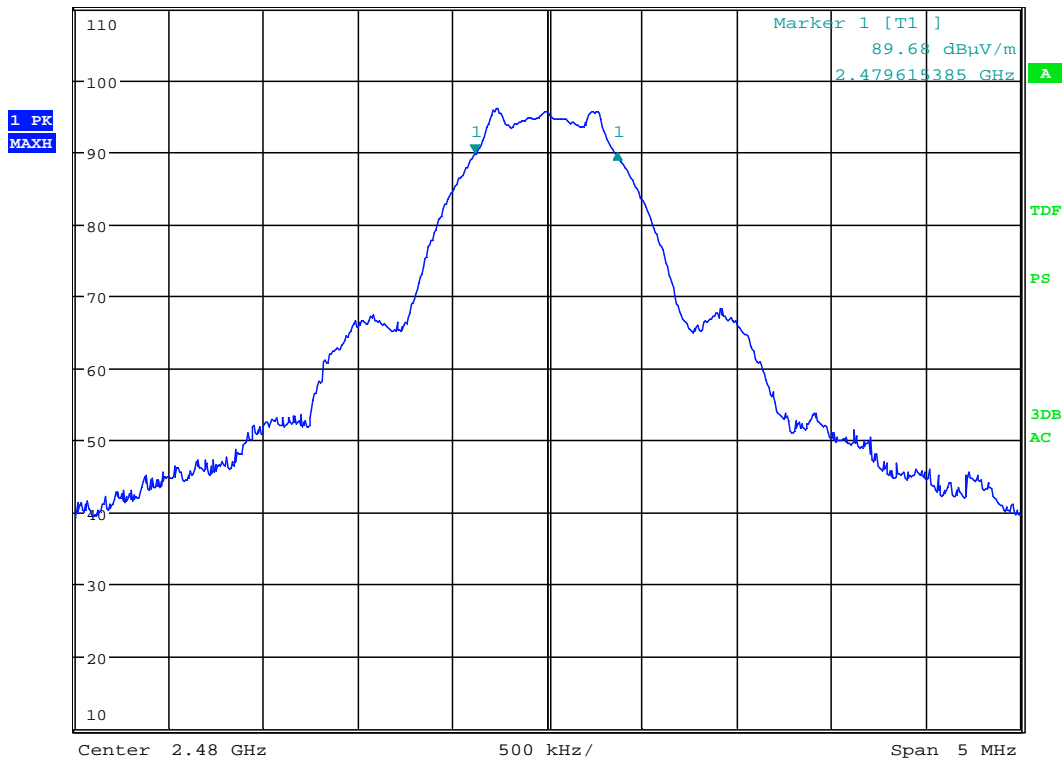


Date: 20.JUL.2015 13:57:00

**6 dB Bandwidth at 2440 MHz**



\*RBW 100 kHz      Delta 1 [T1 ]  
 VBW 300 kHz      -0.01 dB  
 Ref 110 dBuV/m    \*Att 15 dB      SWT 2.5 ms      753.205128201 kHz



Date: 20.JUL.2015 13:36:14

**6 dB Bandwidth at 2480 MHz**

### 3.3 20 dB Bandwidth

Test Performed By: G.Suwanthakumar	Date of Test: 20.07.2015
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**Measurement Data:**

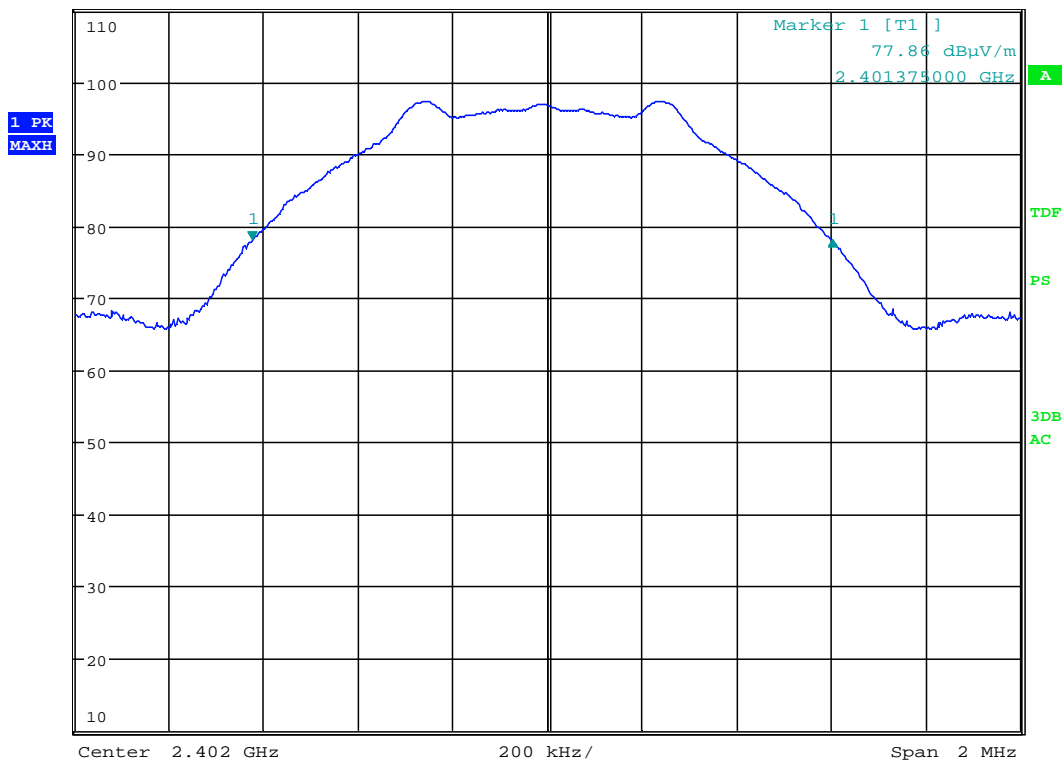
<b>Measured 20 dB Bandwidth (MHz)</b>
<b>2402 MHz</b>
1.23

**Requirements:**

No requirements. Reported only for information.



\*RBW 100 kHz      Delta 1 [T1 ]  
 VBW 300 kHz      0.02 dB  
 Ref 110 dBuV/m    \*Att 15 dB      SWT 2.5 ms      1.227564103 MHz



Date: 20.JUL.2015 12:56:05

**20 dB Bandwidth at 2402 MHz**

### 3.4 Peak Power Output

Para. No.: 15.247 (b)

Test Results: Complies

#### Measurement Data:

	2402 MHz	2440 MHz	2480 MHz
Conducted Power (dBm)	-0.23	-0.76	-1.20
Conducted Power (Watts)	0.00095	0.00084	0.00076
Field Strength (dBµV/m)	98.7	97.8	96.4
EIRP, Calculated (Watts)	0.0022	0.0018	0.0013
Antenna gain (dBi)	3.6	3.3	2.3

Duty cycle: 100%

Antenna gain =  $10 \cdot \log(\text{EIRP}/\text{Conducted power})$  dBi

Tested according to KDB 558074 D01 DTS Meas Guidance v03r02, Section 9.1.1.

EIRP is calculated according to KDB 558074 D01 DTS Meas Guidance v03r02, Section 12.2.2. (e)

The maximum field strength is obtained in Vertical polarization and XY plane.

#### See attached graph.

Detachable antenna?

Yes  No

If detachable, is the antenna connector non-standard?

Yes  No

Type of antenna connector: N/A

#### Requirements:

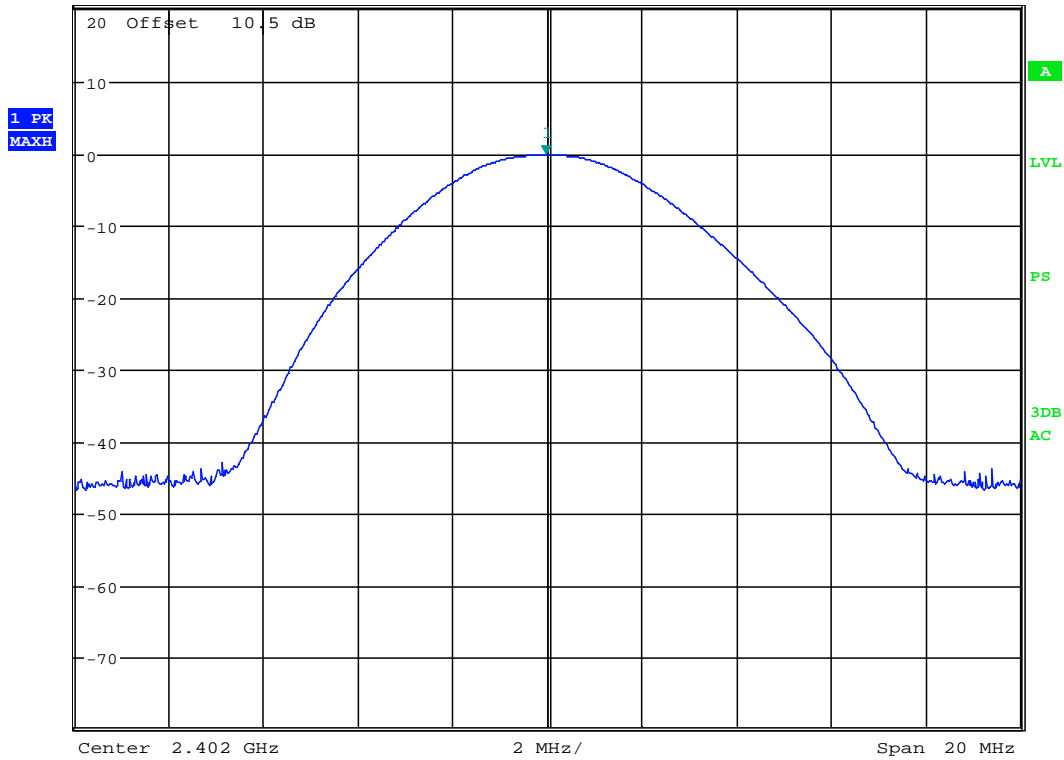
The maximum peak output power shall not exceed the following limits:

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.



\*RBW 3 MHz      Marker 1 [T1 ]  
 VBW 10 MHz      -0.23 dBm  
 Ref 20.5 dBm      \*Att 20 dB      SWT 2.5 ms      2.401967949 GHz



Date: 20.JUL.2015 15:11:14

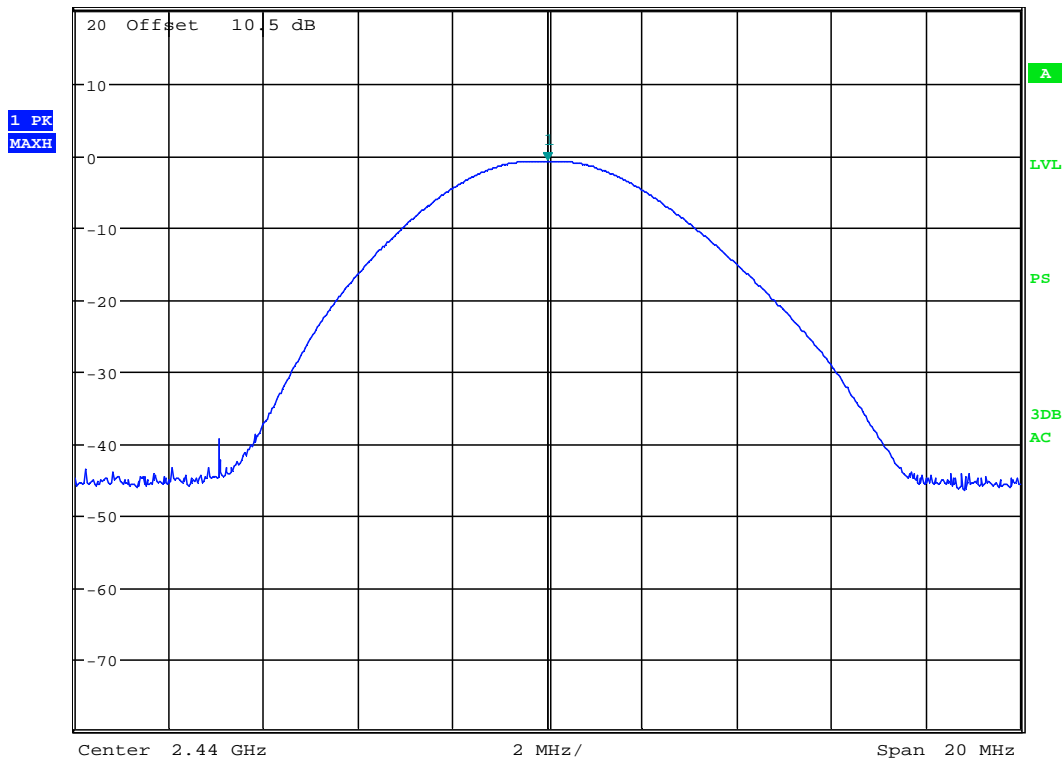
**Conducted power – 2402MHz**





**MARKER 1**  
 2.44 GHz  
 Ref 20.5 dBm \*Att 20 dB

\*RBW 3 MHz Marker 1 [T1 ]  
 VBW 10 MHz -0.76 dBm  
 SWT 2.5 ms 2.44000000 GHz

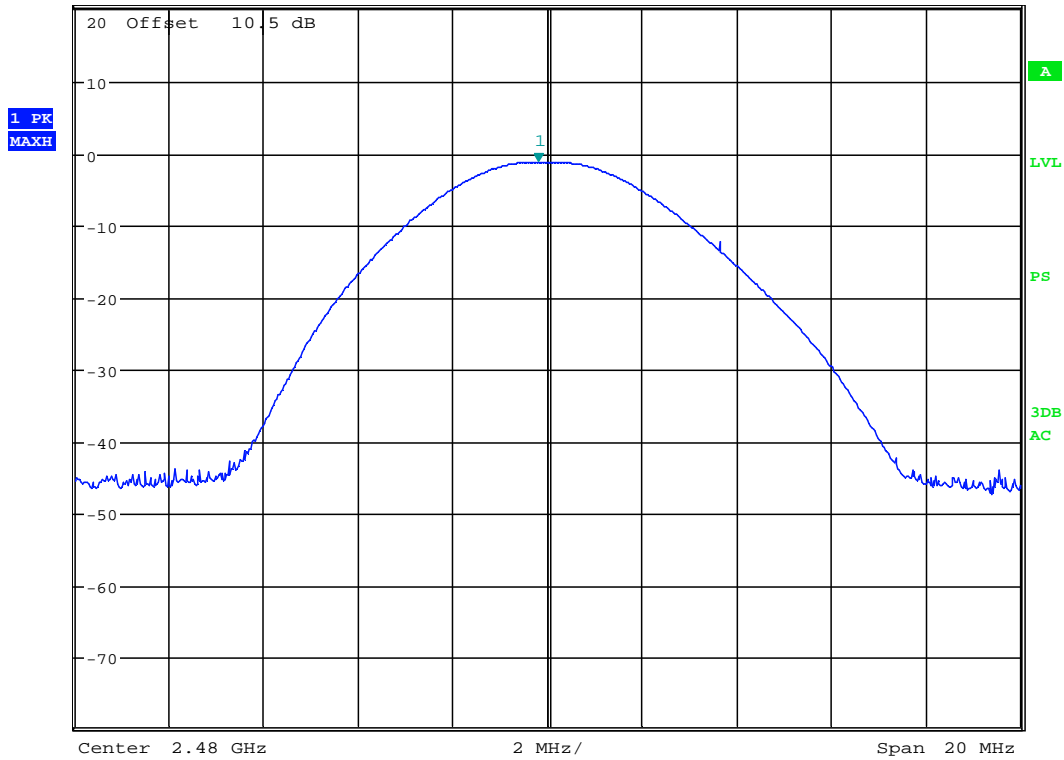


Date: 20.JUL.2015 15:31:10

**Conducted power – 2440MHz**



**MARKER 1**  
 2.479807692 GHz  
 Ref 20.5 dBm \*Att 20 dB \*RBW 3 MHz Marker 1 [T1 ]  
 VBW 10 MHz -1.20 dBm  
 SWT 2.5 ms 2.479807692 GHz



Date: 20.JUL.2015 15:31:42

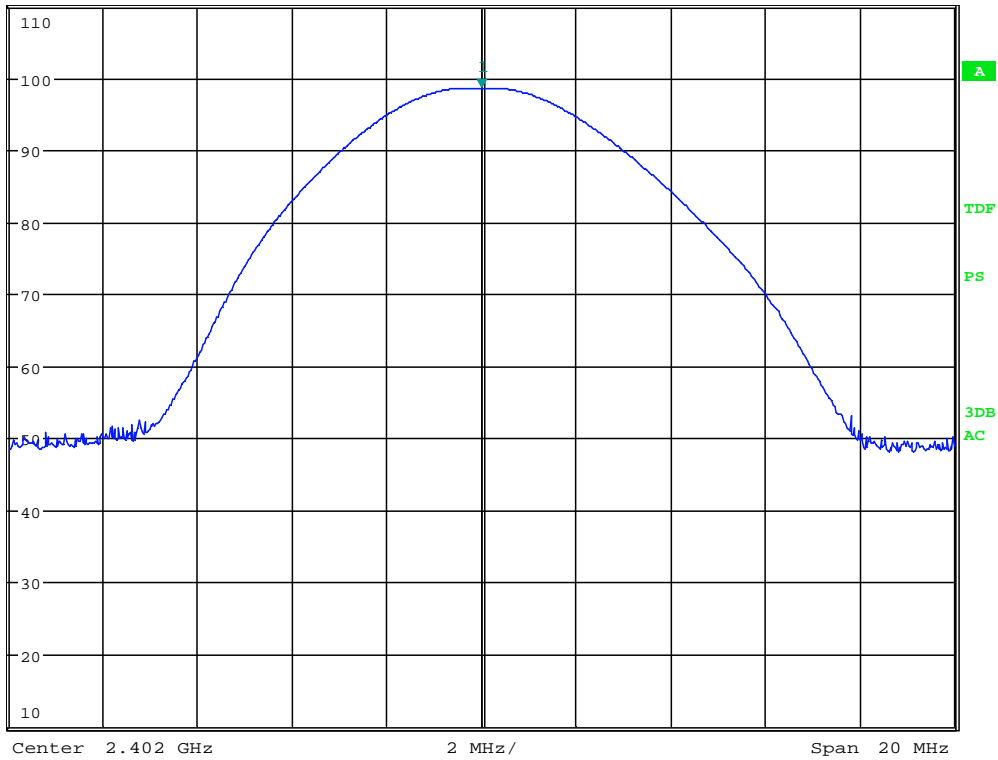
**Conducted power – 2480MHz**



\*RBW 3 MHz      Marker 1 [T1 ]  
 VBW 10 MHz      98.65 dBµV/m  
 SWT 2.5 ms      2.402000000 GHz

Ref 110 dBµV/m      \*Att 15 dB

1 PK  
 MAXH

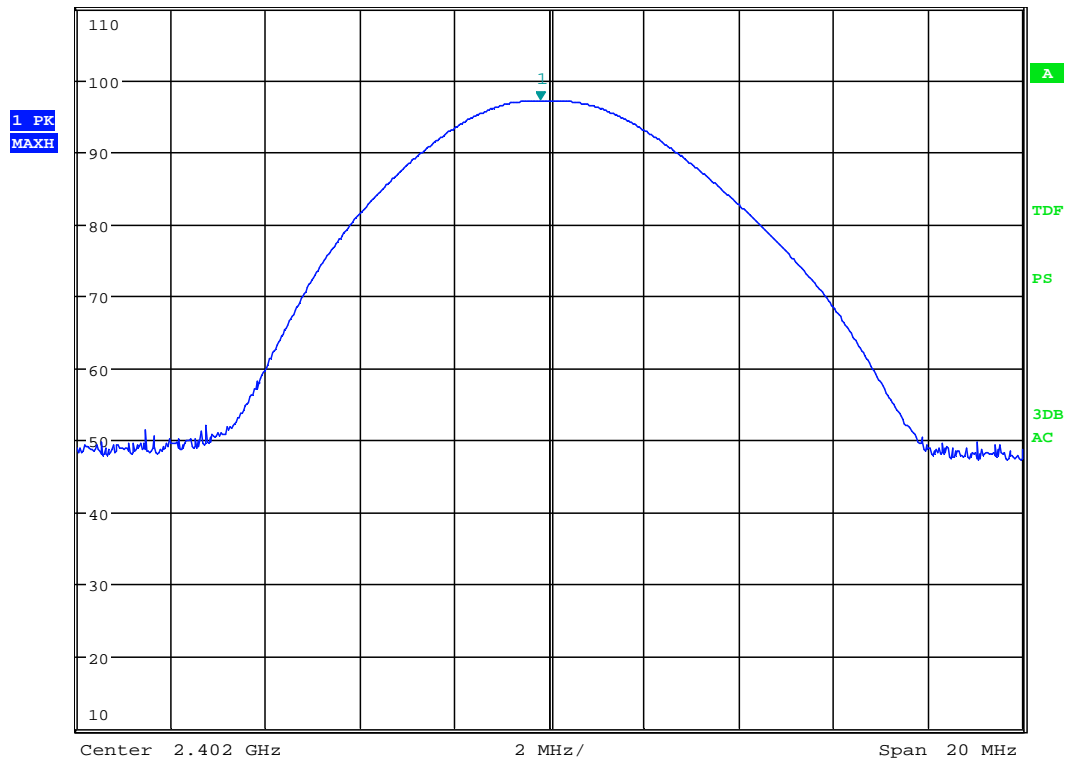


Date: 20.JUL.2015 11:22:45

**Radiated field strength, VP, 2402 MHz**



\*RBW 3 MHz      Marker 1 [T1 ]  
 VBW 10 MHz      97.11 dBµV/m  
 SWT 2.5 ms      2.401807692 GHz  
 Ref 110 dBµV/m    \*Att 15 dB

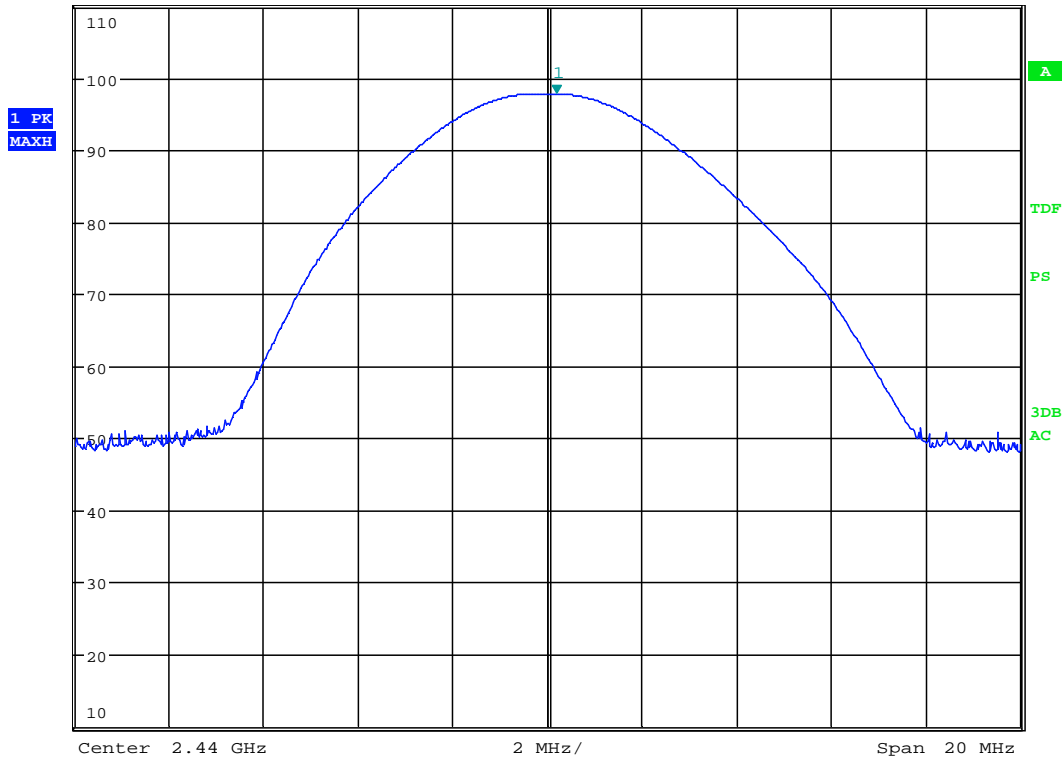


Date: 20.JUL.2015 11:21:54

**Radiated field strength, HP, 2402 MHz**



<b>MARKER 1</b>	*RBW 3 MHz	Marker 1 [T1 ]
2.43974359 GHz	VBW 10 MHz	97.79 dBuV/m
Ref 110 dBuV/m	SWT 2.5 ms	2.440192308 GHz
*Att 15 dB		

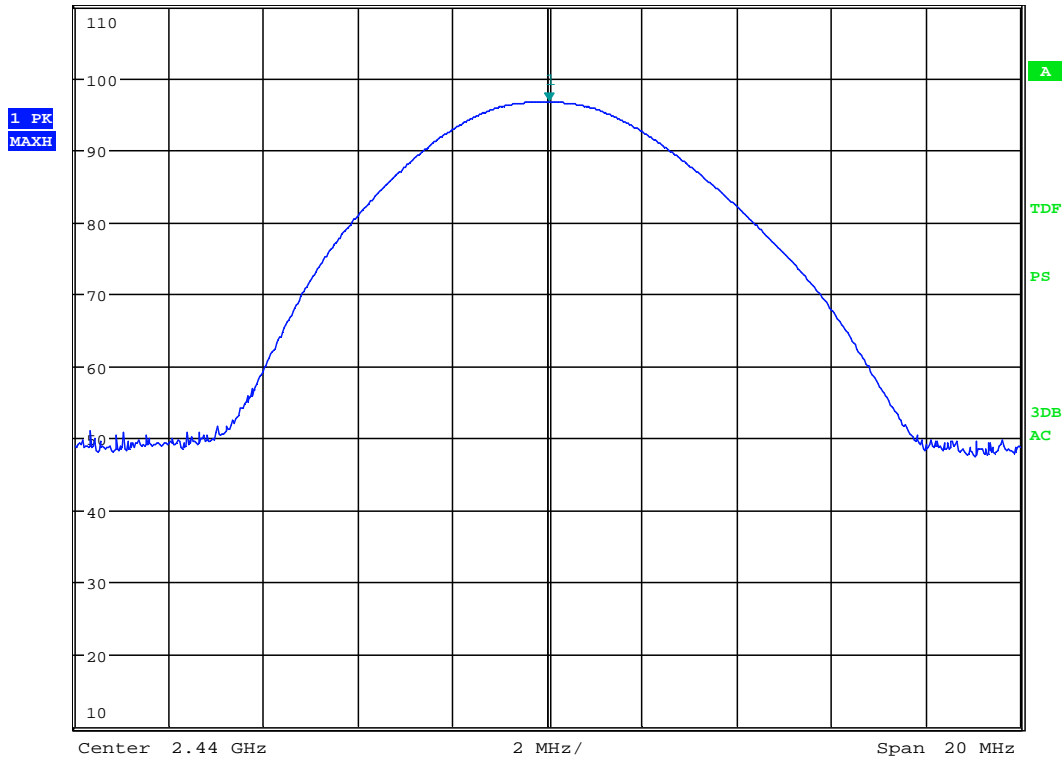


Date: 20.JUL.2015 13:49:49

**Radiated field strength, VP, 2440 MHz**



<b>MARKER 1</b>	*RBW 3 MHz	Marker 1 [T1]
2.43974359 GHz	VBW 10 MHz	96.62 dBµV/m
Ref 110 dBµV/m	*Att 15 dB	SWT 2.5 ms
		2.440032051 GHz

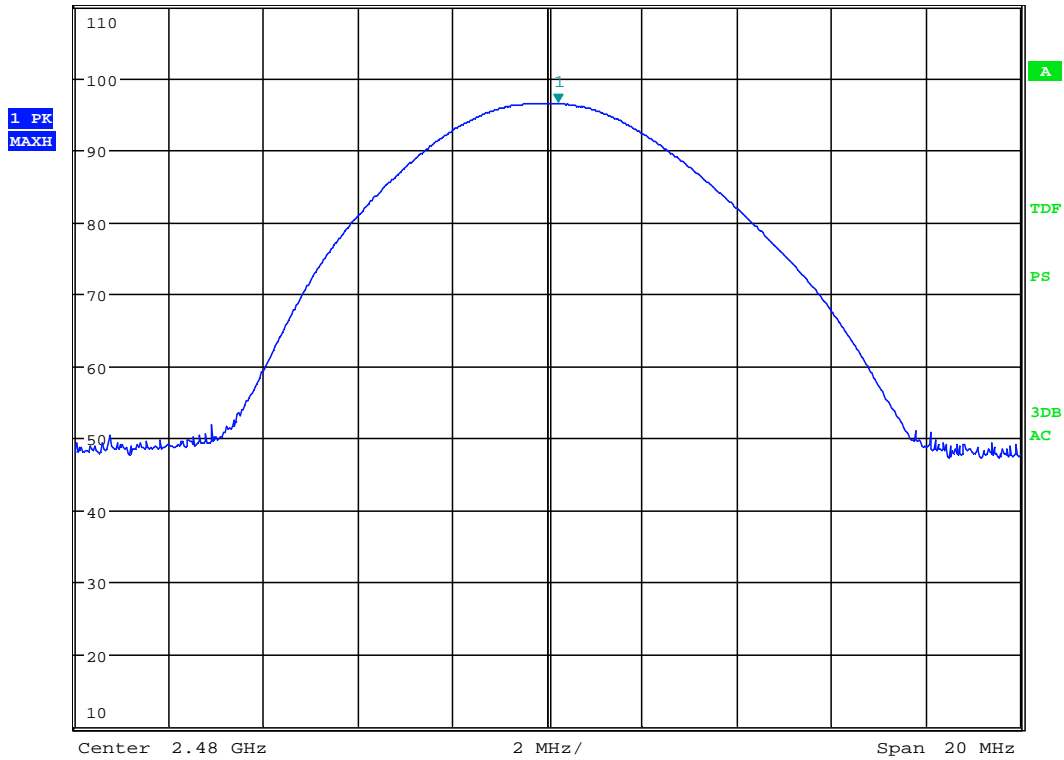


Date: 20.JUL.2015 13:48:57

**Radiated field strength, HP, 2440 MHz**



\*RBW 3 MHz      Marker 1 [T1 ]  
 VBW 10 MHz      96.42 dBμV/m  
 SWT 2.5 ms      2.480224359 GHz  
 Ref 110 dBμV/m    \*Att 15 dB

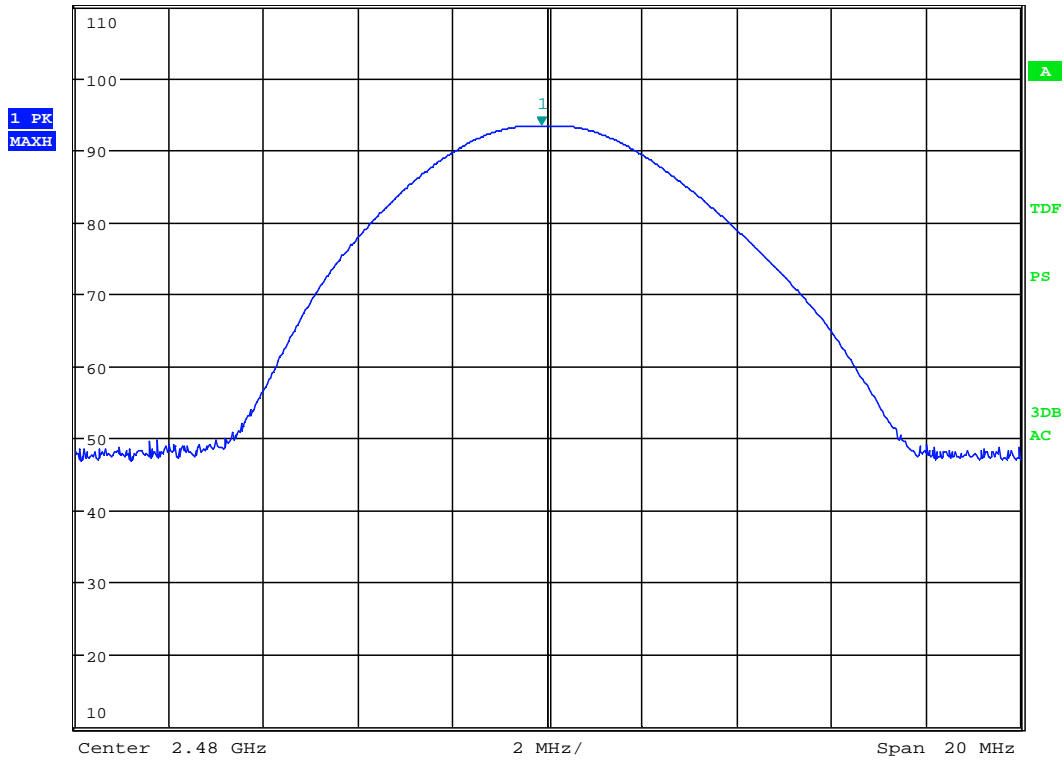


Date: 20.JUL.2015 13:31:48

**Radiated field strength, VP, 2480 MHz**



\*RBW 3 MHz      Marker 1 [T1 ]  
 VBW 10 MHz      93.40 dBµV/m  
 Ref 110 dBµV/m    \*Att 15 dB      SWT 2.5 ms      2.479871795 GHz



Date: 20.JUL.2015 13:30:53

**Radiated field strength, HP, 2480 MHz**



### 3.5 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Results: Complies

Measurement Data:

Peak detector:

Radiated Band-edge:

Frequency	Measured Field Strength dB $\mu$ V/m	Detector	Limit dB $\mu$ V/m	Margin dB
2.39GHz	42.97	PK	74	31.0
2.4835 GHz	55.76	PK	74	18.2

Average detector:

Radiated Band-edge:

Frequency	Measured Field Strength dB $\mu$ V/m	Detector	Limit dB $\mu$ V/m	Margin dB
2.39 GHz	33.24	AV	54	20.8
2.4835 GHz	35.29	AV	54	18.7

Duty cycle : 100%

According to KDB 558074 D01 DTS Meas Guidance v03r02, Section 13.3.1 the band edge is applicable to unwanted emissions within 2 MHz of the authorized band.

**RF conducted power** to 25 GHz see attached graph.

Maximum RF level outside operating band:

RF ch 2402MHz: 20 dB/C, margin >30 dB

RF ch 2440MHz: 20 dB/C, margin >30 dB

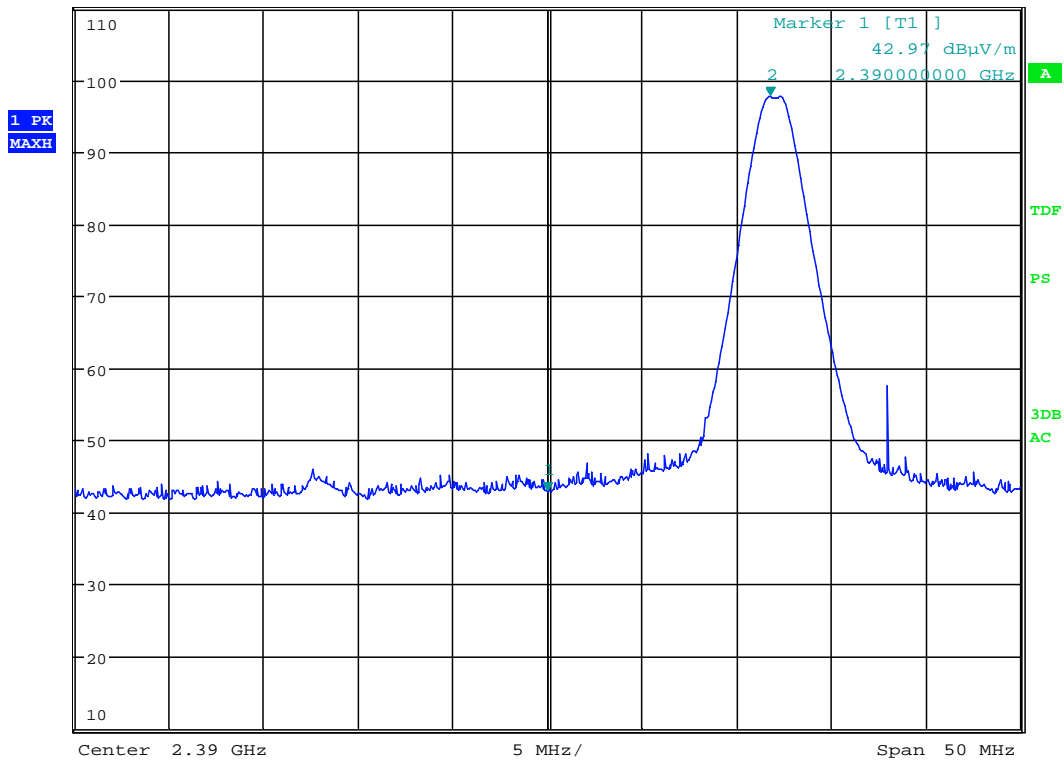
RF ch 2480MHz: 20 dB/C, margin >30 dB

See attached plots.



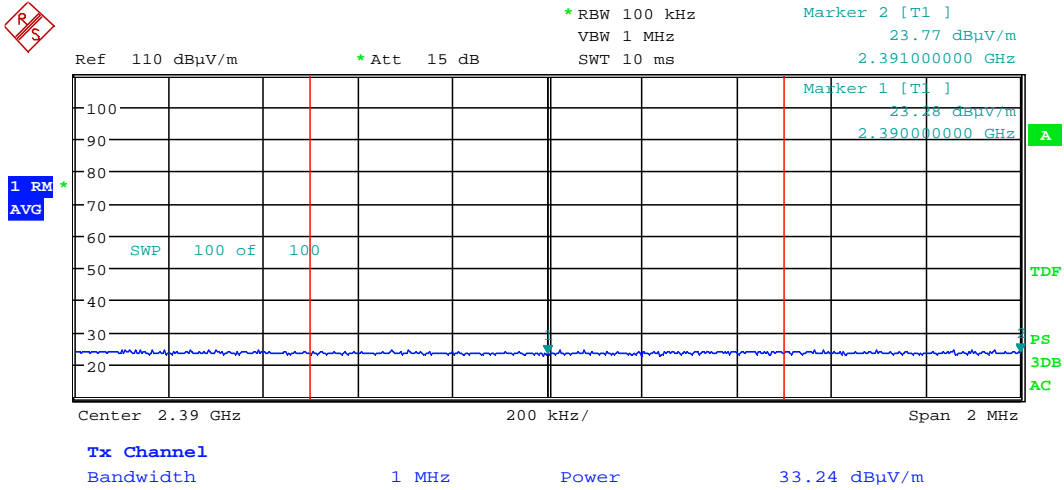
**MARKER 2**  
 2.401778846 GHz  
 Ref 110 dBuV/m \*Att 15 dB

\*RBW 1 MHz Marker 2 [T1 ]  
 VBW 3 MHz 97.63 dBuV/m  
 SWT 2.5 ms 2.401778846 GHz



Date: 20.JUL.2015 12:47:50

**Lower Band Edge, 2390 MHz, Peak Detector**

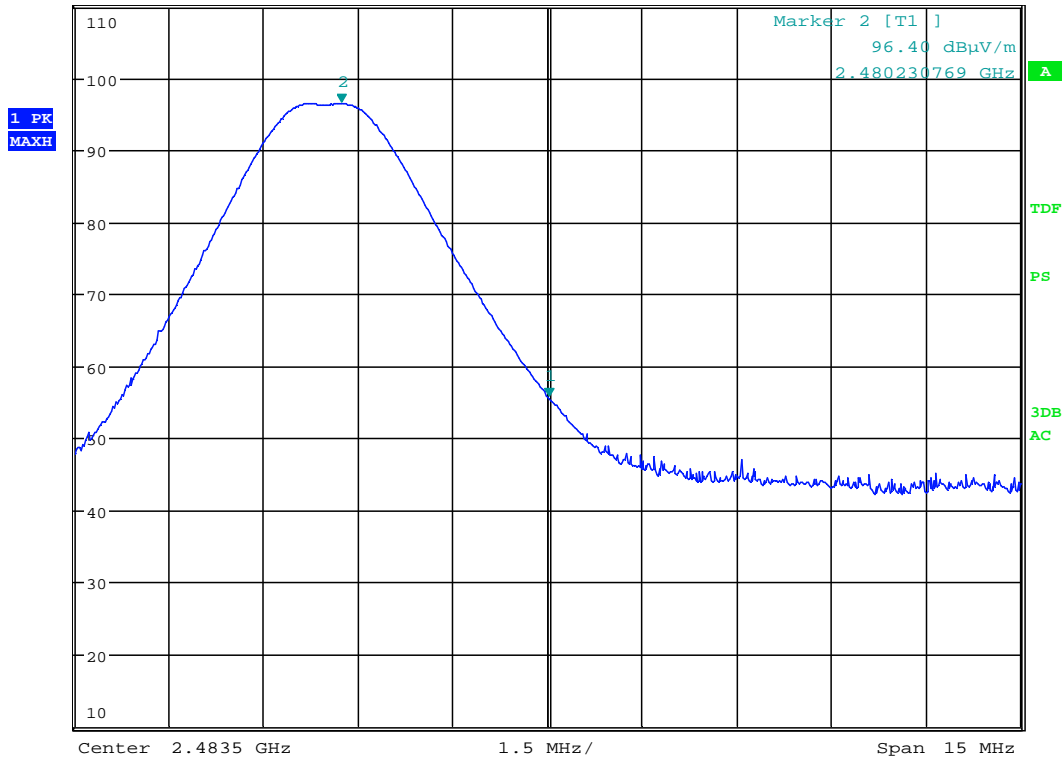


Date: 20.JUL.2015 12:52:48

**Lower Band Edge, 2390 MHz, Average Detector**

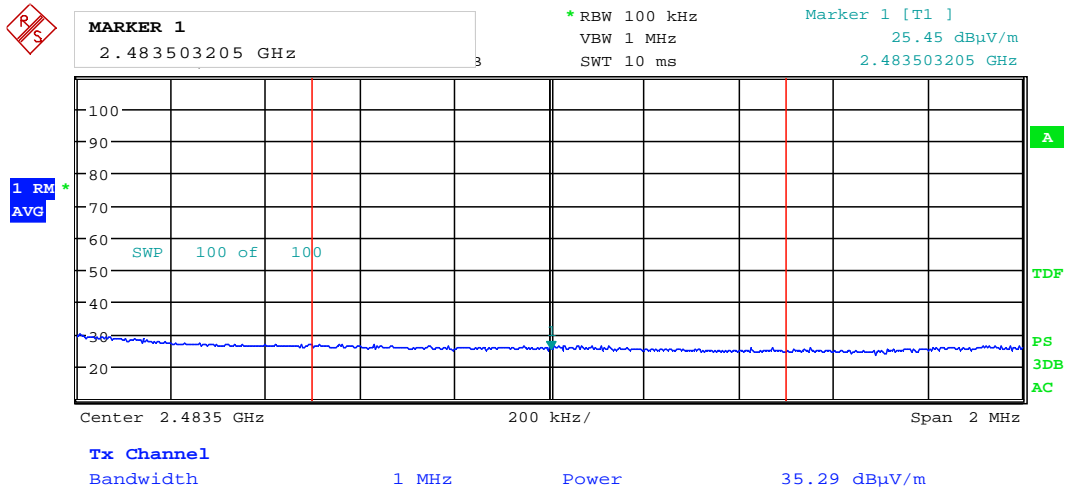


\*RBW 1 MHz      Marker 1 [T1 ]  
 VBW 3 MHz      55.76 dBuV/m  
 Ref 110 dBuV/m    \*Att 15 dB      SWT 2.5 ms      2.483524038 GHz



Date: 20.JUL.2015 13:39:57

**Upper Band Edge, 2483.5 MHz, Peak Detector**

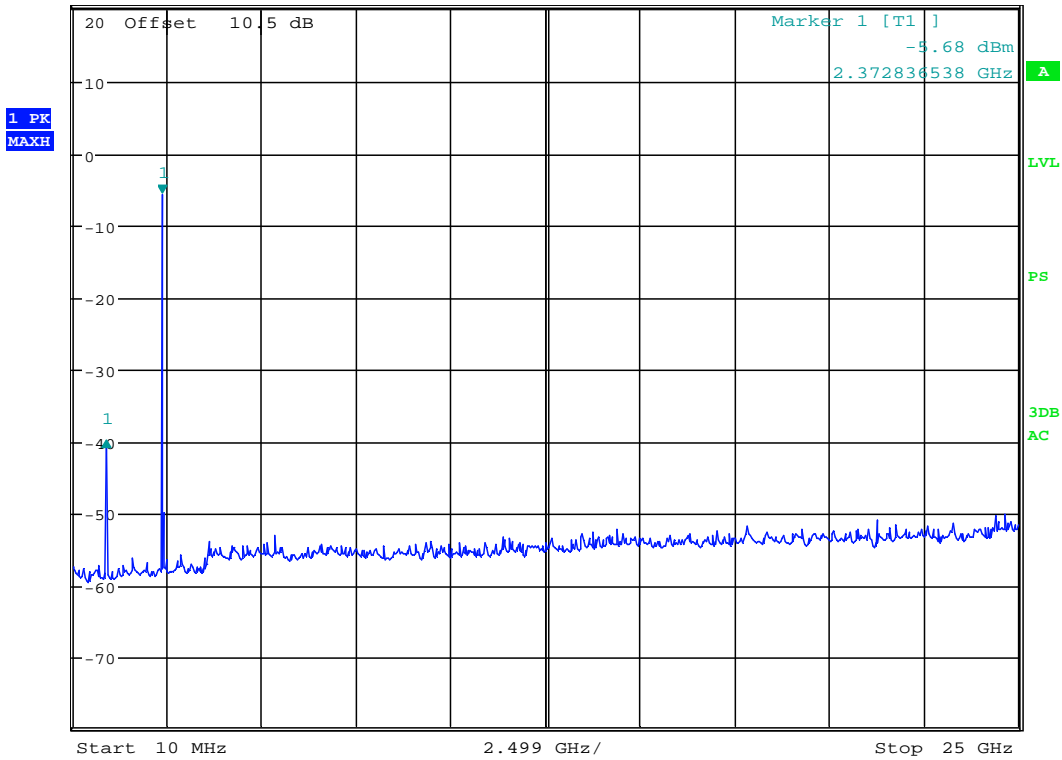


Date: 20.JUL.2015 13:40:59

**Upper Band Edge, 2483.5 MHz, Average Detector**



Ref 20.5 dBm      \*Att 20 dB      \*RBW 100 kHz      Delta 1 [T1 ]  
 VBW 300 kHz      -34.16 dB  
 SWT 2.5 s      -1.481778846 GHz

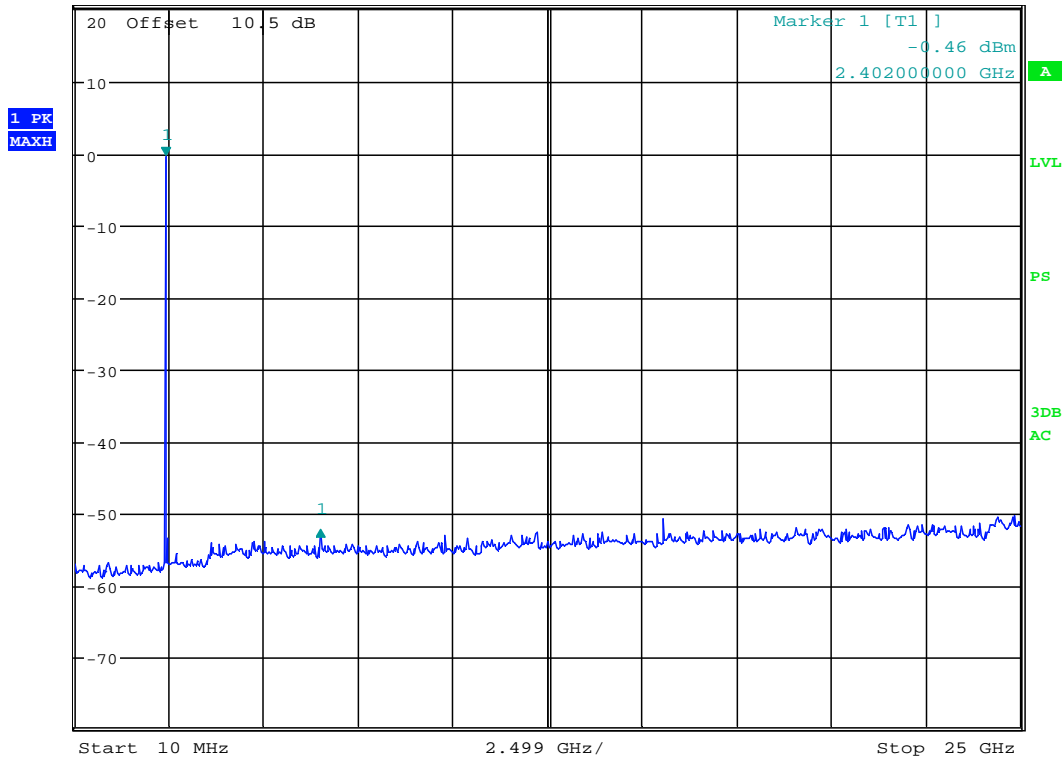


Date: 20.JUL.2015 15:32:54

**Conductd spurious emission 10MHz – 25GHz - ch2402MHz**



Ref 20.5 dBm      \*Att 20 dB      \*RBW 100 kHz      Delta 1 [T1 ]  
 VBW 300 kHz      -51.79 dB  
 SWT 2.5 s      4.095788462 GHz

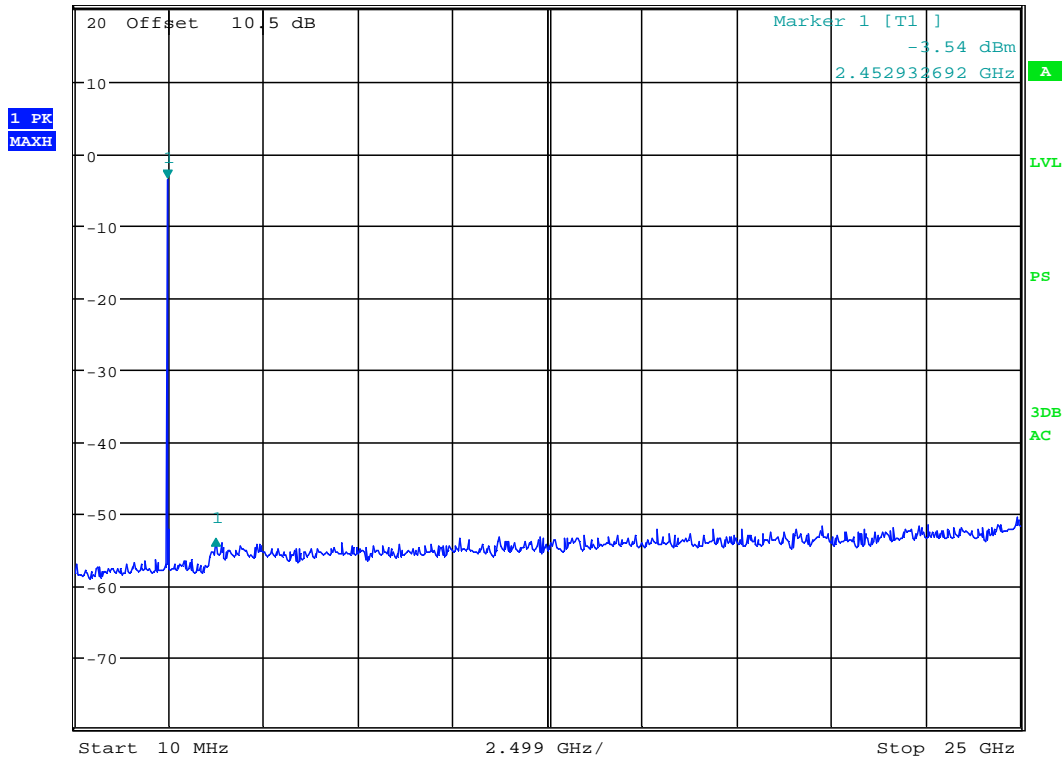


Date: 20.JUL.2015 15:37:53

**Conductd spurious emission 10MHz – 25GHz - ch2440MHz**



Ref 20.5 dBm      \*Att 20 dB      \*RBW 100 kHz      Delta 1 [T1 ]  
 VBW 300 kHz      -50.10 dB  
 SWT 2.5 s      1.281538462 GHz



Date: 20.JUL.2015 15:38:49

**Conductd spurious emission 10MHz – 25GHz - ch2480MHz**

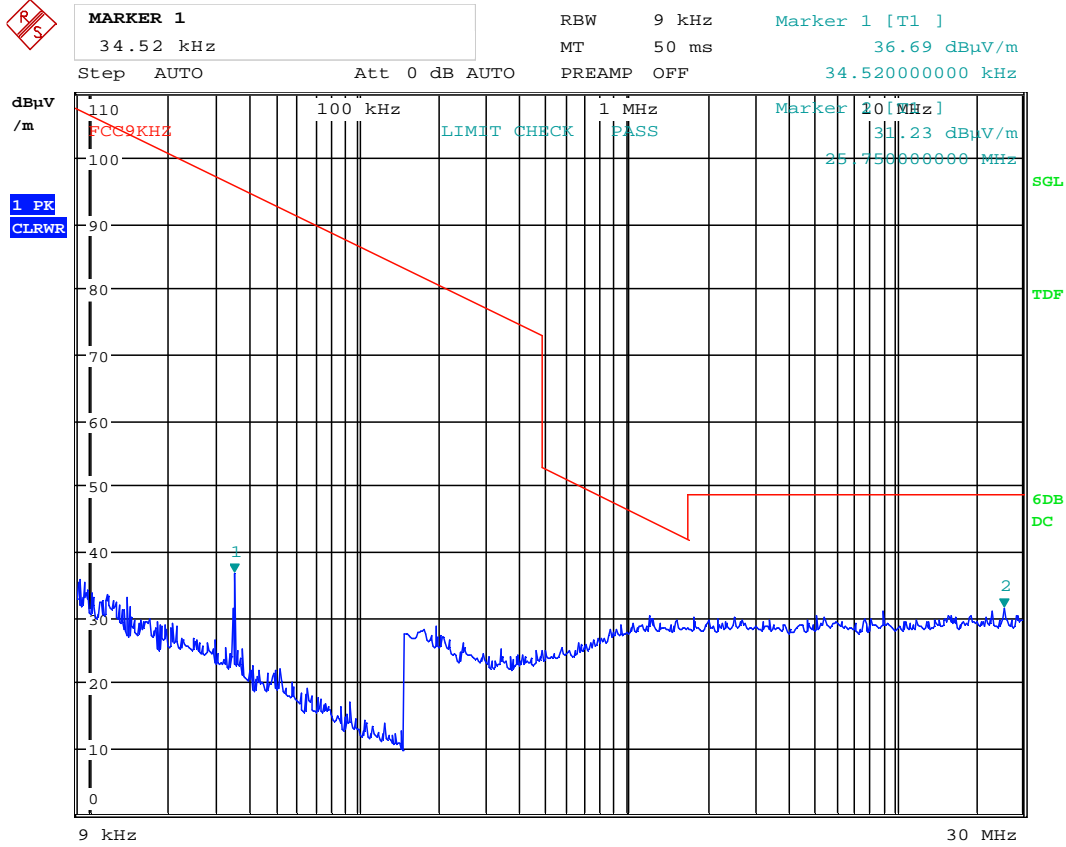


**Radiated emissions 10 kHz-30 MHz.**

Measuring distance 10 m, measured with Peak detector.

No component detected, see attached graph.

Limit is converted to 10 m using 40 dB/decade according to 15.31 (f) (2).

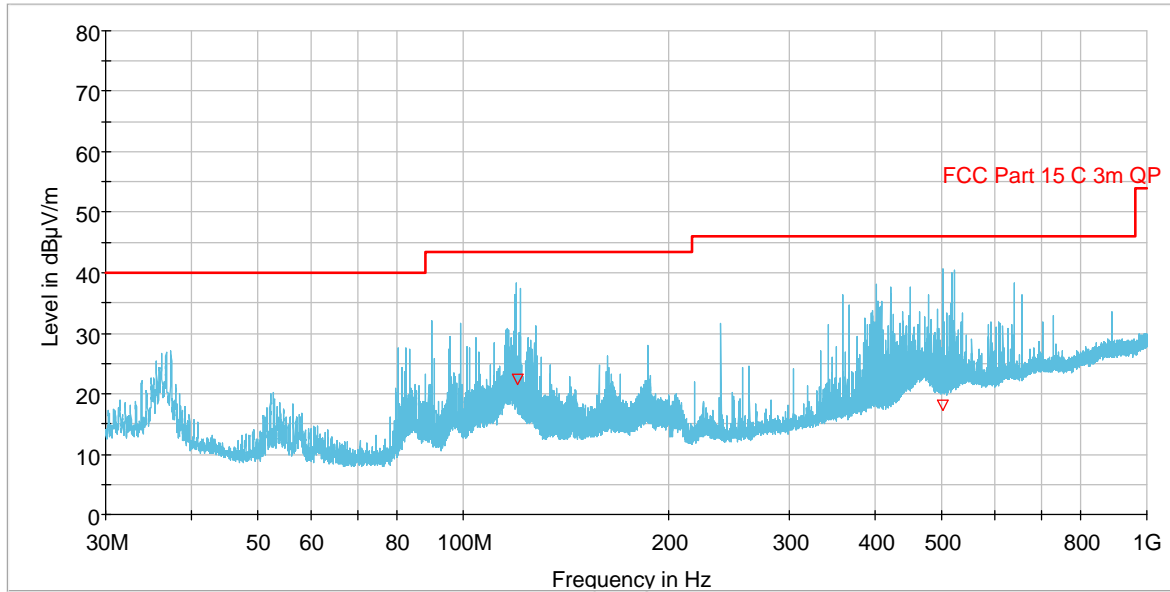


Date: 20.JUL.2015 14:51:44

**Radiated emission 30 – 1000 MHz.**

Detector: Quasi-Peak

Measuring distance 3 m .



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
119.919350	22.34	43.50	21.16	1000.0	120.000	110.0	V	339.0	-12.6
503.607800	17.99	46.00	28.01	1000.0	120.000	111.0	V	326.0	-3.9

**Radiated Emissions, 1-25 GHz**

Measuring distance: 3m (1 – 8 GHz)  
 1m (8 – 18 GHz)

A pre-scan was performed above 18 GHz and no spurious emissions were detected.

**Measurement Data:**

**Radiated : peak detector**

Frequency GHz	Channel MHz	Measured Field Strength (dBµV/m)	Duty cycle correction (dB)	Corrected Field Strength dBµV/m	Detector	Limit dBµV/m	Margin dB
1 - 25	2402	< 54	-	-	PK	74	-
1 - 25	2440	< 54	-	-	PK	74	-
1 - 25	2480	< 54	-	-	PK	74	-

**Radiated: Average detector**

Frequency GHz	Channel MHz	Measured Field Strength (dBµV/m)	Duty cycle correction (dB)	Corrected Field Strength dBµV/m	Detector	Limit dBµV/m	Margin dB
2.311	2402	#	-	-	AV	54	-
2.367	2440	#	-	-	AV	54	-
2.492	2480	#	-	-	AV	54	-

# Measured emission level with peak detector is below the average limit.

Duty cycle : 100%

Tested according to KDB 558074 D01 DTS Meas Guidance v03r02, Section 12.1 ,12.2.3, 12.2.4 & 12.2.5.1

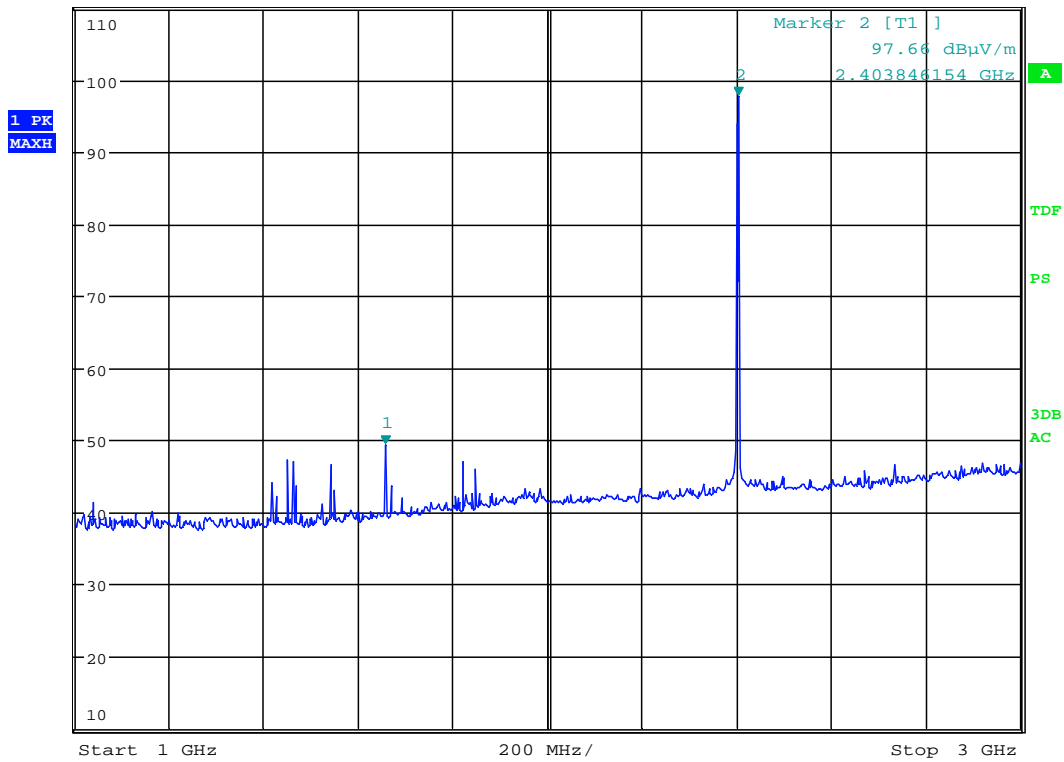
Antenna factor, amplifier gain and cable loss are included in spectrum analyzer "Transducer factor".

See plots.



**MARKER 1**  
 1.657051282 GHz  
 Ref 110 dBuV/m \*Att 15 dB

\*RBW 1 MHz Marker 1 [T1 ]  
 VBW 3 MHz 49.48 dBuV/m  
 SWT 5 ms 1.657051282 GHz



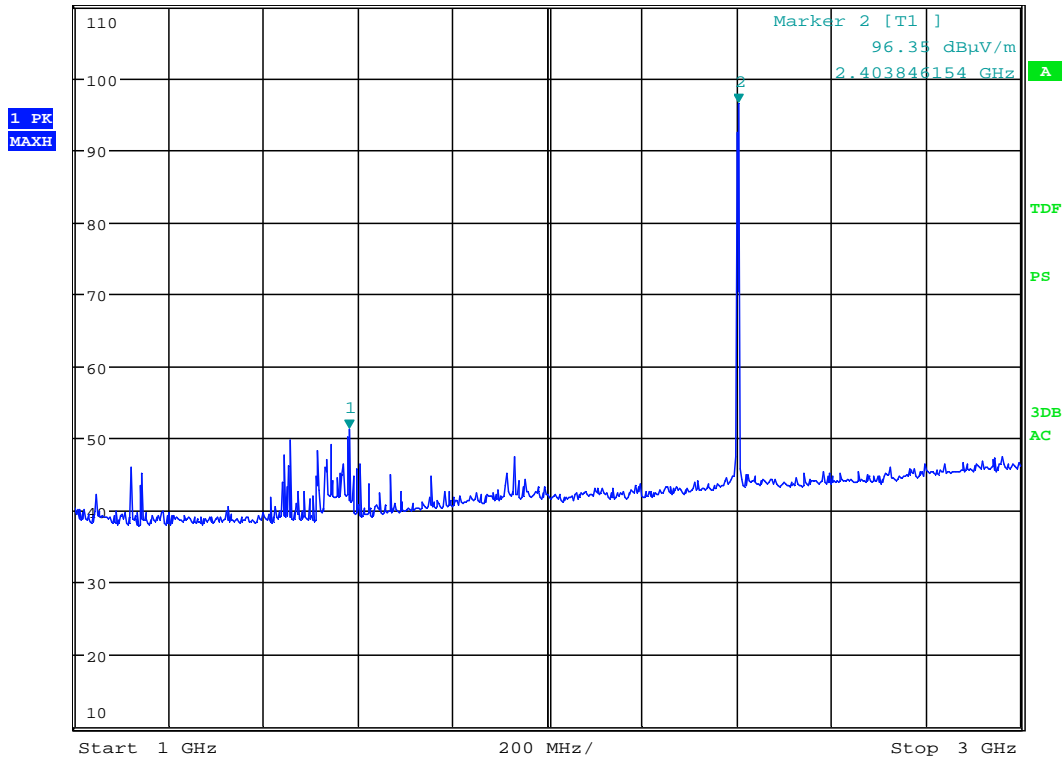
Date: 20.JUL.2015 12:58:11

**Radiated Emissions ch. 2402 MHz, 1 – 3 GHz, VP, @3m – with Peak detector**



**MARKER 1**  
 1.580128205 GHz  
 Ref 110 dBuV/m \*Att 15 dB

\*RBW 1 MHz Marker 1 [T1 ]  
 VBW 3 MHz 51.36 dBuV/m  
 SWT 5 ms 1.580128205 GHz

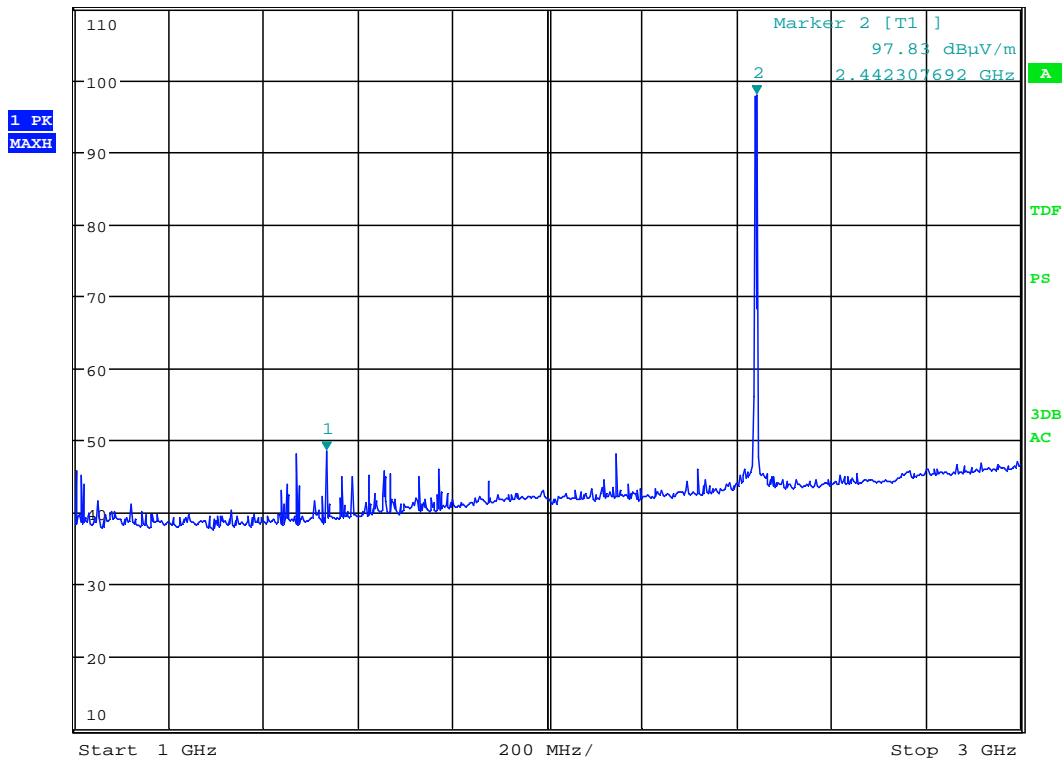


Date: 20.JUL.2015 12:59:51

**Radiated Emissions ch. 2402 MHz, 1 – 3 GHz, HP, @3m – with Peak detector**



<b>MARKER 1</b>	*RBW 1 MHz	Marker 1 [T1 ]
1.533141026 GHz	VBW 3 MHz	48.59 dBuV/m
Ref 110 dBuV/m	SWT 5 ms	1.533141026 GHz
*Att 15 dB		



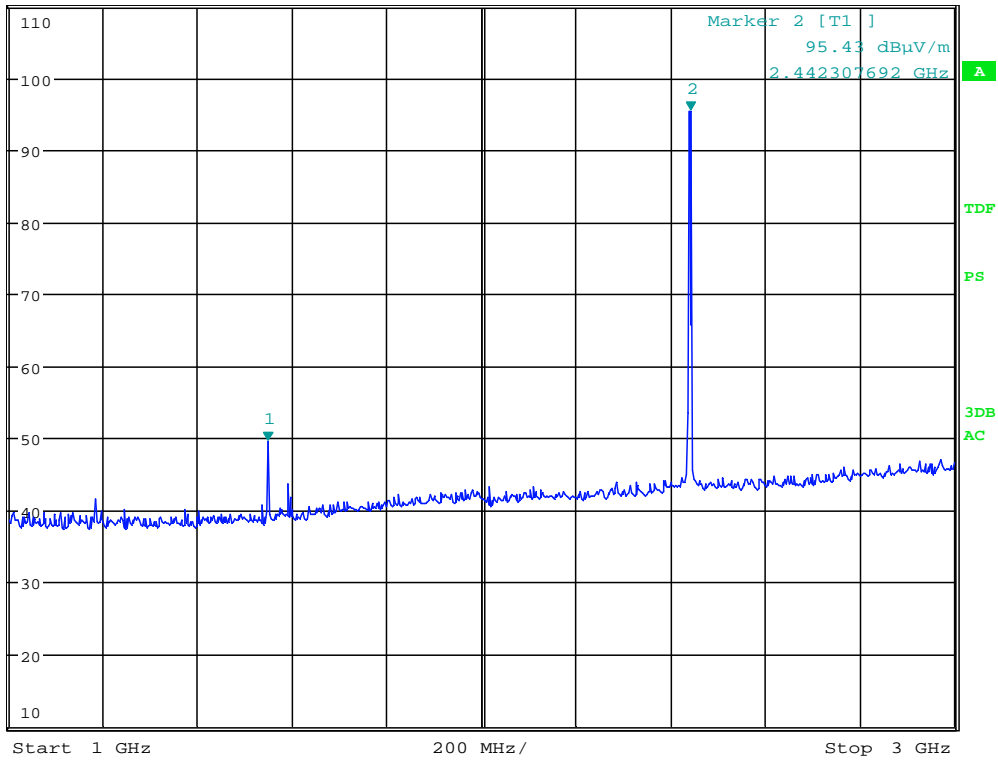
Date: 20.JUL.2015 13:53:16

**Radiated Emissions ch. 2440 MHz, 1 – 3 GHz, VP, @3m – with Peak detector**



**MARKER 1**  
1.549166667 GHz  
Ref 110 dBuV/m \*Att 15 dB \*RBW 1 MHz VBW 3 MHz SWT 5 ms  
Marker 1 [T1 ]  
49.66 dBuV/m  
1.549166667 GHz

1 PK  
MAXH

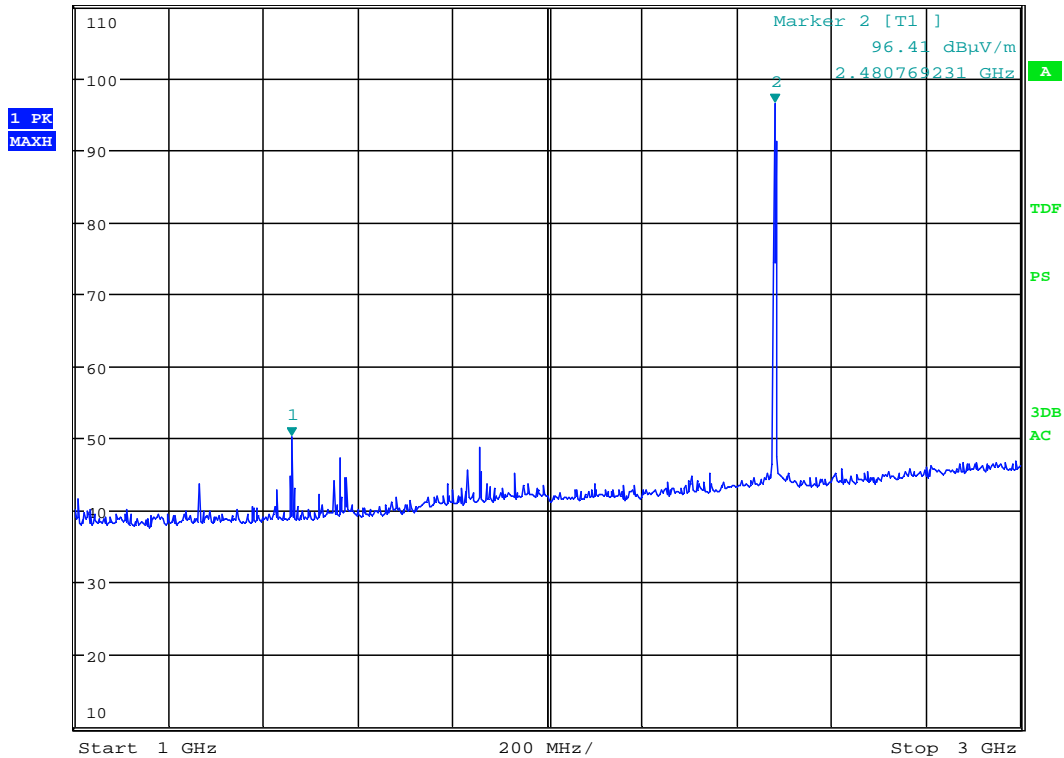


Date: 20.JUL.2015 13:54:00

**Radiated Emissions ch. 2440 MHz, 1 – 3 GHz, HP, @3m – with Peak detector**



**MARKER 1**  
 1.457788462 GHz  
 Ref 110 dBuV/m \*Att 15 dB  
 \*RBW 1 MHz Marker 1 [T1]  
 VBW 3 MHz 50.32 dBuV/m  
 SWT 5 ms 1.457788462 GHz



Date: 20.JUL.2015 13:35:14

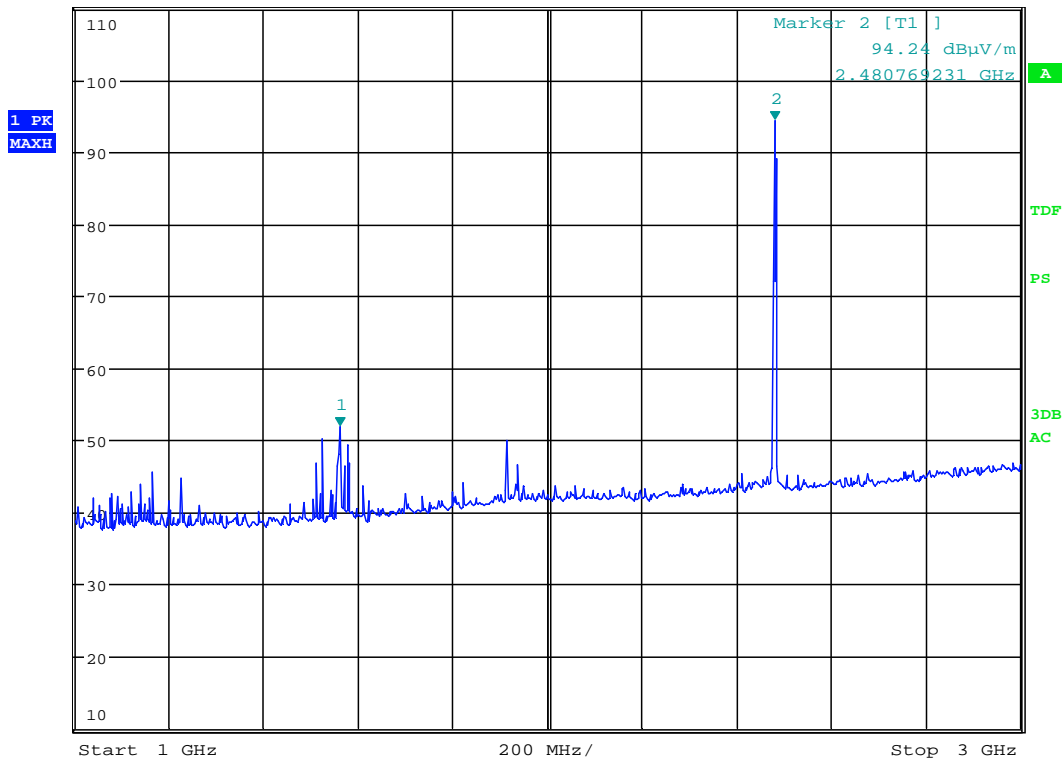
**Radiated Emissions ch. 2480 MHz, 1 – 3 GHz, VP, @3m – with Peak detector**





**MARKER 1**  
 1.560897436 GHz  
 Ref 110 dBuV/m \*Att 15 dB

\*RBW 1 MHz Marker 1 [T1 ]  
 VBW 3 MHz 51.85 dBuV/m  
 SWT 5 ms 1.560897436 GHz

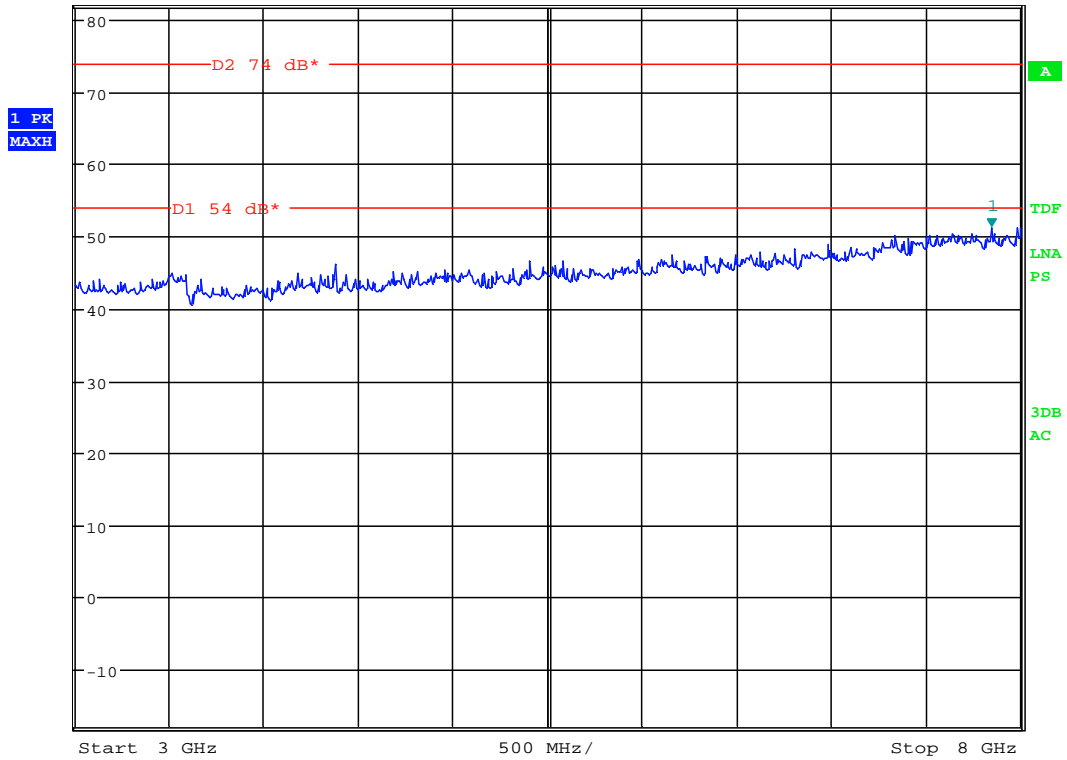


Date: 20.JUL.2015 14:00:23

**Radiated Emissions ch. 2480 MHz, 1 – 3 GHz, HP, @3m – with Peak detector**



**MARKER 1**  
 7.84775641 GHz  
 Ref 82 dB $\mu$ V/m \* Att 10 dB \* RBW 1 MHz  
 VBW 3 MHz Marker 1 [T1 ]  
 SWT 30 ms 51.23 dB $\mu$ V/m  
 7.847756410 GHz

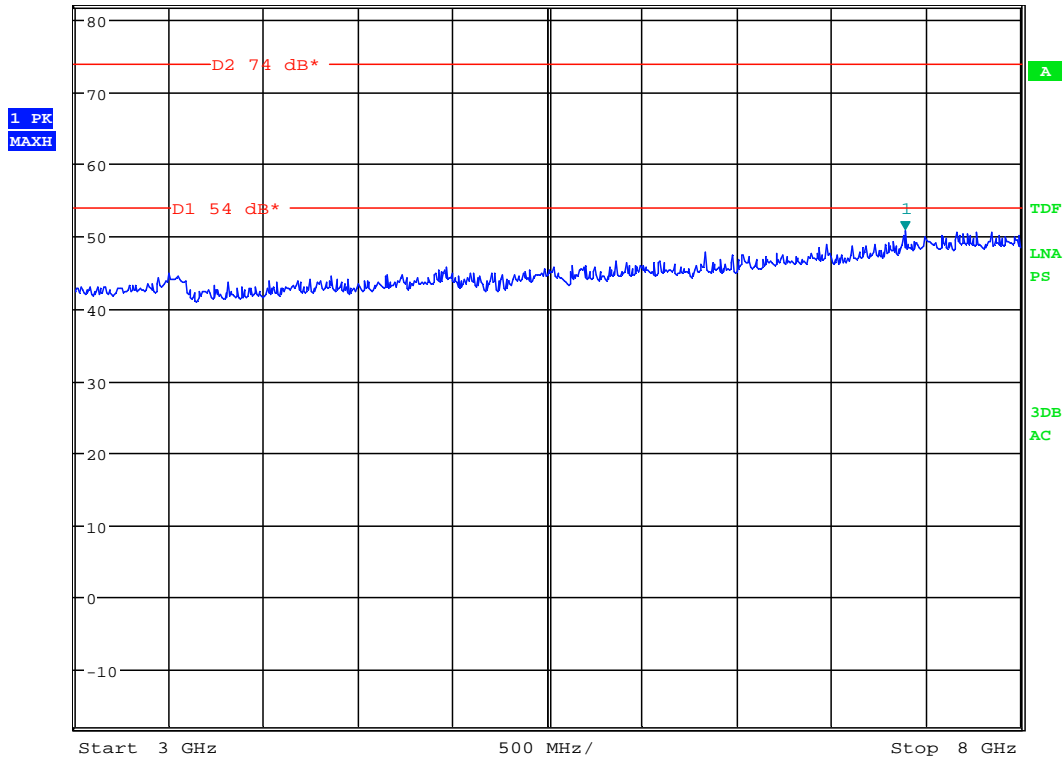


Date: 20.JUL.2015 13:18:57

**Radiated emissions ch 2402 MHz , 3 - 8GHz, HP @3m with Peak detector (measured with HP filter)**



**MARKER 1**  
 7.391025641 GHz  
 Ref 82 dBµV/m \*Att 10 dB \*RBW 1 MHz Marker 1 [T1 ]  
 VBW 3 MHz 50.90 dBµV/m  
 SWT 30 ms 7.391025641 GHz

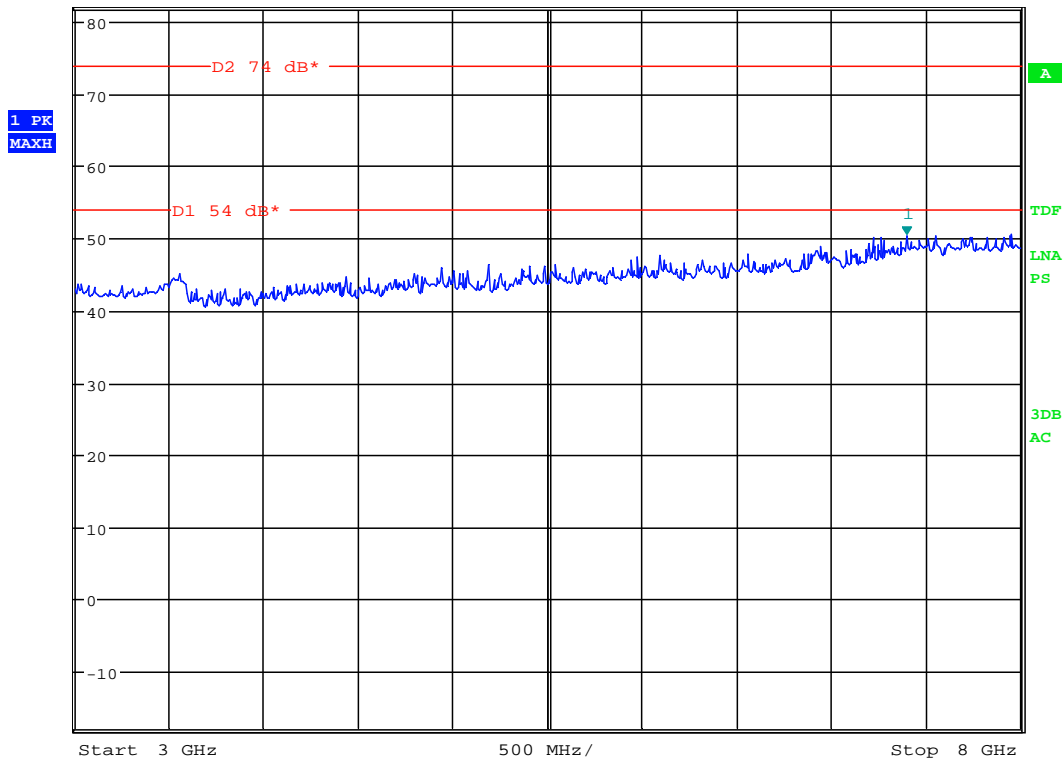


Date: 20.JUL.2015 13:19:41

**Radiated emissions ch 2402 MHz , 3 - 8GHz, VP @3m with Peak detector(measured with HP filter)**



**MARKER 1**  
 7.399038462 GHz  
 Ref 82 dBµV/m \*Att 10 dB \*RBW 1 MHz Marker 1 [T1 ]  
 VBW 3 MHz 50.29 dBµV/m  
 SWT 30 ms 7.399038462 GHz

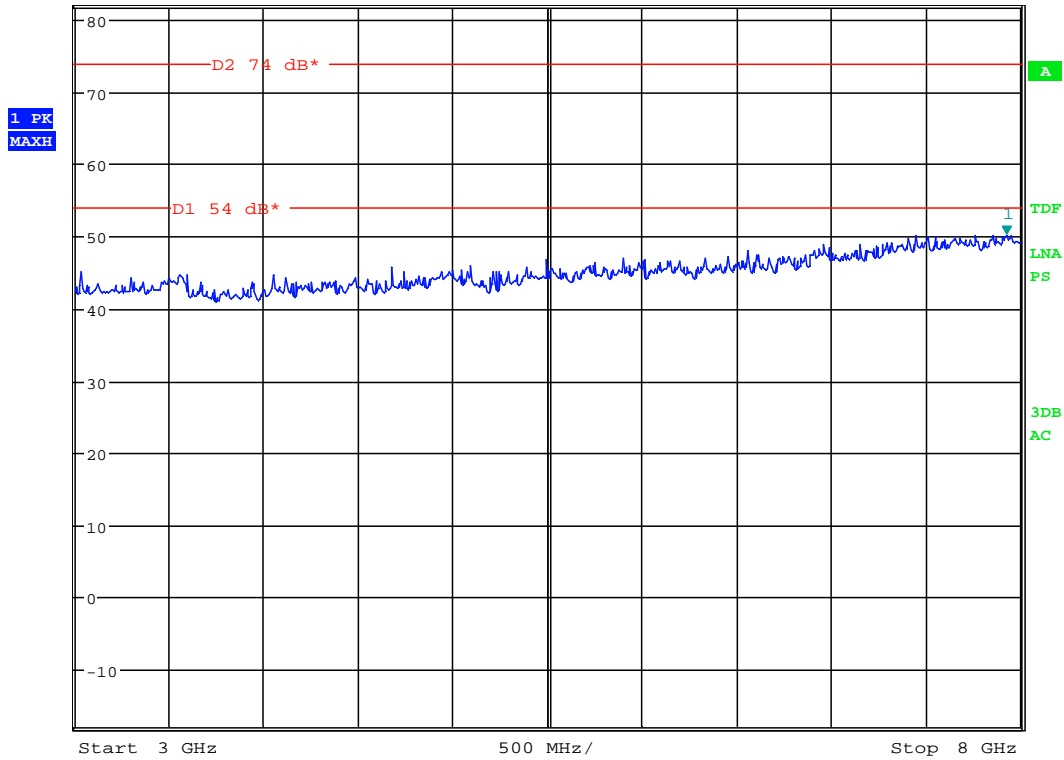


Date: 20.JUL.2015 13:21:34

**Radiated emissions ch 2440 MHz , 3 - 8GHz, HP @3m with Peak detector(measured with HP filter)**



**MARKER 1**  
 7.927884615 GHz  
 Ref 82 dBµV/m \* Att 10 dB \* RBW 1 MHz Marker 1 [T1 ]  
 VBW 3 MHz 50.13 dBµV/m  
 SWT 30 ms 7.927884615 GHz

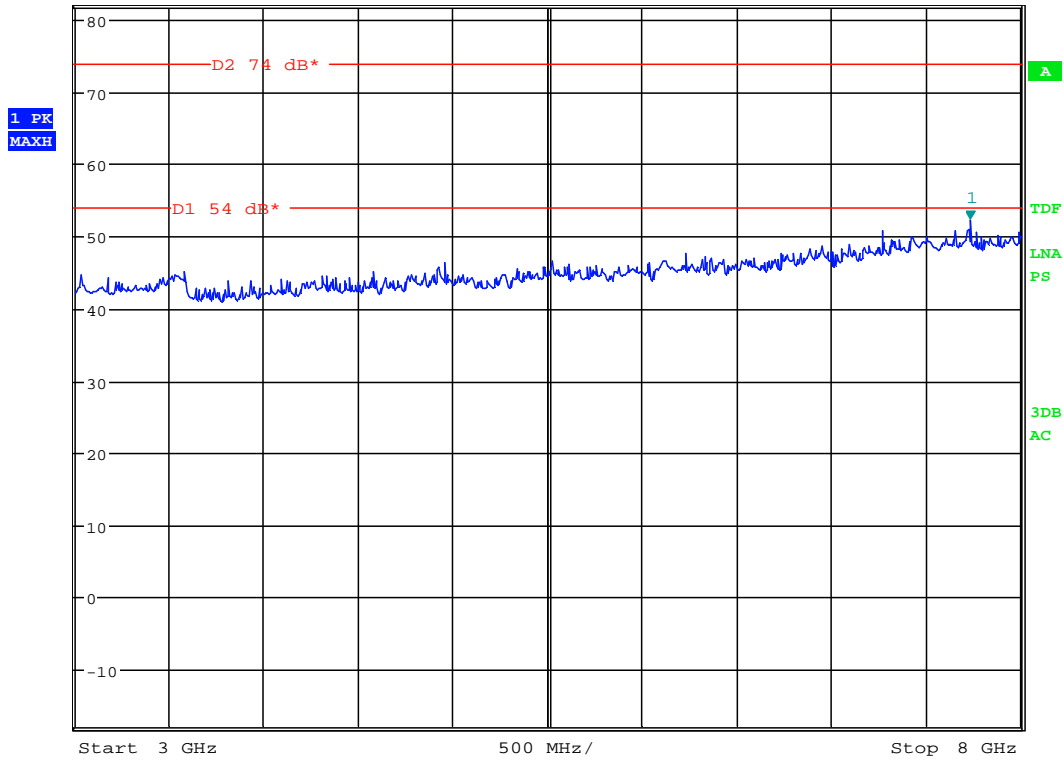


Date: 20.JUL.2015 13:20:55

**Radiated emissions ch 2440 MHz , 3 - 8GHz, VP @3m with Peak detector(measured with HP filter)**



**MARKER 1**  
 7.735576923 GHz  
 Ref 82 dBµV/m \*Att 10 dB \*RBW 1 MHz Marker 1 [T1 ]  
 VBW 3 MHz 52.28 dBµV/m  
 SWT 30 ms 7.735576923 GHz



Date: 20.JUL.2015 13:22:27

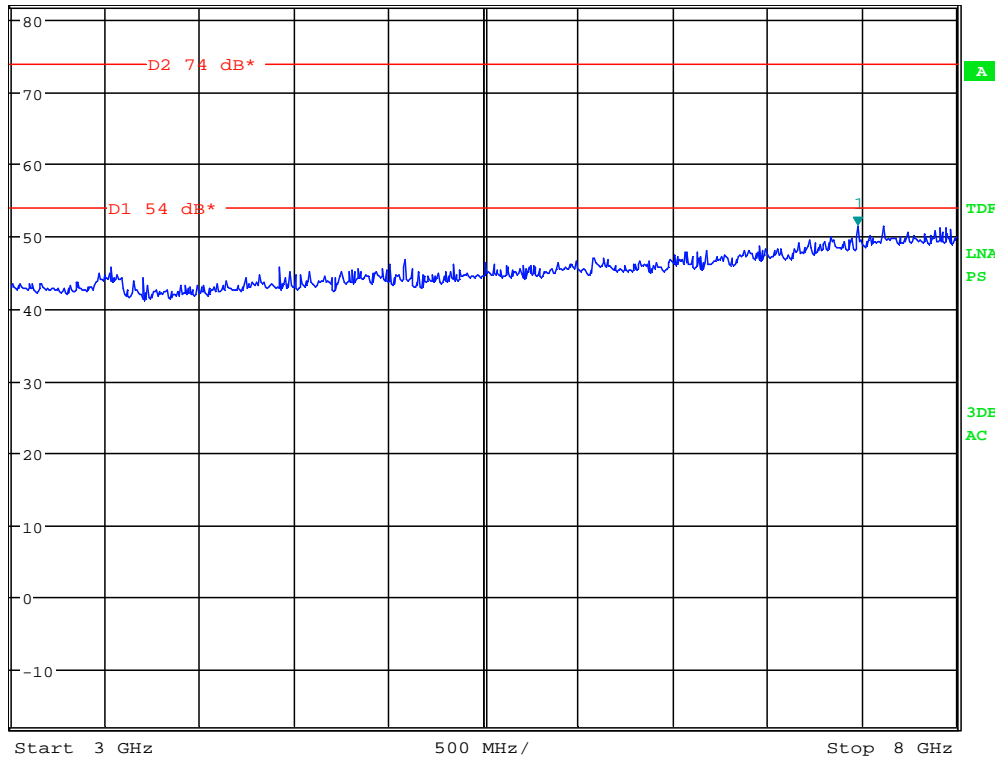
**Radiated emissions ch 2480 MHz , 3 - 8GHz, HP @3m with Peak detector(measured with HP filter)**



**MARKER 1**  
 7.479166667 GHz  
 Ref 82 dBµV/m \*Att 10 dB

\*RBW 1 MHz Marker 1 [T1 ]  
 VBW 3 MHz 51.39 dBµV/m  
 SWT 30 ms 7.479166667 GHz

1 PK  
 MAXH

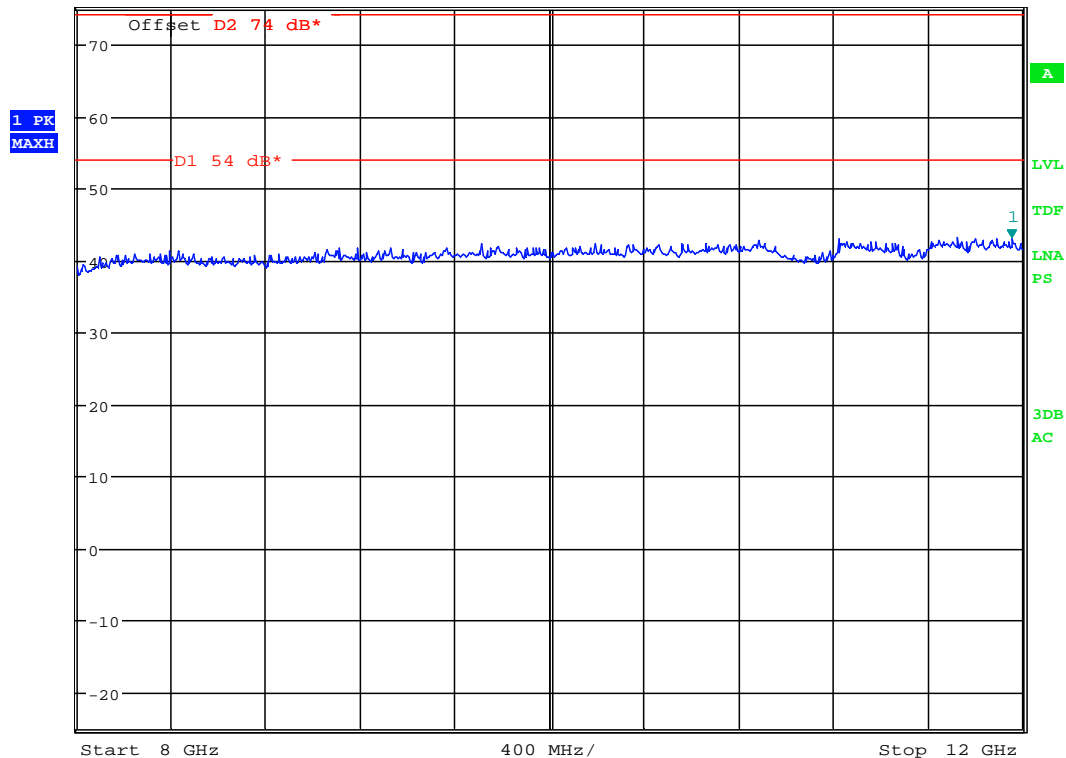


Date: 20.JUL.2015 13:22:55

**Radiated emissions ch 2480 MHz , 3 - 8GHz, VP @3m with Peak detector(measured with HP filter)**



**MARKER 1**  
 11.95512821 GHz  
 Ref 75 dBµV/m \*Att 15 dB \*RBW 1 MHz VBW 3 MHz SWT 25 ms  
 Marker 1 [T1 ] 43.04 dBµV/m  
 11.955128205 GHz



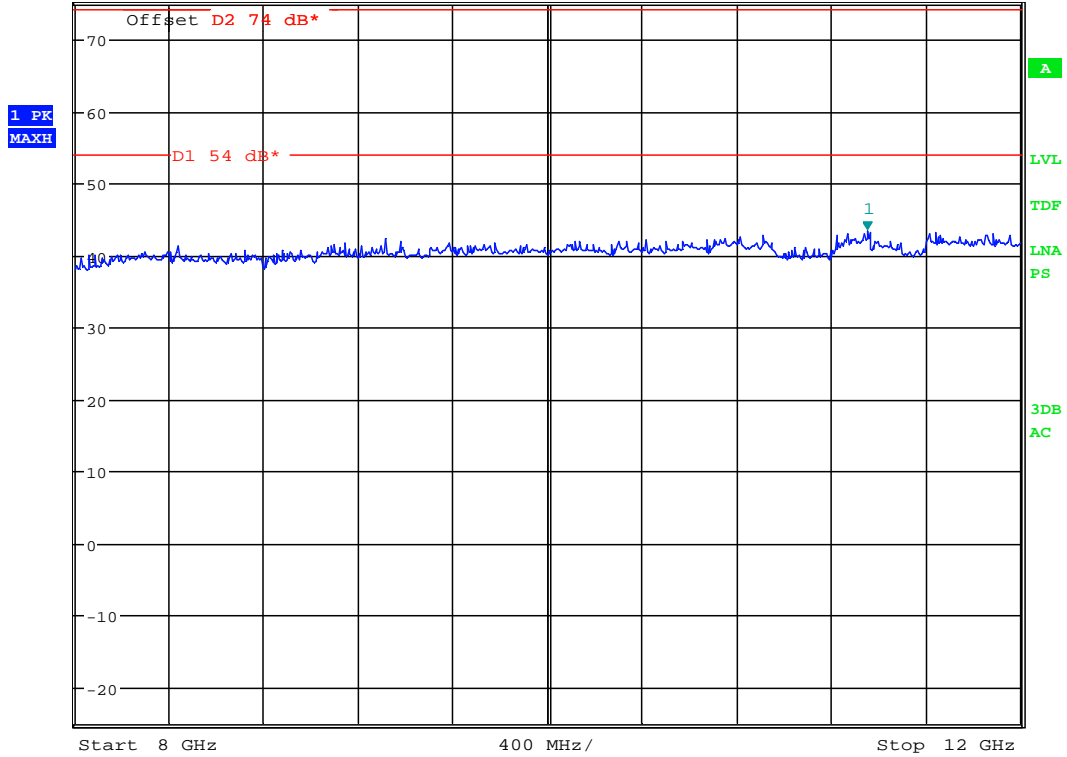
Date: 20.JUL.2015 10:55:02

**Radiated Emissions ch. 2440 MHz, 8 – 12 GHz, VP, @1m – with Peak detector (distance correction factor of -9.5 dB is included in the graph)**





**MARKER 1**  
 11.3525641 GHz  
 Ref 75 dBµV/m \*Att 15 dB \*RBW 1 MHz Marker 1 [T1 ]  
 VBW 3 MHz 43.48 dBµV/m  
 SWT 25 ms 11.352564103 GHz

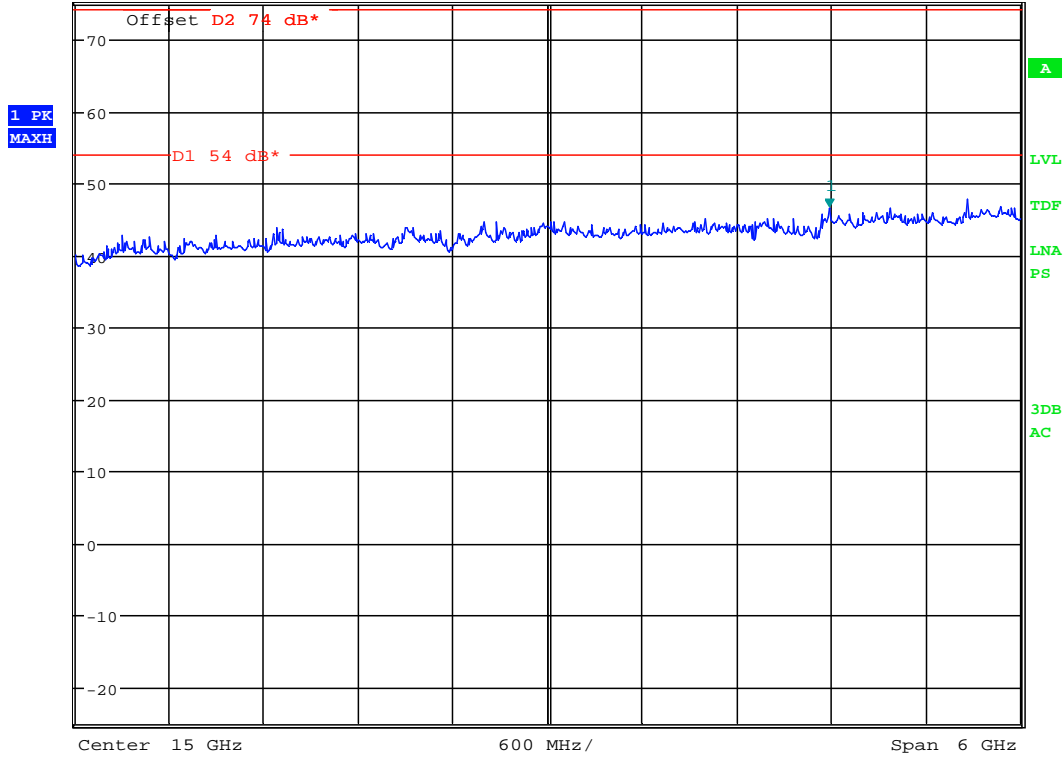


Date: 20.JUL.2015 10:56:11

**Radiated Emissions ch. 2440 MHz, 8 – 12 GHz, HP, @1m – with Peak detector(distance correction factor of -9.5 dB is included in the graph)**



**MARKER 1**  
 16.78846154 GHz  
 Ref 75 dBµV/m \*Att 15 dB \*RBW 1 MHz Marker 1 [T1 ]  
 VBW 3 MHz 46.63 dBµV/m  
 SWT 35 ms 16.788461538 GHz



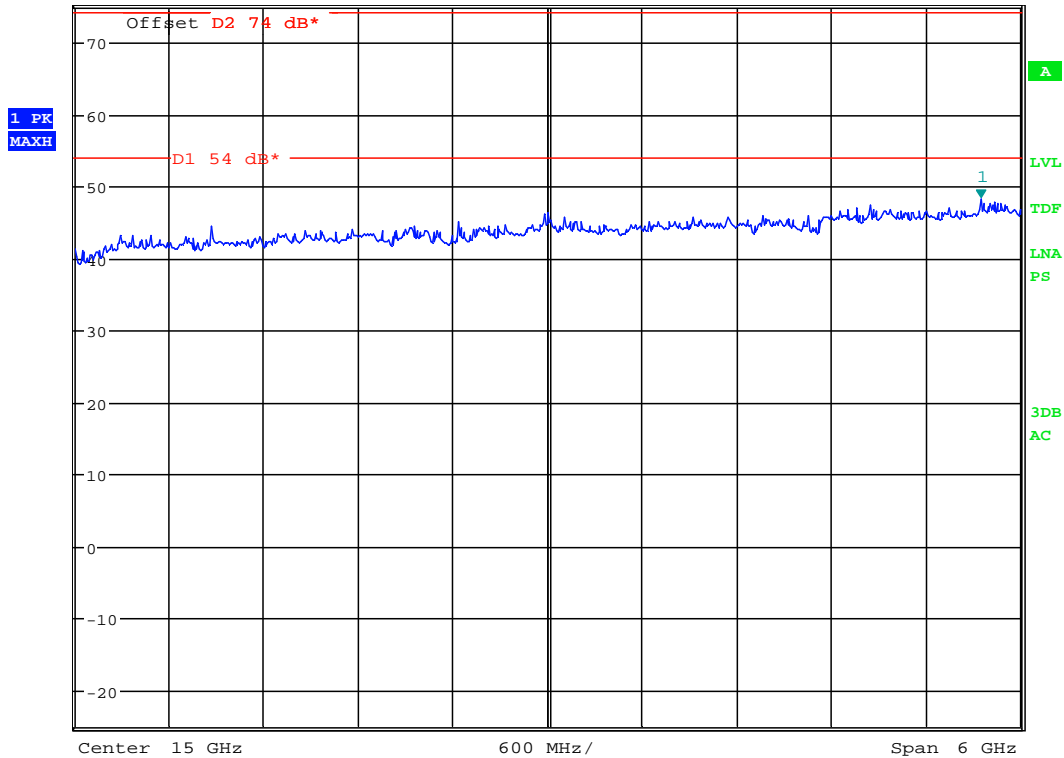
Date: 20.JUL.2015 10:52:10

**Radiated Emissions ch. 2440 MHz, 12 – 18 GHz, VP, @1m – with Peak detector(distance correction factor of -9.5 dB is included in the graph)**



\*RBW 1 MHz      Marker 1 [T1 ]  
 VBW 3 MHz      48.24 dBuV/m  
 SWT 35 ms      17.75000000 GHz

Ref 75 dBuV/m      \*Att 15 dB

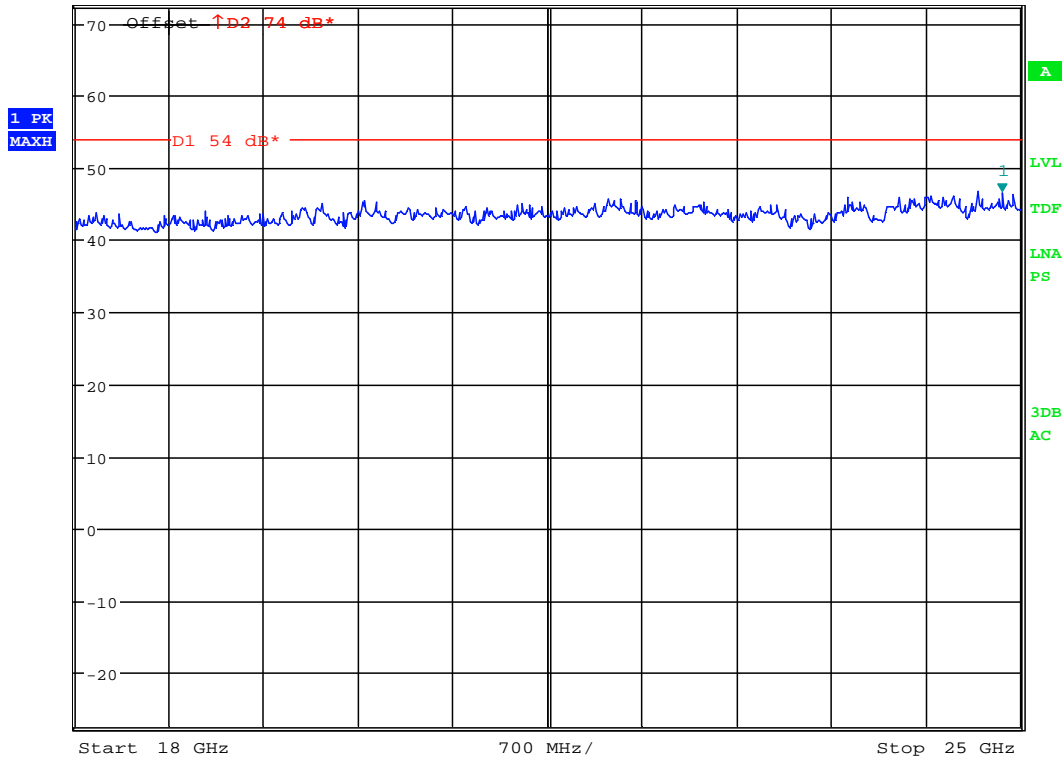


Date: 20.JUL.2015 10:51:28

**Radiated Emissions ch. 2440 MHz, 12 – 18 GHz, HP, @1m – with Peak detector (distance correction factor of -9.5 dB is included in the graph)**



<b>MARKER 1</b>	*RBW 1 MHz	Marker 1 [T1 ]
24.86538462 GHz	VBW 3 MHz	46.59 dBµV/m
Ref 72.5 dBµV/m	*Att 10 dB	SWT 45 ms
		24.865384615 GHz



Date: 20.JUL.2015 15:55:16

**Radiated Emissions ch. 2440 MHz, 18 – 25 GHz, VP/HP, @1m – Pre-scan with Peak detector**

### 3.6 Power Spectral Density (PSD)

Para. No.: 15.247 (d)

Test Performed By: G.Suhanthakumar	Date of Test: 2015.07.20
------------------------------------	--------------------------

Test Results: Passed

#### Measured and Calculated Data:

According to KDB 558074 D01 DTS Meas Guidance v03r02, Section 10.2.

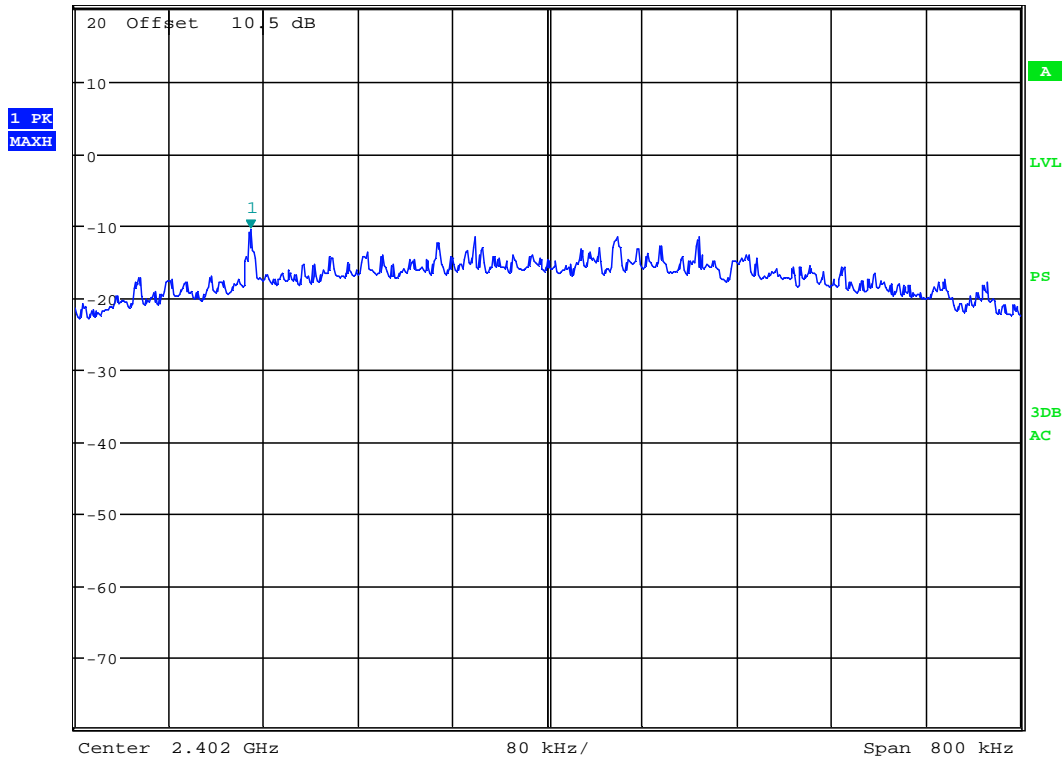
	2402 MHz	2440 MHz	2480 MHz
Measured value (dBm)	-10.4	-11.9	-11.9

#### Requirements:

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



**MARKER 1**  
 2.401748718 GHz  
 Ref 20.5 dBm \*Att 20 dB \*RBW 3 kHz VBW 10 kHz SWT 90 ms  
 Marker 1 [T1 ] -10.41 dBm  
 2.401748718 GHz

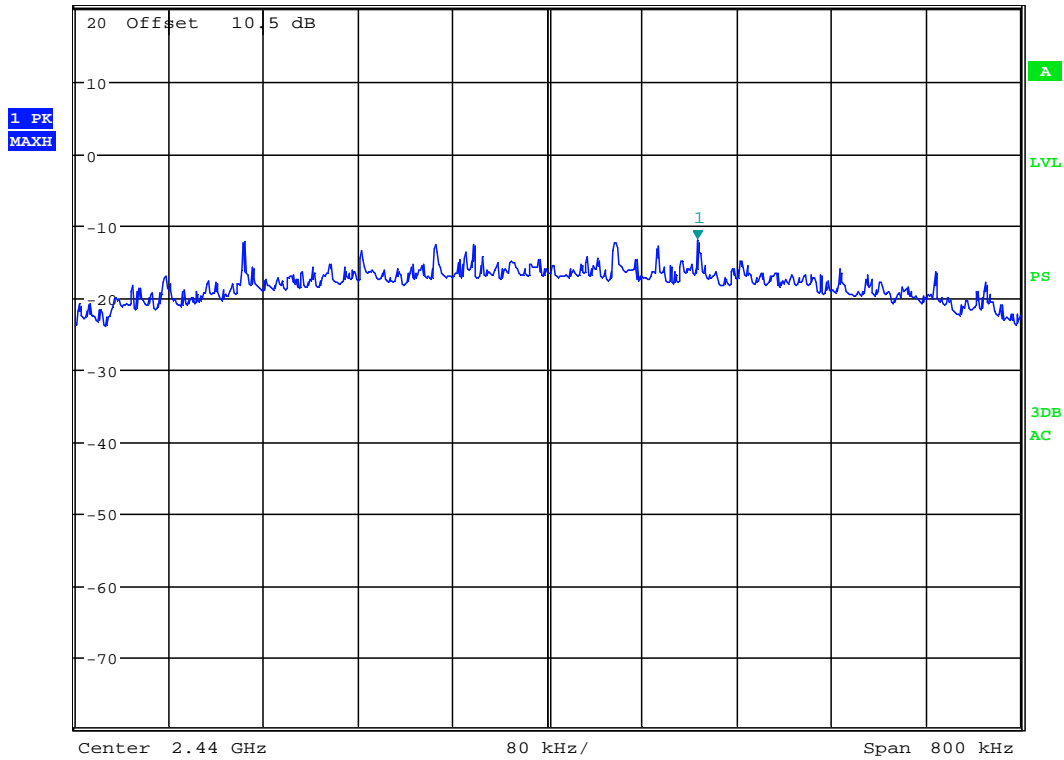


Date: 20.JUL.2015 15:29:00

**Power spectral density, ch2402MHz**



**MARKER 1**  
 2.440126923 GHz  
 Ref 20.5 dBm \*Att 20 dB \*RBW 3 kHz Marker 1 [T1 ]  
 VBW 10 kHz -11.92 dBm  
 SWT 90 ms 2.440126923 GHz

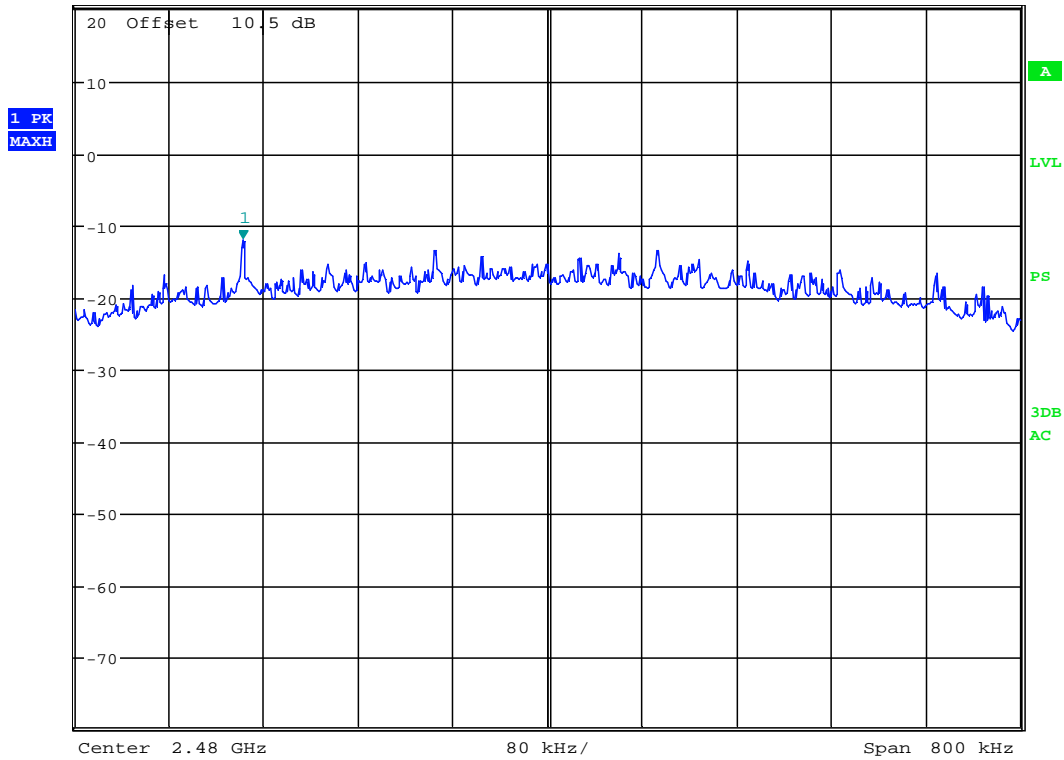


Date: 20.JUL.2015 15:39:43

**Power spectral density, ch2440MHz**



<b>MARKER 1</b>	*RBW 3 kHz	Marker 1 [T1]
2.479742308 GHz	VBW 10 kHz	-11.86 dBm
Ref 20.5 dBm	SWT 90 ms	2.479742308 GHz
*Att 20 dB		



Date: 20.JUL.2015 15:40:09

**Power spectral density, ch2480MHz**



## 4 Measurement Uncertainty

Measurement Uncertainty Values		
Test Item		Uncertainty
Output Power		±0.5 dB
Power Spectral Density		±0.5 dB
Out of Band Emissions, Conducted	< 3.6 GHz	±0.6 dB
	> 3.6 GHz	±0.9 dB
Spurious Emissions, Radiated	< 1 GHz	±2.5 dB
	> 1 GHz	±2.2 dB
Emission Bandwidth		±4 %
Power Line Conducted Emissions		+2.9 / -4.1 dB
Spectrum Mask Measurements	Frequency	±5 %
	Amplitude	±1.0 dB
Frequency Error		±0.6 ppm
Temperature Uncertainty		±1 °C

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor  $k=2$

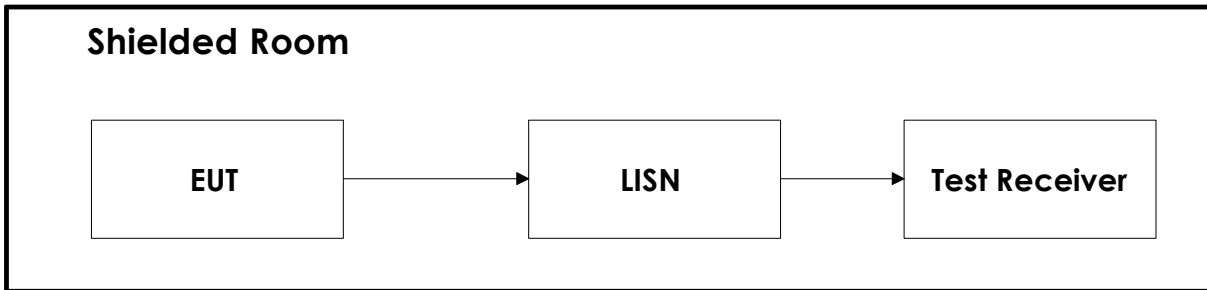
## 5 LIST OF TEST EQUIPMENT

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.

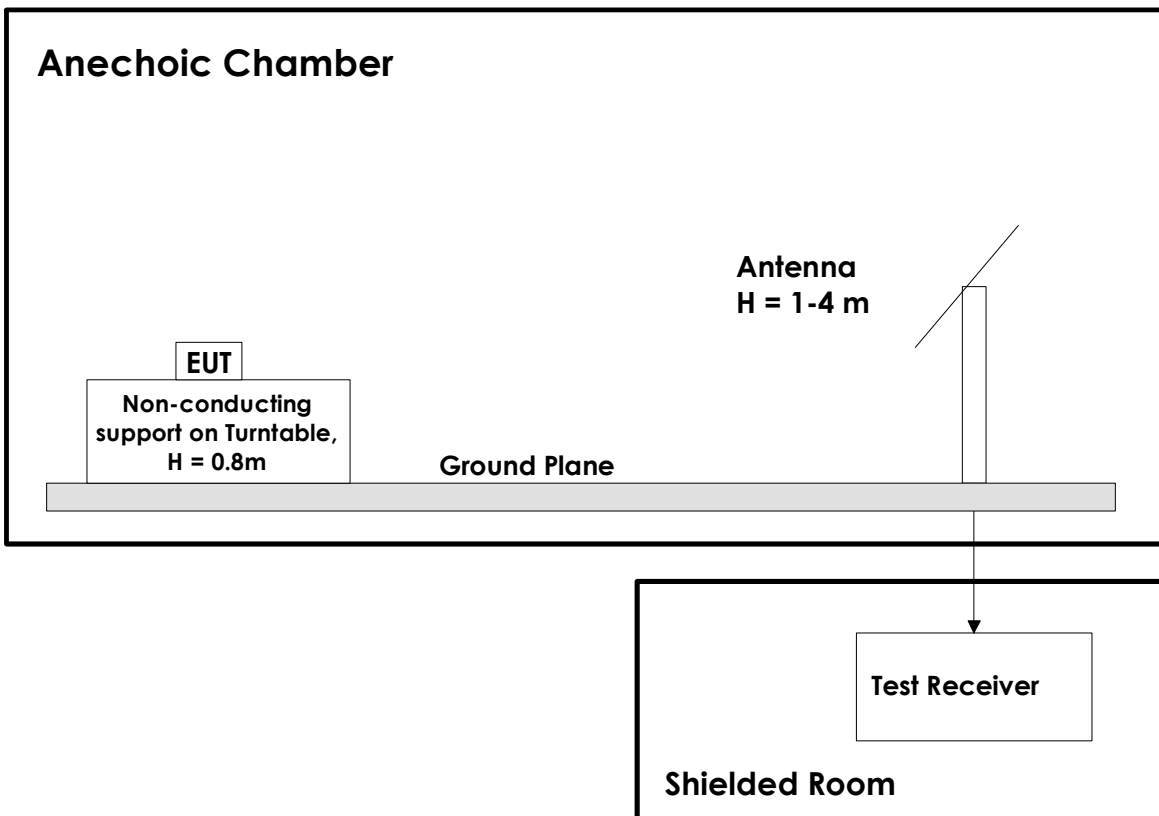
No.	Instrument/ ancillary	Type of instrument/ ancillary	Manufacturer	Ref. no.	Cal. Date	Cal. Due
1	ESU40	EMI Receiver	Rohde & Schwarz	LR 1639	2014.11	2015.11
2	3115	Antenna horn	EMCO	LR 1330	2010.08	2017.08
3	HFH2-Z2	Loop antenna	Rohde & Schwarz	LR1660	2010.08	2017.08
4	HK116	Biconical Antenna	Rohde & Schwarz	LR 1260	2013.12	2015.12
5	HL223	Log Periodic antenna	Rohde & Schwarz	LR 1261	2013.12	2015.12
6	PM7320X	Antenna horn	Siverts lab	LR 103	2009.01.26	2016.01.26
7	DBF-520-20	Antenna horn	Systron Donner	LR 101	2009.01.26	2016.01.26
8	638	Antenna horn	Narda	LR 098	2010.06.17	2016.06.17
9	8449B	Pre-amplifier	Hewlett Packard	LR 1322	2014.11	2015.11
10	LNA6900	Pre-amplifier	Teseq	LR 1593	2014.07	2015.07
11	B603D	DC power supply	Øltronix	LT 666	Cal b4 use	
12	6032A	DC power supply	Hewlett Packard	LT 1062	Cal b4 use	
13	Model 87 V	Multimeter	Fluke	LR 1600	2013.10	2015.10
14	ESH3-Z5	AMN	Rohde & Schwarz	LR 1076	2014.10	2016.10
15	ESHS 10	EMI receiver	Rohde & Schwarz	N -3528	2014.06	2016.06
16	ESH3-Z2	Puls Limiter	Rohde & Schwarz	LR 1074	2014.07	2017.07
17	6812B	AC power source	Agilent	LR 1515	2013.10	2015.10
18	74-10-12	10 attenuator	Aeroflex	LR 1579	Cal b4 use	
19	FA210A1010003030	Microwave cable	Rosenberger	LR1566	Cal b4 use	
20	6HC 3000-18000	HP Filter	Trithlic	LR1614	Cal b4 use	

## 6 BLOCK DIAGRAM

### 6.1 Power Line Conducted Emission



### 6.2 Test Site Radiated Emission



## Revision history

Version	Date	Comment	Sign
1.0	2015.12.08	Version for TCB review	FS