

# Test Report

|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                                                                                                                  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Product</b>                                                                                                                                                                                                                                                                                                                                                                                                          | Bluetooth Low Energy (BLE) module                                                                                                                                                                                |
| <b>Name and address of the applicant</b>                                                                                                                                                                                                                                                                                                                                                                                | ASSA ABLOY Hospitality AS<br>Anolitveien 1-3,<br>1400 Ski, Norway                                                                                                                                                |
| <b>Name and address of the manufacturer</b>                                                                                                                                                                                                                                                                                                                                                                             | ASSA ABLOY Hospitality AS<br>Anolitveien 1-3,<br>1400 Ski, Norway                                                                                                                                                |
| <b>Model</b>                                                                                                                                                                                                                                                                                                                                                                                                            | 4827610CC1                                                                                                                                                                                                       |
| <b>Rating</b>                                                                                                                                                                                                                                                                                                                                                                                                           | 4.5Vdc                                                                                                                                                                                                           |
| <b>Trademark</b>                                                                                                                                                                                                                                                                                                                                                                                                        | ASSA ABLOY                                                                                                                                                                                                       |
| <b>Serial number</b>                                                                                                                                                                                                                                                                                                                                                                                                    | /                                                                                                                                                                                                                |
| <b>Additional information</b>                                                                                                                                                                                                                                                                                                                                                                                           | 2.4GHz, Bluetooth Low Energy (BLE).<br>This product contains RFID transceiver with same FCC/IC ID. But never transmits simultaneously with RFID.                                                                 |
| <b>Tested according to</b>                                                                                                                                                                                                                                                                                                                                                                                              | <b>FCC Part 15.247</b><br>Frequency Hopping Transmitters / Digital Transmission Systems<br><b>Industry Canada RSS-247, Issue 1</b><br>Low Power Licence-Exempt Radiocommunications Devices                       |
| <b>Order number</b>                                                                                                                                                                                                                                                                                                                                                                                                     | 311535                                                                                                                                                                                                           |
| <b>Tested in period</b>                                                                                                                                                                                                                                                                                                                                                                                                 | 2016.06.27 – 2016.07.12 and 2017.02.08                                                                                                                                                                           |
| <b>Issue date</b>                                                                                                                                                                                                                                                                                                                                                                                                       | 2017.02.09                                                                                                                                                                                                       |
| <b>Name and address of the testing laboratory</b>                                                                                                                                                                                                                                                                                                                                                                       | <br>Instituttveien 6<br>Kjeller, Norway<br>FCC No: 994405<br>IC OATS: 2040D-1<br>TEL: +47 22 96 03 30<br>FAX: +47 22 96 05 50 |
| <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <br/> Prepared by [G.Suhanthakumar] </div> <div style="text-align: center;"> <br/> Approved by [Frode Sveinsen] </div> </div> |                                                                                                                                                                                                                  |
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## CONTENTS

|          |                                                           |           |
|----------|-----------------------------------------------------------|-----------|
| <b>1</b> | <b>INFORMATION .....</b>                                  | <b>3</b>  |
| 1.1      | Test Item.....                                            | 3         |
| 1.2      | Normal test conditions .....                              | 4         |
| 1.3      | Test Engineer(s) .....                                    | 4         |
| 1.4      | Description of modification for Modification Filing ..... | 4         |
| 1.5      | Family List Rational .....                                | 4         |
| 1.6      | Comments .....                                            | 4         |
| <b>2</b> | <b>TEST REPORT SUMMARY .....</b>                          | <b>5</b>  |
| 2.1      | General.....                                              | 5         |
| 2.2      | Test Summary .....                                        | 6         |
| <b>3</b> | <b>TEST RESULTS.....</b>                                  | <b>7</b>  |
| 3.1      | Occupied Bandwidth.....                                   | 7         |
| 3.3      | Minimum 6 dB Bandwidth .....                              | 9         |
| 3.4      | Peak Power Output.....                                    | 13        |
| 3.5      | Spurious Emissions (Radiated).....                        | 23        |
| 3.6      | Power Spectral Density (PSD).....                         | 64        |
| <b>4</b> | <b>Measurement Uncertainty.....</b>                       | <b>68</b> |
| <b>5</b> | <b>LIST OF TEST EQUIPMENT.....</b>                        | <b>69</b> |
| <b>6</b> | <b>BLOCK DIAGRAM.....</b>                                 | <b>70</b> |
| 6.1      | Power Line Conducted Emission .....                       | 70        |
| 6.2      | Test Site Radiated Emission.....                          | 70        |

# 1 INFORMATION

## 1.1 Test Item

|                                    |                            |
|------------------------------------|----------------------------|
| Name :                             | ASSA ABLOY                 |
| FCC ID :                           | Y7V-4827610CC1             |
| Industry Canada ID :               | 9514A-4827610CC1           |
| Model/version :                    | 4827610CC1                 |
| Serial number :                    | /                          |
| Hardware identity and/or version:  | 4827610-B (PCBA: 4827644)* |
| Software identity and/or version : | BLE test SW 2.0            |
| Frequency Range :                  | 2402 - 2480MHz             |
| Tunable Bands :                    | None                       |
| Number of Channels :               | 39                         |
| Operating Modes :                  | Transceiver                |
| Type of Modulation :               | GFSK, 250kHz deviation     |
| User Frequency Adjustment :        | None                       |
| Rated Output Power :               | 1.92 mW                    |
| Type of Power Supply :             | 4.5Vdc (3x LR6 batteries)  |
| Antenna Connector :                | None (PCB antenna)         |
| Antenna Diversity Supported :      | No                         |
| Desktop Charger :                  | No                         |

\*This PCBA 4827644 is BLE module in 4827610-B

### Description of Test Item

The Bluetooth Low Energy Module is located on PCB 1104, and is controlled by the main microcontroller located on PCB 1101, both located inside the LCU 5350.

A chip antenna is also located on the PCB 1104. This module will communicate with a BLE enabled Mobile phone held in front of the unit

### Theory of Operation

The module follows the Bluetooth specification 4-0, operating in the 2.4GHz band. The module is designed using the nRF51822 system on chip from Nordic Semiconductor.

This system on chip contains a microcontroller, memory and embedded 2.4GHz transceiver supporting BLE. The transceiver's oscillator is controlled by a 16MHz crystal.

## 1.2 Normal test conditions

|                      |                                 |
|----------------------|---------------------------------|
| Temperature:         | 20 - 24 °C                      |
| Relative humidity:   | 20 - 50 %                       |
| Normal test voltage: | 4.5 V dc(3x1.5Vdc AA batteries) |

The values are the limit registered during the test period. All tests were performed with fully charged batteries.

## 1.3 Test Engineer(s)

G.Suhandhakumar

## 1.4 Description of modification for Modification Filing

Not applicable.

## 1.5 Family List Rational

Not Applicable.

## 1.6 Comments

And the output level is set to maximum in the software.

The radiated measurements are tested on three axis.

Two fully charged primary batteries are used.

All ports were populated during spurious emission measurements.

## 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 ANSI C63.10-2013.

Radiated tests were made in a semi-anechoic chamber at measuring distances of 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, RSS-GEN Issue 4 reference       | Result                |
|----------------------------------------|-------------------------------------|--------------------------------------------------|-----------------------|
| Supply Voltage Variations              | 15.31(e)                            | 6.11 (RSS-GEN)                                   | NA <sup>2</sup>       |
| Number of Operating Frequencies        | 15.31(m)                            | 5.1 (6) (RSS-247)                                | N/A                   |
| Antenna Requirement                    | 15.203                              | 8.3 (RSS-GEN)                                    | Complies <sup>1</sup> |
| Power Line Conducted Emission          | 15.107(a)<br>15.207(a)              | 8.8 (RSS-GEN)                                    | NA <sup>2</sup>       |
| Channel Separation                     | 15.247(a)(1)                        | 5.1 (4) (RSS-247)                                | N/A                   |
| Pseudorandom Hopping Algorithm         | 15.247(a)(1)                        | 5.1 (3) (RSS-247)                                | N/A                   |
| Time of Occupancy                      | 15.247(a)(1)(iii)                   | 5.1 (5) (RSS-247)                                | N/A                   |
| Occupied Bandwidth                     | 15.247(a)(1)                        | 5.1 (7) (RSS-247)                                | Complies              |
| Occupied Bandwidth                     | N/A                                 | 6.6 (RSS-GEN)                                    |                       |
| Minimum 6 dB Bandwidth                 | 15.247(a)(2)                        | 5.2 (1) (RSS-247)                                | Complies              |
| Peak Power Output                      | 15.247(b)                           | 5.4 (RSS-247)                                    | Complies              |
| Power Spectral Density                 | 15.247(d)                           | 5.2 (2) (RSS-247)                                | Complies              |
| Spurious Emissions (Antenna Conducted) | 15.247(c)                           | 5.5 (RSS-247)                                    | Complies <sup>1</sup> |
| Spurious Emissions (Radiated)          | 15.247(c)<br>15.109(a)<br>15.209(a) | 5.5 (RSS-247)<br>6.13 (RSS-GEN)<br>8.9 (RSS-GEN) | Complies              |

<sup>1</sup> The tested equipment has integrated antennas only

<sup>2</sup> EUT is battery powered

### 3 TEST RESULTS

#### 3.1 Occupied Bandwidth

Para. No.: RSS-Gen

Test Performed By: G.Suhanthakumar

Date of Test: 2016-07-02

Test Results: Complies

Measurement Data:

| OBW (MHz) |
|-----------|
| 2440MHz   |
| 1.04      |

Requirements:

For information only

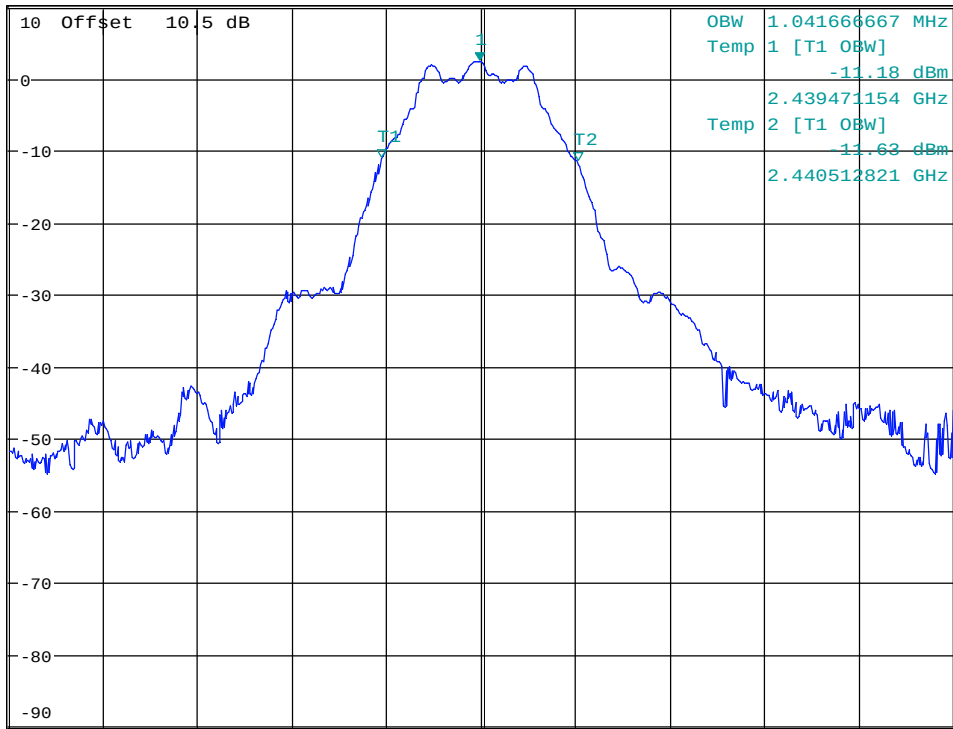


**MARKER 1**  
2.439991987 GHz  
Ref 10 dBm \* Att 10 dB

\* RBW 100 kHz  
VBW 300 kHz  
SWT 2.5 ms

Marker 1 [T1]  
2.40 dBm  
2.439991987 GHz

1 PK  
MAXH



Center 2.44 GHz 500 kHz/ Span 5 MHz

Date: 2.JUL.2016 12:43:22

### 3.3 Minimum 6 dB Bandwidth

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

Test Performed By: G.Suwanthakuar

Date of Test: 2016.07.02 &  
2017.02.08

Test Results: Complies

Measurement Data:

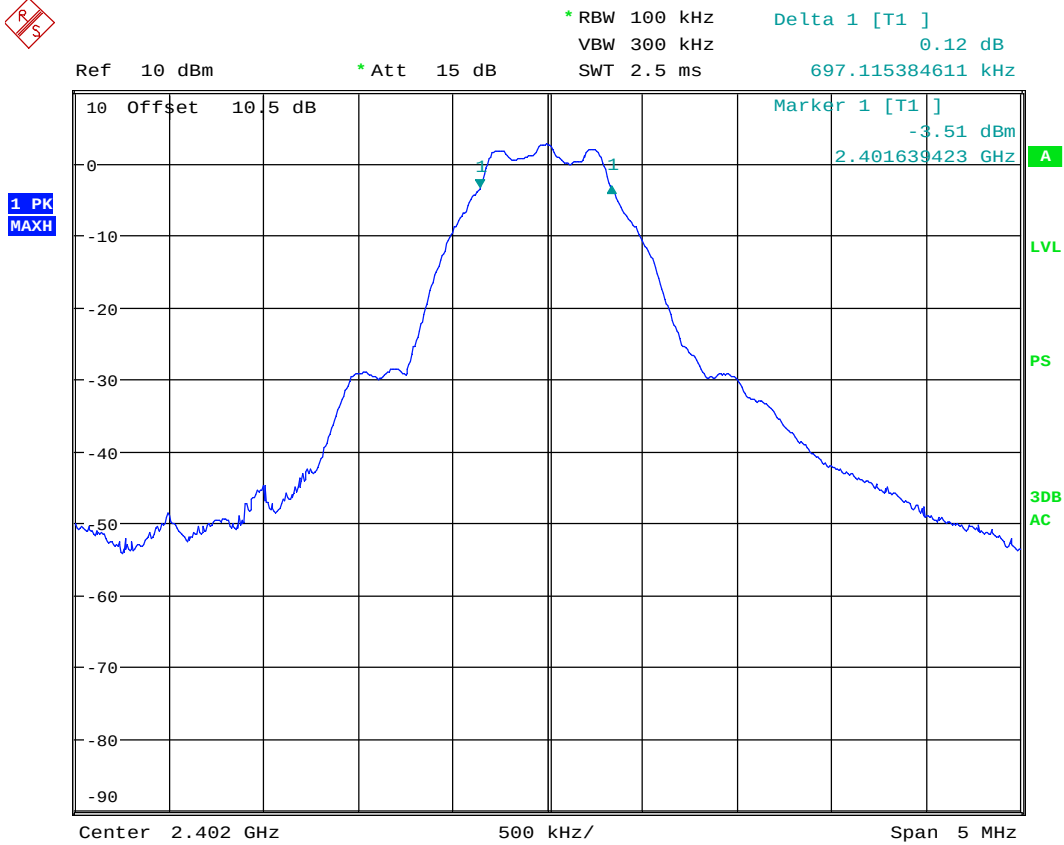
| Measured 6 dB Bandwidth (kHz) |                 |                 |
|-------------------------------|-----------------|-----------------|
| 2402 MHz, Ch 0                | 2440 MHz, Ch 19 | 2480 MHz, Ch 39 |
| 697.12                        | 681.1           | 657.1           |

Fully charged battery is used

**Requirements:**

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

No requirements for Frequency Hopping Systems.



Date: 8.FEB.2017 08:42:31

Ch2402MHz, 6 dB BW



Date: 2.JUL.2016 12:44:22

Ch2440MHz, 6 dB BW



Date: 2.JUL.2016 12:45:33

Ch2480MHz, 6 dB BW

### 3.4 Peak Power Output

Para. No.: 15.247 (b)

Test Performed By: G.Suwanthakuar

Date of Test: 2016.06.27 – 2016.07.02  
& 2017.02.08

Test Results: Complies

#### Measurement Data:

| RF channel                                   | 2402 MHz | 2440 MHz | 2480 MHz |
|----------------------------------------------|----------|----------|----------|
| Measured Maximum Field strength (dBμV/m) –VP | 88.21    | 88.04    | 87.36    |
| Calc. Radiated Power (dBm)                   | -7.02    | -7.19    | -7.87    |
| Calc. Radiated Power (mW)                    | 0.20     | 0.19     | 0.16     |
| Measured Conducted Power (dBm)               | 2.84     | 2.65     | 2.60     |
| Measured Conducted Power (mW)                | 1.92     | 1.84     | 1.82     |
| Calculated Antenna Gain (dBi)                | -9.90    | -9.86    | -10.5    |

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

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

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

#### See attached graph.

Detachable antenna?

☐ Yes

☒ No

If detachable, is the antenna connector non-standard?

☐ Yes

☐ No

Type of antenna connector: N/A

#### Requirements:

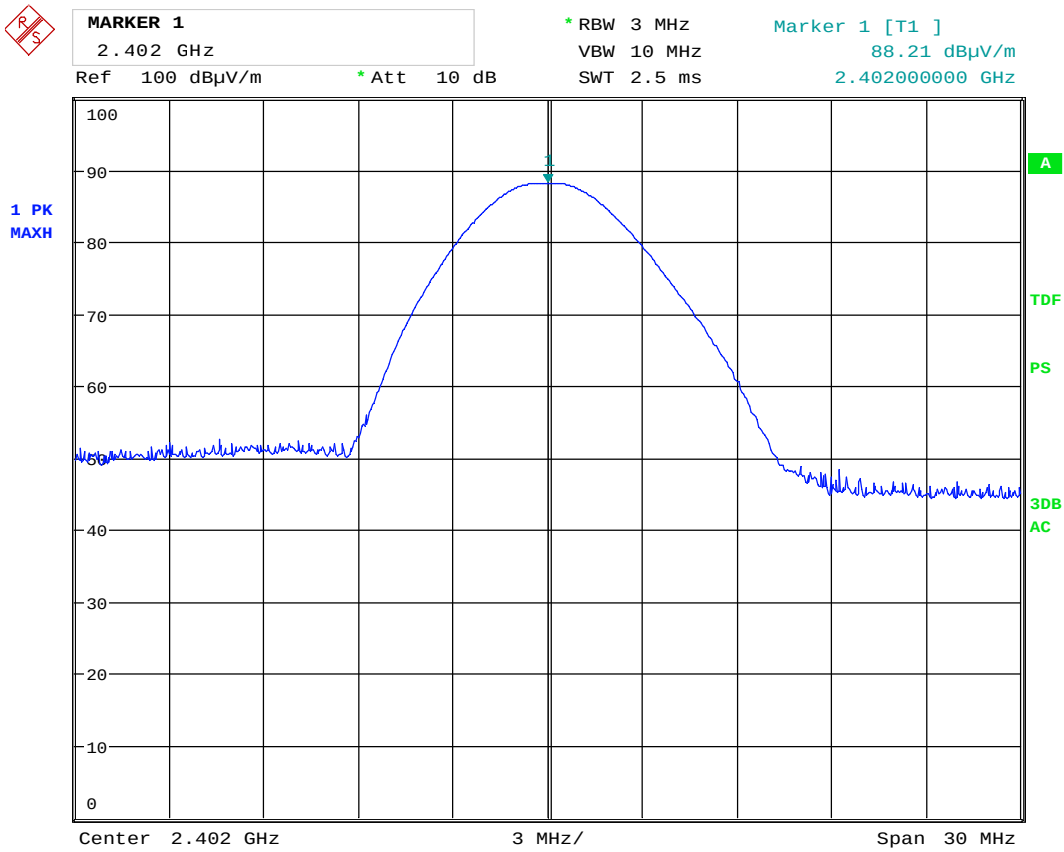
The maximum peak output power shall not exceed the following limits:

For frequency hopping systems employing at least 75 hopping channels: 1 Watt

For all other frequency hopping systems in the 2400 - 2483.5 MHz band: 0.125 Watts

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: 8.FEB.2017 07:48:28

**Radiated Field strength, VP , 2402 MHz**



MARKER 1

2.401951923 GHz

Ref 100 dBμV/m

\* Att 10 dB

\* RBW 3 MHz

VBW 10 MHz

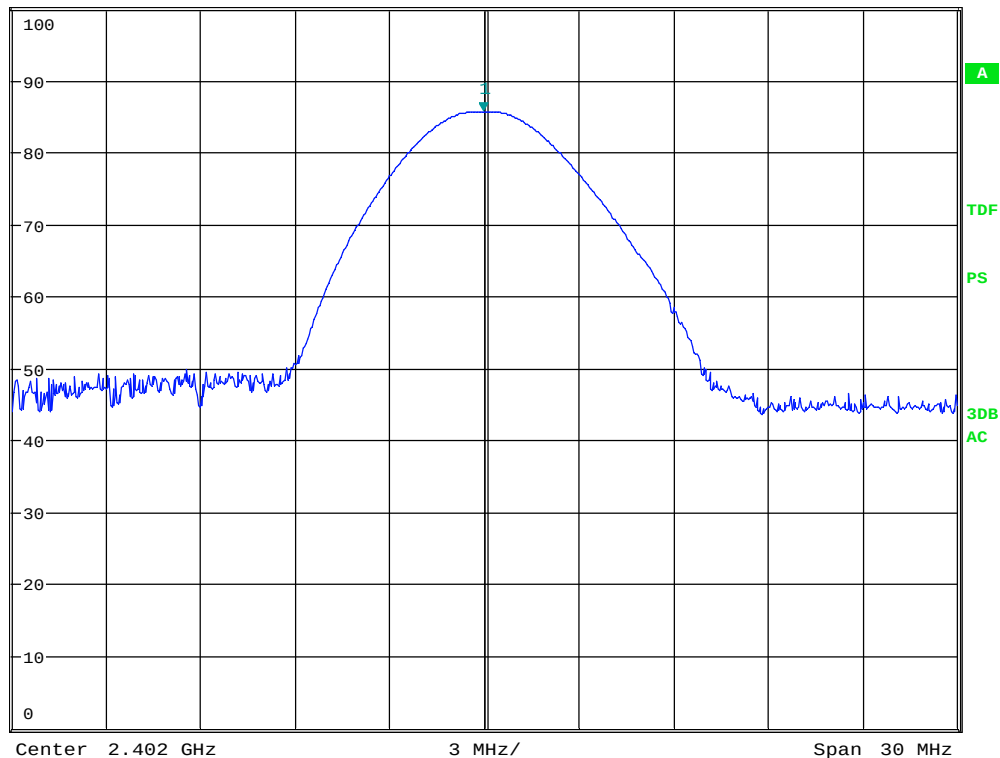
SWT 2.5 ms

Marker 1 [T1]

85.68 dBμV/m

2.401951923 GHz

1 PK  
MAXH



Date: 8.FEB.2017 07:51:21

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



MARKER 1

2.439903846 GHz

\* RBW 3 MHz

VBW 10 MHz

\* SWT 200 ms

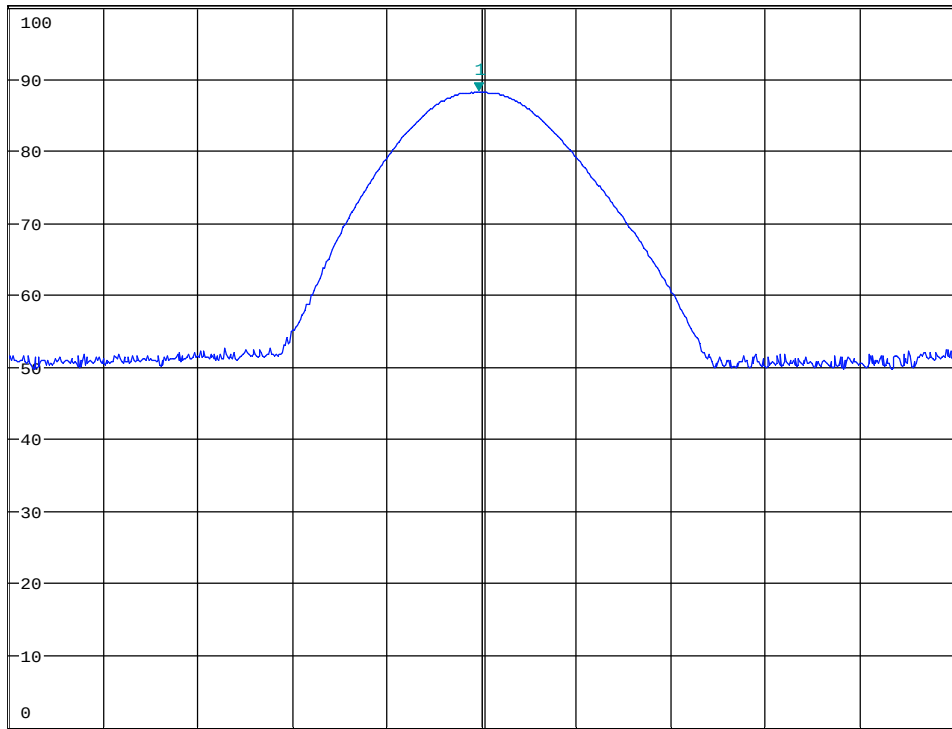
Marker 1 [T1]

88.04 dBμV/m

2.439903846 GHz

Ref 100 dBμV/m \* Att 10 dB

1 PK  
MAXH



Center 2.44 GHz 3 MHz/ Span 30 MHz

Date: 27.JUN.2016 14:14:32

Radiated field strength, VP, 2440 MHz



MARKER 1

2.440048077 GHz

\* RBW 3 MHz

VBW 10 MHz

\* SWT 200 ms

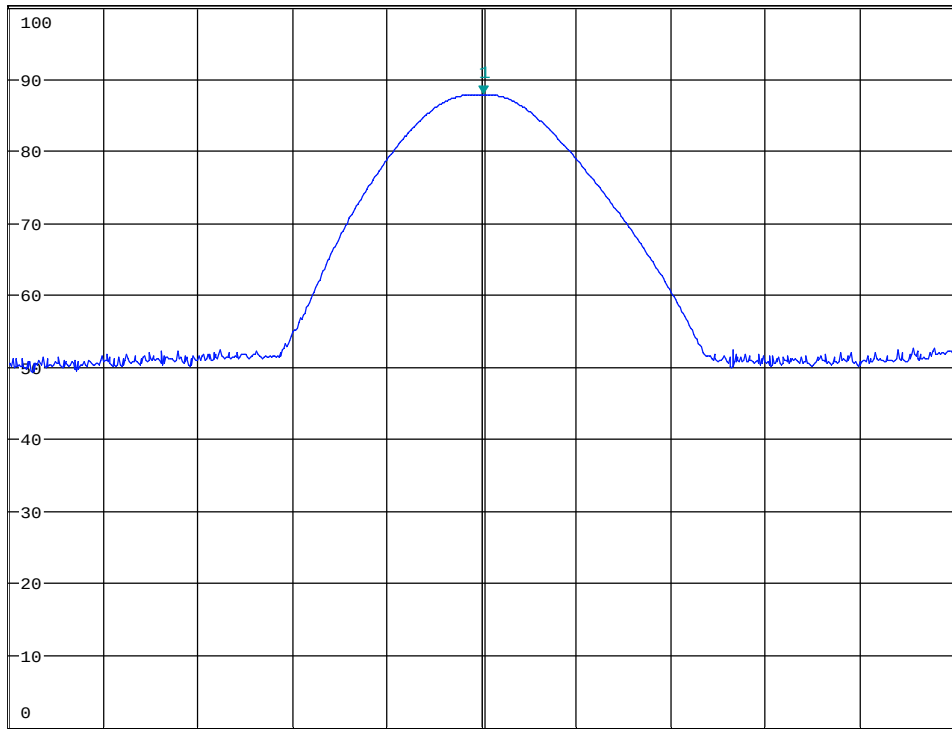
Marker 1 [T1]

87.78 dBμV/m

2.440048077 GHz

Ref 100 dBμV/m \* Att 10 dB

1 PK  
MAXH



Center 2.44 GHz 3 MHz/ Span 30 MHz

Date: 27.JUN.2016 14:13:50

Radiated field strength, HP, 2440 MHz



**MARKER 1**

2.479711538 GHz

Ref 100 dBμV/m

\* Att 10 dB

\* RBW 3 MHz

VBW 10 MHz

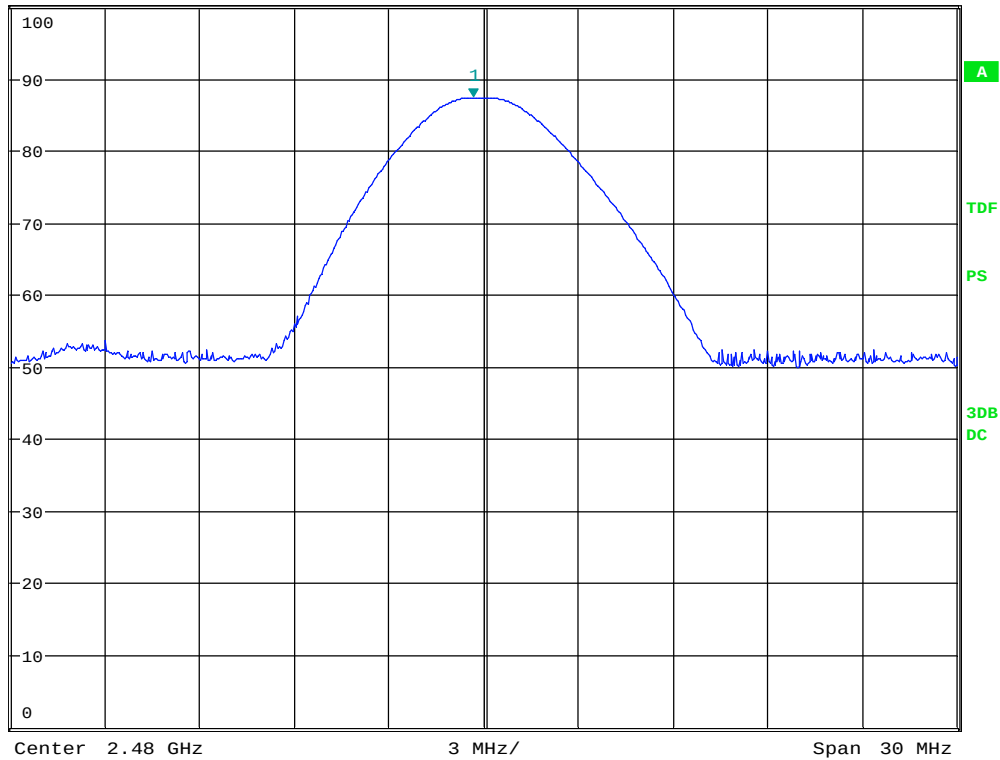
\* SWT 200 ms

Marker 1 [T1]

87.36 dBμV/m

2.479663462 GHz

1 PK  
MAXH



Date: 27.JUN.2016 14:06:57

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



**MARKER 1**

2.479711538 GHz

Ref 100 dBμV/m

\* Att 10 dB

\* RBW 3 MHz

VBW 10 MHz

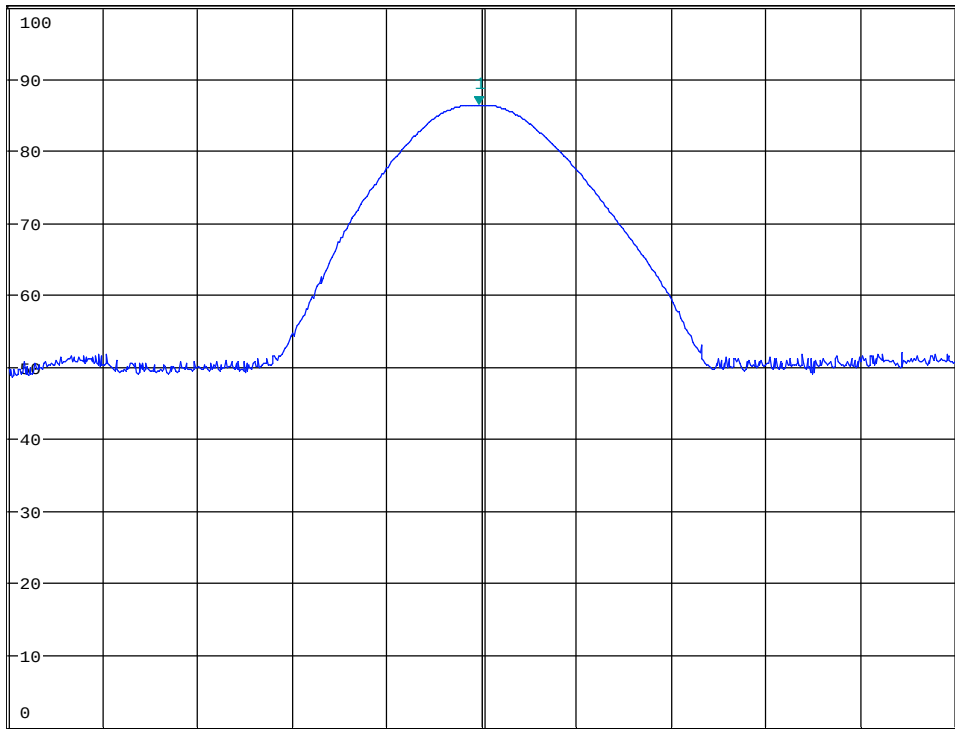
\* SWT 200 ms

Marker 1 [T1]

86.29 dBμV/m

2.479903846 GHz

1 PK  
MAXH



Center 2.48 GHz

3 MHz/

Span 30 MHz

A

TDF

PS

3DB  
DC

Date: 27.JUN.2016 14:06:02

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



MARKER 1

2.401855769 GHz

Ref 10 dBm

\* Att 15 dB

\* RBW 3 MHz

VBW 10 MHz

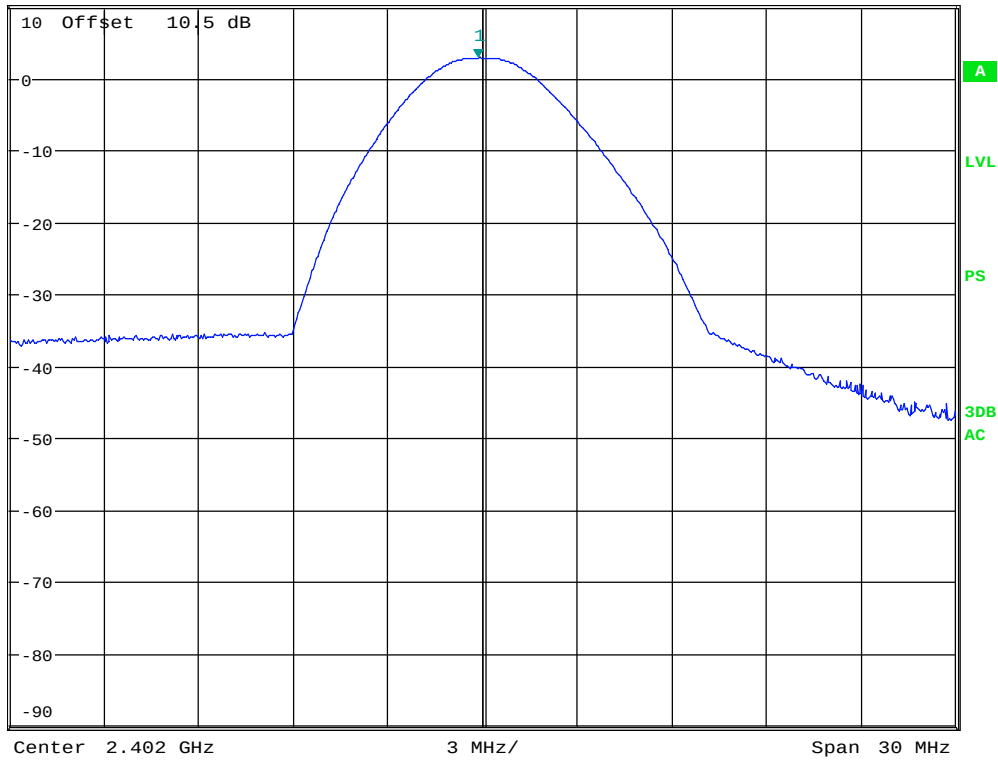
SWT 2.5 ms

Marker 1 [T1]

2.84 dBm

2.401855769 GHz

1 PK  
MAXH



Date: 8.FEB.2017 08:36:27

Conducted power – 2402MHz



MARKER 1

2.439903846 GHz

\* RBW 3 MHz

VBW 10 MHz

SWT 2.5 ms

Marker 1 [T1]

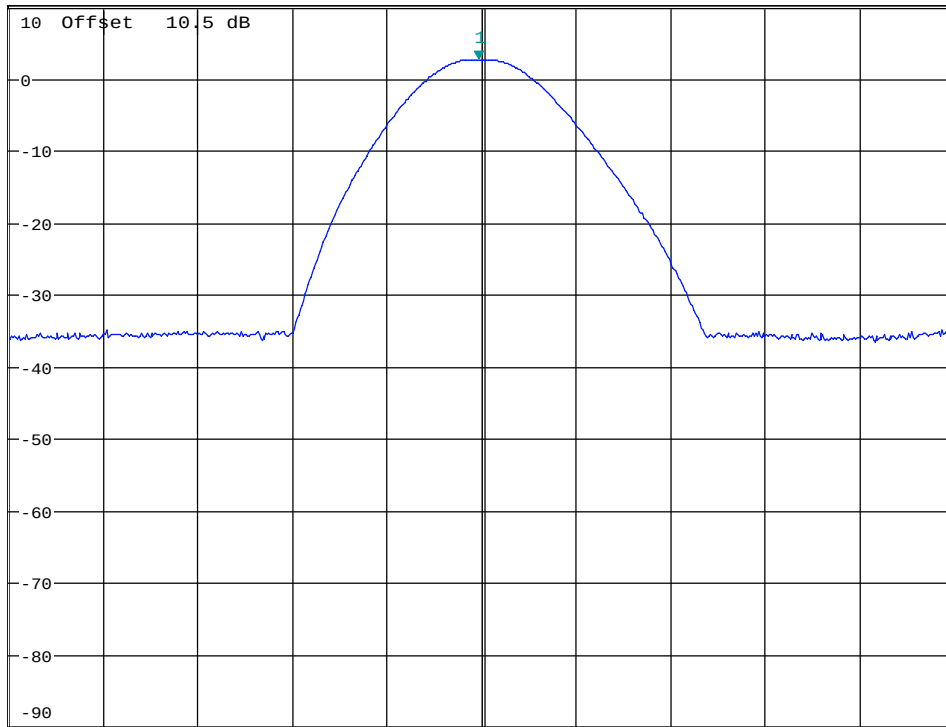
2.65 dBm

2.439903846 GHz

Ref 10 dBm

\* Att 10 dB

1 PK  
MAXH



Center 2.44 GHz

3 MHz/

Span 30 MHz

Date: 2.JUL.2016 12:42:55

Conducted power – 2440MHz



MARKER 1

2.479951923 GHz

\* RBW 3 MHz

VBW 10 MHz

SWT 2.5 ms

Marker 1 [T1]

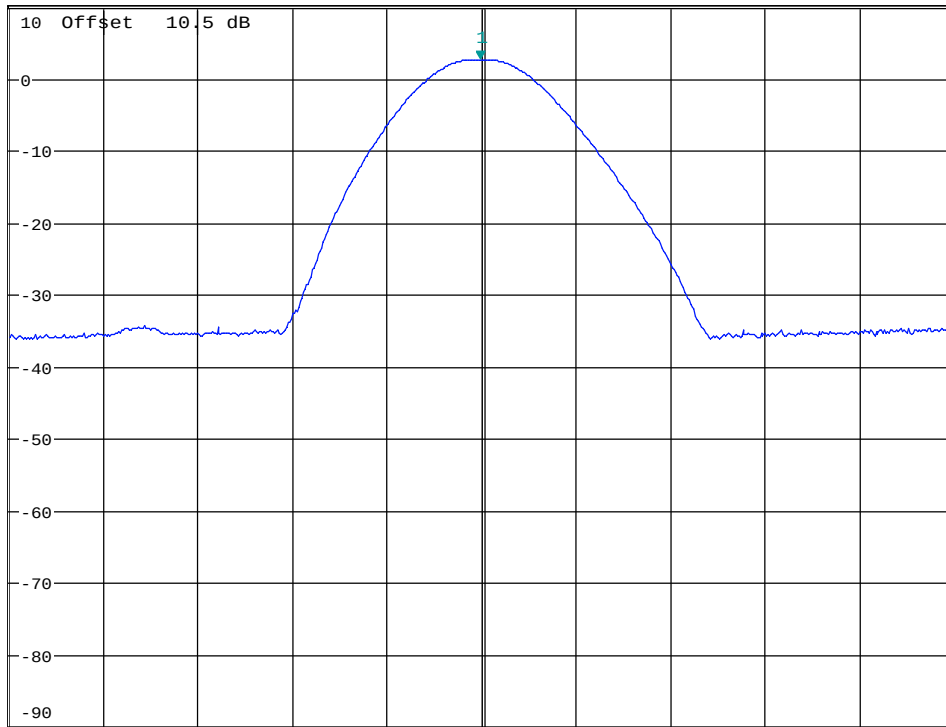
2.60 dBm

2.479951923 GHz

Ref 10 dBm

\* Att 10 dB

1 PK  
MAXH



Center 2.48 GHz

3 MHz/

Span 30 MHz

Date: 2.JUL.2016 12:46:28

Conducted power – 2480MHz

### 3.5 Spurious Emissions (Radiated)

Para. No.: 15.247 (c)

Test Performed By: G.Suwanthakuar

Date of Test: 2016.06.27 – 2016.07.14  
and 2017.02.08

Test Results: Complies

#### Band-edge, @3m

| Frequency  | Measured Field Strength<br>@3m, dBμV/m | Detector | Limit<br>dBμV/m | Margin<br>dB |
|------------|----------------------------------------|----------|-----------------|--------------|
| 2.377 GHz  | 50.1                                   | PK       | 74              | 23.9         |
|            | 30.1                                   | AV       | 54              | 23.9         |
| 2.4835 GHz | 50.8                                   | PK       | 74              | 23.2         |
|            | 30.8                                   | AV       | 54              | 23.2         |

Average values are measured with Peak Detector and corrected for Duty Cycle.  
See attached plots.

#### Duty Cycle Correction Factor Calculation:

Duty Cycle = On Time / (Period \* Number of Channels) = 213 μs / (628 μs \* 39) = 0.0087

Duty Cycle Correction factor = -20 x log (Duty Cycle) = 41.2 dB

Maximum allowed Duty Cycle Correction: 20 dB

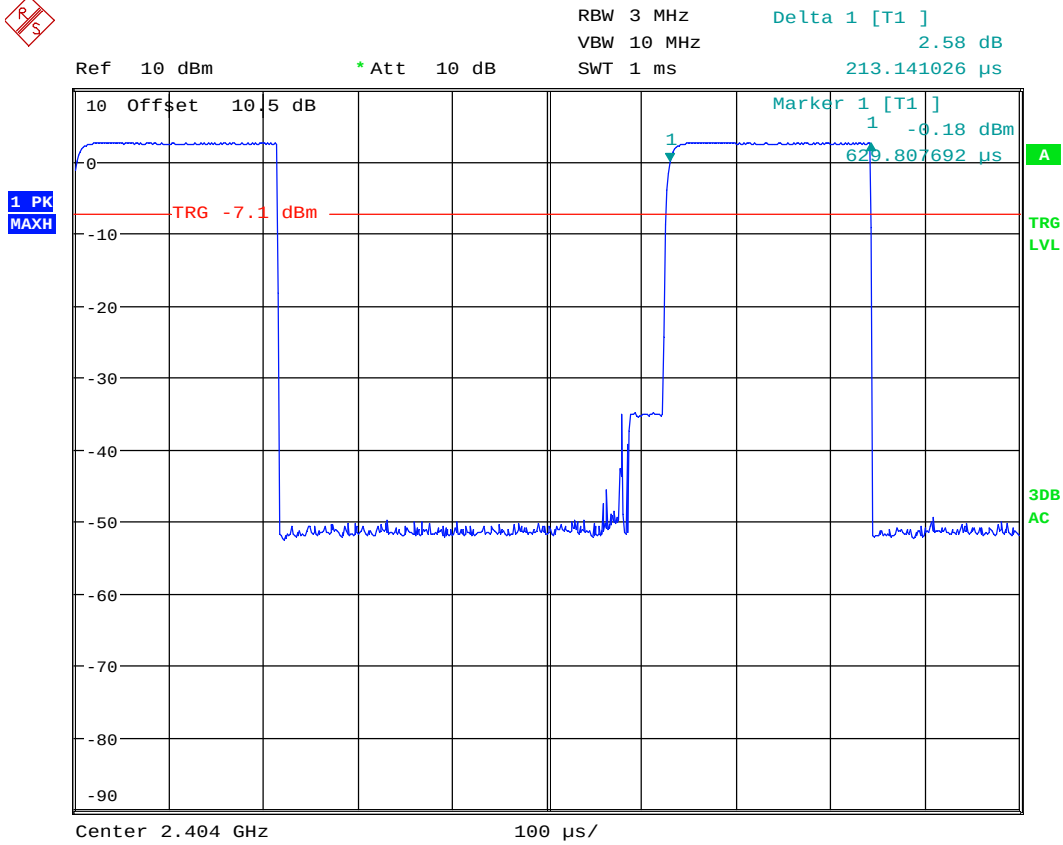
**RF conducted power** to 25 GHz see attached graph.

Maximum RF level outside operating band:

RF ch 01: 56 dB/C, margin >30 dB

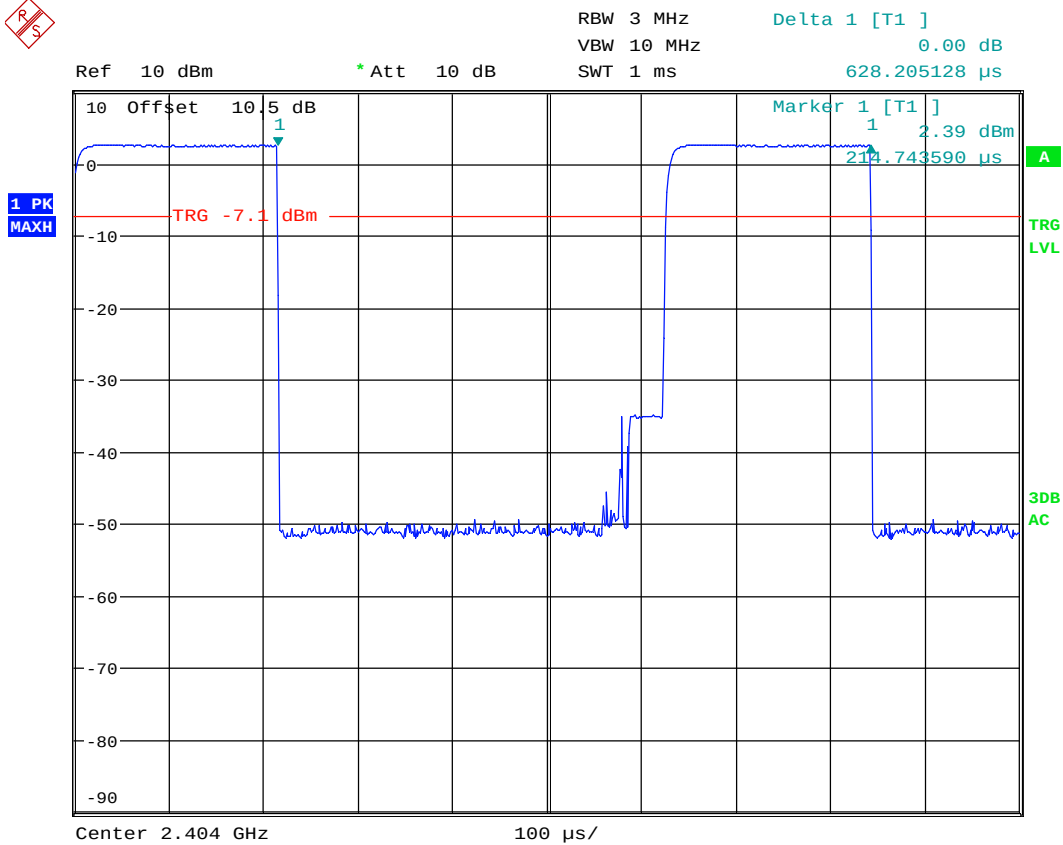
RF ch 19: 53 dB/C, margin >30 dB

RF ch 39: 55 dB/C, margin >30 dB



Date: 2.JUL.2016 12:50:30

ON time



Date: 2.JUL.2016 12:50:57

ON plus OFF time



# MARKER 1

2.39 GHz

Ref 100 dBμV/m

\* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

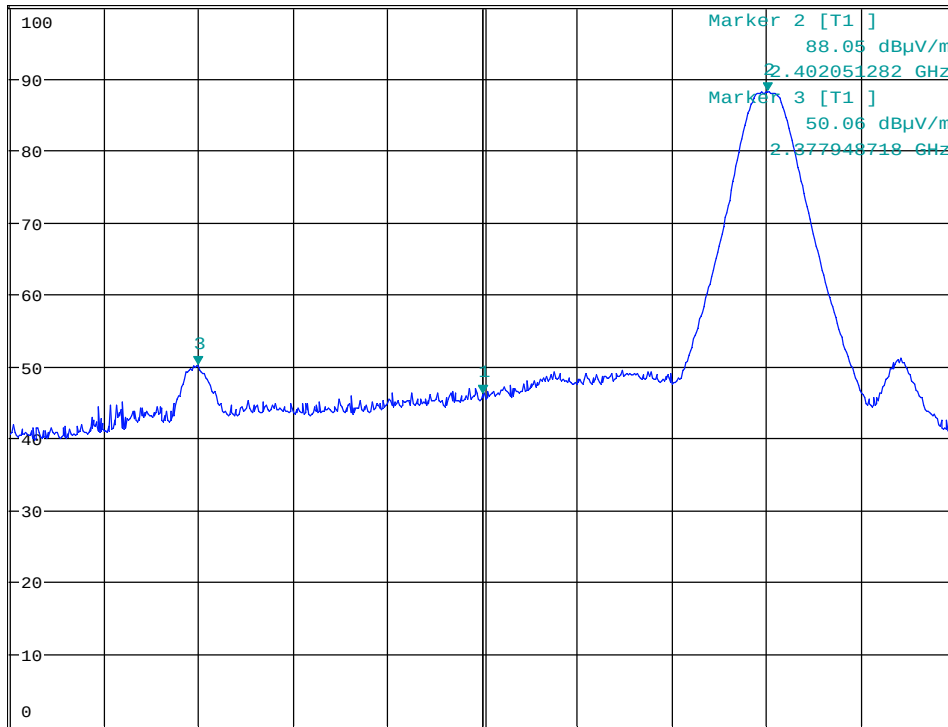
SWT 2.5 ms

Marker 1 [T1]

46.20 dBμV/m

2.390000000 GHz

1 PK  
MAXH



Center 2.39 GHz

4 MHz/

Span 40 MHz

Date: 8.FEB.2017 07:56:15

## Band Edge, 2390 MHz, Peak Detector



# MARKER 2

2.479717949 GHz

Ref 100 dBμV/m

\* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

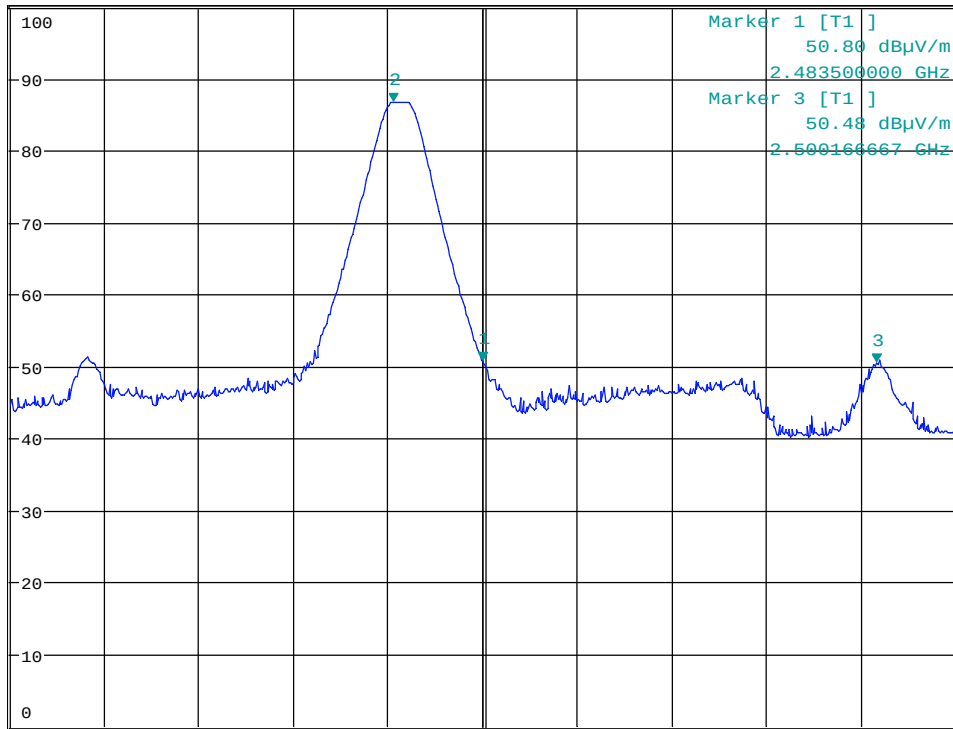
SWT 2.5 ms

Marker 2 [T1]

86.73 dBμV/m

2.479717949 GHz

1 PK  
MAXH



Center 2.4835 GHz

4 MHz/

Span 40 MHz

A

TDF

PS

3DB

AC

Date: 13.JUL.2016 21:26:05

## Band Edge, 2483.5 MHz, Peak Detector



**MARKER 2**

9.589647436 GHz

Ref 10 dBm

\* Att 15 dB

\* RBW 100 kHz

VBW 300 kHz

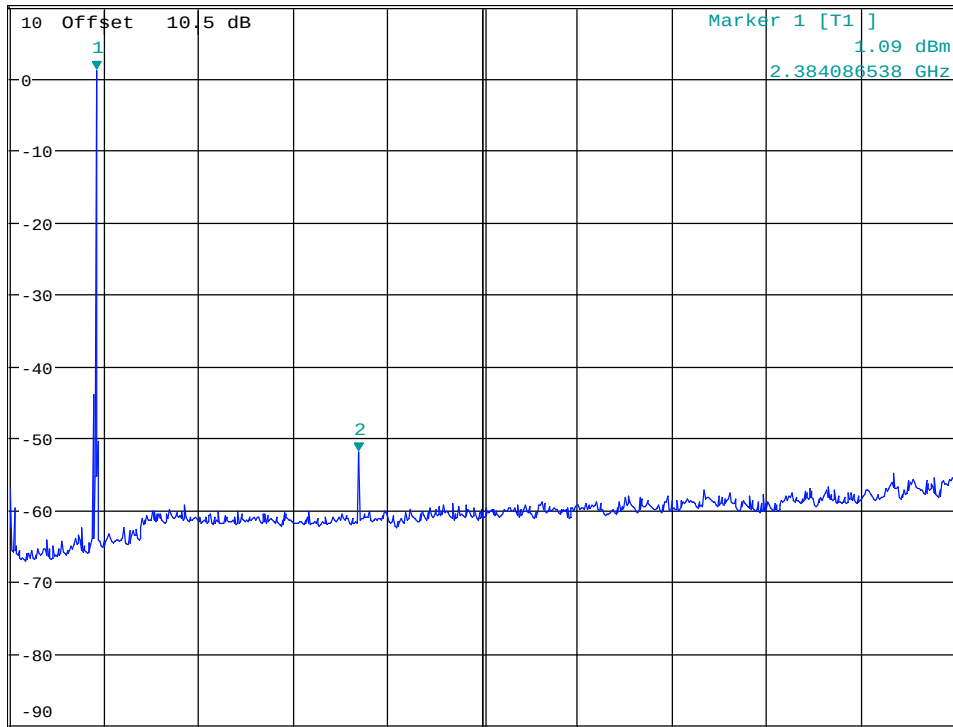
SWT 2.6 s

Marker 2 [T1]

-51.81 dBm

9.589647436 GHz

1 PK  
MAXH



A

LVL

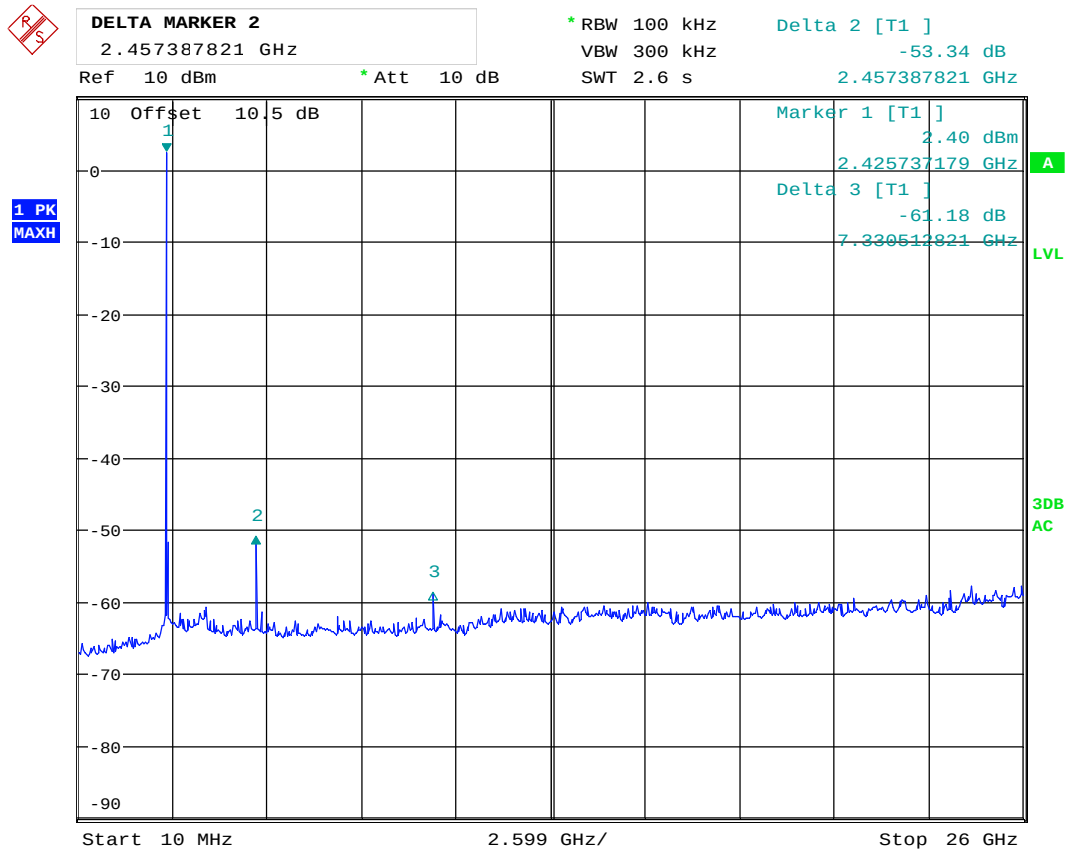
PS

3DB

AC

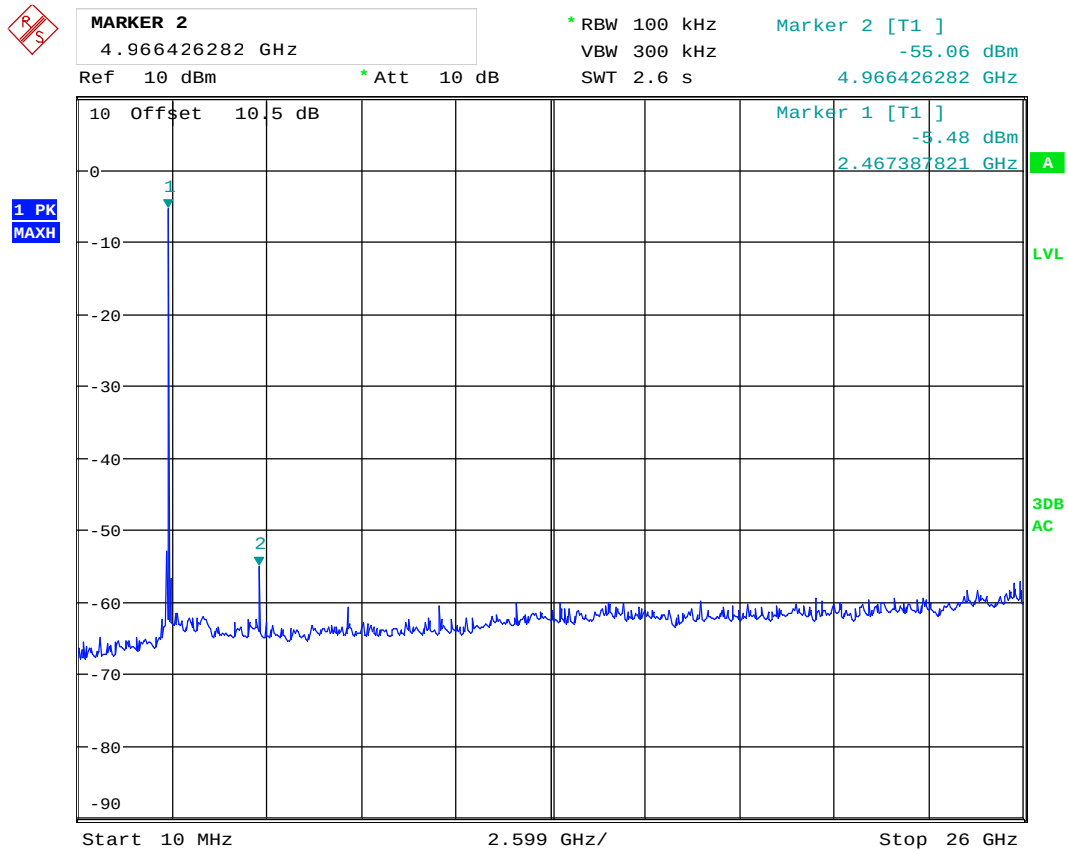
Date: 8.FEB.2017 08:40:35

Conductd spurious emission 10MHz – 25GHz - ch2402MHz



Date: 2.JUL.2016 12:42:08

Conductd spurious emission 10MHz – 25GHz - ch2440MHz



Date: 2.JUL.2016 12:47:12

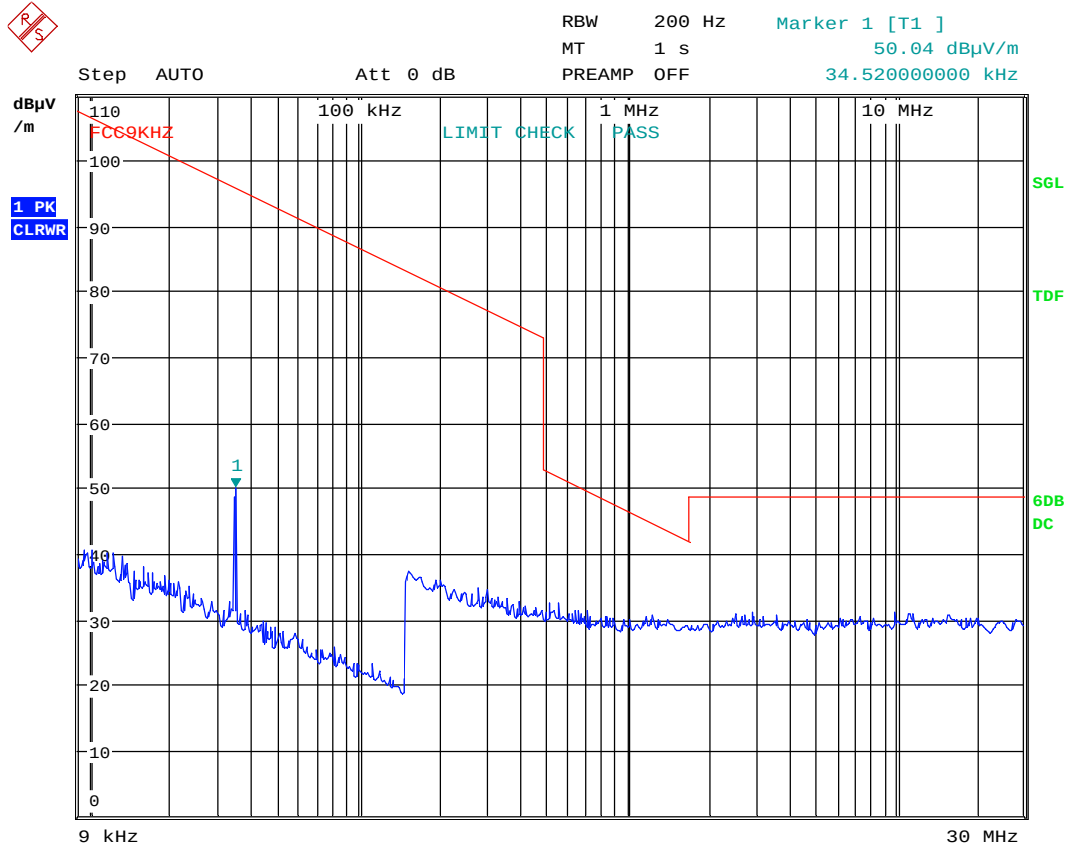
Conducted spurious emission 10MHz – 25GHz - ch2480MHz

### 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: 13.JUL.2016 21:50:28

### Radiated Emissions, 9 kHz – 30 MHz @10m

**Radiated emission 30 – 1000 MHz.**

Detector: Quasi-Peak

Measuring distance 3 .

| Frequency | Operational condition | Detector | Field strength | Measuring distance | Limit<br>FCC15.209 | Margin |
|-----------|-----------------------|----------|----------------|--------------------|--------------------|--------|
| MHz       |                       |          | dB $\mu$ V/m   | metres             | dB $\mu$ V/m       | dB     |
| /         | TX on                 | PK       | /              | 3                  | 40.0               | /      |

See attached graphs.



MARKER 1

198.6378205 MHz

\* RBW 100 kHz

VBW 300 kHz

SWT 20 ms

Marker 1 [T1]

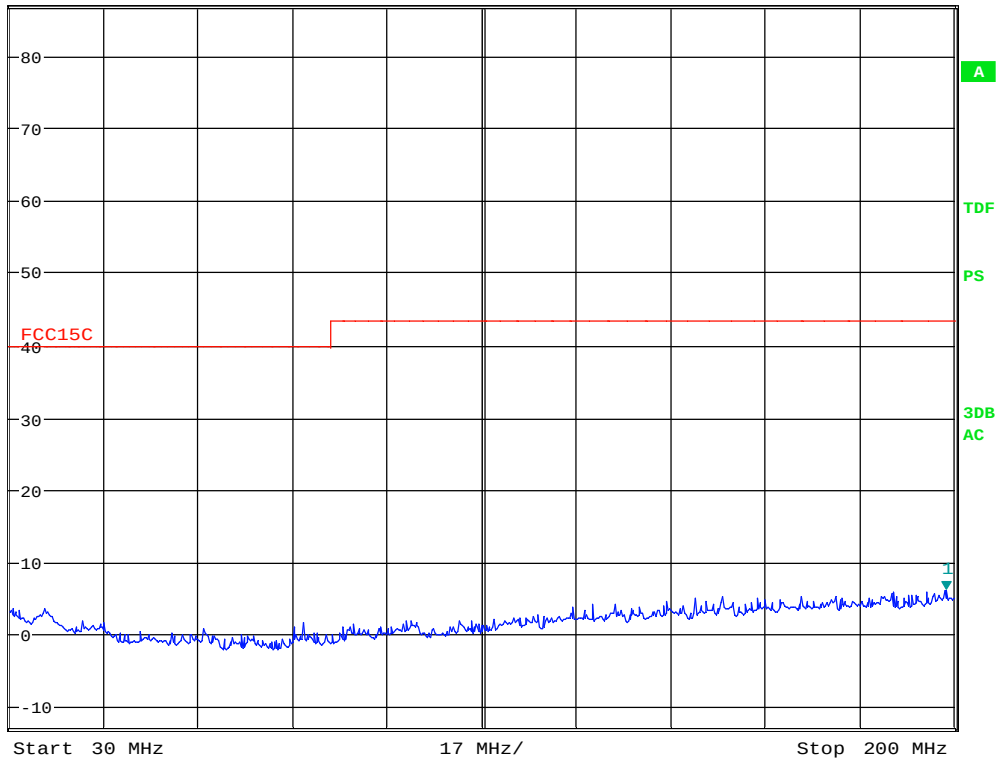
5.98 dBμV/m

198.637820513 MHz

Ref 87 dBμV/m

\* Att 10 dB

1 PK  
MAXH



Date: 27.JUN.2016 17:11:26

**Radiated Emissions, 30 – 200 MHz, VP, @3m, PK scan**



MARKER 1

197.5480769 MHz

\* RBW 100 kHz

VBW 300 kHz

SWT 20 ms

Marker 1 [T1]

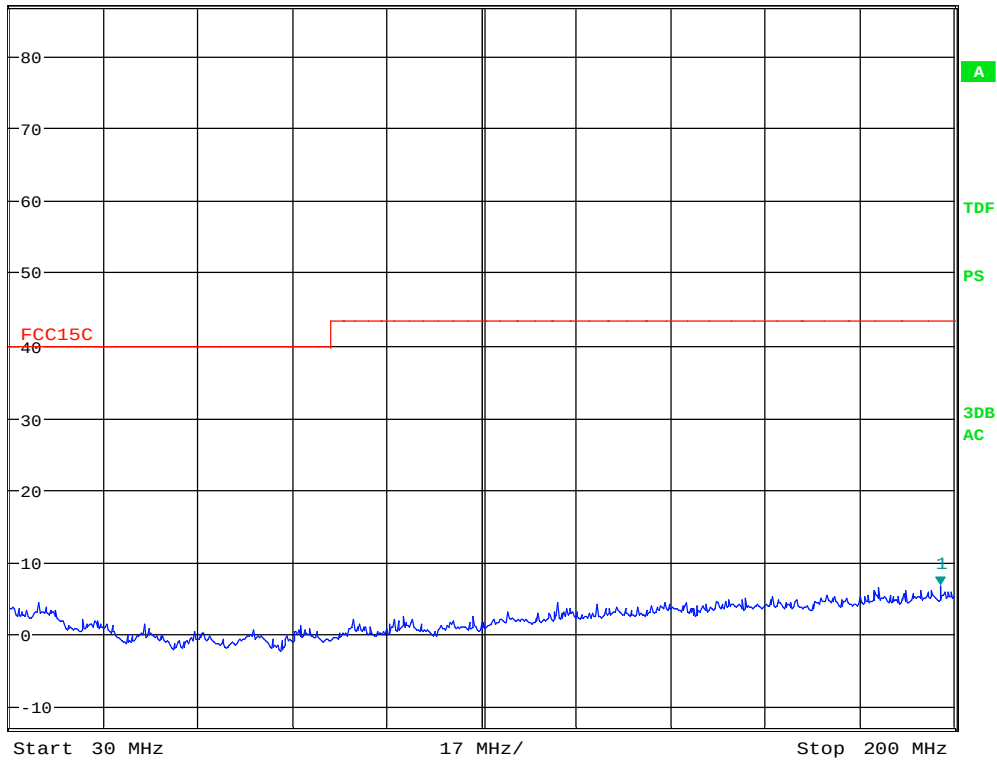
6.56 dBμV/m

197.548076923 MHz

Ref 87 dBμV/m

\* Att 10 dB

1 PK  
MAXH



Date: 27.JUN.2016 17:18:25

Radiated Emissions, 30 – 200 MHz, HP, @3m, PK scan



MARKER 1

997.4358974 MHz

Ref 87 dBμV/m

\* Att 10 dB

\* RBW 100 kHz

VBW 300 kHz

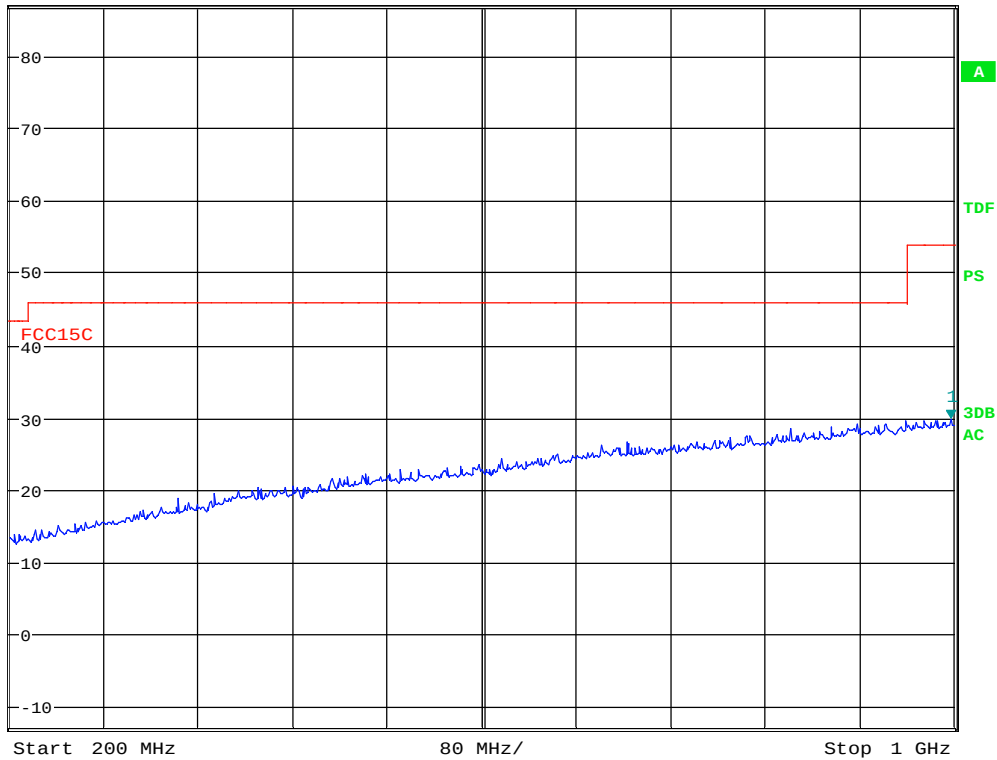
SWT 80 ms

Marker 1 [T1]

29.76 dBμV/m

997.435897436 MHz

1 PK  
MAXH



Date: 27.JUN.2016 17:05:33

**Radiated Emissions, 200 - 1000 MHz, VP , @3m, PK scan**



MARKER 1

991.025641 MHz

Ref 87 dBμV/m

\* Att 10 dB

\* RBW 100 kHz

VBW 300 kHz

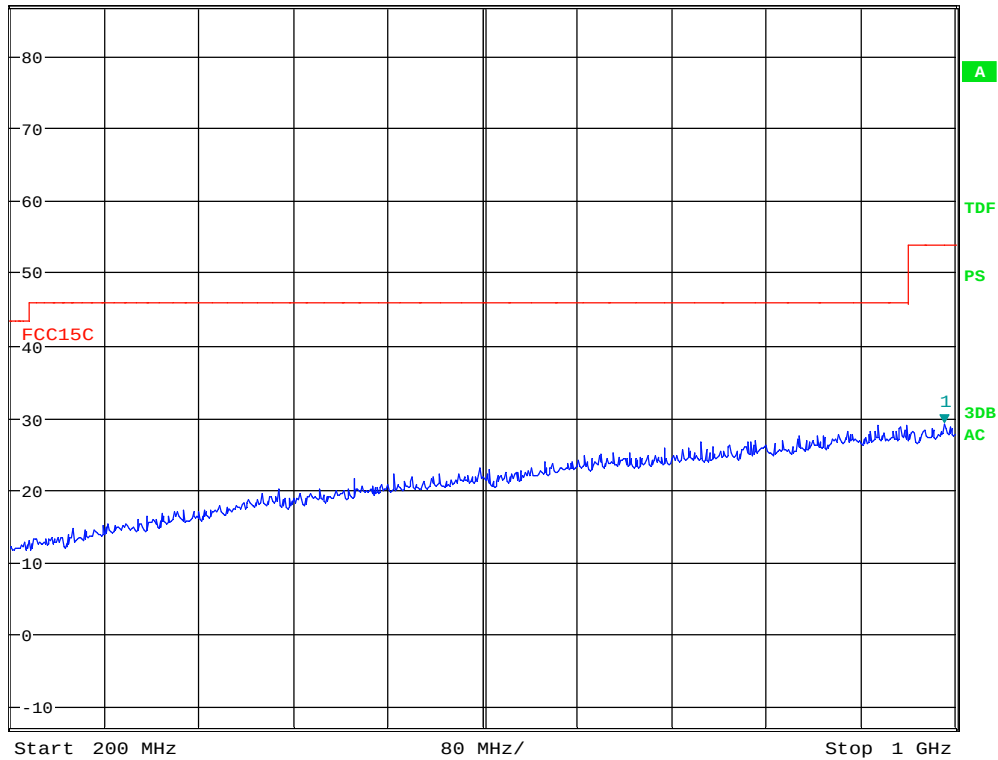
SWT 80 ms

Marker 1 [T1]

29.03 dBμV/m

991.025641026 MHz

1 PK  
MAXH



Date: 27.JUN.2016 17:06:56

**Radiated Emissions, 200 - 1000MHz, HP , @3m, PK scan**

### 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.

#### Peak Detector:

| Frequency   | RF channel | Dist. corr. factor | Field strength, Peak Detector | Duty cycle corr. factor | Limit        | Margin |
|-------------|------------|--------------------|-------------------------------|-------------------------|--------------|--------|
| GHz         | L,M,H      | dB                 | dB $\mu$ V/m                  | dB                      | dB $\mu$ V/m | dB     |
| 4.81        | L          | 0                  | /                             | 0                       | 74           | >20    |
| 4.88        | M          | 0                  | 49.3                          | 0                       | 74           | >20    |
| 4.96        | H          | 0                  | 48.6                          | 0                       | 74           | >20    |
| 7.215       | L          | *                  | /                             | 0                       | 74           | >20    |
| 7.320       | M          | *                  | /                             | 0                       | 74           | >20    |
| 7.440       | H          | *                  | 54.89                         | 0                       | 74           | 19.11  |
| Other freqs | L,M,H      | /                  | < 54                          | 0                       | 74           | >20    |

#### Average Detector:

| Frequency   | RF channel | Dist. corr. factor | Field strength, Average Detector | Duty cycle corr. factor | Limit        | Margin |
|-------------|------------|--------------------|----------------------------------|-------------------------|--------------|--------|
| GHz         | L,M,H      | dB                 | dB $\mu$ V/m                     | dB                      | dB $\mu$ V/m | dB     |
| 4.81        | L          | 0                  | /                                | 0                       | 54           | >20    |
| 4.88        | M          | 0                  | 29.3                             | 0                       | 54           | >20    |
| 4.96        | H          | 0                  | 28.6                             | 0                       | 54           | >20    |
| 7.215       | L          | *                  | /                                | 0                       | 54           | >20    |
| 7.320       | M          | *                  | /                                | 0                       | 54           | >20    |
| 7.440       | H          | *                  | 34.89                            | 4.7                     | 54           | 19.1   |
| Other freqs | L,M,H      | /                  | < 54                             | 0                       | 54           | >20    |

\*Average detector values are calculated from Peak values

Tested according to KDB 558074 D01 DTS Meas Guidance v03r04, Section 12.2.5.2

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

See plots.



**MARKER 1**

12.40100962 GHz

Ref 77.5 dBμV/m \* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

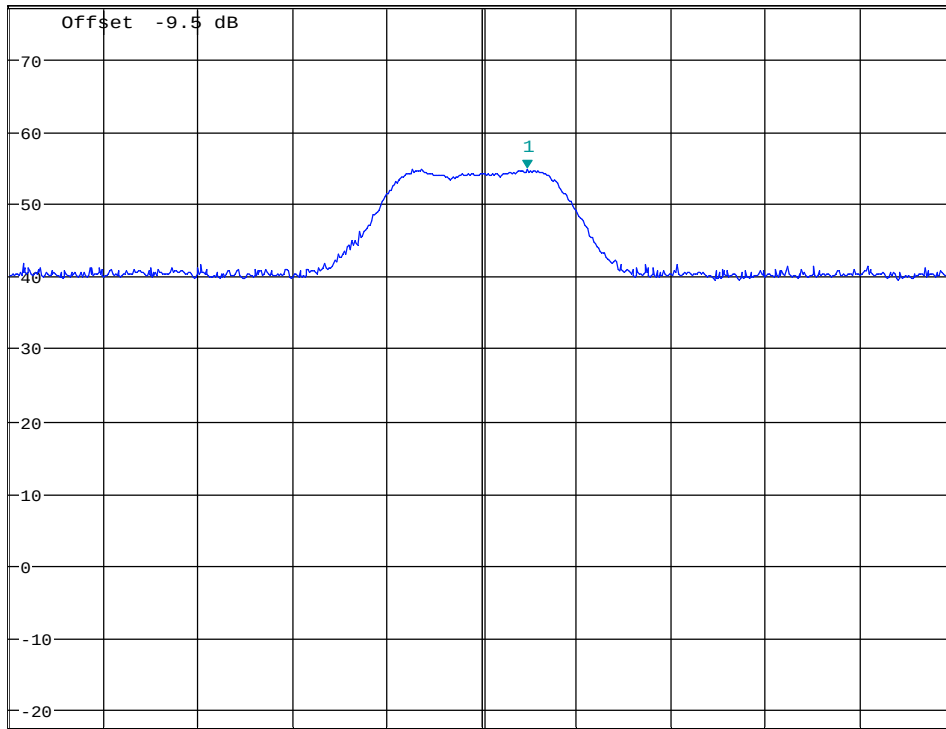
\* SWT 200 ms

Marker 1 [T1]

54.89 dBμV/m

12.401009615 GHz

1 PK  
MAXH



Date: 2.JUL.2016 11:56:41

5<sup>th</sup> Harm, 2480MHz , HP @3m , PK detector



MARKER 2

2.323717949 GHz

Ref 100 dBμV/m

\* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

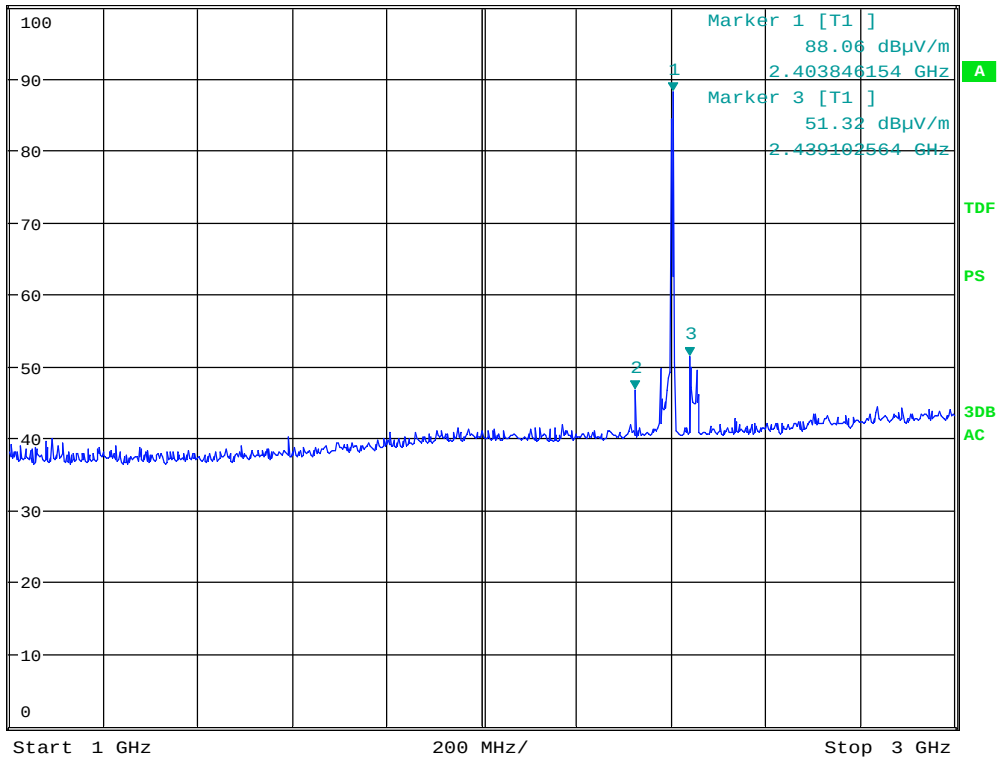
SWT 5 ms

Marker 2 [T1]

46.78 dBμV/m

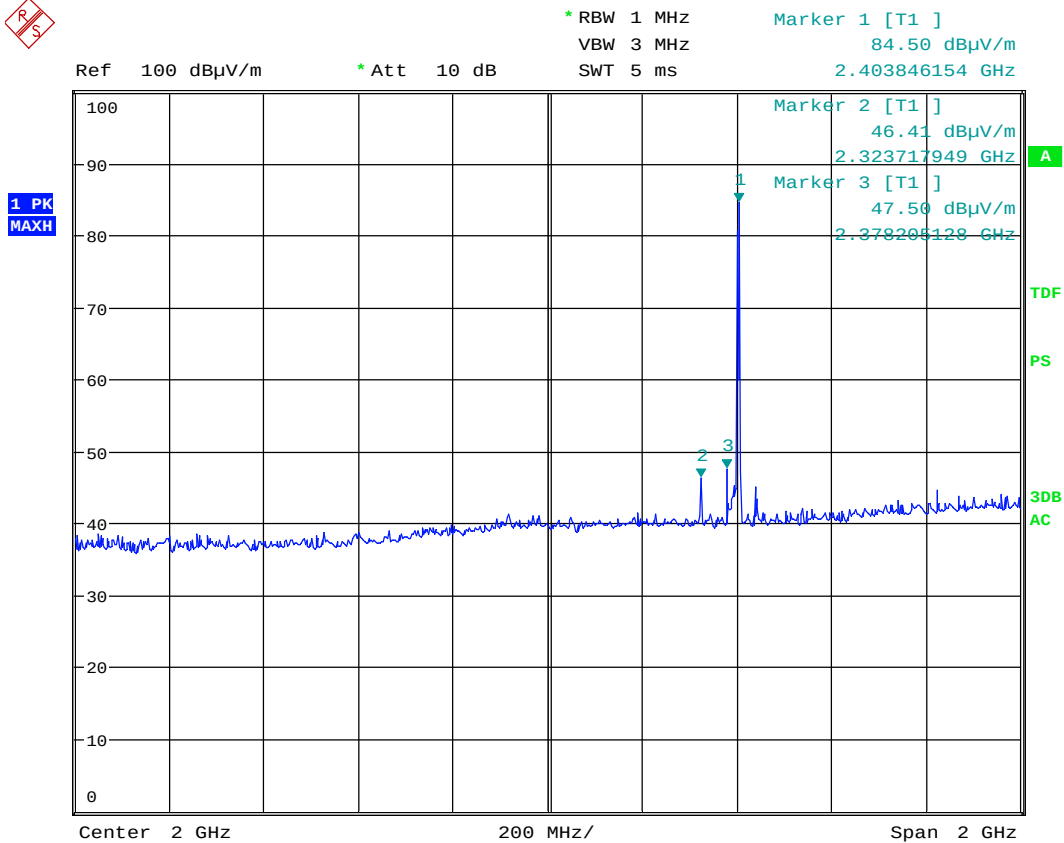
2.323717949 GHz

1 PK  
MAXH



Date: 8.FEB.2017 07:57:44

Radiated Emissions, 2402MHz, 1 – 3 GHz, VP, @3m – Pre-scan



Date: 8.FEB.2017 08:01:52

**Radiated Emissions, 2402 MHz, 1 – 3 GHz, HP, @3m – Pre-scan**



**MARKER 3**

2.503205128 GHz

Ref 100 dBμV/m

\* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

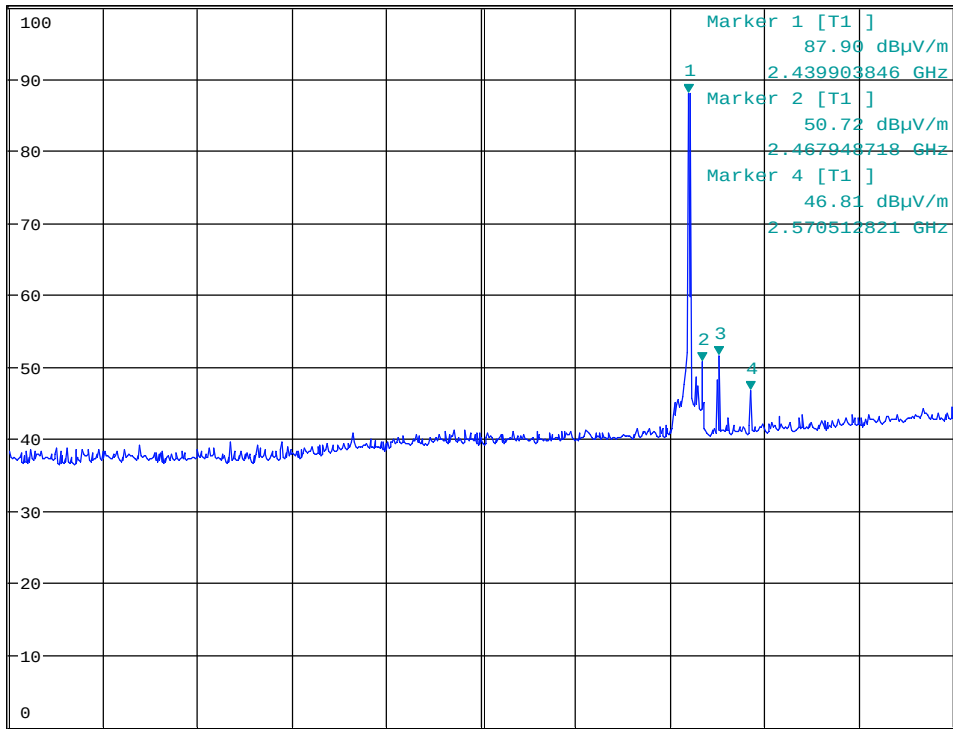
\* SWT 200 ms

Marker 3 [T1]

51.67 dBμV/m

2.503205128 GHz

1 PK  
MAXH



Start 1 GHz

200 MHz/

Stop 3 GHz

Date: 27.JUN.2016 14:15:45

**Radiated Emissions ch. 2440 MHz, 1 – 3 GHz, VP, @3m – Pre-scan**



# MARKER 2

2.467948718 GHz

Ref 100 dBμV/m

\* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

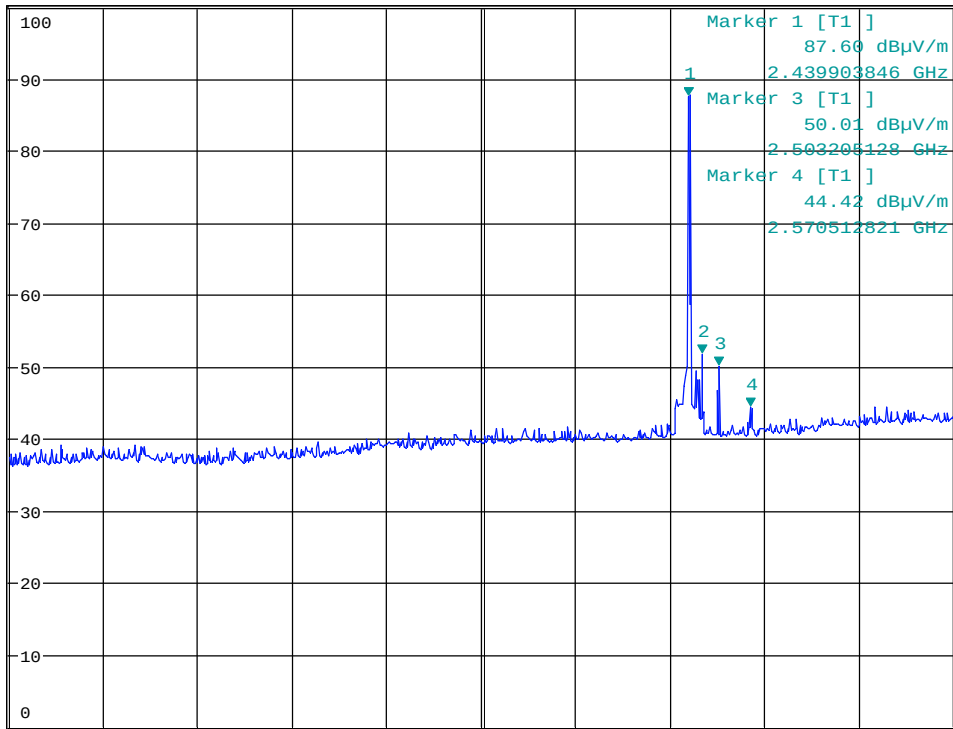
\* SWT 200 ms

Marker 2 [T1]

51.76 dBμV/m

2.467948718 GHz

1 PK  
MAXH



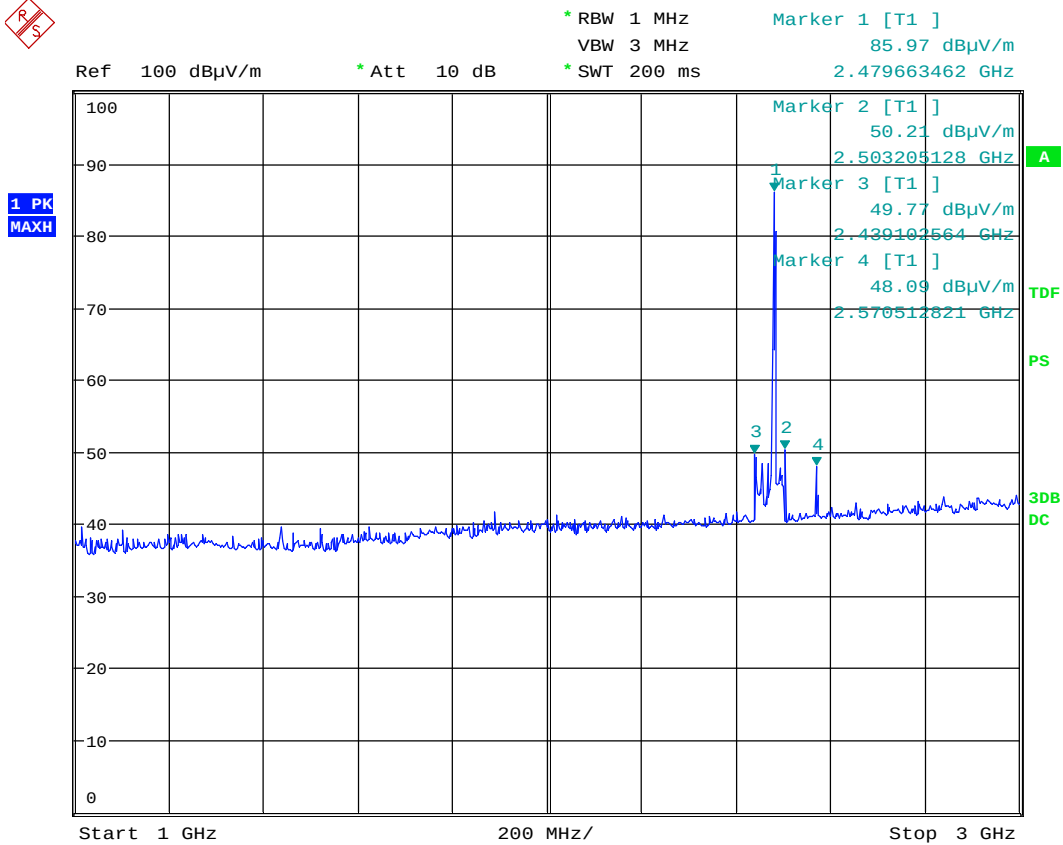
Start 1 GHz

200 MHz/

Stop 3 GHz

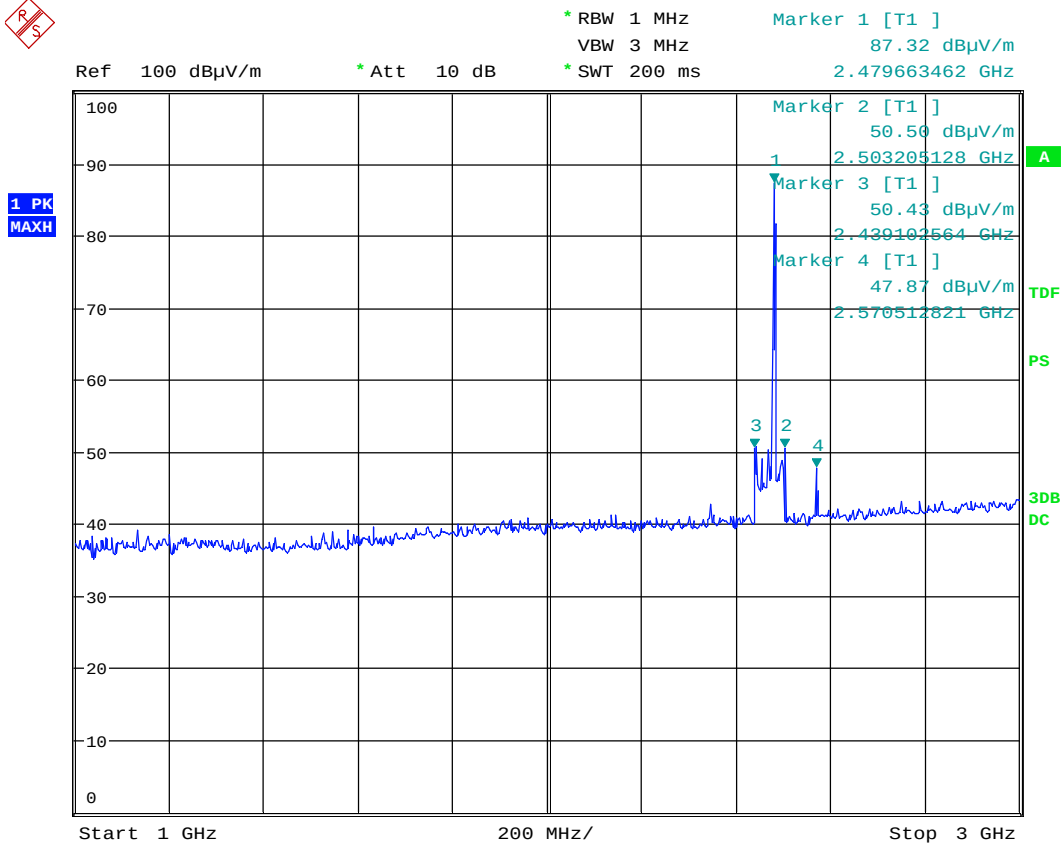
Date: 27.JUN.2016 14:16:25

Radiated Emissions ch. 2440 MHz, 1 – 3 GHz, HP, @3m – Pre-scan



Date: 27.JUN.2016 14:10:05

Radiated Emissions ch. 2480 MHz, 1 – 3 GHz, VP, @3m – Pre-scan



Date: 27.JUN.2016 14:09:17

Radiated Emissions ch. 2480 MHz, 1 – 3 GHz, HP, @3m – Pre-scan



MARKER 1

7.751602564 GHz

Ref 82 dBμV/m

\* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

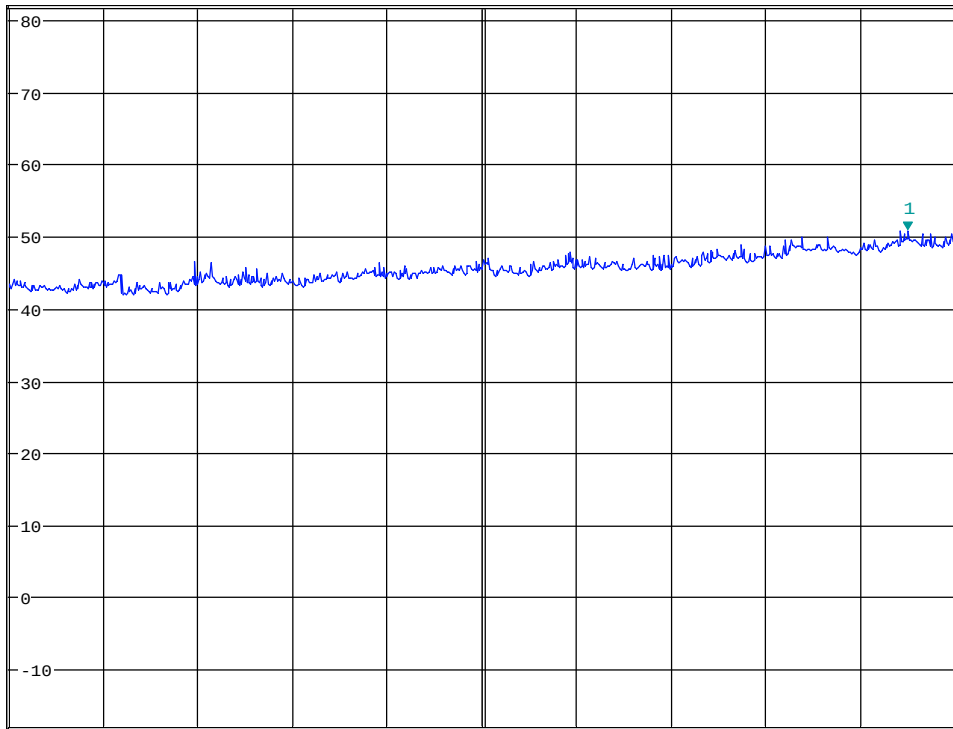
SWT 30 ms

Marker 1 [T1]

50.76 dBμV/m

7.751602564 GHz

1 PK  
MAXH



Start 3 GHz

500 MHz/

Stop 8 GHz

Date: 8.FEB.2017 08:23:00

Radiated Emissions ch. 2402 MHz, 3 – 8 GHz, VP, @3m – Pre-scan



MARKER 1

7.823717949 GHz

Ref 82 dBμV/m

\* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

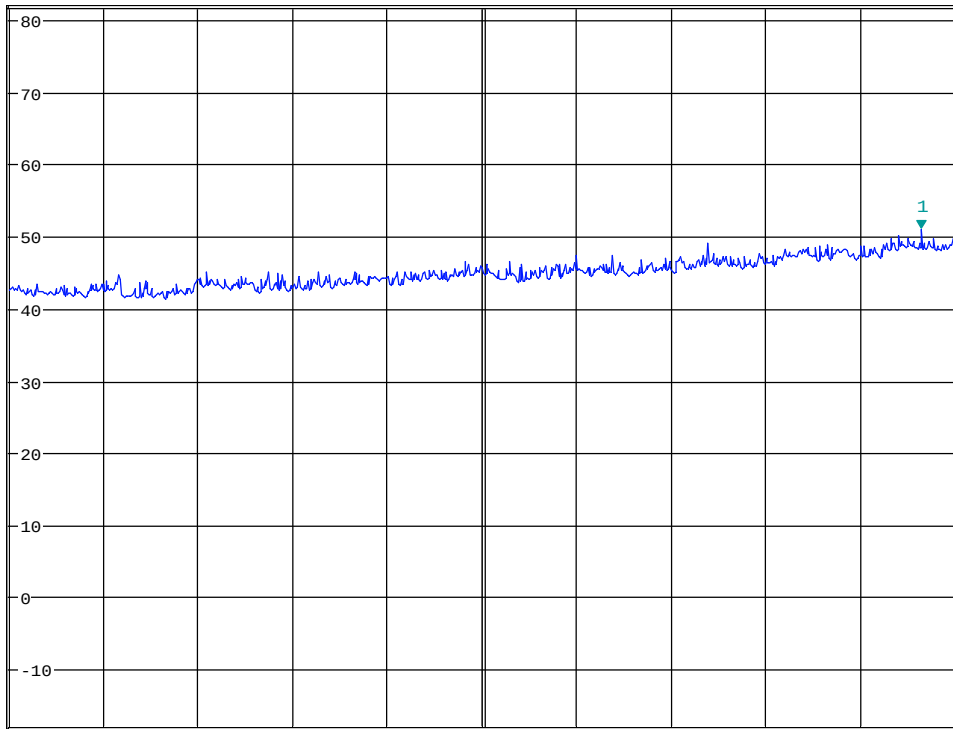
SWT 30 ms

Marker 1 [T1]

51.06 dBμV/m

7.823717949 GHz

1 PK  
MAXH



Start 3 GHz

500 MHz/

Stop 8 GHz

Date: 8.FEB.2017 08:23:44

Radiated Emissions ch. 2402 MHz, 3 – 8 GHz, HP, @3m – Pre-scan

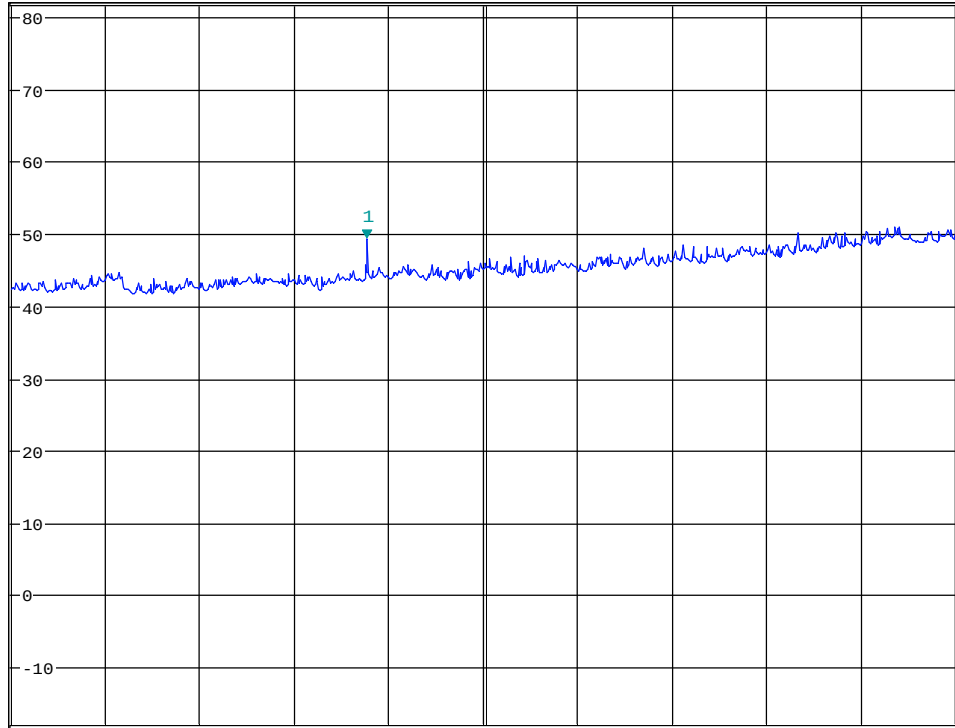


\* RBW 1 MHz      Marker 1 [T1]  
VBW 3 MHz      49.29 dBμV/m  
SWT 30 ms      4.883012821 GHz

Ref 82 dBμV/m

\* Att 10 dB

1 PK  
MAXH



Start 3 GHz

500 MHz/

Stop 8 GHz

Date: 27.JUN.2016 14:18:34

**Radiated Emissions ch. 2440 MHz, 3 – 8 GHz, VP, @3m – Pre-scan**

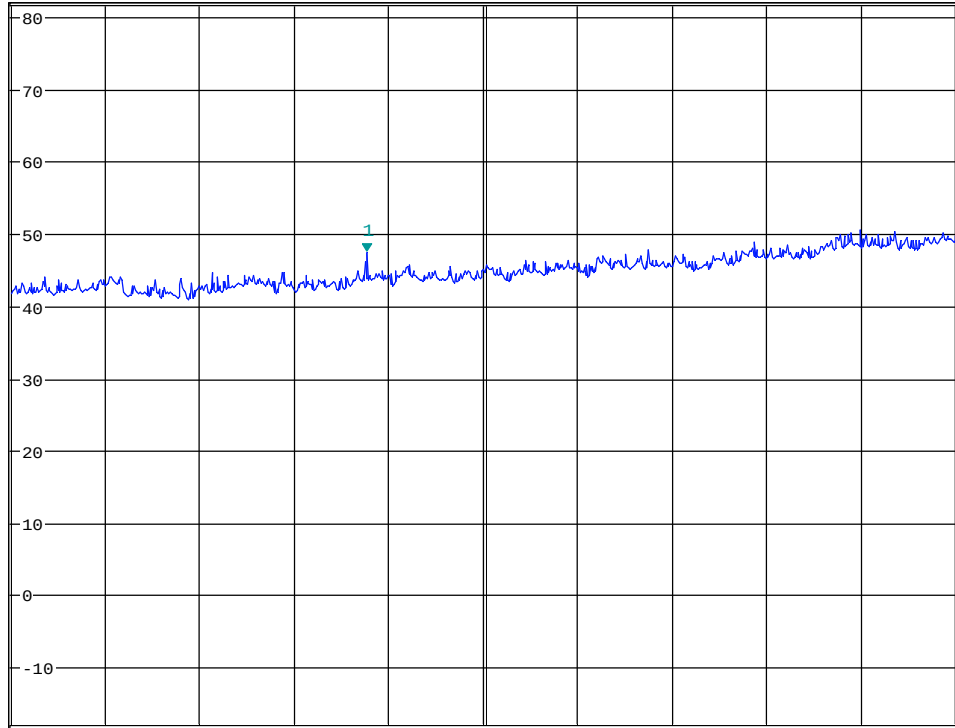


\* RBW 1 MHz  
VBW 3 MHz  
SWT 30 ms  
Marker 1 [T1]  
47.44 dBμV/m  
4.883012821 GHz

Ref 82 dBμV/m

\* Att 10 dB

1 PK  
MAXH



Start 3 GHz

500 MHz/

Stop 8 GHz

Date: 27.JUN.2016 14:17:35

**Radiated Emissions ch. 2440 MHz, 3 – 8 GHz, HP, @3m – Pre-scan**



**MARKER 1**

4.963141026 GHz

Ref 82 dBμV/m

\* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

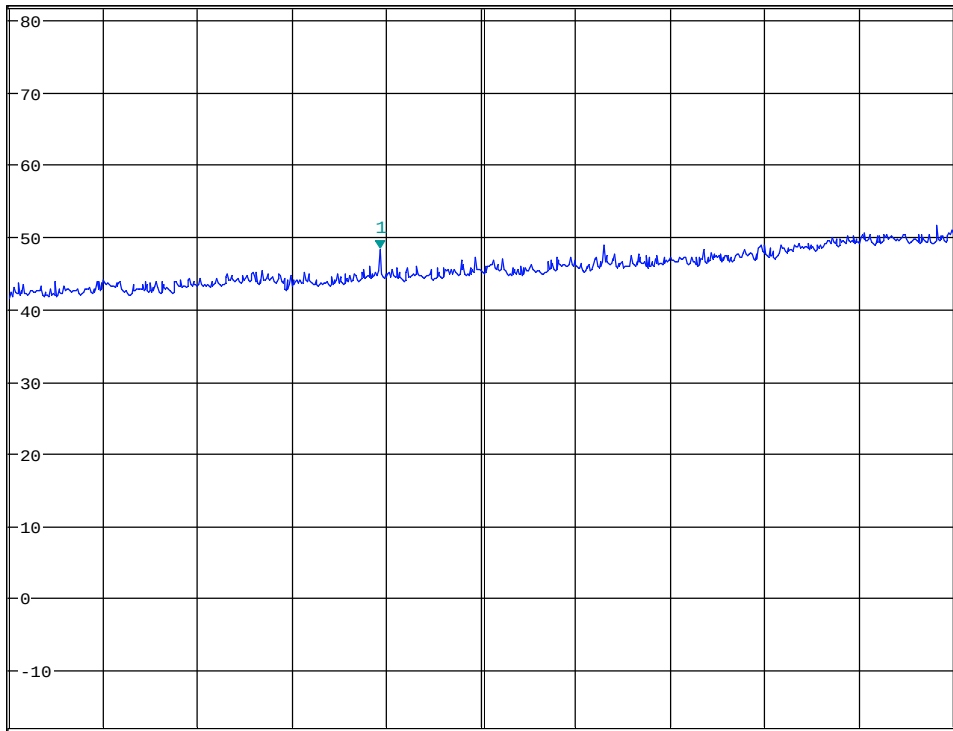
\* SWT 200 ms

Marker 1 [T1]

48.19 dBμV/m

4.963141026 GHz

1 PK  
MAXH



Start 3 GHz

500 MHz/

Stop 8 GHz

Date: 27.JUN.2016 14:10:53

**Radiated Emissions ch. 2480 MHz, 3 – 8 GHz, VP, @3m – Pre-scan**

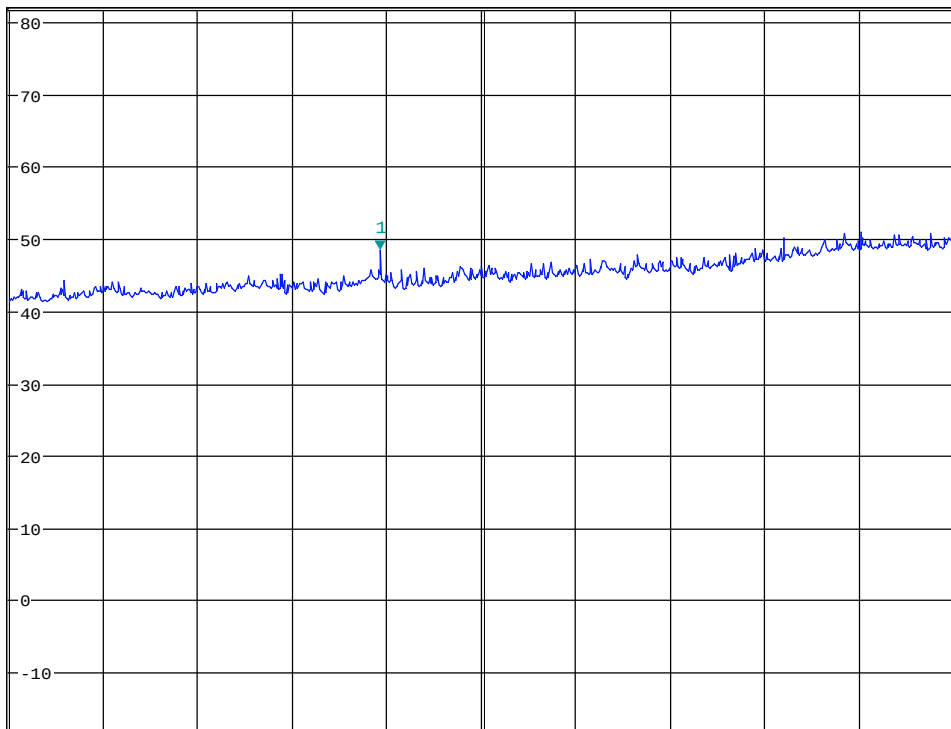


\* RBW 1 MHz      Marker 1 [T1 ]  
VBW 3 MHz      48.57 dBμV/m  
\* SWT 200 ms      4.963141026 GHz

Ref 82 dBμV/m

\* Att 10 dB

1 PK  
MAXH



Start 3 GHz

500 MHz/

Stop 8 GHz

Date: 27.JUN.2016 14:11:32

**Radiated Emissions ch. 2480 MHz, 3 – 8 GHz, HP, @3m – Pre-scan**



**MARKER 1**

10.38461538 GHz

Ref 72.5 dBμV/m

\* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

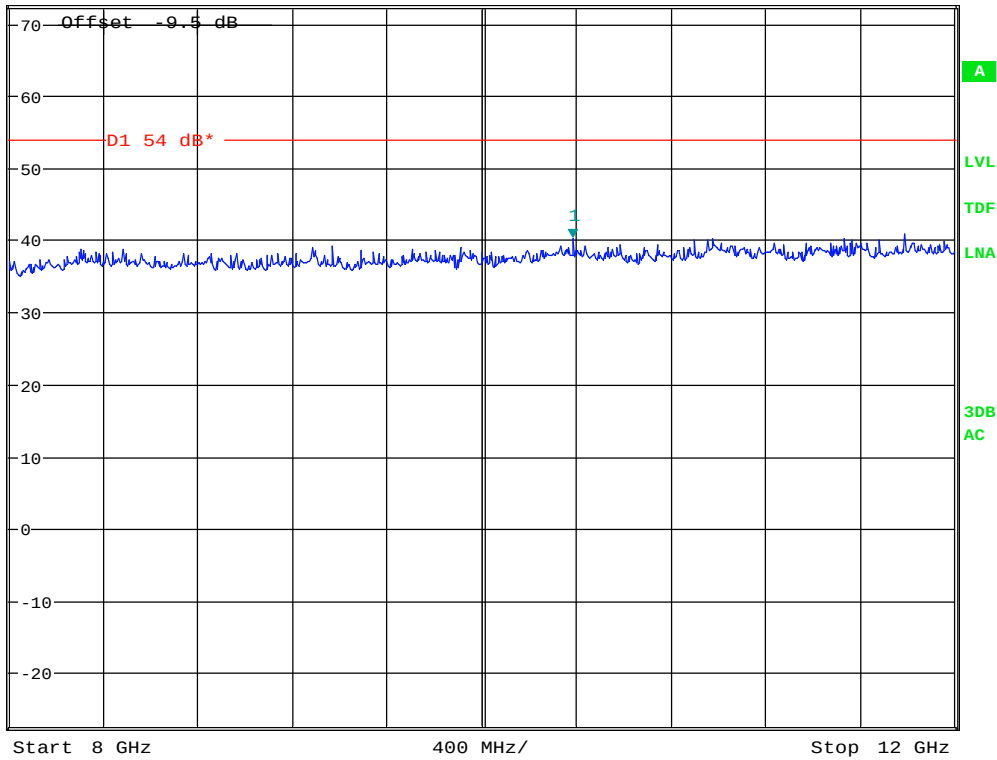
SWT 25 ms

Marker 1 [T1]

40.16 dBμV/m

10.384615385 GHz

1 PK  
MAXH



Date: 8.FEB.2017 08:25:37

**Radiated Emissions ch. 2402 MHz, 8 – 12 GHz, VP, @1m – Pre-scan**



**MARKER 1**

11.58333333 GHz

Ref 72.5 dBμV/m \* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

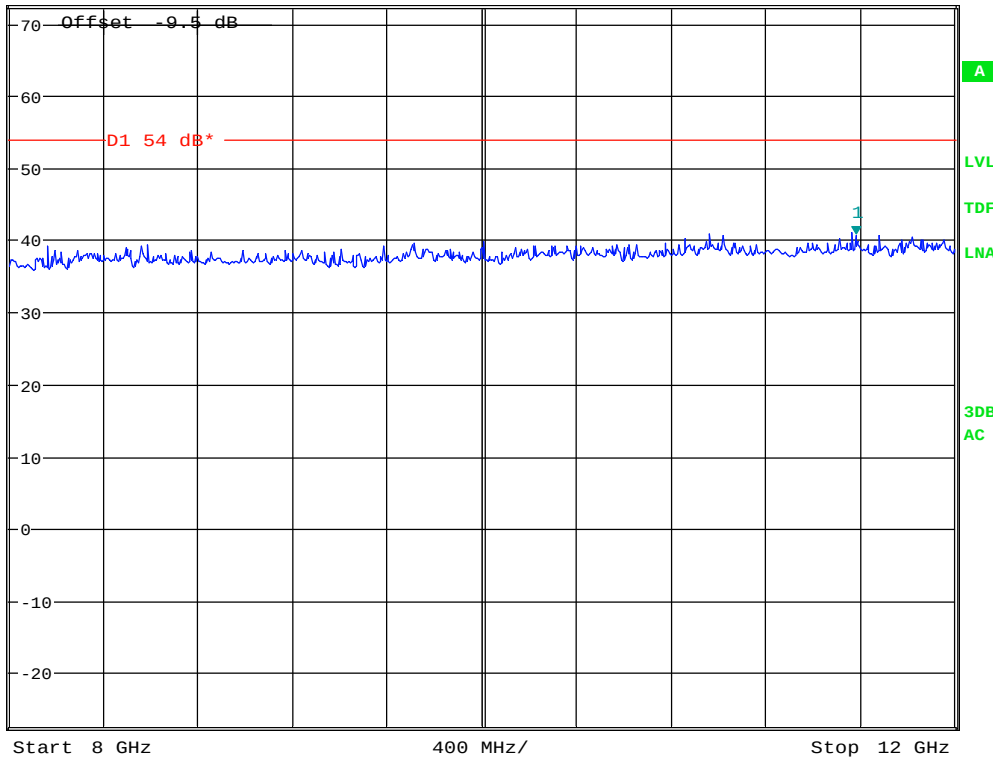
SWT 25 ms

Marker 1 [T1]

40.75 dBμV/m

11.58333333 GHz

1 PK  
MAXH



Date: 8.FEB.2017 08:25:12

**Radiated Emissions ch. 2402 MHz, 8 – 12 GHz, HP, @1m – Pre-scan**



**MARKER 1**

11.19230769 GHz

Ref 77.5 dBμV/m \* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

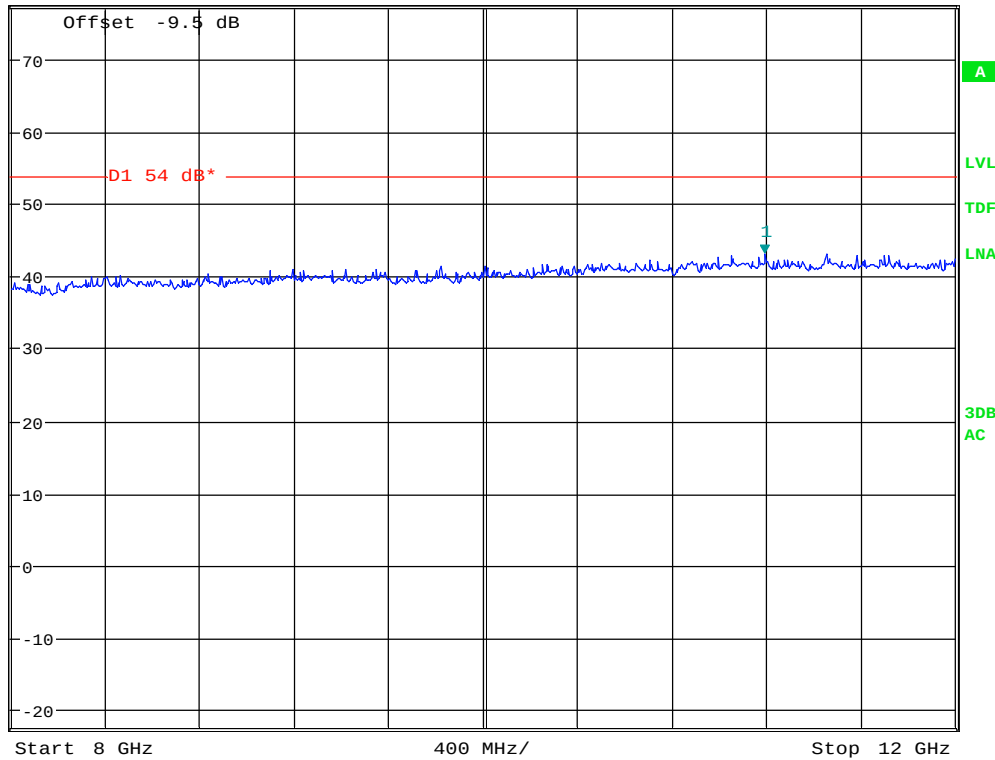
\* SWT 200 ms

Marker 1 [T1]

43.24 dBμV/m

11.192307692 GHz

1 PK  
MAXH



Date: 2.JUL.2016 11:38:15

**Radiated Emissions ch. 2440 MHz, 8 – 12 GHz, VP, @1m – Pre-scan**



**MARKER 1**

11.30128205 GHz

Ref 77.5 dBμV/m \* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

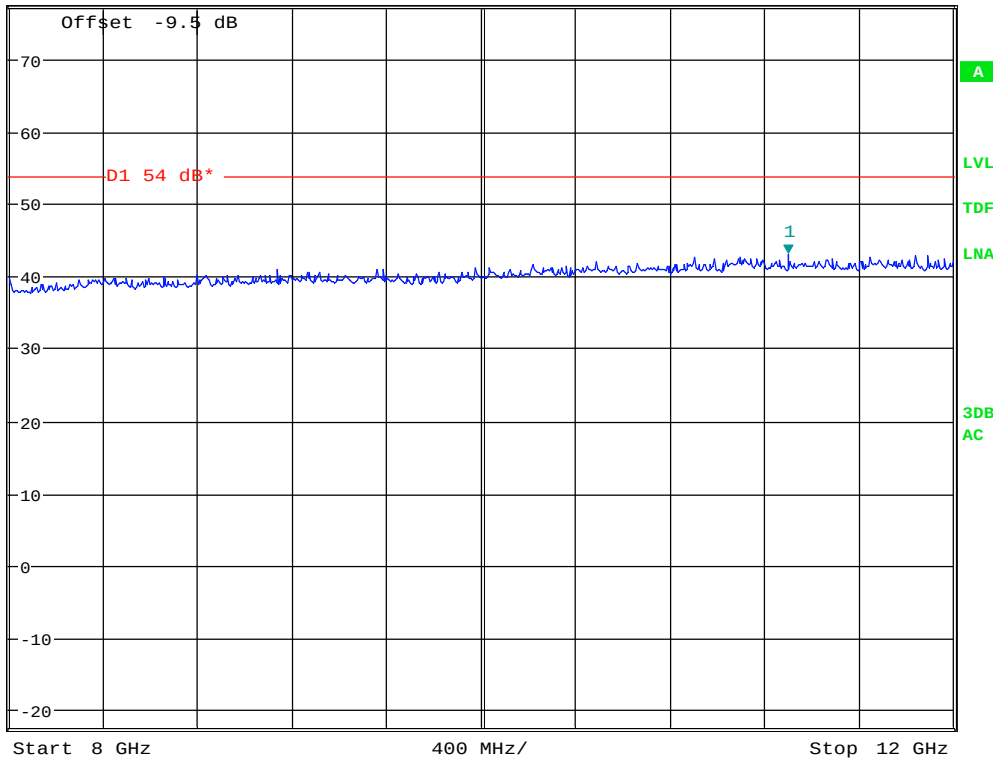
\* SWT 200 ms

Marker 1 [T1]

43.10 dBμV/m

11.301282051 GHz

1 PK  
MAXH



Date: 2.JUL.2016 11:35:57

**Radiated Emissions ch. 2440 MHz, 8 – 12 GHz, HP, @1m – Pre-scan**



**MARKER 1**

11.44871795 GHz

Ref 77.5 dBμV/m \* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

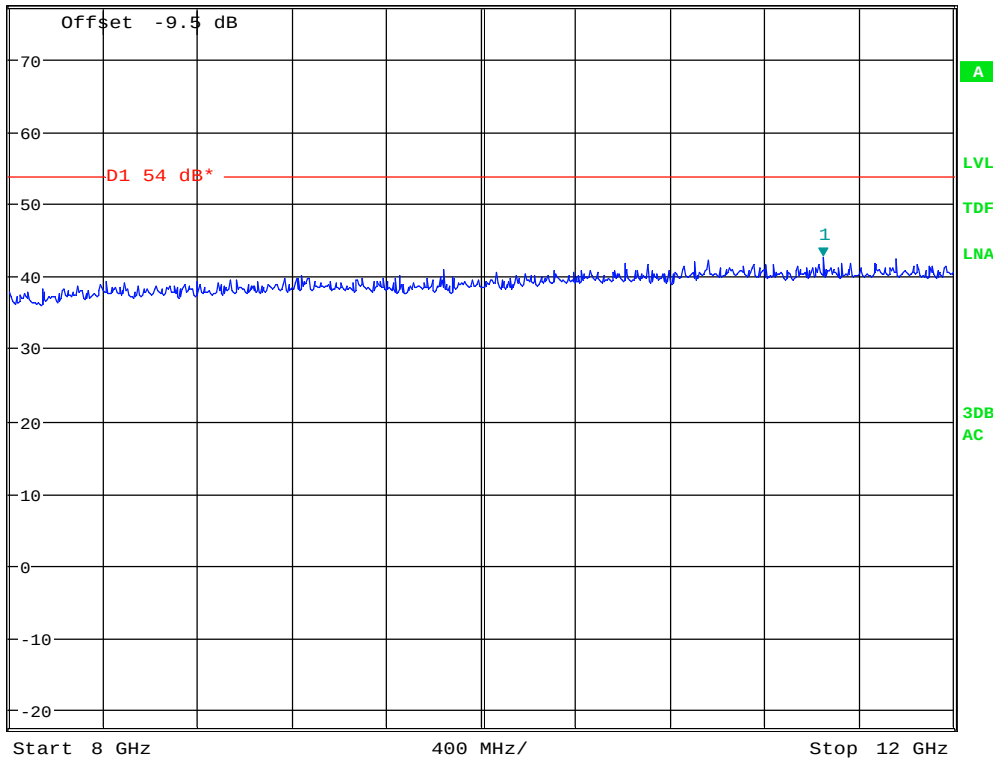
\* SWT 200 ms

Marker 1 [T1]

42.66 dBμV/m

11.448717949 GHz

1 PK  
MAXH



Date: 2.JUL.2016 11:44:17

**Radiated Emissions ch. 2480 MHz, 8 – 12 GHz, VP, @1m – Pre-scan**



**MARKER 1**

11.61538462 GHz

Ref 77.5 dBμV/m \* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

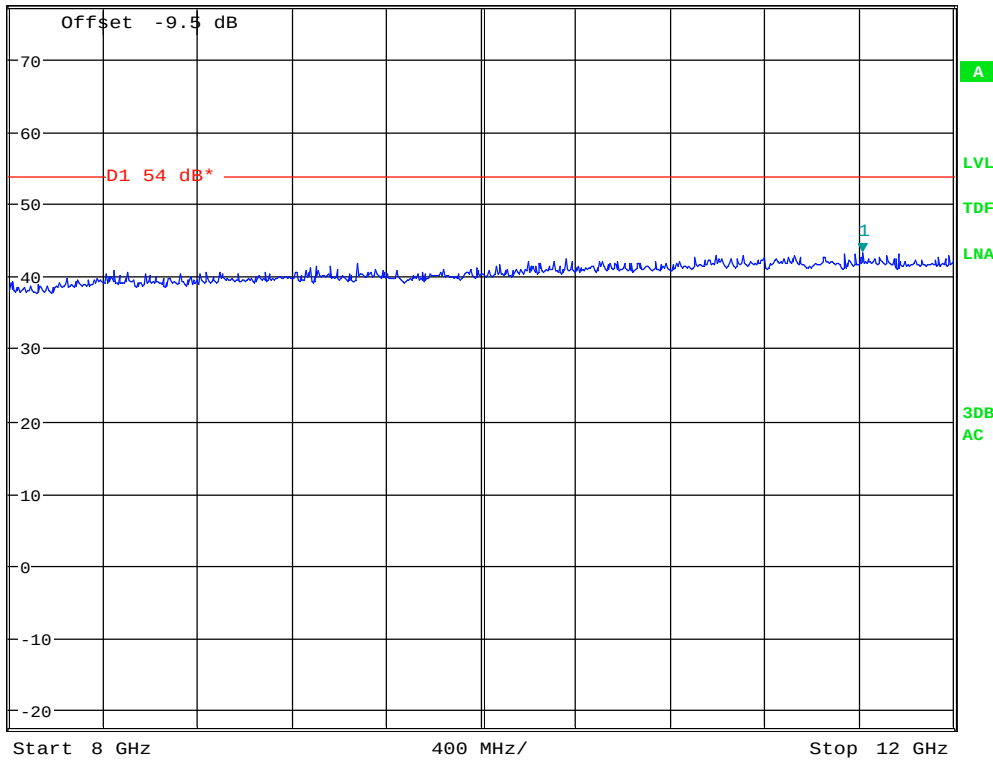
\* SWT 200 ms

Marker 1 [T1]

43.34 dBμV/m

11.615384615 GHz

1 PK  
MAXH



Date: 2.JUL.2016 11:46:45

**Radiated Emissions ch. 2480 MHz, 8 – 12 GHz, HP, @1m – Pre-scan**



**MARKER 1**

17.77884615 GHz

Ref 72.5 dB $\mu$ V/m \* Att 10 dB

\* RBW 1 MHz

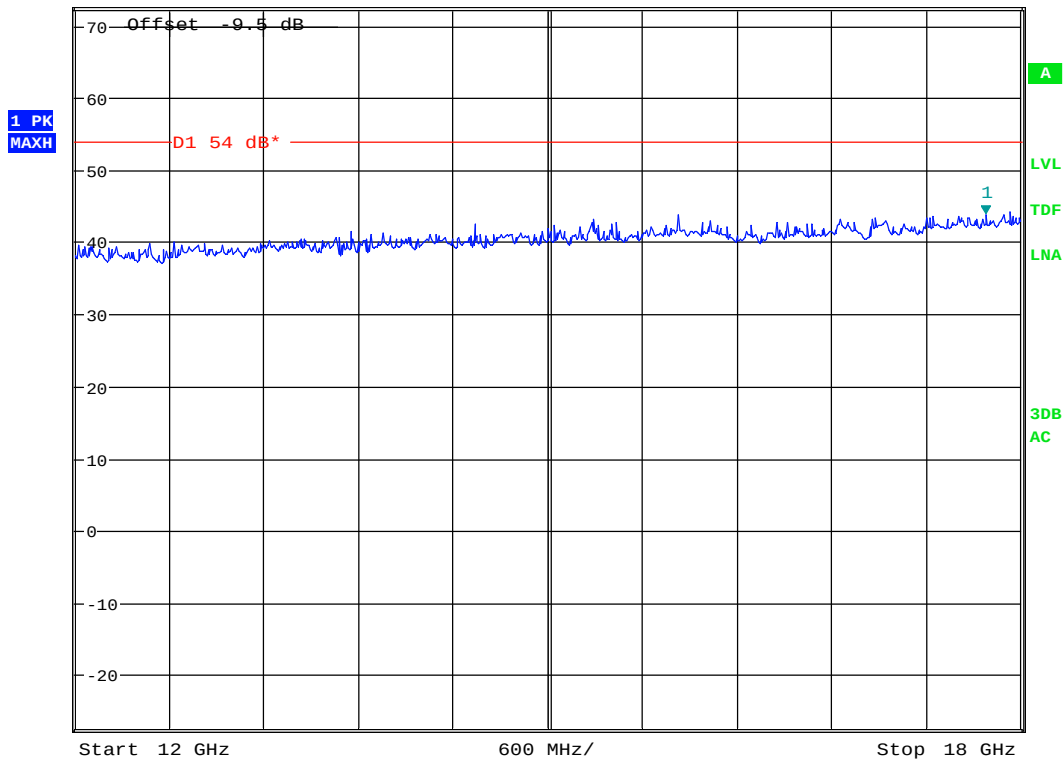
VBW 3 MHz

SWT 35 ms

Marker 1 [T1]

43.82 dB $\mu$ V/m

17.778846154 GHz



Date: 8.FEB.2017 08:26:39

**Radiated Emissions ch. 2402 MHz, 12 – 18 GHz, VP, @1m – Pre-scan**



**MARKER 1**

17.66346154 GHz

Ref 72.5 dBμV/m \* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

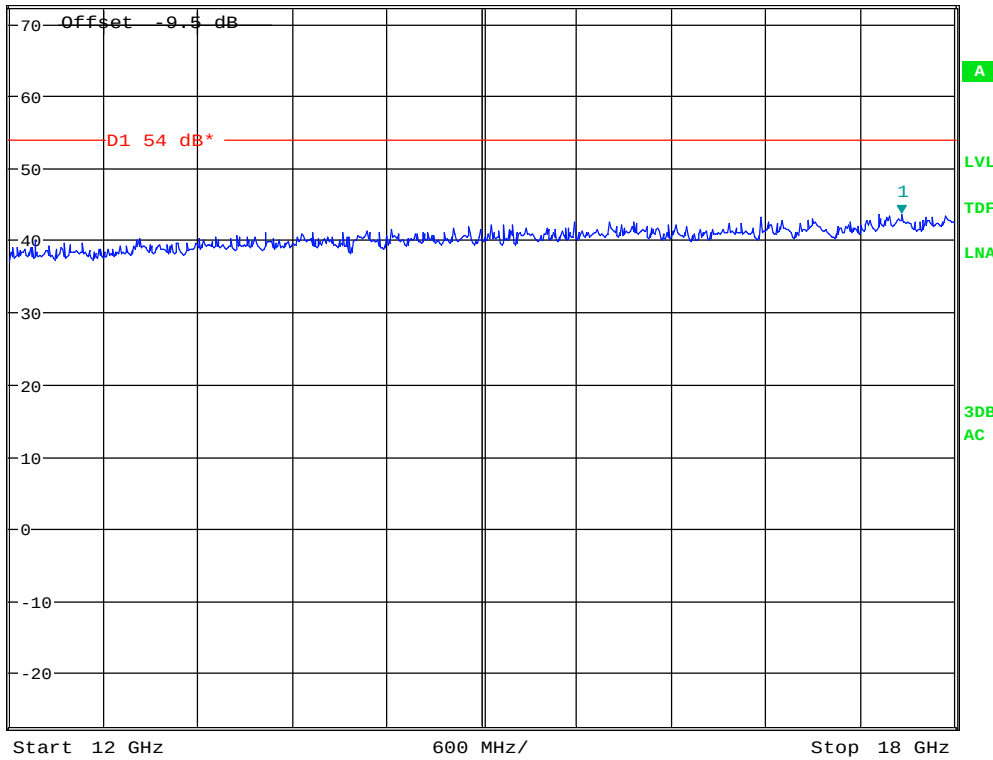
SWT 35 ms

Marker 1 [T1]

43.59 dBμV/m

17.663461538 GHz

1 PK  
MAXH



Date: 8.FEB.2017 08:27:02

**Radiated Emissions ch. 2402 MHz, 12 – 18 GHz, HP, @1m – Pre-scan**



**MARKER 1**

17.95192308 GHz

Ref 77.5 dBμV/m \* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

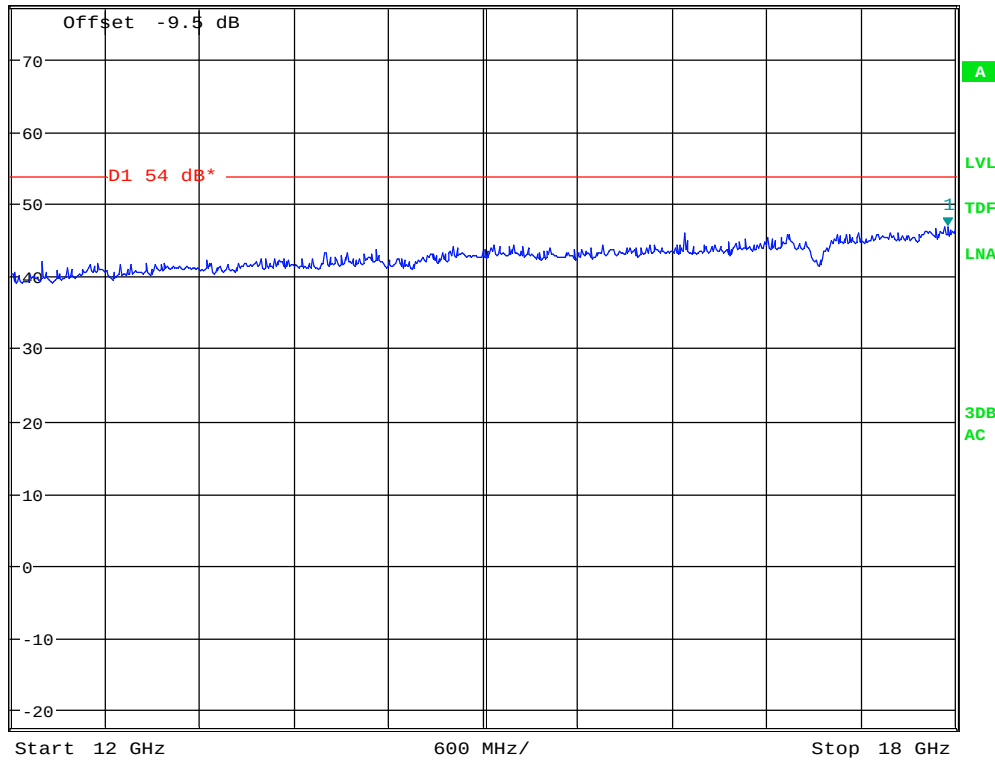
\* SWT 200 ms

Marker 1 [T1]

46.98 dBμV/m

17.951923077 GHz

1 PK  
MAXH



Date: 2.JUL.2016 12:04:12

**Radiated Emissions ch. 2440 MHz, 12 – 18 GHz, VP, @1m – Pre-scan**



**MARKER 1**

17.60576923 GHz

Ref 77.5 dBμV/m \* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

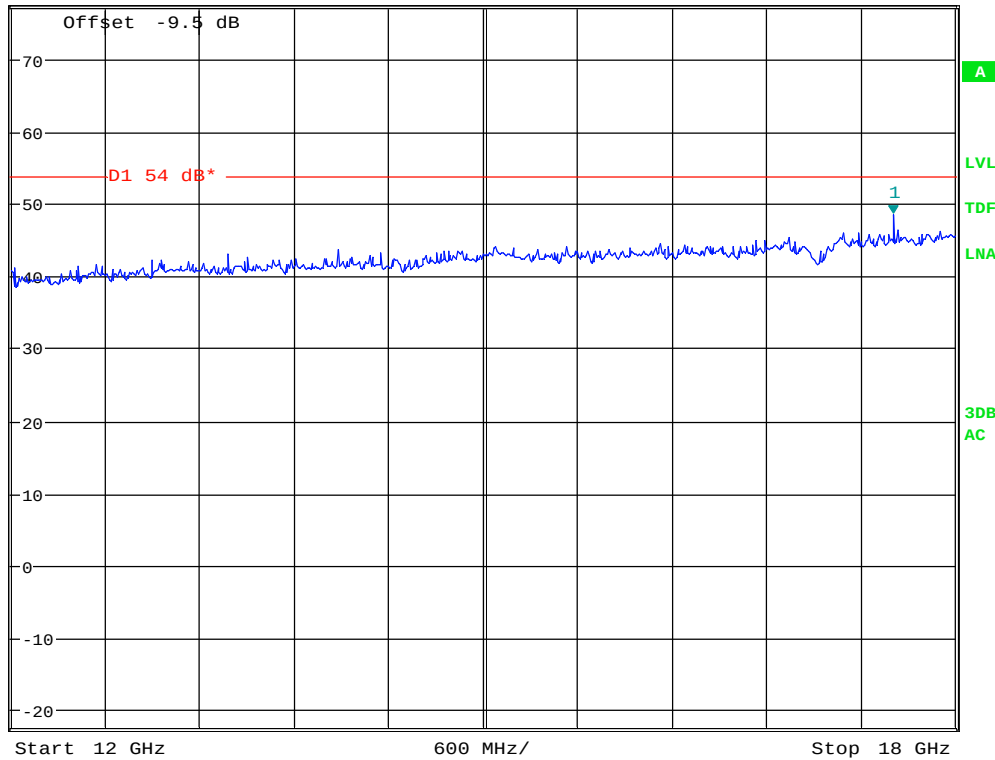
\* SWT 200 ms

Marker 1 [T1]

48.58 dBμV/m

17.605769231 GHz

1 PK  
MAXH



Date: 2.JUL.2016 12:05:24

**Radiated Emissions ch. 2440 MHz, 12 – 18 GHz, HP, @1m – Pre-scan**



**MARKER 1**

12.39423077 GHz

Ref 77.5 dBμV/m \* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

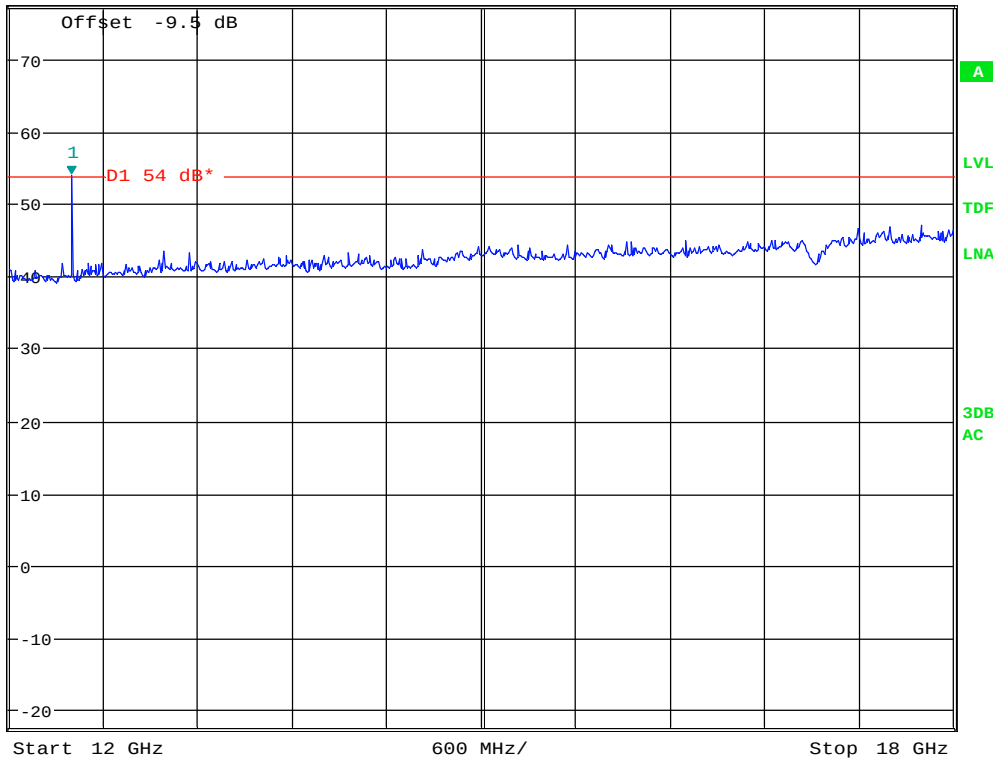
\* SWT 200 ms

Marker 1 [T1]

54.18 dBμV/m

12.394230769 GHz

1 PK  
MAXH

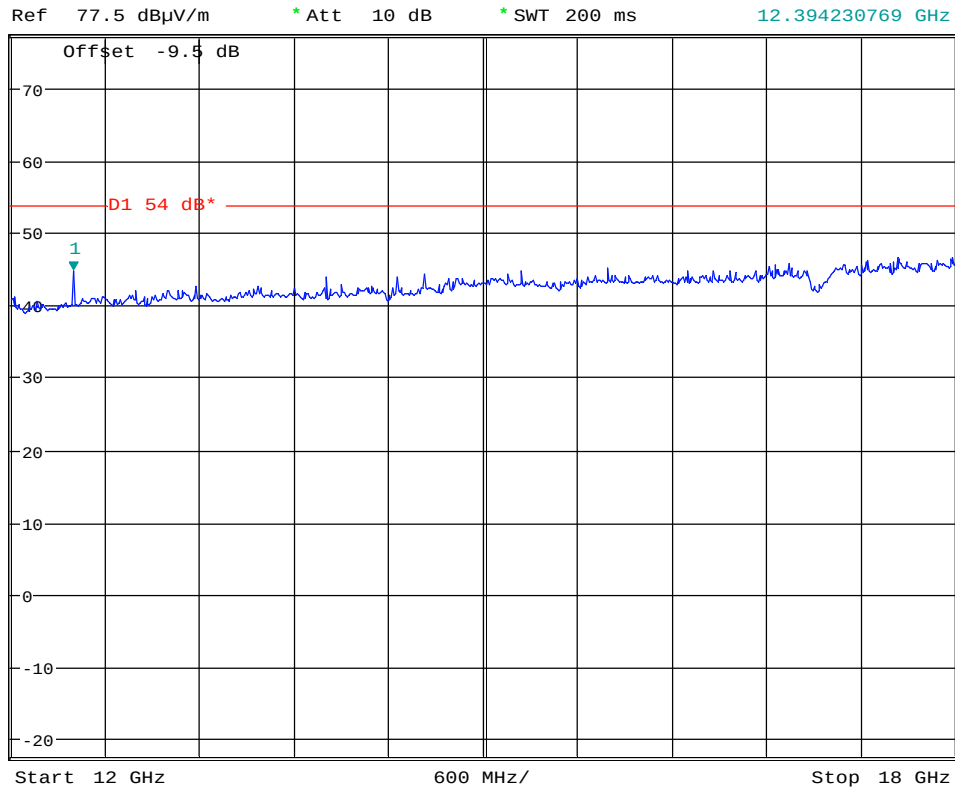


Date: 2.JUL.2016 11:50:02

**Radiated Emissions ch. 2480 MHz, 12 – 18 GHz, VP, @1m – Pre-scan**



\* RBW 1 MHz      Marker 1 [T1]  
VBW 3 MHz      44.91 dBμV/m  
\* SWT 200 ms      12.394230769 GHz



Date: 2.JUL.2016 11:52:05

Radiated Emissions ch. 2480 MHz, 12 – 18 GHz, HP, @1m – Pre-scan



**MARKER 1**

23.84455128 GHz

Ref 72.5 dBμV/m \* Att 10 dB

\* RBW 1 MHz

VBW 3 MHz

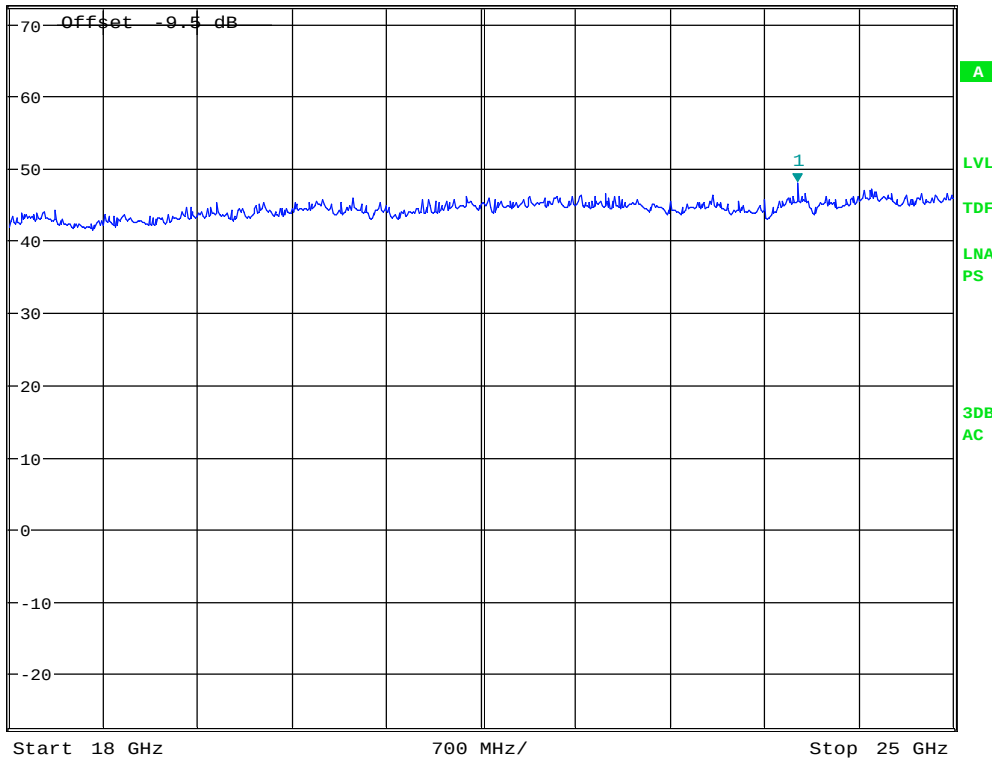
SWT 45 ms

Marker 1 [T1]

47.94 dBμV/m

23.844551282 GHz

1 PK  
MAXH



Date: 2.JUL.2016 14:38:35

**Radiated Emissions ch. 2440 MHz, 18 – 25 GHz, VP/HP, Pre-scan**

### 3.6 Power Spectral Density (PSD)

Para. No.: 15.247 (d)

Test Performed By: G.Suwanthakumar

Date of Test: 2016.07.13 &  
2017.02.08

**Test Results: Passed**

#### Measured and Calculated Data:

The measurement procedures PKPSD described in KDB 558074 D01 v01 was used.

|                                  | calculated peak PSD<br>dBm |
|----------------------------------|----------------------------|
| Power Spectral Density @2402 MHz | -08.70                     |
| Power Spectral Density @2440 MHz | -10.85                     |
| Power Spectral Density @2480 MHz | -10.45                     |

#### 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.



MARKER 1

2.401978365 GHz

\*RBW 3 kHz

VBW 10 kHz

SWT 170 ms

Marker 1 [T1]

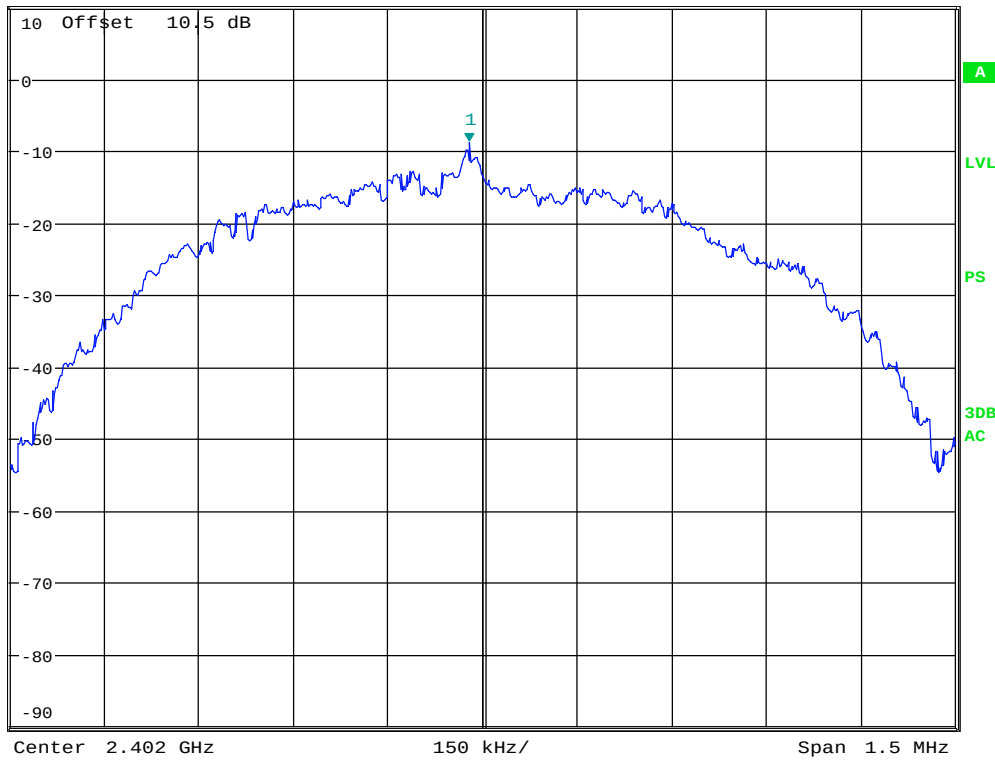
-8.70 dBm

2.401978365 GHz

Ref 10 dBm

\*Att 15 dB

1 PK  
MAXH



Date: 8.FEB.2017 08:43:28

### PSD Measurement - 2402MHz



**MARKER 1**

2.439971154 GHz

Ref 13.5 dBm

\* Att 10 dB

\* RBW 3 kHz

VBW 10 kHz

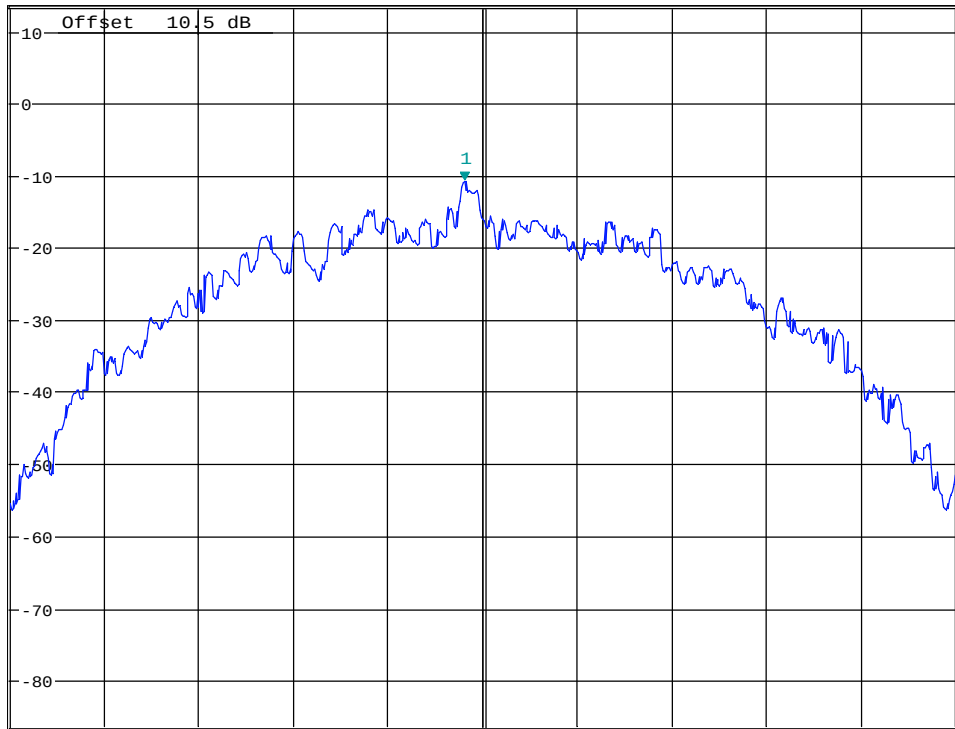
SWT 170 ms

Marker 1 [T1]

-10.85 dBm

2.439971154 GHz

1 PK  
MAXH



Center 2.44 GHz

150 kHz/

Span 1.5 MHz

Date: 13.JUL.2016 20:32:45

**PSD Measurement – 2440MHz**



**MARKER 1**

2.479978365 GHz

Ref 13.5 dBm

\* Att 10 dB

\* RBW 3 kHz

VBW 10 kHz

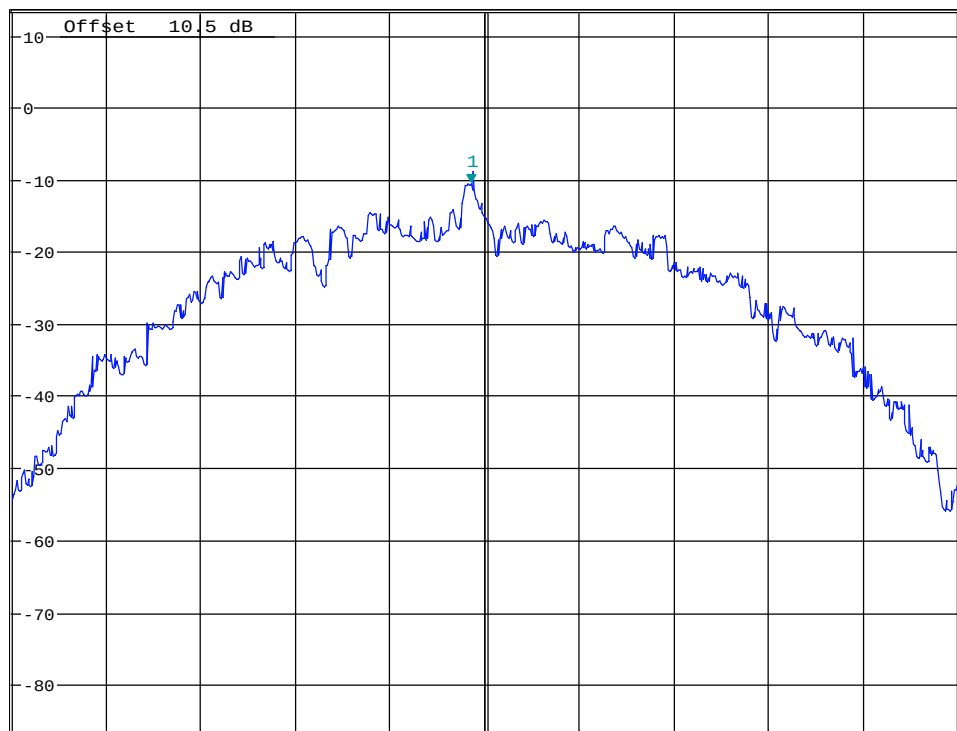
SWT 170 ms

Marker 1 [T1]

-10.45 dBm

2.479978365 GHz

1 PK  
MAXH



Center 2.48 GHz

150 kHz/

Span 1.5 MHz

Date: 13.JUL.2016 20:33:12

**PSD Measurement - 2480MHz**

## 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

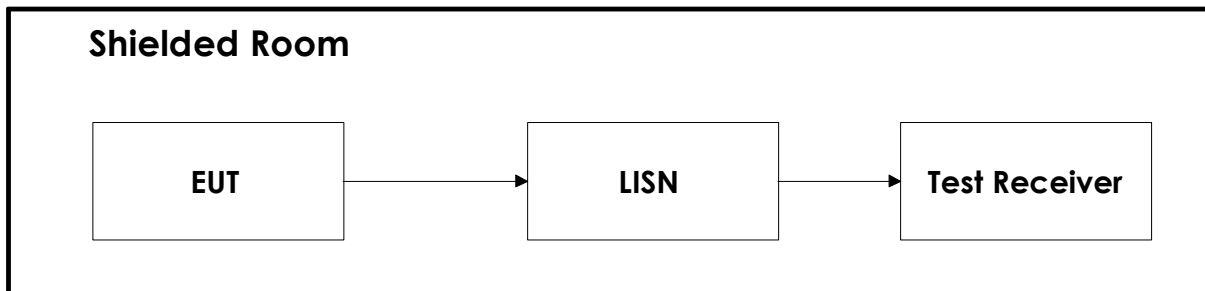
## 5 LIST OF TEST EQUIPMENT

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.

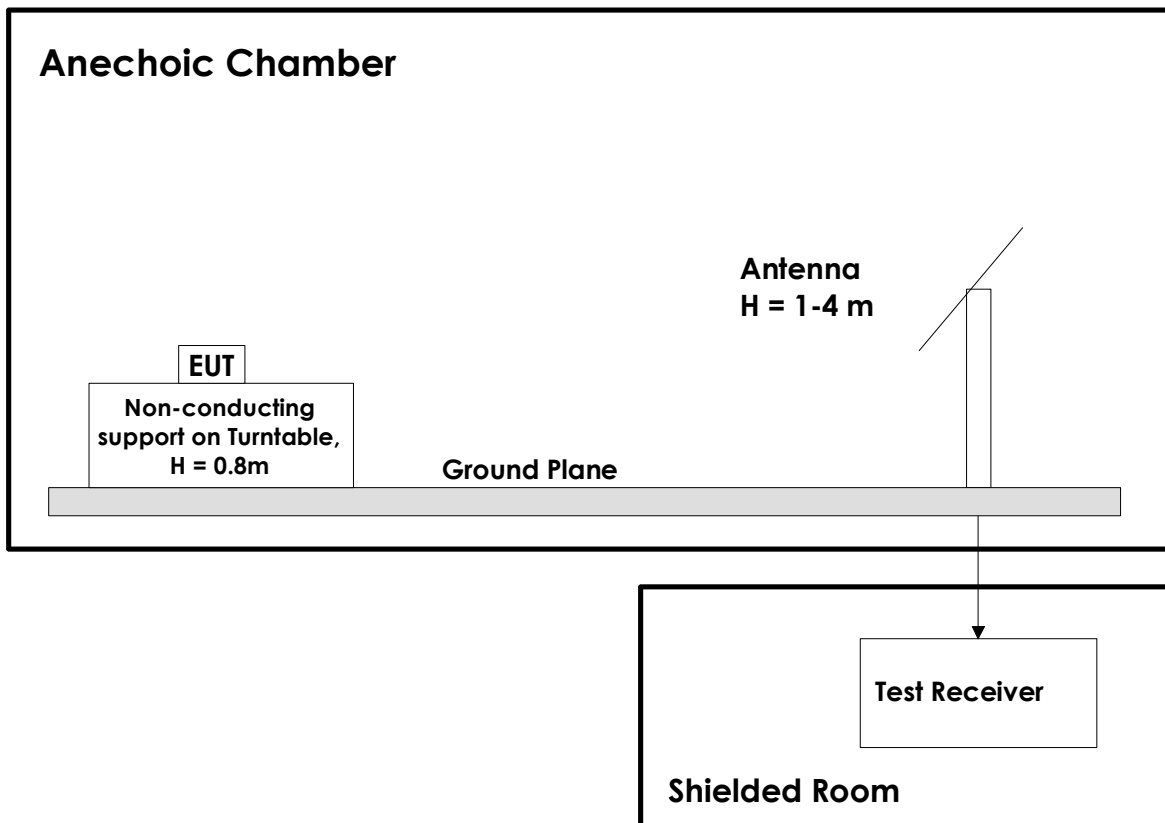
| No. | Instrument/<br>ancillary | Type of instrument/<br>ancillary | Manufacturer    | Ref. no. | Cal.<br>Date | Cal.<br>Due |
|-----|--------------------------|----------------------------------|-----------------|----------|--------------|-------------|
| 1.  | ESU40                    | EMI Receiver                     | Rohde & Schwarz | LR1639   | 2015.11      | 2016.11     |
| 2.  | FSW26                    | Spectrum Analyzer                | Rohde & Schwarz | LR 1640  | 2015.11      | 2016.11     |
| 3.  | HFH2-Z2                  | Active Loop antenna              | Rohde & Schwarz | LR1660   | 2014.10      | 2017.10     |
| 4.  | 3115                     | Antenna horn                     | EMCO            | LR 1330  | 2010.08      | 2017.08     |
| 5.  | HK116                    | Biconical Antenna                | Rohde & Schwarz | LR 1260  | 2013.12      | 2016.12     |
| 6.  | HL223                    | Log Periodic antenna             | Rohde & Schwarz | LR 1261  | 2013.12      | 2016.12     |
| 7.  | 643                      | Antenna Horn                     | Narda           | LR 093   | 2009.10      | 2019.10     |
| 8.  | PM7320X                  | Antenna Horn                     | Sivers Lab      | LR 102   | 2009.10      | 2019.10     |
| 9.  | DBF-520-20               | Antenna Horn                     | Systron Donner  | LR 100   | 2009.10      | 2019.10     |
| 10  | 638                      | Antenna Horn                     | Narda           | LR 1480  | 2009.10      | 2019.10     |
| 11  | 4768-10                  | Attenuator                       | Narda           | LR 1356  | Cal b4 use   |             |
| 12  | 6HC3000/18000            | Highpass Filter                  | Trilithic       | LR 1614  | Cal b4 use   |             |
| 13  | 8449B                    | Pre-amplifier                    | Hewlett Packard | LR 1322  | 2015.09      | 2016.09     |
| 14  | 310N                     | Pre-amplifier                    | Sonoma          | LR 1686  | 2016.05      | 2017.05     |
| 15  | Model 87 V               | Multimeter                       | Fluke           | LR 1597  | 2015.10      | 2016.10     |
| 16  | 6812B                    | Power source                     | Agilent         | LR 1515  | 2015.12.02   | 2017.12.02  |
| 17  | D001                     | DC power supply                  | Farnell         | LT 5150  | Cal b4 use   |             |

## 6 BLOCK DIAGRAM

### 6.1 Power Line Conducted Emission



### 6.2 Test Site Radiated Emission



## Revision history

| Version | Date       | Comment               | Sign |
|---------|------------|-----------------------|------|
| 00      | 2016.11.10 | First version         | gns  |
| 01      | 2017.02.09 | Measured on ch2402MHz | gns  |