



## FCC Test Report

For:  
Luminate Wireless

Model Name:  
LWAP-0001

Product Description:  
4G LTE Access Point

FCC ID: 2AJLI-LWAP-0002

Applied Rules and Standards:  
47 CFR Parts 24 and 27

REPORT #: EMC\_LUMIN-001-16001\_FCC\_24\_27\_Rev2  
DATE: 2016-12-15



A2LA Accredited

IC recognized #  
3462B-1

**CETECOM Inc.**

411 Dixon Landing Road ♦ Milpitas, CA 95035 ♦ U.S.A.

Phone: + 1 (408) 586 6200 ♦ Fax: + 1 (408) 586 6299 ♦ E-mail: [info@cetecom.com](mailto:info@cetecom.com) ♦ <http://www.cetecom.com>

CETECOM Inc. is a Delaware Corporation with Corporation number: 2905571

**TABLE OF CONTENTS**

<b>1</b>	<b>ASSESSMENT.....</b>	<b>3</b>
<b>2</b>	<b>ADMINISTRATIVE DATA .....</b>	<b>4</b>
2.1	IDENTIFICATION OF THE TESTING LABORATORY ISSUING THE EMC TEST REPORT .....	4
2.2	IDENTIFICATION OF THE CLIENT .....	4
2.3	IDENTIFICATION OF THE MANUFACTURER.....	4
<b>3</b>	<b>EQUIPMENT UNDER TEST (EUT).....</b>	<b>5</b>
3.1	EUT SPECIFICATIONS .....	5
3.2	EUT SAMPLE DETAILS .....	5
3.3	ACCESSORY EQUIPMENT (AE) DETAILS.....	5
3.4	TEST SAMPLE CONFIGURATION .....	5
<b>4</b>	<b>SUBJECT OF INVESTIGATION .....</b>	<b>6</b>
4.1	DATES OF TESTING: .....	6
4.2	MEASUREMENT UNCERTAINTY .....	6
4.3	ENVIRONMENTAL CONDITIONS DURING TESTING: .....	6
<b>5</b>	<b>MEASUREMENT PROCEDURES .....</b>	<b>7</b>
5.1	CONDUCTED SETUP BLOCK DIAGRAM .....	7
5.2	RADIATED MEASUREMENT.....	7
5.3	SAMPLE CALCULATIONS FOR FIELD STRENGTH MEASUREMENTS .....	9
<b>6</b>	<b>MEASUREMENT RESULTS SUMMARY .....</b>	<b>10</b>
6.1	FCC 24 / RSS-133 .....	10
6.2	FCC 27 / RSS-139 .....	10
<b>7</b>	<b>TEST RESULT DATA .....</b>	<b>11</b>
7.1	RF OUTPUT POWER.....	11
7.2	FREQUENCY STABILITY .....	31
7.3	OCCUPIED BANDWIDTH.....	33
7.4	BAND EDGE COMPLIANCE .....	40
7.5	RADIATED SPURIOUS EMISSIONS.....	44
<b>8</b>	<b>TEST SETUP PHOTOS .....</b>	<b>67</b>
<b>9</b>	<b>TEST EQUIPMENT AND ANCILLARIES USED FOR TESTING .....</b>	<b>67</b>
<b>10</b>	<b>REVISION HISTORY .....</b>	<b>68</b>

## 1 **Assessment**

The following device as further described in section 3 of this report was evaluated against the applicable criteria specified in the Code of Federal Regulations Title 47 parts 24 and 27.

No deficiencies were ascertained.

Company	Description	Model #
Luminate Wireless	4G LTE Access Point	LWAP-0001

### Responsible for Testing Laboratory:

2016-12-15	Compliance	Franz Engert (Compliance Manager)	
Date	Section	Name	Signature

### Responsible for the Report:

2016-12-15	Compliance	Kris Lazarov (EMC Engineer)	
Date	Section	Name	Signature

The test results of this test report relate exclusively to the test item specified in Section 3.  
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

## 2 Administrative Data

### 2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	Compliance
Street Address:	411 Dixon Landing Road
City/Zip Code	Milpitas, CA 95035
Country	USA
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Compliance Manager:	Franz Engert
Responsible Project Leader:	Kris Lazarov

### 2.2 Identification of the Client

Client Firm/Name:	Luminate Wireless Inc.
Street Address:	20883 Stevens Creek Blvd. S-100
City/Zip Code	Cupertino, CA 95014
Country	USA
Contact Person:	Jerry Martinson
Phone No.	650-600-3899
e-mail:	jerrym@luminatewireless.com

### 2.3 Identification of the Manufacturer

Manufacturer's Name:	Same as Applicant
Manufacturers Address:	-----
City/Zip Code	-----
Country	-----

### 3 Equipment Under Test (EUT)

#### 3.1 EUT Specifications

<b>Model No</b>	LWAP-0001
<b>HW Version</b>	0T
<b>SW Version</b>	DV5.2.3
<b>FCC-ID</b>	2AJLI-LWAP-0002
<b>Product Description</b>	4G LTE Access Point
<b>Transceiver Technology / Type(s) of Modulation</b>	LTE / QPSK / 16-QAM / 64-QAM
<b>Frequency Range</b>	LTE Band 2: Uplink: 1850 – 1910 MHz / Downlink: 1930 – 1990 MHz LTE Band 4: Uplink: 1710 – 1755 MHz / Downlink: 2110 – 2155 MHz
<b>Max. declared antenna gain</b>	Broadband antenna; Gain = 3 dBi
<b>Power Supply/ Rated Operating Voltage Range</b>	44 V (min) / 48 V (nom) / 57 V (max)
<b>Operating Temperature Range</b>	Tmin: 0 °C / Tmax 50 °C
<b>Sample Revision</b>	<input type="checkbox"/> Prototype <input checked="" type="checkbox"/> Production <input type="checkbox"/> Pre-Production
<b>EUT Dimensions</b>	265mm X 265mm X 60mm
<b>EUT Diameter</b>	<input checked="" type="checkbox"/> < 60 cm <input type="checkbox"/> Other _____

#### 3.2 EUT Sample details

EUT #	Sample	Serial Number	HW/SW Version	Notes
1	LWAP-0001	LAPE31	0T / DV5.2.3	

#### 3.3 Accessory Equipment (AE) details

AE #	Type	Manufacturer	Model	Serial Number
1	AC/DC Adapter	Phihong	PSAC60W-480	P54607336A1
2	Ethernet Switch	HP	1920-8G-PoE	CN4BFRL20X

#### 3.4 Test Sample Configuration

Set-up #	EUT / AE used for set-up	Comments
1	EUT#1+AE#1+AE#2	Radiated Measurements
2	EUT#1+AE#1	Conducted Measurements

#### **4    Subject of Investigation**

The objective of the measurements done by CETECOM Inc. was to evaluate the compliance of the EUT against the relevant requirements specified in the Code of Federal Regulations Title 47 parts 24 and 27.

##### **4.1    Dates of Testing:**

7/01/2016 - 11/25/2016

##### **4.2    Measurement Uncertainty**

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus, with 95% confidence interval (in dB delta to result), based on a coverage factor k=1.

Radiated measurement

9 kHz to 30MHz	±2.5 dB (Magnetic Loop Antenna)
30 MHz to 1000 MHz	±2.0 dB (Biconilog Antenna)
1 GHz to 40 GHz	±2.3 dB (Horn Antenna)

Conducted measurement

150 kHz to 30 MHz	±0.7 dB (LISN)
-------------------	----------------

RF conducted measurement	±0.5 dB
--------------------------	---------

##### **4.3    Environmental Conditions during Testing:**

The following environmental conditions were maintained during the course of testing:

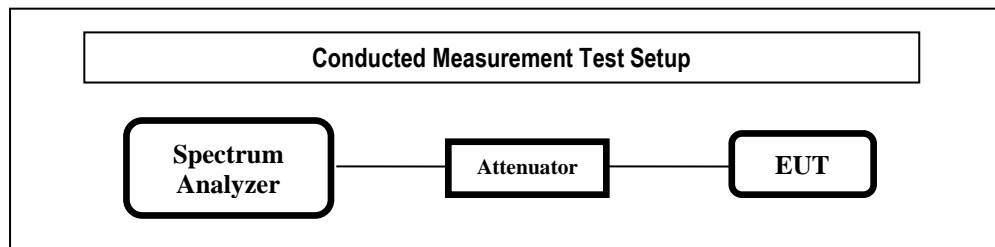
- Ambient Temperature: 20-25°C
- Relative humidity: 40-60%

Deviating test conditions are indicated at individual test description where applicable.

## 5 Measurement Procedures

Testing is performed according to the guidelines provided in FCC publication (KDB) 971168 D01 v02r02 – “Measurement Guidance for Certification of Licensed Digital Transmitters” and according to relevant parts of TIA-603C 2004 and ANSI/TIA-603-D-2010 as detailed below.

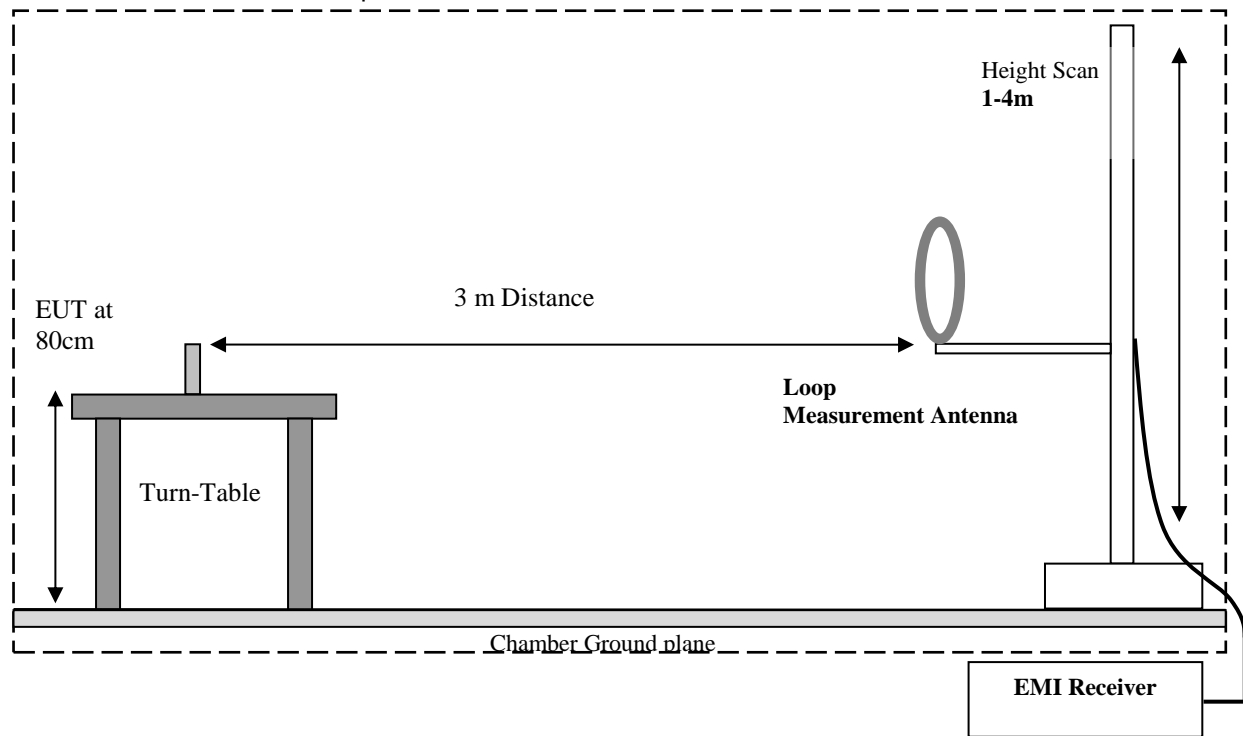
### 5.1 Conducted Setup Block diagram



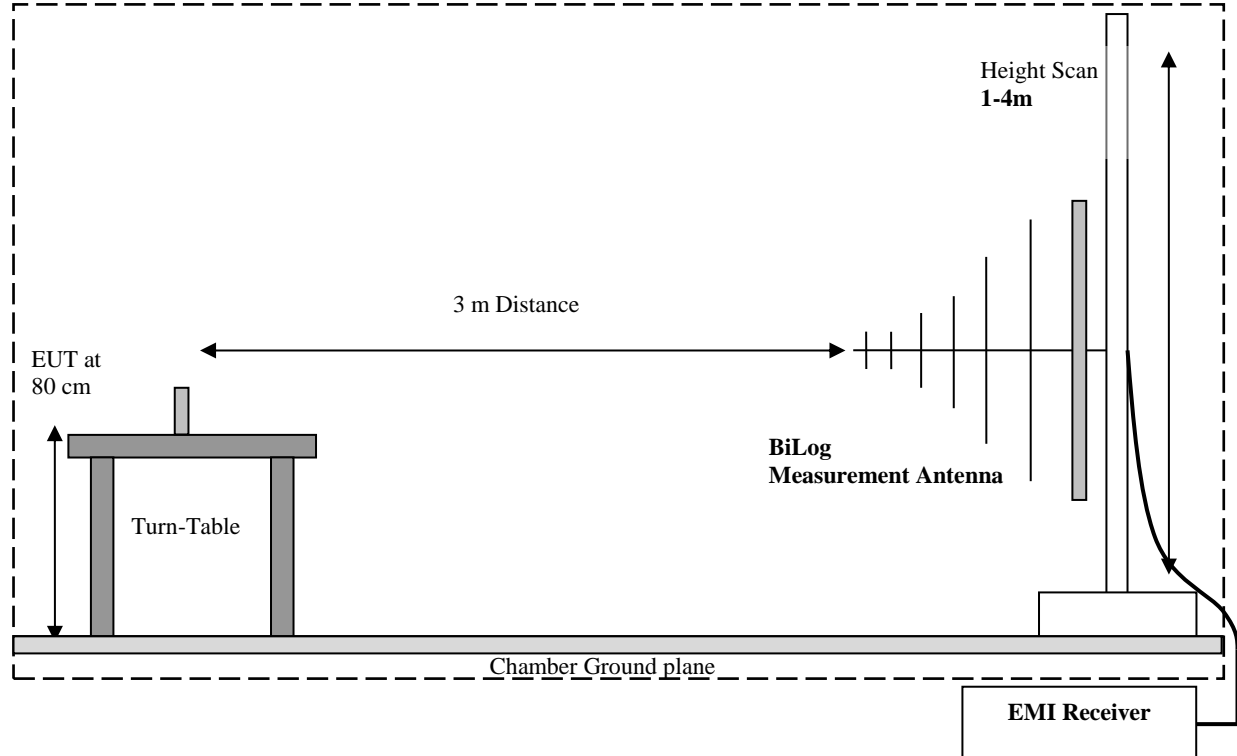
### 5.2 Radiated Measurement

- The exploratory measurement is accomplished by running a matrix of 16 sweeps over the required frequency range with R&S Test-SW EMC32 for 4 positions of the turntable, two orthogonal positions of the EUT and both antenna polarizations. This procedure exceeds the requirement of the above standards to cover the 3 orthogonal axis of the EUT. A max peak detector is utilized during the exploratory measurement. The Test-SW creates an overall maximum trace for all 12 sweeps and saves the settings for each point of this trace. The maximum trace is part of the test report.
- The 10 highest emissions are selected with an automatic algorithm of EMC32 searching for peaks in the noise floor and ensuring that broadband signals are not selected multiple times.
- The maxima are then put through the final measurement and again maximized in a 90deg range of the turntable, fine search in frequency domain and height scan between 1m and 4m.
- The above procedure is repeated for all possible ways of power supply to EUT and for all supported modulations.
- In case there are no emissions above noise floor level only the maximum trace is reported as described above.
- The results are split up into up to 4 frequency ranges due to antenna bandwidth restrictions. A magnetic loop is used from 9 kHz to 30 MHz, a Biconilog antenna is used from 30 MHz to 1 GHz, and two different horn antennas are used to cover frequencies up to 40 GHz.

### Radiated Emissions Test Setup below 30MHz Measurements

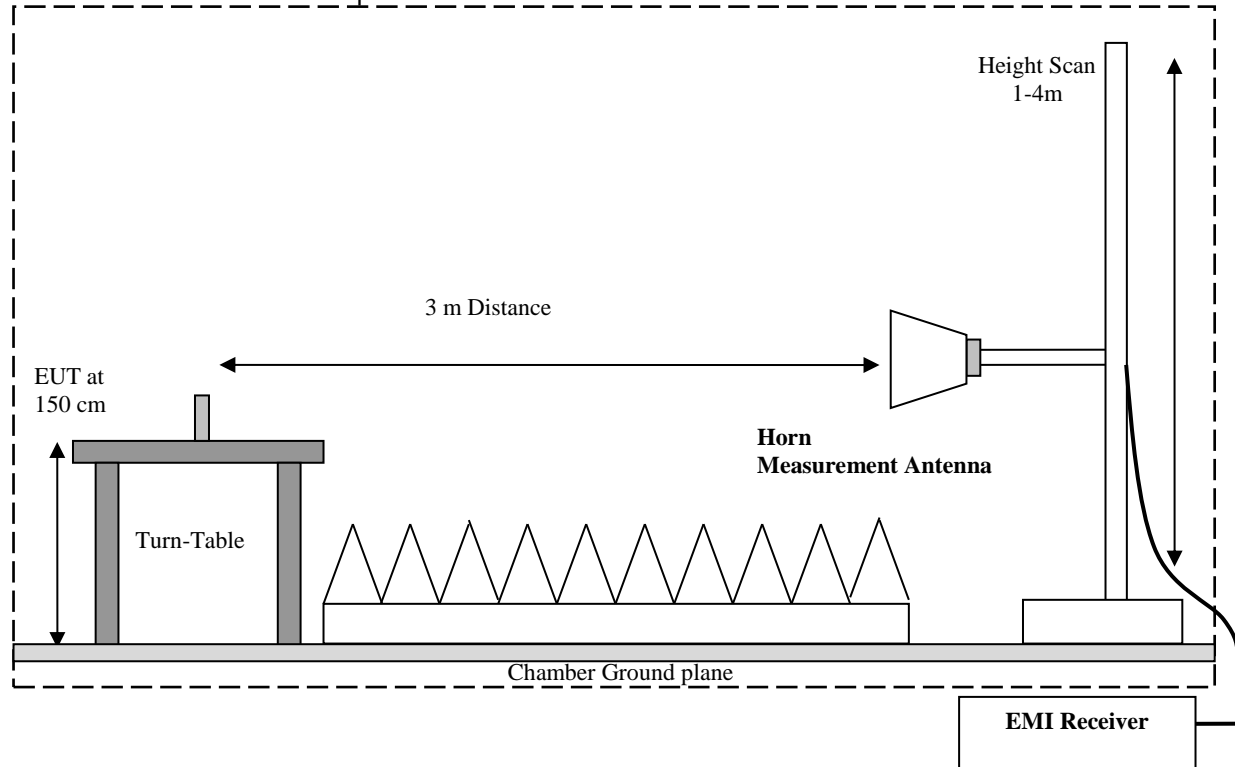


### Radiated Emissions Test Setup 30MHz-1GHz Measurements





### Radiated Emissions Test Setup above 1GHz Measurements



### 5.3 Sample Calculations for Field Strength Measurements

Field Strength is calculated from the Spectrum Analyzer/ Receiver readings, taking into account the following parameters:

- Measured reading in dB $\mu$ V
- Cable Loss between the receiving antenna and SA in dB and
- Antenna Factor in dB/m

All radiated measurement plots in this report are taken from a test SW that calculates the Field Strength based on the following equation:

$$FS \text{ (dB}\mu\text{V/m)} = \text{Measured Value on SA (dB}\mu\text{V)} - \text{Cable Loss (dB)} + \text{Antenna Factor (dB/m)}$$

Example:

Frequency (MHz)	Measured SA (dB $\mu$ V)	Cable Loss (dB)	Antenna Factor Correction (dB)	Field Strength Result (dB $\mu$ V/m)
1000	80.5	3.5	14	98.0

## 6 Measurement Results Summary

### 6.1 FCC 24 / RSS-133

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§2.1046; §24.232	RF Output Power	Nominal	LTE Band 2	■	□	□	□	Complies
§2.1055; §24.235	Frequency Stability	Extreme Temperature and Voltage	LTE Band 2	■	□	□	□	Complies
§2.1049; §24.238	Occupied Bandwidth	Nominal	LTE Band 2	■	□	□	□	Complies
§2.1051; §24.238	Band Edge Compliance	Nominal	LTE Band 2	■	□	□	□	Complies
§2.1051; §24.238	Conducted Spurious Emissions	Nominal	LTE Band 2	□	□	□	■	Note 2
§2.1053; §24.238	Radiated Spurious Emissions	Nominal	LTE Band 2	■	□	□	□	Complies

Note 1: NA= Not Applicable; NP= Not Performed.

Note 2: Spurious emissions were evaluated with radiated measurement.

### 6.2 FCC 27 / RSS-139

Test Specification	Test Case	Temperature and Voltage Conditions	Mode	Pass	Fail	NA	NP	Result
§2.1046; §27.50	RF Output Power	Nominal	LTE Band 4	■	□	□	□	Complies
§2.1055; §27.54	Frequency Stability	Extreme Temperature and Voltage	LTE Band 4	■	□	□	□	Complies
§2.1049; §27.53	Occupied Bandwidth	Nominal	LTE Band 4	■	□	□	□	Complies
§2.1051; §27.53	Band Edge Compliance	Nominal	LTE Band 4	■	□	□	□	Complies
§2.1051; §27.53	Conducted Spurious Emissions	Nominal	LTE Band 4	□	□	□	■	Note 2
§2.1053; §27.53	Radiated Spurious Emissions	Nominal	LTE Band 4	■	□	□	□	Complies

Note 1: NA= Not Applicable; NP= Not Performed.

Note 2: Spurious emissions were evaluated with radiated measurement.

## 7 Test Result Data

### 7.1 RF Output Power

#### 7.1.1 Conducted Measurement according to: FCC: CFR 47 Part 2.1046; Part 24.232; Part 27.50, utilizing KDB 971168 D01 Power Meas License Digital Systems v02r02 - Section 5.2.1

Spectrum Analyzer settings for CCDF procedure for PAPR measurements:

- $RBW \geq OBW$
- Number of counts = 10000
- Sweep time  $\geq 1\text{ms}$
- Record the maximum PAPR level associated with a probability of 0.1%

#### 7.1.2 Limits:

##### 7.1.2.1 FCC Part 24.232

Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications.

Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

##### 7.1.2.2 FCC Part 27.50

The power of each fixed or base station transmitting in the 1995-2000 MHz, the 2110-2155 MHz 2155-2180 MHz band, or 2180-2200 MHz band and situated in any geographic location other than that described in paragraph (d)(1) of this section is limited to an EIRP of 1640 watts/MHz (62.15dBm/MHz) when transmitting with an emission bandwidth greater than 1MHz.

### 7.1.3 Test conditions and setup:

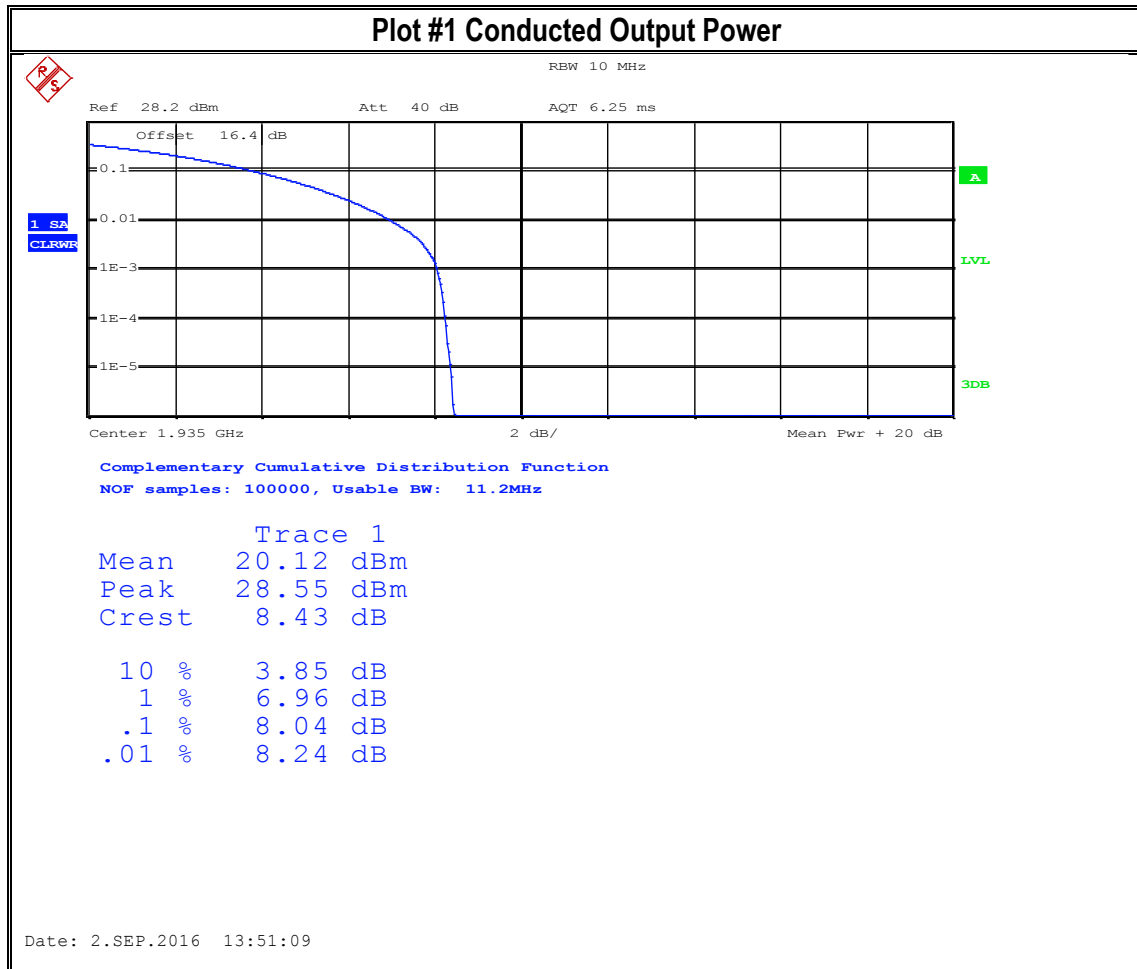
Ambient Temperature (C)	EUT Set-Up #	EUT operating mode	Power Input (VDC)	Measurement Path Correction (dB)
23	2	LTE Band 2 / LTE Band 4	48	16.4

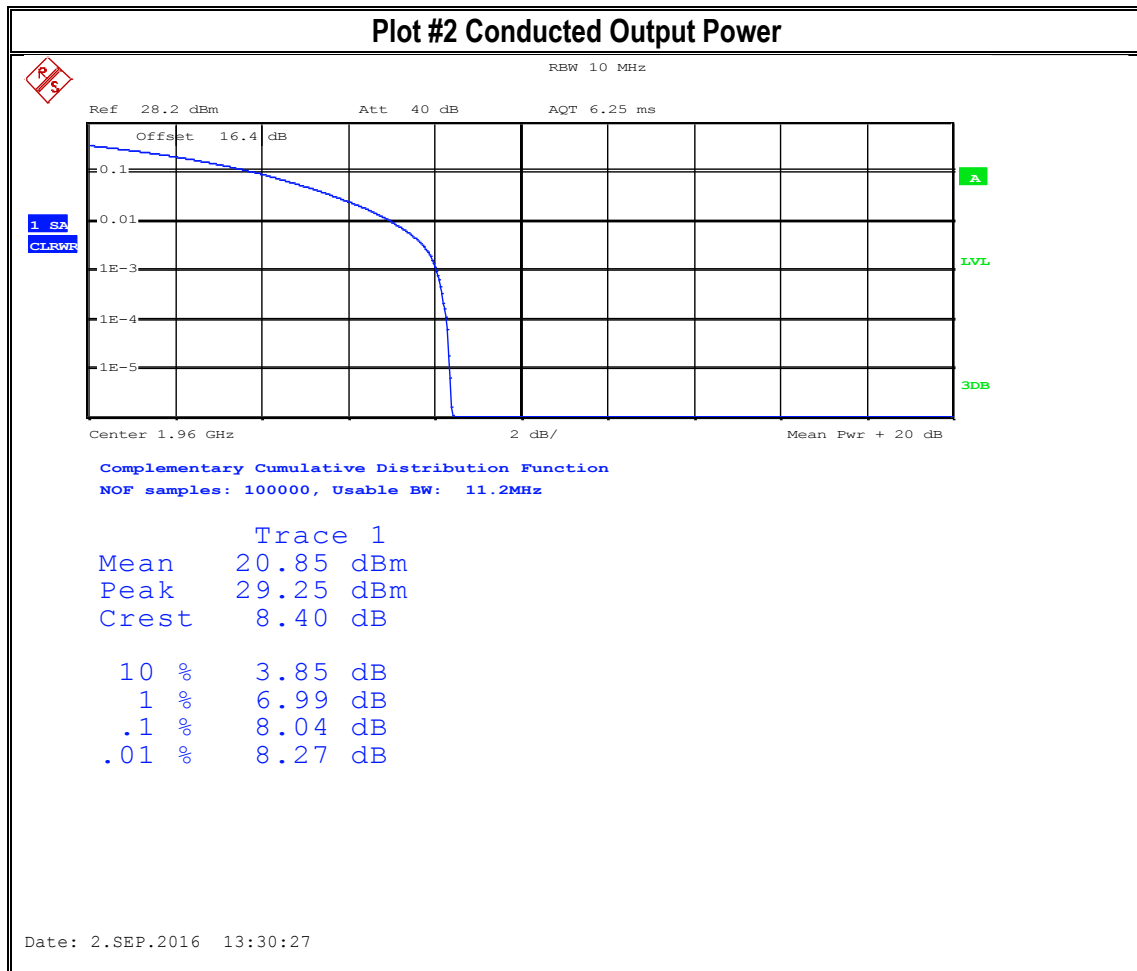
### 7.1.4 Measurement result ERP / EIRP:

QPSK Output Power							
Plot #	Chanel #	Frequency (MHz)	Maximum AVG Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Result
1	LTE B 2 / low	1935	20.12	3	23.12	< 33 EIRP	Pass
2	LTE B 2 / mid	1960	20.85	3	23.85	< 33 EIRP	Pass
3	LTE B 2 / high	1985	19.46	3	22.46	< 33 EIRP	Pass
4	LTE B 4 / low	2115	20.46	3	23.46	< 62.15dBm/MHz	Pass
5	LTE B 4 / mid	2132.5	20.40	3	23.4	< 62.15dBm/MHz	Pass
6	LTE B 4 / high	2150	19.62	3	22.62	< 62.15dBm/MHz	Pass
16-QAM Output Power							
Plot #	Chanel #	Frequency (MHz)	Maximum AVG Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Result
7	LTE B 2 / low	1935	19.56	3	22.56	< 33 EIRP	Pass
8	LTE B 2 / mid	1960	20.01	3	23.01	< 33 EIRP	Pass
9	LTE B 2 / high	1985	18.88	3	21.88	< 33 EIRP	Pass
10	LTE B 4 / low	2115	20.1	3	23.1	< 62.15dBm/MHz	Pass
11	LTE B 4 / mid	2132.5	19.72	3	22.72	< 62.15dBm/MHz	Pass
12	LTE B 4 / high	2150	19.43	3	22.43	< 62.15dBm/MHz	Pass
64-QAM Output Power							
Plot #	Chanel #	Frequency (MHz)	Maximum AVG Conducted Output Power (dBm)	Antenna Gain (dBi)	EIRP (dBm)	Limit (dBm)	Result
13	LTE B 2 / low	1935	19.71	3	22.71	< 33 EIRP	Pass
14	LTE B 2 / mid	1960	20.04	3	23.04	< 33 EIRP	Pass
15	LTE B 2 / high	1985	18.91	3	21.91	< 33 EIRP	Pass
16	LTE B 4 / low	2115	20.1	3	23.1	< 62.15dBm/MHz	Pass
17	LTE B 4 / mid	2132.5	19.75	3	22.75	< 62.15dBm/MHz	Pass
18	LTE B 4 / high	2150	19.41	3	22.41	< 62.15dBm/MHz	Pass

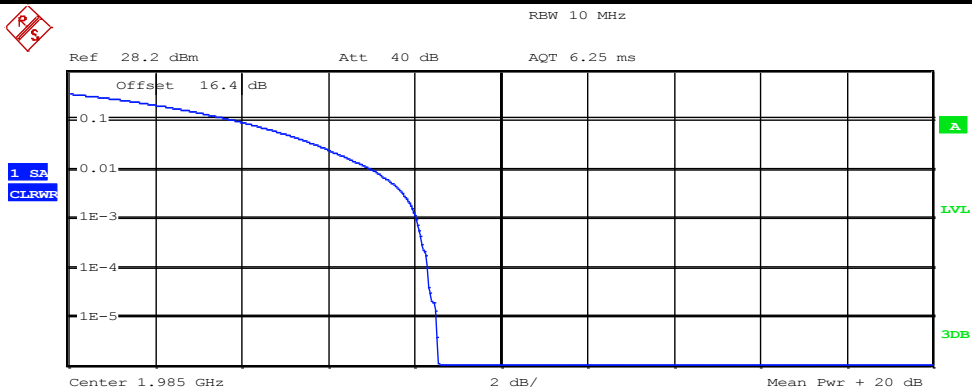


## 7.1.5 Measurement Plots:





### Plot #3 Conducted Output Power

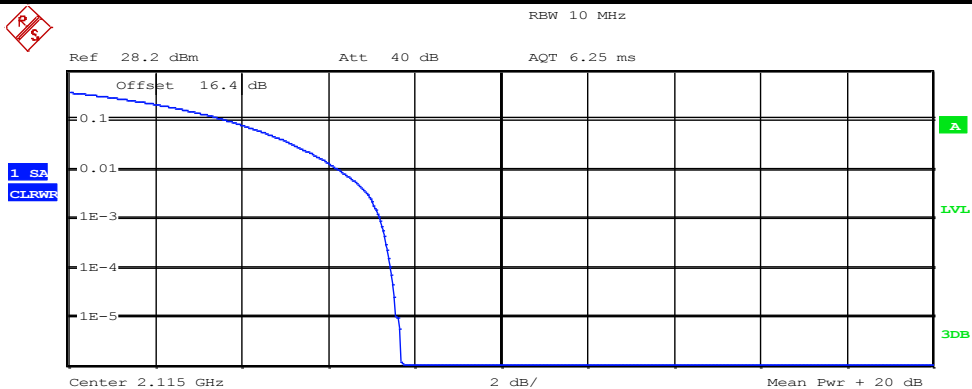


Complementary Cumulative Distribution Function  
 NOF samples: 100000, Usable BW: 11.2MHz

	Trace 1
Mean	19.46 dBm
Peak	27.99 dBm
Crest	8.53 dB
10 %	3.85 dB
1 %	6.99 dB
.1 %	8.04 dB
.01 %	8.30 dB

Date: 2.SEP.2016 13:50:15

### Plot #4 Conducted Output Power



Complementary Cumulative Distribution Function  
NOF samples: 100000, Usable BW: 11.2MHz

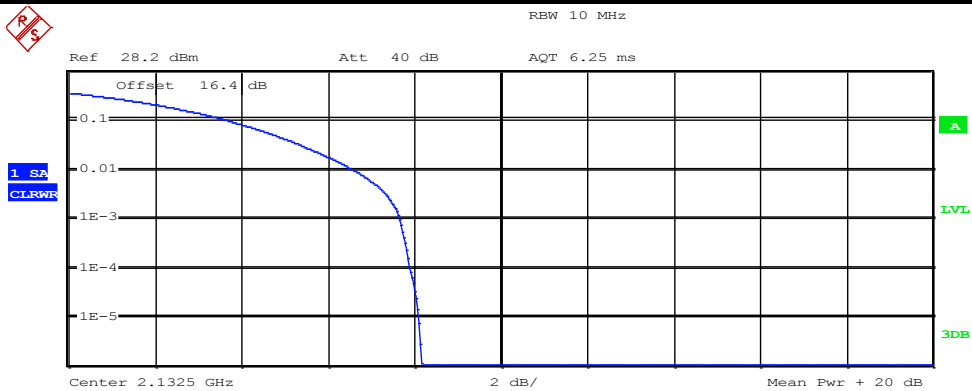
Trace 1  
Mean 20.46 dBm  
Peak 28.15 dBm  
Crest 7.69 dB

10 % 3.69 dB  
1 % 6.22 dB  
.1 % 7.18 dB  
.01 % 7.44 dB

Date: 2.SEP.2016 13:56:31



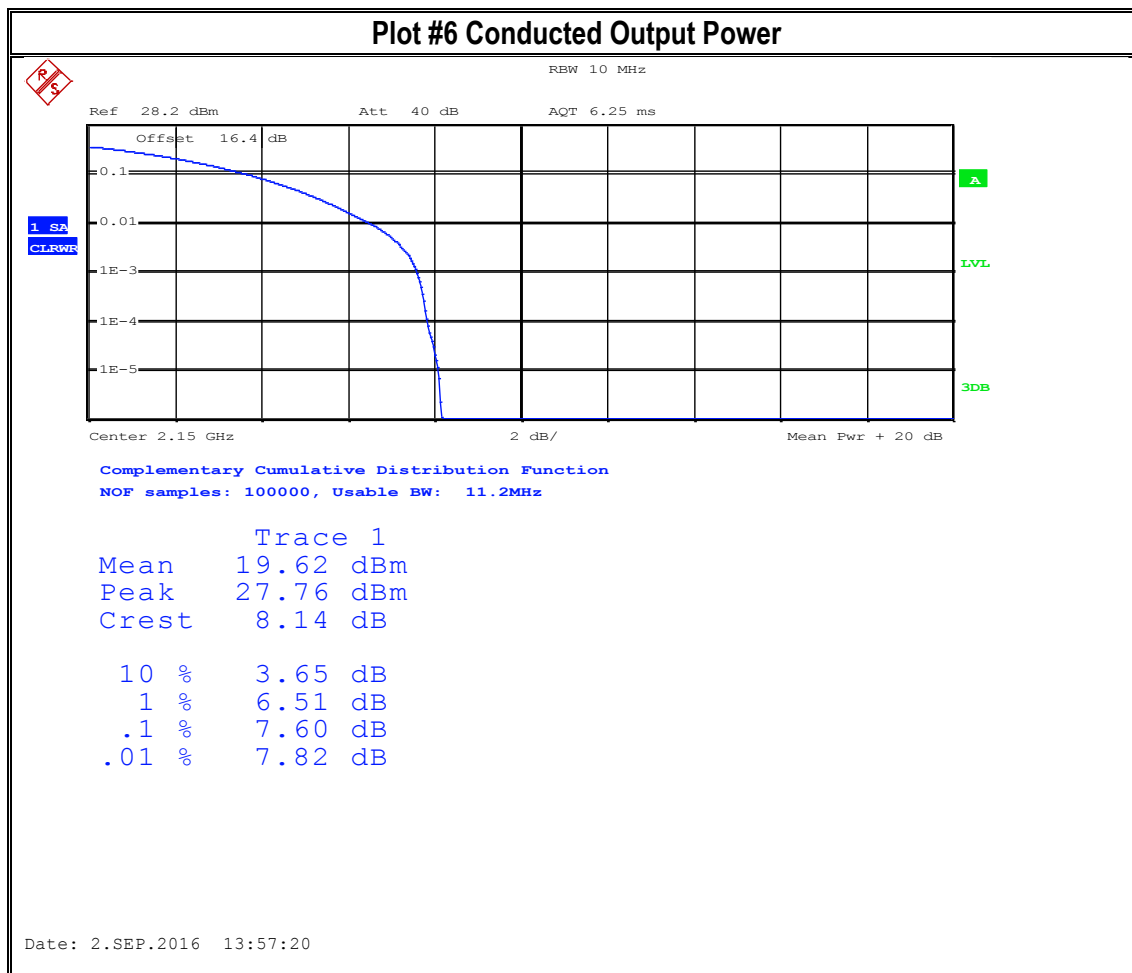
### Plot #5 Conducted Output Power



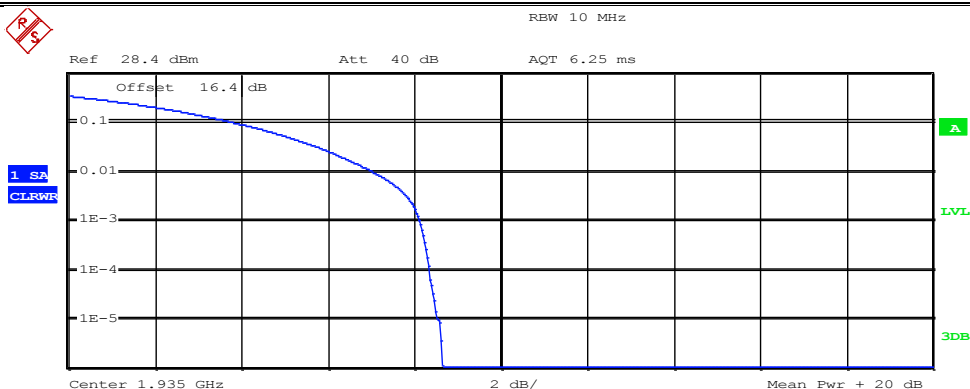
Complementary Cumulative Distribution Function  
 NOF samples: 100000, Usable BW: 11.2MHz

Trace 1  
 Mean 20.40 dBm  
 Peak 28.55 dBm  
 Crest 8.15 dB  
  
 10 % 3.69 dB  
 1 % 6.57 dB  
 .1 % 7.66 dB  
 .01 % 7.88 dB

Date: 2.SEP.2016 13:20:01



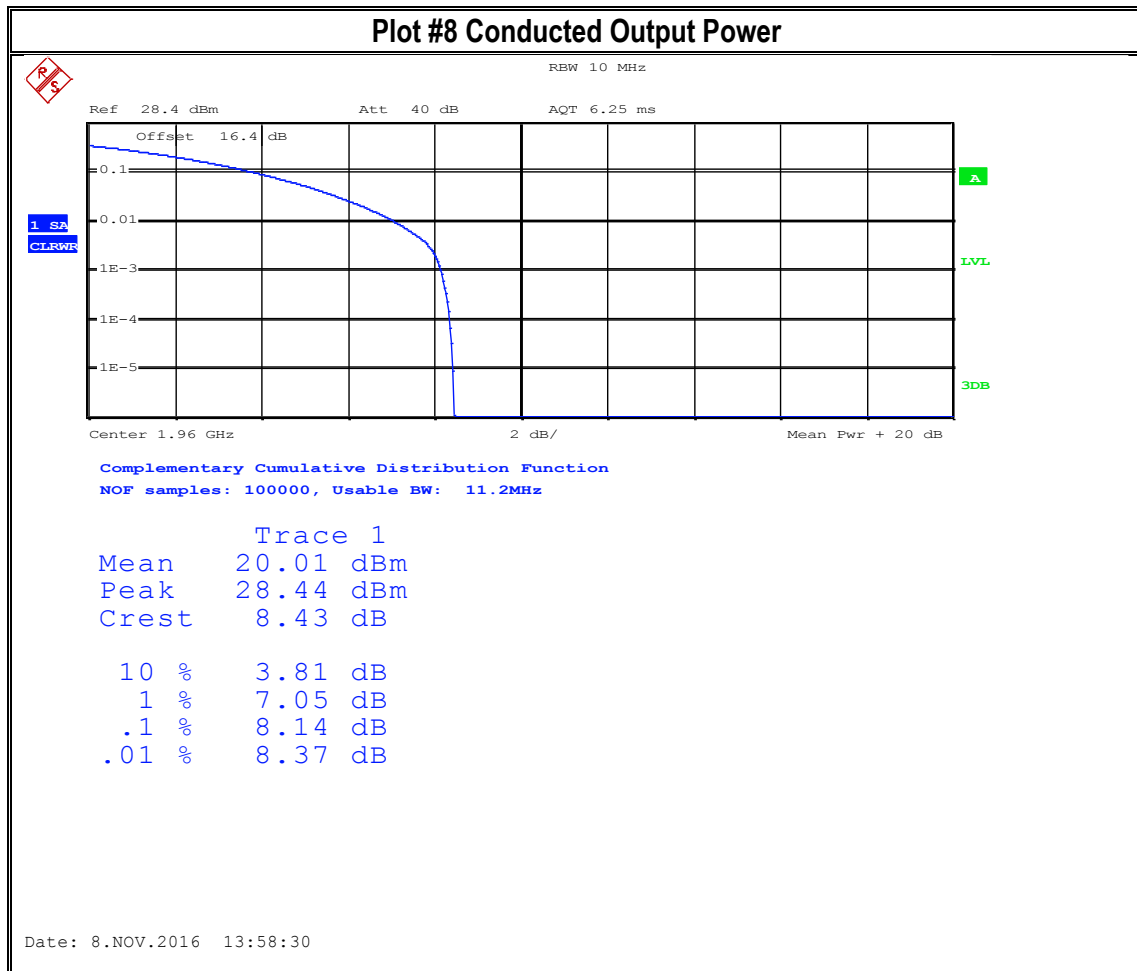
### Plot #7 Conducted Output Power

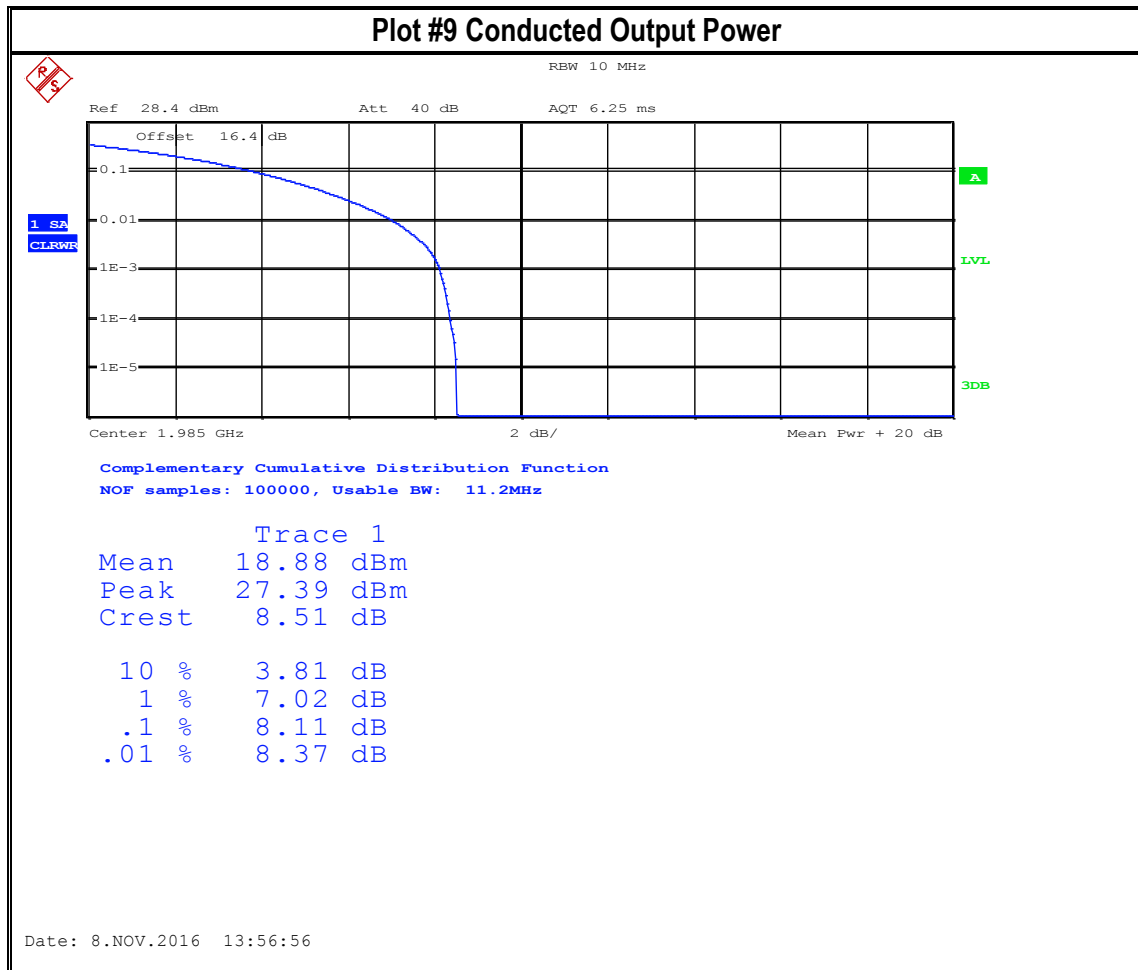


Complementary Cumulative Distribution Function  
 NOF samples: 100000, Usable BW: 11.2MHz

Trace 1  
 Mean 19.56 dBm  
 Peak 28.19 dBm  
 Crest 8.63 dB  
 10 % 3.85 dB  
 1 % 7.02 dB  
 .1 % 8.11 dB  
 .01 % 8.33 dB

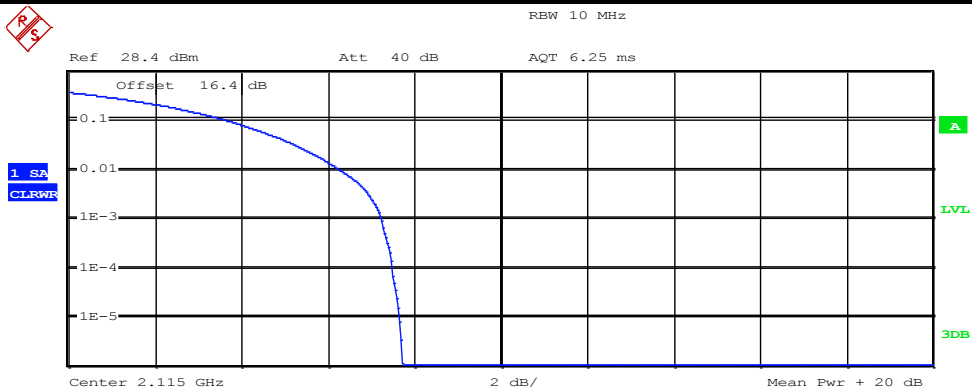
Date: 8.NOV.2016 14:00:00





Date: 8.NOV.2016 13:56:56

### Plot #10 Conducted Output Power

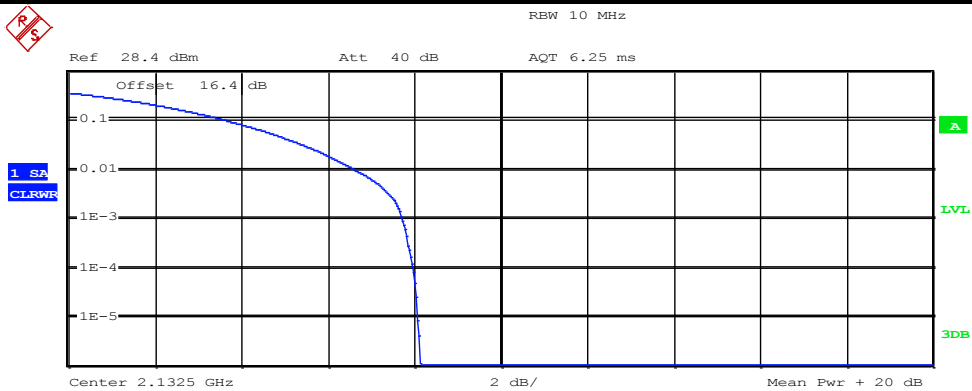


Complementary Cumulative Distribution Function  
 NOF samples: 100000, Usable BW: 11.2MHz

Trace 1  
 Mean 20.10 dBm  
 Peak 27.80 dBm  
 Crest 7.70 dB  
  
 10 % 3.65 dB  
 1 % 6.25 dB  
 .1 % 7.21 dB  
 .01 % 7.47 dB

Date: 8.NOV.2016 14:28:46

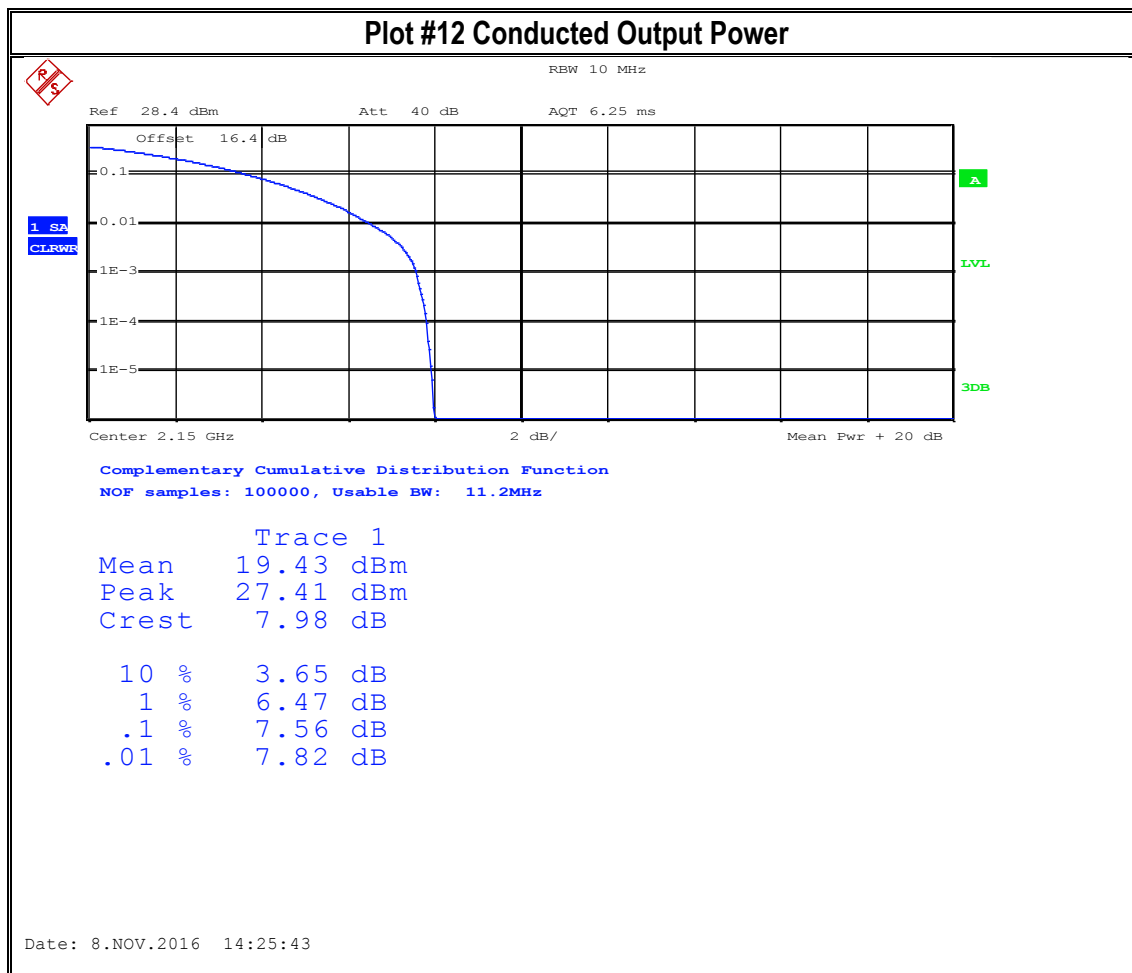
### Plot #11 Conducted Output Power



Complementary Cumulative Distribution Function  
 NOF samples: 100000, Usable BW: 11.2MHz

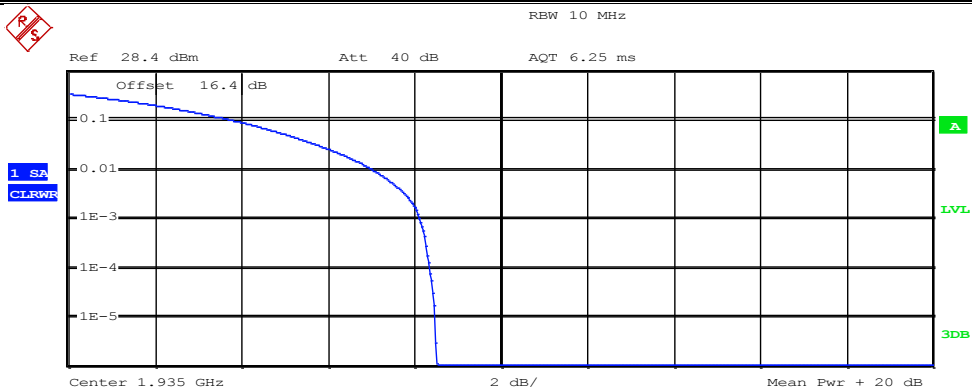
Trace 1  
 Mean 19.72 dBm  
 Peak 27.84 dBm  
 Crest 8.12 dB  
 10 % 3.65 dB  
 1 % 6.60 dB  
 .1 % 7.69 dB  
 .01 % 7.95 dB

Date: 8.NOV.2016 14:27:12





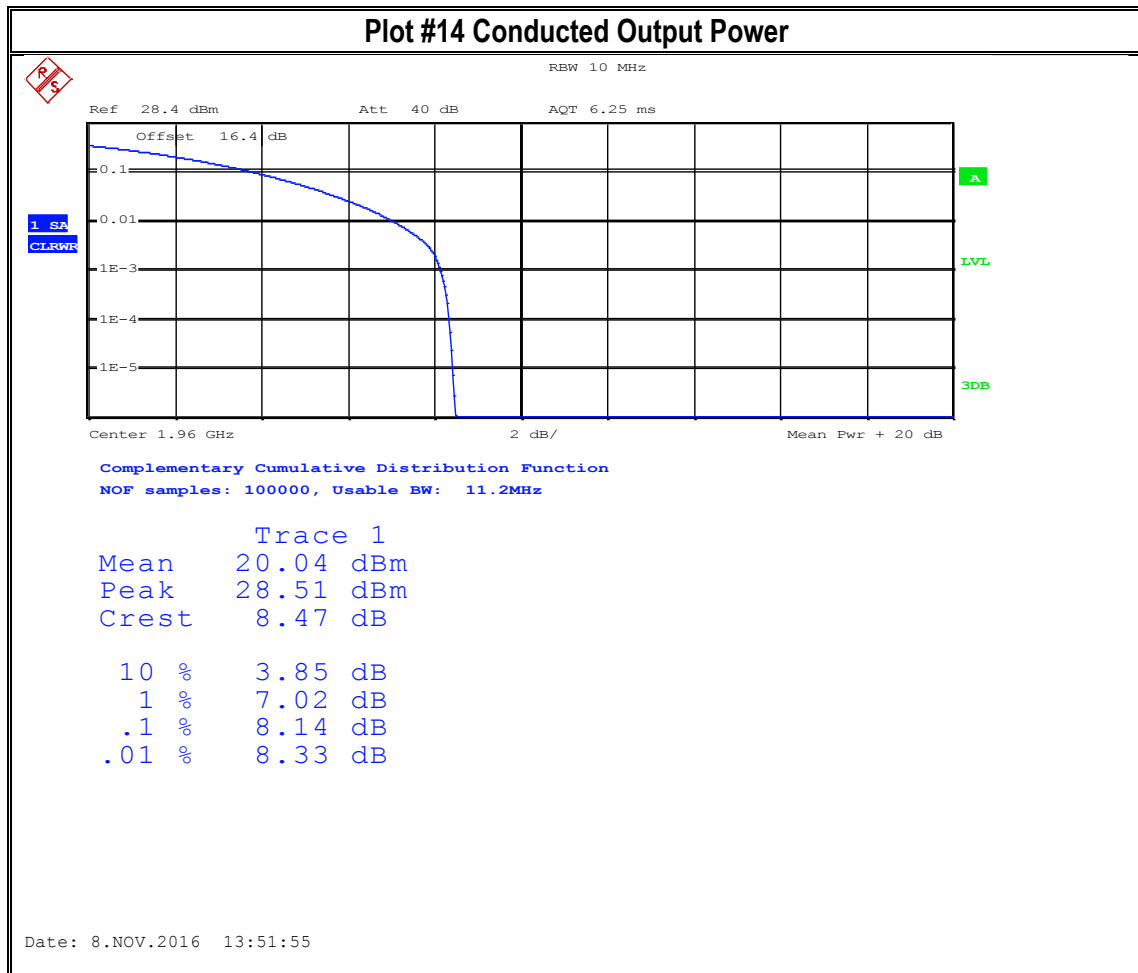
### Plot #13 Conducted Output Power



Complementary Cumulative Distribution Function  
 NOF samples: 100000, Usable BW: 11.2MHz

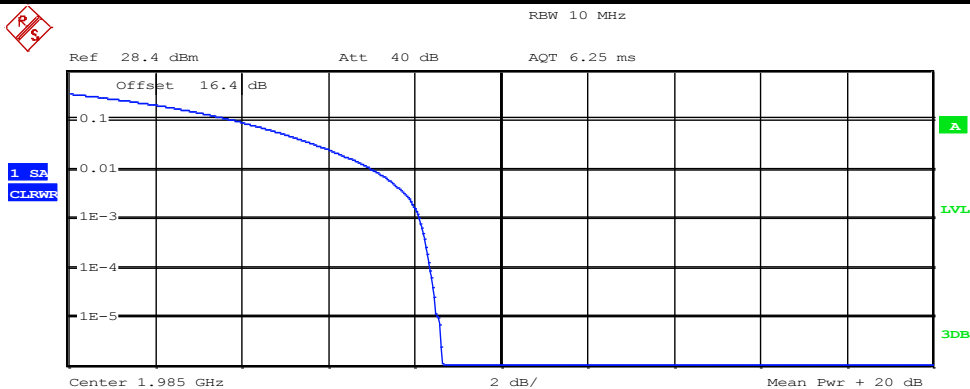
Trace 1  
 Mean 19.71 dBm  
 Peak 28.19 dBm  
 Crest 8.49 dB  
 10 % 3.85 dB  
 1 % 7.02 dB  
 .1 % 8.11 dB  
 .01 % 8.33 dB

Date: 8.NOV.2016 13:49:12





### Plot #15 Conducted Output Power



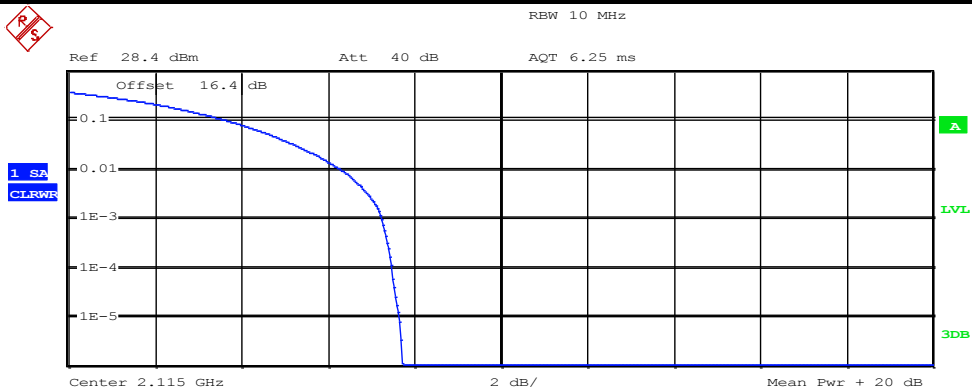
Complementary Cumulative Distribution Function  
 NOF samples: 100000, Usable BW: 11.2MHz

Trace 1  
 Mean 18.91 dBm  
 Peak 27.53 dBm  
 Crest 8.63 dB

10 % 3.85 dB  
 1 % 7.02 dB  
 .1 % 8.11 dB  
 .01 % 8.37 dB

Date: 8.NOV.2016 13:53:30

### Plot #16 Conducted Output Power

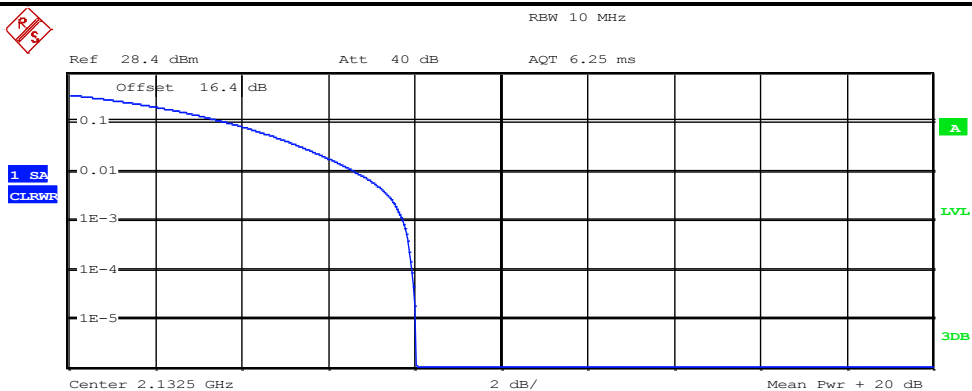


Complementary Cumulative Distribution Function  
 NOF samples: 100000, Usable BW: 11.2MHz

Trace 1  
 Mean 20.10 dBm  
 Peak 27.80 dBm  
 Crest 7.70 dB  
  
 10 % 3.65 dB  
 1 % 6.28 dB  
 .1 % 7.24 dB  
 .01 % 7.47 dB

Date: 8.NOV.2016 14:20:00

### Plot #17 Conducted Output Power

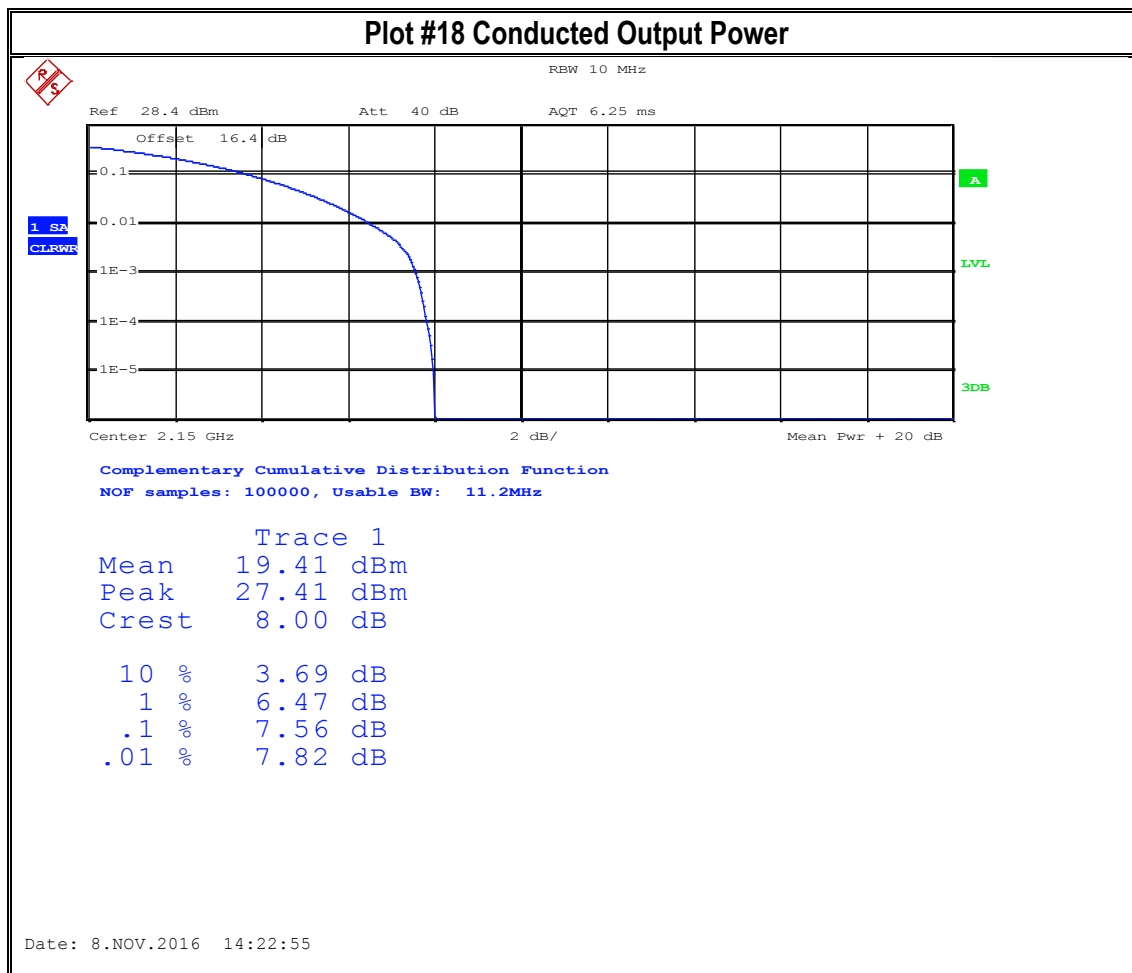


Complementary Cumulative Distribution Function  
 NOF samples: 100000, Usable BW: 11.2MHz

Trace 1

Mean	19.75 dBm
Peak	27.77 dBm
Crest	8.02 dB
10 %	3.69 dB
1 %	6.60 dB
.1 %	7.72 dB
.01 %	7.95 dB

Date: 8.NOV.2016 14:16:33



## 7.2 Frequency Stability

### 7.2.1 Measurement according to: FCC: CFR 47 Part 2.1055; 24.235; 27.54, and ANSI/TIA-603-D-2010

The center frequency of transmission on middle channel was measured at the low and high supply voltage specified for the equipment in the range of 0 °C to 50 °C' at 10 °C intervals. The frequency stability was calculated using the following equation:

$$ppm\ error = \left( \frac{MCF_{MHz}}{ACF_{MHz}} - 1 \right) * 10^6$$

where

$MCF_{MHz}$  is the Measured Carrier Frequency in MHz

$ACF_{MHz}$  is the Assigned Carrier Frequency in MHz

Spectrum Analyzer settings:

- RBW =30 kHz
- VBW ≥ 300Hz
- Set span = 10MHz
- Sweep time = auto couple
- Detector = Pk
- Trace mode = Clear Write
- Marker Stepsize = SWP POINTS
- Sweep Points = 10000 points
- Measure the frequency at the low and high edge (F low and F high)
- Calculate the center frequency  $MCF = F\ low + (F\ high - F\ low)/2$

### 7.2.2 Limits:

#### 7.2.2.1 Part 24.235 Frequency stability:

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

#### 7.2.2.2 Part 27.54 Frequency stability:

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

From the maximum measured occupied bandwidth of 8.92MHz per channel follows that the center frequency for any transmission have to be within 0.5MHz of the ACF so the frequency stability requirements in Part 22.235 and 27.54 are satisfied. This translates to frequency stability limit of < 255ppm.

### 7.2.3 Test conditions and setup:

Ambient Temperature (C)	EUT Set-Up #	EUT operating mode	Power Input (VDC)
0°C and 50°C	2	LTE Band 2 / LTE Band 4	44; 57

### 7.2.4 Measurement result:

Temperature (°C)	Supply Power (V)	MCF (MHz)	ACF (MHz)	Frequency Stability (ppm)	Limit (ppm)	Result
0	44	1960.00217	1960	1.1	255	Pass
0	57	1960.00333	1960	1.7	255	Pass
10	44	1960.00350	1960	1.7	255	Pass
10	57	1960.00250	1960	1.2	255	Pass
20	44	1960.00317	1960	1.6	255	Pass
20	57	1960.00350	1960	1.7	255	Pass
30	44	1960.00250	1960	1.2	255	Pass
30	57	1960.00283	1960	1.4	255	Pass
40	44	1960.00350	1960	1.7	255	Pass
40	57	1960.00333	1960	1.7	255	Pass
50	44	1960.00233	1960	1.1	255	Pass
50	57	1960.00233	1960	1.1	255	Pass

Temperature (°C)	Supply Power (V)	MCF (MHz)	ACF (MHz)	Frequency Stability (ppm)	Limit (ppm)	Result
0	44	2132.49800	2132.5	-0.9	255	Pass
0	57	2132.49783	2132.5	-1	255	Pass
10	44	2132.50000	2132.5	0	255	Pass
10	57	2132.49883	2132.5	-0.5	255	Pass
20	44	2132.50067	2132.5	0.3	255	Pass
20	57	2132.49950	2132.5	-0.2	255	Pass
30	44	2132.49800	2132.5	-0.9	255	Pass
30	57	2132.49850	2132.5	-0.7	255	Pass
40	44	2132.49850	2132.5	-0.7	255	Pass
40	57	2132.49850	2132.5	-0.7	255	Pass
50	44	2132.49667	2132.5	-1.5	255	Pass
50	57	2132.49767	2132.5	-1	255	Pass



## 7.3 Occupied Bandwidth

### 7.3.1 Measurement according to: FCC: CFR 47 Part 2.1049; 24.238; 27.53, utilizing KDB 971168 D01 Power Meas License Digital Systems v02r02 - Power bandwidth (99%) measurement procedure - Section 4.2

Spectrum Analyzer settings:

- $RBW \geq 1\%$  to 5% of anticipated OBW.
- $VBW \geq 3 \times RBW$ .
- Set span  $\geq 2$  to 5 times OBW
- Sweep time = auto couple.
- Detector = Peak
- Trace mode = Max hold.
- Allow trace to fully stabilize.
- Use the 99 % power bandwidth function of the spectrum analyzer (if available) and report the measured bandwidth.

### 7.3.2 Requirement:

#### 7.3.2.1 FCC Part 2.1049

The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

(h) Transmitters employing digital modulation techniques—when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at the discretion of the user.

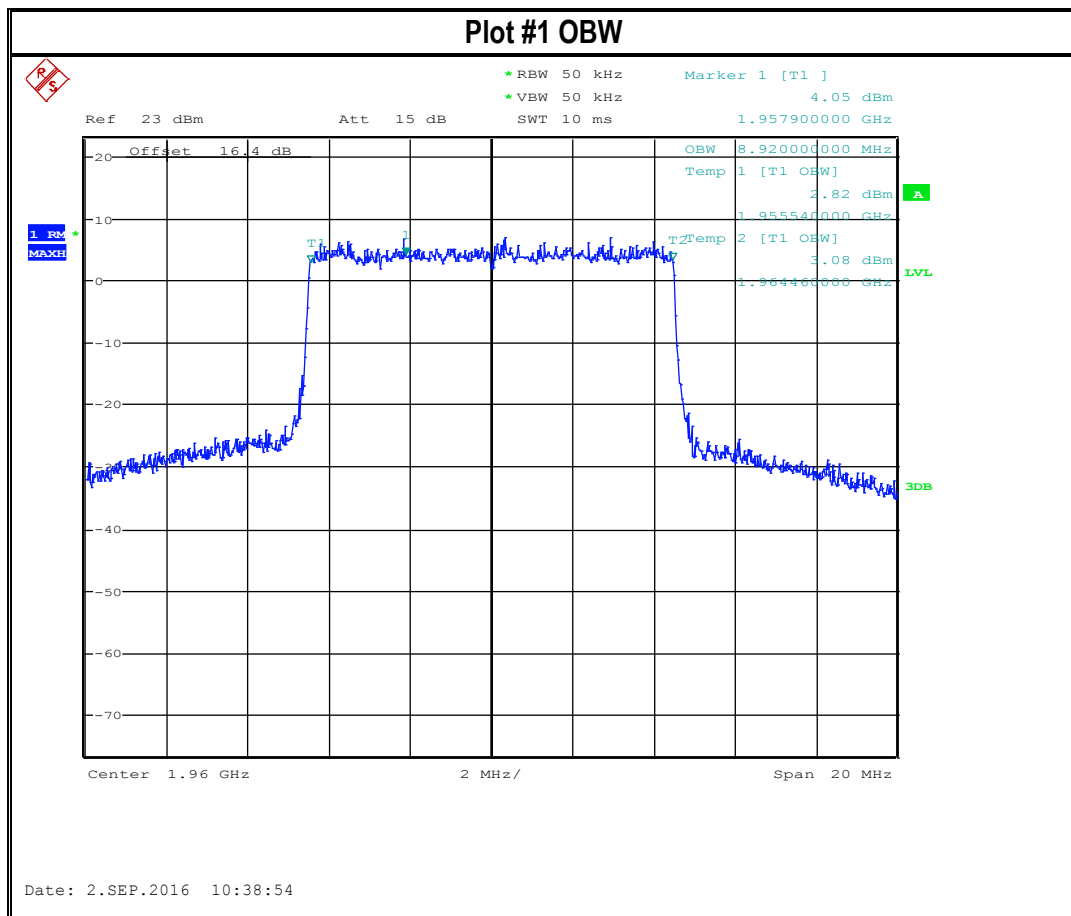
### 7.3.3 Test conditions and setup:

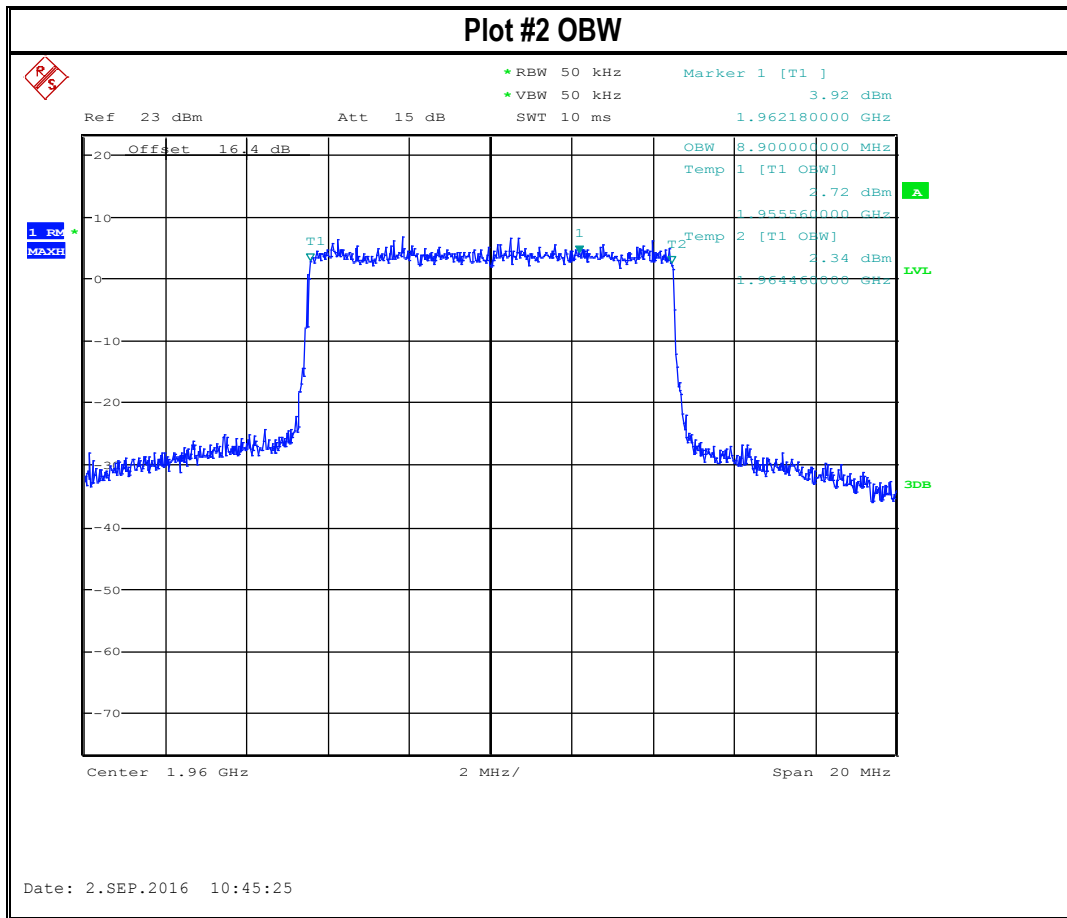
Ambient Temperature (C)	EUT Set-Up #	EUT operating mode	Power Input (VDC)	Measurement Path Correction (dB)
23	2	LTE Band 2 / LTE Band 4	48	16.4

### 7.3.4 Measurement result:

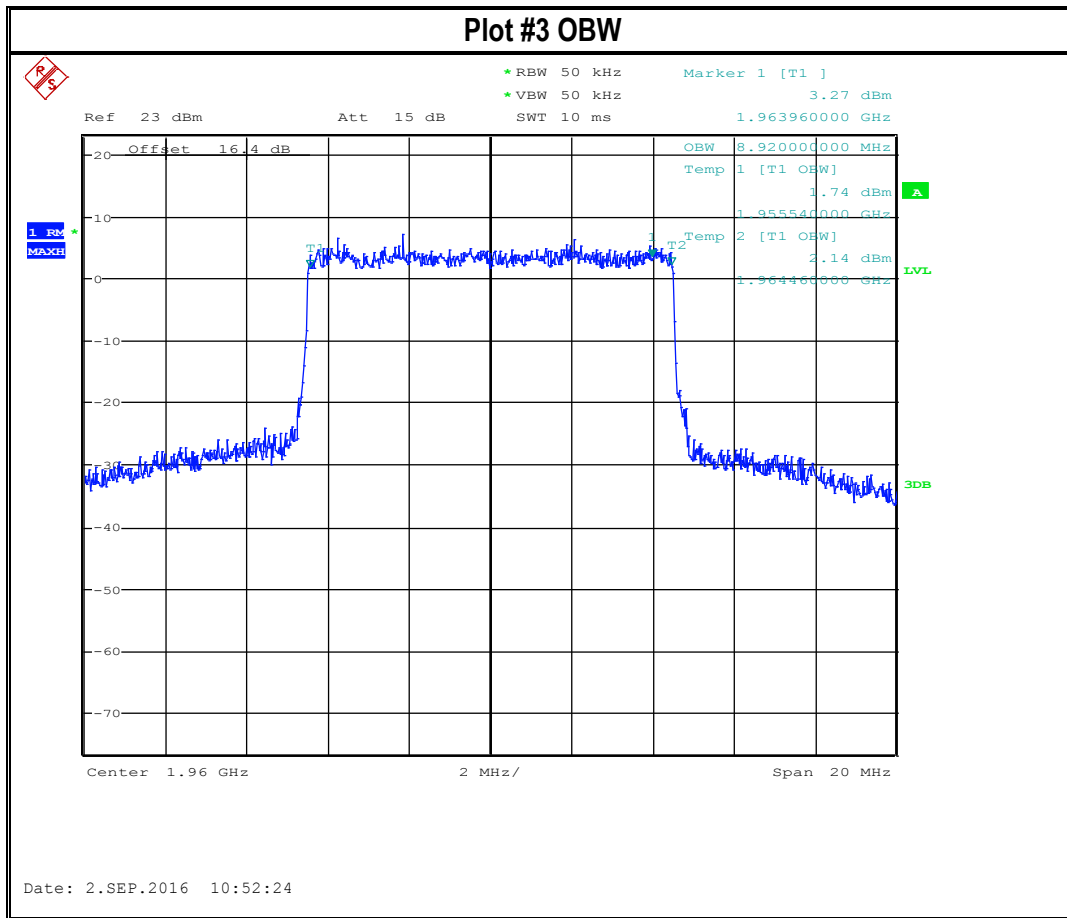
Plot #	EUT operating mode	Channel	Modulation	OBW (MHz)
1	LTE Band 2	Mid	QPSK	8.92
2	LTE Band 2	Mid	16-QAM	8.90
3	LTE Band 2	Mid	64-QAM	8.92
4	LTE Band 4	Mid	QPSK	8.9
5	LTE Band 4	Mid	16-QAM	8.9
6	LTE Band 4	Mid	64-QAM	8.92

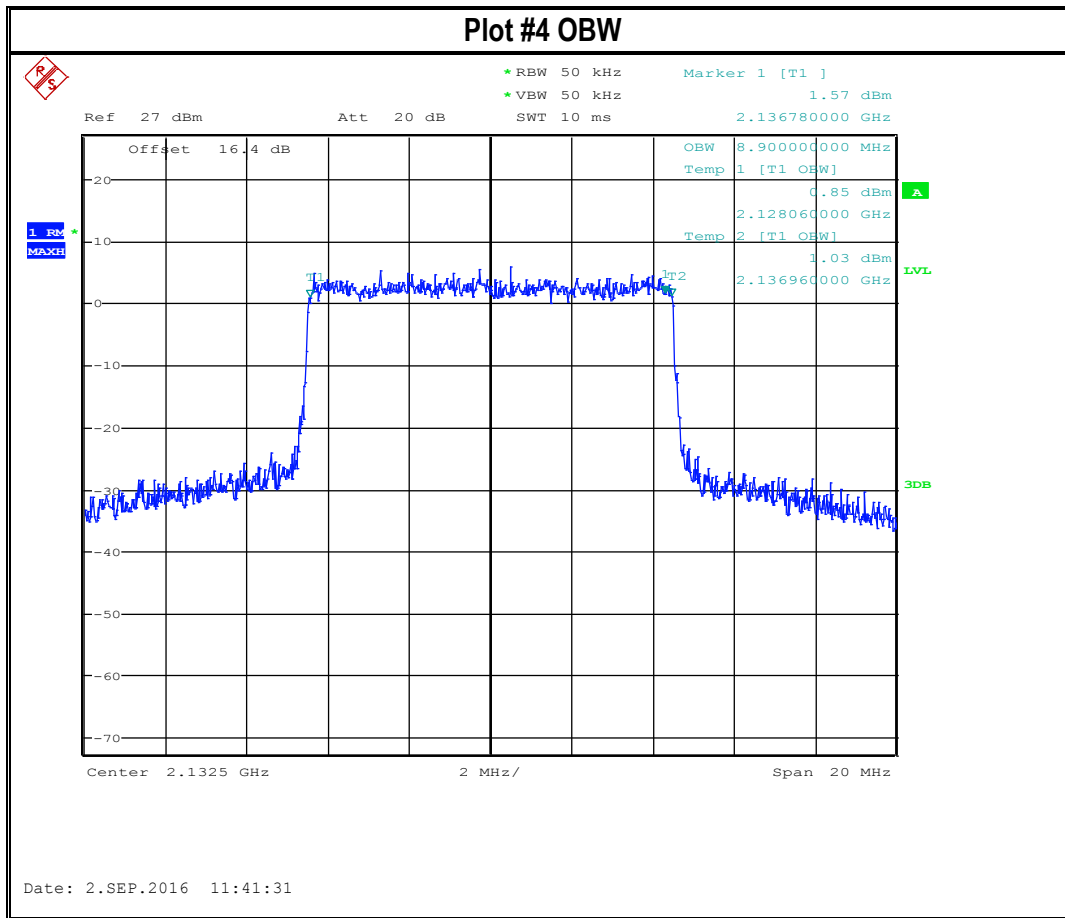
### 7.3.5 Measurement Plots:

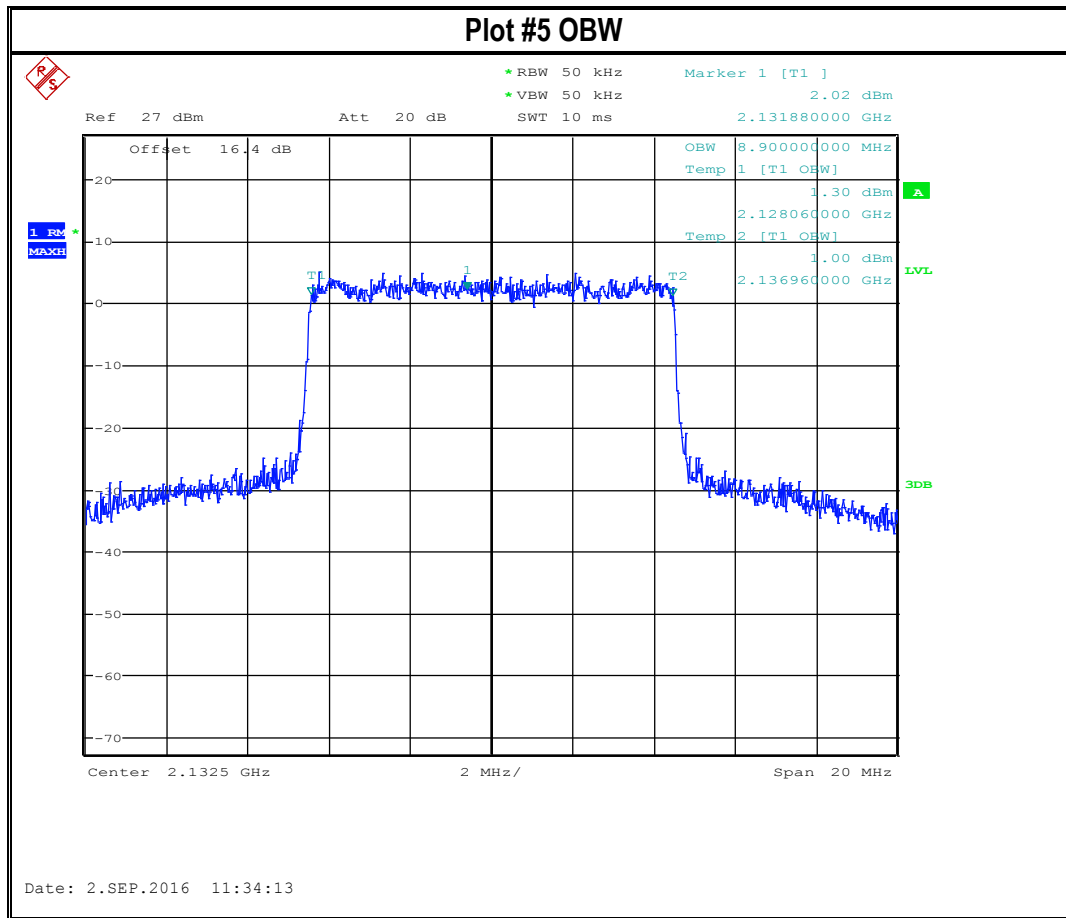


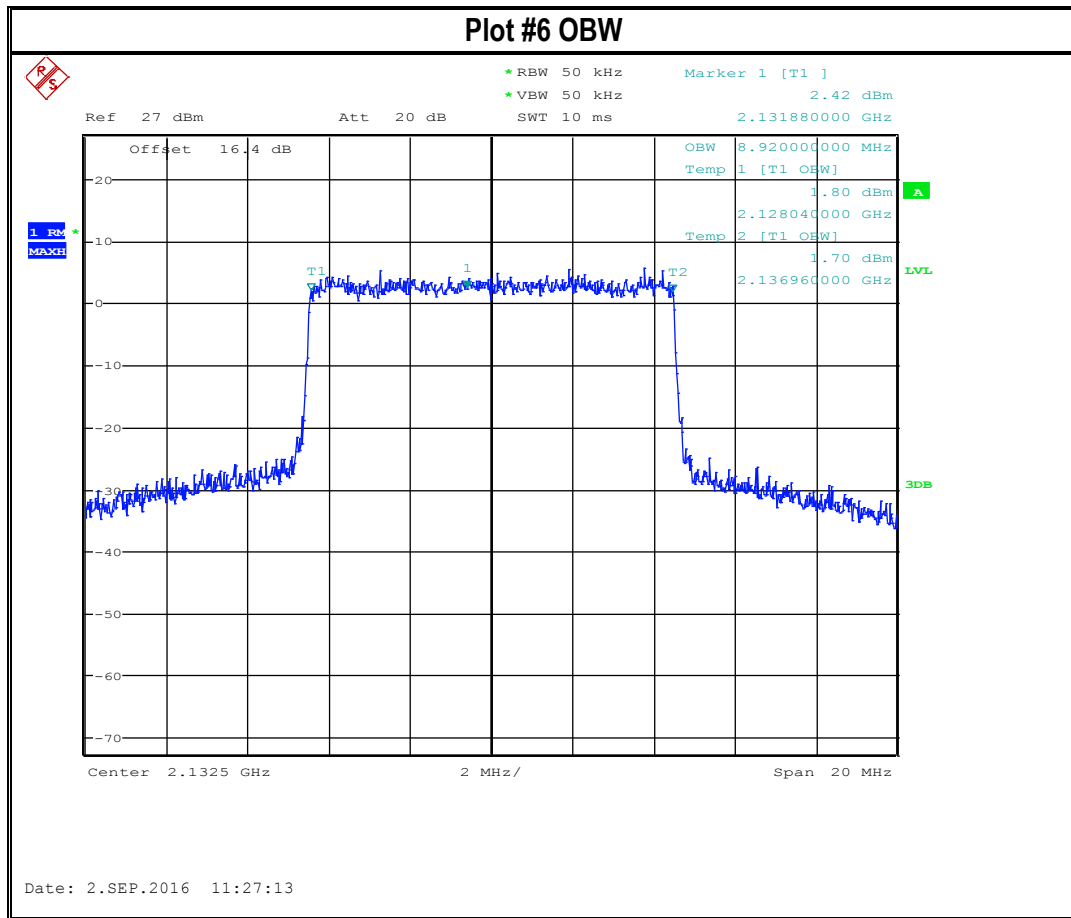


Date: 2.SEP.2016 10:45:25









## 7.4 Band Edge Compliance

### 7.4.1 Measurement according to FCC: CFR 47 Part 2.1051; 24.238; 27.53, utilizing KDB 971168 D01 Power Meas License Digital Systems v02r02 – Section 6

Spectrum Analyzer settings:

- $RBW \geq 1\%$  of OBW.
- $VBW \geq 3 \times RBW$ .
- Set span  $\geq 1$  MHz
- Sweep time = auto couple.
- Detector = RMS
- Trace mode = AVG.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the peak amplitude level.

### 7.4.2 Limits:

#### 7.4.2.1 FCC Part 24.238

(Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

Measurement procedure. Compliance with these rules is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. A narrower resolution bandwidth is permitted in all cases to improve measurement accuracy provided the measured power is integrated over the full required measurement bandwidth (i.e. 100 kHz or 1 percent of emission bandwidth, as specified). The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

#### 7.4.2.2 FCC Part 27.53

AWS emission limits—(1) General protection levels. Except as otherwise specified below, for operations in the 1695-1710 MHz, 1710-1755 MHz, 1755-1780 MHz, 1915-1920 MHz, 1995-2000 MHz, 2000-2020 MHz, 2110-2155 MHz, 2155-2180 MHz, and 2180-2200 bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) in watts by at least  $43 + 10 \log_{10}(P)$  dB.

Note: The limit calculation result is a constant of -13dBm.



#### 7.4.3 Test conditions and setup:

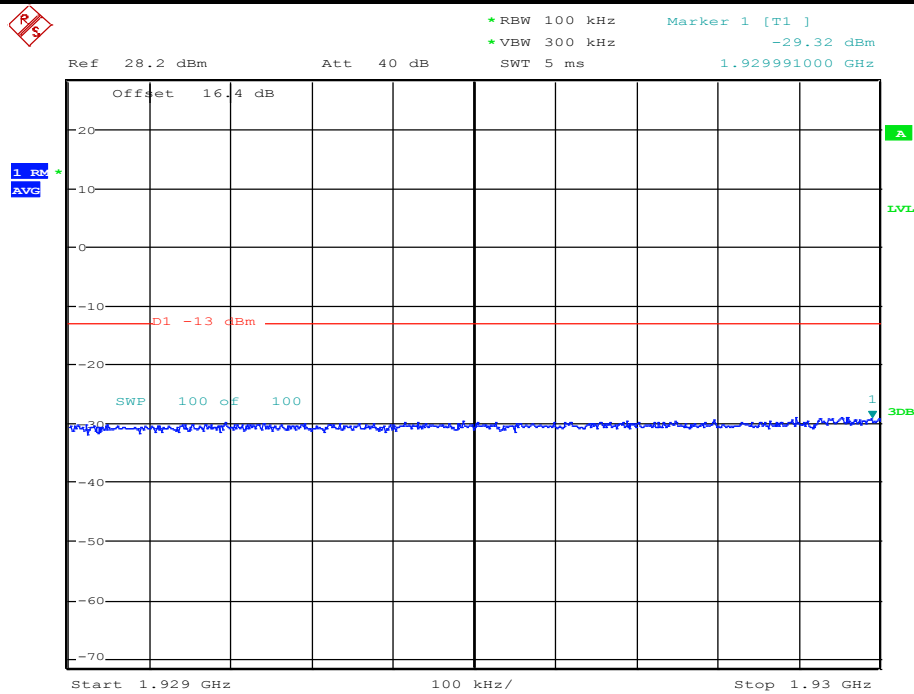
Ambient Temperature (C)	EUT Set-Up #	EUT operating mode	Power Input (VDC)	Measurement Path Correction (dB)
23	2	LTE Band 2 / LTE Band 4	48	16.4

#### 7.4.4 Measurement result:

Plot #	EUT operating mode	Band Edge	EIRP Power (dBm)	Limit (dBm)	Result
1	LTE Band 2	Lower Band Edge	-26.32	-13	Pass
2	LTE Band 2	Upper Band Edge	-28.87	-13	Pass
3	LTE Band 4	Lower Band Edge	-26.34	-13	Pass
4	LTE Band 4	Upper Band Edge	-27.47	-13	Pass

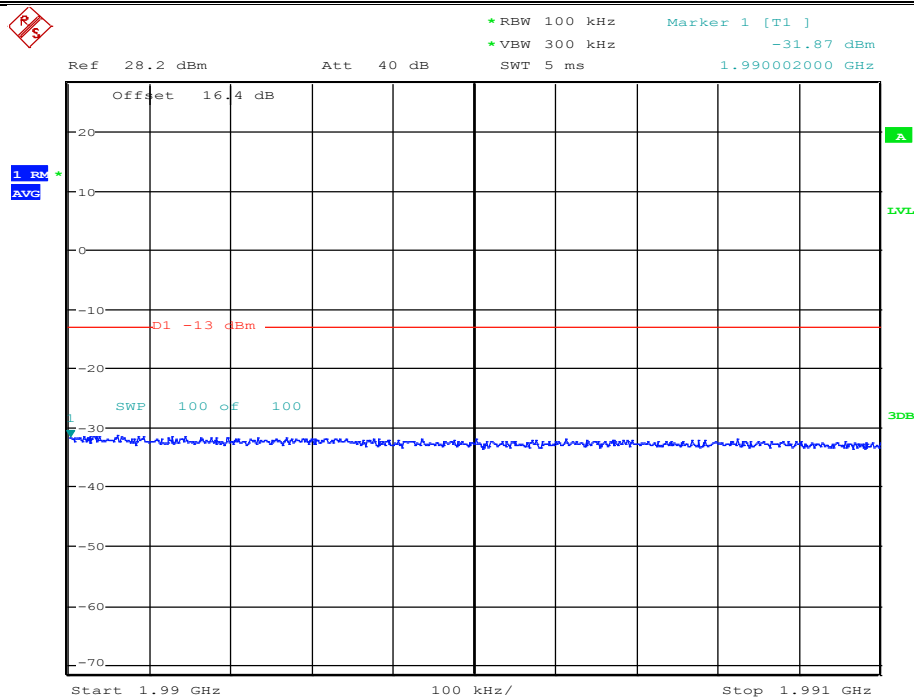
#### 7.4.5 Measurement Plots:

### Plot #1 Lower Band Edge



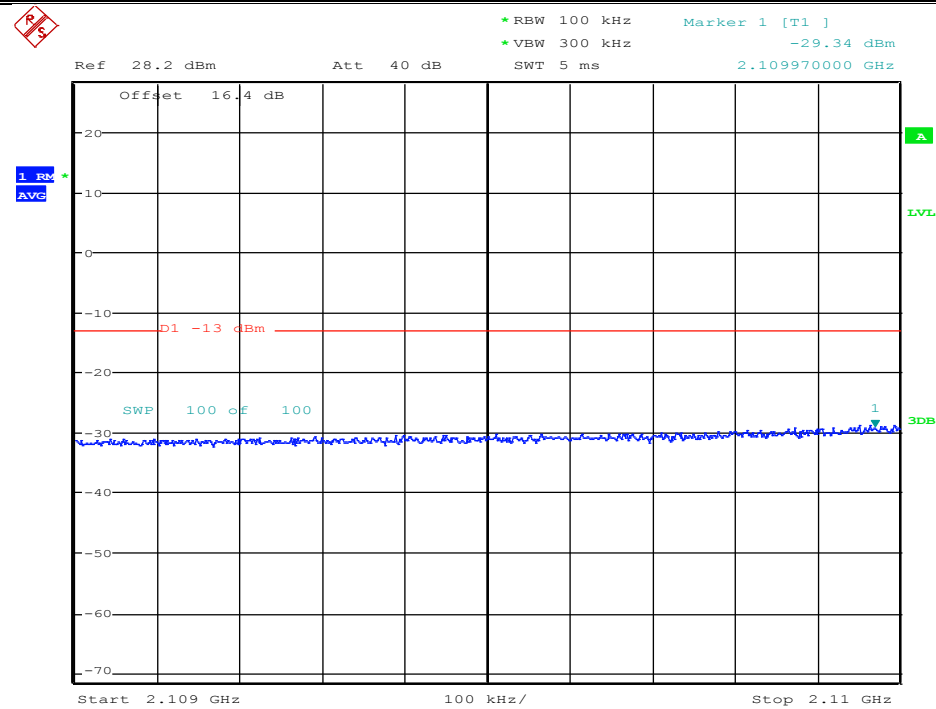
Date: 2.SEP.2016 14:06:53

### Plot #2 Upper Band Edge



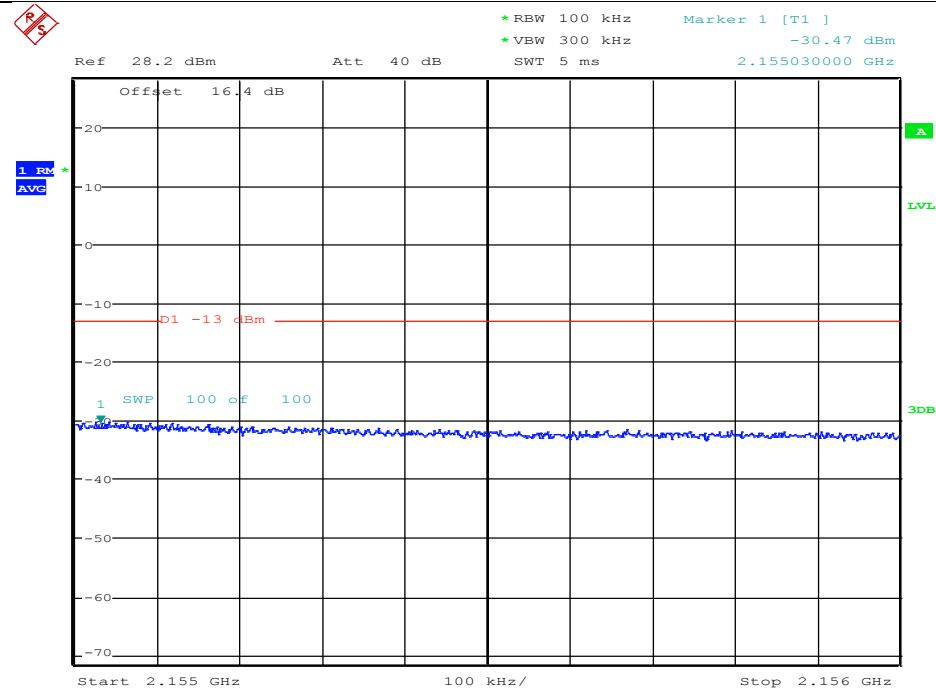
Date: 2.SEP.2016 14:07:56

### Plot #3 Lower Band Edge



Date: 2.SEP.2016 14:04:13

### Plot #4 Upper Band Edge



Date: 2.SEP.2016 14:14:04

## 7.5 Radiated Spurious Emissions

### 7.5.1 Measurement according to FCC: CFR 47 Part 2.1053; 24.238; 27.53, and ANSI/TIA-603-D-2010, utilizing KDB 971168 D01 Power Meas License Digital Systems v02r02

#### Spectrum Analyzer Settings

Frequency Range	30MHz – 1 GHz	1 – 2.7 GHz	2.7 – 18 GHz	18 – 19.1 GHz
Resolution Bandwidth	100 kHz	1 MHz	1 MHz	1 MHz
Video Bandwidth	100 kHz	1 MHz	1 MHz	1 MHz
Detector	Peak	Peak	Peak	Peak
Trace Mode	Max Hold	Max Hold	Max Hold	Max Hold
Sweep Time	Auto	Auto	Auto	Auto

### 7.5.2 Limits:

#### 7.5.2.1 FCC Part 24.238; 27.53

Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least  $43 + 10 \log(P)$  dB.

Note: The limit calculation result is a constant of -13dBm.

### 7.5.3 Test conditions and setup:

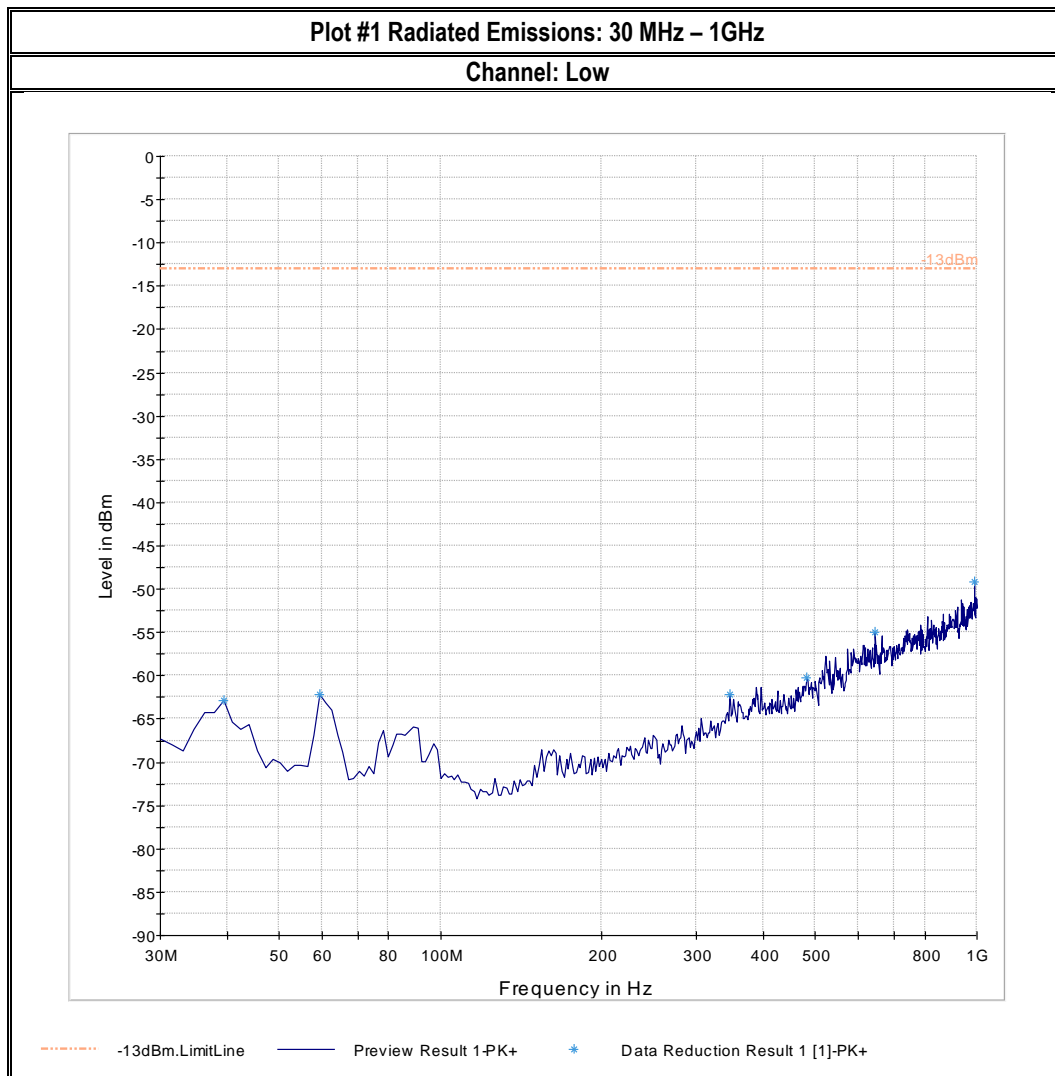
Ambient Temperature (C)	EUT Set-Up #	EUT operating mode	Power Input
23	1	LTE Band 2 / LTE Band 4	110V / 60 Hz

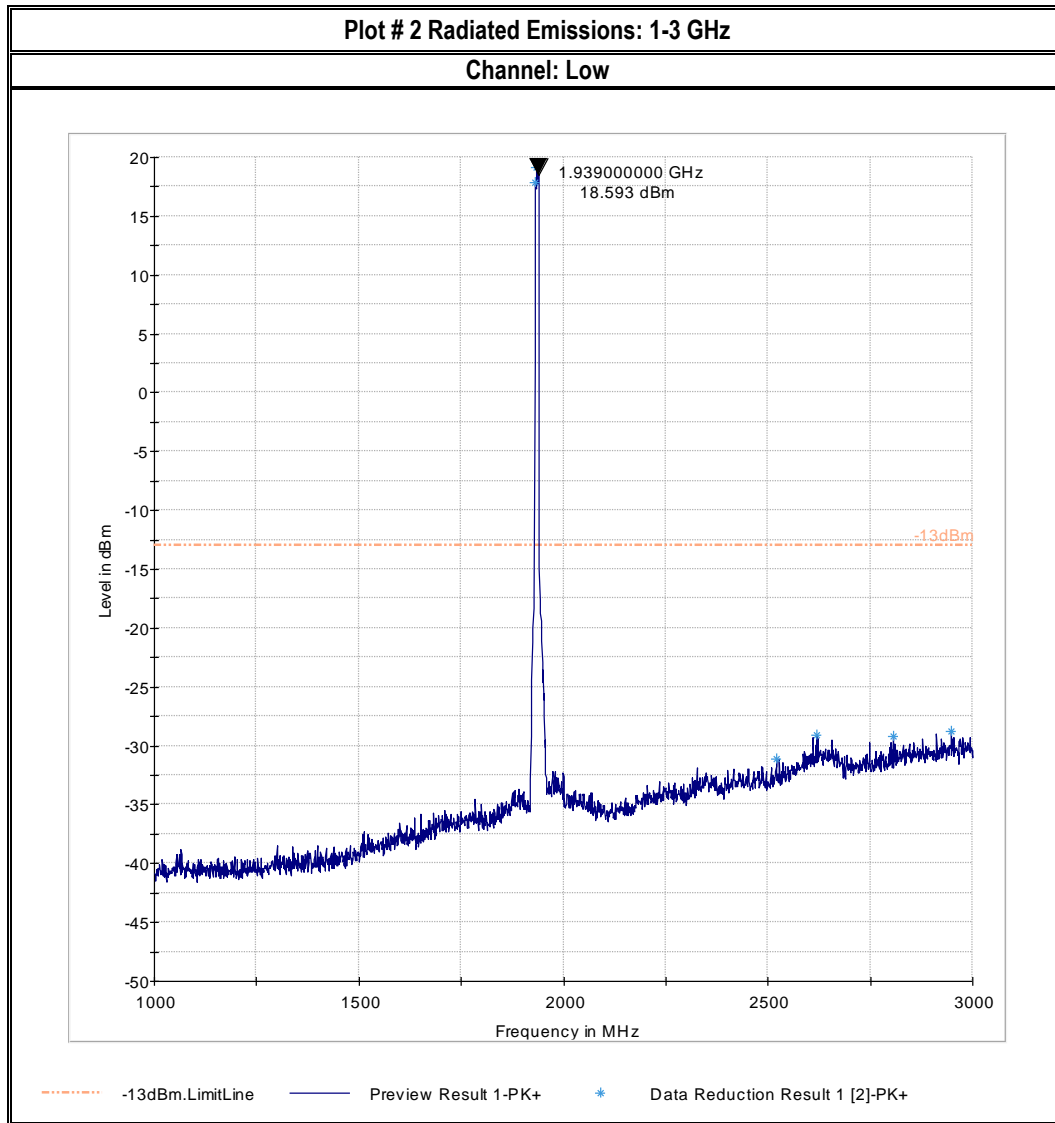
### 7.5.4 Measurement result:

Plot #	Channel	EUT operating mode	Scan Frequency	Limit (dBm)	Result
1-3	Low	LTE Band 2	30 MHz – 18 GHz	-13	Pass
4-8	Mid	LTE Band 2	9 kHz – 22 GHz	-13	Pass
9-11	High	LTE Band 2	30 MHz – 18 GHz	-13	Pass
12-14	Low	LTE Band 2	30 MHz – 18 GHz	-13	Pass
15-19	Mid	LTE Band 2	9 kHz – 22 GHz	-13	Pass
20-22	High	LTE Band 2	30 MHz – 18 GHz	-13	Pass

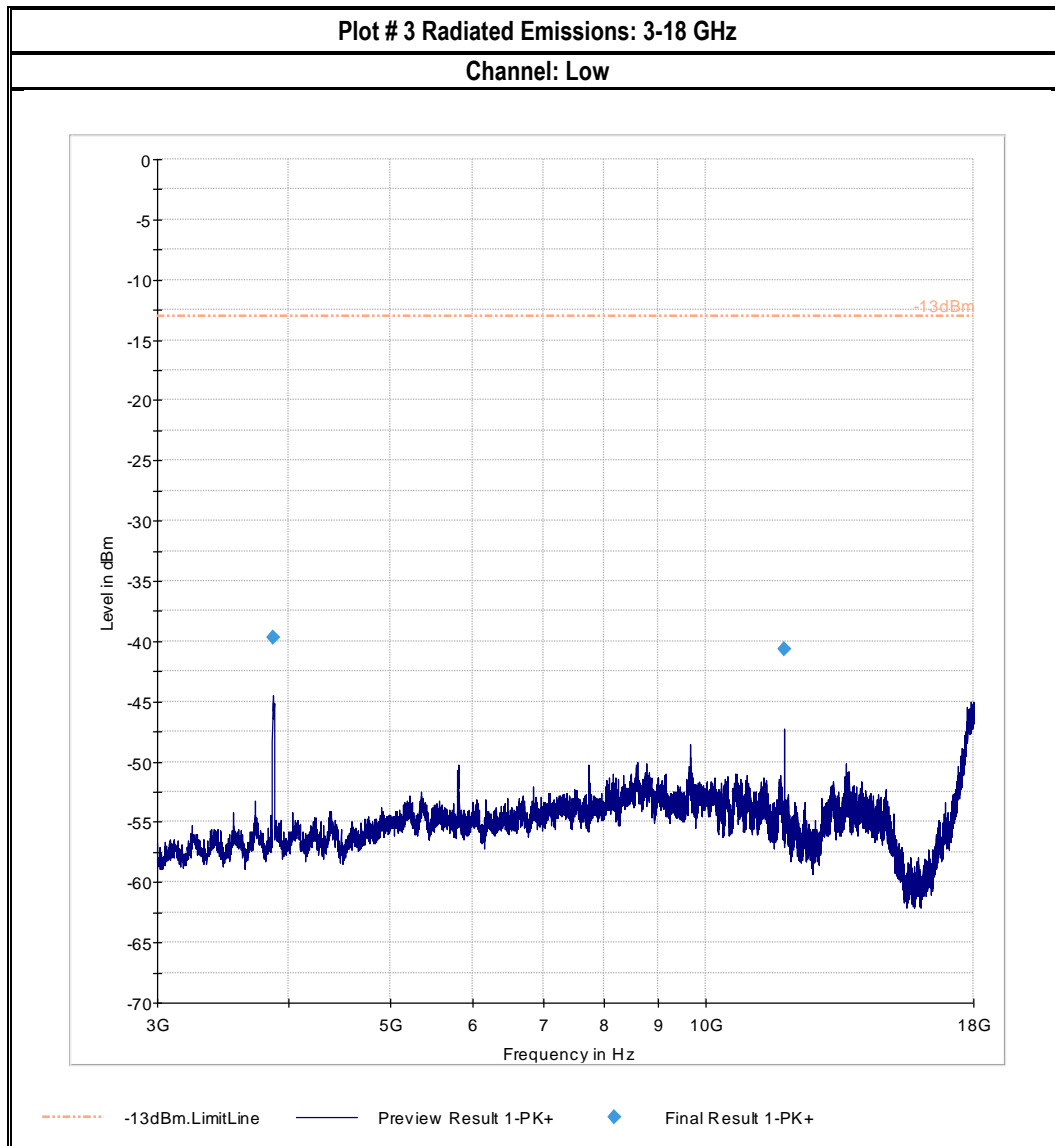
### 7.5.5 Measurement Plots:

## 7.5.6 LTE Band 2



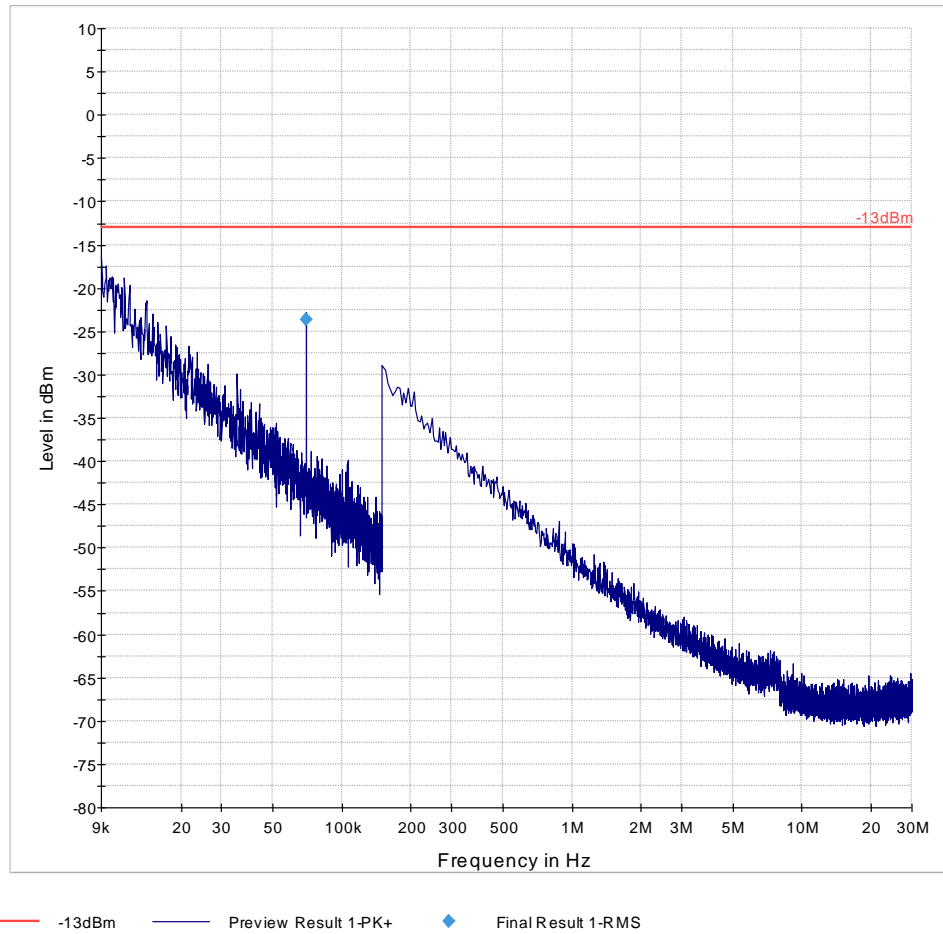


Note: Due to limited resolution during radiated measurements on the Band edges the manual conducted measurement from section 7.4 prevails.



**Plot # 4 Radiated Emissions: 9 kHz-30 MHz**

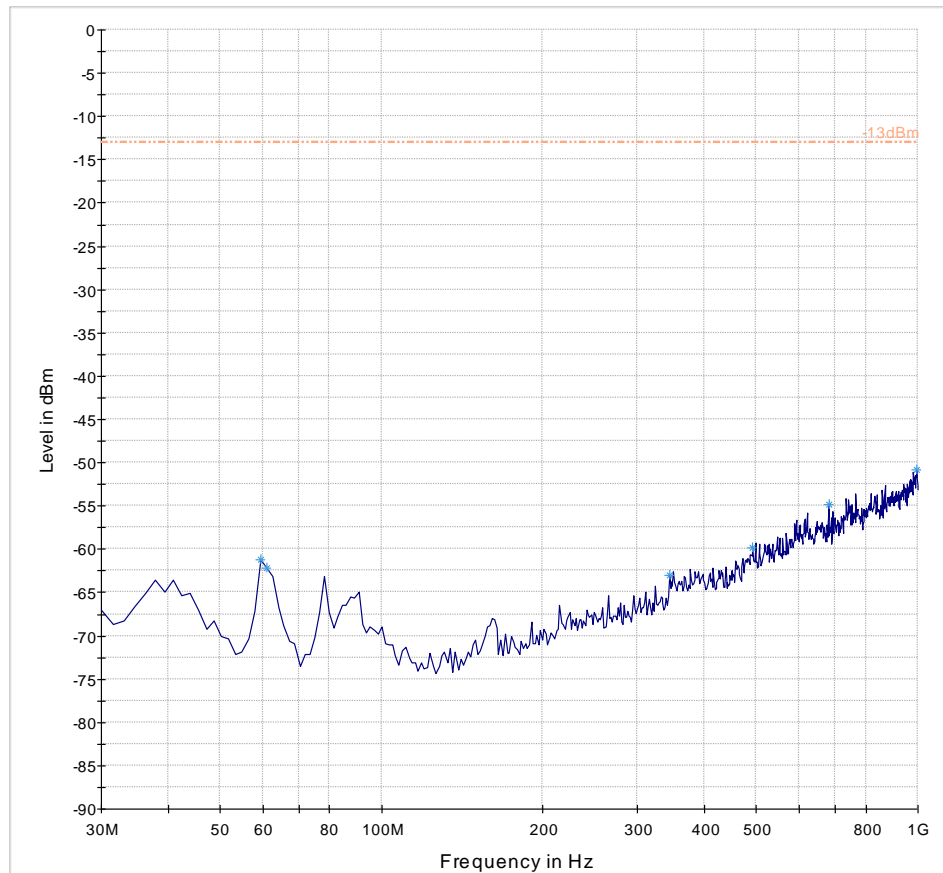
**Channel: Mid**





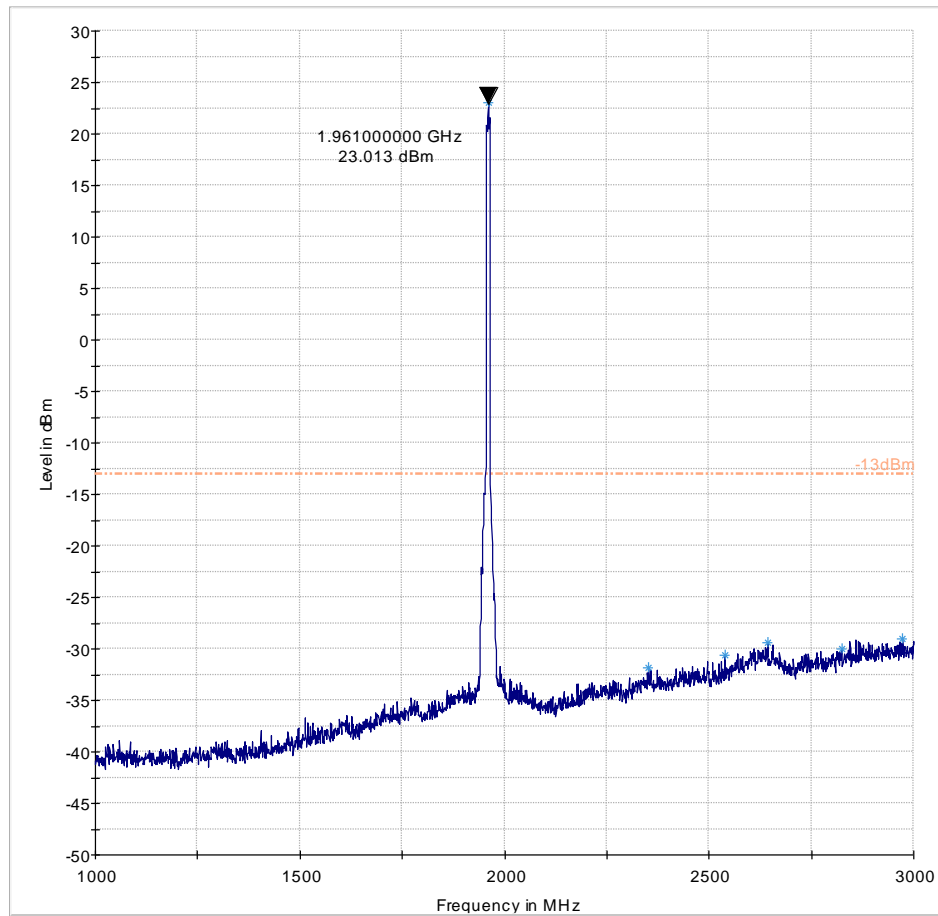
**Plot #5 Radiated Emissions: 30 MHz – 1GHz**

**Channel: Mid**



Plot #6 Radiated Emissions: 1-3 GHz

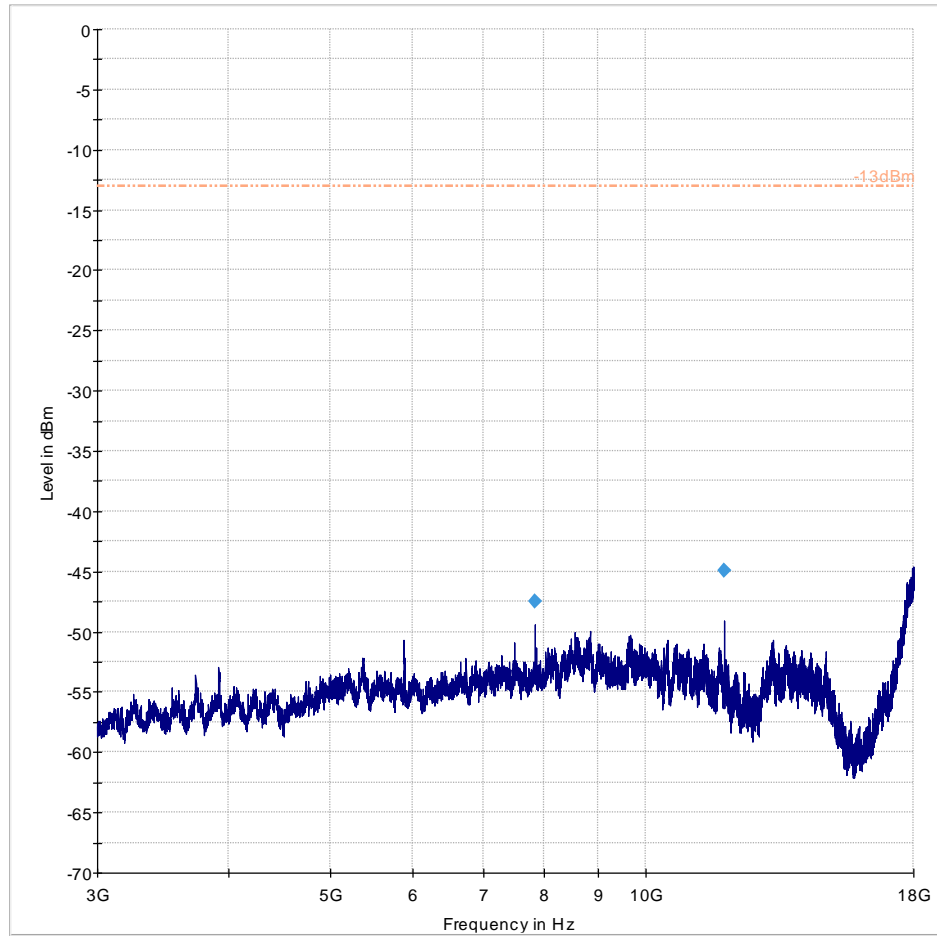
Channel: Mid



----- -13dBm.LimitLine      ——— Preview Result 1-PK+      \* Data Reduction Result 1 [2]-PK+

## Plot #7 Radiated Emissions: 3-18 GHz

Channel: Mid



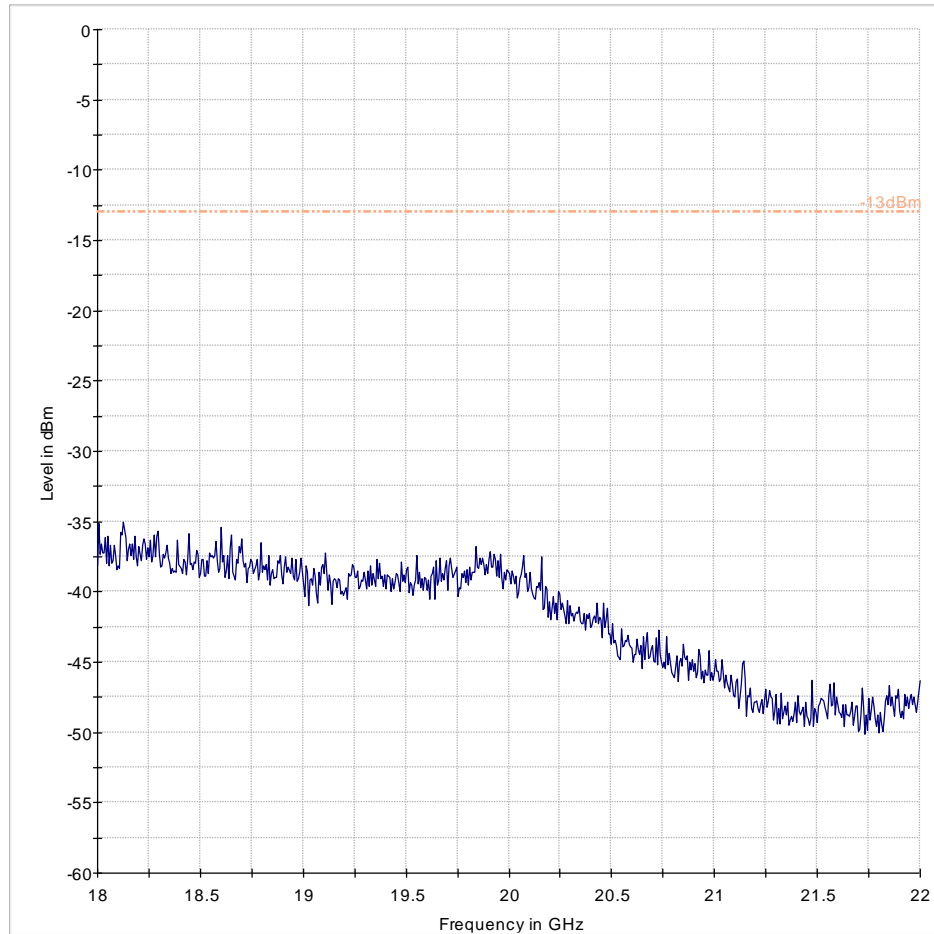
-13dBm.LimitLine

Preview Result 1-PK+

Final Result 1-PK+

## Plot #8 Radiated Emissions: 18-22 GHz

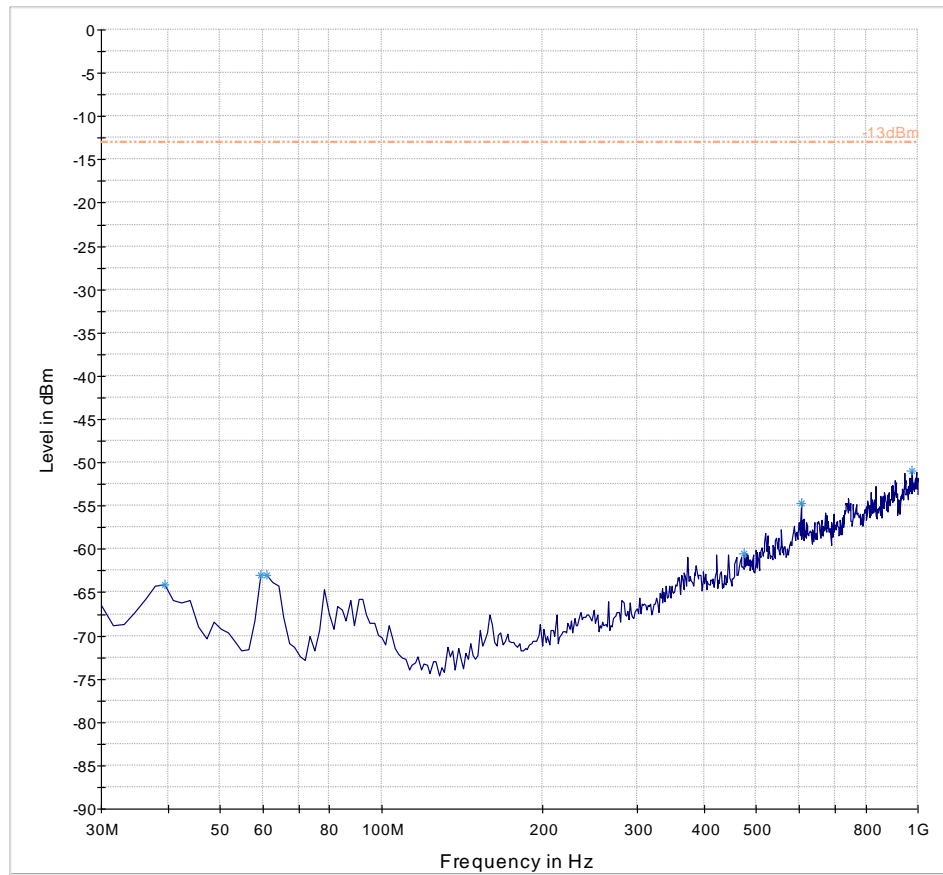
Channel: Mid



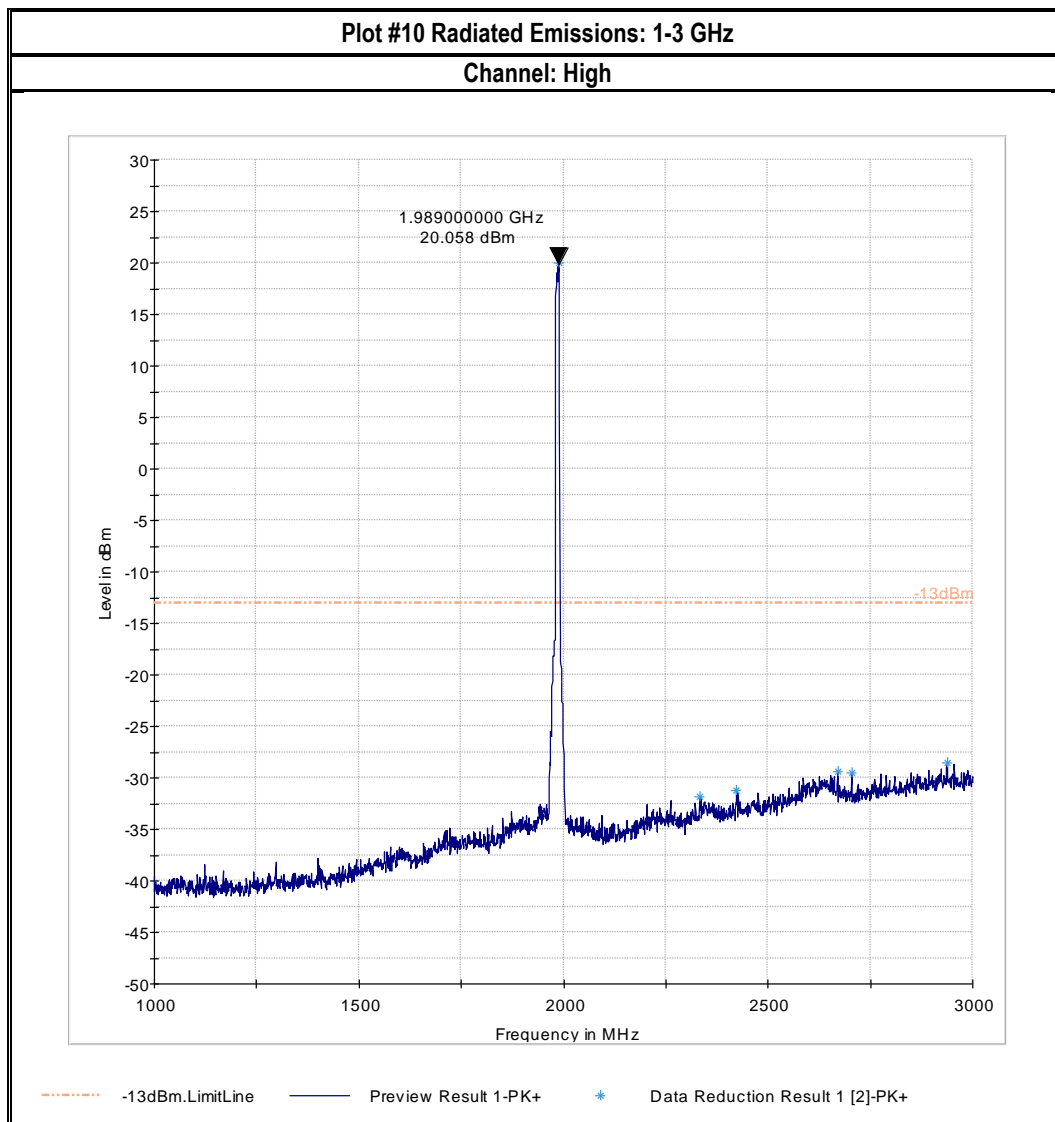
-13dBm      Preview Result 1-PK+

**Plot #9 Radiated Emissions: 30 MHz – 1GHz**

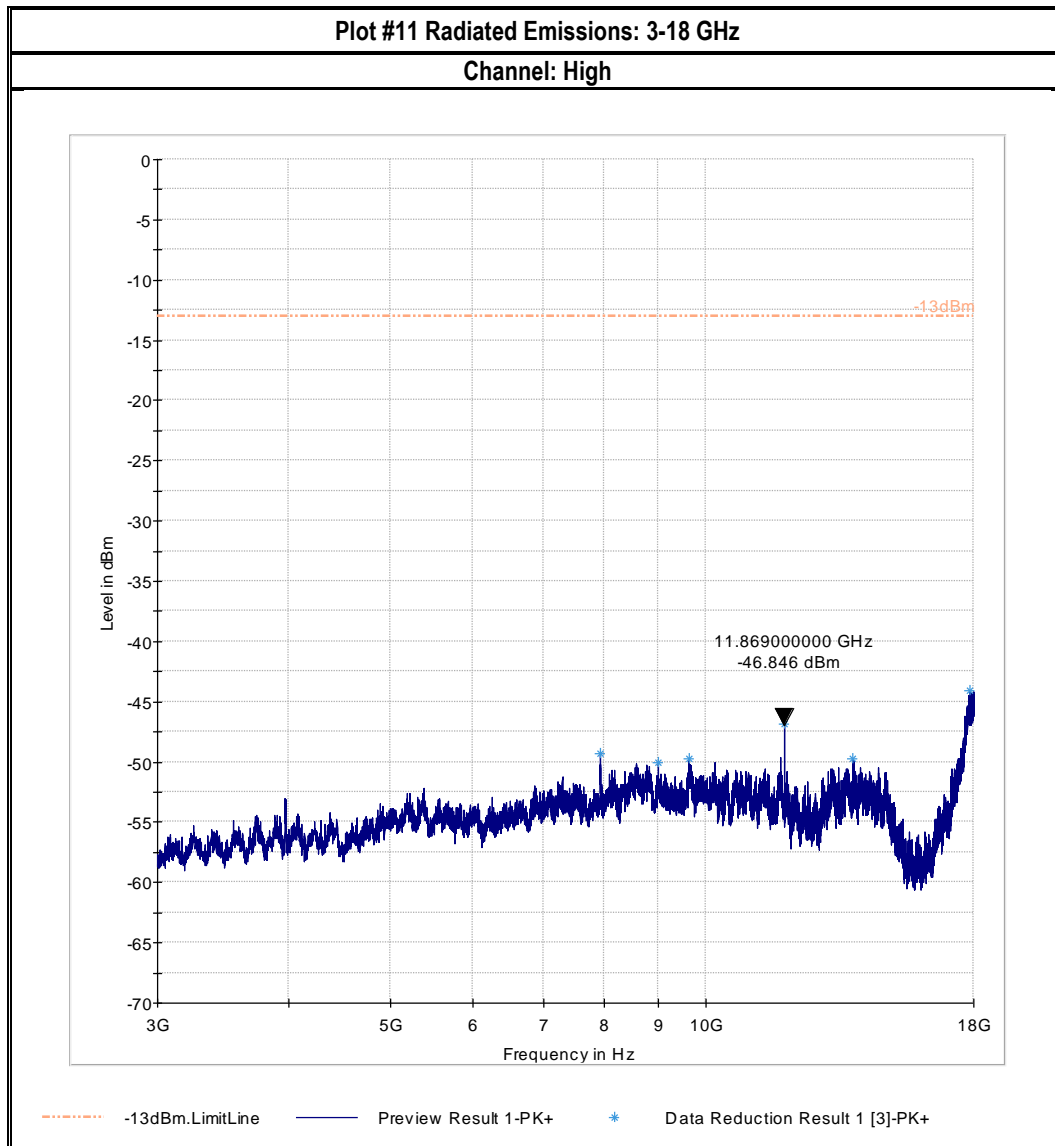
**Channel: High**



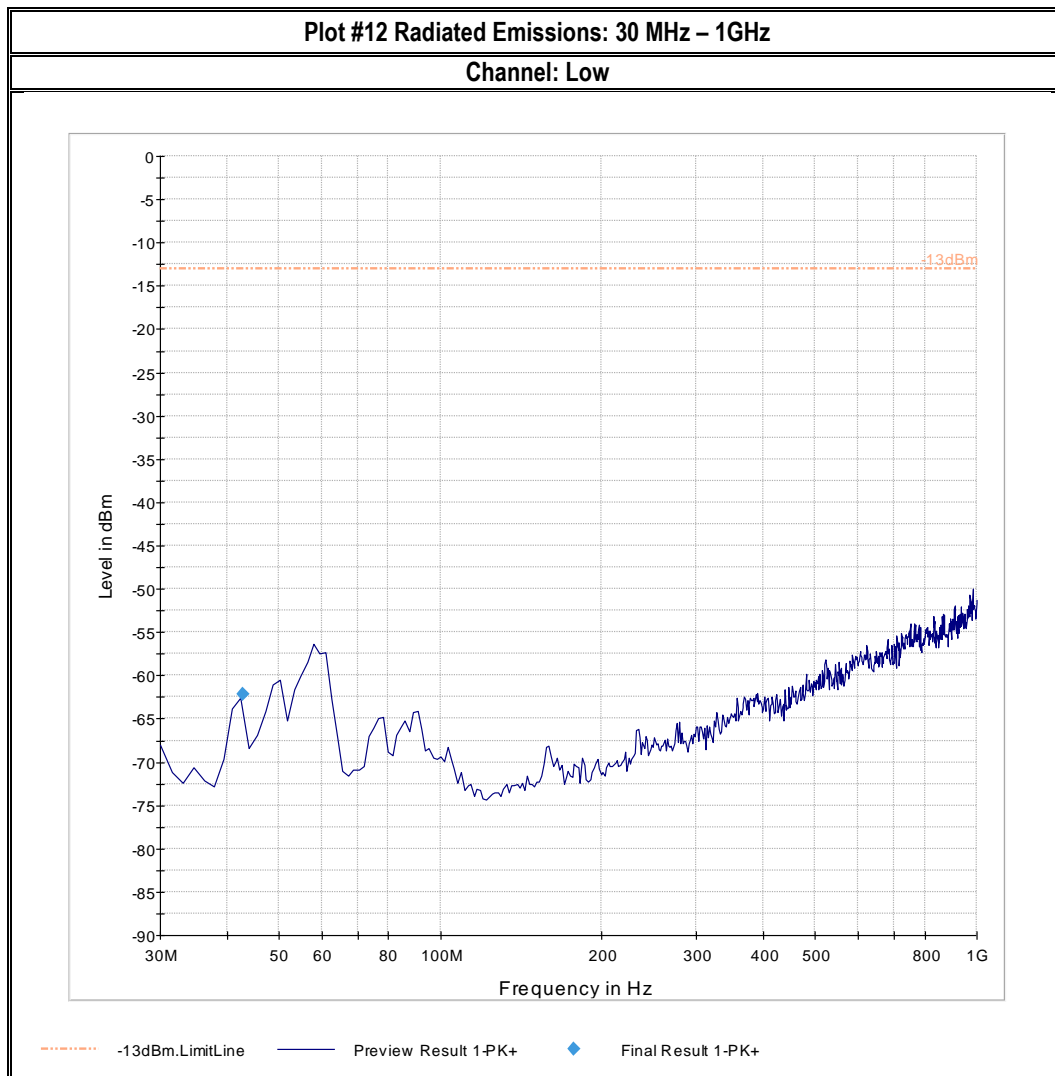
----- -13dBm.LimitLine      Preview Result 1-PK+      \* Data Reduction Result 1 [1]-PK+



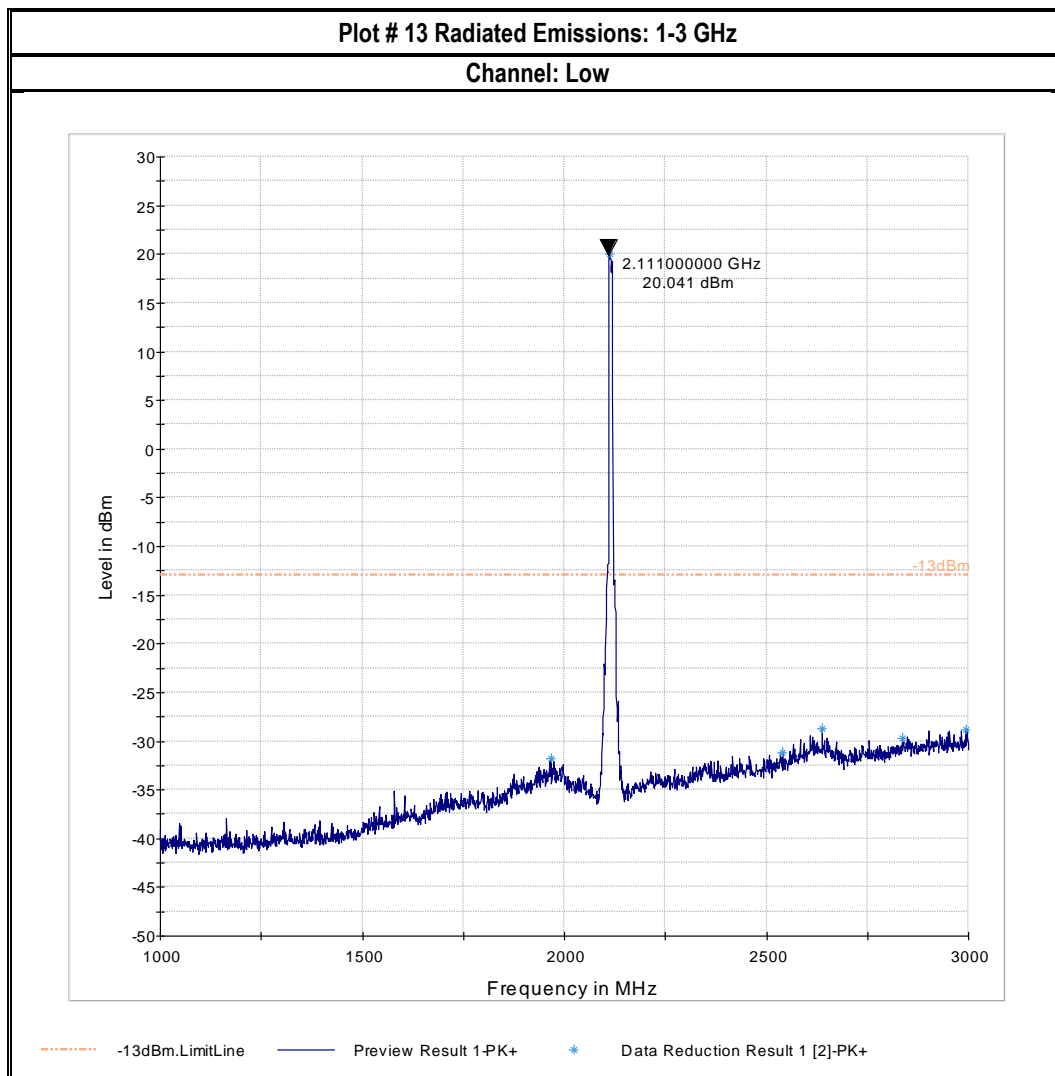
Note: Due to limited resolution during radiated measurements on the Band edges the manual conducted measurement from section 7.4 prevails.



## 7.5.7    LTE Band 4



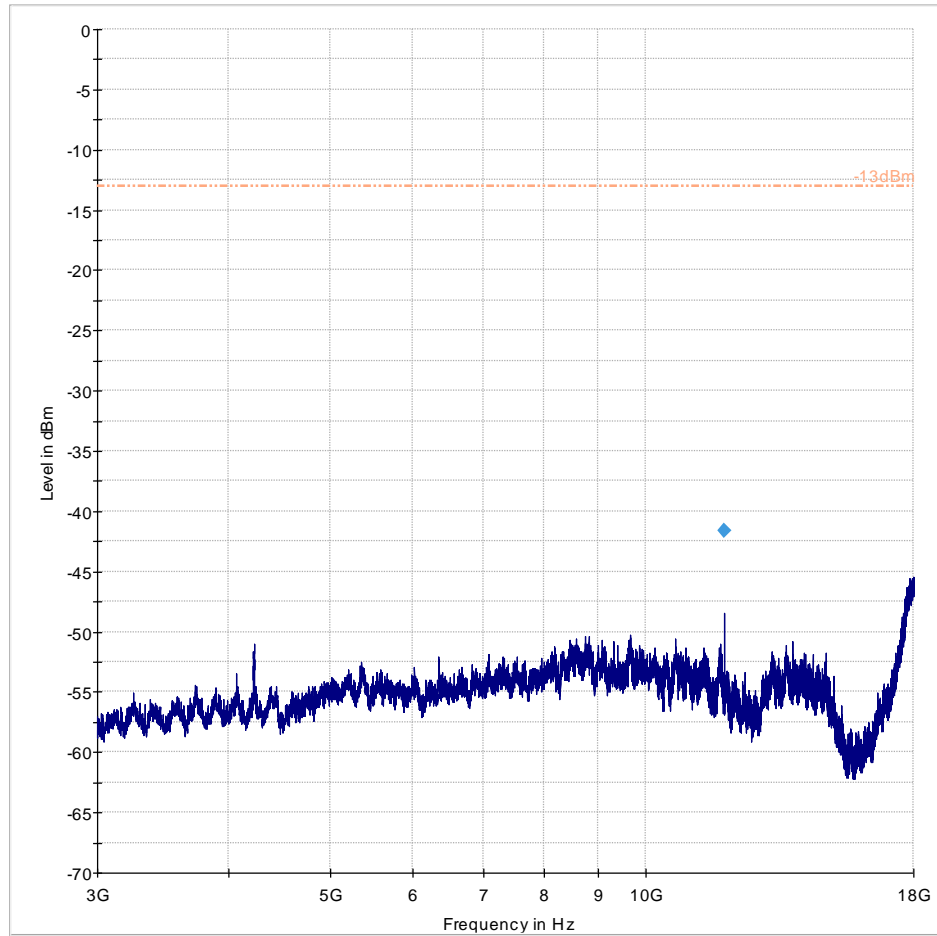




Note: Due to limited resolution during radiated measurements on the Band edges the manual conducted measurement from section 7.4 prevails.

## Plot # 14 Radiated Emissions: 3-18 GHz

Channel: Low



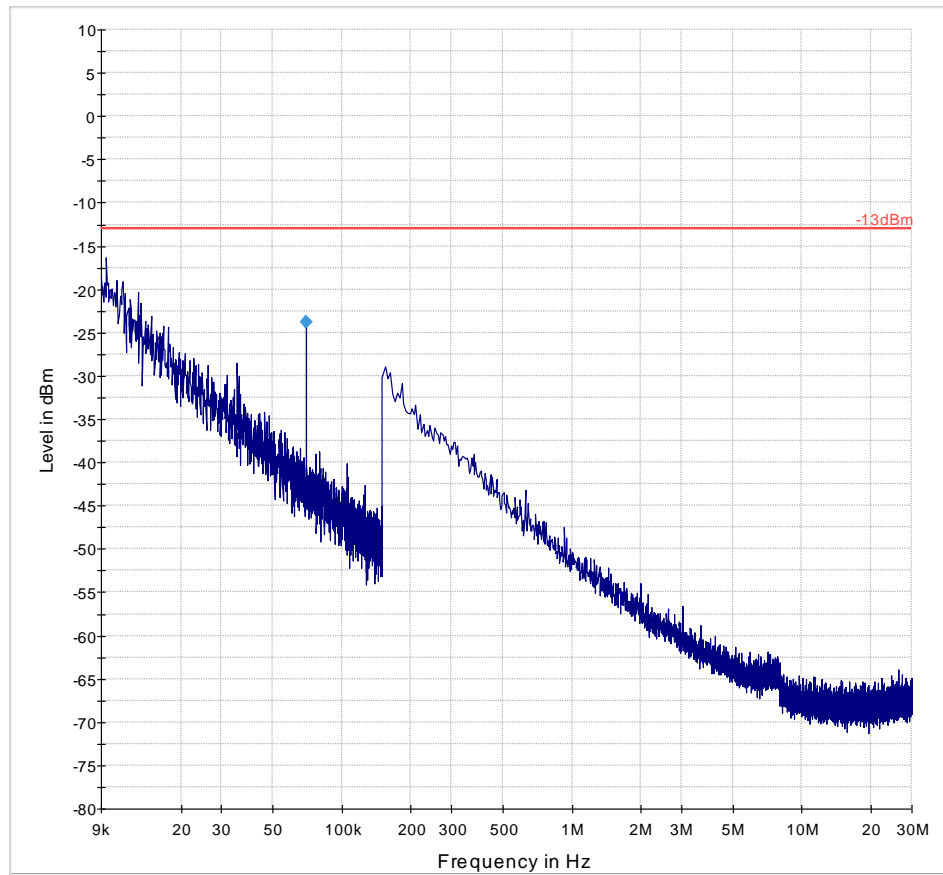
-13dBm.LimitLine

Preview Result 1-PK+

Final Result 1-PK+

**Plot # 15 Radiated Emissions: 9 kHz-30 MHz**

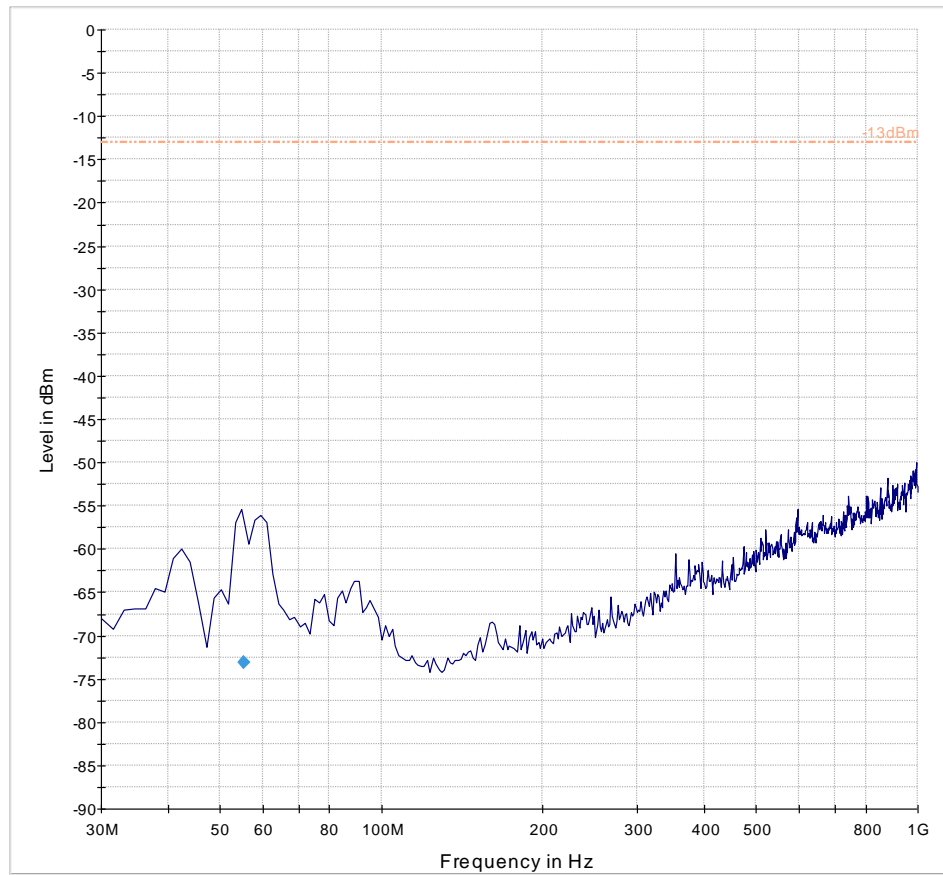
**Channel: Mid**



— -13dBm    — Preview Result 1-PK+    ◆ Final Result 1-RMS

Plot #16 Radiated Emissions: 30 MHz – 1GHz

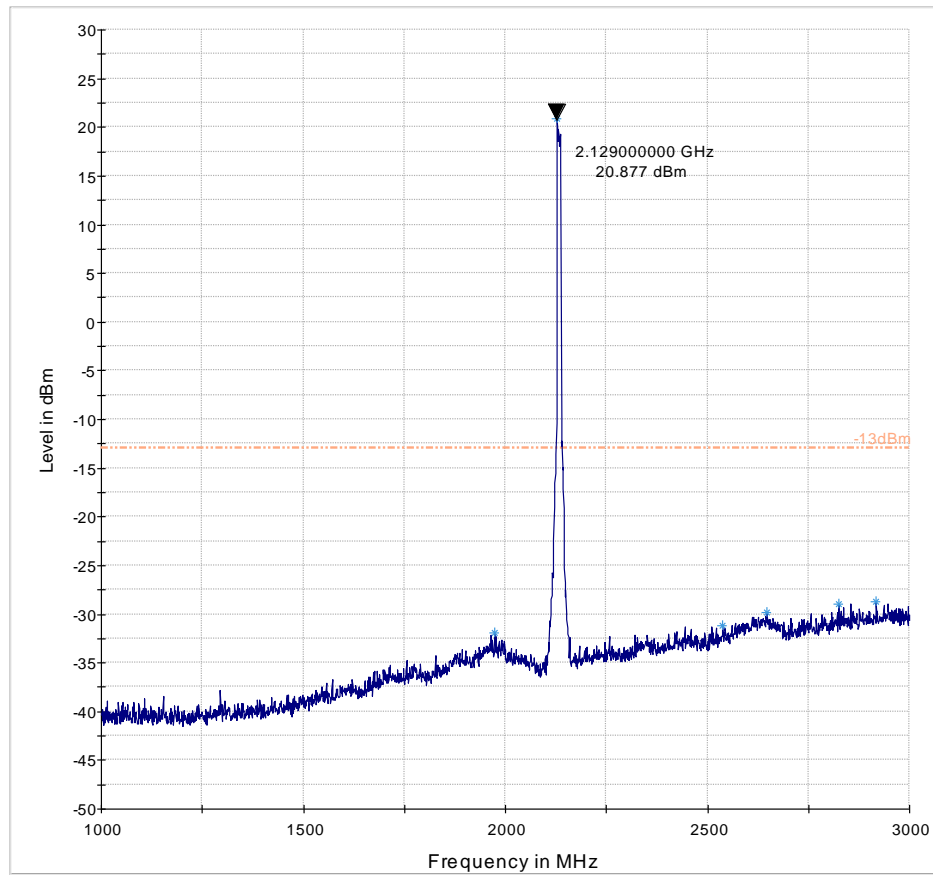
Channel: Mid



----- -13dBm.LimitLine      ——— Preview Result 1-PK+      ◆ Final Result 1-PK+

## Plot #17 Radiated Emissions: 1-3 GHz

Channel: Mid



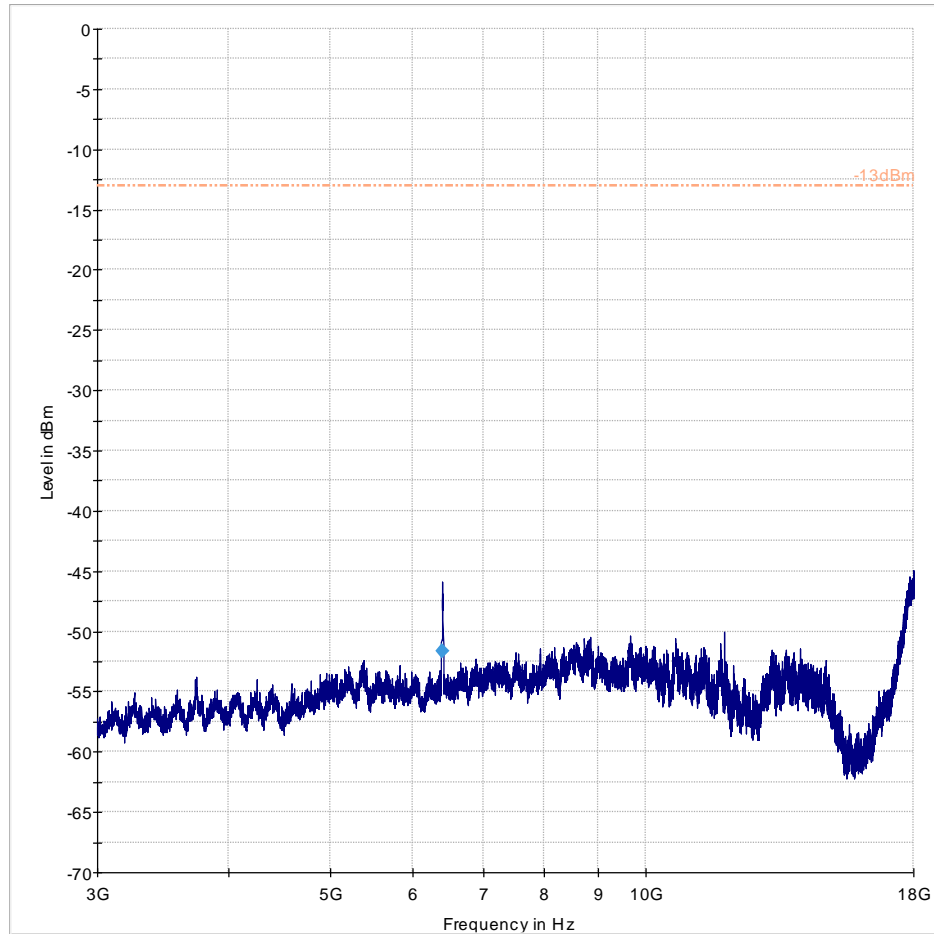
- - - - -13dBm.LimitLine

— Preview Result 1-PK+

\* Data Reduction Result 1 [2]-PK+

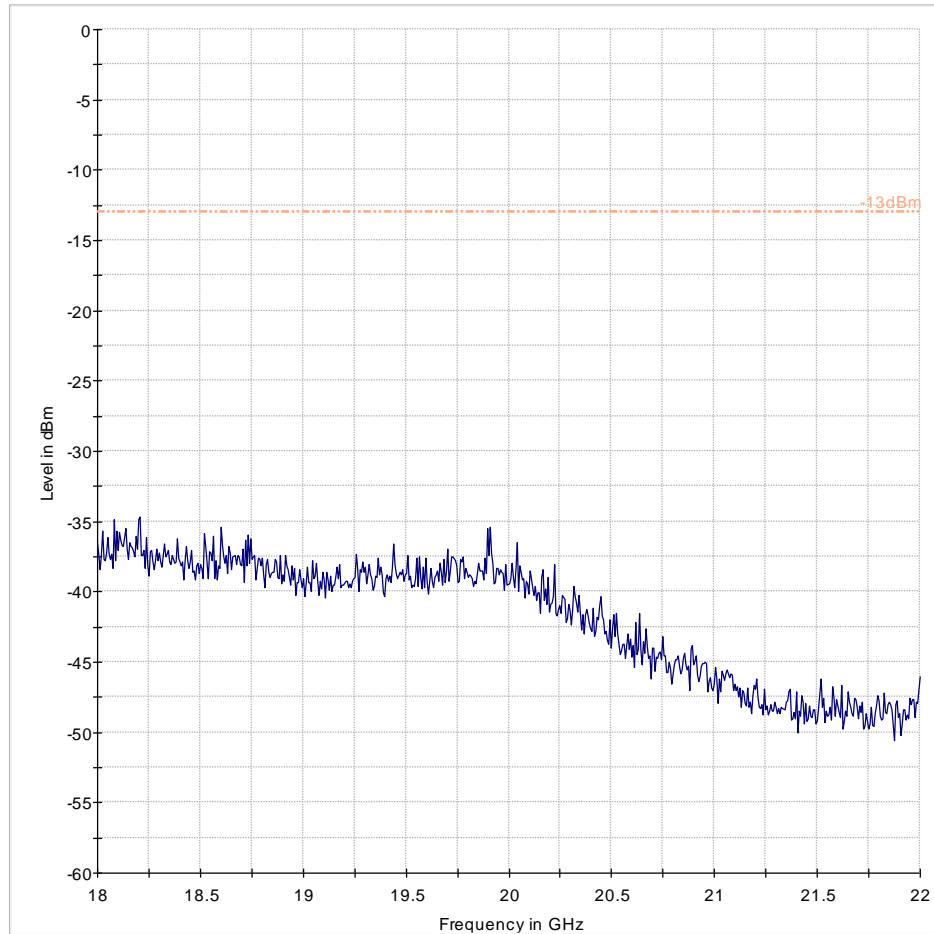
## Plot #18 Radiated Emissions: 3-18 GHz

Channel: Mid

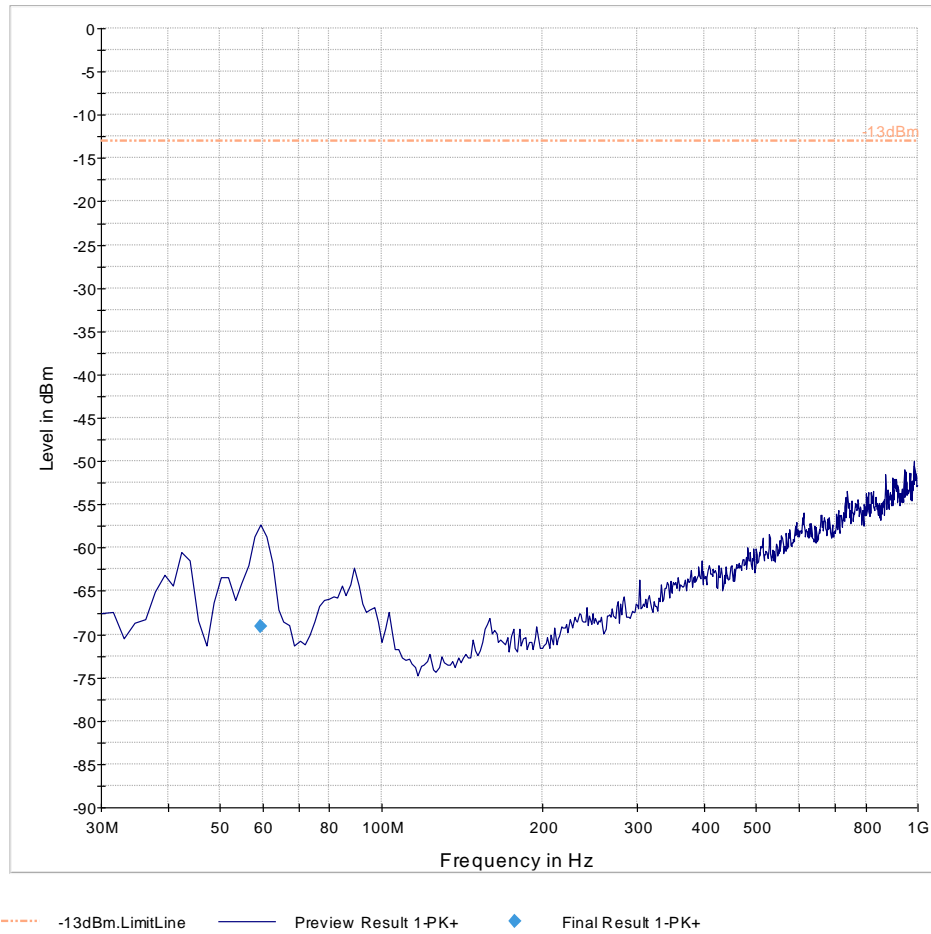


## Plot #19 Radiated Emissions: 18-22 GHz

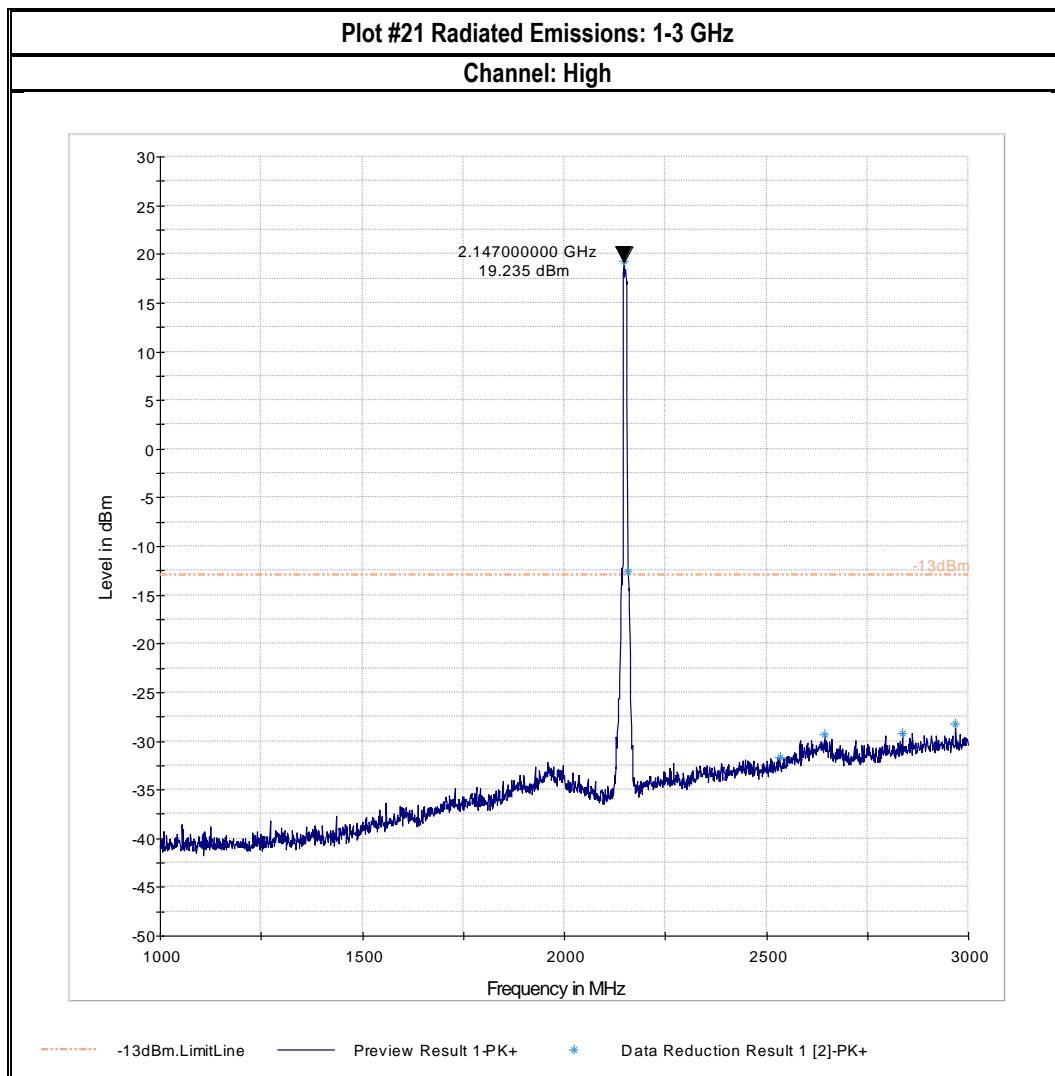
Channel: Mid



-13dBm      Preview Result 1-PK+

**Plot #20 Radiated Emissions: 30 MHz – 1GHz****Channel: High**

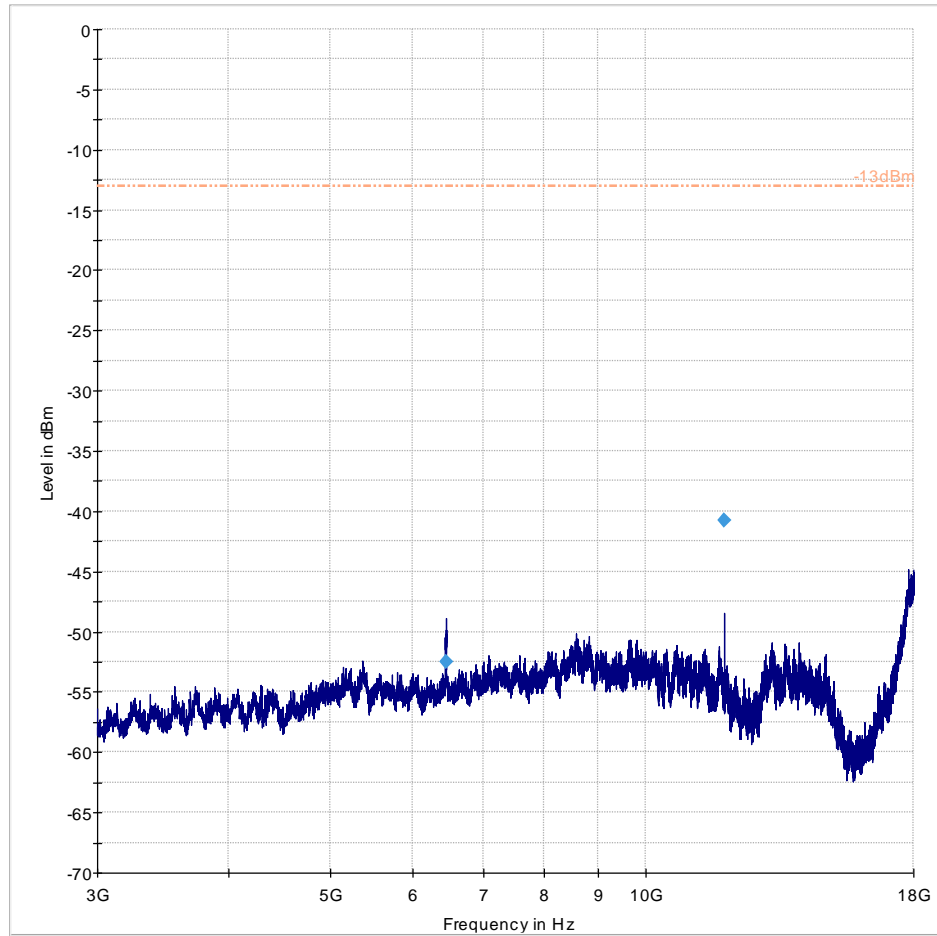




Note: Due to limited resolution during radiated measurements on the Band edges the manual conducted measurement from section 7.4 prevails.

## Plot #22 Radiated Emissions: 3-18 GHz

Channel: High





## 8 Test setup photos

Setup photos are included in supporting file name: "EMC\_LUMIN-001-16001\_FCC\_24\_27\_Setup\_photos\_Rev2.pdf"

## 9 Test Equipment And Ancillaries Used For Testing

Item Name	Equipment Type	Manufacturer	Model	Serial #	Calibration Cycle	Last Calibration Date
Antenna Biconilog 3142E	Biconlog Antenna	EMCO	3142E	166067	3 years	6/14/2014
Antenna Loop 6512	Loop Antenna	ETS Lindgren	6512	49838	3 years	3/13/2014
Antenna Horn 3115 SN 35111	Horn Antenna	EMCO	3115	35111	3 years	7/24/2015
Antenna Horn 3116	Horn Antenna	ETS Lindgren	3116	70497	3 years	7/22/2015
Digital Barometer	Compact Digital Barometer	Control Company	35519-055	91119547	2 Years	4/7/2015
CMU 200	Digital Radio Comm. Tester	R&S	CMU 200	101821	2 Years	7/4/2015
CMU 200	Digital Radio Comm. Tester	R&S	CMU 200	109879	2 Years	7/3/2015
FSU26	Spectrum Analyzer	R&S	FSU26	200065	3 years	7/4/2015
FSU26	Spectrum Analyzer	R&S	FSU26	200302	3 years	7/4/2015
Thermometer Humidity TM320	Thermometer Humidity	Dickson	AY1072	0528	1 Year	11/02/2016

Equipment used meets the measurement uncertainty requirements as required per applicable standards for 95% confidence levels.

Calibration due dates, unless defined specifically, falls on the last day of the month. Items indicated "N/A" for cal status either do not specifically require calibration or is internally characterized before use.

## 10 Revision History

Date	Report Name	Changes to report	Report prepared by
2016-09-19	EMC_LUMIN-001-16001_FCC_24_27	Initial Version	Kris Lazarov
2016-12-05	EMC_LUMIN-001-16001_FCC_24_27_Rev1	Changed the report name to reflect the new revision- Rev1; Updated the FCC ID to 2AJLI-LWAP-0002; Corrected the LTE bands in the EUT specification table; Added reference to the ANSI/TIA-603-D-2010 in the measurement procedures in section 5; Added the EIRP measurement for 16-QAM and 64-QAM modulation in section 7.1; Revised the section 7.2 to the correct method of testing and added the results from a retest of frequency stability. Updated table in section 9.	Kris Lazarov
2016-12-15	EMC_LUMIN-001-16001_FCC_24_27_Rev2	Updated Section 7.5 to correct RSE test method	Kris Lazarov