



**DATE: 19 May 2016**

**I.T.L. (PRODUCT TESTING) LTD.**  
**FCC Radio Test Report**  
**for**  
**Corning Optical Communication Wireless**  
**Equipment under test:**  
**MRU – Mid-Power Remote Unit with AWS-3**  
**Support**

**Chassis MRU-E-ASM-AC-B**  
**Chassis MRU-E-ASM-DC-B**  
**Power Amplifier Module MRU-PAM-17E**

Tested by:

  
M. Zohar

Approved by:

  
D. Shidlow

This report must not be reproduced, except in full, without the written permission of I.T.L. (Product Testing) Ltd.

This report relates only to items tested.



## **Measurement/Technical Report for Corning Optical Communication Wireless**

**MRU – Mid-Power Remote Unit with AWS-3 Support**

**Chassis MRU-E-ASM-AC-B  
Chassis MRU-E-ASM-DC-B  
Power Amplifier Module MRU-PAM-17E**

**FCC ID: OJF1MRU21-3**

This report concerns:      Original Grant: X  
                                         Class II change:  
                                         Class I change:

Equipment type:              PCS Licensed Transmitter

Limits used:                  47CFR Parts 2; 27

Measurement procedure used is KDB 935210 D03 v04 and ANSI/TIA 603-D: 2010

Application for Certification  
prepared by:

R. Pinchuck  
ITL (Product Testing) Ltd.  
1 Bat Sheva St.  
Lod 7120101  
Israel  
e-mail rpinchuck@itl.co.il

Applicant for this device:

(different from "prepared by")

Habib Riazi  
Corning Optical Communication Wireless  
13221 Woodland Park Rd., Suite #400  
Herndon, VA. 20171  
U.S.A.  
Tel: +1-541-758-2880  
Fax: +1-703-848-0260  
e-mail: RiaziH@corning.com



## TABLE OF CONTENTS

|           |                                                                  |           |
|-----------|------------------------------------------------------------------|-----------|
| <b>1.</b> | <b>GENERAL INFORMATION</b>                                       | <b>4</b>  |
| 1.1       | Administrative Information                                       | 4         |
| 1.2       | List of Accreditations                                           | 5         |
| 1.3       | Product Description                                              | 6         |
| 1.4       | Test Methodology                                                 | 6         |
| 1.5       | Test Facility                                                    | 6         |
| 1.6       | Measurement Uncertainty                                          | 6         |
| <b>2.</b> | <b>SYSTEM TEST CONFIGURATION</b>                                 | <b>7</b>  |
| 2.1       | Justification                                                    | 7         |
| 2.2       | EUT Exercise Software                                            | 7         |
| 2.3       | Special Accessories                                              | 7         |
| 2.4       | Equipment Modifications                                          | 7         |
| 2.5       | Configuration of Tested System                                   | 8         |
| <b>3.</b> | <b>TEST SET-UP PHOTOS</b>                                        | <b>10</b> |
| <b>4.</b> | <b>RF POWER OUTPUT AWS</b>                                       | <b>13</b> |
| 4.1       | Test Specification                                               | 13        |
| 4.2       | Test Procedure                                                   | 13        |
| 4.3       | Limit                                                            | 13        |
| 4.4       | Results                                                          | 13        |
| 4.5       | Test Equipment Used; RF Power Output AWS                         | 19        |
| <b>5.</b> | <b>OCCUPIED BANDWIDTH AWS</b>                                    | <b>20</b> |
| 5.1       | Test Specification                                               | 20        |
| 5.2       | Test Procedure                                                   | 20        |
| 5.3       | Limit                                                            | 20        |
| 5.4       | Results                                                          | 20        |
| 5.5       | Test Equipment Used; Occupied Bandwidth                          | 30        |
| <b>6.</b> | <b>SPURIOUS EMISSIONS AT ANTENNA TERMINALS AWS</b>               | <b>31</b> |
| 6.1       | Test Specification                                               | 31        |
| 6.2       | Test procedure                                                   | 31        |
| 6.3       | Limit                                                            | 31        |
| 6.4       | Results                                                          | 31        |
| 6.5       | Test Equipment Used; Spurious Emissions at Antenna Terminals AWS | 35        |
| <b>7.</b> | <b>BAND EDGE SPECTRUM AWS</b>                                    | <b>36</b> |
| 7.1       | Test Specification                                               | 36        |
| 7.2       | Test Procedure                                                   | 36        |
| 7.3       | Limit                                                            | 36        |
| 7.4       | Test Results                                                     | 36        |
| 7.5       | Test Equipment Used; Band Edge Spectrum AWS                      | 40        |
| <b>8.</b> | <b>SPURIOUS RADIATED EMISSION AWS</b>                            | <b>41</b> |
| 8.1       | Test Specification                                               | 41        |
| 8.2       | Test Procedure                                                   | 41        |
| 8.3       | Limit                                                            | 42        |
| 8.4       | Test Results                                                     | 42        |
| 8.5       | Test Instrumentation Used, Radiated Measurements AWS             | 43        |
| <b>9.</b> | <b>APPENDIX A - CORRECTION FACTORS</b>                           | <b>44</b> |
| 9.1       | Correction factors for CABLE                                     | 44        |
| 9.2       | Correction factors for RF cable for Semi Anechoic Chamber        | 45        |
| 9.3       | Correction factors for Horn ANTENNA                              | 46        |
| 9.4       | Correction factors for Horn ANTENNA                              | 47        |
| 9.5       | Correction factors for ACTIVE LOOP ANTENNA                       | 48        |
| 9.6       | Correction factors for Biconical Antenna                         | 49        |
| 9.7       | Correction factors for Log Periodic Antenna                      | 50        |



# 1. General Information

## 1.1 Administrative Information

|                                |                                                                                                                     |
|--------------------------------|---------------------------------------------------------------------------------------------------------------------|
| Manufacturer:                  | Corning Optical Communication<br>Wireless                                                                           |
| Manufacturer's Address:        | 13221 Woodland Park Rd., Suite #400<br>Herndon, VA. 20171<br>U.S.A.<br>Tel: +1-541-758-2880<br>Fax: +1-703-848-0260 |
| Manufacturer's Representative: | Habib Riazi                                                                                                         |
| Equipment Under Test (E.U.T):  | MRU – Mid-Power Remote Unit with<br>AWS-3 Support                                                                   |
| Equipment Model No.:           | Chassis MRU-E-ASM-AC-B<br>Chassis MRU-E-ASM-DC-B<br>Power Amplifier Module MRU-PAM-17E                              |
| Equipment Serial No.:          | Not Designated                                                                                                      |
| Date of Receipt of E.U.T:      | 13.03.2016                                                                                                          |
| Start of Test:                 | 13.03.2016                                                                                                          |
| End of Test:                   | 15.03.2016                                                                                                          |
| Test Laboratory Location:      | I.T.L (Product Testing) Ltd.<br>1 Batsheva St,<br>Lod,<br>Israel 7116002                                            |
| Test Specifications:           | FCC Parts 2; 27                                                                                                     |



## **1.2 List of Accreditations**

The EMC laboratory of I.T.L. is accredited by/registered with the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), FCC Designation Number is IL1005.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-3006, R-2729, T-1877, G-245.
5. Industry Canada (Canada), IC File No.: 46405-4025; Site No. IC 4025A-1, IC 4025A-2.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

### **1.3 Product Description**

Corning's mid-power remote unit (MRU) provides remote indoor and outdoor coverage for the Corning ONE™ wireless platform. It is a fiber-fed, compact, and scalable multiservice solution designed to complement the Corning ONE wireless platform by providing complete RF open space coverage for large-scale public venues such as campus applications.

### **1.4 Test Methodology**

Radiated testing was performed according to the procedures in KDB 935210 D03 v04 and ANSI/TIA 603-D: 2010. Radiated testing was performed at an antenna to EUT distance of 3 meters.

### **1.5 Test Facility**

Both conducted and radiated emissions tests were performed at I.T.L.'s testing facility in Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is US1004.

### **1.6 Measurement Uncertainty**

Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)

0.15 – 30 MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 3.44 dB

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for open site 30-1000MHz:

Expanded Uncertainty (95% Confidence, K=2):

± 4.98 dB

## 2. System Test Configuration

### 2.1 Justification

The test setup was configured to closely resemble the standard installation. The EUT consists of the MRU (Mid-Power Remote Module) which is connected with the head-end ONE equipment using fiber optic cable.

The RF source signals are represented in the setup by appropriate signal generators.

An “Exercise” SW on the computer was used to enable / disable transmission of the EUT, while the EUT output was connected to the spectrum analyzer.

The system was tested under maximum gain conditions while input power level to the RIM is 0 dBm and output power at the antenna port of MRU is 34dBm.

Testing was performed on the following configuration:

| Frequency Range (MHz) |               |                 |
|-----------------------|---------------|-----------------|
| Service/Band          | Downlink (DL) | Technology      |
| AWS 2100              | 2110-2180     | WCDMA, LTE, GSM |

### 2.2 EUT Exercise Software

The Element Management System ver. 1.9 used for commands delivery. These commands are used to enable/disable the EUT transmission. EUT Embedded SW versions is mru\_da64\_19\_01.bin.

### 2.3 Special Accessories

IHU.

### 2.4 Equipment Modifications

No modifications were necessary in order to achieve compliance.

## 2.5 Configuration of Tested System

|                                  |                                                                                                                                                      |
|----------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------|
| Product Name                     | ONE Wireless Platform                                                                                                                                |
| Model Name                       | MRU (Mid Power Remote Unit) with AWS-3 support consists of<br>Chassis MRU-E-ASM-AC-B<br>Chassis MRU-E-ASM-DC-B<br>Power Amplifier Module MRU-PAM-17E |
| Working voltage                  | 115VAC/48VDC                                                                                                                                         |
| Mode of operation                | Industrial Booster for AWS3 band                                                                                                                     |
| Modulations                      | WCDMA, LTE(64QAM), GSM                                                                                                                               |
| Frequency Range                  | 2110MHz-2180MHz                                                                                                                                      |
| Transmit power                   | 34.0 dBm                                                                                                                                             |
| Antenna Gain                     | 12.5 dBi                                                                                                                                             |
| DATA rate                        | N/A                                                                                                                                                  |
| Modulation BW                    | 0.5MHz(GSM), 5MHz(WCDMA); 10MHz(LTE)                                                                                                                 |
| Temperature (°C)/ Humidity (%RH) | 20.5°C/30.0%                                                                                                                                         |

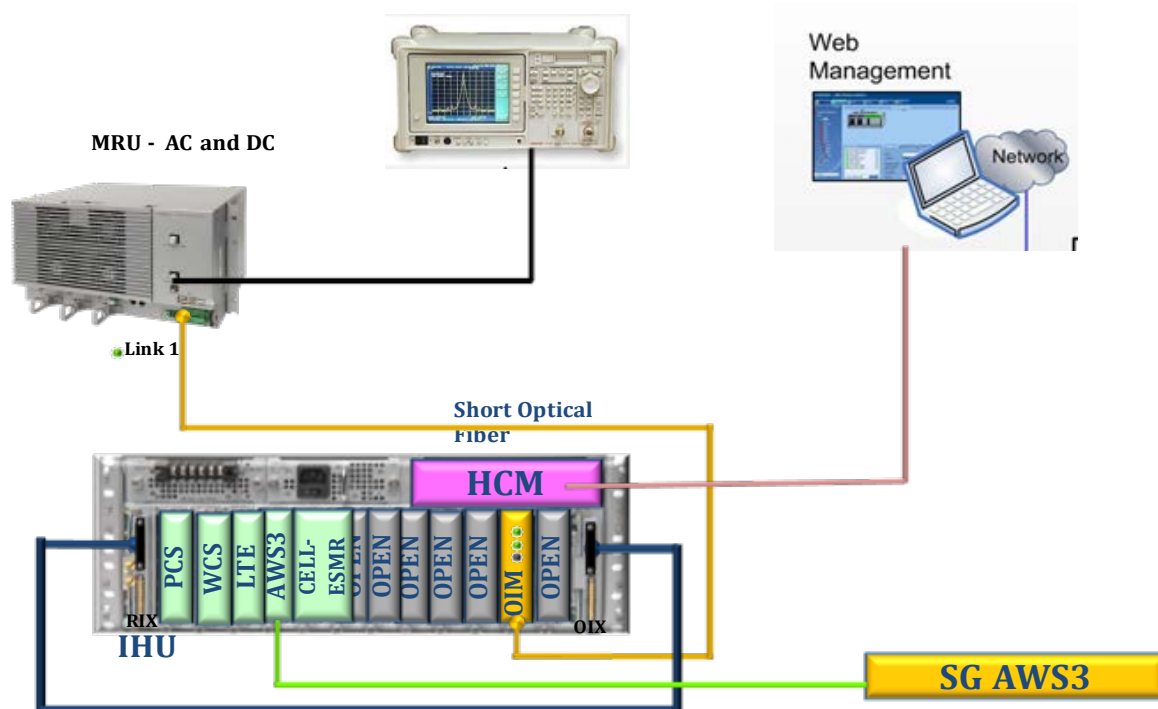


Figure 1. Conducted Test Set-Up

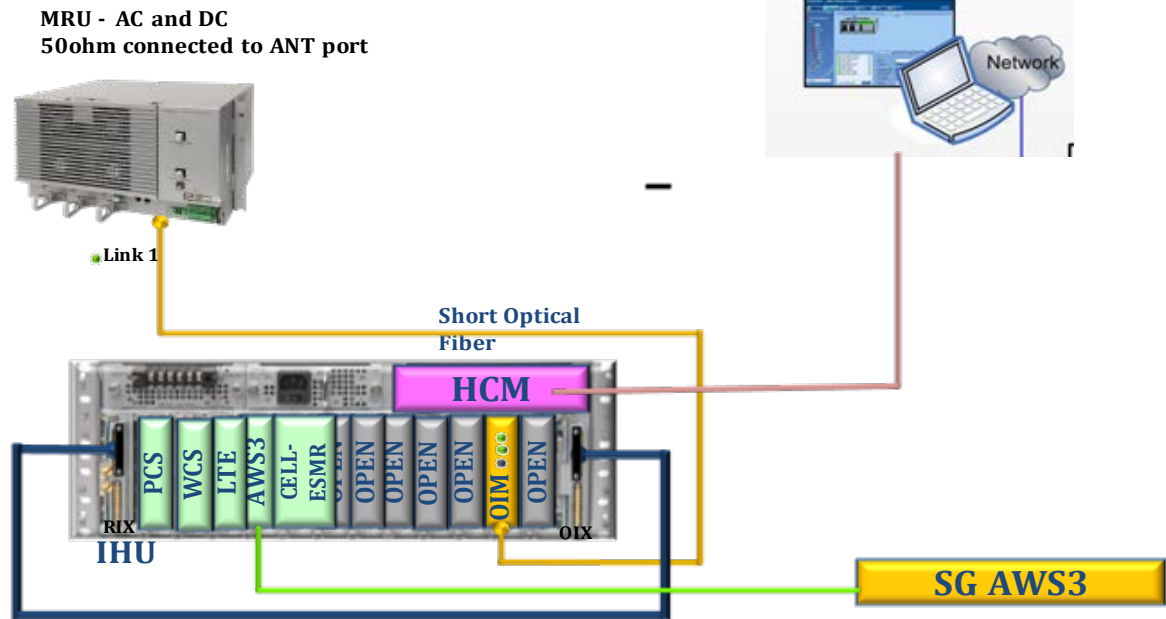
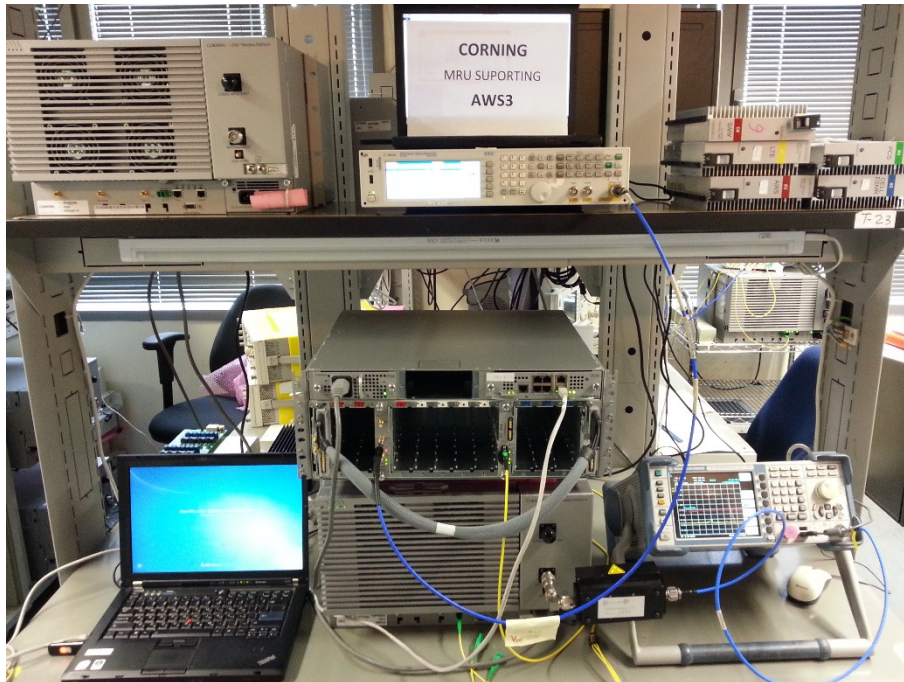


Figure 2. Radiated Test Set-Up

### 3. Test Set-Up Photos



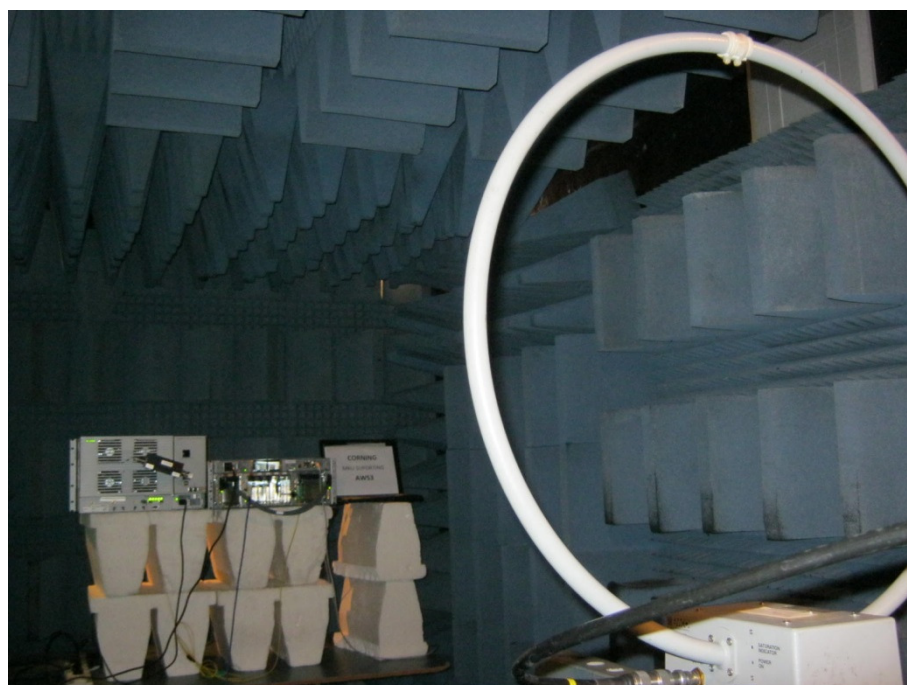
**Figure 3. Conducted Emission from Antenna Ports Test**



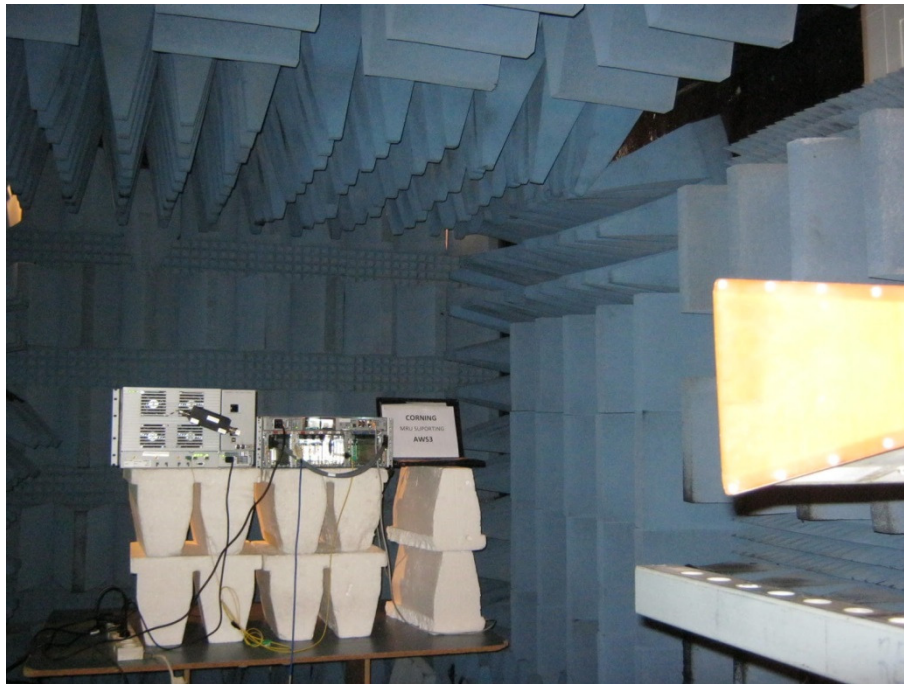
**Figure 4. Radiated Emission Test**



**Figure 5. Radiated Emission Test**



**Figure 6. Radiated Emission Test**



**Figure 7. Radiated Emission Test**

## 4. RF Power Output AWS

### 4.1 Test Specification

FCC Part 27, Subpart C (27.50(d))

### 4.2 Test Procedure

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator (41.0 dB) and an appropriate coaxial cable. Special attention was taken to prevent Spectrum Analyzer RF input overload.

### 4.3 Limit

The power limit is 1640W (62.1 dBm).

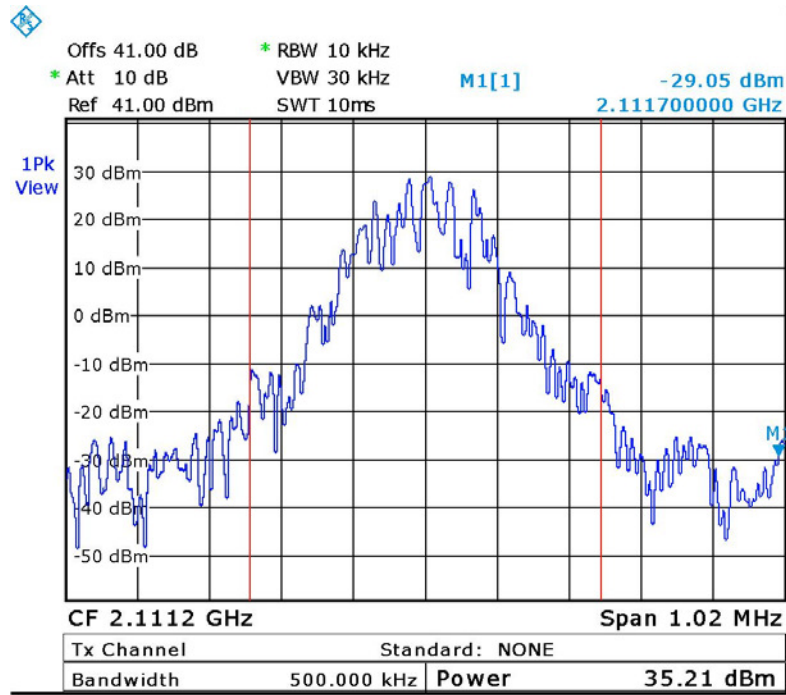
### 4.4 Results

| Modulation | Operation Frequency (MHz) | Reading (dBm) | Antenna Gain (dBi) | EIRP (dBm) | Specification (dBm) | Margin (dB) |
|------------|---------------------------|---------------|--------------------|------------|---------------------|-------------|
| GSM        | 2111.2                    | 35.2          | 12.5               | 47.7       | 62.1                | -14.4       |
| GSM        | 2145.0                    | 34.9          | 12.5               | 47.4       | 62.1                | -14.7       |
| GSM        | 2178.8                    | 34.4          | 12.5               | 46.9       | 62.1                | -15.2       |
| LTE 64QAM  | 2115.0                    | 34.4          | 12.5               | 46.9       | 62.1                | -15.2       |
| LTE 64QAM  | 2145.0                    | 34.8          | 12.5               | 47.3       | 62.1                | -14.8       |
| LTE 64QAM  | 2175.0                    | 34.6          | 12.5               | 47.1       | 62.1                | -15.0       |
| WCDMA      | 2112.5                    | 34.5          | 12.5               | 47.0       | 62.1                | -15.1       |
| WCDMA      | 2145.0                    | 34.3          | 12.5               | 46.8       | 62.1                | -15.3       |
| WCDMA      | 2177.5                    | 34.8          | 12.5               | 47.3       | 62.1                | -14.8       |

**Figure 8 RF Power Output AWS**

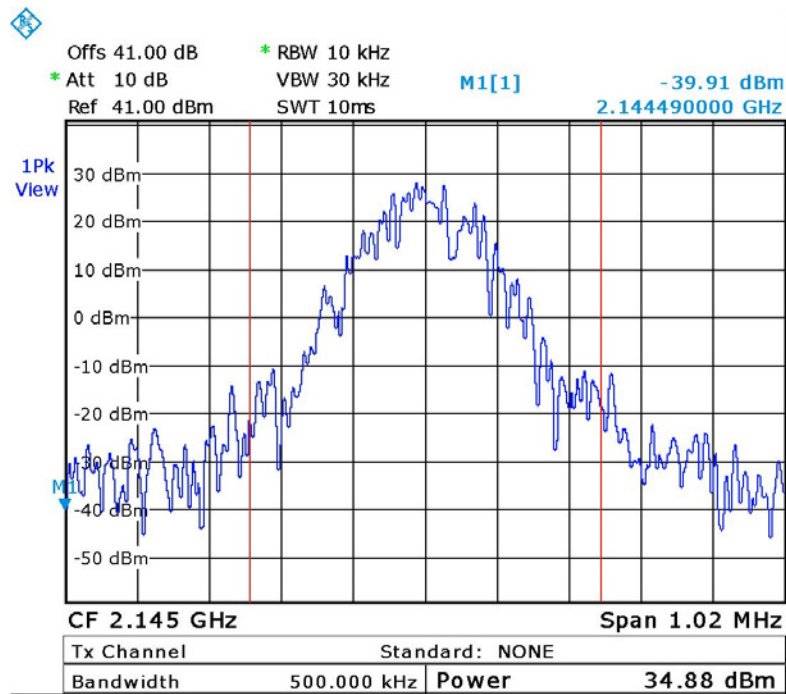
See additional information in *Figure 9* to *Figure 17*.

JUDGEMENT: Passed



Date: 13.MAR.2016 11:50:49

Figure 9. — GSM (2111.2 MHz)



Date: 13.MAR.2016 11:52:19

Figure 10. — GSM (2145.0MHz)

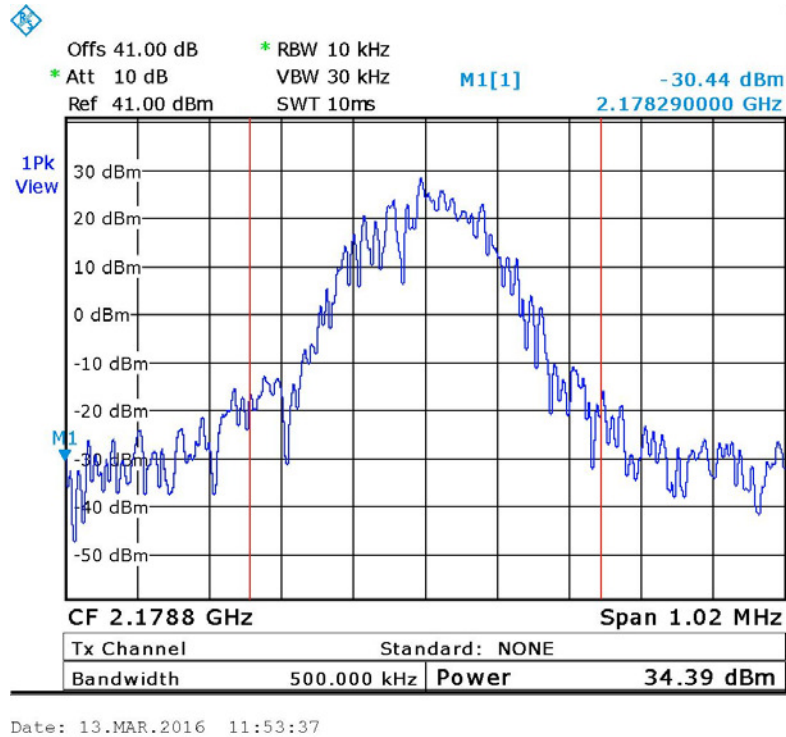


Figure 11. — GSM (2178.8 MHz)

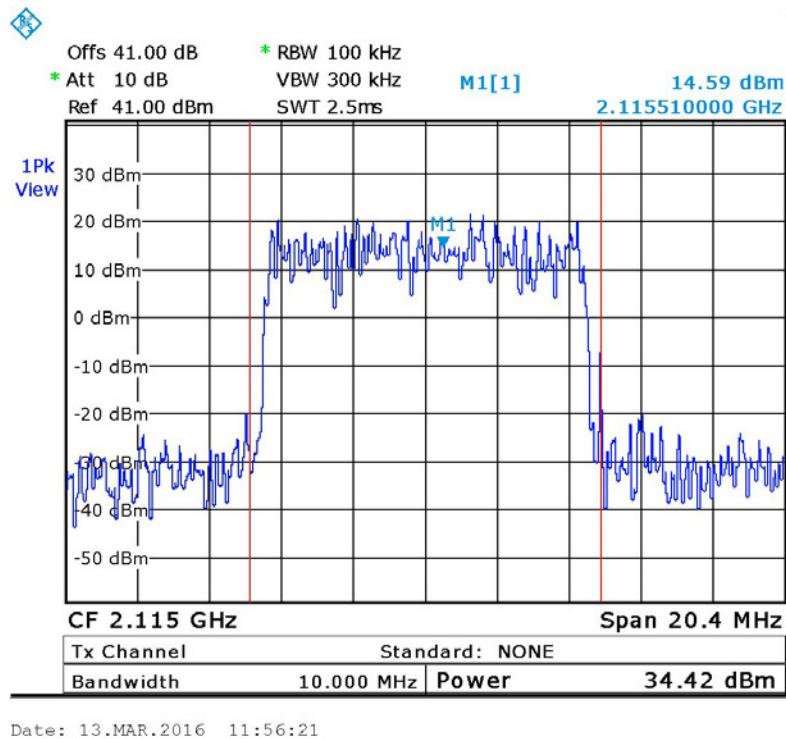


Figure 12. — LTE 64QAM (2115.0 MHz)

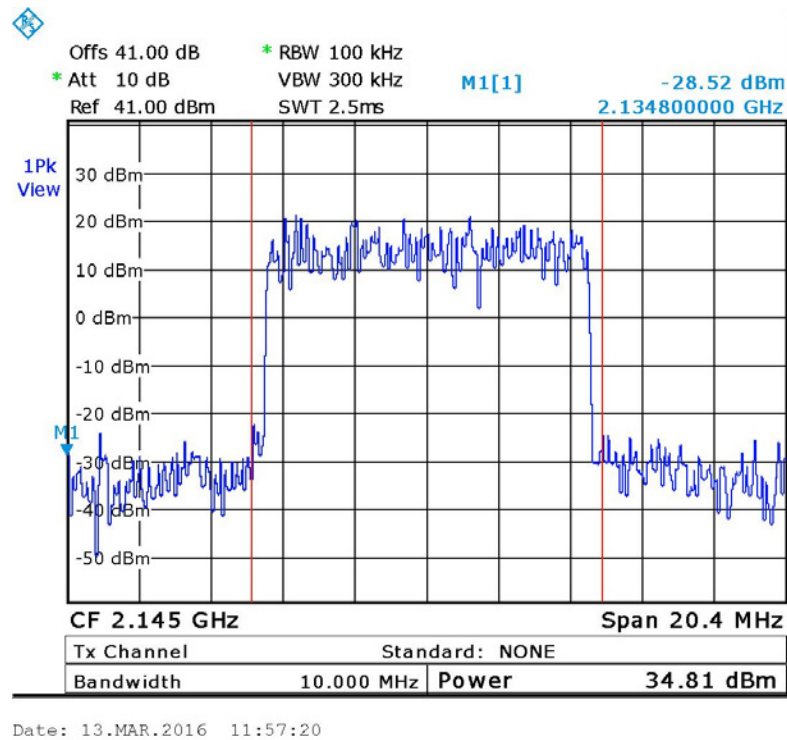


Figure 13. — LTE 64QAM (2145.0MHz)

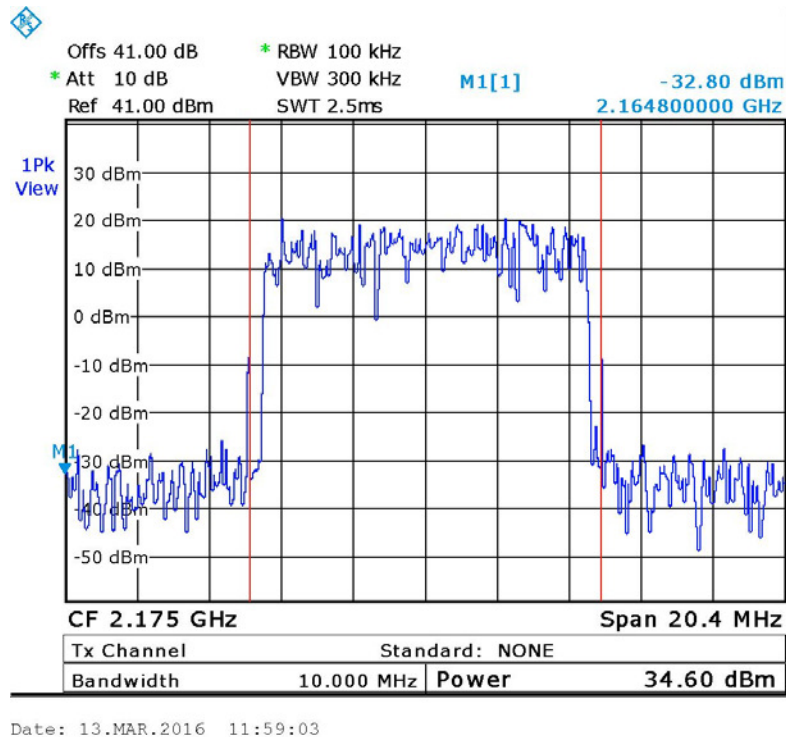


Figure 14. — LTE 64QAM (2175.0MHz)

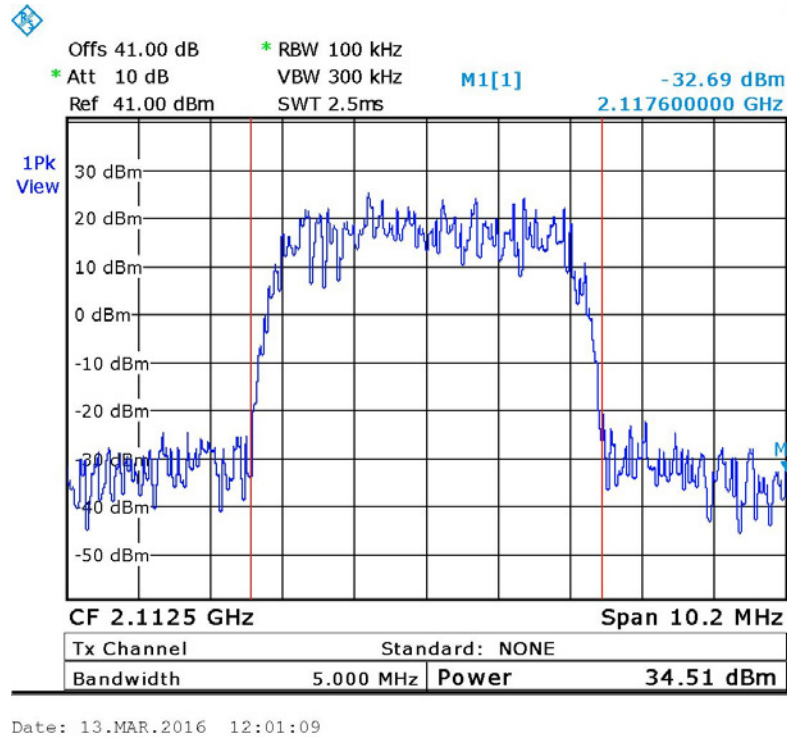


Figure 15. — W-CDMA (2112.5 MHz)

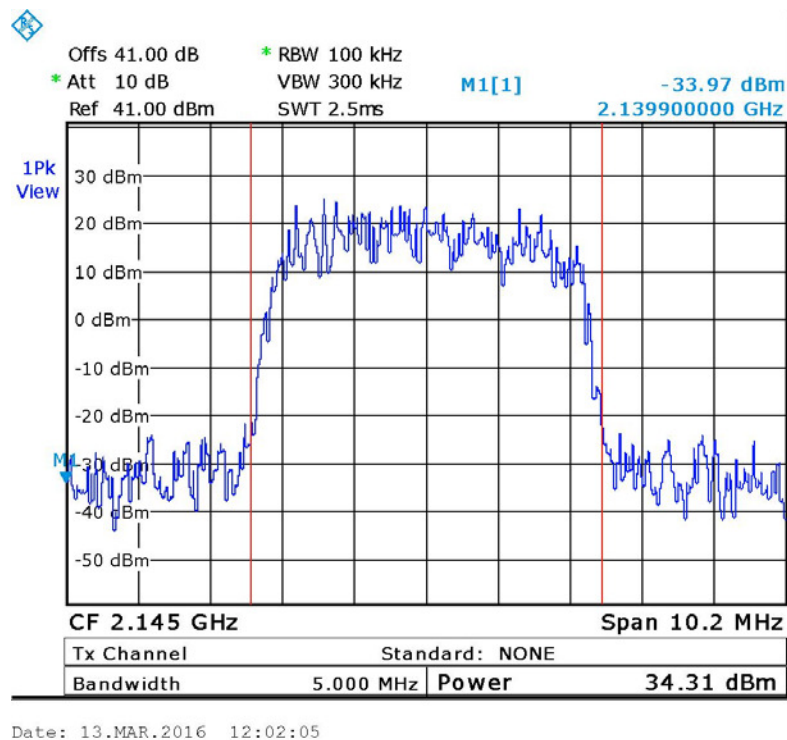


Figure 16. — W-CDMA (2145.0MHz)

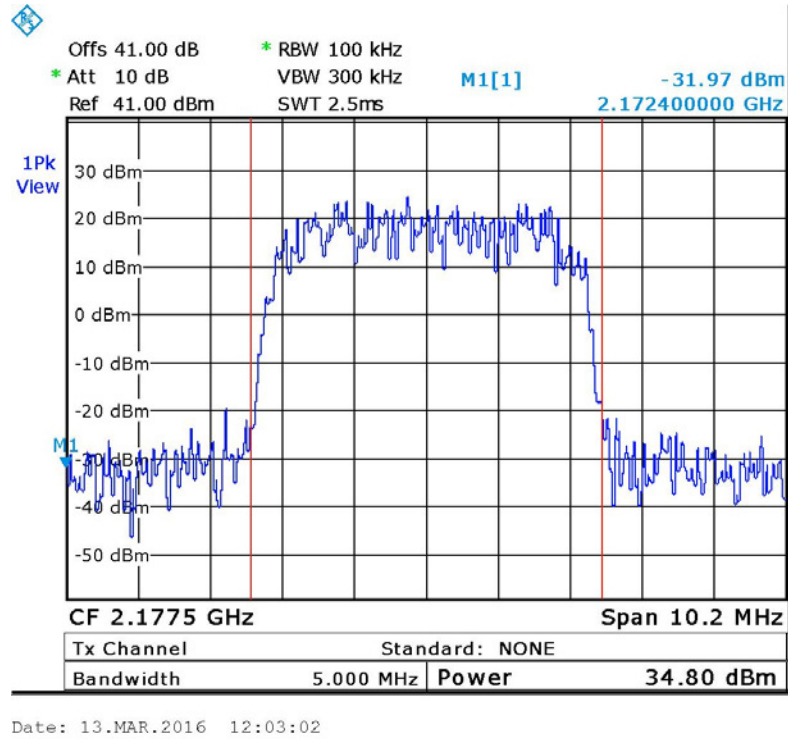


Figure 17. — W-CDMA (2177.5MHz)



#### 4.5 Test Equipment Used; RF Power Output AWS

| Instrument                  | Manufacturer | Model       | Serial Number | Calibration           |                      |
|-----------------------------|--------------|-------------|---------------|-----------------------|----------------------|
|                             |              |             |               | Last Calibration Date | Next Calibration Due |
| EXG Vector Signal Generator | Agilent      | N5172B      | MY51350518    | May 3, 2013           | May 3, 2016          |
| Spectrum Analyzer           | R&S          | FSL6        | 100194        | February 29, 2016     | February 28, 2017    |
| 40 dB Attenuator            | Weinschel    | WA 39-40-33 | A1323         | March 1, 2015         | March 31, 2016       |

**Figure 18 Test Equipment Used**

## 5. Occupied Bandwidth AWS

### 5.1 Test Specification

FCC Part 2, Section 1049

### 5.2 Test Procedure

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (at the output test) and an appropriate coaxial cable (loss=41.0 dB). The spectrum analyzer was set to proper resolution B.W. OBW function (99%) was employed for these evaluation  
Occupied bandwidth measured was repeated in the input terminal of the E.U.T.

### 5.3 Limit

N/A

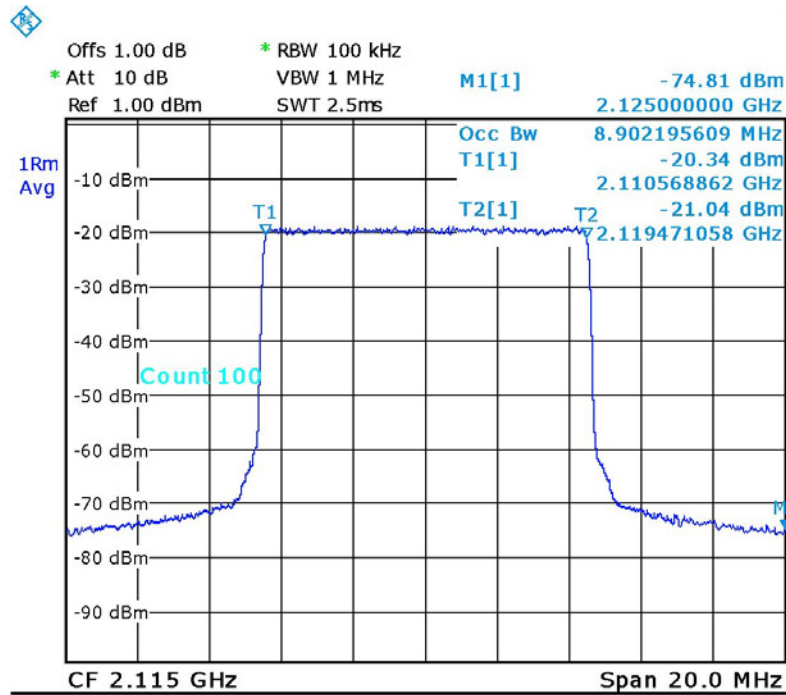
### 5.4 Results

| Modulation | Port   | Operating Frequency (MHz) | Reading (MHz) |
|------------|--------|---------------------------|---------------|
| LTE 64QAM  | Input  | 2115.0                    | 8.90          |
|            | Output | 2115.0                    | 8.90          |
|            | Input  | 2145.0                    | 8.90          |
|            | Output | 2145.0                    | 8.90          |
|            | Input  | 2175.0                    | 8.90          |
|            | Output | 2175.0                    | 8.94          |
| GSM        | Input  | 2111.2                    | 0.24          |
|            | Output | 2111.2                    | 0.24          |
|            | Input  | 2145.0                    | 0.24          |
|            | Output | 2145.0                    | 0.24          |
|            | Input  | 2178.8                    | 0.24          |
|            | Output | 2178.8                    | 0.24          |
| WCDMA      | Input  | 2112.5                    | 4.19          |
|            | Output | 2112.5                    | 4.17          |
|            | Input  | 2145.0                    | 4.19          |
|            | Output | 2145.0                    | 4.17          |
|            | Input  | 2177.5                    | 4.19          |
|            | Output | 2177.5                    | 4.17          |

Figure 19 Occupied Bandwidth AWS

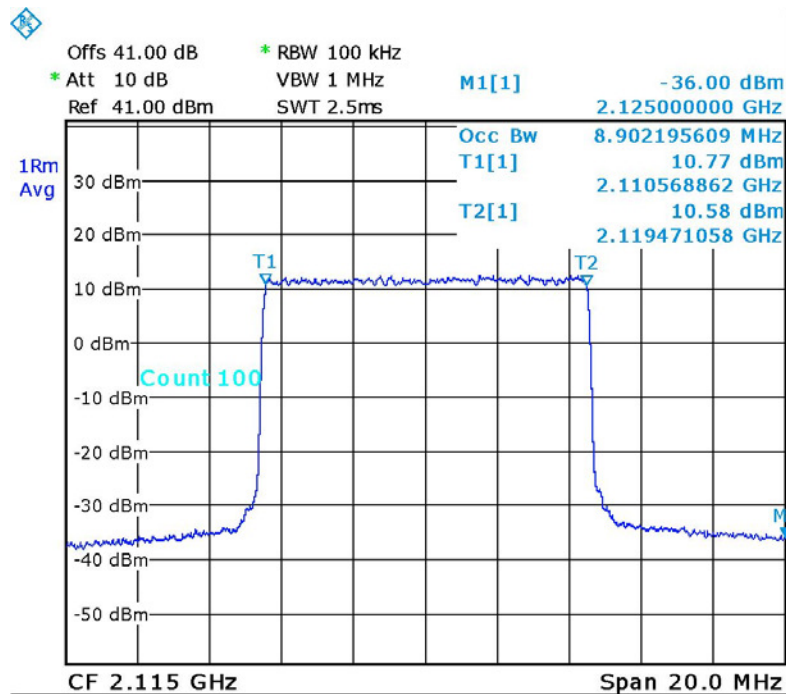
See additional information in *Figure 20* to *Figure 37*.

JUDGEMENT: Passed



Date: 13.MAR.2016 12:39:07

Figure 20. — LTE 64QAM (2115.0 MHz) IN



Date: 13.MAR.2016 12:36:39

Figure 21. — LTE 64QAM (2115.0 MHz) OUT

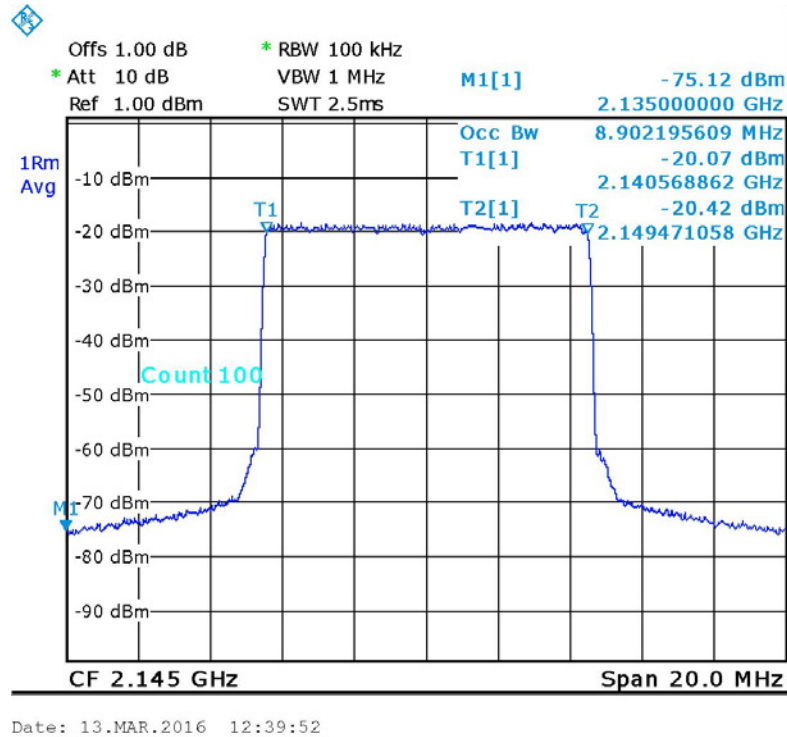


Figure 22. — LTE 64QAM (2145.0MHz) IN

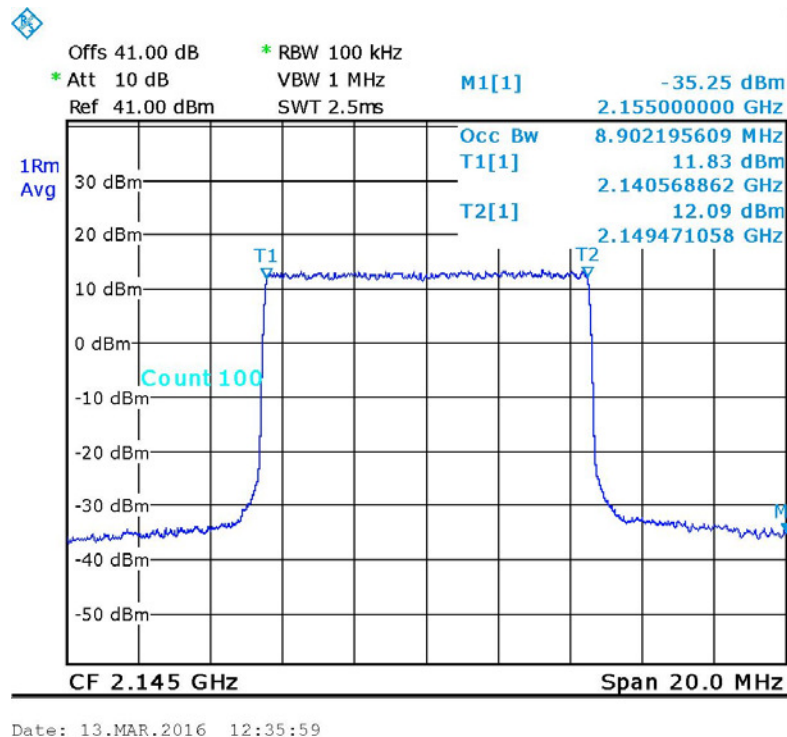


Figure 23. — LTE 64QAM (2145.0MHz) OUT

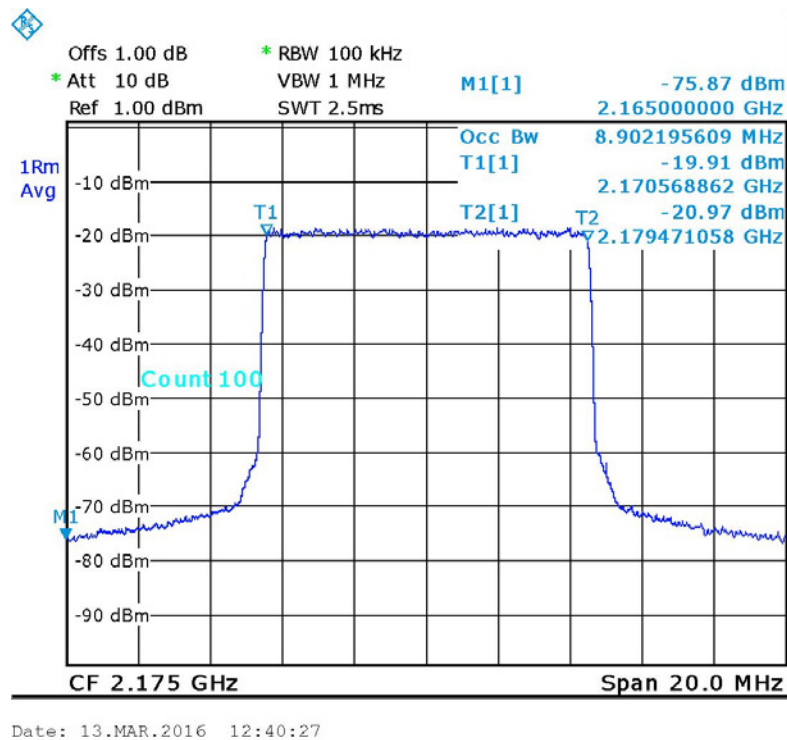


Figure 24. — LTE 64QAM (2175.0 MHz) IN

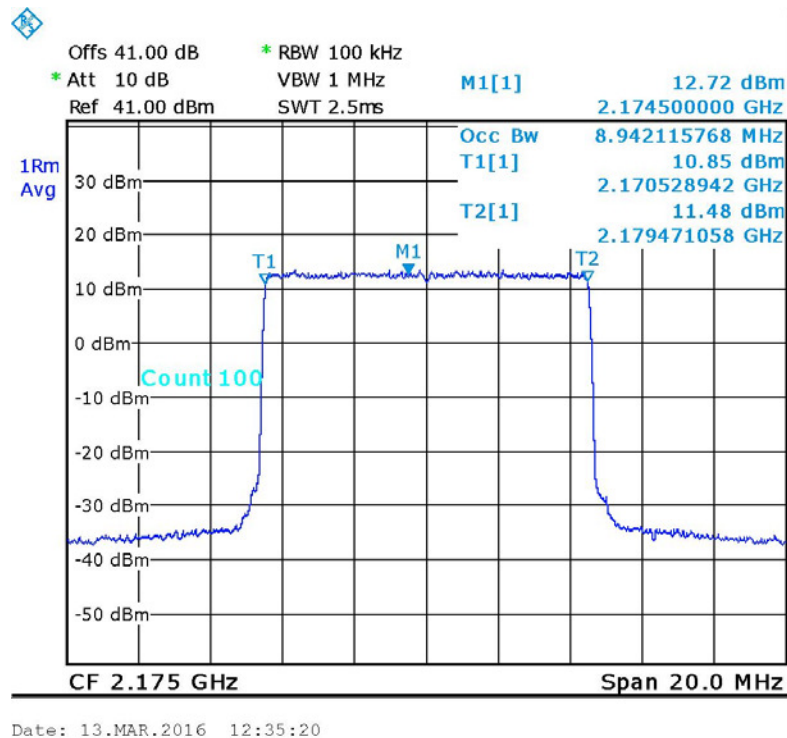


Figure 25. — LTE 64QAM (2175.0 MHz) OUT

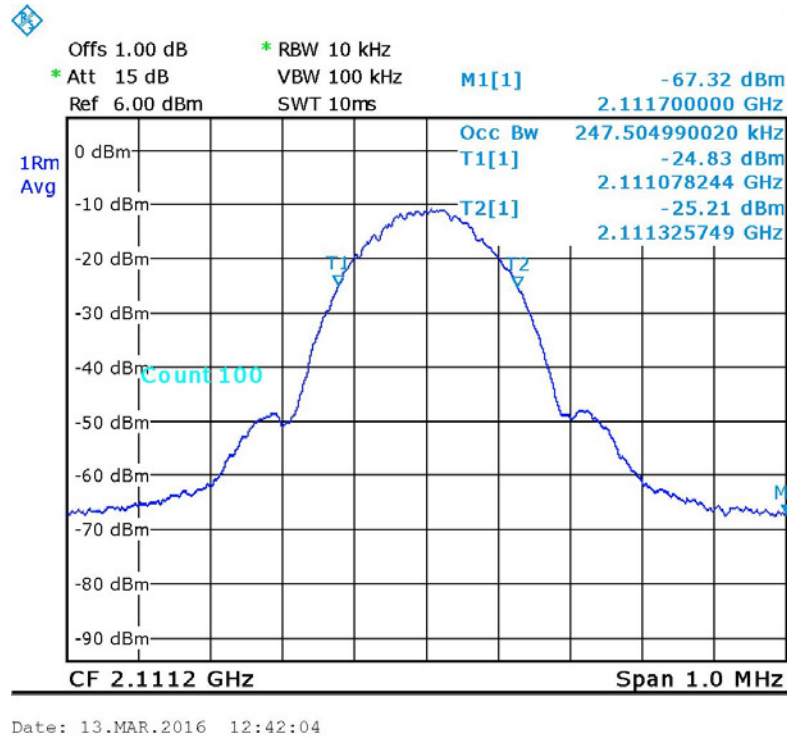


Figure 26. — GSM (2111.2 MHz) IN

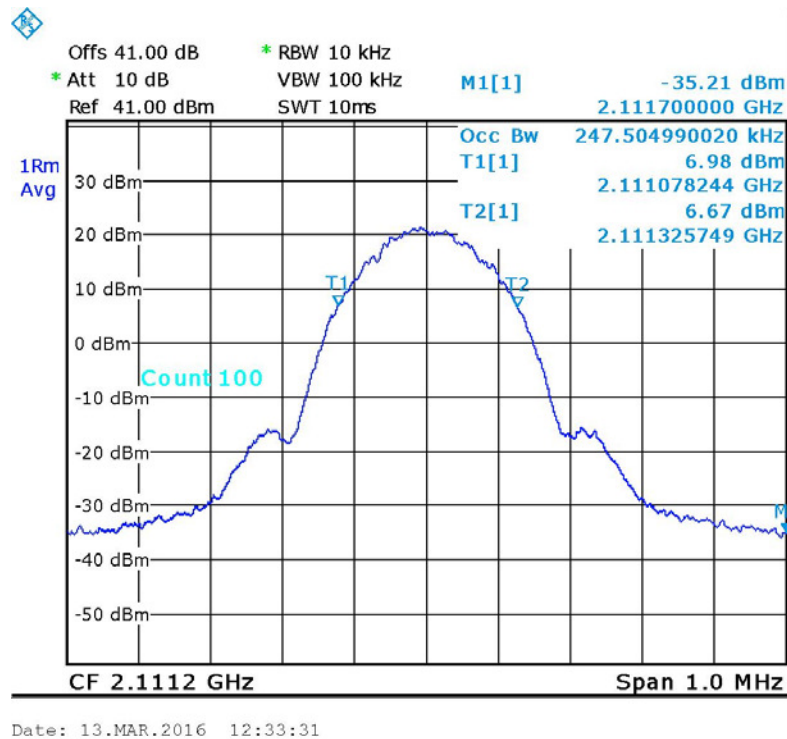


Figure 27. — GSM (2111.2 MHz) OUT

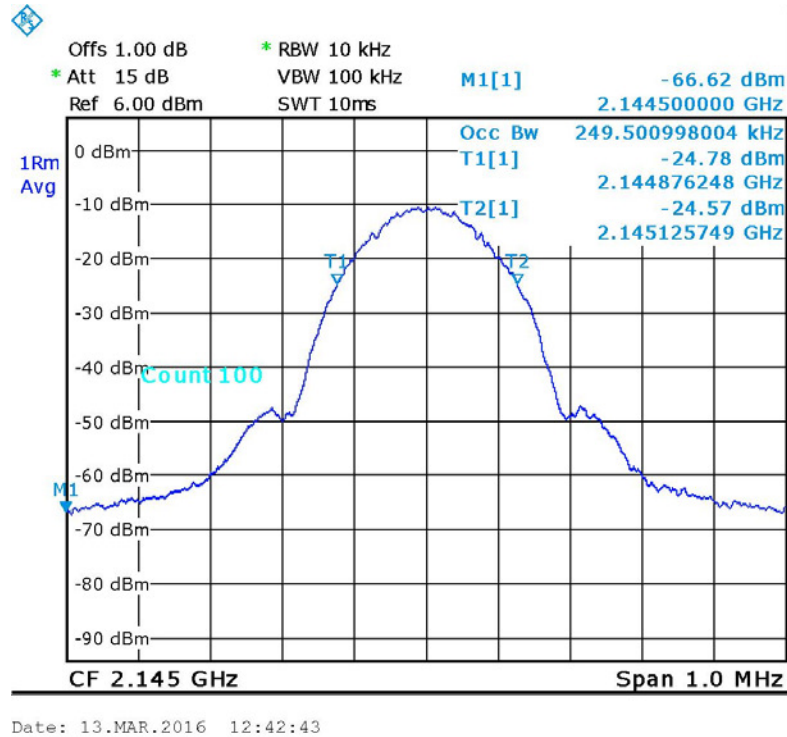


Figure 28. — GSM (2145.0MHz) IN

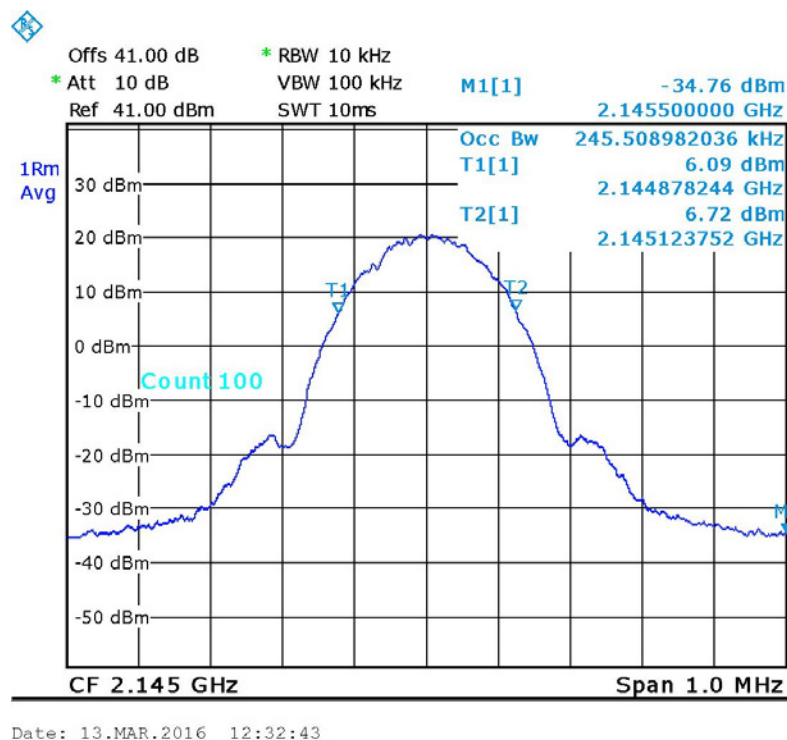
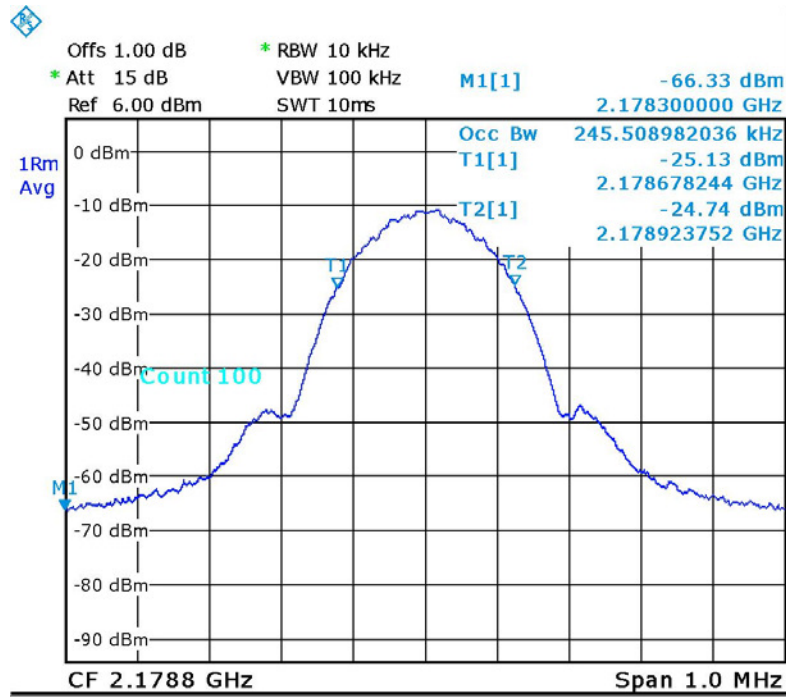
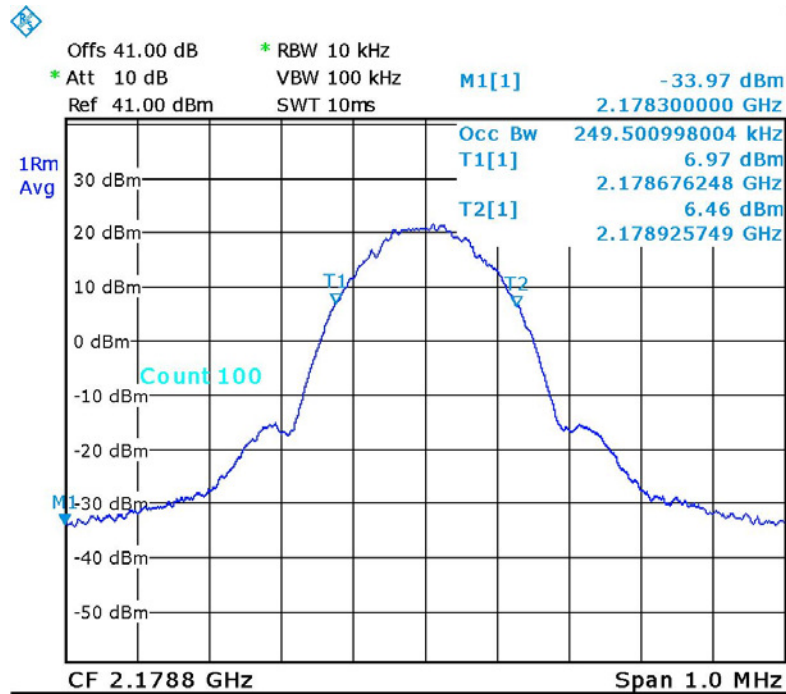


Figure 29. — GSM (2145.0MHz) OUT



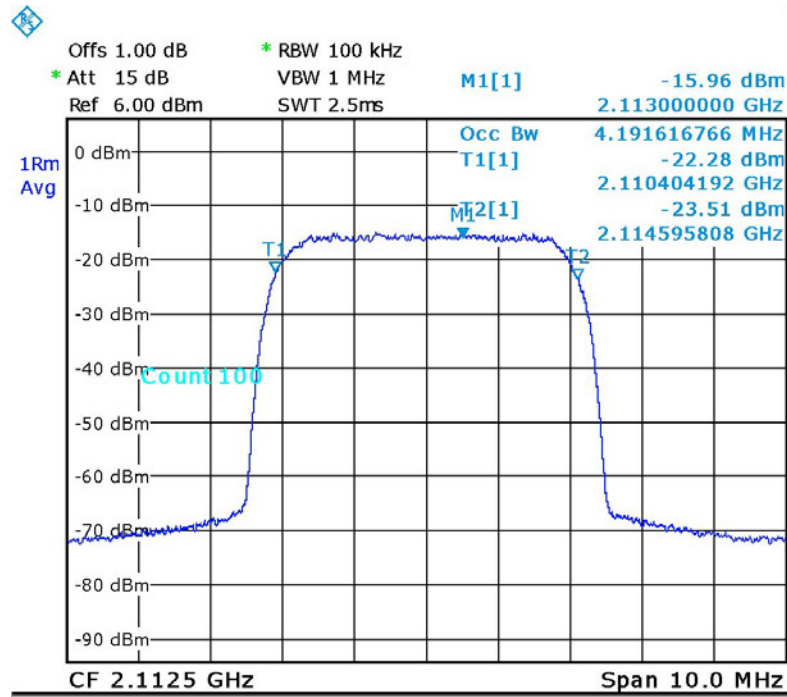
Date: 13.MAR.2016 12:43:25

Figure 30. — GSM (2178.8 MHz) IN



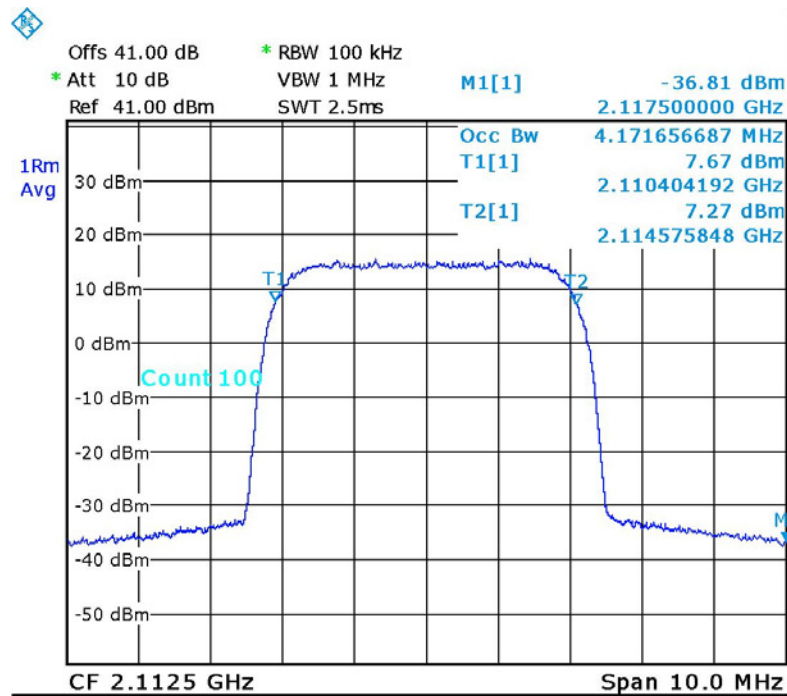
Date: 13.MAR.2016 12:31:57

Figure 31. — GSM (2178.8 MHz) OUT



Date: 13.MAR.2016 12:44:41

Figure 32. — W-CDMA (2112.5 MHz) IN



Date: 13.MAR.2016 12:29:22

Figure 33. — W-CDMA (2112.5 MHz) OUT

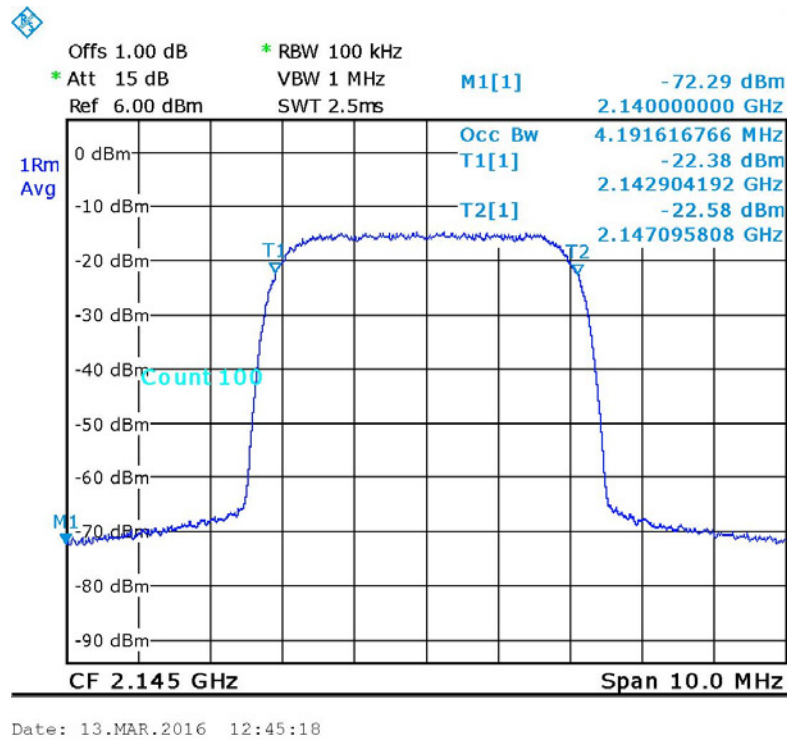


Figure 34. — W-CDMA (2145.0MHz) IN

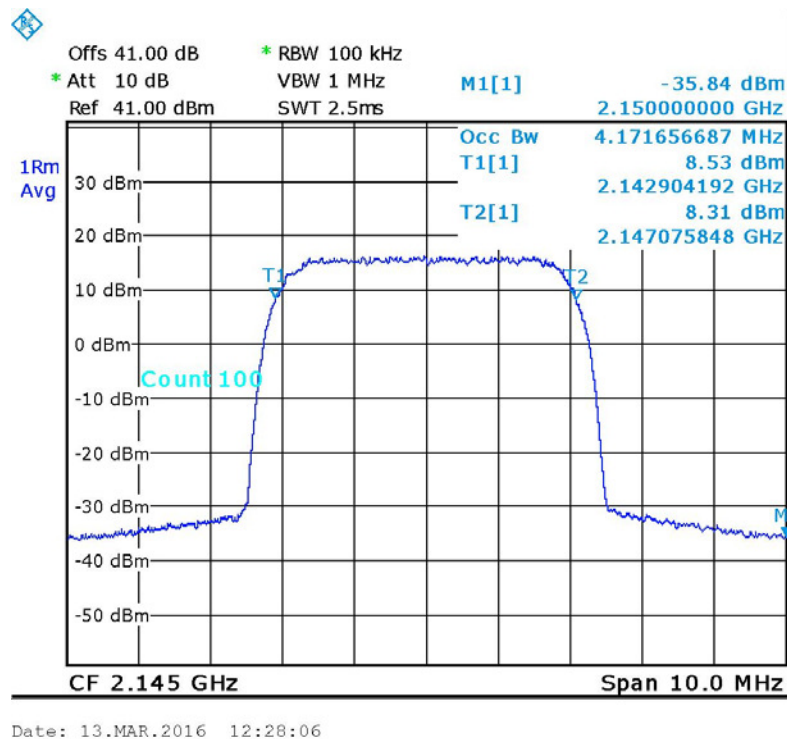
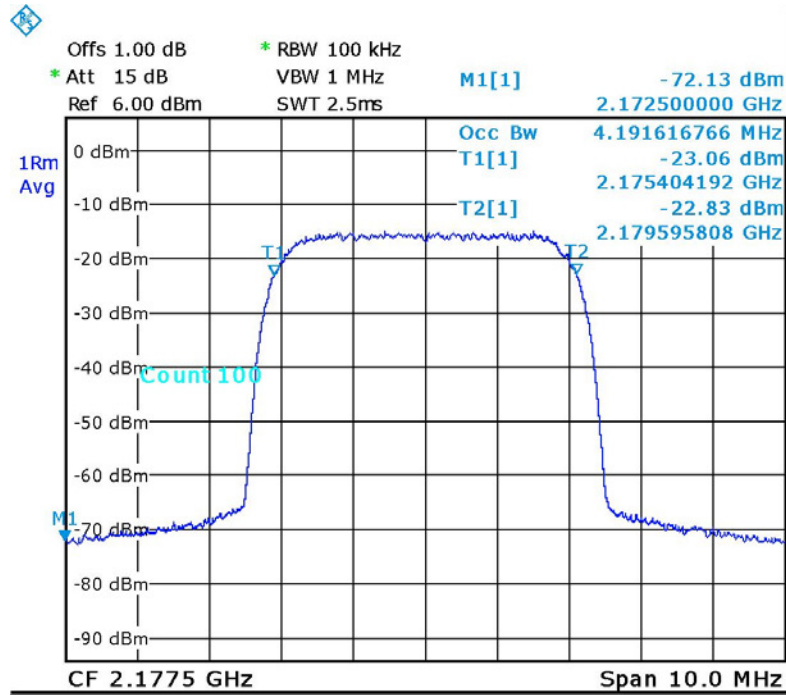
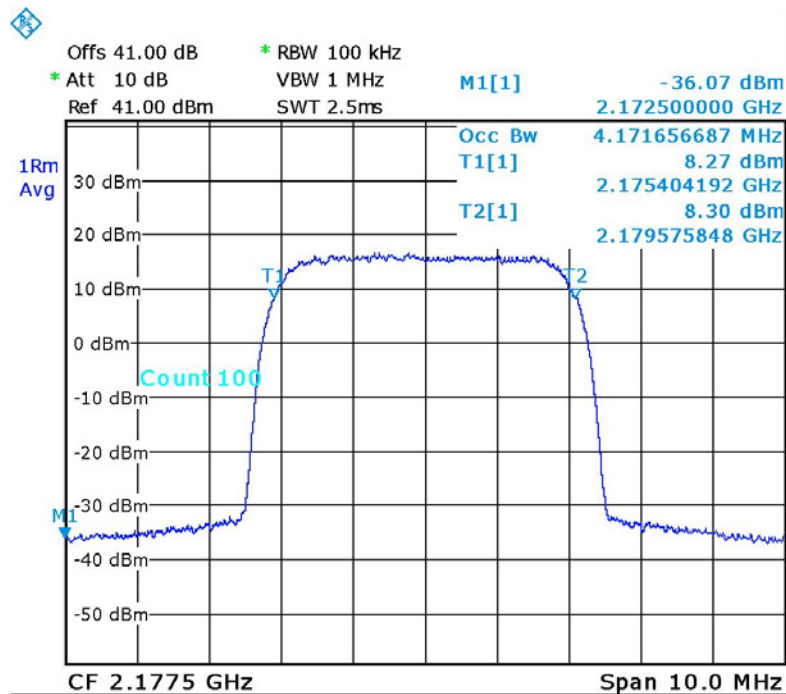


Figure 35. — W-CDMA (2145.0MHz) OUT



Date: 13.MAR.2016 12:46:07

Figure 36. — W-CDMA (2177.5 MHz) IN



Date: 13.MAR.2016 12:26:46

Figure 37. — W-CDMA (2177.5 MHz) OUT



### 5.5 Test Equipment Used; Occupied Bandwidth

| Instrument                  | Manufacturer | Model       | Serial Number | Calibration           |                      |
|-----------------------------|--------------|-------------|---------------|-----------------------|----------------------|
|                             |              |             |               | Last Calibration Date | Next Calibration Due |
| EXG Vector Signal Generator | Agilent      | N5172B      | MY51350518    | May 3, 2013           | May 3, 2016          |
| Spectrum Analyzer           | R&S          | FSL6        | 100194        | February 29, 2016     | February 28, 2017    |
| 40 dB Attenuator            | Weinschel    | WA 39-40-33 | A1323         | March 1, 2015         | March 31, 2016       |

**Figure 38 Test Equipment Used**

## 6. Spurious Emissions at Antenna Terminals AWS

### 6.1 Test Specification

FCC Part 27, Subpart C, Section 27.53 (h)

### 6.2 Test procedure

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable (max loss = 44.0 dB). The spectrum analyzer was set to 1 kHz resolution BW for the frequency range 9.0-150.0 kHz, 10.0 kHz for the frequency range 150.0 kHz-1.0 MHz, 100.0 kHz for the frequency range 1.0 MHz – 30.0 MHz, and 1.0MHz for the frequency range 30.0 MHz - 22.0 GHz.

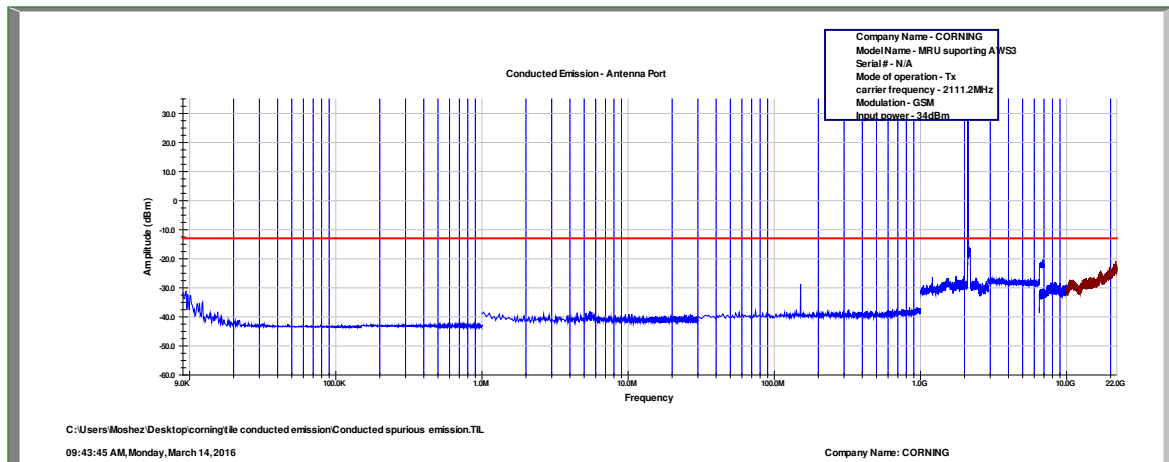
### 6.3 Limit

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  $43 + \log(P)$  dB, yielding -13dBm.

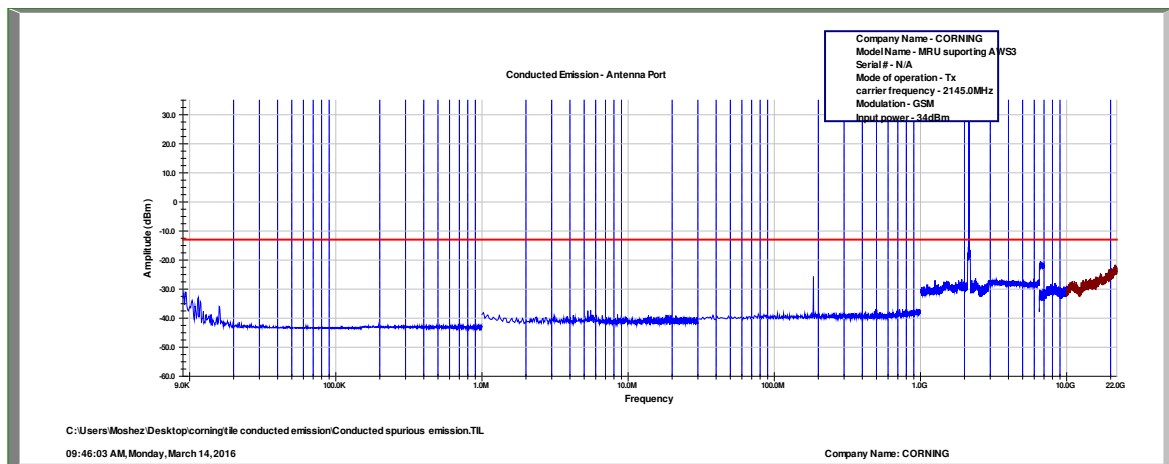
### 6.4 Results

See additional information in *Figure 39* to *Figure 47*.

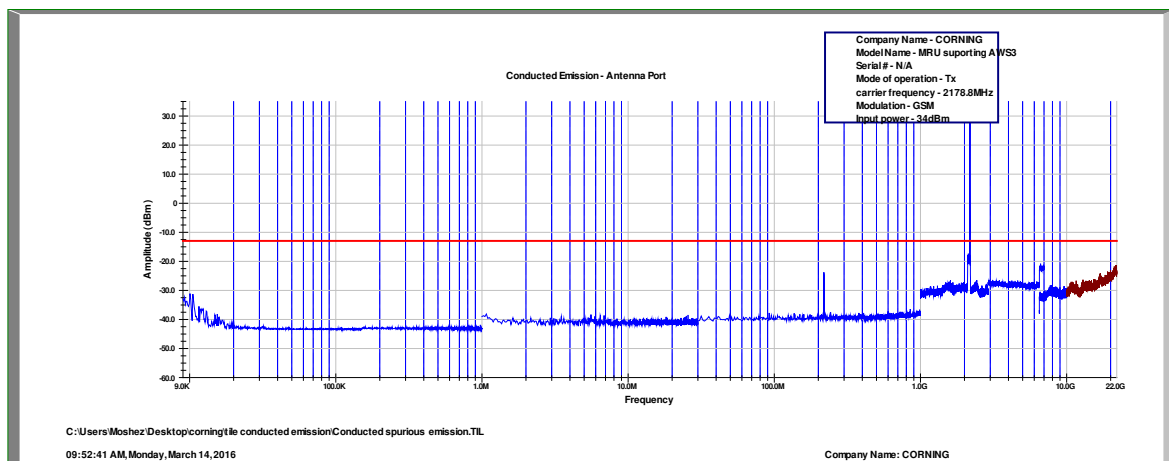
JUDGEMENT: Passed



**Figure 39 Spurious Emissions at Antenna Terminals GSM, 2111.2MHz**



**Figure 40 Spurious Emissions at Antenna Terminals GSM, 2145.0MHz**



**Figure 41 Spurious Emissions at Antenna Terminals GSM, 2178.8MHz**

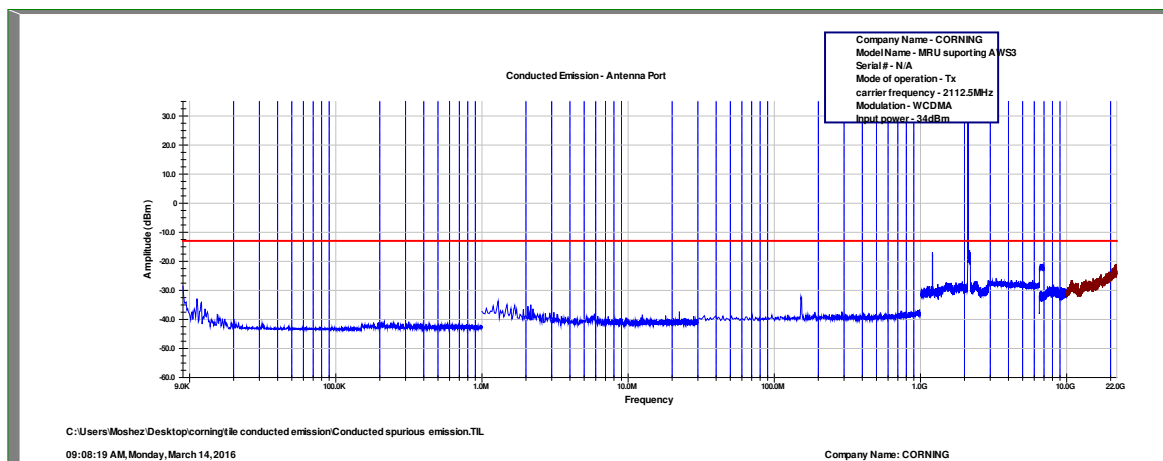


Figure 42 Spurious Emissions at Antenna Terminals WCDMA, 2112.5MHz

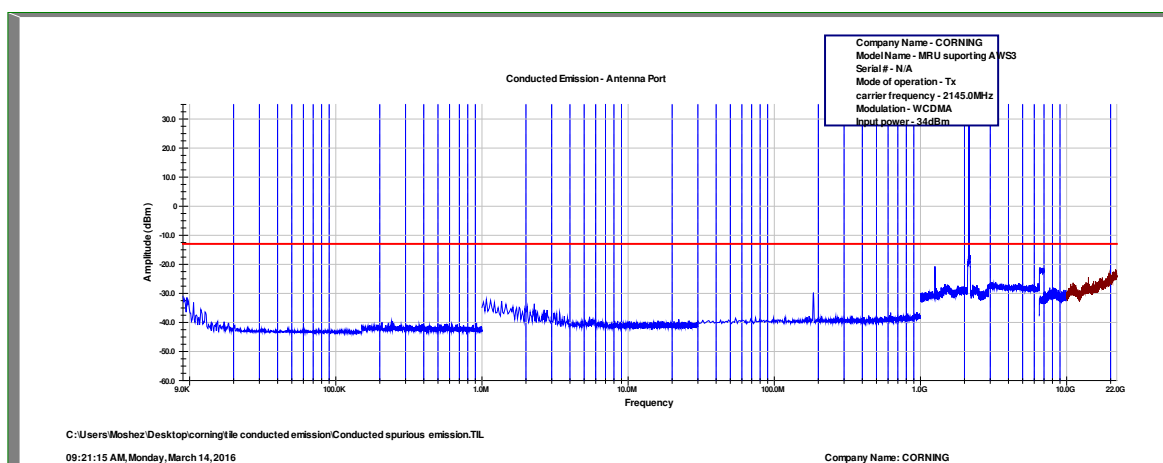


Figure 43 Spurious Emissions at Antenna Terminals WCDMA, 2145.0MHz

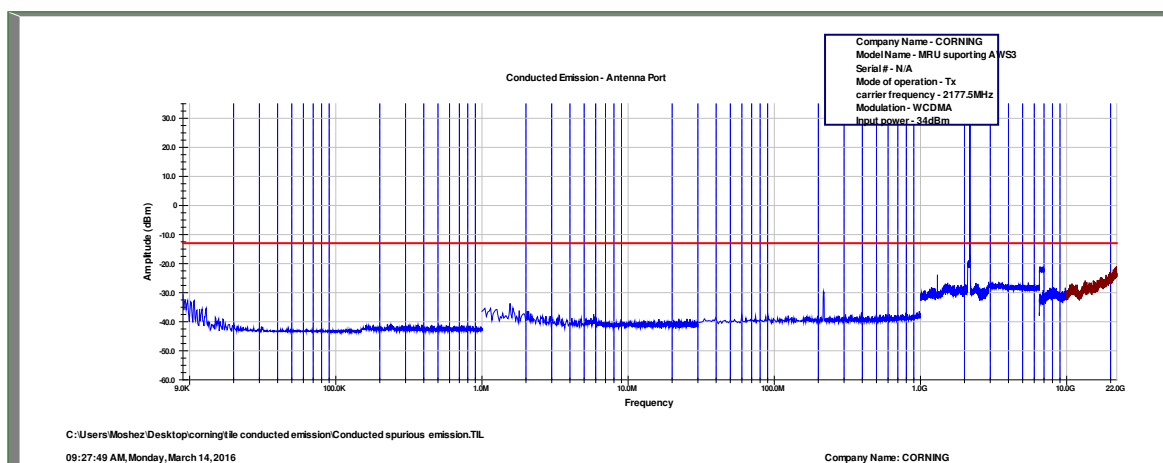
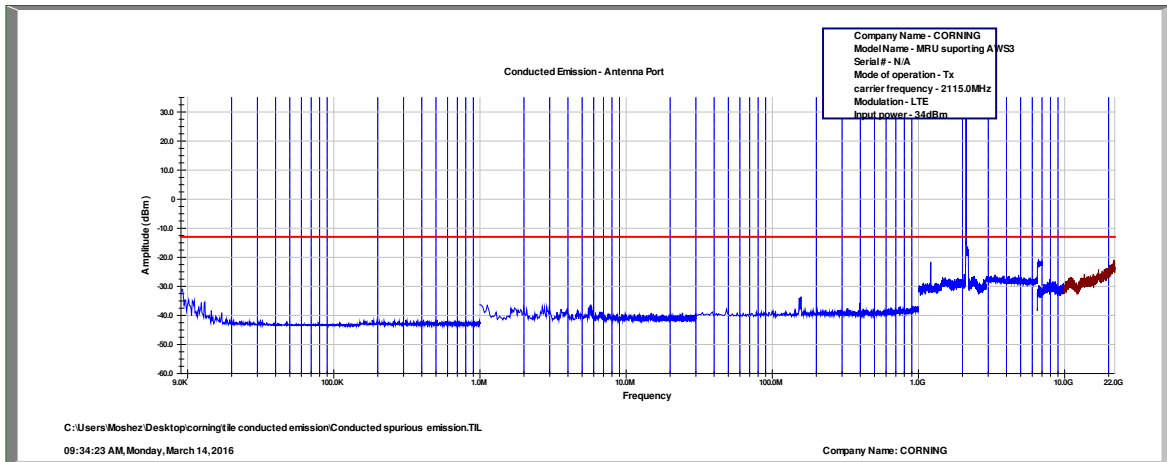
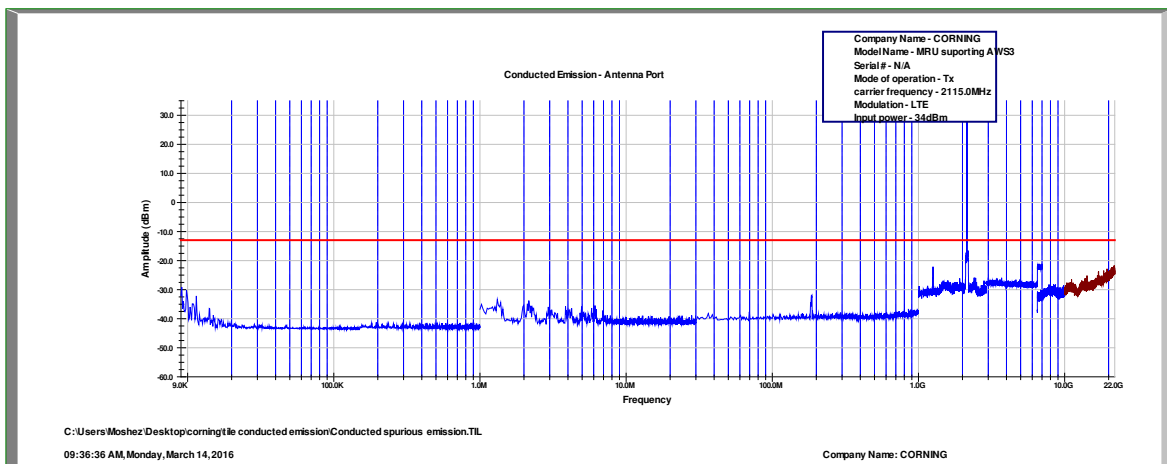


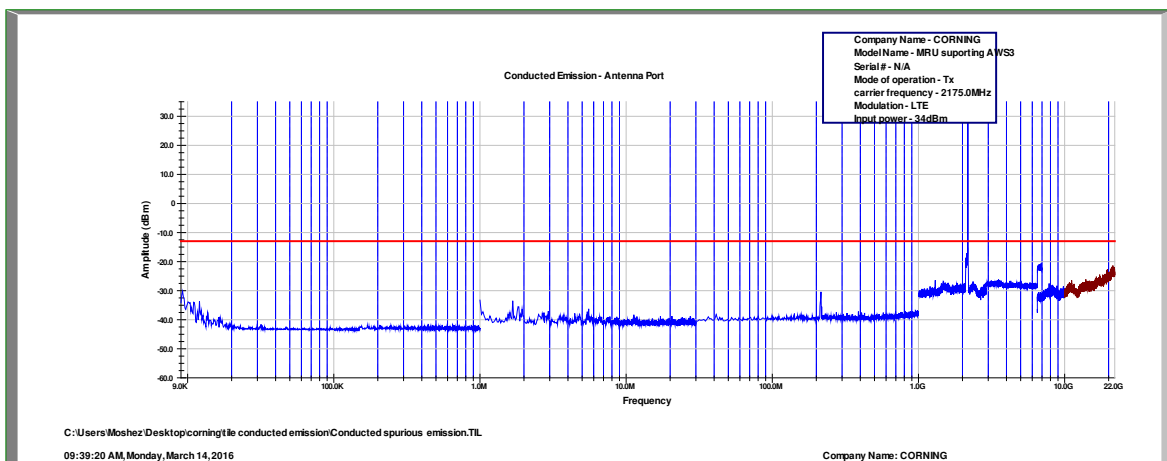
Figure 44 Spurious Emissions at Antenna Terminals WCDMA, 2177.5MHz



**Figure 45 Spurious Emissions at Antenna Terminals LTE, 2115.0MHz**



**Figure 46 Spurious Emissions at Antenna Terminals LTE, 2145.0MHz**



**Figure 47 Spurious Emissions at Antenna Terminals LTE, 2175.0MHz**



**6.5 Test Equipment Used; Spurious Emissions at Antenna Terminals  
AWS**

| Instrument                  | Manufacturer | Model    | Serial Number | Calibration           |                      |
|-----------------------------|--------------|----------|---------------|-----------------------|----------------------|
|                             |              |          |               | Last Calibration Date | Next Calibration Due |
| EXG Vector Signal Generator | Agilent      | N5172B   | MY51350518    | May 3, 2013           | May 3, 2016          |
| Spectrum Analyzer           | HP           | 8592L    | 3826A01204    | March 13, 2016        | March 13, 2017       |
| 30 dB Attenuator            | MCL          | BW-S30W5 | 533           | June 1, 2014          | June 1, 2016         |

**Figure 48 Test Equipment Used**