



DATE: 5 December 2016

I.T.L. (PRODUCT TESTING) LTD.
FCC Radio Test Report
for
Corning Optical Communication Wireless
Equipment under test:

ONE - Optical Network Evolution DAS

**RAU-5X Remote Antenna Unit
AWS-3, CELL/ESMR, LTE, PCS
(AWS-3 Section)**

Tested by:


M. Zohar

Approved by:


D. Shidlowsky

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This report relates only to items tested.



Measurement/Technical Report for
Corning Optical Communication Wireless
ONE - Optical Network Evolution DAS
RAU-5X Remote Antenna Unit

FCC ID: OJF1RAU5X

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

Equipment type: Part 20 Industrial Booster (CMRS)

Limits used: 47CFR Parts 2; 27

Measurement procedure used is KDB 971168 D03 v01 and
KDB 935210 D05 v01r01

Substitution Method used as in ANSI/TIA-603-D: 2010.

Application for Certification
prepared by:
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TABLE OF CONTENTS

| | |
|---|-----------|
| 1. GENERAL INFORMATION | 5 |
| 1.1 Administrative Information | 5 |
| 1.2 List of Accreditations | 6 |
| 1.3 Product Description | 7 |
| 1.4 Test Methodology | 7 |
| 1.5 Test Facility | 7 |
| 1.6 Measurement Uncertainty | 7 |
| 2. SYSTEM TEST CONFIGURATION | 8 |
| 2.1 Justification | 8 |
| 2.2 EUT Exercise Software | 8 |
| 2.3 Special Accessories | 8 |
| 2.4 Equipment Modifications | 8 |
| 2.5 Configuration of Tested System | 9 |
| 3. TEST SET-UP PHOTOS | 11 |
| 4. RF POWER OUTPUT AWS | 15 |
| 4.1 Test Specification | 15 |
| 4.2 Test Procedure | 15 |
| 4.3 Test Limit | 15 |
| 4.4 Test Results | 15 |
| 4.5 Test Equipment Used; RF Power Output AWS | 21 |
| 5. OCCUPIED BANDWIDTH AWS | 22 |
| 5.1 Test Specification | 22 |
| 5.2 Test Procedure | 22 |
| 5.3 Test Limit | 22 |
| 5.4 Test Results | 22 |
| 5.5 Test Equipment Used; Occupied Bandwidth | 32 |
| 6. SPURIOUS EMISSIONS AT ANTENNA TERMINALS AWS | 33 |
| 6.1 Test Specification | 33 |
| 6.2 Test Procedure | 33 |
| 6.3 Test Limit | 33 |
| 6.4 Test Results | 33 |
| 6.5 Test Equipment Used; Spurious Emissions at Antenna Terminals AWS | 37 |
| 7. BAND EDGE SPECTRUM AWS | 38 |
| 7.1 Test Specification | 38 |
| 7.2 Test Procedure | 38 |
| 7.3 Test Limit | 38 |
| 7.4 Test Results | 38 |
| 7.5 Test Equipment Used; Band Edge Spectrum AWS | 42 |
| 8. SPURIOUS RADIATED EMISSION AWS | 43 |
| 8.1 Test Specification | 43 |
| 8.2 Test Procedure | 43 |
| 8.3 Test Limit | 44 |
| 8.4 Test Results | 44 |
| 8.5 Test Instrumentation Used, Radiated Measurements AWS-3 | 45 |
| 9. INTERMODULATION CONDUCTED | 46 |
| 9.1 Test Procedure | 46 |
| 9.2 Test Limit | 46 |
| 9.3 Test Results | 46 |
| 9.4 Test Equipment Used; Intermodulation Conducted | 47 |
| 10. INTERMODULATION RADIATED | 48 |
| 10.1 Test Procedure | 48 |
| 10.2 Test Limit | 49 |
| 10.3 Test Results | 49 |
| 10.4 Test Instrumentation Used; Radiated Measurements Intermodulation | 51 |



| | |
|---|-----------|
| 11. OUT-OF-BAND REJECTION (AWS-3) | 53 |
| 11.1 Test Specification | 53 |
| 11.2 Test Procedure | 53 |
| 11.3 Test Limit..... | 53 |
| 11.4 Test Results..... | 53 |
| 11.5 Test Equipment Used; Out-of-Band Rejection | 54 |
| 12. APPENDIX A - CORRECTION FACTORS | 55 |
| 12.1 Correction factors for RF OATS Cable 35m..... | 55 |
| 12.2 Correction factors for RF OATS Cable 10m ITL #1794 | 56 |
| 12.3 Correction factors for Horn Antenna | 57 |
| 12.4 Correction factors for Horn ANTENNA..... | 58 |
| 12.5 Correction factors for Log Periodic Antenna | 59 |
| 12.6 Correction factors for Biconical Antenna..... | 60 |
| 12.7 Correction factors for ACTIVE LOOP ANTENNA | 61 |



1. General Information

1.1 Administrative Information

Manufacturer: Corning Optical Communication
Wireless

Manufacturer's Address: 13221 Woodland Park Rd., Suite #400
Herndon, VA. 20171
U.S.A.

Tel: +1-541-758-2880
Fax: +1-703-848-0260

Manufacturer's Representative: Habib Riazi

Equipment Under Test (E.U.T): ONE - Optical Network Evolution DAS

Equipment Model No.: RAU-5X Remote Antenna Unit

Equipment Serial No.: 0516110015

Date of Receipt of E.U.T: July 7, 2016

Start of Test: July 7, 2016

End of Test: September 15, 2016

Test Laboratory Location: I.T.L (Product Testing) Ltd.
1 Batsheva St,
Lod,
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**

The Optical Network Platform (ONE™) by Corning provides a flexible in-building RF and network digital coverage solution based on a fiber optic transport backbone.

The fiber-optics infrastructure is easily deployable via a wide range of pre-terminated composite cables and advanced end-to-end equipment. Easy to design, Plug and Play™ connectors, significantly reduce installation cost and deployment time.

The ONE™ solution is an ideal fit for large, high-rise or campus-style deployments. It generates significant CAPEX savings and OPEX savings through the use of user configurable sectorization and an infrastructure that is simple to deploy and efficient in usage.

Dynamic sectorization management allows precise service distribution control to meet changing density needs, and provides further savings by enabling sharing of equipment at various levels for service providers.

Radio source agnostic, remote units can be used as network extenders. Ethernet capability with dedicated fiber link for Wi-Fi offload brings a higher level of granularity and support for devices and applications with very high speed requirements.

1.4 **Test Methodology**

Both conducted and radiated testing were performed according to the procedures in KDB 971168 D03 v01, KDB 935210 D05 v01r01 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 IL1005.

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 E.U.T. was originally FCC certified on 02/18/2016 under FCC ID: OJF1RAU5X.

The E.U.T. transmitter is certified to operate as a 5 band remote unit as part of a booster system that can operate with FCC ID: OJF1RXU.

No changes have been made to the E.U.T.

The C2PC change is to allow the E.U.T. to operate as a 5 band remote unit as part of a booster system that can operate with the new RXU2325 certified under FCC ID: OJF1RXUN.

The E.U.T. has been fully tested with the RXU2325 and results presented in the four reports (for bands AWS-3, CELL/ESMR, PCS & LTE) submitted with this application.

The test setup was configured to closely resemble the standard installation.

The EUT consists of the HEU, the OIU and the RAU5x.

All 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 RAU5x, while the EUT output was connected to the spectrum analyzer.

All channels transmitted during the testing.

There is neither an intermediate amplified nor donor antenna in the uplink.

All components included in the UL path are connected by cables.

2.2 *EUT Exercise Software*

HCM_2.2 Build23

ACM_2a00_22_11.bin

RMM_5a00_22_02. bin

OIM_7a03_22_05. bin

RAU5_9a64_22_12.bin

2.3 *Special Accessories*

No special accessories were needed in order to achieve compliance.

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 | RAU-5X |
| Working voltage | 48VDC (via ac/dc adapter: Manufactory: FSP GROUP P/N: 9NA1201601 S/N: H00003056 |
| Mode of operation | Industrial Booster for AWS-3 band |
| Modulations | WCDMA, LTE(64QAM), GSM |
| Assigned Frequency Range | 2110MHz-2180MHz |
| Transmit power | ~20.0dBm |
| Antenna Gain | 12.5 dBi |
| DATA rate | N/A |
| Modulation BW | 0.5MHz(GSM), 5MHz(WCDMA); 10MHz(LTE) |

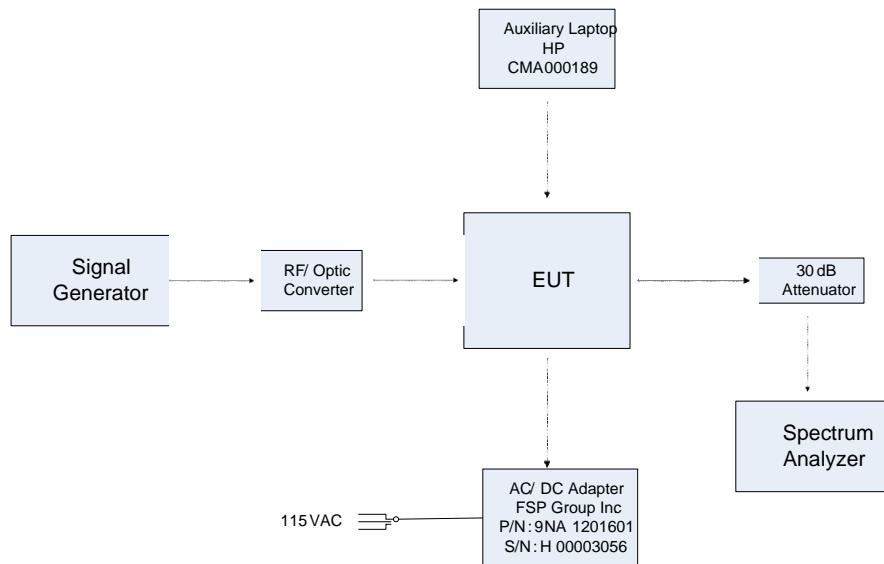


Figure 1. Conducted Test Set-Up

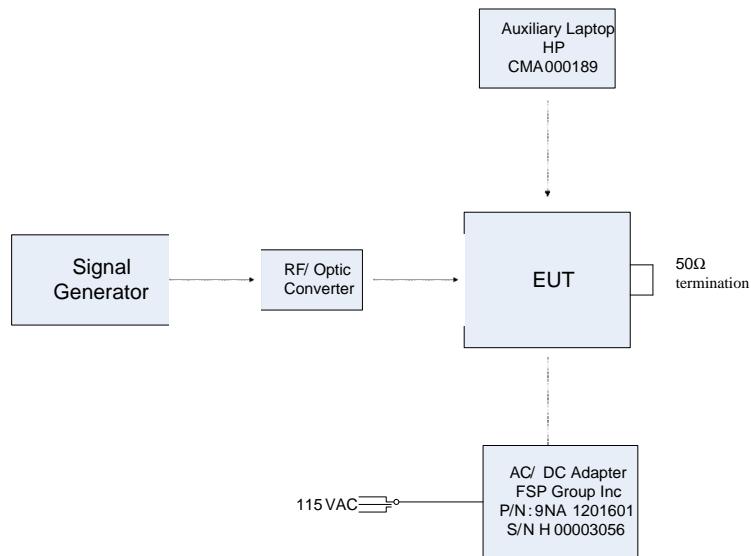


Figure 2. Radiated Test Set-Up

3. Test Set-Up Photos

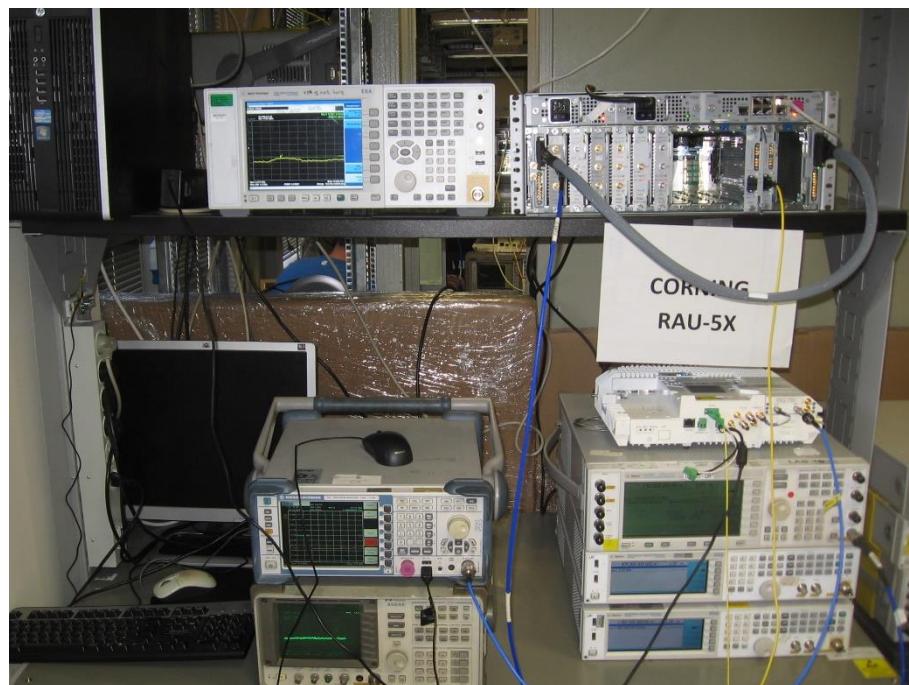


Figure 3. Conducted Emission from Antenna Ports Test



Figure 4. Radiated Emission Test



Figure 5. Radiated Emission Test

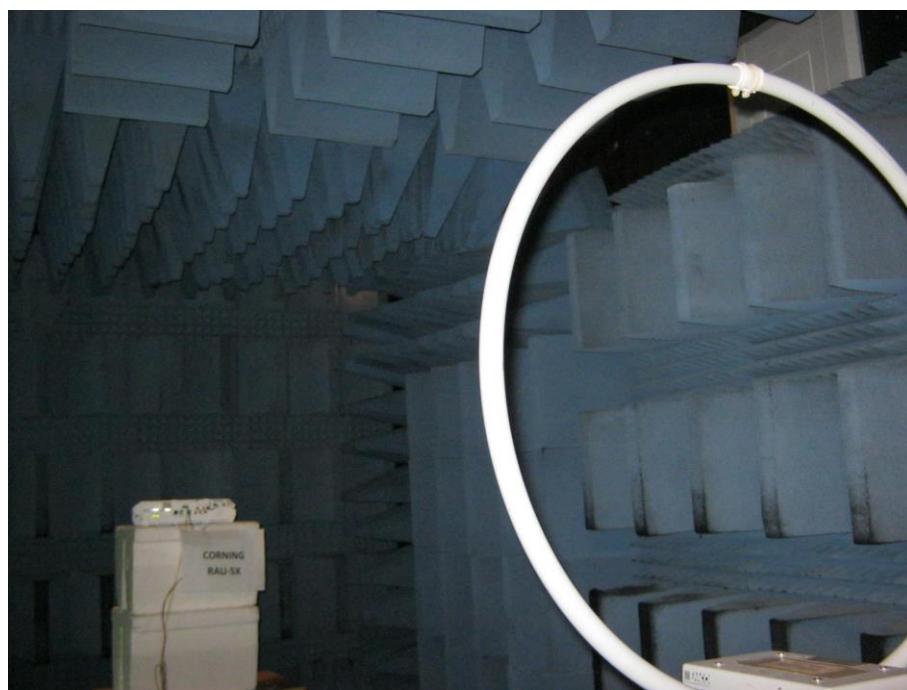


Figure 6. Radiated Emission Test



Figure 7. Radiated Emission Test

Figure 8. Radiated Emission Test

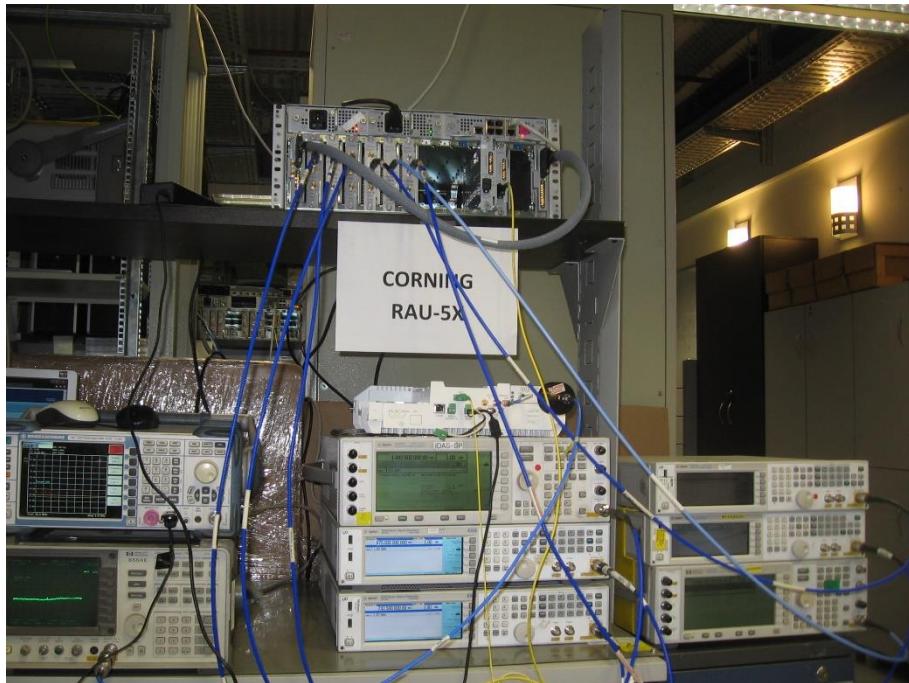


Figure 9. Intermodulated Conducted Emission Test



4. RF Power Output AWS

4.1 Test Specification

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

4.2 Test Procedure

(Temperature (22°C)/ Humidity (38%RH))

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator (31.0 dB) and an appropriate coaxial cable. Special attention was taken to prevent Spectrum Analyzer RF input overload.

4.3 Test Limit

The power limit is 1640W (62.1 dBm).

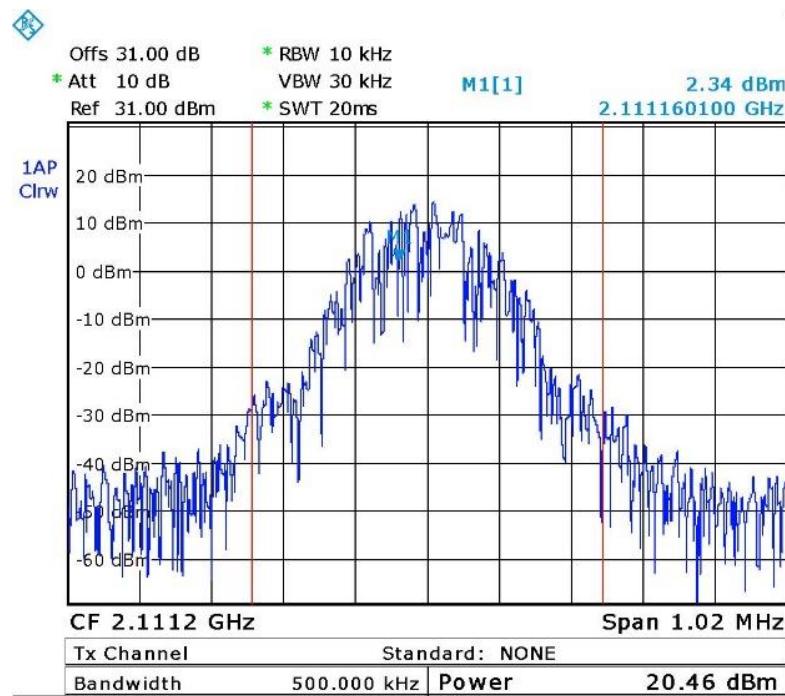
4.4 Test Results

| Modulation | Operation Frequency (MHz) | Reading (dBm) | Antenna Gain (dBi) | EIRP (dBm) | Limit (dBm) | Margin (dB) |
|------------|------------------------------|------------------|-----------------------|---------------|----------------|----------------|
| GSM | 2111.2 | 20.5 | 12.5 | 33.0 | 62.1 | -29.1 |
| | 2145.0 | 20.2 | 12.5 | 32.7 | 62.1 | -29.4 |
| | 2178.8 | 20.5 | 12.5 | 33.0 | 62.1 | -29.1 |
| LTE 64QAM | 2115.0 | 20.9 | 12.5 | 33.4 | 62.1 | -28.7 |
| | 2145.0 | 21.0 | 12.5 | 33.5 | 62.1 | -28.6 |
| | 2175.0 | 20.9 | 12.5 | 33.4 | 62.1 | -28.7 |
| WCDMA | 2112.5 | 21.4 | 12.5 | 33.9 | 62.1 | -28.2 |
| | 2145.0 | 20.9 | 12.5 | 33.4 | 62.1 | -28.7 |
| | 2177.5 | 21.5 | 12.5 | 34.0 | 62.1 | -28.1 |

Figure 10 RF Power Output AWS

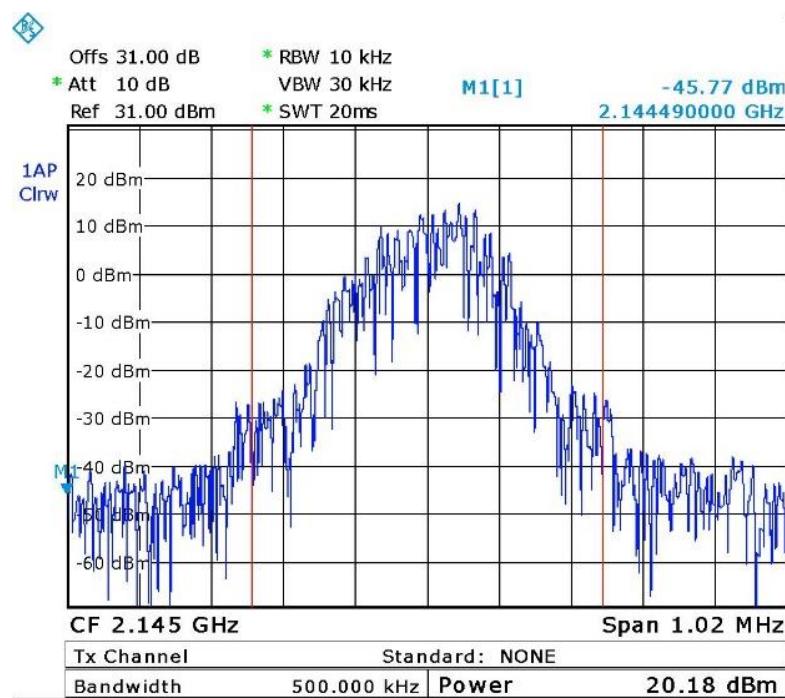
JUDGEMENT: Passed

See additional information in *Figure 11* to *Figure 19*.



Date: 7.JUL.2016 09:49:18

Figure 11. — GSM (2111.2 MHz)



Date: 7.JUL.2016 09:50:34

Figure 12. — GSM (2145.0MHz)

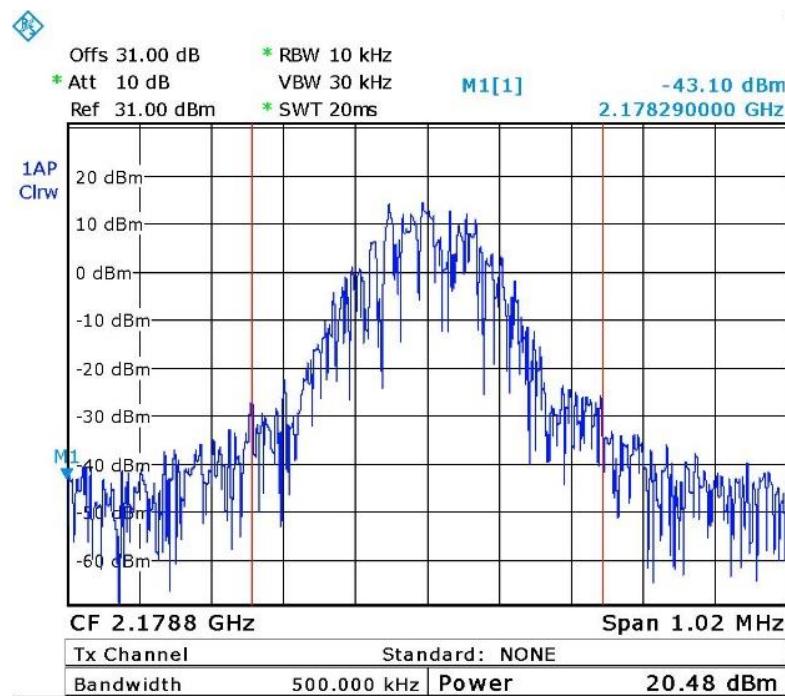


Figure 13. — GSM (2178.8 MHz)

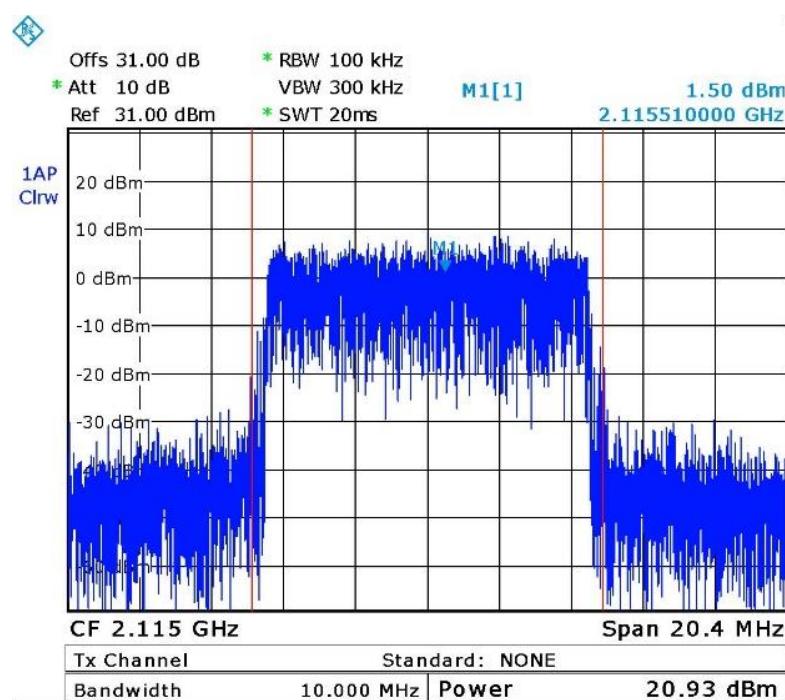
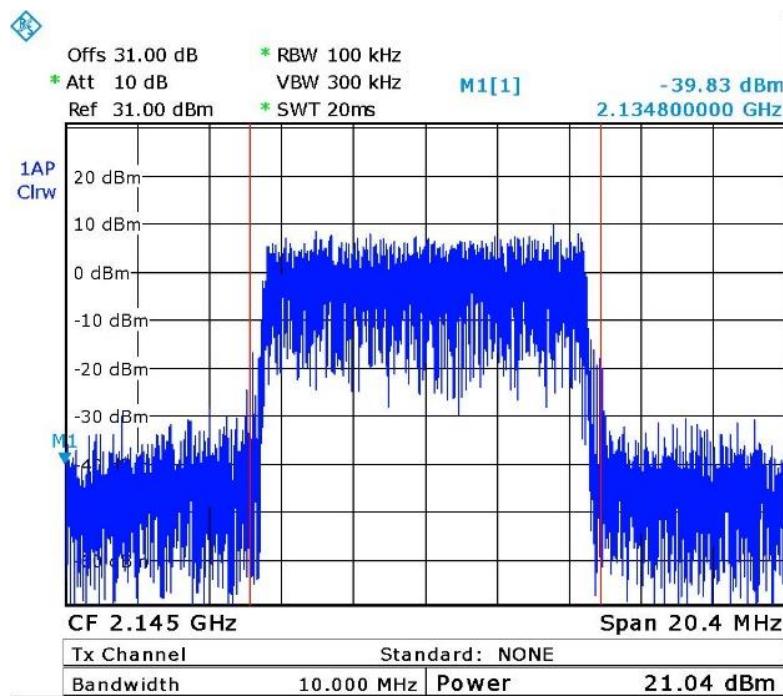
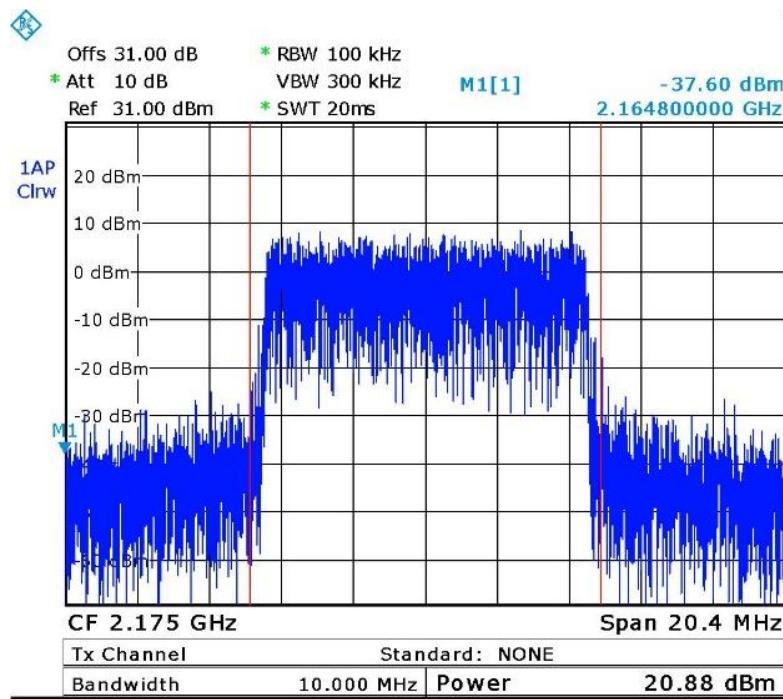


Figure 14. — LTE 64QAM (2115.0 MHz)



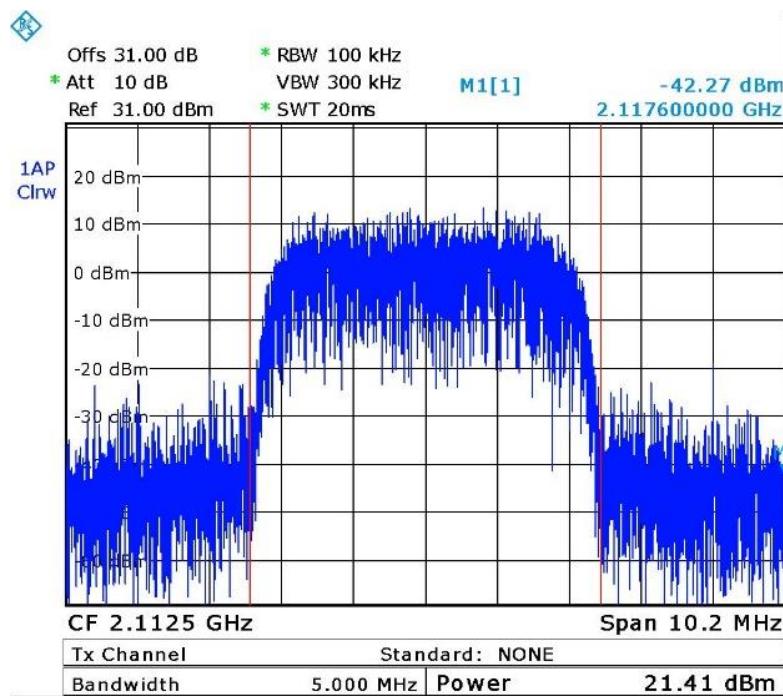
Date: 7.JUL.2016 09:55:07

Figure 15. — LTE 64QAM (2145.0MHz)



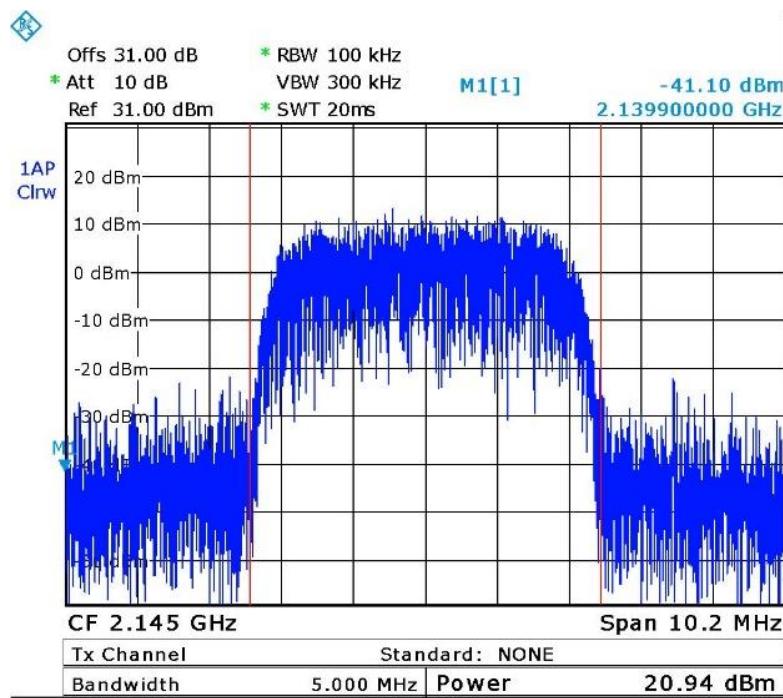
Date: 7.JUL.2016 09:55:45

Figure 16. — LTE 64QAM (2175.0MHz)



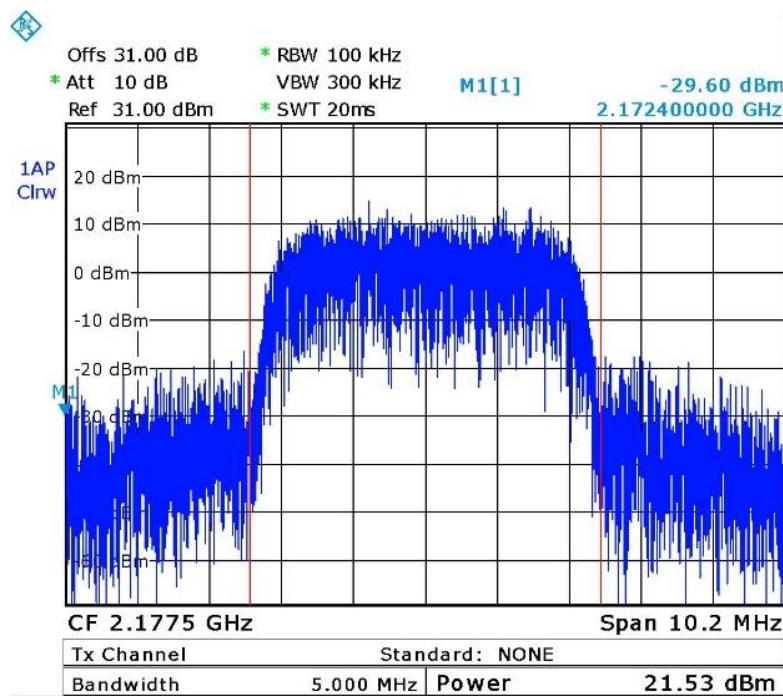
Date: 7.JUL.2016 09:58:28

Figure 17. — W-CDMA (2112.5 MHz)



Date: 7.JUL.2016 09:59:03

Figure 18. — W-CDMA (2145.0MHz)



Date: 7.JUL.2016 09:59:54

Figure 19. — 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 |
| Spectrum Analyzer | R&S | FSL6 | 100194 | February 29, 2016 | March 1, 2017 |
| Vector Signal Generator | Agilent | N5172B | MY51350584 | July 1, 2016 | July 1, 2017 |
| 30 dB Attenuator | MCL | BW-S30W5 | 533 | July 5, 2016 | July 5, 2017 |

Figure 20 Test Equipment Used



5. Occupied Bandwidth AWS

5.1 Test Specification

FCC Part 2, Section 2.1049

5.2 Test Procedure

(Temperature (22°C)/ Humidity (38%RH))

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable (loss=31.0 dB). The spectrum analyzer was set to proper resolution B.W.

OBW function (99%) was employed for this evaluation.

Occupied bandwidth measured was repeated in the input terminal of the E.U.T.

5.3 Test Limit

N/A

5.4 Test Results

| Modulation | Port | Operating Frequency | Reading |
|------------|-----------------|---------------------|---------|
| | (Input/ Output) | (MHz) | (MHz) |
| LTE 64QAM | Input | 2115.0 | 9.0 |
| | Output | 2115.0 | 9.0 |
| | Input | 2145.0 | 8.9 |
| | Output | 2145.0 | 9.0 |
| | Input | 2175.0 | 8.9 |
| | Output | 2175.0 | 9.0 |
| GSM | Input | 2111.2 | 0.2 |
| | Output | 2111.2 | 0.2 |
| | Input | 2145.0 | 0.2 |
| | Output | 2145.0 | 0.2 |
| | Input | 2178.8 | 0.2 |
| | Output | 2178.8 | 0.2 |
| W-CDMA | Input | 2112.5 | 4.2 |
| | Output | 2112.5 | 4.2 |
| | Input | 2145.0 | 4.1 |
| | Output | 2145.0 | 4.2 |
| | Input | 2177.5 | 4.1 |
| | Output | 2177.5 | 4.2 |

Figure 21 Occupied Bandwidth AWS

JUDGEMENT: Passed

See additional information in *Figure 22* to *Figure 39*.

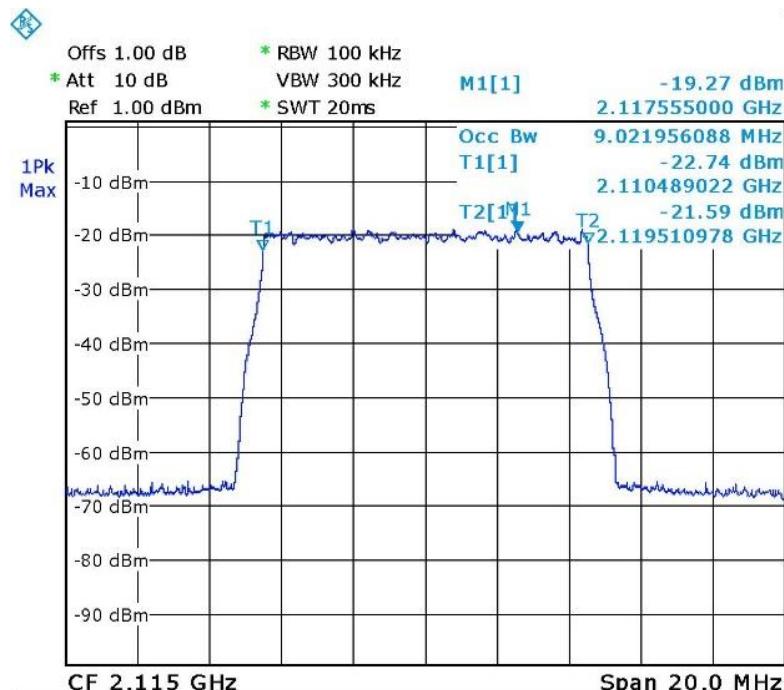


Figure 22. — LTE 64QAM (2115.0 MHz) IN

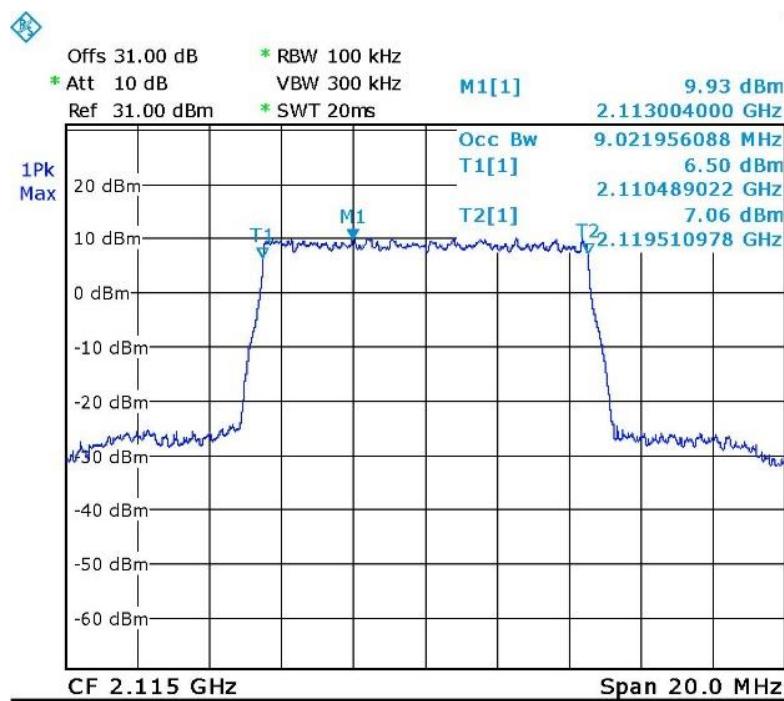
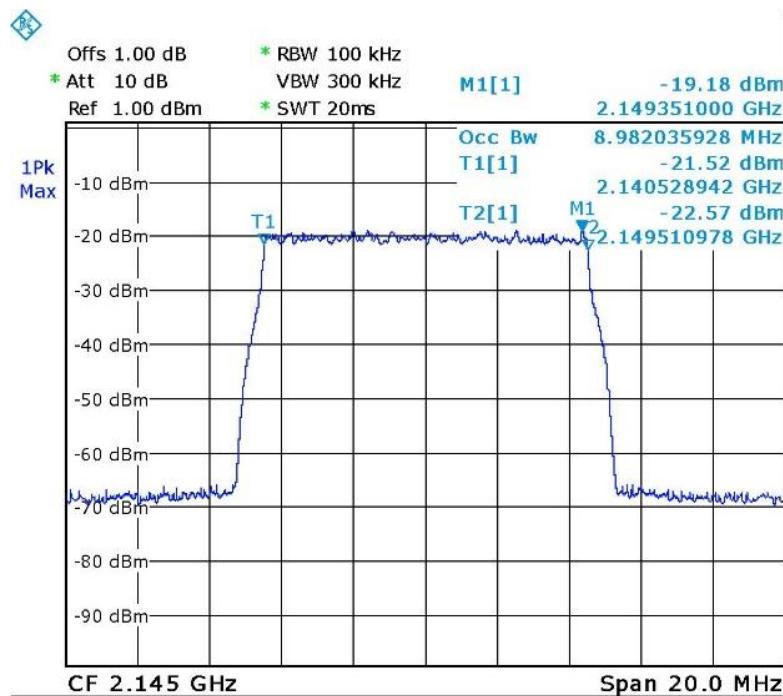
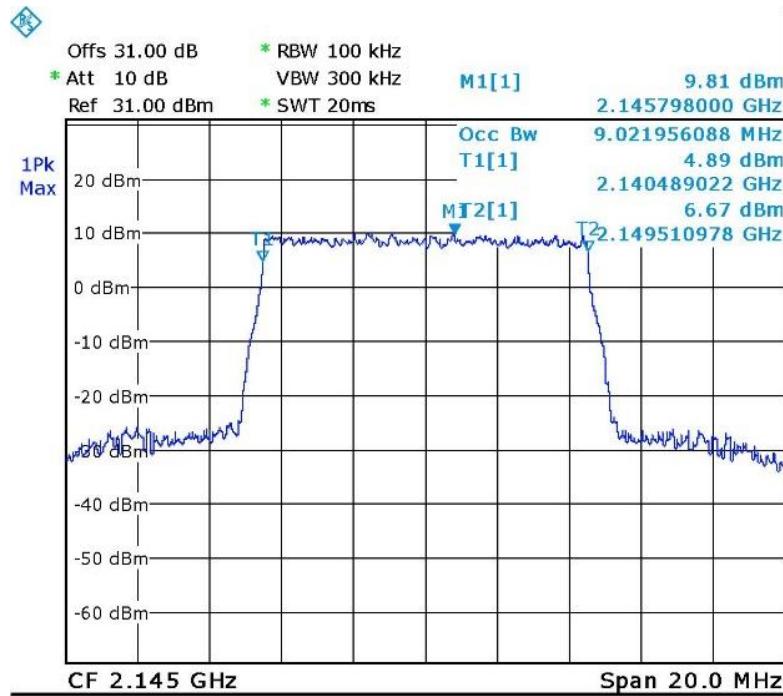


Figure 23. — LTE 64QAM (2115.0 MHz) OUT



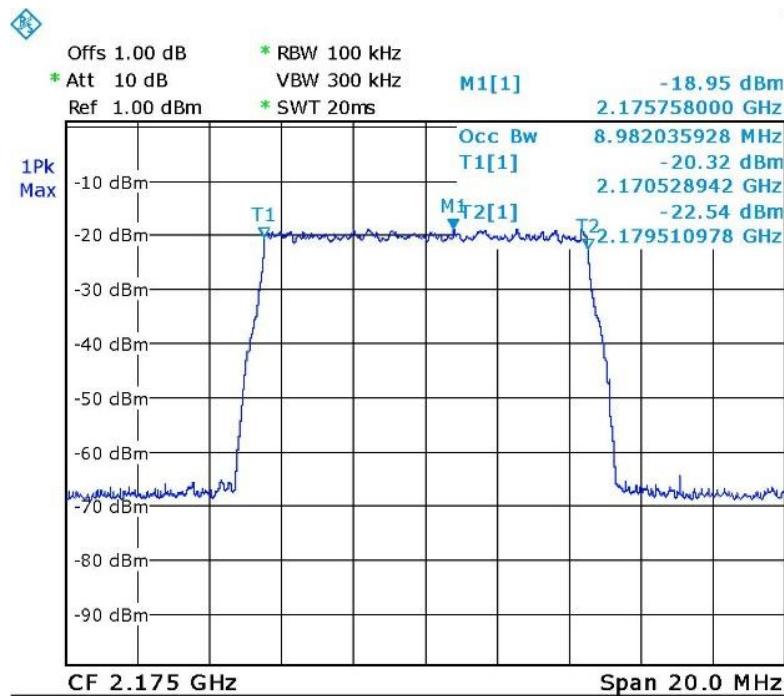
Date: 7.JUL.2016 10:16:37

Figure 24. — LTE 64QAM (2145.0MHz) IN



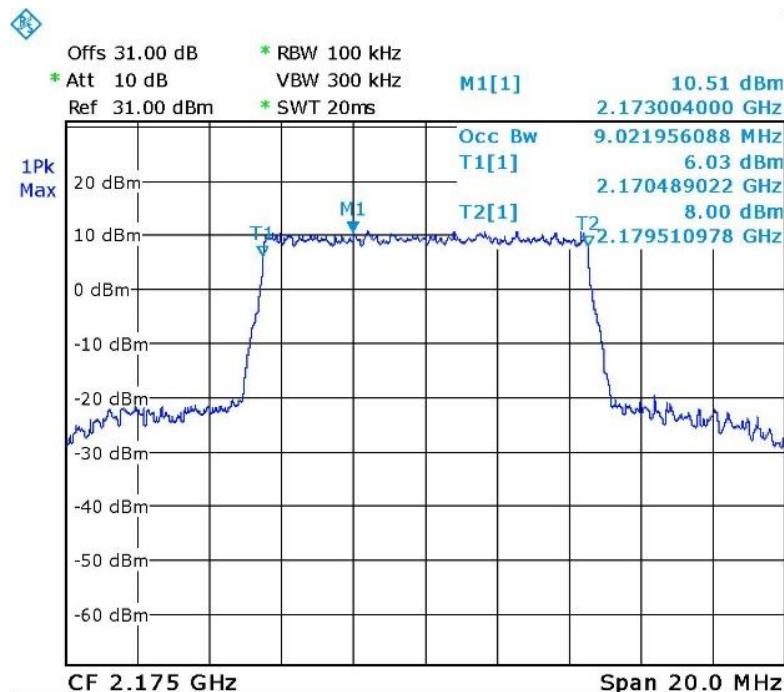
Date: 7.JUL.2016 10:11:04

Figure 25. — LTE 64QAM (2145.0MHz) OUT



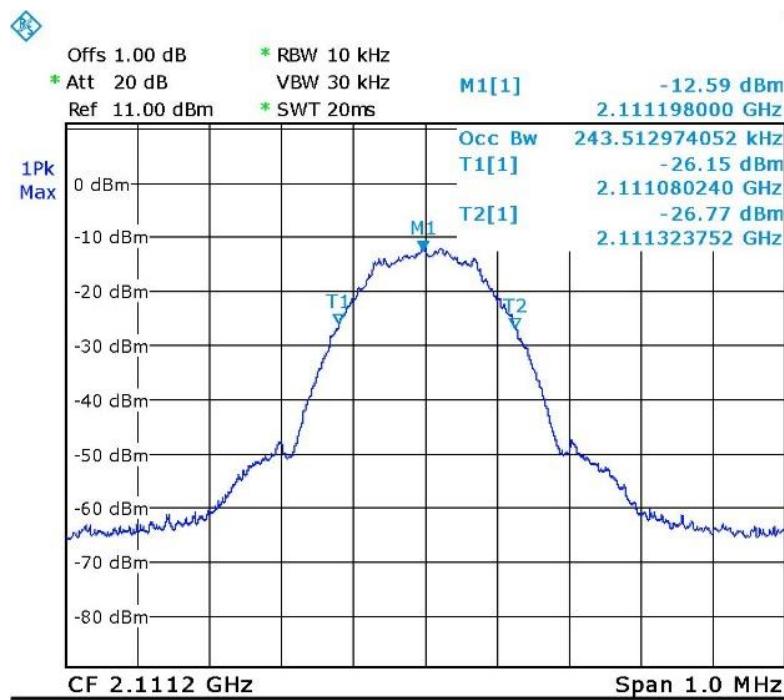
Date: 7.JUL.2016 10:16:02

Figure 26. — LTE 64QAM (2175.0 MHz) IN



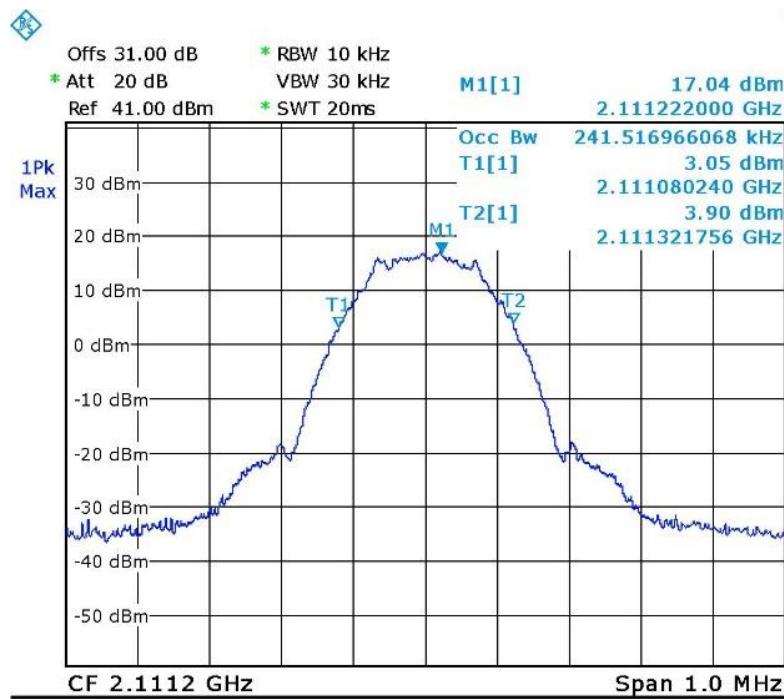
Date: 7.JUL.2016 10:11:45

Figure 27. — LTE 64QAM (2175.0 MHz) OUT



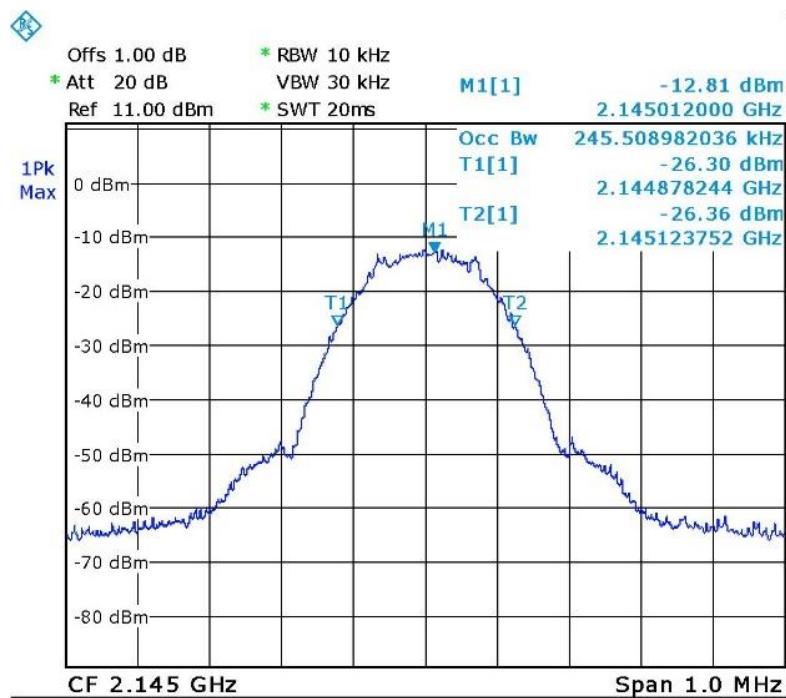
Date: 7.JUL.2016 10:21:11

Figure 28. — GSM (2111.2 MHz) IN



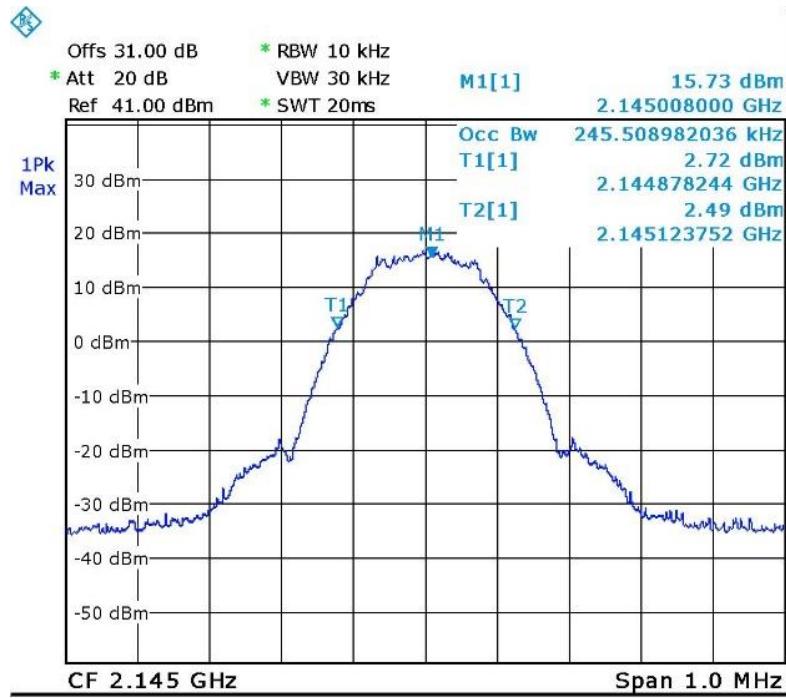
Date: 7.JUL.2016 10:07:13

Figure 29. — GSM (2111.2 MHz) OUT



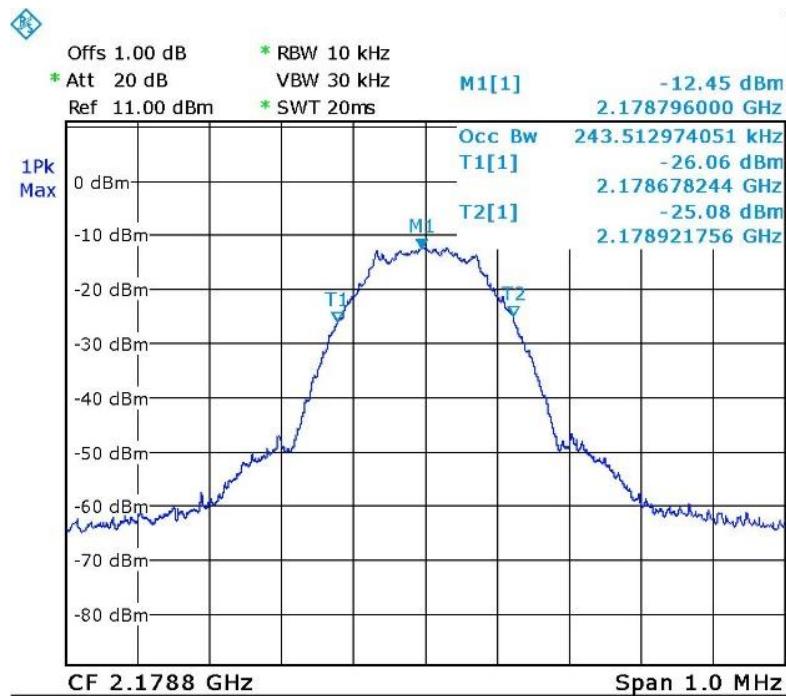
Date: 7.JUL.2016 10:21:45

Figure 30. — GSM (2145.0MHz) IN



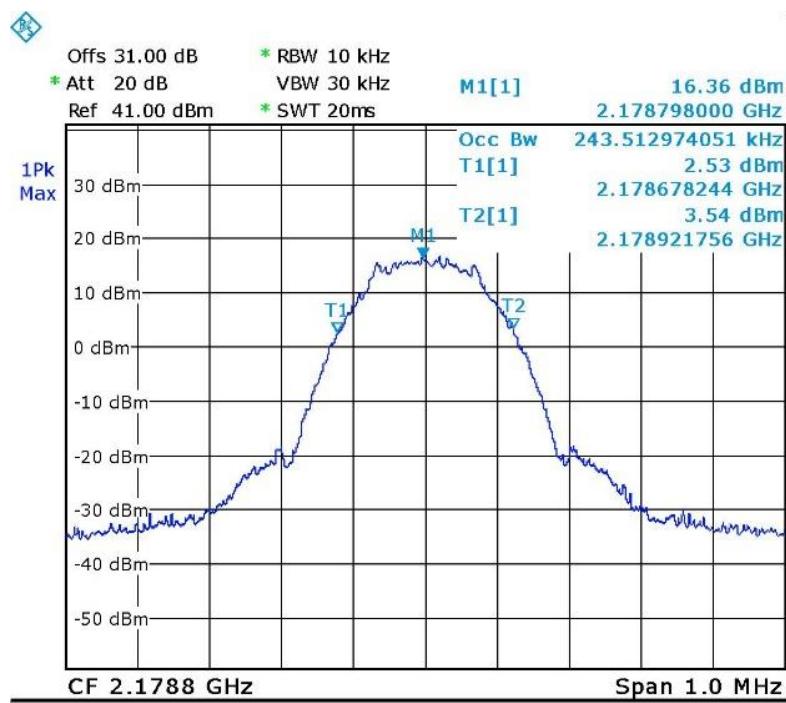
Date: 7.JUL.2016 10:07:52

Figure 31. — GSM (2145.0MHz) OUT



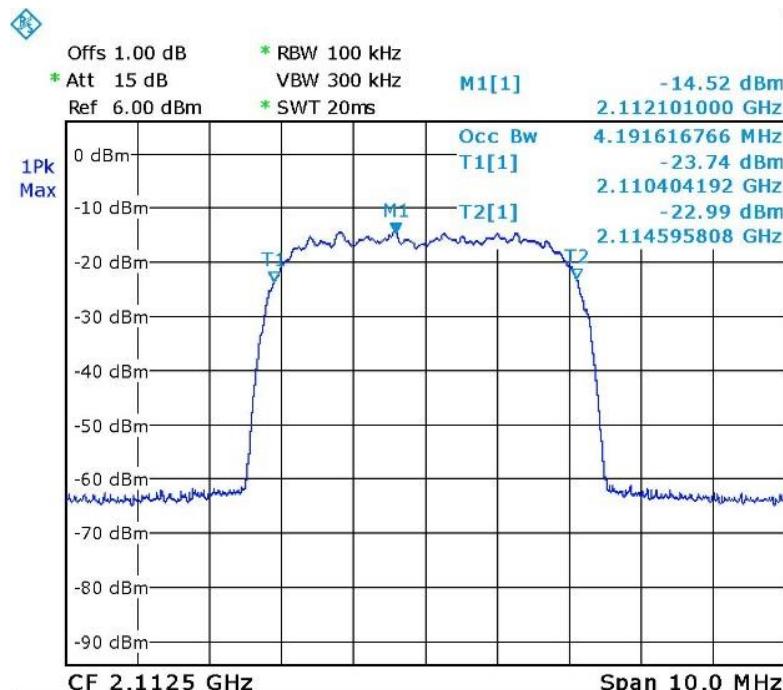
Date: 7.JUL.2016 10:22:27

Figure 32. — GSM (2178.8 MHz) IN



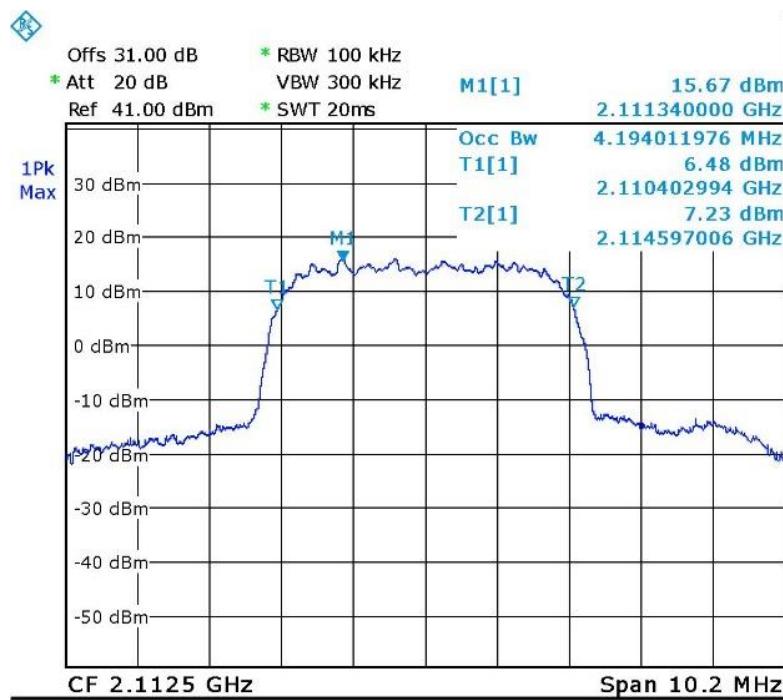
Date: 7.JUL.2016 10:08:39

Figure 33. — GSM (2178.8 MHz) OUT



Date: 7.JUL.2016 10:24:27

Figure 34. — W-CDMA (2112.5 MHz) IN



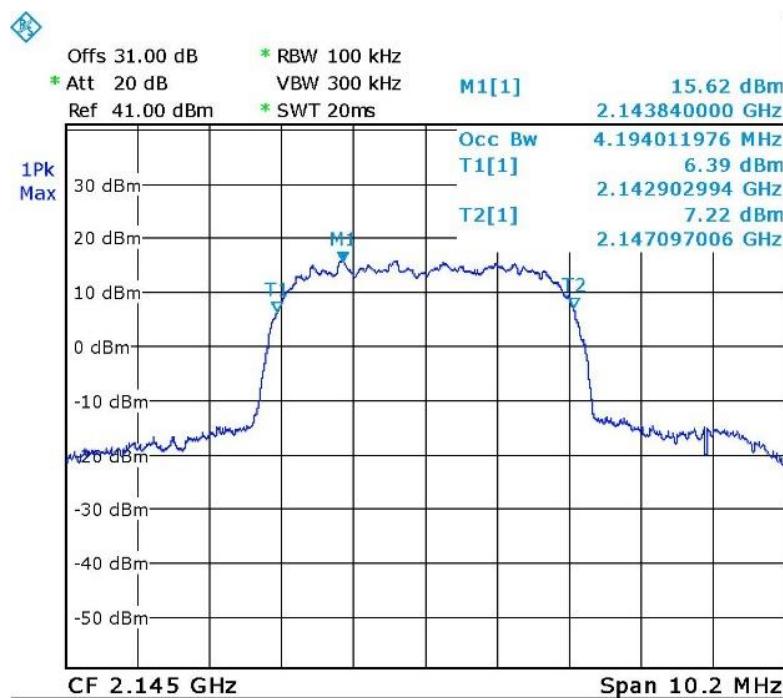
Date: 7.JUL.2016 10:05:12

Figure 35. — W-CDMA (2112.5 MHz) OUT



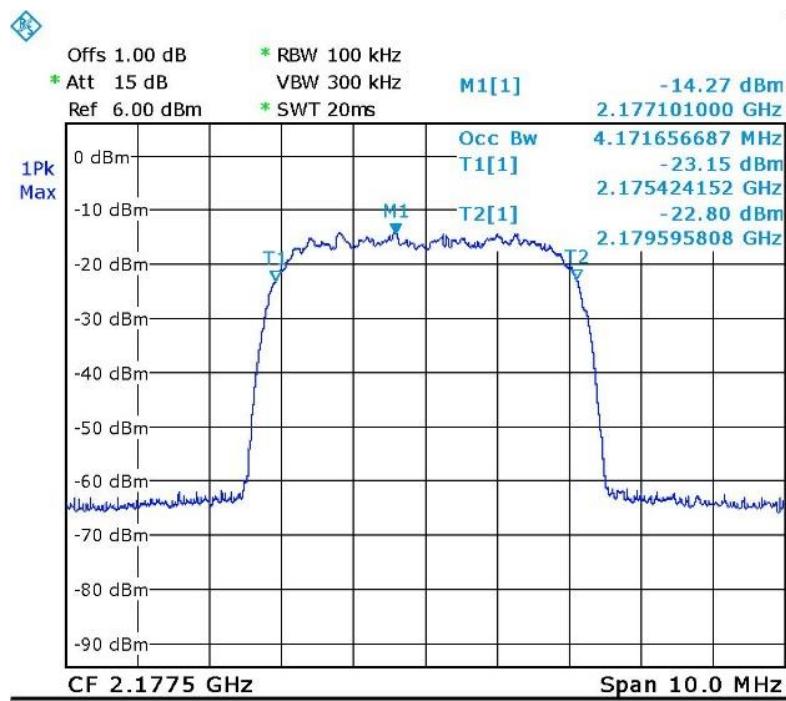
Date: 7.JUL.2016 10:25:11

Figure 36. — W-CDMA (2145.0MHz) IN



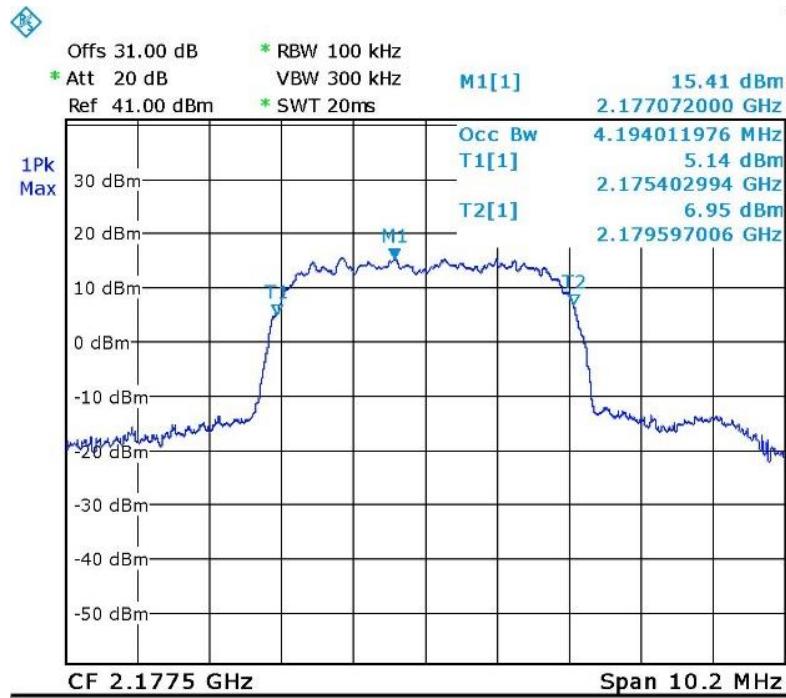
Date: 7.JUL.2016 10:04:22

Figure 37. — W-CDMA (2145.0MHz) OUT



Date: 7.JUL.2016 10:25:55

Figure 38. — W-CDMA (2177.5 MHz) IN



Date: 7.JUL.2016 10:03:40

Figure 39. — 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 |
| Spectrum Analyzer | R&S | FSL6 | 100194 | February 29, 2016 | March 1, 2017 |
| Vector Signal Generator | Agilent | N5172B | MY51350584 | July 1, 2016 | July 1, 2017 |
| 30 dB Attenuator | MCL | BW-S30W5 | 533 | July 5, 2016 | July 5, 2017 |

Figure 40 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***

(Temperature (22°C)/ Humidity (38%RH))

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable (max loss =34.0 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 ***Test Limit***

The power of any emission outside of the authorized operating frequency ranges (2110-2180MHz) must be attenuated below the transmitting power (P) by a factor of at least $43 + \log(P)$ dB, yielding -13dBm .

6.4 ***Test Results***

JUDGEMENT: Passed

See additional information in *Figure 41* to *Figure 49*.

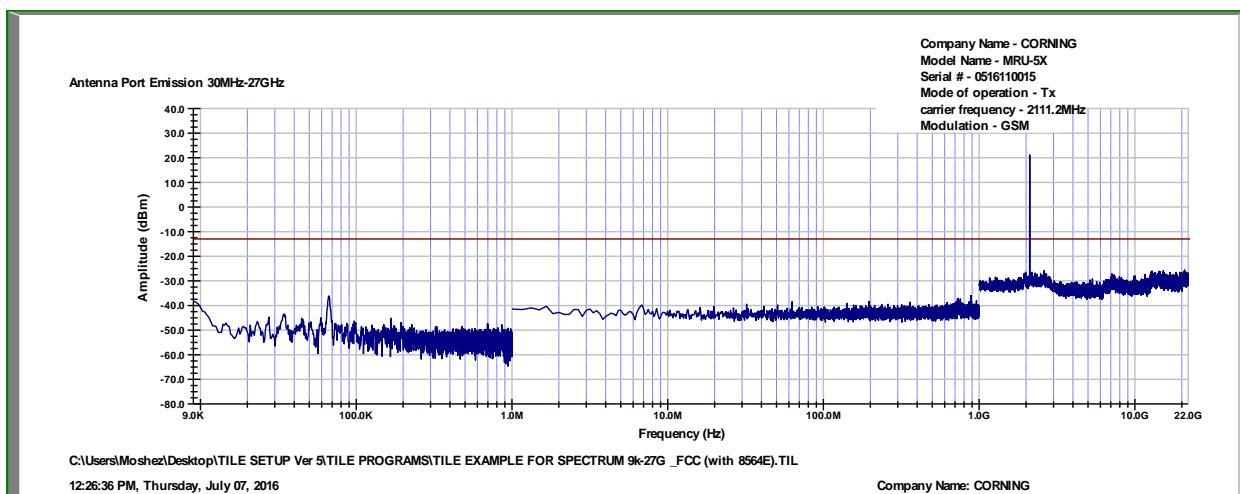


Figure 41 Spurious Emissions at Antenna Terminals GSM, 2111.2MHz

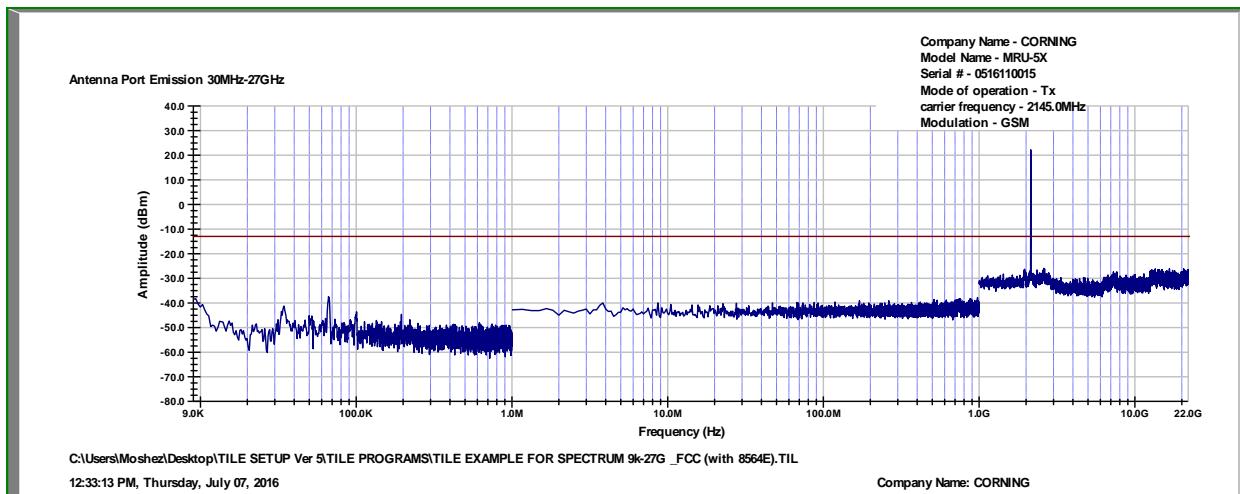


Figure 42 Spurious Emissions at Antenna Terminals GSM, 2145.0MHz

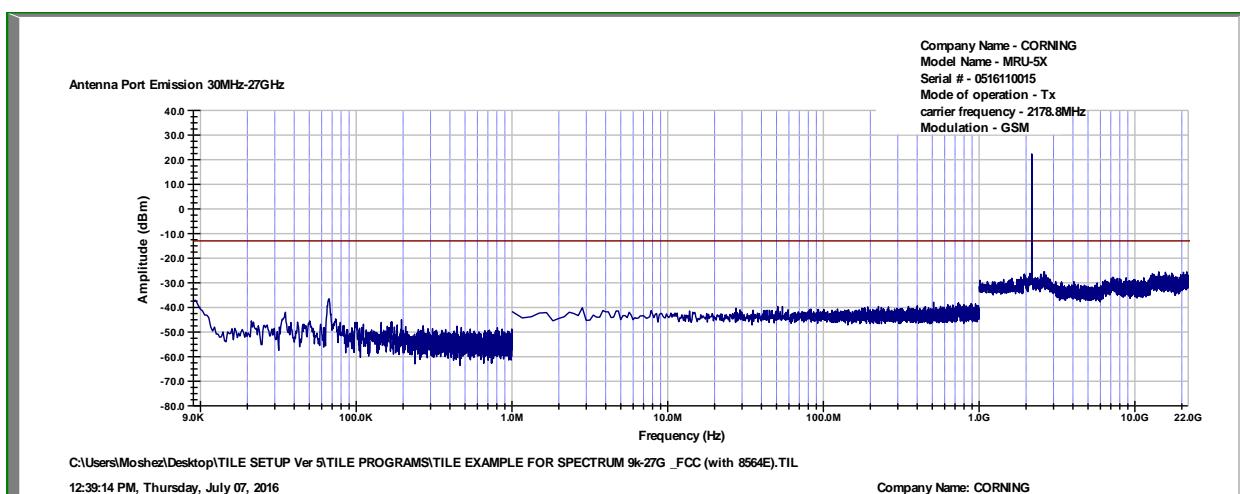


Figure 43 Spurious Emissions at Antenna Terminals GSM, 2178.8MHz

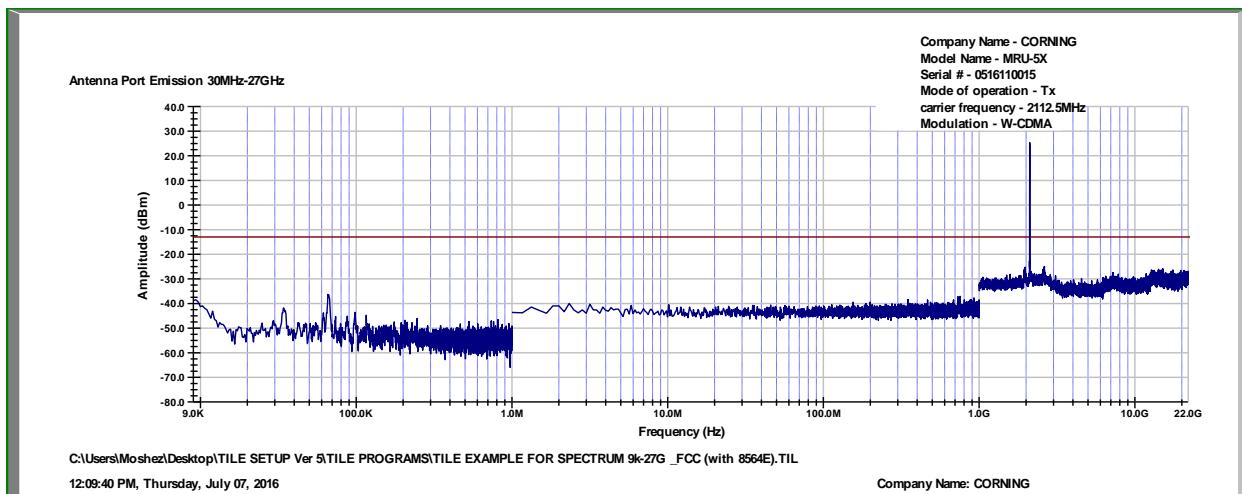


Figure 44 Spurious Emissions at Antenna Terminals WCDMA, 2112.5MHz

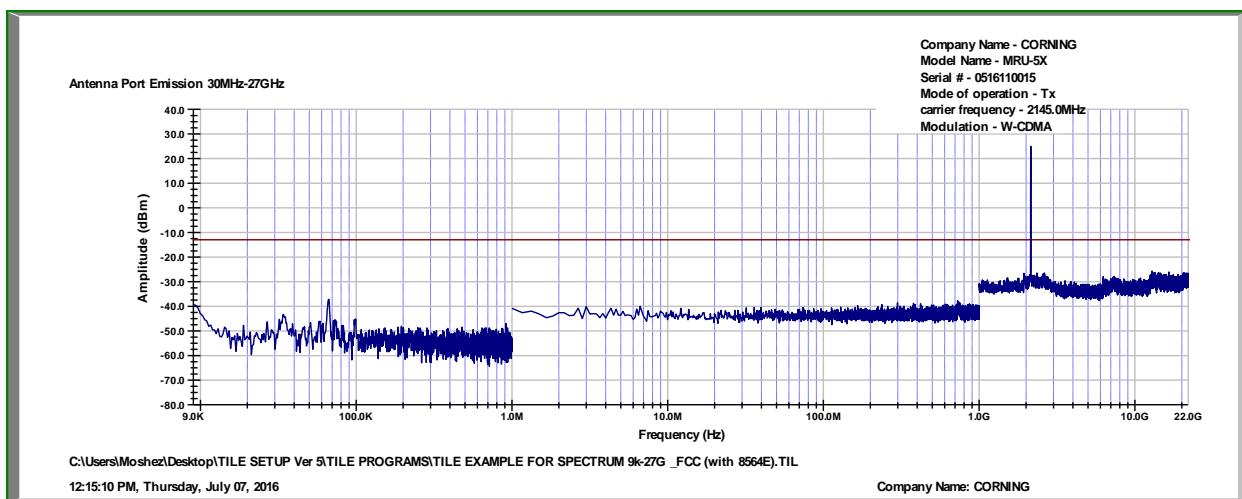


Figure 45 Spurious Emissions at Antenna Terminals WCDMA, 2145.0MHz

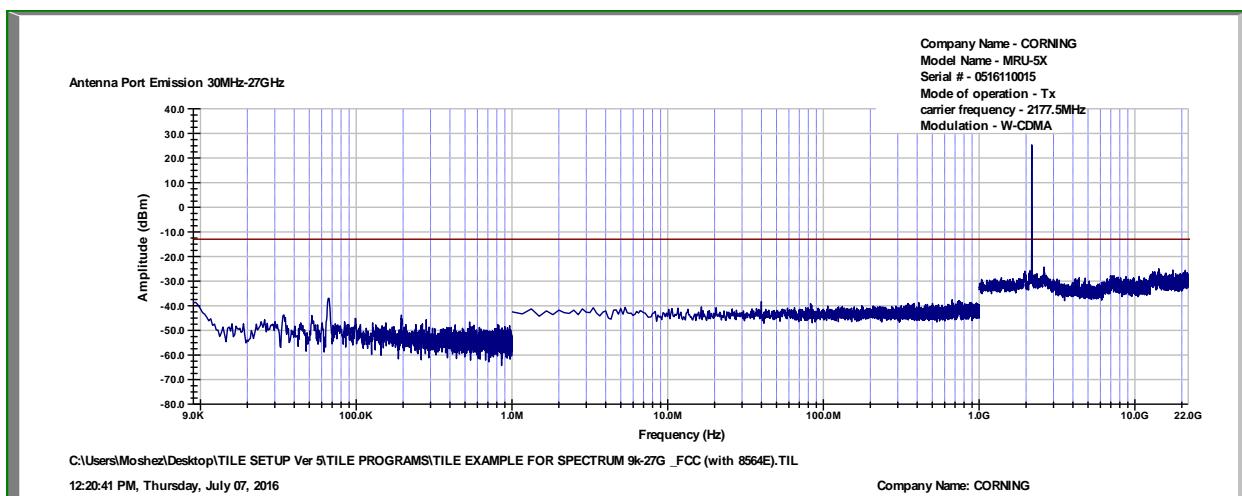


Figure 46 Spurious Emissions at Antenna Terminals WCDMA, 2177.5MHz

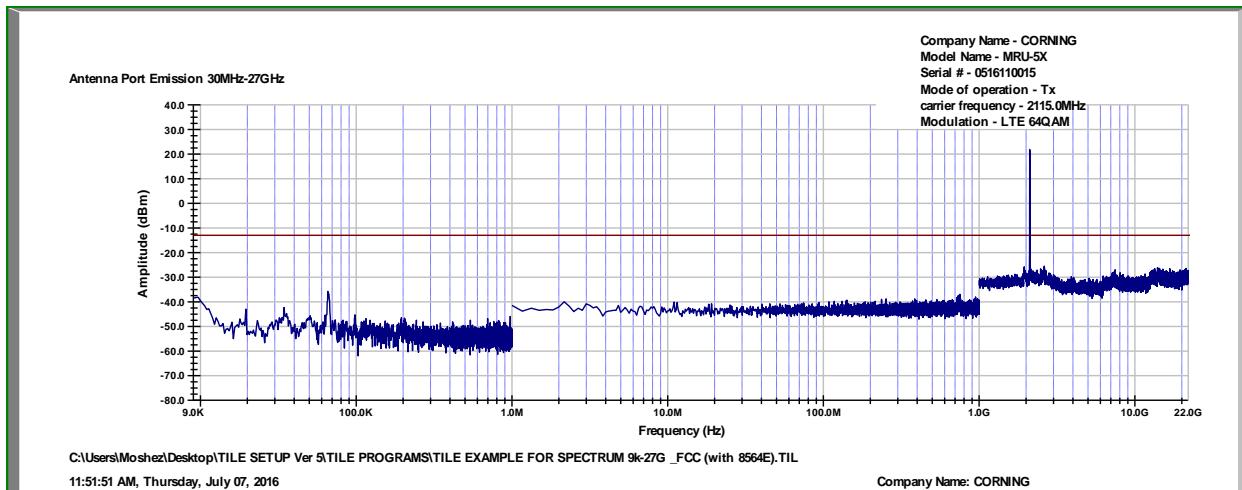


Figure 47 Spurious Emissions at Antenna Terminals LTE, 2115.0MHz

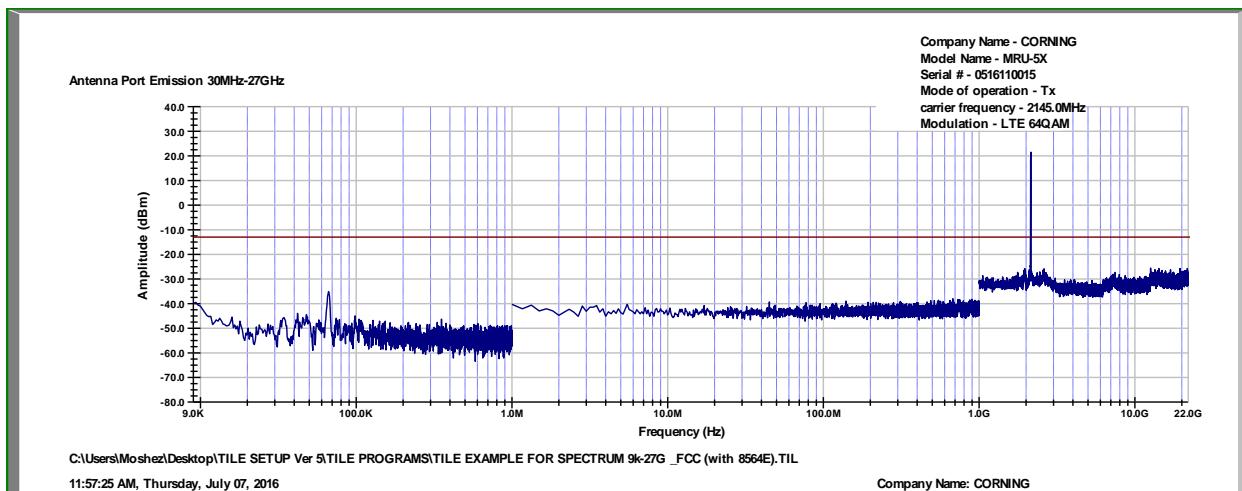


Figure 48 Spurious Emissions at Antenna Terminals LTE, 2145.0MHz

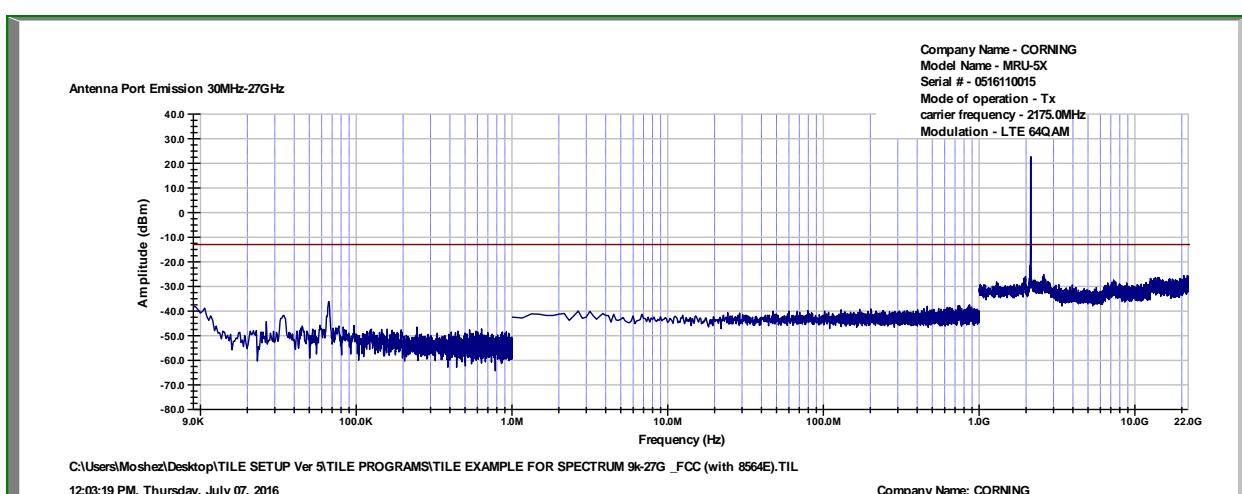


Figure 49 Spurious Emissions at Antenna Terminals LTE, 2175.0MHz



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 | MY51350584 | July 1, 2016 | July 1, 2017 |
| Spectrum Analyzer | HP | 8592L | 3826A01204 | March 13, 2016 | March 13, 2017 |
| 30 dB Attenuator | MCL | BW-S30W5 | 533 | July 5, 2016 | July 5, 2017 |

Figure 50 Test Equipment Used



7. Band Edge Spectrum AWS

7.1 Test Specification

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

7.2 Test Procedure

(Temperature (22°C)/ Humidity (36%RH))

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable (loss = 31.0 dB).

RBW was set to 100kHz.

7.3 Test Limit

The power of any emission outside of the authorized operating frequency ranges (2110-2180MHz) must be attenuated below the transmitting power (P) by a factor of at least $43 + \log(P)$ dB, yielding -13dBm.

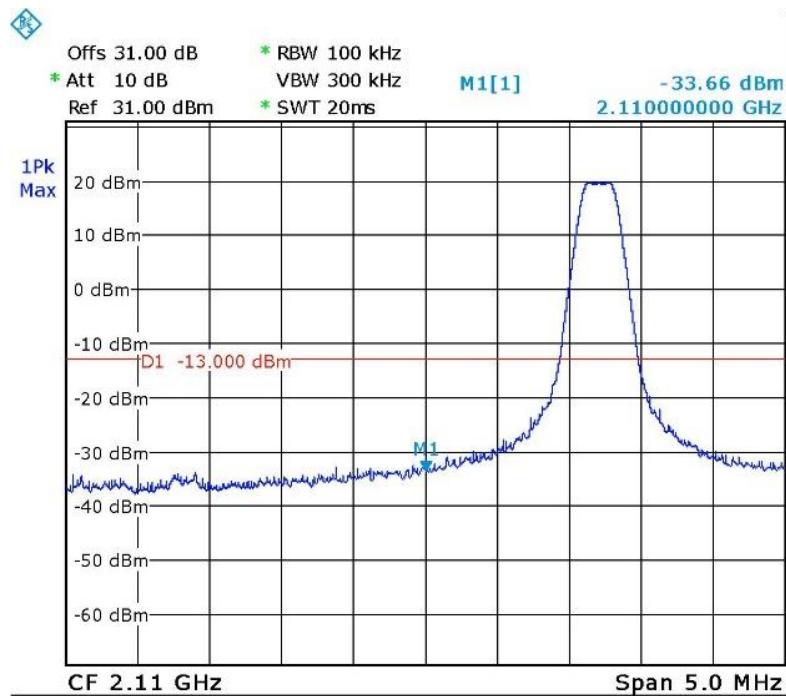
7.4 Test Results

| Modulation | Operation Frequency (MHz) | Band Edge Frequency (MHz) | Reading (dBm) | Limit (dBm) | Margin (dB) |
|------------|------------------------------|------------------------------|------------------|----------------|----------------|
| LTE 64QAM | 2115.0 | 2110.0 | -23.6 | -13.0 | -10.6 |
| LTE 64QAM | 2175.0 | 2180.0 | -24.3 | -13.0 | -11.3 |
| GSM | 2111.2 | 2110.0 | -33.7 | -13.0 | -20.7 |
| GSM | 2178.8 | 2180.0 | -33.2 | -13.0 | -20.2 |
| W-CDMA | 2112.5 | 2110.0 | -16.5 | -13.0 | -3.5 |
| W-CDMA | 2177.5 | 2180.0 | -14.9 | -13.0 | -1.9 |

Figure 51 Band Edge Spectrum Results AWS

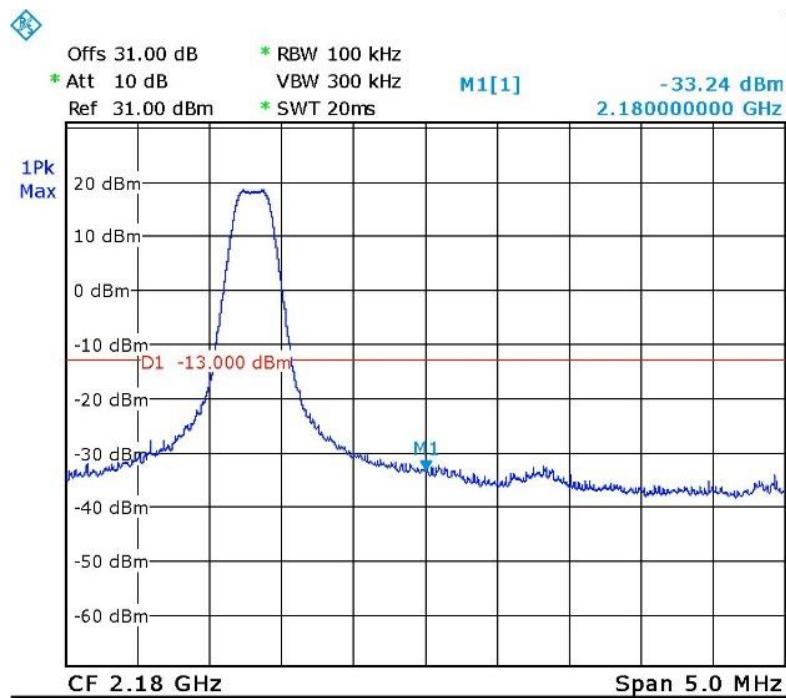
JUDGEMENT: Passed by 1.9 dB

See additional information in *Figure 52* to *Figure 57*.



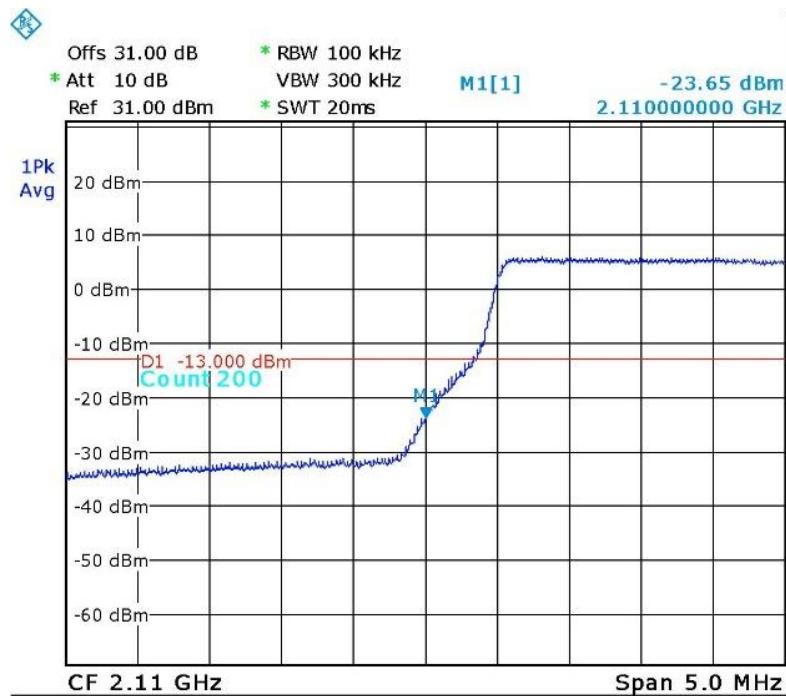
Date: 7.JUL.2016 10:36:08

Figure 52. — GSM 2111.2 MHz



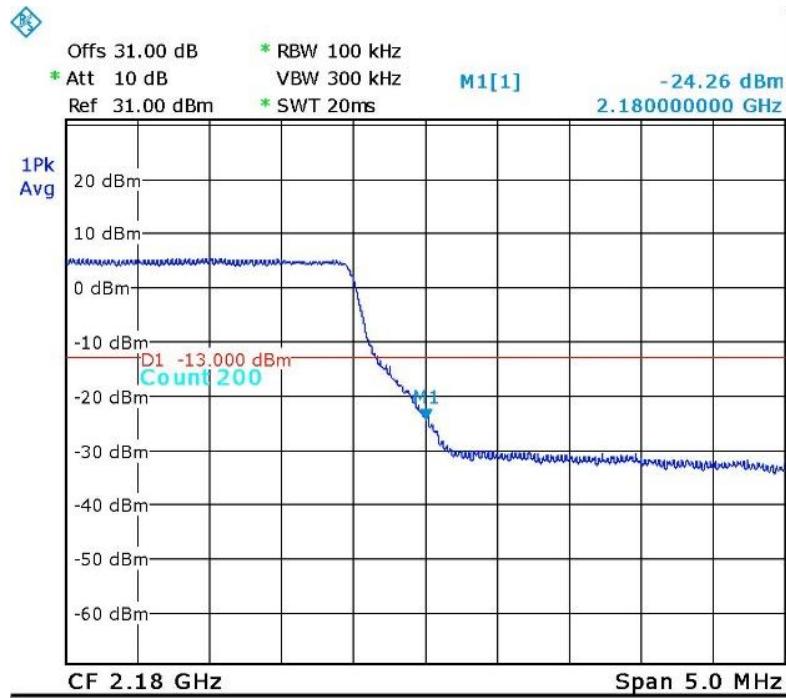
Date: 7.JUL.2016 10:36:59

Figure 53. — GSM 2178.8 MHz



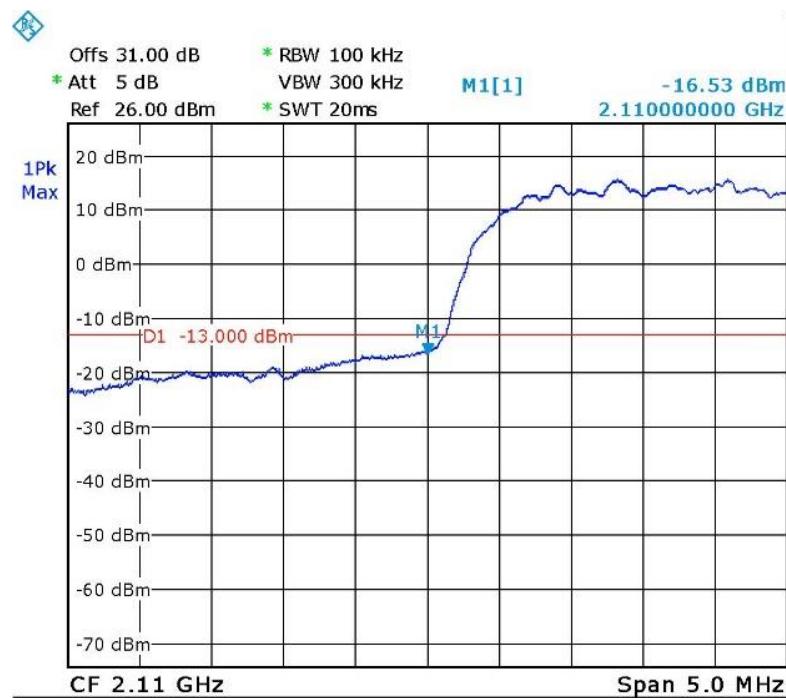
Date: 7.JUL.2016 10:41:23

Figure 54. — LTE 64QAM 2115.0 MHz



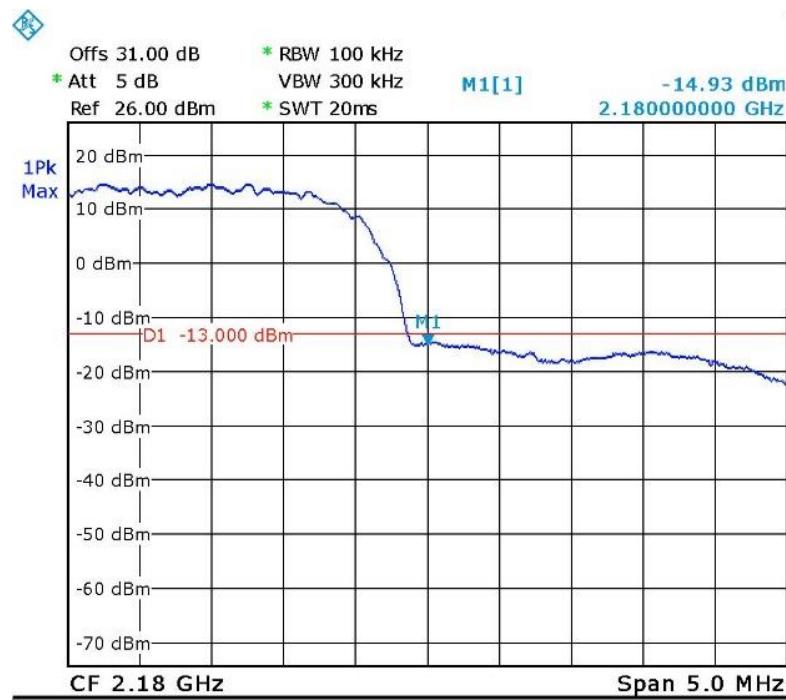
Date: 7.JUL.2016 10:40:37

Figure 55. — LTE 64QAM 2175.0 MHz



Date: 7.JUL.2016 10:34:34

Figure 56. — W-CDMA 2112.5 MHz



Date: 7.JUL.2016 10:33:42

Figure 57. — W-CDMA 2177.5 MHz



7.5 Test Equipment Used; Band Edge Spectrum AWS

| Instrument | Manufacturer | Model | Serial Number | Calibration | |
|-------------------------|--------------|----------|---------------|-----------------------|----------------------|
| | | | | Last Calibration Date | Next Calibration Due |
| Spectrum Analyzer | R&S | FSL6 | 100194 | February 29, 2016 | March 1, 2017 |
| Vector Signal Generator | Agilent | N5172B | MY51350584 | July 1, 2016 | July 1, 2017 |
| 30 dB Attenuator | MCL | BW-S30W5 | 533 | July 5, 2016 | July 5, 2017 |

Figure 58 Test Equipment Used



8. Spurious Radiated Emission AWS

8.1 Test Specification

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

8.2 Test Procedure

(Temperature (28°C)/ Humidity (67%RH))

The test method was based on ANSI/TIA-603-D: 2010, Section 2.2.12 Unwanted Emissions: Radiated Spurious.

The E.U.T. operation mode and test set-up are as described in Section 2 of this report.

For measurements between 0.009MHz-30.0MHz:

The E.U.T was tested inside the shielded room at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The frequency range 0.009MHz-30MHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The emissions were measured at a distance of 3 meters.

For measurements between 30.0MHz-1.0GHz:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.

The emissions were measured at a distance of 3 meters.

For measurements between 1.0GHz-22.0GHz:

The E.U.T was tested inside the shielded room at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The frequency range 1.0GHz -22.0GHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization.

The emissions were measured at a distance of 3 meters.

The E.U.T. was replaced by a substitution antenna (dipole 30MHz-1GHz, Horn Antenna above 1GHz) driven by a signal generator. The height was readjusted for maximum reading. The signal generator level was adjusted to obtain the same reading on the EMI receiver as in step (a).

The signals observed in step (a) were converted to radiated power using:

$$P_d(\text{dBm}) = P_g(\text{dBm}) - \text{Cable Loss (dB)} + \text{Substitution Antenna Gain (dBd)}$$

P_d = Dipole equivalent power (result).

P_g = Signal generator output level.



A Peak detector was used for this test.

The test was performed in 3 operation frequencies: low, mid and high.

Testing was performed when the RF port was connected to $50\ \Omega$ termination.

The table below describe only results with the highest radiation.

8.3 Test Limit

The power of any emission outside of the authorized operating frequency ranges (2110-2180 MHz) must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log (P)$ dB, yielding -13dBm .

8.4 Test Results

| Carrier Channel | Freq. | Antenna Pol. | Maximum Peak Level | Signal Generator RF Output | Cable Loss | Antenna Gain | Effective Radiated Power Level | Limit | Margin |
|-----------------|--------|--------------|--------------------|----------------------------|------------|--------------|--------------------------------|-------|--------|
| (MHz) | (MHz) | (V/H) | (dB μ V/m) | (dBm) | (dB) | (dBd) | (dBm) | (dBm) | (dB) |
| 2111.2 | 4222.4 | V | 56.3 | -42.8 | 0.5 | 9.5 | -33.8 | -13.0 | -20.8 |
| | 4222.4 | H | 56.3 | -42.4 | 0.5 | 9.5 | -33.4 | -13.0 | -20.4 |
| 2145.0 | 4290.0 | V | 56.2 | -42.8 | 0.5 | 9.5 | -33.8 | -13.0 | -20.8 |
| | 4290.0 | H | 56.3 | -42.4 | 0.5 | 9.5 | -33.4 | -13.0 | -20.4 |
| 2178.8 | 4357.6 | V | 56.2 | -42.8 | 0.5 | 9.5 | -33.8 | -13.0 | -20.8 |
| | 4357.6 | H | 56.2 | -42.4 | 0.5 | 9.5 | -33.4 | -13.0 | -20.4 |

Figure 59 Spurious Radiated Emission AWS

JUDGEMENT: Passed by 20.4dB

The E.U.T met the requirements of the FCC, Part 27, Subpart C, Section 27.53 (h) specifications.



8.5 Test Instrumentation Used, Radiated Measurements AWS-3

| Instrument | Manufacturer | Model | Serial Number | Calibration | |
|-----------------------------|-----------------|------------------|---------------|-----------------------|----------------------|
| | | | | Last Calibration Date | Next Calibration Due |
| EMI Receiver | HP | 85422E | 3906A00276 | March 3, 2016 | March 3, 2017 |
| RF Filter Section | HP | 85420E | 3705A00248 | March 3, 2016 | March 3, 2017 |
| EMI Receiver | R&S | ESCI7 | 100724 | February 29, 2016 | March 1, 2017 |
| Spectrum Analyzer | HP | 8593EM | 3536A00120ADI | March 10, 2016 | March 10, 2017 |
| Active Loop Antenna | EMCO | 6502 | 9506-2950 | November 5, 2015 | November 30, 2016 |
| Antenna Biconical | EMCO | 3110B | 9912-3337 | March 24, 2016 | March 24, 2018 |
| Antenna Log Periodic | EMCO | 3146 | 9505-4081 | April 23, 2016 | April 23, 2017 |
| Horn Antenna 1G-18G | ETS | 3115 | 29845 | May 19, 2015 | May 19, 2018 |
| Horn Antenna 18G-26G | ARA | SWH-28 | 1007 | March 30, 2014 | September 30, 2016 |
| Low Noise Amplifier | Narda | LNA-DBS-0411N313 | 013 | March 1, 2015 | September 30, 2016 |
| Low Noise Amplifier | Sophia Wireless | LNA 28-B | 232 | March 1, 2015 | September 30, 2016 |
| MXG Vector Signal Generator | Agilent | N5182A | MY49060440 | July 1, 2016 | July 1, 2017 |
| Semi Anechoic Civil Chamber | ETS | S81 | SL 11643 | N/A | N/A |
| Antenna Mast | ETS | 2070-2 | - | N/A | N/A |
| Turntable | ETS | 2087 | - | N/A | N/A |
| Mast & Table Controller | ETS/EMCO | 2090 | 9608-1456 | N/A | N/A |

Figure 60 Test Equipment Used



9. Intermodulation Conducted

9.1 Test Procedure

(Temperature (22°C)/ Humidity (37%RH))

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable (max loss = 40.0dB). The spectrum analyzer was set to 1 kHz resolution BW for the frequency range 9.0-150.0 kHz, 10 kHz for the frequency range 150 kHz–1.0 MHz, 100 kHz for the frequency range 1.0 MHz – 30 MHz, and 1MHz for the frequency range 30 MHz - 24GHz.

6 input signals were sent simultaneously to the E.U.T. as follows:

LTE band: 742.0 MHz, 0 dBm

CELL&ESMR band: 878.0 MHz, 0 dBm

PCS band: 1962.5 MHz, 0 dBm

AWS-3 band: 2145.0 MHz, 0 dBm

WCS band: 2355.0MHz, 0 dBm

TDD 2.5G band: 2593.0MHz, 0 dBm

The frequency range of 9 kHz – 24.0 GHz was scanned for unwanted signals.

9.2 Test 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 $43 + 10 \log (P)$ dB, yielding -13dBm.

9.3 Test Results

JUDGEMENT: Passed

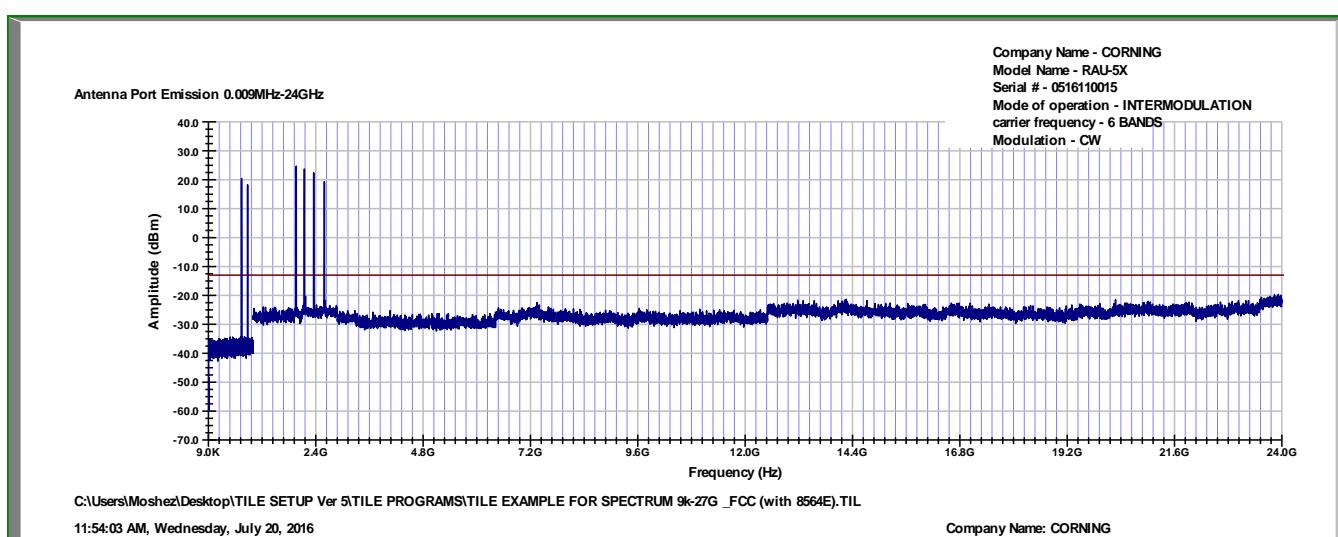


Figure 61 Intermodulation Conducted



9.4 **Test Equipment Used; Intermodulation Conducted**

| Instrument | Manufacturer | Model | Serial Number | Calibration | |
|-----------------------------|----------------------|------------|---------------|-----------------------|----------------------|
| | | | | Last Calibration Date | Next Calibration Due |
| Spectrum Analyzer | HP | 8564E | 3442A00275 | March 10, 2016 | March 10, 2017 |
| EXG Vector Signal Generator | Agilent | N5172B | TE4384 | July 1, 2016 | July 1, 2017 |
| EXG Vector Signal Generator | Agilent | N5172B | MY513500584 | July 1, 2016 | July 1, 2017 |
| MXG Vector Signal Generator | Agilent | N5182A | MY48180244 | July 1, 2016 | July 1, 2017 |
| MXG Vector Signal Generator | Agilent | N5182A | MY49060440 | July 1, 2016 | July 1, 2017 |
| Signal Generator | HP | E4432B | GB40050998 | July 1, 2016 | July 1, 2017 |
| ESG Vector Signal Generator | Agilent | E4438C | MY45094064 | July 1, 2016 | July 1, 2017 |
| 30 dB Attenuator | MCL | BW-S30W5 | 533 | July 5, 2016 | July 5, 2017 |
| 6 dB Attenuator | Weinschel Associates | WA 40-6-34 | 568 | July 6, 2016 | July 6, 2017 |

Figure 62 Test Equipment Used



10. Intermodulation Radiated

10.1 Test Procedure

(Temperature (27°C)/ Humidity (70%RH))

The test method was based on ANSI/TIA-603-D: 2010, Section 2.2.12 Unwanted Emissions: Radiated Spurious.

For measurements between 0.009MHz-30.0MHz:

The E.U.T was tested inside the shielded room at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The frequency range 0.009MHz-30MHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization. The emissions were measured at a distance of 3 meters.

For measurements between 30.0MHz-1.0GHz:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly.

The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization. The emissions were measured at a distance of 3 meters.

For measurements between 1.0GHz-24.0GHz:

The E.U.T was tested inside the shielded room at a distance of 3 meters and the E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The frequency range 1.0GHz -24.0GHz was scanned. The readings were maximized by the turntable azimuth between 0-360°, and the antenna polarization. The emissions were measured at a distance of 3 meters.

The E.U.T. was replaced by a substitution antenna (dipole 30MHz-1GHz, Horn Antenna above 1GHz) driven by a signal generator. The height was readjusted for maximum reading. The signal generator level was adjusted to obtain the same reading on the EMI receiver as in step (a).

The signals observed in step (a) were converted to radiated power using:

$$P_d(\text{dBm}) = P_g(\text{dBm}) - \text{Cable Loss (dB)} + \text{Substitution Antenna Gain (dBD)}$$

P_d = Dipole equivalent power (result).

P_g = Signal generator output level.

6 input signals were sent simultaneously to the E.U.T. as follows:

LTE band: 742.0 MHz, 0 dBm

CELL&ESMR band: 878.0 MHz, 0 dBm

PCS band: 1962.5 MHz, 0 dBm

AWS-3 band: 2145.0MHz, 0 dBm

WCS band: 2355.0MHz, 0 dBm

TDD 2.5G band: 2593.0MHz, 0 dBm



A Peak detector was used for this test.

The test was performed in 3 operation frequencies: low, mid and high.

Testing was performed when the RF port was connected to $50\ \Omega$ termination.

The table below describe only results with the highest radiation.

10.2 Test Limit

The power of any emission outside of the authorized operating frequency ranges (MHz) must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log (P)$ dB, yielding -13dBm .

10.3 Test Results

JUDGEMENT: Passed



| Freq. (MHz) | Antenna Pol. | Maximum Peak Level (dB μ V/m) | Signal Generator RF Output (dBm) | Cable Loss (dB) | Antenna Gain (dBd) | Effective Radiated Power Level (dBm) | Limit (dBm) | Margin (dB) |
|----------------|-----------------|---|---|-----------------------|--------------------------|---|----------------|----------------|
| 1009.0 | V | 50.0 | -49.6 | 0.5 | 6.0 | -44.1 | -13.0 | -31.1 |
| 1009.0 | H | 50.0 | -49.2 | 0.5 | 6.0 | -43.7 | -13.0 | -30.7 |
| 1332.0 | V | 50.3 | -49.1 | 0.5 | 6.0 | -43.6 | -13.0 | -30.6 |
| 1332.0 | H | 50.2 | -49.2 | 0.5 | 6.0 | -43.7 | -13.0 | -30.7 |
| 1372.5 | V | 50.4 | -49.1 | 0.5 | 6.0 | -43.6 | -13.0 | -30.6 |
| 1372.5 | H | 50.3 | -49.2 | 0.5 | 6.0 | -43.7 | -13.0 | -30.7 |
| 2093.5 | V | 50.5 | -50.2 | 0.5 | 7.0 | -43.7 | -13.0 | -30.7 |
| 2093.5 | H | 50.4 | -49.6 | 0.5 | 7.0 | -43.1 | -13.0 | -30.1 |
| 2565.0 | V | 53.7 | -47.0 | 0.5 | 7.0 | -40.5 | -13.0 | -27.5 |
| 2565.0 | H | 53.4 | -46.6 | 0.5 | 7.0 | -40.1 | -13.0 | -27.1 |
| 3223.5 | V | 56.4 | -48.5 | 0.5 | 10.0 | -39.0 | -13.0 | -26 |
| 3223.5 | H | 56.3 | -48.2 | 0.5 | 10.0 | -38.7 | -13.0 | -25.7 |
| 3413.0 | V | 56.5 | -48.5 | 0.5 | 10.0 | -39.0 | -13.0 | -26 |
| 3413.0 | H | 56.5 | -48.2 | 0.5 | 10.0 | -38.7 | -13.0 | -25.7 |
| 3832.0 | V | 56.2 | -42.7 | 0.5 | 9.5 | -33.7 | -13.0 | -20.7 |
| 3832.0 | H | 56.3 | -42.4 | 0.5 | 9.5 | -33.4 | -13.0 | -20.4 |
| 4444.0 | V | 56.5 | -42.3 | 0.5 | 9.5 | -33.3 | -13.0 | -20.3 |
| 4444.0 | H | 56.6 | -42.1 | 0.5 | 9.5 | -33.1 | -13.0 | -20.1 |
| 5099.0 | V | 56.9 | -46.2 | 0.5 | 10.8 | -35.9 | -13.0 | -22.9 |
| 5099.0 | H | 56.7 | -45.0 | 0.5 | 10.8 | -34.7 | -13.0 | -21.7 |

Figure 63 Intermodulation Radiated Results



10.4 Test Instrumentation Used; Radiated Measurements Intermodulation

| Instrument | Manufacturer | Model | Serial Number | Calibration | |
|-----------------------------|-----------------|-------------------|---------------|-----------------------|----------------------|
| | | | | Last Calibration Date | Next Calibration Due |
| EMI Receiver | HP | 85422E | 3906A00276 | March 3, 2016 | March 3, 2017 |
| RF Filter Section | HP | 85420E | 3705A00248 | March 3, 2016 | March 3, 2017 |
| EMI Receiver | R&S | ESCI7 | 100724 | February 29, 2016 | March 1, 2017 |
| Spectrum Analyzer | HP | 8593EM | 3536A00120ADI | March 10, 2016 | March 10, 2017 |
| Active Loop Antenna | EMCO | 6502 | 9506-2950 | November 5, 2015 | November 30, 2016 |
| Antenna Biconical | EMCO | 3110B | 9912-3337 | March 24, 2016 | March 24, 2018 |
| Antenna Log Periodic | EMCO | 3146 | 9505-4081 | April 23, 2016 | April 23, 2017 |
| Horn Antenna 1G-18G | ETS | 3115 | 29845 | May 19, 2015 | May 19, 2018 |
| Horn Antenna 18G-26G | ARA | SWH-28 | 1007 | March 30, 2014 | September 30, 2016 |
| Low Noise Amplifier | Narda | LNA-DBS-0411N313 | 013 | March 1, 2015 | September 30, 2016 |
| Low Noise Amplifier | Sophia Wireless | LNA 28-B | 232 | March 1, 2015 | September 30, 2016 |
| Signal Generator | Marconi | 2022D | 119196015 | March 1, 2016 | March 1, 2017 |
| Signal Generator | HP | 8648C | 3623A04126 | February 29, 2016 | March 1, 2017 |
| Signal Generator | HP | ESG-4000A/E442 2A | US36220118 | February 29, 2016 | March 1, 2017 |
| MXG Vector Signal Generator | Agilent | N5182A | MY49060440 | July 1, 2016 | July 1, 2017 |
| ESG Vector Signal Generator | Agilent | E4438C | MY45094064 | July 1, 2016 | July 1, 2017 |
| Signal Generator | Agilent | E4432B | GB40050998 | July 1, 2016 | July 1, 2017 |
| Semi Anechoic Civil Chamber | ETS | S81 | SL 11643 | N/A | N/A |
| Antenna Mast | ETS | 2070-2 | - | N/A | N/A |
| Turntable | ETS | 2087 | - | N/A | N/A |



| | | | | | |
|-------------------------|----------|------|-----------|-----|-----|
| Mast & Table Controller | ETS/EMCO | 2090 | 9608-1456 | N/A | N/A |
|-------------------------|----------|------|-----------|-----|-----|

Figure 64 Test Equipment Used



11. Out-of-Band Rejection (AWS-3)

11.1 Test Specification

KDB 935210 D05 v01r01, Section 3.3

11.2 Test Procedure

(Temperature (21°C)/ Humidity (35%RH))

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator and an appropriate coaxial cable (max Loss= 31.0 dB).

The signal and spectrum analyzer frequency range was set to $\pm 250\%$ of the passband, Dwell time set to approximately 10msec.

RBW was set between 1% to 5% of the E.U.T passband and VBW set to $\geq 3^*RBW$.

11.3 Test Limit

N/A

11.4 Test Results

JUDGEMENT: Passed

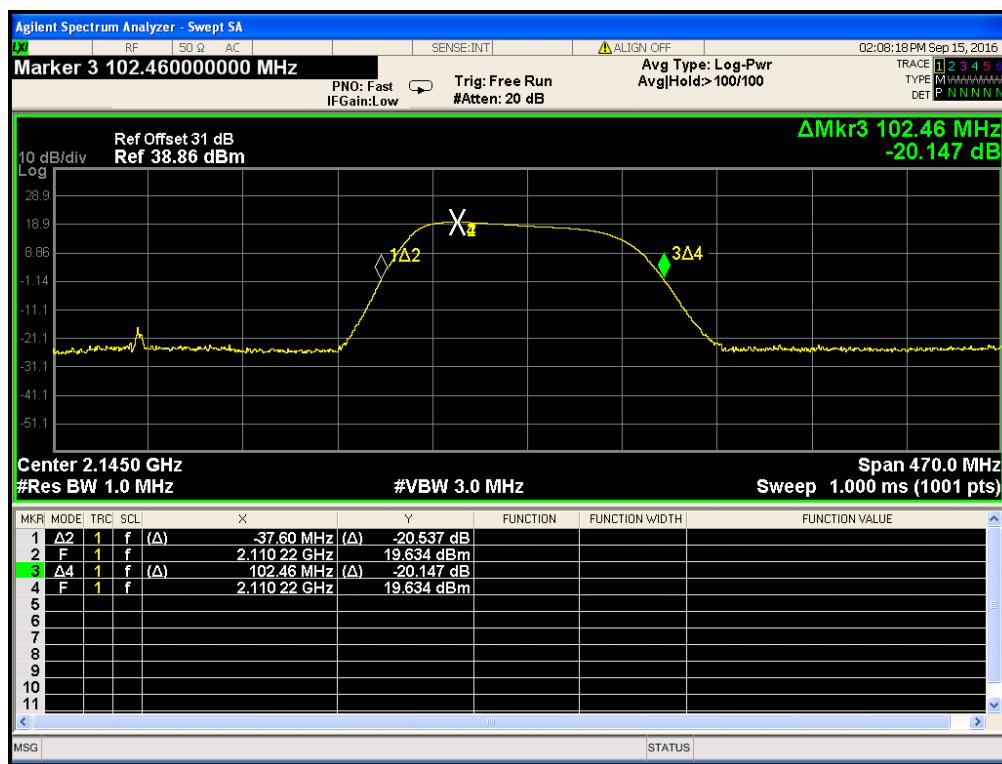


Figure 65. — Out-of-Band Rejection Plot



11.5 **Test Equipment Used; Out-of-Band Rejection**

| Instrument | Manufacturer | Model | Serial Number | Calibration | |
|-----------------------------|--------------|----------|---------------|-----------------------|-----------------------|
| | | | | Last Calibration Date | Next Calibration Date |
| EXA Spectrum Analyzer | Agilent | N9010A | MY48030391 | March 16, 2016 | March 16, 2018 |
| EXG Vector Signal Generator | Agilent | N5172B | MY49060440 | November 11, 2014 | November 19, 2017 |
| 30 dB Attenuator | MCL | BW-S30W5 | 533 | July 5, 2016 | July 15, 2017 |

Figure 66 Test Equipment Used



12. APPENDIX A - CORRECTION FACTORS

**12.1 *Correction factors for* *RF OATS Cable 35m*
 *ITL #1784***

| Frequency (MHz) | Cable loss (dB) |
|------------------|-----------------|
| 10.0 | 0.3 |
| 20.0 | 0.2 |
| 50.0 | -0.1 |
| 100.0 | -0.6 |
| 200.0 | -1.2 |
| 500.0 | -2.3 |
| 1000.0 | -3.6 |



12.2 Correction factors for RF OATS Cable 10m
ITL #1794

| Frequency(MHz) | Cable loss(dB) |
|----------------|----------------|
| 10.0 | -0.3 |
| 20.0 | -0.3 |
| 50.0 | -0.5 |
| 100.0 | -0.7 |
| 200.0 | -1.1 |
| 500.0 | -1.8 |
| 1000.0 | -2.7 |



12.3 Correction factors for

Horn Antenna

**Model: SWH-28
at 1 meter range.**

| FREQUENCY (GHz) | AFE (dB /m) | Gain (dB1) |
|----------------------------|------------------------|-----------------------|
| 18.0 | 40.3 | 16.1 |
| 19.0 | 40.3 | 16.3 |
| 20.0 | 40.3 | 16.1 |
| 21.0 | 40.3 | 16.3 |
| 22.0 | 40.4 | 16.8 |
| 23.0 | 40.5 | 16.4 |
| 24.0 | 40.5 | 16.6 |
| 25.0 | 40.5 | 16.7 |
| 26.0 | 40.6 | 16.4 |



12.4 Correction factors for

Horn ANTENNA

Model: 3115

Antenna serial number: 29845

3 meter range

| f(GHz) | AF(dB/m) | GA(dB) |
|--------|----------|--------|
| 0.75 | 25 | 3 |
| 1G | 23.5 | 7 |
| 1.5G | 26 | 8 |
| 2G | 29 | 7 |
| 2.5G | 27.5 | 10 |
| 3G | 30 | 10 |
| 3.5G | 31.5 | 10 |
| 4G | 32.5 | 9.5 |
| 4.5G | 32.5 | 10.5 |
| 5G | 33 | 10.5 |
| 5.5G | 35 | 10.5 |
| 6G | 36.5 | 9.5 |
| 6.5G | 36.5 | 10 |
| 7G | 37.5 | 10 |
| 7.5G | 37.5 | 10 |
| 8G | 37.5 | 11 |
| 8.5G | 38 | 11 |
| 9G | 37.5 | 11.5 |
| 9.5G | 38 | 11.5 |
| 10G | 38.5 | 11.5 |
| 10.5G | 38.5 | 12 |
| 11G | 38.5 | 12.5 |
| 11.5G | 38.5 | 13 |
| 12G | 38 | 13.5 |
| 12.5G | 38.5 | 13 |
| 13G | 40 | 12 |
| 13.5G | 41 | 12 |
| 14G | 40 | 13 |
| 14.5G | 39 | 14 |
| 15G | 38 | 15.5 |
| 15.5G | 37.5 | 16 |
| 16G | 37.5 | 16 |
| 16.5G | 39 | 15 |
| 17G | 40 | 15 |
| 17.5G | 42 | 13.5 |
| 18G | 42.5 | 13 |



**12.5 Correction factors for Log Periodic Antenna
EMCO, Model 3146,
Serial #9505-4081**

| Frequency [MHz] | AF [dB/m] |
|-----------------|-----------|
| 200.0 | 11.47 |
| 250.0 | 12.06 |
| 300.0 | 14.77 |
| 400.0 | 15.77 |
| 500.0 | 18.01 |
| 600.0 | 18.84 |
| 700.0 | 20.93 |
| 800.0 | 21.27 |
| 900.0 | 22.44 |
| 1000.0 | 24.10 |



**12.6 Correction factors for Biconical Antenna
EMCO, Model 3110B,
Serial #9912-3337**

| Frequency [MHz] | AF [dB/m] |
|-----------------|-----------|
| 30.0 | 14.18 |
| 35.0 | 13.95 |
| 40.0 | 12.84 |
| 45.0 | 11.23 |
| 50.0 | 11.10 |
| 60.0 | 10.39 |
| 70.0 | 9.34 |
| 80.0 | 9.02 |
| 90.0 | 9.31 |
| 100.0 | 8.95 |
| 120.0 | 11.53 |
| 140.0 | 12.20 |
| 160.0 | 12.56 |
| 180.0 | 13.49 |
| 200.0 | 15.27 |



12.7 Correction factors for ACTIVE LOOP ANTENNA

**Model 6502
S/N 9506-2950**

| f(MHz) | MAF(dBs/m) | AF(dB/m) |
|--------|------------|----------|
| 0.01 | -33.1 | 18.4 |
| 0.02 | -37.2 | 14.3 |
| 0.03 | -38.2 | 13.3 |
| 0.05 | -39.8 | 11.7 |
| 0.1 | -40.1 | 11.4 |
| 0.2 | -40.3 | 11.2 |
| 0.3 | -40.3 | 11.2 |
| 0.5 | -40.3 | 11.2 |
| 0.7 | -40.3 | 11.2 |
| 1 | -40.1 | 11.4 |
| 2 | -40 | 11.5 |
| 3 | -40 | 11.5 |
| 4 | -40.1 | 11.4 |
| 5 | -40.2 | 11.3 |
| 6 | -40.4 | 11.1 |
| 7 | -40.4 | 11.1 |
| 8 | -40.4 | 11.1 |
| 9 | -40.5 | 11 |
| 10 | -40.5 | 11 |
| 20 | -41.5 | 10 |
| 30 | -43.5 | 8 |