



DATE: 11 January 2017

I.T.L. (PRODUCT TESTING) LTD. FCC Radio Test Report

for

Corning Optical Communication Wireless

Equipment under test:

ONE - Optical Network Evolution DAS

RAU-4 Remote Antenna Unit AWS, CELL, LTE, PCS (CELL Section)

Tested by:

M. Zohar

Approved by:

D. Shidlowsky

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Measurement/Technical Report for Corning Optical Communication Wireless ONE - Optical Network Evolution DAS

FCC ID: OJF1C85P19L70A17

This report concerns:

Original Grant: Class II change: X Class I change:

Equipment type:

Part 20 Industrial Booster (CMRS)

Limits used: 47CFR Parts 2, 22, 20, 90

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: | Applicant for this device: (different from "prepared by") | | |
|---|---|--|--|
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TABLE OF CONTENTS

| 1. | GENERAL INFORMATION | |
|-----|--|----|
| | 1.1 Administrative Information | 5 |
| | 1.2 List of Accreditations | |
| | 1.3 Product Description | |
| | 1.4 Test Methodology | |
| | 1.5 Test Facility 1.6 Measurement Uncertainty | |
| | · | |
| 2. | SYSTEM TEST CONFIGURATION | |
| | 2.1 Justification | |
| | 2.2 EUT Exercise Software | |
| | 2.3 Special Accessories 2.4 Equipment Modifications | |
| | 2.4 Equipment Modifications2.5 Configuration of Tested System | |
| | | |
| 3. | TEST SET-UP PHOTOS | |
| 4. | PEAK OUTPUT POWER CELL | - |
| | 4.1 Test Specification | |
| | 4.2 Test Procedure | |
| | 4.3 Test Limit | - |
| | 4.4 Test Results 4.5 Test Equipment Used; Peak Output Power CELL | |
| | ••• | |
| 5. | OCCUPIED BANDWIDTH CELL | |
| | 5.1 Test Specification | |
| | 5.2 Test Procedure | |
| | 5.3 Limit 5.4 Test Results | |
| | 5.4 Test Results 5.5 Test Equipment Used; Occupied Bandwidth CELL | |
| | | |
| 6. | SPURIOUS EMISSIONS AT ANTENNA TERMINALS CELL | 33 |
| | 6.1 Test Specification | |
| | 6.2 Test Procedure 6.3 Test Limit | |
| | 6.4 Test Results | |
| | 6.5 Test Equipment Used; Out of Band Emission at Antenna Terminals CELL | |
| 7 | BAND EDGE SPECTRUM CELL | |
| 7. | 7.1 Test Specification | |
| | 7.2 Test Procedure | |
| | 7.3 Test Limit | |
| | 7.4 Test Results | |
| | 7.5 Test Equipment Used; Band Edge Spectrum CELL | |
| 8. | SPURIOUS EMISSIONS (RADIATED) CELL | 43 |
| 0. | 8.1 Test Specification | |
| | 8.2 Test Procedure | |
| | 8.3 Test Limit | 44 |
| | 8.4 Test Results | |
| | 8.5 Test Instrumentation Used, Radiated Measurements CELL | 45 |
| 9. | NTERMODULATION CONDUCTED | 46 |
| | 9.1 Test Procedure | |
| | 9.2 Test Limit | |
| | 9.3 Test Results | |
| | 9.4 Test Equipment Used; Intermodulation Conducted | 47 |
| 10. | NTERMODULATION RADIATED | 48 |
| | 10.1 Test Procedure | 48 |
| | 10.2 Test Limit | - |
| | 10.3 Test Results | - |
| | 10.4 Test Instrumentation Used; Radiated Measurements Intermodulation | 51 |



| 11. | OUT-OF-B | BAND REJECTION (CELL) | 52 |
|-----|----------|--|----|
| | 11.1 | Test Specification | 52 |
| | 11.2 | Test Procedure | 52 |
| | 11.3 | Test Limit | 52 |
| | 11.4 | Test Results | 52 |
| | 11.5 | Test Equipment Used; Out-of-Band Rejection | 53 |
| 12. | APPENDIX | X A - CORRECTION FACTORS | 54 |
| | 12.1 | Correction factors for RF OATS Cable 35m | 54 |
| | 12.2 | Correction factors for RF OATS Cable 10m | 55 |
| | 12.3 | Correction factor for RF CABLE for Semi Anechoic Chamber | 56 |
| | 12.4 | Correction factors for Horn Antenna | 57 |
| | 12.5 | Correction factors for Horn ANTENNA | 58 |
| | 12.6 | Correction factors for Log Periodic Antenna | 59 |
| | 12.7 | Correction factors for Biconical Antenna | 60 |
| | | Correction factors for ACTIVE LOOP ANTENNA | |



1. General Information

1.1 Administrative Information

| 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-4 Remote Antenna Unit |
| | |
| | |
| Equipment Serial No.: | 05143500012 |
| | |
| Date of Receipt of E.U.T: | July 18, 2016 |
| Start of Test: | July 18, 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, 22, 20,90 |



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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 IL1005.
- 3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
- The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-3006, R-2729, T-1877, G-245.
- 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.

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1.3 Product Description

The Optical Network Platform (ONETM) by Corning provides a flexible inbuilding 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 preterminated composite cables and advanced end-to-end equipment. Easy to design, Plug and PlayTM connectors, significantly reduce installation cost and deployment time.

The ONETM 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 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 9/13/2013 under FCC ID: OJF1C85P19L70A17.

A C2PC Grant was issued on 5/5/2014 to remove the limited waiver issued by the FCC.

The E.U.T. is part of a booster system operated with the RXU certified under 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 part of a booster system 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, CELL, PCS & LTE) submitted with this application.

2.2 EUT Exercise Software

HCM_2.2 Build23 ACM_2a00_22_11.bin RMM_5a00_22_02. bin OIM_7a03_22_05. bin RAU_8a03_22_07

2.3 Special Accessories

No special accessories were needed in order to achieve compliance.

2.4 Equipment Modifications

No modifications were needed in order to achieve compliance.



2.5 Configuration of Tested System

| Product Name | ONE Wireless Platform |
|--------------------------|--------------------------------------|
| Model Name | RAU-4 |
| Working voltage | 48.0VDC |
| Mode of operation | Industrial Booster for CELL band |
| Modulations | WCDMA, LTE(64QAM), GSM |
| Assigned Frequency Range | CELL: 869MHz-894MHz |
| Transmit power | ~15.0 dBm |
| Antenna Gain | 12.5dBi |
| DATA rate | N/A |
| Modulation BW | 0.5MHz(GSM), 10MHz(LTE), 5MHz(WCDMA) |

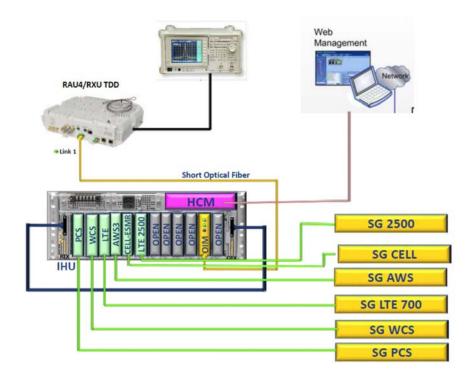


Figure 1. Test Set-Up – Conducted



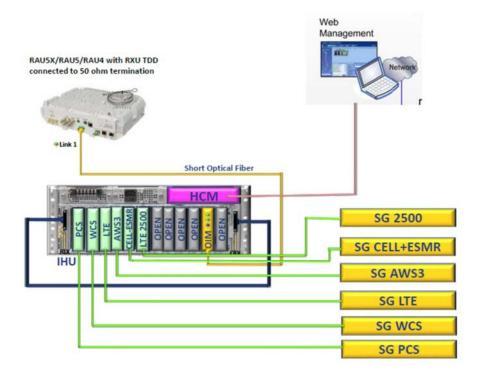


Figure 2. Test Set-Up - Radiated



3. Test Set-Up Photos

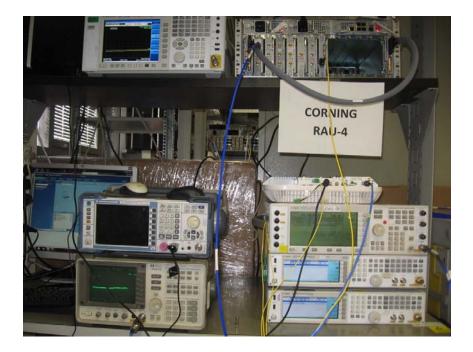


Figure 3. Conducted Emission from Antenna Ports Test



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



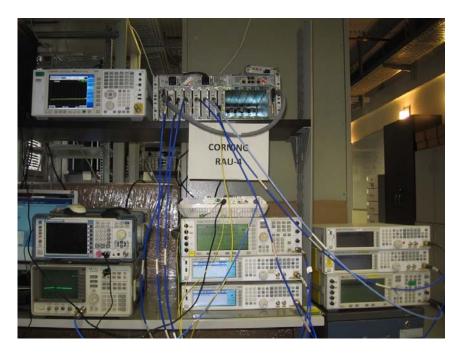


Figure 9. Intermodulation Conducted Test



4. Peak Output Power CELL

4.1 Test Specification

FCC Part 22.913

4.2 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). The E.U.T. RF output was modulated with W-CDMA, GSM and LTE 64QAM. Special attention was taken to prevent Spectrum Analyzer RF input overload.

4.3 Test Limit

Peak Power Output must not exceed 500 Watts (57dBm).

| Modulation | Operation | Reading | Antenna | EIRP | Limit | Margin |
|------------|-----------|---------|---------|-------|-------|--------|
| | Frequency | | Gain | | | |
| | (MHz) | (dBm) | (dBi) | (dBm) | (dBm) | (dB) |
| | 874.0 | 15.8 | 12.5 | 28.3 | 57.00 | -28.7 |
| LTE 64QAM | 881.0 | 16.2 | 12.5 | 28.7 | 57.00 | -28.3 |
| | 889.0 | 16.7 | 12.5 | 29.2 | 57.00 | -27.8 |
| | 870.2 | 15.2 | 12.5 | 27.7 | 57.00 | -29.3 |
| GSM | 881.0 | 15.2 | 12.5 | 27.7 | 57.00 | -29.3 |
| | 892.8 | 15.7 | 12.5 | 28.2 | 57.00 | -28.8 |
| | 871.5 | 15.6 | 12.5 | 28.1 | 57.00 | -28.9 |
| W-CDMA | 881.0 | 16.3 | 12.5 | 28.8 | 57.00 | -28.2 |
| | 891.5 | 16.3 | 12.5 | 28.8 | 57.00 | -28.2 |

4.4 Test Results

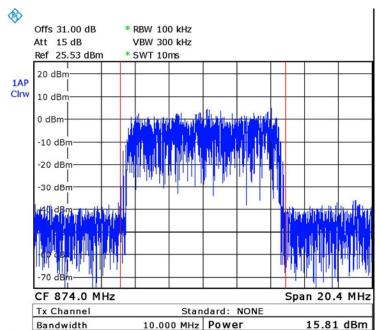
Figure 10 Peak Output Power CELL

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

JUDGEMENT:

Passed by 27.8 dB





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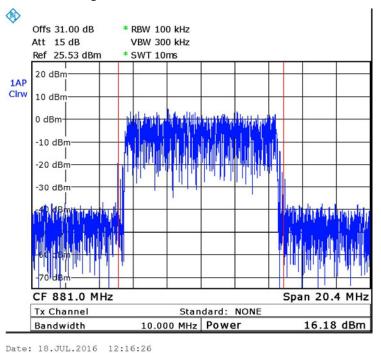
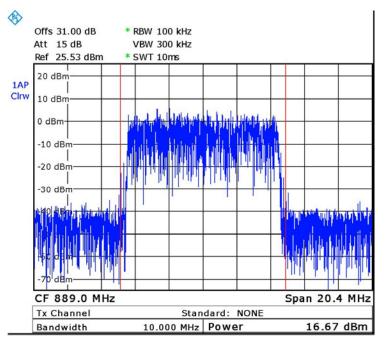


Figure 11. — LTE 64QAM - 874.0 MHz

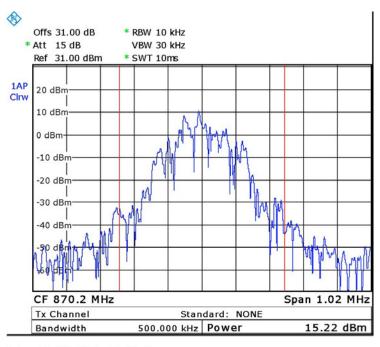
Figure 12. — LTE 64QAM - 881.0 MHz





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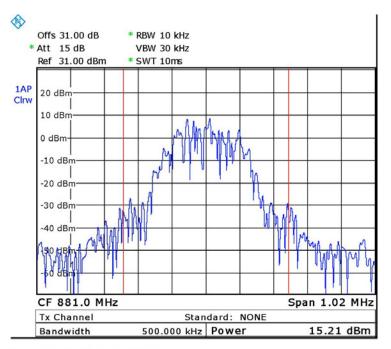
Figure 13. — LTE 64QAM - 889.0 MHz



Date: 18.JUL.2016 12:25:40

Figure 14. — GSM - 870.2 MHz





Date: 18.JUL.2016 12:26:34

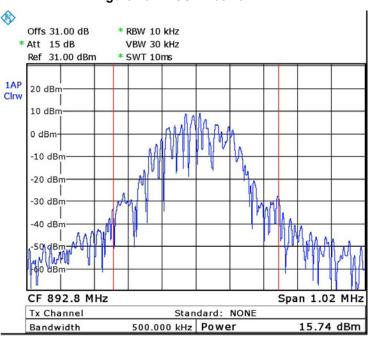


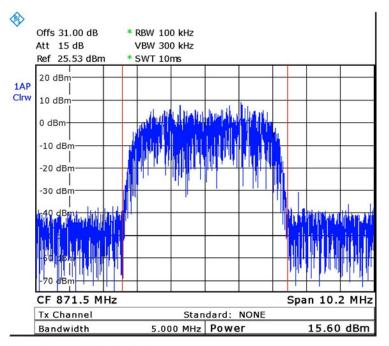
Figure 15. — GSM - 881.0 MHz

Date: 18.JUL.2016 12:27:23

Figure 16. — GSM - 892.8 MHz



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Date: 18.JUL.2016 12:20:59

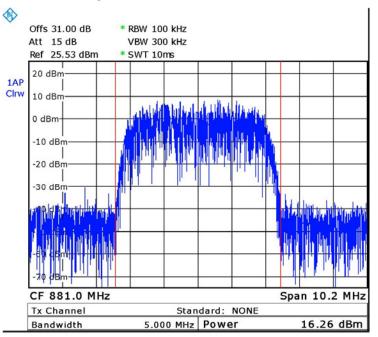
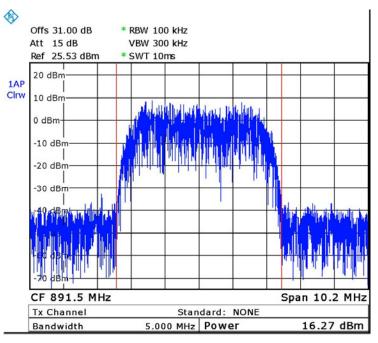


Figure 17. — W-CDMA - 871.5 MHz

Date: 18.JUL.2016 12:21:29

Figure 18. — W-CDMA - 881.0 MHz





Date: 18.JUL.2016 12:23:20

Figure 19. — W-CDMA - 891.5 MHz

| 4.5 | Test Equipment Used; Peak Output Power CELL |
|-----|---|
| 7.0 | |

| | Serial Serial | | Calibration | | |
|----------------------------|---------------|----------|-------------|--------------------------|-------------------------|
| Instrument | Manufacturer | Model | Number | 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 CELL

5.1 Test Specification

FCC Part 2, Section 1049

5.2 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 (loss=31.0 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 Test Results

| Modulation | Port | Operating | Reading | |
|------------|-----------------|-----------|---------|--|
| | | Frequency | - | |
| | (Input/ Output) | (MHz) | (MHz) | |
| | Input | 874.0 | 8.9 | |
| | Output | 874.0 | 8.9 | |
| LTE 64QAM | Input | 881.0 | 8.9 | |
| LIE 04QAM | Output | 881.0 | 8.9 | |
| | Input | 889.0 | 8.9 | |
| | Output | 889.0 | 9.0 | |
| | Input | 870.2 | 0.2 | |
| | Output | 870.2 | 0.2 | |
| GSM | Input | 881.0 | 0.2 | |
| USIM | Output | 881.0 | 0.2 | |
| | Input | 892.8 | 0.2 | |
| | Output | 892.8 | 0.2 | |
| | Input | 871.5 | 4.1 | |
| | Output | 871.5 | 4.1 | |
| W-CDMA | Input | 881.0 | 4.1 | |
| w-CDMA | Output | 881.0 | 4.2 | |
| | Input | 891.5 | 4.1 | |
| | Output | 891.5 | 4.1 | |

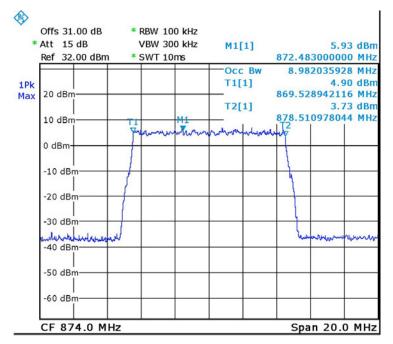
Figure 21 Occupied Bandwidth CELL

JUDGEMENT:

Passed

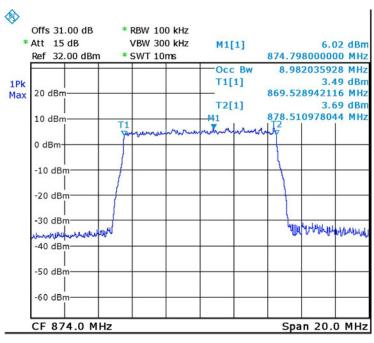
See additional information in Figure 22 to Figure 39.





Date: 18.JUL.2016 14:14:45

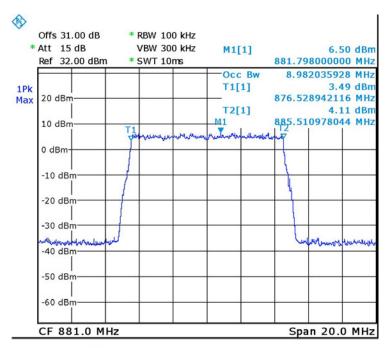




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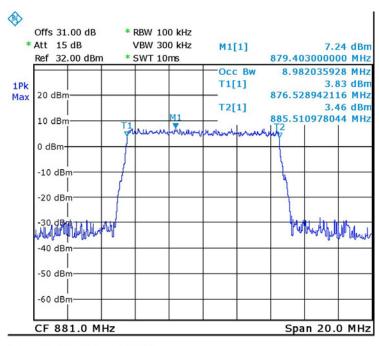






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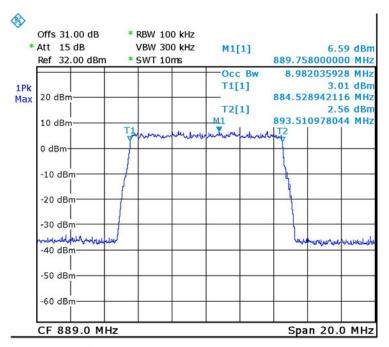




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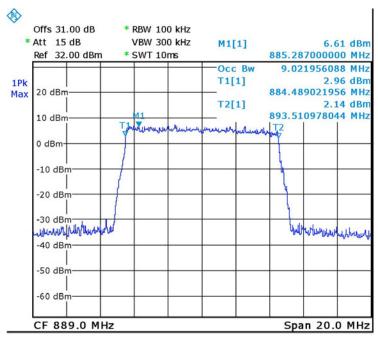
Figure 25. — LTE 64QAM Output 881.0MHz





Date: 18.JUL.2016 14:15:40

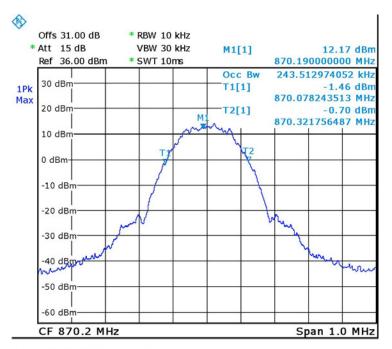
Figure 26. — LTE 64QAM Input 889.00 MHz



Date: 18.JUL.2016 14:06:56

Figure 27. — LTE 64QAM Output 889.0 MHz



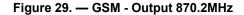


Date: 18.JUL.2016 14:32:51

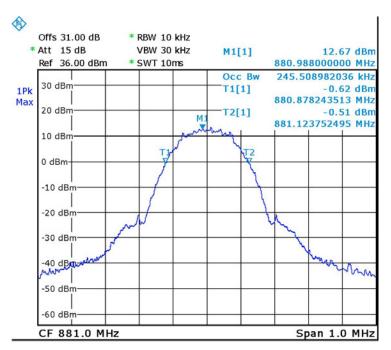
* RBW 10 kHz Offs 31.00 dB * Att 20 dB VBW 30 kHz M1[1] 13.57 dBm Ref 41.00 dBm * SWT 10ms 870.157200000 MHz Occ Bw 244.311377246 kHz -0.47 dBm T1[1] 1AP 30 dBm 870.079880240 MHz Max T2[1] -0.38 dBm 20 dBm 870.324191617 MHz Μ1 M 10 dBm T: 0 dBm -10 dBm -20 dBm h -30 dBm n 40udDe -50 dBm CF 870.2 MHz Span 1.02 MHz

Figure 28. — GSM - Input 870.2MHz

Date: 18.JUL.2016 12:35:51







Date: 18.JUL.2016 14:33:21

Figure 30. — GSM - Input 881.0 MHz

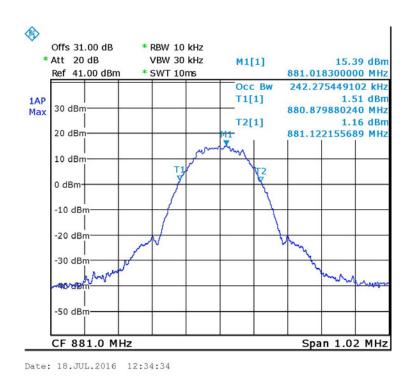
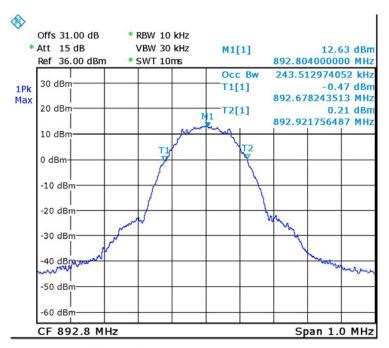


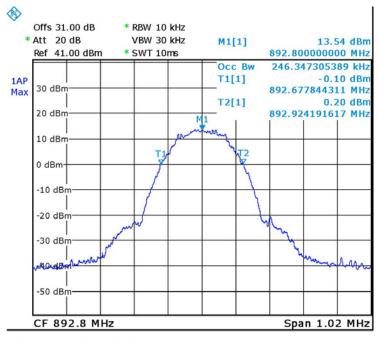
Figure 31. — GSM - Output 881.0MHz





Date: 18.JUL.2016 14:34:18

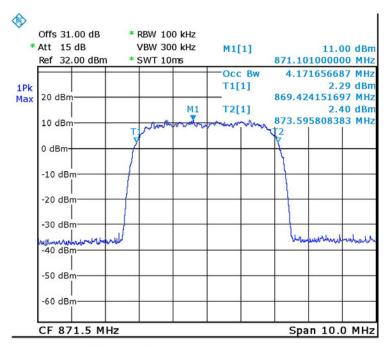
Figure 32. — GSM - Input 892.8 MHz



Date: 18.JUL.2016 12:35:16

Figure 33. — GSM - Output 892.8 MHz





Date: 18.JUL.2016 14:11:57

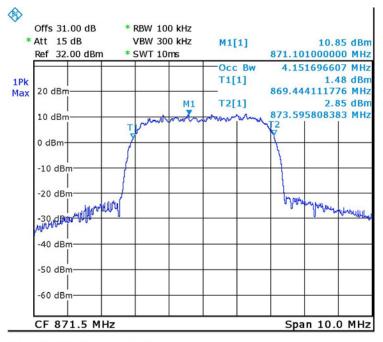


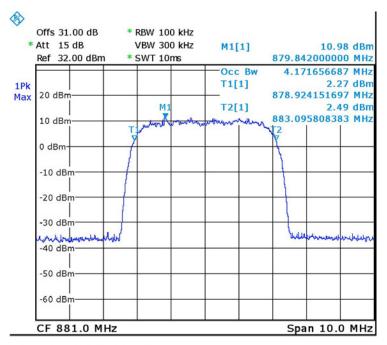
Figure 34. — W-CDMA - Input 871.5MHz

Date: 18.JUL.2016 14:09:25

Figure 35. — W-CDMA - Output 871.5MHz

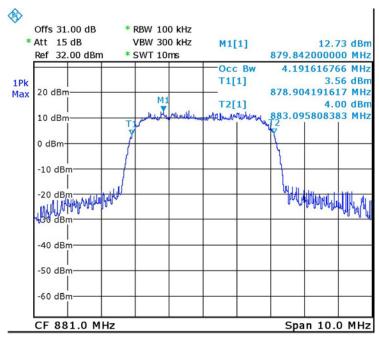


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Date: 18.JUL.2016 14:12:25

Figure 36. — W-CDMA - Input 881.0 MHz

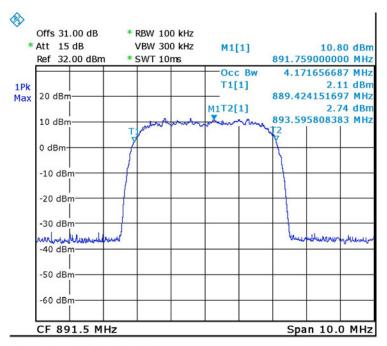


Date: 18.JUL.2016 14:08:51

Figure 37. — W-CDMA - Output 881.0MHz

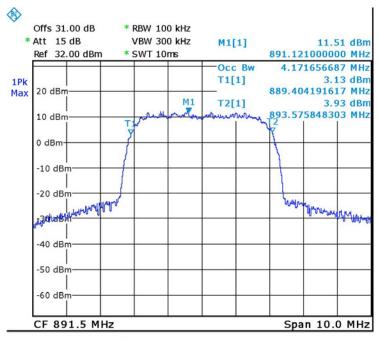


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Date: 18.JUL.2016 14:13:10

Figure 38. — W-CDMA - Input 891.5 MHz



Date: 18.JUL.2016 14:08:11

Figure 39. — W-CDMA - Output 891.5 MHz



| | | Conicil. | | Calibration | | |
|----------------------------|--------------|----------|------------------|--------------------------|-------------------------|--|
| Instrument | Manufacturer | Model | Serial Number | 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 | |

5.5 Test Equipment Used; Occupied Bandwidth CELL

Figure 40 Test Equipment Used



6. Spurious Emissions at Antenna Terminals CELL

6.1 Test Specification

FCC Part 22, Section 917; FCC Part 2.1051

6.2 Test Procedure

(Temperature (23°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=31.5dB). The spectrum analyzer was set to 1 kHz R.B.W for the frequency range of 9 kHz – 1 MHz, 100 kHz for the frequency range of 1 – 30 MHz, and 1 MHz for the frequency range of 30 MHz – 10 GHz.

6.3 Test Limit

The power of any emission outside of the authorized operating frequency ranges(869 - 894 MHz) must be attenuated below the transmitting power (P) by a factor of at least $43 + \log (P) dB$, yielding -13dBm.

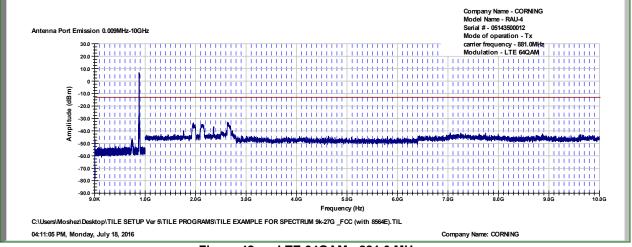
6.4 Test Results

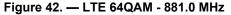
JUDGEMENT: Passed

See additional information in Figure 41 to Figure 49.

ISRAEL TESTING LABORATORIES Global Certifications You Can Trust Company Name - CORNING Model Name - RAU-4 Nodel Name - KAU-4 Serial # - 05143500012 Mode of operation - Tx carrier frequency - 874.0MHz Modulation - LTE 64QAM Antenna Port Emission 0.009MHz-10GHz ^{30.0}Ŧ 20.0 10.0 (dBm) -10.0 -20.0 Amplitude -30.0 -40. -50 0 -60.0 -70.0 -80.0 6.0G 9.0G 1.0G 2.0G 3.0G 4.0G 5.0G 7.0G 8.0G +| 10.0G Frequency (Hz) C:\Users\Moshez\Desktop\TILE SETUP Ver 5\TILE PROGRAMS\TILE EXAMPLE FOR SPECTRUM 9k-27G _FCC (with 8564E).TIL 04:07:38 PM, Monday, July 18, 2016 Company Name: CORNING







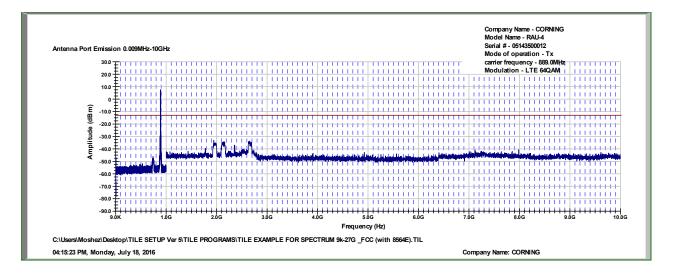
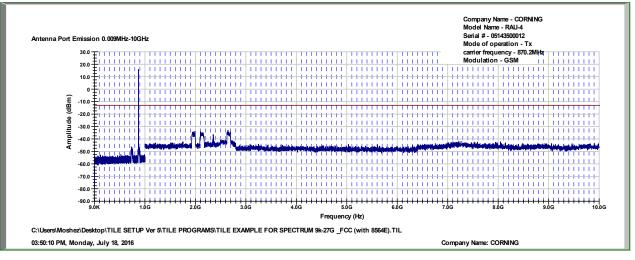


Figure 43. - LTE 64QAM - 889.0 MHz







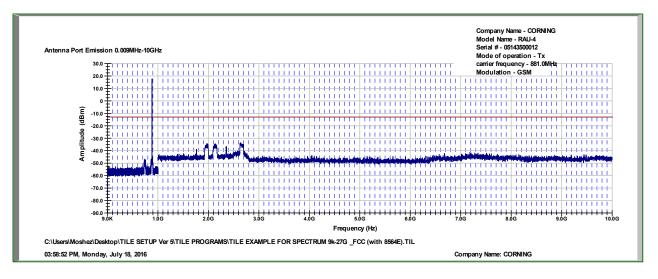
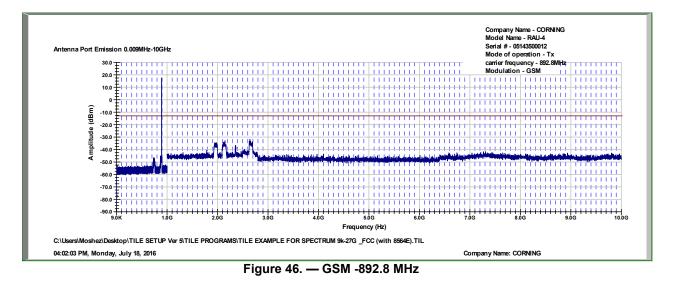
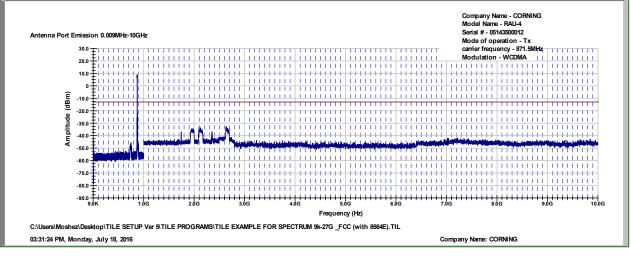


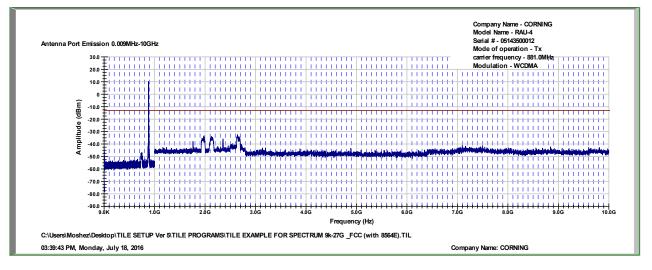
Figure 45. — GSM - 881.0 MHz













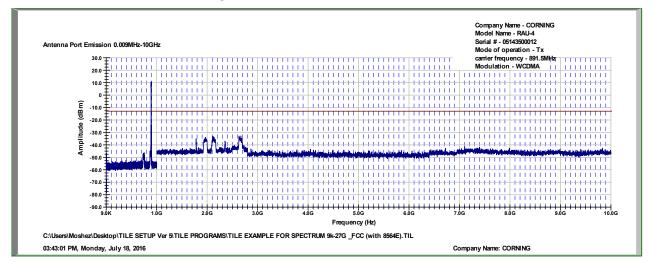


Figure 49. — W-CDMA - 891.5 MHz



6.5 Test Equipment Used; Out of Band Emission at Antenna Terminals CELL

| | | Model Serial – Number | | Calibr | ation |
|--------------------------------|--------------|--------------------------|------------|--------------------------|-------------------------|
| Instrument | Manufacturer | | | 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 CELL

7.1 Test Specification

FCC Part 22, FCC Part 2.1051

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 (31.0 dB). The spectrum analyzer was set to 100 kHz R.B.W.

7.3 Test Limit

The power of any emission outside of the authorized operating frequency ranges (869 - 894 MHz) must be attenuated below the transmitting power (P) by a factor of at least $43 + \log (P) dB$, yielding -13dBm.

| Modulation | Operation | Band Edge | Reading | Limit | Margin |
|------------|-----------|-----------|---------|-------|--------|
| | Frequency | Frequency | | | |
| | (MHz) | (MHz) | (dBm) | (dBm) | (dB) |
| | 874.0 | 869.0 | -20.0 | -13.0 | -7.0 |
| LTE 64QAM | 889.0 | 894.0 | -16.3 | -13.0 | -3.3 |
| | 870.2 | 869.0 | -36.4 | -13.0 | -23.4 |
| GSM | 892.8 | 894.0 | -35.3 | -13.0 | -22.3 |
| | 871.5 | 869.0 | -17.3 | -13.0 | -4.3 |
| W-CDMA | 891.5 | 894.0 | -20.4 | -13.0 | -7.4 |

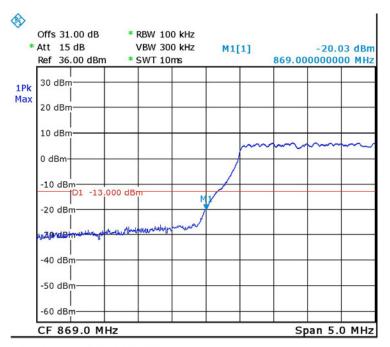
7.4 Test Results

Figure 51 Band Edge Spectrum Results CELL

JUDGEMENT: Passed by 3.3dB

See additional information in Figure 52 to Figure 57.





Date: 18.JUL.2016 14:41:56

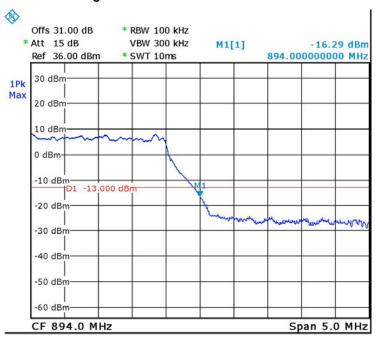


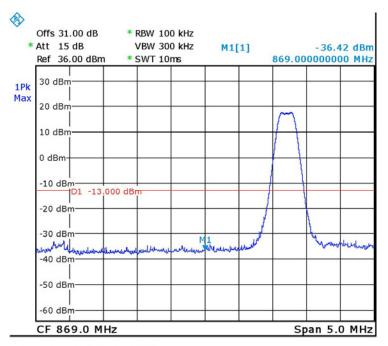
Figure 52. — LTE 64QAM 874.0 MHz

Date: 18.JUL.2016 14:44:13

Figure 53. — LTE 64QAM 889.0 MHz

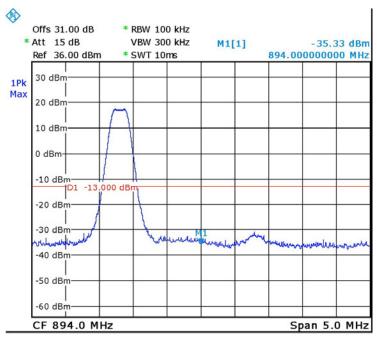


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Date: 18.JUL.2016 14:38:58

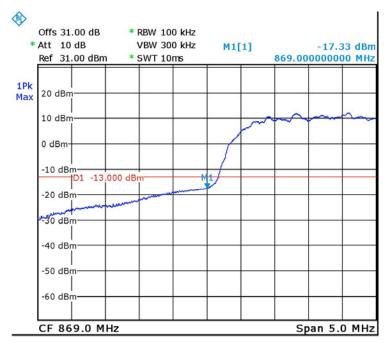
Figure 54. — GSM - 870.2 MHz



Date: 18.JUL.2016 14:38:18

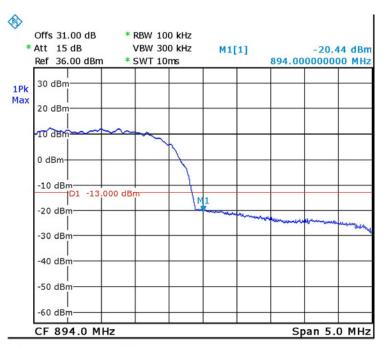
Figure 55. — GSM - 892.8 MHz





Date: 18.JUL.2016 14:48:17

Figure 56. — W-CDMA - 871.5 MHz



Date: 18.JUL.2016 14:46:13

Figure 57. — W-CDMA - 891.5 MHz



7.5 Test Equipment Used; Band Edge Spectrum CELL

| | | Model Serial – Number | | Calibr | ation |
|----------------------------|--------------|--------------------------|------------|--------------------------|-------------------------|
| Instrument | Manufacturer | | | 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



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8. Spurious Emissions (Radiated) CELL

8.1 Test Specification

FCC Part 22, Section 917; FCC Part 2.1053

8.2 Test Procedure

(Temperature (24°C)/ Humidity (50%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-30MHz:

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 $0-360^\circ$, and the antenna polarization. The emissions were measured at a distance of 3 meters.

For measurements between 1.0GHz-10.0GHz:

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 -10.0GHz 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: $P_d(dBm) = P_g(dBm) - Cable Loss (dB) + Substitution Antenna Gain (dBd)$

 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 $\boldsymbol{\Omega}$ 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 (MHz) must be attenuated below the transmitting power (P) by a factor of at least $43 + 10 \log (P) dB$, yielding -13 dBm.

8.4 Test Results

| Carrier Channel | Freq. | Antenna Pol. | Maximum Peak Level | Signal Generator | Cable Loss | Antenna Gain | Effective Radiated | Limit | Margin |
|--------------------|--------|-----------------|-----------------------|---------------------|---------------|-----------------|-----------------------|-------|--------|
| | | (17/11) | (JD17/) | RF Output | | | Power Level | (10) | (4D) |
| (MHz) | (MHz) | (V/H) | (dBµV/m) | (dBm) | (dB) | (dBd) | (dBm) | (dBm) | (dB) |
| 870.2 | 2610.6 | V | 51.6 | -53.0 | 0.5 | 10.0 | -43.5 | -13.0 | -30.5 |
| 870.2 | 2610.6 | Н | 51.4 | -53.5 | 0.5 | 10.0 | -44.0 | -13.0 | -31.0 |
| 881.0 | 2643.0 | V | 51.5 | -53.0 | 0.5 | 10.0 | -43.5 | -13.0 | -30.5 |
| 881.0 | 2643.0 | Н | 51.5 | -53.5 | 0.5 | 10.0 | -44.0 | -13.0 | -31.0 |
| 892.8 | 2678.4 | V | 51.6 | -53.0 | 0.5 | 10.0 | -43.5 | -13.0 | -30.5 |
| 892.8 | 2678.4 | Н | 51.5 | -53.5 | 0.5 | 10.0 | -44.0 | -13.0 | -31.0 |

Figure 59 Spurious Emission (Radiated) CELL

The E.U.T met the requirements of the FCC Part 22, Section 917, FCC Part 2.1053 specifications.

JUDGEMENT; Passed by 30.5 dB



8.5 Test Instrumentation Used, Radiated Measurements CELL

| | | | Serial | Calit | oration |
|--------------------------------|--------------------|----------------------|---------------|--------------------------|-------------------------|
| Instrument | Manufacturer | Model | Number | Last Calibration Date | Next Calibration Due |
| EMI Receiver | НР | 85422E | 3906A00276 | March 3, 2016 | March 3, 2017 |
| RF Filter Section | НР | 85420E | 3705A00248 | March 3, 2016 | March 3, 2017 |
| EMI Receiver | R&S | ESCI7 | 100724 | February 29, 2016 | March 1, 2017 |
| Spectrum Analyzer | НР | 8593EM | 3536A00120ADI | March 10, 2016 | March 10, 2017 |
| Active Loop Antenna | ЕМСО | 6502 | 9506-2950 | November 5, 2015 | November 30, 2016 |
| Antenna Biconical | ЕМСО | 3110B | 9912-3337 | March 24, 2016 | March 24, 2018 |
| Antenna Log Periodic | ЕМСО | 3146 | 9505-4081 | April 23, 2016 | April 23, 2017 |
| Horn Antenna 1G-18G | ETS | 3115 | 29845 | May 19, 2015 | May 19, 2018 |
| Horn Antenna 18-26GHz? | 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 = 34.0dB). 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.

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

LTE band: 742.0 MHz, 0 dBm

CELL band: 878.0 MHz, 0 dBm

PCS band: 1962.5 MHz, 0 dBm

AWS band: 2132.5 MHz, 0 dBm

WCS band: 2355.0MHz, 0 dBm

TDD 2.5G band: 2593.0MHz, 0 dBm

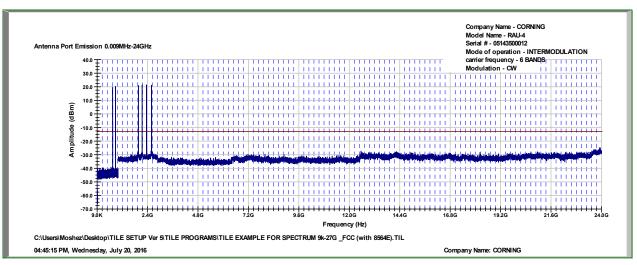
The frequency range of 9 kHz – 24.0 GHz was scanned for unwanted signals.

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 -13 dBm.

9.3 Test Results

JUDGEMENT:



Passed

Figure 61 Intermodulation Conducted



9.4 Test Equipment Used; Intermodulation Conducted

| | | | Serial | Calibr | ration |
|--------------------------------|-------------------------|----------------|-------------|--------------------------|-------------------------|
| Instrument | Manufacturer | Model | Number | 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 (24°C)/ Humidity (50%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-30MHz:

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:

 $P_d(dBm) = P_g(dBm) - Cable Loss (dB) + Substitution Antenna Gain (dBd)$ $P_d = Dipole equivalent power (result).$

 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 band: 878.0 MHz, 0 dBm

PCS band: 1962.5 MHz, 0 dBm

AWS band: 2132.5 MHz, 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 Ω 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 (728-758; 869-894; 1930-1990; 2110-2155 MHz; 2350-2360MHz) 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

For additional information see Figure 63.



| Freq. | Antenna Pol. | Maximum Peak Level | Signal Generator RF Output | Cable Loss | Antenna Gain | Effective Radiated Power Level | Limit | Margin |
|--------|-----------------|-----------------------|----------------------------------|---------------|-----------------|--------------------------------------|-------|--------|
| (MHz) | (V/H) | (dBµV/m) | (dBm) | (dB) | (dBd) | (dBm) | (dBm) | (dB) |
| 1792.5 | V | 53.2 | -49.6 | 0.5 | 7.0 | -43.1 | -13.0 | -30.1 |
| 1792.5 | Н | 53.0 | -49.8 | 0.5 | 7.0 | -43.3 | -13.0 | -30.3 |
| 2219.0 | V | 54.1 | -48.6 | 0.5 | 7.0 | -42.1 | -13.0 | -29.1 |
| 2219.0 | Н | 54.0 | -48.8 | 0.5 | 7.0 | -42.3 | -13.0 | -29.3 |
| 3223.5 | V | 54.2 | -50.6 | 0.5 | 10.0 | -41.1 | -13.0 | -28.1 |
| 3223.5 | Н | 54.4 | -50.0 | 0.5 | 10.0 | -40.5 | -13.0 | -27.5 |
| 3854.0 | V | 54.3 | -50.5 | 0.5 | 9.5 | -41.5 | -13.0 | -28.5 |
| 3854.0 | Н | 54.3 | -50.5 | 0.5 | 9.5 | -41.5 | -13.0 | -28.5 |
| 3978.5 | V | 54.3 | -50.7 | 0.5 | 9.5 | -41.7 | -13.0 | -28.7 |
| 3978.5 | Н | 54.5 | -50.5 | 0.5 | 9.5 | -41.5 | -13.0 | -28.5 |
| 4104.0 | V | 54.3 | -50.7 | 0.5 | 9.5 | -41.7 | -13.0 | -28.7 |
| 4104.0 | Н | 54.7 | -50.5 | 0.5 | 9.5 | -41.5 | -13.0 | -28.5 |
| 4201.0 | V | 54.5 | -50.7 | 0.5 | 9.5 | -41.7 | -13.0 | -28.7 |
| 4201.0 | Н | 54.5 | -50.5 | 0.5 | 9.5 | -41.5 | -13.0 | -28.5 |
| 4308.0 | V | 54.5 | -50.4 | 0.5 | 9.5 | -41.4 | -13.0 | -28.4 |
| 4308.0 | Н | 54.5 | -50.5 | 0.5 | 9.5 | -41.5 | -13.0 | -28.5 |
| 4439.0 | V | 54.5 | -50.4 | 0.5 | 9.5 | -41.4 | -13.0 | -28.4 |
| 4439.0 | Н | 54.5 | -50.5 | 0.5 | 9.5 | -41.5 | -13.0 | -28.5 |
| 5445.0 | V | 54.9 | -50.0 | 0.5 | 10.5 | -40.0 | -13.0 | -27 |
| 5445.0 | Н | 54.8 | -49.5 | 0.5 | 10.8 | -39.2 | -13.0 | -26.2 |

Figure 63 Intermodulation Radiated Results



| 10.4 | Test Instrumentation Used; Radiated Measurements Intermodulation |
|------|--|
|------|--|

| | | | Serial | Calil | Calibration | | |
|--------------------------------|--------------------|--------------------------|---------------|--------------------------|-------------------------|--|--|
| Instrument | Manufacturer | Model | Number | Last Calibration Date | Next Calibration Due | | |
| EMI Receiver | HP | 85422E | 3906A00276 | March 3, 2016 | March 3, 2017 | | |
| RF Filter Section | НР | 85420E | 3705A00248 | March 3, 2016 | March 3, 2017 | | |
| EMI Receiver | R&S | ESCI7 | 100724 | February 29, 2016 | March 1, 2017 | | |
| Spectrum Analyzer | НР | 8593EM | 3536A00120ADI | March 10, 2016 | March 10, 2017 | | |
| Active Loop Antenna | ЕМСО | 6502 | 9506-2950 | November 5, 2015 | November 30, 2016 | | |
| Antenna Biconical | ЕМСО | 3110B | 9912-3337 | March 24, 2016 | March 24, 2018 | | |
| Antenna Log Periodic | ЕМСО | 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 | НР | 8648C | 3623A04126 | February 29, 2016 | March 1, 2017 | | |
| Signal Generator | НР | 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 (CELL)

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

| arlean A | | AC AC | | SENSE:INT | ALIGN OFF | | 02:38:46 PM Sep 15, 20: |
|---|---------------------------------|---------------------------------|---|---------------------------------|---------------------------|-------|--|
| arker 1 | 21.12000 | 00000 MHz | PNO: Fast G | Trig: Free Run #Atten: 20 dB | Avg Type: L Avg Hold>1 | | TRACE 1234 TYPE M DET PNNN |
| dB/div | Ref Offset Ref 38.8 | | | | | L | Mkr1 21.12 MH -19.768 d |
| 9 3.9 | | | | | | | |
| 3.9 | | | | X | | | |
| 86 | | | | 34 | 142 | | |
| .1 | | | | 9 | | | |
| 1 | | | | | | | |
| | | n provingen de trat | han an a | لو | havenonen | | where the second se |
| .t | | | | | | | |
| .t | | | | | | | |
| | 31.0 MHz | | #VP | W 3.0 MHz | | Sweep | Span 240.0 MH 1.000 ms (1001 pt |
| | 1.0 MHz | | | | | | |
| R MODE T | 1.0 MHz | X 24.42 M | Y | FUNCTION | FUNCTION WIDTH | | ICTION VALUE |
| R MODE TH | 1.0 MHz RC SCL f (Δ) | 21.12 M 879.80 M | γ Hz (Δ) -19.7 Hz 15.548 | 68 dB 3 dBm | FUNCTION WIDTH | | ICTION VALUE |
| es BW Δ2 1 F 1 Δ4 1 | 1.0 MHz | 21.12 M | Hz (Δ) -19.7 Hz 15.548 Hz (Δ) -20.2 | 68 dB 3 dBm 36 dB | FUNCTION WIDTH | | ACTION VALUE |
| R MODE TH A2 1 F 1 A4 1 F 1 | 1.0 MHz RC SCL f (Δ) f | 21.12 M 879.80 M -18.24 M | Hz (Δ) -19.7 Hz 15.548 Hz (Δ) -20.2 | 68 dB 3 dBm 36 dB | FUNCTION WIDTH | | ICTION VALUE |
| R MODE TH A2 F A4 F | 1.0 MHz RC SCL f (Δ) f | 21.12 M 879.80 M -18.24 M | Hz (Δ) -19.7 Hz 15.548 Hz (Δ) -20.2 | 68 dB 3 dBm 36 dB | FUNCTION WIDTH | | ICTION VALUE |
| Res BW | 1.0 MHz RC SCL f (Δ) f | 21.12 M 879.80 M -18.24 M | Hz (Δ) -19.7 Hz 15.548 Hz (Δ) -20.2 | 68 dB 3 dBm 36 dB | FUNCTION WIDTH | | ICTION VALUE |

Figure 65. — Out-of-Band Rejection Plot



11.5 Test Equipment Used; Out-of-Band Rejection

| | | | C1 | Calib | ration |
|-----------------------------------|--------------|----------|------------------|--------------------------|--------------------------|
| Instrument | Manufacturer | Model | Serial Number | 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 factor for RF CABLE for Semi Anechoic Chamber

ITL # 1841

| FREQ | LOSS |
|---------|------|
| (MHz) | (dB) |
| 1000.0 | 1.5 |
| 2000.0 | 2.1 |
| 3000.0 | 2.7 |
| 4000.0 | 3.1 |
| 5000.0 | 3.5 |
| 6000.0 | 4.1 |
| 7000.0 | 4.6 |
| 8000.0 | 4.9 |
| 9000.0 | 5.7 |
| 10000.0 | 5.7 |
| 11000.0 | 6.1 |
| 12000.0 | 6.1 |
| 13000.0 | 6.2 |
| 14000.0 | 6.7 |
| 15000.0 | 7.4 |
| 16000.0 | 7.5 |
| 17000.0 | 7.9 |
| 18000.0 | 8.1 |
| 19000.0 | 8.8 |
| 20000.0 | 9.1 |

NOTES:

- 1. The cable is manufactured by Commscope
- 2. The cable type is 0623 WBC-400, serial # G020132 and 10m long



12.4 Correction factors for

Horn Antenna Model: SWH-28 at 1 meter range.

| FREQUENCY | AFE | Gain |
|-----------|---------|-------|
| (GHz) | (dB /m) | (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 |



12.5 Correction factors for

Horn ANTENNA

Model: 3115 Antenna serial number: 29845

<u>3 meter rang</u>e

| 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 5G 32.5 10.5 6G 36.5 9.5 6.5G 36.5 10 7G 37.5 10 7.5G 37.5 10 7.5G 37.5 10 7.5G 37.5 11 8.5G 38 11 9G 37.5 11.5 10G 38.5 12.5 11.6 38.5 12.5 11.5G 38.5 13 12G 38 13.5 12.5G 38.5 < | <u>3 meter rang</u> | | |
|---|---------------------|----------|--------|
| 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 $5G$ 35 10.5 $6G$ 36.5 9.5 $6.5G$ 36.5 10 $7G$ 37.5 10 $7.5G$ 37.5 10 $7.5G$ 37.5 10 $7.5G$ 37.5 11 $8.5G$ 38 11 $9G$ 37.5 11.5 $9.5G$ 38 11.5 $10G$ 38.5 12 $11G$ 38.5 12 $11G$ 38.5 12 $11G$ 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 $15G$ 37.5 16 $16.5G$ 39 15 $17G$ 40 15 $17.5G$ 42 13.5 | f(GHz) | AF(dB/m) | GA(dB) |
| 1.56 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 $5G$ 35 10.5 $6G$ 36.5 9.5 $6.5G$ 36.5 10 $7G$ 37.5 10 $7G$ 37.5 10 $7G$ 37.5 10 $8G$ 37.5 11 $8.5G$ 38 11 $9G$ 37.5 11.5 $9.5G$ 38 11.5 $10G$ 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 $15G$ 37.5 16 $16.5G$ 39 15 17.5 42 13.5 | 0.75 | 25 | 3 |
| 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 $5G$ 35 10.5 $6G$ 36.5 9.5 $6.5G$ 36.5 10 $7G$ 37.5 10 $7G$ 37.5 10 $7G$ 37.5 10 $8G$ 37.5 11 $8.5G$ 38 11 $9G$ 37.5 11.5 $9.5G$ 38 11.5 $10G$ 38.5 12.5 11.6 38.5 12.5 11.6 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 $15G$ 37.5 16 $16G$ 37.5 16 $16.5G$ 39 15 17.6 42 13.5 | 1G | 23.5 | 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 $5G$ 35 10.5 $6G$ 36.5 9.5 $6.5G$ 36.5 10 $7G$ 37.5 10 $7G$ 37.5 10 $7G$ 37.5 10 $7G$ 37.5 10 $8G$ 37.5 11 $8.5G$ 38 11 $9G$ 37.5 11.5 $9.5G$ 38 11.5 $10G$ 38.5 12 $11G$ 38.5 12 $11G$ 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 $15G$ 37.5 16 $16.5G$ 39 15 17.5 42 13.5 | 1.5G | 26 | 8 |
| 3G 30 10 $3.5G$ 31.5 10 $4G$ 32.5 9.5 $4.5G$ 32.5 10.5 $5G$ 33 10.5 $5G$ 35 10.5 $6G$ 36.5 9.5 $6.5G$ 36.5 10 $7G$ 37.5 10 $7G$ 37.5 10 $7G$ 37.5 10 $8G$ 37.5 11 $8.5G$ 38 11 $9G$ 37.5 11.5 $9.5G$ 38 11.5 $10G$ 38.5 12.5 $11G$ 38.5 12.5 11.5 38.5 12.5 $11.5G$ 38.5 13 $12G$ 38.5 13 $12G$ 38.5 13 $13G$ 40 12 $13.5G$ 41 12 $14G$ 40 13 $14.5G$ 39 14 $15G$ 37.5 16 $16.5G$ 37.5 16 $16.5G$ 39 15 17.6 42 13.5 | 2G | 29 | 7 |
| 3.56 31.5 10 46 32.5 9.5 4.56 32.5 10.5 56 33 10.5 5.56 35 10.5 66 36.5 9.5 6.56 36.5 10 76 37.5 10 7.56 37.5 10 7.56 37.5 11 8.56 38 11 96 37.5 11.5 9.56 38 11.5 106 38.5 12.5 11.6 38.5 12.5 11.56 38.5 12 116 38.5 13 126 38.5 13 126 38.5 13 136 40 12 13.56 41 12 146 40 13 14.56 39 14 156 37.5 16 16.56 39 15 17.6 42 13.5 | 2.5G | 27.5 | 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 $7G$ 37.5 10 $7G$ 37.5 10 $8G$ 37.5 11 $8.5G$ 38 11 $9G$ 37.5 11.5 $9.5G$ 38 11.5 $10G$ 38.5 12.5 11.6 38.5 12.5 $11.5G$ 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 $15G$ 37.5 16 $16.5G$ 37.5 16 $16.5G$ 39 15 17.6 42 13.5 | 3G | 30 | 10 |
| 4.56 32.5 10.5 56 33 10.5 5.56 35 10.5 66 36.5 9.5 6.56 36.5 10 76 37.5 10 7.56 37.5 10 86 37.5 11 8.56 38 11 96 37.5 11.5 9.56 38 11.5 106 38.5 11.5 106 38.5 12.5 116 38.5 12.5 11.56 38.5 13 126 38.5 13 126 38.5 13 126 38.5 13 136 40 12 13.56 41 12 146 40 13 14.56 39 14 156 37.5 16 166 37.5 16 166 37.5 16 165 39 15 176 40 15 17.56 42 13.5 | 3.5G | 31.5 | 10 |
| 5G 33 10.5 $5.5G$ 35 10.5 $6G$ 36.5 9.5 $6.5G$ 36.5 10 $7G$ 37.5 10 $7G$ 37.5 10 $7G$ 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 $10G$ 38.5 12.5 11.6 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 $15G$ 37.5 16 $16.5G$ 39 15 $17G$ 40 15 $17.5G$ 42 13.5 | 4G | 32.5 | 9.5 |
| 5.5G 35 10.5 $6G$ 36.5 9.5 $6.5G$ 36.5 10 $7G$ 37.5 10 $7G$ 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 $10G$ 38.5 12 $11G$ 38.5 12.5 $11.5G$ 38.5 12 $11G$ 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 $15G$ 37.5 16 $16G$ 37.5 16 $16.5G$ 39 15 $17G$ 40 15 $17.5G$ 42 13.5 | 4.5G | 32.5 | 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 $10G$ 38.5 12.5 116 38.5 12.5 $11.5G$ 38.5 13 $12G$ 38 13.5 $12.5G$ 38.5 13 $12G$ 38.5 13 $13G$ 40 12 $13.5G$ 41 12 $14G$ 40 13 $14.5G$ 39 14 $15G$ 37.5 16 $16G$ 37.5 16 $16.5G$ 39 15 $17G$ 40 15 $17.5G$ 42 13.5 | 5G | 33 | 10.5 |
| 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 $10G$ 38.5 12 $11G$ 38.5 12.5 $11.5G$ 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 $15G$ 37.5 16 $16G$ 37.5 16 $16.5G$ 39 15 $17G$ 40 15 $17.5G$ 42 13.5 | 5.5G | 35 | 10.5 |
| 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 $10G$ 38.5 11.5 $10G$ 38.5 12 $11G$ 38.5 12.5 $11.5G$ 38.5 13 $12G$ 38 13.5 $12.5G$ 38.5 13 $12G$ 38.5 13 $13G$ 40 12 $13.5G$ 41 12 $14G$ 40 13 $14.5G$ 39 14 $15G$ 37.5 16 $16G$ 37.5 16 $16.5G$ 39 15 $17G$ 40 15 $17.5G$ 42 13.5 | 6G | 36.5 | 9.5 |
| 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 $10G$ 38.5 12 $11G$ 38.5 12 $11G$ 38.5 12 $11G$ 38.5 13 $12G$ 38 13.5 $12.5G$ 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 $15G$ 37.5 16 $16G$ 37.5 16 $16.5G$ 39 15 $17G$ 40 15 $17.5G$ 42 13.5 | 6.5G | 36.5 | 10 |
| 8G 37.5 11 $8.5G$ 38 11 $9G$ 37.5 11.5 $9.5G$ 38 11.5 $10G$ 38.5 11.5 $10G$ 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 $12G$ 38.5 13 $13G$ 40 12 $13.5G$ 41 12 $14G$ 40 13 $14.5G$ 39 14 $15G$ 37.5 16 $16G$ 37.5 16 $16.5G$ 39 15 $17G$ 40 15 $17.5G$ 42 13.5 | 7G | 37.5 | 10 |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 7.5G | 37.5 | 10 |
| 9G 37.5 11.5 9.5G38 11.5 10G 38.5 11.5 10.5G 38.5 12 11G 38.5 12 11G 38.5 12.5 11.5G 38.5 13 12G 38 13.5 12.5G 38.5 13 13G40 12 13.5G41 12 14G40 13 14.5G 39 14 15G 37.5 16 16G 37.5 16 16.5G 39 15 17G 40 15 17.5G 42 13.5 | 8G | 37.5 | 11 |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 8.5G | 38 | 11 |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 9G | 37.5 | 11.5 |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 9.5G | 38 | 11.5 |
| $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 10G | 38.5 | 11.5 |
| 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 37.5 16 16G 37.5 16 16.5G 39 15 17G 40 15 17.5G 42 13.5 | 10.5G | 38.5 | 12 |
| 12G 38 13.5 12.5G 38.5 13 13G 40 12 13.5G 41 12 14G 40 13 14.5G 39 14 15G 38.5 16 16G 37.5 16 16.5G 39 15 17G 40 15 17.5G 42 13.5 | 11G | 38.5 | 12.5 |
| 12.5G 38.5 13 13G 40 12 13.5G 41 12 14G 40 13 14G 40 13 145G 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 | 11.5G | 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 | 12G | 38 | 13.5 |
| 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 | 12.5G | 38.5 | 13 |
| 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 | 13G | 40 | 12 |
| 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 | 13.5G | 41 | 12 |
| 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 | 14G | 40 | 13 |
| 15.5G 37.5 16 16G 37.5 16 16.5G 39 15 17G 40 15 17.5G 42 13.5 | 14.5G | 39 | 14 |
| 16G 37.5 16 16.5G 39 15 17G 40 15 17.5G 42 13.5 | 15G | 38 | 15.5 |
| 16.5G 39 15 17G 40 15 17.5G 42 13.5 | 15.5G | 37.5 | 16 |
| 17G 40 15 17.5G 42 13.5 | 16G | 37.5 | 16 |
| 17.5G 42 13.5 | 16.5G | 39 | 15 |
| | 17G | 40 | 15 |
| 18G 42.5 13 | 17.5G | 42 | 13.5 |
| | 18G | 42.5 | 13 |



12.6 Correction factors for

Log Periodic Antenna EMCO, Model 3146, Serial #9505-4081

| | AF |
|-----------------|--------|
| Frequency [MHz] | [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 |



12.7 Correction factors for

Biconical Antenna EMCO, Model 3110B, Serial #9912-3337

| | AF |
|-----------------|--------|
| Frequency [MHz] | [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 |



12.8 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 |