



### 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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### 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 (ONE<sup>TM</sup>) 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 Play<sup>TM</sup> connectors, significantly reduce installation cost and deployment time.

The ONE<sup>TM</sup> 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):  $\pm 3.44$  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)

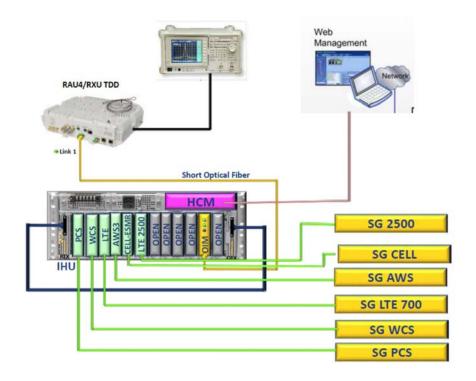


Figure 1. Test Set-Up – Conducted



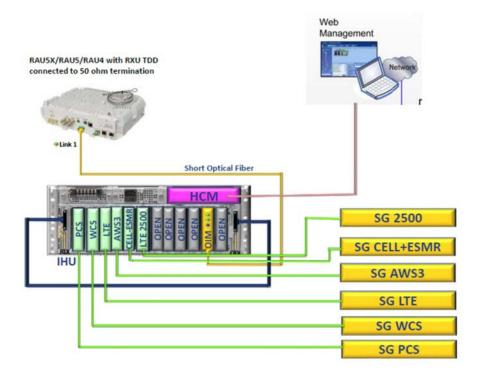


Figure 2. Test Set-Up - Radiated



### 3. Test Set-Up Photos

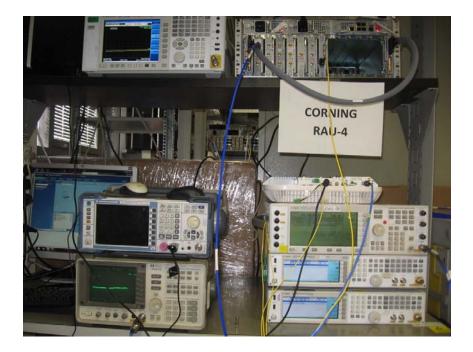


Figure 3. Conducted Emission from Antenna Ports Test



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



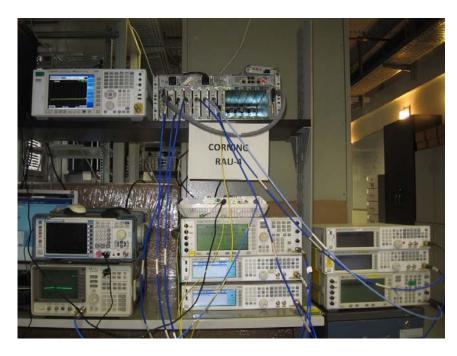


Figure 9. Intermodulation Conducted Test



### 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

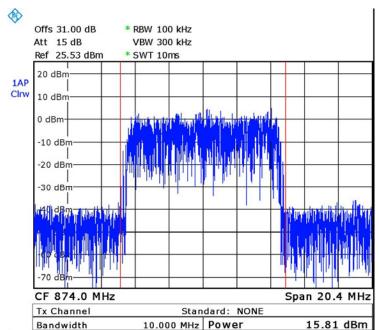
#### Figure 10 Peak Output Power CELL

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

JUDGEMENT:

Passed by 27.8 dB





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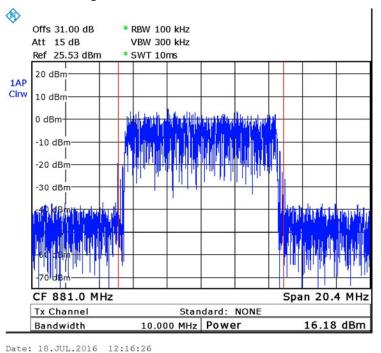
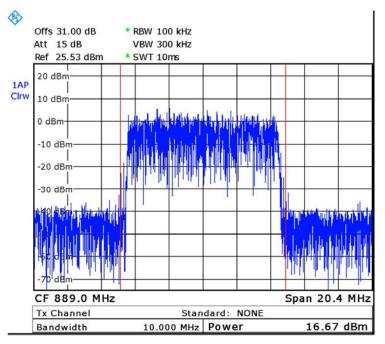


Figure 11. — LTE 64QAM - 874.0 MHz

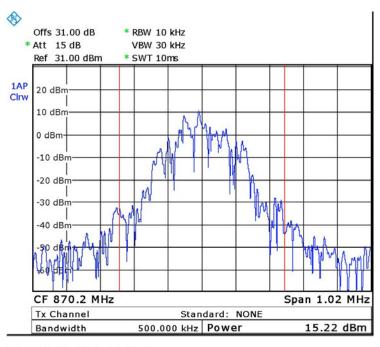
Figure 12. — LTE 64QAM - 881.0 MHz





Date: 18.JUL.2016 12:17:25

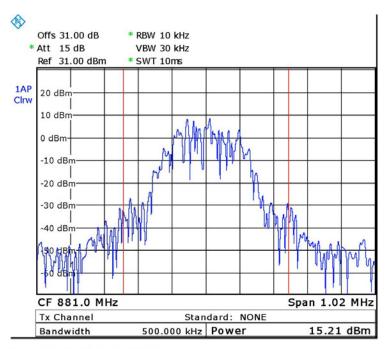
Figure 13. — LTE 64QAM - 889.0 MHz



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

Figure 14. — GSM - 870.2 MHz





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

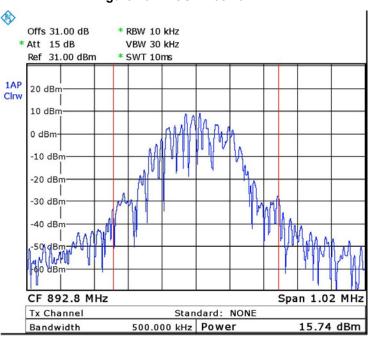


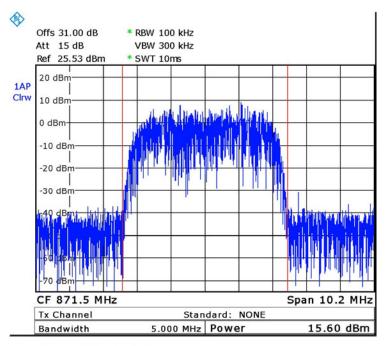
Figure 15. — GSM - 881.0 MHz

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

Figure 16. — GSM - 892.8 MHz



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

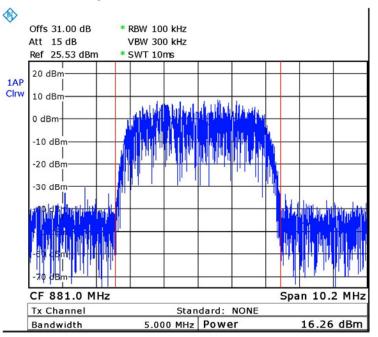
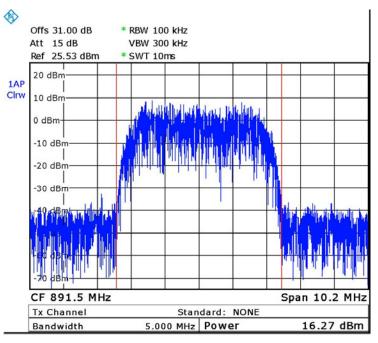


Figure 17. — W-CDMA - 871.5 MHz

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	

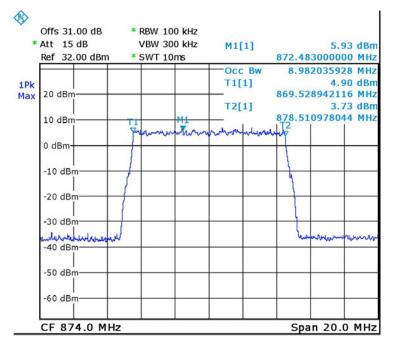
#### Figure 21 Occupied Bandwidth CELL

JUDGEMENT:

Passed

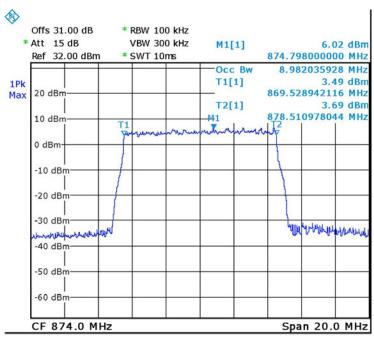
See additional information in Figure 22 to Figure 39.





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

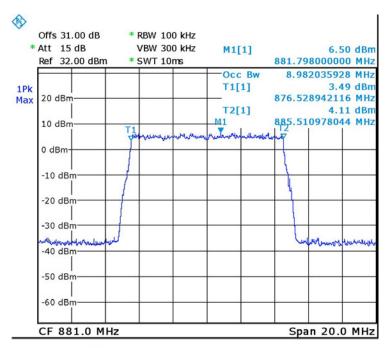




Date: 18.JUL.2016 14:05:56

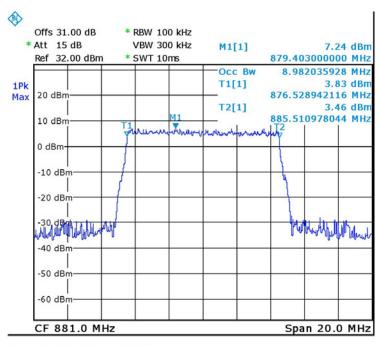






Date: 18.JUL.2016 14:15:11

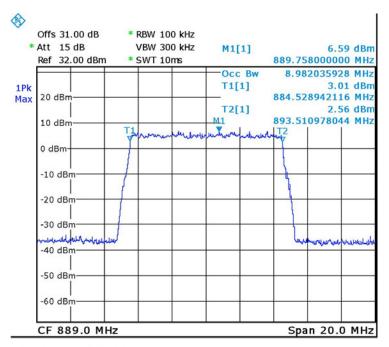




Date: 18.JUL.2016 14:06:29

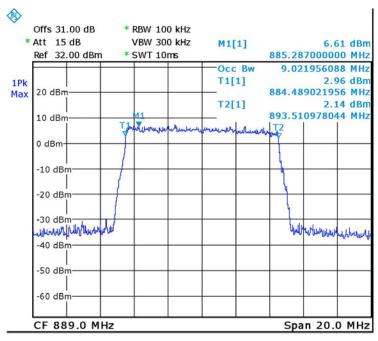
Figure 25. — LTE 64QAM Output 881.0MHz





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

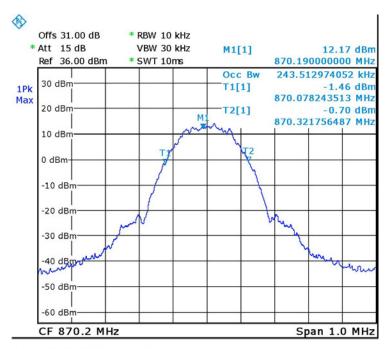
Figure 26. — LTE 64QAM Input 889.00 MHz



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

Figure 27. — LTE 64QAM Output 889.0 MHz



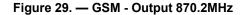


Date: 18.JUL.2016 14:32:51

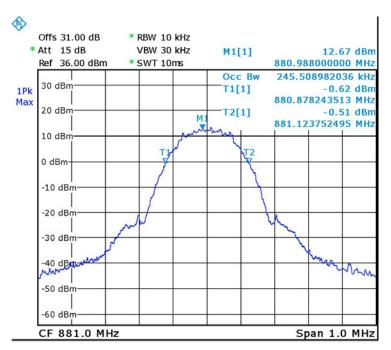
\* RBW 10 kHz Offs 31.00 dB \* Att 20 dB VBW 30 kHz M1[1] 13.57 dBm Ref 41.00 dBm \* SWT 10ms 870.157200000 MHz Occ Bw 244.311377246 kHz -0.47 dBm T1[1] 1AP 30 dBm 870.079880240 MHz Max T2[1] -0.38 dBm 20 dBm 870.324191617 MHz Μ1 M 10 dBm T: 0 dBm -10 dBm -20 dBm h -30 dBm n 40udDe -50 dBm CF 870.2 MHz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

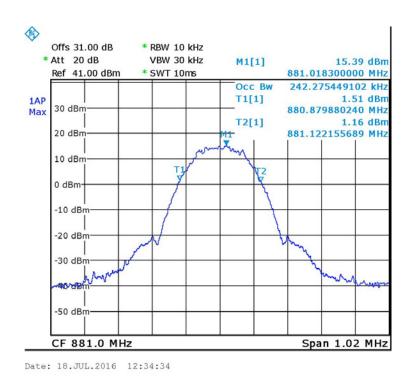
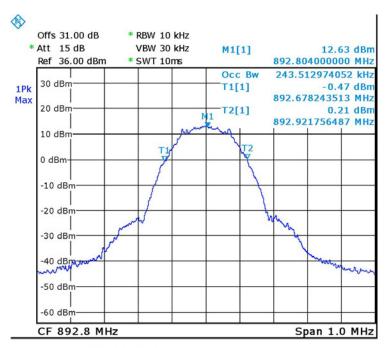


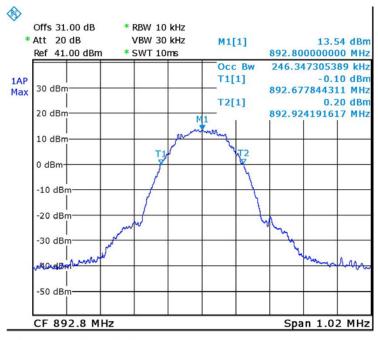
Figure 31. — GSM - Output 881.0MHz





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

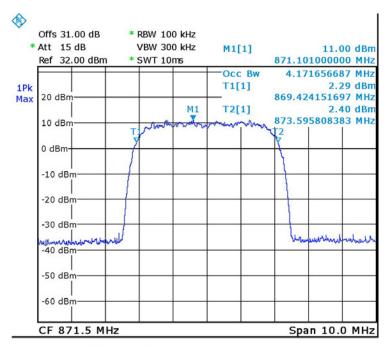
Figure 32. — GSM - Input 892.8 MHz



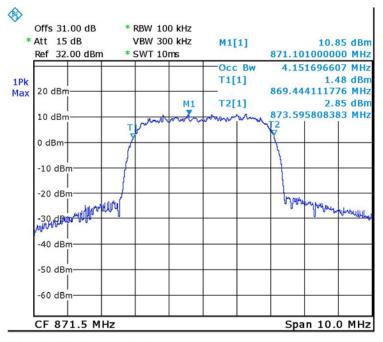
Date: 18.JUL.2016 12:35:16

Figure 33. — GSM - Output 892.8 MHz





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



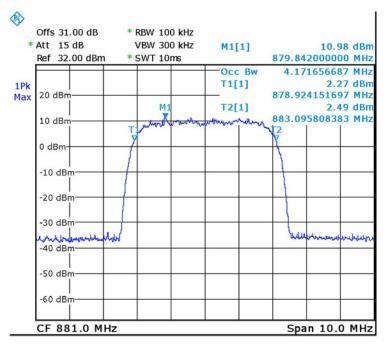
#### Figure 34. — W-CDMA - Input 871.5MHz

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

Figure 35. — W-CDMA - Output 871.5MHz

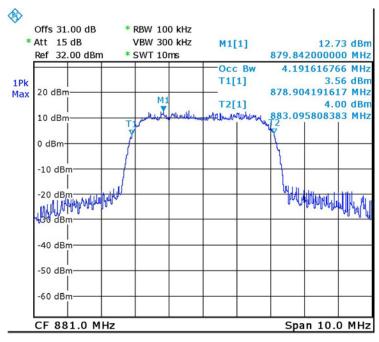


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Date: 18.JUL.2016 14:12:25

Figure 36. — W-CDMA - Input 881.0 MHz

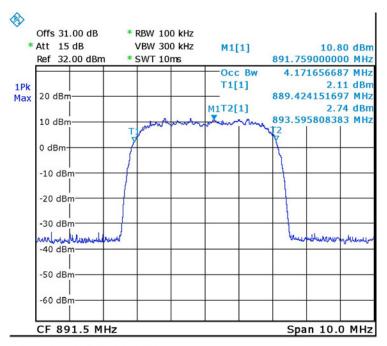


Date: 18.JUL.2016 14:08:51

Figure 37. — W-CDMA - Output 881.0MHz

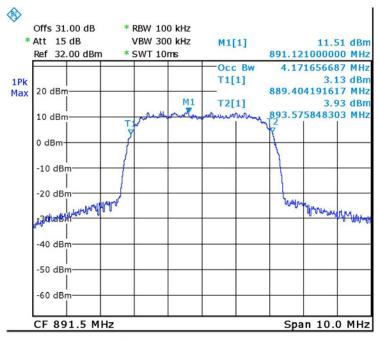


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Date: 18.JUL.2016 14:13:10

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.

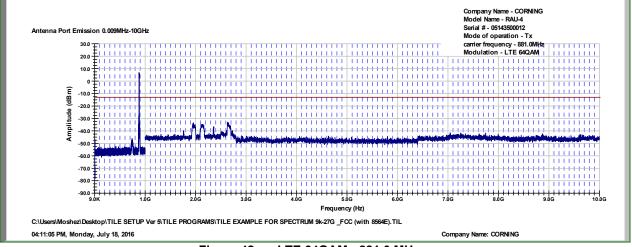
#### 6.4 Test Results

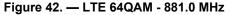
JUDGEMENT: Passed

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 <sup>30.0</sup>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







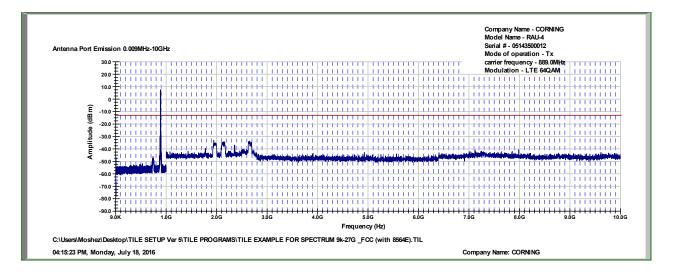
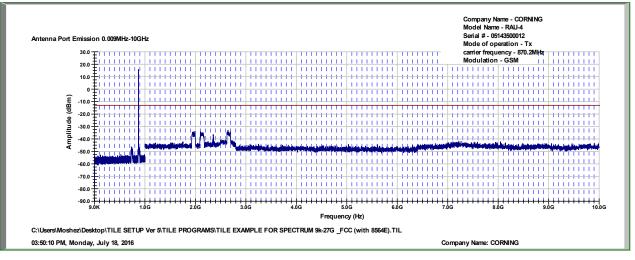


Figure 43. - LTE 64QAM - 889.0 MHz







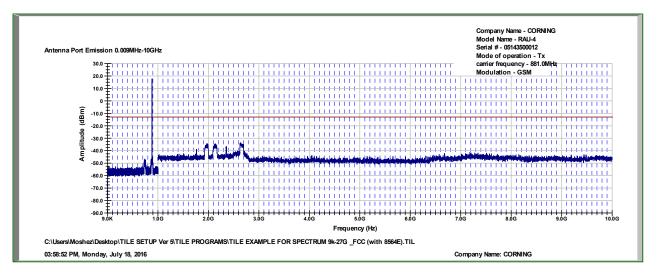
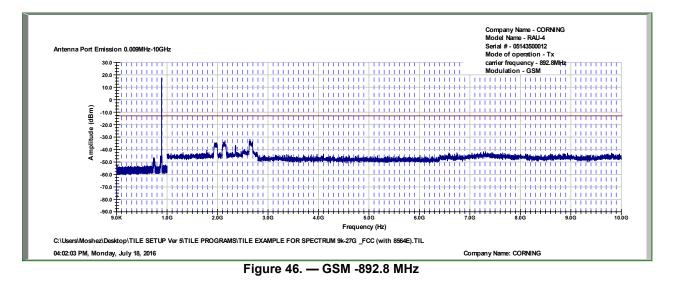
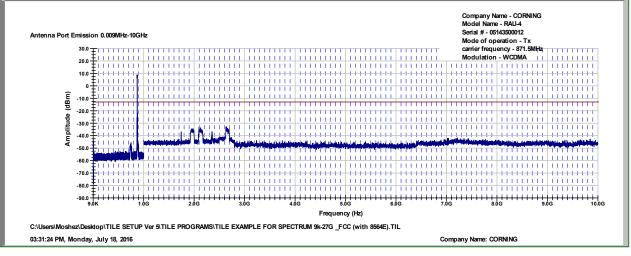


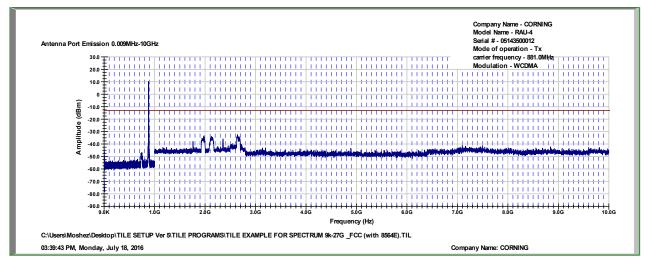
Figure 45. — GSM - 881.0 MHz













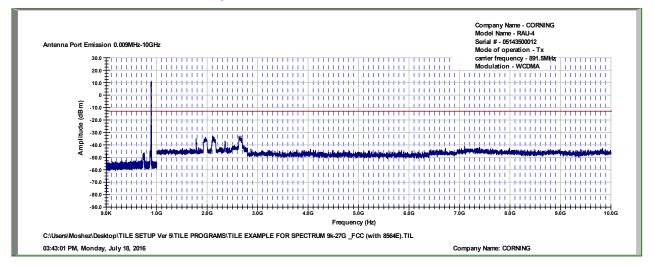


Figure 49. — W-CDMA - 891.5 MHz



## 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

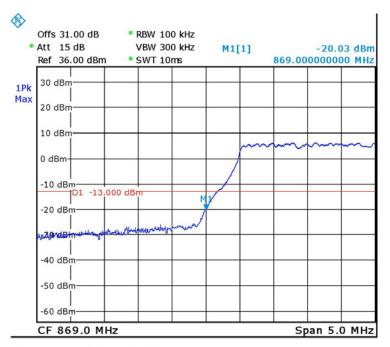
#### 7.4 Test Results

#### 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

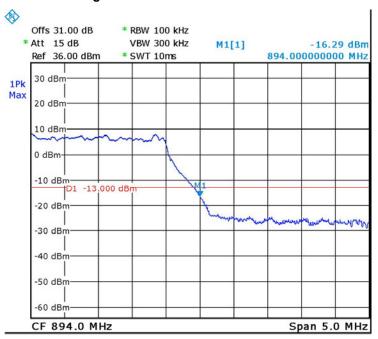


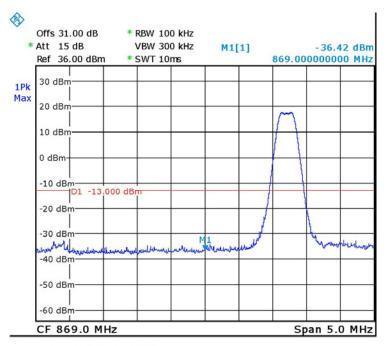
Figure 52. — LTE 64QAM 874.0 MHz

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

Figure 53. — LTE 64QAM 889.0 MHz

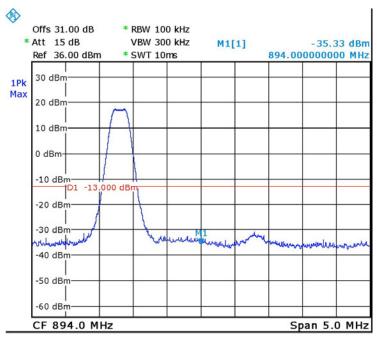


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Date: 18.JUL.2016 14:38:58

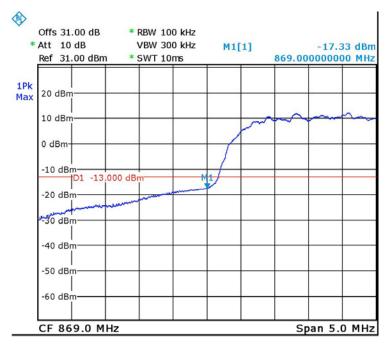
Figure 54. — GSM - 870.2 MHz



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

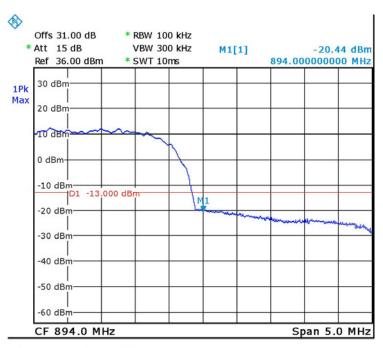
Figure 55. — GSM - 892.8 MHz





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

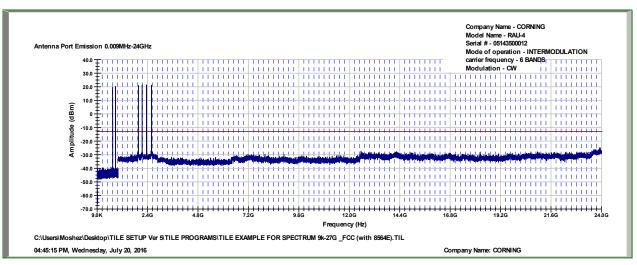
The frequency range of 9 kHz – 24.0 GHz was scanned for unwanted signals.

## 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  $\Omega$  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 (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
<b>9</b> 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