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DATE: 07 September 2016

I.T.L. (PRODUCT TESTING) LTD.

FCC Radio Test Report

for

Corning Optical Communication Wireless

Equipment under test:

ONE- Optical Network Evolution Wireless Platform

MRU (Mid Power Remote Unit)

(PCS Section)

Tested: _____
M. Zohar

Approved by: _____
D. Shidlowsky

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TESTING Cert No.1152.01

Measurement/Technical Report for
Corning Optical Communication Wireless
ONE- Optical Network Evolution Wireless Platform
(PCS SECTION)

FCC ID: OJF1MRU19CR

This report concerns:	Original Grant: X Class II change: Class I change:
Equipment type:	B21 – Part 20 Industrial Booster (CMRS)
Limits used:	47CFR Parts 2, 24

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:

R. Pinchuck
ITL (Product Testing) Ltd.
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Lod 7120101
Israel
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Applicant for this device:
(different from "prepared by")

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Corning Optical Communication Wireless
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Herndon, VA. 20171
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1. General Information

1.1 Administrative Information

Manufacturer:	Corning Optical Communication Wireless
Manufacturer's Address:	13221 Woodland Park Rd., Suite #400 Herndon, VA. 20171 U.S.A. Tel: +1-541-758-2880 Fax: +1-703-848-0260
Manufacturer's Representative:	Habib Riazi
Equipment Under Test (E.U.T):	ONE- Optical Network Evolution Wireless Platform
Equipment Model No.:	MRU (Mid Power Remote Unit)
Equipment Serial No.:	051549901D3
Date of Receipt of E.U.T:	July 3, 2016
Start of Test:	July 3, 2016, September 6, 2016*
End of Test:	August 4, 2016, September 6, 2016*
Test Laboratory Location:	I.T.L (Product Testing) Ltd. 1 Batsheva St, Lod, Israel 7116002
Test Specifications:	FCC Parts 2, 24

*Out of Band Rejection test performed on September 6, 2016

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.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-3006, R-2729, T-1877, G-245.
5. Industry Canada (Canada), IC File No.: 46405-4025; Site No. IC 4025A-1, IC 4025A-2.

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

1.3 Product Description

Modular 7 band Enabled Mid Power Neutral Host Solution –

Supported modular frequency bands

700, ESMR+CELL, PCS, AWS, WCS

Integrated 2.5 GHz expansion ready

Composite Output Power

AWS: 34dBm
PCS, WCS: 33dBm
700, ESMR & CELL: 30dBm

Specifications

100% Modularity

NEBS Class 2 Compliant

Small Footprint – 6 Rack Units

Highlights:

Extended ONE platform design Diversity

100% modular component design

Composite output power: 2W

Small Compact Form Factor (6U)

Non-Service Impacting Upgrades

Lower initial deployment costs

1.4 Test Methodology

Both conducted and radiated testing were performed according to the procedures in KDB 971168 D03 v01, KDB 935210 D05 v01r01 and ANSI/TIA-603-D: 2010. Radiated testing was performed at an antenna to EUT distance of 3 meters.

1.5 Test Facility

Both conducted and radiated emissions tests were performed at I.T.L.'s testing facility in Lod, Israel. I.T.L.'s EMC Laboratory is accredited by A2LA, certificate No. 1152.01 and its FCC Designation Number is IL1005.

1.6 Measurement Uncertainty

Conducted Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4)
0.15 – 30 MHz:
Expanded Uncertainty (95% Confidence, K=2):

± 3.44 dB

Radiated Emission (CISPR 11, EN 55011, CISPR 22, EN 55022, ANSI C63.4) for open site 30-1000MHz:
Expanded Uncertainty (95% Confidence, K=2):

± 4.98 dB

2. System Test Configuration

2.1 Justification

The test setup was configured to closely resemble the standard installation.
The EUT consists of the MRU (Mid-Power Remote Module) which is connected with the head-end ONE equipment using fiber optic cable.
The RF source signals are represented in the setup by appropriate signal generators.
An "Exercise" SW on the computer was used to enable / disable transmission of the EUT, while the EUT output was connected to the spectrum analyzer.
The system was tested under maximum gain conditions while input power level to the RIM is 0 dBm and output antenna port of MRU is 33dBm for PCS and WCS, 34dBm for AWS and 30dBm for low frequency bands. Testing was performed on the following configurations:

Frequency Range (MHz)		
Service/Band	**Downlink (DL)**	**Technology**
700 MHz	728-757	LTE
ESMR 800	862- 869	WCDMA, LTE, GSM
CELL 850	869-894	WCDMA, LTE, GSM
PCS + G 1900	1930-1995	WCDMA, LTE, GSM
AWS 2100	2110-2155	WCDMA, LTE, GSM
WCS	2350-2360	WCDMA, LTE, GSM

2.2 EUT Exercise Software

The Element Management System ver. 2.0 used for commands delivery. These commands are used to enable/disable the EUT transmission. EUT Embedded SW versions is mru_da64_20_02.bin.

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	MRU (Mid Power Remote Unit)
Working voltage	115.0VAC/48.0VDC
Mode of operation	Industrial Booster for PCS band
Modulations	WCDMA, LTE(64QAM), GSM
Assigned Frequency Range	1930.0MHz-1995.0MHz
Transmit power	~33.0 dBm
Antenna Gain	12.5 dBi
DATA rate	N/A
Modulation BW	0.5MHz(GSM), 10MHz(LTE), 5MHz(WCDMA)

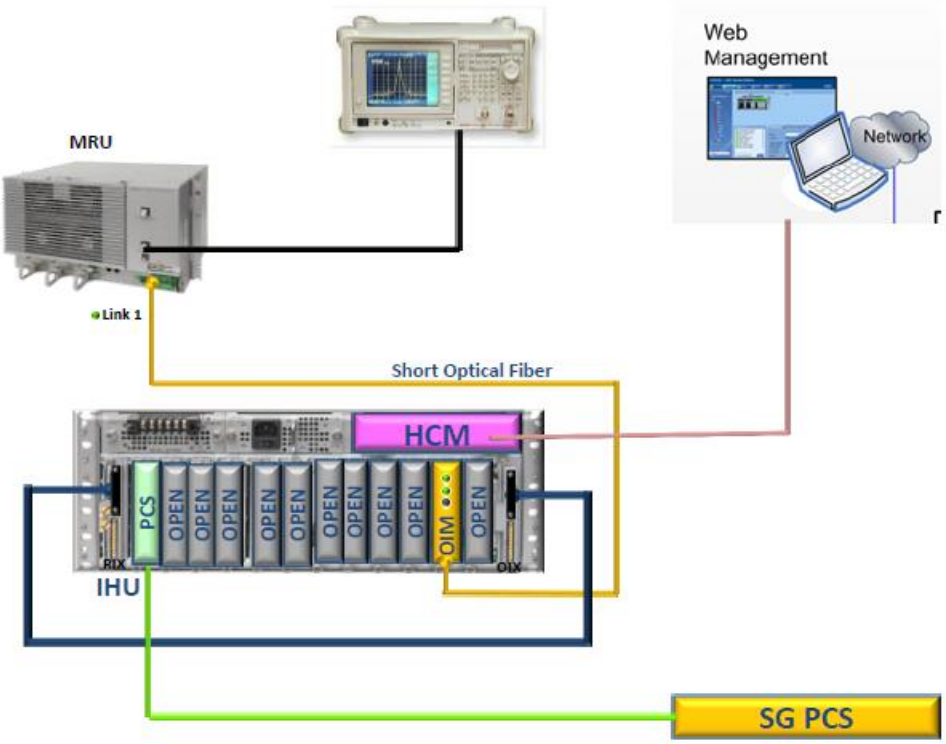

Figure 1. Test Set-Up Conducted

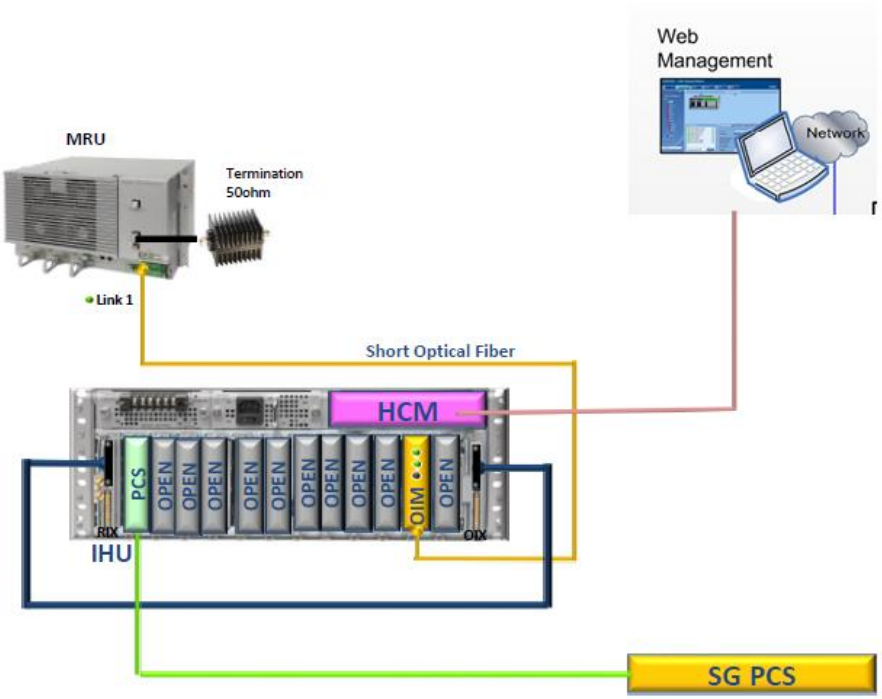

Figure 2. Test Set-Up Radiated

3. Test Set-up Photos

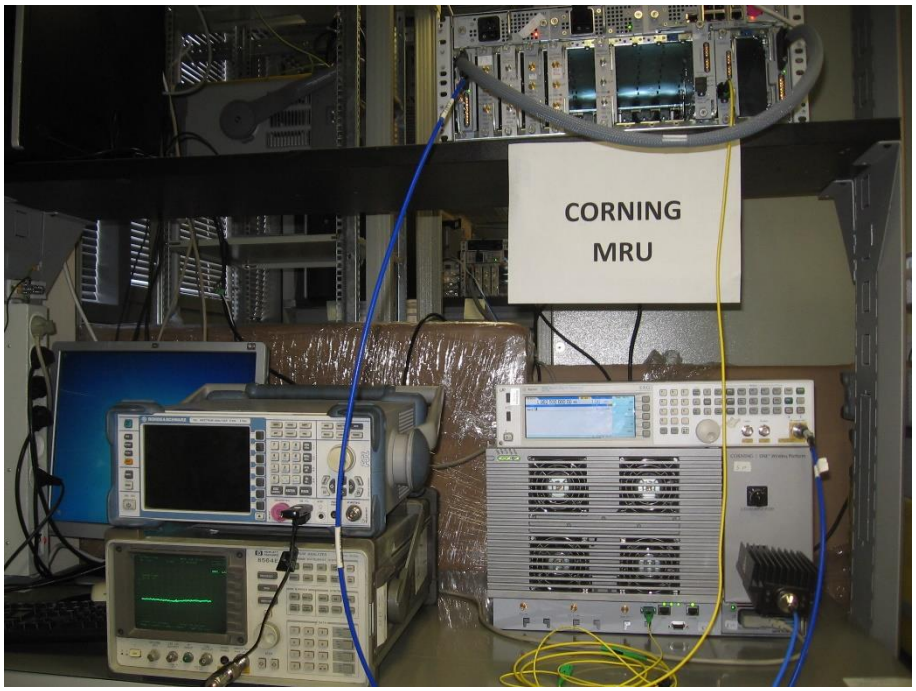

Figure 3. Conducted Emission From Antenna Port Tests

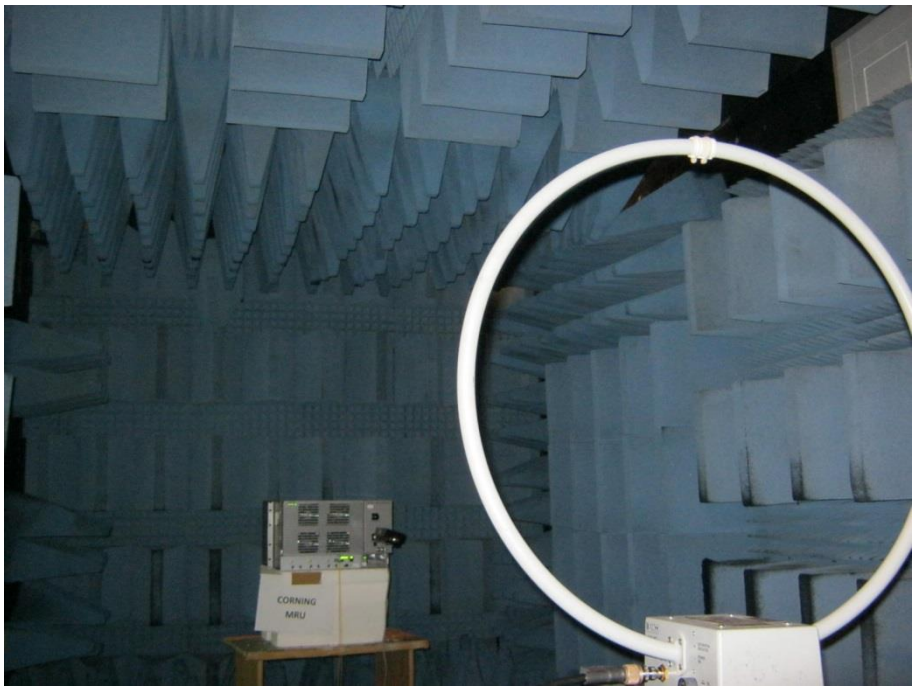

Figure 4. Radiated Emission Test

Figure 5. Radiated Emission Test

Figure 6. Radiated Emission Test

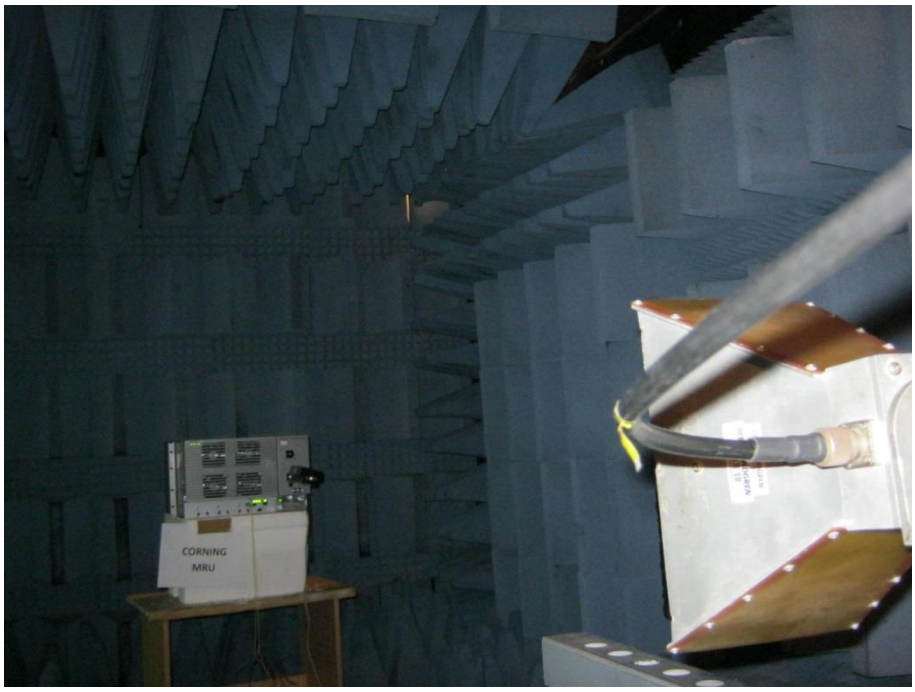

Figure 7. Radiated Emission Test

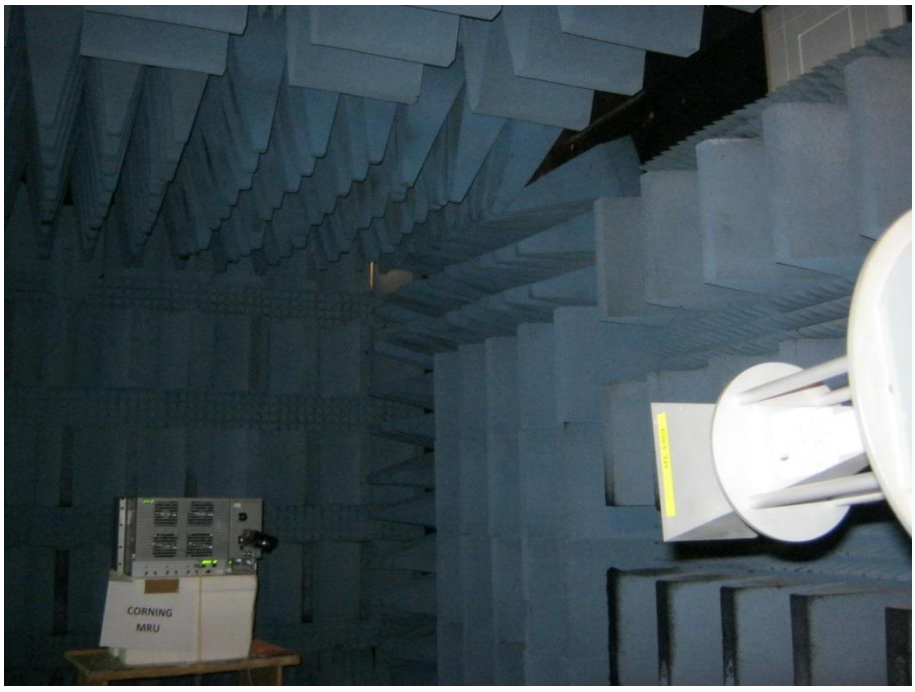

Figure 8. Radiated Emission Test

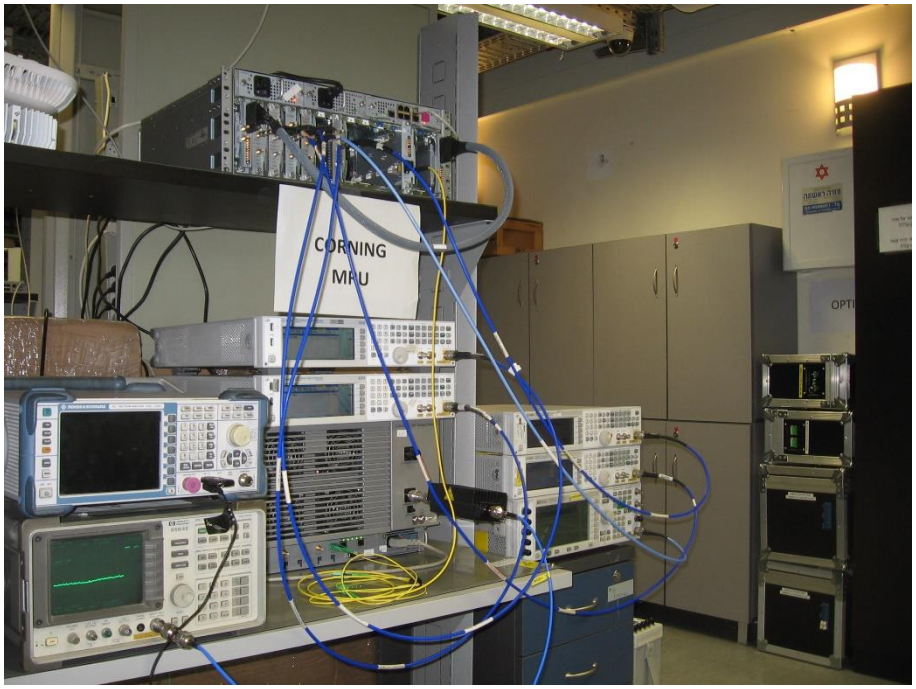

Figure 9. Intermodulation Conducted Emission Test

4. Peak Output Power PCS

4.1 Test Specification

FCC Part 24, Subpart E

4.2 Test Procedure

(Temperature (22°C)/ Humidity (39%RH))

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator and an appropriate coaxial cable (loss = 41.3 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 100 Watts (50dBm).

4.4 Test Results

Modulation	Operation Frequency	Reading	Antenna Gain	EIRP	Limit	Margin
	(MHz)	(dBm)	(dBi)	(dBm)	(dBm)	(dB)
LTE 64QAM	1935.0	33.3	12.5	45.8	50.0	-4.2
	1962.5	33.9	12.5	46.4	50.0	-3.6
	1990.0	33.7	12.5	46.2	50.0	-3.8
GSM	1931.2	33.1	12.5	45.6	50.0	-4.4
	1960.0	33.6	12.5	46.1	50.0	-3.9
	1993.8	34.3	12.5	46.8	50.0	-3.2
W-CDMA	1932.5	33.1	12.5	45.6	50.0	-4.4
	1960.0	34.3	12.5	46.8	50.0	-3.2
	1992.5	34.1	12.5	46.6	50.0	-3.4

Figure 10 Peak Output Power PCS

JUDGEMENT: Passed by 3.2 dB

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

Peak Output Power (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

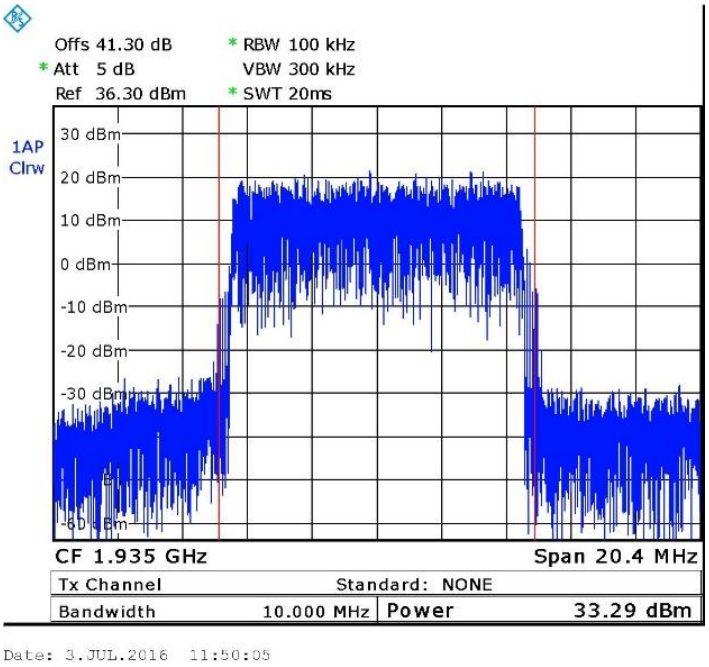

Figure 11. — LTE 64QAM 1935.00 MHz

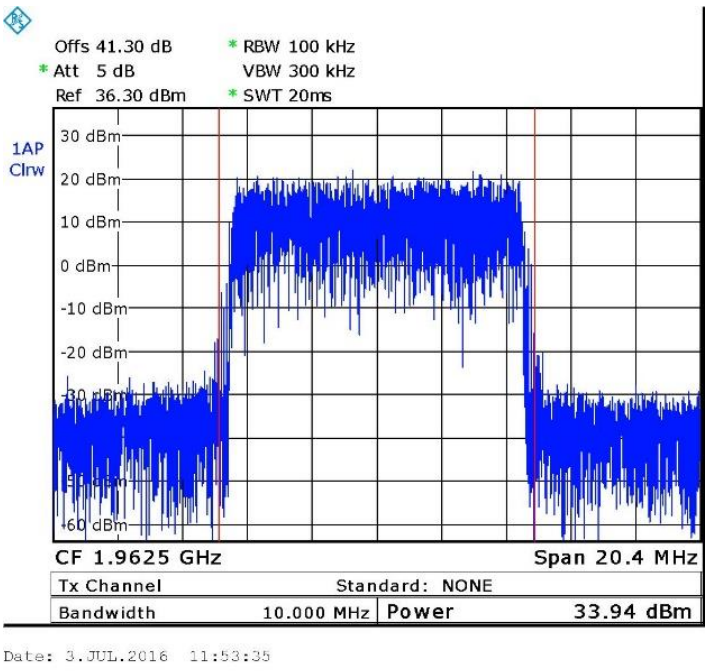

Figure 12. — LTE 64QAM 1962.50 MHz

Peak Output Power (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

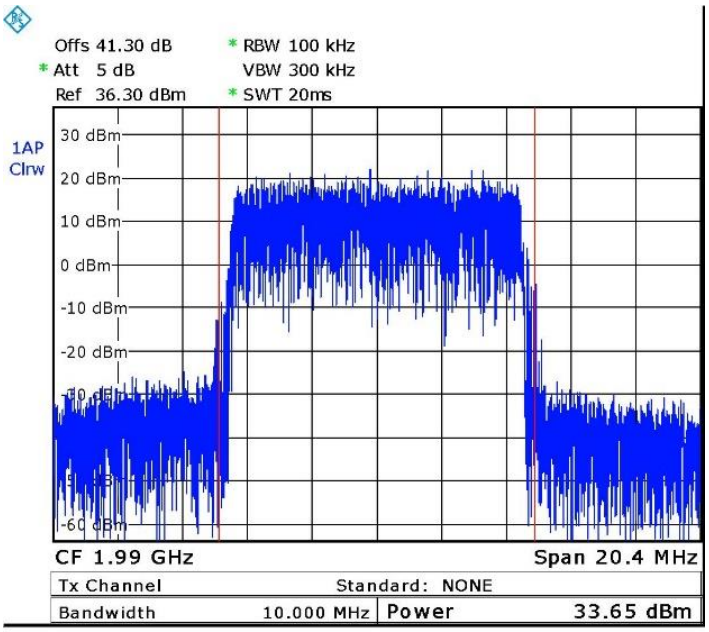

Figure 13. — LTE 64QAM 1990.00 MHz

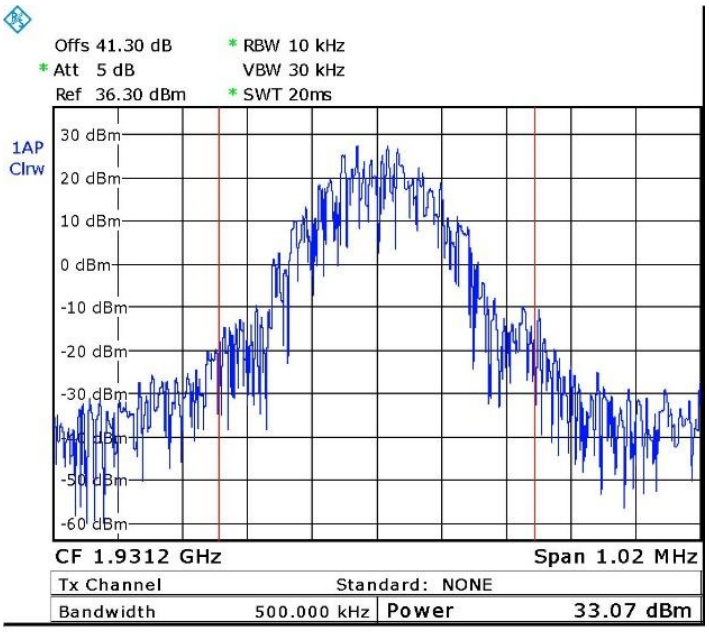

Figure 14. — GSM - 1931.20 MHz

Peak Output Power (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

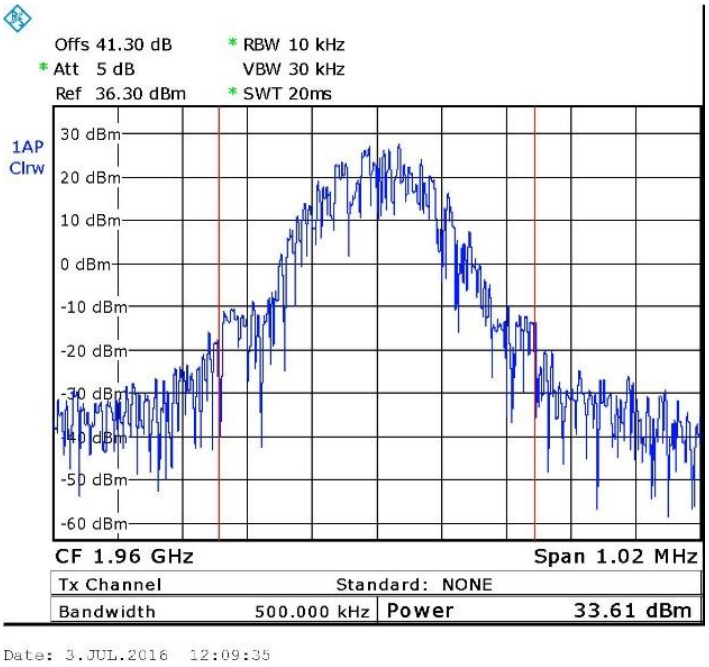

Figure 15. — GSM -1960.00 MHz

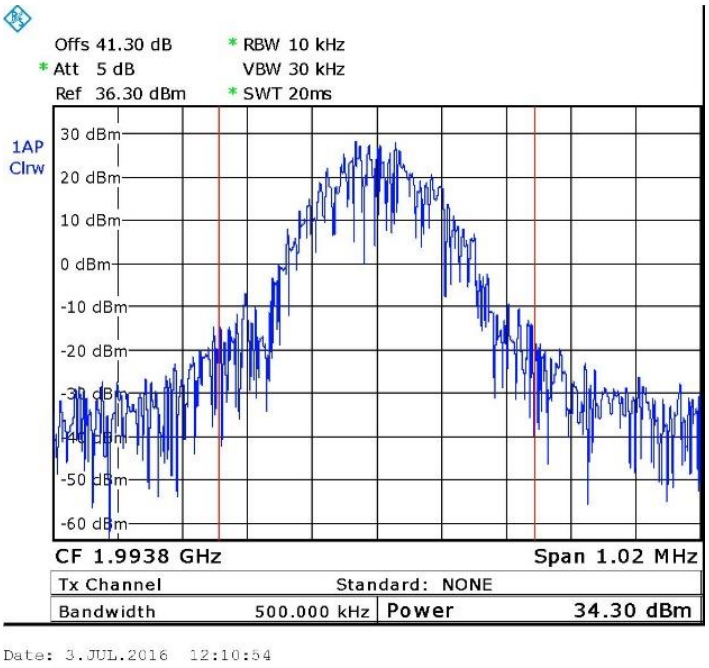

Figure 16. — GSM -1993.80 MHz

Peak Output Power (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

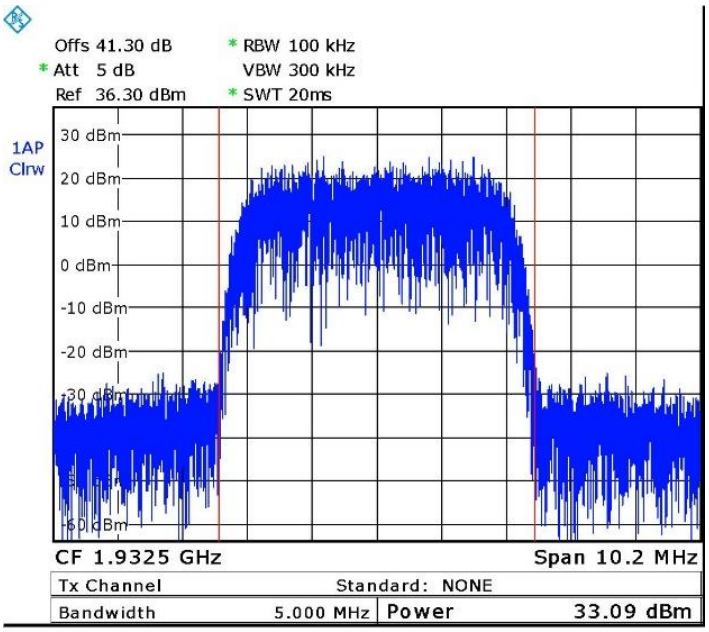

Figure 17. — W-CDMA - 1932.50 MHz

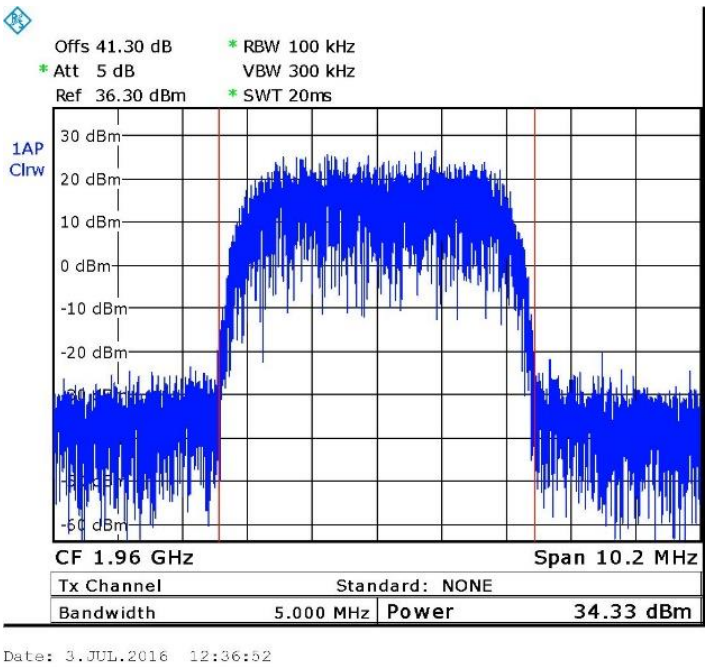

Figure 18. — W-CDMA - 1960.00 MHz

Peak Output Power (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

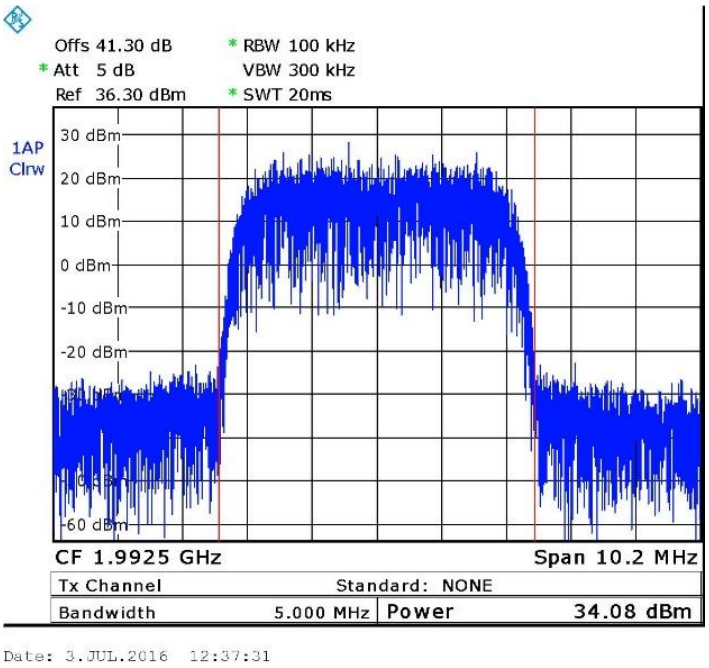

Figure 19. — W-CDMA - 1992.50 MHz

4.5 Test Equipment Used; Peak Output Power PCS

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Date
Spectrum Analyzer	R&S	FSL6	100194	February 29, 2016	March 1, 2017
EXG Vector Signal Generator	Agilent	N5172B	MY51350584	July 1, 2016	July 1, 2017
40 dB Attenuator	Weinschel	WA 39-40-33	A1323	April 3, 2016	April 3, 2017

Figure 20 Test Equipment Used

5. Occupied Bandwidth (PCS)

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=41.3 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 Test Limit

N/A

5.4 Test Results

Modulation	Port	Operating Frequency	Reading
	(Input/ Output)	(MHz)	(MHz)
LTE 64QAM	Input	1935.0	9.0
	Output	1935.0	9.0
	Input	1962.5	9.0
	Output	1962.5	9.0
	Input	1990.0	9.0
	Output	1990.0	9.0
GSM	Input	1931.2	0.2
	Output	1931.2	0.2
	Input	1960.0	0.2
	Output	1960.0	0.2
	Input	1993.8	0.2
	Output	1993.8	0.2
W-CDMA	Input	1932.5	4.2
	Output	1932.5	4.2
	Input	1960.0	4.2
	Output	1960.0	4.2
	Input	1992.5	4.2
	Output	1992.5	4.2

Figure 21 Occupied Bandwidth PCS

JUDGEMENT: Passed

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

Occupied Bandwidth (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

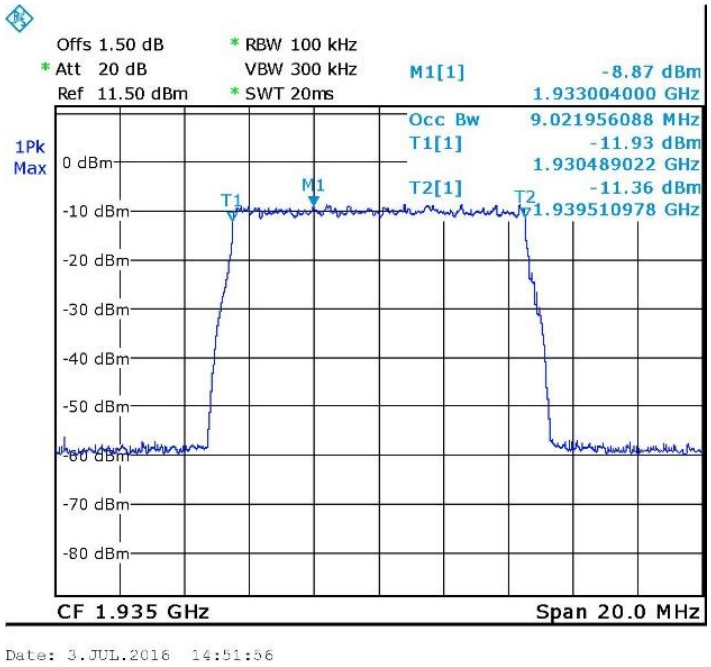

Figure 22. — LTE 64QAM Input 1935.0 MHz

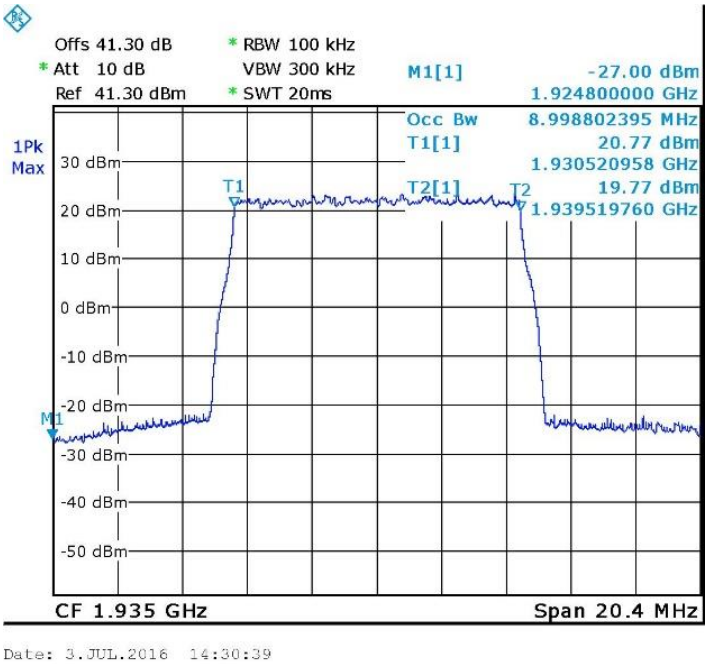

Figure 23. — LTE 64QAM Output 1935.0 MHz

Occupied Bandwidth (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

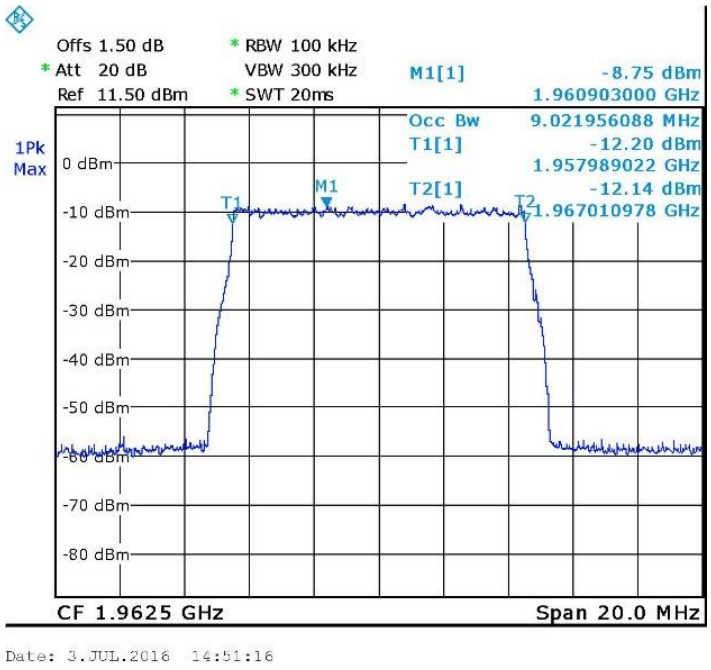

Figure 24. — LTE 64QAM Input 1962.5 MHz

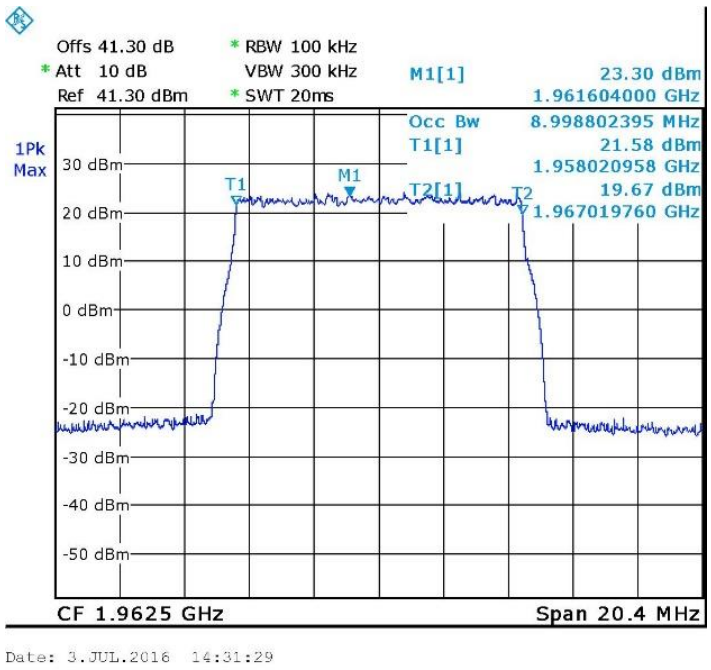

Figure 25. — LTE 64QAM Output 1962.5 MHz

Occupied Bandwidth (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

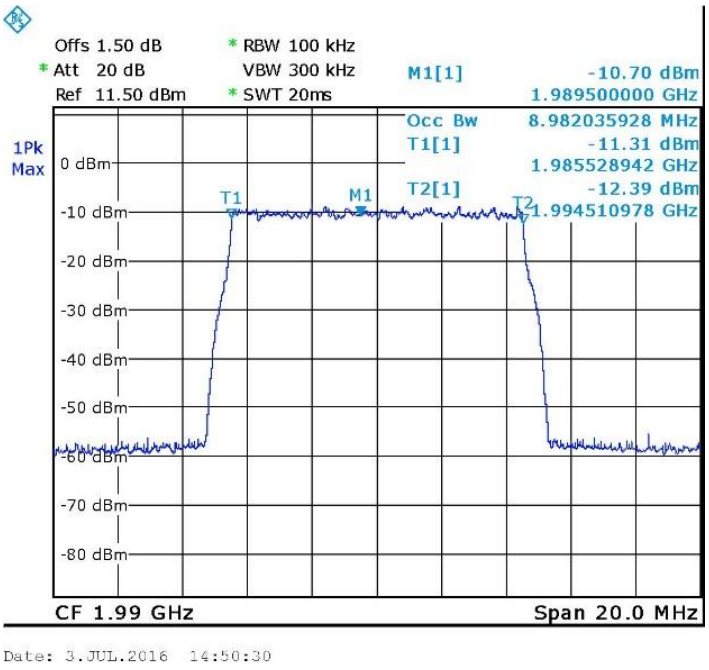

Figure 26. — LTE 64QAM Input 1990.0 MHz

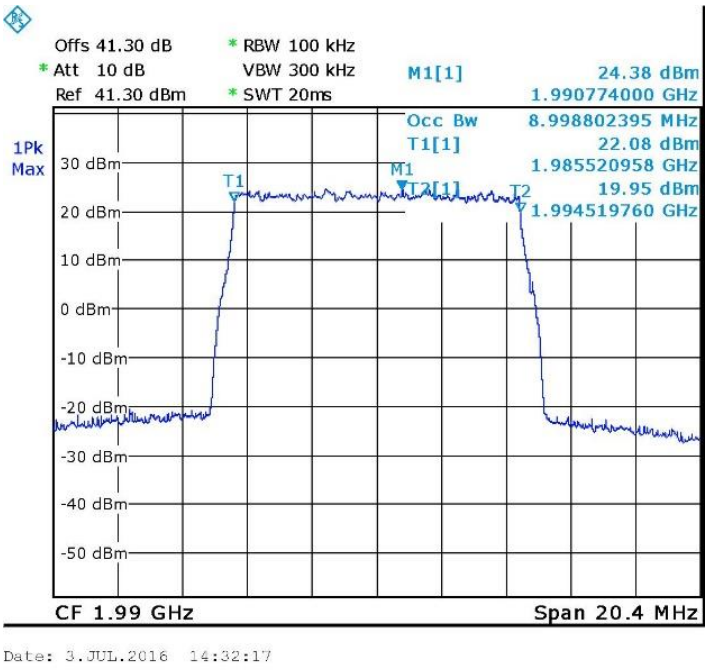

Figure 27. — LTE 64QAM Output 1990.0 MHz

Occupied Bandwidth (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

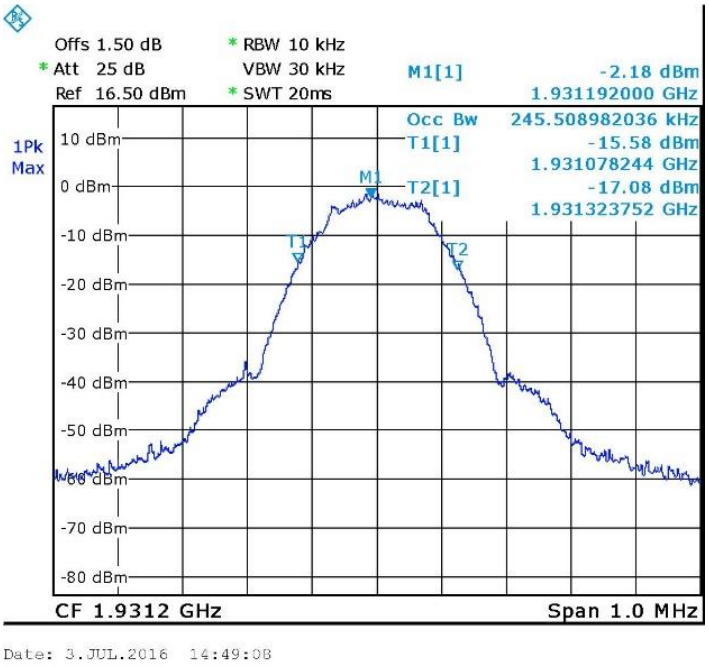

Figure 28. — GSM - Input 1931.2 MHz

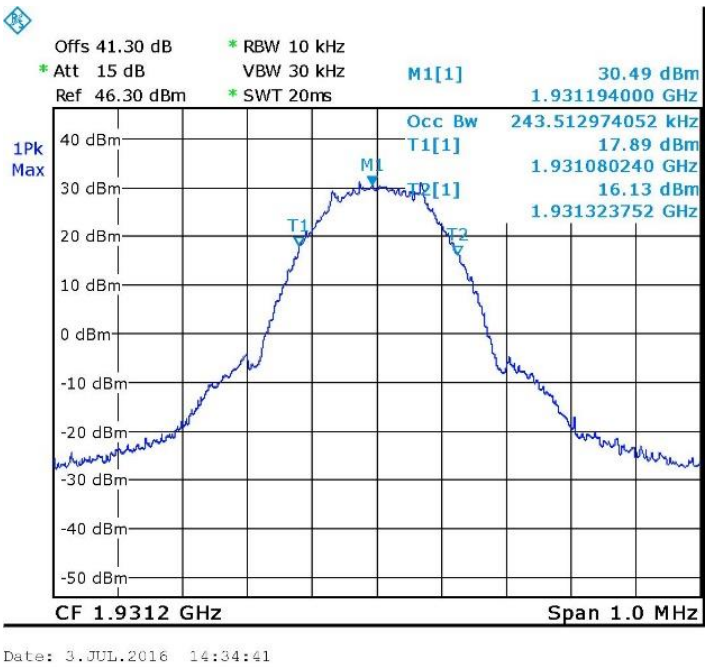

Figure 29. — GSM - Output 1931.2 MHz

Occupied Bandwidth (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

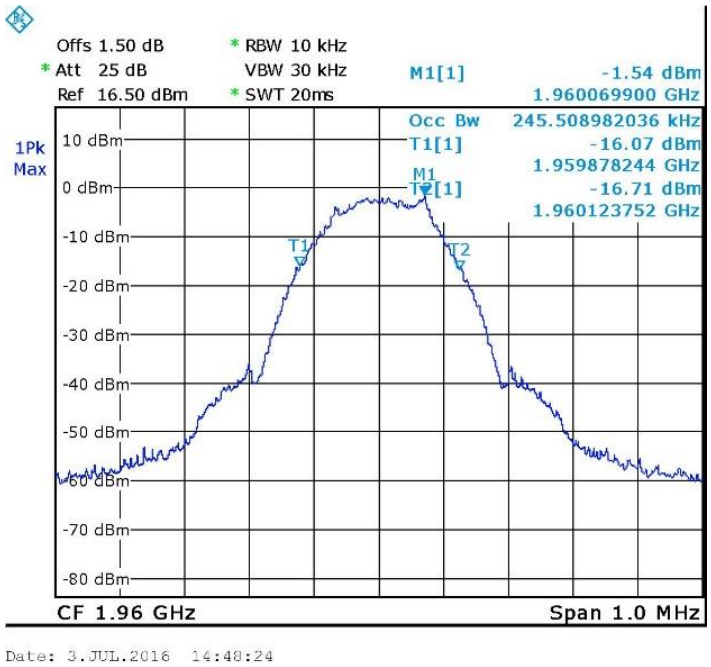

Figure 30. — GSM - Input 1960.0 MHz

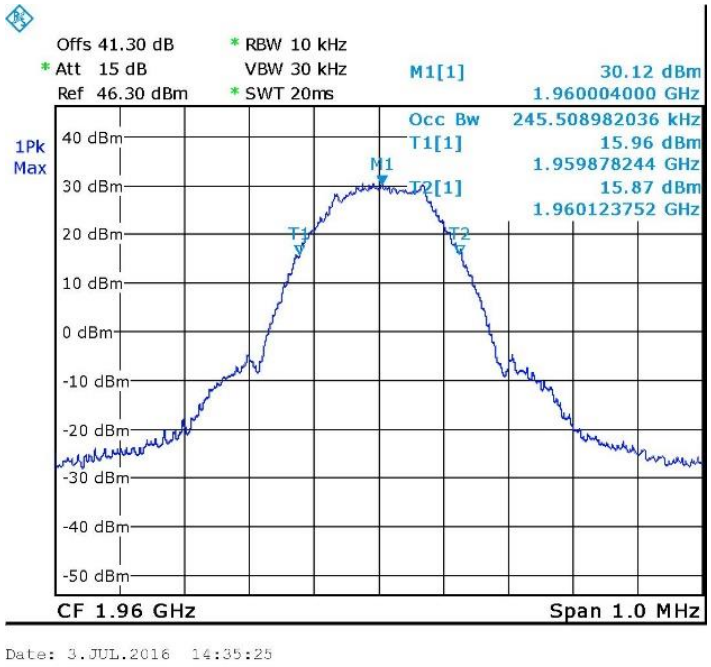

Figure 31. — GSM - Output 1960.0 MHz

Occupied Bandwidth (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

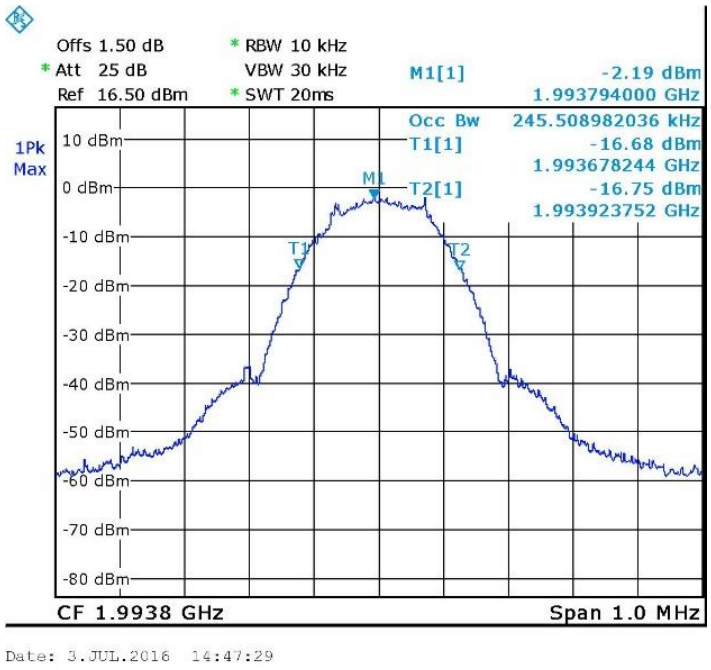

Figure 32. — GSM - Input 1993.8 MHz

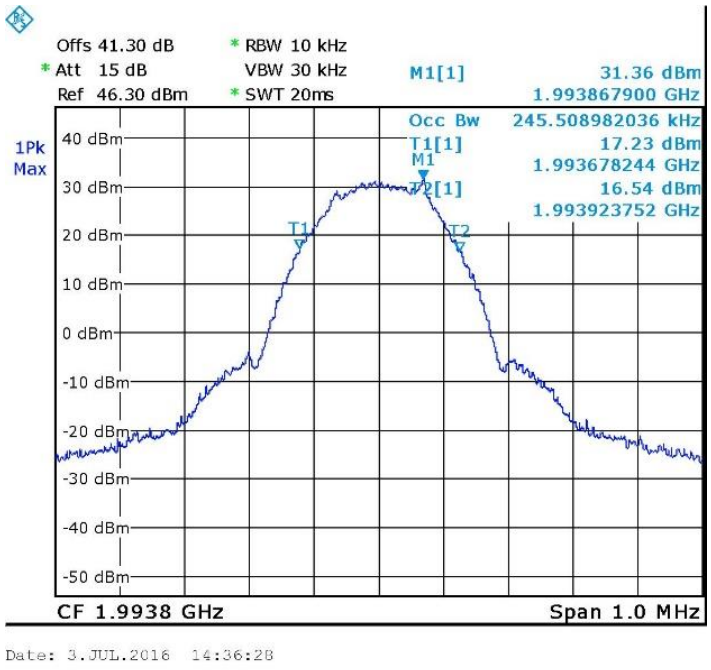

Figure 33. — GSM - Output 1993.8 MHz

Occupied Bandwidth (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

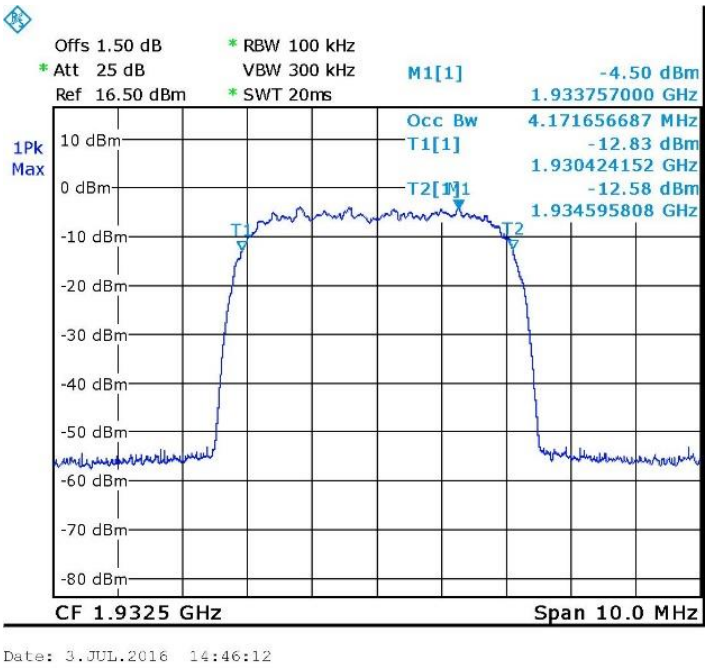

Figure 34. — W-CDMA - Input 1932.5 MHz

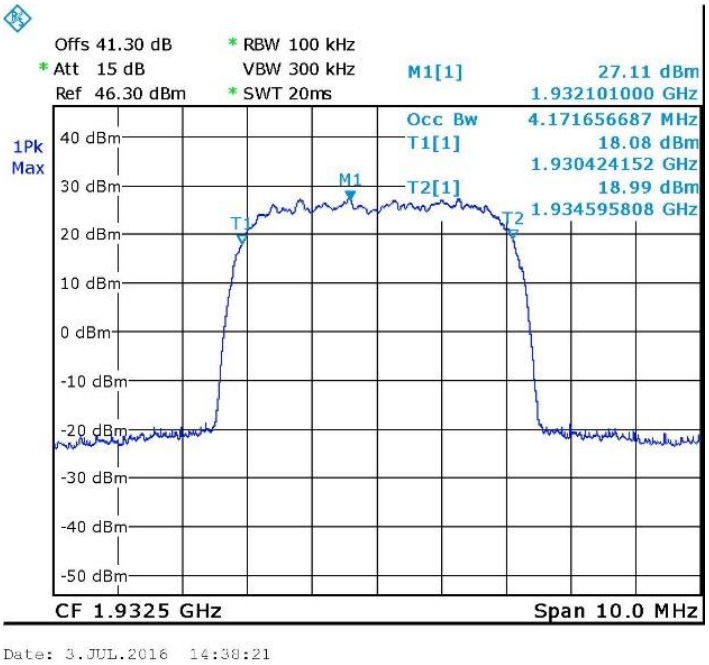

Figure 35. — W-CDMA - Output 1932.5 MHz

Occupied Bandwidth (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

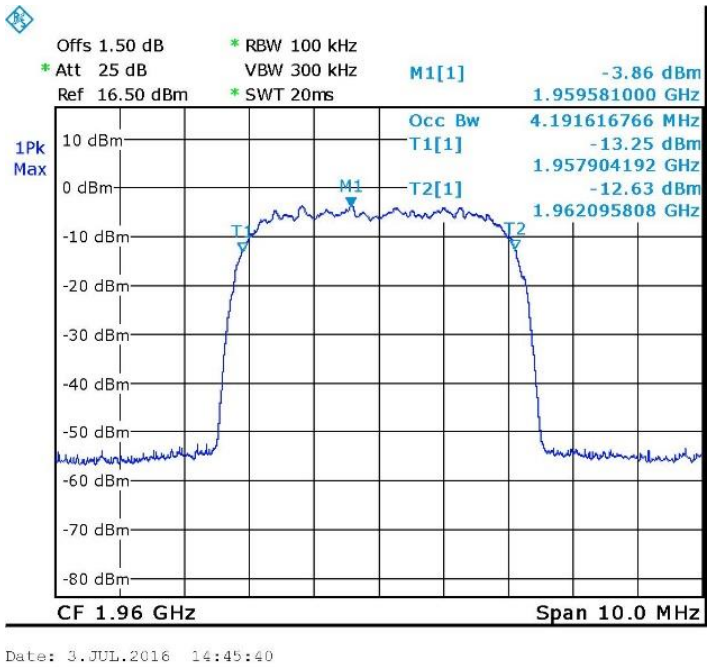

Figure 36. — W-CDMA - Input 1960.0 MHz

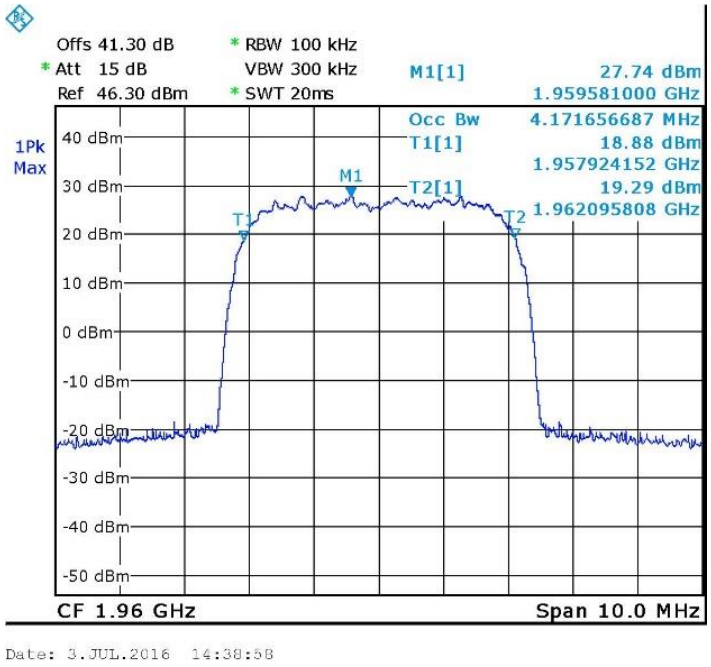

Figure 37. — W-CDMA - Output 1960.0 MHz

Occupied Bandwidth (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

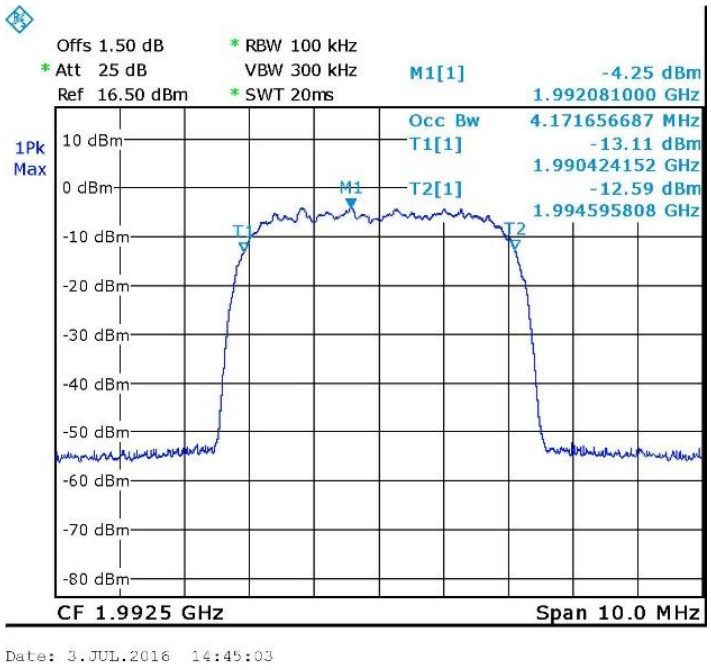

Figure 38. — W-CDMA - Input 1992.5 MHz

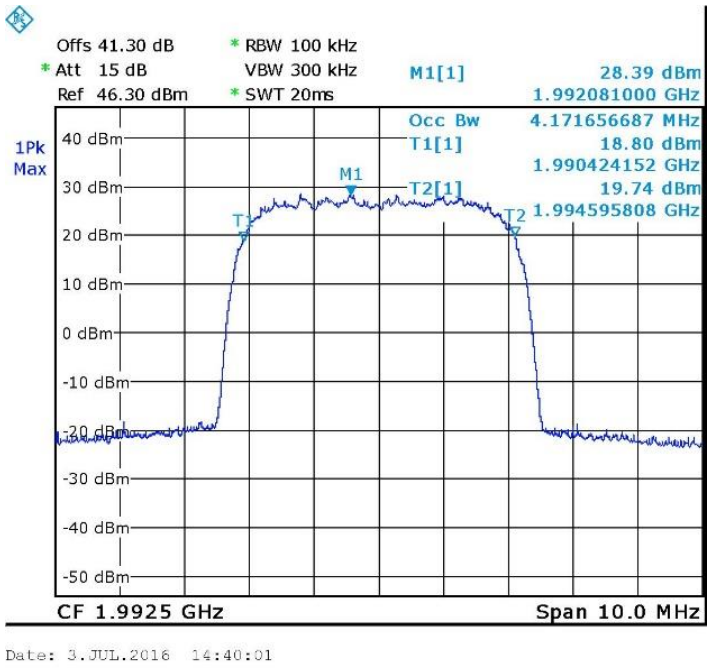

Figure 39. — W-CDMA - Output 1992.5 MHz

5.5 Test Equipment Used; Occupied Bandwidth PCS

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Date
Spectrum Analyzer	R&S	FSL6	100194	February 29, 2016	March 1, 2017
EXG Vector Signal Generator	Agilent	N5172B	MY51350584	July 1, 2016	July 1, 2017
40 dB Attenuator	Weinschel	WA 39-40-33	A1323	April 3, 2016	April 3, 2017

Figure 40 Test Equipment Used

6. Spurious Emissions at Antenna Terminals (PCS)

6.1 Test Specification

FCC Part 24, Subpart E, Section 238; FCC Part 2.1051

6.2 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 (max loss 34.0 dB). The spectrum analyzer was set to 1 kHz resolution BW for the frequency range 9.0-150.0 kHz, 10 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 - 20.0 GHz.

6.3 Test Limit

The power of any emission outside of the authorized operating frequency ranges(1930-1990 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*.

Note – The peaks appearing in the plots in the above mentioned figures relate to the transmission frequency.

Spurious Emissions at Antenna Terminals (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

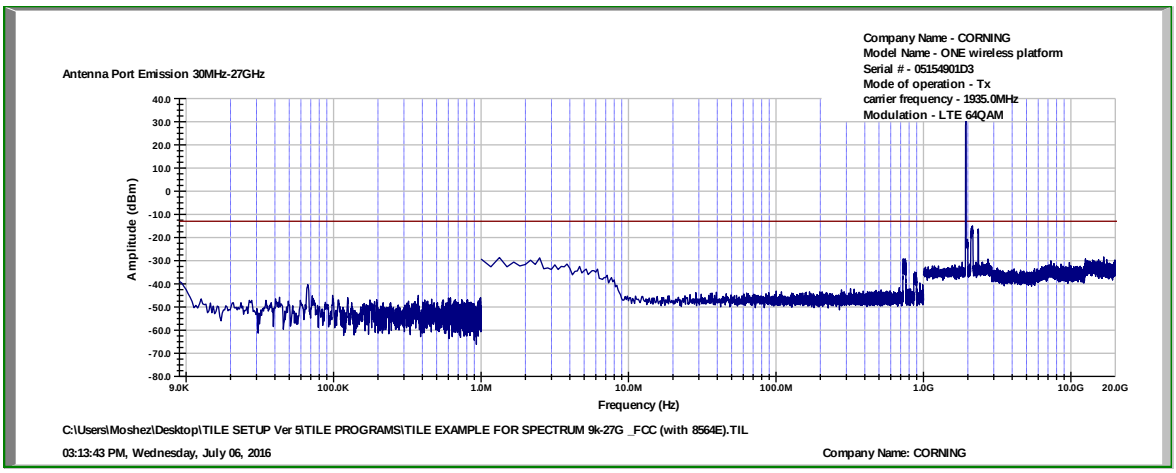

Figure 41. — LTE 64QAM - 1935.0 MHz

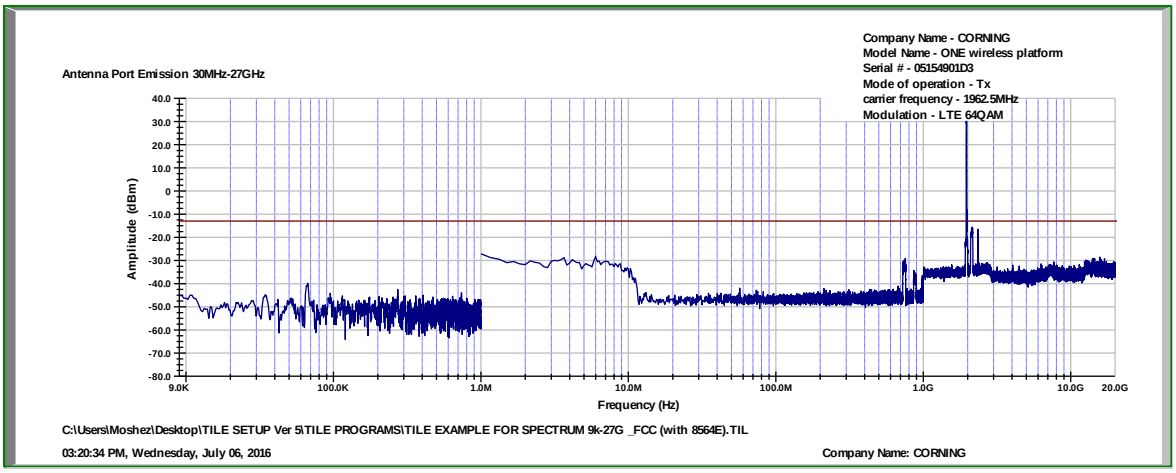

Figure 42. — LTE 64QAM - 1962.5 MHz

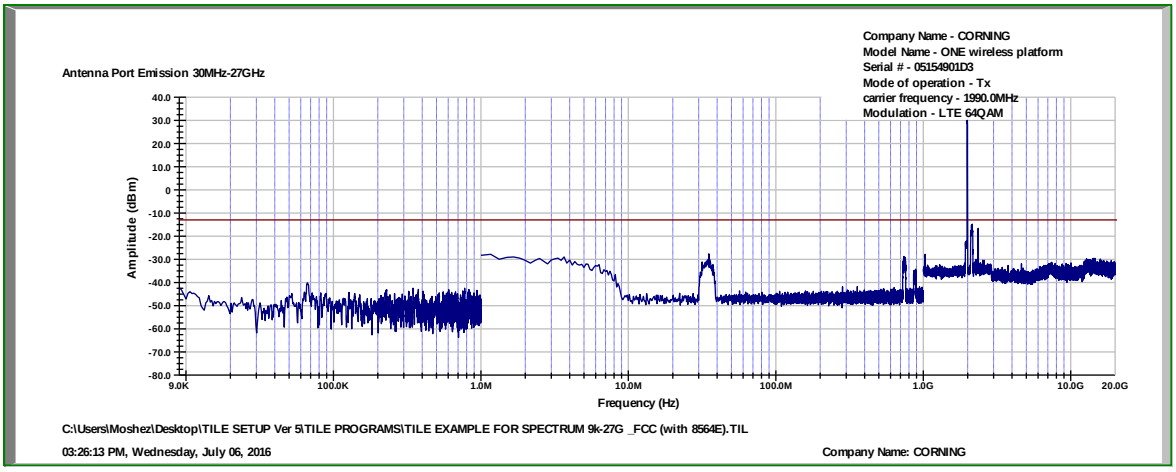

Figure 43. — LTE 64QAM - 1990.0 MHz

Spurious Emissions at Antenna Terminals (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

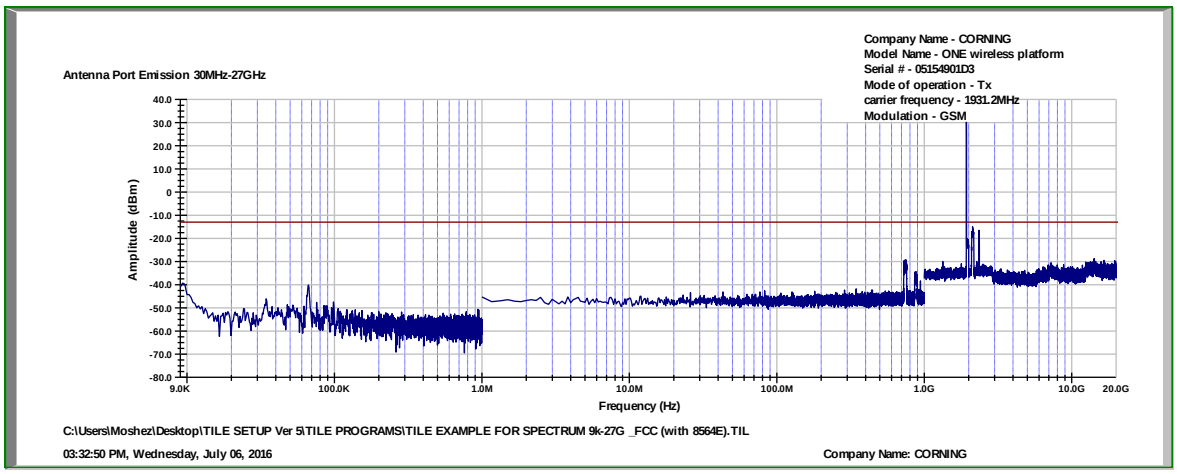

Figure 44. — GSM - 1931.2 MHz

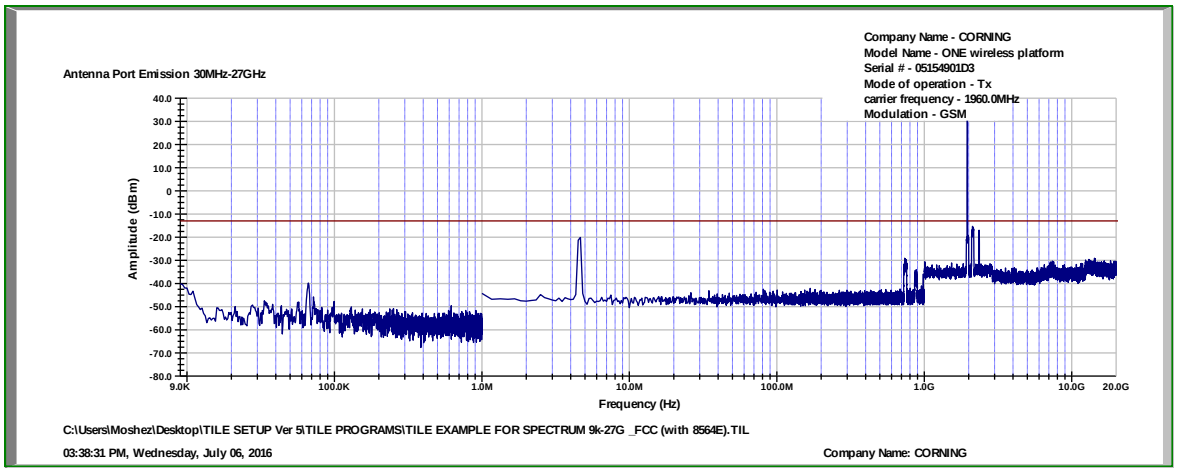

Figure 45. — GSM - 1960.0 MHz

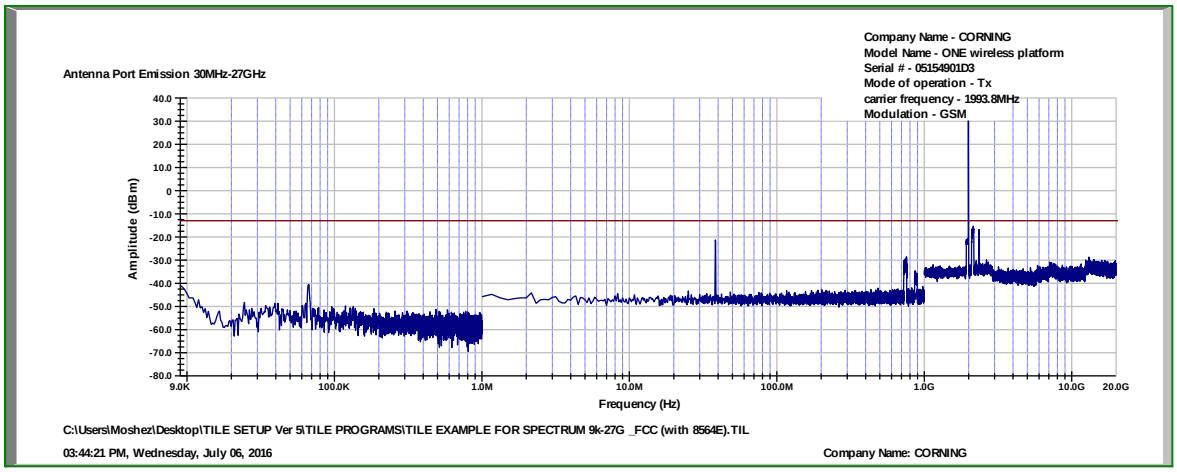

Figure 46. — GSM - 1993.8 MHz

Spurious Emissions at Antenna Terminals (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

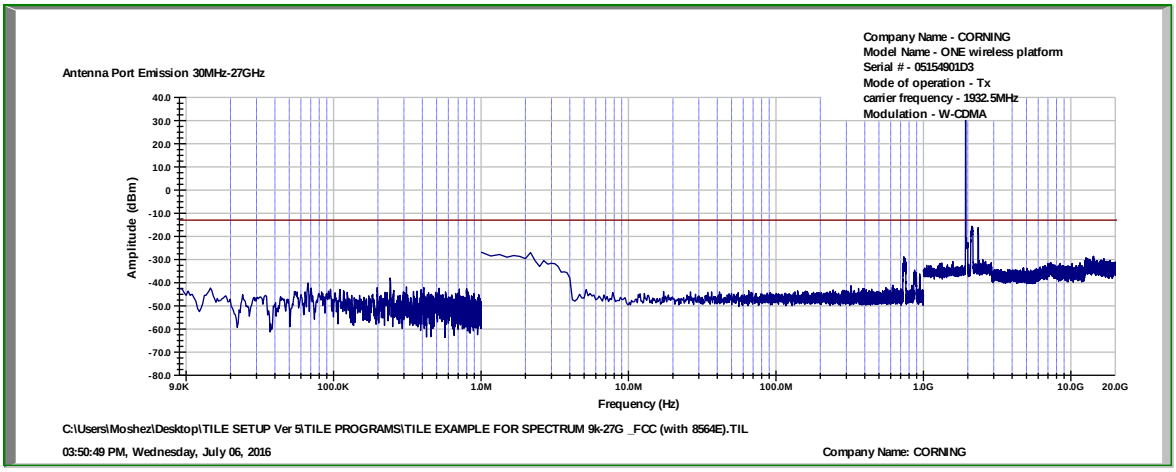

Figure 47. — W-CDMA - 1932.5 MHz

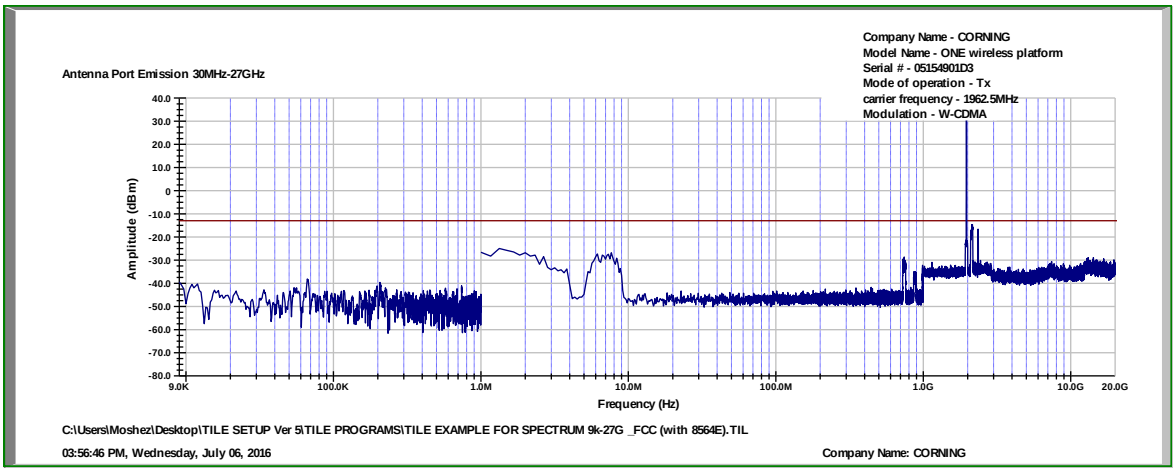

Figure 48. — W-CDMA - 1962.5 MHz

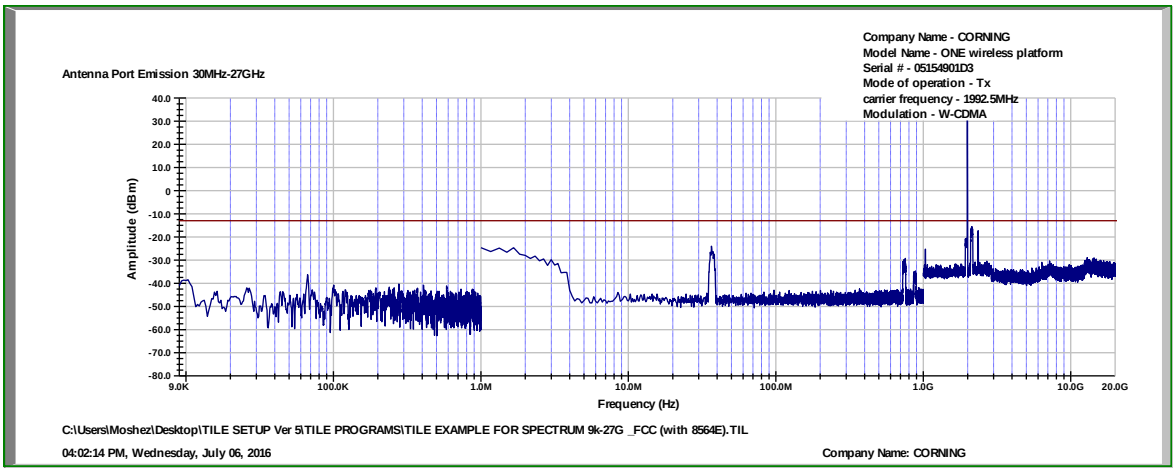

Figure 49. — W-CDMA - 1992.5 MHz

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

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Date
Spectrum Analyzer	HP	8564E	3442A00275	March 10, 2016	March 10, 2017
EXG 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 50 Test Equipment Used

7. Band Edge Spectrum (PCS)

7.1 Test Specification

FCC Part 24, Subpart E, Section 238; FCC Part 2.1051

7.2 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 (41.3 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 (1930.0-1995.0 MHz) must be attenuated below the transmitting power (P) by a factor of at least 43 + log (P) dB, yielding –13dBm.

7.4 Test Results

Modulation	Operation Frequency	Band Edge Frequency	Reading	Limit	Margin
	(MHz)	(MHz)	(dBm)	(dBm)	(dB)
LTE 64QAM	1935.0	1930.0	-19.1	-13.0	-6.1
	1990.0	1995.0	-18.2	-13.0	-5.2
GSM	1931.2	1930.0	-25.1	-13.0	-12.1
	1993.8	1995.0	-24.2	-13.0	-11.2
W-CDMA	1932.5	1930.0	-20.1	-13.0	-7.1
	1992.5	1995.0	-20.1	-13.0	-7.1

Figure 51 Band Edge Spectrum Results PCS

JUDGEMENT: Passed by 5.2 dB

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

Band Edge Spectrum (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

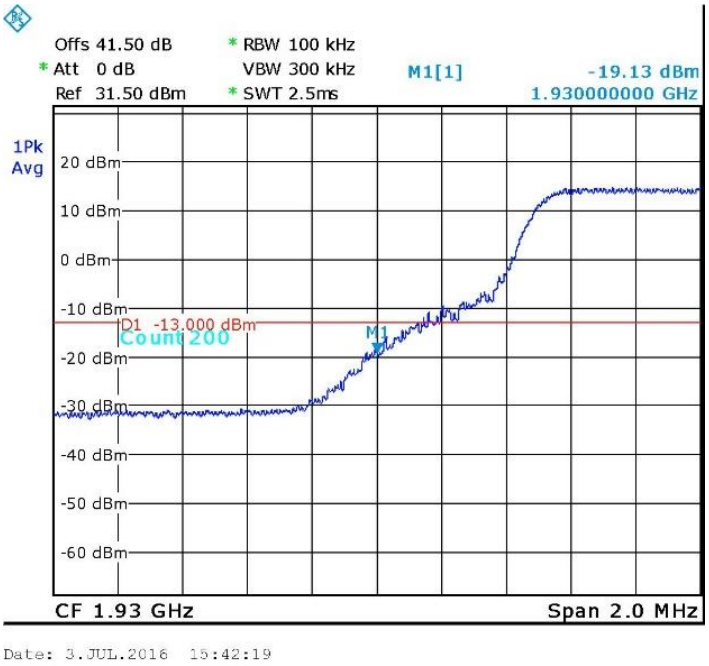

Figure 52. — LTE 64QAM 1935.0 MHz

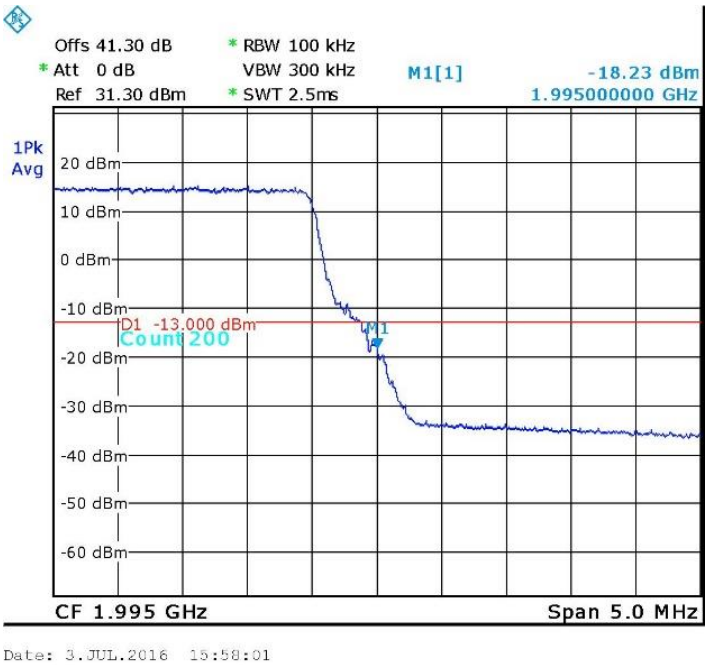

Figure 53. — LTE 64QAM 1990.0 MHz

Band Edge Spectrum (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

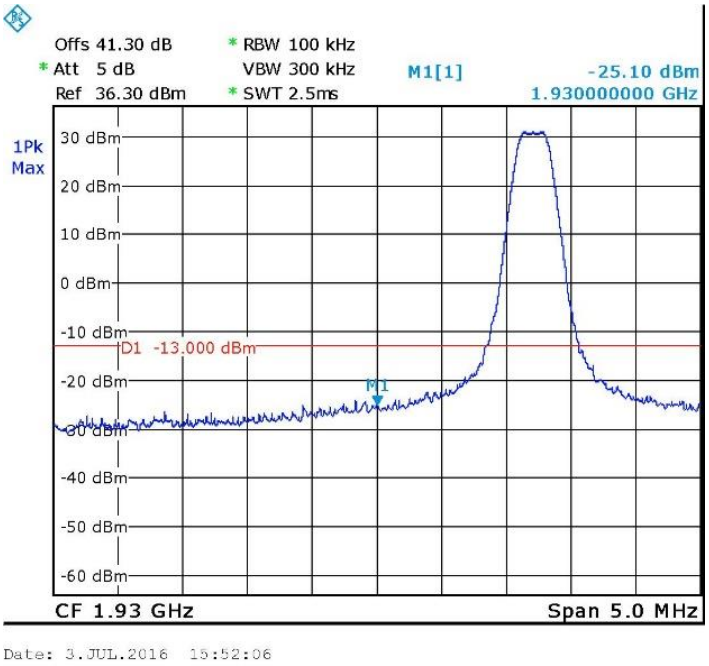

Figure 54. — GSM - 1931.2 MHz

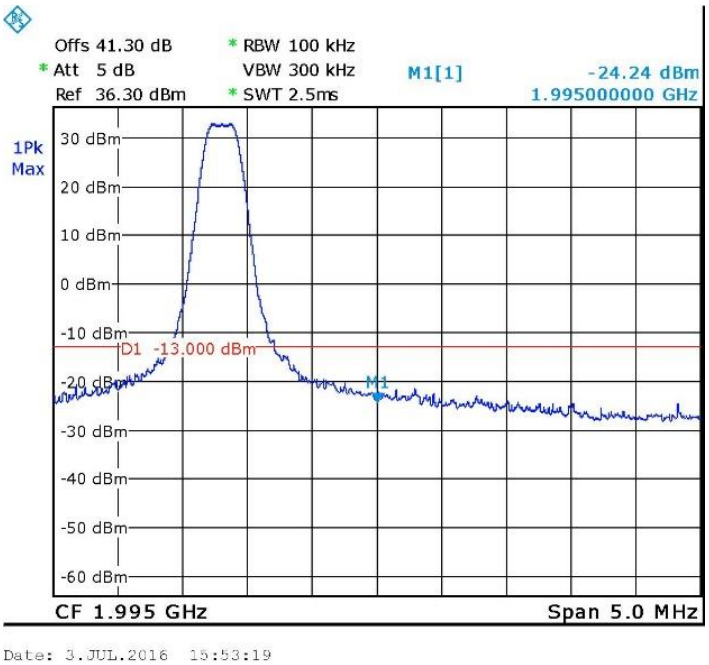

Figure 55. — GSM - 1993.8 MHz

Band Edge Spectrum (PCS)

E.U.T Description	ONE- Optical Network Evolution Wireless Platform
Type	MRU (Mid Power Remote Unit)
Serial Number:	051549901D3

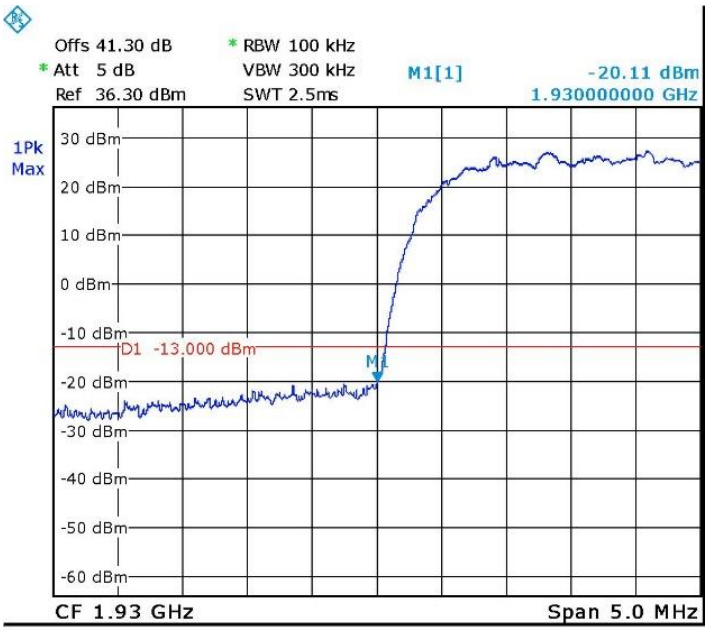

Figure 56. — W-CDMA - 1932.5 MHz

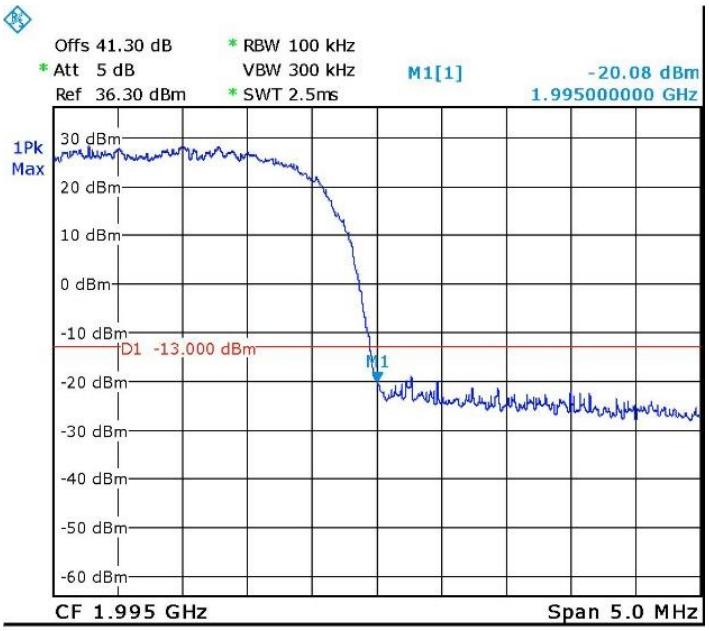

Figure 57. — W-CDMA - 1992.5 MHz

7.5 Test Equipment Used; Band Edge Spectrum PCS

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Date
Spectrum Analyzer	R&S	FSL6	100194	February 29, 2016	March 1, 2017
EXG Vector Signal Generator	Agilent	N5172B	MY51350584	July 1, 2016	July 1, 2017
40 dB Attenuator	Weinschel	WA 39-40-33	A1323	April 3, 2016	April 3, 2017

Figure 58 Test Equipment Used

8. Spurious Emissions (Radiated) PCS

8.1 Test Specification

FCC, Part 24, Subpart E Section 238, FCC Part 2.1053

8.2 Test Procedure

(Temperature (23°C)/ Humidity (57%RH))

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

For measurements between 0.009MHz-30.0MHz:

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

For measurements between 30.0MHz-1.0GHz:

A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly.
The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.
The emissions were measured at a distance of 3 meters.

For measurements between 1.0GHz-20.0GHz:

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 -20.0GHz 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 operational frequencies: low, mid and high and each at 3 modulations: GSM, WCDMA and LTE 64QAM.

Testing was performed when the RF port was connected to 50 Ω termination.

The test results table below describe only results with the highest emission.

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 –13dBm.

8.4 Test Results

Carrier Channel	Freq.	Antenna Pol.	Maximum Peak Level	Signal Generator RF Output	Cable Loss	Antenna Gain	Effective Radiated Power Level	Limit	Margin
(MHz)	(MHz)	(V/H)	(dBµV/m)	(dBm)	(dB)	(dBd)	(dBm)	(dBm)	(dB)
1931.2	3862.4	V	56.8	-42.3	0.5	7.4	-35.4	-13.0	-22.4
	3862.4	H	56.9	-41.7	0.5	7.4	-34.8	-13.0	-21.8
1962.5	3925.0	V	56.9	-42.3	0.5	7.4	-35.4	-13.0	-22.4
	3925.0	H	57.1	-41.5	0.5	7.4	-34.6	-13.0	-21.6
1993.8	3987.6	V	56.9	-42.3	0.5	7.4	-35.4	-13.0	-22.4
	3987.6	H	57.0	-41.7	0.5	7.4	-34.8	-13.0	-21.8

Figure 59 Spurious Emission (Radiated) PCS (Highest Emission)

JUDGEMENT: Passed by 21.6 dB

The E.U.T met the requirements of the FCC, Part 24, Subpart E, Section 238; FCC Part 2.1053 specifications.

8.5 Test Instrumentation Used, Radiated Measurements

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Due
EMI Receiver	HP	85422E	3906A00276	March 3, 2016	March 3, 2017
RF Filter Section	HP	85420E	3705A00248	March 3, 2016	March 3, 2017
EMI Receiver	R&S	ESCI7	100724	February 29, 2016	March 1, 2017
Spectrum Analyzer	HP	8593EM	3536A00120ADI	March 10, 2016	March 10, 2017
Active Loop Antenna	EMCO	6502	9506-2950	November 5, 2015	November 30, 2016
Antenna Biconical	EMCO	3110B	9912-3337	March 24, 2016	March 24, 2018
Antenna Log Periodic	EMCO	3146	9505-4081	April 23, 2016	April 23, 2017
Horn Antenna 1G-18G	ETS	3115	29845	May 19, 2015	May 19, 2018
40dB Attenuator	Weinschel Engineering	WA 39-40-33	A1323	April 3, 2016	April 3, 2017
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 = 44.0dB). 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 & ESMR 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

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

9.2 Test Results

JUDGEMENT: Passed

See additional information in *Figure 61*.

Note – The peaks appearing in the below plot relate to the transmission frequency.

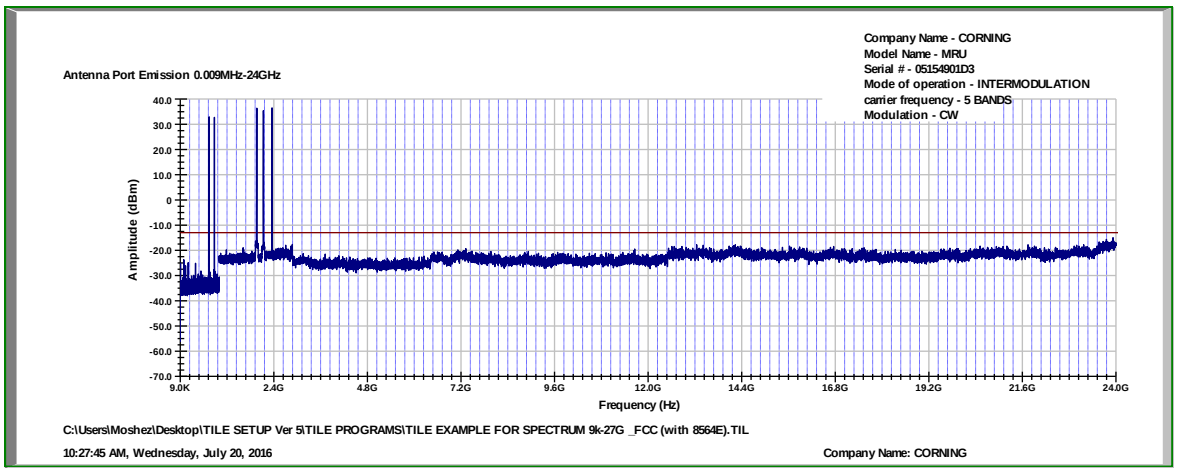

Figure 61 Intermodulation Conducted

9.3 Test Equipment Used; Intermodulation Conducted

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Due
Spectrum Analyzer	HP	8564E	3442A00275	March 10, 2016	March 10, 2017
EXG Vector Signal Generator	Agilent	N5172B	TE4384	July 1, 2016	July 1, 2017
EXG Vector Signal Generator	Agilent	N5172B	MY513500584	July 1, 2016	July 1, 2017
MXG Vector Signal Generator	Agilent	N5182A	MY48180244	July 1, 2016	July 1, 2017
MXG Vector Signal Generator	Agilent	N5182A	MY49060440	July 1, 2016	July 1, 2017
Signal Generator	HP	E4432B	GB40050998	July 1, 2016	July 1, 2017
40 dB Attenuator	Weinschel Engineering	WA 39-40-33	A1323	April 3, 2016	April 3, 2017

Figure 62 Test Equipment Used

10. Intermodulation Radiated

10.1 Test Procedure

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

For measurements between 0.009MHz-30.0MHz:

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

For measurements between 30.0MHz-1.0GHz:
A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 0.8 meters above the ground. The frequency range 30.0MHz -1.0GHz was scanned and the list of the highest emissions was verified and updated accordingly.
The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.
The emissions were measured at a distance of 3 meters.

For measurements between 1.0GHz-24.0GHz:

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

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

$P_d(dBm) = P_g(dBm) – Cable\ Loss\ (dB) + Substitution\ Antenna\ Gain\ (dBd)$

P_d = Dipole equivalent power (result).
P_g = Signal generator output level.

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

LTE band: 742.0 MHz, 0 dBm

CELL & ESMR band: 878.0 MHz, 0 dBm

PCS band: 1962.5 MHz, 0 dBm

AWS band: 2132.5 MHz, 0 dBm

WCS band: 2355.0MHz, 0 dBm

A Peak detector was used for this test.

Testing was performed when the RF port was connected to 50 Ω termination.

The test results table below describe only results with the highest radiation.

10.2 Test Limit

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

10.3 Test Results

JUDGEMENT: Passed

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)
1565.0	V	55.0	-45.7	0.5	7.0	-39.2	-13.0	-26.2
1565.0	H	54.5	-45.5	0.5	7.0	-39.0	-13.0	-26.0
3039.0	V	51.3	-53.9	0.5	10.0	-44.4	-13.0	-31.4
3039.0	H	51.5	-53.0	0.5	10.0	-43.5	-13.0	-30.5
3434.0	V	51.9	-53.5	0.5	10.0	-44.0	-13.0	-31.0
3434.0	H	52.0	-52.0	0.5	10.0	-42.5	-13.0	-29.5
4118.0	V	51.7	-47.1	0.5	9.5	-38.1	-13.0	-25.1
4118.0	H	51.9	-50.0	0.5	10.8	-39.7	-13.0	-26.7
4688.0	V	59.3	-43.2	0.5	10.8	-32.9	-13.0	-19.9
4688.0	H	57.2	-45.0	0.5	10.8	-34.7	-13.0	-21.7
3523.0	V	53.1	-51.9	0.5	10.0	-42.4	-13.0	-29.4
3523.0	H	53.5	-50.5	0.5	10.0	-41.0	-13.0	-28.0
2249.0	V	51.8	-48.7	0.5	7.0	-42.2	-13.0	-29.2
2249.0	H	50.6	-49.4	0.5	7.0	-42.9	-13.0	-29.9
1915.0	V	59.6	-40.7	0.5	7.0	-34.2	-13.0	-21.2
1915.0	H	50.8	-49.0	0.5	7.0	-42.5	-13.0	-29.5
5571.0	V	57.6	-46.2	0.5	10.8	-35.9	-13.0	-22.9
5571.0	H	57.7	-42.9	1.0	9.7	-34.2	-13.0	-21.2
3303.0	V	52.2	-52.9	0.5	10.0	-43.4	-13.0	-30.4
3303.0	H	52.5	-52.5	0.5	10.0	-43.0	-13.0	-30.0

Figure 63 Intermodulation Radiated Results

10.4 Test Instrumentation Used; Radiated Measurements Intermodulation

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Due
EMI Receiver	HP	85422E	3906A00276	March 3, 2016	March 3, 2017
RF Filter Section	HP	85420E	3705A00248	March 3, 2016	March 3, 2017
EMI Receiver	R&S	ESCI7	100724	February 29, 2016	March 1, 2017
Spectrum Analyzer	HP	8593EM	3536A00120ADI	March 10, 2016	March 10, 2017
Active Loop Antenna	EMCO	6502	9506-2950	November 5, 2015	November 30, 2016
Antenna Biconical	EMCO	3110B	9912-3337	March 24, 2016	March 24, 2018
Antenna Log Periodic	EMCO	3146	9505-4081	April 23, 2016	April 23, 2017
Horn Antenna 1G-18G	ETS	3115	29845	May 19, 2015	May 19, 2018
Horn Antenna 18G-26G	ARA	SWH-28	1007	March 30, 2016	March 30, 2018
Low Noise Amplifier	Narda	LNA-DBS-0411N313	013	May 25, 2016	May 25, 2017
Low Noise Amplifier	Sophia Wireless	LNA 28-B	232	March 1, 2016	March 1, 2017
Signal Generator	Marconi	2022D	119196015	March 1, 2016	March 1, 2017
Signal Generator	HP	8648C	3623A04126	February 29, 2016	March 1, 2017
Signal Generator	HP	ESG-4000A/E4422A	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
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 (PCS)

11.1 Test Specification

KDB 935210 D05 v01r01, Section 3.3

11.2 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 (max Loss= 41.5 dB).

The signal and spectrum analyzer frequency range was set to ±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 ≥3*RBW.

11.3 Test Limit

N/A

11.4 Test Results

JUDGEMENT: Passed

Figure 65. — Out-of-Band Rejection Plot

11.5 Test Equipment Used; Out-of-Band Rejection

Instrument	Manufacturer	Model	Serial Number	Calibration	
				Last Calibration Date	Next Calibration Date
EXA Spectrum Analyzer	Agilent	N9010A	MY49061070	July 21, 2016	July 21, 2017
EXG Vector Signal Generator	Agilent	N5172B	MY51350584	July 1, 2016	July 1, 2017
40 dB Attenuator	Weinschel	WA 39-40-33	A1323	April 3, 2016	April 3, 2017

Figure 66 Test Equipment Used

12. APPENDIX A - CORRECTION FACTORS

12.1 Correction factors for CABLE

from EMI receiver to test antenna at 3 meter range.

Frequency (MHz)	Cable Loss (dB)	Frequency (MHz)	Cable Loss (dB)
0.010	0.4	50.00	1.2
0.015	0.2	100.00	0.7
0.020	0.2	150.00	2.1
0.030	0.3	200.00	2.3
0.050	0.3	300.00	2.9
0.075	0.3	500.00	3.8
0.100	0.2	750.00	4.8
0.150	0.2	1000.00	5.4
0.200	0.3	1500.00	6.7
0.500	0.4	2000.00	9.0
1.00	0.4	2500.00	9.4
1.50	0.5	3000.00	9.9
2.00	0.5	3500.00	10.2
5.00	0.6	4000.00	11.2
10.00	0.8	4500.00	12.1
15.00	0.9	5000.00	13.1
20.00	0.8	5500.00	13.5
		6000.00	14.5

NOTES:

1. The cable type is SPUMA400 RF-11N(X2) and 39m long

2. The cable is manufactured by Huber + Suhner

12.2 Correction factors for RF cable for Semi Anechoic Chamber

FREQ (MHz)	LOSS (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

12.3 Correction factors for Horn ANTENNA

Model: 3115
Antenna serial number: 29845
10 meter range

FREQUENCY (MHz)	AFE (dB/m)	FREQUENCY (MHz)	AFE (dB/m)
1000	22.4	10000	36.1
2000	25.2	11000	37.0
3000	31.1	12000	41.3
4000	30.2	13000	38.1
5000	34.2	14000	41.7
6000	31.6	15000	39.0
7000	34.7	16000	38.8
8000	34.8	17000	43.2
9000	36.2	18000	43.7

12.4 Correction factors for Horn ANTENNA

Model: SWH-28
Antenna serial number: 1007
1 meter range

FREQUENCY (GHz)	AFE (dB/m)	Gain (dBi)
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 ACTIVE LOOP ANTENNA

Model 6502
S/N 9506-2950

FREQUENCY (MHz)	Magnetic Antenna Factor (dBs/m)	Electric Antenna Factor (dB/m)
.009	-35.1	16.4
.010	-35.7	15.8
.020	-38.5	13.0
.050	-39.6	11.9
.075	-39.8	11.8
.100	-40.0	11.6
.150	-40.0	11.5
.250	-40.0	11.6
.500	-40.0	11.5
.750	-40.1	11.5
1.000	-39.9	11.7
2.000	-39.5	12.0
3.000	-39.4	12.1
4.000	-39.7	11.9
5.000	-39.7	11.8
10.000	40.2	11.3
15.000	-40.7	10.8
20.000	-40.5	11.0
25.000	-41.3	10.2
30.000	-42.3	9.2

12.6 Correction factors forBiconical Antenna EMCO Model 3110B serial 9912-3337

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

12.7 Correction factors forLog Periodic Antenna EMCO Model 3146 serial 9505-4081

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