MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313
33439 WESTERN AVENUE • UNION CITY, CALIFORNIA 94587 • PHONE (510) 489-6300 • FAX (510) 489-6372
3162 BELICK STREET • SANTA CLARA, CA 95054 • PHONE (408) 748-3585 • FAX (510) 489-6372
13501 MCCALLEN PASS • AUSTIN, TEXAS 78753 • PHONE (512) 287-2500 • FAX (512) 287-2513

December 19, 2017

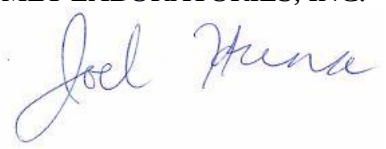
Weir Group Management Services
1 West Regent Street
Glasgow, Scotland G2 1RW

Dear Wayne Cooke,

Enclosed is the EMC Wireless test report for compliance testing of the Weir Group Management Services, Weir Industrial Gateway as tested to the requirements of the FCC Certification rules under Title 47 of the CFR Part 22 Subpart H for Cellular Devices and FCC Part 24 Subpart E for Broadband PCS Devices.

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please contact me.

Sincerely yours,
MET LABORATORIES, INC.



Joel Huna
Documentation Department

Reference: (\Weir Group Management Services\EMC92659A-FCC22_24 Rev. 1)

MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*
914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313
33439 WESTERN AVENUE • UNION CITY, CALIFORNIA 94587 • PHONE (510) 489-6300 • FAX (510) 489-6372
3162 BELICK STREET • SANTA CLARA, CA 95054 • PHONE (408) 748-3585 • FAX (510) 489-6372
13501 MCCALLEN PASS • AUSTIN, TEXAS 78753 • PHONE (512) 287-2500 • FAX (512) 287-2513

Electromagnetic Compatibility Criteria
Test Report

for the

Weir Group Management Services
Weir Industrial Gateway

Tested under
FCC Certification Rules
Title 47 of the CFR,
Part 22 Subpart H for Cellular Devices
&
Part 24 Subpart E for Broadband PCS Devices

MET Report: EMC92659A-FCC22_24 Rev. 1

December 19, 2017

Prepared For:

Weir Group Management Services
1 West Regent Street
Glasgow, Scotland G2 1RW

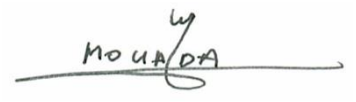
Prepared By:
MET Laboratories, Inc.
914 W. Patapsco Ave
Baltimore, MD 21230

Electromagnetic Compatibility Criteria
Test Report

for the

Weir Group Management Services
Weir Industrial Gateway

Tested Under
FCC Certification Rules
Title 47 of the CFR,
Part 22 Subpart H for Cellular Devices
&
Part 24 Subpart E for Broadband PCS Devices



Djed Mouada
Project Engineer, Electromagnetic Compatibility Lab

Joel Huna
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 22 Subpart H and Part 24 Subpart E of the FCC Rules under normal use and maintenance.

John Mason,
Director, Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	November 29, 2017	Initial Issue.
1	December 19, 2017	Customer Name/Address Update and Engineer Corrections.

Table of Contents

List of Tables

List of Plots

List of Photographs

List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
f	**F**requency
FCC	**F**ederal **C**ommunications **C**ommission
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**er**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**h**er**z**
kPa	**k**ilo**pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**h**ertz
µH	**microh**enry
µ	**microf**arad
µs	**micros**econds
NEBS	**N**etwork **E**quipment-**B**uilding **S**ystem
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
TWT	**T**raveling **W**ave **T**ube
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Executive Summary

A. Purpose of Test

An EMC evaluation was performed to determine compliance of the Weir Group Management Services Weir Industrial Gateway, with the requirements of Part 22 Subpart H and Part 24 Subpart E. All references are to the most current version of Title 47 of the Code of Federal Regulations in effect. In accordance with §2.1033, the following data is presented in support of the Certification of the Weir Industrial Gateway. Weir Group Management Services should retain a copy of this document which should be kept on file for at least two years after the manufacturing of the Weir Industrial Gateway, has been **permanently** discontinued.

B. Executive Summary

The following tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 22 Subpart H and Part 24 Subpart E, in accordance with Weir Group Management Services, purchase order number T10536863.

FCC Reference	Description	Compliance
§2.1049; §22.917; §24.232(d)	Occupied Bandwidth	Compliant
§2.1047	Modulation Characteristics	Compliant
§2.1049, §24.238	Frequency stability	Compliant
§24.323 (d)	Peak to Average Ratio	Compliant
§2.1051; §22.917, §24.238	Conducted Spurious Emissions at Antenna Terminals and Band Edge	Compliant
§2.1046; §22.913; §24.232	RF Power Output (EIRP)	Compliant
§2.1053; §22.917, §24.238	Radiated Spurious Emissions from the Cabinet	Compliant

Table 1. Executive Summary of EMC ComplianceTesting

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Weir Group Management Services to perform testing on the Weir Industrial Gateway, under Weir Group Management Services's purchase order number T10536863.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Weir Group Management Services, Weir Industrial Gateway.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	Weir Industrial Gateway		
Model(s) Covered:	Weir Industrial Gateway		
Filing Status:	Original		
EUT Specifications:	Primary Power: 120/240 VAC 50/60 Hz		
	FCC ID: 2ANXR-STXMPM		
	Type of Modulations:	GMSK, 8PSK, QPSK	
	Equipment Code:	PCB	
	RF Power Output	Part 22 ERP:	Part 24 EIRP:
	GSM	3.664	1.963
	GPRS	3.112	1.871
	EGPRS	2.911	1.871
	WCDMA	0.845	0.962
	EUT Frequency Ranges:	824.2 – 848.8 MHz	1850.2 – 1909.8 MHz
Analysis:	The results obtained relate only to the item(s) tested.		
Environmental Test Conditions:	Temperature: 15-35º C		
	Relative Humidity: 30-60%		
	Barometric Pressure: 860-1060 mbar		
Evaluated by:	Djed Mouada		
Date(s):	December 19, 2017		

B. References

CFR 47, Part 22, Subpart H	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 22: Rules and Regulations for Cellular Devices.
CFR 47, Part 24, Subpart E	Federal Communication Commission, Code of Federal Regulations, Title 47, Part 24: Rules and Regulations for Personal Communications Services
ANSI C63.4:20014	Methods and Measurements of Radio-Noise Emissions from Low-Voltage Electrical And Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.26: 2015	Compliance Testing of Transmitters Used in Licensed Radio Services
ISO/IEC 17025:2005	General Requirements for the Competence of Testing and Calibration Laboratories
EIA/TIA-603-D-2010	Land Mobile FM or PM Communication Equipment Measurement and Performance Standards
KDB 971168 v02r02	MEASUREMENT GUIDANCE FOR CERTIFICATION OF LICENSED DIGITAL TRANSMITTERS

C. Test Site

All testing was performed at MET Laboratories, Inc., 914 W. Patapsco Ave, Baltimore, MD 21230. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

Radiated Emissions measurements were performed in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). In accordance with §2.948(a)(3), a complete site description is contained at MET Laboratories.

D. Description of Test Sample

The Weir Industrial Gateway, Equipment Under Test (EUT), is used to monitor the operation of the components of a drilling rig, in particular the sound and vibration from the bearings in the system. This is monitored through digital signal processing to determine if the bearing is nearing the end of its life and needs to be replaced

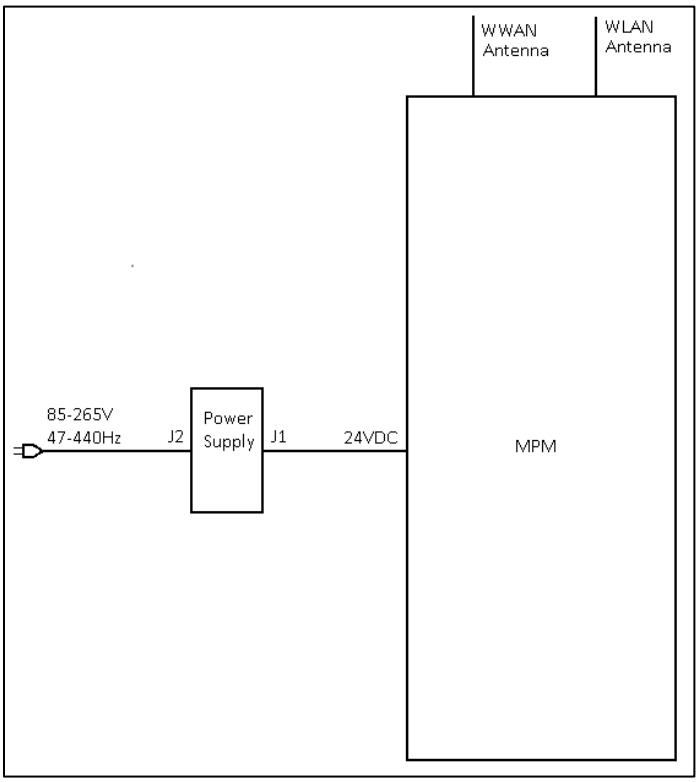


Figure 1. Block Diagram of Equipment Configuration

E. Equipment Configuration

Ref. ID	Name / Description	Model Number	Serial Number	Rev. #
A	Power Supply	CH-SAN500AC-24	161103	01
B	MPM	North America: STX-000004	006	01
P	Antenna	MY-0W4VW8-74431-5CM-0668-A00	N/A	N/A

Table 2. Equipment Configuration

F. Support Equipment

Ref. ID	Name / Description	Manufacturer	Model Number	*Customer Supplied Calibration Data
E	Ethernet Switch	Netgear	N300	N/A
F	External Laptop	Dell	Latitude E5570	N/A
The 'Customer Supplied Calibration Data' column will be marked as either not applicable, not available, or will contain the calibration date supplied by the customer.				

Table 3. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty	Length as tested (m)	Max Length (m)	Shielded ? (Y/N)	Termination Box ID & Port Name
1	AC Input	3 conductor, bare wires at AC Mains end, 14 AWG	1	10	50	No	Power Box.J2
2	24VDC	4 conductor, 14 AWG	1	2	50	No	Power Box.J1
9	LAN	8 conductor, 20 AWG	1	5	50	Yes	Ethernet switch
33	MPM	Antenna cable, 1 conductor, coax, CA120/195-XC	1	10	10	Yes	Antenna

Table 4. Ports and Cabling Information

H. Mode of Operation

Custom software (WinEMI) will exercise all ports and send the system performance to a WiFi link to be monitored by an external laptop.

I. Method of Monitoring EUT Operation

An external laptop with a WiFi link will monitor the system and display the system performance.

J. Modifications

a) Modifications to EUT

No modifications were made to the EUT.

b) Modifications to Test Standard

No modifications were made to the test standard.

K. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Weir Group Management Services upon completion of testing.

III. Electromagnetic Compatibility Criteria for Intentional Radiators

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 2.1046 RF Power Output

Test Requirements: **§ 2.1046 Measurements required: RF power output:**

§ 2.1046 (a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8).The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

§ 2.1046 (b) For single sideband, independent sideband, and single channel, controlled carrier radiotelephone transmitters, the procedure specified in paragraph (a) of this section shall be employed and, in addition, the transmitter shall be modulated during the test as specified and as applicable in § 2.1046 (b) (1-5). In all tests, the input level of the modulating signal shall be such as to develop rated peak envelope power or carrier power, as appropriate, for the transmitter.

§ 2.1046 (c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

§ 22.913(5): The ERP of mobile transmitters and auxiliary test transmitters must not exceed 7 watts

§ 24.232 (c): Mobile and portable stations are limited to 2 watts EIRP and the equipment must employ a means for limiting power to the minimum necessary for successful communications

Test Procedures: The EUT was tested according to the average power integration procedures of ANSI C63.26 5.2.4.4.1. The power measurement function of spectrum analyzer was used and configured in the following manner.

(a) Frequency = channel cf
(b) Span = 2-3 x the OBW
(c) RBW = 1-5 % of the OBW
(d) VBW 1-3 x the RBW
(e) Sweep Time = Auto
(f) Detector = Average

Test Results: The EUT complies with the requirements of this section.

Test Engineer(s): Djed Mouada

Test Date(s): May 26, 2017

GSM	Channel Bandwidth (MHz)	Channel #	Frequency (MHz)	Average Power (dBm)	Antenna Gain (dBi)	Antenna Gain(dBi) 2	Antenna Gain (dBi)3	EIRP / ERP 1 (W)	EIRP/ ERP 2 (W)	EIRP/ ERP 3 (W)	Limit (W)	Rule Part	Band Edges
1900	GSM	18607	1850.2	26.93	4		6	1.239		1.963	2	24E	
		18900	1880	26.26	4		6	1.062		1.683	2		
		19193	1909.8	26.54	4		6	1.132		1.795	2		1850
	GPRS	18615	1850.2	26.5	4		6	1.122		1.778	2		
		18900	1880	26.91	4		6	1.23		1.954	2		
		19185	1909.8	26.36	4		6	1.086		1.722	2		1910
	EGPRS	18625	1850.2	26.57	4		6	1.14		1.807	2		
		18900	1880	26.72	4		6	1.18		1.871	2		
		19175	1909.8	26.03	4		6	1.007		1.596	2		
850	GSM	20407	824.2	29.75	4	8		1.445	3.631		7	22H	
		20525	836.4	29.79	4	8		1.459	3.664		7		
		20643	848.8	29.08	4	8		1.239	3.112		7		
	GPRS	20415	824.2	27.31	4	8		0.824	2.07		7		
		20525	836.4	28.5	4	8		1.084	2.723		7		824
		20635	848.8	28.55	4	8		1.239	3.112		7		849
	EGPRS	20425	824.2	28.79	4	8		1.159	2.911		7		
		20525	836.4	28.26	4	8		1.026	2.576		7		
		20625	848.8	28.58	4	8		1.104	2.773		7		

Table 5. RF Output Power, 22H – 24 E, 2G - 3 G, GSM Test Results

WCDMA	Channel Bandwidth (MHz)	Channel #	Frequency (MHz)	Average Power (dBm)	Antenna Gain (dBi)	Antenna Gain (dBi) 2	Antenna Gain (dBi)3	EIRP / ERP 1 (W)	EIRP / ERP 2 (W)	EIRP / ERP 3 (W)	Limit (W)	Rule Part	Band Edges
Band II	WCDMA		1852.4	23.71	4		6	0.556		0.881	2	24E	1850
			1880	23.83	4		6	0.552		0.828	2		1910
			1907.6	23.4	4		6	0.59		0.935	2		
Band V	WCDMA		826.4	23.42	4	8		0.337	0.845		7	22H	824
			836.4	22.01	4	8		0.35	0.879		7		849
			846.4	22.2	4	8		0.368	0.925		7		

Table 6. RF Output, 22H – 24 E, 2G - 3 G, WCMDA, Test Results

§ 2.1049 Occupied Bandwidth

Test Requirement(s): **§ 2.1049 Measurements required: Occupied bandwidth:** The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the specified conditions of § 2.1049 (a) through (i) as applicable.

§22.917 (1) The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

§24.238 (b) The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

Test Procedures: The EUT was tested according to relative measurement procedure of ANSI C63.26 5.4.3. The OBW measurement function of the spectrum analyzer was used and configured in the following manner.

(a) Frequency = channel cf
(b) Span = 2-5 x the OBW
(c) RBW = 1-5 % of the OBW
(d) VBW 1-3 x the RBW
(e) Sweep Time = Auto
(f) Detector = peak
(g) –X dB = 26

Test Results: Equipment complies with FCC requirements.

Test Engineer(s): Djed Mouada

Test Date(s): May 26, 2017

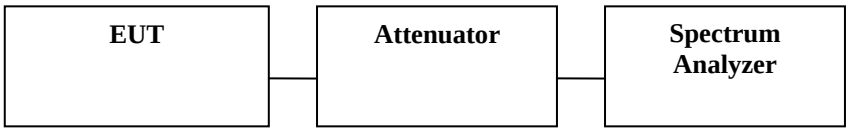
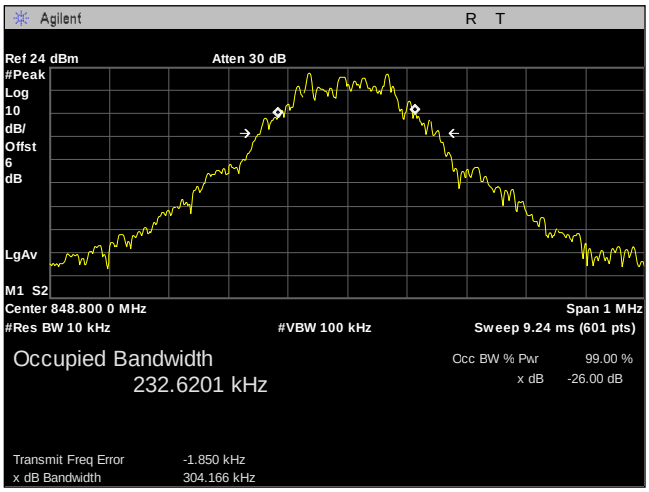
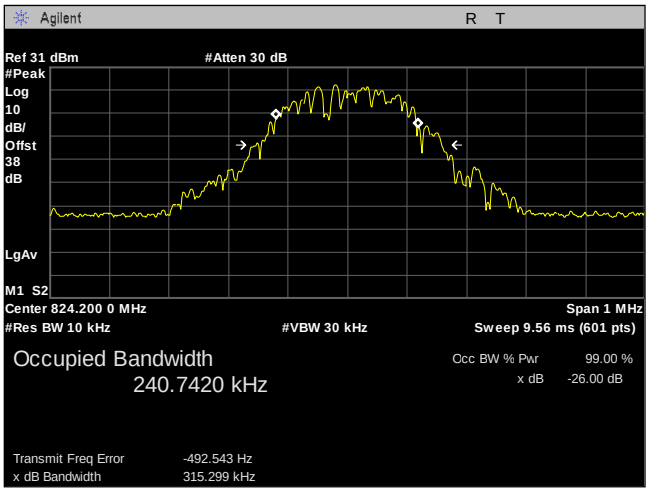


Figure 2. Occupied Bandwidth Test Setup

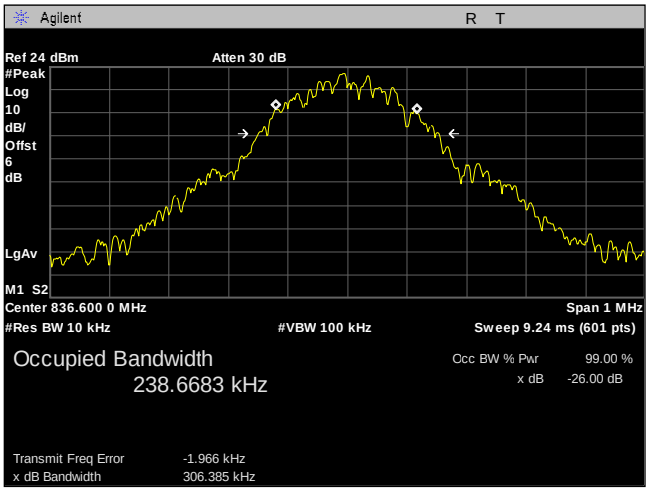
Occupied Bandwidth,



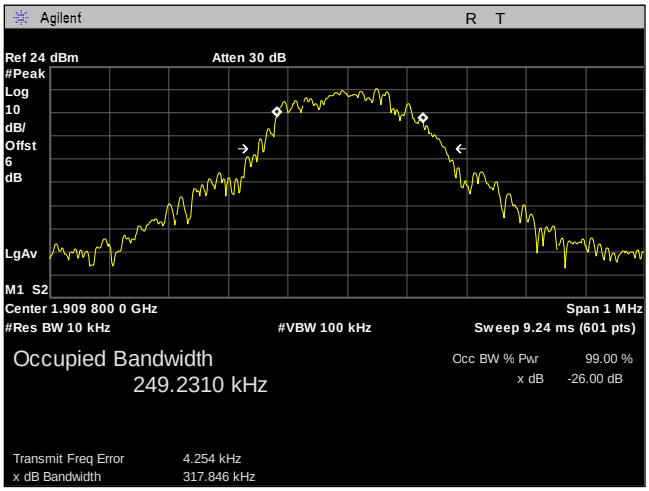
Plot 1. Occupied Bandwidth, GSM, 850, High Channel



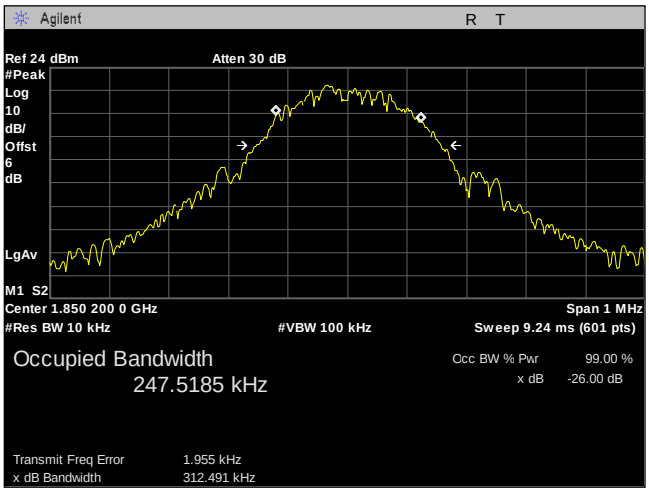
Plot 2. Occupied Bandwidth, GSM, 850, Low Channel



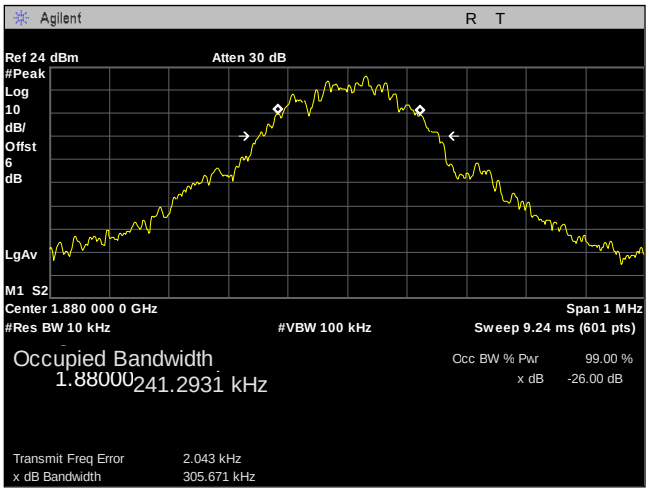
Plot 3. Occupied Bandwidth, GSM, 850, Mid Channel



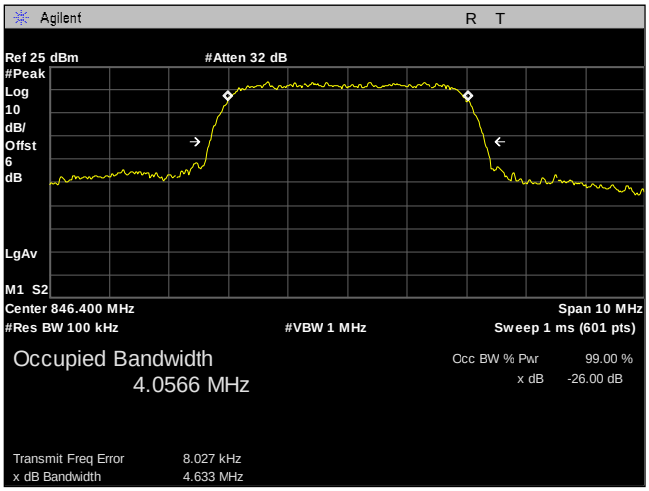
Plot 4. Occupied Bandwidth, GSM, 1900, High Channel



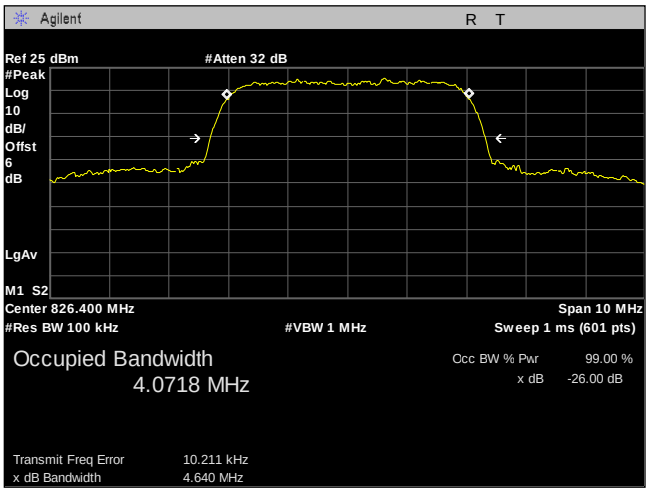
Plot 5. Occupied Bandwidth, GSM, 1900, Low Channel



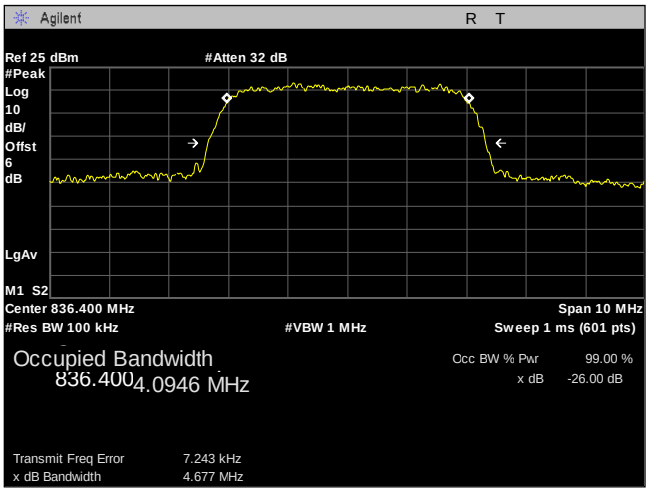
Plot 6. Occupied Bandwidth, GSM, 1900, Mid Channel



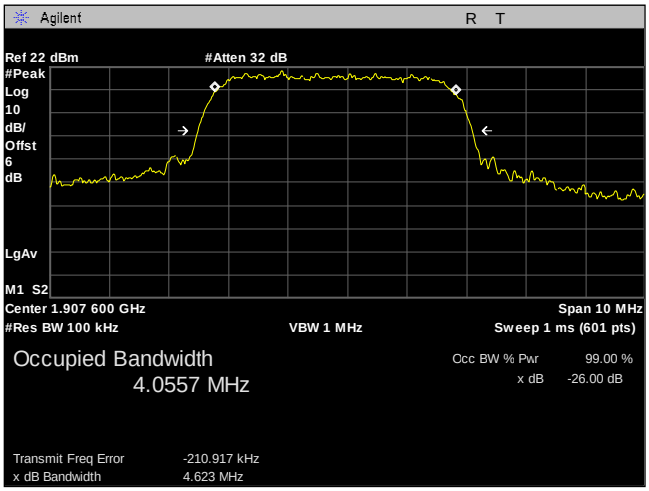
Plot 7. Occupied Bandwidth, WCDMA, Band 5 \High Channel



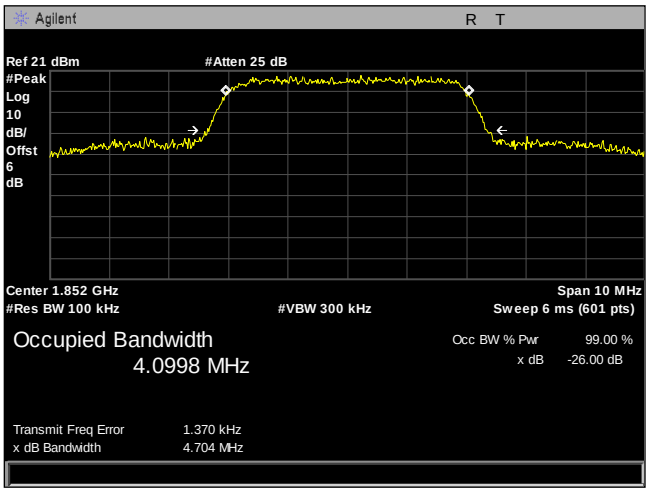
Plot 8. Occupied Bandwidth, WCDMA, Band 5, Low Channel



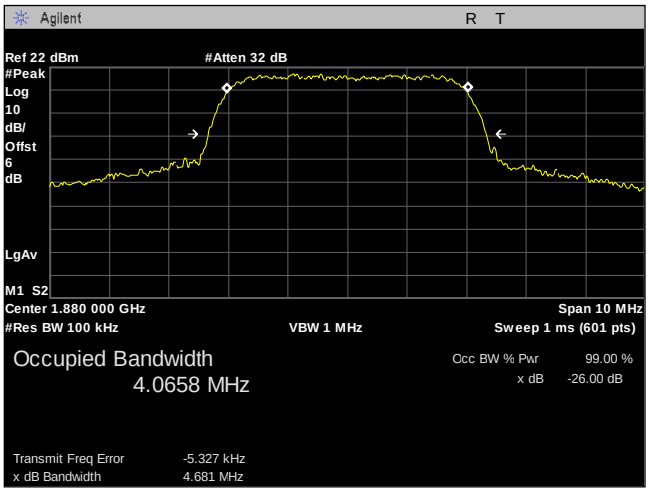
Plot 9. Occupied Bandwidth, WCDMA, Band 5 Mid Channel



Plot 10. Occupied Bandwidth, WCDMA, Band II, High Channel



Plot 11. Occupied Bandwidth, WCDMA, Band II, Low Channel



Plot 12. Occupied Bandwidth, WCDMA, Band II, Mid Channel

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 2.1047 Modulation Characteristics

Test Requirement(s): **(d)** ***Other types of equipment.*** A curve or equivalent data which shows that the equipment will meet the modulation requirements of the rules under which the equipment is to be licensed.

Test Results: The EUT complies with the requirements of this section. The EUT employs GMSK, 8PSK, and QPSK modulation.

Test Engineer: Djed Mouada

Test Date(s): May 26, 2017

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 2.1053 Radiated Spurious Emissions

Test Requirement(s): **§ 2.1053 Measurements required: Field strength of spurious radiation.**

§ 2.1053 (a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

§ 2.1053 (b): The measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emissions are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz.

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

§ 22.917 Emission limitations Cellular equipment: The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.

§ 22.917 (a): Out of band emissions. 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).

§24.238 (a) *Out of band emissions.* 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.

Test Procedures: The EUT was tested according to field strength method of ANSI C63.26 5.5.4. The spectrum analyzer was used and configured in the following manner:

(a) Frequency Range = Lowest Generated – 10th Harmonic
(b) RBW = 1MHz
(c) VBW 1-3 x the RBW
(d) Detector = Average

Radiated emission measurements were performed inside a 3 meter chamber that satisfies the site requirements of ANSI C63.4-2014. The EUT was place on an rf transparent 80 cm table for measurements below 1GHz and an rf transparent 1.5 meter table for measurements above 1GHz. The EUT's RF ports were terminated to 50ohm load. The EUT was tested using all modulations and at the low, mid, and high channels. The EUT was rotated about 360^0 and the receiving antenna scanned from 1-4m in order to capture the maximum emission. The plots are corrected for cable loss, antenna correction factor, and distance correction. The field strength was mathematically corrected to an E.I.R.P.

Emissions below 30MHz and above 18GHz were more than 20dB below the limit. The worse-case configurations are reported.

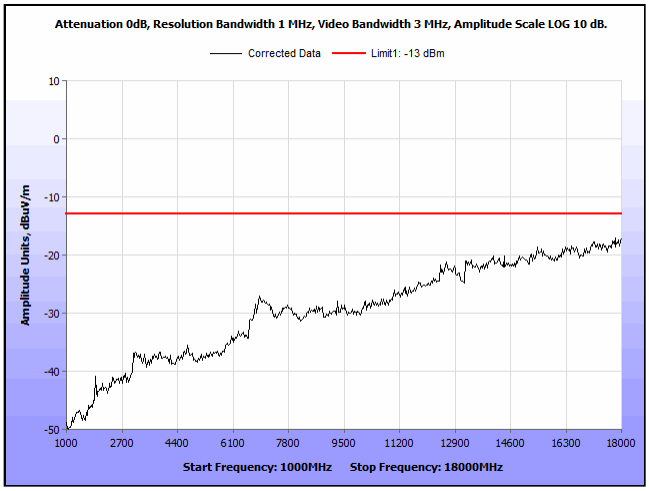
Test Results: The EUT complies with the requirements of this section.

Measurements were made in each configuration. Data is presented for the worse case configuration.

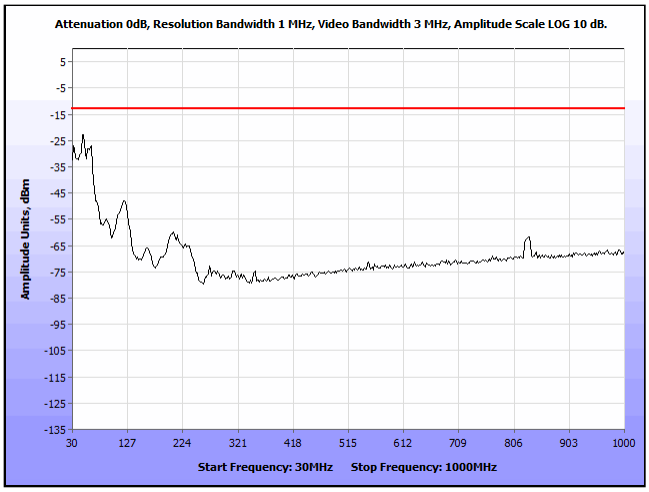
Test Engineer: Djed Mouada

Test Date(s): May 26, 2017

Radiated Spurious Emissions,

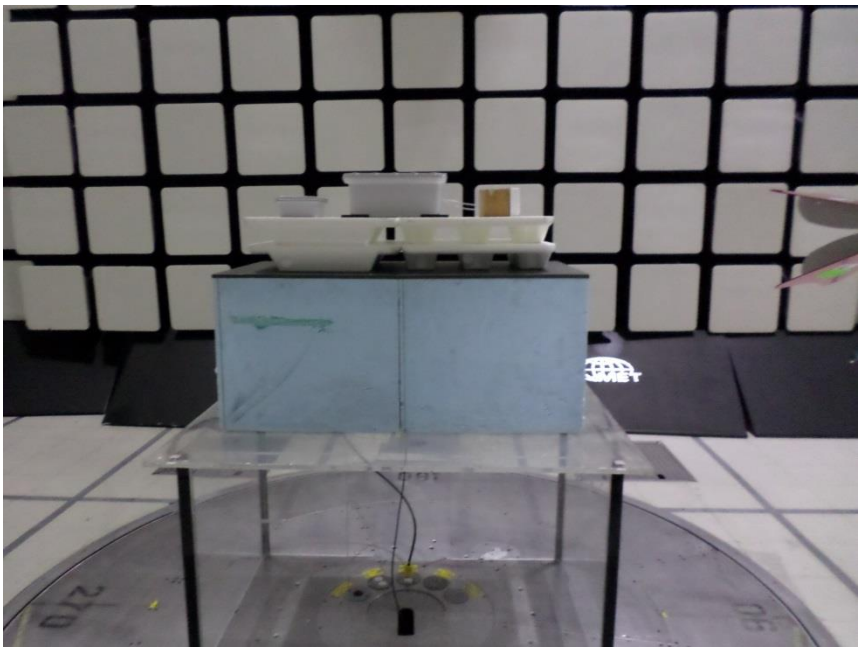


Plot 13. Radiated Emissions, 10MHzBW, 1GHz-18GHz



Plot 14. Radiated Emissions, 30MHz-1GHz

Photograph 1. Radiated Spurious Emissions, Test Setup (Below 1GHz)



Photograph 2. Radiated Spurious Emissions, Test Setup (Above 1GHz)

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 2.1051 Spurious Emissions at Antenna Terminals

Test Requirement(s):

§ 2.1051 Measurements required: Spurious emissions at antenna terminals: The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate.

§ 22.917 The rules in this section govern the spectral characteristics of emissions in the Cellular Radiotelephone Service.

§ 22.917 (a) Out of band emissions. 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.

§24.238 Emission limitations for Broadband PCS equipment: The rules in this section govern the spectral characteristics of emissions in the Broadband Personal Communications Service.

§ 24.238 (a) Out of band emissions. 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.

Test Procedures:

The EUT was tested according to the unwanted emissions procedures of ANSI C63.26 5.7.3.The spectrum analyzer was used and configured in the following manner:

(e) Frequency Range = 30MHz – 10th Harmonic
(f) RBW = 1% of the OBW, or greater
(g) VBW 1-3 x the RBW
(h) Detector = Peak
(i) Sweet Time = Auto

Test Results:

The equipment complies with the requirements of this section.

For out of band emissions, the low, mid, and high channels for each test mode were evaluated, data is presented for the worse case/ highest output channel.

For band edge emissions, each bandwidth mode was evaluated. Data is presented for the worse case configurations.

Test Engineer(s): Djed Mouada

Test Date(s): May 26, 2017

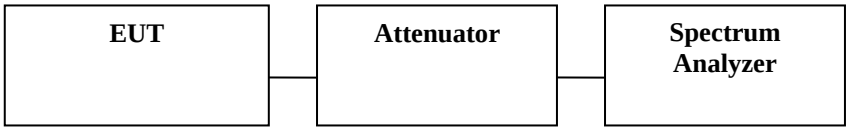
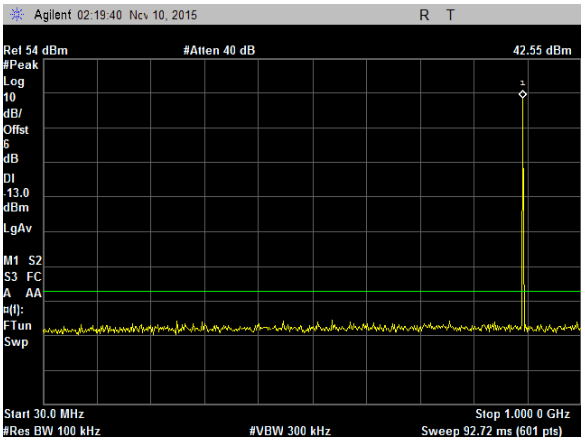
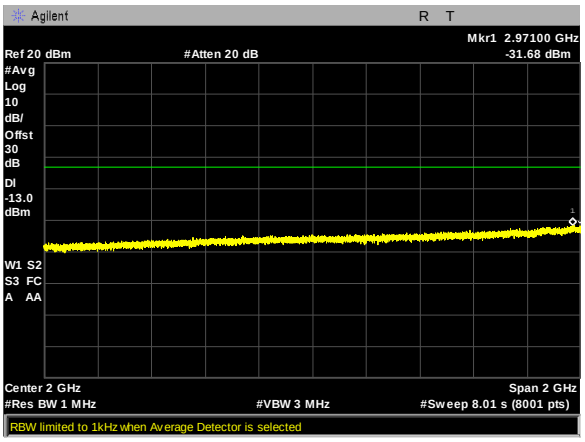


Figure 3. Spurious Emissions at Antenna Terminals Test Setup

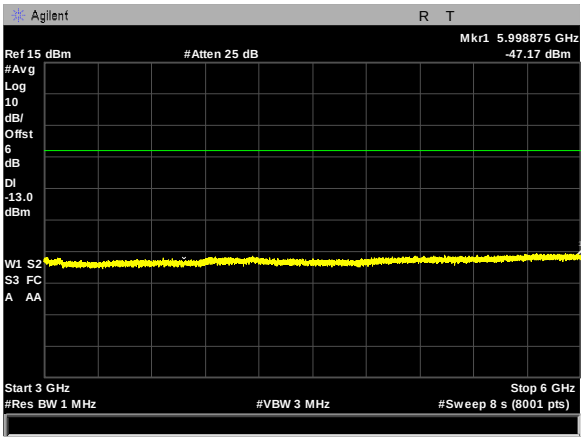
Conducted Spurious Emissions GSM 850, Mid Channel



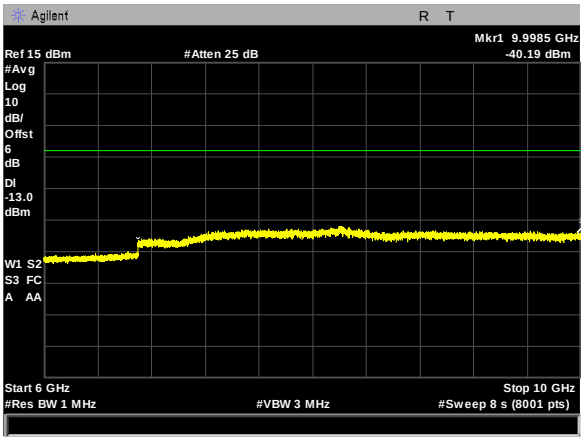
Plot 15. Spurious Emissions at Antenna Terminals, GSM 850, Mid Channel, 30 MHz - 1 GHz



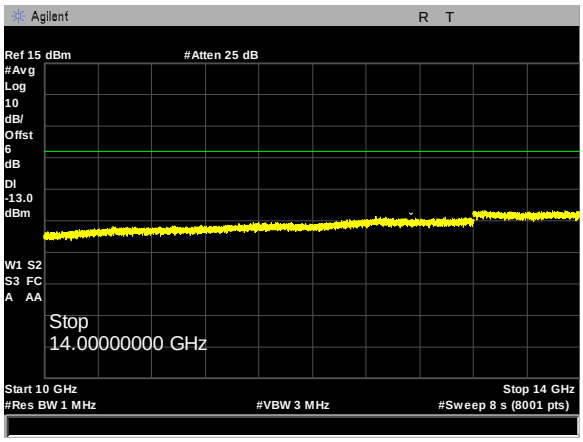
Plot 16. Spurious Emissions at Antenna Terminals, GSM 850, Mid Channel, 1 GHz – 3 GHz



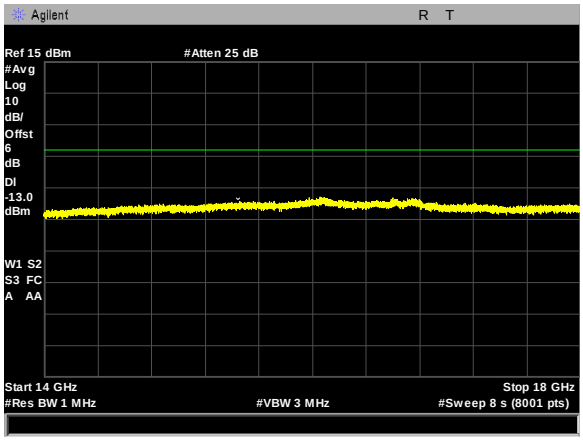
Plot 17. Spurious Emissions at Antenna Terminals, GSM 850, Mid Channel, 3 GHz - 6 GHz



Plot 18. Spurious Emissions at Antenna Terminals, GSM 850, Mid Channel, 6 GHz - 10GHz

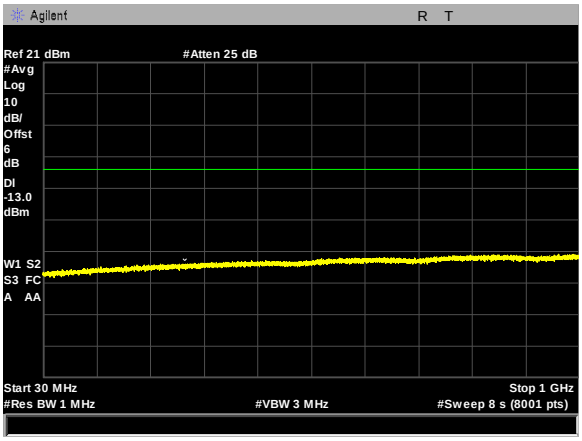


Plot 19. Spurious Emissions at Antenna Terminals, GSM 850 Mid, Low Channel, 10GHz - 14GHz

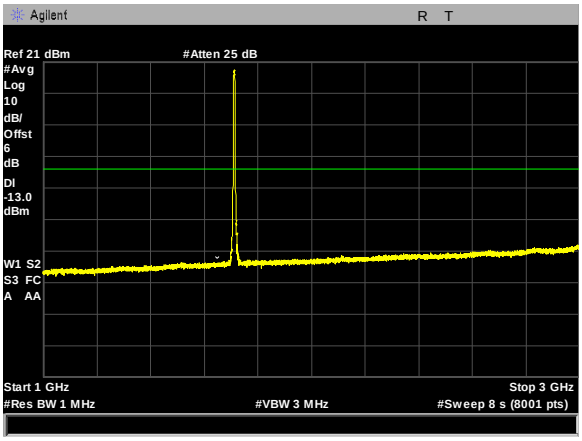


Plot 20. Spurious Emissions at Antenna Terminals, GSM 850 Mid, Low Channel, 14 GHz – 18 GHz

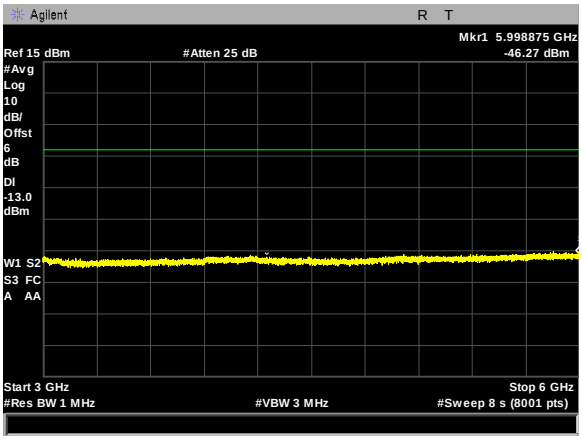
Conducted Spurious Emissions GSM 1900, Low Channel



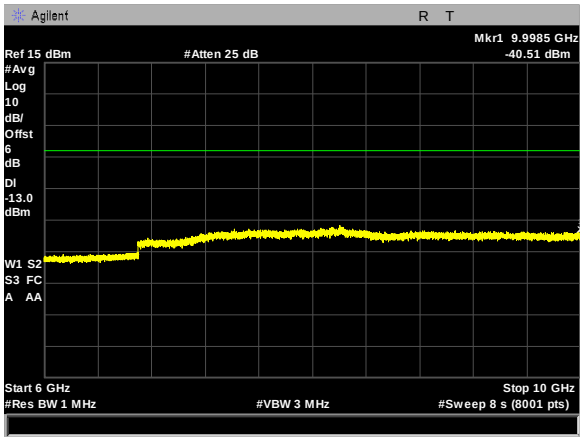
Plot 21. Spurious Emissions at Antenna Terminals, GSM 1900, Low Channels, 30 MHz - 1 GHz



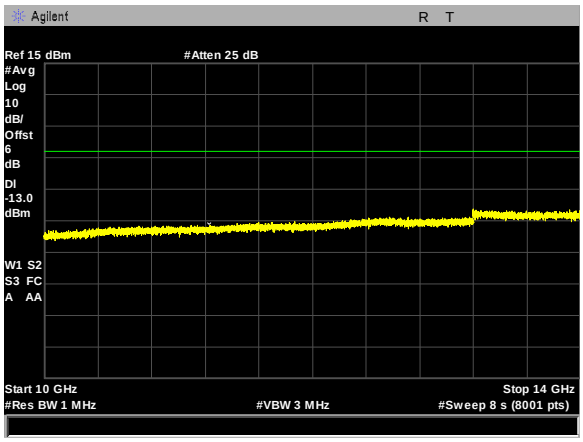
Plot 22. Spurious Emissions at Antenna Terminals, GSM 1900, Low Channel, 1 GHz – 3 GHz



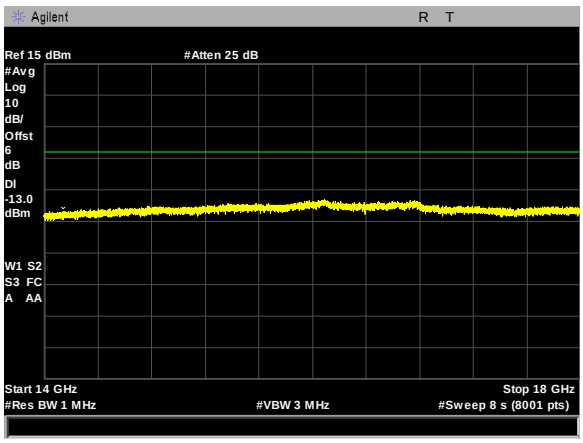
Plot 23. Spurious Emissions at Antenna Terminals, GSM 1900, Low Channel, 3 GHz – 6 GHz



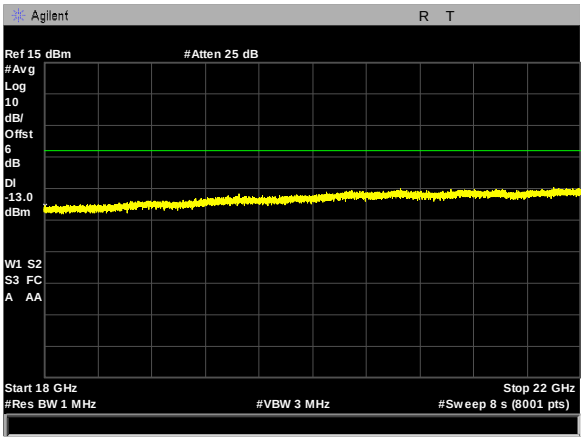
Plot 24. Spurious Emissions at Antenna Terminals, GSM 1900, Low Channel, 6 GHz – 10 GHz



Plot 25. Spurious Emissions at Antenna Terminals, GSM 1900, Low Channel, 10 GHz – 14 GHz

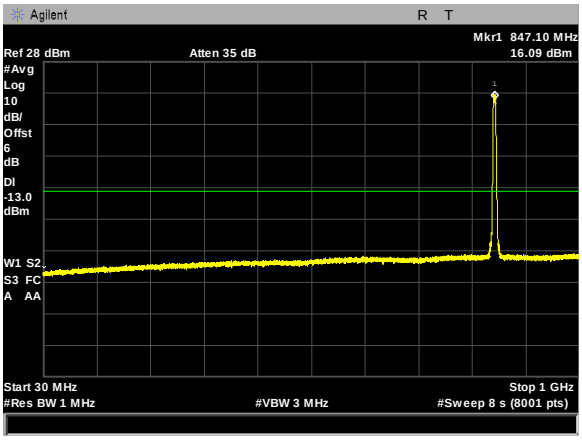


Plot 26, Spurious Emissions at Antenna Terminals, GSM 1900, Low Channel, 14 GHz – 18 GHz

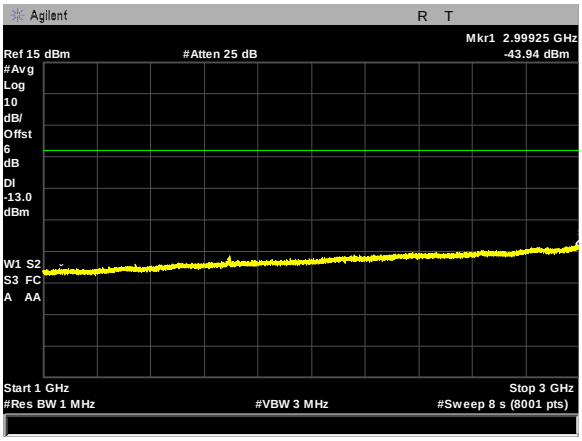


Plots 58. Spurious Emissions at Antenna Terminals, GSM 1900, Low Channel, 18GHz - 22GHz

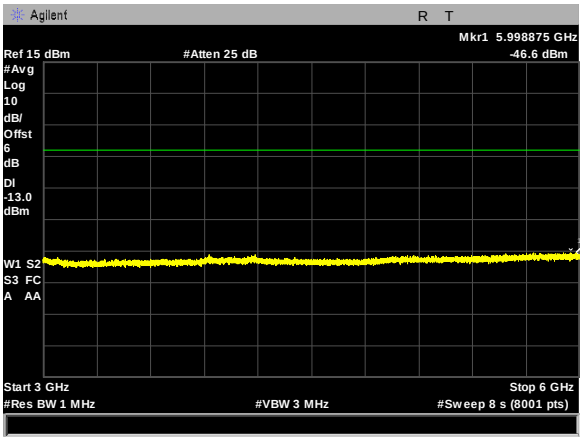
Conducted Spurious Emissions WCDMA Band V, High Channel



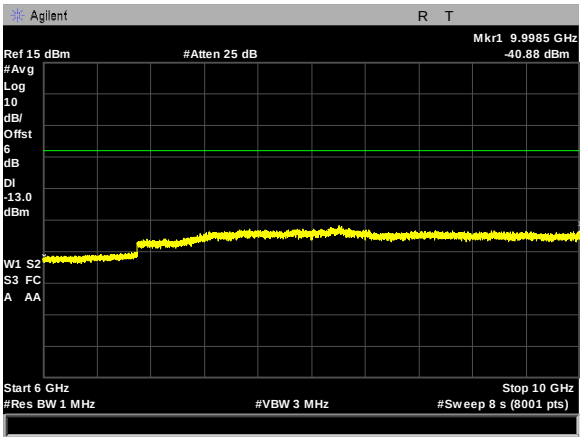
Plot 27. Spurious Emissions at Antenna Terminals, WCDMA Band V, High Channel, 30MHz – 1 GHz



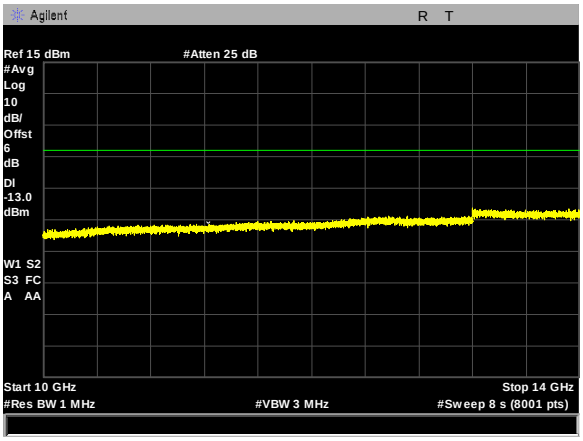
Plot 28. Spurious Emissions at Antenna Terminals, WCDMA Band V, High Channel, 1 GHz – 3 GHz



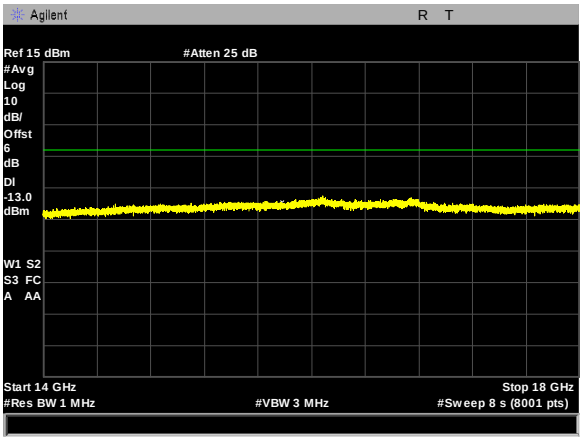
Plot 29. Spurious Emissions at Antenna Terminals, WCDMA Band V, High Channel, 3 GHz – 6 GHz



Plot 30. Spurious Emissions at Antenna Terminals, WCDMA Band V, High Channel, 6 GHz - 10 GHz

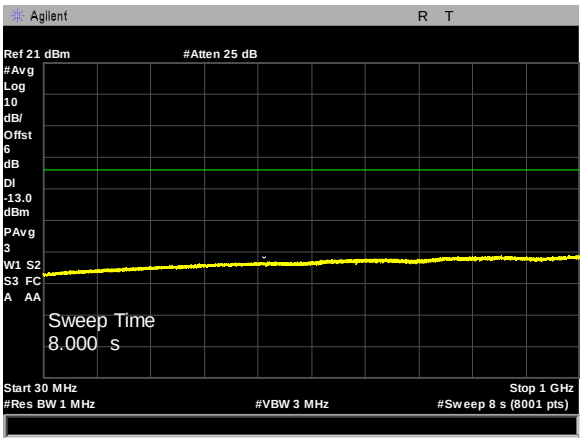


Plot 31. Spurious Emissions at Antenna Terminals, WCDMA Band V, High Channel, 10 GHz - 14 GHz

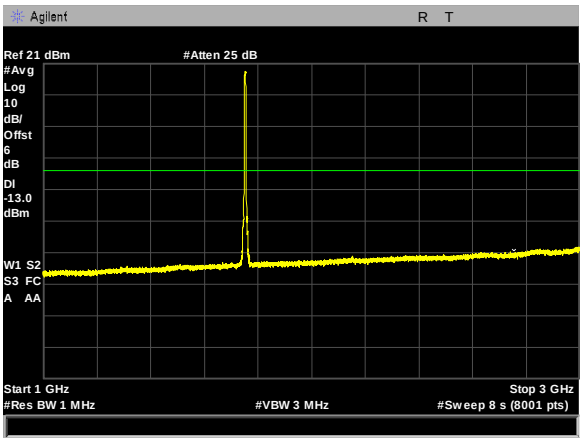


Plot 32. Spurious Emissions at Antenna Terminals, WCDMA Band V, High Channel, 14 GHz - 18 GHz

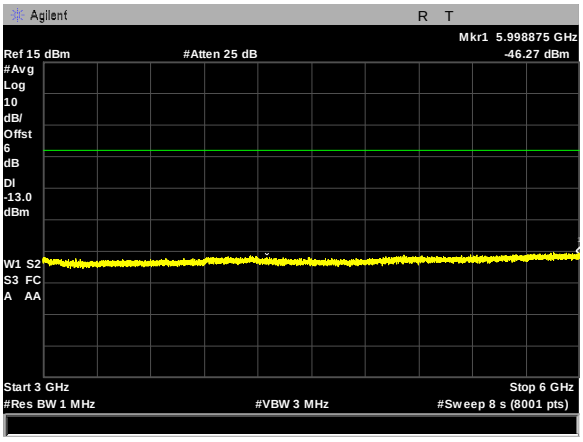
Conducted Spurious Emissions WCDMA Band II, High Channel



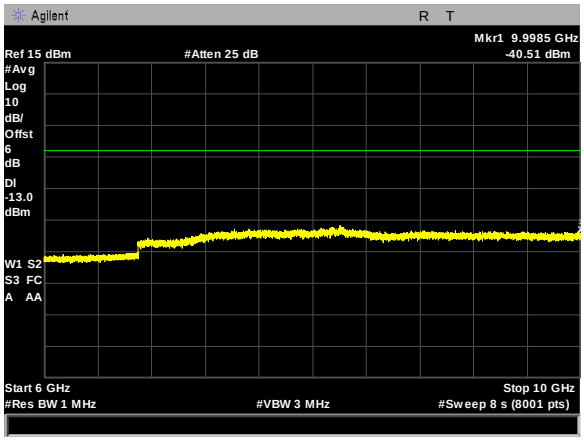
Plot 33. Spurious Emissions at Antenna Terminals, WCDMA II, High Channel, 30 MHz – 1 GHz



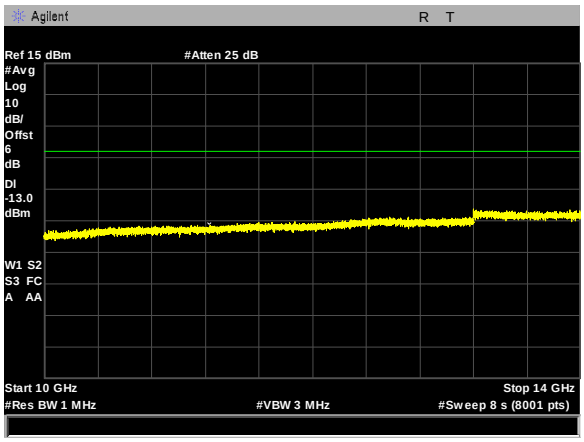
Plot 34. Spurious Emissions at Antenna Terminals, WCDMA II, High Channel, 1 GHz – 3 GHz



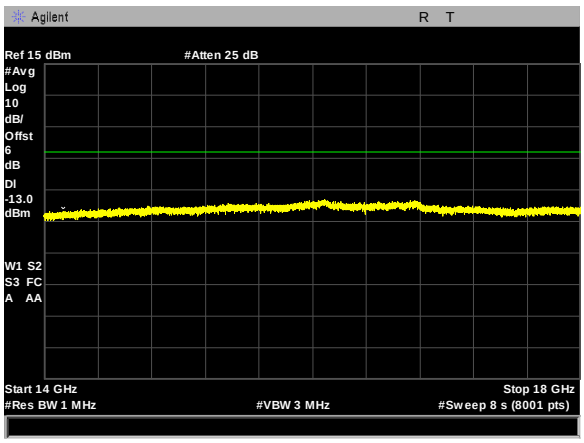
Plot 35. Spurious Emissions at Antenna Terminals, WCDMA II, High Channel, 3 GHz – 6 GHz



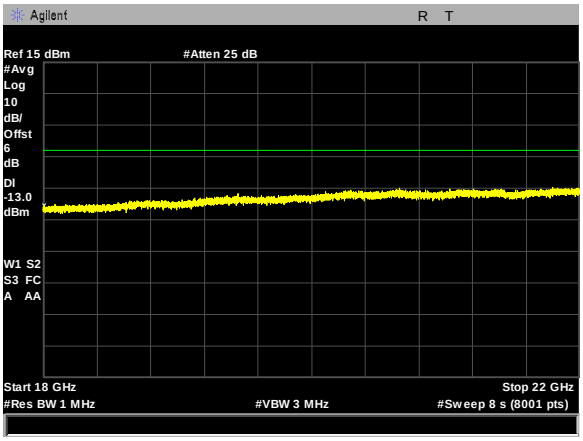
Plot 36. Spurious Emissions at Antenna Terminals, WCDMA II, High Channel, 6 GHz – 10 GHz



Plot 37. Spurious Emissions at Antenna Terminals, WCDMA II, High Channel, 10 GHz – 14 GHz

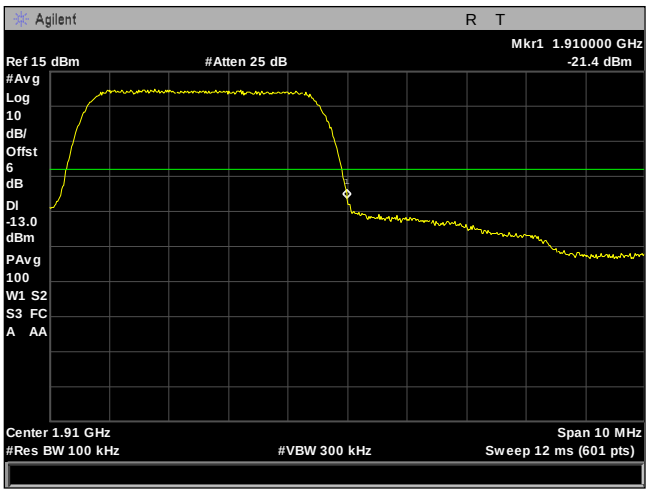


Plot 38. Spurious Emissions at Antenna Terminals, WCDMA II, High Channel, 14 GHz – 18 GHz

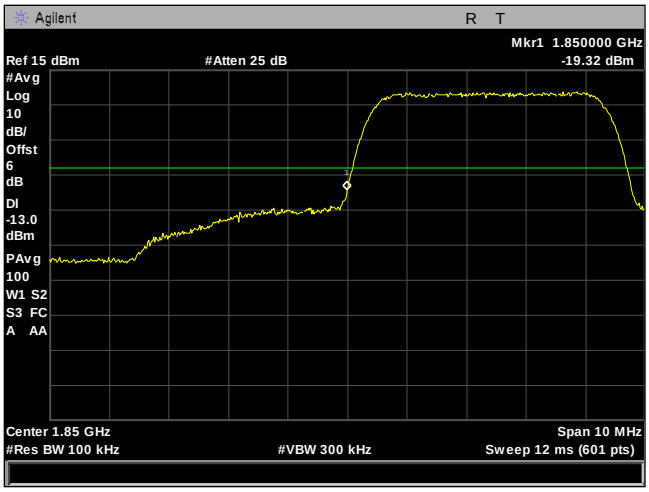


Plot 39. Spurious Emissions at Antenna Terminals, WCDMA II, High Channel, 18 GHz – 22 GHz

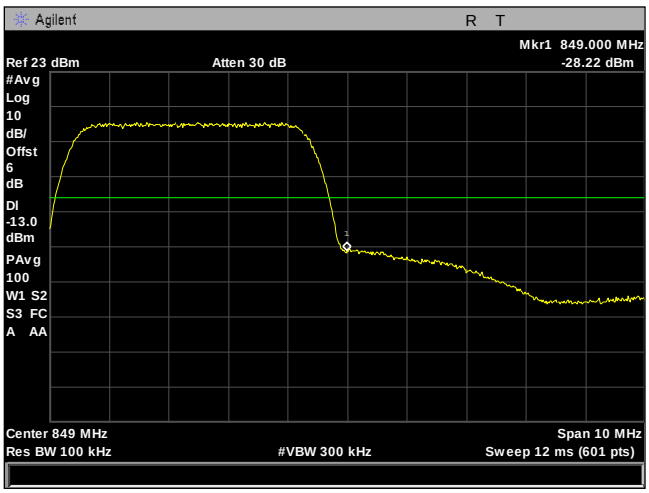
Conducted Bandedge WCDMA Band II



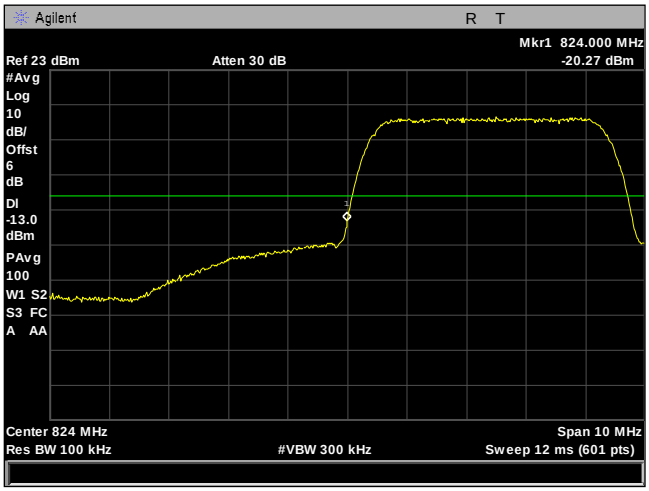
Plot 40. Spurious Emissions at Antenna Terminals, WCDMA Band II, Band Edge High



Plot 41. Spurious Emissions at Antenna Terminals, WCDMA Band II, Band Edge Low



Plot 42. Spurious Emissions at Antenna Terminals, WCDMA, Band V, Band Edge, High



Plot 43. Spurious Emissions at Antenna Terminals, WCDMA, Band V, Band Edge, Low

Electromagnetic Compatibility Criteria for Intentional Radiators

§ 24.232(d) Peak to Average Ratio

Test Requirement(s): **§ 24.232(d)** Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (e) of this section. In both instances, equipment employed must be authorized in accordance with the provisions of §24.51. In measuring transmissions in this band using an average power technique, the peak-to-average ration (PAR) of the transmission may not exceed 13 dB.

Test Procedures: The EUT was tested using the spectrum analyzers peak to average power measurement function.

Test Results: Equipment complies with these requirements.

Test Engineer(s): Djed Mouada

Test Date(s): May 26, 2017

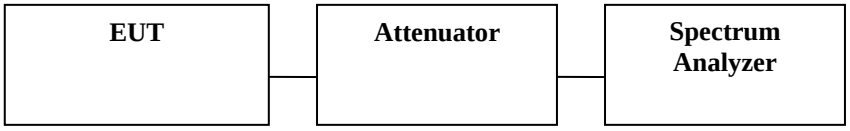
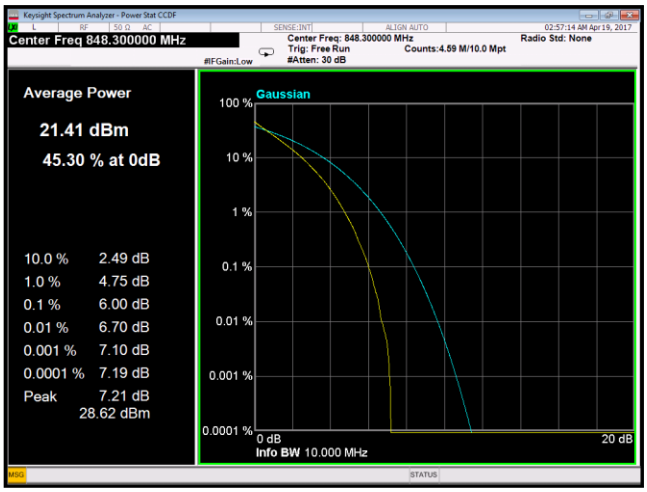
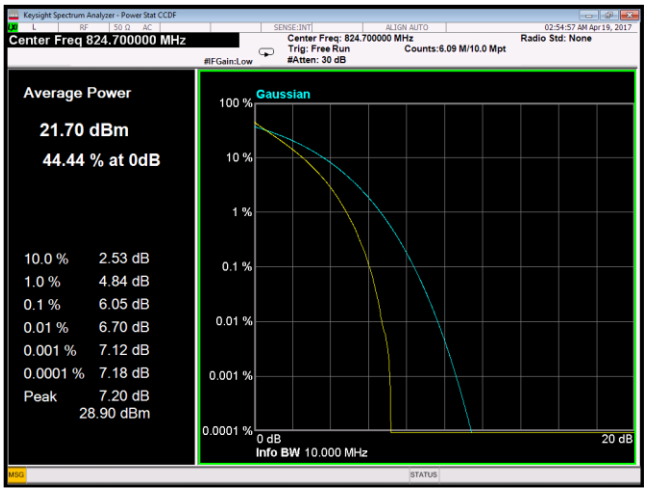


Figure 4. Spurious Emissions at Antenna Terminals Test Setup

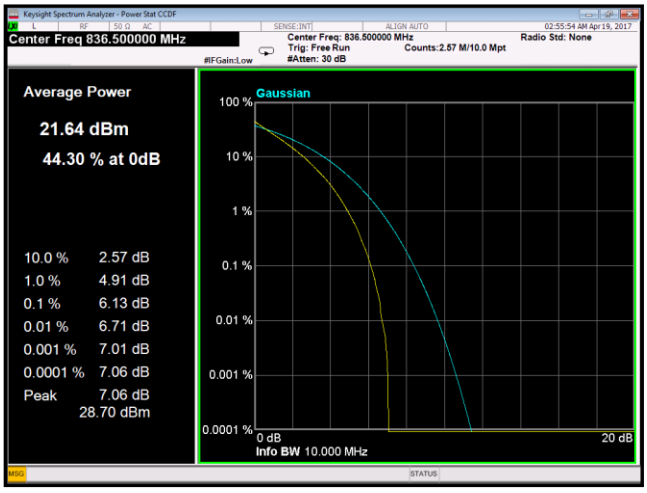
Peak to Average Ratio, GSM 850



Plot 44. Peak To Average Ratio, GSM 850 High Channel

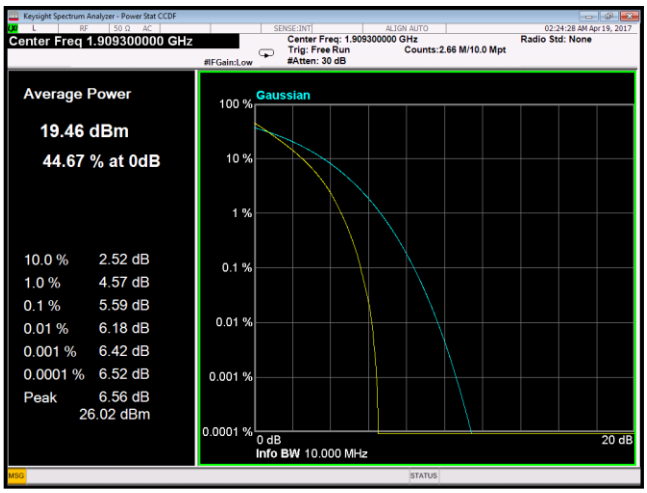


Plot 45. Peak To Average Ratio, GSM 850 Low Channel

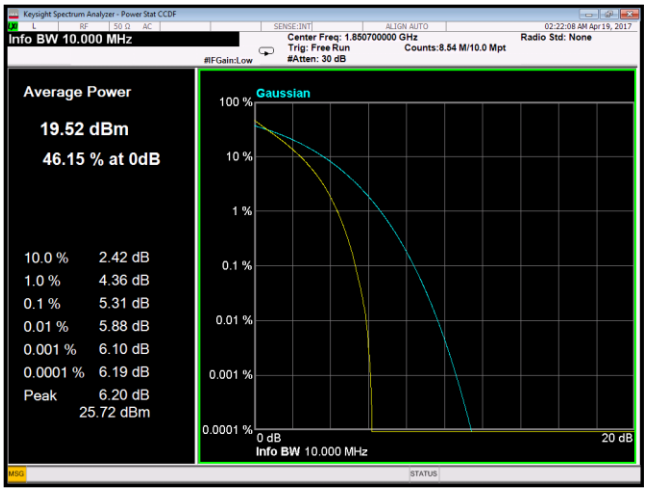


Plot 46. Peak To Average Ratio, GSM 850 MID Channel

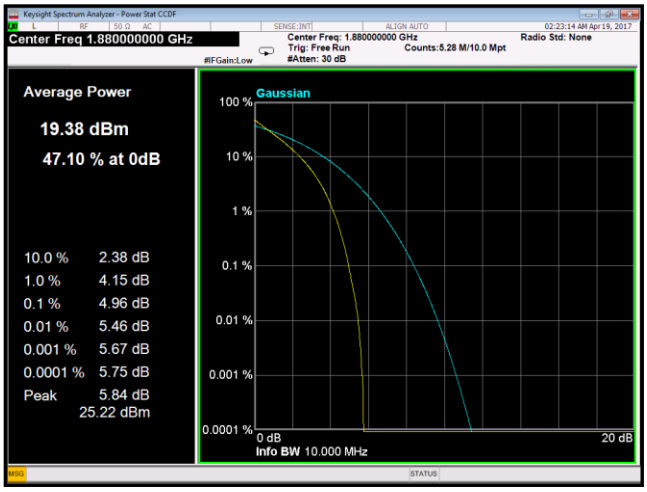
Peak to Average Ratio, GSM 1900



Plot 47. Peak To Average Ratio, GSM 1900 High Channel

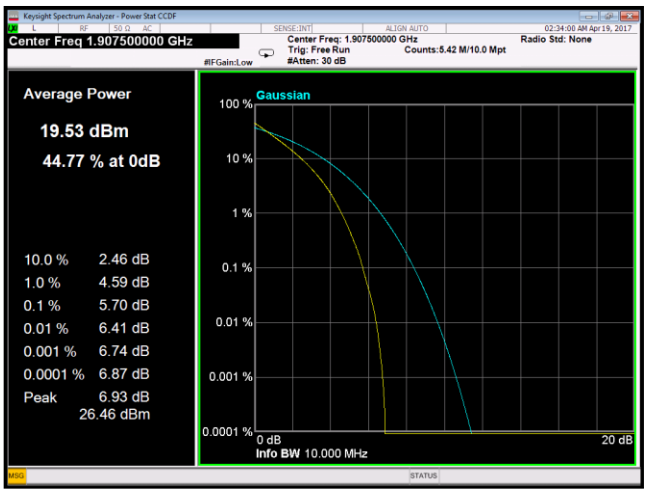


Plot 48. Peak To Average Ratio, GSM 1900 Low Channel

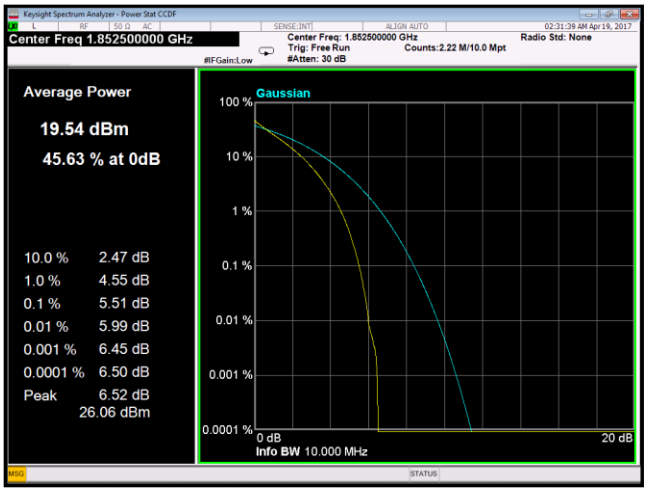


Plot 49. Peak To Average Ratio, GSM 1900 Mid Channel

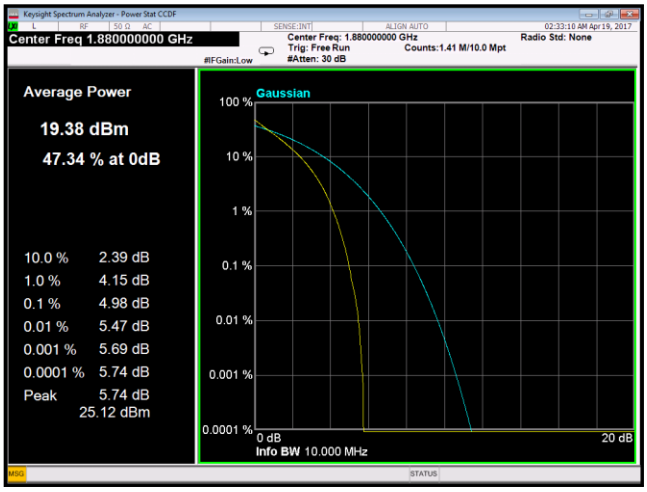
Peak to Average Ratio, WCDMA Band II



Plot 50. Peak To Average Ratio, WCDMA II- High Channel

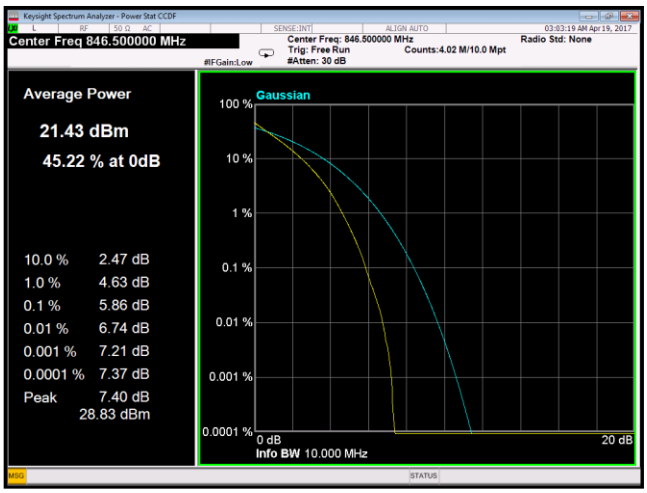


Plot 51. Peak To Average Ratio, WCDMA II- Low Channel

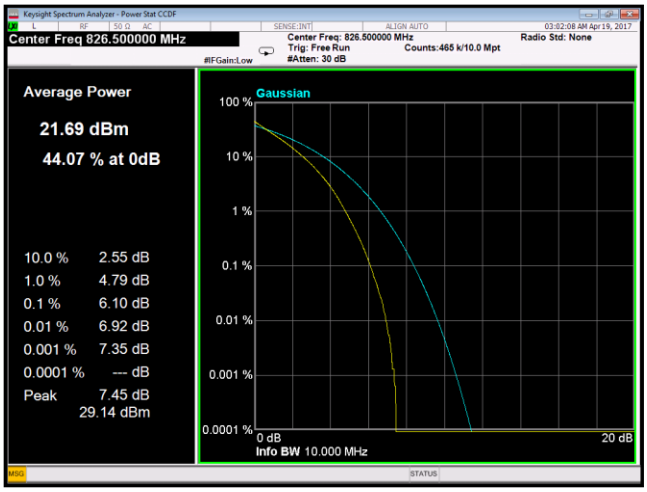


Plot 52. Peak To Average Ratio, WCDMA II- MID Channel

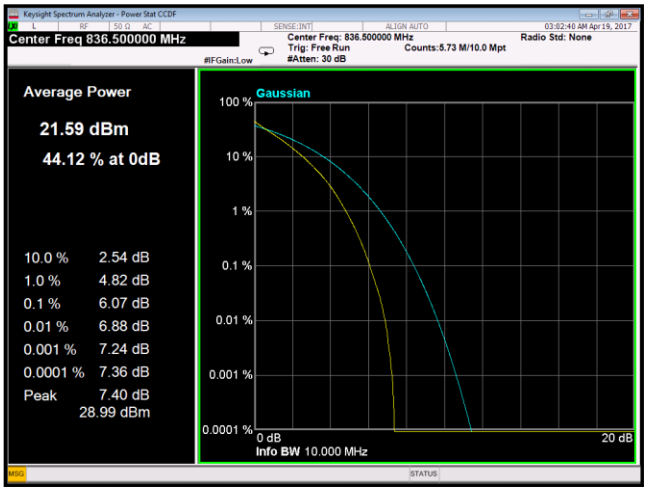
Peak to Average Ratio, WCDMA Band V



Plot 53. Peak To Average Ratio, WCDMA V High Channel



Plot 54. Peak To Average Ratio, WCDMA V Low Channel



Plot 55. Peak To Average Ratio, WCDMA V Mid Channel

Electromagnetic Compatibility Criteria for Intentional Radiators

§2.1049 Frequency Stability

Test Requirement(s): §2.1055 (a) The frequency stability shall be measured with variation of ambient temperature. (d) The frequency stability shall be measured with variation of primary supply voltage.

§24.235 The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

Test Procedures: The EUT was placed inside a temperature chamber and Frequency measurements were made at the extremes of the specified temperature range and at intervals of 10° centigrade through the range. The operating voltage is varied to +/- 15 % of the nominal voltage at normal temperature.

Test Results: Equipment complies with the requirements of this section.

Test Engineer(s): Djed Mouada

Test Date(s): May 26, 2017

WCDMA Band II					
Voltage (DC)	Temperature	Low 26dB Point	Band Edge	High 26dB Point	Band Edge
110	-20	1850.113179	1850	1909.957363	1910
110	-10	1850.012299	1850	1909.867401	1910
110	0	1850.019947	1850	1908.930597	1910
110	10	1850.457912	1850	1909.902822	1910
110	20	1850.034529	1850	1909.575094	1910
110	30	1850.027301	1850	1909.990982	1910
110	40	1850.051004	1850	1909.916226	1910
110	50	1850.028767	1850	1909.941978	1910
110	55	1850.010252	1850	1909.65074	1910
93.5	20	1850.04494	1850	1909.948608	1910
108	20	1850.050066	1850	1909.872302	1910

Table 7. Module Frequency Stability, 2G - 3G, WCDMA Band II, Test Results

WCDMA Band V					
Voltage (DC)	Temperature	low 26dB point	Band Edge	High 26dB point	Band Edge
110	-20	824.045763	824	848.985387	849
110	-10	824.026004	824	848.96569	849
110	0	824.013084	824	848.198463	849
110	10	824.023747	824	848.272865	849
110	20	824.01071	824	848.606647	849
110	30	824.047505	824	848.444946	849
110	40	824.012238	824	848.228362	849
110	50	824.028594	824	848.938627	849
110	55	824.020578	824	848.926811	849
93.5	20	824.031384	824	848.512975	849
108	20	824.058781	824	848.965111	849

Table 8. Module Frequency Stability, 2G - 3G, WCDMA Band V, Test Results

GSM 850					
Voltage (DC)	Temperature	low 26dB point	Band Edge	High 26dB point	Band Edge
110	-20	824.0194	824	848.949852	849
110	-10	824.0158	824	848.952408	849
110	0	824.0475	824	848.95389	849
110	10	824.0136	824	848.97841	849
110	20	824.0292	824	848.938536	849
110	30	824.0356	824	848.975402	849
110	40	824.0423	824	848.853917	849
110	50	824.0177	824	848.985886	849
110	55	824.0463	824	848.94606	849
93.5	20	824.0619	824	848.952832	849
108	20	824.0459	824	898.959713	849

Table 9. Module Frequency Stability, 2G - 3G, GSM 850, Test Results

GSM 1900					
Voltage (DC)	Temperature	low 26dB point	Band Edge	High 26dB point	Band Edge
110	-20	1850.117	1850	1909.979772	1910
110	-10	1850.032	1850	1909.317229	1910
110	0	1850.028	1850	1909.190383	1910
110	10	1850.468	1850	1909.17408	1910
110	20	1850.075	1850	1909.149419	1910
110	30	1850.041	1850	1909.925347	1910
110	40	1850.046	1850	1909.729796	1910
110	50	1850.044	1850	1909.496367	1910
110	55	1850.017	1850	1909.519532	1910
93.5	20	1850.039	1850	1909.259591	1910
108	20	1850.023	1850	1909.87304	1910

Table 10. Module Frequency Stability, 2G - 3G, GSM 1900, Test Results

Frequency Stability, Test Setup

Photograph 3. Frequency Stability, Test Setup

Maximum Permissible Exposure

RF Exposure Requirements: **§1.1307(b)(1) and §1.1307(b)(2):** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines.

RF Radiation Exposure Limit: **§1.1310:** As specified in this section, the Maximum Permissible Exposure (MPE) Limit shall be used to evaluate the environmental impact of human exposure to radiofrequency (RF) radiation as specified in Sec. 1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of Sec. 2.1093 of this chapter.

MPE Limit: EUT's operating frequencies @ 869-894 MHz and 1930-1990 MHz; **Limit for Uncontrolled exposure: 1 mW/cm^2 or 10 W/m^2**

Equation from page 18 of OET 65, Edition 97-01

$S = PG / 4\pi R^2$ or $R = \sqrt{(PG / 4\pi S)}$

where, S = Power Density (mW/cm^2)
P = Power Input to antenna (mW)
G = Antenna Gain (numeric value)
R = Distance (cm)

Test Results:

Frequency (MHz)	Con. Pwr. (dBm)	Con. Pwr. (mW)	Ant. Gain (dBi)	Ant. Gain numeric	Pwr. Density (mW/cm^2)	Limit (mW/cm^2)	Margin	Distance (cm)	Result
836.4	29.79	952.796	8	6.31	1	1	0	21.872	Pass

The safe distance where Power Density is less than the MPE Limit listed above was found to be 22 cm.

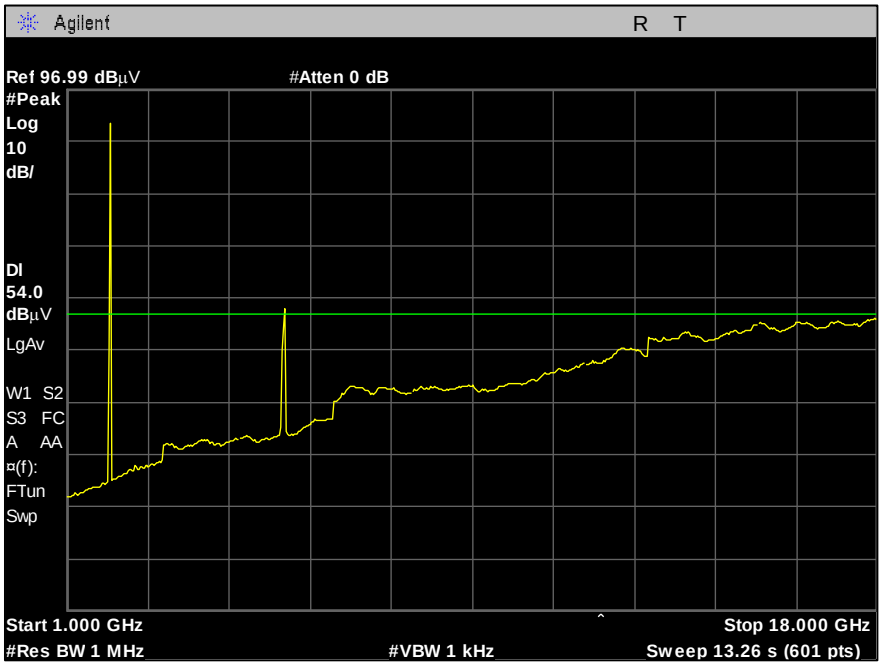
Test Results:

FCC									
Frequency (MHz)	Con. Pwr. (dBm)	Con. Pwr. (mW)	Ant. Gain (dBi)	Ant. Gain numeric	Pwr. Density (mW/cm^2)	Limit (mW/cm^2)	Margin	Distance (cm)	Result
836.4	29.79	952.796	8	6.31	0.7658	1	0.2341	25	Pass
2437.0	20.37	108.893	12	15.849	0.2198	1	0.7801	25	Pass

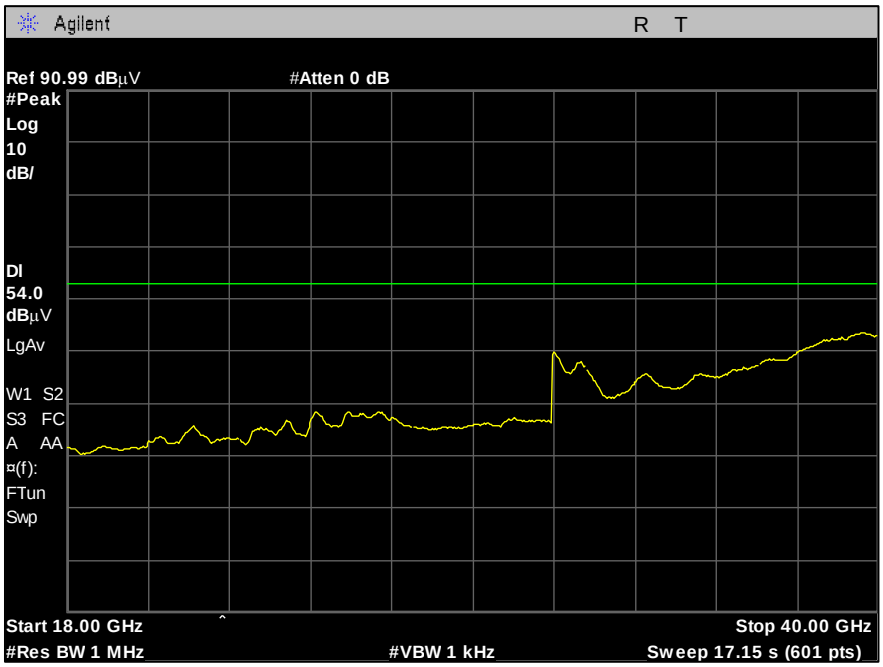
Note: Power used in MPE calculations are tune up tolerance's upper limits.

Total PME = 0.7658 + 0.2198 = 0.9856 mW/cm^2 < 1 mW/cm^2

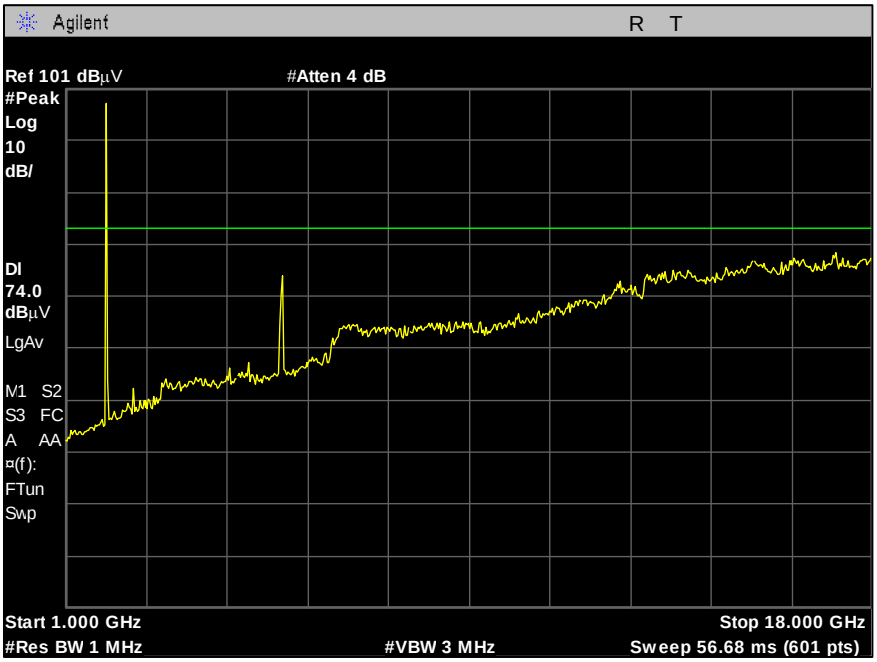
The safe distance where Power Density is less than the MPE Limit listed above was found to be 25 cm.



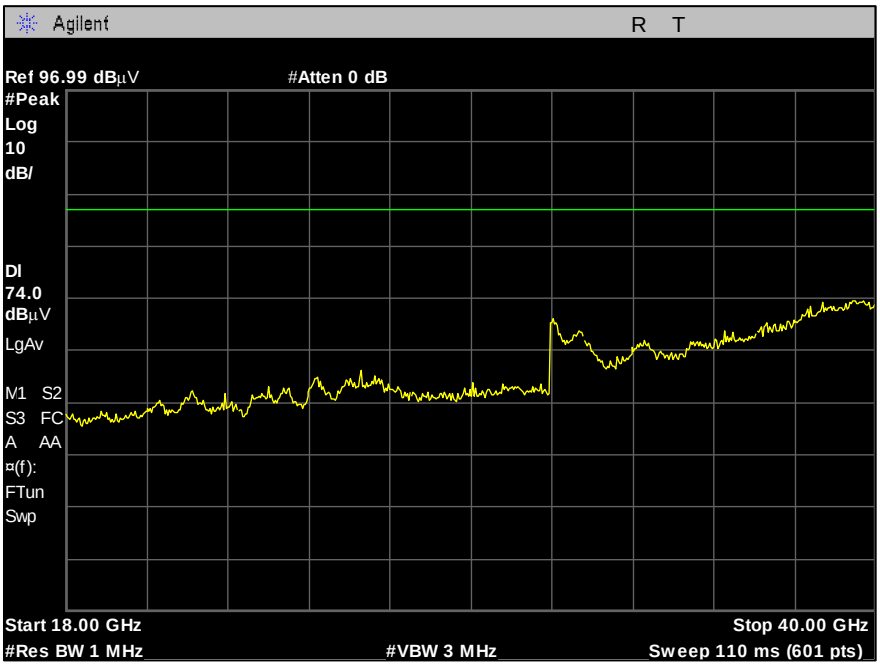
Plot 56. Simultaneous Transmission 3G WiFi 1-18 GHz Average



Plot 57. Simultaneous Transmission 3G WiFi 18-40 GHz Average



Plot 58. Simultaneous Transmission 3G WiFi 1-18 GHz Peak



Plot 59. Simultaneous Transmission 3G WiFi 18-40 GHz Peak

IV. Test Equipment

Test Equipment

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1T8818	Spectrum Analyzer	Agilent Technologies	E4407B	2/24/2017	2/24/2018
1T4753	Antenna - Bilog	Sunol Sciences	JB6	10/24/2016	4/24/2018
1T4563	LISN (10 AMP)	Solar Electronics Company	9322-50-R-10-BNC	3/13/2017	9/13/2018
1T4300	SEMI-ANECHOIC CHAMBER # 1 (NSA)	EMC TEST SYSTEMS	NONE	2/6/2015	2/6/2018
1T4409	EMI Receiver	Rohde & Schwarz	ESIB7	12/7/2016	12/7/2018
1T4269	Antenna: Loop	EMCO	10/28/1917	1/11/2016	7/11/2017
1T4483	Antenna; Horn	ETS-Lindgren	7/13/1908	4/19/2017	10/19/2018
1T4771	PSA Spectrum Analyzer	Agilent Technologies	E4446A	8/10/2016	2/10/2018

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ISO/IEC 17025:2005.

Note: Functionally tested equipment is verified using calibrated instrumentation at the time of testing.

End of Report

