



Hermon Laboratories Ltd.  
Harakevet Industrial Zone, Binyamina 30500,  
Israel  
Tel. +972-4-6288001  
Fax. +972-4-6288277  
E-mail: mail@hermonlabs.com

## **PARTIAL TEST REPORT**

**ACCORDING TO: FCC CFR 47 part 22 subpart H, part 24 subpart E  
RSS-132 issue 3, RSS-133 issue 6**

**FOR:  
Visonic Ltd.  
Control Panel (PSC 2G/3G module)  
Model: PM-360(433) ADT  
FCC ID:WP3PM360433**

This report is in conformity with ISO/ IEC 17025. The "A2LA Accredited" symbol endorsement applies only to the tests and calibrations that are listed in the scope of Hermon Laboratories accreditation. The test results relate only to the items tested. This test report shall not be reproduced in any form except in full with the written approval of Hermon Laboratories Ltd.

## Table of contents

1	Applicant information .....	3
2	Equipment under test attributes .....	3
3	Manufacturer information .....	3
4	Test details .....	3
5	Tests summary .....	4
6	EUT description .....	5
6.1	General information .....	5
6.2	Ports and lines .....	5
6.3	Test configuration .....	5
6.4	Changes made in the EUT .....	5
6.5	EUT test positions .....	6
6.6	Transmitter characteristics, part 22 .....	7
6.7	Transmitter characteristics, part 24 .....	8
7	Transmitter tests according to 47CFR part 22 and RSS-132 requirements .....	9
7.1	Effective radiated power of carrier .....	9
7.2	Radiated spurious emission measurements of 3G module .....	26
7.3	Radiated spurious emission measurements of 2G module .....	35
8	Transmitter tests according to 47CFR part 24 and RSS-133 requirements .....	48
8.1	Equivalent isotropically radiated power of carrier .....	48
8.2	Radiated spurious emission measurements of 3G module .....	65
8.3	Radiated spurious emission measurements of 2G module .....	76
9	APPENDIX A Test equipment and ancillaries used for tests .....	89
10	APPENDIX B Measurement uncertainties .....	90
11	APPENDIX C Test laboratory description .....	91
12	APPENDIX D Specification references .....	91
13	APPENDIX E Test equipment correction factors .....	92
14	APPENDIX F Abbreviations and acronyms .....	100

## 1 Applicant information

**Client name:** Visonic Ltd.  
**Address:** 24 Habarzel street, Tel Aviv 69710, Israel  
**Telephone:** +972 3645 6832  
**Fax:** +972 3645 6788  
**E-mail:** zurir@tycoint.com  
**Contact name:** Mr. Zuri Rubin

## 2 Equipment under test attributes

**Product name:** Cellular (PSC 2G/3G) module of Control Panel  
**Product type:** Transceiver  
**Model(s):** PM-360(433) ADT  
**Serial number:** 1916150170  
**Hardware version:** 90-208059  
**Software release:** JS-702955  
**Receipt date:** 12-Apr-15

## 3 Manufacturer information

**Manufacturer name:** Visonic Ltd.  
**Address:** 24 Habarzel street, Tel Aviv 69710, Israel  
**Telephone:** +972 3645 6832  
**Fax:** +972 3645 6788  
**E-Mail:** zurir@tycoint.com  
**Contact name:** Mr. Zuri Rubin





## 4 Test details

**Project ID:** 28637  
**Location:** Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel  
**Test started:** 21-Apr-15  
**Test completed:** 08-Jul-15  
**Test specification(s):** FCC 47 CFR part 22 subpart H; part 24 subpart E;  
RSS-132 issue 3:2013, RSS-133 issue 6:2013

## 5 Tests summary

Test	Status
<b>Transmitter characteristics</b>	
FCC section 22.913/RSS-132, RF power output	Pass
FCC section 22.917/RSS-132, Radiated spurious emissions	Pass
FCC section 24.232/RSS-133, RF power output	Pass
FCC section 24.238/RSS-133, Radiated spurious emissions	Pass

The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

	Name and Title	Date	Signature
<b>Tested by:</b>	Mr. S. Samokha, test engineer	July 8, 2015	
	Mrs. E. Pitt, test engineer		
<b>Reviewed by:</b>	Mrs. M. Cherniavsky, certification engineer	August 9, 2016	
<b>Approved by:</b>	Mr. M. Nikishin, EMC and Radio group manager	August 14, 2016	

## 6 EUT description

### 6.1 General information

The EUT, Control panel PM-360 (433) ADT is a wireless control panel powered via external AC/DC adaptor. The panel comprises four Visonic RF boards with below radio modules:

1. PG-2 module- communication within the alarm system in 433 MHz band
2. WiFi module with Visonic antenna, connected to RF PCB
  - a. 802.11b
  - b. 802.11g
  - c. 802.11n HT20, 802.11n HT40.
3. Z-wave module with Visonic antenna connected to RF board
4. Cellular (PCS) module - modular approved with FCC ID:RI7UE910NA, IC: 5131A-UE910NA used for 3G/2G modes with Visonic antenna connected to RF board.

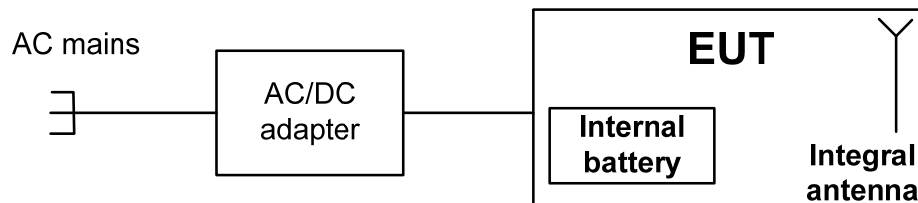
All radios could operate simultaneously.

The present test report involves the test results for certification of Class II permissive change of PCS 2G/3G module as a part of a composite application for certification.

### 6.2 Ports and lines

Port type	Port description	Connected from	Connected to	Qty.	Cable type	Cable length, m
Power	AC power	AC mains	AC/DC adaptor	1	Unshielded	2.0

### 6.3 Test configuration

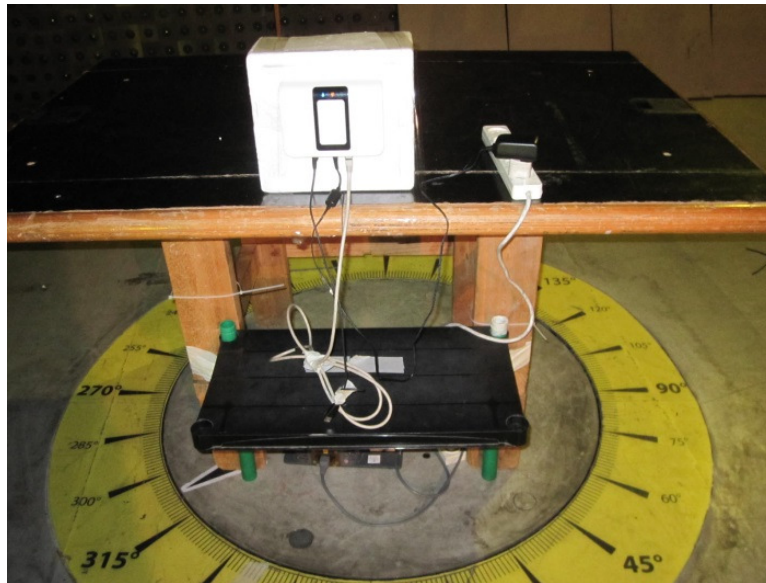


### 6.4 Changes made in the EUT

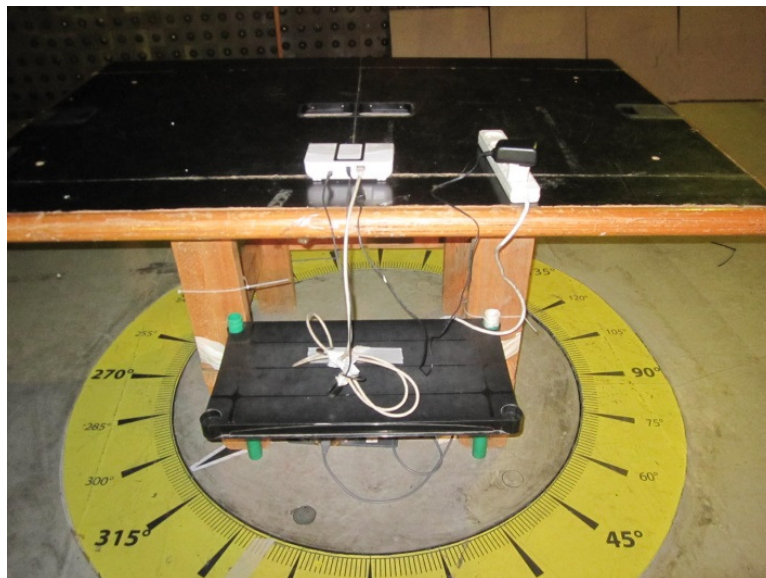
No changes were implemented in the EUT during the testing.

## 6.5 EUT test positions

Photograph 6.5.1 EUT in vertical position



Photograph 6.5.2 EUT in horizontal position





### 6.6 Transmitter characteristics, part 22

<b>Type of equipment</b>						
X	Stand-alone (Equipment with or without its own control provisions)					
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)					
	Plug-in card (Equipment intended for a variety of host systems)					
<b>Intended use</b>		<b>Condition of use</b>				
	fixed	Always at a distance more than 2 m from all people				
X	mobile	Always at a distance more than 20 cm from all people				
	portable	May operate at a distance closer than 20 cm to human body				
<b>Assigned frequency range</b>		824 – 849 MHz				
<b>Operating frequency range</b>		824.2 – 848.8 MHz (2G mode) 826.4 – 846.6 MHz (3G mode)				
<b>Maximum rated output power (ERP)</b>		34.04 dBm (2G mode); 26.93 dBm (3G mode)				
<b>Is transmitter output power variable?</b>		X	No			
				continuous variable		
				stepped variable with stepsize		
				minimum RF power		
				maximum RF power		
<b>Antenna connection</b>						
	unique coupling	standard connector	X	integral	with temporary RF connector without temporary RF connector	
<b>Antenna/s technical characteristics</b>						
Type	Manufacturer	Model number	Gain			
Integral	Visonic	H303518	3 dBi			
<b>Type of modulation</b>		BPSK (2G mode), QPSK (3G mode)				
<b>Transmitter power source</b>						
	Battery	<b>Nominal rated voltage</b>		Battery type	Lithium	
	DC	<b>Nominal rated voltage</b>				
X	AC mains	<b>Nominal rated voltage</b>	120 VAC	Frequency		
<b>Common power source for transmitter and receiver</b>				X	yes	no



### 6.7 Transmitter characteristics, part 24

<b>Type of equipment</b>					
X	Stand-alone (Equipment with or without its own control provisions)				
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)				
	Plug-in card (Equipment intended for a variety of host systems)				
<b>Intended use</b>		<b>Condition of use</b>			
	fixed	Always at a distance more than 2 m from all people			
X	mobile	Always at a distance more than 20 cm from all people			
	portable	May operate at a distance closer than 20 cm to human body			
<b>Assigned frequency range</b>		1850.0 – 1910.0 MHz			
<b>Operating frequency range</b>		1850.2 – 1909.8 MHz (2G mode) 1852.4 – 1907.6 MHz (3G mode)			
<b>Maximum rated output power (EIRP)</b>		27.8 dBm (2G mode) 26.45 dBm (3G mode)			
<b>Is transmitter output power variable?</b>		X	No		
				continuous variable	
				stepped variable with stepsize	
				minimum RF power	
				maximum RF power	
<b>Antenna connection</b>					
unique coupling	standard connector	X	Integral	with temporary RF connector	
				without temporary RF connector	
<b>Antenna/s technical characteristics</b>					
Type	Manufacturer	Model number	Gain		
Integral	Visonic	H303518	0 dBi		
<b>Type of modulation</b>		BPSK (2G mode), QPSK (3G mode)			
<b>Transmitter power source</b>					
	Battery	<b>Nominal rated voltage</b>		Battery type	Lithium
	DC	<b>Nominal rated voltage</b>			
X	AC mains	<b>Nominal rated voltage</b>	120 VAC	Frequency	
<b>Common power source for transmitter and receiver</b>			X	yes	no





<b>Test specification:</b>		<b>Section 22.913/RSS-132, Peak output power</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		21-Apr-15	
<b>Temperature:</b> 23.1 °C		<b>Air Pressure:</b> 1018 hPa	
<b>Relative Humidity:</b> 49 %		<b>Power Supply:</b> 120 VAC	
<b>Remarks:</b> 2G module/ 3G module			
<b>Verdict:</b>		PASS	

## 7 Transmitter tests according to 47CFR part 22 and RSS-132 requirements

### 7.1 Effective radiated power of carrier

#### 7.1.1 General

This test was performed to measure effective radiated power emanated by transmitter at carrier frequency. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Effective radiated power limit

Assigned frequency range, MHz	Peak output power		Equivalent field strength limit @ 3m, dB( $\mu$ V/m)*
	W	dBm	
FCC part 22, ERP			
824 - 849	7.0	38.45	133.68
RSS-132, EIRP			
824 - 849	11.5	40.6	135.83

\* - Equivalent field strength limit was calculated from maximum allowed ERP as follows:  $E = \sqrt{30 \times P \times 1.64} / r$ , where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

#### 7.1.2 Test procedure for field strength measurements

7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and the performance check was conducted.

7.1.2.2 The field strength of the EUT carrier frequency was measured with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was swept throughout the range, specified in Table 7.1.2, in both vertical and horizontal polarizations.

7.1.2.3 The worst test results (the lowest margins) were recorded in Table 7.1.2, Table 7.1.4 and shown in the associated plots.

#### 7.1.3 Test procedure for substitution ERP measurements

7.1.3.1 The test equipment was set up as shown in Figure 7.1.2 and energized.

7.1.3.2 RF signal generator was set to the EUT carrier frequency and the RF output level was preliminary adjusted to produce the same field strength as it was measured from the EUT.

7.1.3.3 The test antenna height was swept throughout the specified in Table 7.1.2, Table 7.1.4 range to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as it was measured from the EUT.

7.1.3.4 The ERP was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

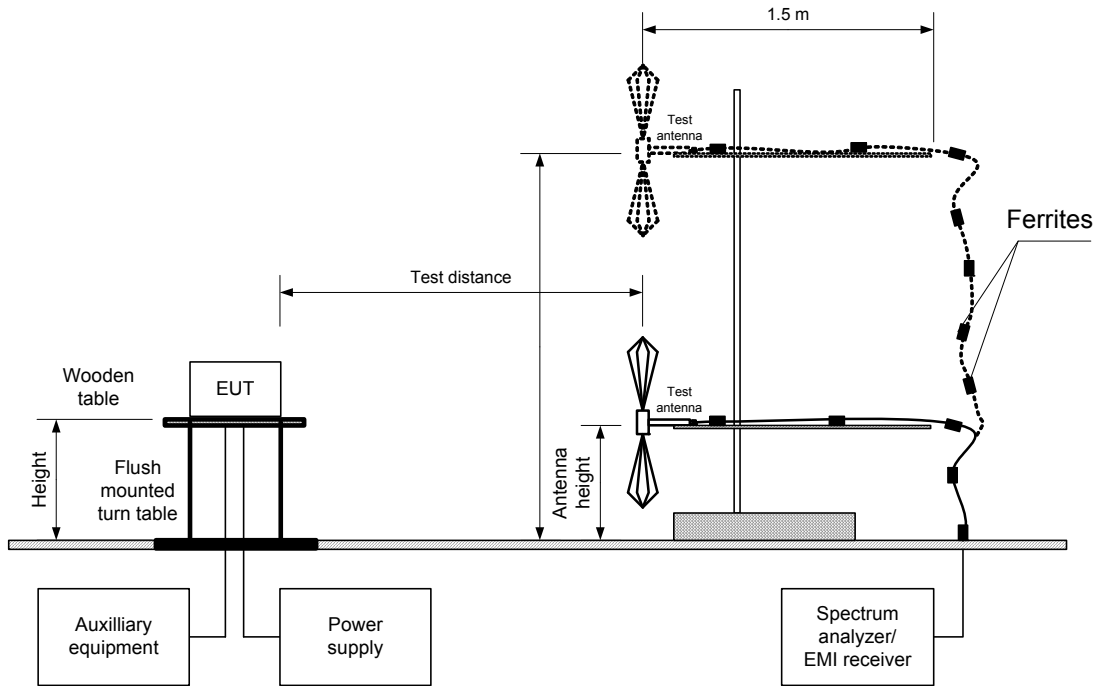
7.1.3.5 The above procedure was performed in both horizontal and vertical polarizations of the test antenna.

7.1.3.6 The worst test results (the lowest margins) were recorded in Table 7.1.3, Table 7.1.5 and shown in the associated plots.



<b>Test specification:</b>	<b>Section 22.913/RSS-132, Peak output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	21-Apr-15		
<b>Temperature:</b> 23.1 °C	<b>Air Pressure:</b> 1018 hPa	<b>Relative Humidity:</b> 49 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module/ 3G module			

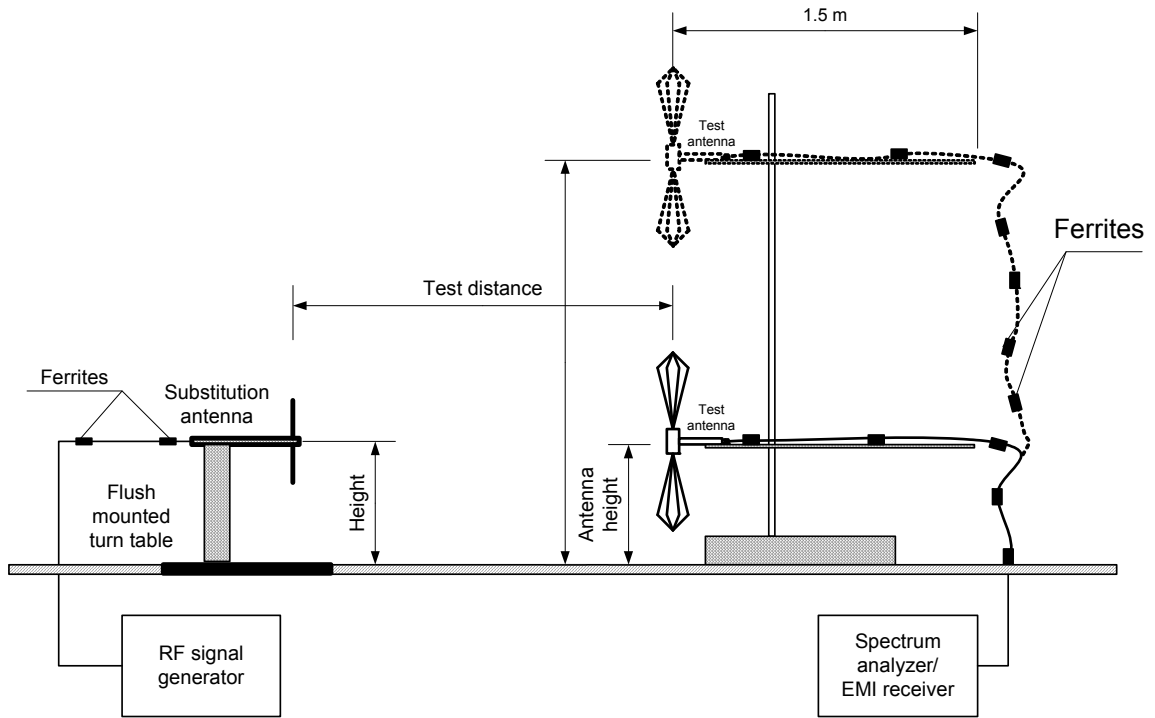
Figure 7.1.1 Setup for carrier field strength measurements





<b>Test specification:</b>	<b>Section 22.913/RSS-132, Peak output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	21-Apr-15		
<b>Temperature:</b> 23.1 °C	<b>Air Pressure:</b> 1018 hPa	<b>Relative Humidity:</b> 49 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module/ 3G module			

Figure 7.1.2 Setup for substitution ERP measurements





<b>Test specification:</b>		<b>Section 22.913/RSS-132, Peak output power</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		21-Apr-15	
<b>Temperature:</b> 23.1 °C		<b>Air Pressure:</b> 1018 hPa	
<b>Remarks:</b> 2G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 49 %	
		<b>Power Supply:</b> 120 VAC	

Table 7.1.2 Transmitter carrier field strength of 2G module

ASSIGNED FREQUENCY RANGE: 824.0-849.0 MHz  
TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
EUT HEIGHT: 0.8 m  
TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m  
DETECTOR USED: Peak  
VIDEO BANDWIDTH: > Resolution bandwidth  
TEST ANTENNA TYPE: Biconical

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
824.18	132.66	133.68	-1.02	1000	Horizontal	1.0	157
836.15	131.86	133.68	-1.82		Horizontal	1.0	153
848.73	131.45	133.68	-2.23		Horizontal	1.0	157

\*- Margin = Field strength – calculated field strength limit.

\*\* - EUT front panel refers to 0 degrees position of turntable.

Table 7.1.3 Transmitter carrier ERP of 2G module

TEST DISTANCE: 3 m  
SUBSTITUTION ANTENNA HEIGHT: 0.8 m  
TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m  
DETECTOR USED: Peak  
VIDEO BANDWIDTH: 3000 kHz  
SUBSTITUTION ANTENNA TYPE: Tunable dipole

Frequency, MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	ERP, dBm	Limit, dBm	Margin, dB*	Verdict
824.18	132.66	1000	Horizontal	38.00	-2.13	1.83	34.04	38.45	-4.41	Pass
836.15	131.86		Horizontal	36.99	-2.00	1.84	33.15	38.45	-5.30	Pass
848.73	131.45		Horizontal	36.44	-1.87	1.86	32.71	38.45	-5.74	Pass

\*- Margin = ERP – specification limit.

#### -2dBi

#### Reference numbers of test equipment used

HL 0521	HL 0604	HL 0661	HL 1565	HL 2871	HL 4279	HL 4353	
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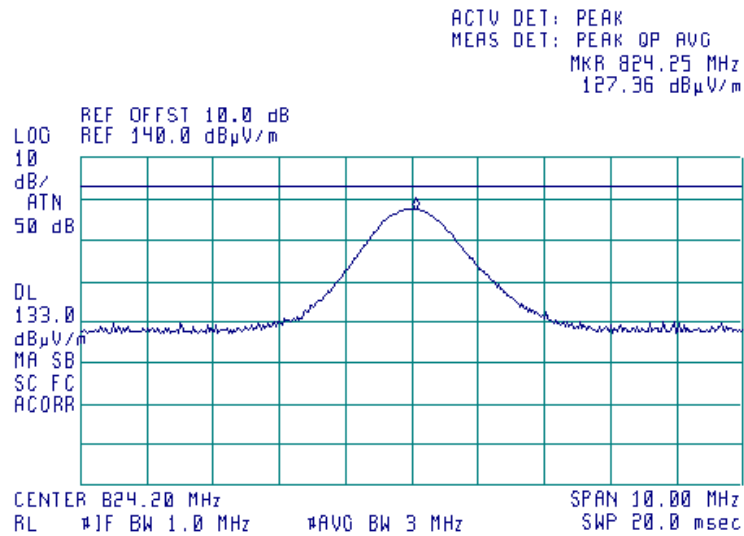
Full description is given in Appendix A.



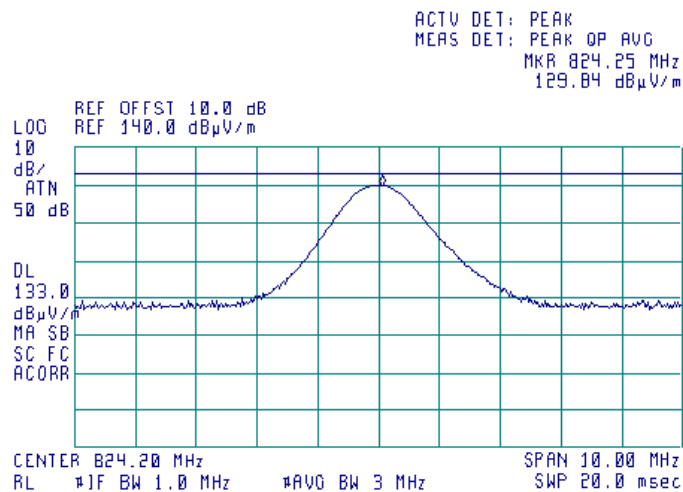
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<b>Test specification:</b>		<b>Section 22.913/RSS-132, Peak output power</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		<b>Verdict:</b>	
Compliance		PASS	
<b>Date(s):</b>		21-Apr-15	
<b>Temperature:</b> 23.1 °C	<b>Air Pressure:</b> 1018 hPa	<b>Relative Humidity:</b> 49 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Plot 7.1.1 Transmitter carrier field strength at low frequency in vertical antenna polarization, EUT vertical position



Plot 7.1.2 Transmitter carrier field strength at low frequency in horizontal antenna polarization, EUT vertical position

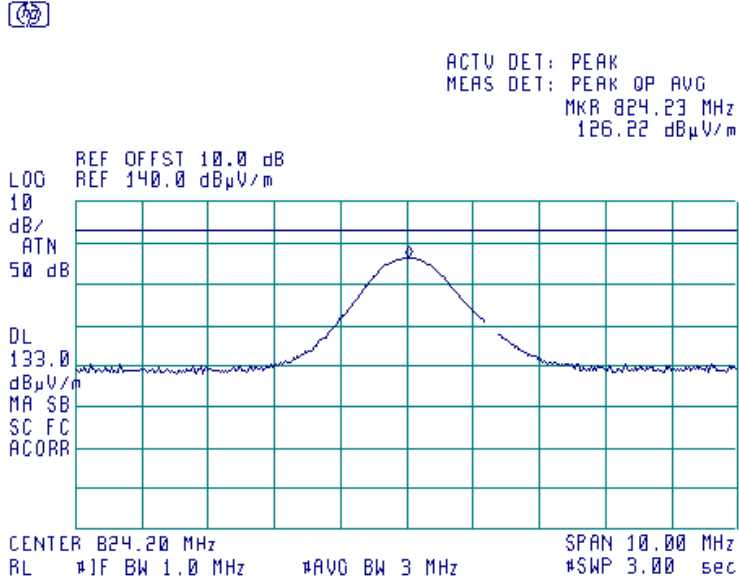




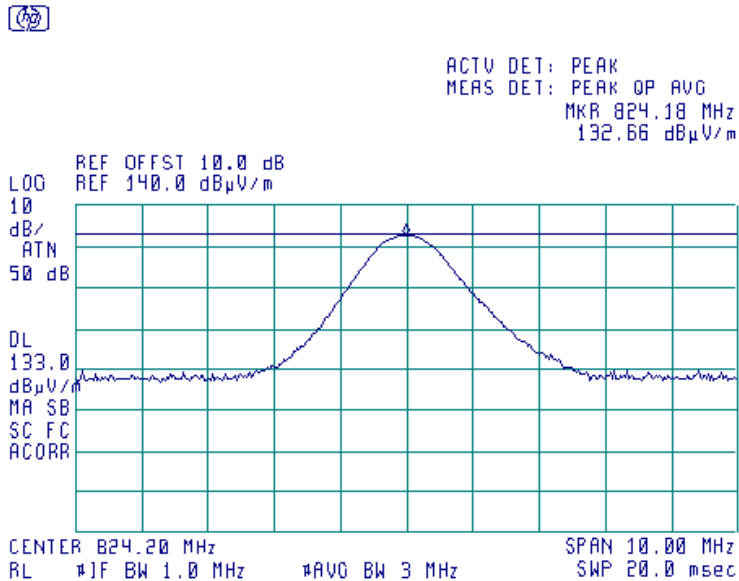
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<b>Test specification:</b>	<b>Section 22.913/RSS-132, Peak output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	21-Apr-15	<b>Relative Humidity:</b>	49 %
<b>Temperature:</b> 23.1 °C	<b>Air Pressure:</b> 1018 hPa	<b>Power Supply:</b>	120 VAC
<b>Remarks:</b> 2G module			

Plot 7.1.3 Transmitter carrier field strength at low frequency in vertical antenna polarization, EUT horizontal position



Plot 7.1.4 Transmitter carrier field strength at low frequency in horizontal antenna polarization, EUT horizontal position

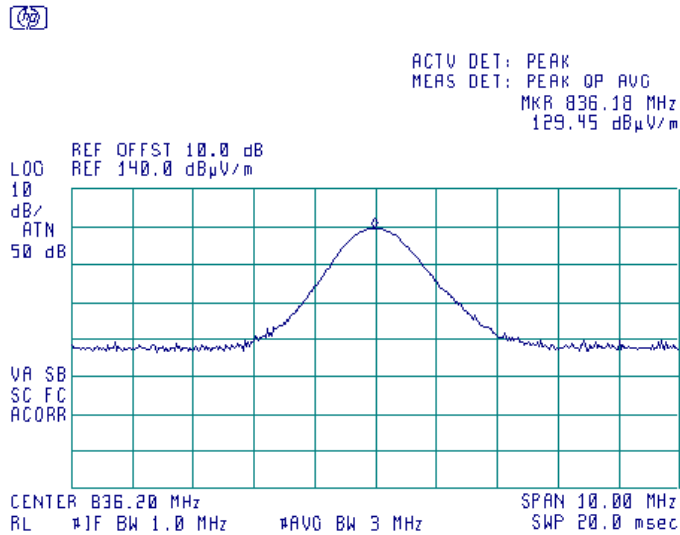




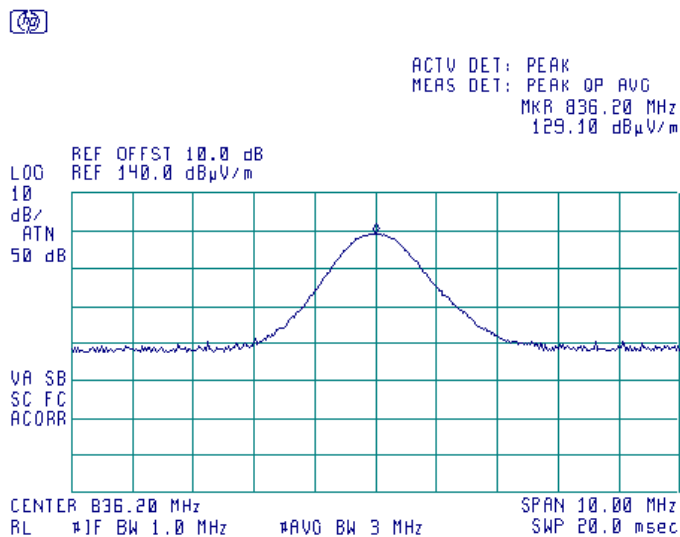
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.913/RSS-132, Peak output power</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		<b>Verdict:</b>	
Compliance		PASS	
<b>Date(s):</b>		21-Apr-15	
<b>Temperature:</b> 23.1 °C	<b>Air Pressure:</b> 1018 hPa	<b>Relative Humidity:</b> 49 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Plot 7.1.5 Transmitter carrier field strength at mid frequency in vertical antenna polarization, EUT vertical position



Plot 7.1.6 Transmitter carrier field strength at mid frequency in horizontal antenna polarization, EUT vertical position

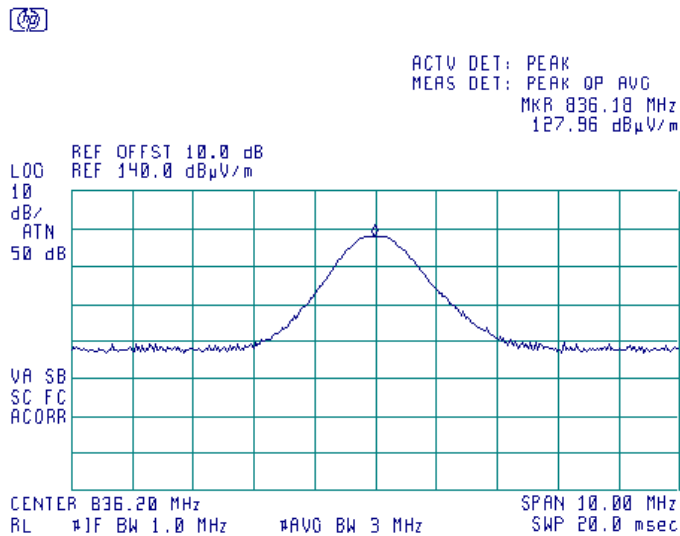




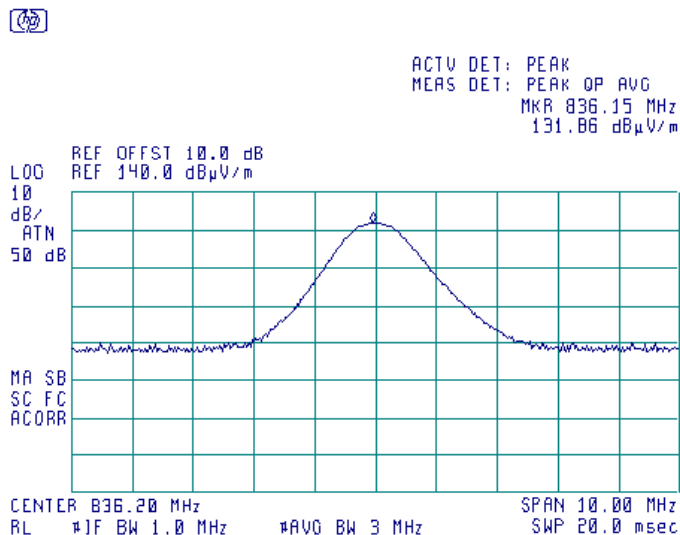
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.913/RSS-132, Peak output power</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		21-Apr-15	
<b>Temperature:</b> 23.1 °C		<b>Air Pressure:</b> 1018 hPa	
<b>Remarks:</b> 2G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 49 %	
		<b>Power Supply:</b> 120 VAC	

Plot 7.1.7 Transmitter carrier field strength at mid frequency in vertical antenna polarization, EUT horizontal position



Plot 7.1.8 Transmitter carrier field strength at mid frequency in horizontal antenna polarization, EUT horizontal position



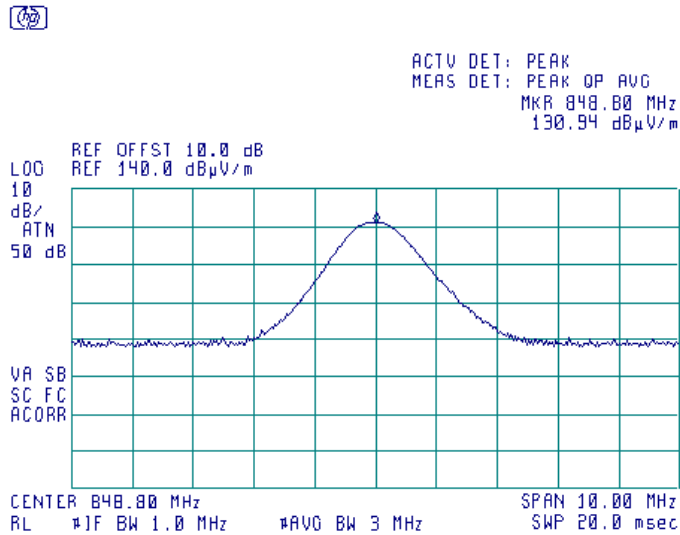




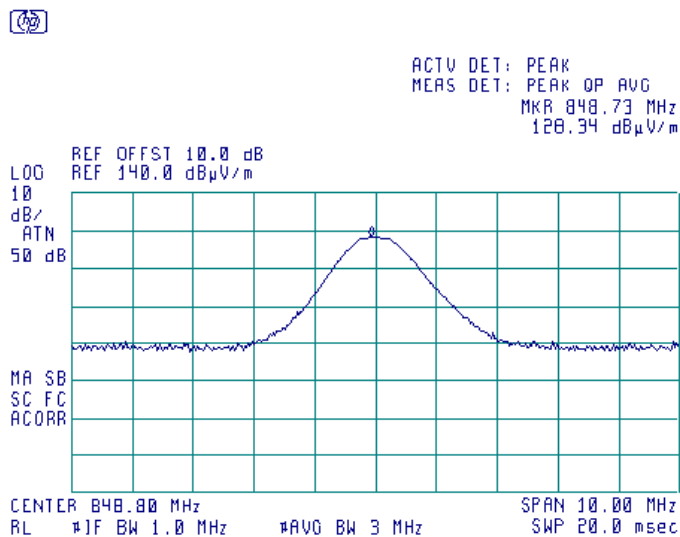
HERMON LABORATORIES

<b>Test specification:</b>	<b>Section 22.913/RSS-132, Peak output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	21-Apr-15		
<b>Temperature:</b> 23.1 °C	<b>Air Pressure:</b> 1018 hPa	<b>Relative Humidity:</b> 49 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Plot 7.1.9 Transmitter carrier field strength at high frequency in vertical antenna polarization, EUT vertical position



Plot 7.1.10 Transmitter carrier field strength at high frequency in horizontal antenna polarization, EUT vertical position

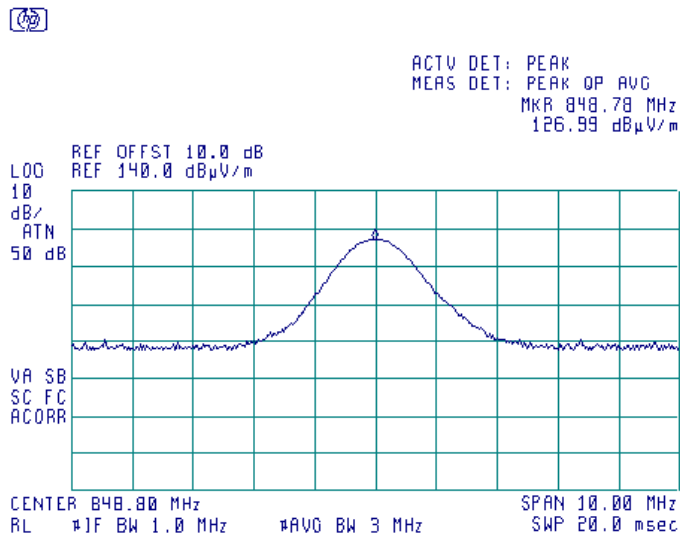




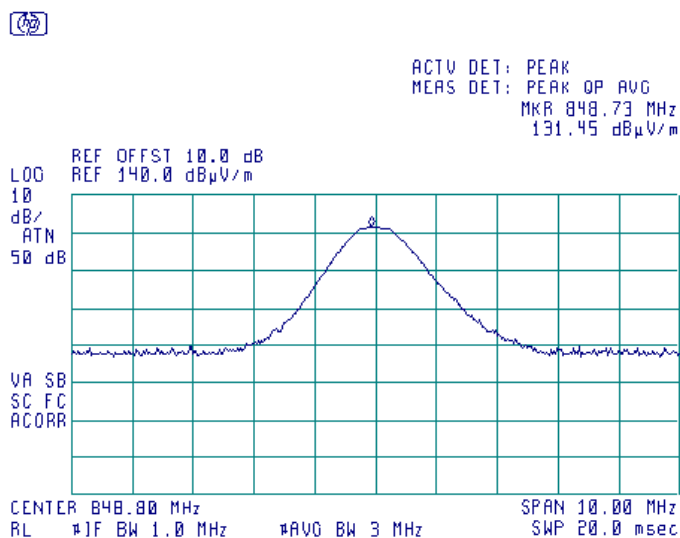
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.913/RSS-132, Peak output power</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		21-Apr-15	
<b>Temperature:</b> 23.1 °C		<b>Air Pressure:</b> 1018 hPa	
<b>Remarks:</b> 2G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 49 %	
		<b>Power Supply:</b> 120 VAC	

Plot 7.1.11 Transmitter carrier field strength at high frequency in vertical antenna polarization, EUT horizontal position



Plot 7.1.12 Transmitter carrier field strength at high frequency in horizontal antenna polarization, EUT horizontal position





<b>Test specification:</b>		<b>Section 22.913/RSS-132, Peak output power</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		09-Jun-15	
<b>Temperature:</b> 21 °C		<b>Air Pressure:</b> 1009 hPa	
<b>Remarks:</b> 3G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 51 %	
		<b>Power Supply:</b> 120 VAC	

**Table 7.1.4 Transmitter carrier field strength of 3G module**

ASSIGNED FREQUENCY RANGE: 824.0-849.0 MHz  
 TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 EUT HEIGHT: 0.8 m  
 TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: > Resolution bandwidth  
 TEST ANTENNA TYPE: Biconical

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
826.40	122.53	133.68	-11.15	3000	Horizontal	1.0	340
836.40	124.96	133.68	-8.72		Horizontal	1.0	236
846.60	125.14	133.68	-8.54		Vertical	1.0	184

\*- Margin = Field strength – calculated field strength limit.  
 \*\*- EUT front panel refers to 0 degrees position of turntable.

**Table 7.1.5 Transmitter carrier ERP of 3G module**

TEST DISTANCE: 3 m  
 SUBSTITUTION ANTENNA HEIGHT: 0.8 m  
 TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: 3000kHz  
 SUBSTITUTION ANTENNA TYPE: Tunable dipole

Frequency, MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	ERP, dBm	Limit, dBm	Margin, dB*	Verdict
826.40	122.53	3000	Horizontal	27.91	-2.10	1.83	23.98	38.45	-14.47	Pass
836.40	124.96		Horizontal	30.39	-2.00	1.84	26.55	38.45	-11.90	Pass
846.60	125.14		Vertical	30.69	-1.90	1.86	26.93	38.45	-11.52	Pass

\*- Margin = ERP – specification limit.

**Reference numbers of test equipment used**

HL 0521	HL 0604	HL 0661	HL 1565	HL 2871	HL 4279	HL 4353	
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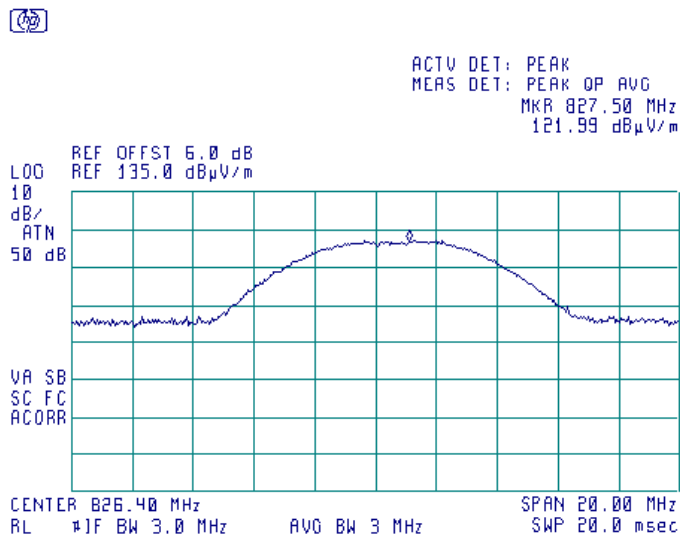
Full description is given in Appendix A.



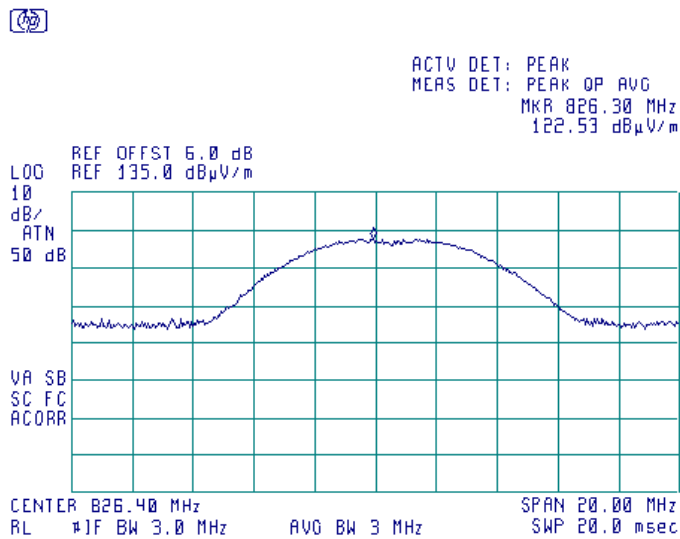
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.913/RSS-132, Peak output power</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

Plot 7.1.13 Transmitter carrier field strength at low frequency in vertical antenna polarization, EUT vertical position



Plot 7.1.14 Transmitter carrier field strength at low frequency in horizontal antenna polarization, EUT vertical position

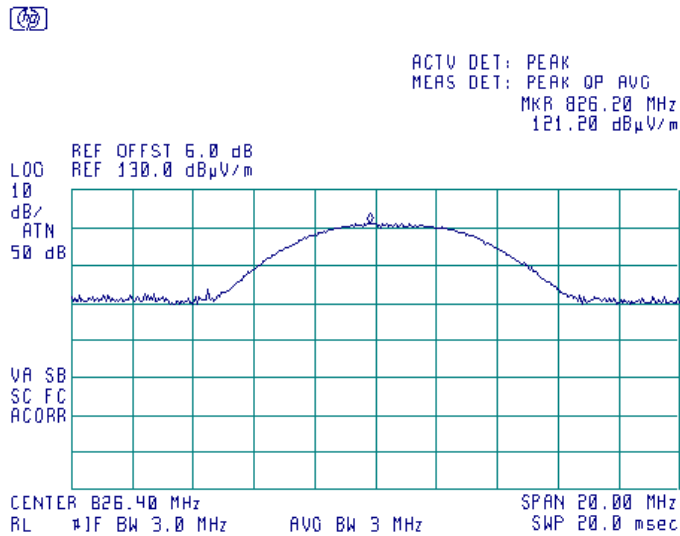




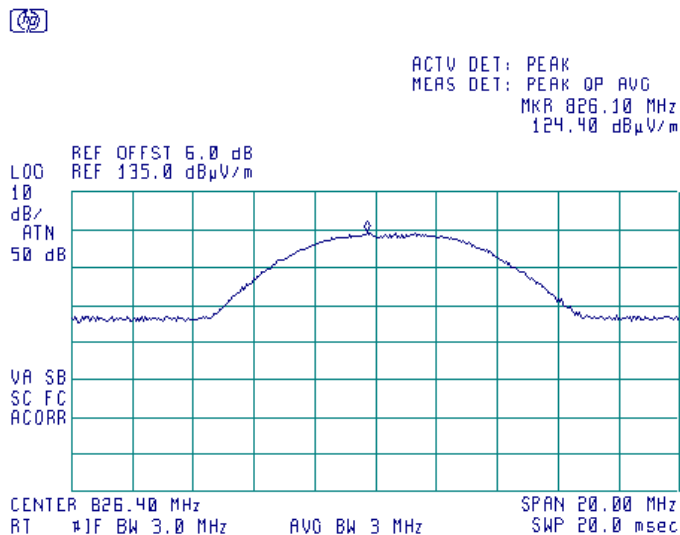
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.913/RSS-132, Peak output power</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

Plot 7.1.15 Transmitter carrier field strength at low frequency in vertical antenna polarization, EUT horizontal position



Plot 7.1.16 Transmitter carrier field strength at low frequency in horizontal antenna polarization, EUT horizontal position

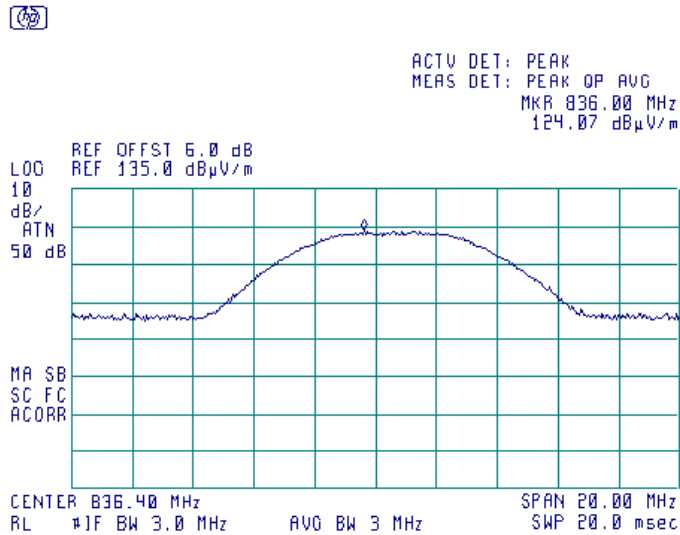




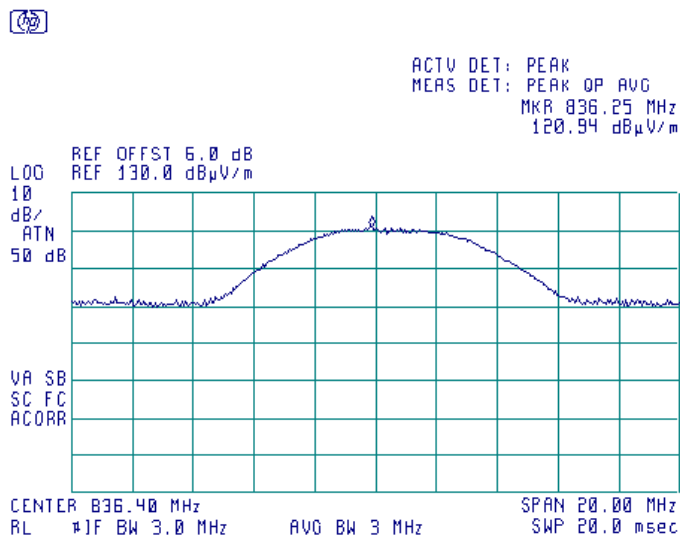
HERMON LABORATORIES

<b>Test specification:</b>	<b>Section 22.913/RSS-132, Peak output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	09-Jun-15		
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

Plot 7.1.17 Transmitter carrier field strength at mid frequency in vertical antenna polarization, EUT vertical position



Plot 7.1.18 Transmitter carrier field strength at mid frequency in horizontal antenna polarization, EUT vertical position

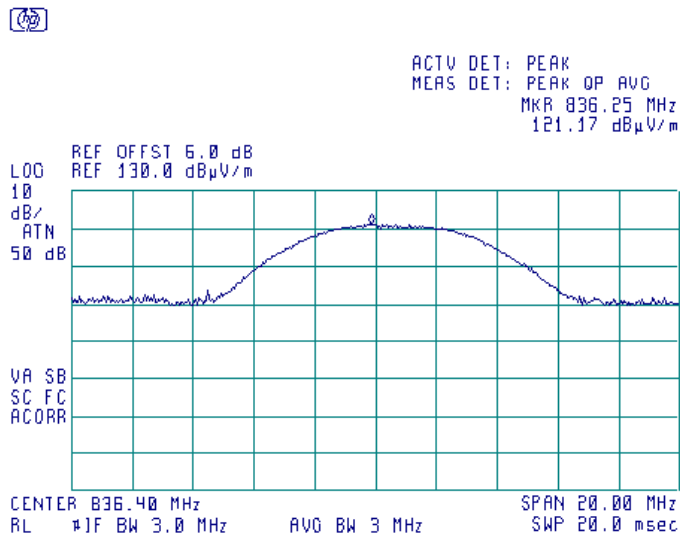




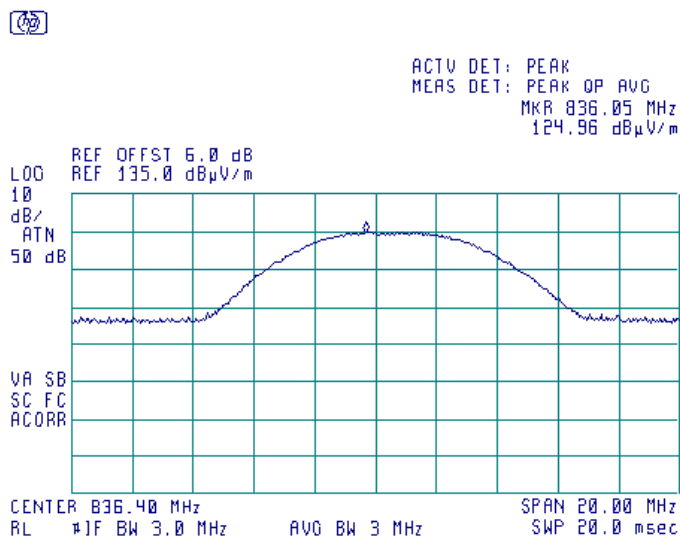
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.913/RSS-132, Peak output power</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		09-Jun-15	
<b>Temperature:</b> 21 °C		<b>Air Pressure:</b> 1009 hPa	
<b>Remarks:</b> 3G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 51 %	
		<b>Power Supply:</b> 120 VAC	

Plot 7.1.19 Transmitter carrier field strength at mid frequency in vertical antenna polarization, EUT horizontal position



Plot 7.1.20 Transmitter carrier field strength at mid frequency in horizontal antenna polarization, EUT horizontal position

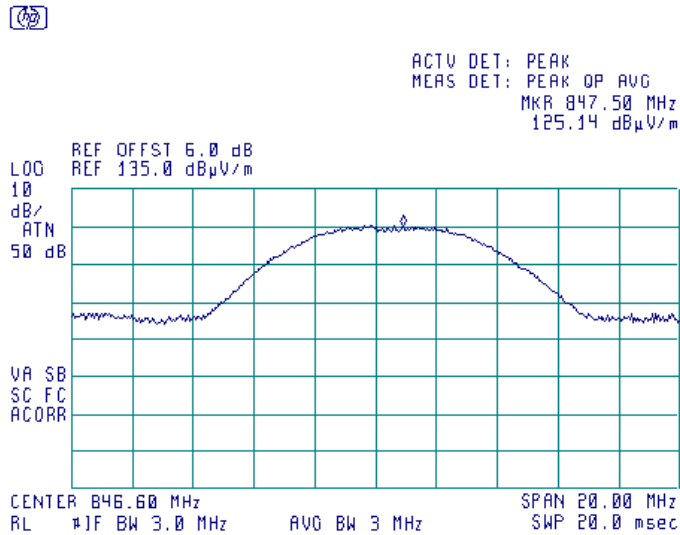




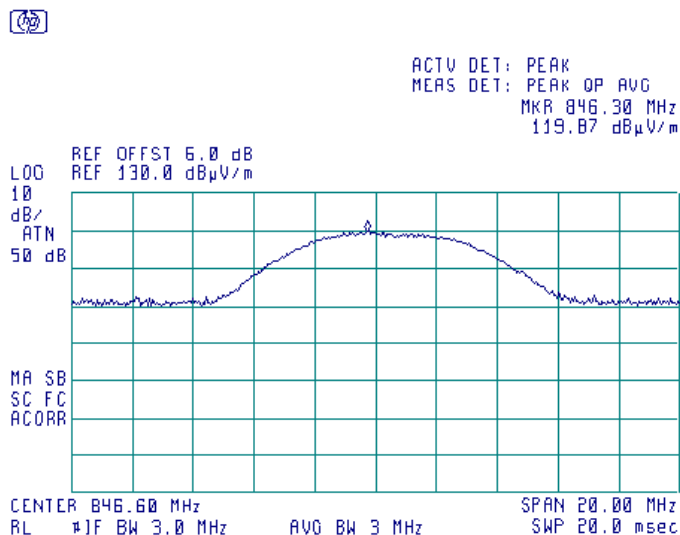
HERMON LABORATORIES

<b>Test specification:</b>	<b>Section 22.913/RSS-132, Peak output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	09-Jun-15		
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

Plot 7.1.21 Transmitter carrier field strength at high frequency in vertical antenna polarization, EUT vertical position



Plot 7.1.22 Transmitter carrier field strength at high frequency in horizontal antenna polarization, EUT vertical position



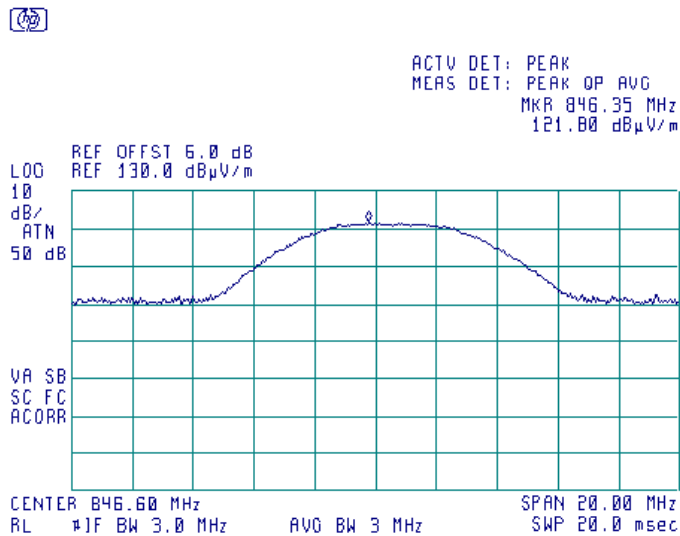




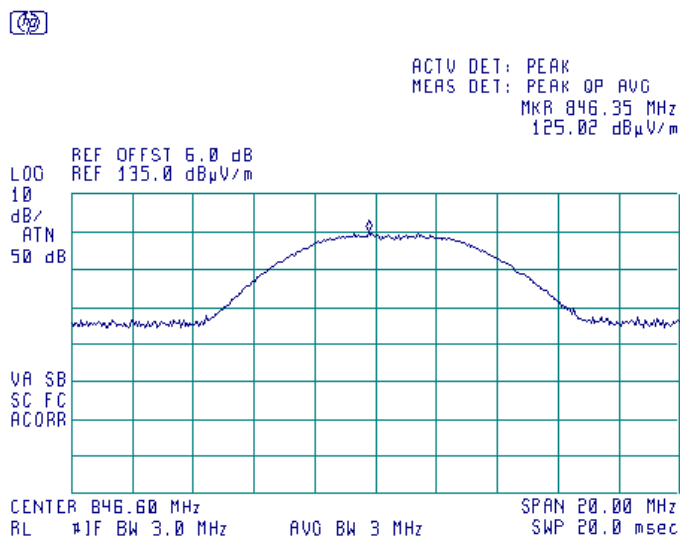
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.913/RSS-132, Peak output power</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		09-Jun-15	
<b>Temperature:</b> 21 °C		<b>Air Pressure:</b> 1009 hPa	
<b>Remarks:</b> 3G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 51 %	
		<b>Power Supply:</b> 120 VAC	

Plot 7.1.23 Transmitter carrier field strength at high frequency in vertical antenna polarization, EUT horizontal position



Plot 7.1.24 Transmitter carrier field strength at high frequency in horizontal antenna polarization, EUT horizontal position





<b>Test specification:</b>	<b>Section 22.917/RSS-132, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	22-Apr-15 - 08-Jul-15		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 53 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

## 7.2 Radiated spurious emission measurements of 3G module

### 7.2.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.1.1.

**Table 7.2.1 Radiated spurious emission test limits**

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB( $\mu$ V/m) <sup>***</sup>
0.009 – 10 <sup>th</sup> harmonic*	43+10logP <sup>**</sup>	-13	84.4

\* - Excluding the in band emission within  $\pm$  250 % of the authorized bandwidth from the carrier

\*\* - P is transmitter output power in Watts

\*\*\* - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows:  
 $E = \sqrt{30 \times P \times 1.64} / r$ , where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

### 7.2.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and the performance check was conducted.

7.2.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

7.2.2.3 The worst test results (the lowest margins) were recorded in Table 7.1.2 and shown in the associated plots.

### 7.2.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.2.3.1 The EUT was set up as shown in Figure 7.2.2, energized and the performance check was conducted.

7.2.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

7.2.3.3 The worst test results (the lowest margins) were recorded in Table 7.1.2 and shown in the associated plots.



<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict: PASS</b>	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 53 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

Figure 7.2.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

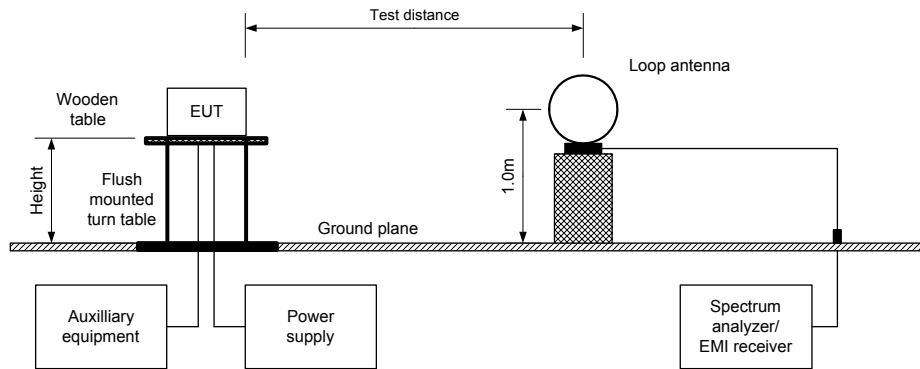
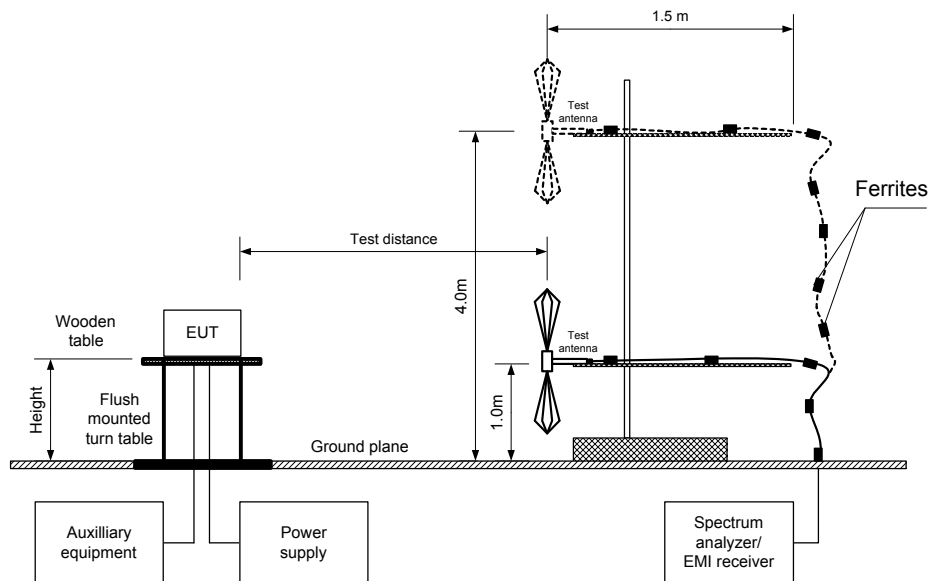


Figure 7.2.2 Setup for spurious emission field strength measurements above 30 MHz





<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1009 hPa	
<b>Remarks:</b> 3G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 53 %	
		<b>Power Supply:</b> 120 VAC	

**Table 7.2.2 Spurious emission field strength test results**

ASSIGNED FREQUENCY RANGE: 824-849 MHz  
 TEST DISTANCE: 3 m  
 TEST SITE: Semi anechoic chamber  
 EUT HEIGHT: 0.8 m  
 INVESTIGATED FREQUENCY RANGE: 0.009 – 9000 MHz  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: > Resolution bandwidth  
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)  
 Biconilog (30 MHz – 1000 MHz)  
 Double ridged guide (above 1000 MHz)  
 MODULATING SIGNAL: PRBS

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height	Turn-table position**, degrees
<b>Low carrier frequency 826.4 MHz</b>							
824.001	80.24	84.4	-4.16	120	Horizontal	1.0	340
Mid carrier frequency 836.4 MHz							
No emissions were found							
<b>High carrier frequency 846.6 MHz</b>							
848.999	79.66	84.4	-4.94	120	Vertical	1.0	184

\*- Margin = Field strength of spurious – calculated field strength limit.

\*\*- EUT front panel refers to 0 degrees position of turntable.

**Table 7.2.3 Substitution ERP of spurious emission test results**

TEST DISTANCE: 3 m  
 SUBSTITUTION ANTENNA HEIGHT: 0.8 m  
 TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: 3000kHz  
 SUBSTITUTION ANTENNA TYPE: Tunable dipole

Frequency, MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBi	Cable loss, dB	ERP, dBm	Limit, dBm	Margin, dB*	Verdict
<b>Low carrier frequency 826.4 MHz</b>										
824.001	80.24	300	Horizontal	-14.42	0.02	1.83	-16.23	-13.00	-3.23	Pass
<b>High carrier frequency 846.6 MHz</b>										
848.999	79.66	300	Vertical	-15.35	0.28	1.86	-16.93	-13.00	-3.93	Pass

\*- Margin = ERP – specification limit.



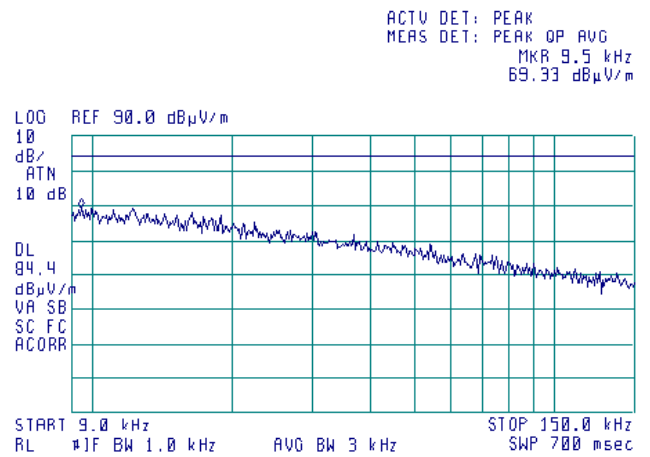
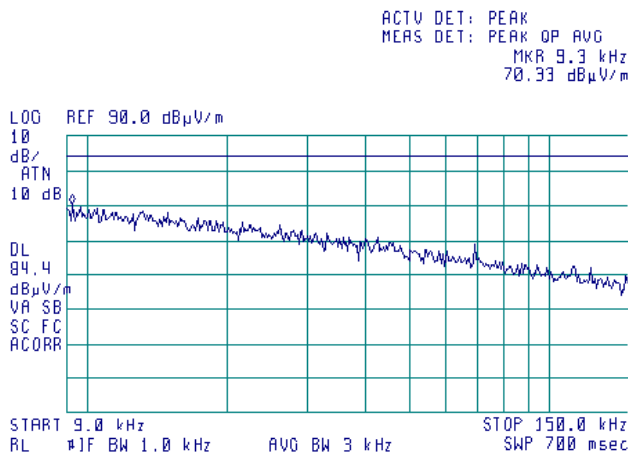
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 53 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

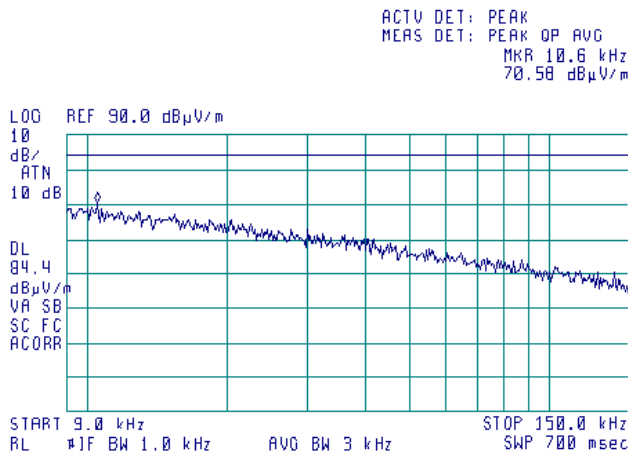
Plot 7.2.1 Radiated emission measurements in 9 - 150 kHz range

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 53 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

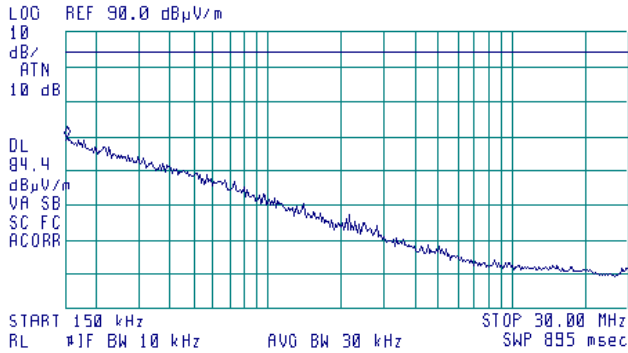
**Plot 7.2.2 Radiated emission measurements in 0.15 - 30 MHz range**

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

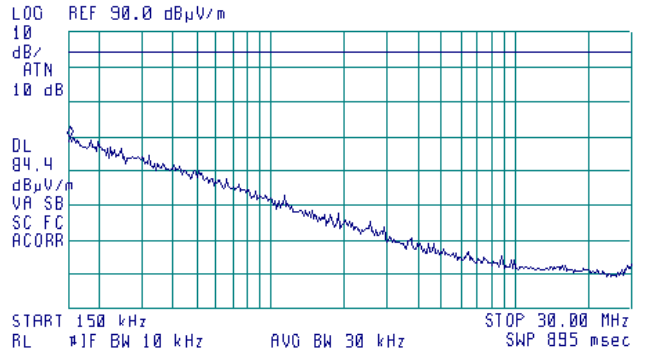
Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 150 kHz  
59.60 dBµV/m



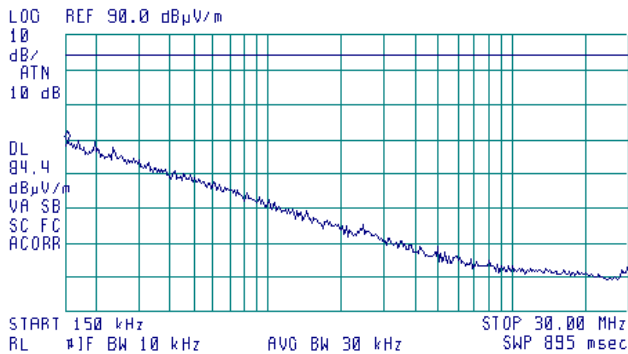
ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 150 kHz  
59.85 dBµV/m



CARRIER FREQUENCY: High



ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 150 kHz  
59.30 dBµV/m





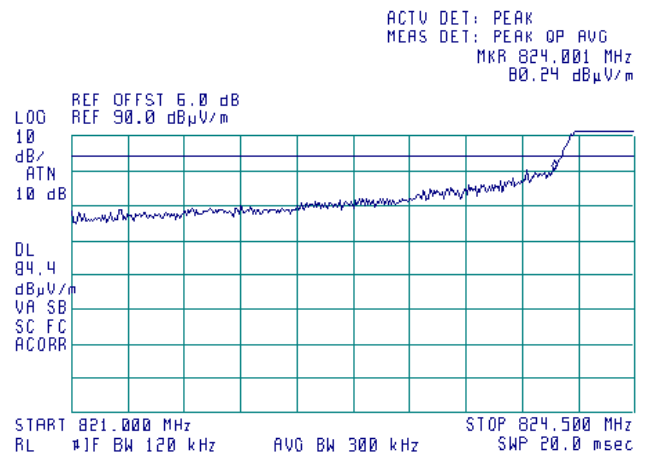
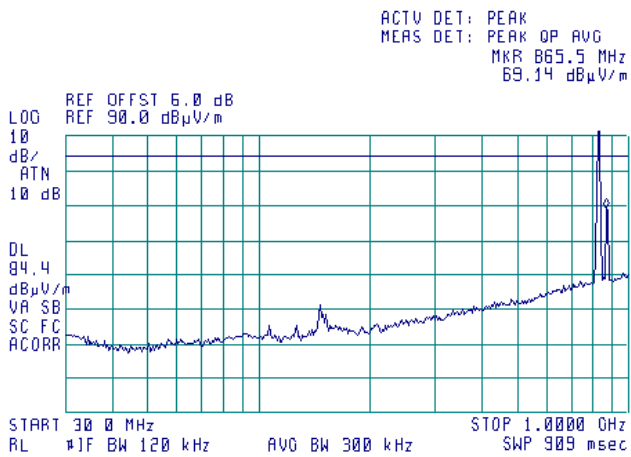
HERMON LABORATORIES

<b>Test specification:</b> Section 22.917/RSS-132, Radiated spurious emissions	
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa
	<b>Relative Humidity:</b> 53 %
	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module	

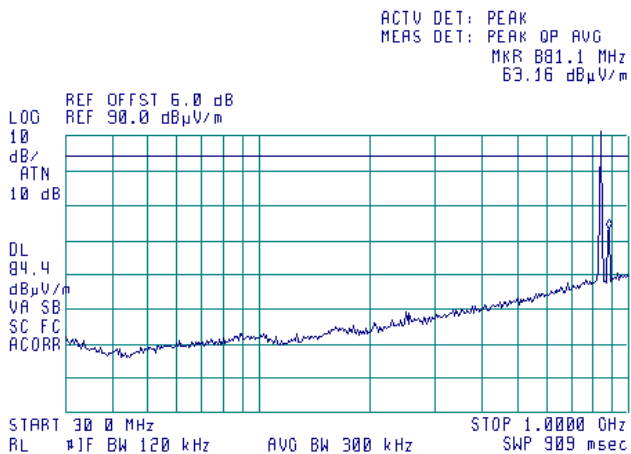
### Plot 7.2.3 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m



CARRIER FREQUENCY: Mid



NOTE: 871.4 MHz, 881.4 MHz and 891.6 MHz are the auxiliary base station signals



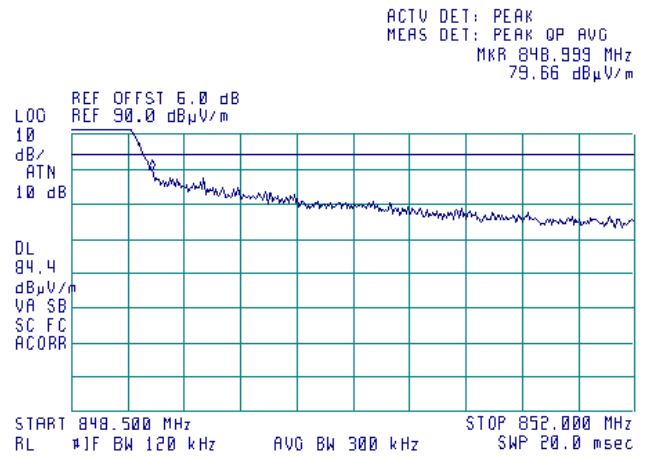
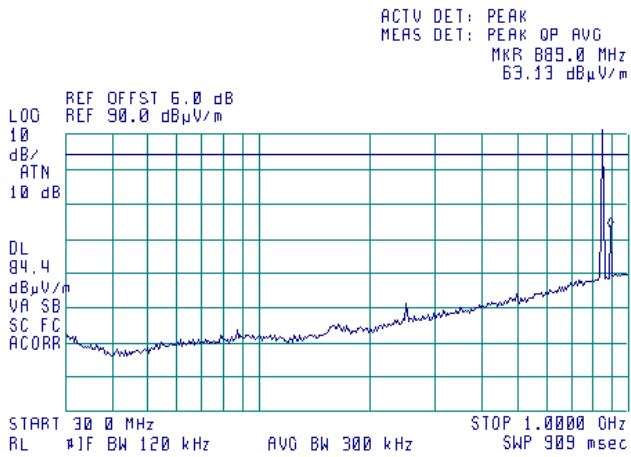
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b>	
Compliance		PASS	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 53 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

Plot 7.2.4 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: High

Semi anechoic chamber  
Vertical and Horizontal  
3 m



NOTE: 871.4 MHz, 881.4 MHz and 891.6 MHz are the auxiliary base station signals





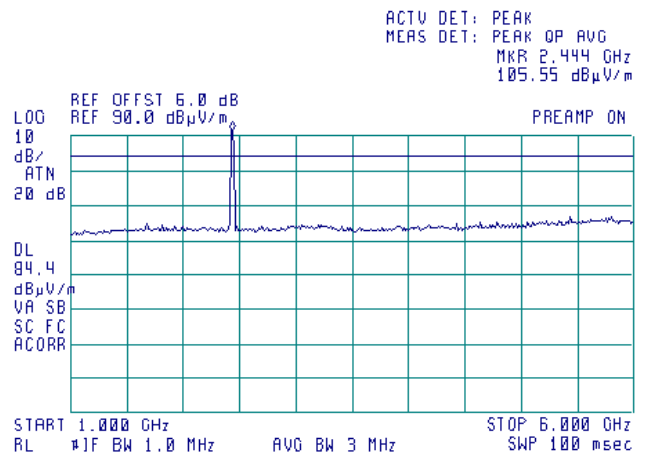
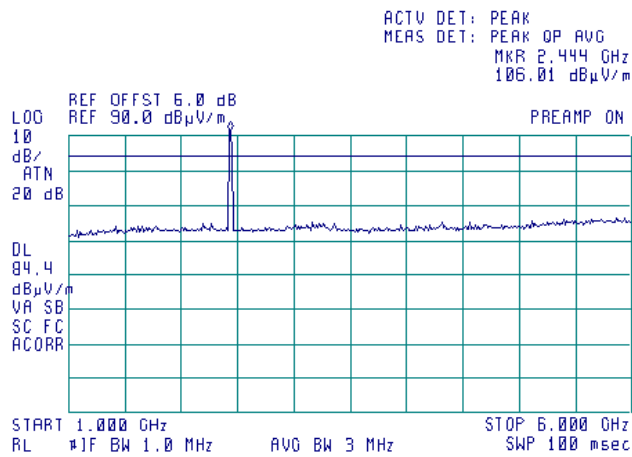
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 53 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

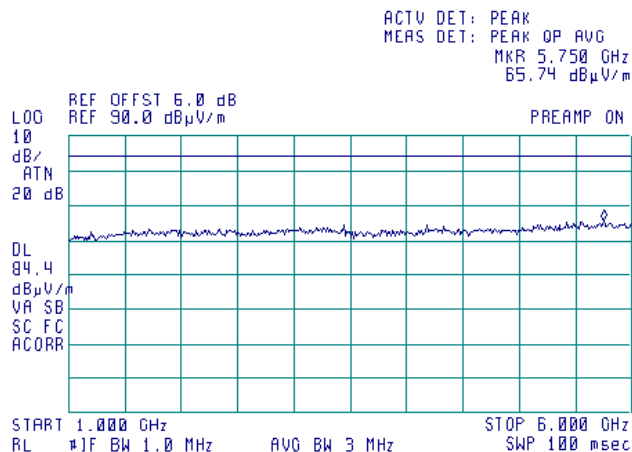
**Plot 7.2.5 Radiated emission measurements in 1000 – 6000 MHz range**

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



2444 MHz is the Wi-Fi module fundamental frequency



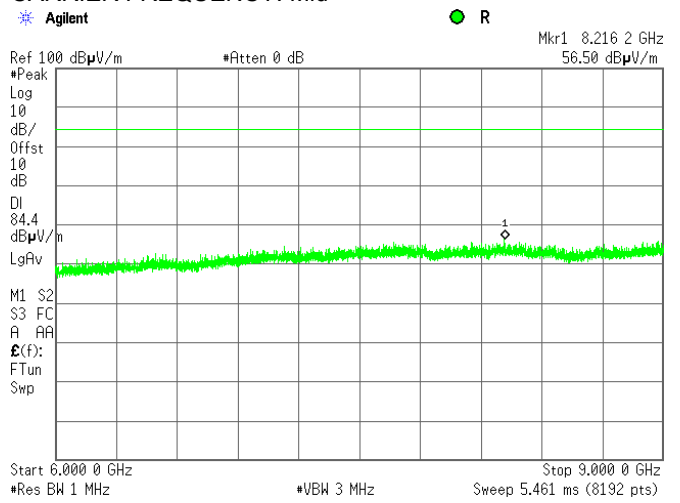
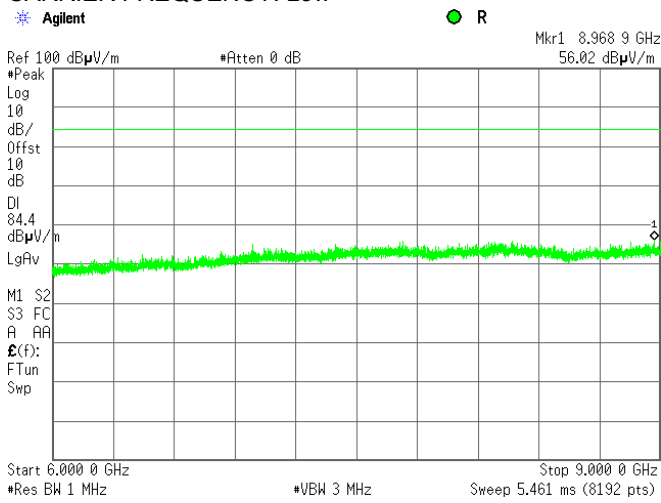
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1009 hPa	
		<b>Relative Humidity:</b> 53 %	
		<b>Power Supply:</b> 120 VAC	
<b>Remarks:</b> 3G module			

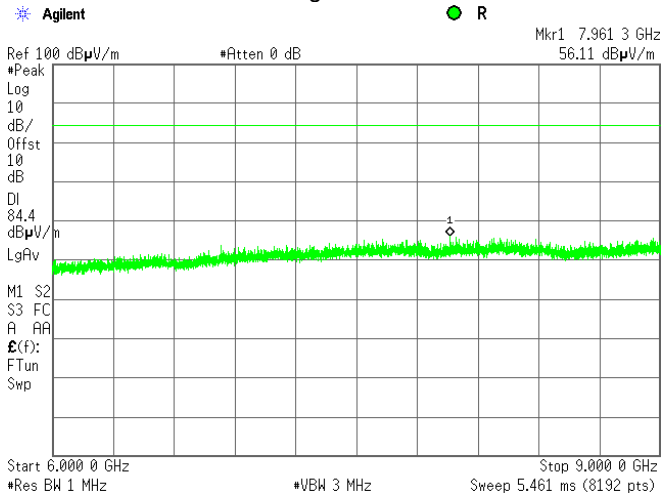
Plot 7.2.6 Radiated emission measurements in 6000 – 8960 MHz range

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C		<b>Air Pressure:</b> 1009 hPa	
<b>Remarks:</b> 2G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 51 %	
		<b>Power Supply:</b> 120 VAC	

### 7.3 Radiated spurious emission measurements of 2G module

#### 7.3.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.1.1.

Table 7.3.1 Radiated spurious emission test limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB(μV/m)***
0.009 – 10 <sup>th</sup> harmonic*	43+10logP**	-13	84.4

\* - Excluding the in band emission within ± 250 % of the authorized bandwidth from the carrier

\*\* - P is transmitter output power in Watts

\*\*\* - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows:  $E = \sqrt{30 \times P \times 1.64} / r$ , where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

#### 7.3.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

7.3.2.1 The EUT was set up as shown in Figure 7.2.1, energized and the performance check was conducted.

7.3.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

7.3.2.3 The worst test results (the lowest margins) were recorded in Table 7.1.2 and shown in the associated plots.

#### 7.3.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.3.3.1 The EUT was set up as shown in Figure 7.2.2, energized and the performance check was conducted.

7.3.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

7.3.3.3 The worst test results (the lowest margins) were recorded in Table 7.1.2 and shown in the associated plots.

#### 7.3.4 Test procedure for substitution ERP measurements of spurious

7.3.4.1 The test equipment was set up as shown in Figure 7.1.2 and energized.

7.3.4.2 RF signal generator was set to the frequency of investigated spurious emission and the RF output level was preliminary adjusted to produce the same field strength as it was measured from the EUT.

7.3.4.3 The test antenna height was swept from 1 to 4 m to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as it was measured from the EUT.

7.3.4.4 The above procedure was performed in both, horizontal and vertical, polarizations of the test and substitution antennas.

7.3.4.5 The ERP of spurious emissions was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

7.3.4.6 The above procedure was repeated at the rest of investigated frequencies.

7.3.4.7 The worst test results (the lowest margins) were recorded in Table 7.1.3 and shown in the associated plots.



<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict: PASS</b>	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Figure 7.3.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

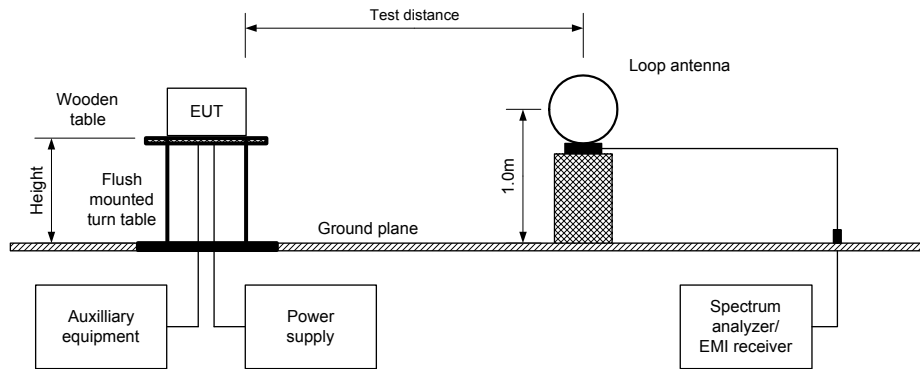
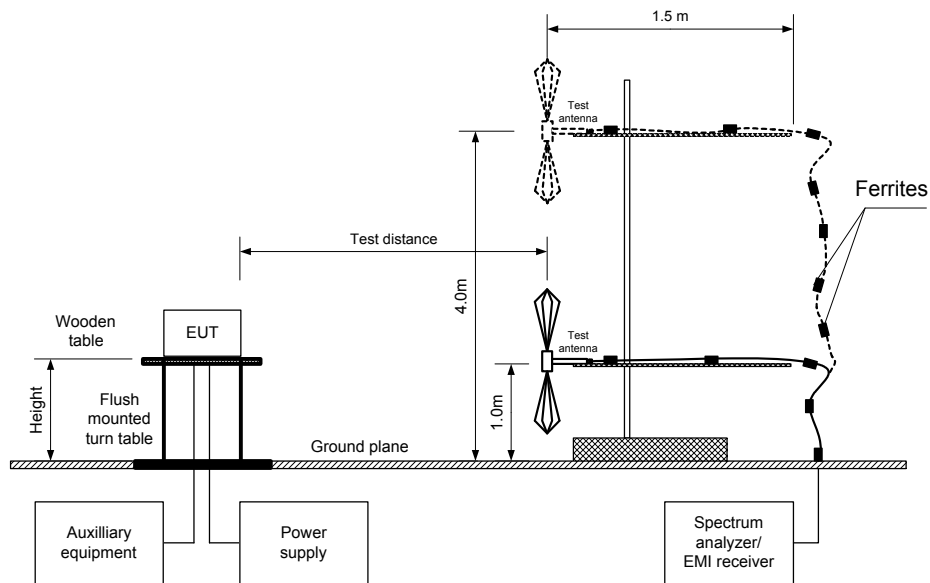


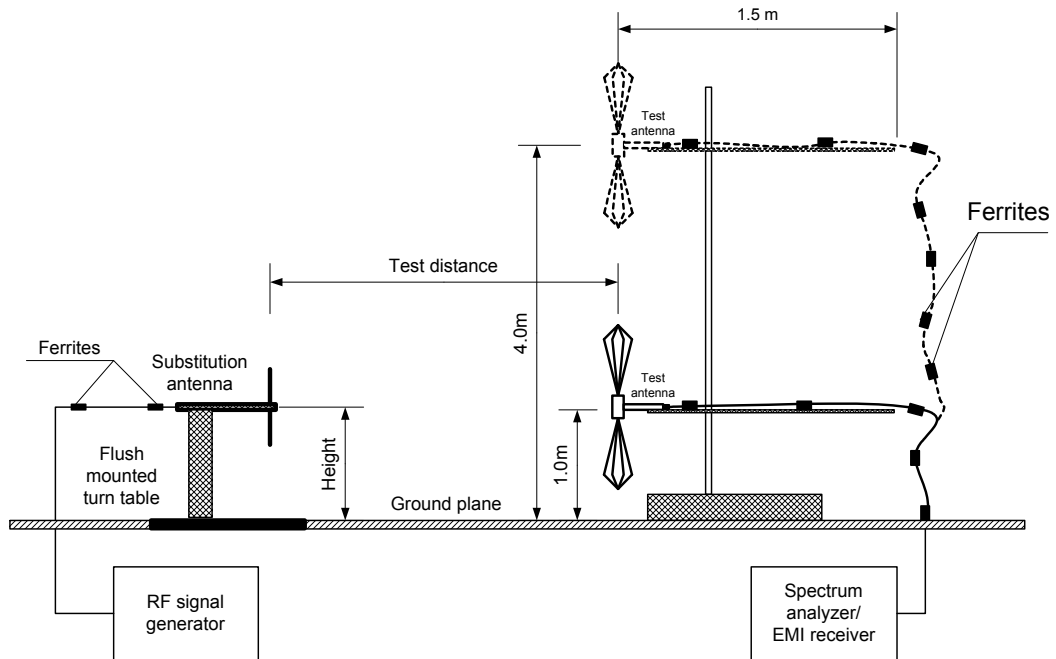
Figure 7.3.2 Setup for spurious emission field strength measurements above 30 MHz





<b>Test specification:</b>	<b>Section 22.917/RSS-132, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	22-Apr-15 - 08-Jul-15		
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Figure 7.3.3 Setup for substitution ERP measurements of spurious





<b>Test specification:</b>	<b>Section 22.917/RSS-132, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	22-Apr-15 - 08-Jul-15		
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks: 2G module</b>			

**Table 7.3.2 Spurious emission field strength test results**

ASSIGNED FREQUENCY RANGE: 824-849 MHz  
 TEST DISTANCE: 3 m  
 TEST SITE: Semi anechoic chamber  
 EUT HEIGHT: 0.8 m  
 INVESTIGATED FREQUENCY RANGE: 0.009 – 9000 MHz  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: > Resolution bandwidth  
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)  
 Biconilog (30 MHz – 1000 MHz)  
 Double ridged guide (above 1000 MHz)  
 MODULATING SIGNAL: PRBS

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
<b>Low carrier frequency 824.2 MHz</b>							
823.978	80.19	84.4	-4.21	120	Horizontal	1.0	157
6594.02	56.69	84.4	-27.71	1000	Horizontal	1.9	143
7417.40	63.75	84.4	-20.65	1000	Horizontal	1.5	160
<b>Mid carrier frequency 836.2 MHz</b>							
6689.57	59.90	84.4	-24.50	1000	Horizontal	1.6	155
7525.43	60.99	84.4	-23.41	1000	Horizontal	1.8	150
<b>High carrier frequency 848.8 MHz</b>							
849.021	85.55	84.4	1.15	120	Horizontal	1.0	157
6790.73	62.40	84.4	-22.00	1000	Horizontal	1.7	140
7638.75	60.26	84.4	-24.14	1000	Horizontal	1.6	144

\*- Margin = Field strength of spurious – calculated field strength limit.

\*\* - EUT front panel refers to 0 degrees position of turntable.



<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C		<b>Air Pressure:</b> 1009 hPa	
<b>Remarks:</b> 2G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 51 %	
		<b>Power Supply:</b> 120 VAC	

**Table 7.3.3 Substitution ERP of spurious test results**

ASSIGNED FREQUENCY RANGE: 824-849 MHz  
 TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 SUBSTITUTION ANTENNA HEIGHT: 0.8 m  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: > Resolution bandwidth  
 SUBSTITUTION ANTENNA TYPE: Tunable dipole (30 MHz – 1000 MHz)  
 Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength, dB(µV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBi	Cable loss, dB	ERP, dBm	Limit, dBm	Margin, dB*	Verdict
<b>Low carrier frequency 824.2 MHz</b>										
823.978	80.19	300	Horizontal	-13.43	0.02	1.83	-15.24	-13.00	-2.24	Pass
<b>High carrier frequency 848.8 MHz</b>										
849.021	84.44	300	Horizontal	-11.57	0.28	1.86	-13.15	-13.00	-0.15	Pass

\*- Margin = Spurious emission – specification limit.

**Reference numbers of test equipment used**

HL 0446	HL 0521	HL 0604	HL 0661	HL 1984	HL 3818	HL 4279	HL 4353
HL 4722	HL 4933						

Full description is given in Appendix A.



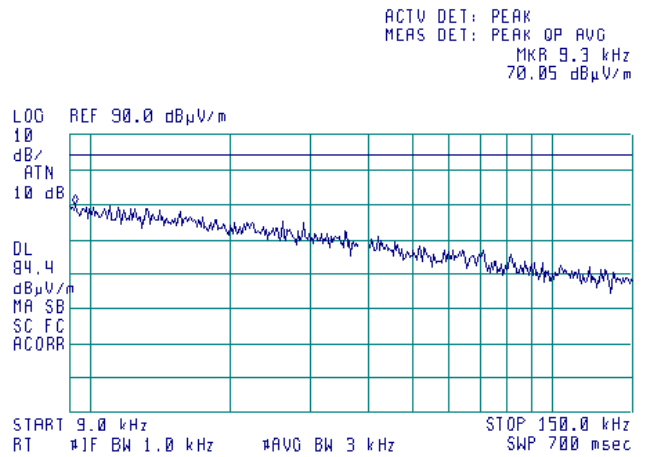
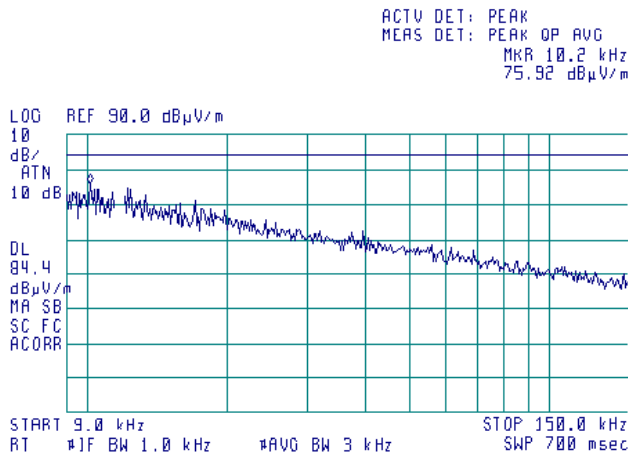
HERMON LABORATORIES

<b>Test specification:</b> Section 22.917/RSS-132, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 22-Apr-15 - 08-Jul-15			
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

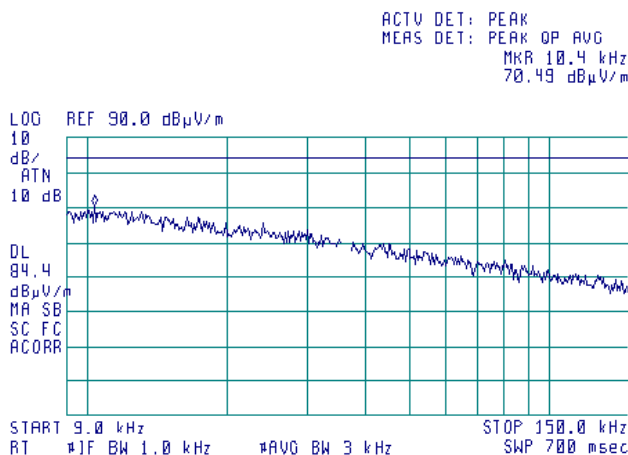
Plot 7.3.1 Radiated emission measurements in 9 - 150 kHz range

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High







HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

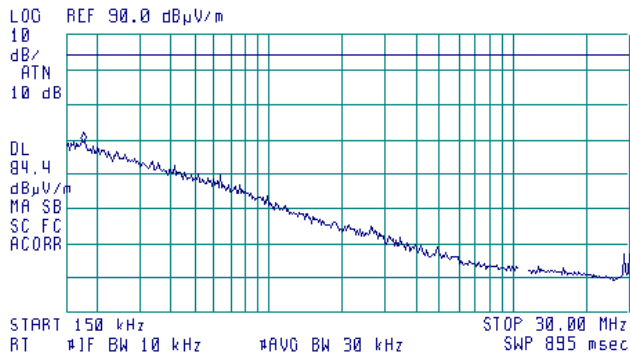
Plot 7.3.2 Radiated emission measurements in 0.15 - 30 MHz range

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

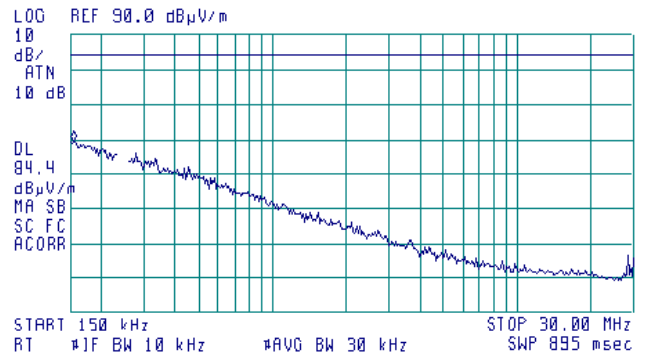
Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 100 kHz  
58.97 dBµV/m



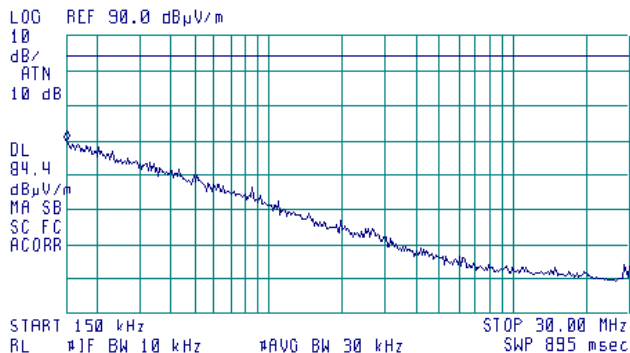
ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 150 kHz  
59.46 dBµV/m



CARRIER FREQUENCY: High



ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 150 kHz  
59.81 dBµV/m





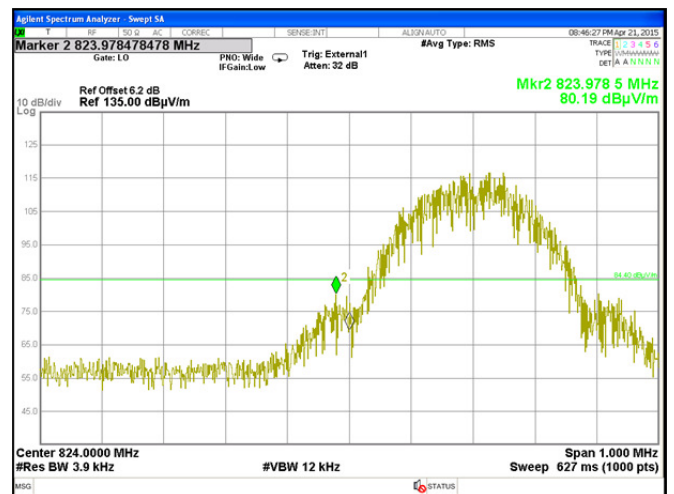
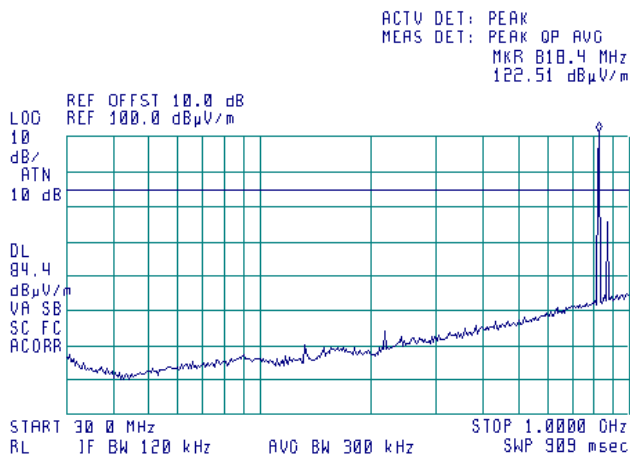
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C		<b>Air Pressure:</b> 1009 hPa	
<b>Remarks:</b> 2G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 51 %	
		<b>Power Supply:</b> 120 VAC	

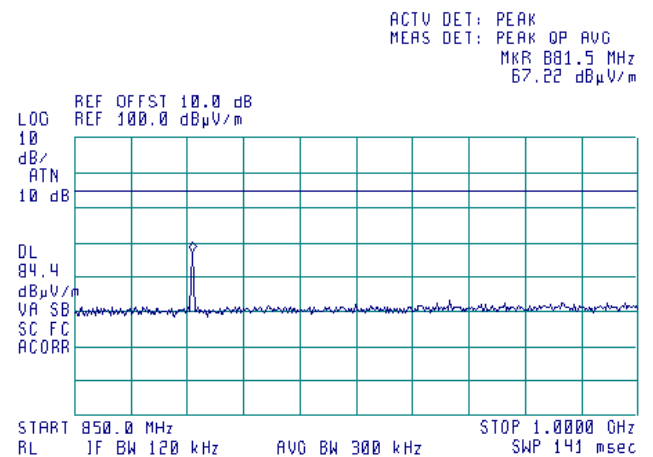
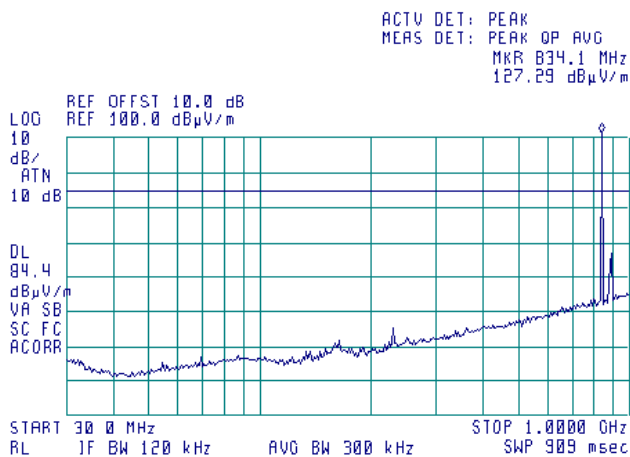
### Plot 7.3.3 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m



CARRIER FREQUENCY: Mid





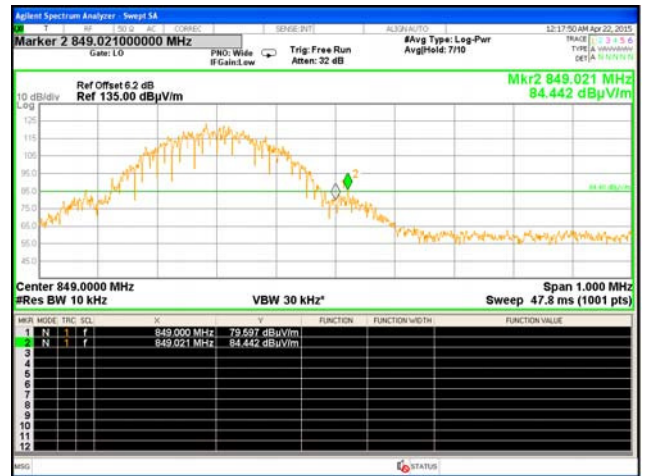
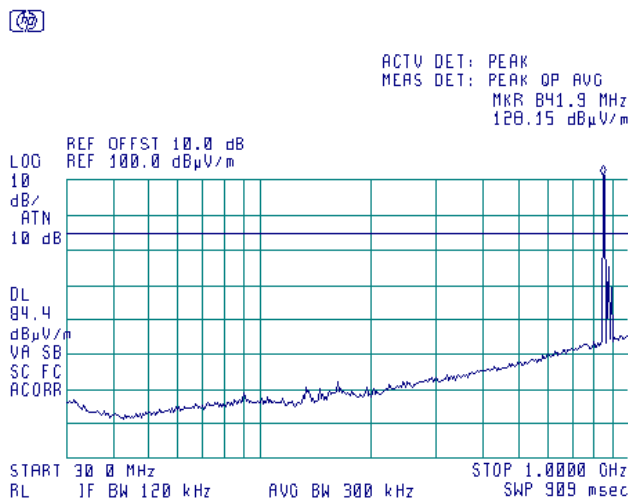
HERMON LABORATORIES

<b>Test specification:</b> Section 22.917/RSS-132, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 22-Apr-15 - 08-Jul-15			
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Plot 7.3.4 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE:  
ANTENNA POLARIZATION:  
CARRIER FREQUENCY: High

Semi anechoic chamber  
Vertical and Horizontal



NOTE: 869.5 MHz, 881.5 MHz and 893.9 MHz are the auxiliary base station signals



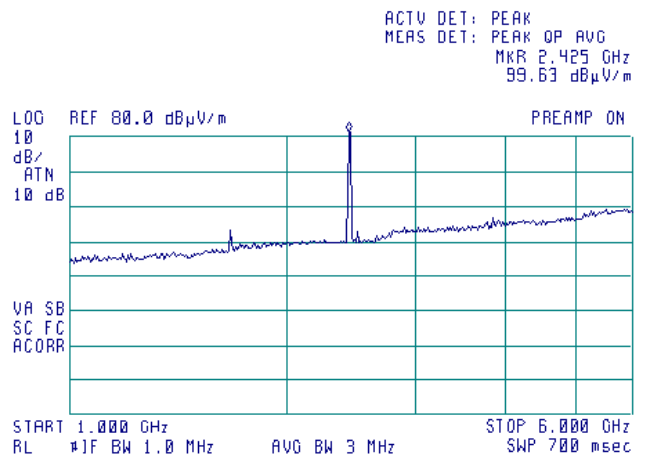
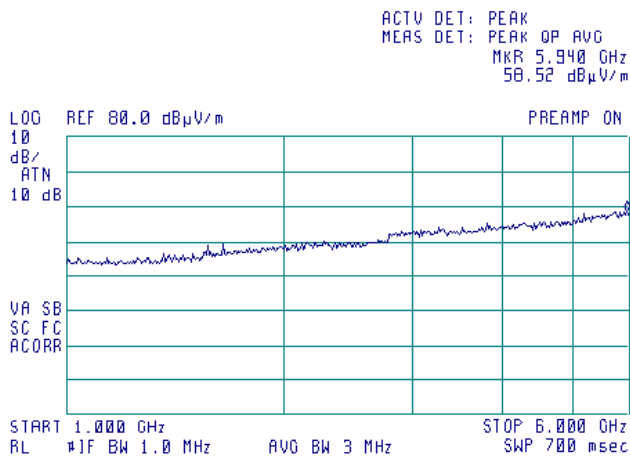
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

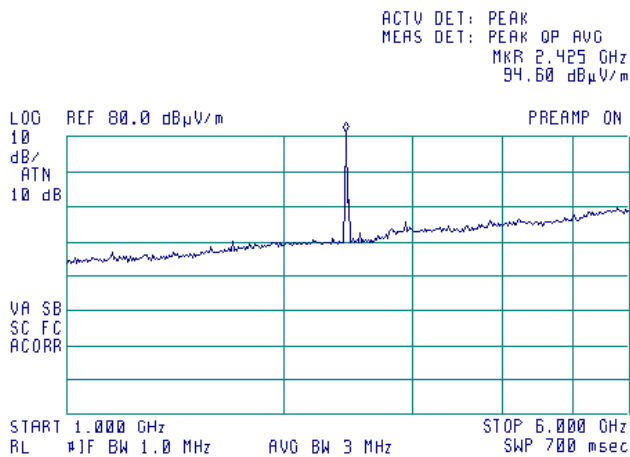
Plot 7.3.5 Radiated emission measurements in 1000 – 6000 MHz range

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



2425 MHz is Wi-Fi module fundamental frequency



HERMON LABORATORIES

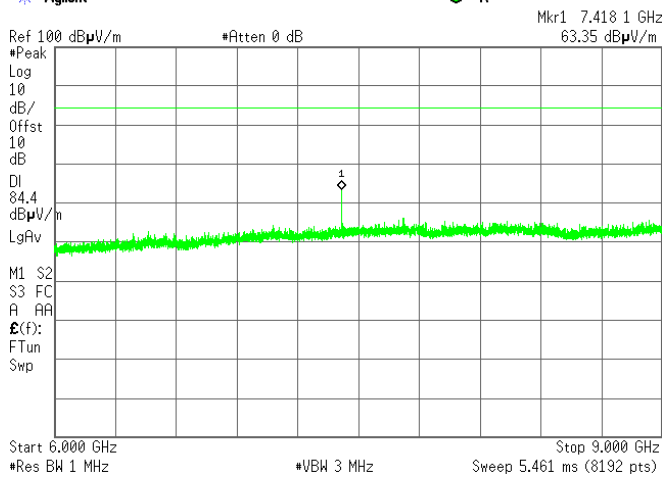
<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b>	
Compliance		PASS	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Plot 7.3.6 Radiated emission measurements in 6000 – 8960 MHz range

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Agilent

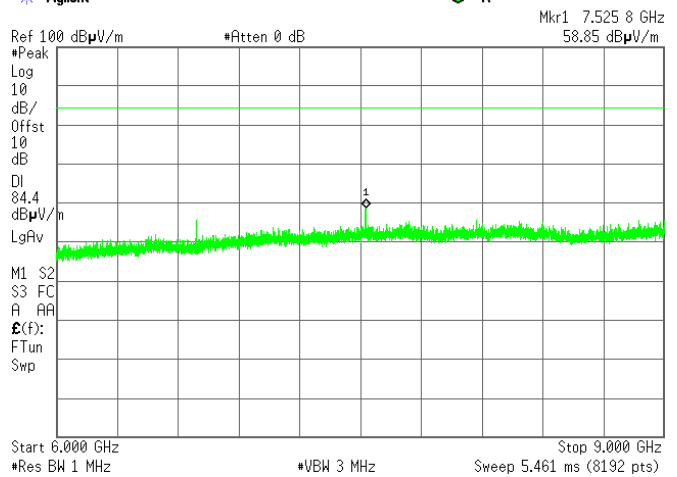
R



Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid

Agilent

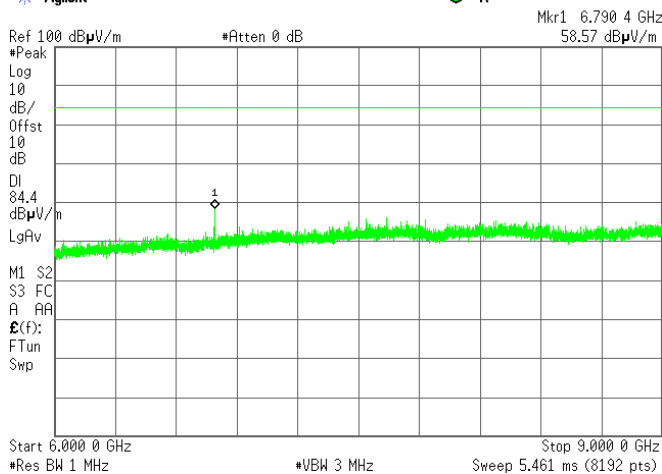
R



CARRIER FREQUENCY: High

Agilent

R





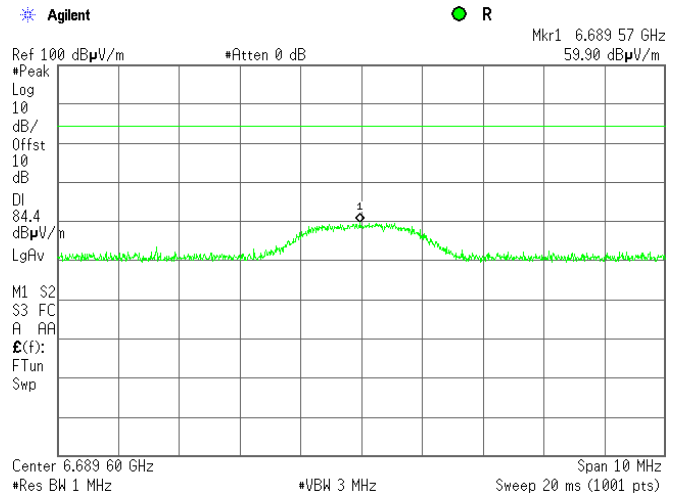
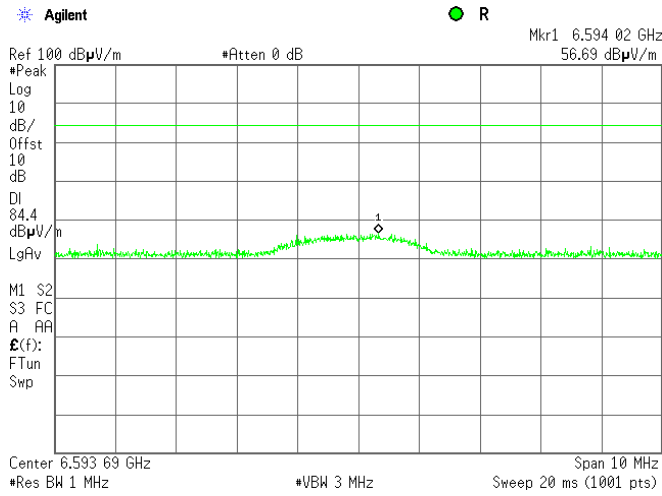
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict: PASS</b>	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

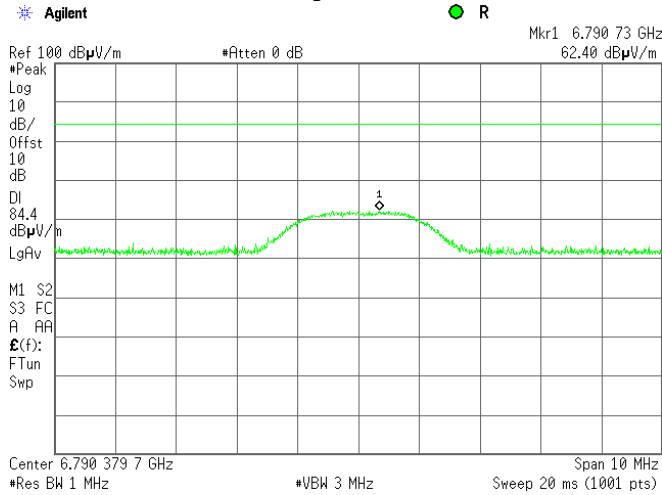
Plot 7.3.7 Radiated emission measurements at the 8<sup>th</sup> harmonic

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





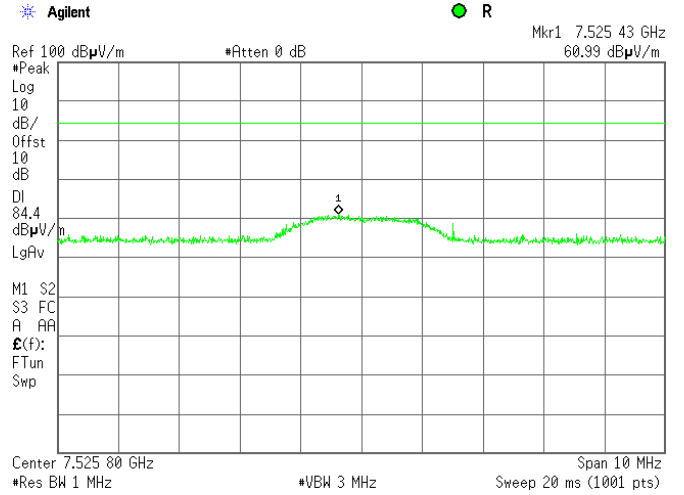
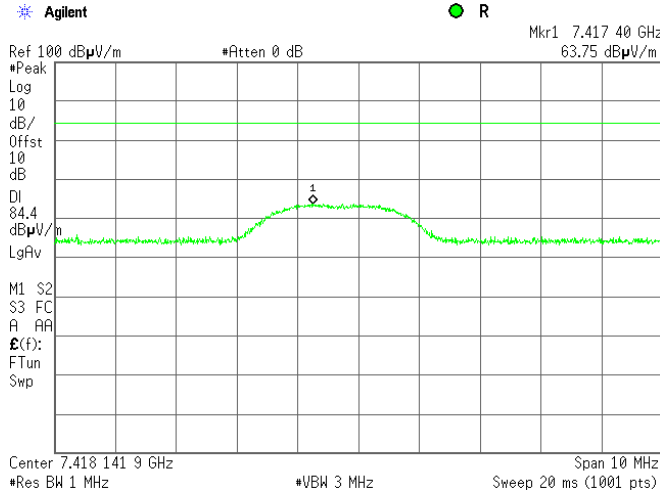
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 22.917/RSS-132, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 22.917; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		22-Apr-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

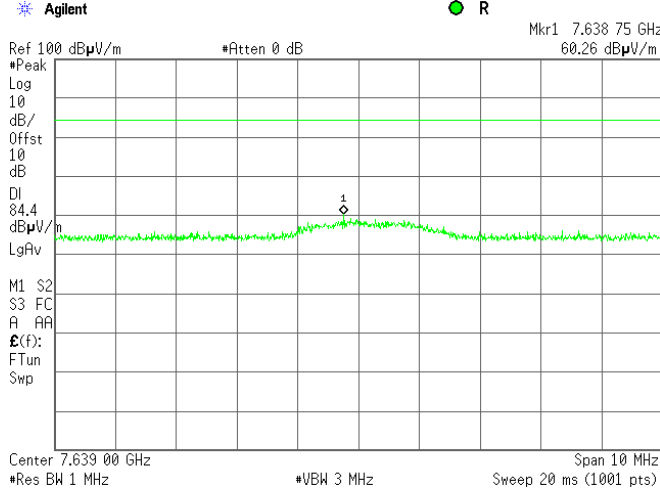
Plot 7.3.8 Radiated emission measurements at the 9<sup>th</sup> harmonic

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





<b>Test specification:</b>	<b>Section 24.232/RSS-133/, RF power output</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	22-Jun-15		
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module/ 3G module			

## 8 Transmitter tests according to 47CFR part 24 and RSS-133 requirements

### 8.1 Equivalent isotropically radiated power of carrier

#### 8.1.1 General

This test was performed to measure equivalent isotropically radiated power emanated by transmitter at carrier frequency. Specification test limits are given in Table 7.1.1.

**Table 8.1.1 Peak output power limit**

Assigned frequency range, MHz	EIRP		Equivalent field strength limit @ 3m, dB( $\mu$ V/m)*
	W	dBm	
1850 – 1910	2.0	33.00	128.23

\* - Equivalent field strength limit was calculated from maximum allowed ERP as follows:  $E = \sqrt{30 \times P \times 1.64} / r$ , where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

#### 8.1.2 Test procedure for field strength measurements

8.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and the performance check was conducted.

8.1.2.2 The field strength of the EUT carrier frequency was measured with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated  $360^\circ$ , the measuring antenna height was swept throughout the range, specified in Table 7.1.2, in both vertical and horizontal polarizations.

8.1.2.3 The worst test results (the lowest margins) were recorded in Table 7.1.2 and shown in the associated plots.

#### 8.1.3 Test procedure for substitution ERP measurements

8.1.3.1 The test equipment was set up as shown in Figure 7.1.2 and energized.

8.1.3.2 RF signal generator was set to the EUT carrier frequency and the RF output level was preliminary adjusted to produce the same field strength as it was measured from the EUT.

8.1.3.3 The test antenna height was swept throughout the specified in Table 7.1.2 range to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as it was measured from the EUT.

8.1.3.4 The ERP was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

8.1.3.5 The above procedure was performed in both horizontal and vertical polarizations of the test antenna.

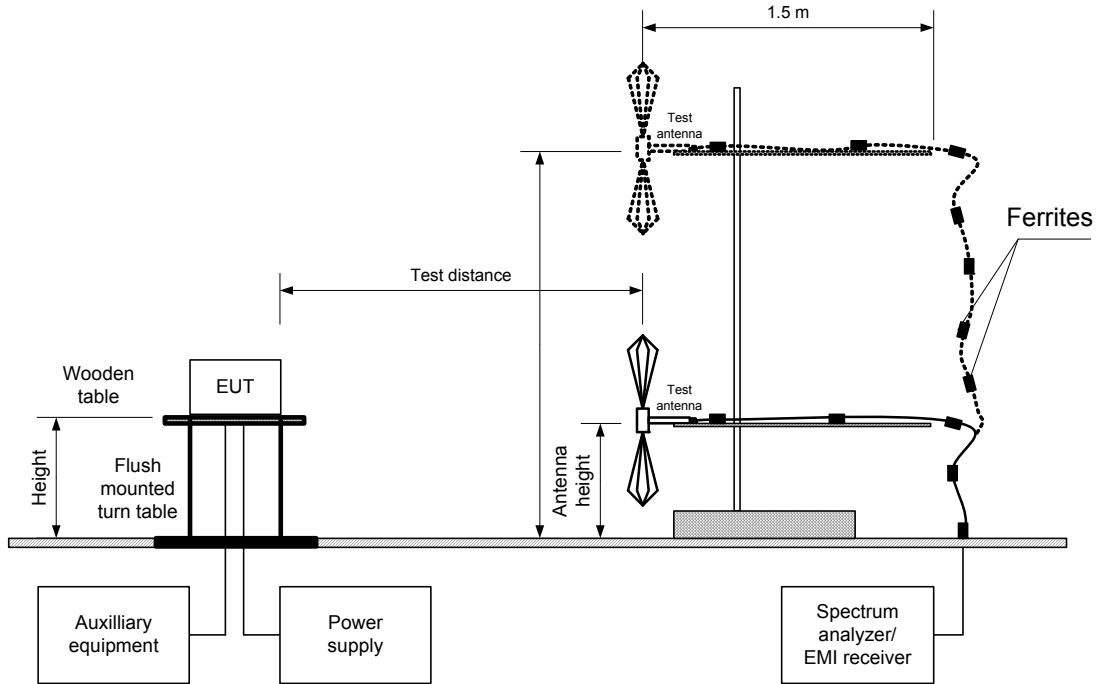
8.1.3.6 The worst test results (the lowest margins) were recorded in Table 7.1.3 and shown in the associated plots.





<b>Test specification:</b>	<b>Section 24.232/RSS-133/, RF power output</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	22-Jun-15		
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module/ 3G module			

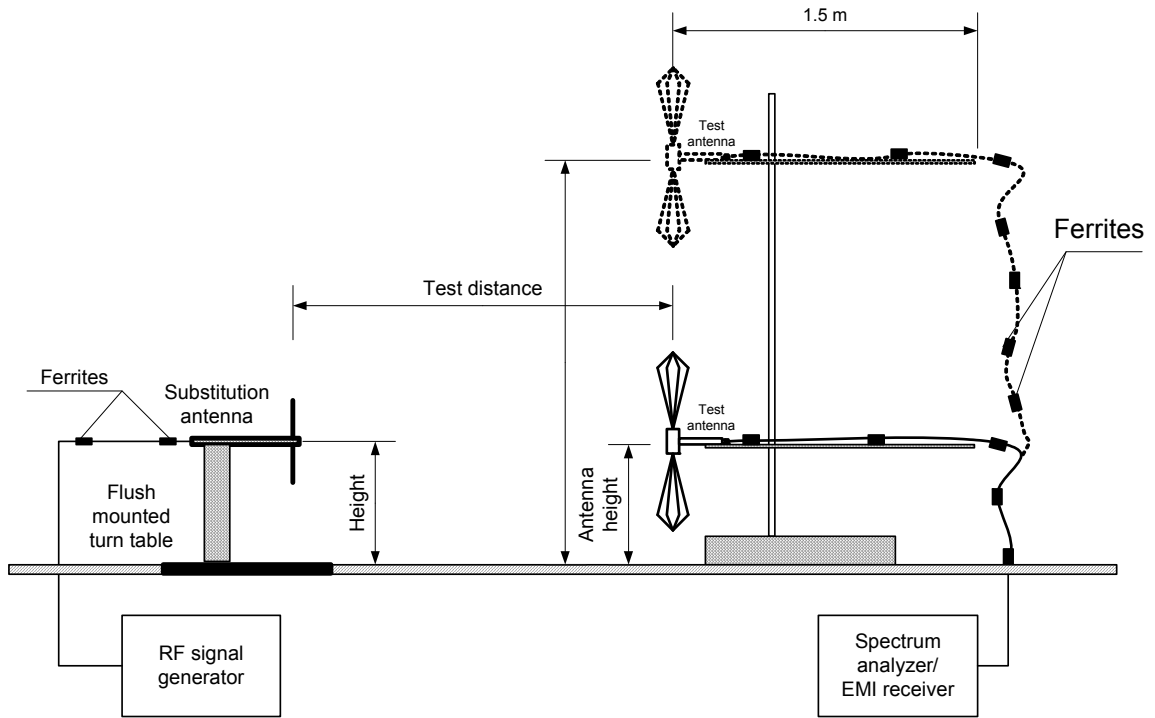
Figure 8.1.1 Setup for carrier field strength measurements





<b>Test specification:</b> Section 24.232/RSS-133/, RF power output			
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 22-Jun-15			
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module/ 3G module			

Figure 8.1.2 Setup for substitution ERP measurements





<b>Test specification:</b> Section 24.232/RSS-133/, RF power output	
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 22-Jun-15	
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa
<b>Relative Humidity:</b> 51 %	
<b>Power Supply:</b> 120 VAC	
<b>Remarks:</b> 2G module	

Table 8.1.2 Transmitter carrier field strength of 2G module

ASSIGNED FREQUENCY RANGE: 1850.0 – 1910.0 MHz  
TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
EUT HEIGHT: 0.8 m  
TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m  
DETECTOR USED: Peak  
VIDEO BANDWIDTH: 3000 kHz  
TEST ANTENNA TYPE: Biconical  
TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
1850.15	121.99	128.3	-6.31	3000	Vert	1.1	281
1850.08	119.11	128.3	-9.19		Hor	1.3	133
1880.05	123.25	128.3	-5.05		Vert	1.8	241
1879.95	120.47	128.3	-7.83		Hor	1.7	232
1909.85	123.73	128.3	-4.57		Vert	1.8	263
1909.73	122.56	128.3	-5.74		Hor	1.0	175

\*- Margin = Field strength – calculated field strength limit.

\*\* - EUT front panel refers to 0 degrees position of turntable.

Table 8.1.3 Transmitter carrier EIRP of 2G module

TEST DISTANCE: 3 m  
SUBSTITUTION ANTENNA HEIGHT: 0.8 m  
TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m  
DETECTOR USED: Peak  
VIDEO BANDWIDTH: 3000 kHz  
SUBSTITUTION ANTENNA TYPE: Tunable dipole

Frequency, MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBi	Cable loss, dB	EIRP, dBm	Limit, dBm	Margin, dB*	Verdict
1850.15	121.99	3000	Vert	22.84	4.67	1.26	26.25	33.0	-6.75	Pass
1850.08	119.11		Hor	18.91	4.67	1.26	22.32	33.0	-10.68	Pass
1880.05	123.25		Vert	24.1	4.58	1.27	27.41	33.0	-5.59	Pass
1879.95	120.47		Hor	20.27	4.58	1.27	23.58	33.0	-9.42	Pass
1909.85	123.73		Vert	24.58	4.52	1.28	27.82	33.0	-5.18	Pass
1909.73	122.56		Hor	22.36	4.52	1.28	25.60	33.0	-7.40	Pass

\*- Margin = ERP – specification limit.

## Reference numbers of test equipment used

HL 0661	HL 1984	HL 2871	HL 4114	HL 4353	HL 4722		
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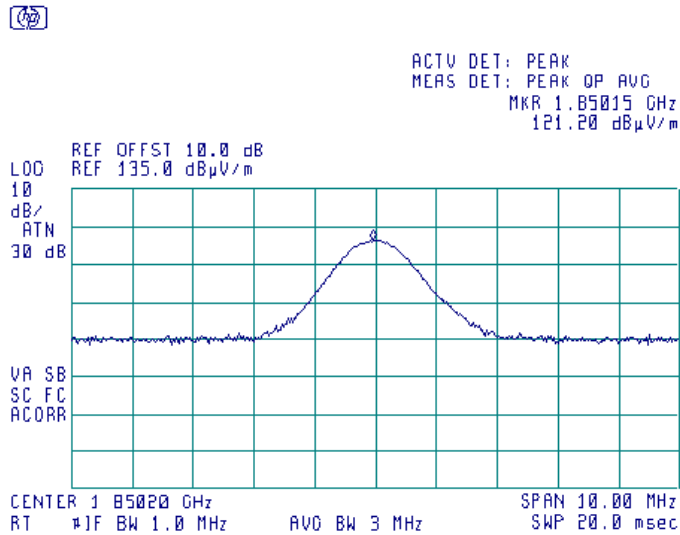
Full description is given in Appendix A.



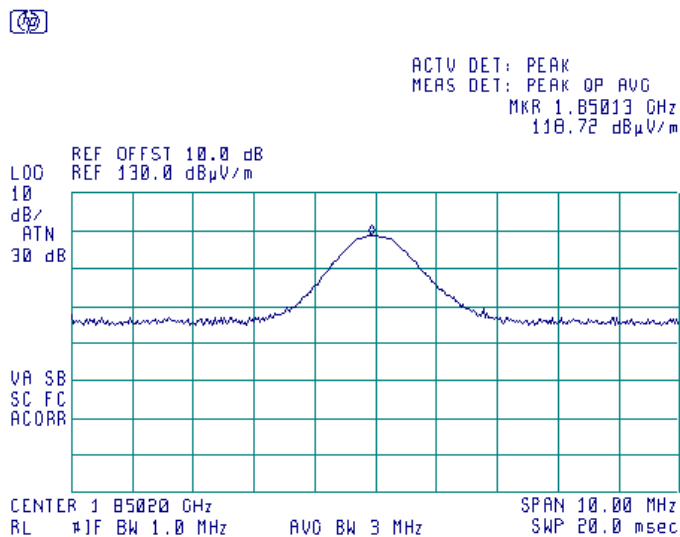
HERMON LABORATORIES

<b>Test specification:</b> Section 24.232/RSS-133/, RF power output			
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 22-Jun-15			
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Plot 8.1.1 Transmitter carrier field strength at low frequency in vertical antenna polarization, EUT vertical position



Plot 8.1.2 Transmitter carrier field strength at low frequency in horizontal antenna polarization, EUT vertical position

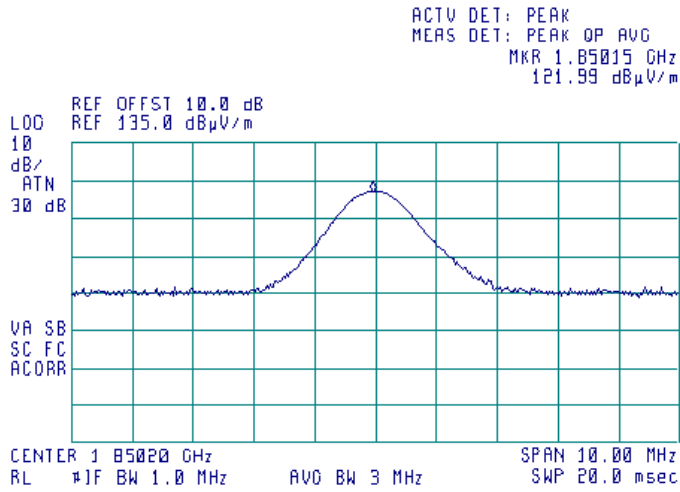




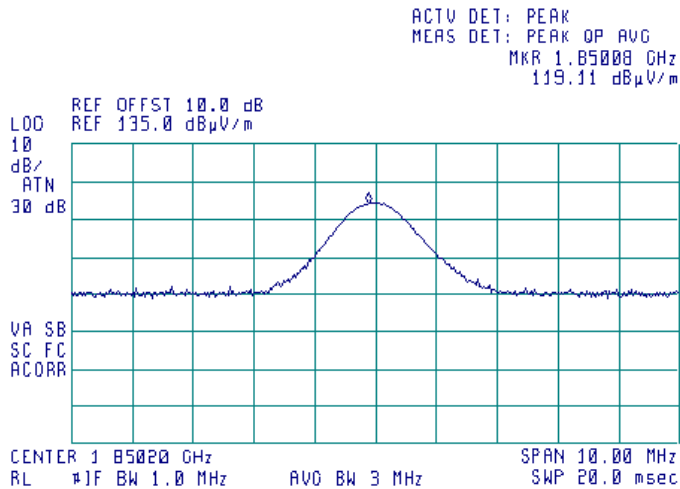
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.232/RSS-133/, RF power output</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		<b>Verdict:</b>	
Compliance		PASS	
<b>Date(s):</b>		22-Jun-15	
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Plot 8.1.3 Transmitter carrier field strength at low frequency in vertical antenna polarization, EUT horizontal position



Plot 8.1.4 Transmitter carrier field strength at low frequency in horizontal antenna polarization, EUT horizontal position

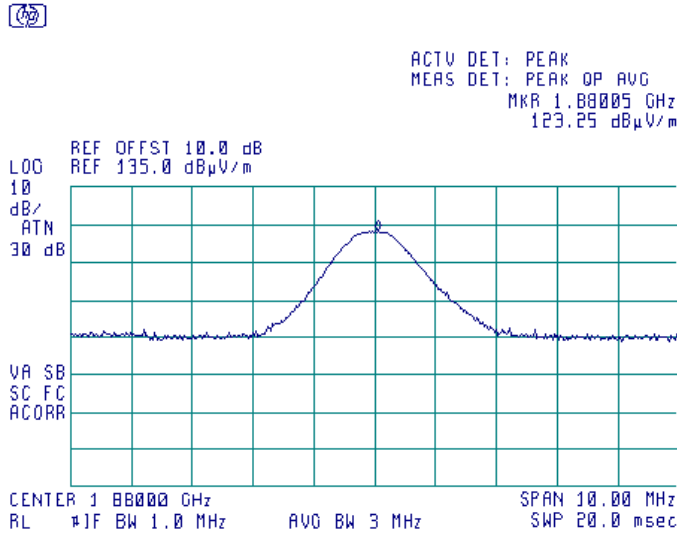




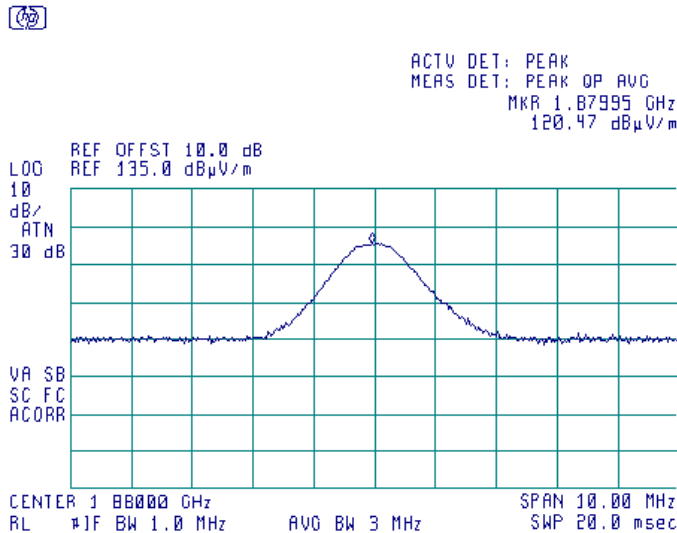
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.232/RSS-133/, RF power output</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		22-Jun-15	
<b>Temperature:</b> 21.3 °C		<b>Air Pressure:</b> 1009 hPa	
<b>Remarks:</b> 2G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 51 %	
		<b>Power Supply:</b> 120 VAC	

Plot 8.1.5 Transmitter carrier field strength at mid frequency in vertical antenna polarization, EUT vertical position



Plot 8.1.6 Transmitter carrier field strength at mid frequency in horizontal antenna polarization, EUT vertical position

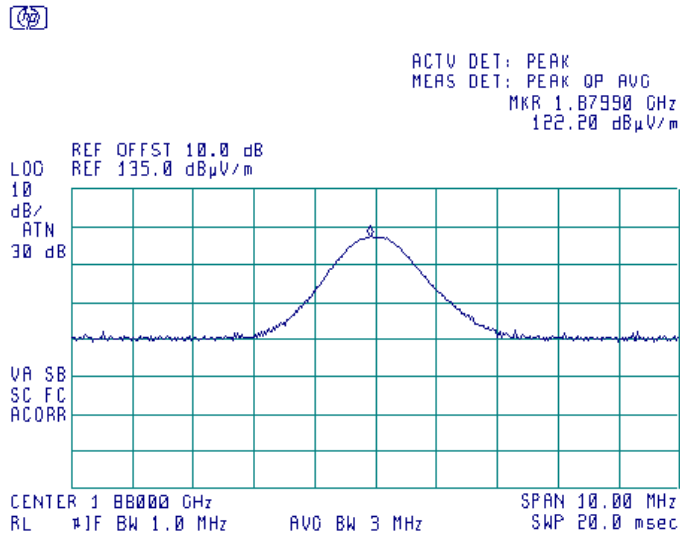




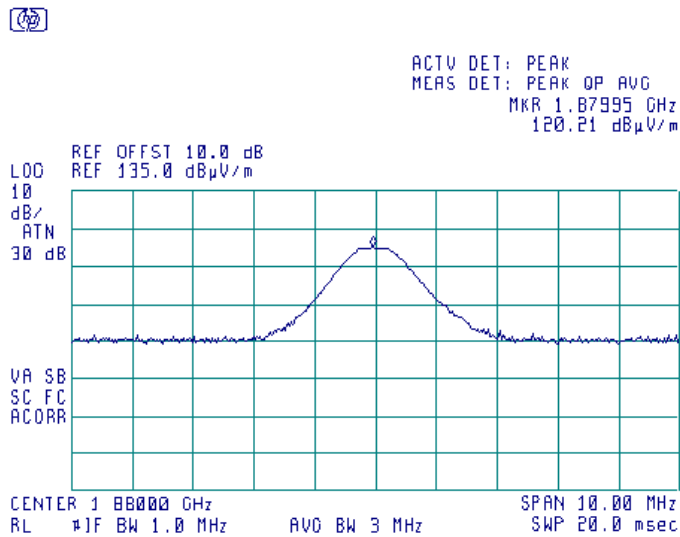
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.232/RSS-133/, RF power output</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		<b>Verdict:</b>	
Compliance		PASS	
<b>Date(s):</b>		22-Jun-15	
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Plot 8.1.7 Transmitter carrier field strength at mid frequency in vertical antenna polarization, EUT horizontal position



Plot 8.1.8 Transmitter carrier field strength at mid frequency in horizontal antenna polarization, EUT horizontal position

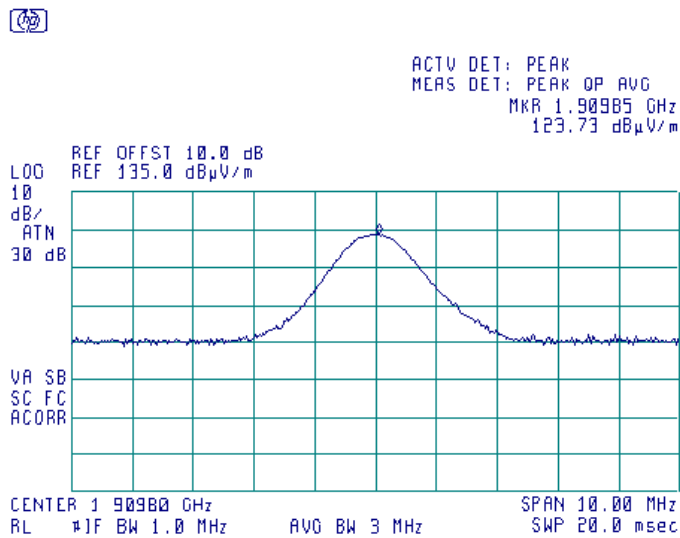




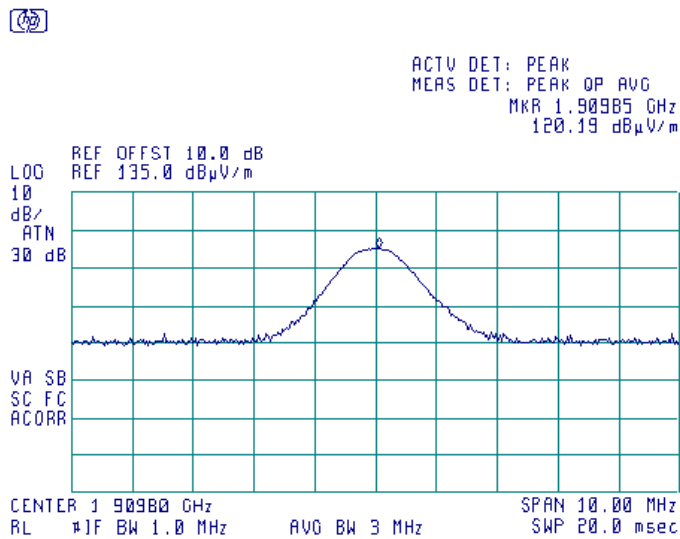
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.232/RSS-133/, RF power output</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		<b>Verdict:</b>	
Compliance		PASS	
<b>Date(s):</b>		22-Jun-15	
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Plot 8.1.9 Transmitter carrier field strength at high frequency in vertical antenna polarization, EUT vertical position



Plot 8.1.10 Transmitter carrier field strength at high frequency in horizontal antenna polarization, EUT vertical position

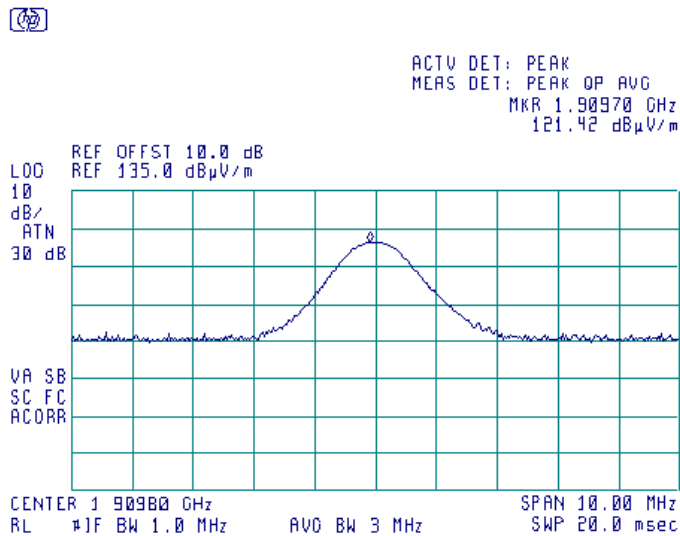




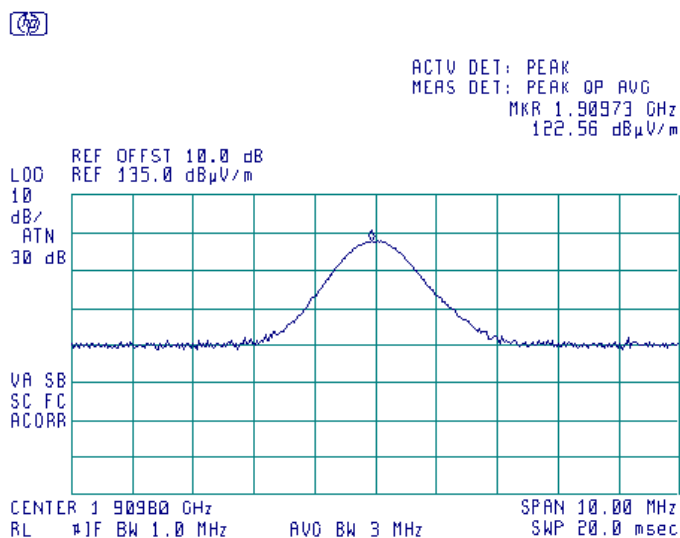


<b>Test specification:</b>		<b>Section 24.232/RSS-133/, RF power output</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b>		<b>Verdict:</b>	
Compliance		PASS	
<b>Date(s):</b>		22-Jun-15	
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Plot 8.1.11 Transmitter carrier field strength at high frequency in vertical antenna polarization, EUT horizontal position



Plot 8.1.12 Transmitter carrier field strength at high frequency in horizontal antenna polarization, EUT horizontal position





<b>Test specification:</b> Section 24.232/RSS-133/, RF power output	
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 09-Jun-15	
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa
<b>Remarks:</b> 3G module	

**Table 8.1.4 Transmitter carrier field strength of 3G module**

ASSIGNED FREQUENCY RANGE: 1850.0 – 1910.0 MHz  
 TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 EUT HEIGHT: 0.8 m  
 TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: 3000 kHz  
 TEST ANTENNA TYPE: Biconical  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
1851.80	122.18	128.3	-6.12	3000	Vert	1.6	279
1851.95	118.27	128.3	-10.03		Hor	1.7	183
1881.25	120.32	128.3	-7.98		Vert	1.6	278
1879.65	118.56	128.3	-9.74		Hor	1.6	243
1907.40	121.14	128.3	-7.16		Vert	1.5	264
1907.60	118.61	128.3	-9.69		Hor	1.5	224

\*- Margin = Field strength – calculated field strength limit.  
 \*\*- EUT front panel refers to 0 degrees position of turntable.

**Table 8.1.5 Transmitter carrier EIRP of 3G module**

TEST DISTANCE: 3 m  
 SUBSTITUTION ANTENNA HEIGHT: 0.8 m  
 TEST ANTENNA HEIGHTS RANGE: 1.0 – 4.0 m  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: 3000 kHz  
 SUBSTITUTION ANTENNA TYPE: Tunable dipole

Frequency, MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBi	Cable loss, dB	EIRP, dBm	Limit, dBm	Margin, dB*	Verdict
1851.80	122.18	3000	Vert	23.03	4.68	1.26	26.45	33.0	-6.55	Pass
1851.95	118.27		Hor	18.07	4.68	1.26	21.49	33.0	-11.51	Pass
1881.25	120.32		Vert	21.17	4.59	1.27	24.49	33.0	-8.51	Pass
1879.65	118.56		Hor	18.36	4.58	1.27	21.67	33.0	-11.33	Pass
1907.40	121.14		Vert	21.99	4.51	1.28	25.22	33.0	-7.78	Pass
1907.60	118.61		Hor	18.41	4.51	1.28	21.64	33.0	-11.36	Pass

\*- Margin = ERP – specification limit.

**Reference numbers of test equipment used**

HL 0661	HL 1984	HL 2871	HL 4114	HL 4353	HL 4722		
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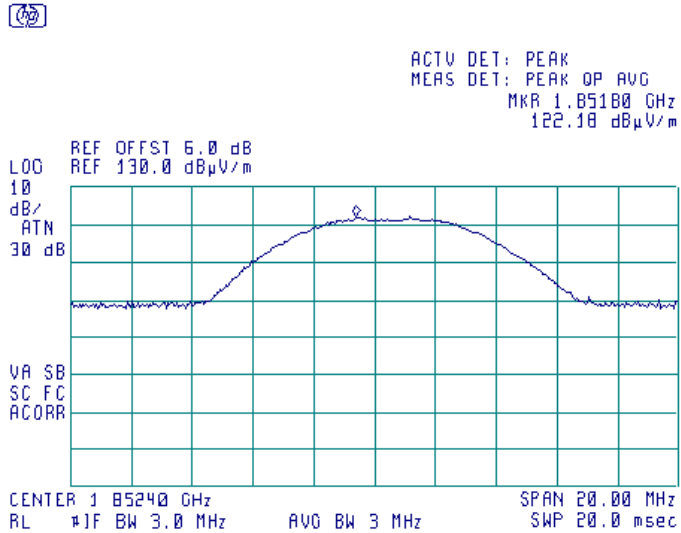
Full description is given in Appendix A.



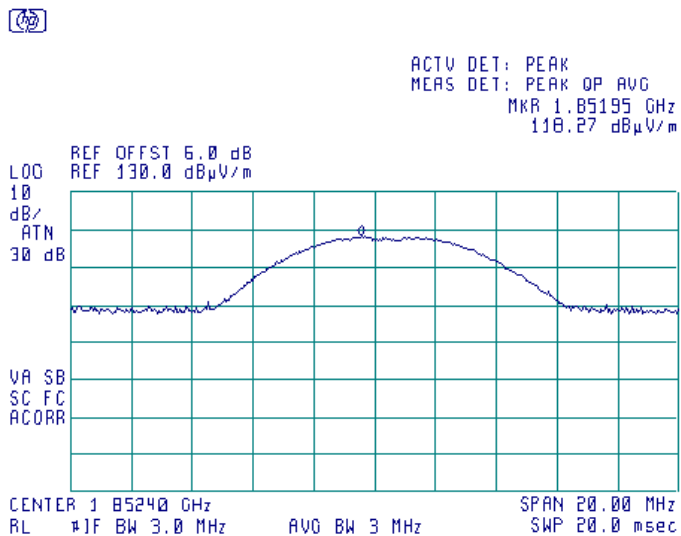
HERMON LABORATORIES

<b>Test specification:</b> Section 24.232/RSS-133/, RF power output			
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 09-Jun-15			
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

Plot 8.1.13 Transmitter carrier field strength at low frequency in vertical antenna polarization, EUT vertical position



Plot 8.1.14 Transmitter carrier field strength at low frequency in horizontal antenna polarization, EUT vertical position

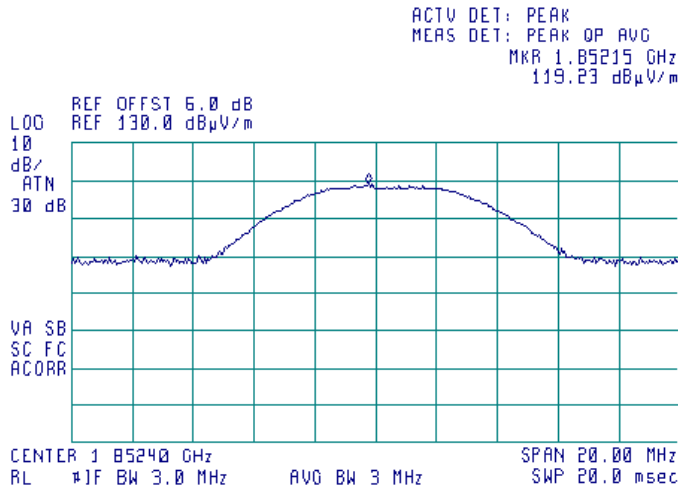




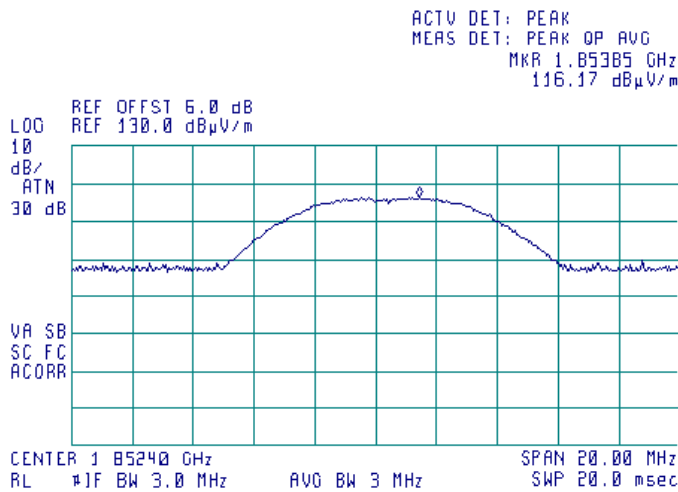
HERMON LABORATORIES

<b>Test specification:</b> Section 24.232/RSS-133/, RF power output			
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 09-Jun-15			
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

Plot 8.1.15 Transmitter carrier field strength at low frequency in vertical antenna polarization, EUT horizontal position



Plot 8.1.16 Transmitter carrier field strength at low frequency in horizontal antenna polarization, EUT horizontal position

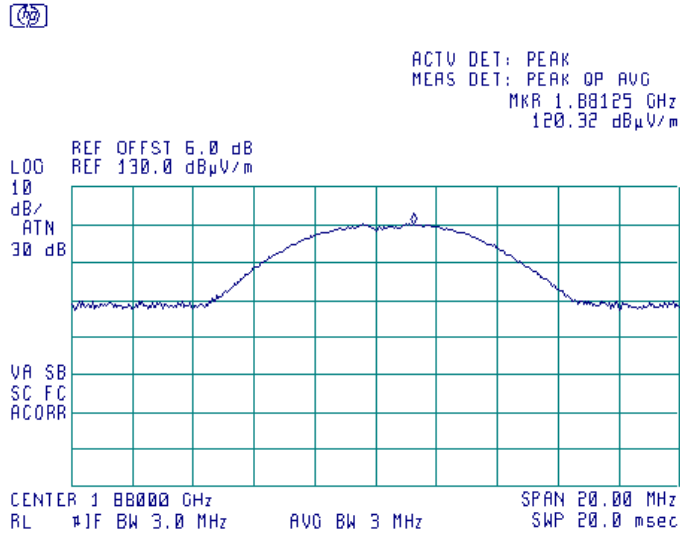




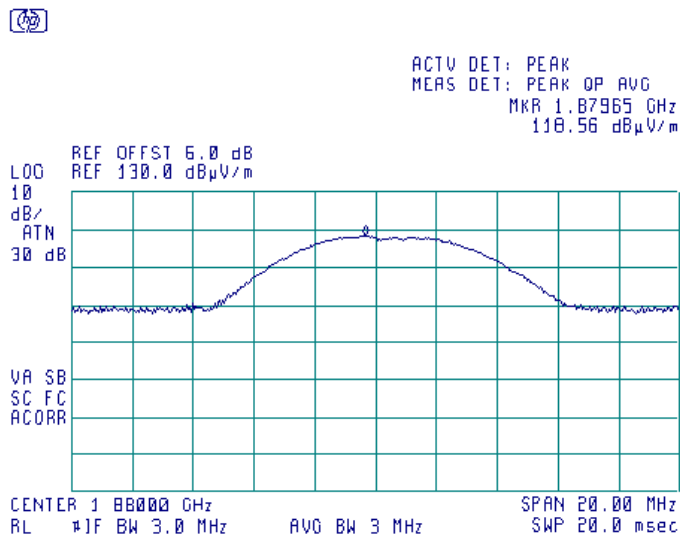
HERMON LABORATORIES

<b>Test specification:</b> Section 24.232/RSS-133/, RF power output			
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 09-Jun-15			
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

Plot 8.1.17 Transmitter carrier field strength at mid frequency in vertical antenna polarization, EUT vertical position



Plot 8.1.18 Transmitter carrier field strength at mid frequency in horizontal antenna polarization, EUT vertical position

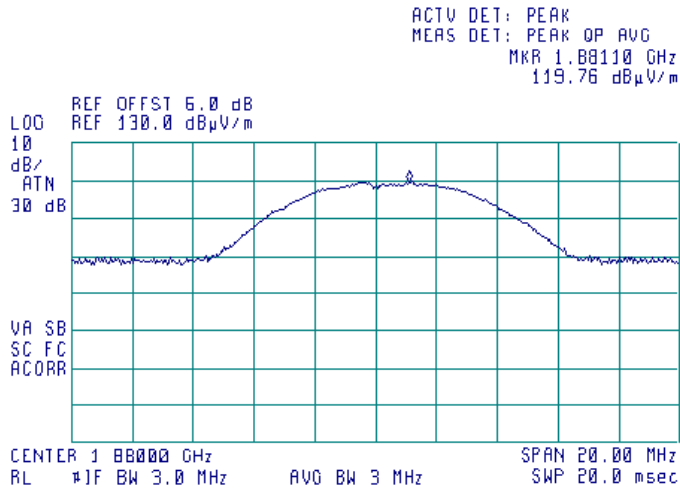




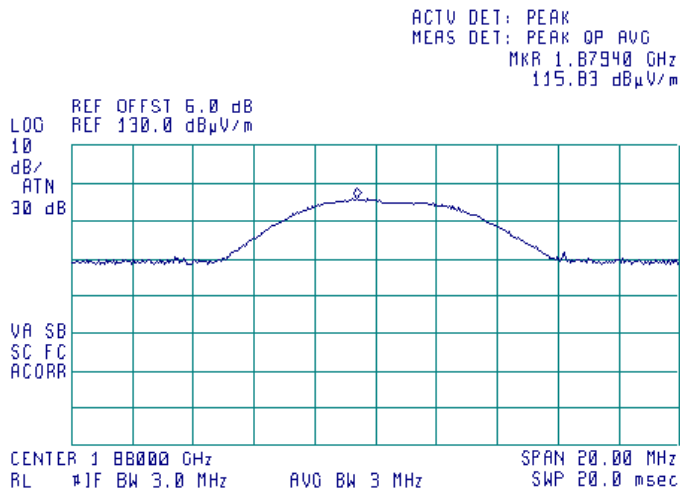
HERMON LABORATORIES

<b>Test specification:</b> Section 24.232/RSS-133/, RF power output			
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 09-Jun-15			
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

Plot 8.1.19 Transmitter carrier field strength at mid frequency in vertical antenna polarization, EUT horizontal position



Plot 8.1.20 Transmitter carrier field strength at mid frequency in horizontal antenna polarization, EUT horizontal position

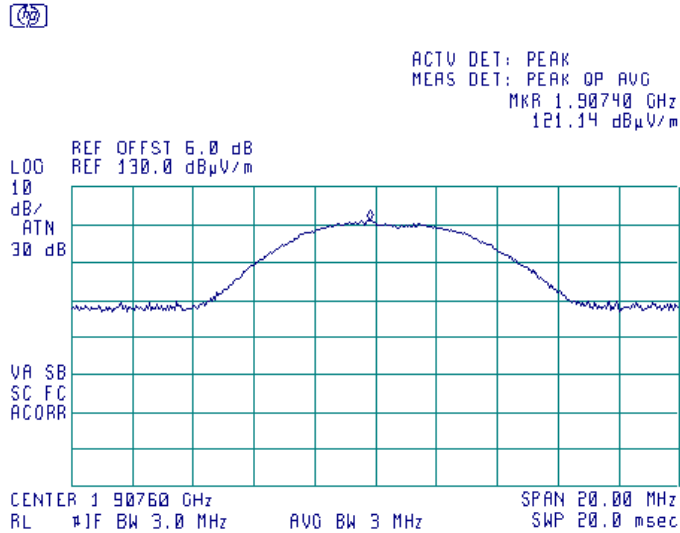




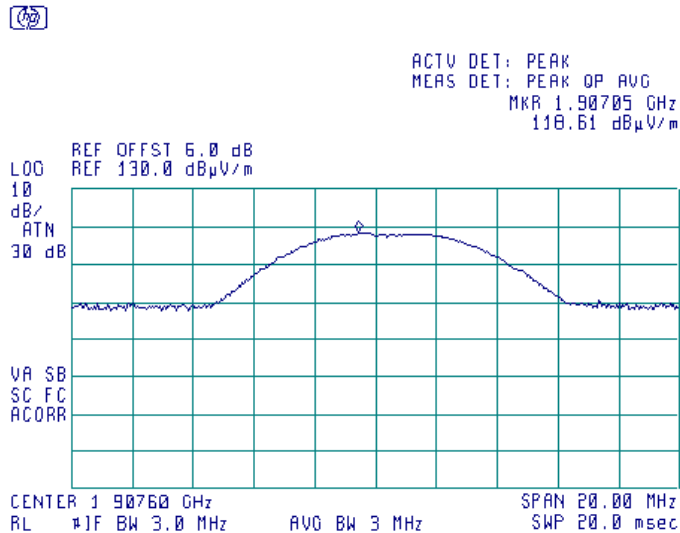
HERMON LABORATORIES

<b>Test specification:</b> Section 24.232/RSS-133/, RF power output			
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 09-Jun-15			
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

Plot 8.1.21 Transmitter carrier field strength at high frequency in vertical antenna polarization, EUT vertical position



Plot 8.1.22 Transmitter carrier field strength at high frequency in horizontal antenna polarization, EUT vertical position

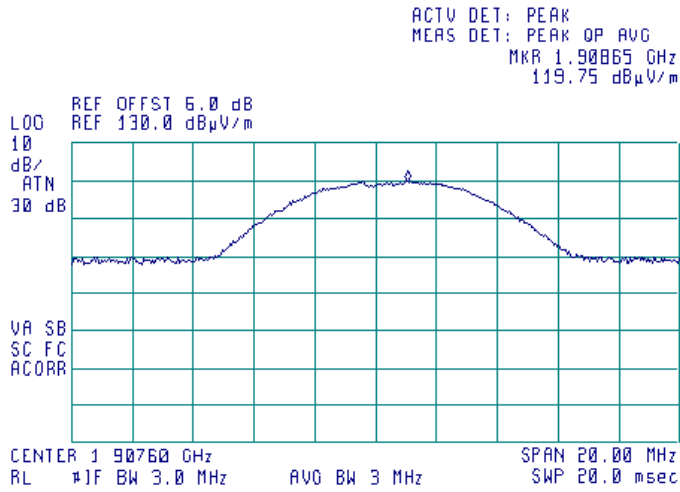




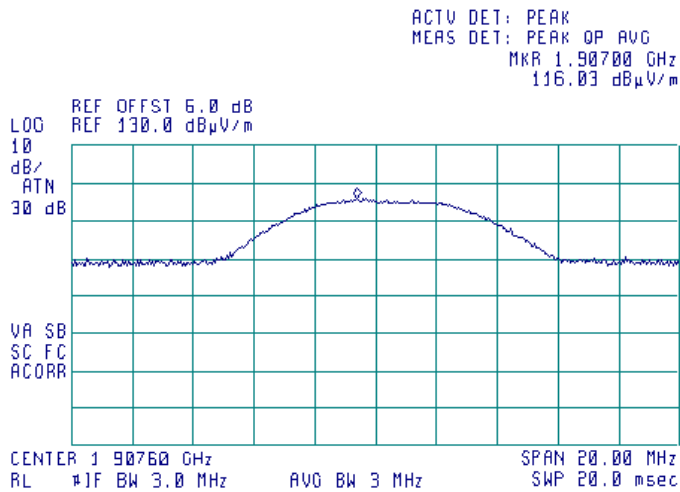
HERMON LABORATORIES

<b>Test specification:</b> Section 24.232/RSS-133/, RF power output			
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 09-Jun-15			
<b>Temperature:</b> 21.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

Plot 8.1.23 Transmitter carrier field strength at high frequency in vertical antenna polarization, EUT horizontal position



Plot 8.1.24 Transmitter carrier field strength at high frequency in horizontal antenna polarization, EUT horizontal position







<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1009 hPa	
<b>Remarks:</b> 3G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 51 %	
		<b>Power Supply:</b> 120 VAC	

## 8.2 Radiated spurious emission measurements of 3G module

### 8.2.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 8.2.1.

Table 8.2.1 Radiated spurious emission test limits

Frequency, MHz	Attenuation below carrier, dBc	EIRP of spurious, dBm	Equivalent field strength limit @ 3m, dB( $\mu$ V/m) <sup>***</sup>
0.009 – 10 <sup>th</sup> harmonic*	43+10logP <sup>**</sup>	-13	82.25

\* - Excluding the in band emission within  $\pm 250$  % of the authorized bandwidth from the carrier

\*\* - P is transmitter output power in Watts

\*\*\* - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows:  $E = \sqrt{(30 \times P \times 1.64)} / r$ , where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

### 8.2.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

8.2.2.1 The EUT was set up as shown in Figure 8.2.1, energized and the performance check was conducted.

8.2.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

8.2.2.3 The worst test results (the lowest margins) were recorded in Table 8.2.2 and shown in the associated plots.

### 8.2.3 Test procedure for spurious emission field strength measurements above 30 MHz

8.2.3.1 The EUT was set up as shown in Figure 8.2.2, energized and the performance check was conducted.

8.2.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

8.2.3.3 The worst test results (the lowest margins) were recorded in Table 8.2.2 and shown in the associated plots.



<b>Test specification:</b> Section 24.238, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 09-Jun-15 - 08-Jul-15			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

Figure 8.2.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

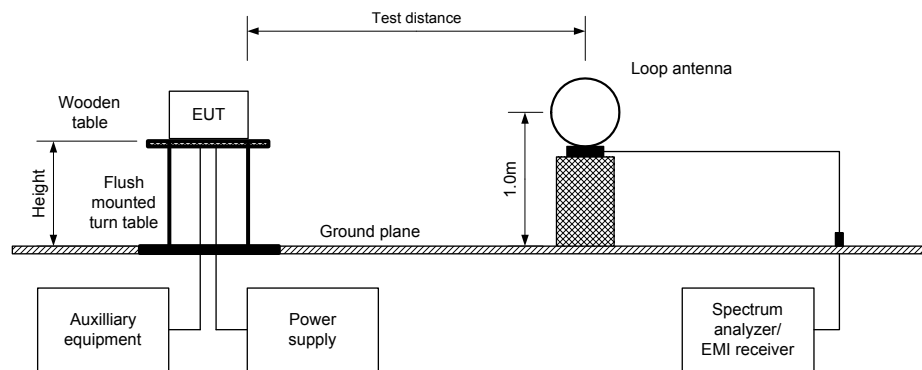
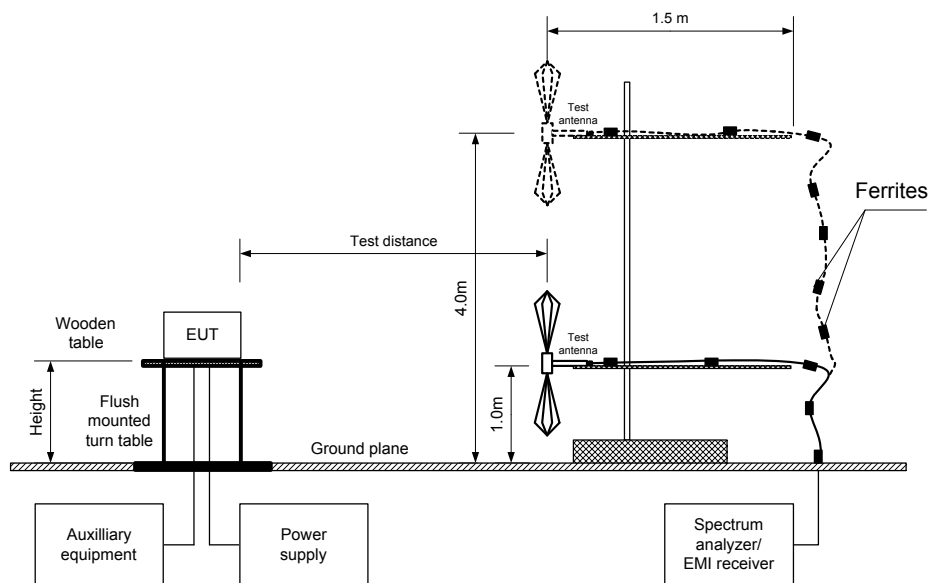


Figure 8.2.2 Setup for spurious emission field strength measurements above 30 MHz





<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1009 hPa	
<b>Remarks:</b> 3G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 51 %	
		<b>Power Supply:</b> 120 VAC	

Table 8.2.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE: 1850-1910 MHz  
TEST DISTANCE: 3 m  
TEST SITE: Semi anechoic chamber  
EUT HEIGHT: 0.8 m  
INVESTIGATED FREQUENCY RANGE: 0.009 – 19000 MHz  
DETECTOR USED: Peak  
VIDEO BANDWIDTH: > Resolution bandwidth  
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)  
Biconilog (30 MHz – 1000 MHz)  
Double ridged guide (above 1000 MHz)

MODULATING SIGNAL: PRBS

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
<b>Low carrier frequency 1852.4 MHz</b>							
No emissions except fundamental carriers were found.							
<b>Mid carrier frequency 1880 MHz</b>							
No emissions except fundamental carriers were found.							
<b>High carrier frequency 1907.6 MHz</b>							
No emissions except fundamental carriers were found.							

Verdict: Pass

\*- Margin = Field strength of spurious – calculated field strength limit.

\*\* - EUT front panel refers to 0 degrees position of turntable.

Reference numbers of test equipment used

HL 0446	HL 0521	HL 1984	HL 3818	HL 4353	HL 4722	HL 4856	HL 4933
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Full description is given in Appendix A.



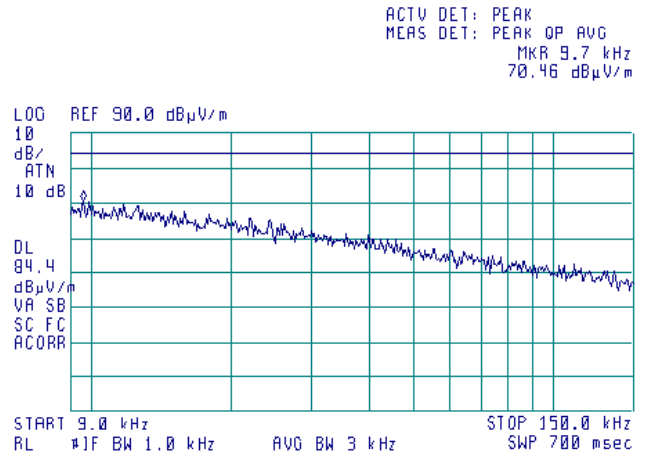
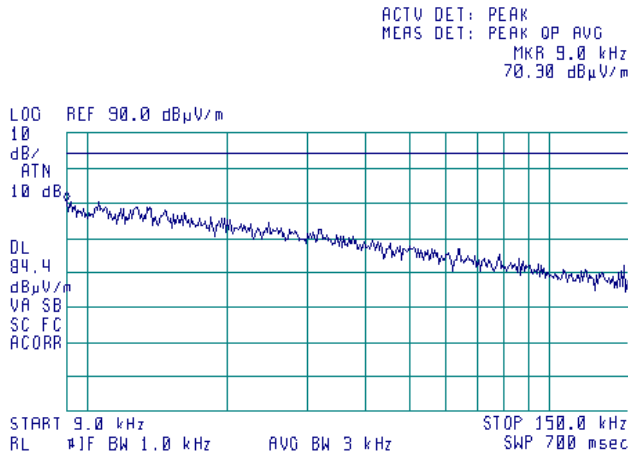
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

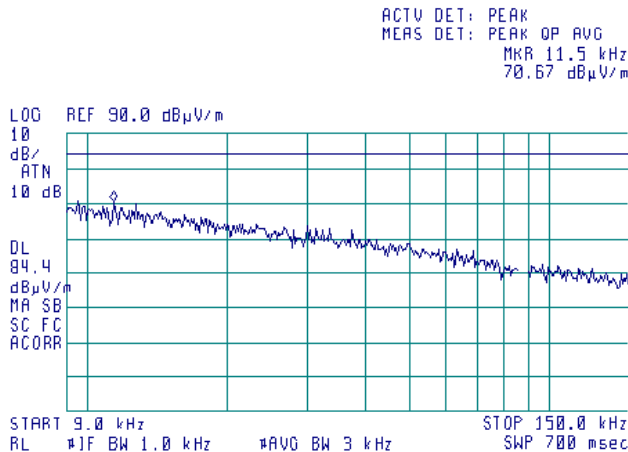
**Plot 8.2.1 Radiated emission measurements in 9 - 150 kHz range**

TEST SITE:  
CARRIER FREQUENCY:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Low  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





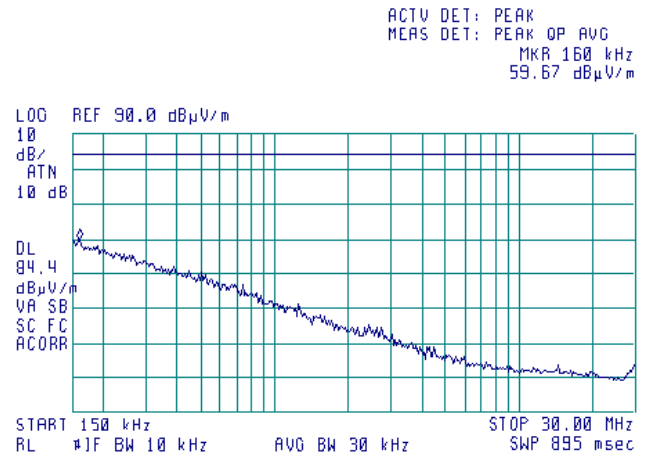
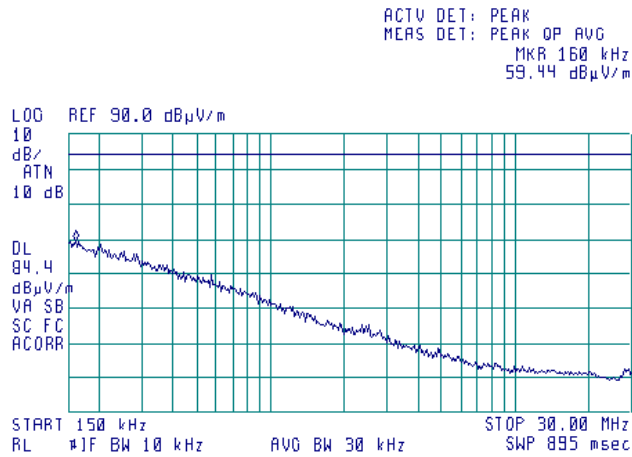
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

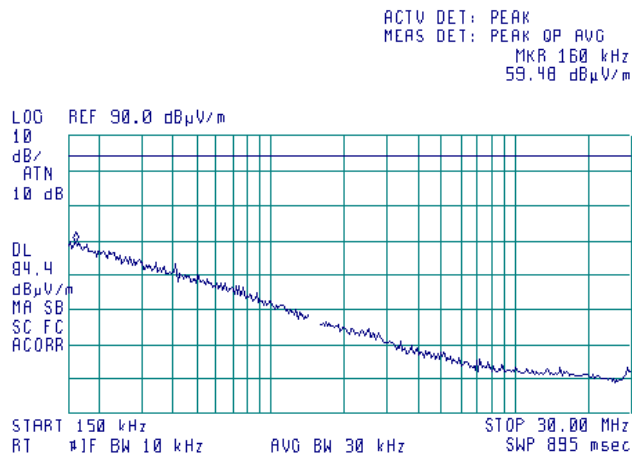
Plot 8.2.2 Radiated emission measurements in 0.15 - 30 MHz range

TEST SITE:  
CARRIER FREQUENCY:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Low  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





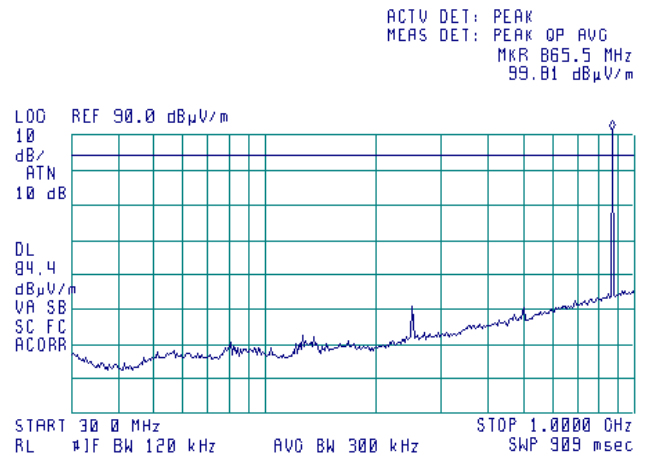
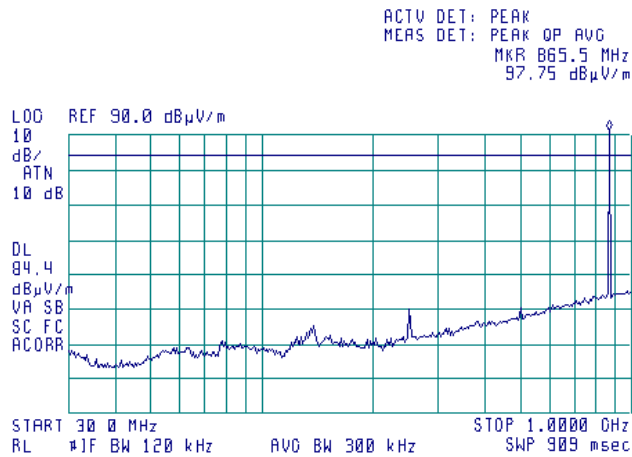
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

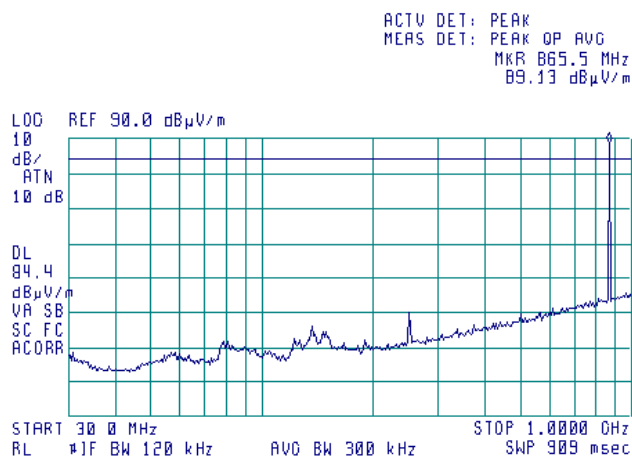
**Plot 8.2.3 Radiated emission measurements in 30 - 1000 MHz range**

TEST SITE:  
CARRIER FREQUENCY:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Low  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



NOTE: 868 MHz carrier from RF module PG2



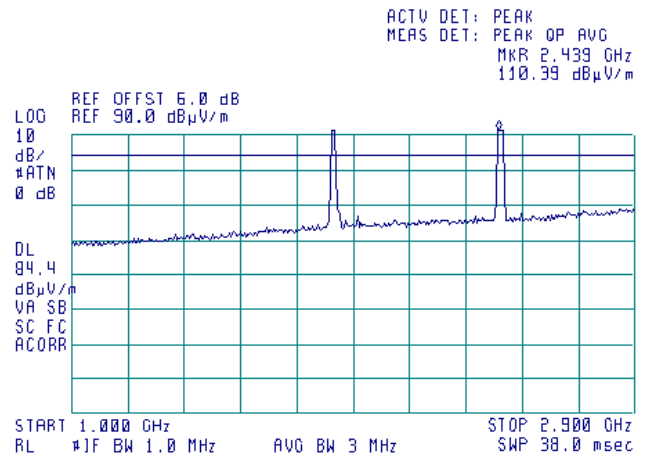
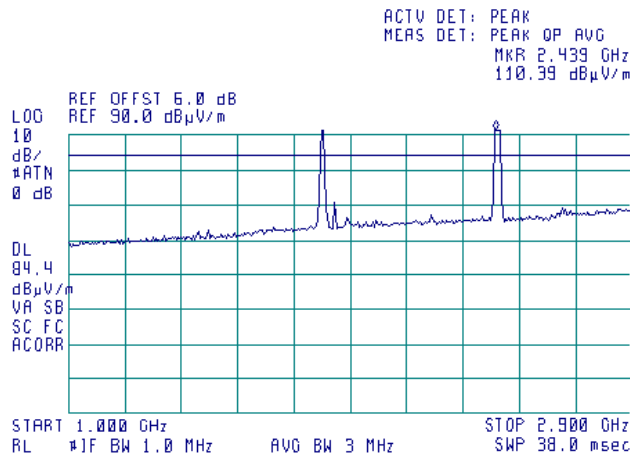
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

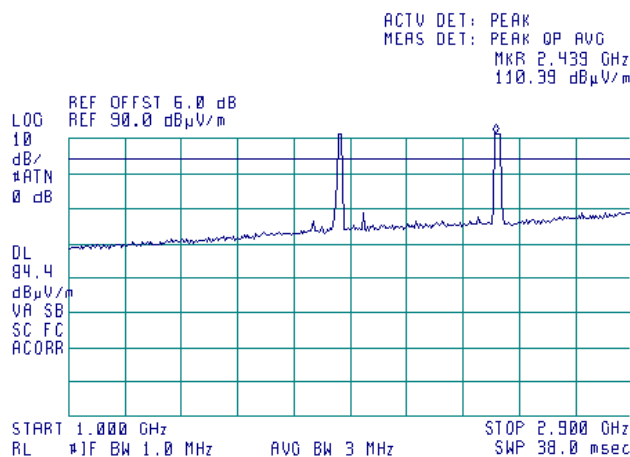
**Plot 8.2.4 Radiated emission measurements in 1000 – 2900 MHz range**

TEST SITE:  
CARRIER FREQUENCY:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Low  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



2.44GHz – WiFi fundamental  
1852.4 MHz low frequency



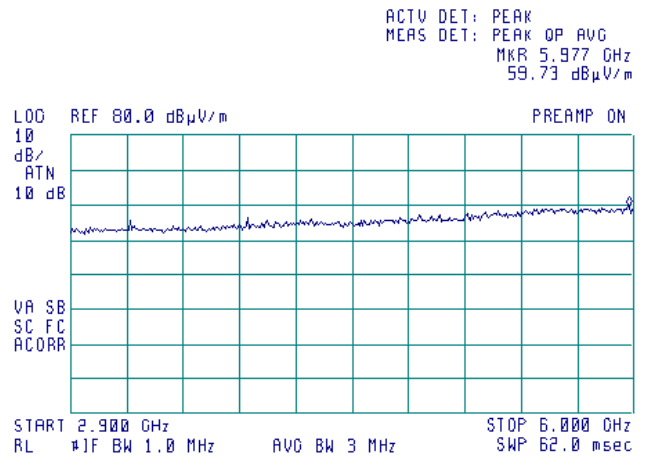
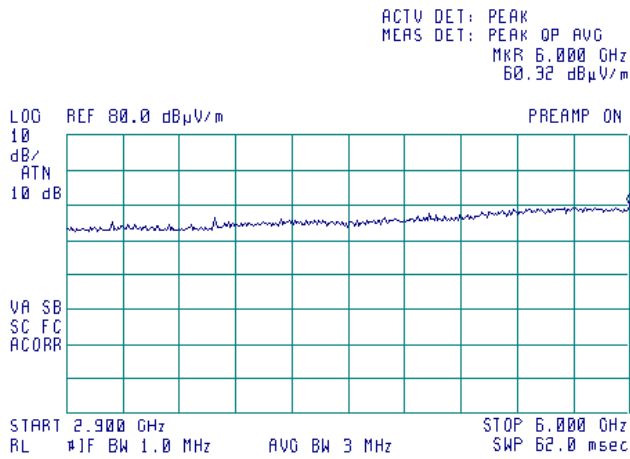
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

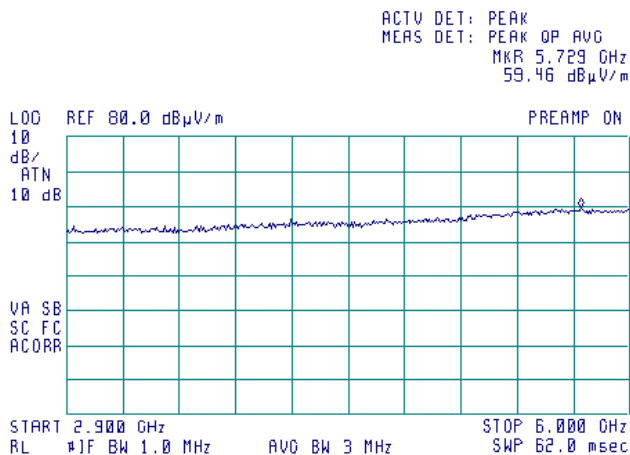
**Plot 8.2.5 Radiated emission measurements in 2900 – 6000 MHz range**

TEST SITE:  
CARRIER FREQUENCY:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Low  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High







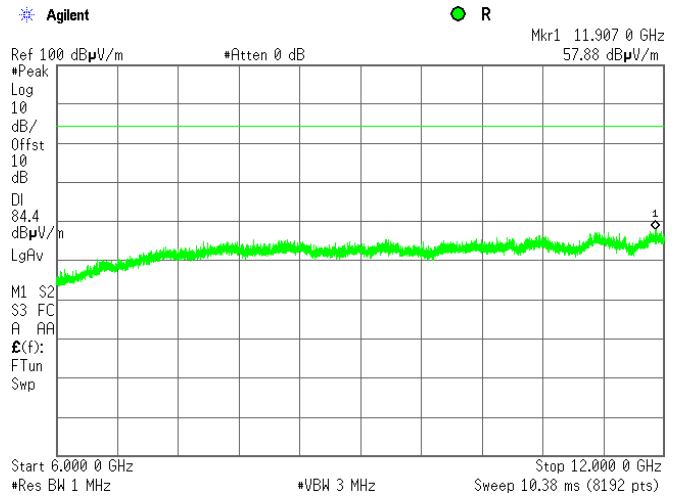
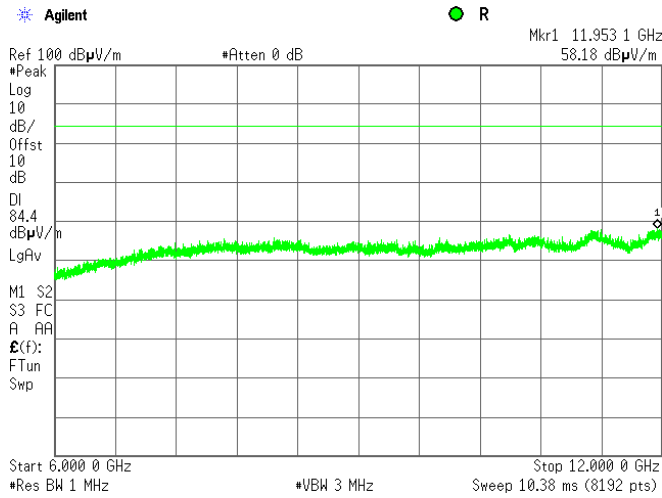
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

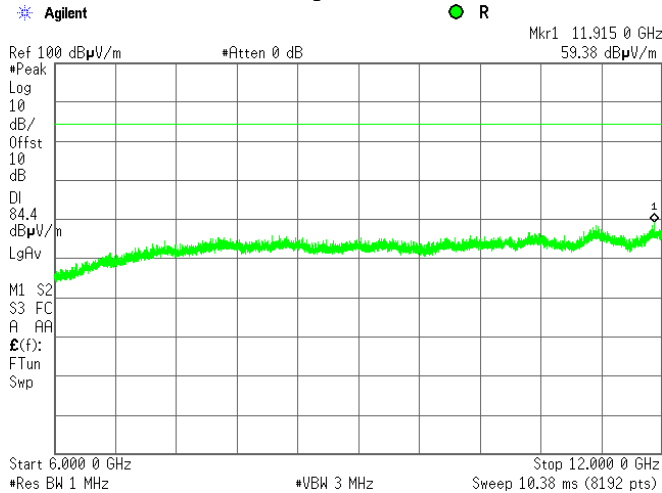
Plot 8.2.6 Radiated emission measurements in 6.0 – 12.0 GHz range

TEST SITE:  
CARRIER FREQUENCY:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Low  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





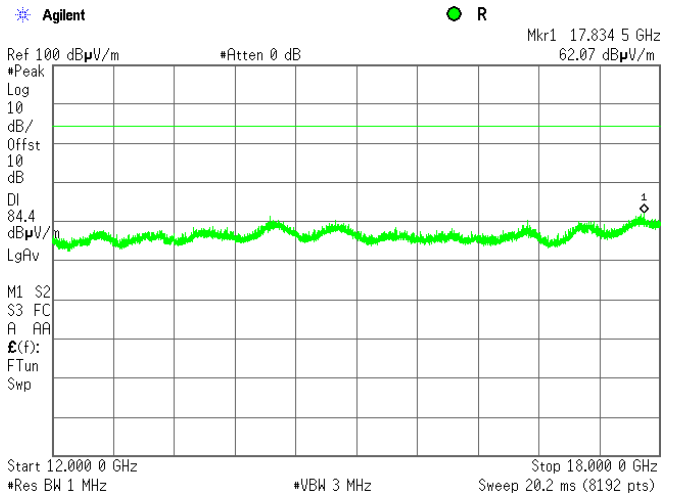
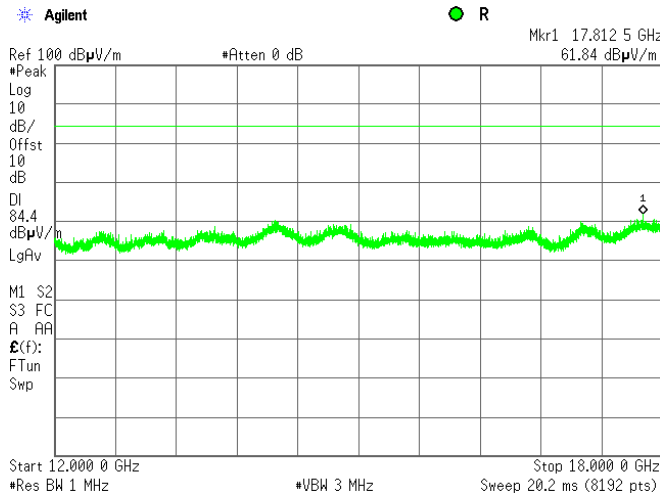
HERMON LABORATORIES

<b>Test specification:</b> Section 24.238, Radiated spurious emissions	
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa
<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module	

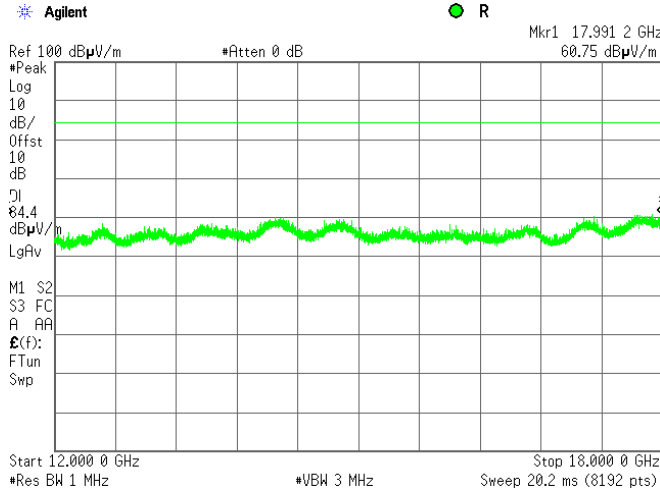
Plot 8.2.7 Radiated emission measurements in 12.0 – 18.0 GHz range

TEST SITE:  
CARRIER FREQUENCY:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Low  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





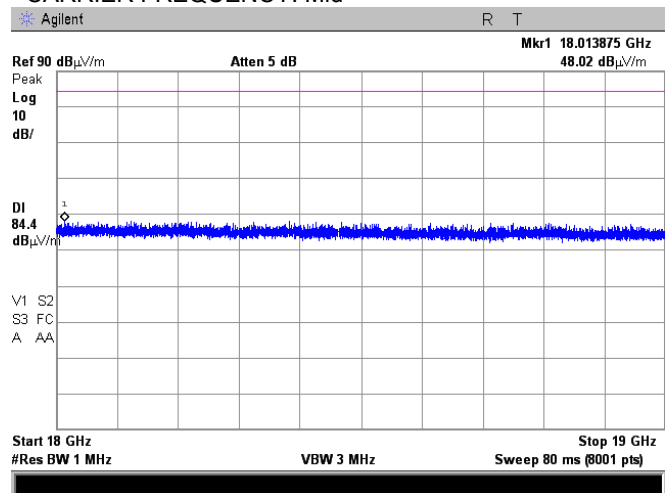
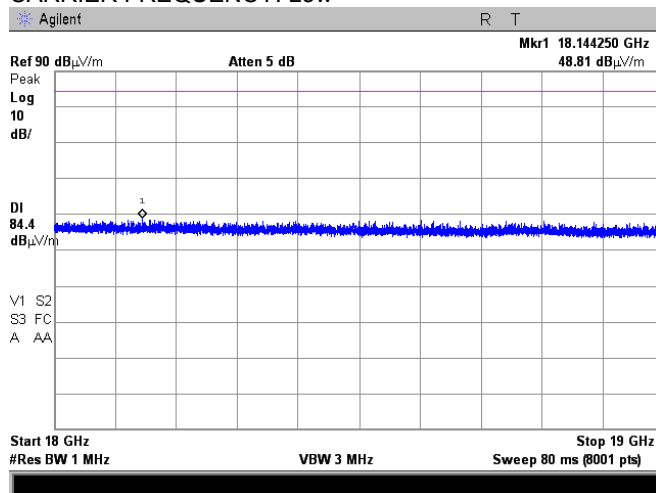
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 3G module			

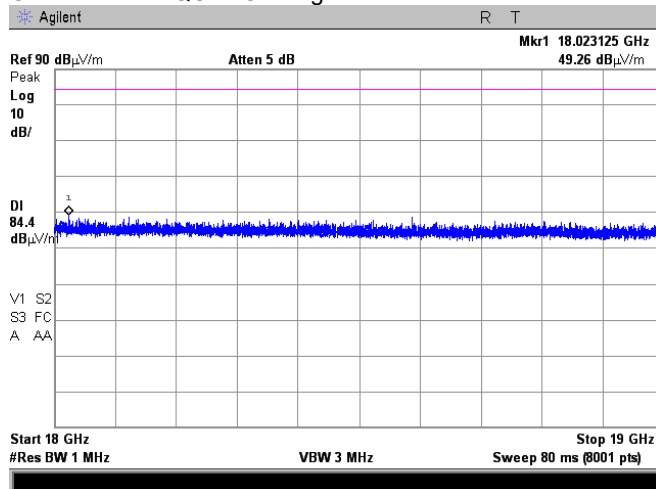
Plot 8.2.8 Radiated emission measurements in 18.0 – 19.0 GHz range

TEST SITE:  
CARRIER FREQUENCY:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Low  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C		<b>Air Pressure:</b> 1008 hPa	
<b>Remarks:</b> 2G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 51 %	
		<b>Power Supply:</b> 120 VAC	

### 8.3 Radiated spurious emission measurements of 2G module

#### 8.3.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 8.3.1.

Table 8.3.1 Radiated spurious emission test limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB(μV/m)***
0.009 – 10 <sup>th</sup> harmonic*	43+10logP**	-13	84.4

\* - Excluding the in band emission within ± 250 % of the authorized bandwidth from the carrier

\*\* - P is transmitter output power in Watts

\*\*\* - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows:  $E = \sqrt{30 \times P \times 1.64} / r$ , where P is ERP in Watts, 1.64 is numeric gain of ideal dipole and r is antenna to EUT distance in meters

#### 8.3.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band

8.3.2.1 The EUT was set up as shown in Figure 8.3.1, energized and the performance check was conducted.

8.3.2.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna was rotated around its vertical axis.

8.3.2.3 The worst test results (the lowest margins) were recorded in Table 8.3.2 and shown in the associated plots.

#### 8.3.3 Test procedure for spurious emission field strength measurements above 30 MHz

8.3.3.1 The EUT was set up as shown in Figure 8.3.2, energized and the performance check was conducted.

8.3.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360° and the measuring antenna height was swept from 1 to 4 m in both, vertical and horizontal, polarizations.

8.3.3.3 The worst test results (the lowest margins) were recorded in Table 8.3.2 and shown in the associated plots.

#### 8.3.4 Test procedure for substitution ERP measurements of spurious

8.3.4.1 The test equipment was set up as shown in Figure 8.3.3 and energized.

8.3.4.2 RF signal generator was set to the frequency of investigated spurious emission and the RF output level was preliminary adjusted to produce the same field strength as it was measured from the EUT.

8.3.4.3 The test antenna height was swept from 1 to 4 m to find maximum emission from substitution antenna and RF signal generator output was fine adjusted to produce the same field strength as it was measured from the EUT.

8.3.4.4 The above procedure was performed in both, horizontal and vertical, polarizations of the test and substitution antennas.

8.3.4.5 The ERP of spurious emissions was calculated as a sum of signal generator output power in dBm and antenna gain in dBd reduced by cable loss in dB.

8.3.4.6 The above procedure was repeated at the rest of investigated frequencies.

8.3.4.7 The worst test results (the lowest margins) were recorded in Table 8.3.3 and shown in the associated plots.



<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict: PASS</b>	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Figure 8.3.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

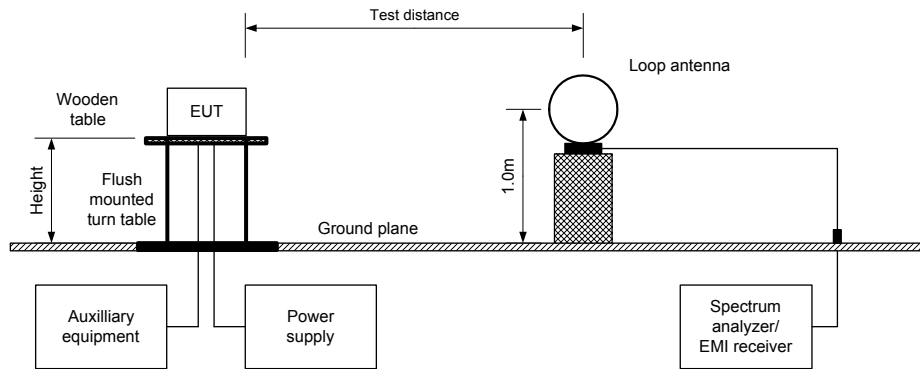
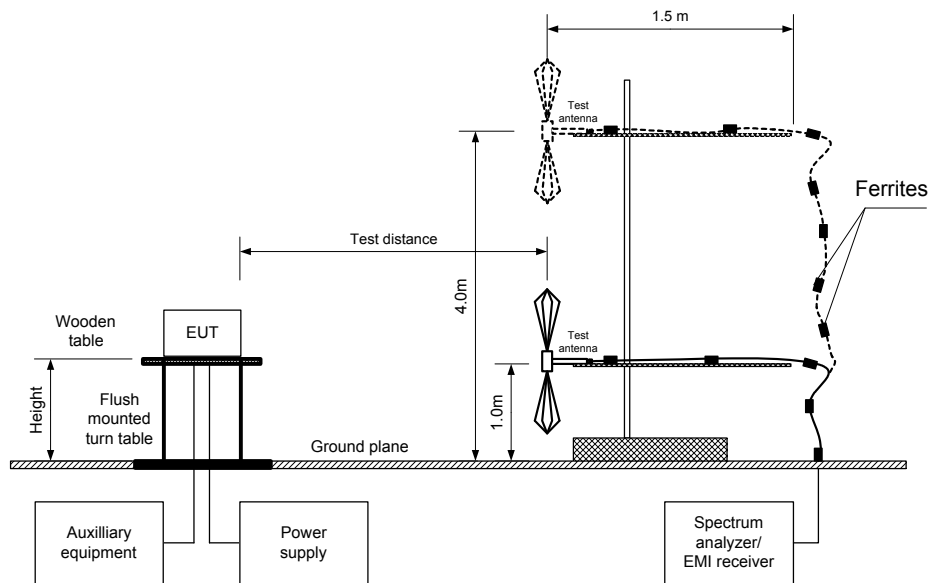


Figure 8.3.2 Setup for spurious emission field strength measurements above 30 MHz

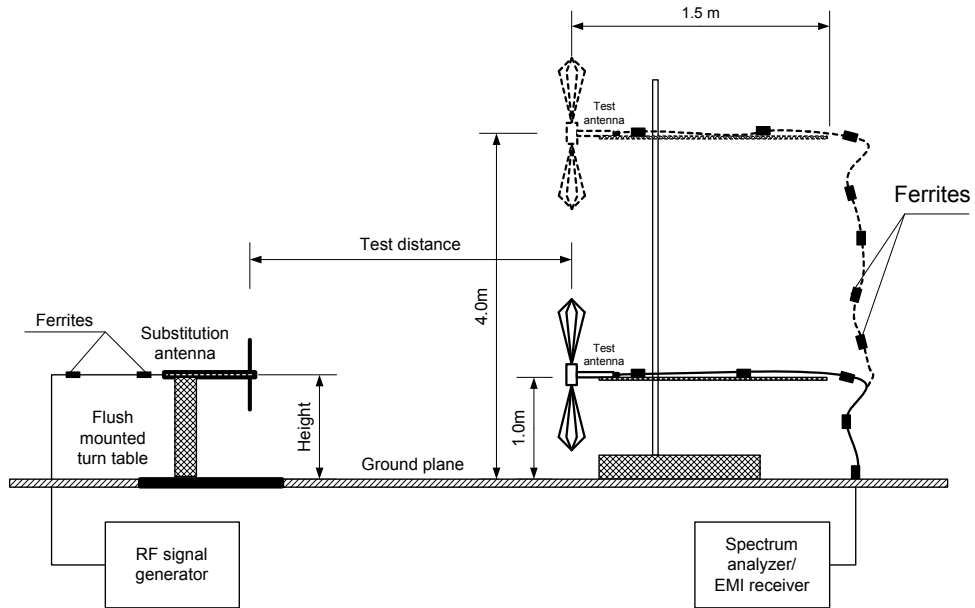




HERMON LABORATORIES

<b>Test specification:</b>	<b>Section 24.238, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	09-Jun-15 - 08-Jul-15		
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Figure 8.3.3 Setup for substitution ERP measurements of spurious





<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C		<b>Air Pressure:</b> 1008 hPa	
<b>Remarks:</b> 2G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 51 %	
		<b>Power Supply:</b> 120 VAC	

**Table 8.3.2 Spurious emission field strength test results**

ASSIGNED FREQUENCY RANGE: 1850-1910 MHz  
 TEST DISTANCE: 3 m  
 TEST SITE: Semi anechoic chamber  
 EUT HEIGHT: 0.8 m  
 INVESTIGATED FREQUENCY RANGE: 0.009 – 19000 MHz  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: > Resolution bandwidth  
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)  
 Biconilog (30 MHz – 1000 MHz)  
 Double ridged guide (above 1000 MHz)  
 MODULATING SIGNAL: PRBS

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
<b>Low carrier frequency 1850.2MHz</b>							
7401.04	65.56	84.4	-18.84	1000	Hor	1.3	170
<b>Mid carrier frequency 1880 MHz</b>							
7520.07	64.44	84.4	-19.96	1000	Hor	1.3	160
<b>High carrier frequency 1909.8 MHz</b>							
7638.92	63.98	84.4	-20.42	1000	Hor	1.6	170

\*- Margin = Field strength of spurious – calculated field strength limit.

\*\* - EUT front panel refers to 0 degrees position of turntable.

**Table 8.3.3 Substitution EIRP of spurious test results**

ASSIGNED FREQUENCY RANGE: 1850-1910 MHz  
 TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 SUBSTITUTION ANTENNA HEIGHT: 0.8 m  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: > Resolution bandwidth  
 SUBSTITUTION ANTENNA TYPE: Tunable dipole (30 MHz – 1000 MHz)  
 Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBi	Cable loss, dB	EIRP, dBm	Limit, dBm	Margin, dB*	Verdict
<b>Low carrier frequency</b>										
7401.04	65.56	1000	Hor	-39.77	9.40	2.71	-33.08	-13.00	-20.08	Pass
<b>Mid carrier frequency</b>										
7520.07	64.44	1000	Hor	-41.02	9.56	2.73	-34.19	-13.00	-21.19	Pass
<b>High carrier frequency</b>										
7638.92	63.98	1000	Hor	-41.79	9.63	2.76	-34.92	-13.00	-21.92	Pass

\*- Margin = Spurious emission – specification limit.

**Reference numbers of test equipment used**

HL 0446	HL 0521	HL 1984	HL 3818	HL 4114	HL 4353	HL 4722	HL 4856
HL 4933							

Full description is given in Appendix A.



HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

Plot 8.3.1 Radiated emission measurements in 9 - 150 kHz range

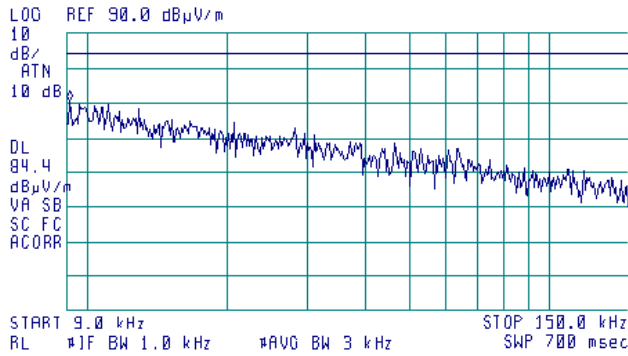
TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m

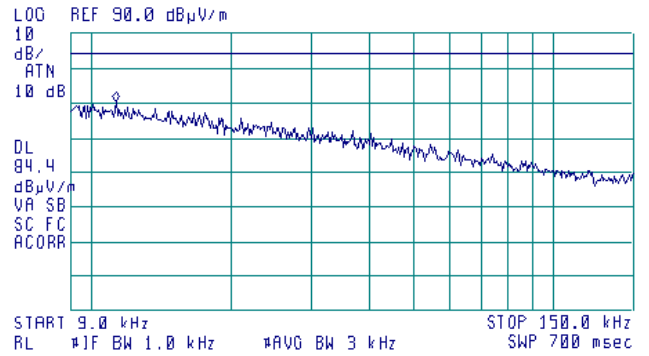
CARRIER FREQUENCY: Mid



ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 9.2 kHz  
70.53 dBµV/m



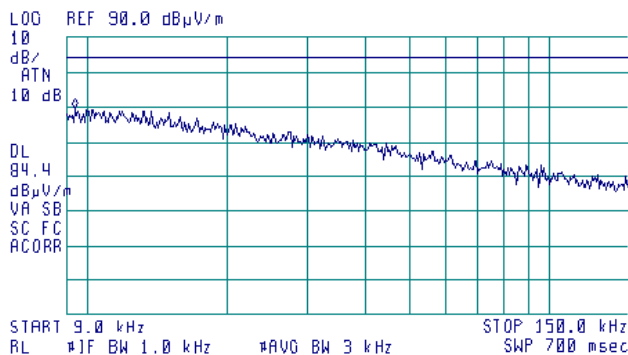
ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 11.4 kHz  
70.29 dBµV/m



CARRIER FREQUENCY: High



ACTV DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 9.5 kHz  
69.45 dBµV/m







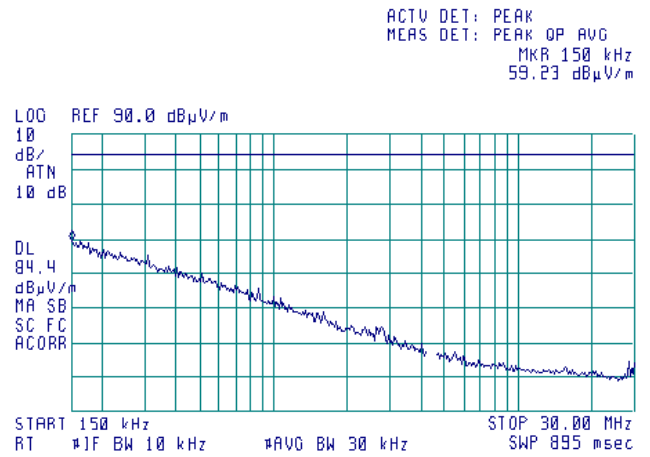
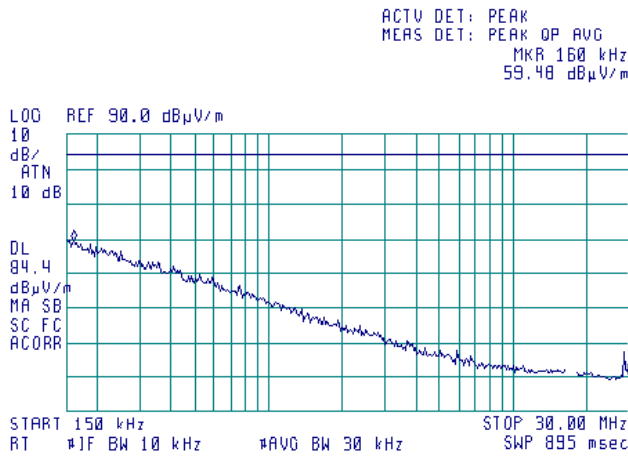
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

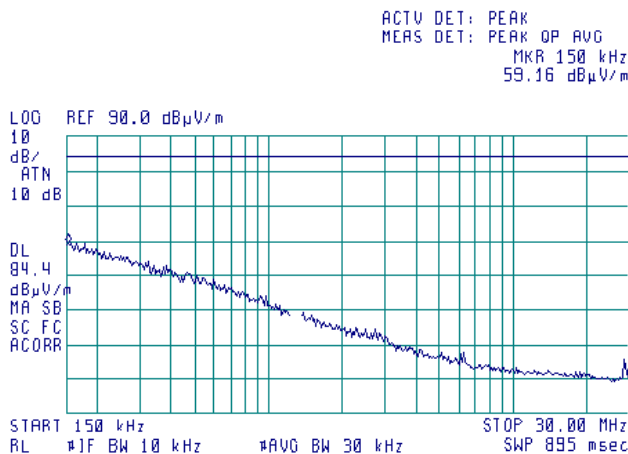
**Plot 8.3.2 Radiated emission measurements in 0.15 - 30 MHz range**

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





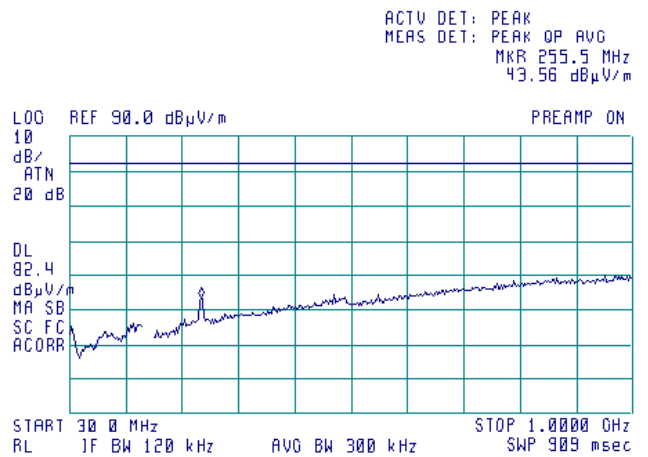
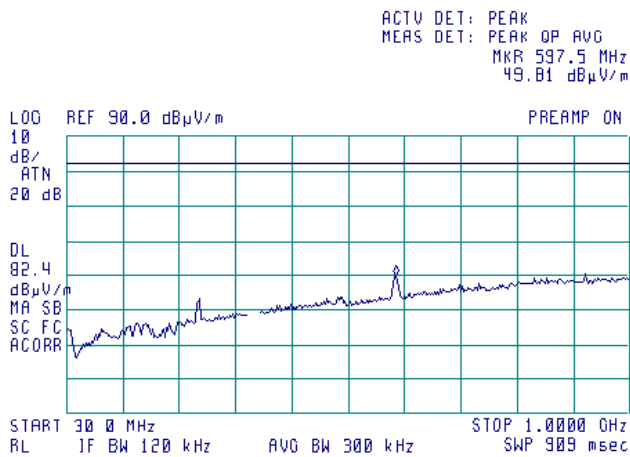
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

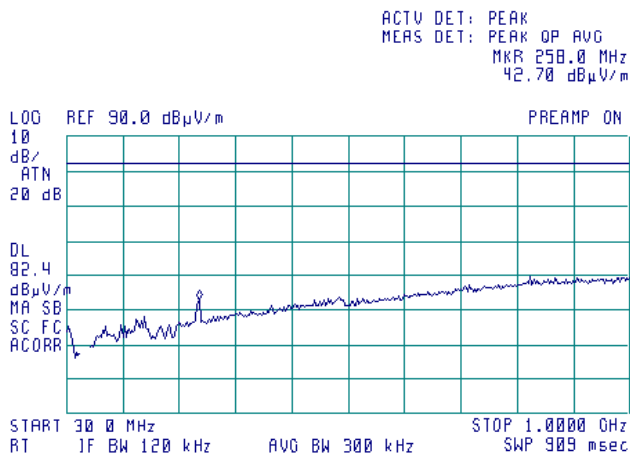
**Plot 8.3.3 Radiated emission measurements in 30 - 1000 MHz range**

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





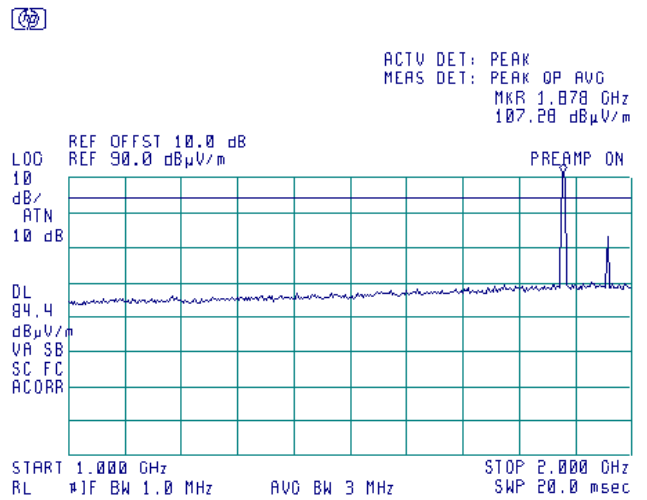
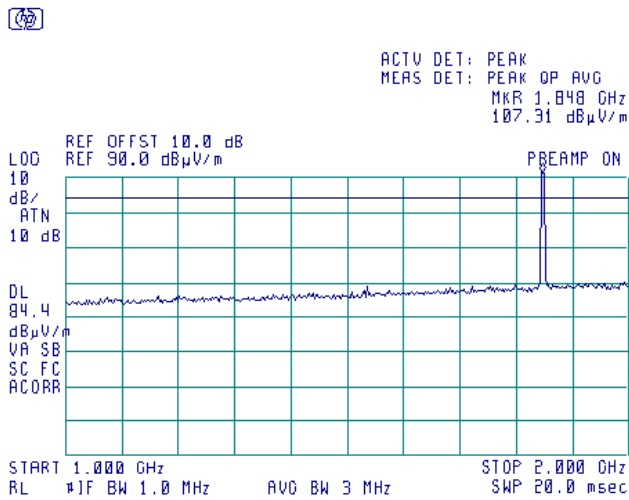
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C		<b>Air Pressure:</b> 1008 hPa	
<b>Remarks:</b> 2G module		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 51 %	
		<b>Power Supply:</b> 120 VAC	

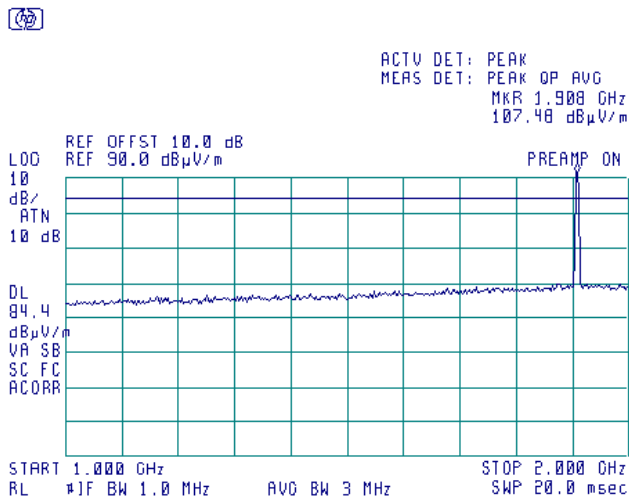
Plot 8.3.4 Radiated emission measurements in 1000 – 2000 MHz range

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



1960 MHz is the auxiliary base station frequency



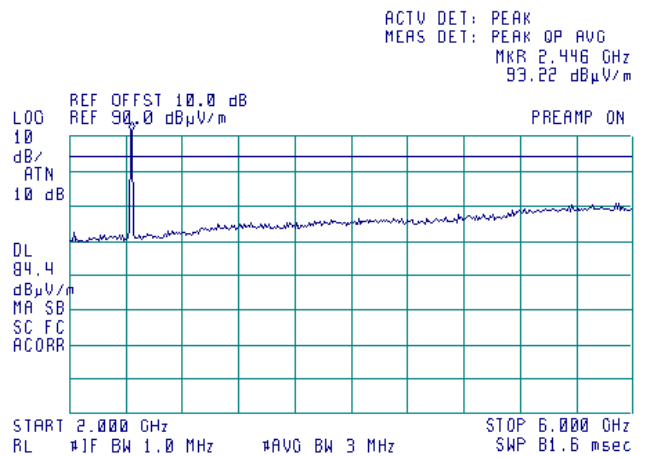
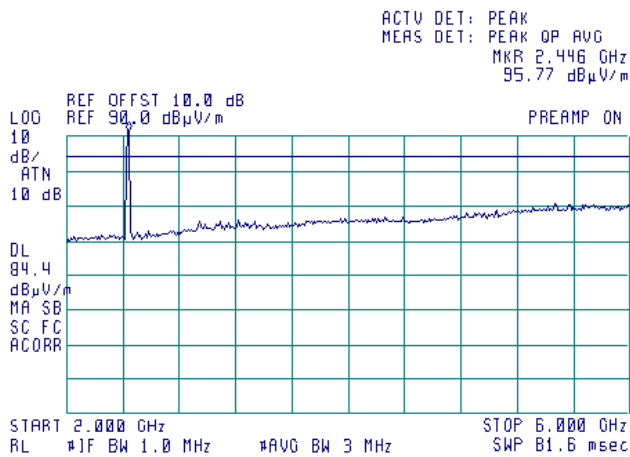
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

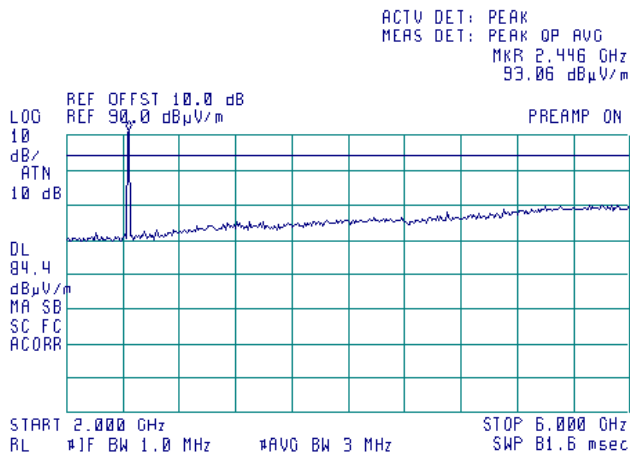
**Plot 8.3.5 Radiated emission measurements in 2000 – 6000 MHz range**

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



2446 MHz is a carrier frequency of Wi-Fi module



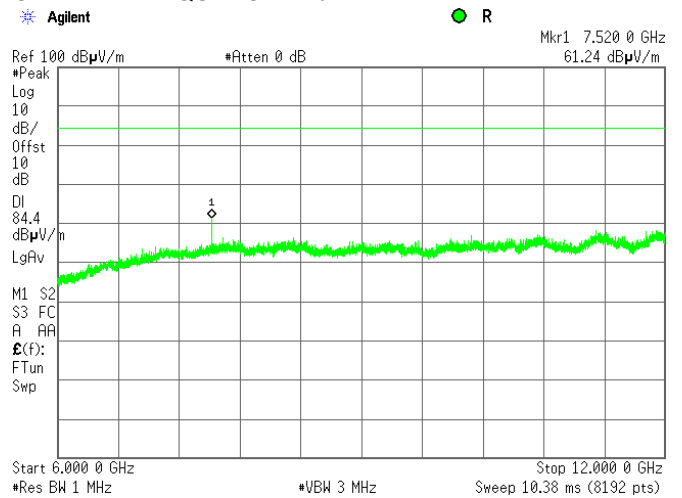
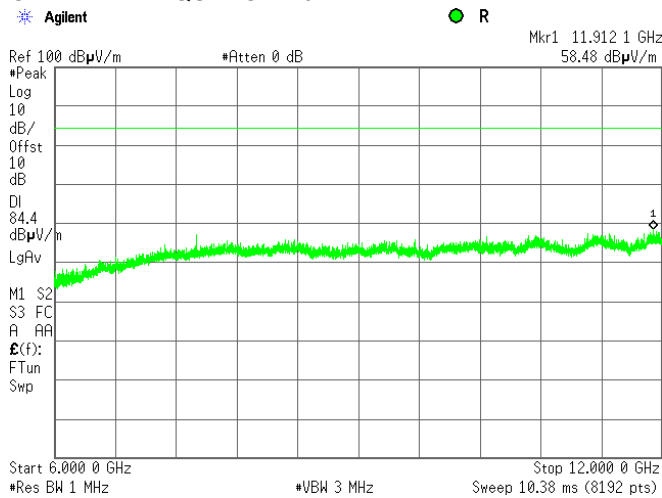
HERMON LABORATORIES

<b>Test specification:</b> Section 24.238, Radiated spurious emissions	
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1008 hPa
<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module	

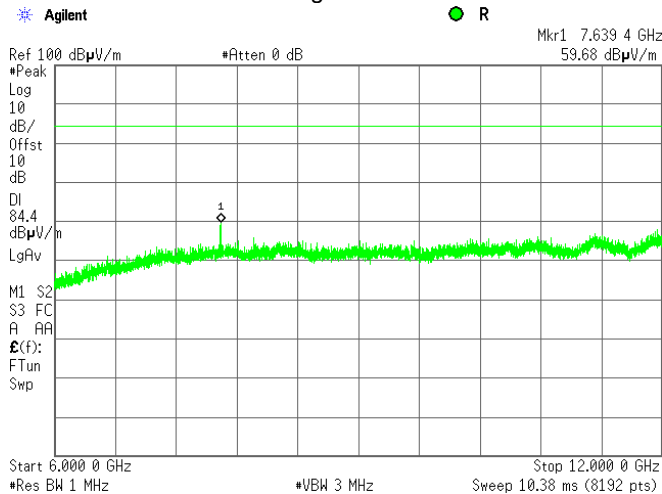
Plot 8.3.6 Radiated emission measurements in 6.0 – 12.0 GHz range

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





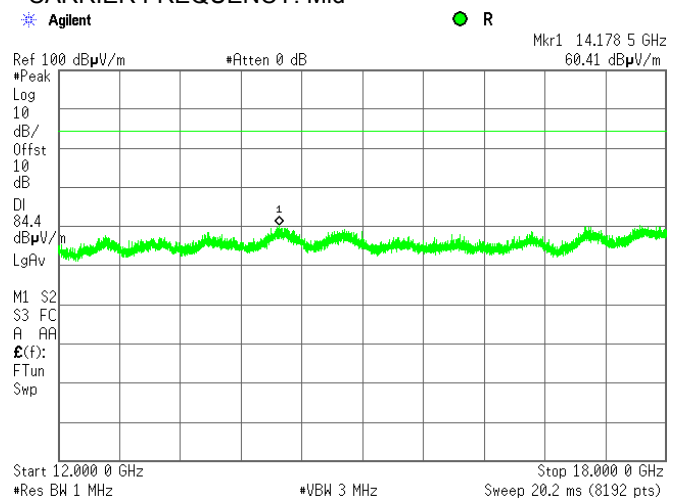
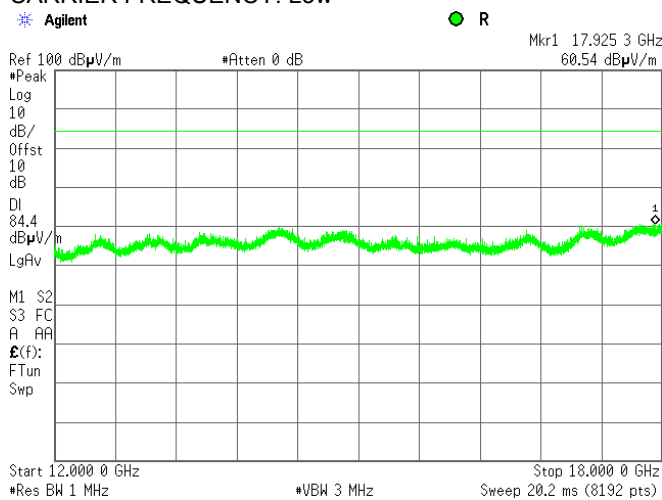
HERMON LABORATORIES

<b>Test specification:</b> Section 24.238, Radiated spurious emissions	
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1008 hPa
	<b>Relative Humidity:</b> 51 %
	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module	

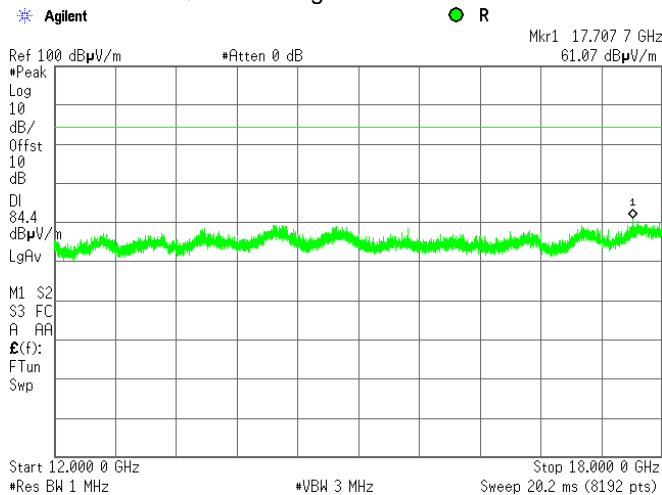
Plot 8.3.7 Radiated emission measurements in 12.0 – 18.0 GHz range

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





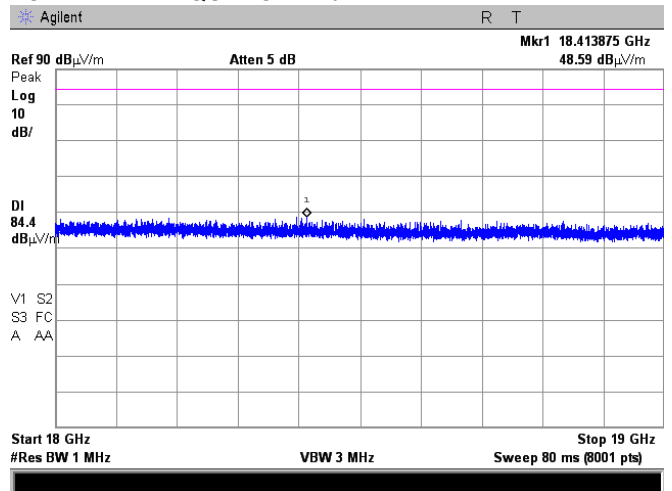
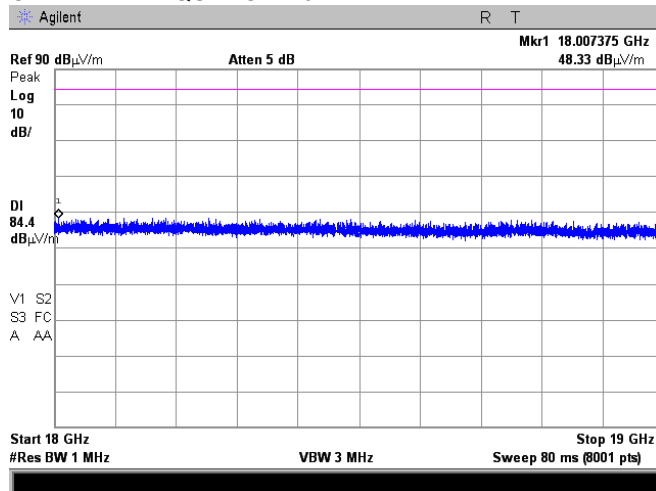
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

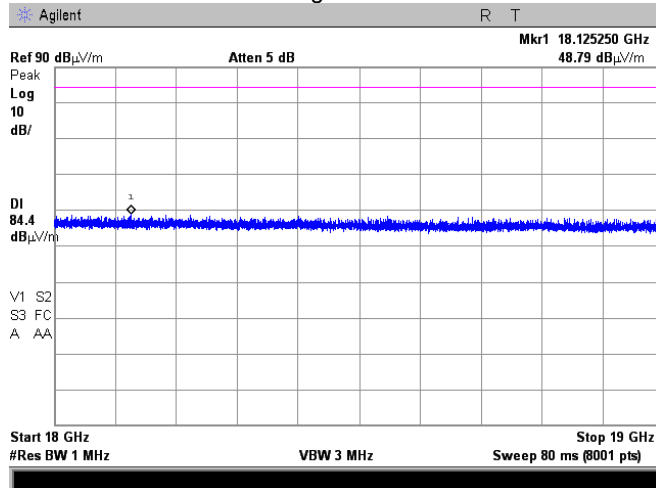
Plot 8.3.8 Radiated emission measurements in 18.0 – 19.9 GHz range

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





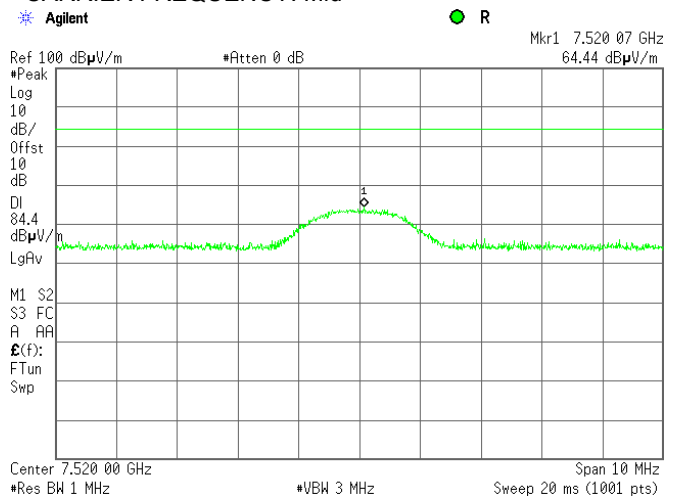
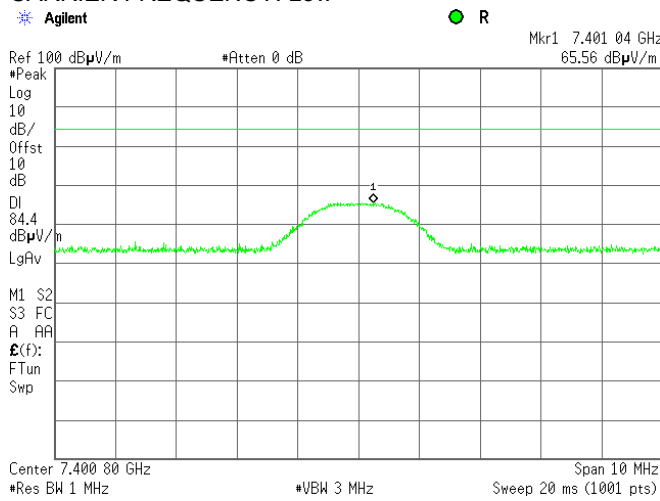
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 24.238, Radiated spurious emissions</b>	
<b>Test procedure:</b>		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-D, Section 2.2.12	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		09-Jun-15 - 08-Jul-15	
<b>Temperature:</b> 21 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b> 2G module			

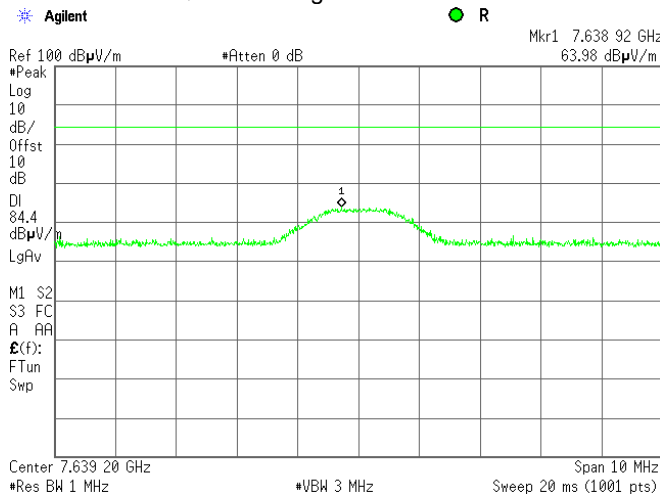
### Plot 8.3.9 Radiated emission measurements at the 3<sup>rd</sup> harmonic

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low

Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





**9 APPENDIX A Test equipment and ancillaries used for tests**

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check*	Due Cal./ Check*
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	13-Jan-15	13-Jan-16
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	22-Oct-15	22-Oct-16
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	15-May-15	15-May-16
0661	Generator Swept Signal, 10 MHz to 40 GHz, + 10 dBm	Hewlett Packard	83640B	3614A002 66	07-Apr-15	07-Apr-16
1565	Antenna, Dipole, Tunable 500 - 1000 MHz	Electro-Metrics	TDS-30-2	334	05-Feb-15	05-Feb-16
1984	Antenna, Double-Ridged Waveguide Horn, 1 to 18 GHz, 300 W	EMC Test Systems	3115	9911-5964	17-Apr-15	17-Apr-16
2871	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-8155-00	2871	02-Dec-14	02-Dec-15
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY482502 88	29-Apr-15	29-Apr-16
4114	Antenna, Double-Ridged Waveguide Horn, 1 to 18 GHz	ETS Lindgren	3117	00123515	19-Dec-14	19-Dec-15
4279	Test Cable , DC-18 GHz, 4.6 m, N/M - N/M	Mini-Circuits	APC-15FT-NMNM+	0757A	20-Nov-14	20-Nov-15
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101 003	15-Mar-15	15-Mar-16
4722	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	51228701 001	31-Aug-15	31-Aug-16
4856	Amplifier, solid state, 18 GHz to 40 GHz, 20 dBm output power	Quinstar Technology	QGW-18402023-JO	167790010 01	03-Apr-15	03-Apr-16
4933	Active Horn Antenna, 1 GHz to 18 GHz	Com-Power Corporation	AHA-118	701046	04-Sep-15	04-Sep-16

\*Calibration was valid at the testing time.

## 10 APPENDIX B Measurement uncertainties

### Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
<b>Transmitter tests</b>	
Carrier power conducted at antenna connector	± 1.7 dB
Carrier power radiated (substitution method)	± 4.5 dB
Occupied bandwidth	±8%
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Spurious emissions radiated 30 MHz – 40 GHz (substitution method)	± 4.5 dB
Frequency stability	30 – 300 MHz: ± 50.5 Hz (1.68 ppm) 300 – 1000 MHz: ± 168 Hz (0.56 ppm)

Hermon Laboratories is accredited by A2LA for calibration according to present requirements of ISO/IEC 17025 and NCSL Z540-1. The accreditation is granted to perform calibration of parameters that are listed in the Scope of Hermon Laboratories Accreditation.

Hermon Laboratories calibrates its reference and transfer standards by calibration laboratories accredited to ISO/IEC 17025 by a mutually recognized Accreditation Body or by a recognized national metrology institute. All reference and transfer standards used in the calibration system are traceable to national or international standards.

In-house calibration of all test and measurement equipment is performed on a regular basis according to Hermon Laboratories calibration procedures, manufacturer calibration/verification procedures or procedures defined in the relevant standards. The Hermon Laboratories test and measurement equipment is calibrated within the tolerances specified by the manufacturers and/or by the relevant standards.

## 11 APPENDIX C Test laboratory description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, safety, environmental and telecommunication testing facility.

Hermon Laboratories is listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), Registration Numbers 90624 for OATS and 90623 for the anechoic chamber; by Industry Canada for electromagnetic emissions (file number IC 2186A-1 for OATS), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, C-845 for conducted emissions site, T-1606 for conducted emissions at telecommunication ports), has a status of a Telefication - Listed Testing Laboratory, Certificate No. L138/00. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing and environmental simulation (for exact scope please refer to Certificate No. 839.01). The FCC Designation Number is IL1001.

Address: P.O. Box 23, Binyamina 30500, Israel.  
Telephone: +972 4628 8001  
Fax: +972 4628 8277  
e-mail: mail@hermonlabs.com  
website: www.hermonlabs.com

Person for contact: Mr. Alex Usoskin, CEO.

## 12 APPENDIX D Specification references

FCC 47CFR part 22: 2014	Private land mobile radio services
FCC 47CFR part 24: 2014	Private land mobile radio services
FCC 47CFR part 1: 2014	Practice and procedure
FCC 47CFR part 2: 2014	Frequency allocations and radio treaty matters; general rules and regulations
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4: 2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI/TIA/EIA-603-D: 2010	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
RSS-132 issue 3, January 2013	Cellular Telephone Systems Operating in the Bands 824-849 MHz and 869-894 MHz
RSS-133 issue 6 January 2013	2 GHz Personal Communications Services
SRSP-510 issue 4 February 2008	Technical Requirements for Personal Communications Services in the Bands 1850-1915 MHz and 1930-1995 MHz



### 13 APPENDIX E Test equipment correction factors

Antenna factor  
Active loop antenna  
Model 6502, S/N 2857, HL 0446

Frequency, MHz	Magnetic antenna factor, dB	Electric antenna factor, dB
0.009	-32.8	18.7
0.010	-33.8	17.7
0.020	-38.3	13.2
0.050	-41.1	10.4
0.075	-41.3	10.2
0.100	-41.6	9.9
0.150	-41.7	9.8
0.250	-41.6	9.9
0.500	-41.8	9.8
0.750	-41.9	9.7
1.000	-41.4	10.1
2.000	-41.5	10.0
3.000	-41.4	10.2
4.000	-41.4	10.1
5.000	-41.5	10.1
10.000	-41.9	9.6
15.000	-41.9	9.6
20.000	-42.2	9.3
25.000	-42.8	8.7
30.000	-44.0	7.5

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB( $\mu$ V) to convert it into field strength in dB( $\mu$ V/m).



**Antenna factor**  
**Biconilog antenna EMCO Model 3141**  
**Ser.No.1011, HL 0604**

Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)	Frequency, MHz	Antenna factor, dB(1/m)
26	7.8	580	20.6	1320	27.8
28	7.8	600	21.3	1340	28.3
30	7.8	620	21.5	1360	28.2
40	7.2	640	21.2	1380	27.9
60	7.1	660	21.4	1400	27.9
70	8.5	680	21.9	1420	27.9
80	9.4	700	22.2	1440	27.8
90	9.8	720	22.2	1460	27.8
100	9.7	740	22.1	1480	28.0
110	9.3	760	22.3	1500	28.5
120	8.8	780	22.6	1520	28.9
130	8.7	800	22.7	1540	29.6
140	9.2	820	22.9	1560	29.8
150	9.8	840	23.1	1580	29.6
160	10.2	860	23.4	1600	29.5
170	10.4	880	23.8	1620	29.3
180	10.4	900	24.1	1640	29.2
190	10.3	920	24.1	1660	29.4
200	10.6	940	24.0	1680	29.6
220	11.6	960	24.1	1700	29.8
240	12.4	980	24.5	1720	30.3
260	12.8	1000	24.9	1740	30.8
280	13.7	1020	25.0	1760	31.1
300	14.7	1040	25.2	1780	31.0
320	15.2	1060	25.4	1800	30.9
340	15.4	1080	25.6	1820	30.7
360	16.1	1100	25.7	1840	30.6
380	16.4	1120	26.0	1860	30.6
400	16.6	1140	26.4	1880	30.6
420	16.7	1160	27.0	1900	30.6
440	17.0	1180	27.0	1920	30.7
460	17.7	1200	26.7	1940	30.9
480	18.1	1220	26.5	1960	31.2
500	18.5	1240	26.5	1980	31.6
520	19.1	1260	26.5	2000	32.0
540	19.5	1280	26.6		
560	19.8	1300	27.0		

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB(μV) to convert it into field strength in dB(μV/m).



**Antenna factor**  
**Double-ridged wave guide horn antenna**  
**Model 3115, S/N 9911-5964, HL1984**

Frequency, MHz	Antenna factor, dB(1/m)
1000.0	24.7
1500.0	25.7
2000.0	27.6
2500.0	28.9
3000.0	31.2
3500.0	32.0
4000.0	32.5
4500.0	32.7
5000.0	33.6
5500.0	35.1
6000.0	35.4
6500.0	34.9
7000.0	36.1
7500.0	37.8
8000.0	38.0
8500.0	38.1
9000.0	39.1
9500.0	38.3
10000.0	38.6
10500.0	38.2
11000.0	38.7
11500.0	39.5
12000.0	40.0
12500.0	40.4
13000.0	40.5
13500.0	41.1
14000.0	41.6
14500.0	41.7
15000.0	38.7
15500.0	38.2
16000.0	38.8
16500.0	40.5
17000.0	42.5
17500.0	45.9
18000.0	49.4

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB( $\mu$ V) to convert it into field strength in dB( $\mu$ V/m).



**Antenna factor**  
**Double-ridged waveguide horn antenna**  
**ETS Lindgren, Model 3117, serial number: 00123515, HL 4114**

Frequency, MHz	Antenna factor, dB/m		
	Measured	Manufacturer	Deviation
1000	28.0	28.4	-0.4
1500	28.0	27.4	0.6
2000	31.2	30.9	0.3
2500	32.5	33.4	-0.9
3000	32.9	32.6	0.3
3500	32.7	32.8	-0.1
4000	33.1	33.4	-0.3
4500	33.8	33.9	-0.1
5000	33.8	34.1	-0.3
5500	34.4	34.5	-0.1
6000	35.0	35.2	-0.2
6500	35.4	35.5	-0.1
7000	35.7	35.7	0.0
7500	35.9	35.7	0.2
8000	35.8	35.8	0.0
8500	35.9	35.8	0.1
9000	36.3	36.2	0.1
9500	36.6	36.6	0.0
10000	37.1	37.1	0.0
10500	37.6	37.5	0.1
11000	37.9	37.7	0.2
11500	38.5	38.1	0.4
12000	39.2	38.7	0.5
12500	39.0	38.9	0.1
13000	39.1	39.1	0.0
13500	38.9	38.8	0.1
14000	39.0	38.8	0.2
14500	39.6	39.9	-0.3
15000	39.9	39.7	0.2
15500	39.9	40.1	-0.2
16000	40.7	40.8	-0.1
16500	41.3	41.8	-0.5
17000	42.5	42.1	0.4
17500	41.3	41.2	0.1
18000	41.4	40.9	0.5

Antenna factor is to be added to receiver meter reading in dB(μV) to convert to field strength in dB(μV/meter)



**Cable loss**  
Cable coaxial, Huber-Suhner, 18 GHz, 6.4 m, SMA - SMA, model 198-8155-00,  
HL 2871

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.12	5750	2.34	12000	3.55
30	0.14	6000	2.39	12250	3.61
100	0.27	6250	2.46	12500	3.67
250	0.45	6500	2.52	12750	3.74
500	0.63	6750	2.58	13000	3.79
750	0.76	7000	2.64	13250	3.82
1000	0.89	7250	2.68	13500	3.83
1250	1.01	7500	2.73	13750	3.83
1500	1.12	7750	2.78	14000	3.88
1750	1.23	8000	2.83	14250	3.93
2000	1.32	8250	2.88	14500	3.96
2250	1.41	8500	2.94	14750	4.01
2500	1.49	8750	2.97	15000	4.00
2750	1.58	9000	3.02	15250	4.01
3000	1.66	9250	3.07	15500	4.00
3250	1.73	9500	3.13	15750	4.13
3500	1.80	9750	3.18	16000	4.22
3750	1.87	10000	3.21	16250	4.29
4000	1.93	10250	3.26	16500	4.29
4250	2.01	10500	3.30	16750	4.32
4500	2.06	10750	3.36	17000	4.37
4750	2.12	11000	3.39	17250	4.45
5000	2.17	11250	3.44	17500	4.49
5250	2.24	11500	3.48	17750	4.53
5500	2.29	11750	3.52	18000	4.55





**Cable loss**  
**Test cable, Mini-Circuits, S/N 0757A, 18 GHz, 4.6 m, N/M - N/M**  
**APC-15FT-NMNM+, HL 4279**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.26	5000	4.23	10200	6.47	15400	8.46
30	0.26	5100	4.28	10300	6.53	15500	8.49
50	0.34	5200	4.32	10400	6.57	15600	8.50
100	0.50	5300	4.37	10500	6.59	15700	8.53
200	0.72	5400	4.41	10600	6.62	15800	8.56
300	0.90	5500	4.46	10700	6.64	15900	8.60
400	1.05	5600	4.51	10800	6.66	16000	8.62
500	1.20	5700	4.57	10900	6.69	16100	8.65
600	1.31	5800	4.61	11000	6.69	16200	8.68
700	1.44	5900	4.64	11100	6.70	16300	8.70
800	1.53	6000	4.70	11200	6.72	16400	8.72
900	1.63	6100	4.75	11300	6.74	16500	8.76
1000	1.74	6200	4.76	11400	6.79	16600	8.77
1100	1.83	6300	4.82	11500	6.83	16700	8.78
1200	1.92	6400	4.83	11600	6.85	16800	8.82
1300	2.01	6500	4.88	11700	6.89	16900	8.85
1400	2.09	6600	4.90	11800	6.94	17000	8.91
1500	2.17	6700	4.95	11900	7.00	17100	8.94
1600	2.25	6800	5.01	12000	7.04	17200	8.98
1700	2.33	6900	4.98	12100	7.10	17300	9.03
1800	2.39	7000	5.03	12200	7.18	17400	9.05
1900	2.47	7100	5.11	12300	7.23	17500	9.08
2000	2.53	7200	5.13	12400	7.29	17600	9.10
2100	2.60	7300	5.20	12500	7.34	17700	9.12
2200	2.67	7400	5.28	12600	7.39	17800	9.14
2300	2.74	7500	5.33	12700	7.45	17900	9.17
2400	2.80	7600	5.37	12800	7.49	18000	9.21
2500	2.87	7700	5.44	12900	7.53		
2600	2.92	7800	5.52	13000	7.58		
2700	3.00	7900	5.56	13100	7.62		
2800	3.06	8000	5.63	13200	7.67		
2900	3.12	8100	5.67	13300	7.71		
3000	3.18	8200	5.71	13400	7.74		
3100	3.24	8300	5.76	13500	7.79		
3200	3.30	8400	5.79	13600	7.82		
3300	3.35	8500	5.85	13700	7.84		
3400	3.41	8600	5.88	13800	7.87		
3500	3.46	8700	5.92	13900	7.90		
3600	3.51	8800	5.96	14000	7.94		
3700	3.56	8900	6.02	14100	7.98		
3800	3.61	9000	6.05	14200	8.01		
3900	3.66	9100	6.08	14300	8.05		
4000	3.71	9200	6.15	14400	8.10		
4100	3.77	9300	6.18	14500	8.12		
4200	3.83	9400	6.20	14600	8.16		
4300	3.89	9500	6.25	14700	8.22		
4400	3.94	9600	6.28	14800	8.26		
4500	3.99	9700	6.31	14900	8.29		
4600	4.05	9800	6.35	15000	8.33		
4700	4.09	9900	6.37	15100	8.39		
4800	4.15	10000	6.40	15200	8.41		
4900	4.19	10100	6.45	15300	8.44		



**Cable loss**  
**Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M,**  
**NC29-N1N1-244S/N 12025101 003,**  
**HL 4353**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
50	0.20	9000	2.71
100	0.27	9500	2.81
300	0.47	10000	2.90
500	0.61	10500	2.97
1000	0.87	11000	3.06
1500	1.07	11500	3.13
2000	1.24	12000	3.20
2500	1.39	12500	3.26
3000	1.53	13000	3.34
3500	1.65	13500	3.39
4000	1.77	14000	3.47
4500	1.89	14500	3.54
5000	1.99	15000	3.62
5500	2.07	15500	3.69
6000	2.20	16000	3.76
6500	2.30	16500	3.83
7000	2.39	17000	3.86
7500	2.51	17500	3.94
8000	2.58	18000	4.02
8500	2.65		



**Cable loss**  
**Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M,**  
**NC29-N1N1-244, S/N 51228701001**  
**HL 4722**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
50	0.22	9000	2.93
100	0.30	9500	3.06
300	0.52	10000	3.16
500	0.66	10500	3.20
1000	0.93	11000	3.34
1500	1.15	11500	3.39
2000	1.33	12000	3.48
2500	1.49	12500	3.55
3000	1.64	13000	3.66
3500	1.77	13500	3.75
4000	1.90	14000	3.76
4500	2.03	14500	3.87
5000	2.17	15000	3.98
5500	2.30	15500	4.01
6000	2.39	16000	4.14
6500	2.51	16500	4.15
7000	2.59	17000	4.32
7500	2.67	17500	4.36
8000	2.76	18000	4.38
8500	2.84		



## 14 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
AM	amplitude modulation
AVRG	average (detector)
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB( $\mu$ V)	decibel referred to one microvolt
dB( $\mu$ V/m)	decibel referred to one microvolt per meter
dB( $\mu$ A)	decibel referred to one microampere
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
$\mu$ s	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
$\Omega$	Ohm
PM	pulse modulation
PS	power supply
ppm	part per million ( $10^{-6}$ )
QP	quasi-peak
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
WB	wideband

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