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# TEST REPORT

ACCORDING TO: FCC 47 CFR PART 15 subpart C, section 15.249

FOR:

**Wisecsec Ltd.**

**BEACON32 BT sensor**

**Model: B0213A**

**FCC ID:2AA8H-B0213A**

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## 1 Applicant information

**Client name:** Wisecsec Ltd.  
**Address:** 145A Yafo street, Colbo Building 9th Floor, Haifa 3525114, Israel  
**Telephone:** +972 4850 0340  
**E-mail:** vadim@wisecsec.com  
**Contact name:** Mr. Vadim Maor

## 2 Equipment under test attributes

**Product name:** BEACON32 BT sensor  
**Product type:** Transmitter operating at 2.4 GHz  
**Model(s):** B0213A  
**Serial number:** Prototype  
**Hardware version:** Rev.4  
**Software release:** Rev.1  
**Receipt date** 14-May-14

## 3 Manufacturer information

**Manufacturer name:** Wisecsec Ltd.  
**Address:** 145A Yafo street, Colbo Building 9th Floor, Haifa 3525114, Israel  
**Telephone:** +972 4850 0340  
**E-Mail:** vadim@wisecsec.com  
**Contact name:** Mr. Vadim Maor




## 4 Test details

**Project ID:** 25727  
**Location:** Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel  
**Test started:** 6/18/2013  
**Test completed:** 6/26/2013, 5/22/2014  
**Test specification(s):** FCC 47 CFR Part 15, subpart C, §15.249

## 5 Tests summary

Test	Status
<b>Transmitter characteristics</b>	
Section 15.249(a)(d), Field strength of emissions	Pass
Section 15.249(d), Band edge emissions	Pass
Section 15.207(a), Conducted emission	Pass
Section 15.203, Antenna requirement	Pass
Section 15.215(c), Occupied bandwidth	Pass

Testing was completed against all relevant requirements of the test standard. The results obtained indicate that the product under test complies in full with the requirements tested. 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. Alex Chaplik, test engineer	May 22, 2014	
<b>Reviewed by:</b>	Mrs. M. Cherniavsky, certification engineer	July 1, 2015	
<b>Approved by:</b>	Mr. M. Nikishin, EMC and Radio group manager	July 1, 2015	

## 6 EUT description

### 6.1 General information

The EUT is a BT sensor which transmits RF signals to defined environment. The EUT is equipped with an integral antenna and is powered by 5 VDC from USB or other power source. The EUT may be installed in vertical or horizontal typical position.

### 6.2 Ports and lines

Port type	Port description	Connected from	Connected to	Qty.	Cable type	Cable length	Indoor / outdoor
Power	DC power	EUT	AC/DC adapter	1	Unshielded	3 m*	Indoor

\* May be longer than 100 m.

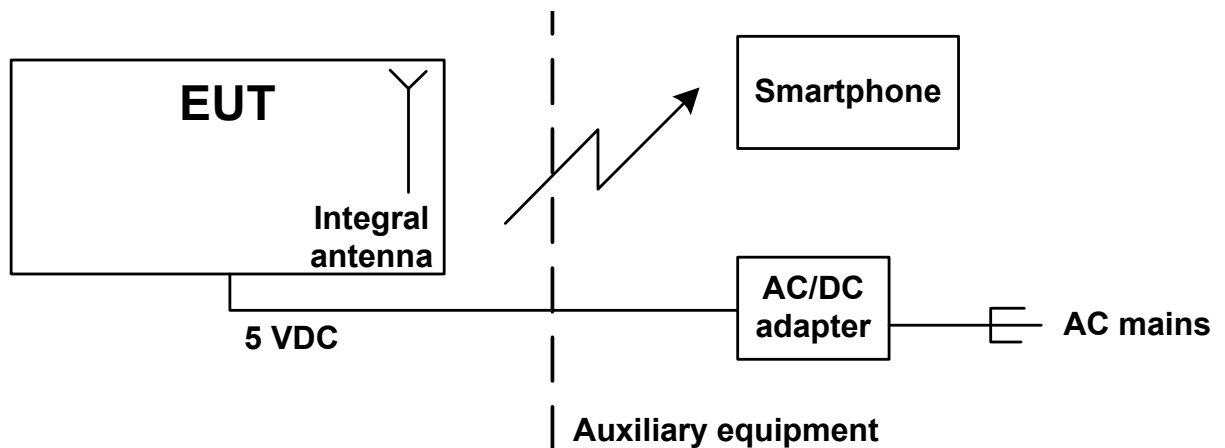
### 6.3 Auxiliary equipment

Description	Manufacturer	Model or part number	Serial number
Smartphone	Samsung	GT-I9000	RZHB366145R
AC/DC adapter	RasBerry	RPI-PSU-EU-NK1	NA

### 6.4 Changes made in EUT

No changes were performed in the EUT during the testing.

### 6.5 Test configuration





## 6.6 Transmitter characteristics

<b>Type of equipment</b>					
<b>V</b>	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>Assigned frequency range</b>		2400 – 2483.5 MHz			
<b>Operating frequencies</b>		2402 MHz, 2426 MHz, 2480 MHz			
<b>Maximum field strength</b>		98.46 dB(µV/m) peak value at 3 m test distance			
<b>Is transmitter output power variable?</b>		<b>V</b>	No		
		Yes	continuous variable		
			stepped variable with stepsize, software controlled	dB	
			Maximum field strength	97.76 dB(µV/m) at 3 m test distance	
<b>Antenna connection</b>					
unique coupling	standard connector	<b>V</b>	Integral	with temporary RF connector	
				<b>V</b>	without temporary RF connector
<b>Antenna/s technical characteristics</b>					
Type	Manufacturer	Model number		Gain	
Printed	Wisesecc	NA		Not defined	
<b>Transmitter aggregate data rate/s</b>		1 Mbit/s			
<b>Type of modulation</b>		GFSK			
<b>Transmitter duty cycle supplied for test</b>		100%			
<b>Transmitter power source</b>					
	Battery	<b>Nominal rated voltage</b>		Battery type	Lithium
<b>V</b>	DC	<b>Nominal rated voltage</b>	5.0 V from USB		
	AC mains	<b>Nominal rated voltage</b>		Frequency	



<b>Test specification:</b>		<b>Section 15.249(a)(d), Field strength of emissions</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.4	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		13-May-14 - 22-May-14	
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1014 hPa	
		<b>Relative Humidity:</b> 41 %	
		<b>Power Supply:</b> 5 VDC	
<b>Remarks:</b>			

## 7 Transmitter tests according to 47CFR part 15 subpart C and RSS-210 requirements

### 7.1 Field strength of emissions

#### 7.1.1 General

This test was performed to measure field strength of fundamental and spurious emissions from the EUT. Specification test limits are given in Table 7.1.1, Table 7.1.2 and Table 7.1.3.

Table 7.1.1 Radiated fundamental emission limits

Fundamental frequency, MHz	Field strength at 3 m, dB(μV/m)		
	Peak	Average	Quasi-Peak
2400 – 2483.5	114.0	94.0	NA

Table 7.1.2 Harmonics limits

Fundamental frequency, MHz	Field strength at 3 m, dB(μV/m)	
	Peak	Average
2400 – 2483.5	74.0	54.0

Table 7.1.3 Radiated spurious emissions limits (other than harmonics)

Frequency, MHz	Field strength at 3 m, dB(μV/m)*			Attenuation below carrier
	Peak	Quasi Peak	Average	
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5**	50 dBc (whichever is the less stringent)
0.090 – 0.110	NA	108.5 – 106.8**	NA	
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8**	
0.490 – 1.705	NA	73.8 – 63.0**	NA	
1.705 – 30.0*		69.5		
30 – 88		40.0		
88 – 216		43.5		
216 – 960		46.0		
960 - 1000		54.0		
Above 1000	74.0	NA	54.0	

\*- The limit for 3 m test distance was calculated using the inverse square distance extrapolation factor as follows:

$$\text{Lim}_{S_2} = \text{Lim}_{S_1} + 40 \log (S_1/S_2),$$

where  $S_1$  and  $S_2$  – standard defined and test distance respectively in meters.

\*\*- The limit decreases linearly with the logarithm of frequency.

*Note:* The above field strength limits applied from the lowest radio frequency generated in the device, without going below 9 kHz up to the tenth harmonic of the highest fundamental frequency but not exceeding 40 GHz for intentional radiators operated below 10 GHz and up to the fifth harmonic of the highest fundamental frequency but not exceeding 100 GHz for intentional radiators operated above 10 GHz.



<b>Test specification:</b>		<b>Section 15.249(a)(d), Field strength of emissions</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.4	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		13-May-14 - 22-May-14	
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1014 hPa	
		<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

**7.1.2 Test procedure for spurious emission field strength measurements in 9 kHz to 30 MHz band**

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

7.1.2.3 The worst test results (the lowest margins) were recorded in the associated tables and shown in the associated plots.

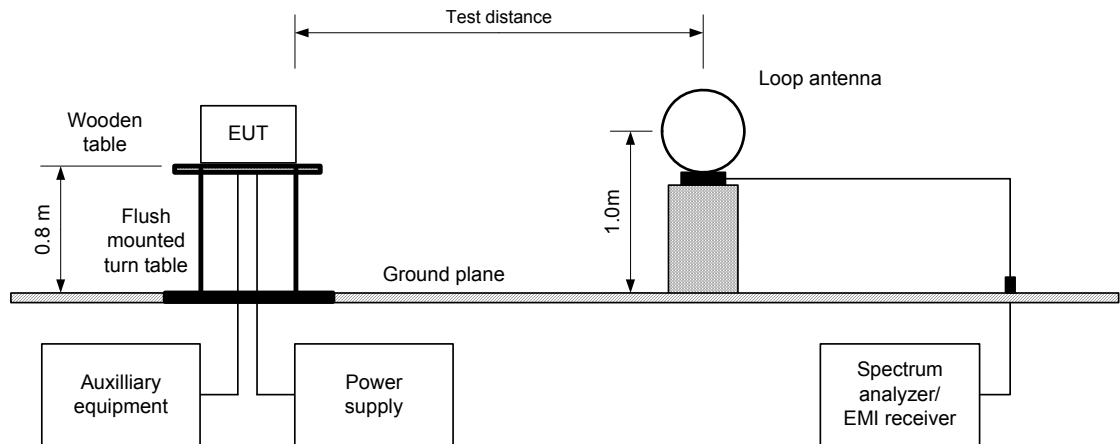
**7.1.3 Test procedure for spurious emission field strength measurements above 30 MHz**

7.1.3.1 The EUT was set up as shown in Figure 7.1.2, energized and the performance check was conducted.

7.1.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer/ EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal.

7.1.3.3 The worst test results (the lowest margins) were recorded in the associated tables and shown in the associated plots.

**Figure 7.1.1 Setup for spurious emission field strength measurements below 30 MHz**

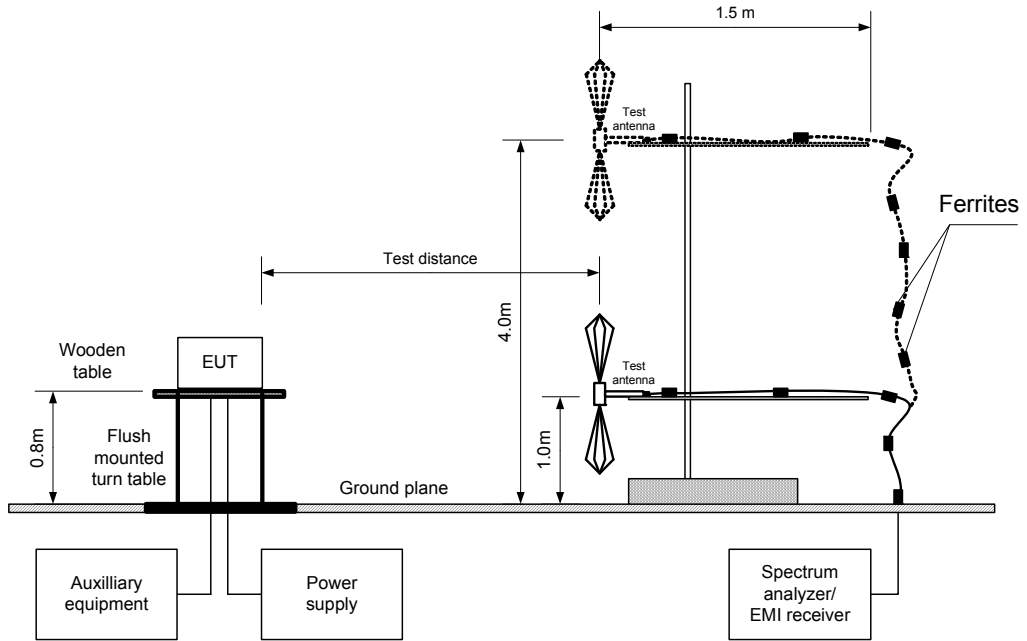






<b>Test specification:</b>	<b>Section 15.249(a)(d), Field strength of emissions</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 13.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	13-May-14 - 22-May-14		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

Figure 7.1.2 Setup for spurious emission field strength measurements above 30 MHz





<b>Test specification:</b>		<b>Section 15.249(a)(d), Field strength of emissions</b>			
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.4			
<b>Test mode:</b>		Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b>		13-May-14 - 22-May-14			
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1014 hPa		<b>Relative Humidity:</b> 41 %	
<b>Power Supply:</b> 5 VDC					
<b>Remarks:</b>					

**Table 7.1.4 Field strength of fundamental emission and spurious emissions**

TEST DISTANCE: 3 m  
 EUT POSITION: Typical (vertical, horizontal)  
 MODULATION: GFSK  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 INVESTIGATED FREQUENCY RANGE: 0.009 – 25000 MHz  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH: 1.0 kHz (9 kHz – 150 kHz)  
 9.0 kHz (150 kHz – 30 MHz)  
 120 kHz (30 MHz – 1000 MHz)  
 1.0 MHz (above 1000 MHz)  
 VIDEO BANDWIDTH: ≥ Resolution bandwidth  
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)  
 Biconilog (30 MHz – 1000 MHz)  
 Double ridged guide (above 1000 MHz)

F, GHz	Antenna		Azimuth, degrees*	Peak field strength			Avr factor, dB	Average field strength			Verdict
	Pol.	Height, m		Measured, dB(µV/m)	Limit, dB(µV/m)	Margin, dB**		Measured, dB(µV/m)	Limit, dB(µV/m)	Margin, dB***	
<b>Fundamental emission****</b>											
2.402	Vert	1.0	300	97.76	114.00	-16.24	-42.85	95.20	94.00	-41.65	Pass
2.426	Vert	1.0	360	97.43	114.00	-16.57	-42.85	95.01	94.00	-41.84	
2.480	Vert	1.0	360	94.31	114.00	-19.69	-42.85	91.00	94.00	-45.85	
<b>Spurious emissions</b>											
<b>Low carrier frequency</b>											
4.804	Hor	1.5	300	48.77	74.00	-25.23	-42.85	44.20	54.00	-52.65	Pass
7.206	Ver	1.0	220	59.28	74.00	-14.72	-42.85	53.83	54.00	-43.02	
<b>Mid carrier frequency</b>											
4.852	Hor	1.6	360	51.64	74.00	-22.36	-42.85	48.26	54.00	-48.59	Pass
7.278	Ver	1.0	170	59.50	74.00	-14.50	-42.85	54.02	54.00	-42.83	
<b>High carrier frequency</b>											
4.960	Hor	1.0	360	54.48	74.00	-19.52	-42.85	51.51	54.00	-45.34	Pass
7.440	Ver	1.5	360	58.24	74.00	-15.76	-42.85	53.98	54.00	-42.87	

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

\*\*- Margin, dB = Measured value, dB(µV/m) - Limit, dB(µV/m).

\*\*\*- Margin, dB = Calculated value, dB(µV/m) - Limit, dB(µV/m) = Measured value, dB(µV/m) - Average factor, dB - Limit, dB(µV/m).

\*\*\*\* Max value was obtained in Typical vertical position and at Unom input power voltage.

**Table 7.1.5 Average factor calculation**

Transmission pulse		Transmission burst		Transmission train duration, ms	Average factor, dB
Duration, ms	Period, ms	Duration, ms	Period, ms		
0.72	100	NA			-42.85

\*- Average factor was calculated as follows

for pulse train shorter than 100 ms:

$$Average\ factor = 20 \times \log_{10} \left( \frac{Pulse\ duration}{Pulse\ period} \times \frac{Burst\ duration}{Train\ duration} \times Number\ of\ bursts\ within\ pulse\ train \right)$$

for pulse train longer than 100 ms:

$$Average\ factor = 20 \times \log_{10} \left( \frac{Pulse\ duration}{Pulse\ period} \times \frac{Burst\ duration}{100\ ms} \times Number\ of\ bursts\ within\ 100\ ms \right)$$

**Reference numbers of test equipment used**

HL 0446	HL 0768	HL 1984	HL 2697	HL 2780	HL 2871	HL 3531	HL 3533
HL 3535	HL 3901	HL 4114	HL 4160	HL 4276	HL 4278	HL 4353	

Full description is given in Appendix A.

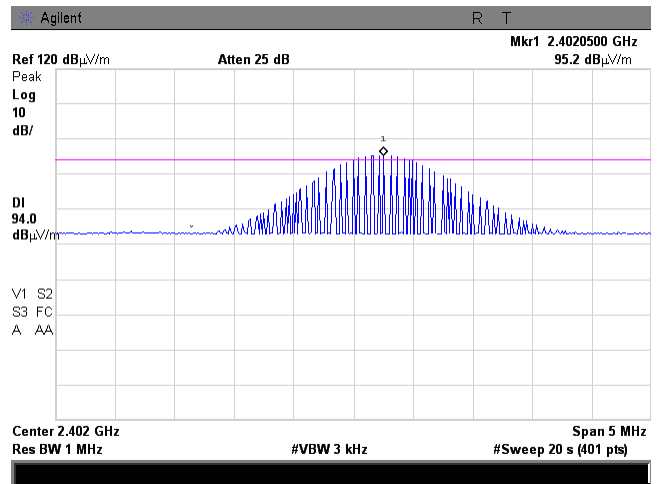
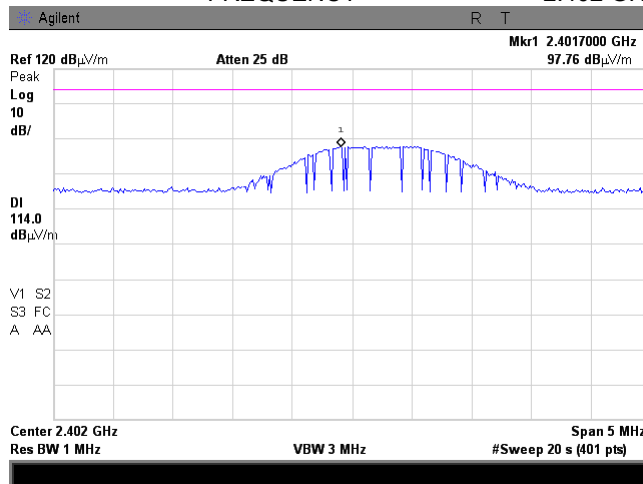


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<b>Test specification:</b> Section 15.249(a)(d), Field strength of emissions			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 13-May-14 - 22-May-14			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

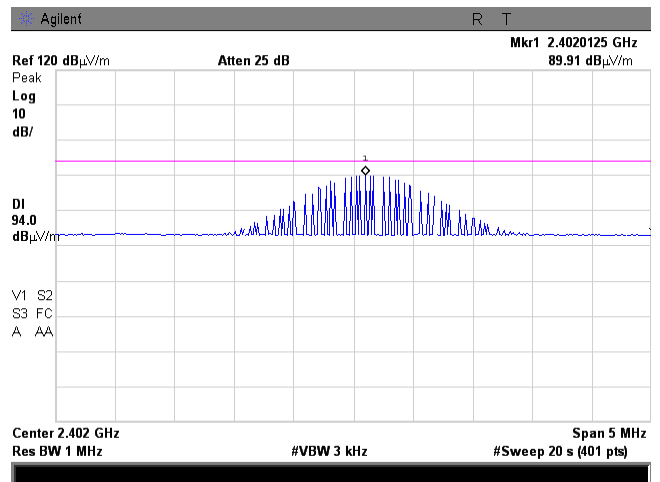
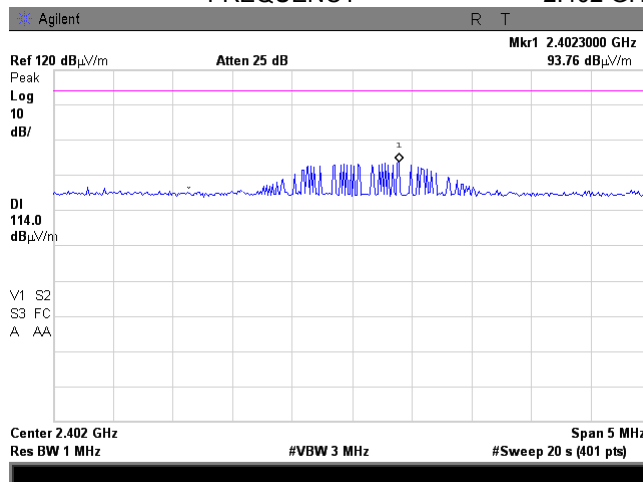
### Plot 7.1.1 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: Typical (Vertical)  
INPUT VOLTAGE: Unom  
FREQUENCY: 2.402 GHz



### Plot 7.1.2 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
EUT POSITION: Typical (Vertical)  
INPUT VOLTAGE: Unom  
FREQUENCY: 2.402 GHz



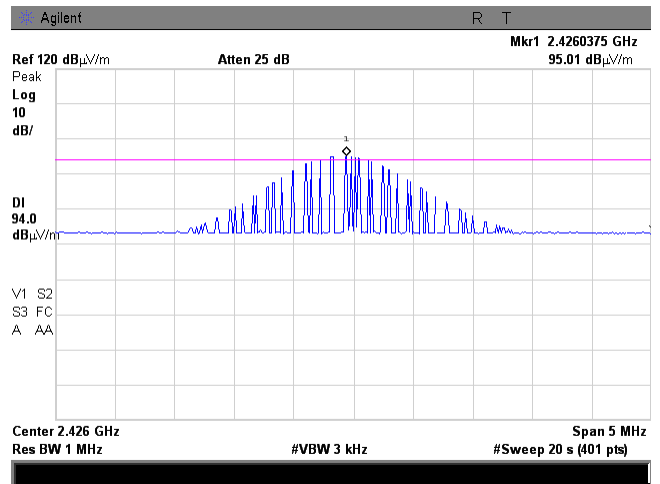
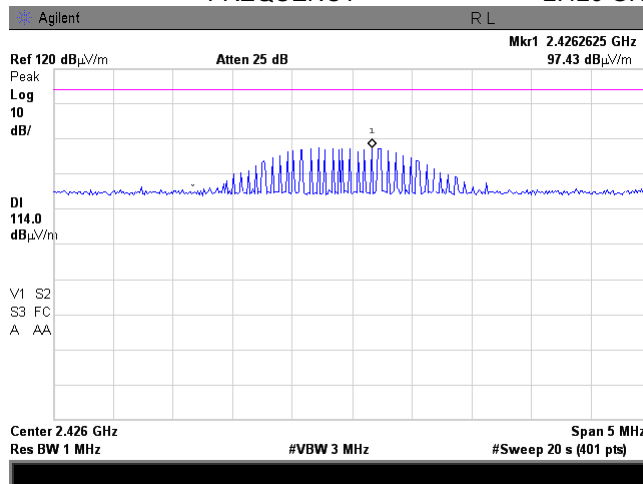


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<b>Test specification:</b> Section 15.249(a)(d), Field strength of emissions			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 13-May-14 - 22-May-14			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

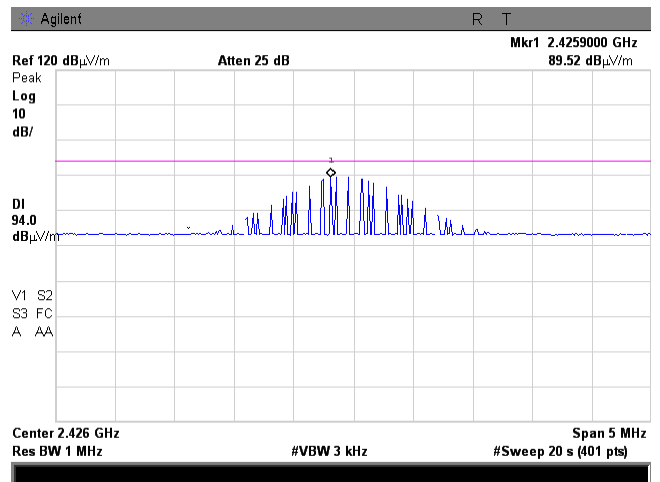
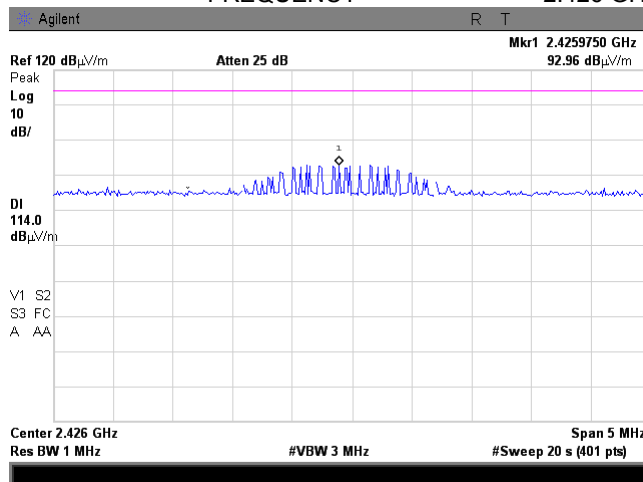
**Plot 7.1.3 Radiated emission measurements at the fundamental frequency**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: Typical (Vertical)  
INPUT VOLTAGE: Unom  
FREQUENCY: 2.426 GHz



**Plot 7.1.4 Radiated emission measurements at the fundamental frequency**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
EUT POSITION: Typical (Vertical)  
INPUT VOLTAGE: Unom  
FREQUENCY: 2.426 GHz



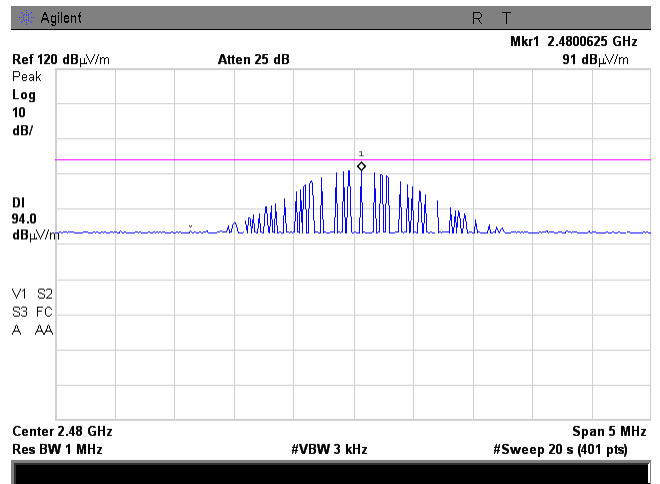
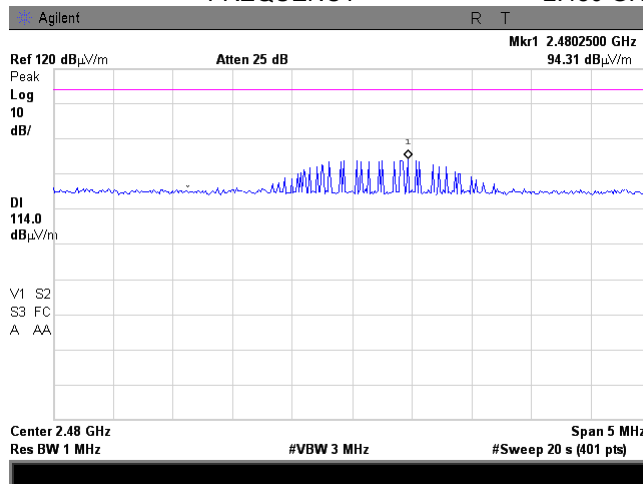


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<b>Test specification:</b> Section 15.249(a)(d), Field strength of emissions			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 13-May-14 - 22-May-14			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

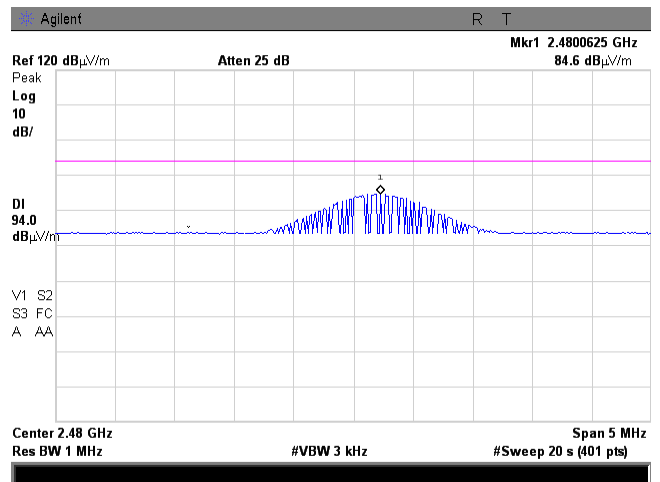
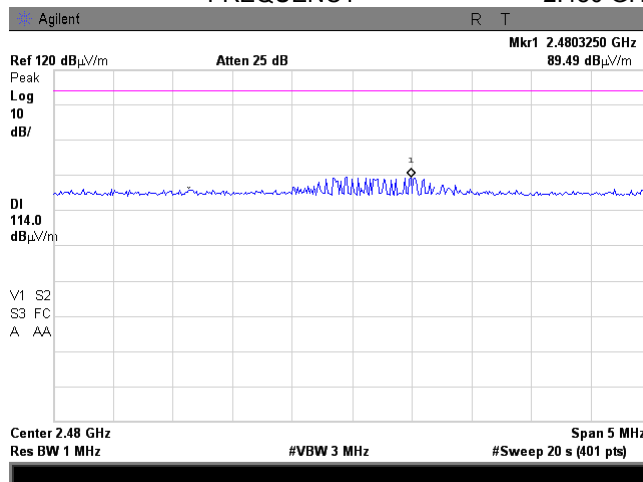
### Plot 7.1.5 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Vertical  
 EUT POSITION: Typical (Vertical)  
 INPUT VOLTAGE: Unom  
 FREQUENCY: 2.480 GHz



### Plot 7.1.6 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Horizontal  
 EUT POSITION: Typical (Vertical)  
 INPUT VOLTAGE: Unom  
 FREQUENCY: 2.480 GHz



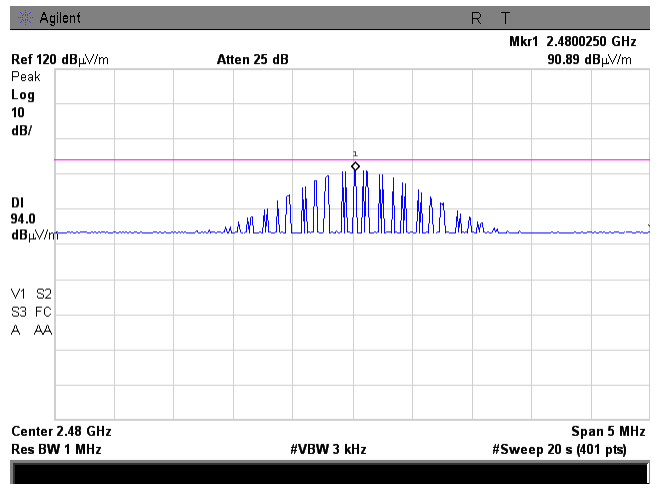
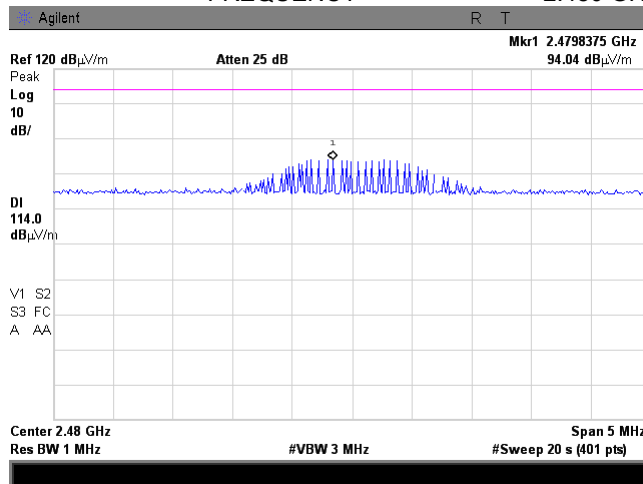


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<b>Test specification:</b> Section 15.249(a)(d), Field strength of emissions			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 13-May-14 - 22-May-14			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

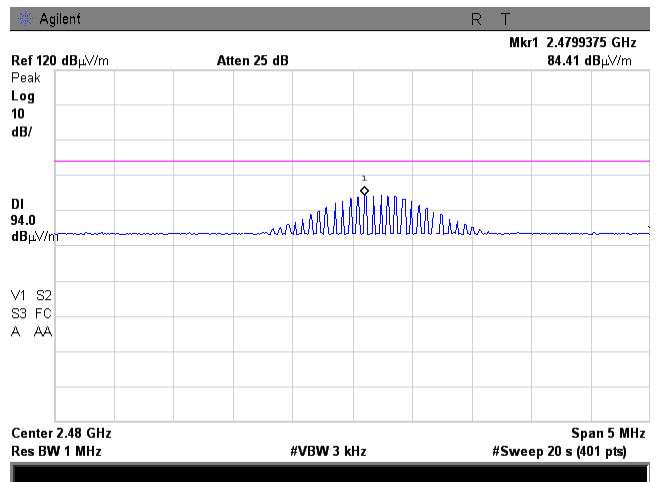
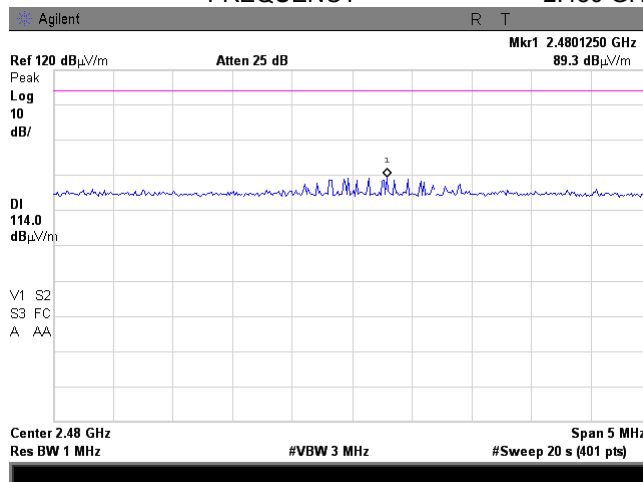
Plot 7.1.7 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: Typical (Vertical)  
INPUT VOLTAGE: 115%Unom  
FREQUENCY: 2.480 GHz



Plot 7.1.8 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
EUT POSITION: Typical (Vertical)  
INPUT VOLTAGE: 115%Unom  
FREQUENCY: 2.480 GHz



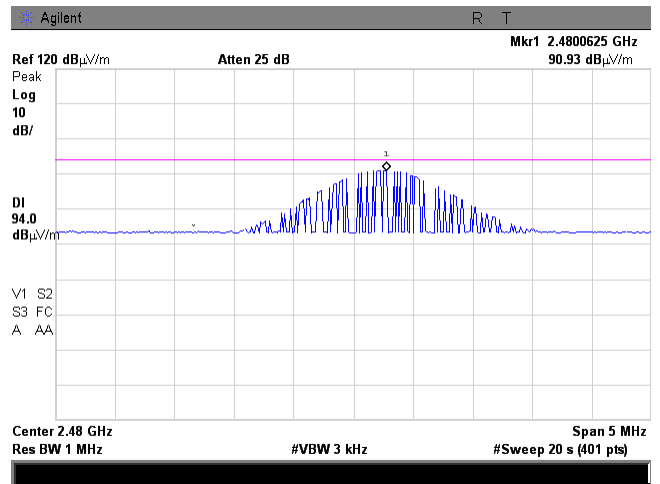
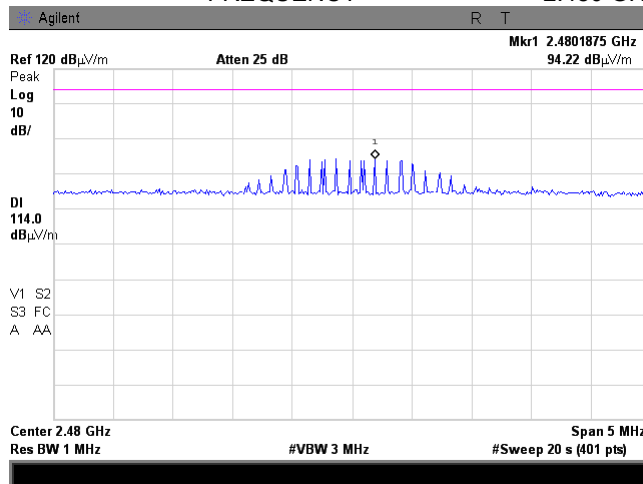


HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 15.249(a)(d), Field strength of emissions</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.4	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		13-May-14 - 22-May-14	
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1014 hPa	
<b>Remarks:</b>		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 41 %	
		<b>Power Supply:</b> 5 VDC	

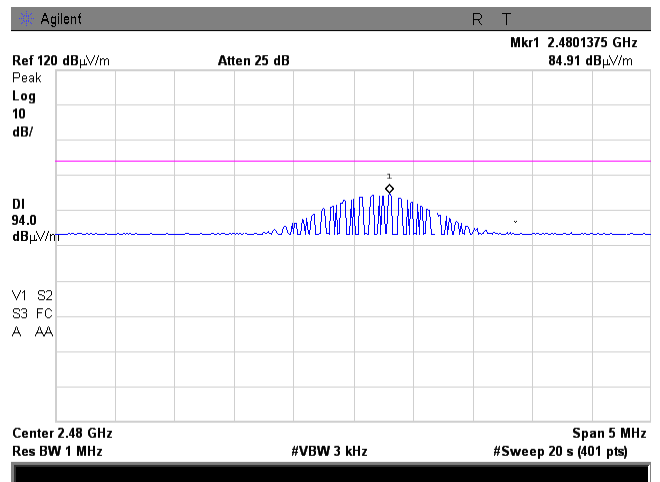
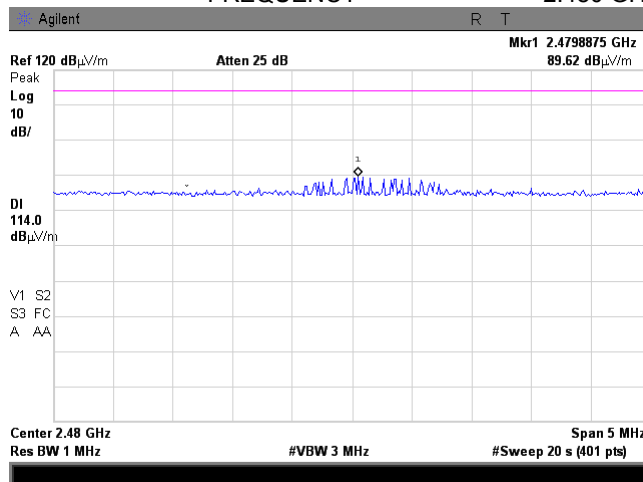
Plot 7.1.9 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Vertical  
 EUT POSITION: Typical (Vertical)  
 INPUT VOLTAGE: 85%Unom  
 FREQUENCY: 2.480 GHz



Plot 7.1.10 Radiated emission measurements at the fundamental frequency

TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Horizontal  
 EUT POSITION: Typical (Vertical)  
 INPUT VOLTAGE: 85%Unom  
 FREQUENCY: 2.480 GHz



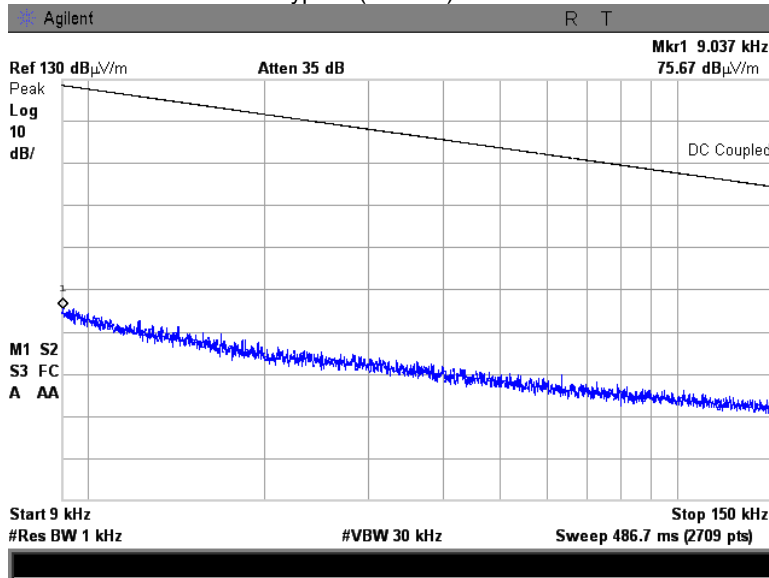


HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 15.249(a)(d), Field strength of emissions</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.4	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		13-May-14 - 22-May-14	
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1014 hPa	
		<b>Relative Humidity:</b> 41 %	
		<b>Power Supply:</b> 5 VDC	
<b>Remarks:</b>			

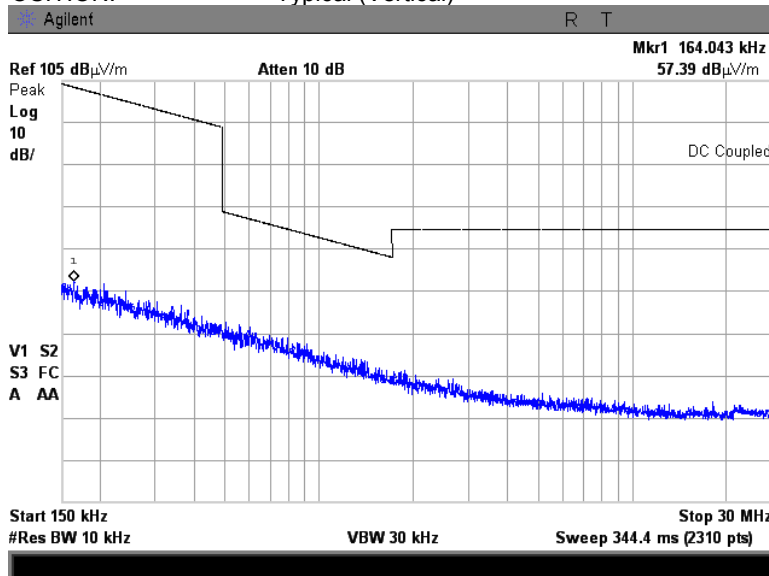
Plot 7.1.11 Radiated emission measurements from 9 to 150 kHz

TEST SITE: Anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: Typical (Vertical)



Plot 7.1.12 Radiated emission measurements from 0.15 to 30 MHz

TEST SITE: Anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: Typical (Vertical)



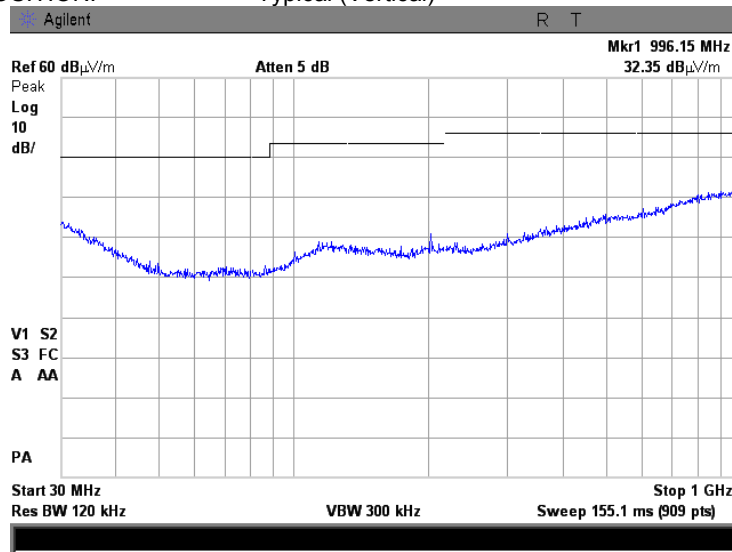




<b>Test specification:</b> Section 15.249(a)(d), Field strength of emissions			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 13-May-14 - 22-May-14			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

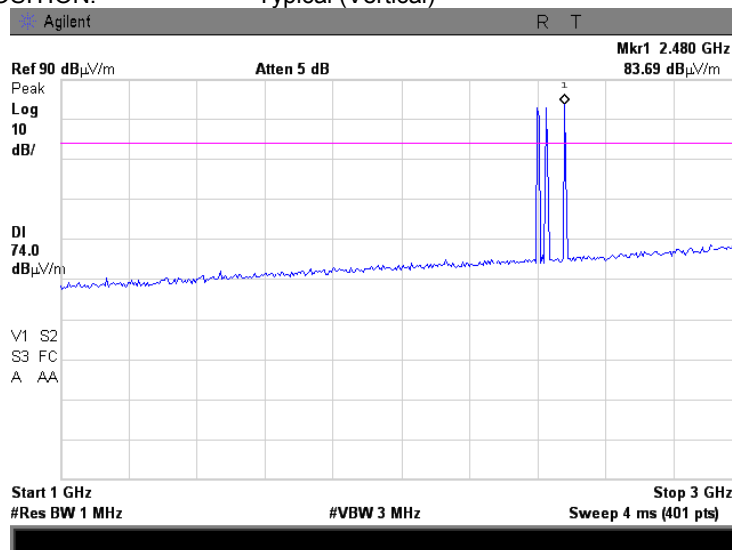
Plot 7.1.13 Radiated emission measurements from 30 to 1000 MHz

TEST SITE: Anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Vertical and Horizontal  
 EUT POSITION: Typical (Vertical)



Plot 7.1.14 Radiated emission measurements from 1.0 to 3.0 GHz

TEST SITE: Anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Vertical and Horizontal  
 EUT POSITION: Typical (Vertical)



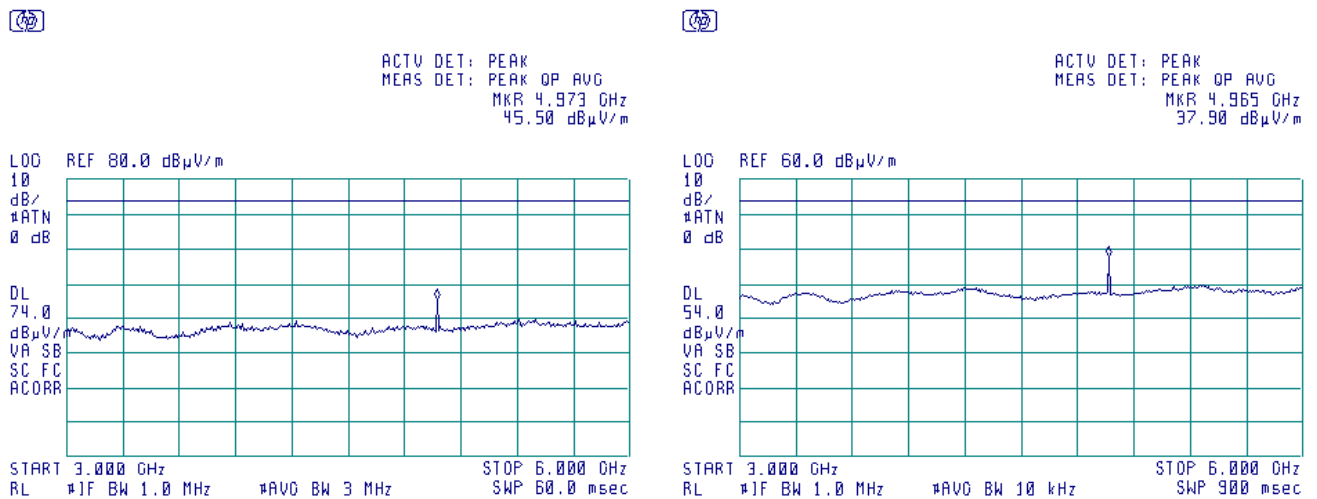


HERMON LABORATORIES

<b>Test specification:</b> Section 15.249(a)(d), Field strength of emissions			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 13-May-14 - 22-May-14			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

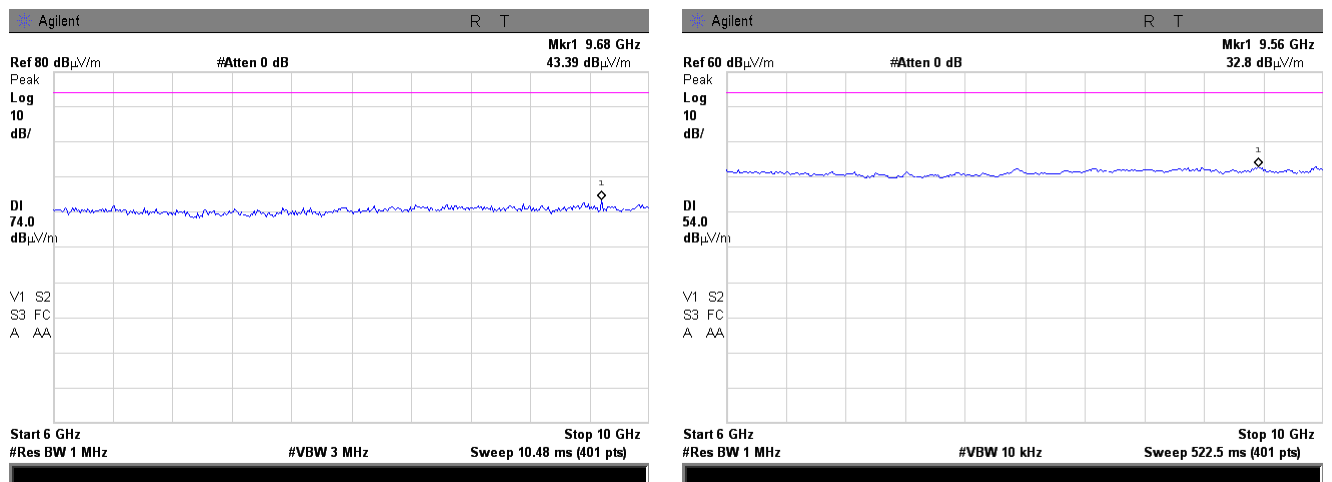
**Plot 7.1.15 Radiated emission measurements from 3.0 to 6.0 GHz**

TEST SITE: Anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal  
EUT POSITION: Typical (Vertical)



**Plot 7.1.16 Radiated emission measurements from 6.0 to 10.0 GHz**

TEST SITE: Anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal  
EUT POSITION: Typical (Vertical)



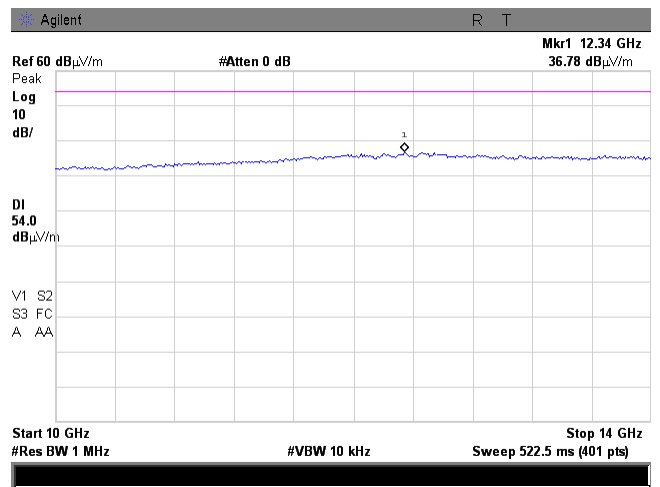
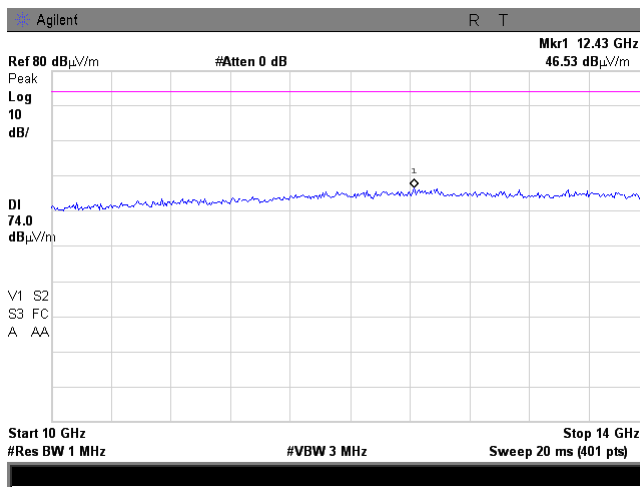


HERMON LABORATORIES

<b>Test specification:</b> Section 15.249(a)(d), Field strength of emissions			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 13-May-14 - 22-May-14			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

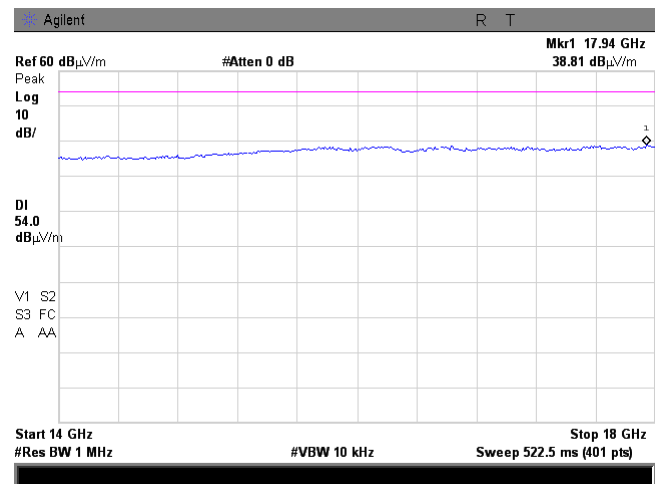
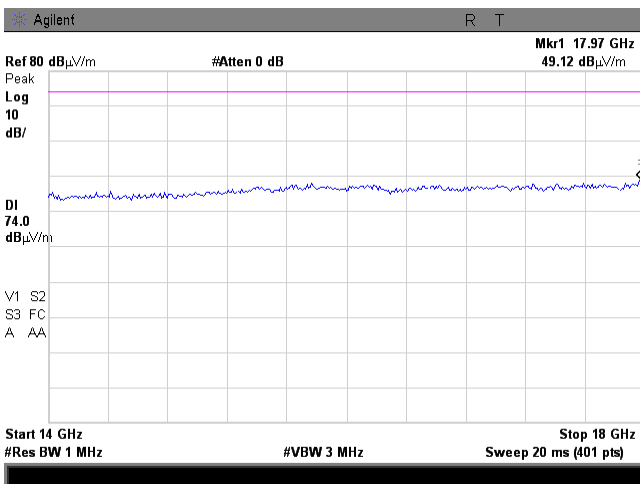
Plot 7.1.17 Radiated emission measurements from 10.0 to 14.0 GHz

TEST SITE: Anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal  
EUT POSITION: Typical (Vertical)



Plot 7.1.18 Radiated emission measurements from 14.0 to 18.0 GHz

TEST SITE: Anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal  
EUT POSITION: Typical (Vertical)



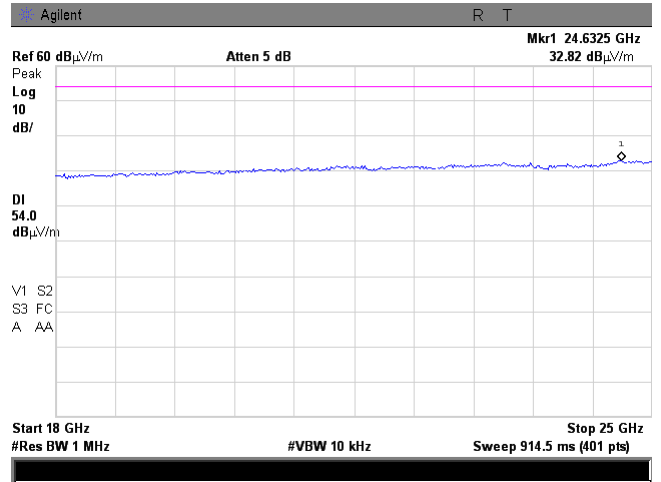
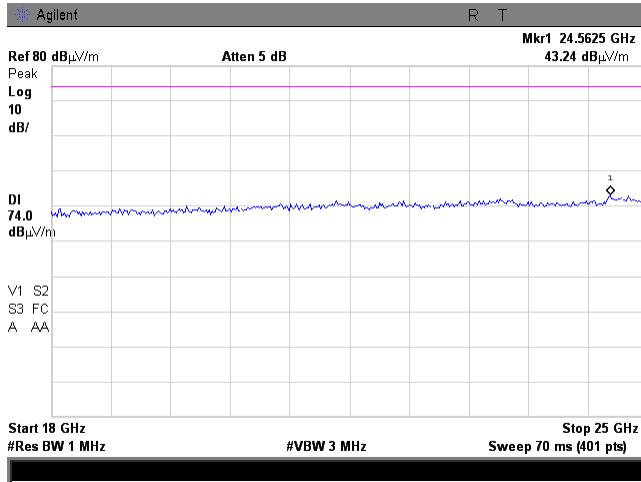


HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 15.249(a)(d), Field strength of emissions</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.4	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		13-May-14 - 22-May-14	
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1014 hPa	
		<b>Relative Humidity:</b> 41 %	
		<b>Power Supply:</b> 5 VDC	
<b>Remarks:</b>			

Plot 7.1.19 Radiated emission measurements from 18.0 to 25.0 GHz

TEST SITE: Anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal  
EUT POSITION: Typical (Vertical)



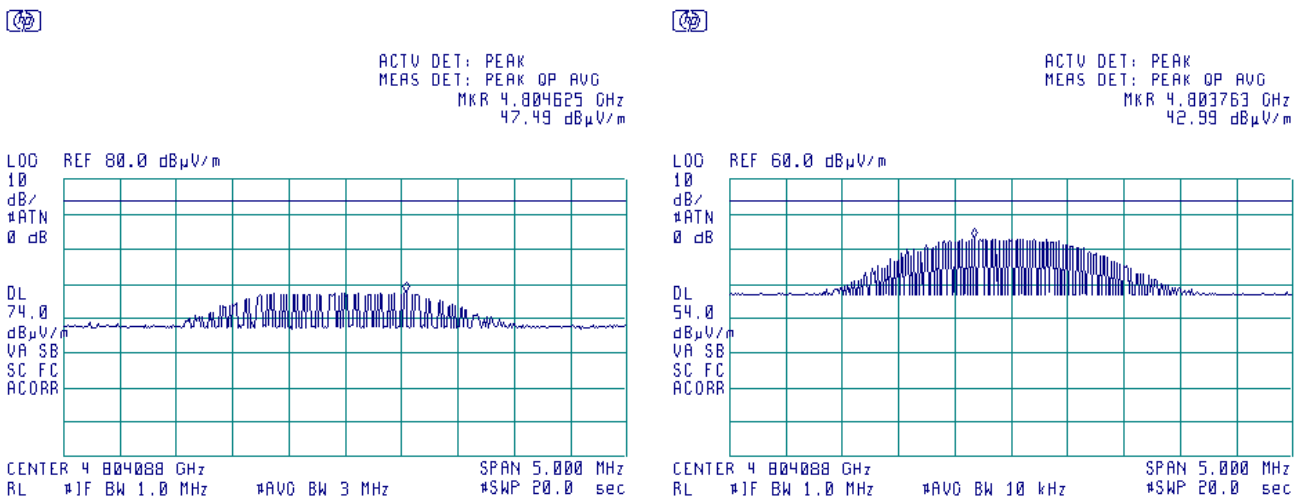


HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 15.249(a)(d), Field strength of emissions</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.4	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		13-May-14 - 22-May-14	
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1014 hPa	
		<b>Relative Humidity:</b> 41 %	
		<b>Power Supply:</b> 5 VDC	
<b>Remarks:</b>			

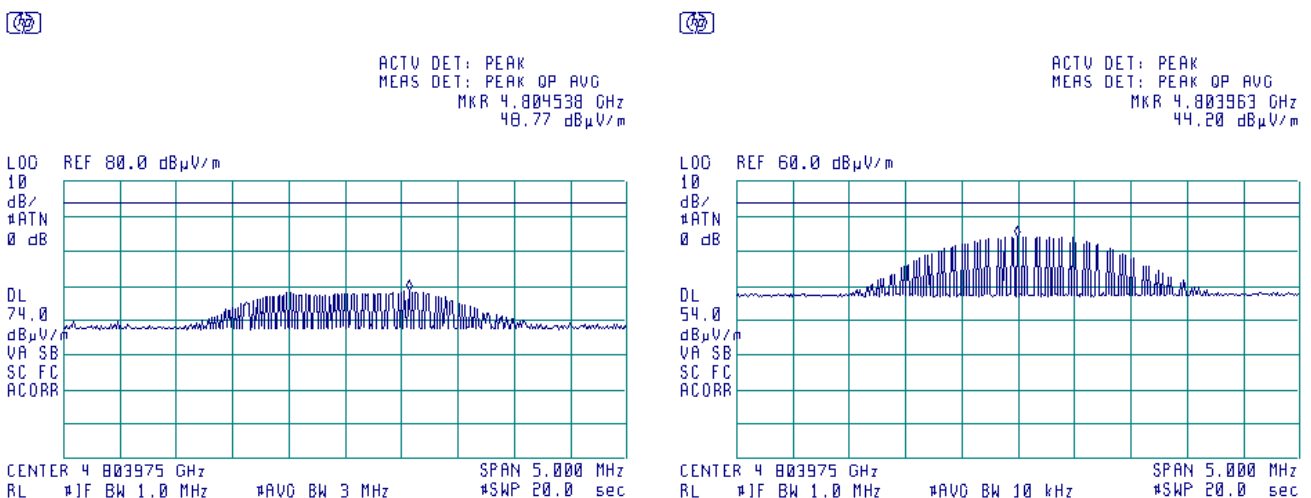
**Plot 7.1.20 Radiated emission measurements at the second harmonic frequency**

TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Vertical  
 EUT POSITION: Typical  
 FREQUENCY: 2.402 GHz



**Plot 7.1.21 Radiated emission measurements at the second harmonic frequency**

TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Horizontal  
 EUT POSITION: Typical  
 FREQUENCY: 2.402 GHz



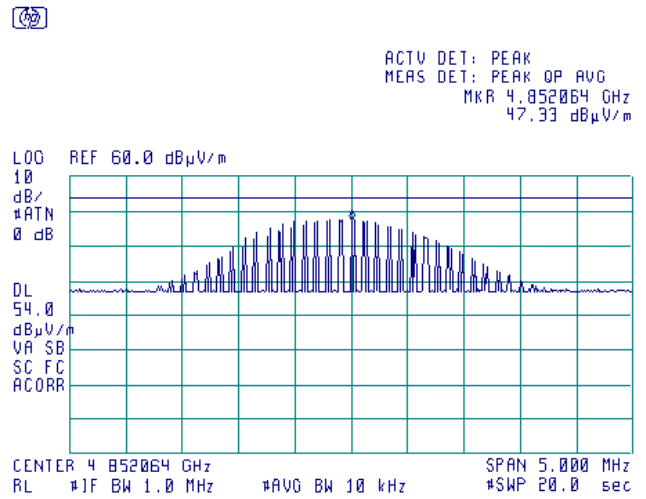
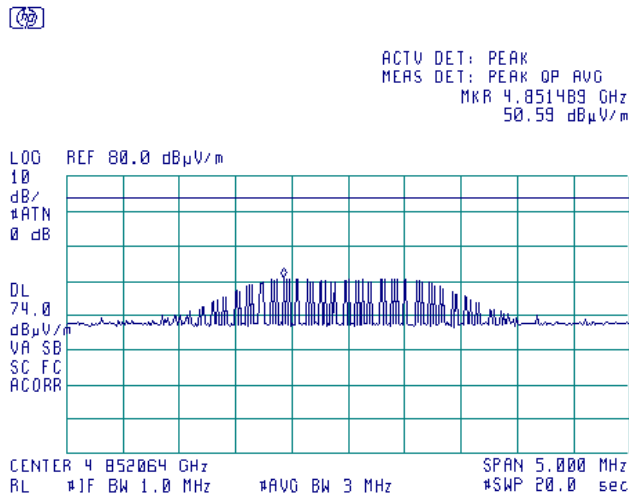


HERMON LABORATORIES

<b>Test specification:</b> Section 15.249(a)(d), Field strength of emissions			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.4			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 13-May-14 - 22-May-14			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

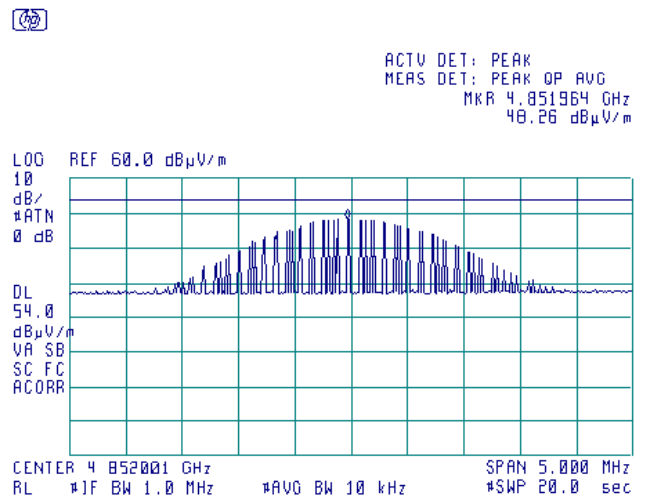
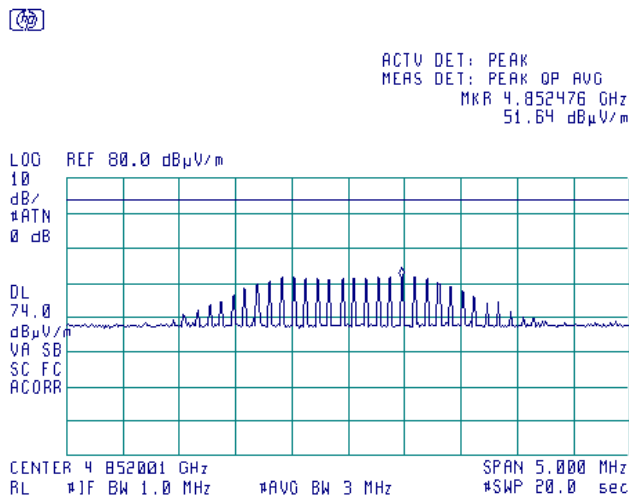
Plot 7.1.22 Radiated emission measurements at the second harmonic frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: Typical  
FREQUENCY: 2.426 GHz



Plot 7.1.23 Radiated emission measurements at the second harmonic frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
EUT POSITION: Typical  
FREQUENCY: 2.426 GHz



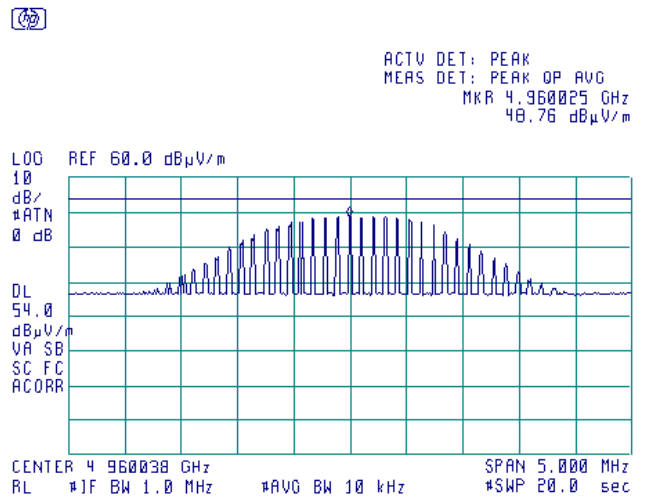
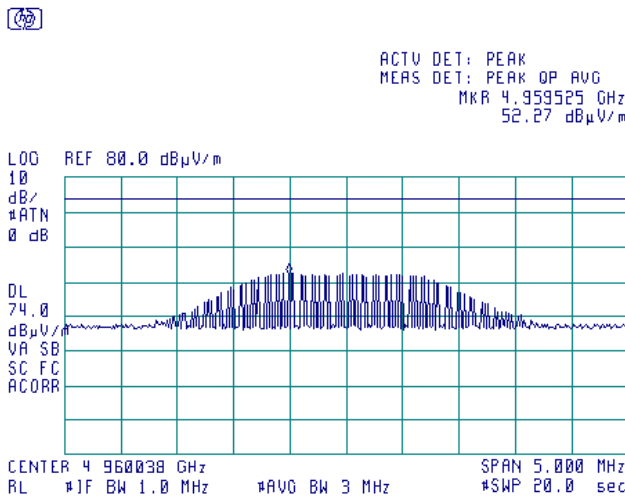


HERMON LABORATORIES

<b>Test specification:</b> Section 15.249(a)(d), Field strength of emissions			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 13-May-14 - 22-May-14			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

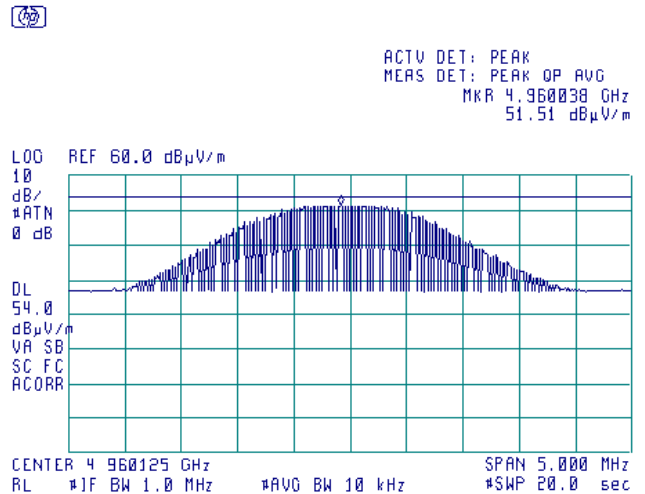
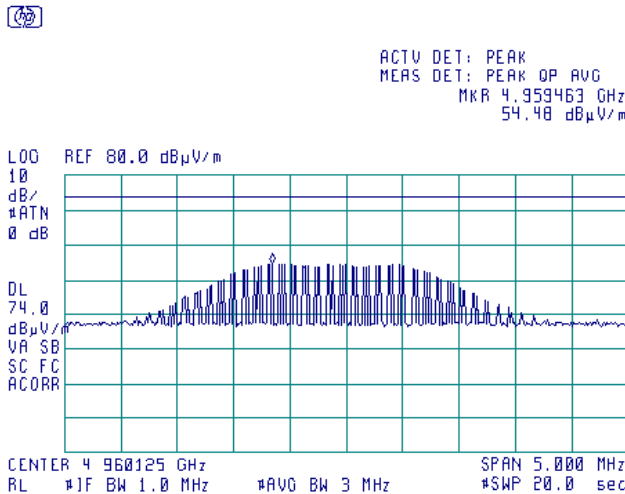
**Plot 7.1.24 Radiated emission measurements at the second harmonic frequency**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: Typical  
FREQUENCY: 2.480 GHz



**Plot 7.1.25 Radiated emission measurements at the second harmonic frequency**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
EUT POSITION: Typical  
FREQUENCY: 2.480 GHz



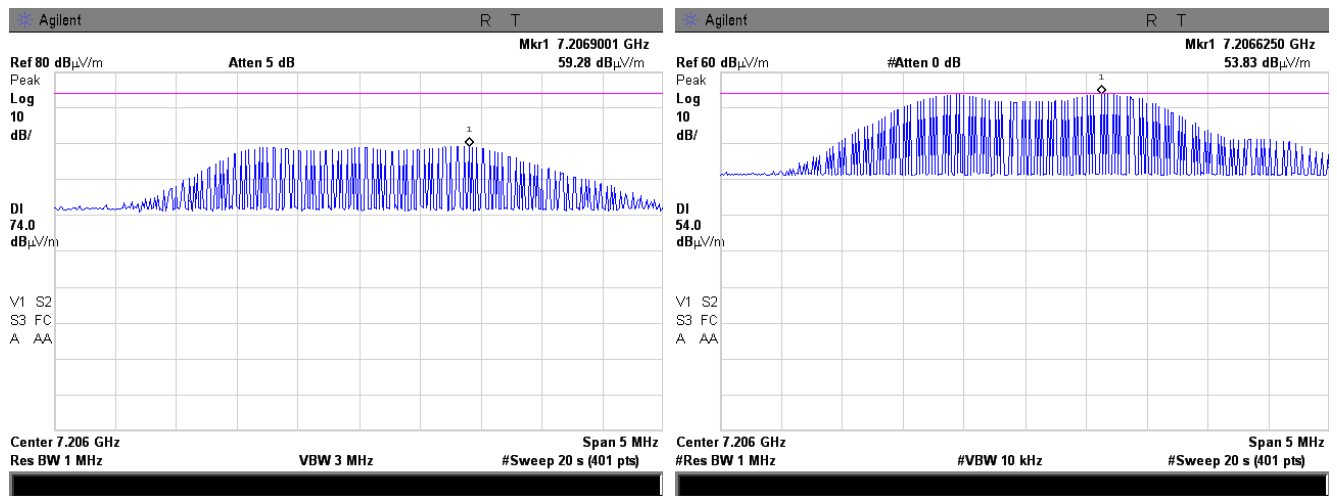


HERMON LABORATORIES

<b>Test specification:</b> Section 15.249(a)(d), Field strength of emissions			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 13-May-14 - 22-May-14			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

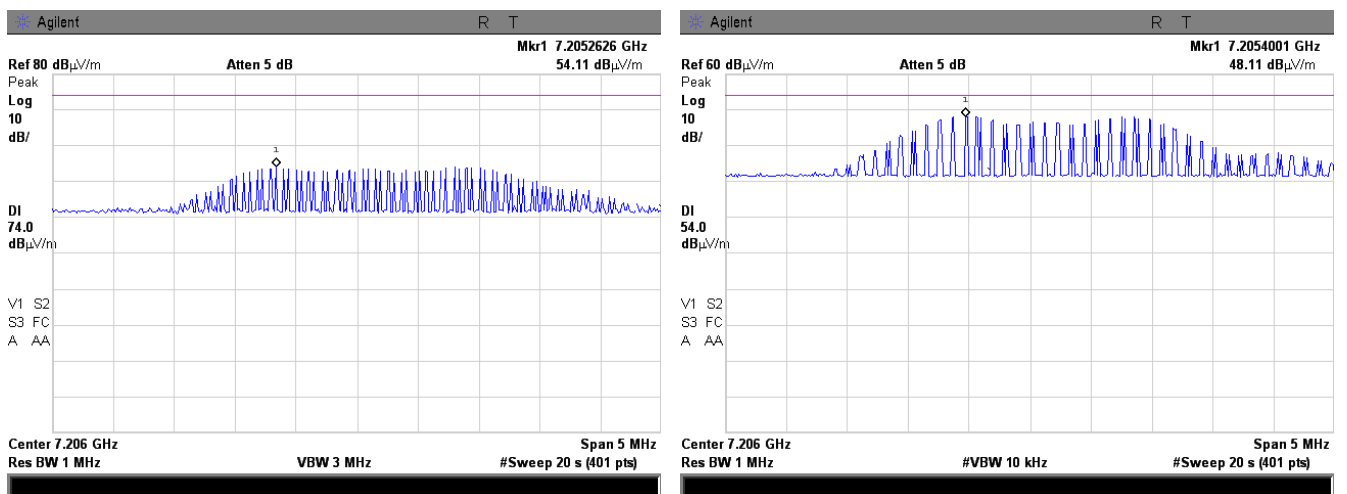
Plot 7.1.26 Radiated emission measurements at the third harmonic frequency

TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Vertical  
 EUT POSITION: Typical  
 FREQUENCY: 2.402 GHz



Plot 7.1.27 Radiated emission measurements at the third harmonic frequency

TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Horizontal  
 EUT POSITION: Typical  
 FREQUENCY: 2.402 GHz





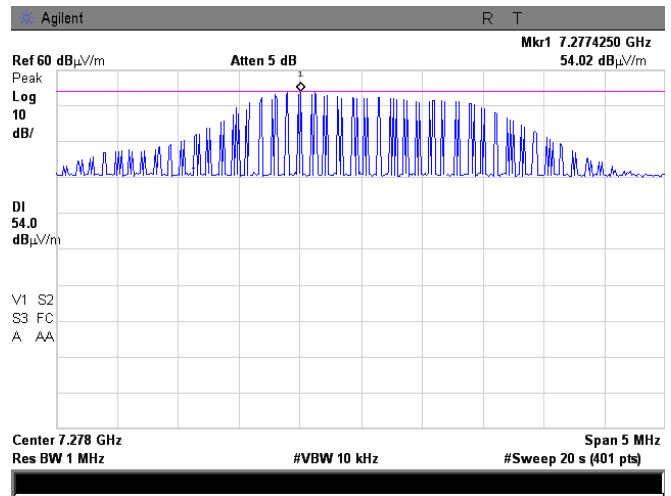
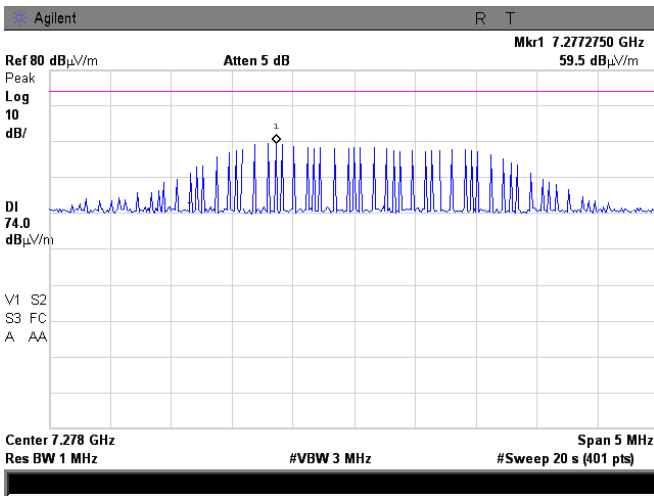


HERMON LABORATORIES

<b>Test specification:</b> Section 15.249(a)(d), Field strength of emissions			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 13-May-14 - 22-May-14			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

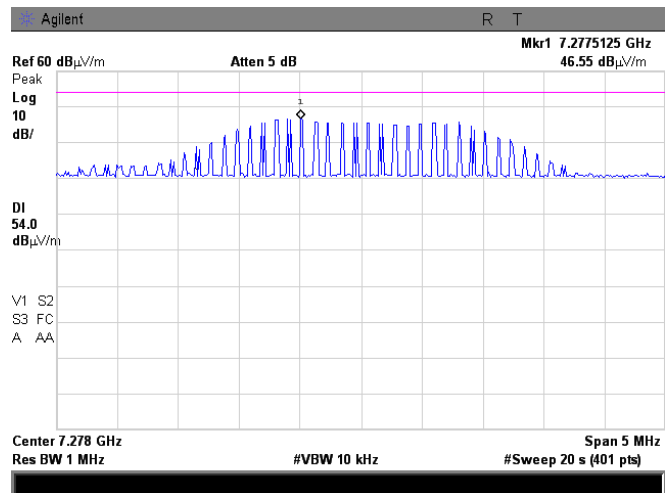
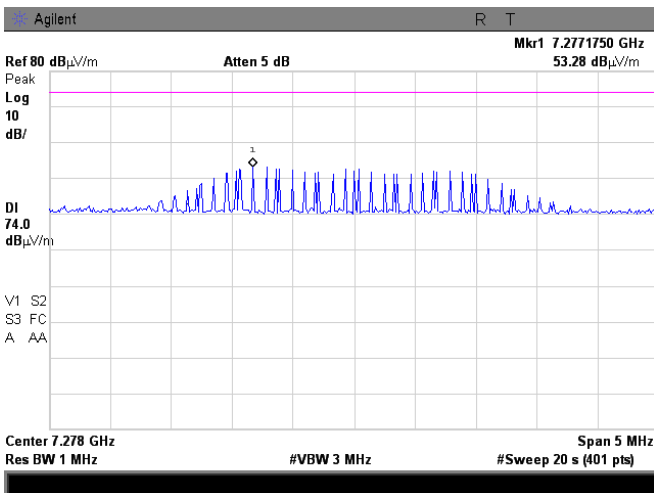
Plot 7.1.28 Radiated emission measurements at the third harmonic frequency

TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Vertical  
 EUT POSITION: Typical  
 FREQUENCY: 2.426 GHz



Plot 7.1.29 Radiated emission measurements at the third harmonic frequency

TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Horizontal  
 EUT POSITION: Typical  
 FREQUENCY: 2.426 GHz



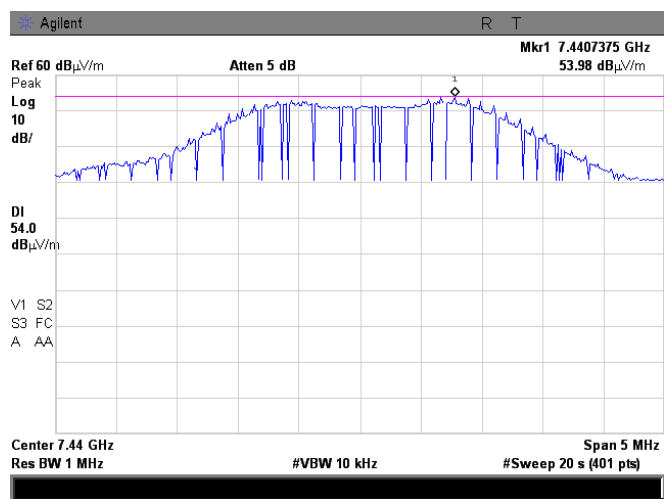
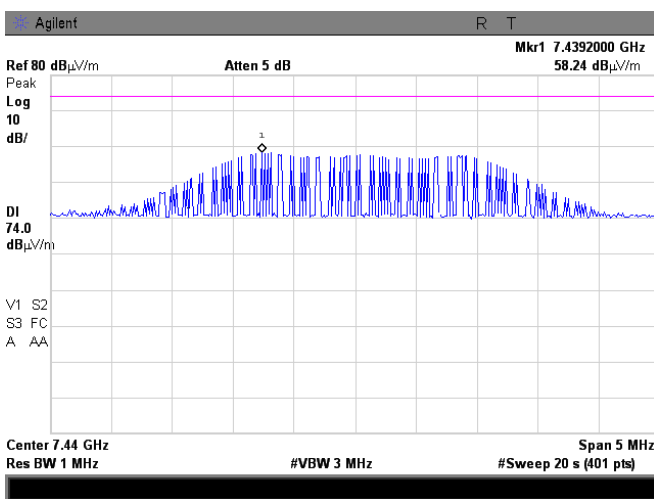


HERMON LABORATORIES

<b>Test specification:</b> Section 15.249(a)(d), Field strength of emissions			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 13-May-14 - 22-May-14			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

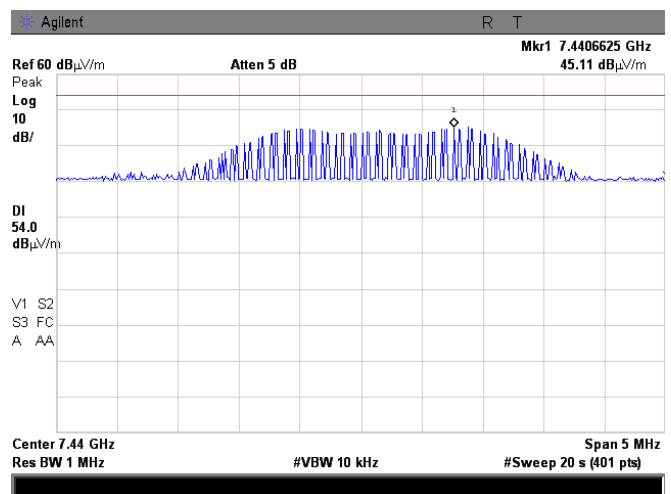
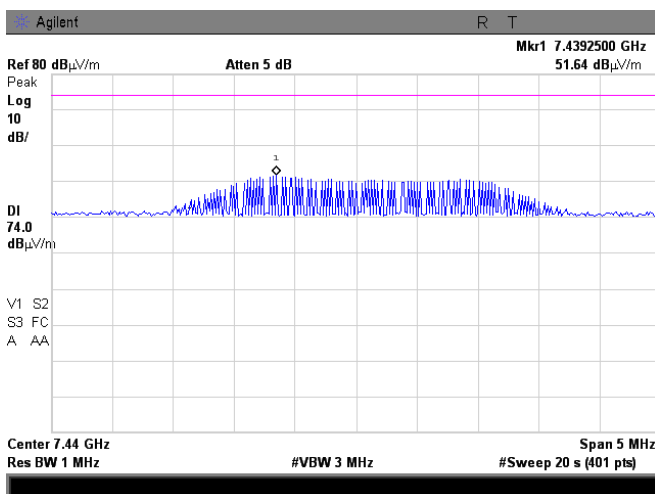
Plot 7.1.30 Radiated emission measurements at the third harmonic frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical  
EUT POSITION: Typical 1.5 360  
FREQUENCY: 2.480 GHz



Plot 7.1.31 Radiated emission measurements at the third harmonic frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Horizontal  
EUT POSITION: Typical  
FREQUENCY: 2.480 GHz



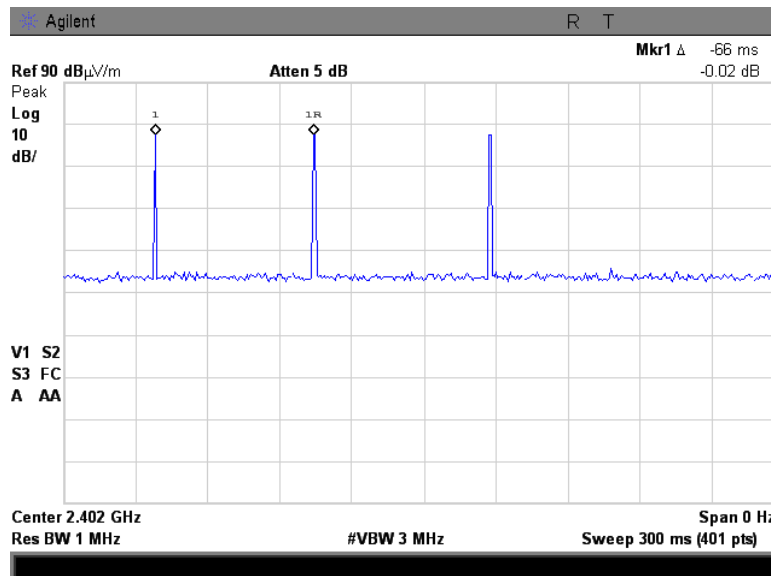


<b>Test specification:</b>		<b>Section 15.249(a)(d), Field strength of emissions</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.4	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		13-May-14 - 22-May-14	
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1014 hPa	
		<b>Relative Humidity:</b> 41 %	
		<b>Power Supply:</b> 5 VDC	
<b>Remarks:</b>			
		<b>Verdict: PASS</b>	

Plot 7.1.32 Transmission pulse duration



Plot 7.1.33 Transmission pulse period





<b>Test specification:</b>		<b>Section 15.249(d), Band edge emissions</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.4	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		6/18/2013 - 6/25/2013	
<b>Temperature:</b> 24 °C		<b>Air Pressure:</b> 1005 hPa	
		<b>Relative Humidity:</b> 41 %	
		<b>Power Supply:</b> 5 VDC	
<b>Remarks:</b>			

## 7.2 Band edge emission

### 7.2.1 General

This test was performed to verify the EUT band edge emission including all associated side bands was attenuated at least 50 dB below the unmodulated carrier level or below the general spurious emission limit. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Band edge emission limits

Frequency band, MHz	Field strength limit at 3 m, dBµV/m		Attenuation below carrier, dBc
	Peak	Average	
2400.000 – 2483.500	74.0	54.0	50

### 7.2.2 Test procedure

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 spectrum analyzer frequency span was set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

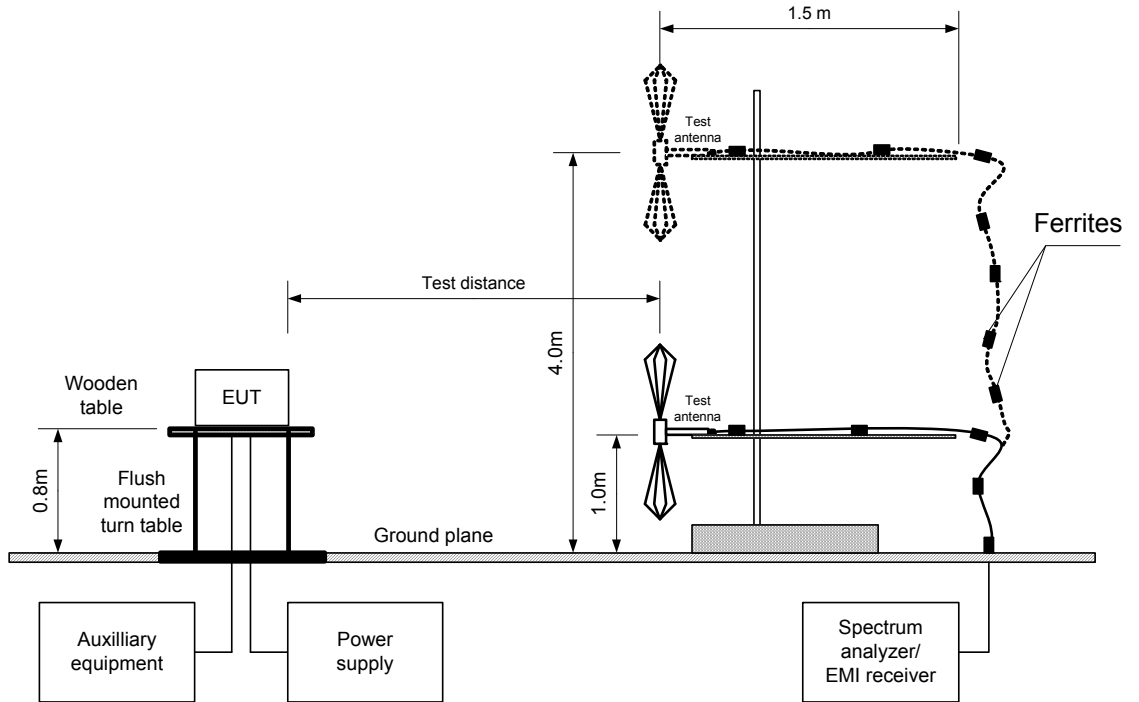
7.2.2.3 The frequency of modulation envelope points beyond which power level drops below the band edge emission limit was measured.

7.2.2.4 The test results were recorded in Table 7.2.2 and shown in the associated plots.



<b>Test specification:</b>	<b>Section 15.249(d), Band edge emissions</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 13.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	6/18/2013 - 6/25/2013		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

Figure 7.2.1 Band edge emission measurement set up





<b>Test specification:</b>		<b>Section 15.249(d), Band edge emissions</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.4	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		6/18/2013 - 6/25/2013	
<b>Temperature:</b> 24 °C		<b>Air Pressure:</b> 1005 hPa	
		<b>Relative Humidity:</b> 41 %	
		<b>Power Supply:</b> 5 VDC	
<b>Remarks:</b>			

Table 7.2.2 Band edge emission test results

ASSIGNED FREQUENCY RANGE: 2400.000 – 2483.500 MHz  
DETECTOR USED: Peak hold  
RESOLUTION BANDWIDTH: 1 MHz  
VIDEO BANDWIDTH: 3 MHz  
MODULATION: GFSK  
BIT RATE: 1 Mbit/s  
TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
ATTENUATION BELOW CARRIER: 50 dBc

Modulation envelope		Band edge limit, MHz	Margin, kHz***	Verdict
Edge	Frequency, MHz*			
Low	2400.153	2400.000	-153	Pass
High	2481.830	2483.500	1670	Pass

\* - Measured frequency beyond which the emission dropped 50 dB below the carrier emission or below the field strength limit whichever was a less stringent

\*\* - Margin = Band edge limit – Band edge frequency

Reference numbers of test equipment used

HL 1984	HL 2871	HL 3818	HL 4160	HL 4353			
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Full description is given in Appendix A.

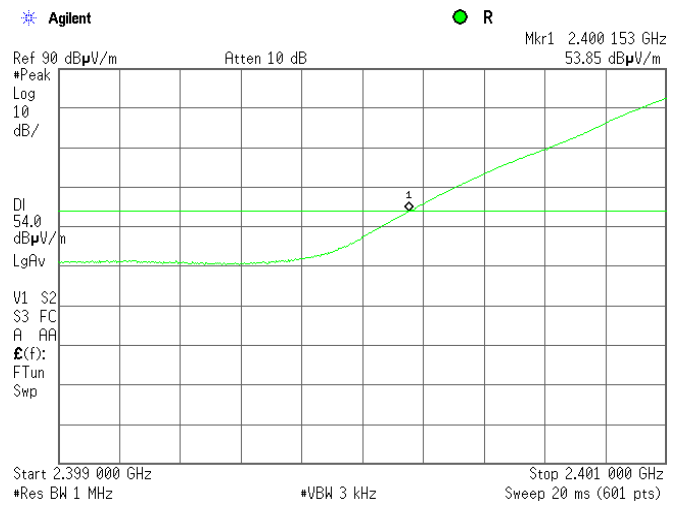
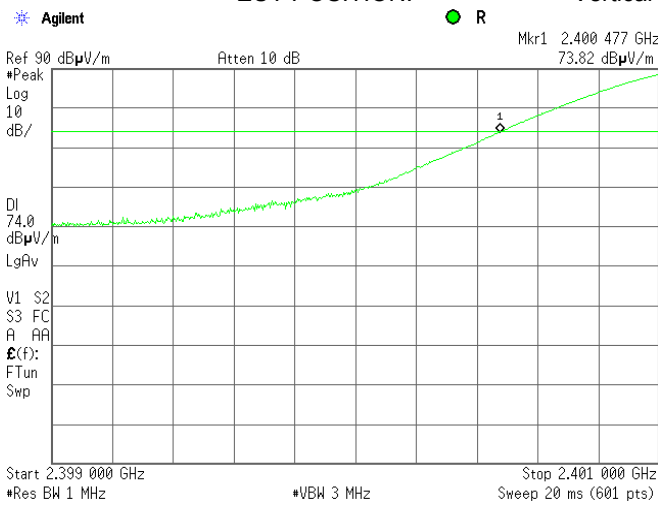


HERMON LABORATORIES

<b>Test specification:</b> Section 15.249(d), Band edge emissions			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 6/18/2013 - 6/25/2013			
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1005 hPa	<b>Relative Humidity:</b> 41 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

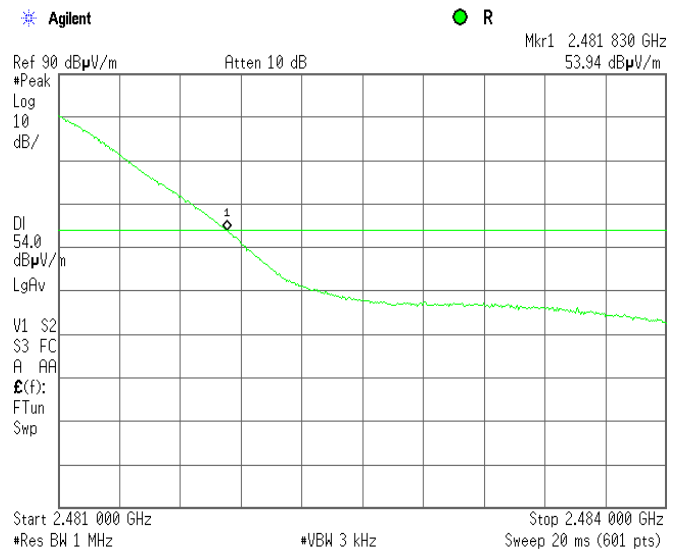
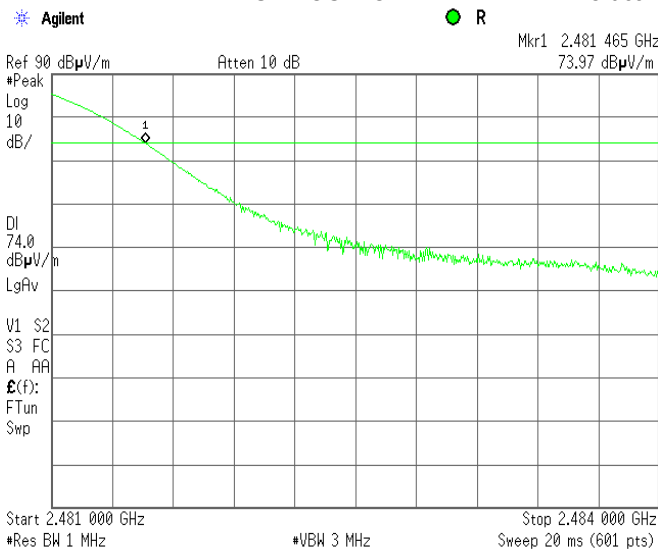
Plot 7.2.1 Low band edge emission test result

TEST SITE: Anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Vertical and Horizontal  
 EUT POSITION: Vertical



Plot 7.2.2 High band edge emission test result

TEST SITE: Anechoic chamber  
 TEST DISTANCE: 3 m  
 ANTENNA POLARIZATION: Vertical and Horizontal  
 EUT POSITION: Vertical





<b>Test specification:</b>	<b>Section 15.203, Antenna requirement</b>		
<b>Test procedure:</b>	Visual inspection / supplier declaration		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	6/25/2013		
<b>Temperature:</b> 25.1 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 31 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

### 7.3 Antenna requirements

The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed for use with the EUT. This requirement does not apply to professionally installed transmitters. The rationale for compliance with the above requirements was either visual inspection results or supplier declaration. The summary of results is provided in Table 7.3.1.

Table 7.3.1 Antenna requirements

Requirement	Rationale	Verdict
The transmitter antenna is permanently attached	Visual inspection	Comply
The transmitter employs a unique antenna connector	NA	
The transmitter requires professional installation	NA	

Photograph 7.3.1 Antenna assembly







<b>Test specification:</b> Section 15.215(c), Occupied bandwidth	
<b>Test procedure:</b>	ANSI C63.4, Section 13.1.7
<b>Test mode:</b>	Compliance
<b>Date(s):</b>	6/26/2013
<b>Temperature:</b> 24.8 °C	<b>Air Pressure:</b> 1008 hPa
<b>Relative Humidity:</b> 36 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>	
<b>Verdict: PASS</b>	

## 7.4 Occupied bandwidth test

### 7.4.1 General

This test was performed to verify that the 20 dB bandwidth of the emissions was contained within the standard specified frequency band according to FCC §15.215 requirements. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc
902 - 928	20.0
2400 – 2483.5	
5725 – 5875	
24000 – 24250	

\*- Modulation envelope reference points provided in terms of attenuation below modulated carrier.

### 7.4.2 Test procedure

7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and its proper operation was checked.

7.4.2.2 The spectrum analyzer sweep time and bandwidth were set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

7.4.2.3 The peak of emission was measured. The transmitter occupied bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.4.2 and associated plot.

7.4.2.4 Modulation bandwidth was calculated by adding of the negative frequency drift to the lower measured frequency and the positive frequency drift to the higher measured frequency. The obtained modulation bandwidth was verified to be within the allowed frequency range.

Figure 7.4.1 Occupied bandwidth test setup





<b>Test specification:</b>		<b>Section 15.215(c), Occupied bandwidth</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.7	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		6/26/2013	
<b>Temperature:</b> 24.8 °C		<b>Air Pressure:</b> 1008 hPa	
		<b>Relative Humidity:</b> 36 %	
		<b>Power Supply:</b> 5 VDC	
<b>Remarks:</b>			

Table 7.4.2 Occupied bandwidth test results

ASSIGNED FREQUENCY BAND 2400.0 – 2483.5MHz  
DETECTOR USED: Peak hold  
RESOLUTION BANDWIDTH: 10kHz  
VIDEO BANDWIDTH: 30kHz  
MODULATION: GFSK  
MODULATING SIGNAL: enable

MODULATION ENVELOPE REFERENCE POINTS: 20 dBc

Carrier frequency, MHz	Occupied bandwidth, 20 dB, kHz	Limit, kHz	Margin, kHz	Verdict
Low frequency 2402 MHz	1147.0	500.0	647.0	Pass
Mid frequency 2426 MHz	1177.0	500.0	677.0	Pass
High frequency 2480 MHz	1163.0	500.0	663.0	Pass

Carrier frequency, MHz	Occupied bandwidth, 99%, kHz	Limit, kHz	Margin, kHz	Verdict
Low frequency 2402 MHz	1230.0	500.0	730.0	Pass
Mid frequency 2426 MHz	1243.0	500.0	743.0	Pass
High frequency 2480 MHz	1213.0	500.0	713.0	Pass

Reference numbers of test equipment used

HL 3818								
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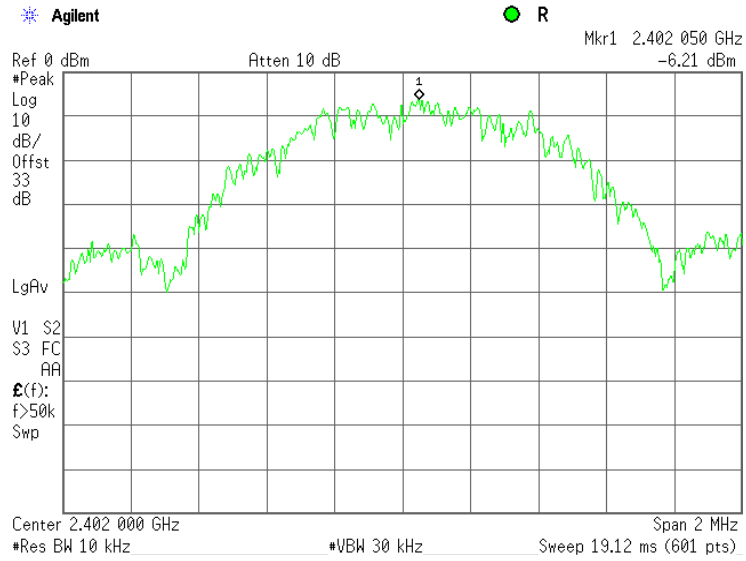
Full description is given in Appendix A.



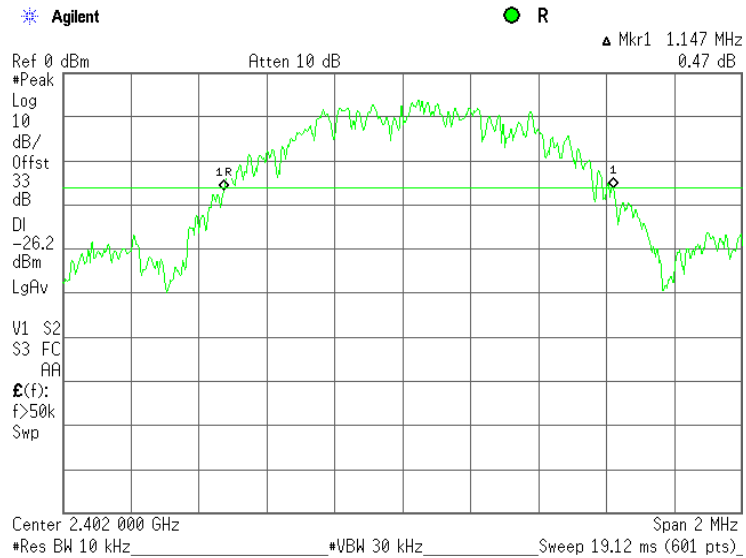
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 15.215(c), Occupied bandwidth</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.7	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		6/26/2013	
<b>Temperature:</b> 24.8 °C		<b>Air Pressure:</b> 1008 hPa	
		<b>Relative Humidity:</b> 36 %	
		<b>Power Supply:</b> 5 VDC	
<b>Remarks:</b>			

Plot 7.4.1 Occupied bandwidth test result at low carrier frequency 2402 MHz



Plot 7.4.2 The 20 dB occupied bandwidth test result at low carrier frequency 2402 MHz

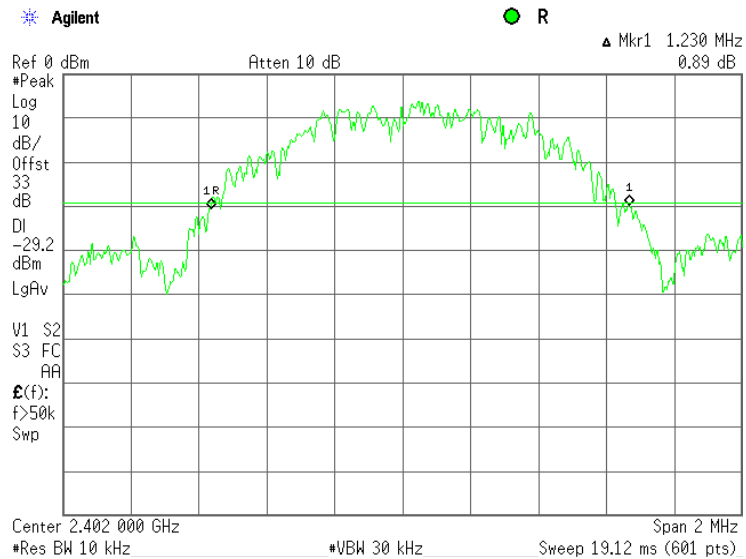




HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 15.215(c), Occupied bandwidth</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.7	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		6/26/2013	
<b>Temperature:</b> 24.8 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 36 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

Plot 7.4.3 The 99% occupied bandwidth test result at low carrier frequency 2402 MHz

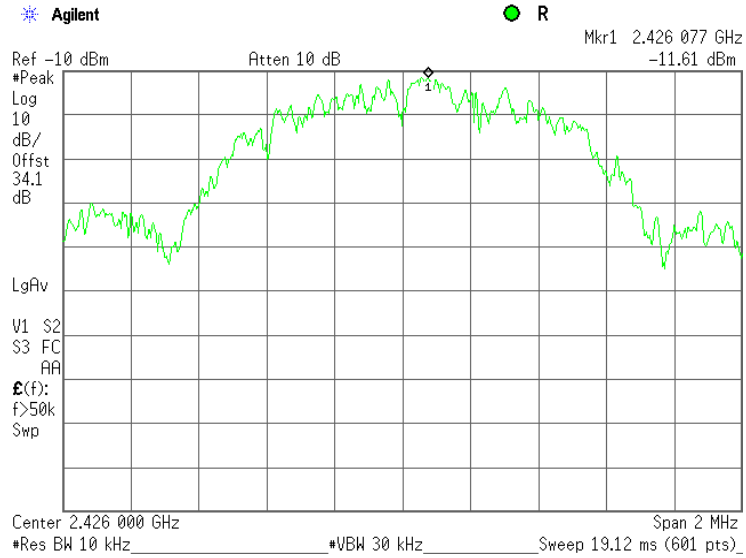




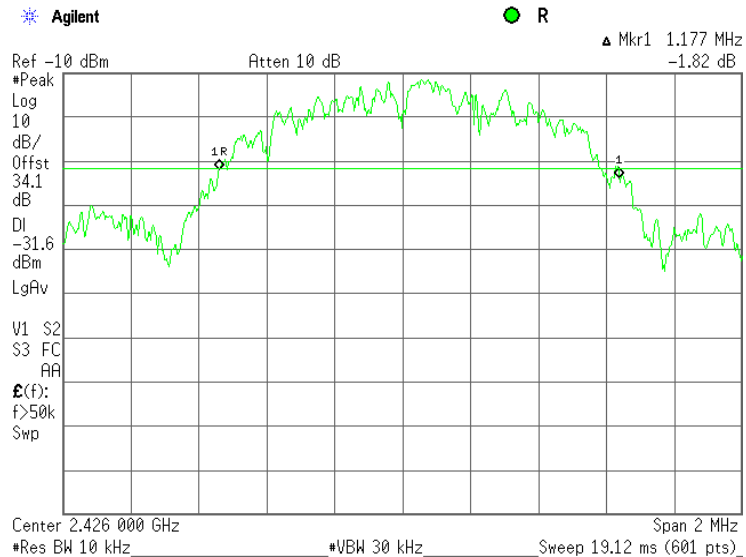
HERMON LABORATORIES

<b>Test specification:</b> Section 15.215(c), Occupied bandwidth			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.7			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 6/26/2013			
<b>Temperature:</b> 24.8 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 36 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

Plot 7.4.4 Occupied bandwidth test result at mid carrier frequency 2426 MHz



Plot 7.4.5 The 20 dB occupied bandwidth test result at mid carrier frequency 2426 MHz

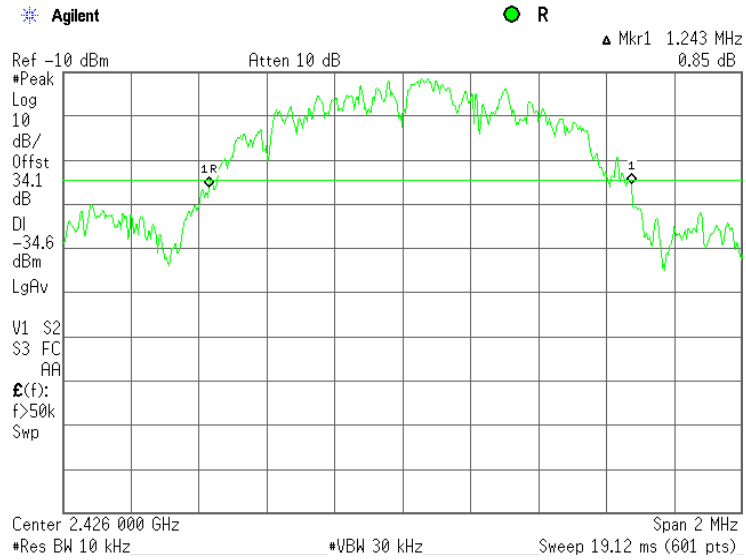




HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 15.215(c), Occupied bandwidth</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.7	
<b>Test mode:</b>		<b>Verdict:</b>	
Compliance		PASS	
<b>Date(s):</b>		6/26/2013	
<b>Temperature:</b> 24.8 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 36 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			

Plot 7.4.6 The 99% occupied bandwidth test result at mid carrier frequency 2426 MHz

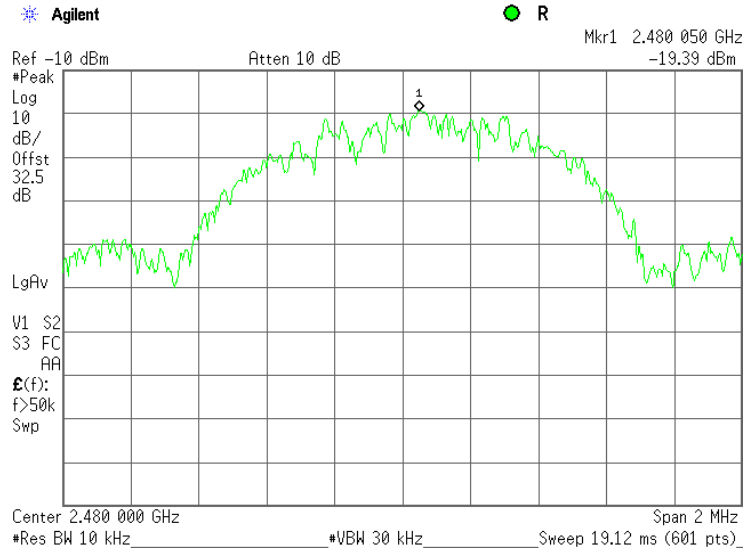




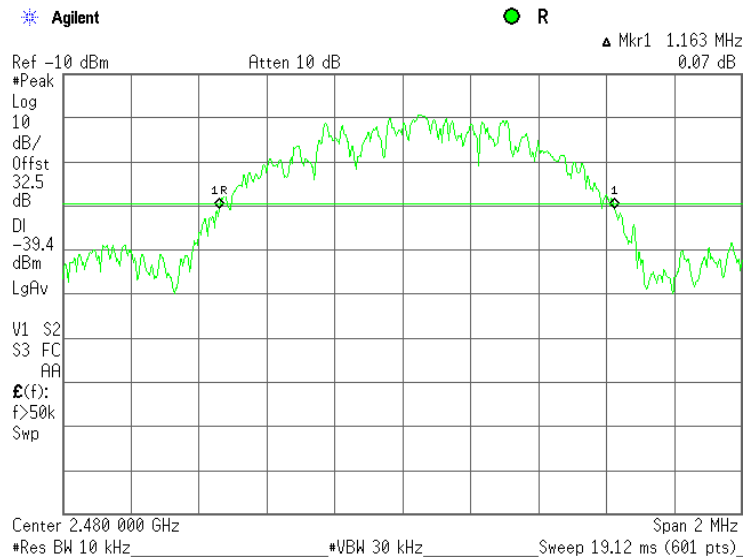
HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 15.215(c), Occupied bandwidth</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.7	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		6/26/2013	
<b>Temperature:</b> 24.8 °C		<b>Air Pressure:</b> 1008 hPa	
		<b>Relative Humidity:</b> 36 %	
		<b>Power Supply:</b> 5 VDC	
<b>Remarks:</b>			
		<b>Verdict: PASS</b>	

Plot 7.4.7 Occupied bandwidth test result at high carrier frequency 2480 MHz



Plot 7.4.8 The 20 dB occupied bandwidth test result at high carrier frequency 2480 MHz

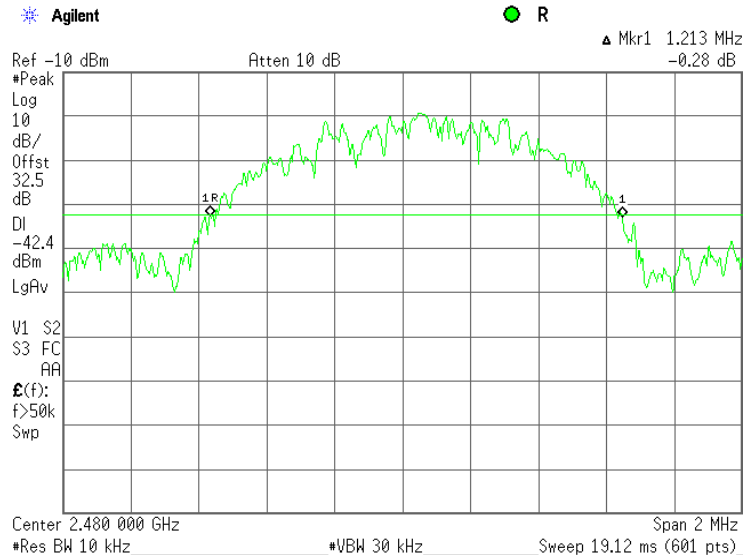




HERMON LABORATORIES

<b>Test specification:</b>		<b>Section 15.215(c), Occupied bandwidth</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.7	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		6/26/2013	
<b>Temperature:</b> 24.8 °C		<b>Air Pressure:</b> 1008 hPa	
		<b>Relative Humidity:</b> 36 %	<b>Power Supply:</b> 5 VDC
<b>Remarks:</b>			
		<b>Verdict: PASS</b>	

Plot 7.4.9 The 99% occupied bandwidth test result at high carrier frequency 2480 MHz







<b>Test specification:</b>		<b>FCC section 15.207(a), Conducted emission</b>	
<b>Test procedure:</b>		ANSI C63.4, Section 13.1.3	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		6/25/2013	
<b>Temperature:</b> 25.2 °C		<b>Air Pressure:</b> 1007 hPa	
		<b>Relative Humidity:</b> 35 %	
		<b>Power Supply:</b> 120 VAC	
<b>Remarks:</b>			

## 7.5 Conducted emissions

### 7.5.1 General

This test was performed to measure common mode conducted emissions at the power port. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(μV)	
	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*
0.5 - 5.0	56	46
5.0 - 30	60	50

\* - The limit decreases linearly with the logarithm of frequency.

### 7.5.2 Test procedure

7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and the performance check was conducted.

7.5.2.2 The measurements were performed at power terminals with the LISN, connected to a spectrum analyzer while unused coaxial connector of the LISN was terminated with 50 Ohm.

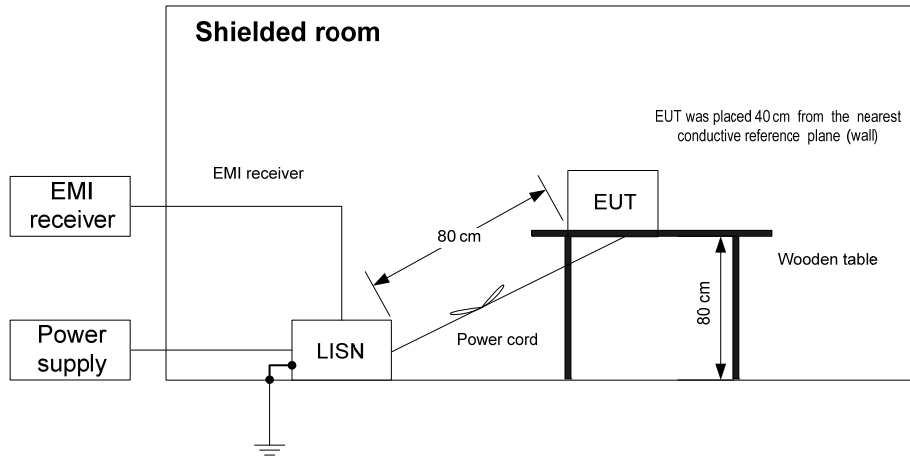
7.5.2.3 The position of the device cables was varied to determine maximum emission level.

7.5.2.4 The worst test results (the lowest margins) were recorded in Table 7.5.2 and shown in the associated plots.



<b>Test specification:</b>	<b>FCC section 15.207(a), Conducted emission</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 13.1.3		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	6/25/2013		
<b>Temperature:</b> 25.2 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 35 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Figure 7.5.1 Setup for conducted emission measurements, table-top equipment





HERMON LABORATORIES

<b>Test specification:</b> FCC section 15.207(a), Conducted emission	
<b>Test procedure:</b> ANSI C63.4, Section 13.1.3	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 6/25/2013	
<b>Temperature:</b> 25.2 °C	<b>Air Pressure:</b> 1007 hPa
<b>Relative Humidity:</b> 35 %	
<b>Power Supply:</b> 120 VAC	
<b>Remarks:</b>	

Table 7.5.2 Conducted emission test results

LINE: AC mains  
EUT OPERATING MODE: Transmit  
EUT SET UP: TABLE-TOP  
TEST SITE: SHIELDED ROOM  
FREQUENCY RANGE: 150 kHz - 30 MHz  
RESOLUTION BANDWIDTH: 9 kHz

Frequency, MHz	Peak emission, dB(µV)	Quasi-peak			Average			Line ID	Verdict
		Measured emission, dB(µV)	Limit, dB(µV)	Margin, dB*	Measured emission, dB(µV)	Limit, dB(µV)	Margin, dB*		
0.348625	40.84	35.93	59.06	-23.13	18.59	49.06	-30.47	L1	Pass
0.342750	48.34	43.88	59.20	-15.32	33.98	49.20	-15.22	L2	Pass
1.221250	41.02	36.65	56.00	-19.35	26.16	46.00	-19.84		
1.936000	40.54	33.24	56.00	-22.76	22.12	46.00	-23.88		

\*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

HL 0787	HL 1425	HL 1513	HL 2888	HL 3612			
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Full description is given in Appendix A.



HERMON LABORATORIES

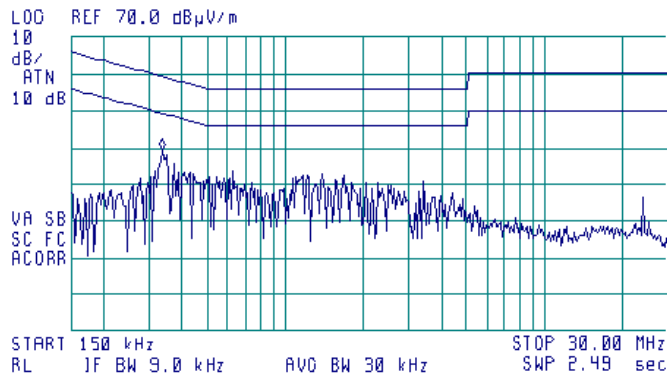
<b>Test specification:</b> FCC section 15.207(a), Conducted emission			
<b>Test procedure:</b> ANSI C63.4, Section 13.1.3			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 6/25/2013			
<b>Temperature:</b> 25.2 °C	<b>Air Pressure:</b> 1007 hPa	<b>Relative Humidity:</b> 35 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

**Plot 7.5.1 Conducted emission measurements**

LINE: L1  
EUT OPERATING MODE: Transmit  
LIMIT: QUASI-PEAK, AVERAGE  
DETECTOR: PEAK



ACTU DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 340 kHz  
39.21 dBµV/m

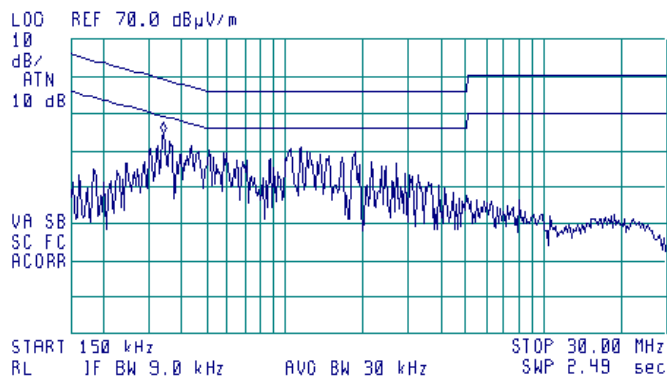


**Plot 7.5.2 Conducted emission measurements**

LINE: L2  
EUT OPERATING MODE: Transmit  
LIMIT: QUASI-PEAK, AVERAGE  
DETECTOR: PEAK



ACTU DET: PEAK  
MEAS DET: PEAK OP AVG  
MKR 340 kHz  
44.77 dBµV/m



**8 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	21-Jan-14	21-Jan-15
0768	Antenna Standard Gain Horn, 18-26.5 GHz, WR-42, 25 dB gain	Quinstar Technology	QWH-4200-BA	110	12-Dec-12	12-Dec-15
0787	Transient Limiter 9 kHz-200 MHz	Hewlett Packard	11947A	3107A01877	13-Oct-13	13-Oct-14
1425	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1426, HL1427	Agilent Technologies	8542E	3710A00222, 3705A00204	25-Oct-13	25-Dec-14
1513	Cable RF, 8 m, BNC/BNC	Belden	M17/167 MIL-C-17	1513	05-Nov-13	05-Nov-14
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W	EMC Test Systems	3115	9911-5964	03-Jan-14	03-Jan-15
2697	Antenna, 30 MHz - 3.0 GHz	Sunol Sciences. Corp. Pleasanton, California USA	JB3	A022805	22-May-14	22-May-15
2780	EMC analyzer, 100 Hz to 26.5 GHz	Agilent Technologies	E7405A	MY45102462	10-Jul-13	10-Jul-14
2871	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-8155-00	2871	04-Dec-13	04-Dec-14
2888	LISN Two-line V-Network 50 Ohm / 50 uH + 5 Ohm, 16A, MIL STD 461E, CISPR 16-1	Rolf Heine	NNB-2/16Z	02/10018	24-Mar-14	24-Mar-15
3531	Amplifier, low noise, 2 to 8 GHz	Quinstar Technology	QLJ-02084040-J0	11159002002	23-Dec-13	23-Dec-14
3533	Amplifier, low noise, 6 to 18 GHz	Quinstar Technology	QLJ-06184040-J0	11159001001	10-Jul-13	10-Jul-14
3535	Amplifier, low noise, 18 to 40 GHz	Quinstar Technology	QLJ-18404537-J0	11159003001	10-Jul-13	10-Jul-14
3612	Cable RF, 17.5 m, N type-N type	Teldor	RG-214/U	NA	05-Dec-13	05-Dec-14
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY48250288	20-May-14	20-May-15
3901	Microwave Cable Assembly, 40.0 GHz, 3.5 m, SMA/SMA	Huber-Suhner	SUCOFLEX 102A	1225/2A	06-Feb-14	06-Feb-15
4114	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz	ETS Lindgren	3117	00123515	27-Dec-13	27-Dec-14
4160	Preamplifier, 0.1 to 18 GHz, Gain 25 dB, N-type(f) in, N-type(m) out.	Agilent Technologies	87405C	MY47010594	11-Aug-13	11-Aug-14
4276	Test Cable , DC-18 GHz, 3.05 m, N/M - N/M	Mini-Circuits	APC-10FT-NMNM+	0747A	27-Nov-13	27-Nov-14
4278	Test Cable , DC-18 GHz, 4.6 m, N/M - N/M	Mini-Circuits	APC-15FT-NMNM+	0755A	27-Nov-13	27-Nov-14
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101003	16-Mar-14	16-Mar-15



## 9 APPENDIX B Measurement uncertainties

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

Test description	Expanded uncertainty
Conducted emissions with LISN	9 kHz to 150 kHz: $\pm 3.9$ dB 150 kHz to 30 MHz: $\pm 3.8$ dB
Radiated emissions at 3 m measuring distance Horizontal polarization  Vertical polarization	Biconilog antenna: $\pm 5.3$ dB Biconical antenna: $\pm 5.0$ dB Log periodic antenna: $\pm 5.3$ dB Double ridged horn antenna: $\pm 5.3$ dB Biconilog antenna: $\pm 6.0$ dB Biconical antenna: $\pm 5.7$ dB Log periodic antenna: $\pm 6.0$ dB Double ridged horn antenna: $\pm 6.0$ dB
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: $\pm 2.6$ dB 2.9 GHz to 6.46 GHz: $\pm 3.5$ dB 6.46 GHz to 13.2 GHz: $\pm 4.3$ dB 13.2 GHz to 22.0 GHz: $\pm 5.0$ dB 22.0 GHz to 26.8 GHz: $\pm 5.5$ dB 26.8 GHz to 40.0 GHz: $\pm 4.8$ dB
Duty cycle, timing (Tx ON / OFF) and average factor measurements	$\pm 1.0$ %
Occupied bandwidth	$\pm 8.0$ %

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.



## 10 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 numbers IC 2186A-1 for OATS, IC 2186A-2 for anechoic chamber, IC 2186A-3 for full-anechoic chamber for RE measurements above 1 GHz), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-27 for full-anechoic chamber for RE measurements above 1 GHz, 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 US1003.

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e-mail: mail@hermonlabs.com  
website: www.hermonlabs.com

Person for contact: Mr. Alex Usoskin, CEO.

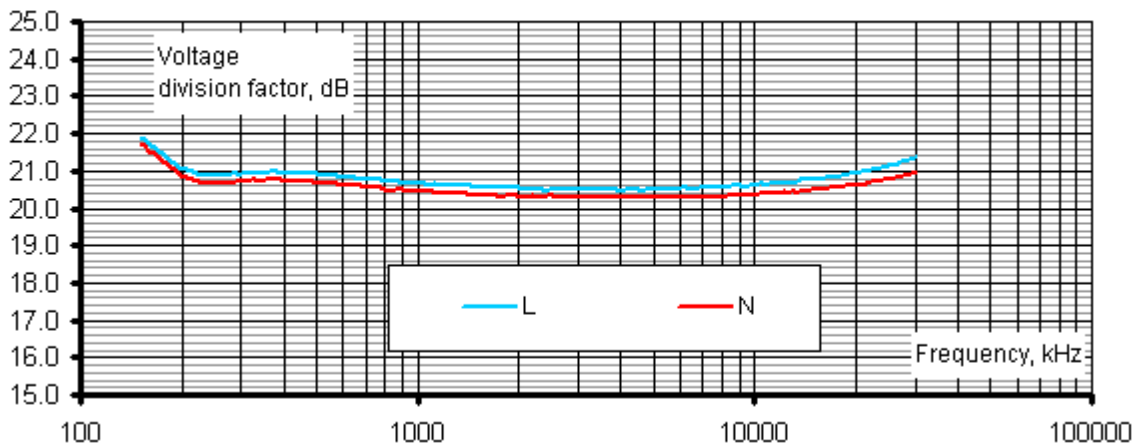
## 11 APPENDIX D Specification references

FCC 47CFR part 15: 2014	Radio Frequency Devices
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications
ANSI C63.4: 2003	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

## 12 APPENDIX E Test equipment correction factors

Correction factor  
Line impedance stabilization network  
Model NNB-2/16Z, Rolf Heine, HL 2888

Frequency, kHz	Correction factor, dB	
	L	N
150	21.92	21.74
170	21.52	21.36
200	21.06	20.85
250	20.88	20.68
300	20.92	20.70
350	20.96	20.77
400	20.96	20.74
500	20.92	20.69
600	20.85	20.63
700	20.78	20.58
800	20.73	20.52
900	20.68	20.50
1000	20.67	20.45
1200	20.61	20.43
1500	20.56	20.33
2000	20.54	20.32
2500	20.51	20.33
3000	20.53	20.29
4000	20.46	20.30
5000	20.53	20.33
7000	20.54	20.32
10000	20.62	20.36
15000	20.78	20.49
20000	20.94	20.63
30000	21.37	20.95







**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 intensity in dB( $\mu$ V/m).

**Antenna factor**  
**Standard gain horn antenna**  
**Quinstar Technology**  
**Model QWH**  
**Ser.No.112, HL 0768, 0769, 0770, 0771, 0772**

Frequency min, GHz	Frequency max, GHz	Antenna factor, dB(1/m)
18.000	26.500	32.01
26.500	40.000	35.48
40.000	60.000	39.03
60.000	90.000	42.55
90.000	140.000	46.23
140.000	220.000	50.11

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 calibration  
Sunlo Sciences Inc., model JB3, serial number A022805, HL 2697

Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain
30	22.2	-22.5	0.01	620	19.7	6.3	4.27	1215	24.9	7.0	5.05	1810	28.3	7.1	5.08	2405	30.9	6.9	4.83
35	18.5	-17.4	0.02	625	19.7	6.5	4.42	1220	24.9	7.0	4.99	1815	28.5	6.9	4.91	2410	30.9	6.9	4.89
40	14.7	-12.5	0.06	630	19.6	6.6	4.57	1225	25.1	6.9	4.91	1820	28.6	6.8	4.74	2415	31.0	6.9	4.85
45	11.3	-8.1	0.16	635	19.7	6.5	4.48	1230	25.2	6.8	4.82	1825	28.7	6.8	4.75	2420	31.0	6.8	4.82
45	11.3	-8.1	0.16	640	19.9	6.4	4.40	1235	25.1	7.0	4.96	1830	28.7	6.8	4.76	2425	31.1	6.8	4.81
50	8.9	-4.7	0.34	645	19.9	6.5	4.45	1240	25.0	7.1	5.09	1835	28.7	6.7	4.72	2430	31.0	6.9	4.87
55	7.9	-2.8	0.52	650	19.9	6.5	4.51	1245	25.0	7.1	5.12	1840	28.8	6.7	4.69	2435	31.0	6.9	4.86
60	7.8	-2.1	0.82	655	19.9	6.6	4.60	1250	25.0	7.1	5.15	1845	28.8	6.9	4.93	2440	31.2	6.8	4.74
65	8.5	-2.0	0.63	660	19.9	6.7	4.69	1255	25.0	7.2	5.25	1850	28.4	7.1	5.12	2445	31.1	6.9	4.91
70	9.0	-1.9	0.64	665	19.9	6.7	4.70	1260	24.9	7.3	5.36	1855	28.5	7.0	5.07	2450	31.0	7.0	4.96
75	8.8	-1.1	0.78	670	20.0	6.7	4.71	1265	25.0	7.3	5.31	1860	28.6	7.0	5.01	2455	31.0	7.0	5.01
80	8.4	-0.2	0.97	675	20.1	6.7	4.71	1270	25.1	7.2	5.26	1865	28.5	7.1	5.17	2460	30.9	7.2	5.19
85	8.0	0.8	1.20	680	20.1	6.7	4.71	1275	25.3	7.0	5.05	1870	28.4	7.3	5.33	2465	31.1	6.9	4.95
90	8.2	1.1	1.29	685	20.1	6.8	4.79	1280	25.5	6.8	4.94	1875	28.4	7.2	5.28	2470	31.3	6.8	4.78
95	9.2	0.5	1.13	690	20.1	6.9	4.88	1285	25.4	7.0	4.97	1880	28.5	7.2	5.32	2475	31.4	6.7	4.69
100	10.6	-0.4	0.92	695	20.2	6.8	4.82	1290	25.3	7.1	5.10	1885	28.5	7.2	5.22	2480	31.3	6.8	4.79
110	12.6	-1.6	0.70	705	20.4	6.8	4.75	1300	25.2	7.3	5.33	1895	28.6	7.2	5.24	2490	31.1	7.0	4.99
120	13.9	-2.1	0.62	715	20.5	6.8	4.80	1310	25.5	7.1	5.09	1905	28.5	7.3	5.36	2500	30.9	7.2	5.27
125	14.2	-2.0	0.63	720	20.5	6.9	4.85	1315	25.4	7.2	5.23	1910	28.5	7.4	5.45	2505	31.1	7.1	5.15
130	14.2	-1.7	0.68	725	20.6	6.8	4.81	1320	25.3	7.3	5.36	1915	28.5	7.3	5.38	2510	31.0	7.2	5.22
140	13.4	-0.3	0.94	735	20.9	6.7	4.85	1330	25.6	7.0	5.08	1925	28.5	7.3	5.35	2520	31.2	7.0	5.05
150	12.9	0.8	1.21	745	21.0	6.6	4.59	1340	25.7	7.1	5.09	1935	28.5	7.4	5.54	2530	31.0	7.3	5.37
160	12.7	1.6	1.44	755	21.0	6.8	4.74	1350	25.7	7.1	5.17	1945	28.5	7.5	5.59	2540	31.2	7.1	5.09
165	12.5	2.0	1.59	760	21.0	6.8	4.83	1355	25.8	7.0	5.06	1950	28.6	7.4	5.48	2545	31.0	7.3	5.43
170	12.2	2.6	1.83	765	21.1	6.8	4.73	1360	25.9	6.9	4.95	1955	28.6	7.5	5.57	2550	31.0	7.3	5.39
175	11.8	3.3	2.13	770	21.3	6.7	4.64	1365	26.0	6.9	4.95	1960	28.6	7.5	5.65	2555	31.1	7.2	5.30
180	11.6	3.7	2.36	775	21.3	6.7	4.68	1370	26.0	7.0	4.98	1965	28.7	7.4	5.47	2560	31.0	7.4	5.47
185	11.5	4.0	2.54	780	21.3	6.7	4.72	1375	26.0	7.0	5.01	1970	28.6	7.2	5.29	2565	30.8	7.6	5.70
190	11.6	4.2	2.61	785	21.3	6.8	4.77	1380	26.0	7.0	5.06	1975	28.9	7.2	5.22	2570	31.1	7.3	5.37
200	13.1	3.2	2.07	795	21.4	6.8	4.79	1390	26.1	6.9	4.92	1985	29.1	7.1	5.11	2580	31.6	6.9	4.87
205	12.0	4.4	2.76	800	21.5	6.8	4.77	1395	26.2	6.9	4.94	1990	29.1	7.0	5.06	2585	31.6	6.8	4.79
210	11.0	5.6	3.66	805	21.6	6.7	4.71	1400	26.2	7.0	4.96	1995	29.1	7.1	5.09	2590	31.6	6.9	4.88
215	11.3	5.6	3.59	810	21.7	6.7	4.65	1405	26.1	7.0	5.02	2000	29.1	7.1	5.11	2595	31.5	7.0	4.97
220	11.6	5.5	3.52	815	21.7	6.7	4.72	1410	26.1	7.1	5.09	2005	29.1	7.1	5.16	2600	31.6	6.9	4.86
225	11.7	5.5	3.45	820	21.7	6.8	4.80	1415	26.2	7.0	5.02	2010	29.2	7.1	5.15	2605	31.3	7.2	5.30
230	11.9	5.6	3.57	825	21.7	6.8	4.82	1420	26.3	7.0	4.96	2015	29.2	7.1	5.13	2610	31.4	7.1	5.15
235	12.1	5.5	3.56	830	21.7	6.9	4.85	1425	26.2	7.1	5.10	2020	29.2	7.1	5.18	2615	31.7	6.9	4.88
240	12.3	5.5	3.54	835	21.8	6.8	4.82	1430	26.1	7.2	5.25	2025	29.3	7.1	5.08	2620	31.6	7.0	4.97
245	12.3	5.7	3.71	840	21.9	6.8	4.80	1435	26.1	7.2	5.24	2030	29.3	7.0	5.05	2625	31.4	7.1	5.17
250	12.3	5.9	3.88	845	21.9	6.8	4.83	1440	26.2	7.2	5.24	2035	29.3	7.1	5.07	2630	31.6	7.0	5.00
255	12.5	5.9	3.85	850	21.9	6.9	4.86	1445	26.3	1	5.11	2040	29.3	7.1	5.13	2635	31.8	6.8	4.82
260	12.7	5.8	3.83	855	22.0	6.8	4.80	1450	26.5	7.0	4.98	2045	29.2	7.2	5.23	2640	31.7	7.0	4.98
265	13.2	5.5	3.54	860	22.0	6.8	4.74	1455	26.4	7.1	5.07	2050	29.2	7.2	5.27	2645	31.7	6.9	4.93
270	13.7	5.2	3.32	865	22.0	6.9	4.92	1460	26.4	7.1	5.17	2055	29.3	7.2	5.21	2650	31.8	6.9	4.85
275	13.7	5.3	3.39	870	21.9	7.1	5.11	1465	26.4	7.2	5.19	2060	29.5	7.0	5.02	2655	31.8	6.9	4.85
280	13.7	5.4	3.50	875	22.0	7.1	5.08	1470	26.4	7.2	5.22	2065	29.4	7.1	5.08	2660	31.7	7.0	5.02
285	13.7	5.6	3.61	880	22.1	7.0	5.05	1475	26.4	7.1	5.17	2070	29.4	7.1	5.10	2665	32.0	6.7	4.71
290	13.7	5.7	3.72	885	22.1	7.0	5.06	1480	26.5	7.1	5.12	2075	29.5	7.0	5.01	2670	32.0	6.7	4.67
295	13.8	5.8	3.77	890	22.1	7.0	5.06	1485	26.5	7.1	5.14	2080	29.6	6.8	4.76	2675	31.9	6.8	4.81
300	13.9	5.8	3.81	895	22.2	7.1	5.09	1490	26.5	7.1	5.17	2085	29.7	6.9	4.89	2680	31.7	7.0	5.04
305	14.0	5.9	3.85	900	22.2	7.1	5.12	1495	26.5	7.2	5.24	2090	29.7	6.9	4.86	2685	31.9	6.8	4.83
310	14.1	5.9	3.88	905	22.3	7.1	5.09	1500	26.5	7.2	5.31	2095	29.8	6.8	4.78	2690	32.1	6.7	4.72
315	14.3	5.8	3.89	910	22.3	7.0	5.05	1505	26.5	7.2	5.37	2100	29.8	6.8	4.75	2695	32.1	6.7	4.71
320	14.4	5.8	3.90	915	22.4	7.0	4.99	1510	26.6	7.2	5.23	2105	29.8	6.8	4.81	2700	32.0	6.8	4.81
325	14.5	5.9	3.92	920	22.6	6.9	4.92	1515	26.6	7.2	5.30	2110	29.9	6.8	4.78	2705	32.0	6.8	4.80
330	14.6	5.9	3.93	925	22.7	6.9	4.85	1520	26.5	7.3	5.38	2115	29.9	6.8	4.76	2710	32.1	6.8	4.79
335	14.7	6.0	4.02	930	22.8	6.8	4.77	1525	26.6	7.3	5.37	2120	29.9	6.8	4.84	2715	32.1	6.7	4.71
340	14.7	6.2	4.12	935	22.8	6.8	4.83	1530	26.6	7.3	5.36	2125	29.9	6.9	4.89	2720	32.4	6.5	4.47
345	14.9	6.1	4.06	940	22.8	6.9	4.89	1535	26.6	7.4	5.44	2130	29.9	6.9	4.90	2725	32.2	6.7	4.63
350	15.1	6.0	3.99	945	22.8	6.9	4.87	1540	26.5	7.4	5.53	2135	29.8	6.9	4.94	2730	31.9	7.0	5.05
355	15.3	5.9	3.88	950	22.9	6.9	4.85	1545	26.5	7.5	5.58	2140	29.8	7.1	5.08	2735	31.6	7.4	5.44
360	15.7	5.8	3.78	955	23.0	6.8	4.81	1550	26.5	7.5	5.63	2145	29.8	6.9	4.92	2740	31.8	7.1	5.45
365	15.5	5.9	3.80	960	23.1	6.8	4.77	1555	26.7	7.3	5.39	2150	29.9	7.0	4.98	2745	31.9	7.0	5.06
370	15.5	6.0	4.01	965	23.1	6.7	4.73	1560	26.9	7.1	5.18	2155	29.8	7.1	5.10	2750	32.0	6.9	4.94
375	15.6	6.1	4.03	970	23.2	6.7	4.69	1565	26.9	7.2	5.23	2160	29.8	7.1	5.09	2755	32.0	7.0	4.98
380	15.7	6.1	4.05	975	23.3	6.6	4.62	1570	26.9	7.2	5.30	2165	29.9	7.0	5.00	2760	32.0	7.0	5.06
385	15.7	6.2	4.15	980	23.5	6.6	4.54	1575	27.0	7.2	5.23	2170	29.9	7.1	5.07	2765	32.2	6.8	4.80
390	15.7	6.3	4.25	985	23.5	6.6													



**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 intensity 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( $\mu$ V) to convert to field strength in dB( $\mu$ V/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**  
**Cable coaxial, RG-214/U, N type-N type, 17 m**  
**Teldor, HL 3612**

Frequency, MHz	Cable loss, dB
0.1	0.05
0.5	0.07
1	0.10
3	0.22
5	0.29
10	0.39
30	0.68
50	0.90
100	1.27
150	1.58
200	1.80
250	2.12
300	2.36
350	2.60
400	2.82
450	2.99
500	3.23
550	3.40
600	3.56
650	3.71
700	3.90
750	4.04
800	4.23
850	4.39
900	4.55
950	4.65
1000	4.79



**Cable loss**  
**Microwave Cable Assembly, Huber-Suhner, 40 GHz, 3.5 m, SMA-SMA, S/N 1225/2A**  
**HL 3901**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.09	9500	4.29	21000	6.67
100	0.41	10000	4.40	22000	6.92
500	0.93	10500	4.52	23000	7.00
1000	1.33	11000	4.64	24000	7.18
1500	1.63	11500	4.76	25000	7.29
2000	1.90	12000	4.87	26000	7.55
2500	2.12	12500	4.99	27000	7.70
3000	2.33	13000	5.11	28000	7.88
3500	2.50	13500	5.20	29000	8.02
4000	2.67	14000	5.31	30000	8.15
4500	2.82	14500	5.42	31000	8.35
5000	2.99	15000	5.51	32000	8.40
5500	3.16	15500	5.58	33000	8.62
6000	3.32	16000	5.68	34000	8.73
6500	3.51	16500	5.78	35000	8.78
7000	3.65	17000	5.91	36000	8.94
7500	3.79	17500	5.99	37000	9.21
8000	3.92	18000	6.07	38000	9.37
8500	4.04	19000	6.36	39000	9.45
9000	4.18	20000	6.49	40000	9.52



**Cable loss**  
**Test cable, Mini-Circuits, S/N 0747A, 18 GHz, 3.05 m, N/M - N/M**  
**APC-10FT-NMNM+, HL 4276**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.11	4500	2.81	9300	4.30	14100	5.59
30	0.19	4600	2.85	9400	4.33	14200	5.61
50	0.25	4700	2.88	9500	4.36	14300	5.63
100	0.36	4800	2.92	9600	4.39	14400	5.66
150	0.44	4900	2.95	9700	4.42	14500	5.68
200	0.52	5000	3.00	9800	4.46	14600	5.70
300	0.64	5100	3.03	9900	4.49	14700	5.72
400	0.75	5200	3.08	10000	4.53	14800	5.75
500	0.84	5300	3.11	10100	4.56	14900	5.77
600	0.93	5400	3.13	10200	4.60	15000	5.80
700	1.01	5500	3.16	10300	4.64	15100	5.82
800	1.08	5600	3.20	10400	4.66	15200	5.85
900	1.15	5700	3.22	10500	4.68	15300	5.88
1000	1.22	5800	3.26	10600	4.70	15400	5.91
1100	1.28	5900	3.30	10700	4.73	15500	5.93
1200	1.34	6000	3.34	10800	4.75	15600	5.97
1300	1.40	6100	3.39	10900	4.77	15700	5.99
1400	1.46	6200	3.42	11000	4.80	15800	6.02
1500	1.51	6300	3.47	11100	4.83	15900	6.07
1600	1.57	6400	3.50	11200	4.86	16000	6.08
1700	1.62	6500	3.52	11300	4.88	16100	6.11
1800	1.68	6600	3.55	11400	4.90	16200	6.12
1900	1.72	6700	3.58	11500	4.92	16300	6.14
2000	1.77	6800	3.60	11600	4.94	16400	6.17
2100	1.82	6900	3.62	11700	4.96	16500	6.19
2200	1.87	7000	3.64	11800	4.98	16600	6.21
2300	1.92	7100	3.66	11900	5.01	16700	6.22
2400	1.96	7200	3.68	12000	5.03	16800	6.24
2500	2.01	7300	3.71	12100	5.06	16900	6.26
2600	2.05	7400	3.74	12200	5.09	17000	6.28
2700	2.10	7500	3.78	12300	5.12	17100	6.31
2800	2.14	7600	3.81	12400	5.15	17200	6.33
2900	2.18	7700	3.84	12500	5.17	17300	6.36
3000	2.23	7800	3.87	12600	5.20	17400	6.39
3100	2.27	7900	3.90	12700	5.22	17500	6.42
3200	2.31	8000	3.93	12800	5.25	17600	6.45
3300	2.35	8100	3.96	12900	5.28	17700	6.48
3400	2.39	8200	4.00	13000	5.32	17800	6.50
3500	2.42	8300	4.03	13100	5.35	17900	6.52
3600	2.46	8400	4.06	13200	5.38	18000	6.55
3700	2.50	8500	4.08	13300	5.40		
3800	2.54	8600	4.11	13400	5.42		
3900	2.58	8700	4.13	13500	5.44		
4000	2.61	8800	4.16	13600	5.46		
4100	2.65	8900	4.18	13700	5.48		
4200	2.69	9000	4.21	13800	5.51		
4300	2.73	9100	4.24	13900	5.53		
4400	2.77	9200	4.27	14000	5.56		





**Cable loss**  
**Test cable, Mini-Circuits, S/N 0755A, 18 GHz, 4.6 m, N/M - N/M**  
**APC-15FT-NMNM+, HL 4278**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.24	4900	4.19	10000	6.47	15100	8.33
30	0.26	5000	4.25	10100	6.50	15200	8.35
50	0.34	5100	4.29	10200	6.52	15300	8.37
100	0.50	5200	4.32	10300	6.57	15400	8.40
200	0.72	5300	4.38	10400	6.59	15500	8.42
300	0.90	5400	4.41	10500	6.61	15600	8.46
400	1.06	5500	4.46	10600	6.64	15700	8.50
500	1.20	5600	4.51	10700	6.64	15800	8.52
600	1.32	5700	4.56	10800	6.65	15900	8.56
700	1.44	5800	4.59	10900	6.68	16000	8.61
800	1.54	5900	4.64	11000	6.68	16100	8.64
900	1.64	6000	4.69	11100	6.69	16200	8.66
1000	1.74	6100	4.72	11200	6.70	16300	8.70
1100	1.83	6200	4.77	11300	6.74	16400	8.73
1200	1.92	6300	4.80	11400	6.78	16500	8.74
1300	2.01	6400	4.83	11500	6.81	16600	8.75
1400	2.09	6500	4.89	11600	6.84	16700	8.78
1500	2.18	6600	4.90	11700	6.87	16800	8.79
1600	2.25	6700	4.95	11800	6.92	16900	8.81
1700	2.33	6800	5.01	11900	6.98	17000	8.85
1800	2.39	6900	4.99	12000	7.02	17100	8.90
1900	2.47	7000	5.04	12100	7.08	17200	8.95
2000	2.53	7100	5.11	12200	7.15	17300	8.99
2100	2.60	7200	5.14	12300	7.20	17400	9.03
2200	2.67	7300	5.21	12400	7.26	17500	9.07
2300	2.73	7400	5.29	12500	7.31	17600	9.11
2400	2.80	7500	5.33	12600	7.36	17700	9.15
2500	2.87	7600	5.38	12700	7.41	17800	9.19
2600	2.93	7700	5.46	12800	7.46	17900	9.24
2700	3.00	7800	5.52	12900	7.51	18000	9.28
2800	3.06	7900	5.58	13000	7.55		
2900	3.12	8000	5.64	13100	7.59		
3000	3.18	8100	5.69	13200	7.65		
3100	3.24	8200	5.75	13300	7.69		
3200	3.30	8300	5.80	13400	7.72		
3300	3.35	8400	5.84	13500	7.78		
3400	3.42	8500	5.90	13600	7.82		
3500	3.46	8600	5.97	13700	7.86		
3600	3.52	8700	5.99	13800	7.91		
3700	3.57	8800	6.04	13900	7.96		
3800	3.61	8900	6.10	14000	8.01		
3900	3.67	9000	6.13	14100	8.06		
4000	3.71	9100	6.17	14200	8.10		
4100	3.77	9200	6.23	14300	8.13		
4200	3.83	9300	6.27	14400	8.16		
4300	3.89	9400	6.30	14500	8.19		
4400	3.94	9500	6.35	14600	8.21		
4500	4.00	9600	6.37	14700	8.23		
4600	4.05	9700	6.40	14800	8.26		
4700	4.10	9800	6.44	14900	8.28		
4800	4.16	9900	6.45	15000	8.30		



**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**

<b>Frequency, MHz</b>	<b>Cable loss, dB</b>	<b>Frequency, MHz</b>	<b>Cable loss, dB</b>
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		



## 13 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
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
OATS	open area test site
$\Omega$	Ohm
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

END OF DOCUMENT