

# TEST REPORT

ACCORDING TO: FCC 47CFR part 15 subpart C § 15.247(DTS) and subpart B;  
RSS-247 issue 1, RSS-Gen issue 4 section 7

FOR:

**Elpas Solutions Ltd.  
Lone Worker Active RFID Tag**

**Models:**

**5-LW243037-1**

**5-LW242057-1**

**FCC ID:O4X5-LW2430371**

**IC:1467G-5LW2430371**

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## 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	Test configuration .....	5
6.3	Changes made in EUT .....	5
6.4	EUT test positions .....	6
6.5	Transmitter characteristics .....	7
7	Transmitter tests according to 47CFR part 15 subpart C requirements .....	8
7.1	Minimum 6 dB bandwidth .....	8
7.2	Peak output power .....	12
7.3	Field strength of spurious emissions .....	18
7.4	Band edge radiated emissions .....	32
7.5	Peak spectral power density .....	36
7.6	Antenna requirements .....	41
8	Unintentional emissions .....	42
8.1	Radiated emission measurements .....	42
9	APPENDIX A Test equipment and ancillaries used for tests .....	47
10	APPENDIX B Measurement uncertainties .....	48
11	APPENDIX C Test laboratory description .....	49
12	APPENDIX D Specification references .....	49
13	APPENDIX E Test equipment correction factors .....	50
14	APPENDIX F Abbreviations and acronyms .....	59

## 1 Applicant information

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**Contact name:** Mr. Arick Elshtein

## 2 Equipment under test attributes

**Product name:** Lone Worker Active RFID Tag, Bluetooth module  
**Product type:** Transceiver  
**Model(s):** 5-LW243037-1  
**Hardware version:** 5-LW243037-1  
**Software release:** FW: JS-702987, E2: JS-702991  
**Receipt date** 12-May-15

## 3 Manufacturer information

**Manufacturer name:** Elpas Solutions Ltd.  
**Address:** 23 Habarzel street, Tel Aviv 69710, Israel  
**Telephone:** +972 3768 1400  
**Fax:** +972 3768 1415  
**E-Mail:** aelshtein@tycoint.com  
**Contact name:** Mr. Arick Elshtein




## 4 Test details

**Project ID:** 26773  
**Location:** Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel  
**Test started:** 21-Jun-15  
**Test completed:** 28-Jun-15  
**Test specification(s):** FCC Part 15 subpart C §15.247 (DTS), subpart B §15.109;  
RSS-247 issue 1, RSS-Gen issue 4 section 7, ICES-003 issue 5:2012

## 5 Tests summary

Test	Status
<b>Transmitter characteristics</b>	
FCC Section 15.247(a)2 / RSS-247 section 5.2(1), 6 dB bandwidth	Pass
FCC Section 15.247(b)3/ RSS-247 section 5.4(4), Peak output power	Pass
FCC section 15.247(i) / RSS-102 section 2.5.1, RF exposure	Pass, the exhibit to the application of certification is provided
FCC Section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions	Pass
FCC Section 15.247(d)/ RSS-247 section 5.5, Emissions at band edges	Pass
FCC Section 15.247(e) / RSS-247 section 5.2(2), Peak power density	Pass
FCC section 15.203 / RSS-Gen section 8.3, Antenna requirement	Pass
FCC section 15.207(a) / RSS-Gen section 8.8, Conducted emission	Not required
<b>Unintentional emissions</b>	
FCC section 15.107/ RSS-Gen section 8.8, Conducted emission at AC power port	Not required
FCC section 15.109, RSS-Gen section 7.1.2, Radiated emission	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. V. Einem, test engineer	June 28, 2015	
<b>Reviewed by:</b>	Mrs. M. Cherniavsky, certification engineer	August 31, 2015	
<b>Approved by:</b>	Mr. M. Nikishin, EMC and Radio group manager	December 30, 2015	

## 6 EUT description

### 6.1 General information

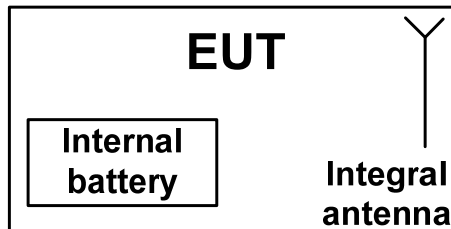
The EUT, model numbers 5-LW243037-1 and 5-LW242057-1, is a Lone Worker active RFID tag that comprises the 433.42 MHz transmitter, Bluetooth @ 2.4 GHz and the 125 kHz receiver radio modules. The EUT comprises a fall detector and is powered from 3V internal battery.

- the EUT model 5-LW243037-1 has also an IR transmitter;
- the EUT model 5-LW242057-1 does not have an IR transmitter.

The EUT model 5-LW243037-1 was tested as the most populated version covering all other variants.

The present test report involves the test results for certification of Bluetooth transmitter as a part of a composite application for certification.

### 6.2 Test configuration

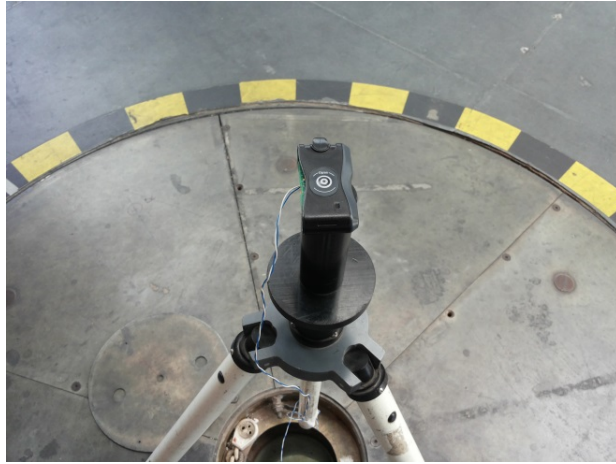


### 6.3 Changes made in EUT

No changes were implemented in the EUT during the testing.

## 6.4 EUT test positions

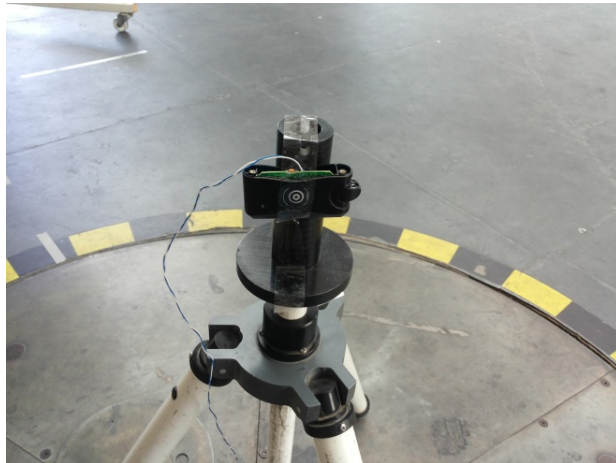
Photograph 6.4.1 EUT in X-axis orthogonal position



Photograph 6.4.2 EUT in Y-axis orthogonal position



Photograph 6.4.3 EUT in Z-axis orthogonal position





### 6.5 Transmitter characteristics

Type of equipment					
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)				
Assigned frequency range		2400 -2483.5 MHz			
Operating frequencies		2402-2480 MHz			
Maximum rated output power		Peak output power -13.3 dBm			
Is transmitter output power variable?	X	No			
		Yes	continuous variable		
			stepped variable with stepsize		dB
			minimum RF power	dBm	
		maximum RF power	dBm		
Antenna connection					
unique coupling	standard connector	X	integral	X with temporary RF connector without temporary RF connector	
Antenna/s technical characteristics					
Type	Manufacturer	Model number		Gain	
Compact Reach Xtend chip antenna	Fractus	FR05-S1-N-0-102		1.7 dBi	
Transmitter aggregate data rate/s		1 Mbps			
Type of modulation		FSK			
Modulating test signal (baseband)		PRBS			
Transmitter power source					
V	Battery	Nominal rated voltage	3.0 V	Battery type	Lithium
	DC	Nominal rated voltage			
	AC mains	Nominal rated voltage		Frequency	Hz



<b>Test specification:</b>	<b>FCC section 15.247(a)(2) / RSS-247 section 5.2(1), 6 dB bandwidth</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	25-Jun-15		
<b>Temperature:</b> 24.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

## 7 Transmitter tests according to 47CFR part 15 subpart C and RSS-247 requirements

### 7.1 Minimum 6 dB bandwidth

#### 7.1.1 General

This test was performed to measure 6 dB bandwidth of the EUT carrier frequency. Specification test limits are given in Table 7.1.1.

Table 7.1.1 The 6 dB bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Minimum bandwidth, kHz
2400.0 – 2483.5	6.0	500.0

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

#### 7.1.2 Test procedure

7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

7.1.2.2 The EUT was set to transmit modulated carrier.

7.1.2.3 The transmitter minimum 6 dB bandwidth was measured with spectrum analyzer as frequency delta between reference points on modulation envelope and provided in Table 7.1.2 and associated plot.

Figure 7.1.1 The 6 dB bandwidth test setup







<b>Test specification:</b>	<b>FCC section 15.247(a)(2) / RSS-247 section 5.2(1), 6 dB bandwidth</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	25-Jun-15		
<b>Temperature:</b> 24.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Table 7.1.2 The 6 dB bandwidth test results

ASSIGNED FREQUENCY BAND: 2400-2483.5 MHz  
DETECTOR USED: Peak  
SWEEP MODE: Continue  
SWEEP TIME: Auto  
RESOLUTION BANDWIDTH: 100 kHz  
VIDEO BANDWIDTH: 300 kHz  
MODULATION: FSK  
MODULATING SIGNAL: PRBS

MODULATION ENVELOPE REFERENCE POINTS: 6.0 dBc

Carrier frequency, MHz	6 dB bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
Low frequency				
2402.0	741.2	500.0	-241.2	Pass
Mid frequency				
2440.0	637.2	500.0	-134.2	Pass
High frequency				
2480.0	694.7	500.0	-194.7	Pass

MODULATION ENVELOPE REFERENCE POINTS: 99% power

Carrier frequency, MHz	99% bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
Low frequency				
2402	1109.2	500	-609.2	Pass
Mid frequency				
2440	1121.8	500	-621.8	Pass
High frequency				
2480	1101.4	500	-601.4	Pass

- Margin, kHz = Occupied bandwidth, kHz - Limit, kHz

Reference numbers of test equipment used

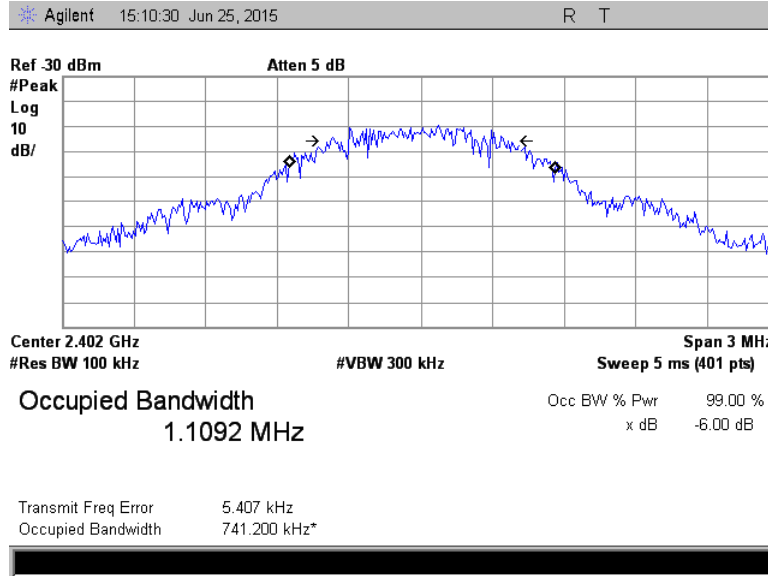
HL 2909	HL 4273							
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Full description is given in Appendix A.

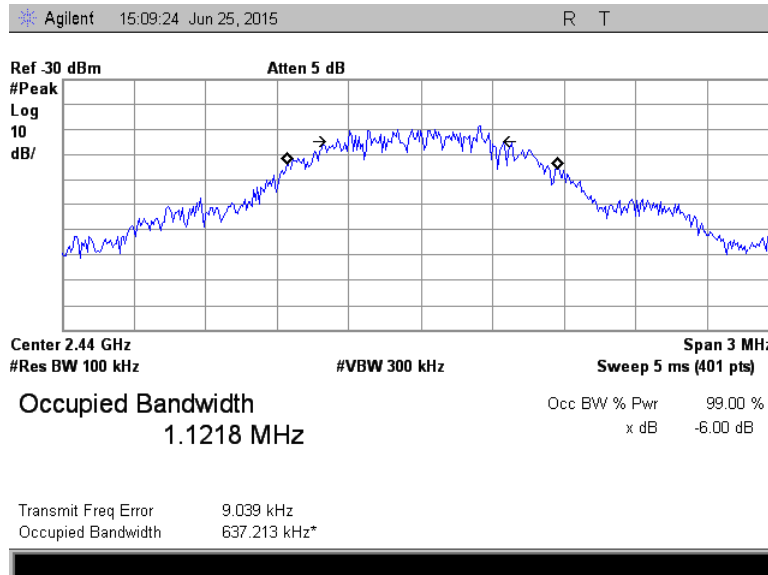


<b>Test specification:</b>		<b>FCC section 15.247(a)(2) / RSS-247 section 5.2(1), 6 dB bandwidth</b>	
<b>Test procedure:</b>		558074 D01 DTS Meas Guidance v03r03	
<b>Test mode:</b>		<b>Verdict: PASS</b>	
<b>Date(s):</b>		25-Jun-15	
<b>Temperature:</b> 24.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Plot 7.1.1 The 6 dB bandwidth test result at low frequency



Plot 7.1.2 The 6 dB bandwidth test result at mid frequency

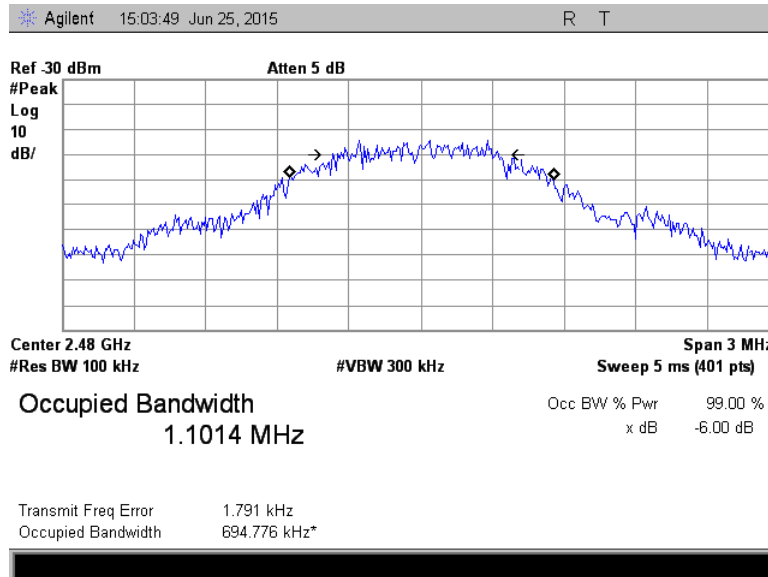




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<b>Test specification:</b>		<b>FCC section 15.247(a)(2) / RSS-247 section 5.2(1), 6 dB bandwidth</b>	
<b>Test procedure:</b>		558074 D01 DTS Meas Guidance v03r03	
<b>Test mode:</b>		<b>Verdict:</b> PASS	
<b>Date(s):</b>		25-Jun-15	
<b>Temperature:</b> 24.3 °C	<b>Air Pressure:</b> 1009 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Plot 7.1.3 The 6 dB bandwidth test result at high frequency





<b>Test specification:</b>		<b>FCC section 15.247(b)3 / RSS-247 section 5.4(4), Peak output power</b>	
<b>Test procedure:</b>		558074 D01 DTS Meas Guidance v03r03	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		21-Jun-15	
<b>Temperature: 25 °C</b>		<b>Air Pressure: 1008 hPa</b>	
<b>Remarks:</b>		<b>Verdict: PASS</b>	
		<b>Relative Humidity: 50 %</b>	
		<b>Power Supply: Battery</b>	

## 7.2 Peak output power

### 7.2.1 General

This test was performed to measure the maximum peak output power radiated by transmitter. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Peak output power limits

Assigned frequency range, MHz	Maximum antenna gain, dBi	Peak output power*		Equivalent field strength limit @ 3m, dB(μV/m)**
		W	dBm	
2400.0 – 2483.5	6.0	1.0	30.0	131.2

\*- The limit is provided in terms of conducted RF power at the antenna connector. If transmitting antennas of directional gain greater than 6 dBi are used, the peak output power limit shall be reduced below the stated value as follows:

- by 1 dB for every 3 dB that the directional gain of antenna exceeds 6 dBi for fixed point-to-point transmitters operate in 2400-2483.5 MHz band;
- without any corresponding reduction for fixed point-to-point transmitters operate in 5725-5850 MHz band;
- by the amount in dB that the directional gain of antenna exceeds 6 dBi for the rest of transmitters.

\*\* - Equivalent field strength limit was calculated from the peak output power as follows:  $E = \sqrt{30 \times P \times G} / r$ , where P is peak output power in Watts, r is antenna to EUT distance in meters and G is transmitter antenna gain in dBi.

### 7.2.2 Test procedure

7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

7.2.2.2 The EUT was adjusted to produce maximum available to end user RF output power.

7.2.2.3 The resolution bandwidth of spectrum analyzer was set wider than 6 dB bandwidth of the EUT and 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° and the measuring antenna height was swept in both vertical and horizontal polarizations.

7.2.2.4 The maximum field strength of the EUT carrier frequency was measured as provided in Table 7.2.2 and associated plots.

7.2.2.5 The maximum peak output power was calculated from the field strength of carrier as follows:

$$P = (E \times d)^2 / (30 \times G),$$

where P is the peak output power in W, E is the field strength in V/m, d is the test distance and G is the transmitter numeric antenna gain over an isotropic radiator.

The above equation was converted in logarithmic units for 3 m test distance:

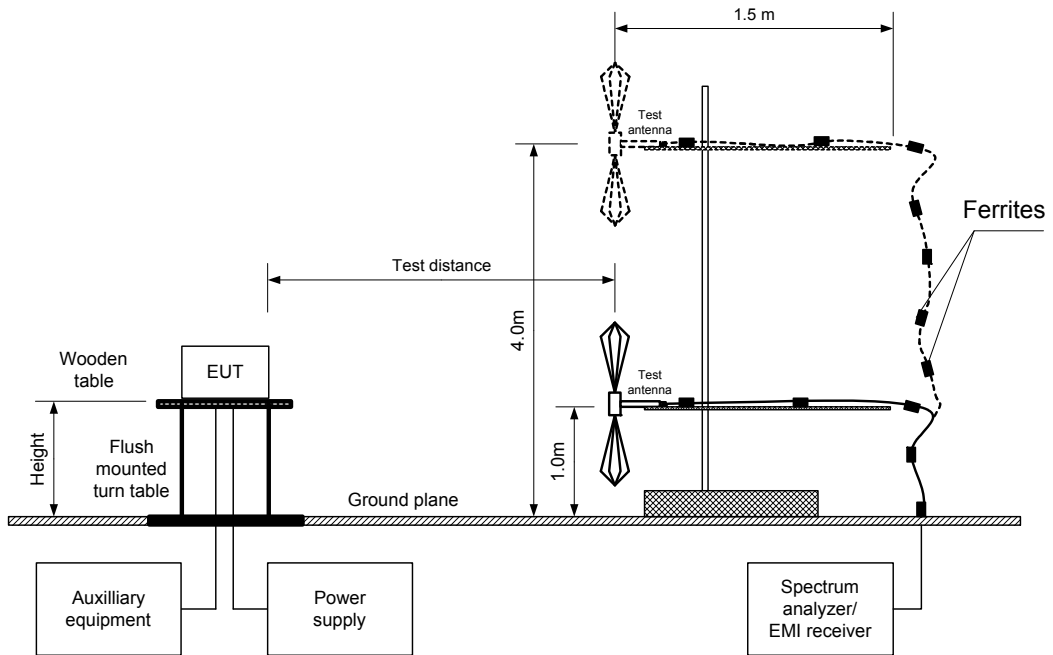
$$\text{Peak output power in dBm} = \text{Field strength in dB}(\mu\text{V/m}) - \text{Transmitter antenna gain in dBi} - 95.2 \text{ dB}$$

7.2.2.6 The worst test results (the lowest margins) were recorded in Table 7.2.2.



<b>Test specification:</b>	<b>FCC section 15.247(b)3 / RSS-247 section 5.4(4), Peak output power</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 25 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Figure 7.2.1 Setup for carrier field strength measurements





<b>Test specification:</b>	<b>FCC section 15.247(b)3 / RSS-247 section 5.4(4), Peak output power</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 25 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Table 7.2.2 Peak output power test results

ASSIGNED FREQUENCY BAND: 2400-2483.5 MHz  
TEST DISTANCE: 3 m  
TEST SITE: OATS  
EUT HEIGHT: 0.8 m  
DETECTOR USED: Peak  
TEST ANTENNA TYPE: Double ridged guide (above 1000 MHz)  
MODULATION: FSK  
MODULATING SIGNAL: PRBS  
BIT RATE: 1 Mbps  
DETECTOR USED: Peak  
EUT 6 dB BANDWIDTH: 627.3 kHz  
RESOLUTION BANDWIDTH: 1.5 MHz  
VIDEO BANDWIDTH: 3 MHz

Frequency, MHz	Field strength, dB( $\mu$ V/m)	Antenna polarization	Antenna height, m	Azimuth, degrees*	EUT antenna gain, dBi	Peak output power, dBm**	Limit, dBm	Margin, dB***	Verdict
2402.00	83.60	Vertical	1.4	180	1.7	-13.30	30	-43.30	Pass
2440.10	83.09	Vertical	1.3	221	1.7	-13.81	30	-43.81	Pass
2479.73	81.99	Vertical	1.4	360	1.7	-14.91	30	-44.91	Pass

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

\*\* - Peak output power was calculated from the field strength of carrier as follows:  $P = (E \times d)^2 / (30 \times G)$ ,

where P is the peak output power in W, E is the field strength in V/m, d is the test distance in meters and G is the transmitter numeric antenna gain over an isotropic radiator. The above equation was converted in logarithmic units for 3 m test distance: *Peak output power in dBm = Field strength in dB( $\mu$ V/m) - Transmitter antenna gain in dBi - 95.2 dB*

\*\*\* - Margin = Peak output power - specification limit.

#### Reference numbers of test equipment used

HL 0415	HL 3818	HL 4114	HL 4294				
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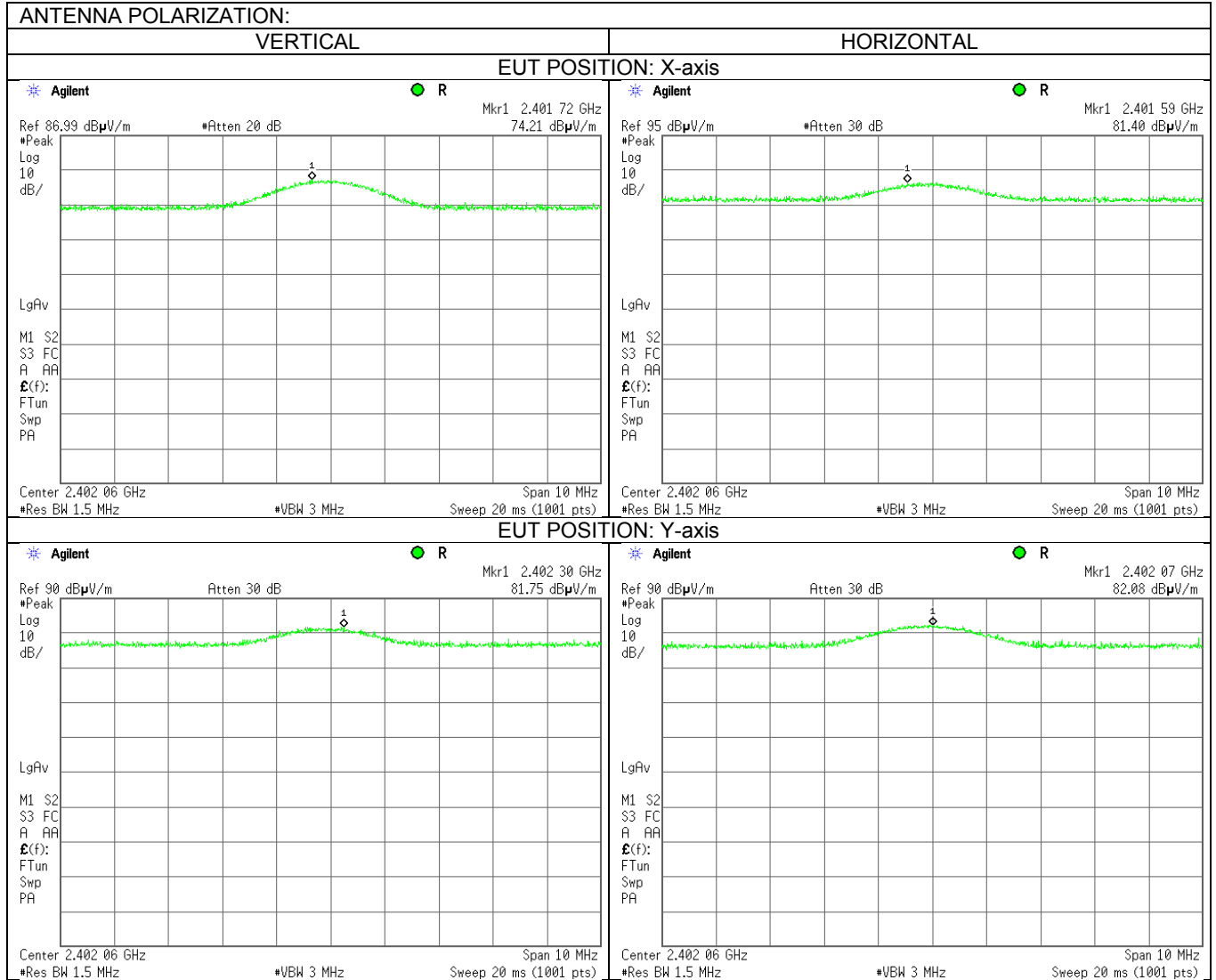
Full description is given in Appendix A.



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<b>Test specification:</b> FCC section 15.247(b)3 / RSS-247 section 5.4(4), Peak output power	
<b>Test procedure:</b> 558074 D01 DTS Meas Guidance v03r03	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 21-Jun-15	
<b>Temperature:</b> 25 °C	<b>Air Pressure:</b> 1008 hPa
	<b>Relative Humidity:</b> 50 %
<b>Remarks:</b>	<b>Power Supply:</b> Battery

Plot 7.2.1 Field strength of carrier at low frequency

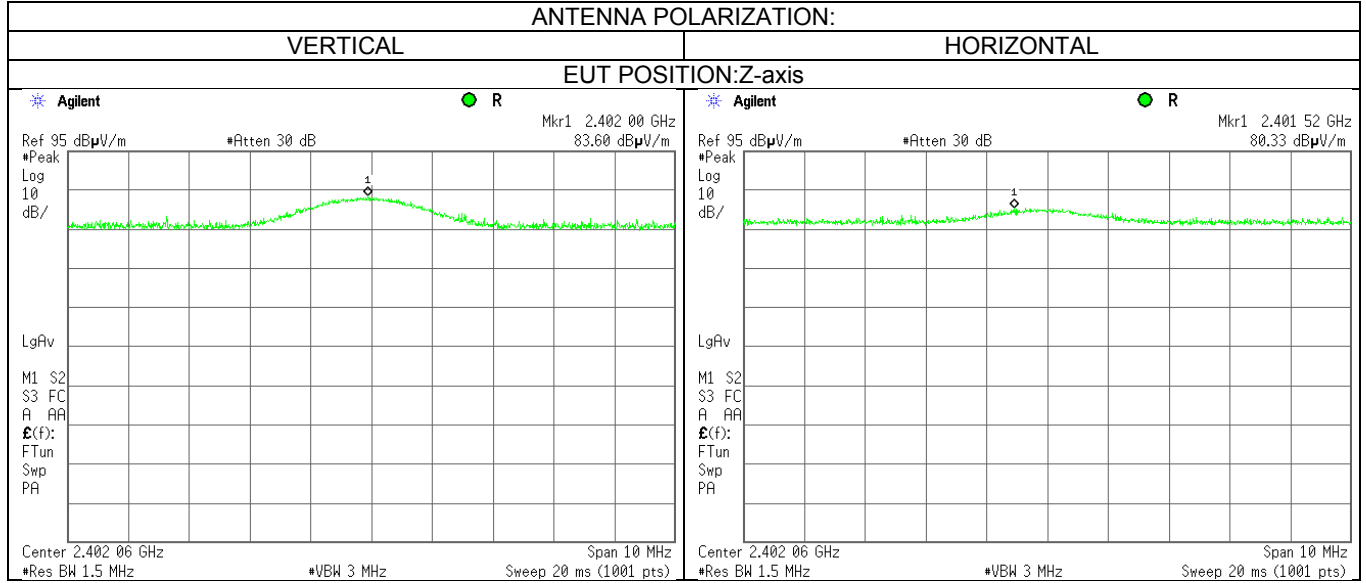




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<b>Test specification:</b>		<b>FCC section 15.247(b)3 / RSS-247 section 5.4(4), Peak output power</b>	
<b>Test procedure:</b>		558074 D01 DTS Meas Guidance v03r03	
<b>Test mode:</b>		<b>Verdict:</b>	
Compliance		PASS	
<b>Date(s):</b>		21-Jun-15	
<b>Temperature:</b> 25 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Plot 7.2.1 Field strength of carrier at low frequency (continued)



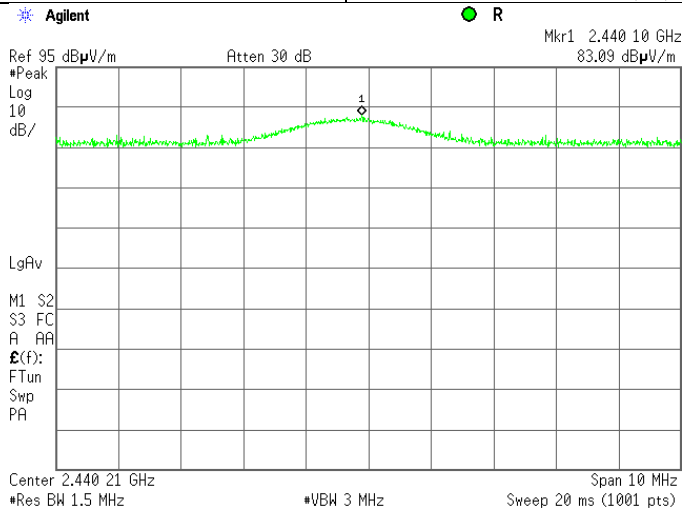




<b>Test specification:</b>		<b>FCC section 15.247(b)3 / RSS-247 section 5.4(4), Peak output power</b>	
<b>Test procedure:</b>		558074 D01 DTS Meas Guidance v03r03	
<b>Test mode:</b>		<b>Verdict:</b>	
Compliance		PASS	
<b>Date(s):</b>		21-Jun-15	
<b>Temperature:</b> 25 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

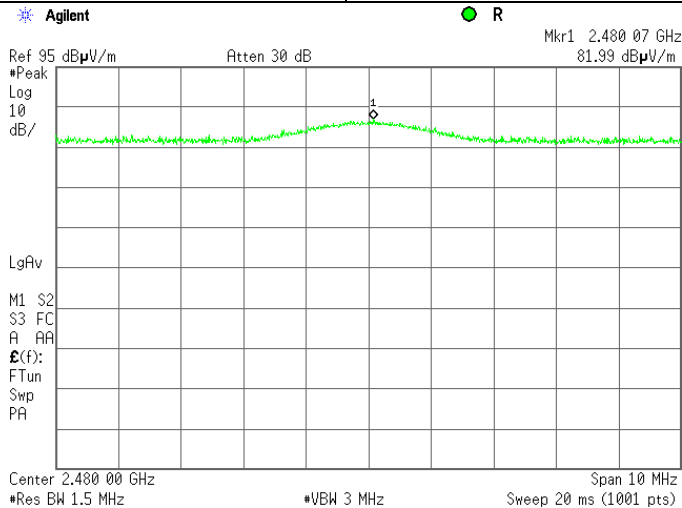
Plot 7.2.2 Field strength of carrier at mid frequency

<b>ANTENNA POLARIZATION:</b>	<b>VERTICAL and HORIZONTAL</b>
<b>EUT POSITION:</b>	<b>X, Y, Z-axes</b>



Plot 7.2.3 Field strength of carrier at high frequency

<b>ANTENNA POLARIZATION:</b>	<b>VERTICAL and HORIZONTAL</b>
<b>EUT POSITION:</b>	<b>X, Y, Z-axes</b>





<b>Test specification:</b>	<b>FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

### 7.3 Field strength of spurious emissions

#### 7.3.1 General

This test was performed to measure field strength of spurious emissions from the EUT. Specification test limits are given in Table 7.3.1.

**Table 7.3.1 Radiated spurious emissions limits**

Frequency, MHz	Field strength at 3 m within restricted bands, dB(μV/m) <sup>***</sup>			Attenuation of field strength of spurious versus carrier outside restricted bands, dBc <sup>***</sup>
	Peak	Quasi Peak	Average	
0.009 – 0.090	148.5 – 128.5	NA	128.5 – 108.5 <sup>**</sup>	20.0
0.090 – 0.110	NA	108.5 – 106.8 <sup>**</sup>	NA	
0.110 – 0.490	126.8 – 113.8	NA	106.8 – 93.8 <sup>**</sup>	
0.490 – 1.705	NA	73.8 – 63.0 <sup>**</sup>	NA	
1.705 – 30.0 <sup>*</sup>		69.5		
30 – 88		40.0		
88 – 216		43.5		
216 – 960		46.0		
960 - 1000		54.0		
1000 – 10 <sup>th</sup> harmonic	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<sub>1</sub> and S<sub>2</sub> – standard defined and test distance respectively in meters.

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

\*\*\* - The 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.

#### 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 7.3.1, energized and the performance check was conducted.

7.3.2.2 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.

7.3.2.3 The worst test results (the lowest margins) were recorded 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 7.3.2, energized and the performance check was conducted.

7.3.3.2 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.

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



<b>Test specification:</b>	<b>FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Figure 7.3.1 Setup for spurious emission field strength measurements below 30 MHz

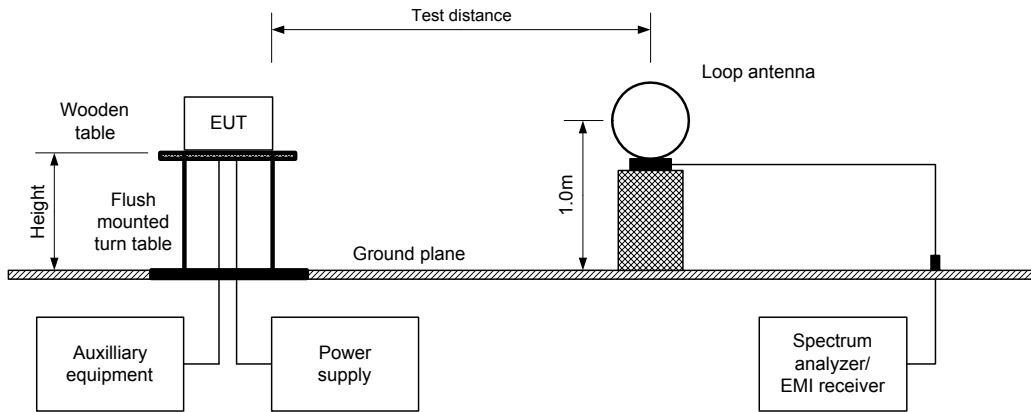
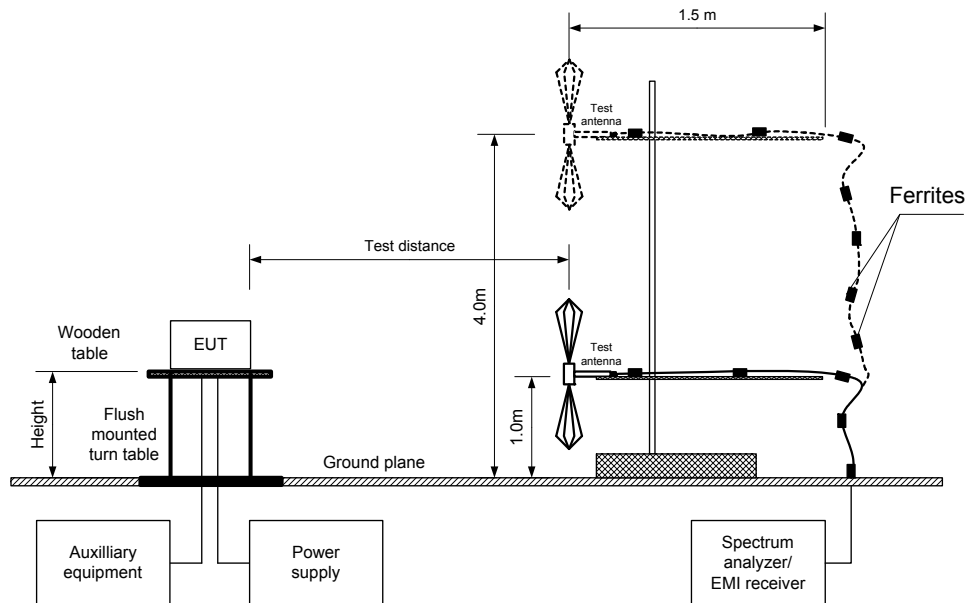


Figure 7.3.2 Setup for spurious emission field strength measurements above 30 MHz





<b>Test specification:</b>	<b>FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

**Table 7.3.2 Field strength of emissions outside restricted bands**

ASSIGNED FREQUENCY BAND: 2400.0 – 2483.5 MHz  
 INVESTIGATED FREQUENCY RANGE: 0.009 - 25000 MHz  
 TEST DISTANCE: 3 m  
 MODULATION: FSK  
 MODULATING SIGNAL: PRBS  
 BIT RATE: 1 Mbps  
 DUTY CYCLE: 100 %  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH: 100 kHz  
 VIDEO BANDWIDTH: 300 kHz  
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)  
 Biconilog (30 MHz – 1000 MHz)  
 Double ridged guide (above 1000 MHz)  
 FREQUENCY HOPPING: Disabled

Frequency, MHz	Field strength of spurious, dB(μV/m)	Antenna polarization	Antenna height, m	Azimuth, degrees*	Field strength of carrier, dB(μV/m)	Attenuation below carrier, dBc	Limit, dBc	Margin, dB**	Verdict
<b>Low carrier frequency</b>									Pass
No spurious emissions were found									
<b>Mid carrier frequency</b>									Pass
No spurious emissions were found									
<b>High carrier frequency</b>									Pass
No spurious emissions were found									

\*- EUT front panel refers to 0 degrees position of turntable.  
 \*\*- Margin = Attenuation below carrier – specification limit.



<b>Test specification:</b>	<b>FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

**Table 7.3.3 Field strength of spurious emissions above 1 GHz within restricted bands**

ASSIGNED FREQUENCY BAND: 2400.0 – 2483.5 MHz  
 INVESTIGATED FREQUENCY RANGE: 1000 - 25000 MHz  
 TEST DISTANCE: 3 m  
 MODULATION: FSK  
 MODULATING SIGNAL: PRBS  
 BIT RATE: 1 Mbps  
 DUTY CYCLE: 100 %  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH: 1000 kHz  
 TEST ANTENNA TYPE: Double ridged guide  
 FREQUENCY HOPPING: Disabled

Frequency, MHz	Antenna		Azimuth, degrees*	Peak field strength(VBW=3 MHz)			Average field strength(VBW=10 Hz)				Verdict
	Polarization	Height, m		Measured, dB(μV/m)	Limit, dB(μV/m)	Margin, dB**	Measured, dB(μV/m)	Calculated, dB(μV/m)	Limit, dB(μV/m)	Margin, dB***	
<b>Low carrier frequency</b>											
No emissions were found										Pass	
<b>Mid carrier frequency</b>											
No emissions were found										Pass	
<b>High carrier frequency</b>											
No emissions were found										Pass	

\*- EUT front panel refers to 0 degrees position of turntable.  
 \*\*- Margin = Measured field strength - specification limit.  
 \*\*\*- Margin = Calculated field strength - specification limit,  
 where Calculated field strength = Measured field strength + average factor.



<b>Test specification:</b>	<b>FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

**Table 7.3.4 Field strength of spurious emissions below 1 GHz within restricted bands**

ASSIGNED FREQUENCY: 2400.0 – 2483.5 MHz  
 INVESTIGATED FREQUENCY RANGE: 0.009 -1000 MHz  
 TEST DISTANCE: 3 m  
 MODULATION: FSK  
 MODULATING SIGNAL: PRBS  
 BIT RATE: 1 Mbps  
 DUTY CYCLE: 100 %  
 RESOLUTION BANDWIDTH: 1.0 kHz (9 kHz – 150 kHz)  
 9.0 kHz (150 kHz – 30 MHz)  
 120 kHz (30 MHz – 1000 MHz)  
 VIDEO BANDWIDTH: > Resolution bandwidth  
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)  
 Biconilog (30 MHz – 1000 MHz)  
 FREQUENCY HOPPING: Disabled

Frequency, MHz	Peak emission, dB(µV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
<b>Low carrier frequency</b>								
No emissions were found								Pass
<b>Mid carrier frequency</b>								
No emissions were found								Pass
<b>High carrier frequency</b>								
No emissions were found								Pass

\*- Margin = Measured emission - specification limit.  
 \*\*- EUT front panel refer to 0 degrees position of turntable.

**Reference numbers of test equipment used**

HL 0446	HL 0604	HL 2909	HL 3818	HL 3901	HL 4354	HL 4722	HL 4933
HL 4956							

Full description is given in Appendix A.



<b>Test specification:</b>	<b>FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions</b>			
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03			
<b>Test mode:</b>	Compliance	<b>Verdict:</b>		<b>PASS</b>
<b>Date(s):</b>	21-Jun-15			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> Battery	
<b>Remarks:</b>				

Table 7.3.5 Restricted bands according to FCC section 15.205

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.37625 - 8.38675	73 - 74.6	399.9 - 410	2690 - 2900	10.6 - 12.7
0.495 - 0.505	8.41425 - 8.41475	74.8 - 75.2	608 - 614	3260 - 3267	13.25 - 13.4
2.1735 - 2.1905	12.29 - 12.293	108 - 121.94	960 - 1240	3332 - 3339	14.47 - 14.5
4.125 - 4.128	12.51975 - 12.52025	123 - 138	1300 - 1427	3345.8 - 3358	15.35 - 16.2
4.17725 - 4.17775	12.57675 - 12.57725	149.9 - 150.05	1435 - 1626.5	3600 - 4400	17.7 - 21.4
4.20725 - 4.20775	13.36 - 13.41	156.52475 - 156.52525	1645.5 - 1646.5	4500 - 5150	22.01 - 23.12
6.215 - 6.218	16.42 - 16.423	156.7 - 156.9	1660 - 1710	5350 - 5460	23.6 - 24
6.26775 - 6.26825	16.69475 - 16.69525	162.0125 - 167.17	1718.8 - 1722.2	7250 - 7750	31.2 - 31.8
6.31175 - 6.31225	16.80425 - 16.80475	167.72 - 173.2	2200 - 2300	8025 - 8500	36.43 - 36.5
8.291 - 8.294	25.5 - 25.67	240 - 285	2310 - 2390	9000 - 9200	Above 38.6
8.362 - 8.366	37.5 - 38.25	322 - 335.4	2483.5 - 2500	9300 - 9500	

Table 7.3.6 Restricted bands according to RSS-Gen

MHz	MHz	MHz	MHz	MHz	GHz
0.09 - 0.11	8.291 - 8.294	16.80425 - 16.80475	399.9 - 410	3260 - 3267	10.6 - 12.7
2.1735 - 2.1905	8.362 - 8.366	25.5 - 25.67	608 - 614	3332 - 3339	13.25 - 13.4
3.020 - 3.026	8.37625 - 8.38675	37.5 - 38.25	960 - 1427	3345.8 - 3358	14.47 - 14.5
4.125 - 4.128	8.41425 - 8.41475	73 - 74.6	1435 - 1626.5	3500 - 4400	15.35 - 16.2
4.17725 - 4.17775	12.29 - 12.293	74.8 - 75.2	1645.5 - 1646.5	4500 - 5150	17.7 - 21.4
4.20725 - 4.20775	12.51975 - 12.52025	108 - 138	1660 - 1710	5350 - 5460	22.01 - 23.12
5.677 - 5.683	12.57675 - 12.57725	156.52475 - 156.52525	1718.8 - 1722.2	7250 - 7750	23.6 - 24
6.215 - 6.218	13.36 - 13.41	156.7 - 156.9	2200 - 2300	8025 - 8500	31.2 - 31.8
6.26775 - 6.26825	16.42 - 16.423	240 - 285	2310 - 2390	9000 - 9200	36.43 - 36.5
6.31175 - 6.31225	16.69475 - 16.69525	322 - 335.4	2655 - 2900	9300 - 9500	Above 38.6

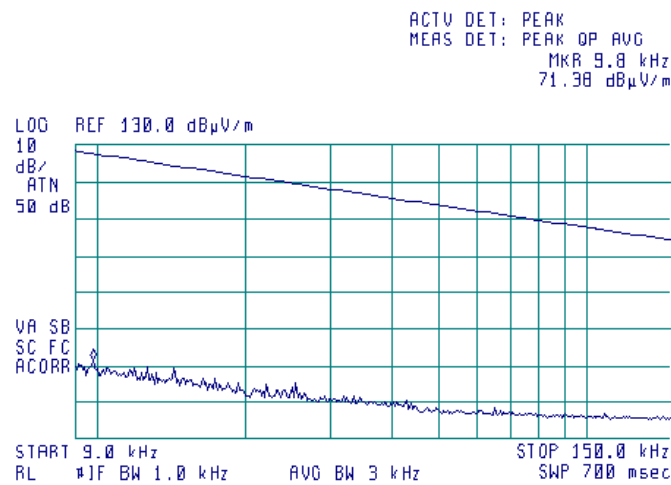


HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

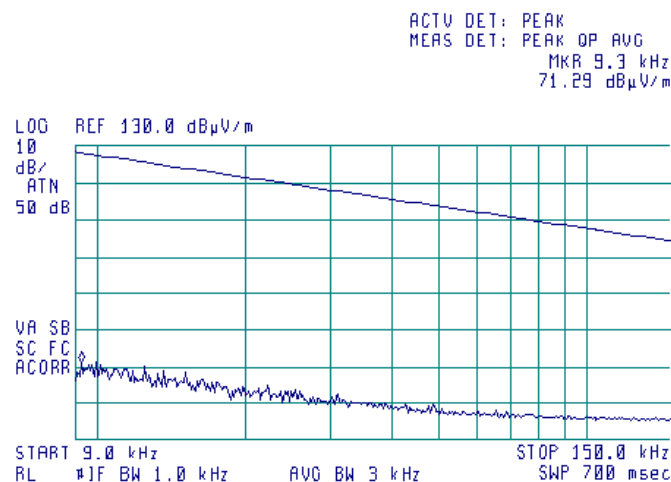
Plot 7.3.1 Radiated emission measurements from 9 to 150 kHz at the low carrier frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical



Plot 7.3.2 Radiated emission measurements from 9 to 150 kHz at the mid carrier frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical



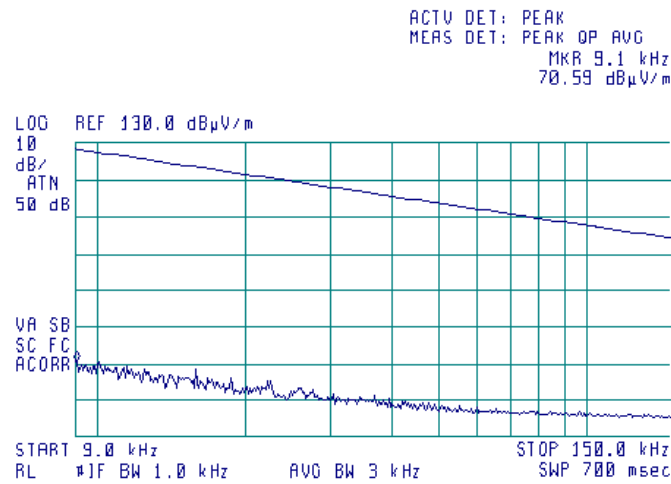




<b>Test specification:</b>		<b>FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions</b>	
<b>Test procedure:</b>		558074 D01 DTS Meas Guidance v03r03	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		21-Jun-15	
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1008 hPa	
<b>Remarks:</b>		<b>Relative Humidity:</b> 51 %	
		<b>Power Supply:</b> Battery	
		<b>Verdict:</b> PASS	

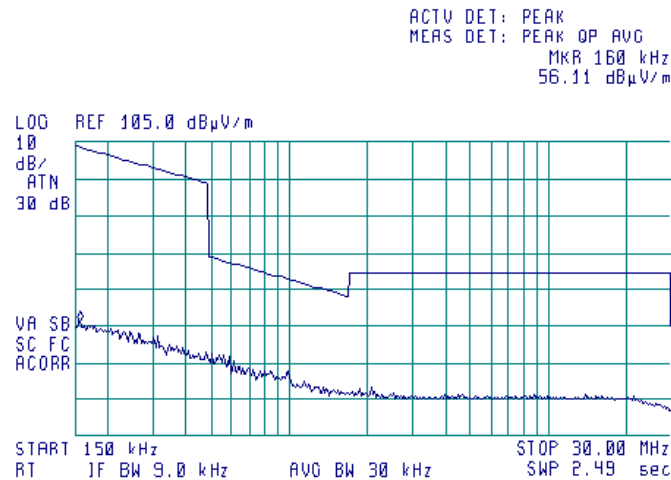
**Plot 7.3.3 Radiated emission measurements from 9 to 150 kHz at the high carrier frequency**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical



**Plot 7.3.4 Radiated emission measurements from 0.15 to 30 MHz at the low carrier frequency**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical





HERMON LABORATORIES

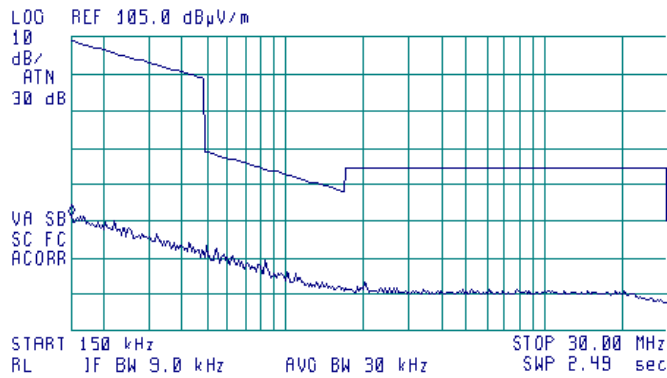
<b>Test specification:</b> FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
<b>Test procedure:</b> 558074 D01 DTS Meas Guidance v03r03			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 21-Jun-15			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

**Plot 7.3.5 Radiated emission measurements from 0.15 to 30 MHz at the mid carrier frequency**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical



ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 150 kHz  
56.39 dBµV/m

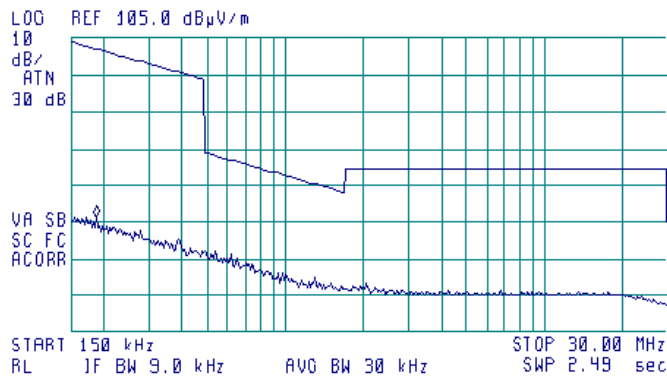


**Plot 7.3.6 Radiated emission measurements from 0.15 to 30 MHz at the high carrier frequency**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical



ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR 190 kHz  
56.20 dBµV/m



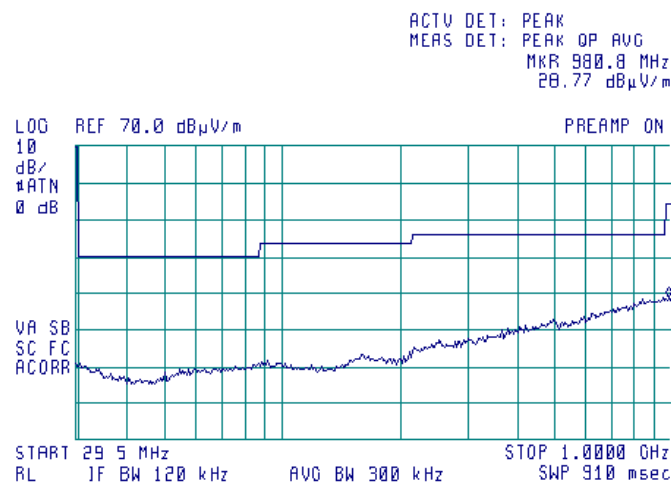


HERMON LABORATORIES

<b>Test specification:</b> FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
<b>Test procedure:</b> 558074 D01 DTS Meas Guidance v03r03			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 21-Jun-15			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

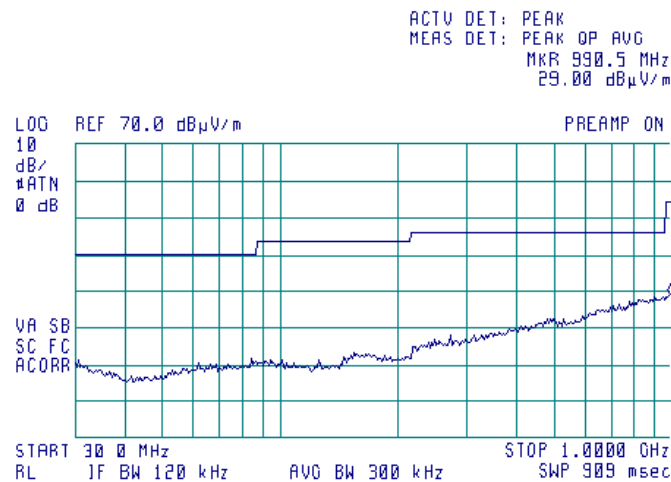
**Plot 7.3.7 Radiated emission measurements from 30 to 1000 MHz at the low carrier frequency**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal



**Plot 7.3.8 Radiated emission measurements from 30 to 1000 MHz at the mid carrier frequency**

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal



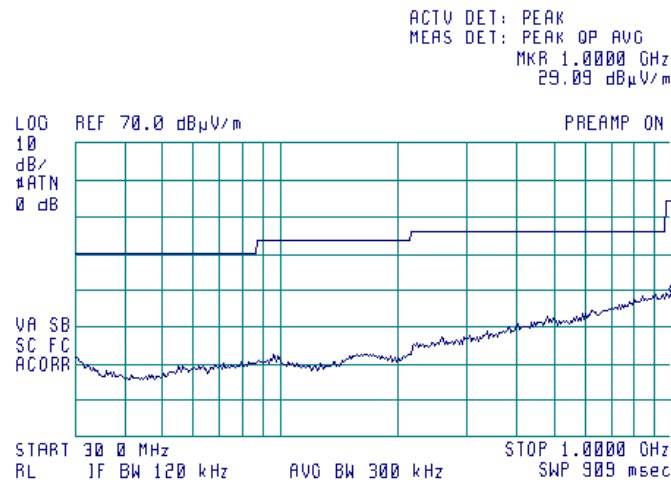


HERMON LABORATORIES

<b>Test specification:</b> FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
<b>Test procedure:</b> 558074 D01 DTS Meas Guidance v03r03			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 21-Jun-15			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

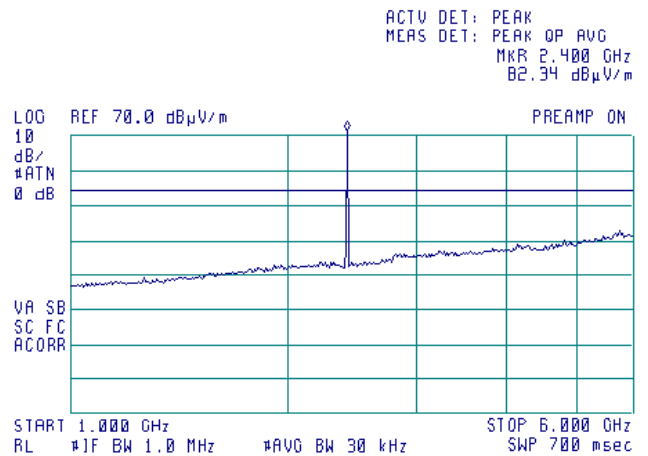
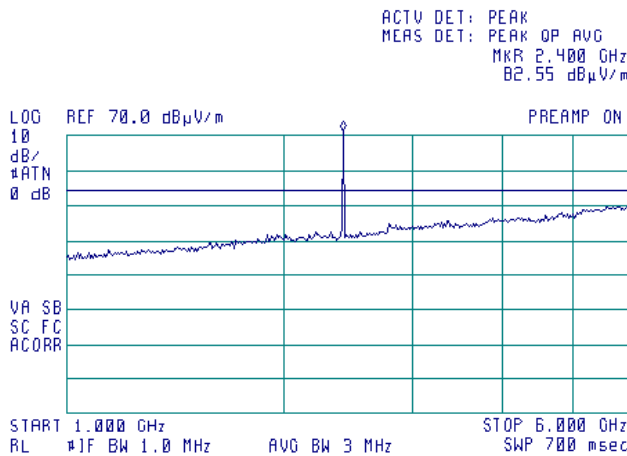
Plot 7.3.9 Radiated emission measurements from 30 to 1000 MHz at the high carrier frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal



Plot 7.3.10 Radiated emission measurements from 1000 to 6000 MHz at the low carrier frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal



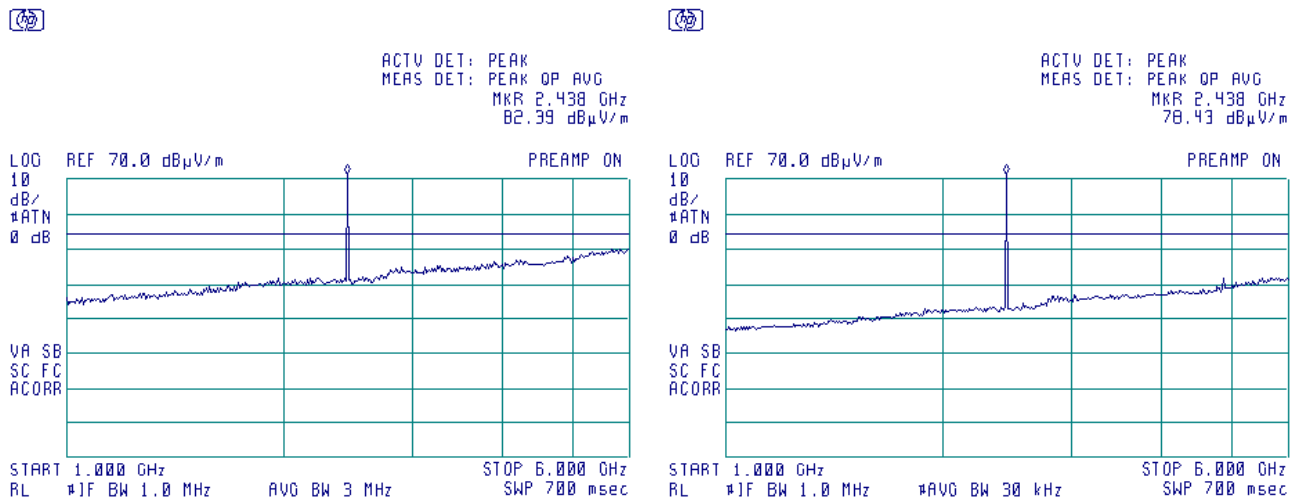
NOTE: 2402 MHz – fundamental frequency



<b>Test specification:</b> FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions			
<b>Test procedure:</b> 558074 D01 DTS Meas Guidance v03r03			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 21-Jun-15			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 51 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Plot 7.3.11 Radiated emission measurements from 1000 to 6000 MHz at the mid carrier frequency

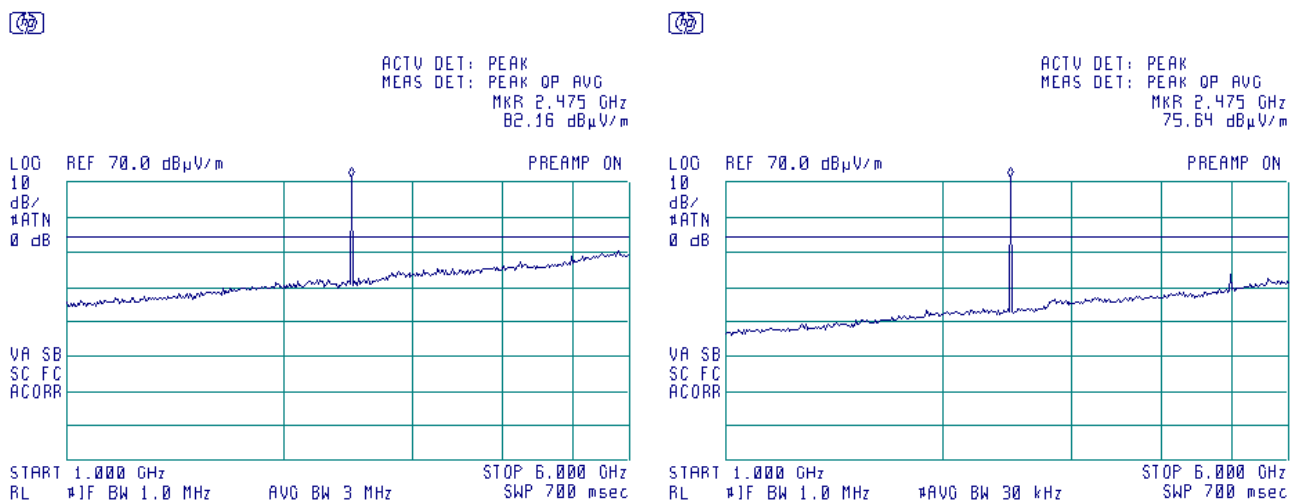
TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal



NOTE: 2440 MHz – fundamental frequency

Plot 7.3.12 Radiated emission measurements from 1000 to 6000 MHz at the high carrier frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal



NOTE: 2480 MHz – fundamental frequency

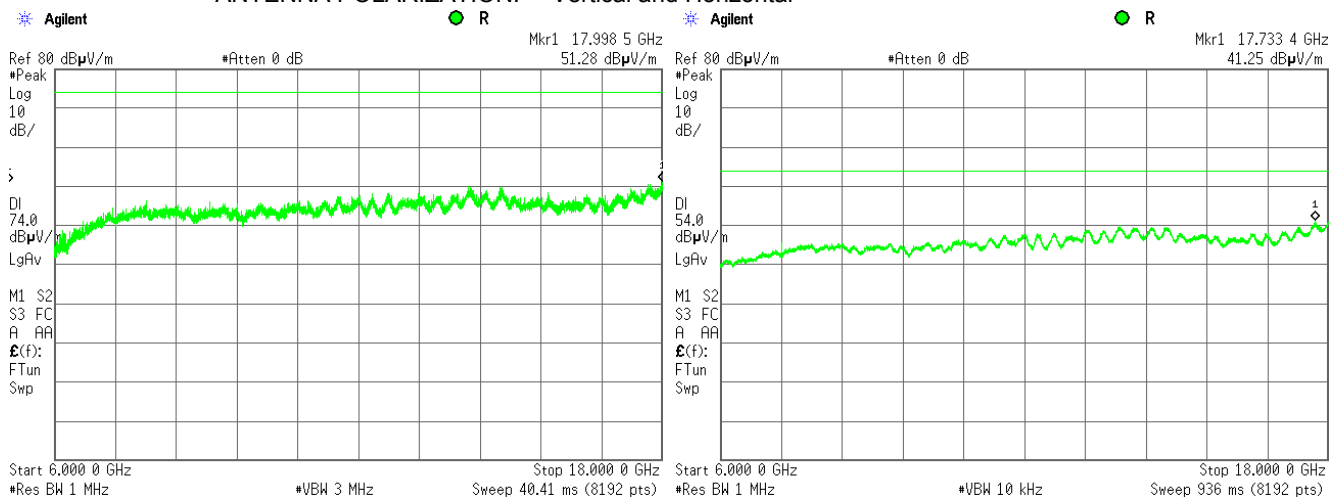


HERMON LABORATORIES

<b>Test specification:</b> FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions	
<b>Test procedure:</b> 558074 D01 DTS Meas Guidance v03r03	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 21-Jun-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1008 hPa
	<b>Relative Humidity:</b> 51 %
<b>Power Supply:</b> Battery	
<b>Remarks:</b>	

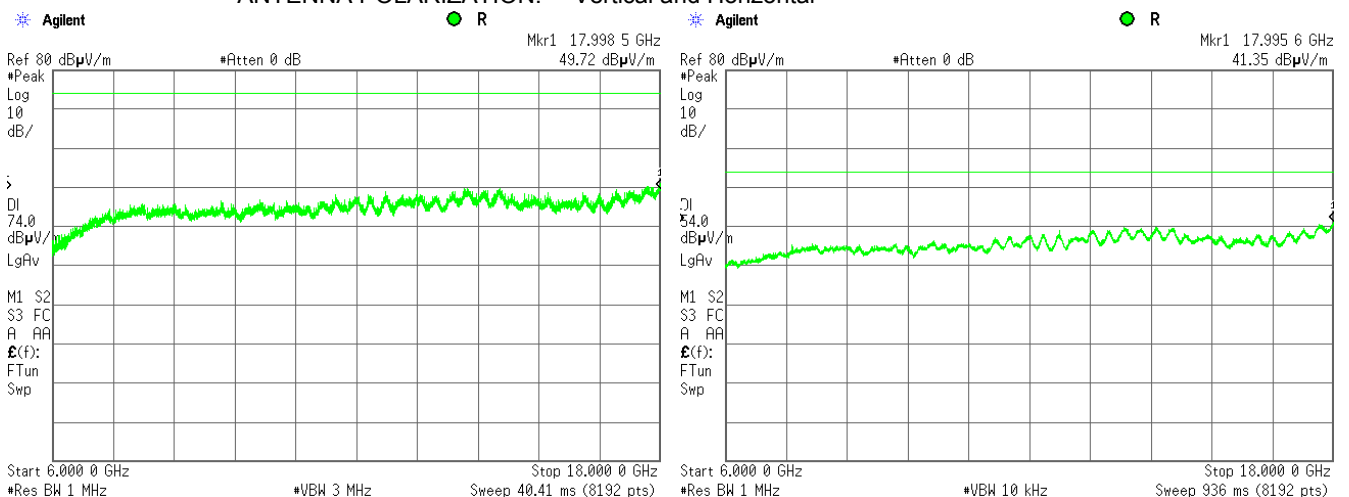
Plot 7.3.13 Radiated emission measurements from 6.0 to 18.0 GHz at the low carrier frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal



Plot 7.3.14 Radiated emission measurements from 6.0 to 18.0 GHz at the mid carrier frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal



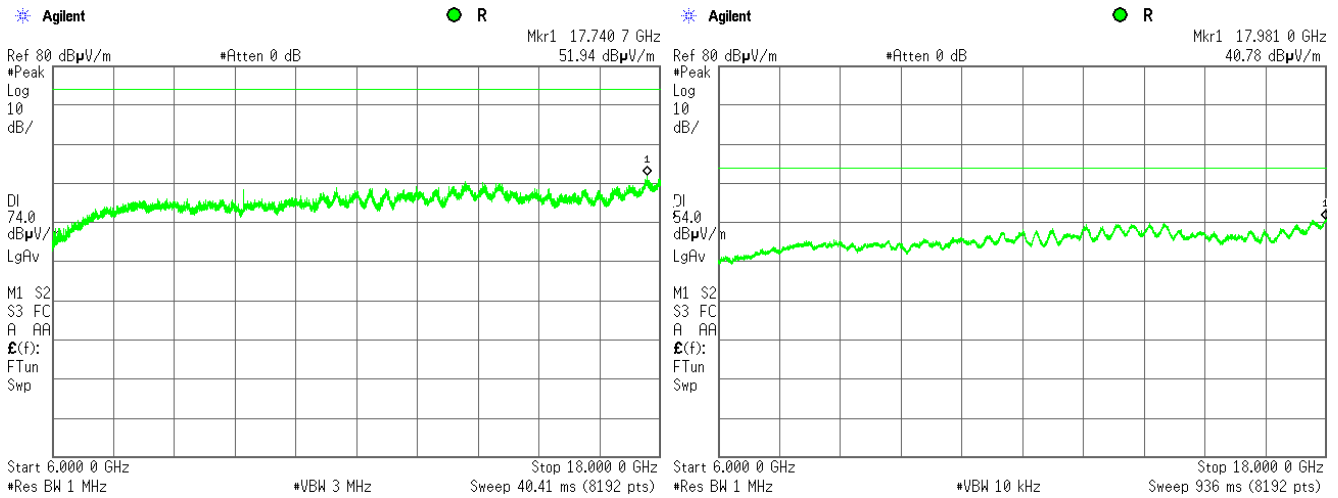


HERMON LABORATORIES

<b>Test specification:</b> FCC section 15.247(d) / RSS-247 section 5.5, Radiated spurious emissions	
<b>Test procedure:</b> 558074 D01 DTS Meas Guidance v03r03	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 21-Jun-15	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1008 hPa
	<b>Relative Humidity:</b> 51 %
<b>Power Supply:</b> Battery	
<b>Remarks:</b>	

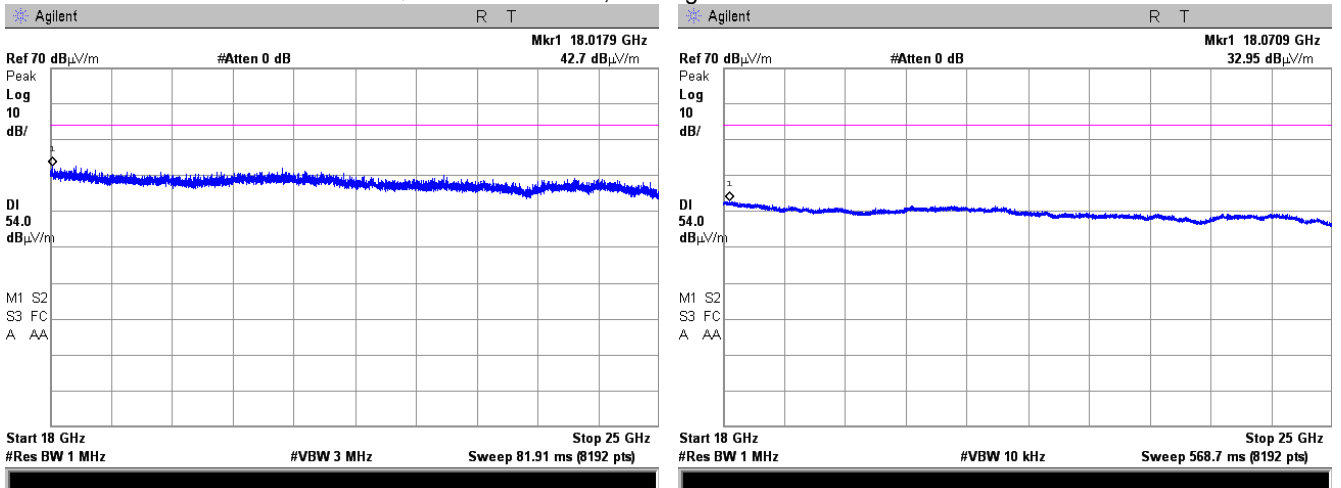
Plot 7.3.15 Radiated emission measurements from 6.0 to 18.0 GHz at the high carrier frequency

TEST SITE: Semi anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal



Plot 7.3.16 Radiated emission measurements from 18.0 to 25.0 GHz at the low carrier frequency

TEST SITE: Anechoic chamber  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical and Horizontal  
CARRIER FREQUENCY: Low, Mid High





<b>Test specification:</b>	<b>FCC section 15.247(d) / RSS-247 section 5.5, Band edge emissions</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

## 7.4 Band edge radiated emissions

### 7.4.1 General

This test was performed to measure emissions, radiated from the EUT at the assigned frequency band edges. Specification test limits are given in Table 7.4.1.

**Table 7.4.1 Band edge emission limits**

Output power	Assigned frequency, MHz	Attenuation below carrier*, dBc	Field strength at 3 m within restricted bands, dB( $\mu$ V/m)	
			Peak	Average
Peak	2400.0 – 2483.5	20.0	74.0	54.0
Averaged over a time interval	2400.0 – 2483.5	30.0	74.0	54.0

\* - Band edge emission limit is provided in terms of attenuation below the peak of modulated carrier measured with the same resolution bandwidth.

### 7.4.2 Test procedure

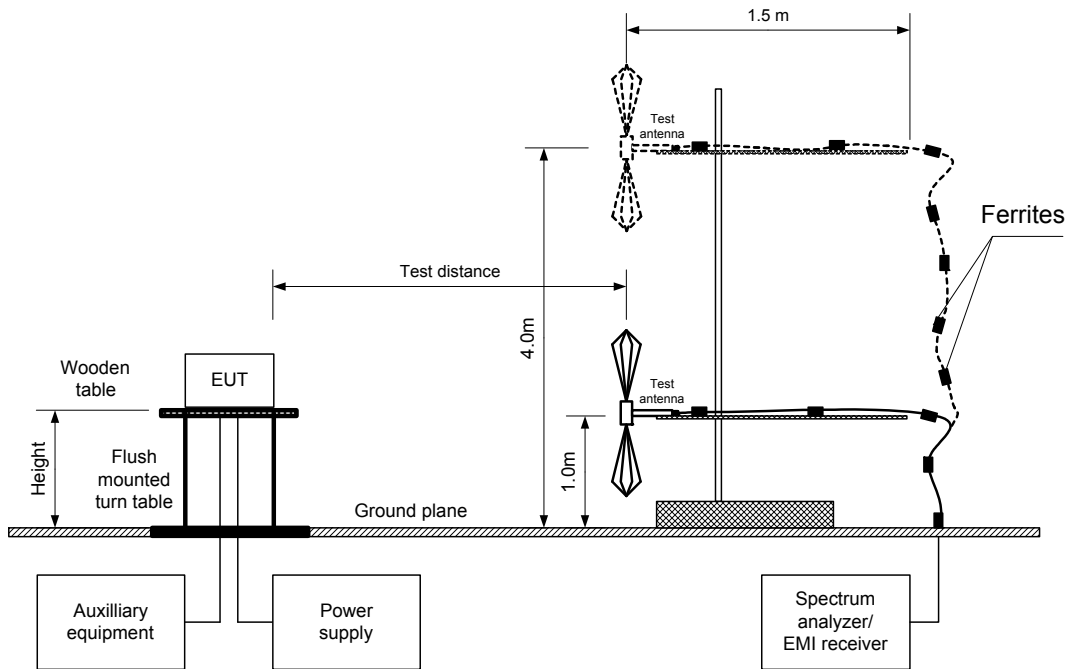
- 7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized normally modulated at the maximum data rate and its proper operation was checked.
- 7.4.2.2 The EUT was adjusted to produce maximum available to end user RF output power at the lowest carrier frequency.
- 7.4.2.3 The spectrum analyzer span was set to capture the carrier frequency and associated modulation products. The resolution bandwidth was set wider than 1 % of the frequency span.
- 7.4.2.4 The spectrum analyzer was set in max hold mode and allowed trace to stabilize. The highest emission level within the authorized band was measured.
- 7.4.2.5 The maximum band edge emission and modulation product outside of the band were measured as provided in Table 7.4.2 and associated plots and referenced to the highest emission level measured within the authorized band.
- 7.4.2.6 The above procedure was repeated with the EUT adjusted to produce maximum RF output power at the highest carrier frequency.
- 7.4.2.7 The above procedure was repeated with the frequency hopping function enabled.





<b>Test specification:</b>	<b>FCC section 15.247(d) / RSS-247 section 5.5, Band edge emissions</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Figure 7.4.1 Band edge emission test setup





<b>Test specification:</b>	<b>FCC section 15.247(d) / RSS-247 section 5.5, Band edge emissions</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Table 7.4.2 Band edge emission test results

ASSIGNED FREQUENCY RANGE: 2400-2483.5 MHz  
DETECTOR USED: Peak  
MODULATION: FSK  
MODULATING SIGNAL: PRBS  
BIT RATE: 1Mbps  
RESOLUTION BANDWIDTH: ≥ 1% of the span  
VIDEO BANDWIDTH: ≥ RBW

Frequency, MHz	Band edge emission, dBµV/m	Emission at carrier, dBµV/m	Attenuation below carrier, dBc	Limit, dBµV/m	Margin, dB*	Verdict
Peak power						
2400.0	66.21	NA	NA	74.0	-7.79	Pass
2483.5	65.75		NA		-8.25	
Averaged Power						
2400.0	44.13	NA	NA	54.0	-9.87	Pass
2483.5	44.14		NA		-9.86	

\*- Margin = Attenuation below carrier – specification limit.

Reference numbers of test equipment used

HL 0415	HL 3818	HL 4114	HL 4294				
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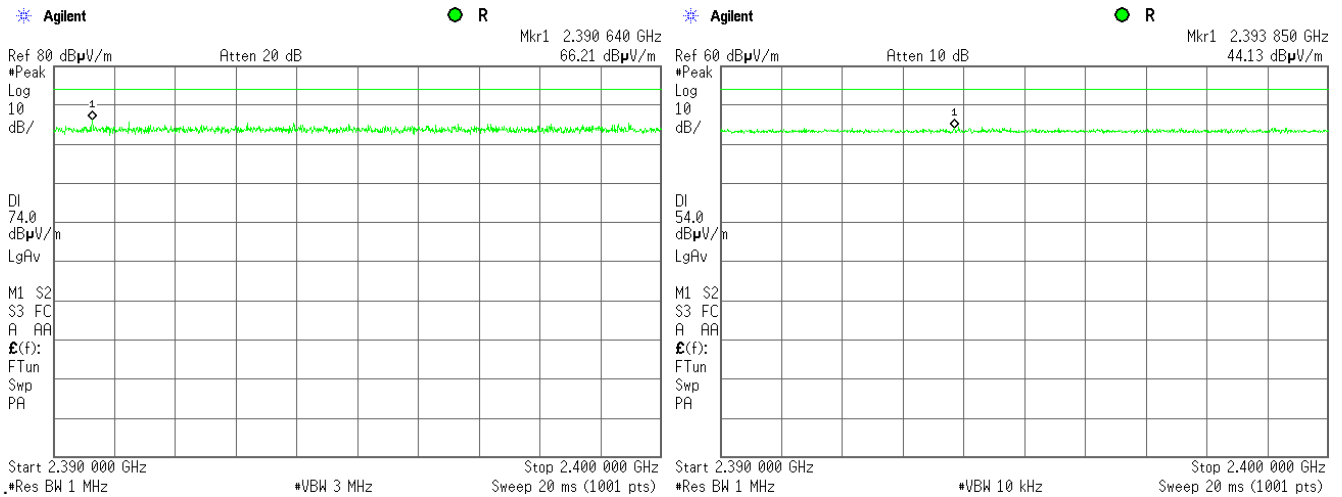
Full description is given in Appendix A.



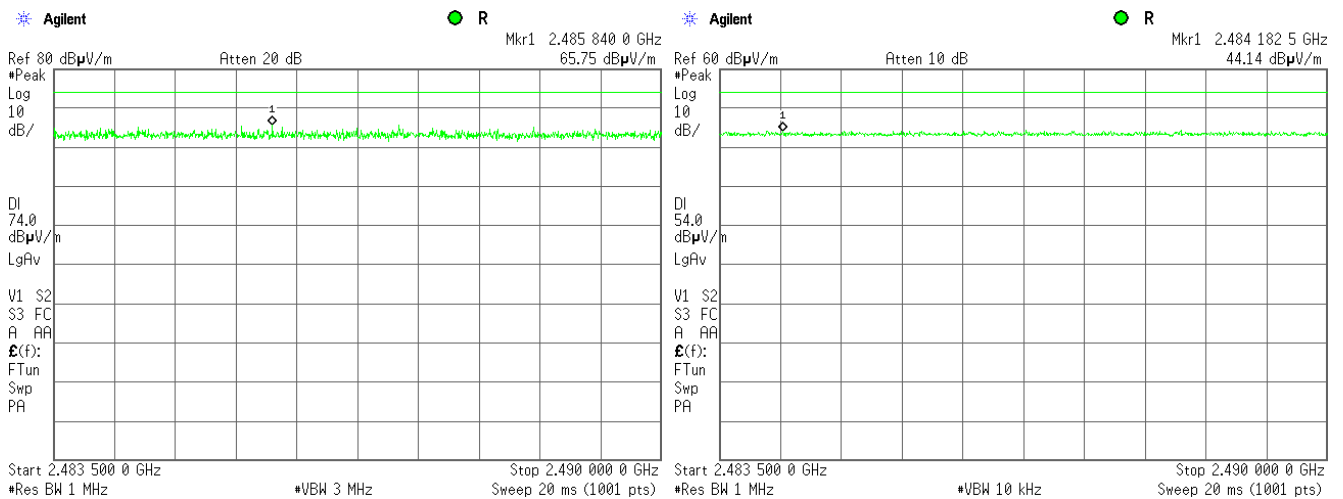
HERMON LABORATORIES

<b>Test specification:</b> FCC section 15.247(d) / RSS-247 section 5.5, Band edge emissions			
<b>Test procedure:</b> 558074 D01 DTS Meas Guidance v03r03			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 21-Jun-15			
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Plot 7.4.1 Band edge emission at low carrier frequency



Plot 7.4.2 Band edge emission at high carrier frequency





<b>Test specification:</b>		<b>FCC section 15.247(e) / RSS-247 section 5.2(2), Peak power density</b>	
<b>Test procedure:</b>		558074 D01 DTS Meas Guidance v03r03, Method 10.2	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		21-Jun-15	
<b>Temperature:</b> 24 °C		<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 49 %
<b>Remarks:</b>		<b>Verdict:</b> PASS	
		<b>Power Supply:</b> Battery	

## 7.5 Peak spectral power density

### 7.5.1 General

This test was performed to measure the peak spectral power density radiated by the transmitter RF antenna. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Peak spectral power density limits

Assigned frequency range, MHz	Measurement bandwidth, kHz	Peak spectral power density, dBm	Equivalent field strength limit @ 3m, dB(µV/m)*
902.0 – 928.0	3.0	8.0	103.2
2400.0 – 2483.5			
5725.0 – 5850.0			

\* - Equivalent field strength limit was calculated from the peak spectral power density as follows:  $E = \sqrt{30 \times P} / r$ , where P is peak spectral power density and r is antenna to EUT distance in meters.

### 7.5.2 Test procedure for field strength measurements

7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and its proper operation was checked.

7.5.2.2 The EUT was adjusted to produce maximum available to end user RF output power.

7.5.2.3 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° and the measuring antenna height was swept in both vertical and horizontal polarizations.

7.5.2.4 The maximum power spectral density was measured using a peak detector with resolution bandwidth set to 100 kHz, VBW≥300 kHz, sweep time = auto couple, trace mode=max hold.

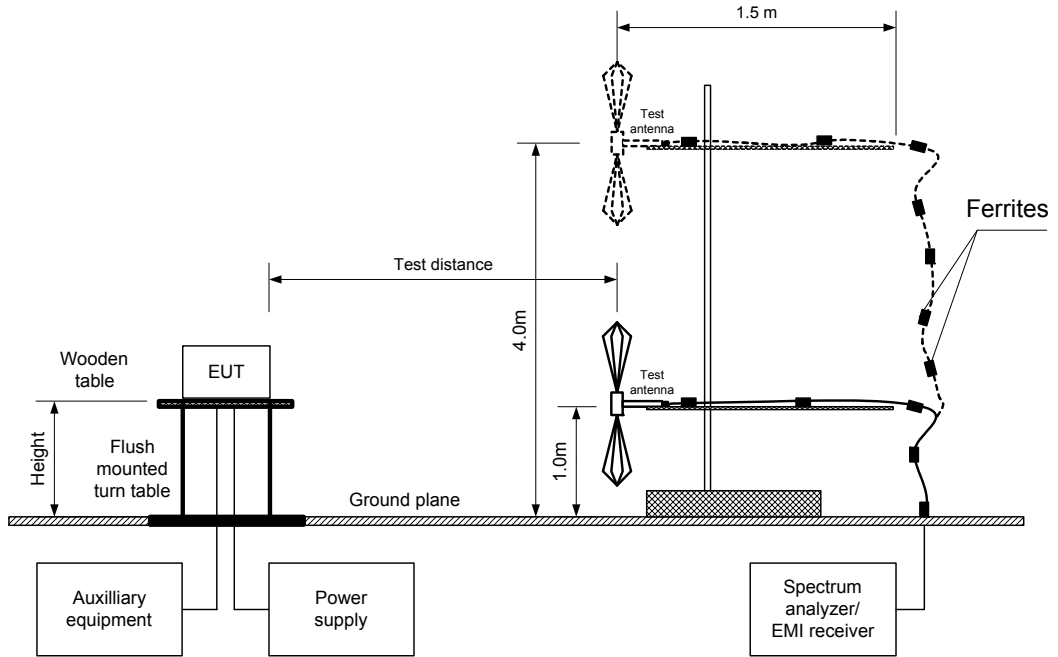
7.5.2.5 The maximum power level was determined in any 100 kHz band within the fundamental EBW. The measured value did not exceed the limit.

7.5.2.6 The test results provided in Table 7.5.2 and the associated plots.



<b>Test specification:</b>	<b>FCC section 15.247(e) / RSS-247 section 5.2(2), Peak power density</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03, Method 10.2		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 49 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Figure 7.5.1 Setup for carrier field strength measurements





<b>Test specification:</b> FCC section 15.247(e) / RSS-247 section 5.2(2), Peak power density	
<b>Test procedure:</b> 558074 D01 DTS Meas Guidance v03r03, Method 10.2	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 21-Jun-15	
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1008 hPa
<b>Relative Humidity:</b> 49 %	
<b>Power Supply:</b> Battery	
<b>Remarks:</b>	

Table 7.5.2 Field strength measurement of peak spectral power density

ASSIGNED FREQUENCY: 2400-2483.5 MHz  
TEST DISTANCE: 3 m  
TEST SITE: OATS  
EUT HEIGHT: 0.8 m  
DETECTOR USED: Peak  
RESOLUTION BANDWIDTH: 100 kHz  
VIDEO BANDWIDTH: 300 kHz  
TEST ANTENNA TYPE: Double ridged guide (above 1000 MHz)  
MODULATION: FSK  
MODULATING SIGNAL: PRBS  
BIT RATE: 1 Mbps

Frequency, MHz	Field strength, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*	Antenna polarization	Antenna height, m	Turn-table position**, degrees
2402.00	82.21	103.2	-21.00	Vertical	1.4	180
2440.10	82.00	103.2	-21.20	Vertical	1.3	221
2480.07	80.84	103.2	-22.36	Vertical	1.4	360

**Verdict: Pass**

\*- Margin = Field strength - EUT antenna gain - calculated field strength limit.

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

**Reference numbers of test equipment used**

HL 0415	HL 3818	HL 4114	HL 4294				
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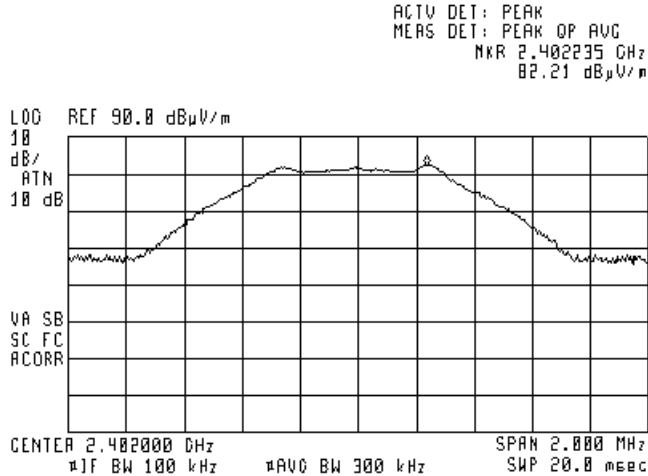
Full description is given in Appendix A.



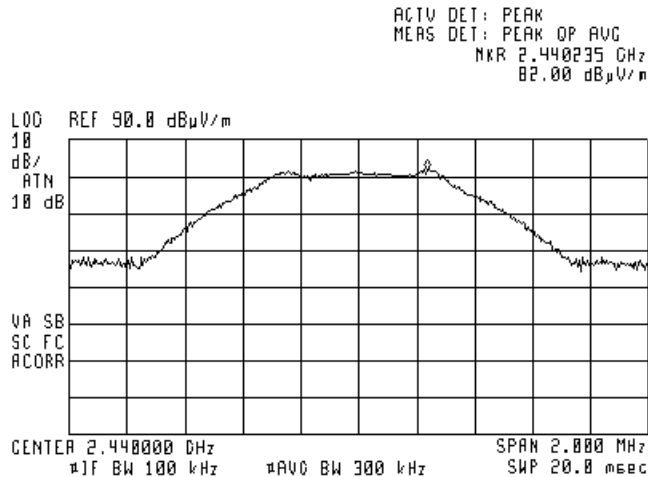
HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC section 15.247(e) / RSS-247 section 5.2(2), Peak power density</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03, Method 10.2		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 49 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Plot 7.5.1 Peak spectral power density at low frequency zoomed at the peak



Plot 7.5.2 Peak spectral power density at mid frequency zoomed at the peak

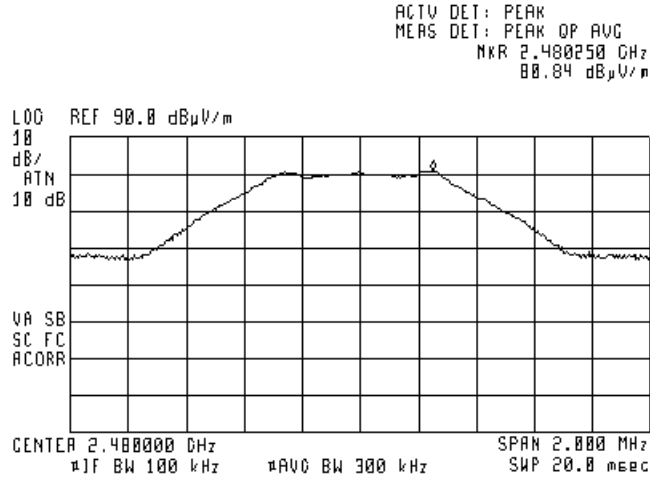




HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC section 15.247(e) / RSS-247 section 5.2(2), Peak power density</b>		
<b>Test procedure:</b>	558074 D01 DTS Meas Guidance v03r03, Method 10.2		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	21-Jun-15		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> 1008 hPa	<b>Relative Humidity:</b> 49 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Plot 7.5.3 Peak spectral power density at high frequency zoomed at the peak







<b>Test specification:</b>	<b>FCC Part 15, Section 203 / RSS-Gen, Section 8.3, Antenna requirements</b>		
<b>Test procedure:</b>	Visual inspection / supplier declaration		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	11-Jun-15		
<b>Temperature:</b> 24 °C	<b>Air Pressure:</b> hPa	<b>Relative Humidity:</b> 55 %	<b>Power Supply:</b> 3V battery
<b>Remarks:</b>			

## 7.6 Antenna requirements

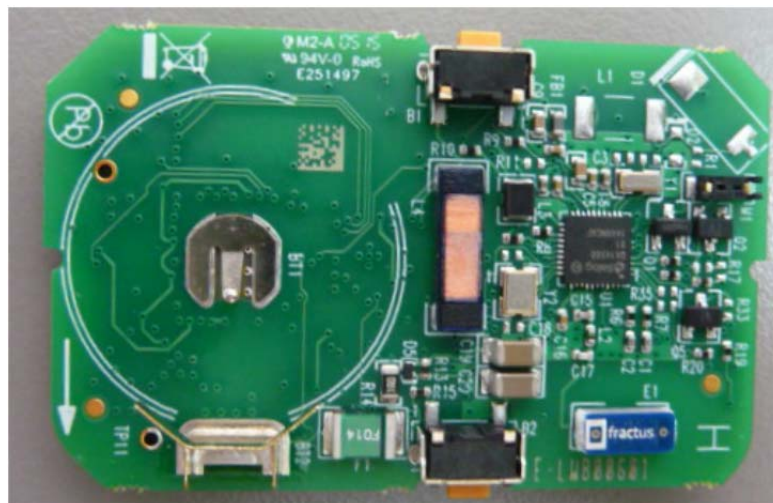
The EUT was verified for compliance with antenna requirements. A transmitter shall be designed to ensure that no antenna other than that furnished by the responsible party will be used with the device. It may be either permanently attached or employs a unique antenna connector for every antenna proposed 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 7.6.1.

**Table 7.6.1 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 7.6.1 Antenna assembly**





<b>Test specification:</b>	<b>FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Section 6.2, Class B, Radiated emission</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 11.6 and 12.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	28-Jun-15		
<b>Temperature:</b> 25 °C	<b>Air Pressure:</b> 1010 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

## 8 Unintentional emissions

### 8.1 Radiated emission measurements

#### 8.1.1 General

This test was performed to measure radiated emissions from the EUT enclosure. Specification test limits are given in Table 8.1.1, Table 8.1.2.

**Table 8.1.1 Radiated emission test limits according to FCC Part 15 Section 15.109 and ICES-003, Section 6.2**

Frequency, MHz	Class B limit, dB( $\mu$ V/m)		Class A limit, dB( $\mu$ V/m)	
	10 m distance	3 m distance	10 m distance	3 m distance
30 - 88	29.5*	40.0	39.0	49.5*
88 - 216	33.0*	43.5	43.5	54.0*
216 - 960	35.5*	46.0	46.4	56.9*
Above 960	43.5*	54.0	49.5	60.0*

\* The limit for test distance other than specified was calculated using the inverse linear distance extrapolation factor as follows:  $Lim_{S_2} = Lim_{S_1} + 20 \log(S_1/S_2)$ , where  $S_1$  and  $S_2$  – standard defined and test distance respectively in meters.

**Table 8.1.2 Radiated emission limits according to RSS-Gen, Section 7.1.2**

Frequency, MHz	Field strength limit at 3 m test distance, dB( $\mu$ V/m)
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
960 – 5 <sup>th</sup> harmonic**	54.0

\*\* - harmonic of the highest frequency the EUT generates, uses, operates or tunes to.

#### 8.1.2 Test procedure

**8.1.2.1** The EUT was set up as shown in Figure 8.1.1 and associated photographs, energized and the performance check was conducted.

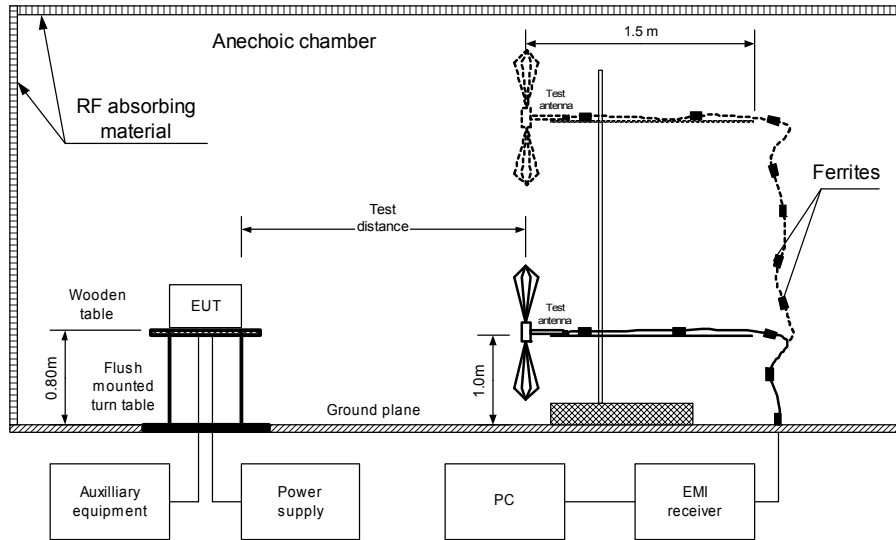
**8.1.2.2** The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 360°, the measuring antenna height was changed from 1 to 4 m, its polarization was switched from vertical to horizontal and the EUT cables position was varied.

**8.1.2.3** The worst test results (the lowest margins) were recorded in Table 8.1.3 and shown in the associated plots.

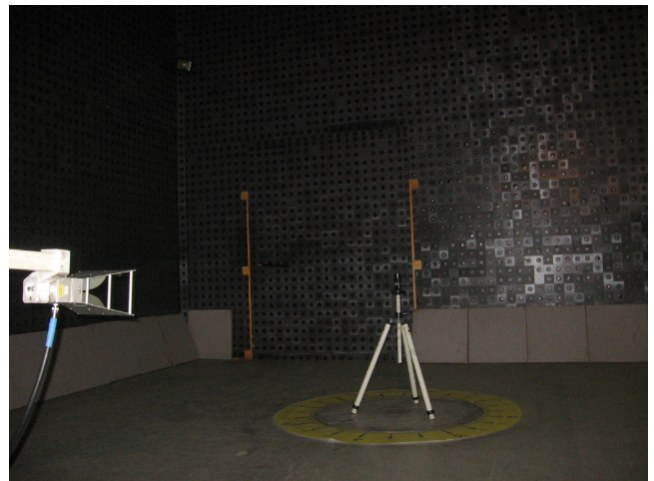
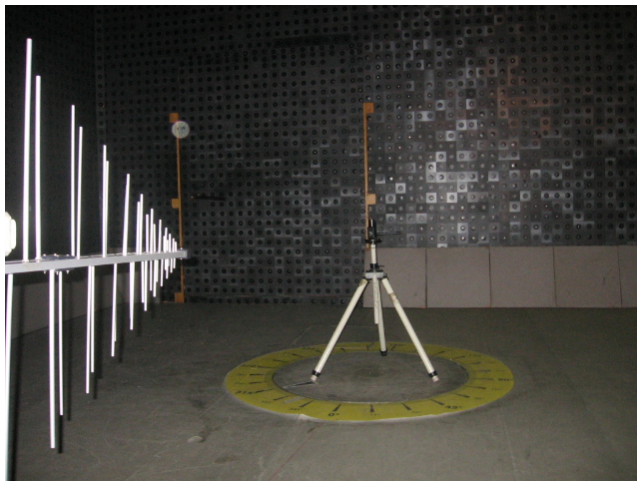


<b>Test specification:</b>	<b>FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Section 6.2, Class B, Radiated emission</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 11.6 and 12.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	28-Jun-15		
<b>Temperature:</b> 25 °C	<b>Air Pressure:</b> 1010 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

Figure 8.1.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment



Photograph 8.1.1 Setup for radiated emission measurements





<b>Test specification:</b>	<b>FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Section 6.2, Class B, Radiated emission</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 11.6 and 12.1.4		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	28-Jun-15		
<b>Temperature:</b> 25 °C	<b>Air Pressure:</b> 1010 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

**Table 8.1.3 Radiated emission test results**

EUT SET UP: TABLE-TOP  
 LIMIT: Class B  
 EUT OPERATING MODE: Stand-by/Receive  
 TEST SITE: SEMI ANECHOIC CHAMBER  
 TEST DISTANCE: 3 m

DETECTORS USED: PEAK / QUASI-PEAK  
 FREQUENCY RANGE: 30 MHz – 1000 MHz  
 RESOLUTION BANDWIDTH: 120 kHz

Frequency, MHz	Peak emission, dB(µV/m)	Quasi-peak			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
		Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
No emissions were found								Pass

DETECTORS USED: PEAK / AVERAGE  
 FREQUENCY RANGE: 1 GHz – 25 GHz  
 RESOLUTION BANDWIDTH: 1000 kHz

Frequency, MHz	Peak			Average			Antenna polarization	Antenna height, m	Turn-table position**, degrees	Verdict
	Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*	Measured emission, dB(µV/m)	Limit, dB(µV/m)	Margin, dB*				
No emissions were found										Pass

\*- Margin = Measured emission - specification limit.  
 \*\*- EUT front panel refer to 0 degrees position of turntable.

**Reference numbers of test equipment used**

HL 0604	HL 2909	HL 3818	HL 3901	HL 4354	HL 4722	HL 4933	HL 4956
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Full description is given in Appendix A.

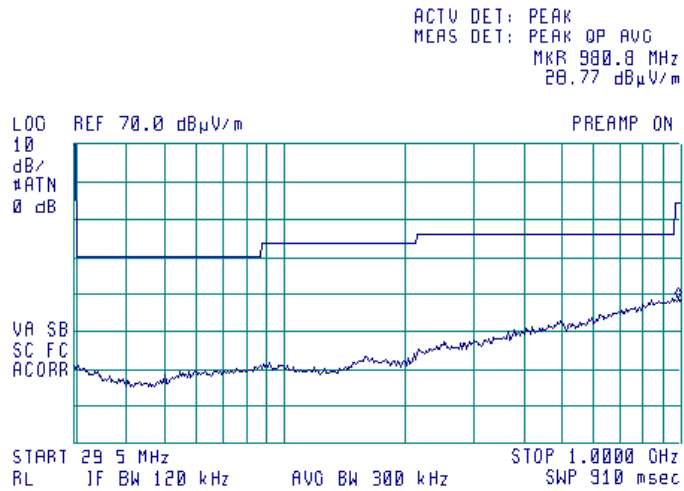


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<b>Test specification:</b>		<b>FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Section 6.2, Class B, Radiated emission</b>	
<b>Test procedure:</b>		ANSI C63.4, Sections 11.6 and 12.1.4	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		28-Jun-15	
<b>Temperature:</b> 25 °C		<b>Air Pressure:</b> 1010 hPa	
<b>Remarks:</b>		<b>Verdict:</b> PASS	
		<b>Relative Humidity:</b> 50 %	
		<b>Power Supply:</b> Battery	

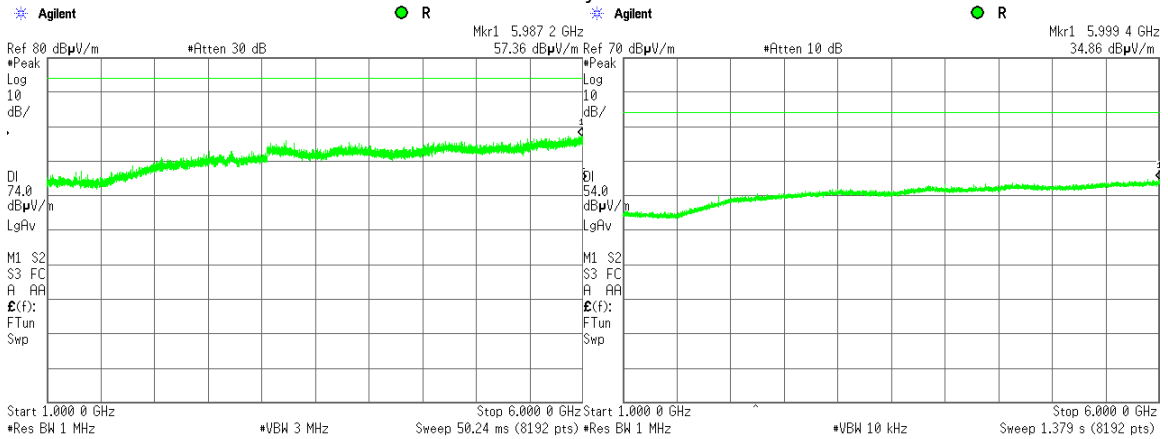
**Plot 8.1.1 Radiated emission measurements in 30 - 1000 MHz range, vertical antenna polarization**

TEST SITE: Semi anechoic chamber  
LIMIT: Class B  
TEST DISTANCE: 3 m  
EUT OPERATING MODE: Stand-by/Receive



**Plot 8.1.2 Radiated emission measurements from 1000 to 6000 MHz**

TEST SITE: Anechoic chamber  
LIMIT: Class B  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m  
EUT OPERATING MODE: Stand-by/Receive



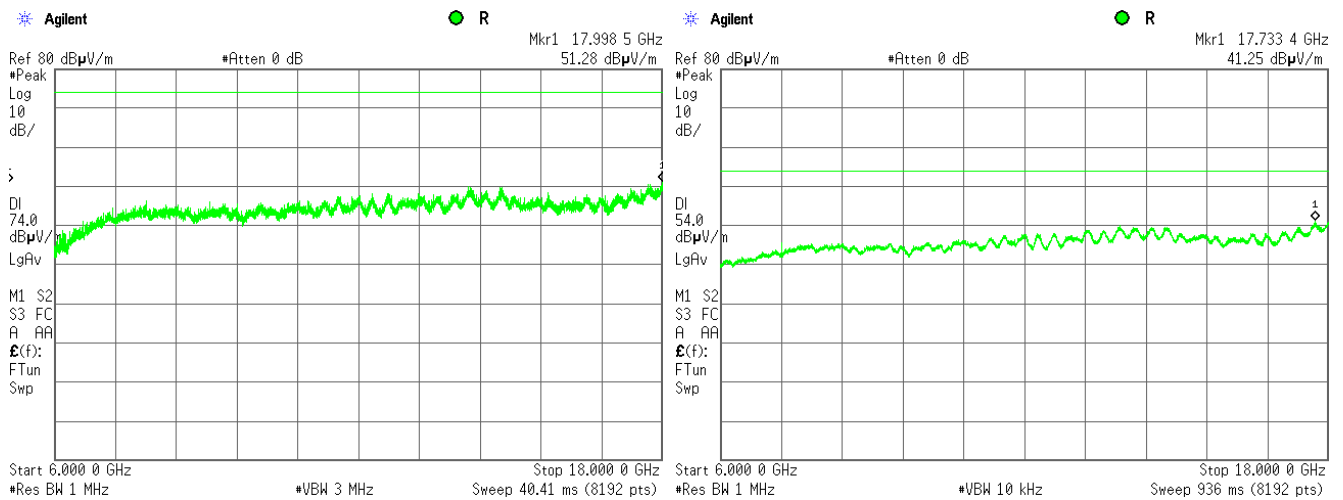


HERMON LABORATORIES

<b>Test specification:</b> FCC Part 15, Section 109 / RSS-Gen, Section 7.1.2 / ICES-003, Section 6.2, Class B, Radiated emission			
<b>Test procedure:</b> ANSI C63.4, Sections 11.6 and 12.1.4			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 28-Jun-15			
<b>Temperature:</b> 25 °C	<b>Air Pressure:</b> 1010 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> Battery
<b>Remarks:</b>			

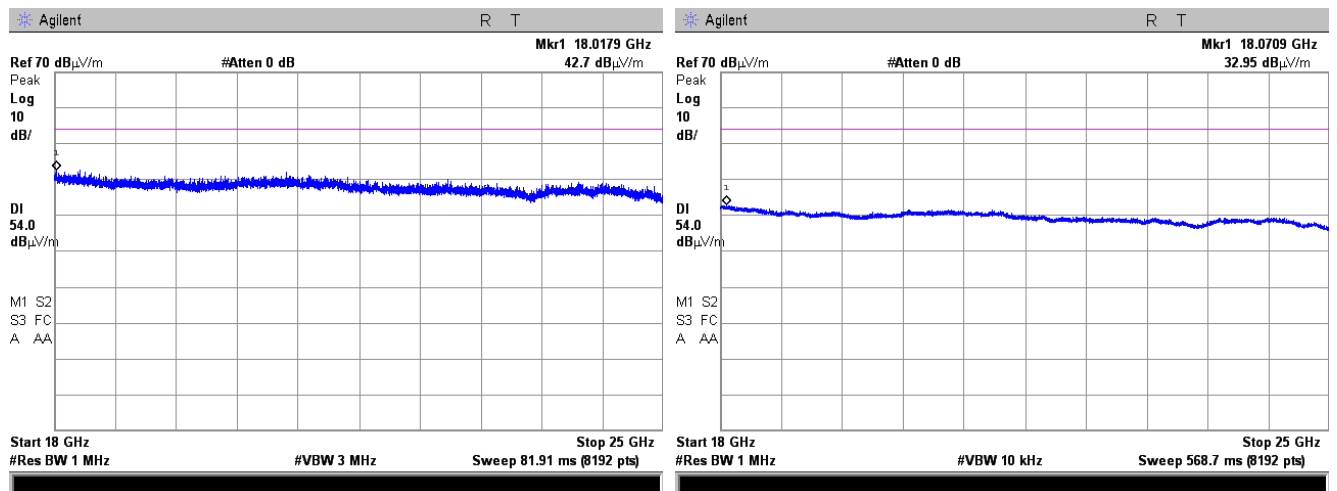
Plot 8.1.3 Radiated emission measurements from 6000 to 18000 MHz

TEST SITE: Anechoic chamber  
LIMIT: Class B  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m  
EUT OPERATING MODE: Stand-by/Receive



Plot 8.1.4 Radiated emission measurements from 18000 to 25000 MHz

TEST SITE: Anechoic chamber  
LIMIT: Class B  
ANTENNA POLARIZATION: Vertical and Horizontal  
TEST DISTANCE: 3 m  
EUT OPERATING MODE: Stand-by/Receive



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

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0415	Cable, Coax, RF, RG-214, 12.3 m	Hermon Laboratories	CC-3	056	04-Dec-14	04-Dec-15
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	13-Jan-15	13-Jan-16
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	15-May-15	15-May-16
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY414447 62	22-Feb-15	22-Feb-16
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY482502 88	29-Apr-15	29-Apr-16
3901	Microwave Cable Assembly, 40.0 GHz, 3.5 m, SMA/SMA	Huber-Suhner	SUCOFLE X 102A	1225/2A	10-Feb-15	10-Feb-16
4114	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz	ETS Lindgren	3117	00123515	19-Dec-14	19-Dec-15
4273	Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M	Mini-Circuits	CBL-6FT- SMNM+	70045	28-May-15	28-May-16
4294	Microwave Cable Assembly, 18.0 GHz, 3.4 m, SMA/SMA	Huber-Suhner	Sucoflex P103	NA	07-Dec-14	07-Dec-15
4354	Vector Signal Generator, 100 kHz to 6.0 GHz	Rohde & Schwarz	SMJ 100A	1403.4507 K02- 101777-rc	27-Jun-14	27-Jun-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	26-Aug-14	26-Aug-15
4933	Active Horn Antenna, 1 GHz to 18 GHz	Com-Power Corporation	AHA-118	701046	12-Nov-14	12-Nov-15
4956	Active horn antenna, 18 to 40 GHz	Com-Power Corporation	AHA-840	105004	26-Jan-15	26-Jan-16



**10 APPENDIX B Measurement uncertainties****Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements**

Test description	Expanded uncertainty
Conducted carrier power at RF antenna connector	Below 12.4 GHz: $\pm 1.7$ dB 12.4 GHz to 40 GHz: $\pm 2.3$ 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
Occupied bandwidth	$\pm 8.0$ %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	$\pm 1.0$ %
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

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 numbers 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 US1003.

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Person for contact: Mr. Alex Usoskin, CEO.

## 12 APPENDIX D Specification references

FCC 47CFR part 15: 2014	Radio Frequency Devices
558074 D01 DTS Meas Guidance v03r03, June 9, 2015	FCC Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247
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
RSS-247 Issue 1: 2015	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSs) and Licence- Exempt Local Area Network (LE-LAN) Devices
RSS-Gen Issue 4: 2014	General Requirements for Compliance of Radio Apparatus



### 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 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)



Antenna factor, HL 4933



### Active Horn Antenna Factor Calibration

1 GHz to 18 GHz

<b>Equipment:</b>	<b>ACTIVE HORN ANTENNA</b>
<b>Model:</b>	<b>AHA-118</b>
<b>Serial Number:</b>	<b>701046</b>
<b>Calibration Distance:</b>	<b>3 Meter</b>
<b>Polarization:</b>	<b>Horizontal</b>
<b>Calibration Date:</b>	<b>11/12/2014</b>

Frequency (GHz)	Preamplifier Gain (dB)	Antenna Factor with pre-amp (dB/m)	Frequency (GHz)	Preamplifier Gain (dB)	Antenna Factor with pre-amp (dB/m)
1	40.96	-16.47	10	40.94	-1.97
1.5	41.21	-14.53	10.5	40.63	-1.06
2	41.44	-13.30	11	40.74	-1.50
2.5	41.71	-12.87	11.5	40.65	-0.52
3	41.96	-12.26	12	40.76	-0.15
3.5	42.14	-11.77	12.5	41.03	-0.85
4	42.13	-10.91	13	41.37	-0.81
4.5	41.79	-9.41	13.5	41.18	0.05
5	41.44	-7.54	14	40.98	0.36
5.5	40.91	-6.47	14.5	40.81	1.26
6	40.69	-5.48	15	40.65	0.25
6.5	40.64	-5.53	15.5	40.93	-1.05
7	40.76	-4.12	16	41.31	-1.44
7.5	40.94	-3.12	16.5	40.96	-0.80
8	40.68	-1.69	17	40.64	-0.02
8.5	40.08	-1.71	17.5	40.57	1.81
9	40.41	-1.86	18	40.08	3.63
9.5	41.21	-2.73			

Calibration according to ARP 958

**Antenna Factor to be added to receiver reading:**

Meter Reading (dBuV) + Antenna Factor (dB/m) = Corrected Reading (dBuV/m)



Antenna factor, HL 4956



### Active Horn Antenna Factor Calibration 18 GHz to 40 GHz

<b>Equipment:</b>			<b>ACTIVE HORN ANTENNA</b>		
<b>Model:</b>			<b>AHA-840</b>		
<b>Serial Number:</b>			<b>105004</b>		
<b>Calibration Distance:</b>			<b>3 meter</b>		
<b>Polarization:</b>			<b>Horizontal</b>		
<b>Calibration Date:</b>			<b>1/26/2015</b>		
Frequency (GHz)	Preamplifier Gain (dB)	Antenna Factor with pre-amp (dB/m)	Frequency (GHz)	Preamplifier Gain (dB)	Antenna Factor with pre-amp (dB/m)
18	38.83	-1.06	29.5	42.47	-5.33
18.5	39.34	-2.65	30	41.91	-4.86
19	39.71	-3.88	30.5	41.60	-4.64
19.5	39.87	-4.35	31	41.52	-4.60
20	39.98	-3.97	31.5	41.56	-4.79
20.5	40.42	-3.68	32	41.80	-5.21
21	41.12	-4.06	32.5	42.29	-5.54
21.5	41.74	-5.46	33	42.79	-5.63
22	42.14	-6.22	33.5	42.88	-5.38
22.5	42.35	-6.42	34	42.62	-4.76
23	42.50	-6.59	34.5	42.63	-4.84
23.5	42.65	-6.82	35	43.15	-5.13
24	42.81	-7.01	35.5	43.91	-5.83
24.5	42.86	-7.37	36	44.59	-6.39
25	42.73	-7.53	36.5	45.04	-6.64
25.5	42.77	-7.45	37	45.08	-6.40
26	42.85	-7.21	37.5	44.82	-5.75
26.5	42.98	-7.17	38	44.16	-4.58
27	43.14	-7.22	38.5	42.90	-2.66
27.5	43.18	-7.32	39	42.39	-1.71
28	43.04	-7.10	39.5	43.76	-2.49
28.5	43.01	-6.73	40	45.98	-5.21
<p>Calibration per ANSI C63.5: 2006  <b>Standard Site Method, Equations 1-6 (3-antenna)</b></p> <p>Corrected Reading (dBμV/m) = Meter Reading (dBμV) + AFE(dB/m)</p>					





**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 70045, 18 GHz, 1.8 m, SMA/M - N/M**  
**CBL-6FT-SMNM+, HL 4273**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.09	4800	1.76	9800	2.70	14800	3.59
30	0.11	4900	1.78	9900	2.71	14900	3.59
50	0.14	5000	1.81	10000	2.73	15000	3.60
100	0.20	5100	1.82	10100	2.75	15100	3.63
200	0.30	5200	1.86	10200	2.76	15200	3.67
300	0.38	5300	1.89	10300	2.79	15300	3.70
400	0.45	5400	1.92	10400	2.81	15400	3.68
500	0.50	5500	1.96	10500	2.82	15500	3.70
600	0.55	5600	2.00	10600	2.83	15600	3.71
700	0.60	5700	2.03	10700	2.87	15700	3.77
800	0.65	5800	2.04	10800	2.87	15800	3.75
900	0.69	5900	2.07	10900	2.88	15900	3.77
1000	0.73	6000	2.10	11000	2.89	16000	3.79
1100	0.77	6100	2.10	11100	2.91	16100	3.85
1200	0.80	6200	2.11	11200	2.92	16200	3.82
1300	0.84	6300	2.11	11300	2.94	16300	3.83
1400	0.88	6400	2.14	11400	2.95	16400	3.88
1500	0.92	6500	2.15	11500	2.98	16500	3.89
1600	0.95	6600	2.15	11600	3.00	16600	3.92
1700	0.98	6700	2.16	11700	3.02	16700	3.88
1800	1.01	6800	2.19	11800	3.04	16800	3.95
1900	1.04	6900	2.22	11900	3.08	16900	3.91
2000	1.07	7000	2.24	12000	3.09	17000	3.97
2100	1.09	7100	2.26	12100	3.12	17100	3.92
2200	1.13	7200	2.29	12200	3.13	17200	3.94
2300	1.15	7300	2.32	12300	3.16	17300	3.94
2400	1.18	7400	2.36	12400	3.17	17400	3.98
2500	1.21	7500	2.39	12500	3.19	17500	3.93
2600	1.24	7600	2.41	12600	3.20	17600	3.95
2700	1.27	7700	2.43	12700	3.21	17700	3.96
2800	1.30	7800	2.46	12800	3.21	17800	3.97
2900	1.34	7900	2.49	12900	3.22	17900	3.96
3000	1.36	8000	2.52	13000	3.22	18000	3.97
3100	1.38	8100	2.52	13100	3.24		
3200	1.41	8200	2.54	13200	3.24		
3300	1.45	8300	2.59	13300	3.27		
3400	1.46	8400	2.61	13400	3.28		
3500	1.49	8500	2.60	13500	3.31		
3600	1.51	8600	2.63	13600	3.31		
3700	1.55	8700	2.65	13700	3.35		
3800	1.34	8800	2.65	13800	3.37		
3900	1.36	8900	2.65	13900	3.40		
4000	1.38	9000	2.66	14000	3.43		
4100	1.41	9100	2.66	14100	3.45		
4200	1.45	9200	2.67	14200	3.46		
4300	1.46	9300	2.67	14300	3.46		
4400	1.49	9400	2.67	14400	3.49		
4500	1.51	9500	2.68	14500	3.50		
4600	1.55	9600	2.69	14600	3.50		
4700	1.34	9700	2.69	14700	3.52		





**Cable loss**  
**Microwave Cable Assembly, 18.0 GHz, 3.4 m, SMA/SMA, Huber-Suhner,**  
**Sucoflex P103, HL 4294**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.11	4900	2.09	10000	2.90	15100	3.61
30	0.17	5000	2.10	10100	2.92	15200	3.67
50	0.22	5100	2.14	10200	2.95	15300	3.63
100	0.30	5200	2.16	10300	2.96	15400	3.64
200	0.42	5300	2.17	10400	2.99	15500	3.68
300	0.51	5400	2.19	10500	2.99	15600	3.71
400	0.59	5500	2.19	10600	3.03	15700	3.74
500	0.66	5600	2.22	10700	3.03	15800	3.71
600	0.72	5700	2.24	10800	3.04	15900	3.74
700	0.77	5800	2.23	10900	3.05	16000	3.71
800	0.82	5900	2.26	11000	3.09	16100	3.73
900	0.88	6000	2.27	11100	3.07	16200	3.76
1000	0.93	6100	2.26	11200	3.08	16300	3.82
1100	0.98	6200	2.29	11300	3.11	16400	3.90
1200	1.02	6300	2.30	11400	3.12	16500	3.81
1300	1.06	6400	2.34	11500	3.11	16600	3.88
1400	1.10	6500	2.34	11600	3.15	16700	3.87
1500	1.14	6600	2.36	11700	3.16	16800	3.89
1600	1.19	6700	2.36	11800	3.18	16900	3.95
1700	1.23	6800	2.39	11900	3.19	17000	4.02
1800	1.27	6900	2.39	12000	3.23	17100	4.04
1900	1.30	7000	2.44	12100	3.25	17200	3.99
2000	1.35	7100	2.46	12200	3.22	17300	4.03
2100	1.38	7200	2.44	12300	3.25	17400	4.03
2200	1.42	7300	2.48	12400	3.25	17500	4.06
2300	1.45	7400	2.47	12500	3.28	17600	4.05
2400	1.48	7500	2.48	12600	3.27	17700	4.12
2500	1.51	7600	2.50	12700	3.27	17800	4.14
2600	1.55	7700	2.53	12800	3.30	17900	4.18
2700	1.59	7800	2.56	12900	3.30	18000	4.14
2800	1.62	7900	2.55	13000	3.27		
2900	1.65	8000	2.56	13100	3.32		
3000	1.66	8100	2.56	13200	3.32		
3100	1.69	8200	2.57	13300	3.32		
3200	1.71	8300	2.59	13400	3.35		
3300	1.74	8400	2.62	13500	3.38		
3400	1.76	8500	2.67	13600	3.39		
3500	1.78	8600	2.65	13700	3.42		
3600	1.80	8700	2.68	13800	3.47		
3700	1.85	8800	2.68	13900	3.45		
3800	1.88	8900	2.68	14000	3.49		
3900	1.90	9000	2.74	14100	3.50		
4000	1.91	9100	2.74	14200	3.55		
4100	1.93	9200	2.76	14300	3.59		
4200	1.96	9300	2.78	14400	3.58		
4300	1.97	9400	2.79	14500	3.56		
4400	1.99	9500	2.80	14600	3.57		
4500	2.02	9600	2.83	14700	3.57		
4600	2.02	9700	2.84	14800	3.57		
4700	2.04	9800	2.86	14900	3.64		
4800	2.05	9900	2.92	15000	3.64		



**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**

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