

# TEST REPORT

ACCORDING TO: FCC part 90, subpart I, part 15, subpart B and  
RSS-119 Issue 11:2011, ICES-003 Issue 5:2012

FOR:

**Telematics Wireless Ltd.**  
**Water meeter system base station**  
**Model: 2WAY Base Station**  
**FCC ID:NTA2WBS1**  
**IC: 4732A-2WBS1**

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## 1 Applicant information

**Client name:** Telematics Wireless Ltd.  
**Address:** 26 Hamelaha street, POB 1911, Holon, 58117, Israel  
**Telephone:** +972 3557 5706  
**Fax:** +972 3557 5703  
**E-mail:** itsikk@tlmw.com  
**Contact name:** Mr. Itsik Kanner

## 2 Equipment under test attributes

**Product name:** Water meeter system base station  
**Product type:** Transceiver  
**Model(s):** 2WAY Base Station  
**Serial number:** 100002  
**Hardware version:** Rev A  
**Software release:** 2WBST\_260213\_SW\_v100  
**Receipt date** 2/24/2013

## 3 Manufacturer information

**Manufacturer name:** Telematics Wireless Ltd.  
**Address:** 26 Hamelaha street, POB 1911, Holon, 58117, Israel  
**Telephone:** +972 3557 5706  
**Fax:** +972 3557 5703  
**E-Mail:** itsikk@tlmw.com  
**Contact name:** Mr. Itsik Kanner




## 4 Test details

**Project ID:** 24209  
**Location:** Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel  
**Test started:** 2/24/2013  
**Test completed:** 3/25/2013  
**Test specification(s):** FCC part 90, subpart I; part 15, subpart B, §§15.107, 15.109, 15.111;  
RSS-119 issue 11, RSS-Gen issue 3, ICES-003 issue 5:2012

## 5 Tests summary

Test	Status
<b>Transmitter characteristics</b>	
FCC part 90 Section 90.261(b) / RSS-119 Section 5.4, Maximum output power	Pass
FCC part 90 Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth	Pass
FCC part 90 Section 90.210(e) / RSS-119 Section 5.8.4, Emission mask	Pass
FCC part 90 Section 90.210(e) / RSS-119 Section 5.8.4, Radiated spurious emissions	Pass
FCC part 90 Section 90.210(e) / RSS-119 Section 5.8.4, Conducted spurious emissions	Pass
FCC part 90 Section 90.213/ RSS-119 Section 5.3, Frequency stability	Pass
FCC Section 90.214, Transient frequency behaviour	Pass
FCC part 1 Section 1.1310 / RSS-Gen Section 5.5, RF radiation exposure evaluation	Pass, Exhibit in application for certification provided
<b>Unintentional emissions</b>	
FCC part 15 Section 15.107 / RSS-Gen, Section 7.2.4/ ICES-003, Section 6.1 class B, Conducted emission at AC power port	Pass
FCC part 15 Section 15.109 / RSS-119 Section 5.11 / RSS-Gen, Section 6.1/ ICES-003, Section 6.2 class B, Radiated emission	Pass
FCC part 15 Section 15.111/ RSS-Gen Section 6.2, Conducted emission at receiver antenna port	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.

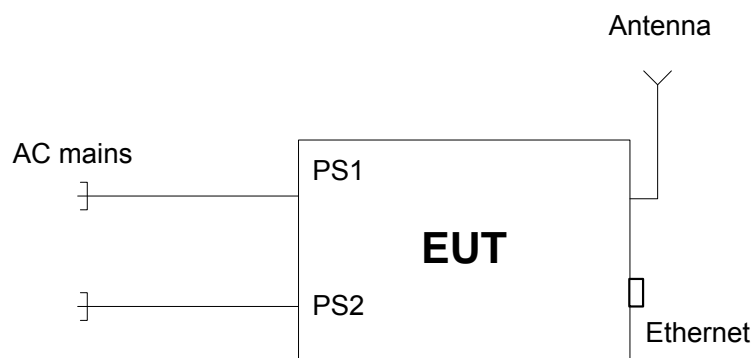
	Name and Title	Date	Signature
<b>Tested by:</b>	Mrs. E. Pitt, test engineer	March 25, 2013	
<b>Reviewed by:</b>	Mrs. M. Cherniavsky, certification engineer	April 7, 2013	
<b>Approved by:</b>	Mr. M. Nikishin, EMC and Radio group manager	May 31, 2013	

## 6 EUT description

### 6.1 General information

The EUT is a Base Station transceiver of an automatic water meter reading system, which operates in 450-470 MHz band. The device utilizes an external antenna and is powered by AC via PS1 and PS2 internal power supplies. The device block diagram is provided in Operational description exhibit of Application for certification.

### 6.2 Test configuration



### 6.3 Operating frequencies

Source	Frequency, MHz	
Clock	6.3	
LO	940	380-400

### 6.4 Changes made in the EUT

The following changes were implemented in the EUT during testing to withstand the standard requirements:

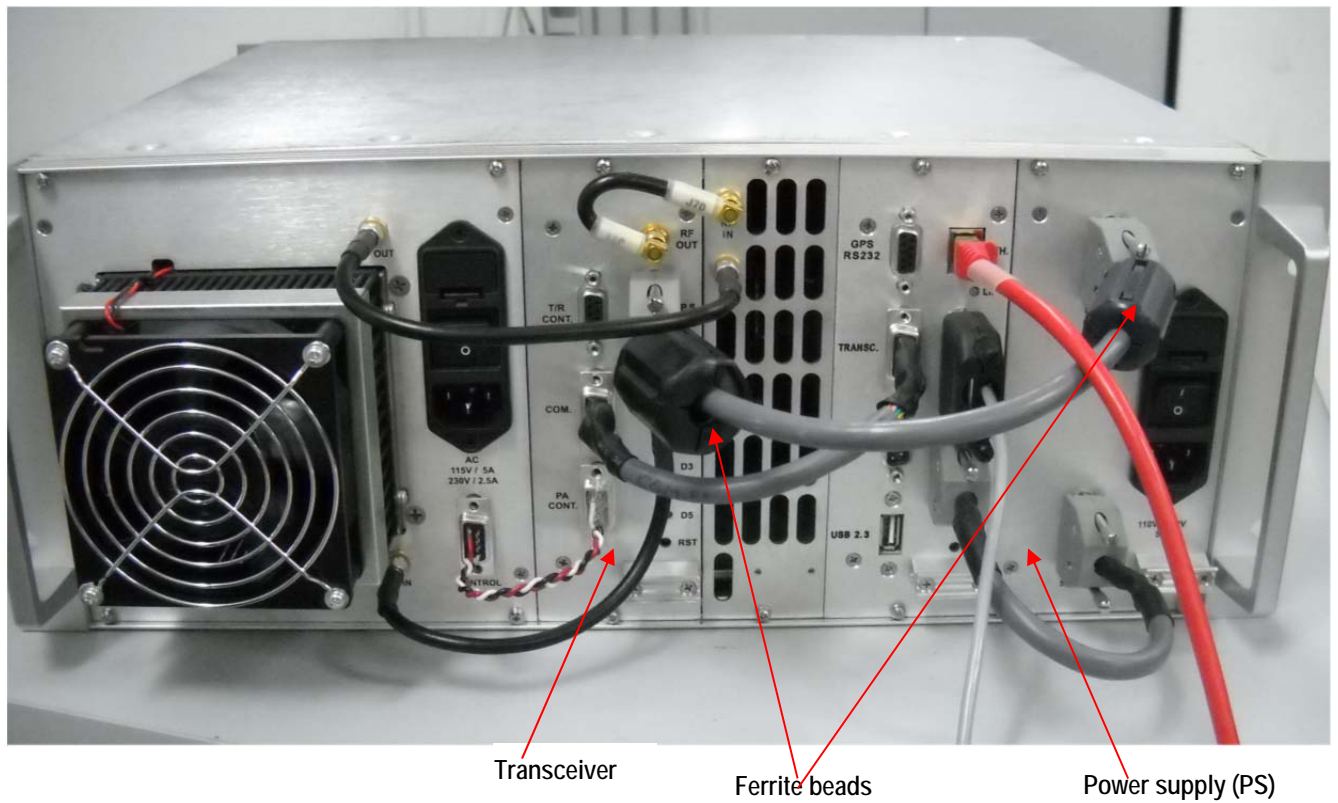
- 1) a ferrite bead p/n 0446164181 manufactured by Fair-Rite was installed on OCXO cable inside the EUT as shown in Photograph 6.4.1;
- 2) 2 ferrite beads p/n 0431164181 and p/n 0431167281 manufactured by Fair-Rite were installed between transceiver module and PS module as shown in Photograph 6.4.2.

It is manufacturer responsibility to implement the change in the production version of the EUT. In any case the test report applies to the tested item only.

Photograph 6.4.1 Changes made inside EUT



Photograph 6.4.2 Changes made outside EUT





### 6.5 Transmitter characteristics

<b>Type of equipment</b>											
X	Stand-alone (Equipment with or without its own control provisions)										
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)										
	Plug-in card (Equipment intended for a variety of host systems)										
<b>Intended use</b>		<b>Condition of use</b>									
X	fixed	Always at a distance more than 2 m from all people									
	mobile	Always at a distance more than 20 cm from all people									
	portable	May operate at a distance closer than 20 cm to human body									
<b>Assigned frequency range</b>		450- 470 MHz									
<b>Maximum rated output power</b>		At transmitter 50 Ω RF output connector		43 dBm							
<b>Is transmitter output power variable?</b>		No									
		continuous variable									
		stepped variable with stepsize									
		0.5 dB		minimum RF power		33 dBm					
		X	Yes		maximum RF power		43 dBm				
<b>Antenna connection</b>											
unique coupling		X	standard connector		integral		with temporary RF connector				
						without temporary RF connector					
<b>Antenna/s technical characteristics</b>											
<b>Type</b>		<b>Manufacturer</b>		<b>Model number</b>		<b>Gain</b>					
External		Kenbotong		TQJ-450A3L		2 dBi					
External		Kenbotong		TQJ-400C		5.8 dBi					
<b>Transmitter 99% power bandwidth</b>		6 kHz									
<b>Transmitter aggregate data rate/s</b>		4.8 kbps									
<b>Type of modulation</b>		4GFSK									
<b>Modulating test signal (baseband)</b>		PRBS									
<b>Maximum transmitter duty cycle in normal use</b>		23 %		<b>Tx ON time</b>		900 ms		<b>Period</b>		4 s	
<b>Transmitter duty cycle supplied for test</b>		25 %		<b>Tx ON time</b>		1 s		<b>Period</b>		4 s	
<b>Transmitter power source</b>											
Battery		<b>Nominal rated voltage</b>		VDC		<b>Battery type</b>					
DC		<b>Nominal rated voltage</b>		VDC							
X	AC mains	<b>Nominal rated voltage</b>		120 VAC		<b>Frequency</b>		60 Hz			
<b>Common power source for transmitter and receiver</b>						X		yes		no	



<b>Test specification:</b>	<b>FCC Section 90.261(b) / RSS-119 Section 5.4, Maximum output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

## 7 Transmitter tests according to 47CFR part 90 and RSS-119 requirements

### 7.1 Peak output power test

#### 7.1.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Peak output power limits

Assigned frequency range, MHz	Maximum peak output power	
	W	dBm
450.0 –470.0	20	43.0

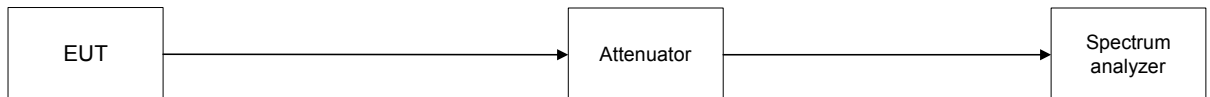
#### 7.1.2 Test procedure

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 adjusted to produce maximum available to the end user RF output power.

7.1.2.3 The peak output power was measured with spectrum analyzer as provided in Table 7.1.2 and the associated plots.

Figure 7.1.1 Peak output power test setup







<b>Test specification:</b>	<b>FCC Section 90.261(b) / RSS-119 Section 5.4, Maximum output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Table 7.1.2 Peak output power test results

ASSIGNED FREQUENCY RANGE: 450 – 470 MHz  
DETECTOR USED: Peak  
RESOLUTION BANDWIDTH: 120 kHz  
VIDEO BANDWIDTH: 300 kHz  
MODULATION: 4GFSK  
MODULATING SIGNAL: PRBS  
BIT RATE: 4.8 kbps  
TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
ANTENNA GAIN: 2 dBi

Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	Cable loss, dB	RF output power, dBm	Limit, dBm	Margin, dB	Verdict
450	42.76	included	included	42.76	43	-0.24	Pass
460	42.94	included	included	42.94	43	-0.06	Pass
470	43.00	included	included	43.00	43	-0.00	Pass

Reference numbers of test equipment used

HL 1876	HL 3390	HL 3768	HL 3776	HL 3818	HL 3994		
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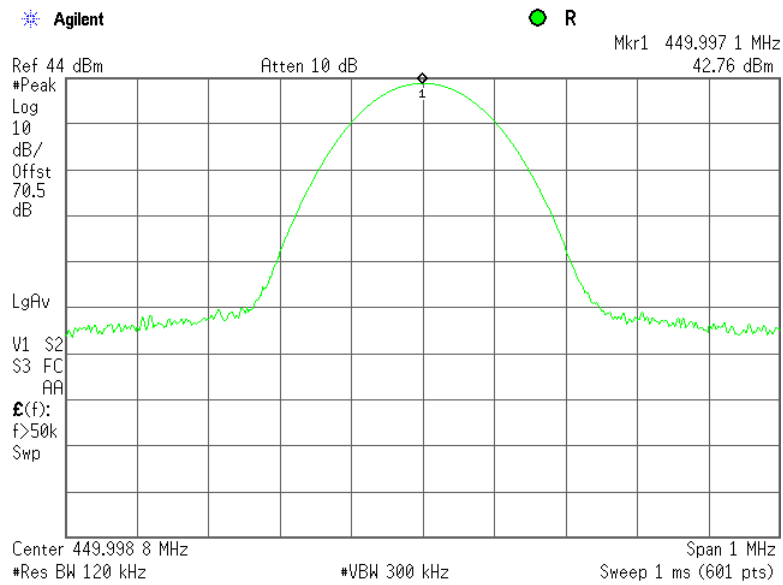
Full description is given in Appendix A.



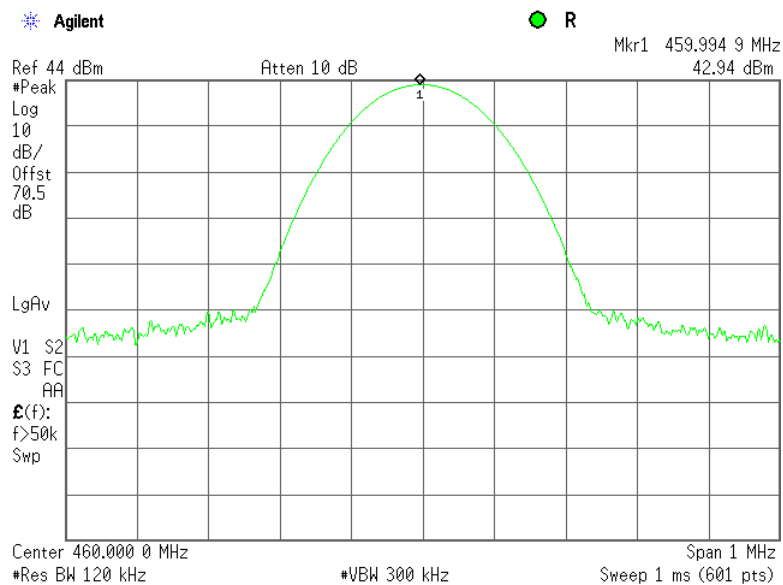
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<b>Test specification:</b>	<b>FCC Section 90.261(b) / RSS-119 Section 5.4, Maximum output power</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

**Plot 7.1.1 Peak output power test results at low frequency**



**Plot 7.1.2 Peak output power test results at mid frequency**

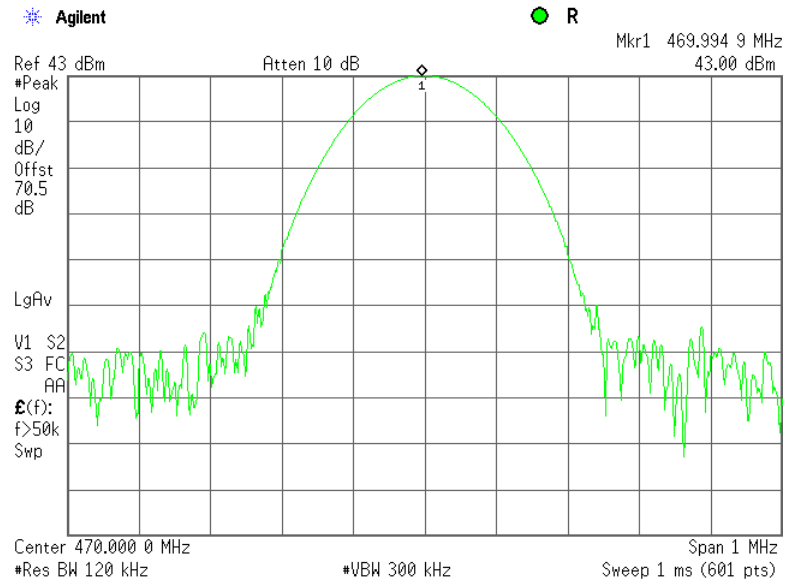




HERMON LABORATORIES

<b>Test specification:</b>		<b>FCC Section 90.261(b) / RSS-119 Section 5.4, Maximum output power</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1	
<b>Test mode:</b>		<b>Verdict:</b>	
Compliance		PASS	
<b>Date(s):</b>		3/3/2013	
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.1.3 Peak output power test results at high frequency





<b>Test specification:</b>		<b>FCC Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1049	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		3/3/2013	
<b>Temperature:</b> 23 °C		<b>Air Pressure:</b> 1016 hPa	
		<b>Relative Humidity:</b> 48 %	
		<b>Power Supply:</b> 120 VAC	
<b>Remarks:</b>			

## 7.2 Occupied bandwidth test

### 7.2.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Occupied bandwidth limits

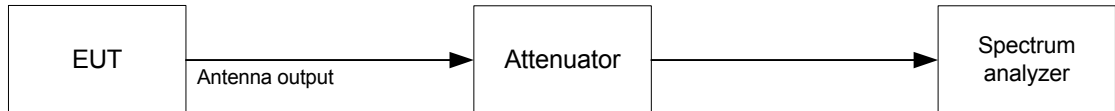
Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
450-470	26	6

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

### 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 set to transmit the unmodulated carrier and the reference peak power level was measured.
- 7.2.2.3 The EUT was set to transmit the normally modulated carrier.
- 7.2.2.4 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.2.2 and the associated plots.

Figure 7.2.1 Occupied bandwidth test setup





<b>Test specification:</b>	<b>FCC Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth</b>		
<b>Test procedure:</b>	47 CFR, Section 2.1049		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1016 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Table 7.2.2 Occupied bandwidth test results

DETECTOR USED: Peak hold  
 RESOLUTION BANDWIDTH: 300 Hz  
 VIDEO BANDWIDTH: 3 kHz  
 MODULATION ENVELOPE REFERENCE POINTS: 26 dBc  
 MODULATION: 4GFSK  
 MODULATING SIGNAL: PRBS  
 BIT RATE: 4.8 kbps

MODULATION ENVELOPE REFERENCE POINTS: 20 dBc

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
450	5.094	6	-0.906	Pass
460	5.011	6	-0.989	Pass
470	4.794	6	-1.206	Pass

MODULATION ENVELOPE REFERENCE POINTS: 99% power

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit stated by manufacturer, kHz	Margin, kHz	Verdict
450	3.535	3.7	-0.165	Pass
460	3.4975	3.7	-0.202	Pass
470	3.6863	3.7	-0.014	Pass

Reference numbers of test equipment used

HL 1876	HL 3390	HL 3768	HL 3776	HL 3818	HL 3994		
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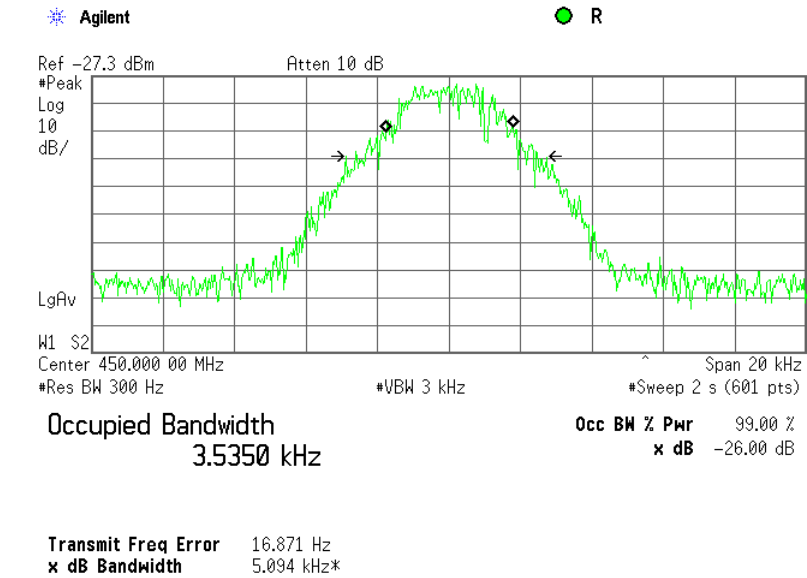
Full description is given in Appendix A.



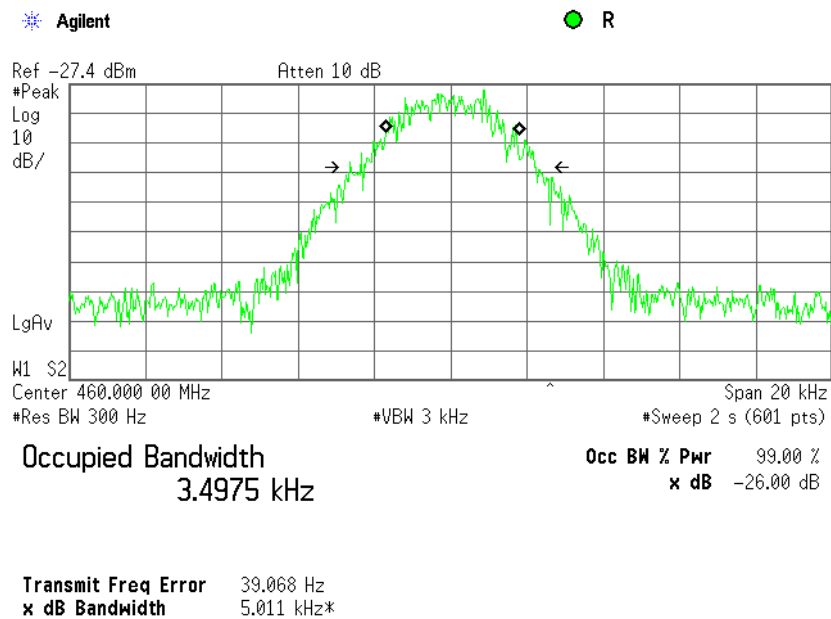
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<b>Test specification:</b> FCC Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth	
<b>Test procedure:</b> 47 CFR, Section 2.1049	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 3/3/2013	
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1016 hPa
	<b>Relative Humidity:</b> 48 %
<b>Power Supply:</b> 120 VAC	
<b>Remarks:</b>	

Plot 7.2.1 Occupied bandwidth test result at low frequency



Plot 7.2.2 Occupied bandwidth test result at mid frequency

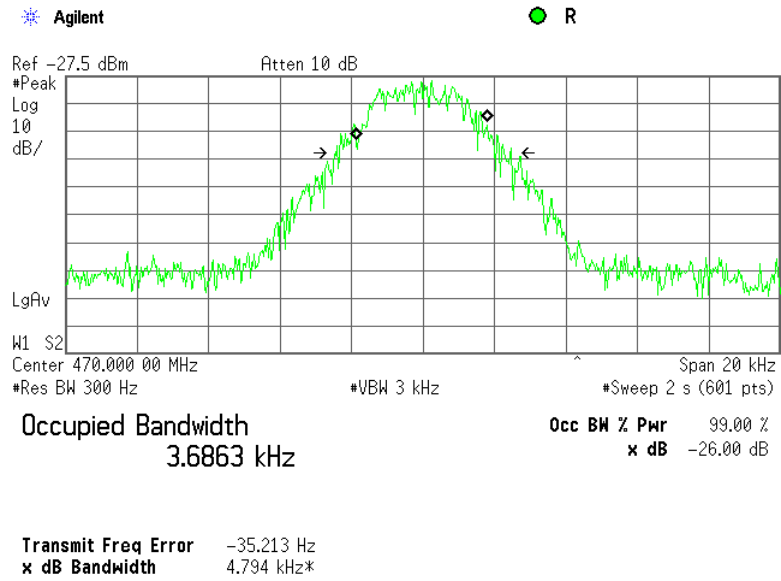




HERMON LABORATORIES

<b>Test specification:</b> FCC Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth			
<b>Test procedure:</b> 47 CFR, Section 2.1049			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 3/3/2013			
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1016 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.2.3 Occupied bandwidth test result at high frequency





<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Emission mask</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051, 2.1047 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

### 7.3 Emission mask test

#### 7.3.1 General

This test was performed to measure emission mask at RF antenna connector. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Emission mask limits

Frequency displacement from carrier	Attenuation below carrier, dBc	
	FCC section 90.210	RSS-119
Emission mask E (Channel bandwidth 6.25 kHz, authorized bandwidth 6 kHz)		
0 – 3.0 kHz	0	0
3.0 – 4.6 kHz	30 +16.67 (fd -3 kHz)	30 +16.67 (fd -3 kHz) or 55+10logP(W) whichever is the lesser
More than 4.6 kHz	55+10logP(W) or 65 whichever is the lesser	55+10logP(W) or 57 whichever is the lesser

\* - linearly increase with frequency

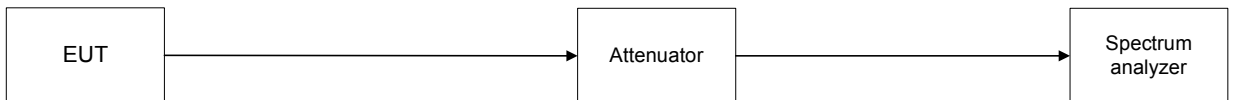
\*\* - emission mask includes carrier modulation envelope within ± 250 % of the authorized bandwidth; the frequency range removed beyond ± 250 % of the authorized bandwidth from carrier was investigated as spurious emission

#### 7.3.2 Test procedure

7.3.2.1 The EUT was set up as shown in Figure 7.3.1, energized and its proper operation was checked.

7.3.2.2 The emission mask was measured with spectrum analyzer as provided in the associated plots. The test results recorded in Table 7.3.2.

Figure 7.3.1 Emission mask test setup







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<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Emission mask</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051, 2.1047 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Table 7.3.2 Emission mask test results

Carrier frequency, MHz	Limit	Verdict
450	Emission mask E	Pass
460		
470		

**Reference numbers of test equipment used**

HL 1876	HL 3390	HL 3768	HL 3776	HL 3818	HL 3994		
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Full description is given in Appendix A.

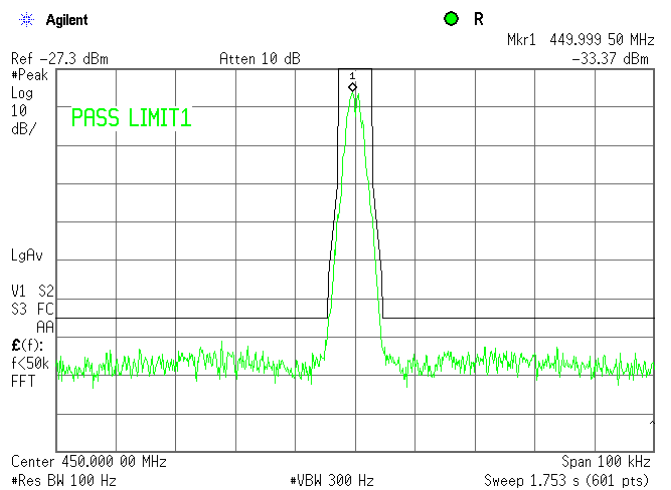
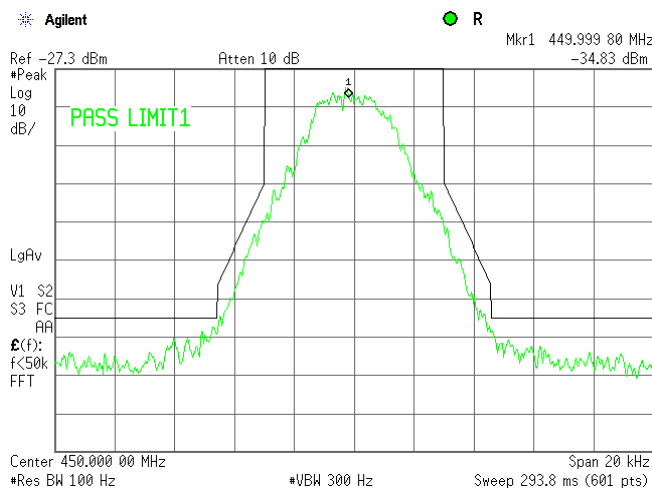
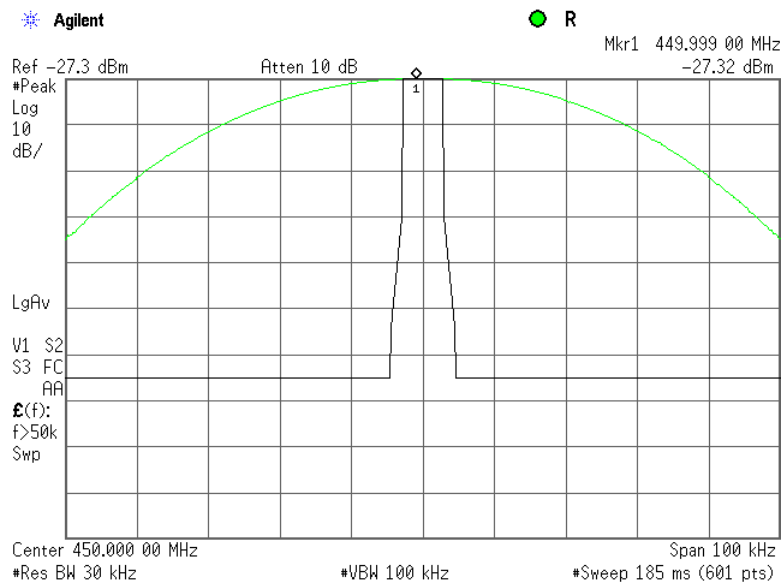


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<b>Test specification:</b> FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Emission mask	
<b>Test procedure:</b> 47 CFR, Sections 2.1051, 2.1047 and 90.210(e); TIA/EIA-603-C, Section 2.2.13	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 3/3/2013	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa
	<b>Relative Humidity:</b> 48 %
	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>	

**Plot 7.3.1 Emission mask test results at low carrier frequency**

OPERATING FREQUENCY RANGE: 450-470 MHz  
DETECTOR USED: Peak  
MODULATION: 4 GFSK  
MODULATING SIGNAL: PRBS  
BIT RATE: 4.8 kbps  
TRANSMITTER OUTPUT POWER SETTINGS: Maximum



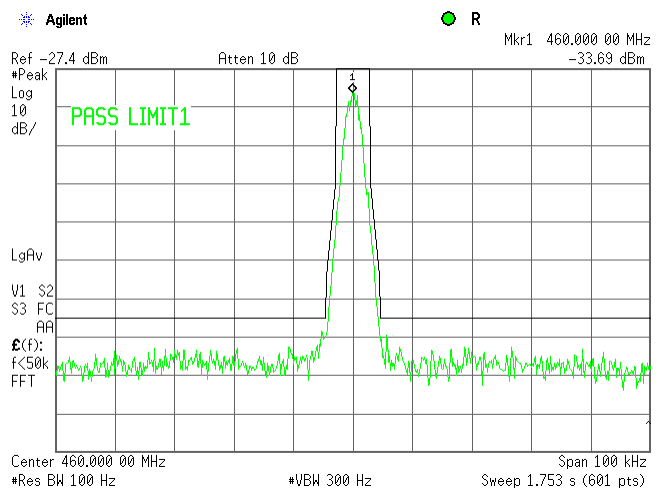
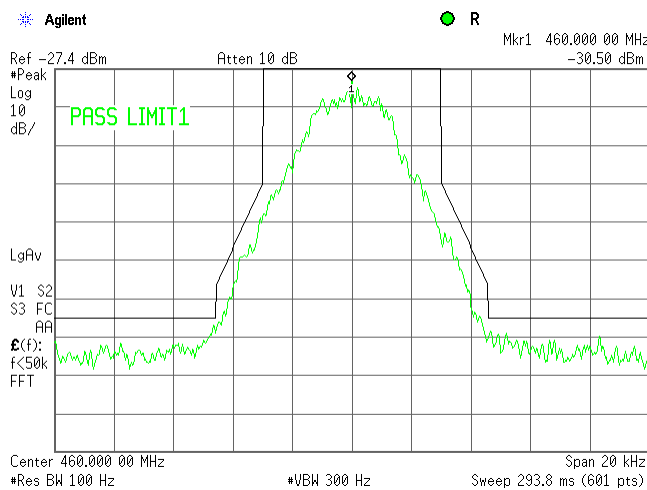
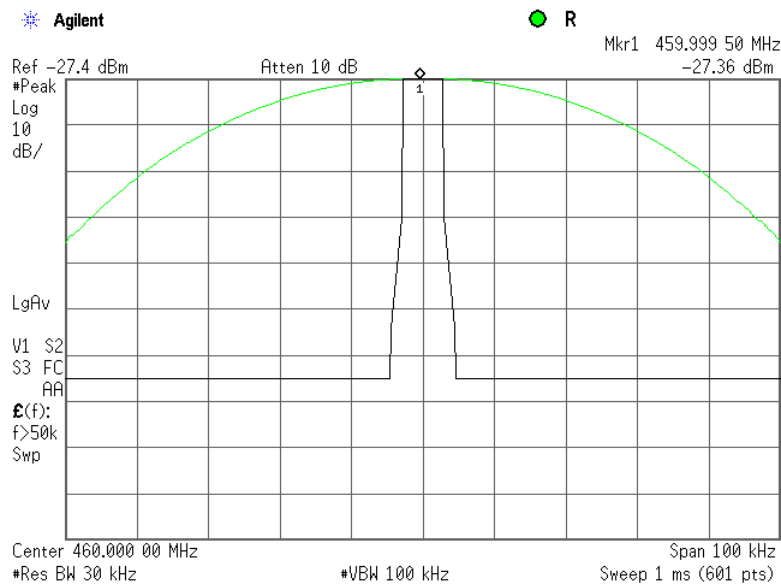


HERMON LABORATORIES

<b>Test specification:</b> FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Emission mask	
<b>Test procedure:</b> 47 CFR, Sections 2.1051, 2.1047 and 90.210(e); TIA/EIA-603-C, Section 2.2.13	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 3/3/2013	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa
	<b>Relative Humidity:</b> 48 %
	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>	

**Plot 7.3.2 Emission mask test results at mid carrier frequency**

OPERATING FREQUENCY RANGE: 450-470 MHz  
DETECTOR USED: Peak  
MODULATION: 4 GFSK  
MODULATING SIGNAL: PRBS  
BIT RATE: 4.8 kbps  
TRANSMITTER OUTPUT POWER SETTINGS: Maximum



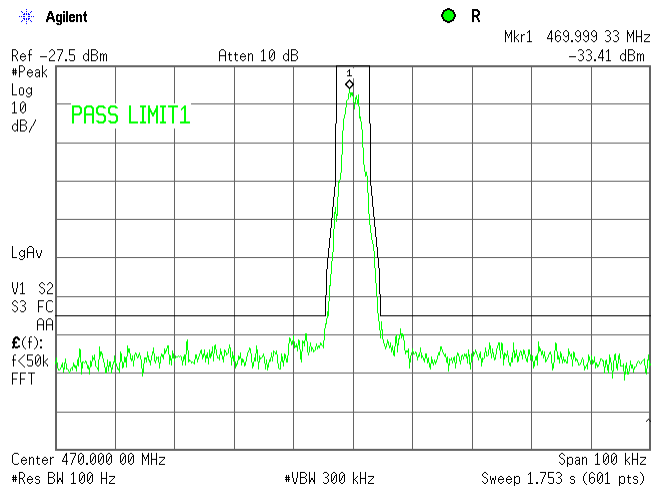
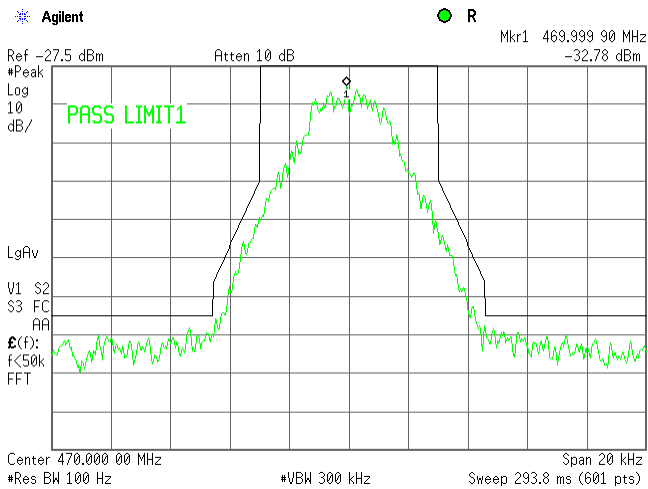
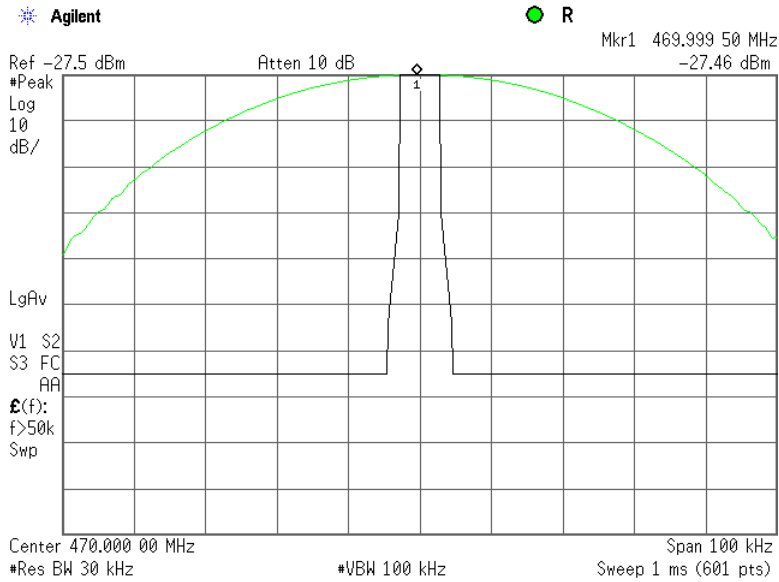


HERMON LABORATORIES

<b>Test specification:</b> FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Emission mask	
<b>Test procedure:</b> 47 CFR, Sections 2.1051, 2.1047 and 90.210(e); TIA/EIA-603-C, Section 2.2.13	
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS
<b>Date(s):</b> 3/3/2013	
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa
	<b>Relative Humidity:</b> 48 %
	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>	

**Plot 7.3.3 Emission mask test results at high carrier frequency**

OPERATING FREQUENCY RANGE: 450-470 MHz  
DETECTOR USED: Peak  
MODULATION: 4 GFSK  
MODULATING SIGNAL: PRBS  
BIT RATE: 4.8 kbps  
TRANSMITTER OUTPUT POWER SETTINGS: Maximum





<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-C, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	3/5/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

## 7.4 Radiated spurious emission measurements

### 7.4.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Radiated spurious emission test limits

Frequency, MHz	Attenuation below carrier, dBc	ERP of spurious, dBm	Equivalent field strength limit @ 3m, dB( $\mu$ V/m) <sup>***</sup>
0.009–10th harmonic*	55+10logP <sup>**</sup>	-25	72.4

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

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

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

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

7.4.2.1 The EUT was set up as shown in Figure 7.4.1, energized and the performance check was conducted.

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

7.4.2.3 The worst test results (the lowest margins) were recorded in Table 7.4.2 and shown in the associated plots.

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

7.4.3.1 The EUT was set up as shown in Figure 7.4.2, energized and the performance check was conducted.

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

7.4.3.3 The worst test results (the lowest margins) were recorded in Table 7.4.2 and shown in the associated plots.



<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-C, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/5/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Figure 7.4.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

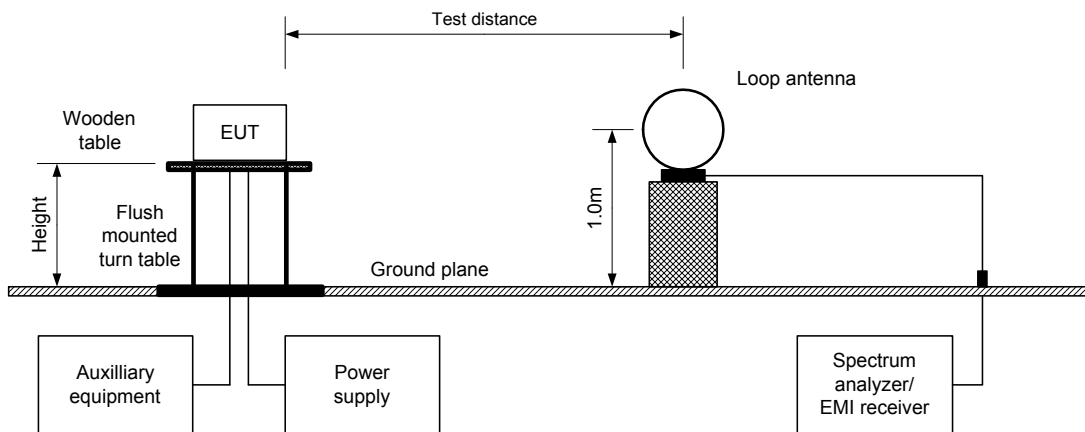
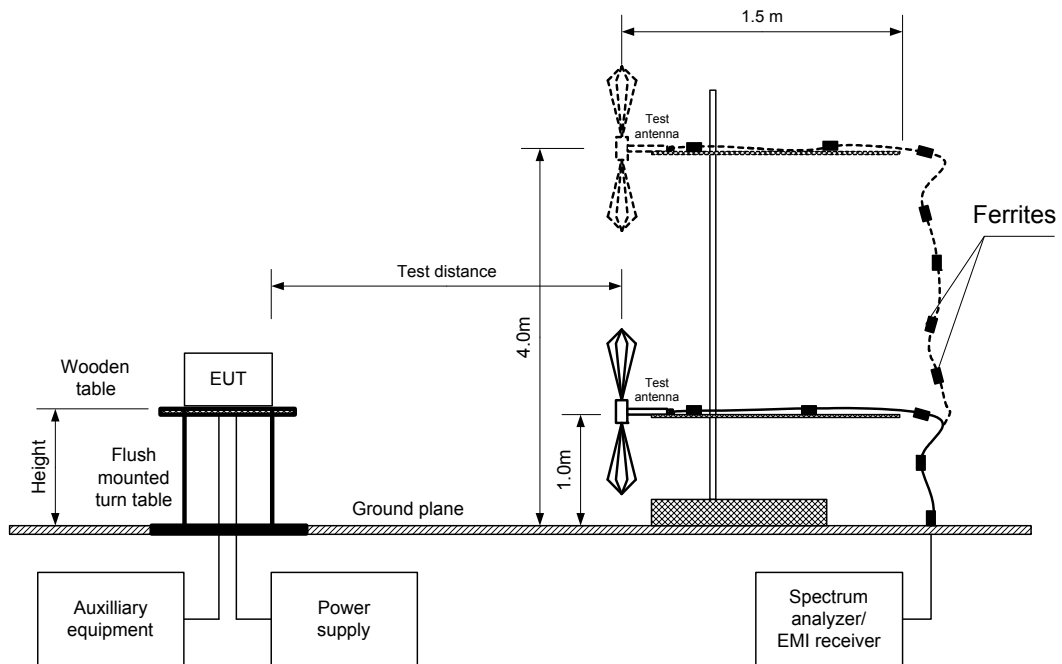


Figure 7.4.2 Setup for spurious emission field strength measurements above 30 MHz





<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-C, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	3/5/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

**Table 7.4.2 Spurious emission field strength test results**

ASSIGNED FREQUENCY RANGE: 450-470 MHz  
 TEST DISTANCE: 3 m  
 TEST SITE: Semi anechoic chamber  
 EUT HEIGHT: 0.8 m  
 INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: > Resolution bandwidth  
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)  
 Biconilog (30 MHz – 1000 MHz)  
 Double ridged guide (above 1000 MHz)  
 MODULATION: 4GFSK  
 BIT RATE: 4.8 kbps  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	Field strength, dB(μV/m)	Limit, dB(μV/m)	Margin, dB*	RBW, kHz	Antenna polarization	Antenna height, m	Turn-table position**, degrees
At least 20 dB below the specified limit							

Verdict: Pass

**Reference numbers of test equipment used**

HL 0446	HL 0604	HL 1984	HL 3340	HL 4160	HL 4339	HL 4352	HL 4353
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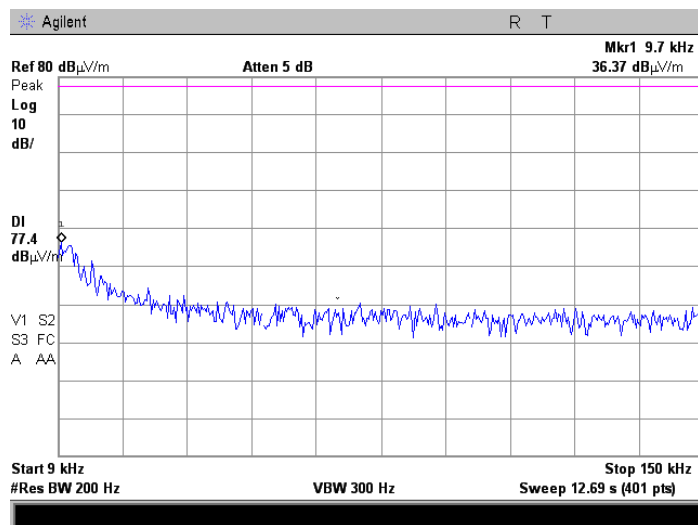
Full description is given in Appendix A.



<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-C, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/5/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

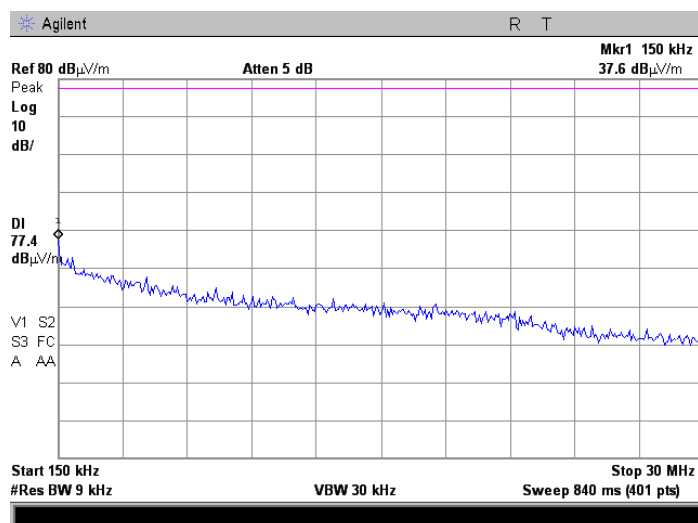
**Plot 7.4.1 Radiated emission measurements in 9 - 150 kHz range**

TEST SITE: Semi anechoic chamber  
 CARRIER FREQUENCY: Low, mid; high  
 TEST DISTANCE: 3 m



**Plot 7.4.2 Radiated emission measurements in 0.15 - 30 MHz range**

TEST SITE: Semi anechoic chamber  
 CARRIER FREQUENCY: Low, mid; high  
 TEST DISTANCE: 3 m





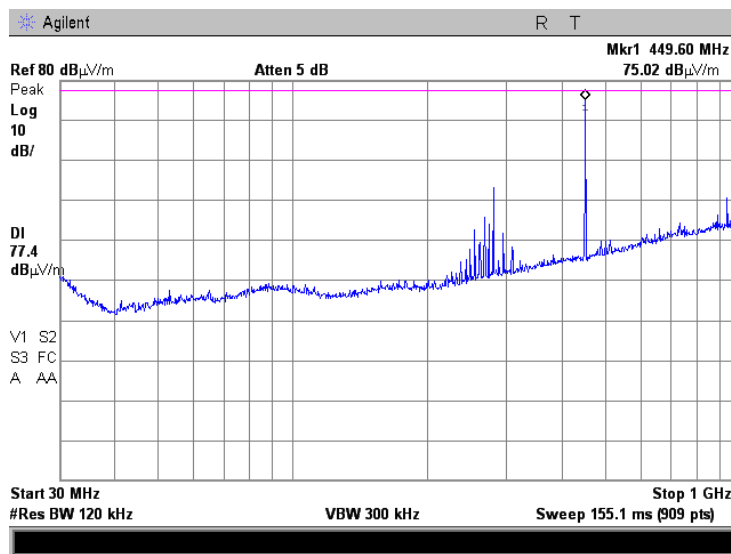


HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-C, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/5/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

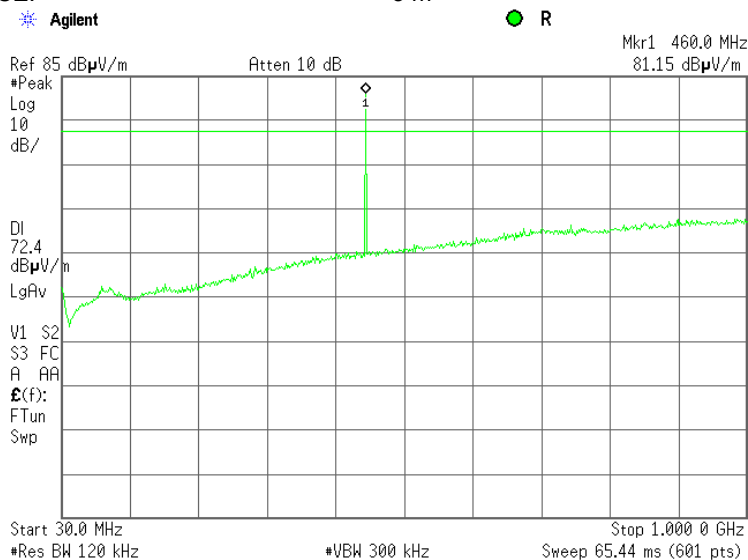
**Plot 7.4.3 Radiated emission measurements in 30 - 1000 MHz range**

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



**Plot 7.4.4 Radiated emission measurements in 30 - 1000 MHz range**

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



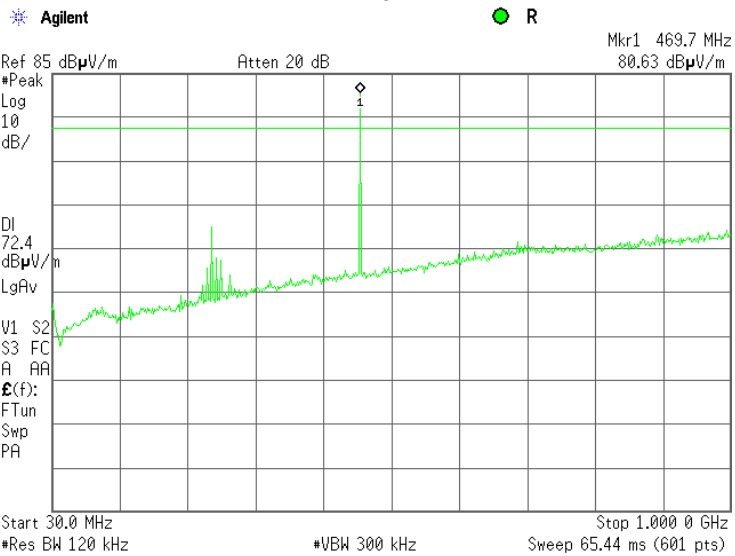


HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Radiated spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-C, Section 2.2.12		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/5/2013	<b>Relative Humidity:</b>	50 %
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Power Supply:</b>	120 VAC
<b>Remarks:</b>			

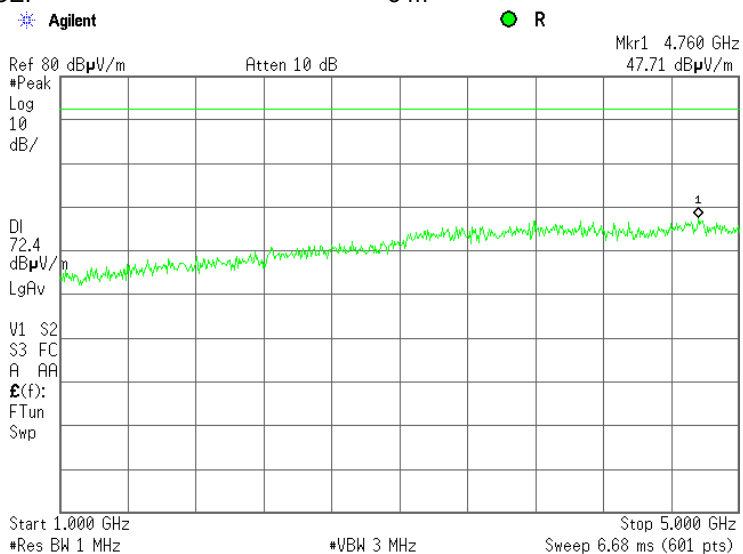
**Plot 7.4.5 Radiated emission measurements in 30 - 1000 MHz range**

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



**Plot 7.4.6 Radiated emission measurements in 1000 – 5000 MHz range**

TEST SITE: Semi anechoic chamber  
 CARRIER FREQUENCY: Low, mid, high  
 ANTENNA POLARIZATION: Vertical and Horizontal  
 TEST DISTANCE: 3 m





<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

## 7.5 Spurious emissions at RF antenna connector test

### 7.5.1 General

This test was performed to measure spurious emissions at RF antenna connector. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Spurious emission limits

Frequency, MHz	Attenuation below carrier, dBc	Limit, dBm
0.009 – 10th harmonic*	65 (mask E)	-22.0

\* - spurious emission limits do not apply to the in band emission within  $\pm 250\%$  of the authorized bandwidth from the carrier; investigated in course of emission mask testing

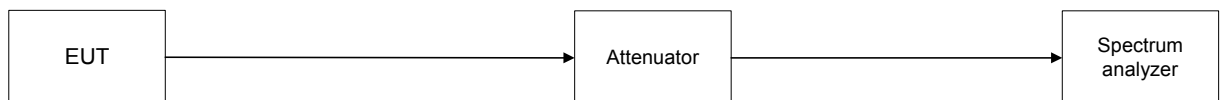
### 7.5.2 Test procedure

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 for end user RF output power.

7.5.2.3 The spurious emission was measured with spectrum analyzer as provided in Table 7.5.2 and the associated plots.

Figure 7.5.1 Spurious emission test setup





<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	3/3/2013		
<b>Temperature: 22 °C</b>	<b>Air Pressure: 1014 hPa</b>	<b>Relative Humidity: 40 %</b>	<b>Power Supply: 120 VAC</b>
<b>Remarks:</b>			

**Table 7.5.2 Spurious emission test results**

ASSIGNED FREQUENCY RANGE: 450 - 470 MHz  
 INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: ≥ Resolution bandwidth  
 MODULATION: 4GFSK  
 MODULATING SIGNAL: PRBS  
 BIT RATE: 4.8 kbps  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Frequency, MHz	SA reading, dBm	Attenuator, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
<b>Low carrier frequency 450 MHz</b>									
439.33	-31.34	included	included	100	-31.34	74.10	65	9.10	Pass
448.45	-28.34	included	included	100	-28.34	71.10	65	6.10	Pass
451.55	-25.31	included	included	100	-25.31	68.07	65	3.07	Pass
900.00	-31.52	included	included	100	-31.52	74.28	65	9.28	Pass
1353.00	-29.59	included	included	1000	-29.59	72.35	65	7.35	Pass
<b>Mid carrier frequency 460 MHz</b>									
458.35	-23.90	included	included	100	-23.90	66.84	65	1.84	Pass
461.55	-32.80	included	included	100	-32.80	75.74	65	10.74	Pass
920.00	-34.71	included	included	100	-34.71	77.65	65	12.65	Pass
1380.00	-37.65	included	included	1000	-37.65	80.59	65	15.59	Pass
<b>High carrier frequency 470 MHz</b>									
468.45	-24.83	included	included	100	-24.83	67.83	65	2.83	Pass
471.55	-33.18	included	included	100	-33.18	76.18	65	11.18	Pass
940.00	-32.25	included	included	100	-32.25	75.25	65	10.25	Pass
1410.00	-31.85	included	included	1000	-31.85	74.85	65	9.85	Pass

\*- Margin = Spurious emission – specification limit.

**Reference numbers of test equipment used**

HL 1876	HL 3339	HL 3350	HL 3390	HL 3768	HL 3776	HL 3818	HL 3994
HL 4339							

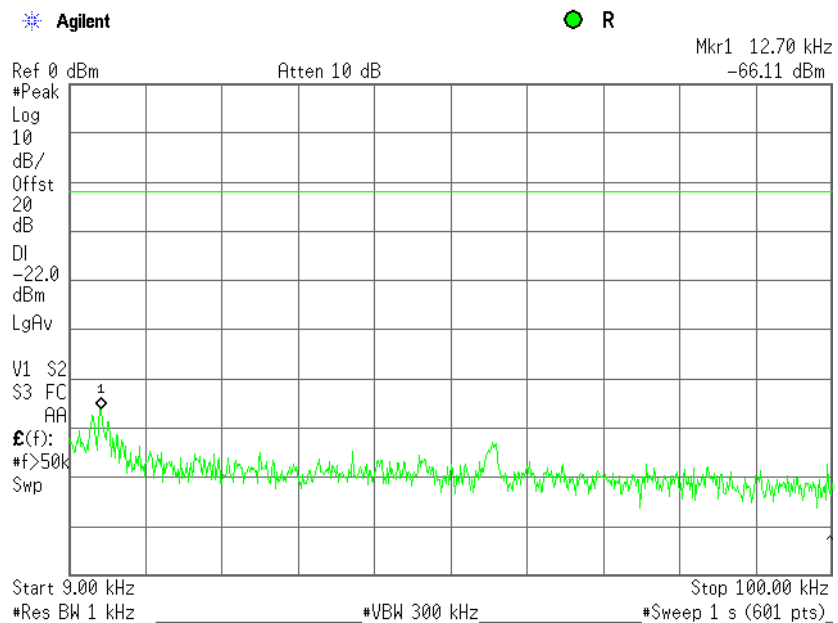
Full description is given in Appendix A.



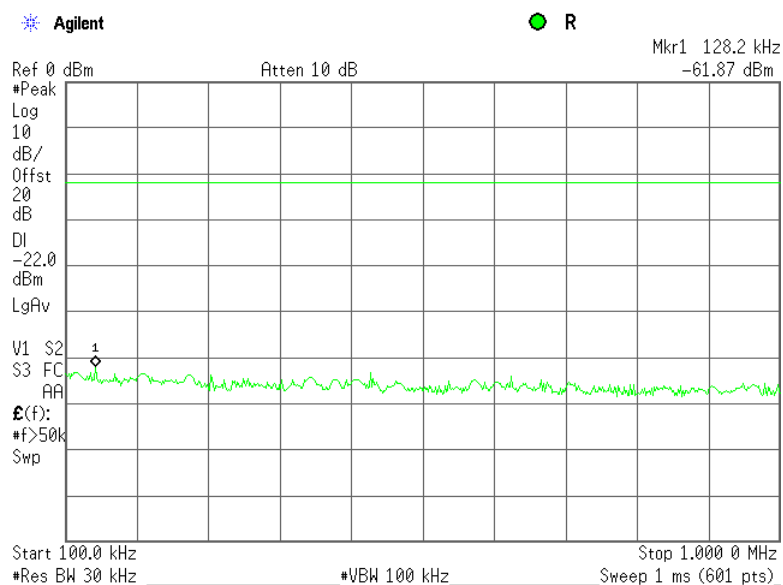
HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.5.1 Spurious emission measurements in 9 - 100 kHz range at low carrier frequency



Plot 7.5.2 Spurious emission measurements in 0.10 - 1.0 MHz range at mid carrier frequency

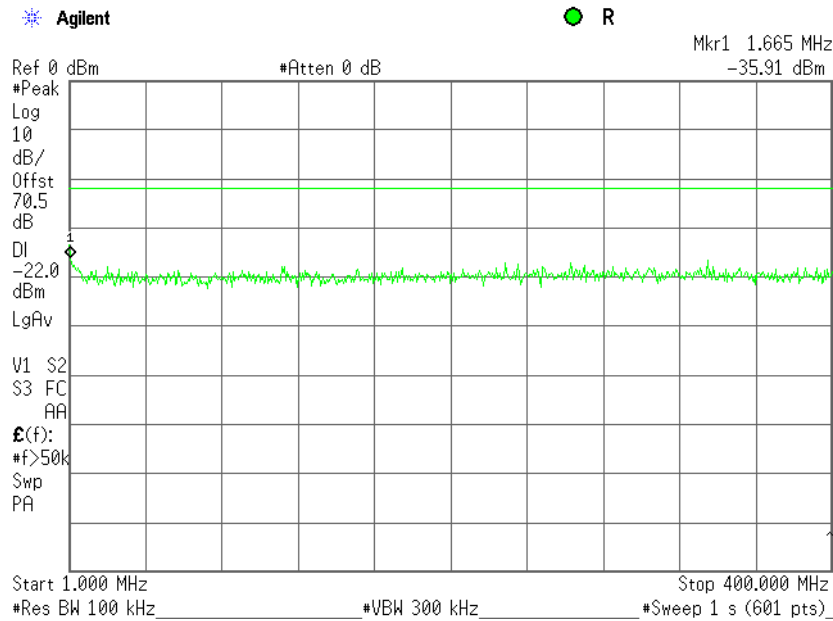




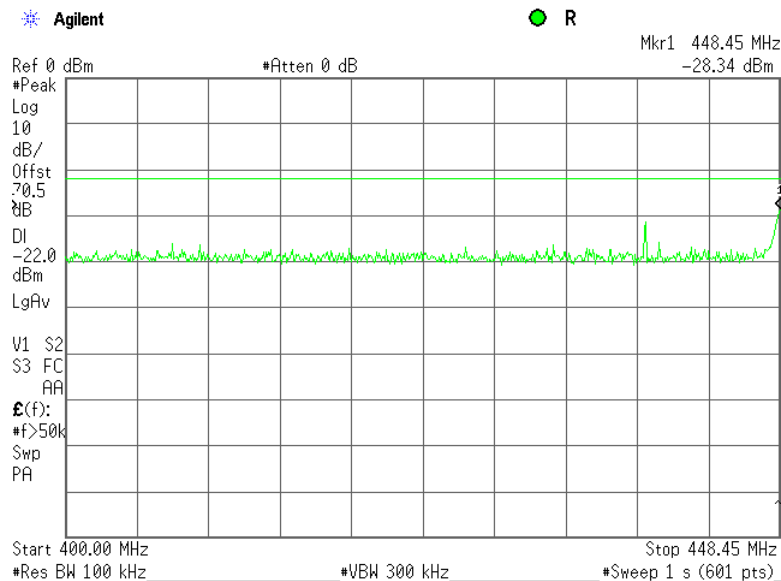
HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013	<b>Relative Humidity:</b>	40 %
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Power Supply:</b>	120 VAC
<b>Remarks:</b>			

Plot 7.5.3 Spurious emission measurements in 1.0 - 400 MHz range at low carrier frequency



Plot 7.5.4 Spurious emission measurements in 400 -448.45 MHz range at low carrier frequency

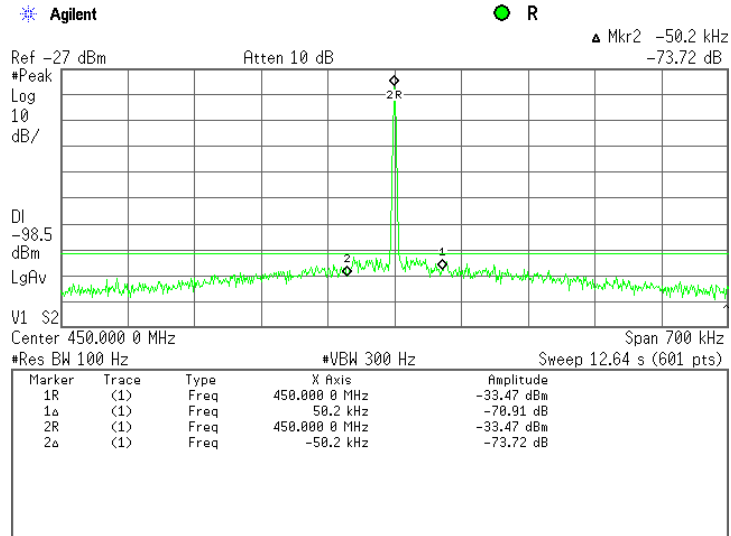




HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

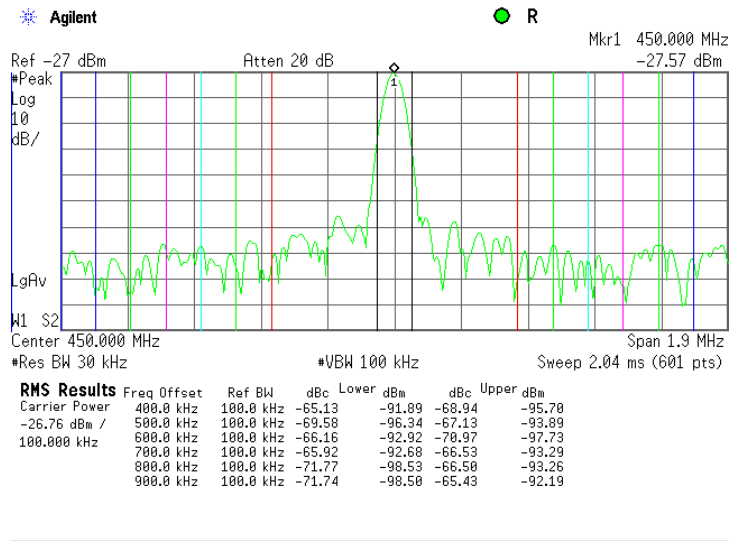
Plot 7.5.5 Spurious emission measurements in 448.45 – 451.55 MHz range at low carrier frequency



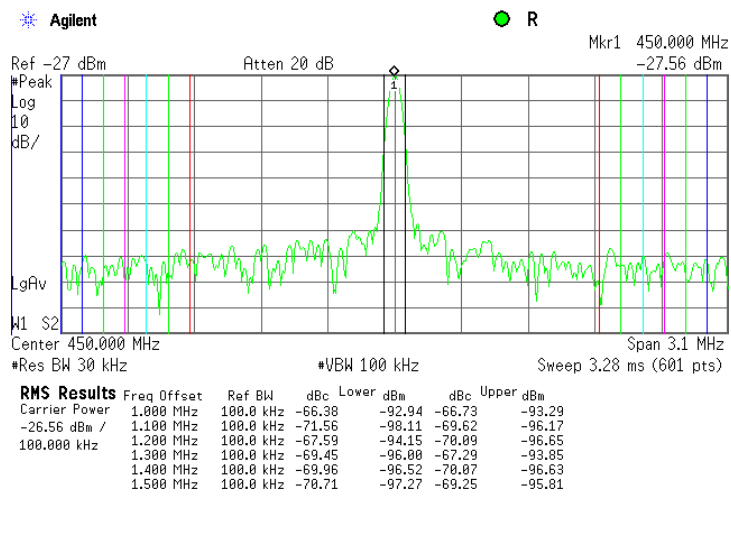


<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature: 22 °C</b>	<b>Air Pressure: 1014 hPa</b>	<b>Relative Humidity: 40 %</b>	<b>Power Supply: 120 VAC</b>
<b>Remarks:</b>			

Plot 7.5.6 Spurious emission measurements in 448.45 – 451.55 MHz range at low carrier frequency



Plot 7.5.7 Spurious emission measurements in 448.45 – 451.55 MHz range at low carrier frequency

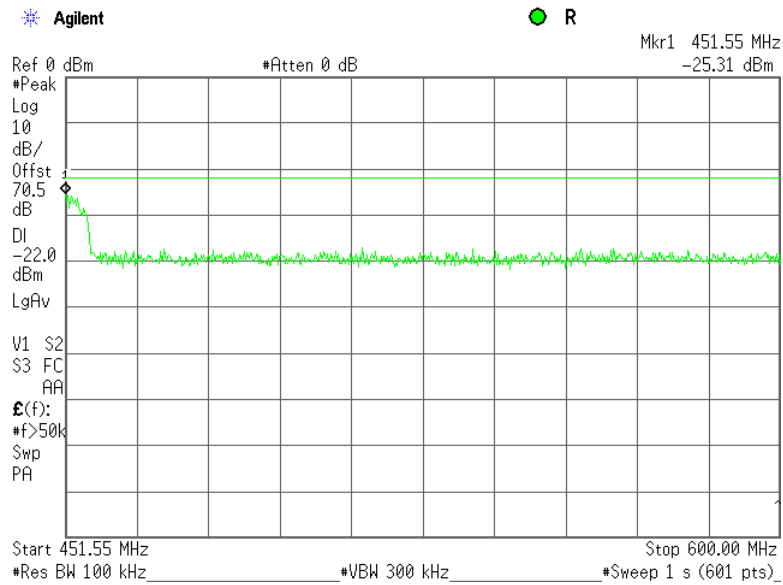




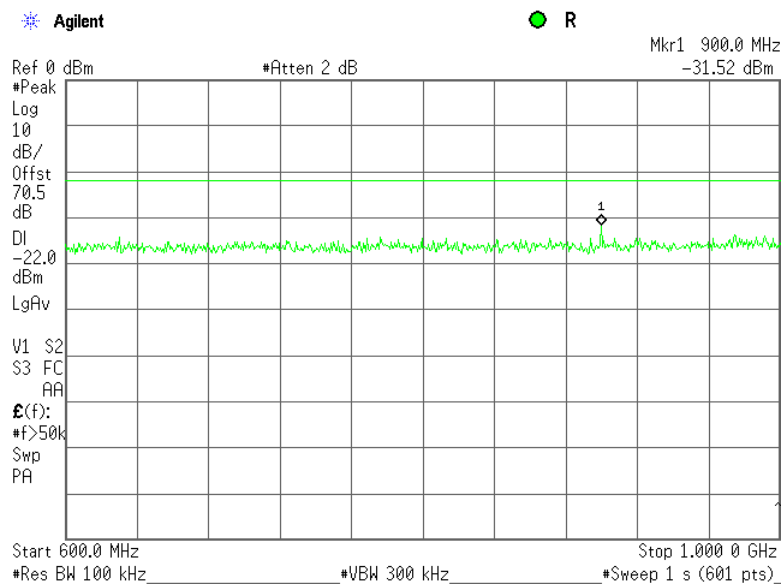


<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.5.8 Spurious emission measurements in 451.55 -600 MHz range at low carrier frequency



Plot 7.5.9 Spurious emission measurements in 600 - 1000 MHz range at low carrier frequency

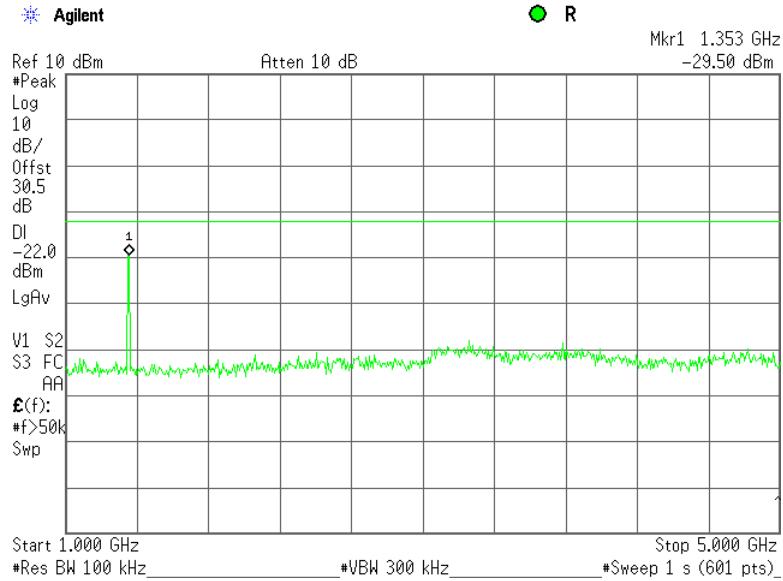




HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.5.10 Spurious emission measurements in 1000 – 5000 MHz at low carrier frequency

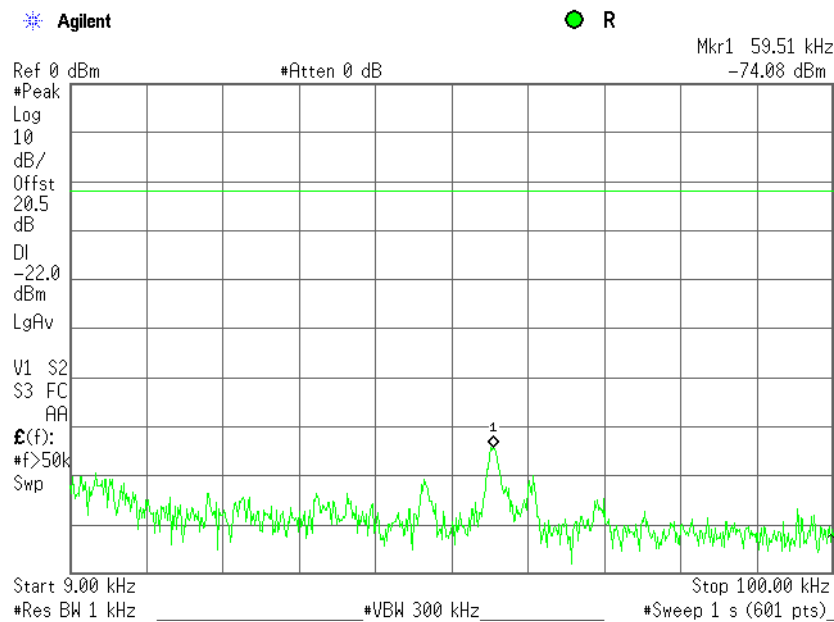




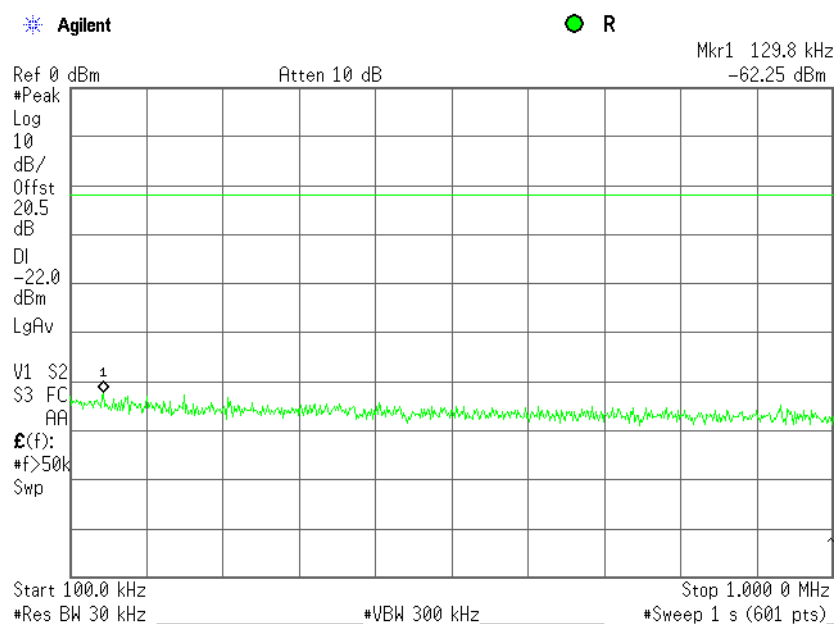
HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.5.11 Spurious emission measurements in 9 - 100 kHz range at mid carrier frequency



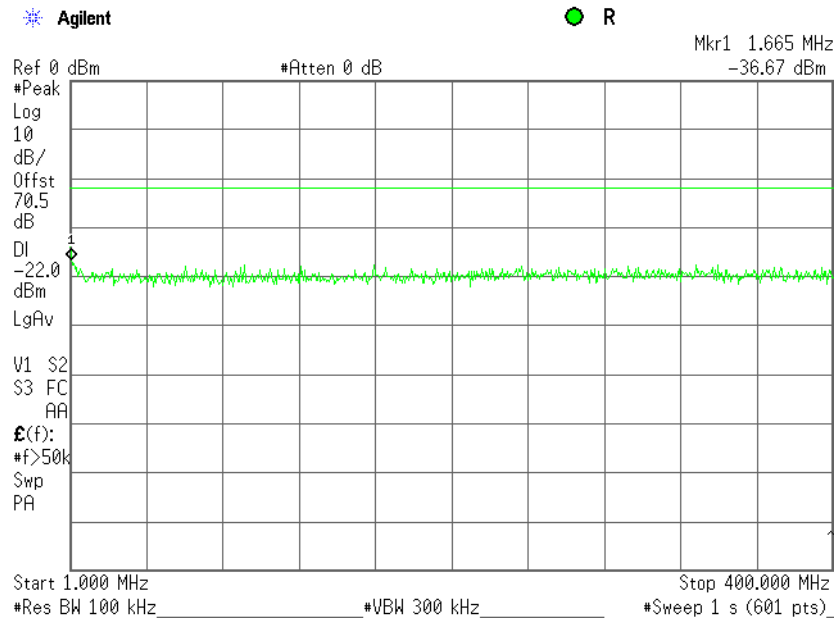
Plot 7.5.12 Spurious emission measurements in 0.10 - 1.0 MHz range at mid carrier frequency



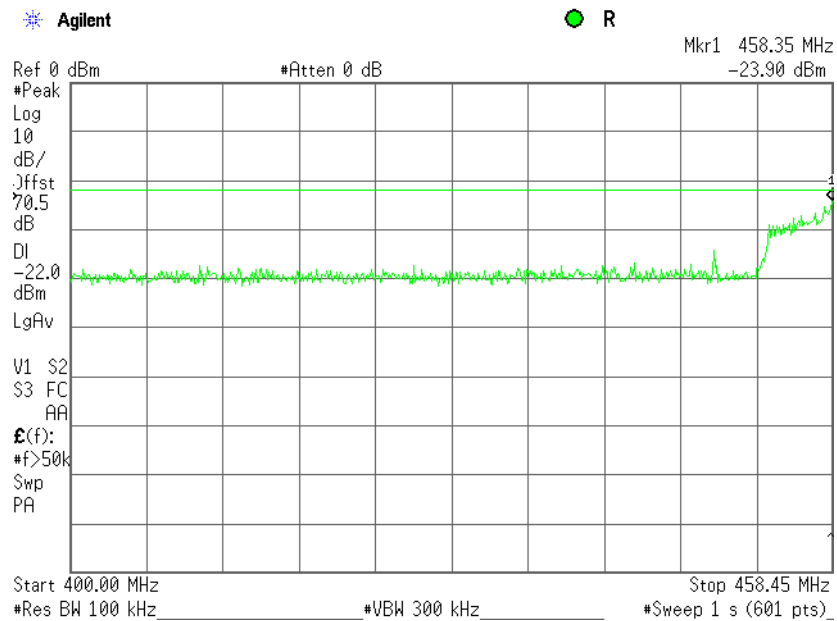


<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.5.13 Spurious emission measurements in 1.0 - 400 MHz range at mid carrier frequency



Plot 7.5.14 Spurious emission measurements in 400 -458.45 MHz range at mid carrier frequency

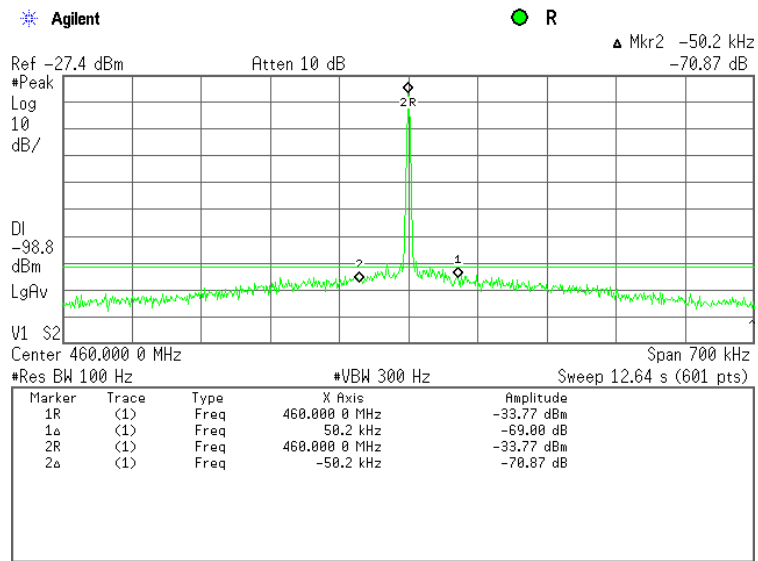




HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.5.15 Spurious emission measurements in 458.45 – 461.55 MHz range at mid carrier frequency

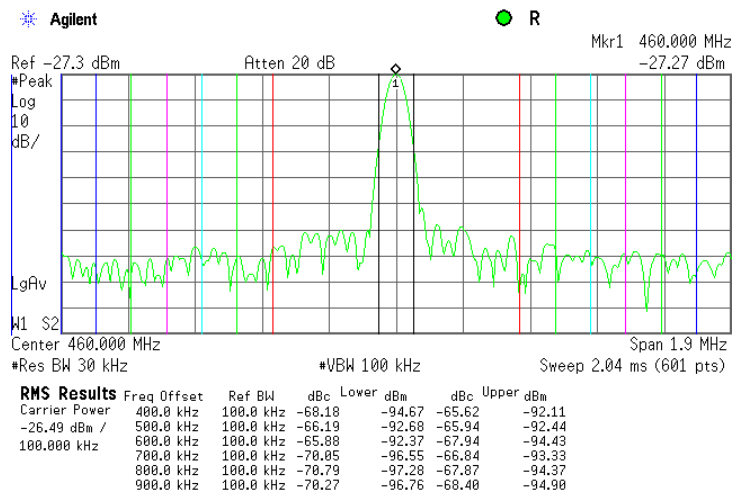




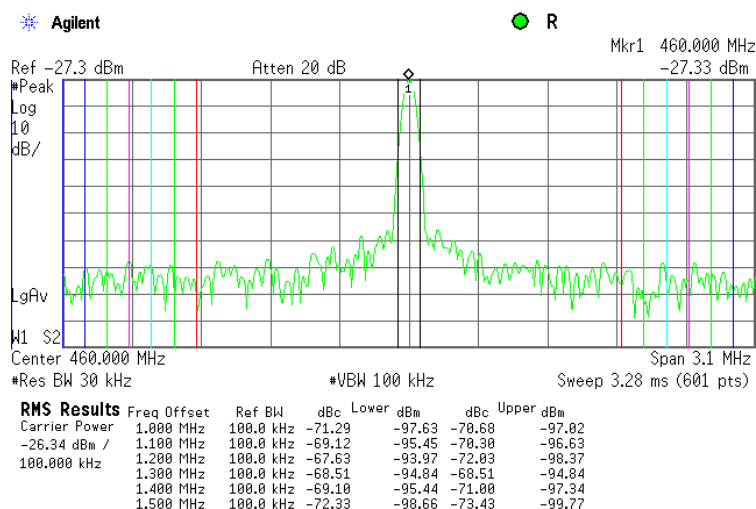
HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature: 22 °C</b>	<b>Air Pressure: 1014 hPa</b>	<b>Relative Humidity: 40 %</b>	<b>Power Supply: 120 VAC</b>
<b>Remarks:</b>			

Plot 7.5.16 Spurious emission measurements in 458.45 – 461.55 MHz range at mid carrier frequency



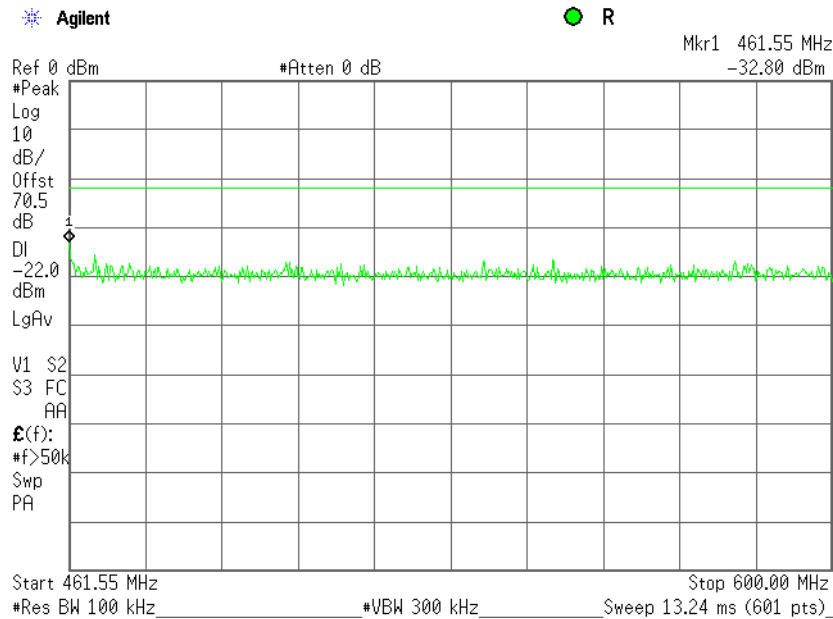
Plot 7.5.17 Spurious emission measurements in 458.45 – 461.55 MHz range at mid carrier frequency



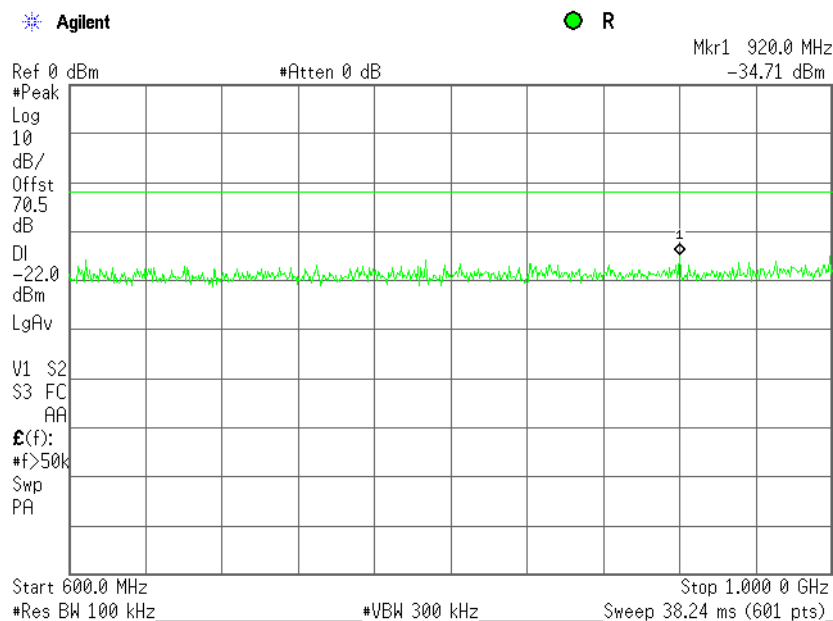


<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.5.18 Spurious emission measurements in 461.55 -600 MHz range at mid carrier frequency



Plot 7.5.19 Spurious emission measurements in 600 - 1000 MHz range at mid carrier frequency

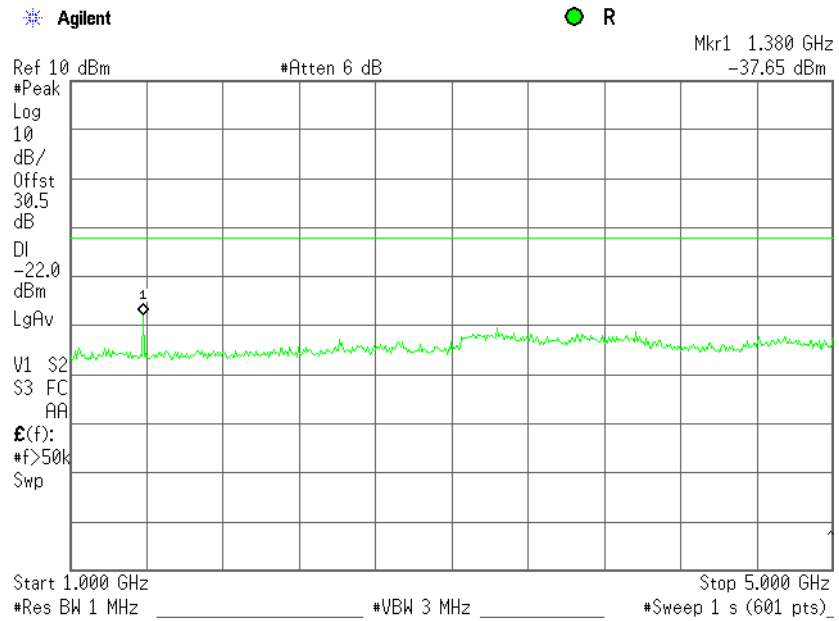




HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.5.20 Spurious emission measurements in 1000 – 5000 MHz at mid carrier frequency



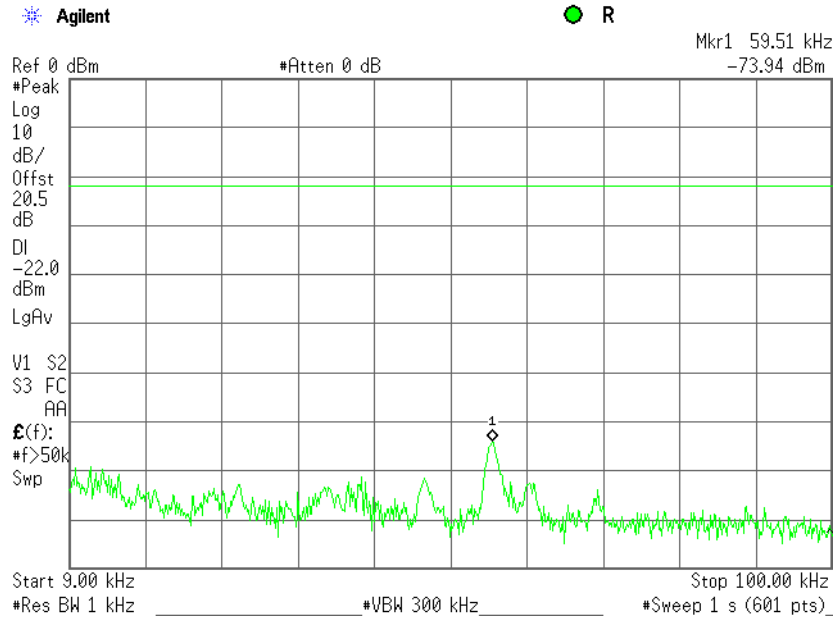




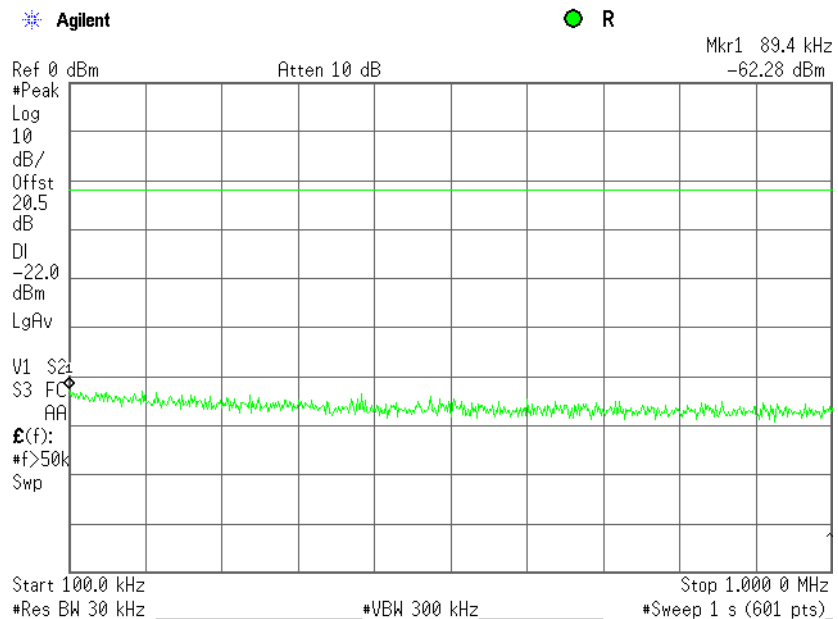
HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.5.21 Spurious emission measurements in 9 - 100 kHz range at high carrier frequency



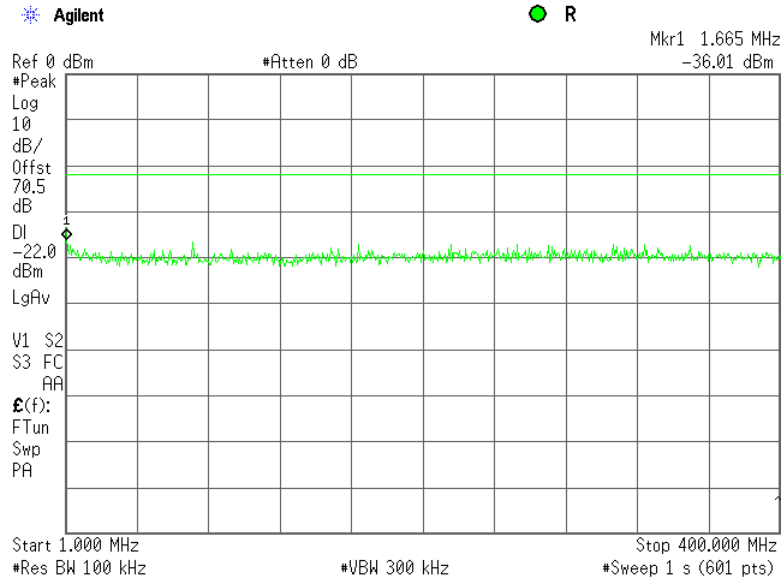
Plot 7.5.22 Spurious emission measurements in 0.10 - 1.0 MHz range at high carrier frequency



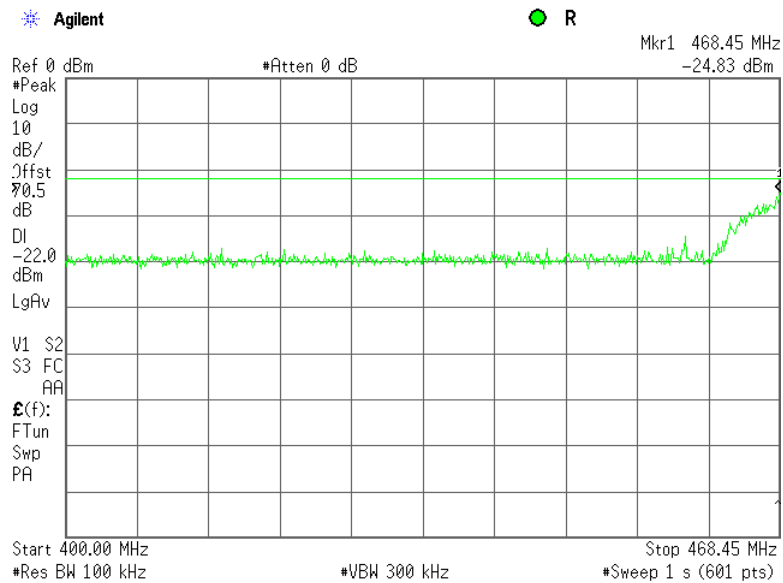


<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.5.23 Spurious emission measurements in 1.0 - 400 MHz range at high carrier frequency



Plot 7.5.24 Spurious emission measurements in 400 -468.45 MHz range at high carrier frequency

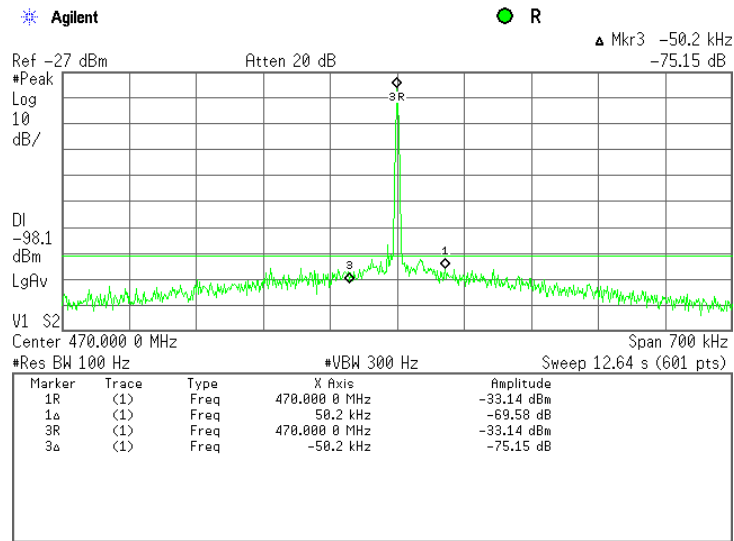




HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.5.25 Spurious emission measurements in 468.45 – 471.55 MHz range at high carrier frequency

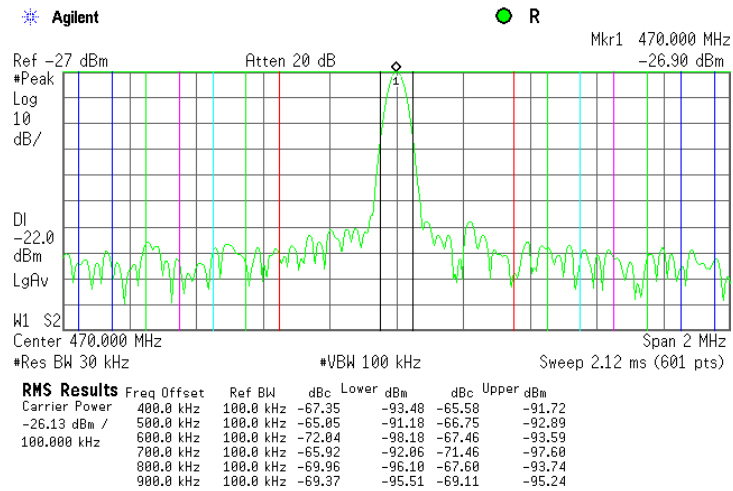




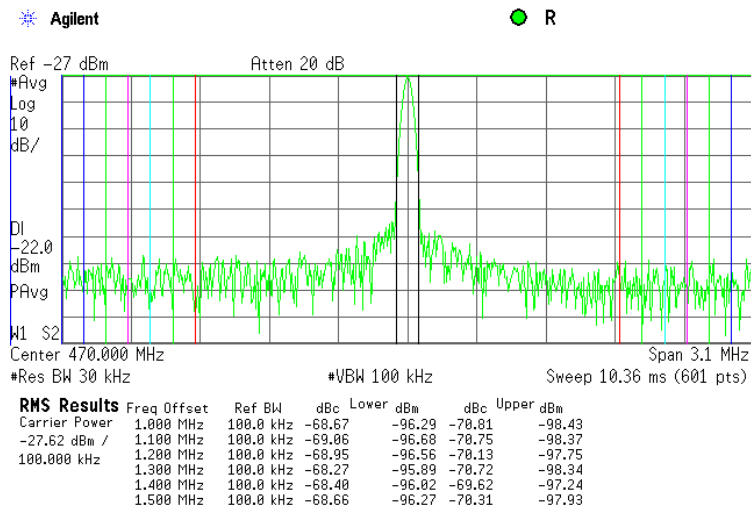
HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature: 22 °C</b>	<b>Air Pressure: 1014 hPa</b>	<b>Relative Humidity: 40 %</b>	<b>Power Supply: 120 VAC</b>
<b>Remarks:</b>			

Plot 7.5.26 Spurious emission measurements in 468.45 – 471.55 MHz range at high carrier frequency



Plot 7.5.27 Spurious emission measurements in 468.45 – 471.55 MHz range at high carrier frequency

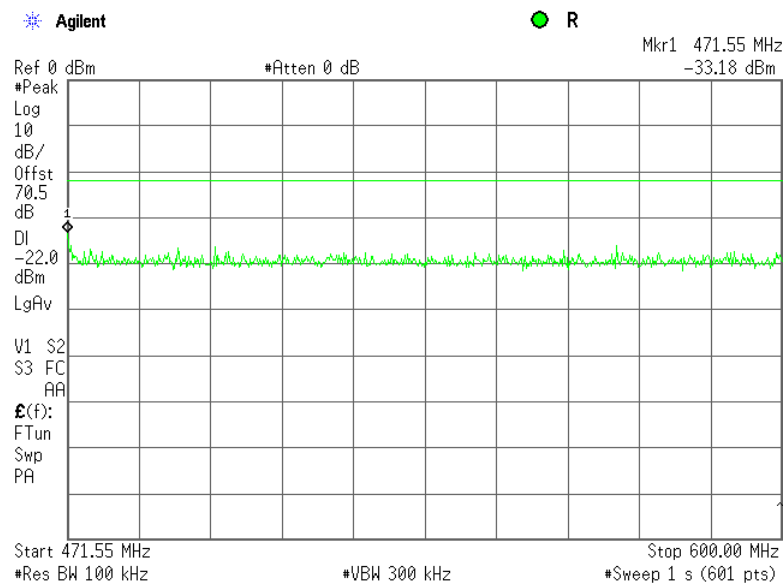




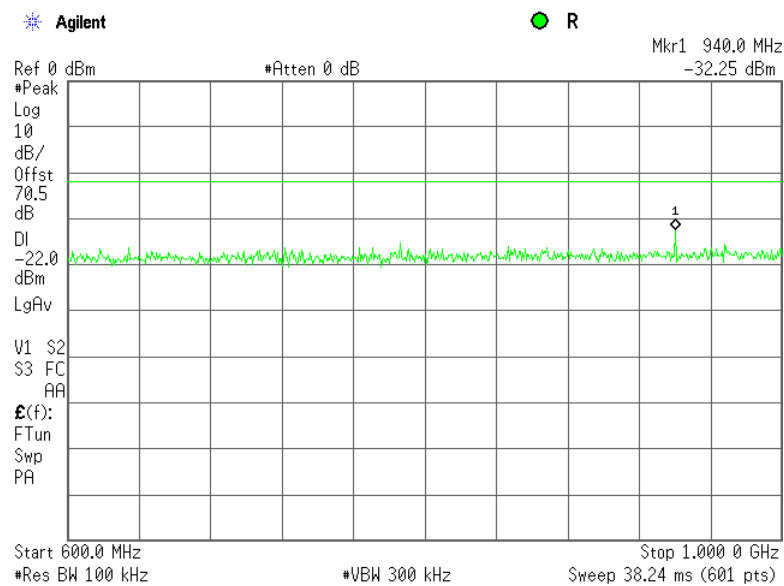
HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/3/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.5.28 Spurious emission measurements in 471.55 -600 MHz range at high carrier frequency



Plot 7.5.29 Spurious emission measurements in 600 - 1000 MHz range at high carrier frequency

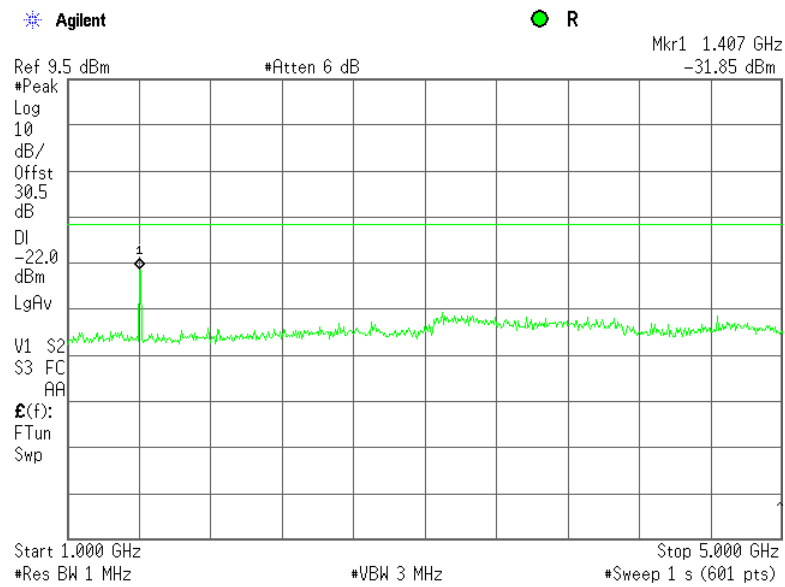




HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 90.210 (e) / RSS-119 Section 5.8.4, Conducted spurious emissions</b>		
<b>Test procedure:</b>	47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-C, Section 2.2.13		
<b>Test mode:</b>	Compliance	<b>Verdict: PASS</b>	
<b>Date(s):</b>	3/3/2013		
<b>Temperature: 22 °C</b>	<b>Air Pressure: 1014 hPa</b>	<b>Relative Humidity: 40 %</b>	<b>Power Supply: 120 VAC</b>
<b>Remarks:</b>			

Plot 7.5.30 Spurious emission measurements in 1000 – 5000 MHz at high carrier frequency





<b>Test specification:</b>		<b>FCC Section 90.213 / RSS-119 Section 5.3, Frequency stability</b>	
<b>Test procedure:</b>		47 CFR, Section 2.1055; TIA/EIA-603-C Section 2.2.2	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		2/28/2013 - 3/3/2013	
<b>Temperature:</b> 23 °C		<b>Air Pressure:</b> 1014 hPa	
		<b>Relative Humidity:</b> 50 %	
		<b>Power Supply:</b> 120 VAC	
<b>Remarks:</b>			

## 7.6 Frequency stability test

### 7.6.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.6.1.

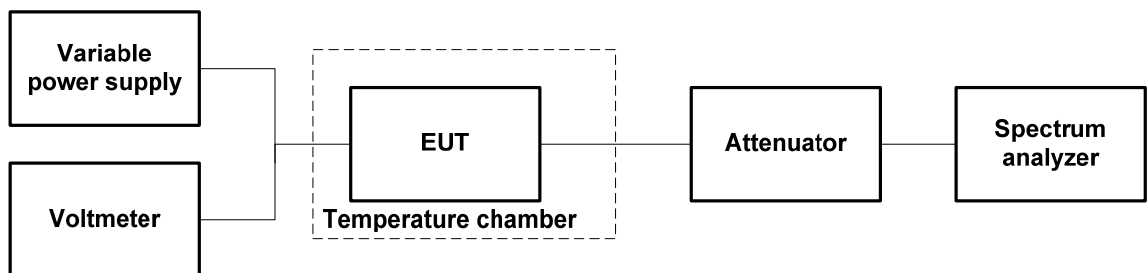
Table 7.6.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement	
	ppm	Hz
450	0.5	225
460		230
470		235

### 7.6.2 Test procedure

- 7.6.2.1 The EUT was set up as shown in Figure 7.6.1, energized and its proper operation was checked.
- 7.6.2.2 The EUT power was turned off. Temperature within test chamber was set to +30°C and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.
- 7.6.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then every minute until frequency had been stabilized or 10 minutes elapsed whichever reached the last. The EUT was powered off.
- 7.6.2.4 The above procedure was repeated at 0°C and at the lowest test temperature.
- 7.6.2.5 The EUT was powered on and carrier frequency was measured at start up moment and at the end of stabilization period at the rest of test temperatures and voltages. The EUT was powered off.
- 7.6.2.6 Frequency displacement was calculated and compared with the limit as provided in Table 7.6.2.

Figure 7.6.1 Frequency stability test setup





HERMON LABORATORIES

<b>Test specification:</b>		<b>FCC Section 90.213 / RSS-119 Section 5.3, Frequency stability</b>			
<b>Test procedure:</b>		47 CFR, Section 2.1055; TIA/EIA-603-C Section 2.2.2			
<b>Test mode:</b>		Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b>		2/28/2013 - 3/3/2013			
<b>Temperature:</b> 23 °C		<b>Air Pressure:</b> 1014 hPa		<b>Relative Humidity:</b> 50 %	
<b>Power Supply:</b> 120 VAC					
<b>Remarks:</b>					

Table 7.6.2 Frequency stability test results

OPERATING FREQUENCY: 450-470 MHz  
 NOMINAL POWER VOLTAGE: 120 VAC  
 TEMPERATURE STABILIZATION PERIOD: 20 min  
 POWER DURING TEMPERATURE TRANSITION: Off  
 SPECTRUM ANALYZER MODE: Counter  
 RESOLUTION BANDWIDTH: 10 Hz  
 VIDEO BANDWIDTH: 10 Hz  
 MODULATION: Unmodulated

T, °C	Voltage, V	Frequency, MHz							Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	1 <sup>st</sup> min	2 <sup>nd</sup> min	3 <sup>rd</sup> min	4 <sup>th</sup> min	5 <sup>th</sup> min	10 <sup>th</sup> min	Positive	Negative			
<b>Low frequency 450 MHz</b>													
-30	nominal	449.998773	449.998773	449.998773	449.998773	449.998773	449.998773	449.998773	1	0	225	-224	Pass
-20	nominal	449.998773	NA	NA	NA	NA	NA	449.998773	1	0		-224	Pass
-10	nominal	449.998773	NA	NA	NA	NA	NA	449.998773	1	0		-224	Pass
0	nominal	449.998773	449.998773	449.998773	449.998773	449.998773	449.998773	449.998773	1	0		-224	Pass
10	nominal	449.998773	NA	NA	NA	NA	NA	449.998773	1	0		-224	Pass
20	+15%	449.998773	NA	NA	NA	NA	NA	449.998773	0	0		-224	Pass
20	nominal	449.998772	NA	NA	NA	NA	NA	449.998772*	0	0		-224	Pass
20	-15%	449.998771	NA	NA	NA	NA	NA	449.998771	0	1		-224	Pass
30	nominal	449.998773	449.998773	449.998773	449.998773	449.998773	449.998773	449.998773	1	0		-224	Pass
40	nominal	449.998772	NA	NA	NA	NA	NA	449.998772	0	0		-225	Pass
50	nominal	449.998772	NA	NA	NA	NA	NA	449.998772	0	0		-225	Pass
60	nominal	449.998772	NA	NA	NA	NA	NA	449.998772	0	0		-225	Pass
70	nominal	449.998772	NA	NA	NA	NA	NA	449.998772	0	0	-225	Pass	
<b>Mid frequency</b>													
-30	nominal	459.998767	459.998767	459.998767	459.998767	459.998767	459.998767	459.998767	0	3	230	-227-	Pass
-20	nominal	459.998767	NA	NA	NA	NA	NA	459.998767	0	3		-227-	Pass
-10	nominal	459.998767	NA	NA	NA	NA	NA	459.998767	0	3		-227-	Pass
0	nominal	459.998769	459.998769	459.998769	459.998769	459.998769	459.998769	459.998769	0	1		-229	Pass
10	nominal	459.998770	NA	NA	NA	NA	NA	459.998770	0	0		-230	Pass
20	+15%	459.998771	NA	NA	NA	NA	NA	459.998771	1	0		-229	Pass
20	nominal	459.998770	NA	NA	NA	NA	NA	459.998770*	0	0		-230	Pass
20	-15%	459.998769	NA	NA	NA	NA	NA	459.998769	0	1		-229	Pass
30	nominal	459.998770	459.998770	459.998770	459.998770	459.998770	459.998770	459.998770	0	0		-230	Pass
40	nominal	459.998770	NA	NA	NA	NA	NA	459.998770	0	0		-230	Pass
50	nominal	459.998770	NA	NA	NA	NA	NA	459.998770	0	0		-230	Pass
60	nominal	459.998770	NA	NA	NA	NA	NA	459.998770	0	0		-230	Pass
70	nominal	459.998770	NA	NA	NA	NA	NA	459.998770	0	0	-230	Pass	





<b>Test specification:</b>		<b>FCC Section 90.213 / RSS-119 Section 5.3, Frequency stability</b>			
<b>Test procedure:</b>		47 CFR, Section 2.1055; TIA/EIA-603-C Section 2.2.2			
<b>Test mode:</b>		Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b>		2/28/2013 - 3/3/2013			
<b>Temperature:</b> 23 °C		<b>Air Pressure:</b> 1014 hPa		<b>Relative Humidity:</b> 50 %	
<b>Remarks:</b>		<b>Power Supply:</b> 120 VAC			

Table 7.6.2 Frequency stability test results (continued)

OPERATING FREQUENCY: 450-470 MHz  
 NOMINAL POWER VOLTAGE: 120 VAC  
 TEMPERATURE STABILIZATION PERIOD: 20 min  
 POWER DURING TEMPERATURE TRANSITION: Off  
 SPECTRUM ANALYZER MODE: Counter  
 RESOLUTION BANDWIDTH: 10 Hz  
 VIDEO BANDWIDTH: 10 Hz  
 MODULATION: Unmodulated

T, °C	Voltage, V	Frequency, MHz							Max frequency drift, Hz		Limit, Hz	Margin, Hz	Verdict
		Start up	1 <sup>st</sup> min	2 <sup>nd</sup> min	3 <sup>rd</sup> min	4 <sup>th</sup> min	5 <sup>th</sup> min	10 <sup>th</sup> min	Positive	Negative			
<b>High frequency</b>													
-30	nominal	469.998767	469.998767	469.998767	469.998767	469.998767	469.998767	469.998767	0	3	235	-232	Pass
-20	nominal	469.998767	NA	NA	NA	NA	NA	469.998767	0	3		-232	Pass
-10	nominal	469.998767	NA	NA	NA	NA	NA	469.998767	0	3		-232	Pass
0	nominal	469.998768	469.998770	469.998770	469.998770	469.998770	469.998770	469.998770	0	3		-232	Pass
10	nominal	469.998770	NA	NA	NA	NA	NA	469.998770	0	0		-235	Pass
20	+15%	469.998770	NA	NA	NA	NA	NA	469.998770	0	0		-235	Pass
20	nominal	469.998770	NA	NA	NA	NA	NA	469.998770*	0	0		-235	Pass
20	-15%	469.998769	NA	NA	NA	NA	NA	469.998769	0	1		-234	Pass
30	nominal	469.998769	NA	469.998769	469.998769	469.998769	469.998769	469.998769	0	1		-234	Pass
40	nominal	469.998769	NA	NA	NA	NA	NA	469.998769	0	1		-234	Pass
50	nominal	469.998769	NA	NA	NA	NA	NA	469.998769	0	1		-234	Pass
60	nominal	469.998769	NA	NA	NA	NA	NA	469.998769	0	1		-234	Pass
70	nominal	469.998769	NA	NA	NA	NA	NA	469.998769	0	1		-235	Pass

\* - Reference frequency

Reference numbers of test equipment used

HL 0495	HL 1457	HL 1876	HL 3286	HL 3310	HL 3390	HL 3768	HL 3776
HL 3818							

Full description is given in Appendix A.



<b>Test specification:</b>	<b>FCC Section 90.214, Transient frequency behaviour</b>		
<b>Test procedure:</b>	TIA/EIA-603-C, Section 2.2.19		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/4/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

## 7.7 Transient frequency behaviour test

### 7.7.1 General

This test was performed to measure carrier frequency drift as function of time during transmitter start up and shut down. Specification test limits are given in Table 7.7.1.

Table 7.7.1 Transient frequency limits

Channel bandwidth, kHz	Carrier frequency tolerance, kHz	Duration, ms	Time interval*
<b>421.0 – 512.0 MHz band</b>			
25.0	± 25.0	10.0	t <sub>1</sub>
	± 12.5	25.0	t <sub>2</sub>
	± 25.0	10.0	t <sub>3</sub>
12.5	± 12.5	10.0	t <sub>1</sub>
	± 6.25	25.0	t <sub>2</sub>
	± 12.5	10.0	t <sub>3</sub>
6.25	± 6.25	10.0	t <sub>1</sub>
	± 3.125	25.0	t <sub>2</sub>
	± 6.25	10.0	t <sub>3</sub>

\* - t<sub>on</sub> is the instant when a 1 kHz test signal is completely suppressed;

t<sub>1</sub> is the time period immediately following t<sub>on</sub>;

t<sub>2</sub> is the time period immediately following t<sub>1</sub>;

t<sub>3</sub> is the time period from the instant when the transmitter is turned off until t<sub>off</sub>;

t<sub>off</sub> is the instant when the 1 kHz test signal starts to rise.

### 7.7.2 Test procedure

**7.7.2.1** The EUT was set up as shown in Figure 7.7.1, energized and its proper operation was checked. Variable attenuator was adjusted to provide signal level approximately 40 dB below the FM receiver maximum allowed level as measured with RF power meter. The EUT was turned off.

**7.7.2.2** The signal generator was set to the assigned transmitter frequency modulated with 1 kHz tone at 25 kHz deviation and the output power was adjusted to provide the same as the EUT signal level at the FM receiver input as measured with power meter.

**7.7.2.3** The storage oscilloscope was set to provide horizontal sweep rate 10 milliseconds per division. Amplitude control of the storage oscilloscope was adjusted to obtain 1 kHz sinusoidal signal vertically centered with ± 4 divisions amplitude.

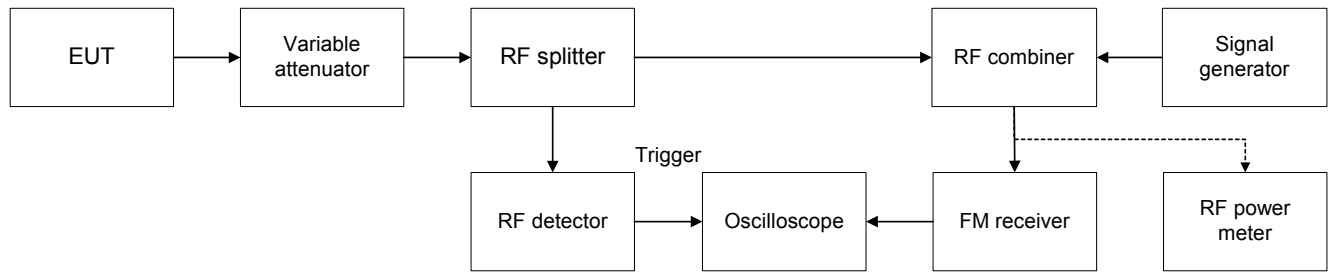
**7.7.2.4** The variable attenuator was adjusted to increase RF level supplied to splitter by 30 dB and the EUT was consequently turned on and off. Transient frequency during power switching was captured and shown in the associated plots.

**7.7.2.5** The test results are provided in Table 7.7.2 and the associated plots.



<b>Test specification:</b>	<b>FCC Section 90.214, Transient frequency behaviour</b>		
<b>Test procedure:</b>	TIA/EIA-603-C, Section 2.2.19		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/4/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Figure 7.7.1 Transient frequency test setup





<b>Test specification:</b>		<b>FCC Section 90.214, Transient frequency behaviour</b>	
<b>Test procedure:</b>		TIA/EIA-603-C, Section 2.2.19	
<b>Test mode:</b>		Compliance	
<b>Date(s):</b>		3/4/2013	
<b>Temperature:</b> 22 °C		<b>Air Pressure:</b> 1014 hPa	
		<b>Relative Humidity:</b> 48 %	
		<b>Power Supply:</b> 120 VAC	
<b>Remarks:</b>			

Table 7.7.2 Transient frequency behaviour test results

Carrier frequency, MHz	Time interval	Duration, ms	Frequency tolerance, kHz	Limit, kHz	Margin, kHz	Verdict
450	t <sub>1</sub>	10.0	2.5	± 6.25	-3.750	Pass
	t <sub>2</sub>	25.0	<1.5	± 3.125	-1.625	
	t <sub>3</sub>	10.0	1.5	± 6.25	-4.750	
460	t <sub>1</sub>	10.0	3.75	± 6.25	-2.500	Pass
	t <sub>2</sub>	25.0	<1.5	± 3.125	-1.625	
	t <sub>3</sub>	10.0	1.5	± 6.25	-4.750	
470	t <sub>1</sub>	10.0	2.5	± 6.25	-3.750	Pass
	t <sub>2</sub>	25.0	<1.5	± 3.125	-1.625	
	t <sub>3</sub>	10.0	2.5	± 6.25	-3.750	

Reference numbers of test equipment used

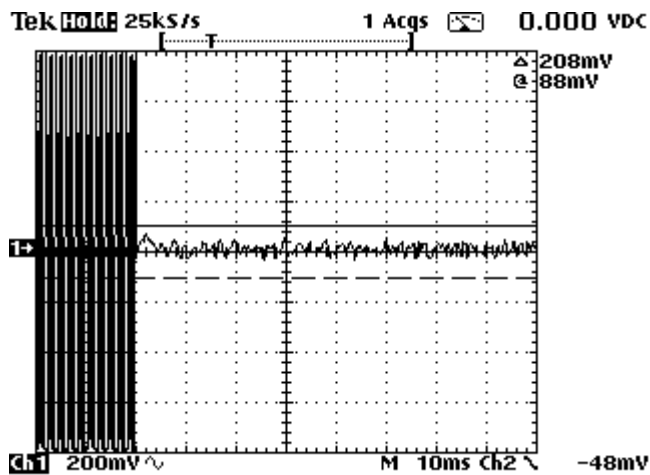
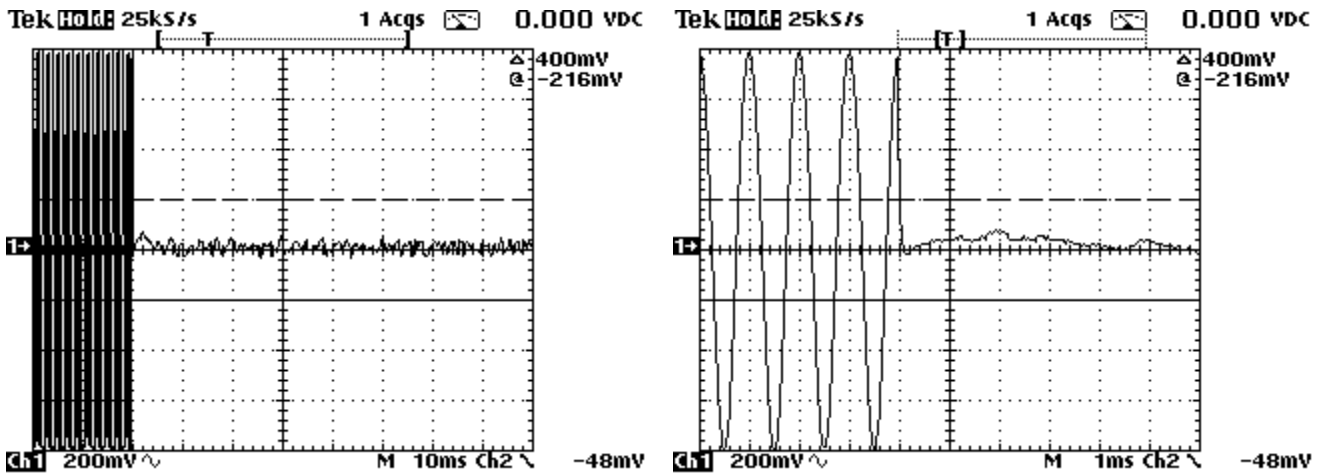
HL 0539	HL 0808	HL 1457	HL 1481	HL 1562	HL 1876	HL 1908	HL 2227
HL 3025	HL 3390	HL 3768	HL 3776				

Full description is given in Appendix A.



Test specification:	FCC Section 90.214, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-C, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/4/2013		
Temperature: 22 °C	Air Pressure: 1014 hPa	Relative Humidity: 48 %	Power Supply: 120 VAC
Remarks:			

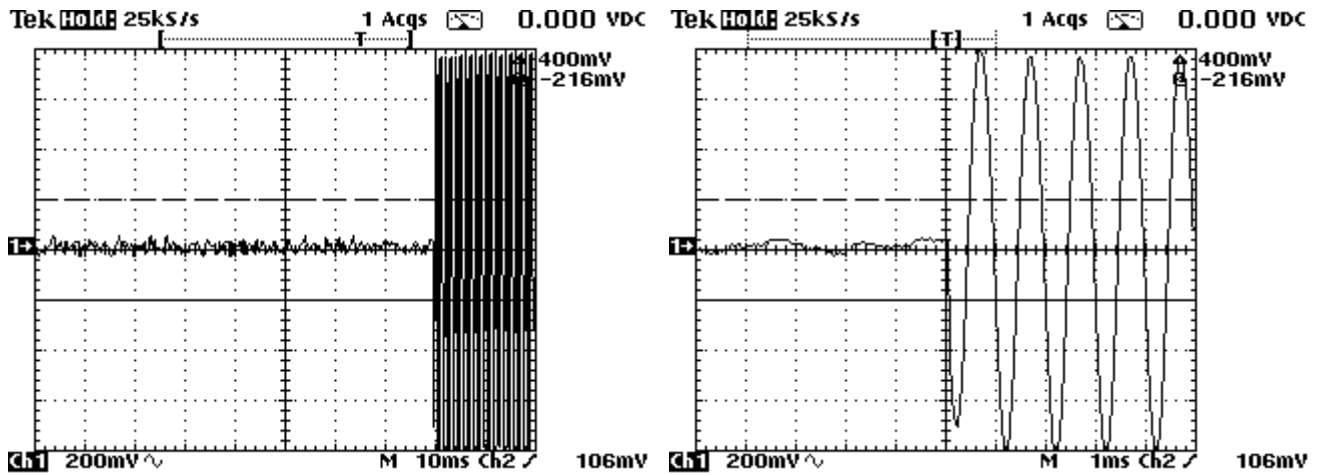
Plot 7.7.1 Transient frequency during power ON test results at low carrier frequency





<b>Test specification:</b> FCC Section 90.214, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-C, Section 2.2.19			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 3/4/2013			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.7.2 Transient frequency during power OFF test results at low carrier frequency

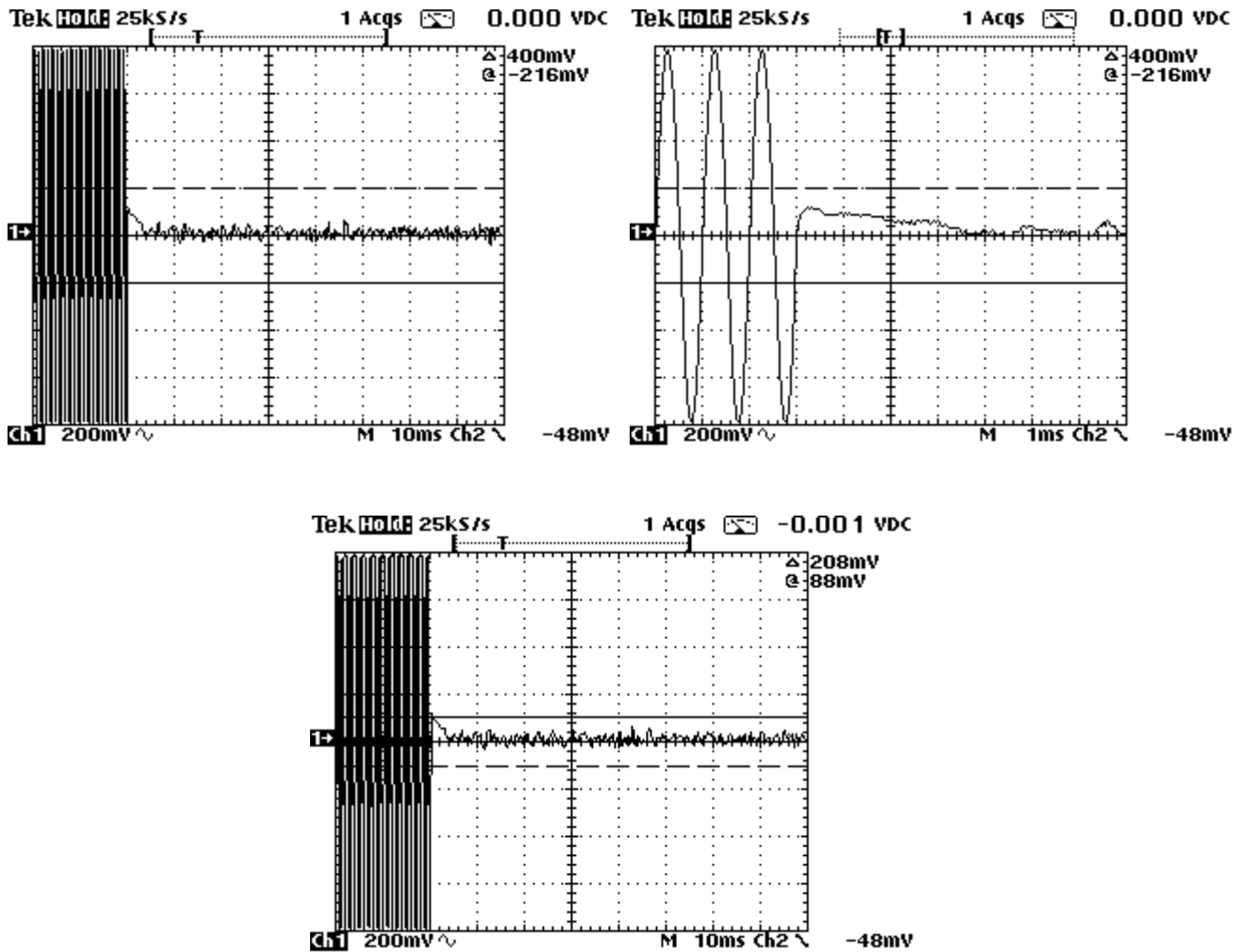




HERMON LABORATORIES

<b>Test specification:</b> FCC Section 90.214, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-C, Section 2.2.19			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 3/4/2013			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

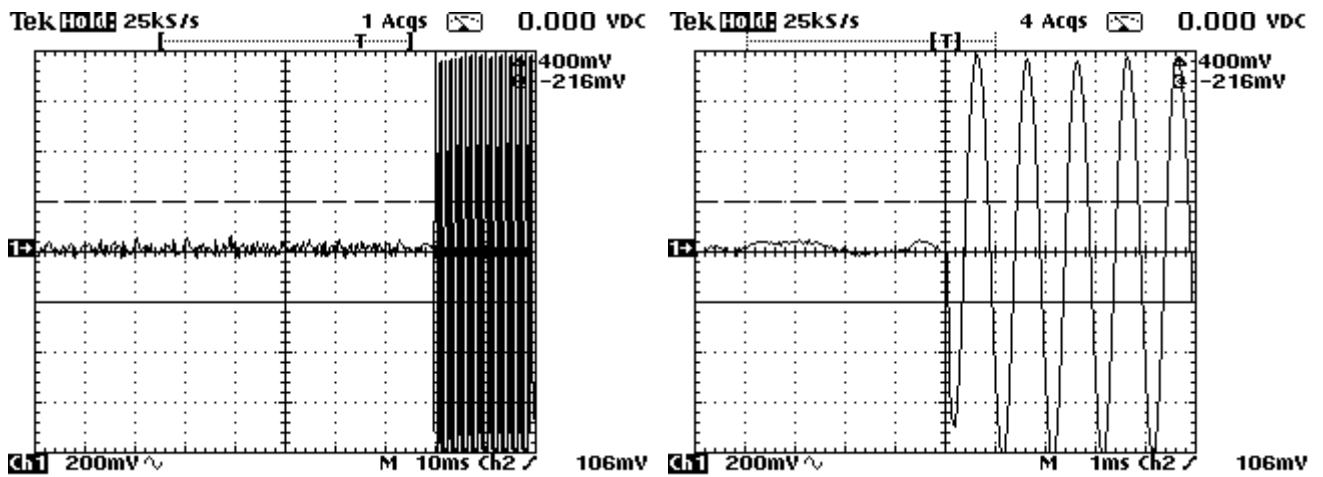
Plot 7.7.3 Transient frequency during power ON test results at mid carrier frequency





<b>Test specification:</b> FCC Section 90.214, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-C, Section 2.2.19			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 3/4/2013			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.7.4 Transient frequency during power OFF test results at mid carrier frequency

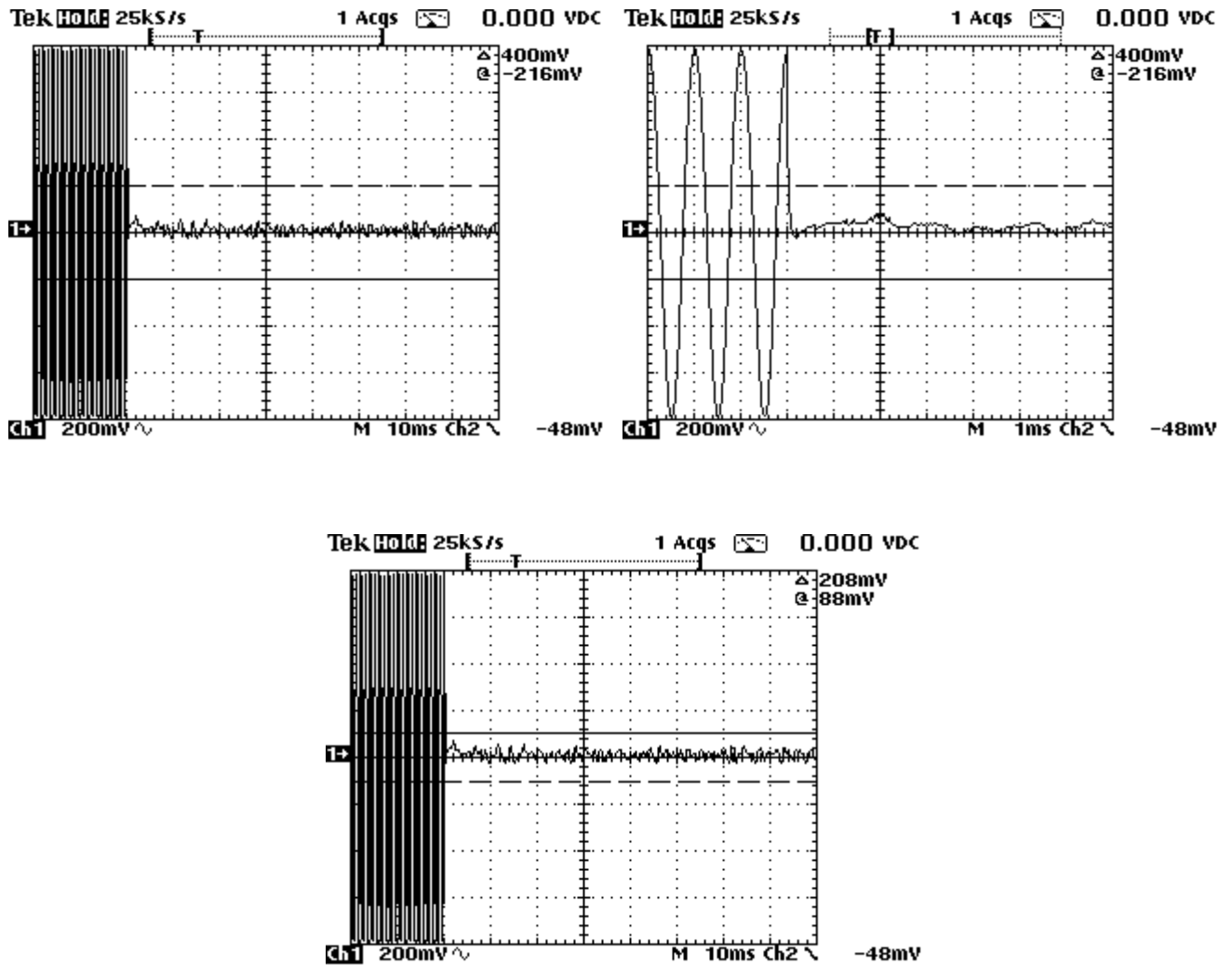






Test specification:	FCC Section 90.214, Transient frequency behaviour		
Test procedure:	TIA/EIA-603-C, Section 2.2.19		
Test mode:	Compliance	Verdict:	PASS
Date(s):	3/4/2013	Relative Humidity:	48 %
Temperature: 22 °C	Air Pressure: 1014 hPa	Power Supply:	120 VAC
Remarks:			

Plot 7.7.5 Transient frequency during power ON test results at high carrier frequency

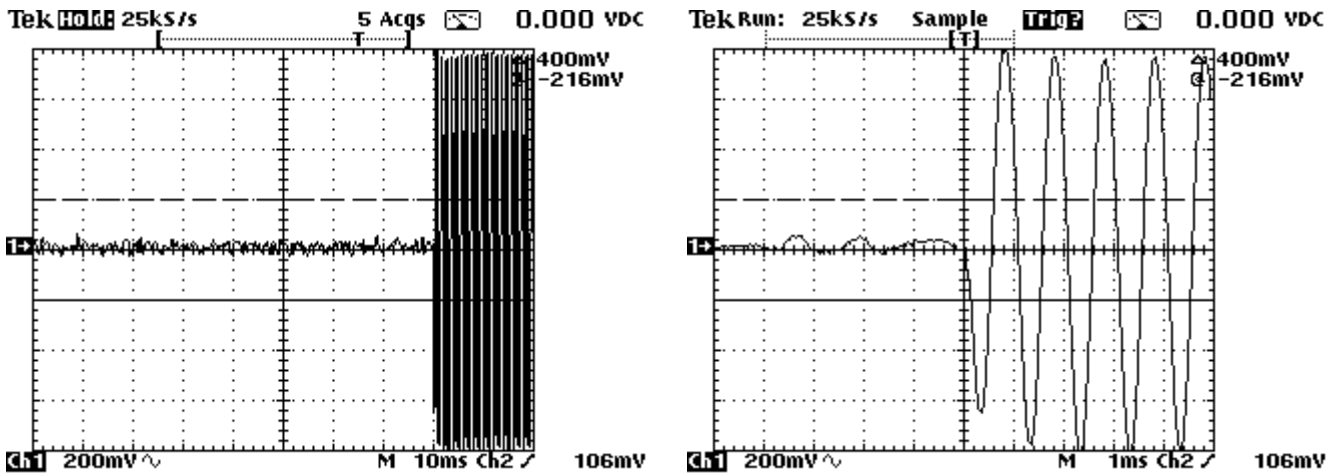




HERMON LABORATORIES

<b>Test specification:</b> FCC Section 90.214, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-C, Section 2.2.19			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 3/4/2013			
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1014 hPa	<b>Relative Humidity:</b> 48 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 7.7.6 Transient frequency during power OFF test results at high carrier frequency





<b>Test specification:</b>	<b>FCC Part 15, Section 107 / ICES-003 Section 6.1 Class B / RSS-Gen, Section 7.2.4, Conducted emission at AC power port</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 11.5 and 12.1.3		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/6/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1021 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

## 8 Unintentional emission tests

### 8.1 Conducted emissions measurements

#### 8.1.1 General

This test was performed to measure common mode conducted emissions at the mains power port. Specification test limits are given in Table 8.1.1.

Table 8.1.1 Limits for conducted emissions

Frequency, MHz	Class B limit, dB(μV)		Class A limit, dB(μV)	
	QP	AVRG	QP	AVRG
0.15 - 0.5	66 - 56*	56 - 46*	79	66
0.5 - 5.0	56	46	73	60
5.0 - 30	60	50	73	60

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

#### 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 measurements were performed at power terminals with the LISN, connected to a spectrum analyzer in the frequency range referred to in Table 8.1.2. Unused coaxial connector of the LISN was terminated with 50 Ohm. Quasi-peak and average detectors were used throughout the testing.

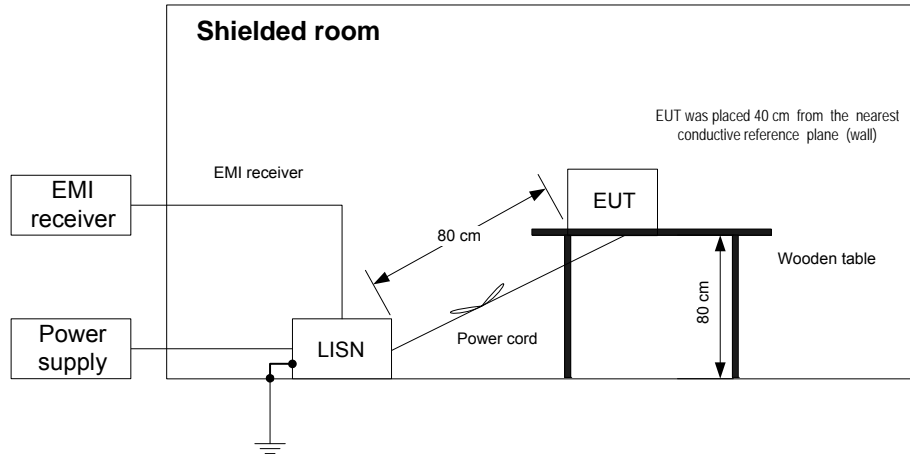
8.1.2.3 The position of the device cables was varied to determine maximum emission level.

8.1.2.4 The worst test results (the lowest margins) were recorded in Table 8.1.2 and shown in the associated plots.



<b>Test specification:</b>	<b>FCC Part 15, Section 107 / ICES-003 Section 6.1 Class B / RSS-Gen, Section 7.2.4, Conducted emission at AC power port</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 11.5 and 12.1.3		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/6/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1021 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Figure 8.1.1 Setup for conducted emission measurements, table-top equipment



Photograph 8.1.1 Setup for conducted emission measurements





<b>Test specification:</b>	FCC Part 15, Section 107 / ICES-003 Section 6.1 Class B / RSS-Gen, Section 7.2.4, Conducted emission at AC power port		
<b>Test procedure:</b>	ANSI C63.4, Sections 11.5 and 12.1.3		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	3/6/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1021 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Table 8.1.2 Conducted emission test results

LINE: AC mains  
LIMIT: Class B  
EUT OPERATING MODE: Receive  
EUT SET UP: TABLE-TOP  
TEST SITE: SHIELDED ROOM  
DETECTORS USED: PEAK / QUASI-PEAK / AVERAGE  
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*		
0.188	43.4	41.5	64	-22.5	38.0	54	-16.0	L1 PS2	Pass
1.075	32.1	28.7	56	-27.3	20.5	46	-25.5		
0.188	43.9	41.8	64	-22.2	38.1	54	-15.9	L2 PS2	
1.075	31.8	27.1	56	-28.9	21.4	46	-24.6		
0.189	35.7	34.5	64	-29.5	28.4	54	-25.6	L1 PS1	Pass
1.070	32.6	29.5	56	-26.5	21.0	46	-25.0		
0.189	35.7	34.5	64	-29.5	28.4	54	-25.6	L2 PS1	
1.070	32.6	29.5	56	-26.5	21.0	46	-25.0		

\*- Margin = Measured emission - specification limit.

Reference numbers of test equipment used

HL 0163	HL 0447	HL 0787	HL 1425	HL 1513	HL 3612		
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Full description is given in Appendix A.

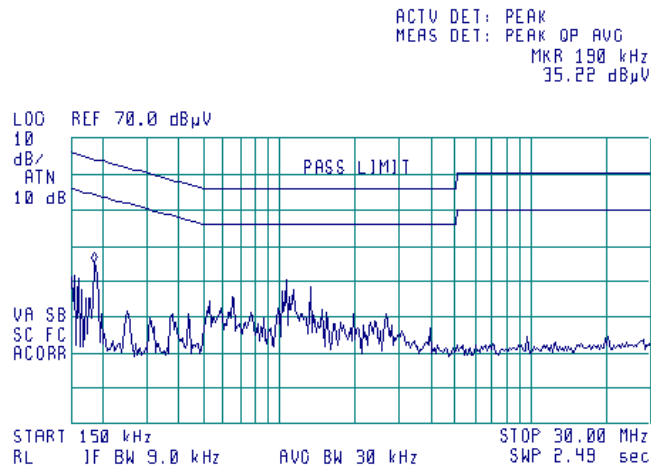


HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Part 15, Section 107 / ICES-003 Section 6.1 Class B / RSS-Gen, Section 7.2.4, Conducted emission at AC power port</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 11.5 and 12.1.3		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/6/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1021 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

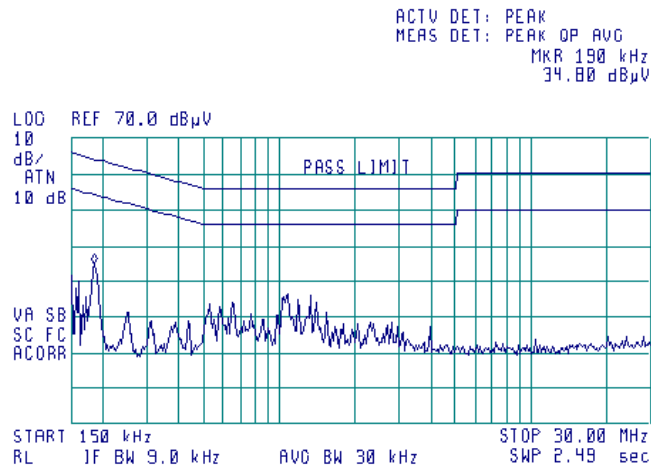
**Plot 8.1.1 Conducted emission measurements**

LINE: L1 PS1  
LIMIT: Class B  
EUT OPERATING MODE: Receive  
LIMIT: QUASI-PEAK, AVERAGE  
DETECTOR: PEAK



**Plot 8.1.2 Conducted emission measurements**

LINE: L2 PS1  
LIMIT: Class B  
EUT OPERATING MODE: Receive  
LIMIT: QUASI-PEAK, AVERAGE  
DETECTOR: PEAK



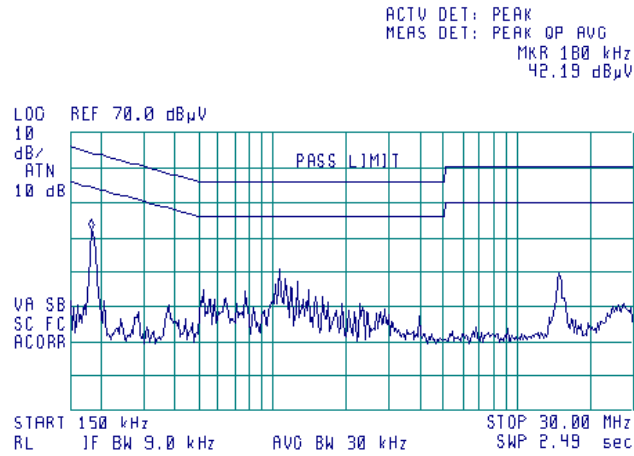


HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Part 15, Section 107 / ICES-003 Section 6.1 Class B / RSS-Gen, Section 7.2.4, Conducted emission at AC power port</b>		
<b>Test procedure:</b>	ANSI C63.4, Sections 11.5 and 12.1.3		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/6/2013		
<b>Temperature:</b> 22 °C	<b>Air Pressure:</b> 1021 hPa	<b>Relative Humidity:</b> 40 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

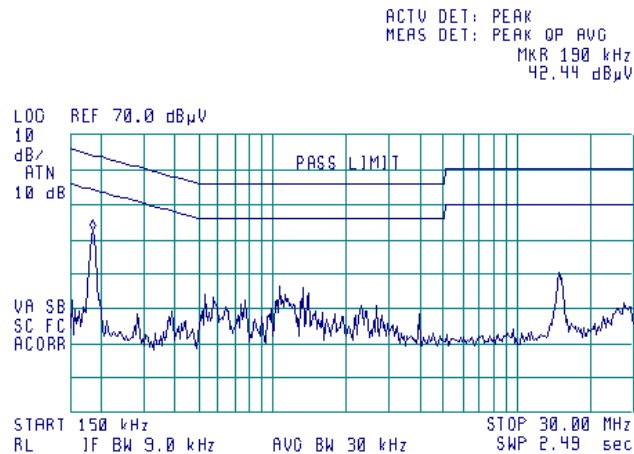
**Plot 8.1.3 Conducted emission measurements**

LINE: L1 PS2  
LIMIT: Class B  
EUT OPERATING MODE: Receive  
LIMIT: QUASI-PEAK, AVERAGE  
DETECTOR: PEAK



**Plot 8.1.4 Conducted emission measurements**

LINE: L2 PS2  
LIMIT: Class B  
EUT OPERATING MODE: Receive  
LIMIT: QUASI-PEAK, AVERAGE  
DETECTOR: PEAK





<b>Test specification:</b>	FCC Part 15, Section 109 / ICES-003 Section 6.2 Class B, RSS-Gen, Section 6.1, 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>	3/5/2013 - 3/25/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

## 8.2 Radiated emission measurements

### 8.2.1 General

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

**Table 8.2.1 Radiated emission limits according to FCC Part 15, Section 109 and ICES-003 section 6.2**

Frequency, MHz	Class B limit, dB(μV/m)		Class A limit, dB(μV/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*
960 - 5 <sup>th</sup> harmonic**	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 8.2.2 Radiated emission limits according to RSS-Gen Section 6.1**

Frequency, MHz	Field strength limit at 3 m test distance, dB(μV/m)
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
960 - 3 <sup>rd</sup> harmonic**	54.0

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

### 8.2.2 Test procedure

**8.2.2.1** The EUT was set up as shown in Figure 8.2.1 and associated photograph/s, energized and the performance check was conducted.

**8.2.2.2** The specified frequency range was investigated with biconilog antenna connected to EMI receiver. To find maximum radiation the turntable was rotated 3600, 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.

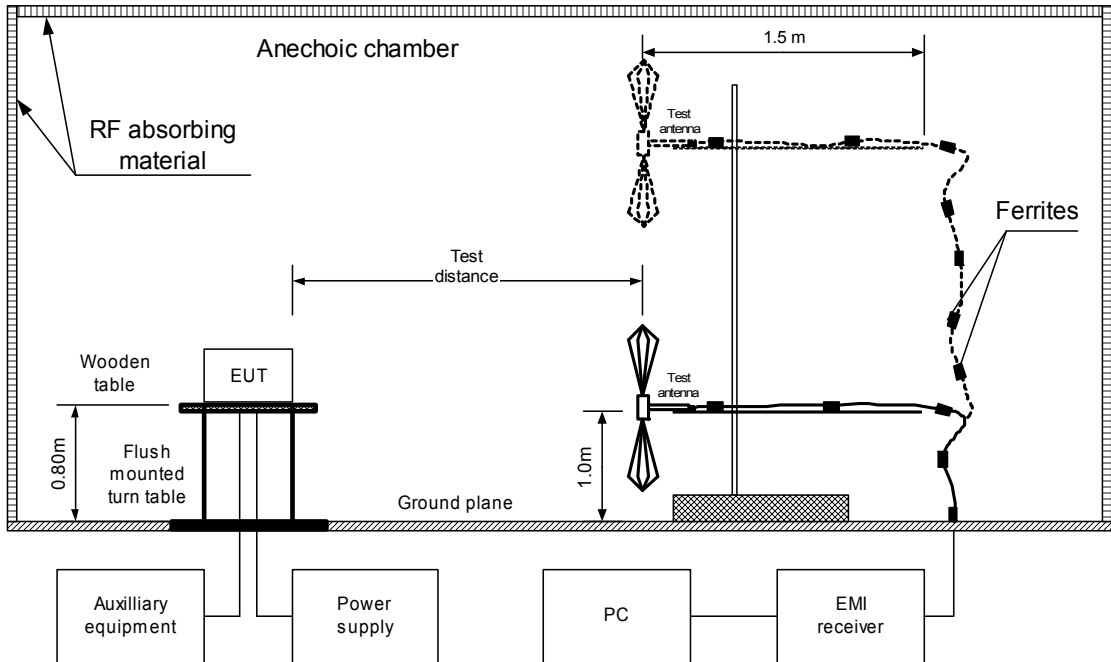
**8.2.2.3** The worst test results (the lowest margins) were recorded in Table 8.2.3 and shown in the associated plots.





<b>Test specification:</b>	FCC Part 15, Section 109 / ICES-003 Section 6.2 Class B, RSS-Gen, Section 6.1, 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>	3/5/2013 - 3/25/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Figure 8.2.1 Setup for radiated emission measurements in anechoic chamber, table-top equipment





<b>Test specification:</b>	<b>FCC Part 15, Section 109 / ICES-003 Section 6.2 Class B, RSS-Gen, Section 6.1, 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>	3/5/2013 - 3/25/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Photograph 8.2.1 Setup for radiated emission measurements



Photograph 8.2.2 Setup for final radiated emission measurements, EUT cabling





HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Part 15, Section 109 / ICES-003 Section 6.2 Class B, RSS-Gen, Section 6.1, 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>	3/5/2013 - 3/25/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

**Table 8.2.3 Radiated emission test results**

EUT SET UP: TABLE-TOP  
LIMIT: Class B  
EUT OPERATING MODE: 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*				
371.7	33.0	31.7	46	-14.3	H	23.0	23	Pass
466.3	36.7	35.3	46	-10.7	H	108.0	108	
819.1	36.7	33.8	46	-12.2	H	16.0	16	
887.8	36.4	33.0	46	-13.0	V	141.0	141	
916.4	40.3	37.7	46	-8.3	V	1.28	181	
940.0	42.4	39.8	46	-6.2	V	1.47	111	

TEST SITE: SEMI ANECHOIC CHAMBER  
TEST DISTANCE: 3 m  
DETECTORS USED: PEAK / AVERAGE  
FREQUENCY RANGE: 1000 MHz – 3000 MHz  
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 signals 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 1984	HL 3818	HL 4352	HL 4353	HL 4360	
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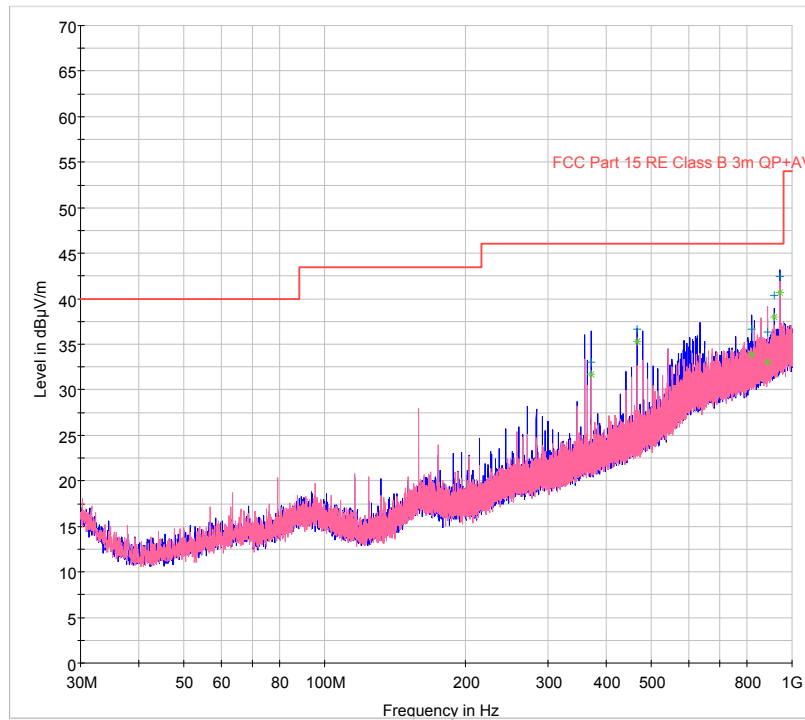
Full description is given in Appendix A.



<b>Test specification:</b>	<b>FCC Part 15, Section 109 / ICES-003 Section 6.2 Class B, RSS-Gen, Section 6.1, 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>	3/5/2013 - 3/25/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

**Plot 8.2.1 Radiated emission measurements in 30 - 1000 MHz range**

TEST SITE: Semi anechoic chamber  
LIMIT: Class B  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical & Horizontal  
EUT OPERATING MODE: Receive



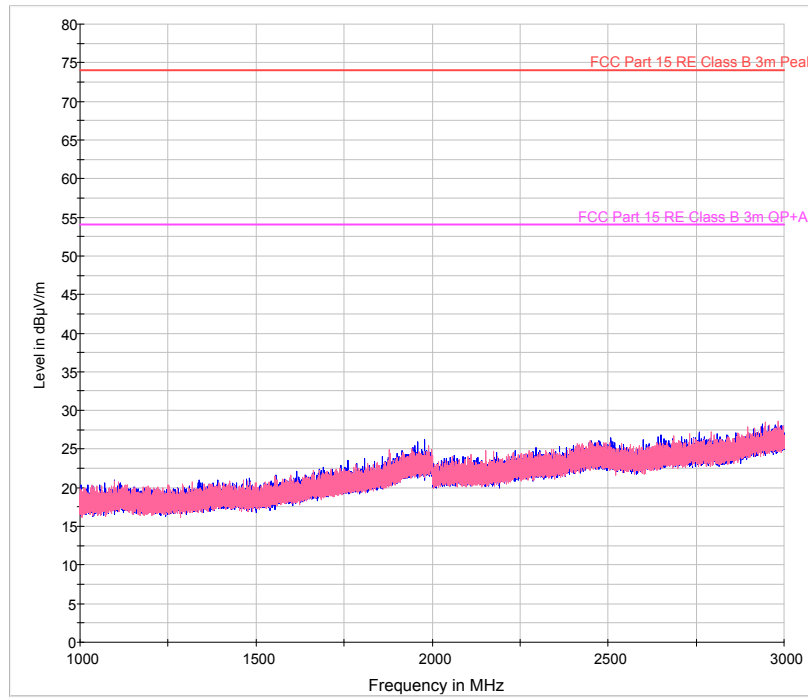


HERMON LABORATORIES

<b>Test specification:</b>		<b>FCC Part 15, Section 109 / ICES-003 Section 6.2 Class B, RSS-Gen, Section 6.1, 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>	PASS
<b>Date(s):</b>	3/5/2013 - 3/25/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

**Plot 8.2.2 Radiated emission measurements in 1000-3000 MHz range**

TEST SITE: Semi anechoic chamber  
LIMIT: Class B  
TEST DISTANCE: 3 m  
ANTENNA POLARIZATION: Vertical & Horizontal  
EUT OPERATING MODE: Receive





<b>Test specification:</b>	FCC Section 15.111 / RSS-Gen, Section 6.2, Conducted emission at receiver antenna port		
<b>Test procedure:</b>	ANSI C63.4, Section 12.1.5		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	PASS
<b>Date(s):</b>	3/5/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

### 8.3 Spurious emissions at RF antenna connector

#### 8.3.1 General

This test was performed to measure spurious emissions at RF antenna connector of receiver operated within 30 to 960 MHz band or a citizens band (CB) receiver which was tested for compliance with radiated emission limits with the antenna port connected to resistive termination. Specification test limits are given in Table 8.3.1.

Table 8.3.1 Antenna conducted measurement spurious emission limits

Frequency range, MHz	Power of spurious		Measurement bandwidth, (min) kHz
	nW	dBm	
30 – 1000	2	-57	4
1000 – 3 <sup>rd</sup> harmonic	5	-53	4

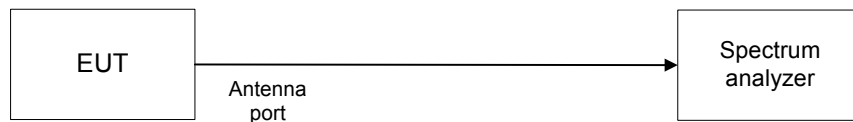
\* - harmonic of the highest frequency the EUT generates, uses, operates or tunes to (without exceeding 40 GHz).

#### 8.3.2 Test procedure

8.3.2.1 The EUT was set up as shown in Figure 8.3.1, energized and its proper operation was checked.

8.3.2.2 The spurious emission was measured with spectrum analyzer as provided in Table 8.3.2 and associated plots.

Figure 8.3.1 Spurious emission test setup





<b>Test specification:</b>	<b>FCC Section 15.111 / RSS-Gen, Section 6.2, Conducted emission at receiver antenna port</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 12.1.5		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/5/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

**Table 8.3.2 Spurious emission test results**

INVESTIGATED FREQUENCY RANGE: 30-3000 MHz  
 RECEIVER TYPE: Other than CB or superheterodyne  
 EUT OPERATING MODE: Receive  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH: 120 kHz  
 VIDEO BANDWIDTH: 300 kHz

Frequency, MHz	Spurious emission, dBm	Limit, dBm	Margin, dB	Verdict
821.9	-68.74	-57.0	-11.74	Pass
2453.0	-70.29	-53.0	-17.29	Pass

**Reference numbers of test equipment used**

HL 1876	HL 3776	HL 3818					
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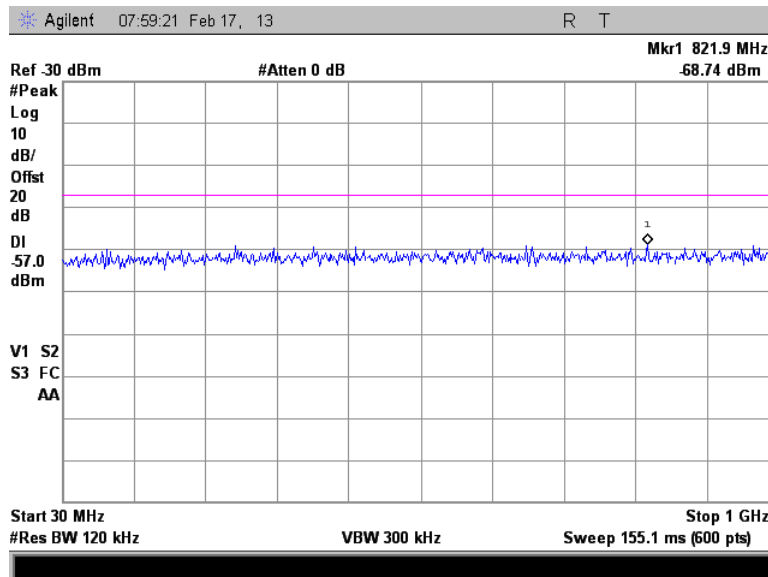
Full description is given in Appendix A.



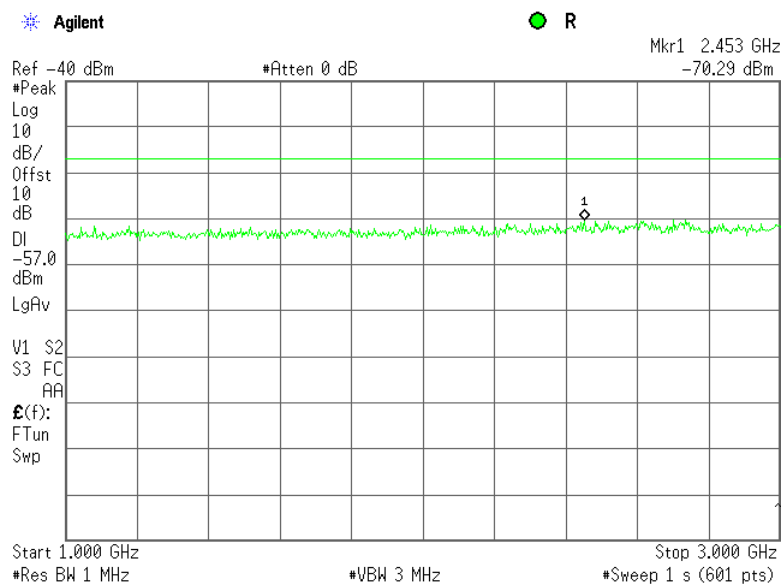
HERMON LABORATORIES

<b>Test specification:</b>	<b>FCC Section 15.111 / RSS-Gen, Section 6.2, Conducted emission at receiver antenna port</b>		
<b>Test procedure:</b>	ANSI C63.4, Section 12.1.5		
<b>Test mode:</b>	Compliance	<b>Verdict:</b>	<b>PASS</b>
<b>Date(s):</b>	3/5/2013		
<b>Temperature:</b> 23 °C	<b>Air Pressure:</b> 1015 hPa	<b>Relative Humidity:</b> 50 %	<b>Power Supply:</b> 120 VAC
<b>Remarks:</b>			

Plot 8.3.1 Spurious emission test results in 30 - 1000 MHz range



Plot 8.3.2 Spurious emission test results in 1000 – 3000 MHz range







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

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0163	LISN FCC/VDE/50 Ohm/50 uH + 5 Ohm, MIL-STD-461E, CISPR 16-1	Electro-Metrics	ANS 25/2	1314	15-Jan-13	15-Jan-14
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	03-Jul-12	03-Jul-13
0447	LISN, 16/2, 300V RMS, 50 Ohm/50 uH + 5 Ohm, STD CISPR 16-1	Hermon Laboratories	LISN 16 - 1	066	18-Oct-12	18-Oct-13
0539	Generator Signal, 10 kHz - 1.2 GHz	Marconi Instruments	2023	112121/04 1	28-Aug-12	28-Aug-13
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	20-May-12	20-May-14
0787	Transient Limiter 9 kHz-200 MHz	Hewlett Packard	11947A	3107A018 77	15-Oct-12	15-Oct-13
0808	Analyzer, Spectrum, 100 Hz to 2.2 GHz	Anritsu	MS2601B	M178731	21-Apr-11	21-Apr-13
1425	EMI Receiver, 9 kHz - 2.9 GHz, System: HL1426, HL1427	Agilent Technologies	8542E	3710A002 22, 3705A002 04	26-Aug-12	26-Aug-13
1457	Cable, 1 m	Harbour Industries	MIL 17/60-RG142	1457	02-Sep-12	02-Sep-13
1481	Cable, 1 m	Harbour Industries	MIL 17/60-RG142	1481	02-Sep-12	02-Sep-13
1513	Cable RF, 8 m, BNC/BNC	Belden	M17/167 MIL-C-17	1513	02-Sep-12	02-Sep-13
1562	Oscilloscope 100 MHz, DMM	Tektronix	THS720A	B039444	24-Sep-12	24-Sep-13
1876	Attenuator, 50 Ohm, 100 W, 20 dB	Bird Electronic Corp.	8343-200	2200	01-Feb-13	01-Feb-14
1908	Power Splitter / Combiner 0.5-1 GHz	Mini-Circuits	ZAPD-1	1908	02-Jul-12	02-Jul-15
1984	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz, 300 W	EMC Test Systems	3115	9911-5964	07-Dec-12	07-Dec-13
2227	Crystal Detector 0.01-18 GHz, 100 mW	Hewlett Packard Co	8472A	NA	19-Oct-11	19-Oct-13
3025	Directional Coupler High Power, 80 to 1000 MHz, 200 W, 40 dB	WERLATONE	C 3910	6726	11-May-12	11-May-13
3286	Temperature Chamber, (-50 to +170) °C	Thermotron	EL-8-CH-1-1-CO2	21-9048	13-Sep-12	13-Sep-13
3310	Multimeter	Fluke	115C	94321810	09-Jul-12	09-Jul-13
3339	High Pass Filter, 50 Ohm, 600 to 3000 MHz.	Mini-Circuits	SHP-600+	NA	03-Oct-12	03-Oct-13
3340	High Pass Filter, 50 Ohm, 1000 to 3000 MHz	Mini-Circuits	SHP-1000+	NA	03-Oct-12	03-Oct-13
3350	Low Pass Filter, 50 Ohm, DC to 270 MHz	Mini-Circuits	NLP-300+	NA	03-Oct-12	03-Oct-13
3390	Microwave Cable Assembly, 26.5 GHz, 1.0 m, N type/N type	Suhner Sucoflex	104EA	3390	06-Feb-13	06-Feb-14
3612	Cable RF, 17.5 m, N type-N type	Teldor	RG-214/U	NA	02-Dec-12	02-Dec-13



HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
3768	Attenuator, N-type, 20 dB, DC to 18 GHz, 5 W	Mini-Circuits	BW-N20W5+	NA	22-Aug-12	22-Aug-13
3776	Attenuator, N-type, 10 dB, DC to 18 GHz, 5 W	Mini-Circuits	BW-N10W5+	NA	22-Aug-12	22-Aug-13
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY48250288	16-Feb-12	16-Feb-14
3994	Attenuator, N-type, 20 dB, DC to 18 GHz, 5 W	Mini-Circuits	BW-N20W5+	NA	16-Jul-12	16-Jul-13
4160	Preamplifier, 0.1 to 18 GHz, Gain 25 dB, N-type(f) in, N-type(m) out.	Agilent Technologies	87405C	MY47010594	08-Aug-12	08-Aug-13
4339	High pass Filter, 50 Ohm, 1000 to 18000 MHz, SMA-FM / SMA-M	Micro-Tronics	HPM50115-02	001	23-Apr-12	23-Apr-13
4352	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101002	06-Mar-13	06-Mar-14
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101003	06-Mar-13	06-Mar-14
4360	EMI Test Receiver, 20 Hz to 40 GHz.	Rohde & Schwarz	ESU40	100322	05-Jun-12	05-Jun-13



**10 APPENDIX B Measurement uncertainties**

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

Test description	Expanded uncertainty
<b>Transmitter tests</b>	
Carrier power conducted at antenna connector	± 1.7 dB
Carrier power radiated (substitution method)	± 4.5 dB
Occupied bandwidth	±8%
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Spurious emissions radiated 30 MHz – 40 GHz (substitution method)	± 4.5 dB
Frequency error	30 – 300 MHz: ± 50.5 Hz (1.68 ppm) 300 – 1000 MHz: ± 168 Hz (0.56 ppm)
Transient frequency behaviour	187 Hz ± 13.9 %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
<b>Unintentional radiator tests</b>	
Conducted emissions with LISN	9 kHz to 150 kHz: ± 3.9 dB 150 kHz to 30 MHz: ± 3.8 dB
Radiated emissions at 3 m measuring distance Horizontal polarization	Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB
Vertical polarization	Biconilog antenna: ± 6.0 dB Biconical antenna: ± 5.7 dB Log periodic antenna: ± 6.0 dB Double ridged horn antenna: ± 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, 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.

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

Person for contact: Mr. Alex Usoskin, CEO.

## 12 APPENDIX D Specification references

FCC 47CFR part 15: 2012	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
ANSI/TIA/EIA-603-C:2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
RSS-119 Issue 11: 2011	
RSS-Gen Issue 3: 2010	General Requirements and Information for the Certification of Radiocommunication Equipment
ICES-003 issue 5:2012	Information Technology Equipment (ITE) – Limits and methods of measurement



### 13 APPENDIX E Test equipment correction factors

**Correction factor  
Line impedance stabilization network  
Model ANS-25/2, Electro-Metrics, HL 0163**

Frequency, kHz	Correction factor, dB
10	4.9
15	2.86
20	1.83
25	1.25
30	0.91
35	0.69
40	0.53
50	0.35
60	0.25
70	0.18
80	0.14
90	0.11
100	0.09
125	0.06
150	0.04

The correction factor in dB is to be added to meter readings of an interference analyzer or a spectrum analyzer.

**Correction factor  
Line impedance stabilization network  
Model LISN 16 - 1  
Hermon Laboratories, HL 0447**

Frequency, kHz	Correction factor, dB
10	4.9
15	2.86
20	1.83
25	1.25
30	0.91
35	0.69
40	0.53
50	0.35
60	0.25
70	0.18
80	0.14
90	0.11
100	0.09
125	0.06
150	0.04

The correction factor in dB is to be added to meter readings of an interference analyzer or a spectrum analyzer.



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  
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( $\mu$ V) to convert it into field strength in dB( $\mu$ V/m).



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

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

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





**Cable loss**  
**Cable MIL 17/60-RG142, HL 1481**

Frequency, GHz	Cable loss, dB
2	1
2.2	1.1
2.4	1.1
2.6	1.2
2.8	1.2
3	1.2
3.2	1.3
3.4	1.3
3.6	1.5
3.8	1.5
4	1.6
4.2	1.7
4.4	1.8
4.6	1.9
4.8	2
5	2
5.2	2
5.4	2.1
5.6	2.1
5.8	2.2
6	2.2
6.2	2.2
6.4	2.3
6.6	2.3
6.8	2.3
7	2.4
7.2	2.4
7.4	2.5
7.6	2.5
7.8	2.6
8	2.7
8.2	2.8
8.4	3.1
8.6	3.3
8.8	3.5
9	4



**Cable loss**  
**Cable coaxial, Microwave Cable Assembly, 104EA, 18 GHz, 1.0 m**  
**Suhner Sucoflex, HL 3390**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.03	4800	0.55	9800	0.89	14900	1.07
30	0.04	4900	0.56	9900	0.89	15000	1.07
50	0.05	5000	0.57	10000	0.86	15100	1.08
100	0.07	5100	0.58	10100	0.86	15200	1.07
200	0.10	5200	0.58	10200	0.88	15300	1.09
300	0.12	5300	0.59	10300	0.92	15400	1.10
400	0.14	5400	0.59	10400	0.94	15500	1.10
500	0.16	5500	0.60	10500	0.96	15600	1.12
600	0.17	5600	0.61	10600	0.93	15700	1.15
700	0.18	5700	0.61	10700	0.89	15800	1.15
800	0.20	5800	0.63	10800	0.89	15900	1.17
900	0.21	5900	0.63	10900	0.88	16000	1.14
1000	0.23	6000	0.64	11000	0.92	16100	1.14
1100	0.24	6100	0.64	11100	0.91	16200	1.15
1200	0.25	6200	0.64	11200	0.89	16300	1.14
1300	0.27	6300	0.65	11300	0.88	16400	1.13
1400	0.28	6400	0.65	11400	0.88	16500	1.13
1500	0.28	6500	0.66	11500	0.90	16600	1.13
1600	0.30	6600	0.67	11600	0.94	16700	1.14
1700	0.31	6700	0.67	11700	0.96	16800	1.14
1800	0.32	6800	0.67	11800	0.92	16900	1.14
1900	0.33	6900	0.68	11900	0.92	17000	1.14
2000	0.34	7000	0.67	12000	0.91	17100	1.15
2100	0.35	7100	0.68	12100	0.92	17200	1.14
2200	0.35	7200	0.69	12200	0.95	17300	1.15
2300	0.36	7300	0.69	12300	0.98	17400	1.15
2400	0.37	7400	0.68	12400	0.96	17500	1.16
2500	0.39	7500	0.69	12500	0.99	17600	1.16
2600	0.40	7600	0.70	12600	0.96	17700	1.16
2700	0.41	7700	0.71	12700	0.93	17800	1.19
2800	0.42	7800	0.72	12800	0.94	17900	1.21
2900	0.42	7900	0.72	12900	0.98	18000	1.25
3000	0.43	8000	0.72	13000	0.99		
3100	0.44	8100	0.73	13100	0.99		
3200	0.45	8200	0.74	13200	0.99		
3300	0.46	8300	0.75	13300	0.99		
3400	0.46	8400	0.74	13400	1.00		
3500	0.47	8500	0.73	13500	1.02		
3600	0.47	8600	0.73	13600	1.05		
3700	0.47	8700	0.75	13700	1.03		
3800	0.49	8800	0.77	13800	1.02		
3900	0.49	8900	0.77	13900	1.03		
4000	0.50	9000	0.77	14000	1.03		
4100	0.51	9100	0.77	14100	1.05		
4200	0.52	9200	0.78	14200	1.05		
4300	0.52	9300	0.80	14300	1.04		
4400	0.53	9400	0.82	14400	1.03		
4500	0.53	9500	0.82	14600	1.06		
4600	0.54	9600	0.83	14700	1.07		
4700	0.56	9700	0.89	14800	1.08		



**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**  
**Low Loss Armored Test Cable, MegaPhase, 18 GHz, 6.2 m, N type-M/N type-M,**  
**NC29-N1N1-244S/N 12025101 002,**  
**HL 4352**

<b>Frequency, MHz</b>	<b>Cable loss, dB</b>	<b>Frequency, MHz</b>	<b>Cable loss, dB</b>
50	0.20	9000	2.81
100	0.28	9500	2.89
300	0.49	10000	3.00
500	0.63	10500	3.07
1000	0.90	11000	3.15
1500	1.10	11500	3.23
2000	1.28	12000	3.30
2500	1.44	12500	3.38
3000	1.57	13000	3.47
3500	1.71	13500	3.55
4000	1.85	14000	3.61
4500	1.95	14500	3.68
5000	2.05	15000	3.76
5500	2.14	15500	3.86
6000	2.27	16000	3.92
6500	2.38	16500	3.97
7000	2.47	17000	4.03
7500	2.58	17500	4.10
8000	2.65	18000	4.18
8500	2.74		



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

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



## 14 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