

# TEST REPORT

ACCORDING TO: FCC 47 CFR Part 90, RSS-Gen issue 5: 2019 and

RSS-119 Issue 12:2015

FOR:

**ST Engineering Telematics Wireless Ltd.**

**Light Control Unit**

**Product name: LCU NEMA**

**Model: LCUN2GUS**

**FCC ID: NTALCUN2G1**

**IC: 4732A-LCUN2G1**

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## 1 Applicant information

**Client name:** ST Engineering Telematics Wireless Ltd.  
**Address:** 26 Hamelacha street, POB 1911, Holon, 5811801, Israel  
**Telephone:** +972 3557 5700  
**Fax:** +972 3557 5703  
**E-mail:** itsikk@tlmw.com  
**Contact name:** Mr. Itsik Kanner

## 2 Equipment under test attributes

**Product name:** LCU NEMA  
**Product type:** Transceiver  
**Model(s):** LCUN2GUS  
**Serial number:** 68915  
**Hardware version:** REV A  
**Software release:** 2.31  
**Receipt date** 04-Jul-17

## 3 Manufacturer information

**Manufacturer name:** ST Engineering Telematics Wireless Ltd.  
**Address:** 26 Hamelacha street, POB 1911, Holon, 5811801, Israel  
**Telephone:** +972 3557 5700  
**Fax:** +972 3557 5703  
**E-Mail:** itsikk@tlmw.com  
**Contact name:** Mr. Itsik Kanner

## 4 Test details

**Project ID:** 40583  
**Location:** Hermon Laboratories Ltd. P.O. Box 23, Binyamina 3055001, Israel  
**Test started:** 04-Jul-17  
**Test completed:** 19-Jul-17  
**Test specification(s):** FCC 47 CFR part 90, RSS-Gen Issue 5, RSS-119 issue 12

## 5 Tests summary




Test	Status
<b>Transmitter characteristics</b>	
FCC Section 90.267 / RSS-119 Section 5.4, Maximum output power	Pass
FCC Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth	Pass
FCC Section 90.210 / RSS-119 Section 5.8.4, Emission mask	Pass
FCC Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions	Pass
FCC Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions	Pass
FCC Section 90.213 / RSS-119 Section 5.3, Frequency stability	Pass
FCC Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour	Pass
FCC Section 2.1091 / RSS-102 section 2.5, RF radiation exposure evaluation	Pass, Exhibit in application for certification provided

The original EUT configuration was certified by FCC under FCC ID: NTALCUN2G1 and by ISED under IC: 4732A-LCUN2G1. The report was revised to reflect the following changes:

1. Additional EUT configuration with external antenna.

Testing was completed against all relevant requirements of the test standard. The results obtained indicate that the product under test complies in full with the requirements tested.

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

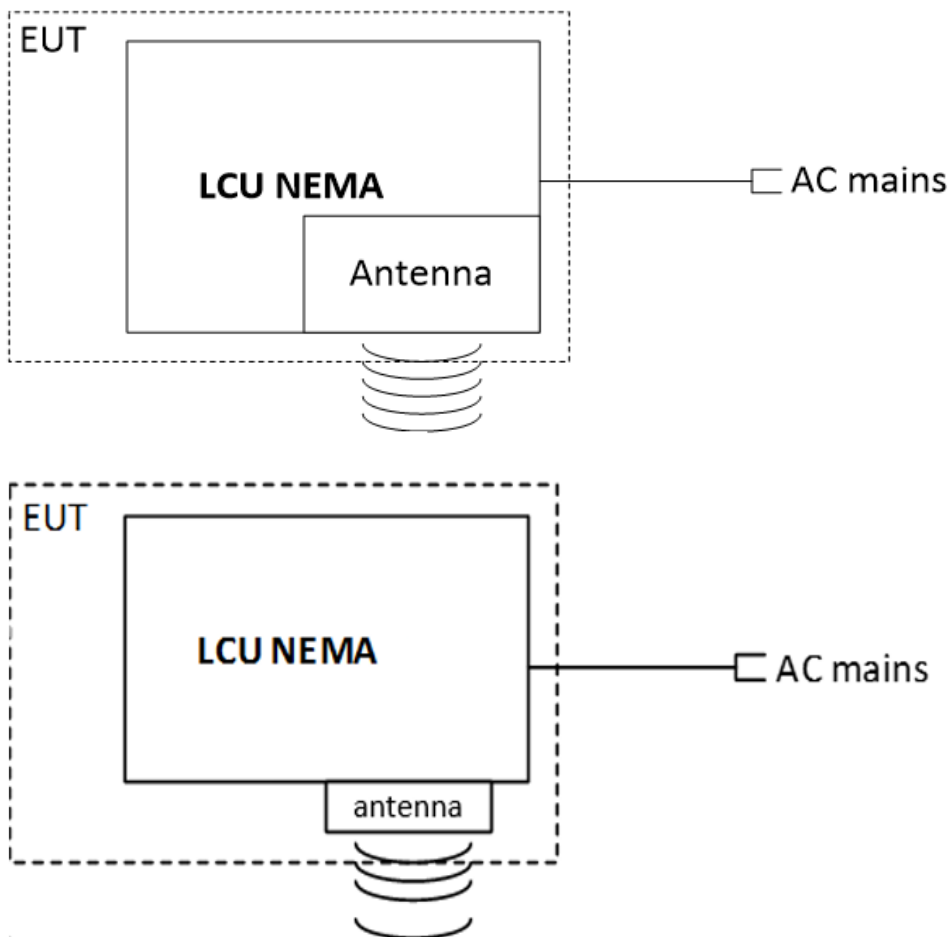
	Name and Title	Date	Signature
<b>Tested by:</b>	Mr. S. Samokha, technical manager, EMC & Radio	19-July-17	
<b>Reviewed by:</b>	Mrs. S. Peysahov Sheynin, test engineer, EMC & Radio	15-Oct-20	
<b>Approved by:</b>	Mr. M. Nikishin, group leader, EMC & Radio	26-Oct-20	

## 6 EUT description

### 6.1 General information

The EUT, LCU NEMA, is a luminaire control unit, easily installed on top of the luminaire utilizing a standard (twist and lock) NEMA socket. LCU NEMA is a unit of the T-Light Galaxy star network. Control features offer On/Off and dimming level operations. Monitoring features include identification of lamp and measurement of electrical parameters.

### 6.2 Test configuration



### 6.3 Changes made in EUT

No changes were implemented in the EUT during testing.



### 6.4 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>			
	fixed	Always at a distance more than 2 m from all people			
X	mobile	Always at a distance more than 20 cm from all people			
	portable	May operate at a distance closer than 20 cm to human body			
<b>Assigned frequency ranges</b>		450- 470 MHz			
<b>Maximum rated output power</b>		At transmitter 50 Ω RF output connector		35.23 dBm	
<b>Is transmitter output power variable?</b>		X	No		
			Yes	continuous variable	
				stepped variable with stepsize	dB
				minimum RF power	dBm
				maximum RF power	dBm
<b>Antenna connection</b>					
X	unique coupling	standard connector	integral	with temporary RF connector	
				X without temporary RF connector	
<b>Antenna/s technical characteristics</b>					
Type	Manufacturer	Model number		Gain	
*Integral	Telematics Wireless	Printed		2 dBi	
External	Hongsense Technology	HSA-450TFH1		2 dBi	
<b>Transmitter aggregate data rate/s</b>		4.8 kbps			
<b>Type of modulation</b>		4GFSK			
<b>Modulating test signal (baseband)</b>		PRBS			
<b>Transmitter power source</b>					
	Battery	<b>Nominal rated voltage</b>		Battery type	
	DC	<b>Nominal rated voltage</b>	3.6 V to module		
X	AC mains	<b>Nominal rated voltage</b>	120 AC	Frequency	60 Hz

\* - The worst case of antenna configuration delivering the highest radiated emissions was tested.



<b>Test specification:</b> Section 90.267 / RSS-119 Section 5.4, Maximum output power			
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-E, Section 2.2.1			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 04-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1004 hPa	<b>Power:</b> 120 VAC, 60 Hz
<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
<b>FCC</b>		
450.0 – 470.0	6	37.78
<b>RSS-119 Table 2</b>		
450.0 – 470.0	60	47.78

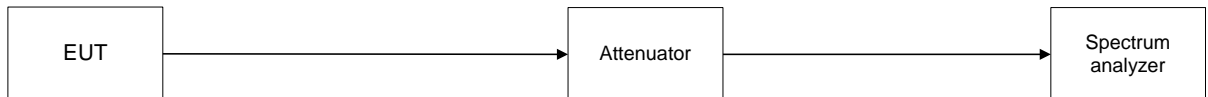
#### 7.1.2 Test procedure

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 associated plots.

Figure 7.1.1 Peak output power test setup





<b>Test specification:</b> Section 90.267 / RSS-119 Section 5.4, Maximum output power			
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-E, Section 2.2.1			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 04-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1004 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Table 7.1.2 Peak output power test results

OPERATING FREQUENCY RANGE: 450.0 – 470.0 MHz  
 DETECTOR USED: Peak  
 RESOLUTION BANDWIDTH: 100 kHz  
 VIDEO BANDWIDTH: 300 kHz  
 MODULATION: 4GFSK  
 MODULATING SIGNAL: ID code  
 BIT RATE: 4.8 kbps  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

Carrier frequency, MHz	Spectrum analyzer reading, dBm	External attenuation, dB	Cable loss, dB	RF output power, dBm	Limit, dBm	Margin, dB	Verdict
450.003125	34.16	Included	Included	34.16	37.78	-3.62	Pass
460.000000	34.83	Included	Included	34.83	37.78	-2.95	Pass
469.996875	35.23	Included	Included	35.23	37.78	-2.55	Pass

**Note 1:** The manufacturer's rated power is 35 dBm. The measured output power is within ±1 dB required by the RSS-119 standard.

Reference numbers of test equipment used

HL 3433	HL 3818	HL 4070	HL 4071				
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Full description is given in Appendix A.

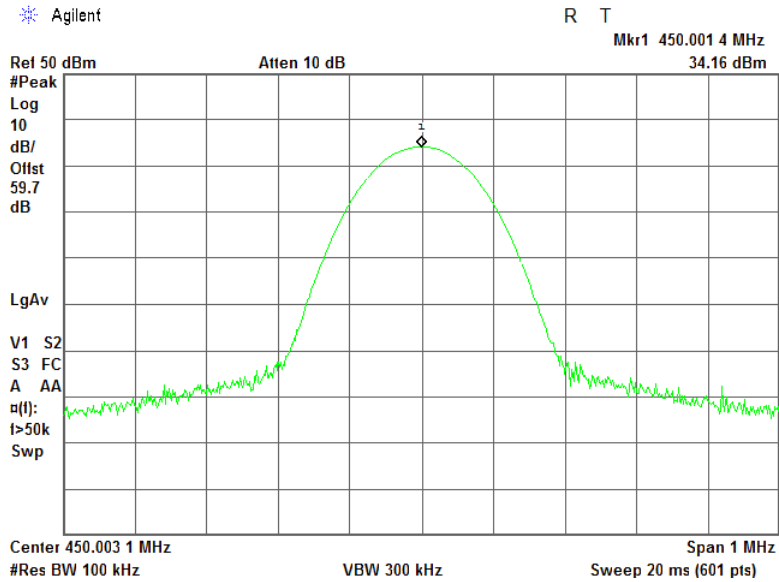




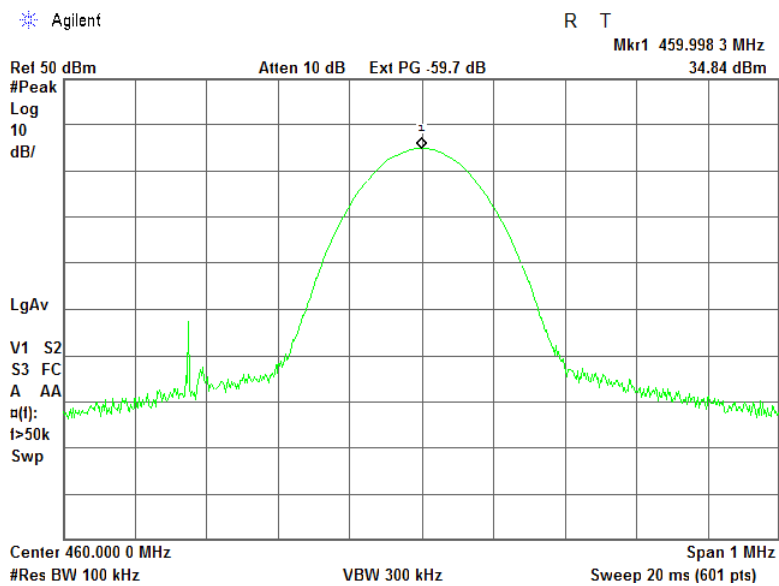
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<b>Test specification:</b> Section 90.267 / RSS-119 Section 5.4, Maximum output power			
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-E, Section 2.2.1			
<b>Test mode:</b> Compliance	<b>Verdict:</b> PASS		
<b>Date(s):</b> 04-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1004 hPa	<b>Power:</b> 120 VAC, 60 Hz
<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

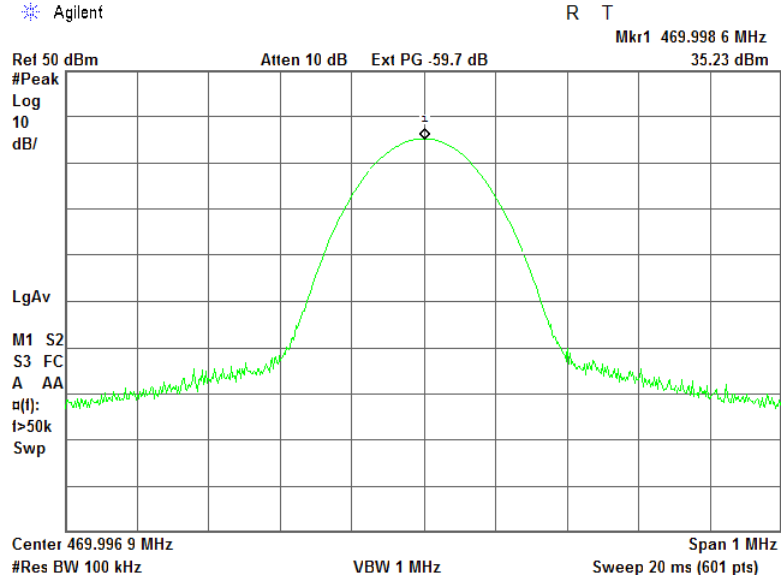




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<b>Test specification:</b> Section 90.267 / RSS-119 Section 5.4, Maximum output power			
<b>Test procedure:</b> 47 CFR, Section 2.1046; TIA/EIA-603-E, Section 2.2.1			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 04-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1004 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Plot 7.1.3 Peak output power test results at high frequency





<b>Test specification:</b> 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> 04-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 42 %	<b>Air Pressure:</b> 1004 hPa	<b>Power:</b> 120 VAC, 60 Hz
<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
450.0 – 470.0	26	6

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

### 7.2.2 Test procedure

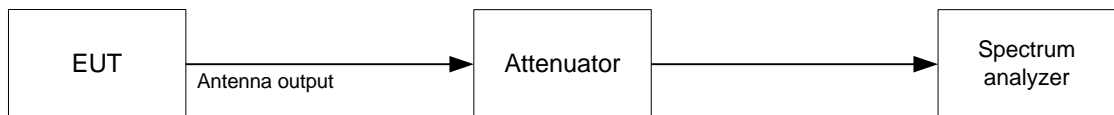
7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

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> 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> 04-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 42 %	<b>Air Pressure:</b> 1004 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Table 7.2.2 Occupied bandwidth test results

DETECTOR USED: Peak hold  
 RESOLUTION BANDWIDTH: 100 Hz  
 VIDEO BANDWIDTH: 1 kHz  
 MODULATION ENVELOPE REFERENCE POINTS: 26 dBc  
 MODULATION: 4GFSK  
 MODULATING SIGNAL: ID code  
 BIT RATE: 4.8 kbps

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
MODULATION ENVELOPE REFERENCE POINTS: 99%				
450.003125	3.5247	6	-2.4753	Pass
460.000000	3.5164	6	-2.4836	Pass
469.996875	3.5055	6	-2.4945	Pass
MODULATION ENVELOPE REFERENCE POINTS: 26 dBc				
450.003125	4.8160	6	-1.184	Pass
460.000000	4.4710	6	-1.529	Pass
469.996875	4.5910	6	-1.409	Pass

Reference numbers of test equipment used

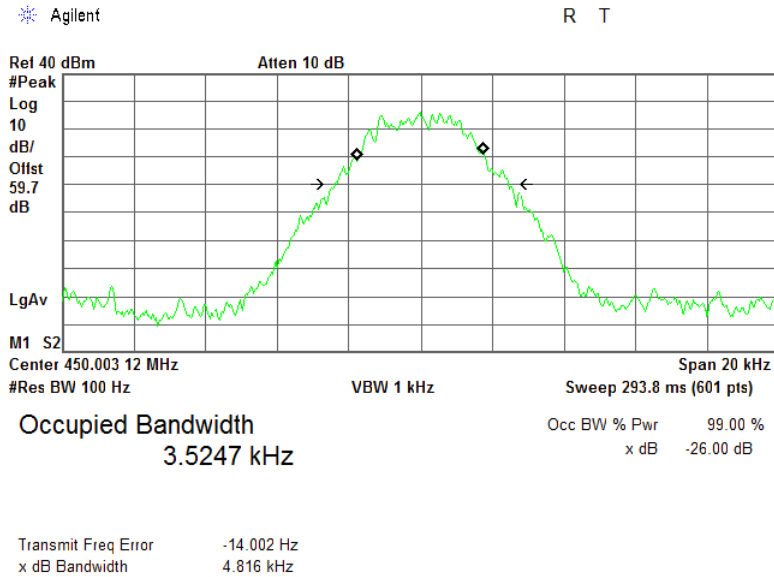
HL 3334	HL 3818	HL 4070	HL 4071				
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Full description is given in Appendix A.

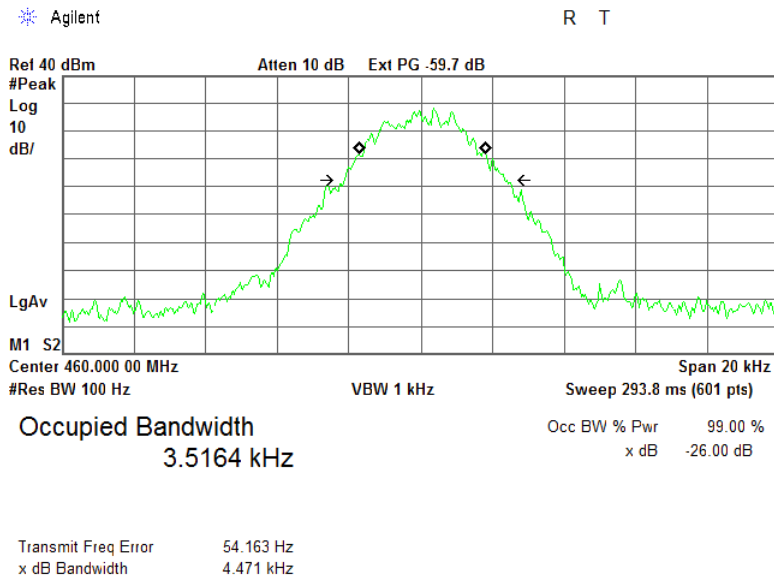


<b>Test specification: Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth</b>			
<b>Test procedure:</b> 47 CFR, Section 2.1049			
<b>Test mode:</b> Compliance		<b>Verdict: PASS</b>	
<b>Date(s):</b> 04-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 42 %	<b>Air Pressure:</b> 1004 hPa	<b>Power:</b> 120 VAC, 60 Hz
<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

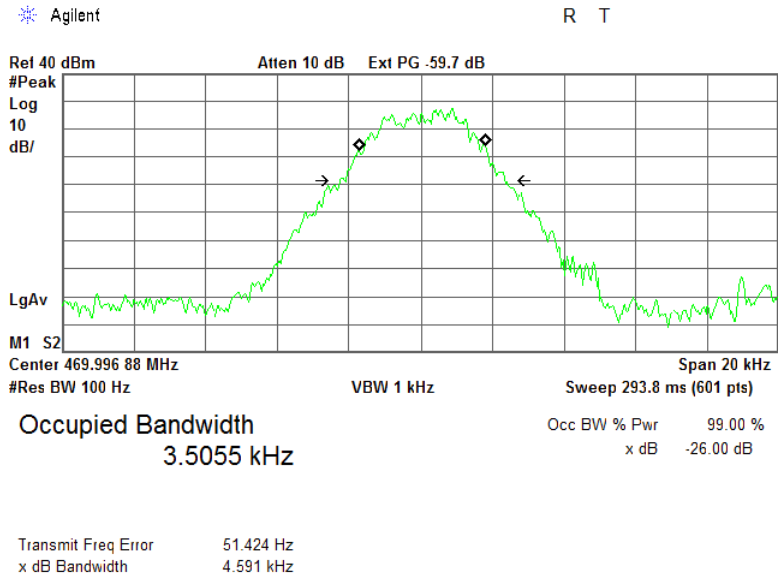




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<b>Test specification: Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth</b>			
<b>Test procedure:</b> 47 CFR, Section 2.1049			
<b>Test mode:</b> Compliance		<b>Verdict: PASS</b>	
<b>Date(s):</b> 04-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 42 %	<b>Air Pressure:</b> 1004 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

**Plot 7.2.3 Occupied bandwidth test result at high frequency**





<b>Test specification: Section 90.210 / 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-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict: PASS</b>	
<b>Date(s):</b> 04-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 44 %	<b>Air Pressure:</b> 1004 hPa	<b>Power:</b> 120 VAC, 60 Hz
<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
Emission mask E (Channel bandwidth 6.25 kHz, authorized bandwidth 6.0 kHz) with audio low pass filter)	
0 – 3.0 kHz	0
3.0 – 4.6 kHz	30 + 16.67( $f_d^{**}$ - 3 kHz) or 55+10logP(W) whichever is the lesser
More than 4.6 kHz	55+10logP(W) or 57 whichever is the lesser (RSS-119) 55+10logP(W) or 65 whichever is the lesser (FCC)

\* - linearly increase with frequency

\*\* - displacement frequency

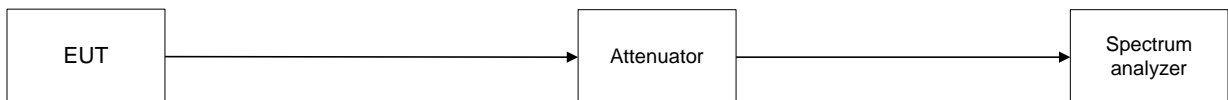
#### 7.3.2 Test procedure

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.

7.3.2.3 The test results are provided in Table 7.3.2 and the the associated plots.

Figure 7.3.1 Emission mask test setup





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<b>Test specification:</b> Section 90.210 / 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-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 04-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 44 %	<b>Air Pressure:</b> 1004 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Table 7.3.2 Emission mask test results

Carrier frequency, MHz	Limit	Verdict
450.003125	Emission mask E	Pass
460.000000		
469.996875		

**Reference numbers of test equipment used**

HL 3433	HL 3818	HL 4070	HL 4071				
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Full description is given in Appendix A.





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<b>Test specification: Section 90.210 / 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-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 04-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 44 %	<b>Air Pressure:</b> 1004 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Plot 7.3.1 Emission mask test results at low carrier frequency

OPERATING FREQUENCY RANGE:

450.0 – 470.0 MHz

DETECTOR USED:

Peak

MODULATION:

4GFSK

MODULATING SIGNAL:

ID code

BIT RATE:

4.8 kbps

TRANSMITTER OUTPUT POWER SETTINGS:

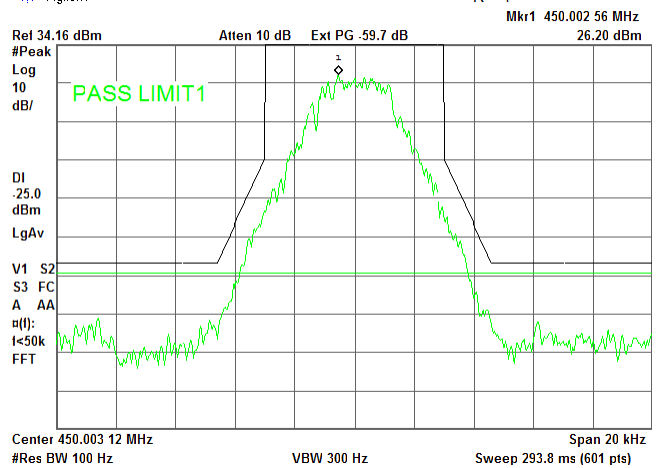
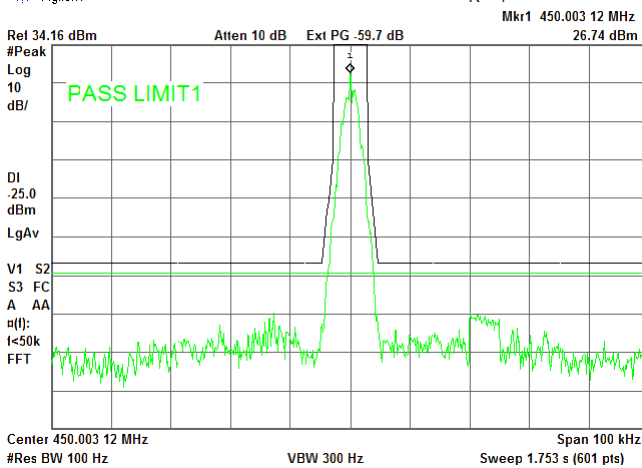
Maximum

\* Agilent

R T

\* Agilent

R T



Plot 7.3.2 Emission mask test results at mid carrier frequency

OPERATING FREQUENCY RANGE:

450.0 – 470.0 MHz

DETECTOR USED:

Peak

MODULATION:

4GFSK

MODULATING SIGNAL:

ID code

BIT RATE:

4.8 kbps

TRANSMITTER OUTPUT POWER SETTINGS:

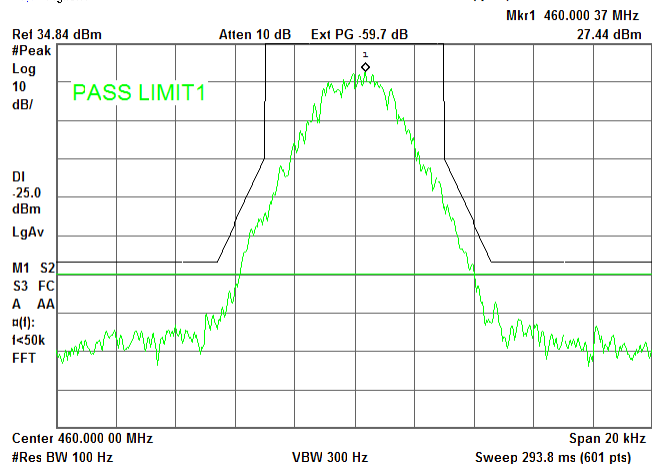
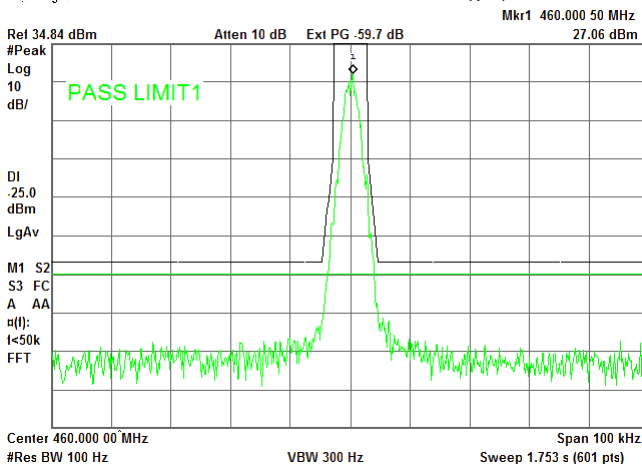
Maximum

\* Agilent

R T

\* Agilent

R T



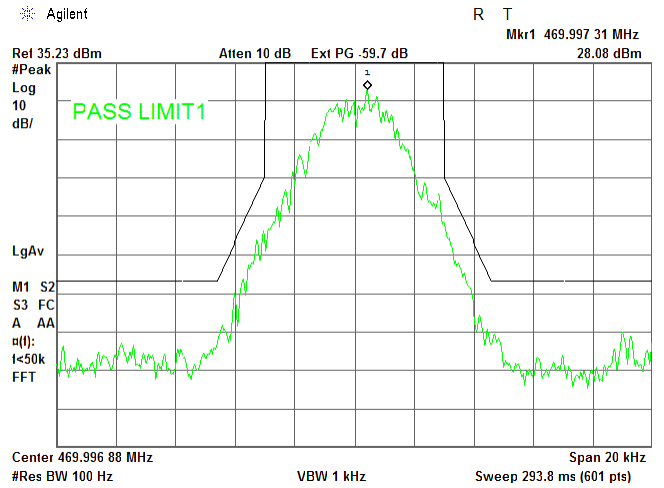
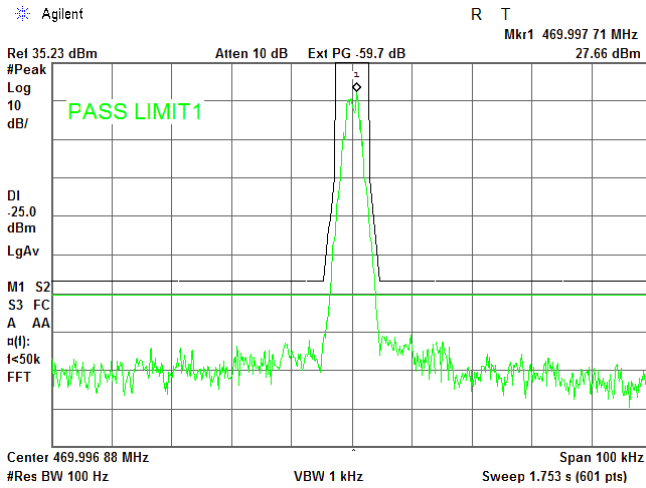


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<b>Test specification: Section 90.210 / RSS-119 Section 5.8.4, Emission mask</b>			
<b>Test procedure:</b> 47 CFR, Sections 2.1051, 2.1047 and 90.210(e); TIA/EIA-603-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict: PASS</b>	
<b>Date(s):</b> 04-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 44 %	<b>Air Pressure:</b> 1004 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

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

OPERATING FREQUENCY RANGE: 450.0 – 470.0 MHz  
DETECTOR USED: Peak  
MODULATION: 4-GFSK  
MODULATING SIGNAL: ID code  
BIT RATE: 4.8 kbps  
TRANSMITTER OUTPUT POWER SETTINGS: Maximum





<b>Test specification: Section 90.210 / 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-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict: PASS</b>	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<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(μV/m) <sup>***</sup>
0.009 – 10th harmonic*	55+10logP <sup>**</sup>	-25	72.4

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

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

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

### 7.4.2 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.

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

7.4.4.1 The test equipment was set up as shown in Figure 7.4.3 and energized.

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

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

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

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

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

7.4.4.7 The worst test results (the lowest margins) were recorded in Table 7.4.3 and shown in the associated plots.



<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

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

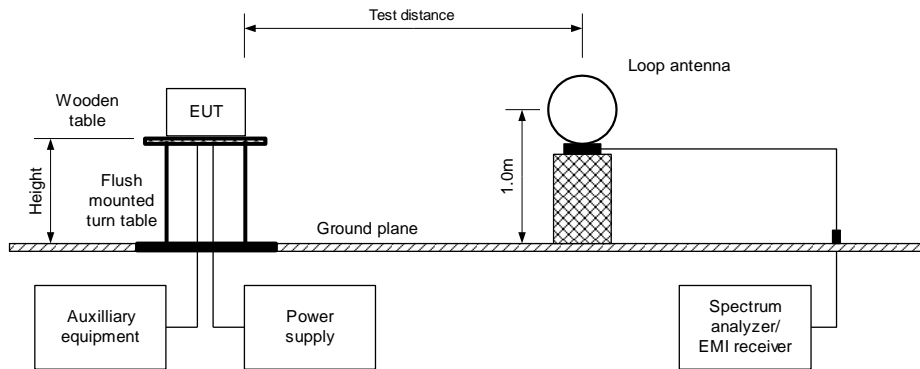
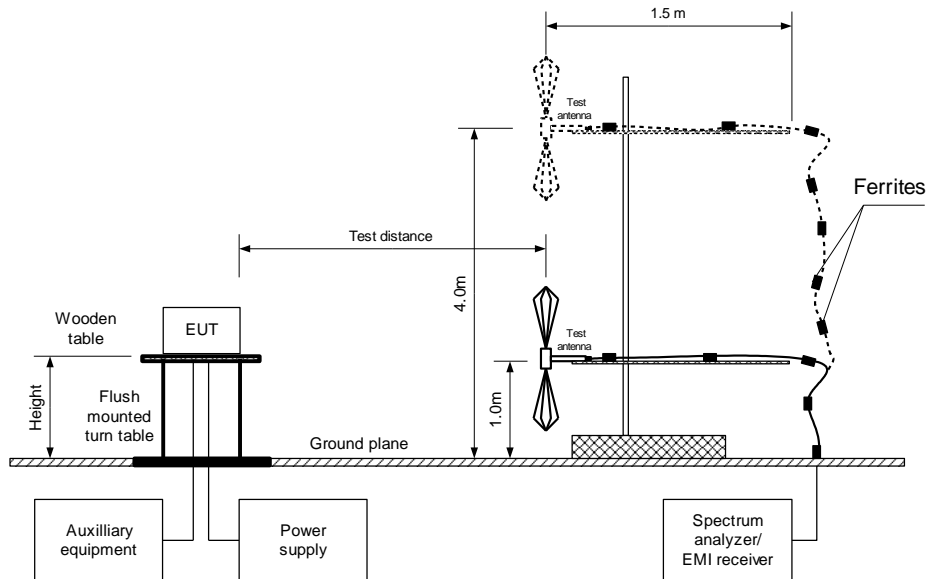


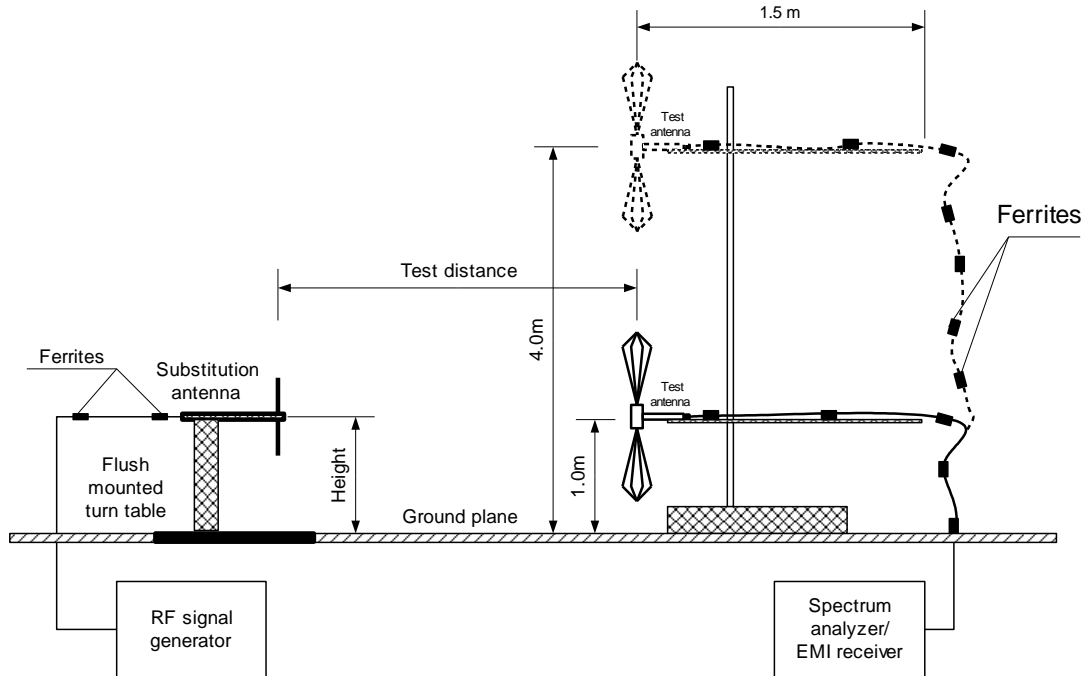
Figure 7.4.2 Setup for spurious emission field strength measurements above 30 MHz





<b>Test specification: Section 90.210 / 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-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Figure 7.4.3 Setup for substitution ERP measurements of spurious





<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

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

ASSIGNED FREQUENCY RANGE: 450.0 – 470.0 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
<b>Low carrier frequency 450.003125 MHz</b>							
899.991	67.69	72.4	-4.71	100	Vert	1.4	138
1350.050	63.68	72.4	-8.72	1000	Vert	1.5	340
1800.050	56.64	72.4	-15.76	1000	Hor	1.2	46
<b>Mid carrier frequency 460.0 MHz</b>							
920.013	70.28	72.4	-2.12	100	Vert	1.4	156
1379.950	65.71	72.4	-6.69	1000	Vert	1.5	343
1840.150	57.93	72.4	-14.47	1000	Hor	1.2	60
2300.000	54.95	72.4	-17.45	1000	Hor	1.3	294
<b>High carrier frequency 469.996875 MHz</b>							
940.031	66.16	72.4	-6.24	100	Vert	1.4	144
1409.990	67.45	72.4	-4.95	1000	Vert	1.5	339
1880.030	57.71	72.4	-14.69	1000	Hor	1.2	83
2350.030	54.77	72.4	-17.63	1000	Vert	1.3	304

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

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



<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Table 7.4.3 Substitution ERP of spurious test results

ASSIGNED FREQUENCY RANGE: 450 -470 MHz  
 TEST SITE: Semi anechoic chamber  
 TEST DISTANCE: 3 m  
 SUBSTITUTION ANTENNA HEIGHT: 0.8 m  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: > Resolution bandwidth  
 SUBSTITUTION ANTENNA TYPE: Tunable dipole (30 MHz – 1000 MHz)  
 Double ridged guide (above 1000 MHz)

Frequency, MHz	Field strength, dB(µV/m)	RBW, kHz	Antenna polarization	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	ERP, dBm	Limit, dBm	Margin, dB*	Verdict
<b>Low carrier frequency 450.003125 MHz</b>										
899.991	67.69	100	Vert	-28.54	-1.47	1.54	-31.55	-25.00	-6.55	Pass
1350.050	63.68	1000	Vert	-37.65	4.92	1.99	-34.72	-25.00	-9.72	Pass
1800.050	56.64	1000	Hor	-44.69	5.68	2.33	-41.34	-25.00	-16.34	Pass
<b>Mid carrier frequency 460.0 MHz</b>										
920.013	70.28	100	Vert	-26.05	-1.39	1.56	-29.00	-25.00	-4.00	Pass
1379.950	65.71	1000	Vert	-35.62	5.04	2.01	-32.59	-25.00	-7.59	Pass
1840.150	57.93	1000	Hor	-43.4	5.69	2.35	-40.06	-25.00	-15.06	Pass
2300.000	54.95	1000	Hor	-46.38	6.10	2.51	-42.79	-25.00	-17.79	Pass
<b>High carrier frequency 469.996875 MHz</b>										
940.031	66.16	100	Vert	-30.25	-1.33	1.58	-33.16	-25.00	-8.16	Pass
1409.990	67.45	1000	Vert	-33.88	5.15	2.04	-30.77	-25.00	-5.77	Pass
1880.030	57.71	1000	Hor	-43.62	5.68	2.36	-40.30	-25.00	-15.30	Pass
2350.030	54.77	1000	Vert	-46.56	6.16	2.55	-42.95	-25.00	-17.95	Pass

\*- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

HL 0446	HL 0521	HL 0604	HL 0661	HL 1565	HL 1984	HL 2432	HL 2909
HL 3632	HL 4278	HL 4339	HL 4353	HL 5121			

Full description is given in Appendix A.



HERMON LABORATORIES

<b>Test specification: Section 90.210 / 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-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict: PASS</b>	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

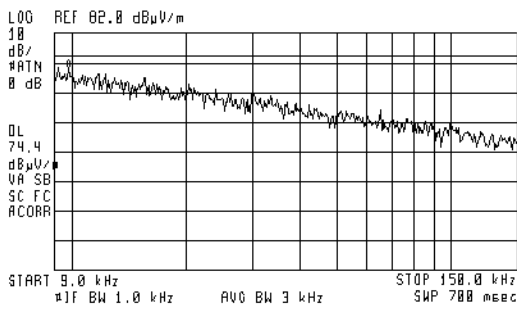
**Plot 7.4.1 Radiated emission measurements in 9 - 150 kHz range**

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

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

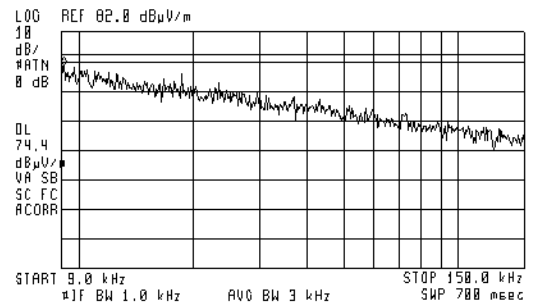
22:19:44 JUL 04, 2017

ACTV DET: PEAK  
MERS DET: PEAK OP AVG  
MKR 9.8 kHz  
78.46 dBµV/m



22:22:18 JUL 04, 2017

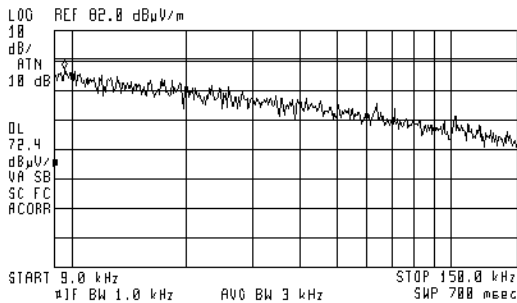
ACTV DET: PEAK  
MERS DET: PEAK OP AVG  
MKR 9.2 kHz  
78.67 dBµV/m



CARRIER FREQUENCY: High

22:27:48 JUL 04, 2017

ACTV DET: PEAK  
MERS DET: PEAK OP AVG  
MKR 9.7 kHz  
69.37 dBµV/m







HERMON LABORATORIES

<b>Test specification: Section 90.210 / 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-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

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

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

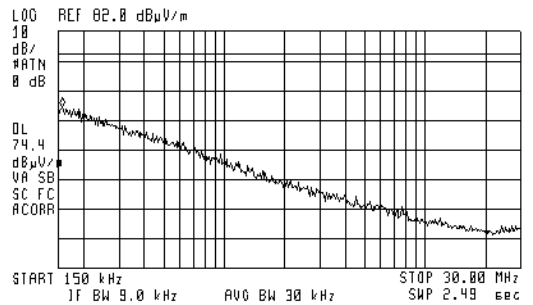
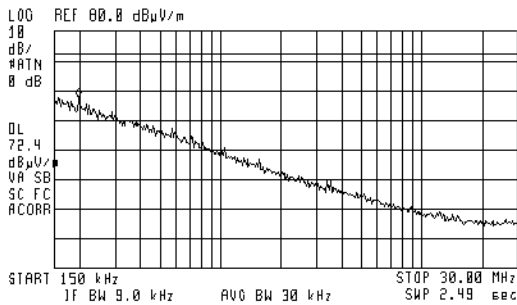
Semi anechoic chamber  
Vertical and Horizontal  
3 m  
CARRIER FREQUENCY: Mid

22:14:38 JUL 04, 2017

22:23:38 JUL 04, 2017

ACTV DET: PEAK  
MERS DET: PEAK OP AVG  
MKR 200 kHz  
57.90 dBµV/m

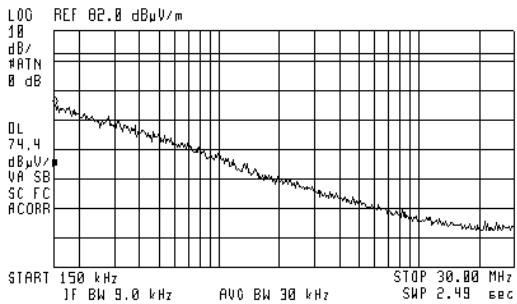
ACTV DET: PEAK  
MERS DET: PEAK OP AVG  
MKR 160 kHz  
56.50 dBµV/m



CARRIER FREQUENCY: High

22:25:21 JUL 04, 2017

ACTV DET: PEAK  
MERS DET: PEAK OP AVG  
MKR 150 kHz  
57.05 dBµV/m





HERMON LABORATORIES

<b>Test specification: Section 90.210 / 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-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

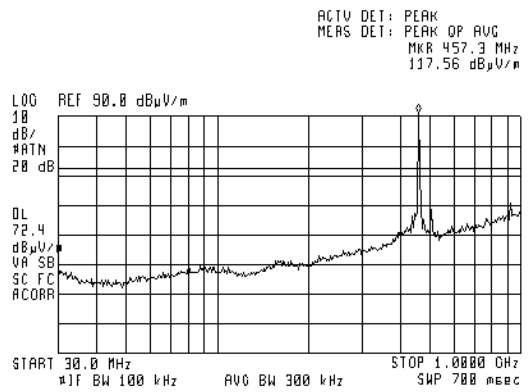
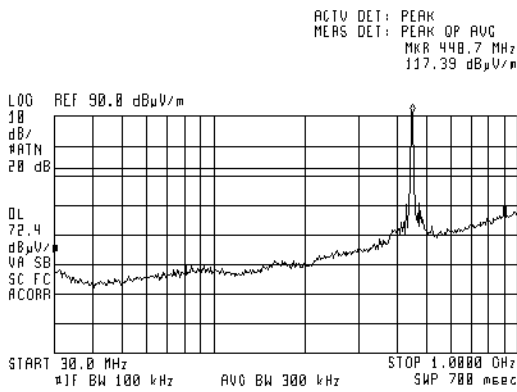
**Plot 7.4.3 Radiated emission measurements in 30 - 1000 MHz range**

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

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

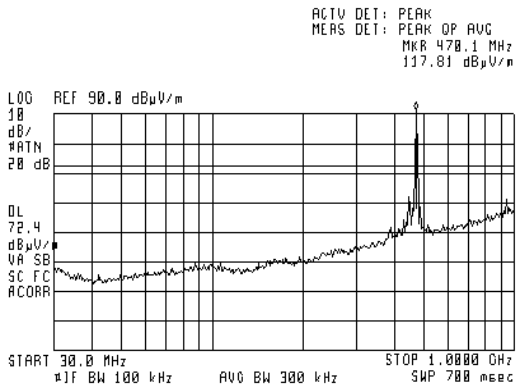
21:17:06 JUL 04, 2017

21:15:29 JUL 04, 2017



CARRIER FREQUENCY: High

21:18:16 JUL 04, 2017





HERMON LABORATORIES

<b>Test specification: Section 90.210 / 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-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

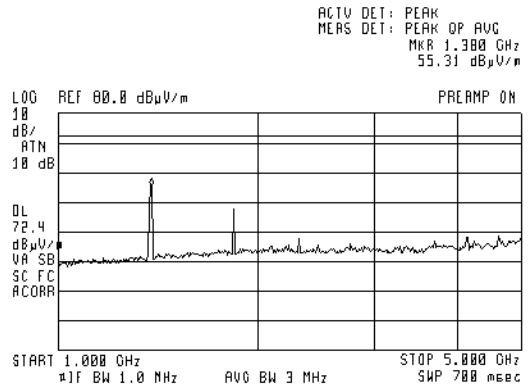
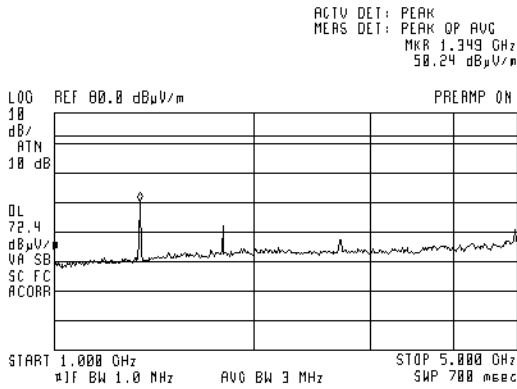
**Plot 7.4.4 Radiated emission measurements in 1000 – 5000 MHz range**

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

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

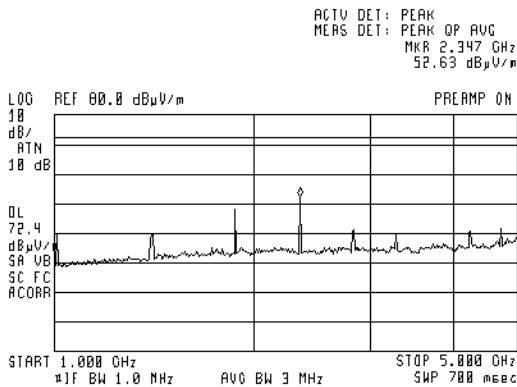
22:52:18 JUL 04, 2017

22:47:39 JUL 04, 2017



CARRIER FREQUENCY: High

22:43:56 JUL 04, 2017





HERMON LABORATORIES

<b>Test specification: Section 90.210 / 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-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

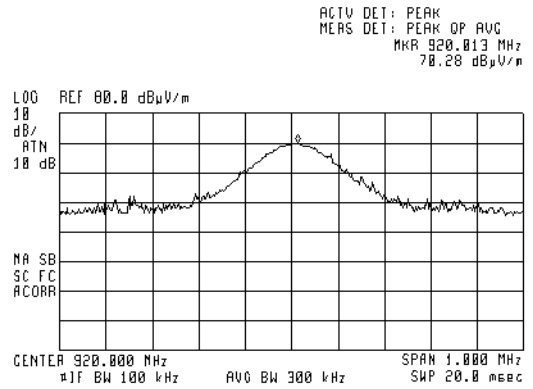
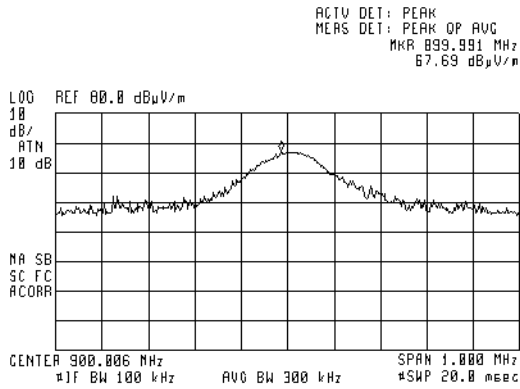
**Plot 7.4.5 Radiated emission measurements at the 2<sup>nd</sup> harmonic**

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

Semi anechoic chamber  
Vertical  
3 m  
CARRIER FREQUENCY: Mid

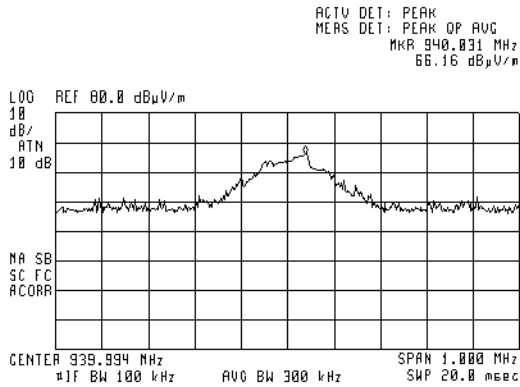
18:58:49 JUL 04, 2017

19:06:39 JUL 04, 2017



CARRIER FREQUENCY: High

19:56:47 JUL 04, 2017





HERMON LABORATORIES

<b>Test specification: Section 90.210 / 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-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

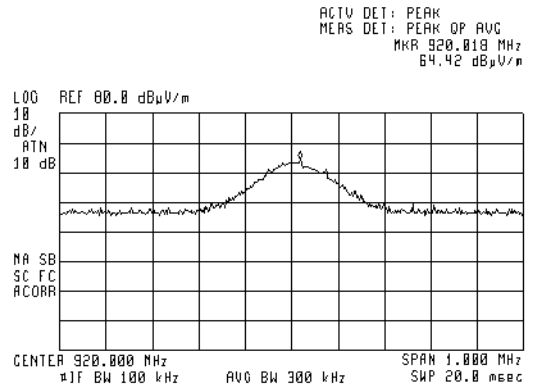
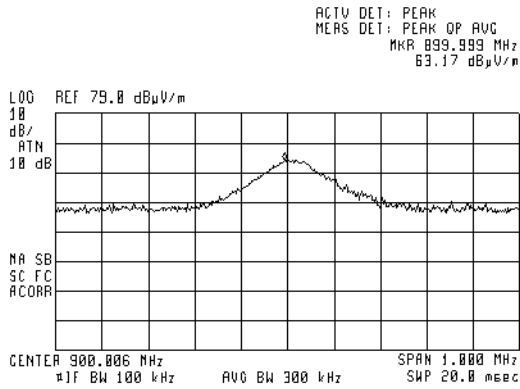
**Plot 7.4.6 Radiated emission measurements at the 2<sup>nd</sup> harmonic**

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

Semi anechoic chamber  
Horizontal  
3 m  
CARRIER FREQUENCY: Mid

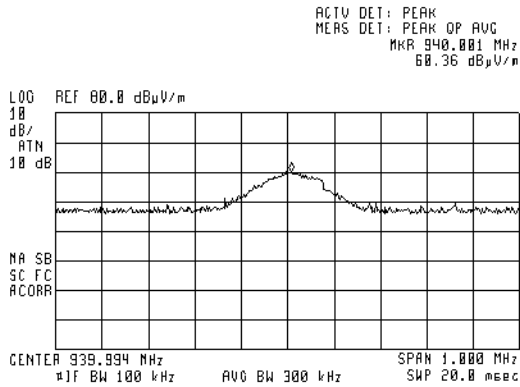
18:53:00 JUL 04, 2017

19:41:31 JUL 04, 2017



CARRIER FREQUENCY: High

19:48:20 JUL 04, 2017





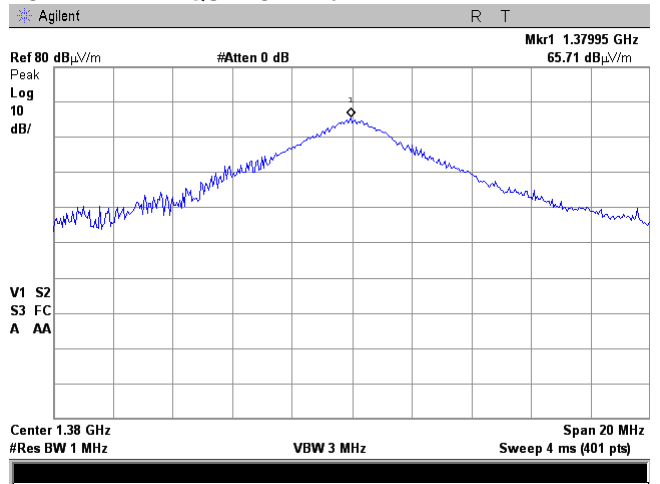
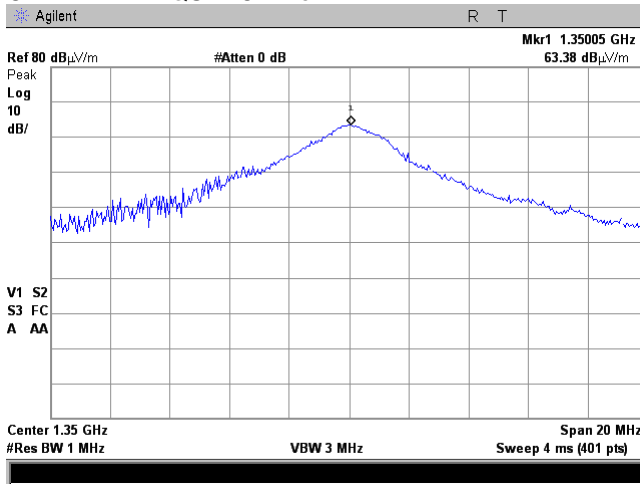
HERMON LABORATORIES

<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

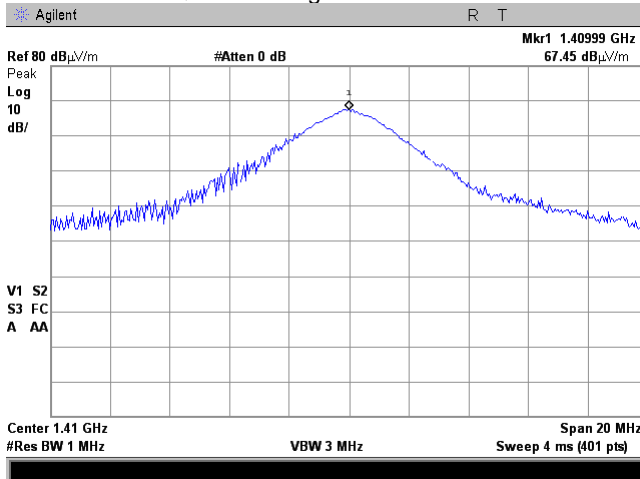
Plot 7.4.7 Radiated emission measurements at the 3<sup>rd</sup> harmonic

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

OATS  
Vertical  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





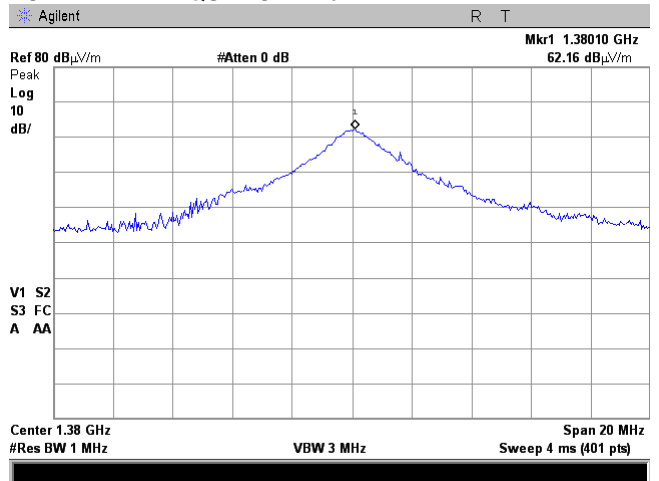
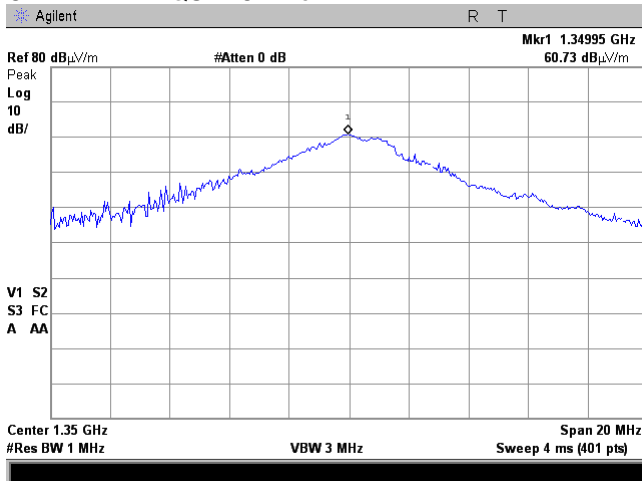
HERMON LABORATORIES

<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

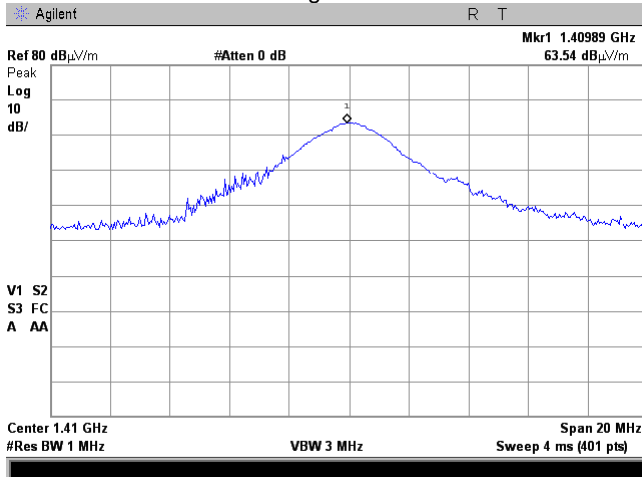
Plot 7.4.8 Radiated emission measurements at the 3<sup>rd</sup> harmonic

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

OATS  
Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





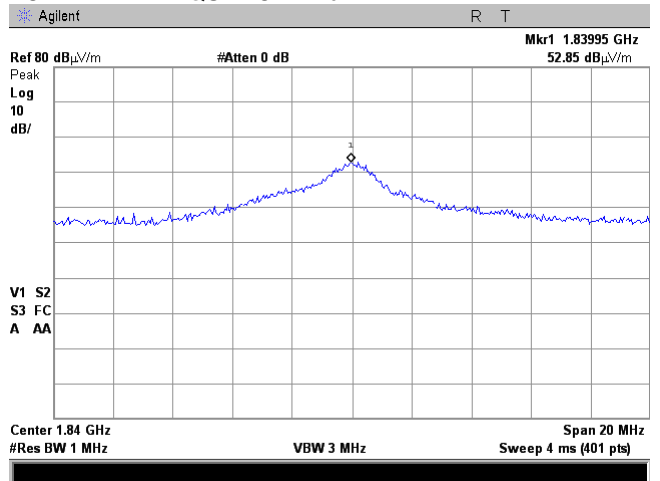
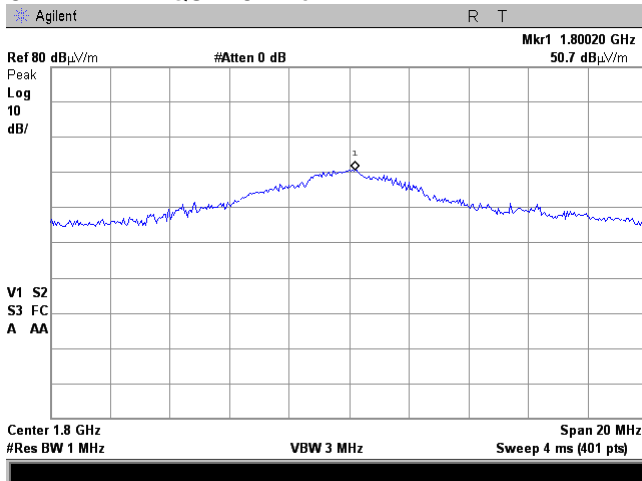
HERMON LABORATORIES

<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

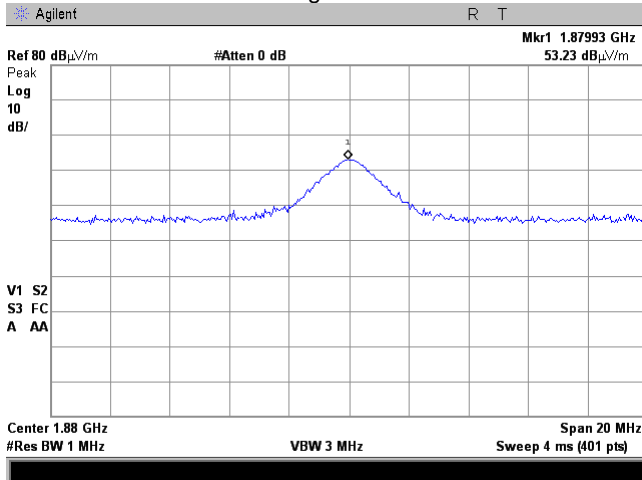
Plot 7.4.9 Radiated emission measurements at the 4<sup>th</sup> harmonic

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

OATS  
Vertical  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High







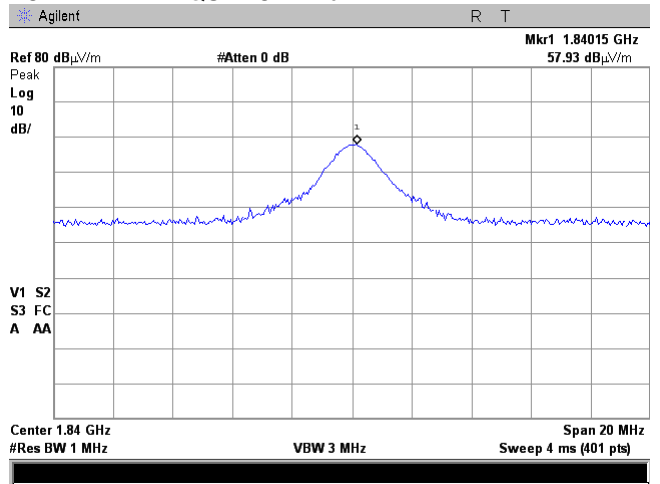
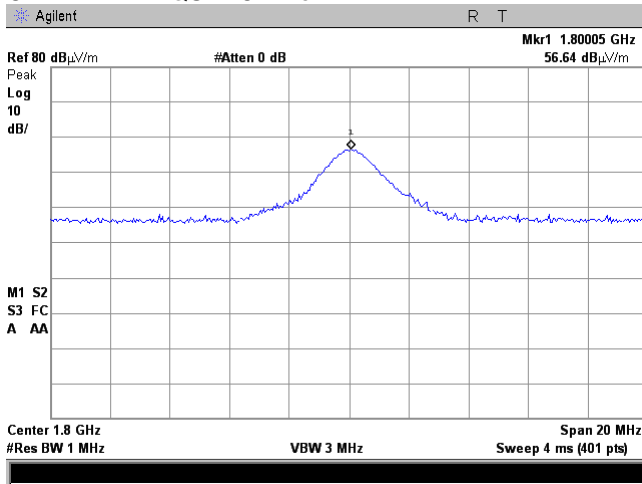
HERMON LABORATORIES

<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

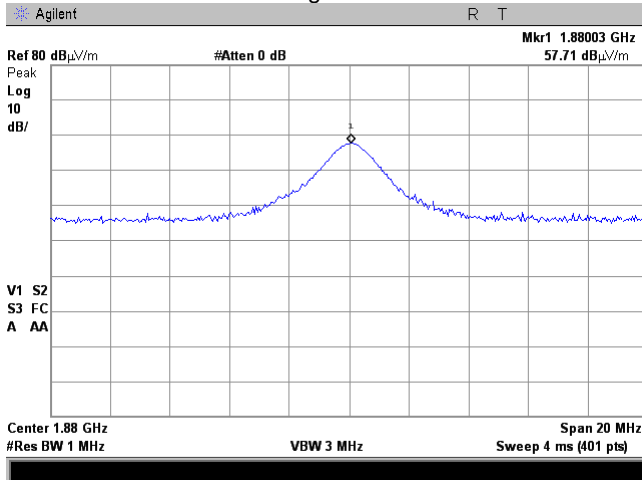
Plot 7.4.10 Radiated emission measurements at the 4<sup>th</sup> harmonic

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

OATS  
Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





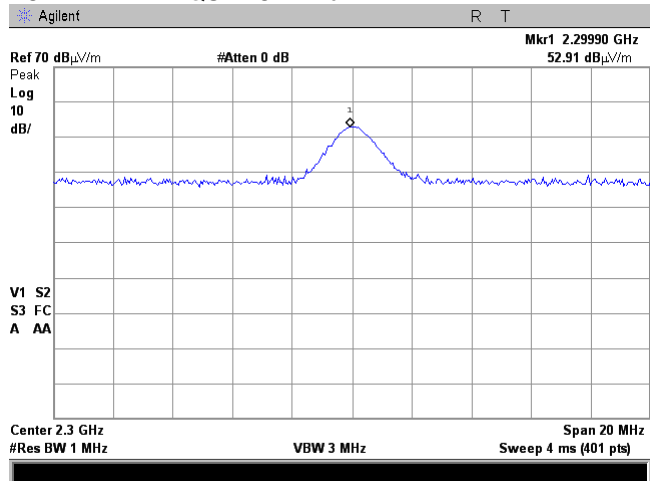
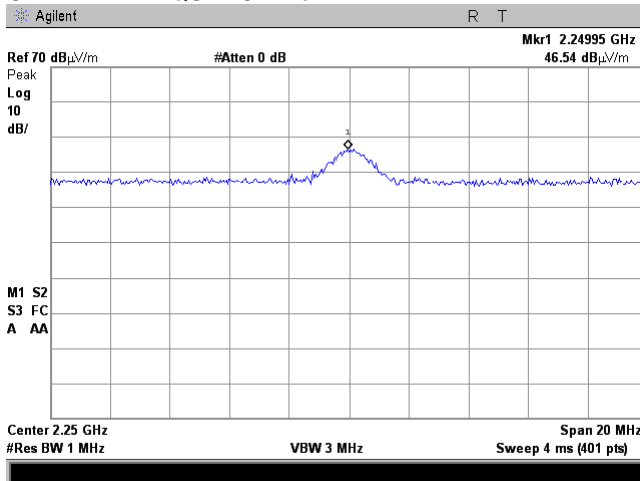
HERMON LABORATORIES

<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

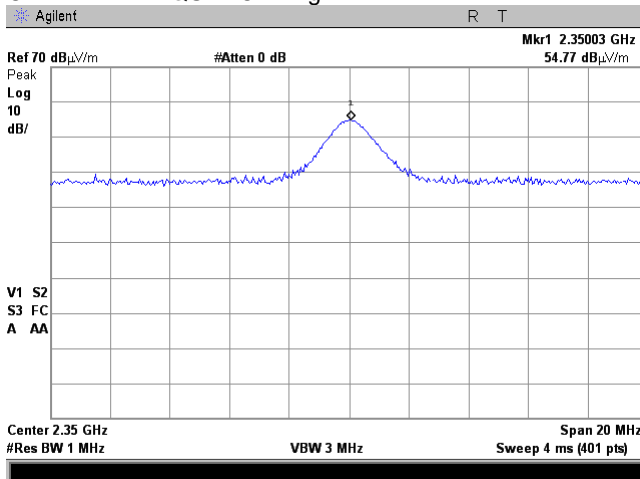
Plot 7.4.11 Radiated emission measurements at the 5<sup>th</sup> harmonic

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

OATS  
Vertical  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





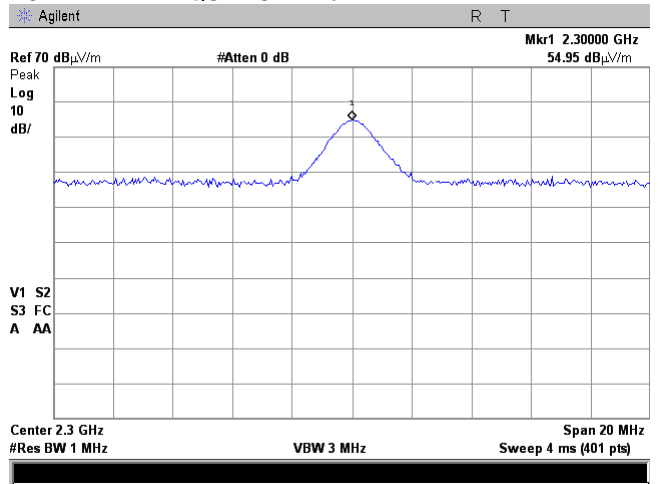
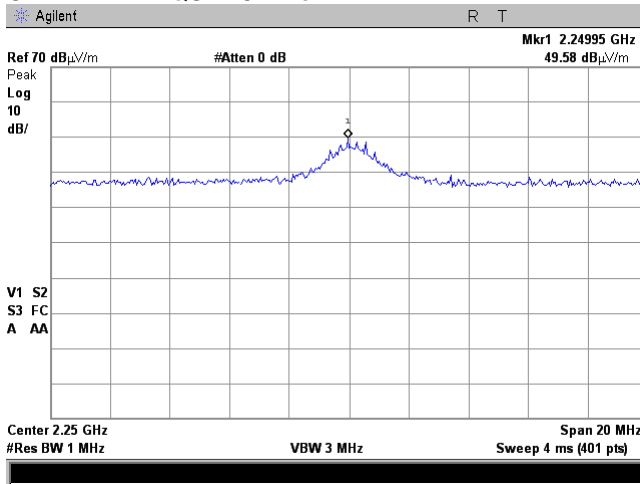
HERMON LABORATORIES

<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

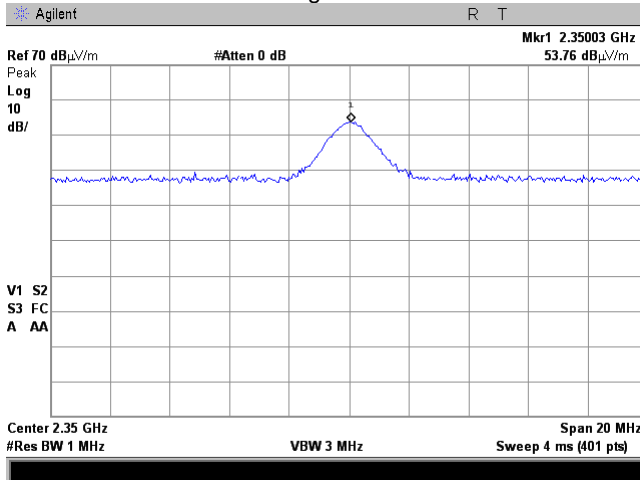
Plot 7.4.12 Radiated emission measurements at the 5<sup>th</sup> harmonic

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

OATS  
Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





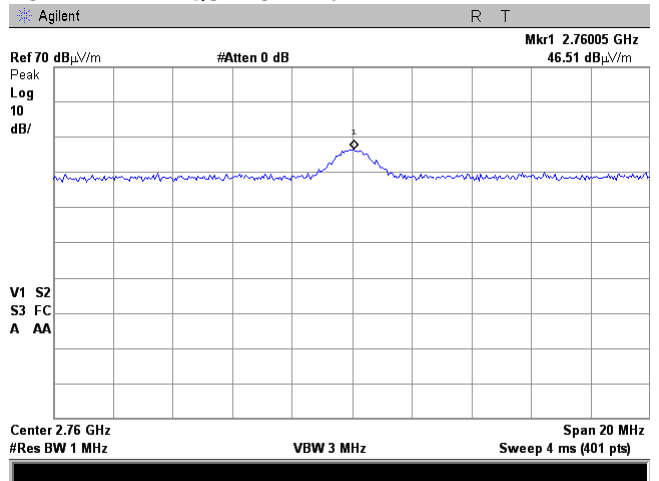
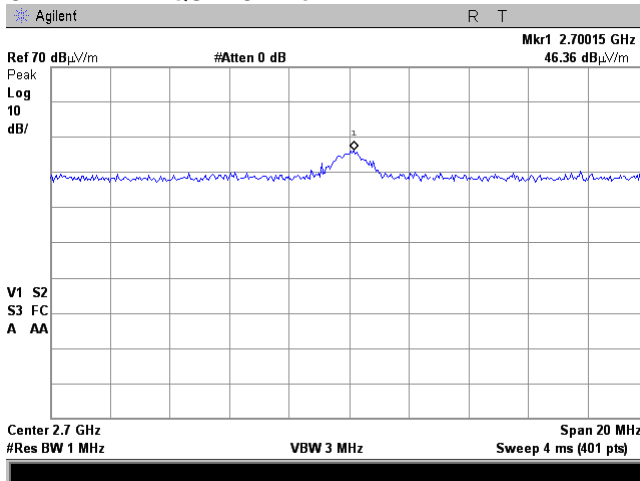
HERMON LABORATORIES

<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

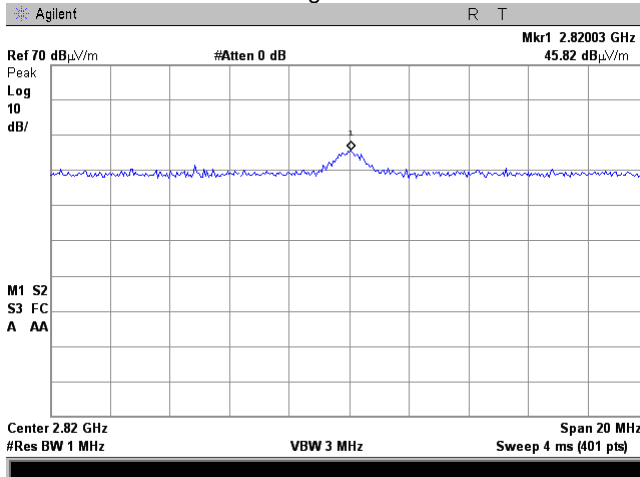
Plot 7.4.13 Radiated emission measurements at the 6<sup>th</sup> harmonic

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

OATS  
Vertical  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





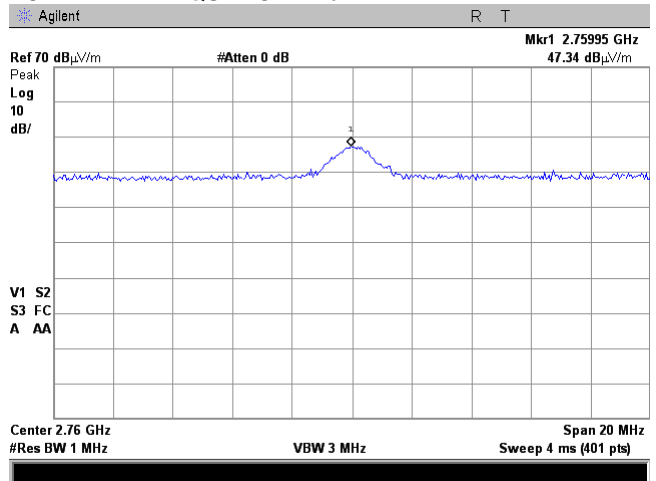
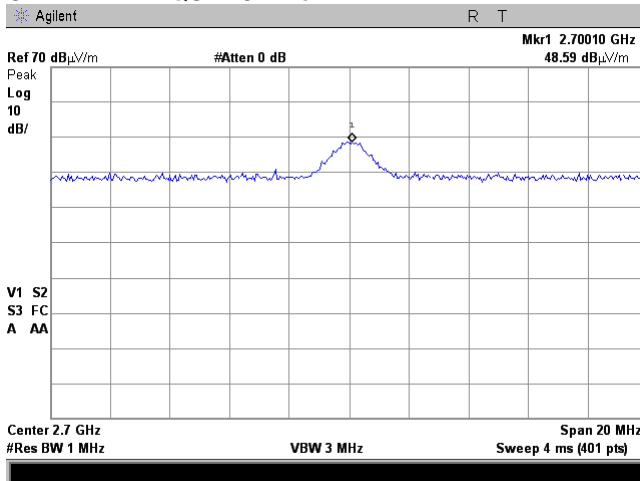
HERMON LABORATORIES

<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

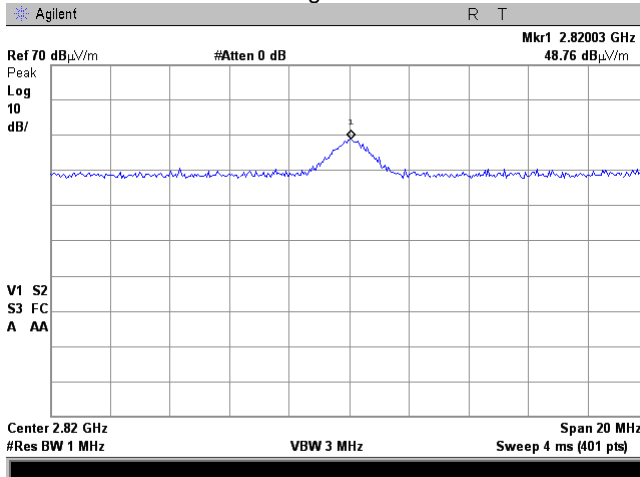
Plot 7.4.14 Radiated emission measurements at the 6<sup>th</sup> harmonic

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

OATS  
Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

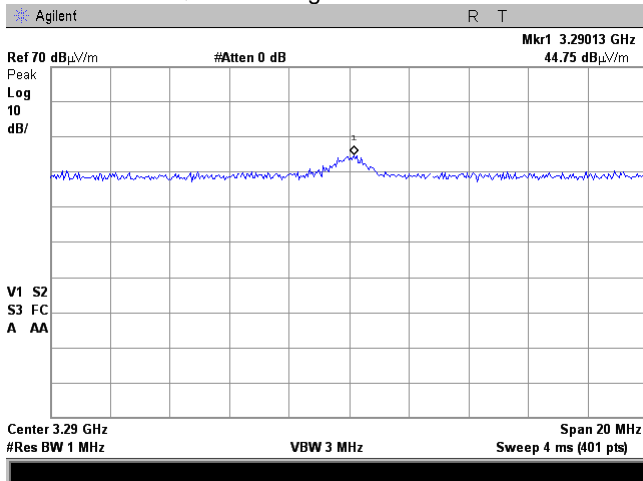
<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Plot 7.4.15 Radiated emission measurements at the 7<sup>th</sup> harmonic

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low  
**More than 20 dB Below the limit**

OATS  
Vertical  
3 m  
CARRIER FREQUENCY: Mid  
**More than 20 dB Below the limit**

CARRIER FREQUENCY: High





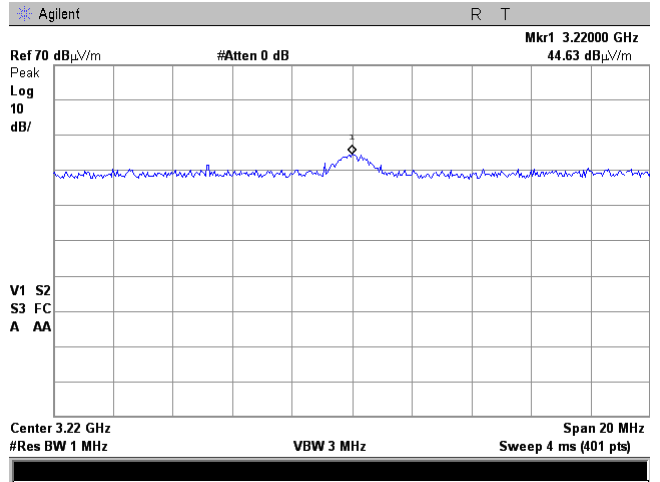
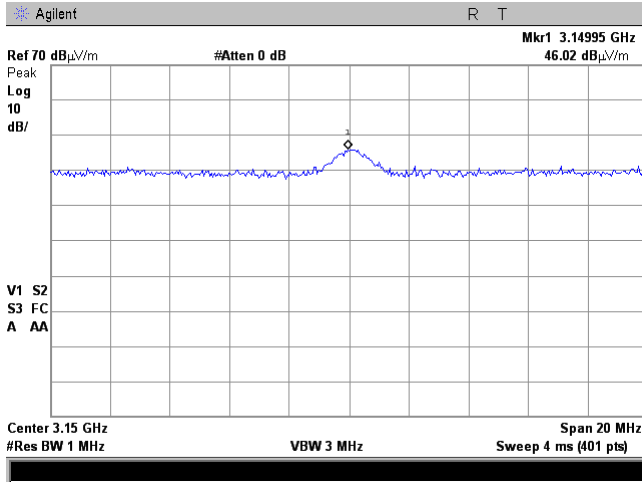
HERMON LABORATORIES

<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

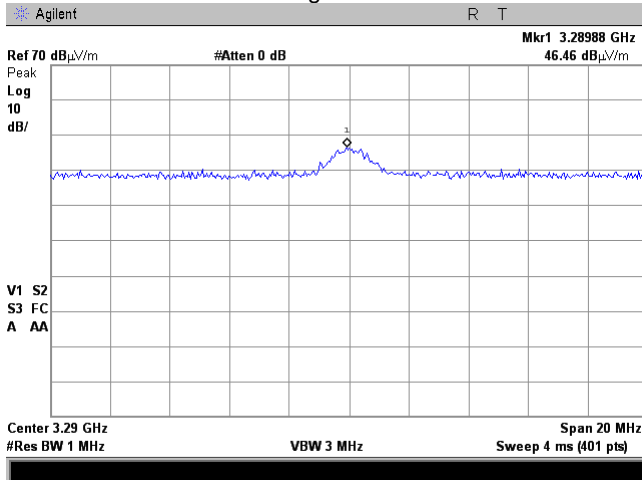
Plot 7.4.16 Radiated emission measurements at the 7<sup>th</sup> harmonic

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

OATS  
Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

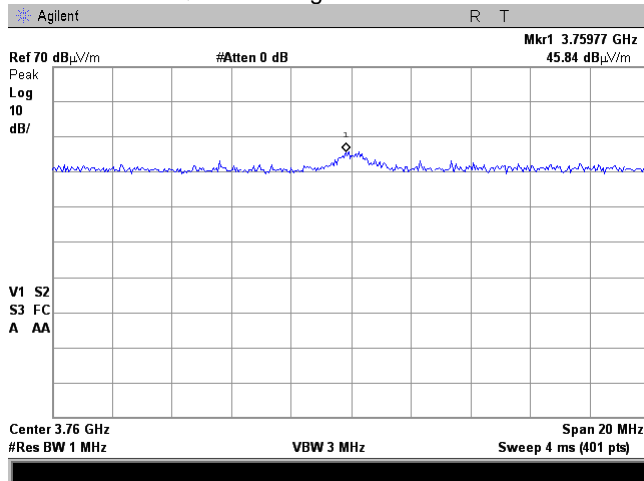
<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

**Plot 7.4.17 Radiated emission measurements at the 8<sup>th</sup> harmonic**

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low  
**More than 20 dB Below the limit**

OATS  
Vertical  
3 m  
CARRIER FREQUENCY: Mid  
**More than 20 dB Below the limit**

CARRIER FREQUENCY: High







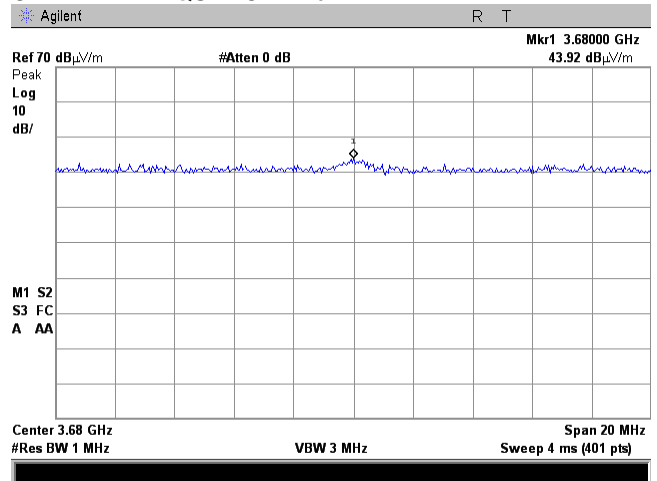
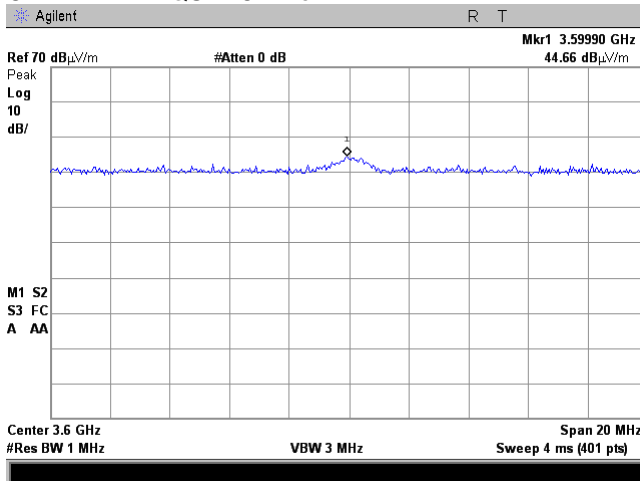
HERMON LABORATORIES

<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

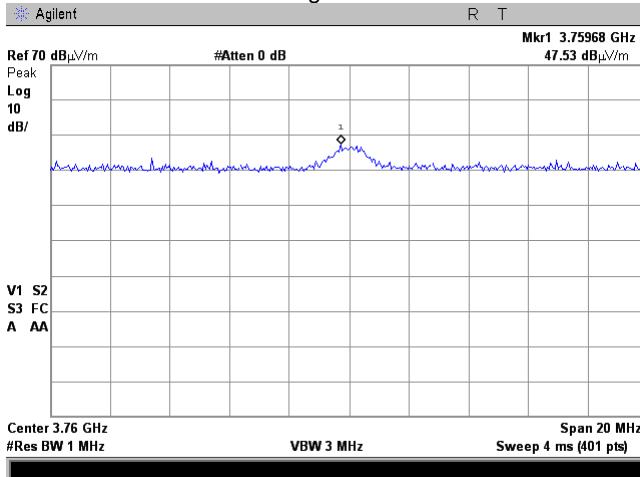
Plot 7.4.18 Radiated emission measurements at the 8<sup>th</sup> harmonic

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

OATS  
Horizontal  
3 m  
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

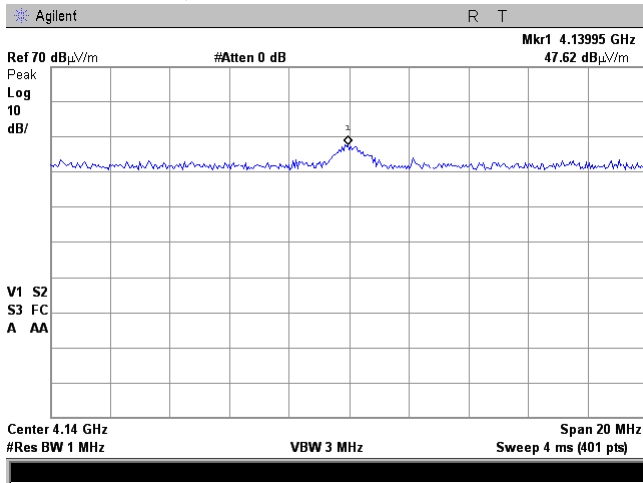
<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Plot 7.4.19 Radiated emission measurements at the 9th harmonic

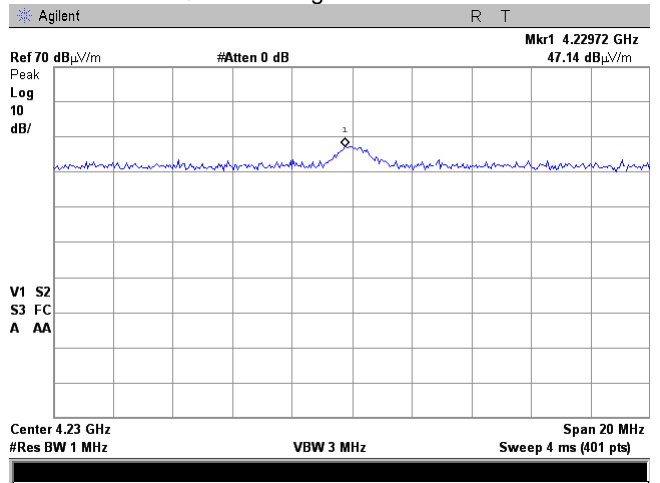
TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low  
**More than 20 dB below the limit**

OATS  
Vertical  
3 m

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





HERMON LABORATORIES

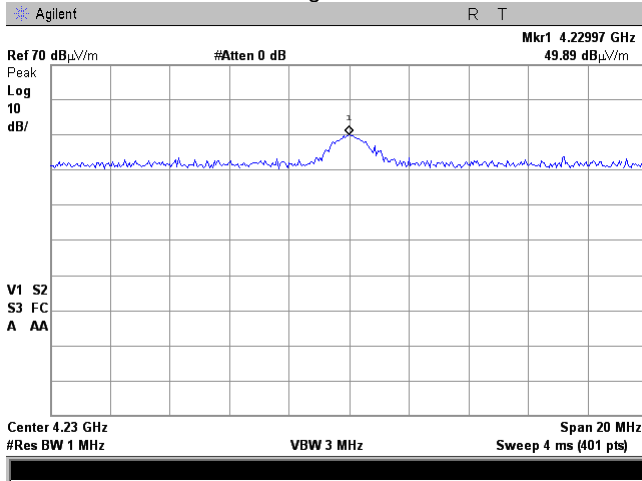
<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

**Plot 7.4.20 Radiated emission measurements at the 9<sup>th</sup> harmonic**

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low  
**More than 20 dB Below the limit**

OATS  
Horizontal  
3 m  
CARRIER FREQUENCY: Mid  
**More than 20 dB Below the limit**

CARRIER FREQUENCY: High





HERMON LABORATORIES

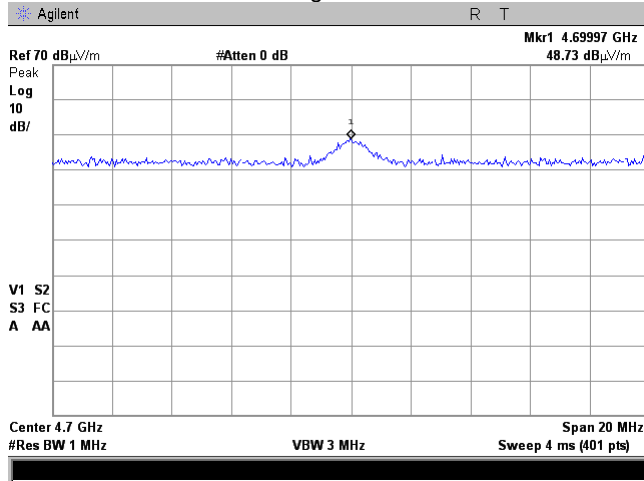
<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

**Plot 7.4.21 Radiated emission measurements at the 10th harmonic**

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low  
**More than 20 dB Below the limit**

OATS  
Vertical  
3 m  
CARRIER FREQUENCY: Mid  
**More than 20 dB Below the limit**

CARRIER FREQUENCY: High





HERMON LABORATORIES

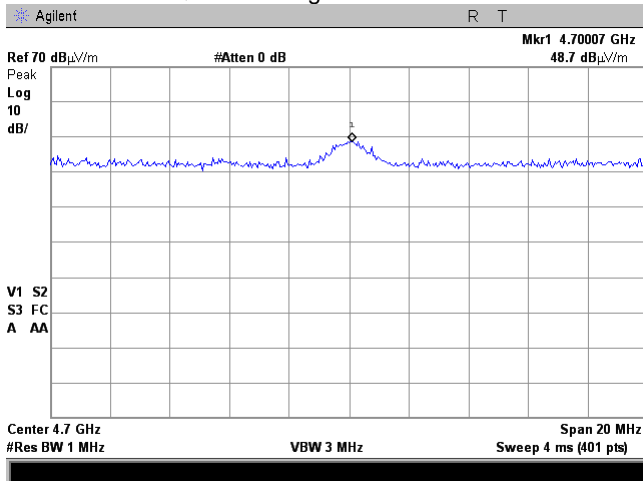
<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-E, Section 2.2.12			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 19-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

**Plot 7.4.22 Radiated emission measurements at the 10th harmonic**

TEST SITE:  
ANTENNA POLARIZATION:  
TEST DISTANCE:  
CARRIER FREQUENCY: Low  
**More than 20 dB Below the limit**

OATS  
Horizontal  
3 m  
CARRIER FREQUENCY: Mid  
**More than 20 dB Below the limit**

CARRIER FREQUENCY: High





<b>Test specification: Section 90.210 / 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-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict: PASS</b>	
<b>Date(s):</b> 11-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<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	ERP of spurious, dBm
0.009 – 10th harmonic*	55+10logP** (mask E)	-25.0

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

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

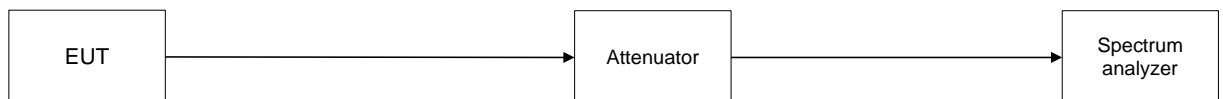
### 7.5.2 Test procedure

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, Table 7.5.3 and the associated plots.

Figure 7.5.1 Spurious emission test setup





<b>Test specification: Section 90.210 / 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-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict: PASS</b>	
<b>Date(s):</b> 11-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Table 7.5.2 purious emission test results according to FCC part 90

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  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 TRANSMITTER OUTPUT POWER: 34.16 dBm at low frequency  
 34.83 dBm at mid frequency  
 35.23 dBm at high frequency

Frequency, MHz	Spurious emission, dBm	RBW, kHz	Limit, dBm	Margin, dB*	Verdict
<b>Low carrier frequency 450.003125 MHz</b>					
430.0126	-37.61	100	-25.0	-12.61	Pass
449.7000	-25.69	100	-25.0	-0.69	Pass
450.3000	-25.04	100	-25.0	-0.04	Pass
470.0250	-37.72	100	-25.0	-12.72	Pass
485.3625	-29.42	100	-25.0	-4.42	Pass
900.0000	-38.88	100	-25.0	-13.88	Pass
<b>Mid carrier frequency 460.0 MHz</b>					
420.0000	-33.44	100	-25.0	-8.44	Pass
434.2500	-30.08	100	-25.0	-5.08	Pass
459.6500	-26.59	100	-25.0	-1.59	Pass
460.3500	-26.15	100	-25.0	-1.15	Pass
499.9875	-34.66	100	-25.0	-9.66	Pass
920.0000	-37.93	100	-25.0	-12.93	Pass
<b>High carrier frequency 469.996875 MHz</b>					
450.0000	-35.68	100	-25.0	-10.68	Pass
469.6500	-26.03	100	-25.0	-1.03	Pass
470.3500	-26.00	100	-25.0	-1.00	Pass
480.0125	-36.48	100	-25.0	-11.48	Pass
503.7750	-31.64	100	-25.0	-6.64	Pass
940.0000	-33.68	100	-25.0	-8.68	Pass

\*- Margin = Spurious emission – specification limit.



<b>Test specification: Section 90.210 / 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-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict: PASS</b>	
<b>Date(s):</b> 11-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

**Table 7.5.3 Spurious emission test results according to RSS-119**

ASSIGNED FREQUENCY RANGE: 450 - 470 MHz  
 INVESTIGATED FREQUENCY RANGE: 0.009 – 5000 MHz  
 DETECTOR USED: Peak  
 VIDEO BANDWIDTH: ≥ Resolution bandwidth  
 MODULATION: 4-GFSK  
 MODULATING SIGNAL: PRBS  
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum  
 TRANSMITTER OUTPUT POWER: 34.16 dBm at low frequency  
 34.83 dBm at mid frequency  
 35.23 dBm at high frequency

Frequency, MHz	Spurious emission, dBm	RBW, kHz	Fundamental emission, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
<b>Low carrier frequency 450.003125 MHz</b>							
430.0126	-37.61	100	34.16	71.77	57.0	14.77	Pass
449.7000	-25.69	100		59.85	57.0	2.85	Pass
450.3000	-25.04	100		59.20	57.0	2.20	Pass
470.0250	-37.72	100		71.88	57.0	14.88	Pass
485.3625	-29.42	100		63.58	57.0	6.58	Pass
900.0000	-38.88	100		73.04	57.0	16.04	Pass
<b>Mid carrier frequency 460.0 MHz</b>							
420.0000	-33.44	100	34.83	68.27	57.0	11.27	Pass
434.2500	-30.08	100		64.91	57.0	7.91	Pass
459.6500	-26.59	100		61.42	57.0	4.42	Pass
460.3500	-26.15	100		60.98	57.0	3.98	Pass
499.9875	-34.66	100		69.49	57.0	12.49	Pass
920.0000	-37.93	100		72.76	57.0	15.76	Pass
<b>High carrier frequency 469.996875 MHz</b>							
450.0000	-35.68	100	35.23	70.91	57.0	13.91	Pass
469.6500	-26.03	100		61.26	57.0	4.26	Pass
470.3500	-26.00	100		61.23	57.0	4.23	Pass
480.0125	-36.48	100		71.71	57.0	14.71	Pass
503.7750	-31.64	100		66.87	57.0	9.87	Pass
940.0000	-33.68	100		68.91	57.0	11.91	Pass

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

**Reference numbers of test equipment used**

HL 2784	HL 3339	HL 3350	HL 3433	HL 3787	HL 3818	HL 4070	HL 4071
HL 4339							

Full description is given in Appendix A.





HERMON LABORATORIES

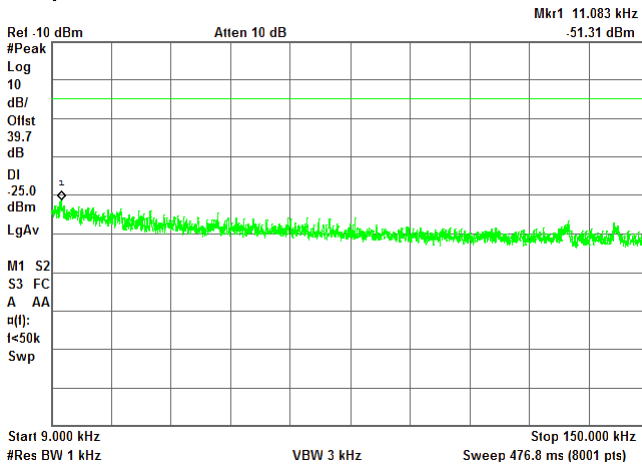
<b>Test specification: Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions</b>			
<b>Test procedure:</b> 47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 11-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Plot 7.5.1 Spurious emission measurements in 9 - 150 kHz range

DETECTOR USED:  
OPERATING FREQUENCY: Low

Agilent

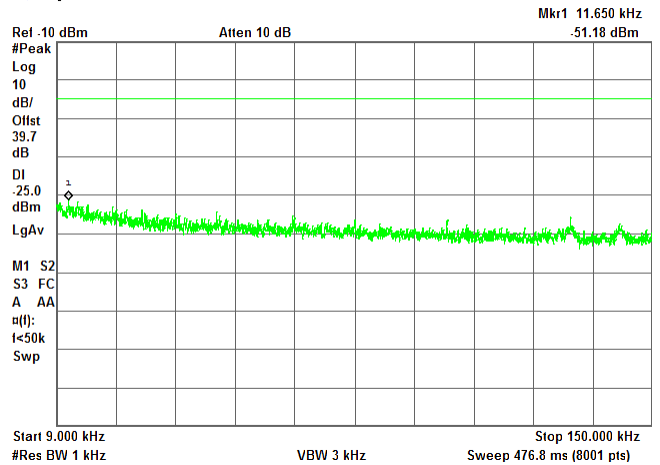
R T



Peak  
OPERATING FREQUENCY: Mid

Agilent

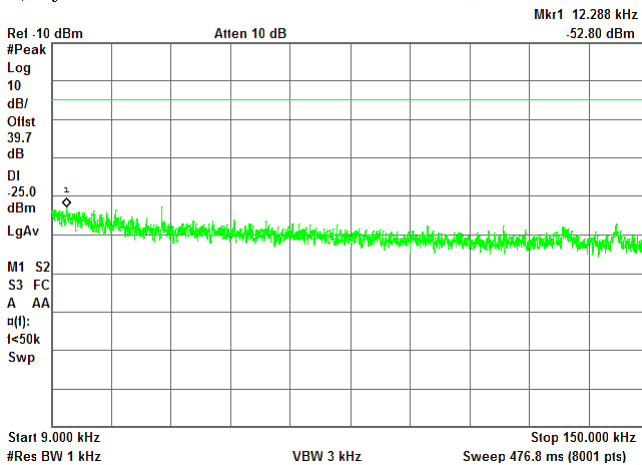
R T



OPERATING FREQUENCY: High

Agilent

R T





HERMON LABORATORIES

<b>Test specification: Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions</b>			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-E, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 11-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: 1008 hPa	Power: 120 VAC, 60 Hz
Remarks:			

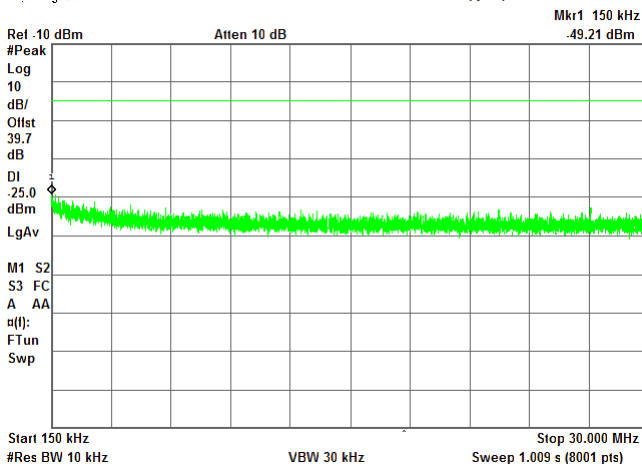
Plot 7.5.2 Spurious emission measurements in 0.150 - 30.0 MHz range

DETECTOR USED:

OPERATING FREQUENCY: Low

Agilent

R T

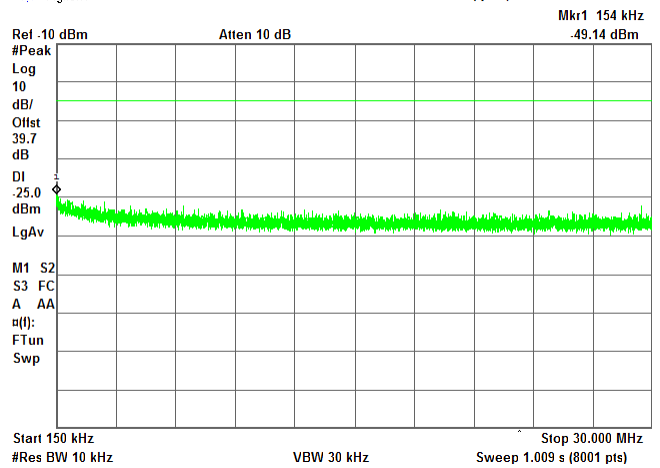


Peak

OPERATING FREQUENCY: Mid

Agilent

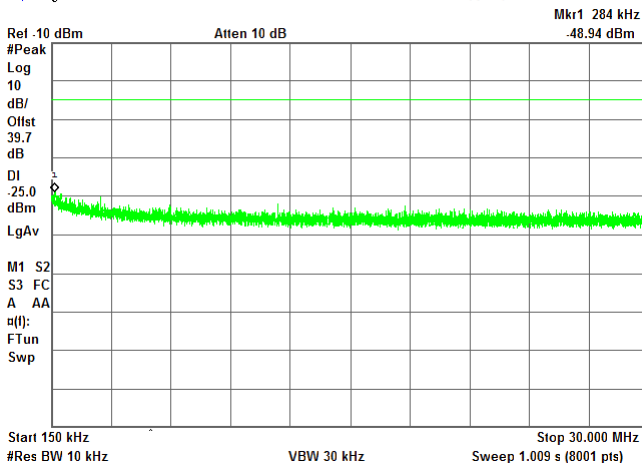
R T



OPERATING FREQUENCY: High

Agilent

R T





HERMON LABORATORIES

<b>Test specification: Section 90.210 / 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-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 11-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

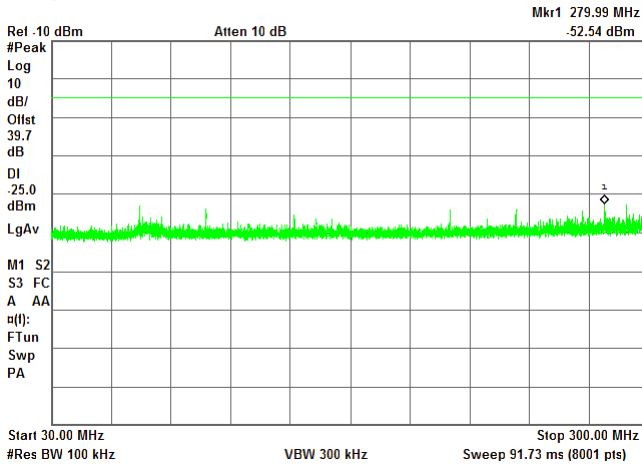
**Plot 7.5.3 Spurious emission measurements in 30.0 - 300 MHz range**

DETECTOR USED:

OPERATING FREQUENCY: Low

Agilent

R T

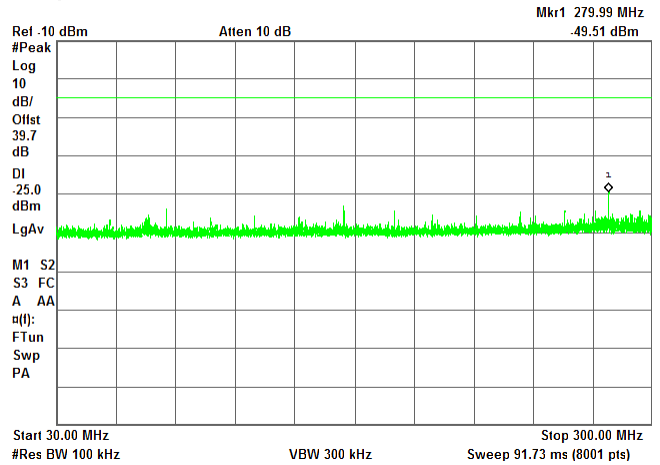


Peak

OPERATING FREQUENCY: Mid

Agilent

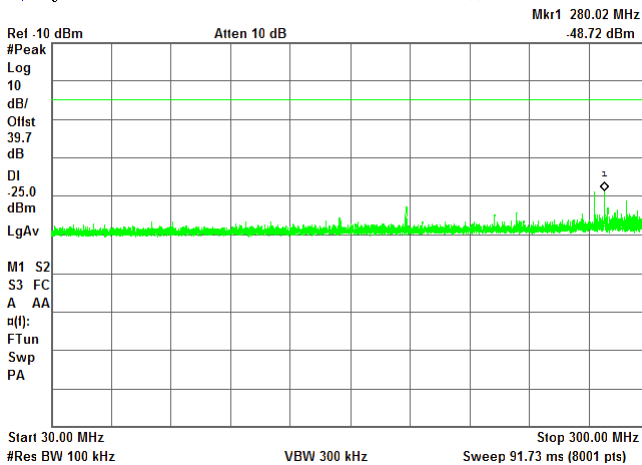
R T



OPERATING FREQUENCY: High

Agilent

R T





HERMON LABORATORIES

<b>Test specification:</b> Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions			
<b>Test procedure:</b> 47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 11-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

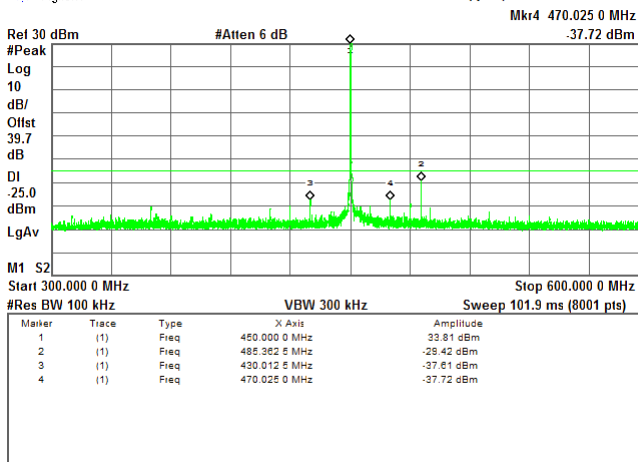
Plot 7.5.4 Spurious emission measurements in 300.0 – 600.0 MHz range

DETECTOR USED:

OPERATING FREQUENCY: Low

Agilent

R T

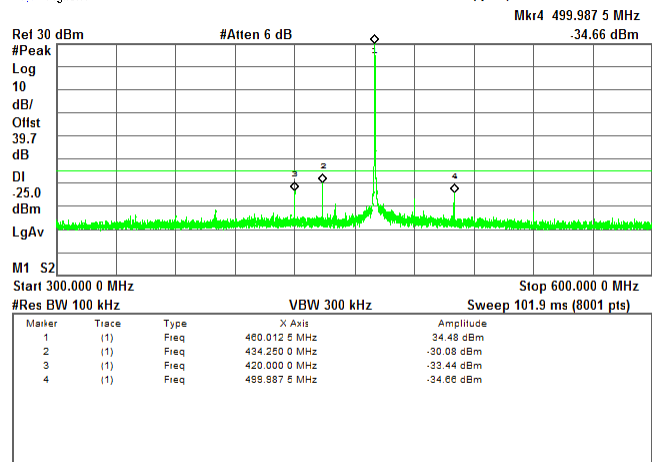


Peak

OPERATING FREQUENCY: Mid

Agilent

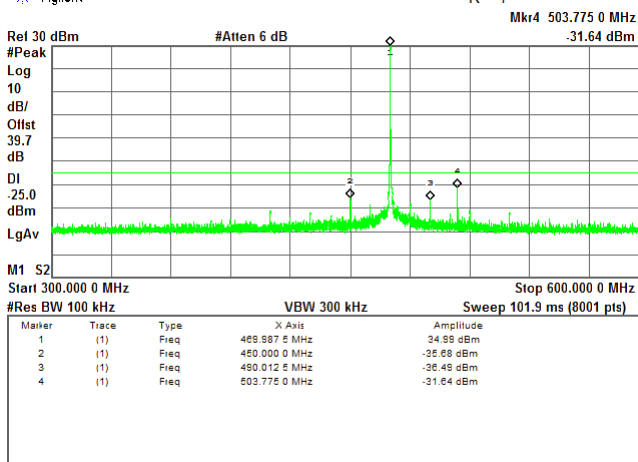
R T



OPERATING FREQUENCY: High

Agilent

R T





HERMON LABORATORIES

<b>Test specification: Section 90.210 / 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-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 11-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

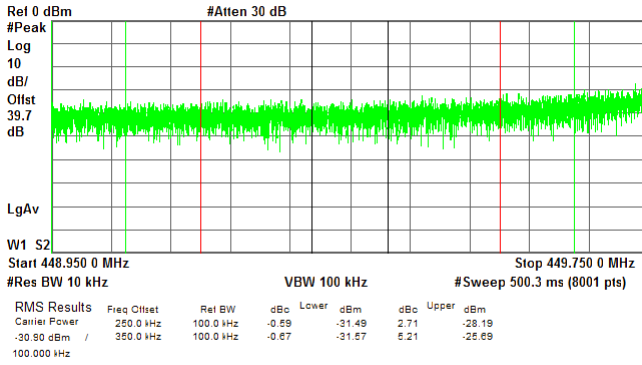
**Plot 7.5.5 Spurious emission measurements in 300.0 – 600.0 MHz range**

DETECTOR USED:

OPERATING FREQUENCY: Low

\* Agilent

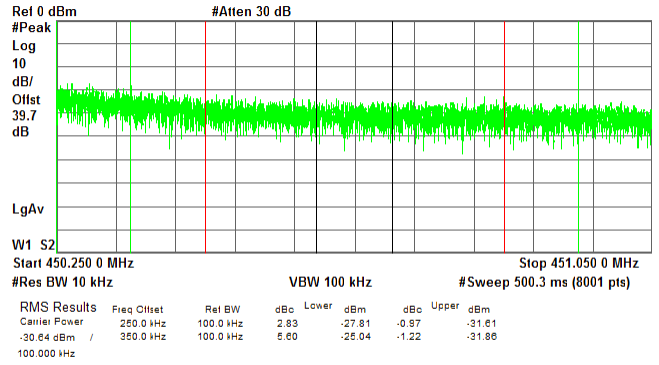
R T



Peak

\* Agilent

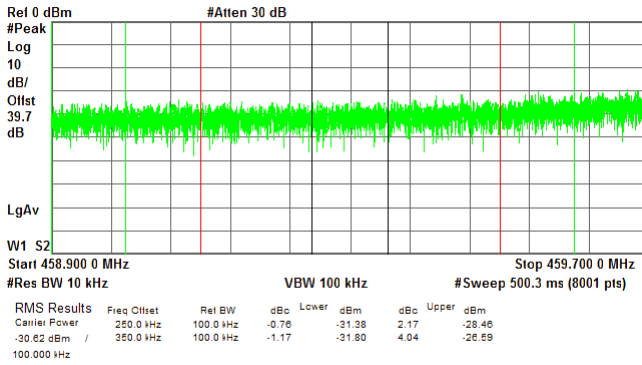
R T



OPERATING FREQUENCY: Mid

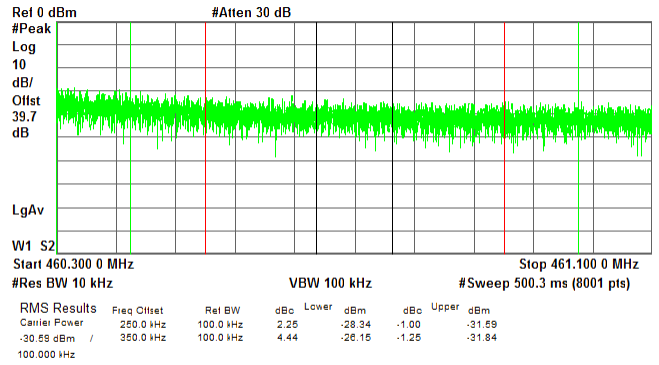
\* Agilent

R T



\* Agilent

R T





HERMON LABORATORIES

<b>Test specification: Section 90.210 / 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-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 11-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

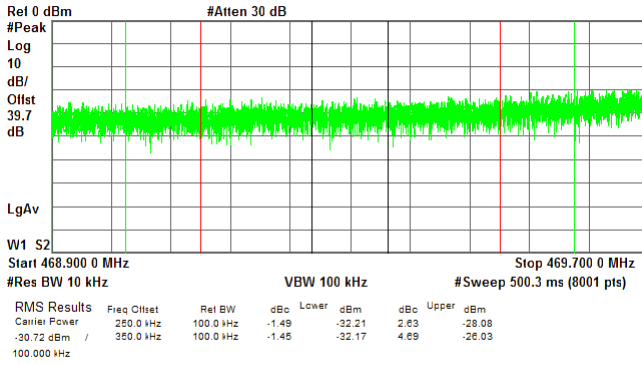
Plot 7.5.6 Spurious emission measurements in 300.0 – 600.0 MHz range

DETECTOR USED:

OPERATING FREQUENCY: High

Agilent

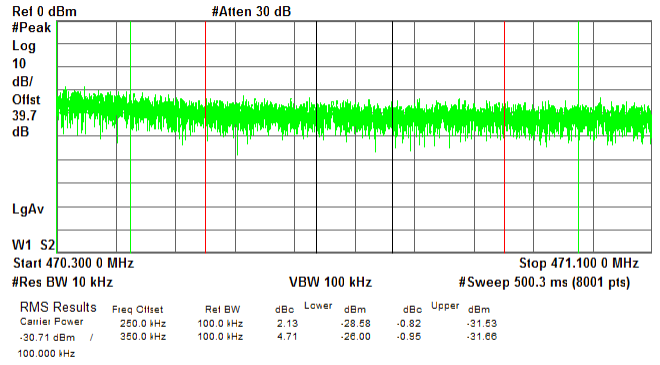
R T



Peak

Agilent

R T





HERMON LABORATORIES

<b>Test specification: Section 90.210 / 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-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 11-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

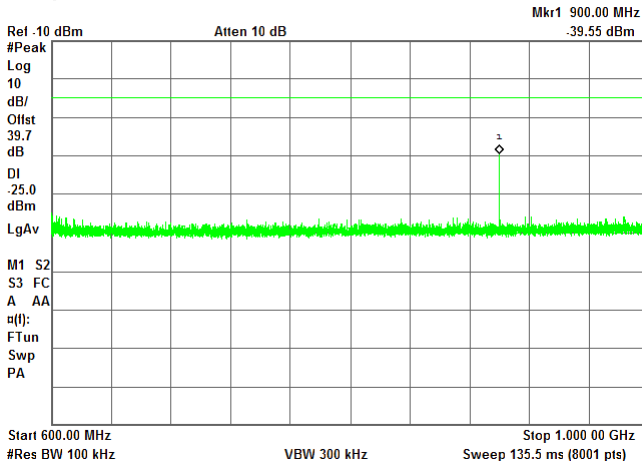
Plot 7.5.7 Spurious emission measurements in 600.0 - 1000 MHz range

DETECTOR USED:

OPERATING FREQUENCY: Low

Agilent

R T

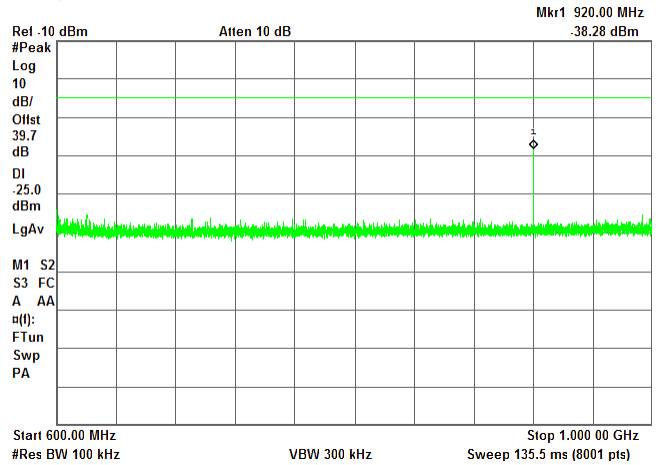


Peak

OPERATING FREQUENCY: Mid

Agilent

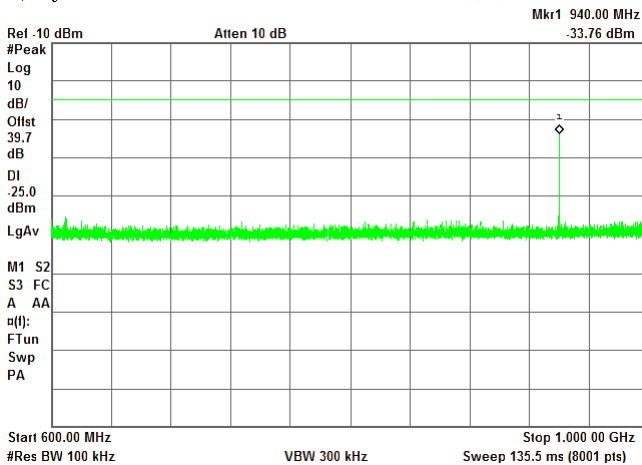
R T



OPERATING FREQUENCY: High

Agilent

R T





HERMON LABORATORIES

<b>Test specification: Section 90.210 / 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-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 11-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

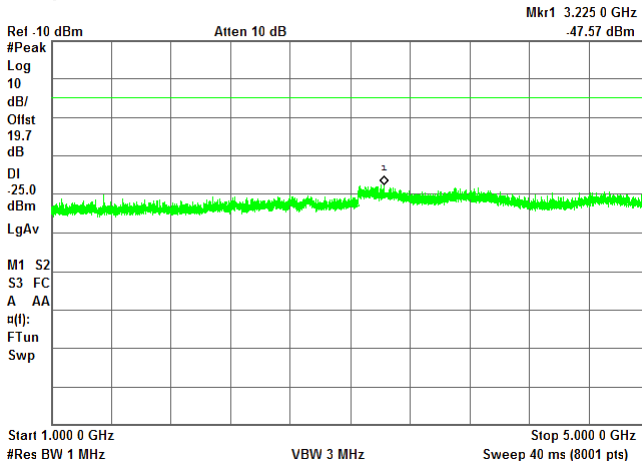
Plot 7.5.8 Spurious emission measurements in 1000 - 5000 MHz range

DETECTOR USED:

OPERATING FREQUENCY: Low

Agilent

R T

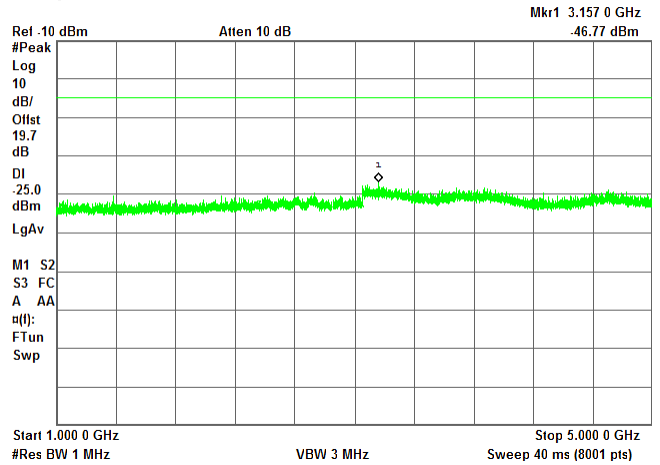


Peak

OPERATING FREQUENCY: Mid

Agilent

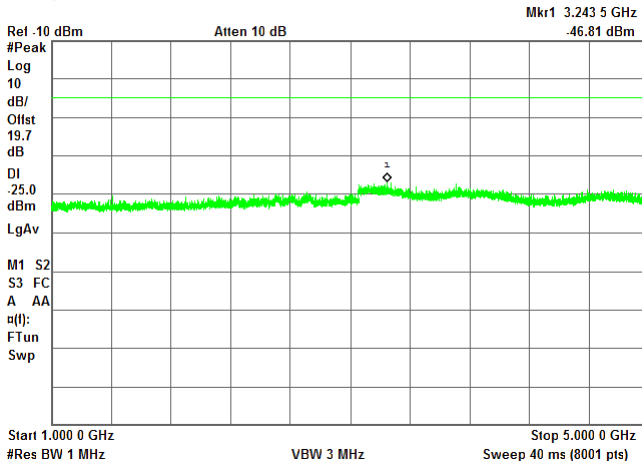
R T



OPERATING FREQUENCY: High

Agilent

R T







HERMON LABORATORIES

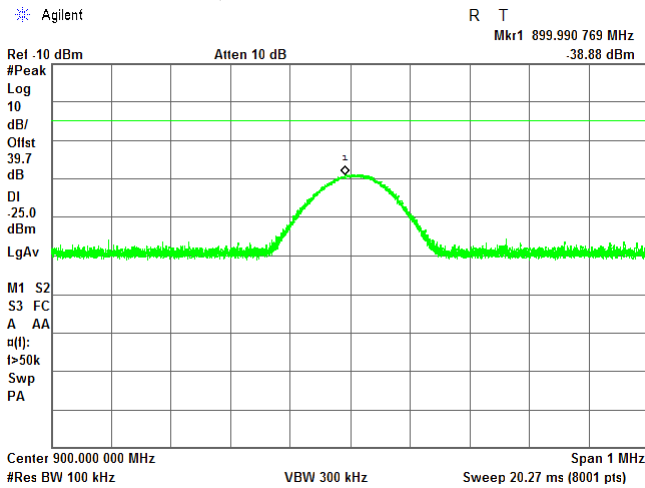
<b>Test specification: Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions</b>			
<b>Test procedure:</b> 47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-E, Section 2.2.13			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 11-Jul-17			
<b>Temperature:</b> 25.2 °C	<b>Relative Humidity:</b> 43 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Plot 7.5.9 Conducted spurious emission measurements at the 2<sup>nd</sup> harmonic

DETECTOR USED:

OPERATING FREQUENCY: Low

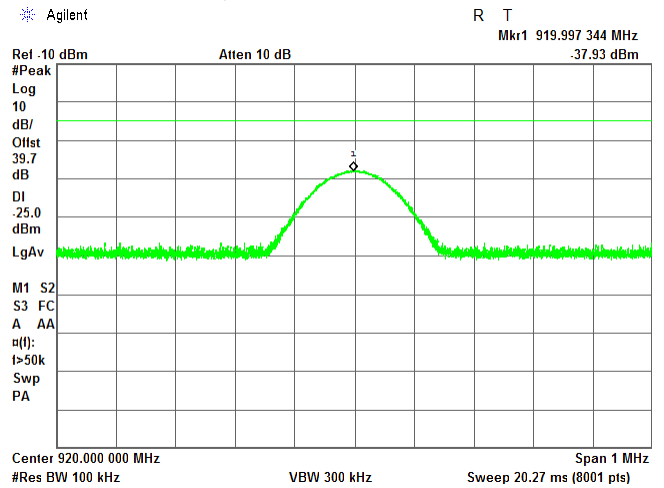
Agilent



Peak

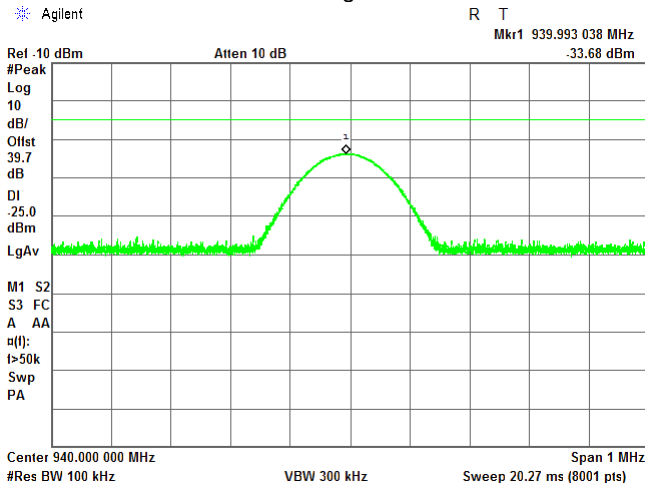
OPERATING FREQUENCY: Mid

Agilent



OPERATING FREQUENCY: High

Agilent





<b>Test specification:</b> Section 90.213 / RSS-119 Section 5.3, Frequency stability			
<b>Test procedure:</b> 47 CFR, Section 2.1055; TIA/EIA-603-E, Section 2.2.2			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 10-Jul-17			
<b>Temperature:</b> 23.4 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<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
450.003125	1	450
460.000000		460
469.996875		470

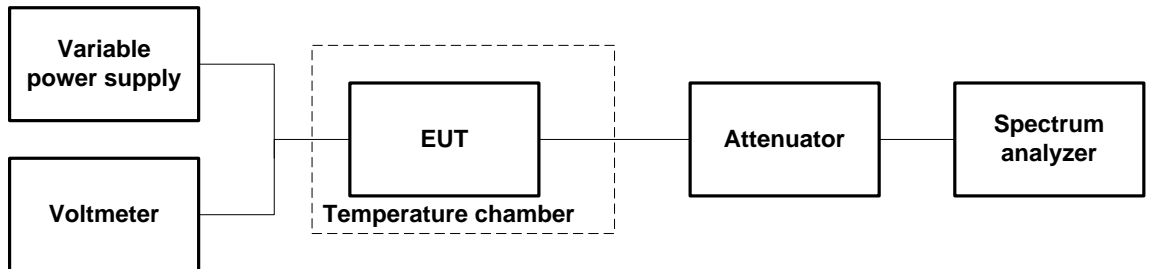
### 7.6.2 Test procedure

- 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.



<b>Test specification:</b> Section 90.213 / RSS-119 Section 5.3, Frequency stability			
<b>Test procedure:</b> 47 CFR, Section 2.1055; TIA/EIA-603-E, Section 2.2.2			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 10-Jul-17			
<b>Temperature:</b> 23.4 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Figure 7.6.1 Frequency stability test setup





HERMON LABORATORIES

<b>Test specification:</b> Section 90.213 / RSS-119 Section 5.3, Frequency stability			
<b>Test procedure:</b> 47 CFR, Section 2.1055; TIA/EIA-603-E, Section 2.2.2			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 06-Jul-17 - 10-Jul-17			
<b>Temperature:</b> 23.4 °C	<b>Relative Humidity:</b> 45 %	<b>Air Pressure:</b> 1008 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Table 7.6.2 Frequency stability test results

OPERATING FREQUENCY: 450.0 – 470.0 MHz  
 NOMINAL POWER VOLTAGE: 120 V  
 TEMPERATURE STABILIZATION PERIOD: 20 min  
 POWER DURING TEMPERATURE TRANSITION: Off  
 SPECTRUM ANALYZER MODE: Counter  
 RESOLUTION BANDWIDTH: 10 Hz  
 VIDEO BANDWIDTH: 30 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</b>													
-30	nominal	450.003197	450.003200	450.003197	450.003200	450.003200	450.003197	450.003197	17	0	450	-433	Pass
-20	nominal	450.003145	NA	NA	NA	NA	NA	450.003152	0	-38		-412	Pass
-10	nominal	450.003097	NA	NA	NA	NA	NA	450.003100	0	-86		-364	Pass
0	nominal	450.003142	450.003147	450.003145	450.003147	450.003149	450.003152	450.003142	0	-41		-409	Pass
10	nominal	450.003167	NA	NA	NA	NA	NA	450.003172	0	-16		-434	Pass
20	+15%	450.003185	NA	NA	NA	NA	NA	450.003183	2	0		-448	Pass
20	nominal	450.003180	NA	NA	NA	NA	NA	450.003183*	0	-3		-447	Pass
20	-15%	450.003185	NA	NA	NA	NA	NA	450.003185	2	0		-448	Pass
30	nominal	450.003205	450.003205	450.003203	450.003205	450.003205	450.003205	450.003203	22	0		-428	Pass
40	nominal	450.003215	NA	NA	NA	NA	NA	450.003212	32	0		-418	Pass
50	nominal	450.003227	NA	NA	NA	NA	NA	450.003230	47	0	-403	Pass	
<b>Mid frequency</b>													
-30	nominal	460.000147	460.000149	460.000147	460.000149	460.000147	460.000147	460.000147	13	0	460	-447	Pass
-20	nominal	460.000090	NA	NA	NA	NA	NA	460.000095	0	-46		-414	Pass
-10	nominal	460.000042	NA	NA	NA	NA	NA	460.000042	0	-94		-366	Pass
0	nominal	460.000092	460.000097	460.000095	460.000095	460.000097	460.000100	460.000095	0	-44		-416	Pass
10	nominal	460.000117	NA	NA	NA	NA	NA	460.000120	0	-19		-441	Pass
20	+15%	460.000138	NA	NA	NA	NA	NA	460.000133	2	-3		-457	Pass
20	nominal	460.000132	NA	NA	NA	NA	NA	460.000136*	0	-4		-456	Pass
20	-15%	460.000138	NA	NA	NA	NA	NA	460.000138	2	0		-458	Pass
30	nominal	460.000132	460.000134	460.000129	460.000129	460.000132	460.000134	460.000132	0	-7		-453	Pass
40	nominal	460.000165	NA	NA	NA	NA	NA	460.000167	31	0		-429	Pass
50	nominal	460.000180	NA	NA	NA	NA	NA	460.000185	49	0	-411	Pass	
<b>High frequency</b>													
-30	nominal	469.997025	469.997028	469.997025	469.997027	469.997029	469.997030	469.997035	23	0	470	-447	Pass
-20	nominal	469.996967	NA	NA	NA	NA	NA	469.996970	0	-45		-425	Pass
-10	nominal	469.996920	NA	NA	NA	NA	NA	469.996915	0	-97		-373	Pass
0	nominal	469.996972	469.996977	469.996972	469.996975	469.996977	469.996977	469.996977	0	-40		-430	Pass
10	nominal	469.996995	NA	NA	NA	NA	NA	469.996995	0	-17		-453	Pass
20	+15%	469.997010	NA	NA	NA	NA	NA	469.997012	0	-2		-468	Pass
20	nominal	469.997007	NA	NA	NA	NA	NA	469.997012*	0	-5		-465	Pass
20	-15%	469.997012	NA	NA	NA	NA	NA	469.997007	0	-5		-465	Pass
30	nominal	469.997007	469.997007	469.997005	469.997010	469.997007	469.997010	469.997007	0	-7		-463	Pass
40	nominal	469.997040	NA	NA	NA	NA	NA	469.997037	28	0		-442	Pass
50	nominal	469.997060	NA	NA	NA	NA	NA	469.997065	53	0	-417	Pass	

\* - Reference frequency

Reference numbers of test equipment used

HL 2909	HL 3433	HL 3770	HL 3810				
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Full description is given in Appendix A.



<b>Test specification:</b> Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-E, Section 2.2.19			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 10-Jul-17 - 11-Jul-17			
<b>Temperature:</b> 24.3 °C	<b>Relative Humidity:</b> 47 %	<b>Air Pressure:</b> 1009 hPa	<b>Power:</b> 120 VAC, 60 Hz
<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>			
6.25	$\pm 6.25$	10.0	$t_1$
	$\pm 3.125$	25.0	$t_2$
	$\pm 6.25$	10.0	$t_3$

\* -  $t_{on}$  is the instant when a 1 kHz test signal is completely suppressed;

$t_1$  is the time period immediately following  $t_{on}$ ;

$t_2$  is the time period immediately following  $t_1$ ;

$t_3$  is the time period from the instant when the transmitter is turned off until  $t_{off}$ ;

$t_{off}$  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  $\pm 4$  divisions amplitude.

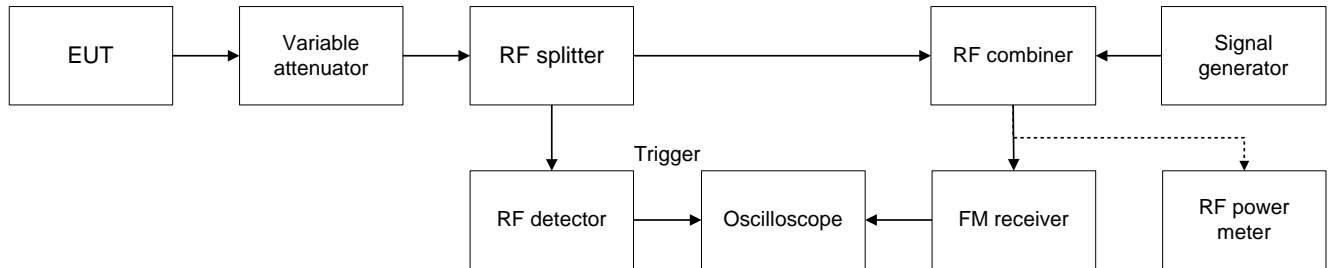
**7.7.2.4** The variable attenuator was adjusted to increase RF level supplied to splitter by 30 dB and the EUT was consequently turned on and off. Transient frequency during power switching was captured and shown in the associated plots.

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



<b>Test specification:</b> Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-E, Section 2.2.19			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 10-Jul-17 - 11-Jul-17			
<b>Temperature:</b> 24.3 °C	<b>Relative Humidity:</b> 47 %	<b>Air Pressure:</b> 1009 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

Figure 7.7.1 Transient frequency test setup





<b>Test specification:</b> Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-E, Section 2.2.19			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 10-Jul-17 - 11-Jul-17			
<b>Temperature:</b> 24.3 °C	<b>Relative Humidity:</b> 47 %	<b>Air Pressure:</b> 1009 hPa	<b>Power:</b> 120 VAC, 60 Hz
<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
<b>Channel bandwidth 6.25 kHz</b>						
450.003125	t <sub>1</sub>	10.0	3.437	± 6.25	-2.812	Pass
	t <sub>2</sub>	25.0	1.312	± 3.125	-1.813	
	t <sub>3</sub>	10.0	3.687	± 6.25	-2.563	
460.000000	t <sub>1</sub>	10.0	3.250	± 6.25	-3.000	Pass
	t <sub>2</sub>	25.0	1.562	± 3.125	-1.563	
	t <sub>3</sub>	10.0	0.875	± 6.25	-5.375	
469.996875	t <sub>1</sub>	10.0	2.687	± 6.25	-3.563	Pass
	t <sub>2</sub>	25.0	1.437	± 3.125	-1.688	
	t <sub>3</sub>	10.0	0.875	± 6.25	-5.375	

Reference numbers of test equipment used

HL 0521	HL 0539	HL 0911	HL 1501	HL 1503	HL 2227	HL 3300	HL 3333
HL 3433	HL 3787	HL 4273	HL 4275	HL 4413			

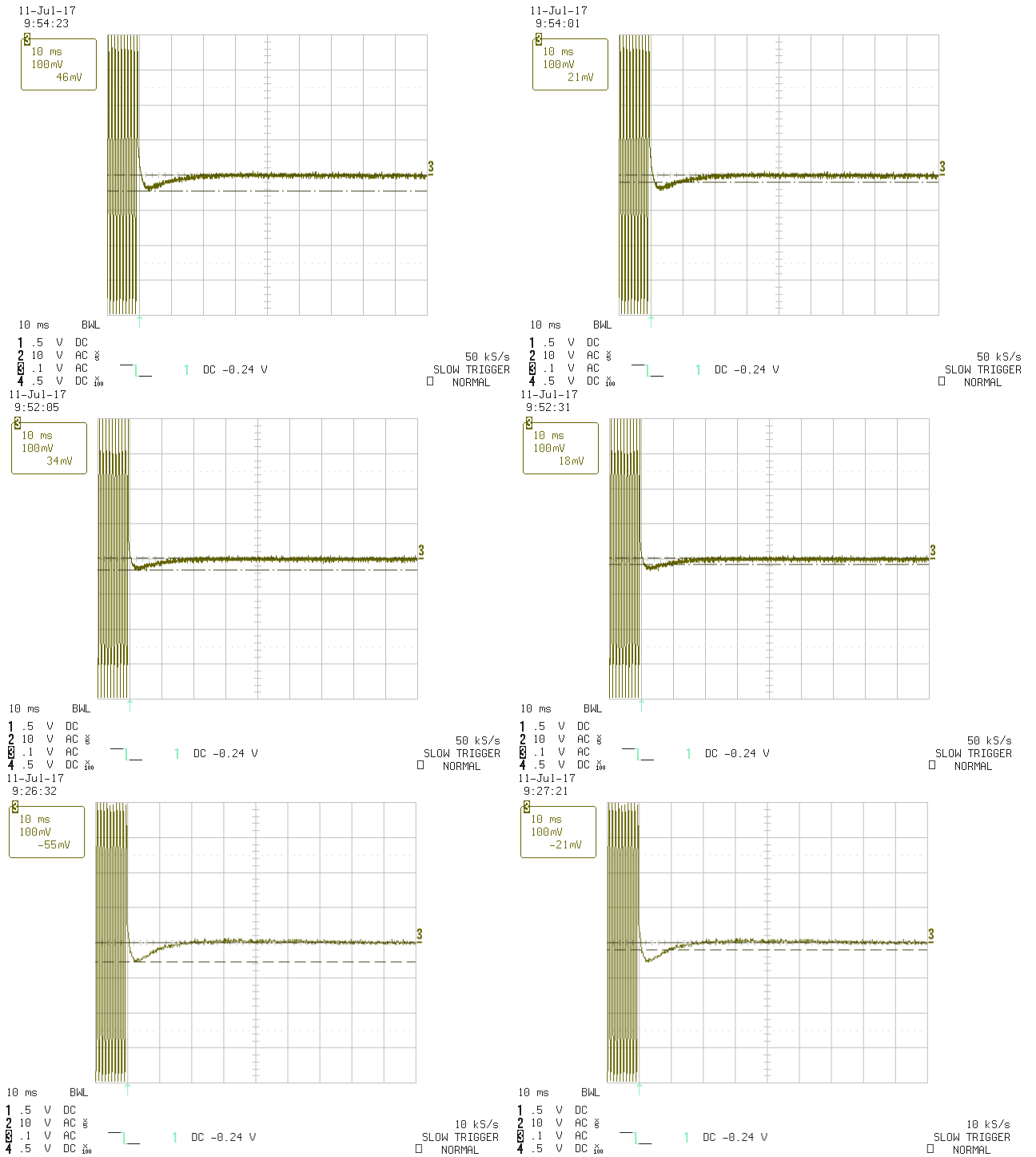
Full description is given in Appendix A.



HERMON LABORATORIES

<b>Test specification:</b> Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-E, Section 2.2.19			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 10-Jul-17 - 11-Jul-17			
<b>Temperature:</b> 24.3 °C	<b>Relative Humidity:</b> 47 %	<b>Air Pressure:</b> 1009 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

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



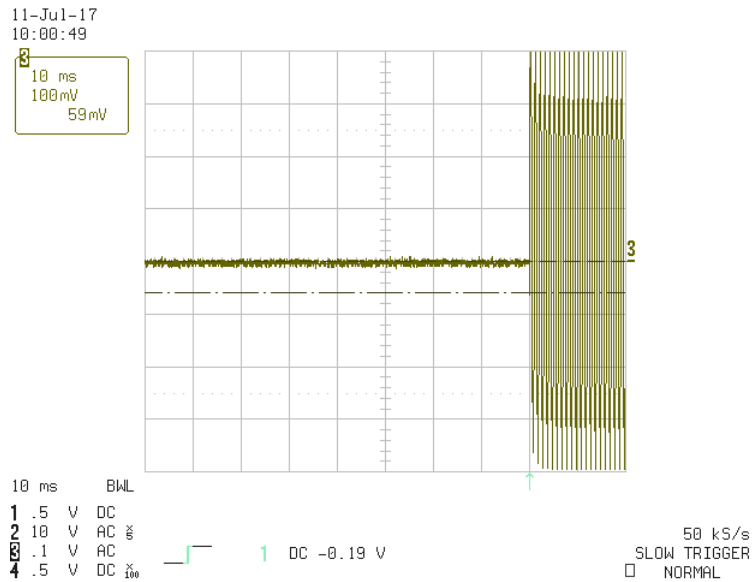




HERMON LABORATORIES

<b>Test specification:</b> Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-E, Section 2.2.19			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 10-Jul-17 - 11-Jul-17			
<b>Temperature:</b> 24.3 °C	<b>Relative Humidity:</b> 47 %	<b>Air Pressure:</b> 1009 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

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

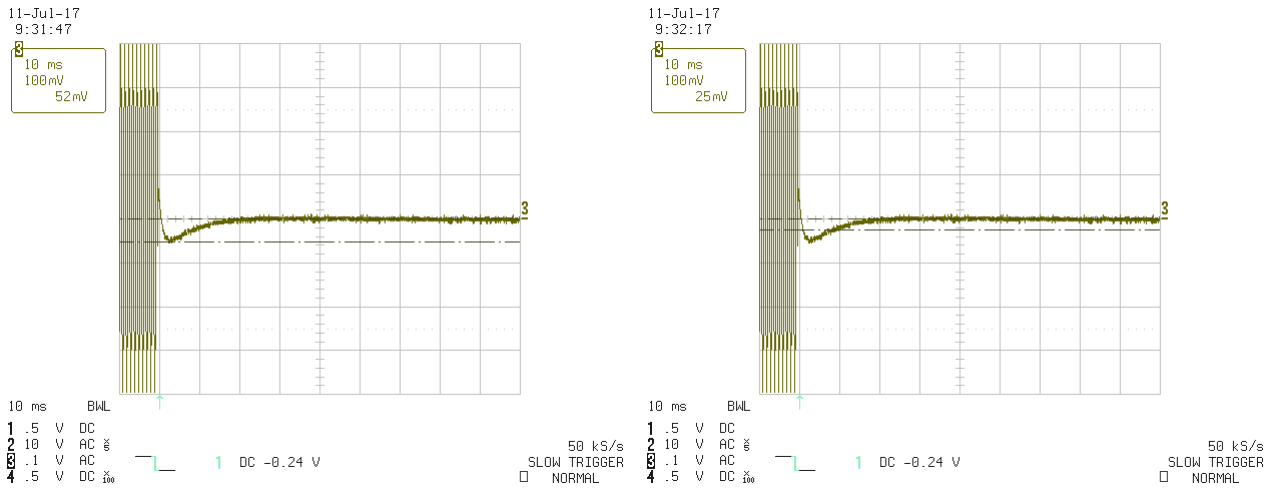




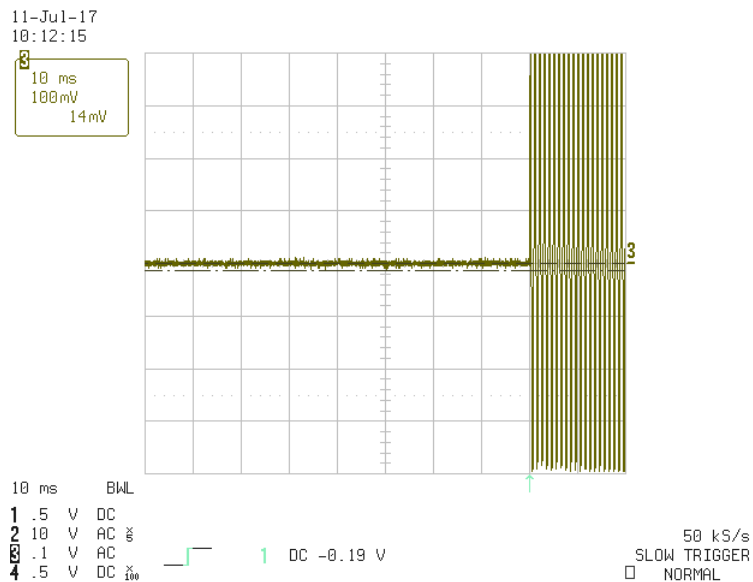
HERMON LABORATORIES

<b>Test specification:</b> Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-E, Section 2.2.19			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 10-Jul-17 - 11-Jul-17			
<b>Temperature:</b> 24.3 °C	<b>Relative Humidity:</b> 47 %	<b>Air Pressure:</b> 1009 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

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



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

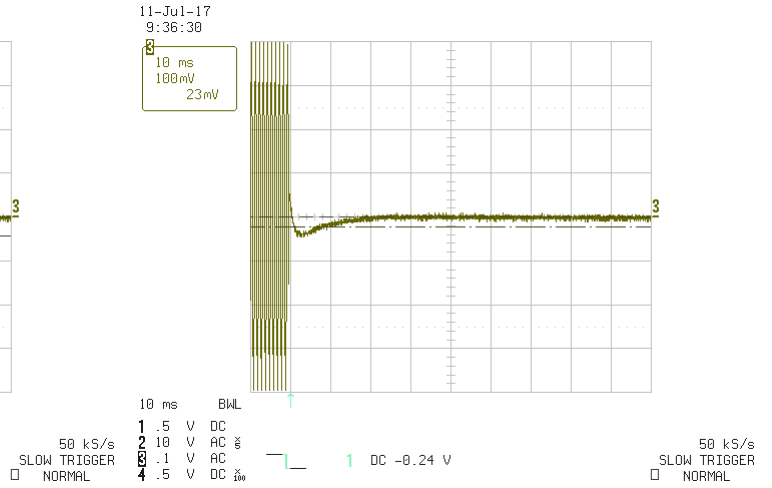
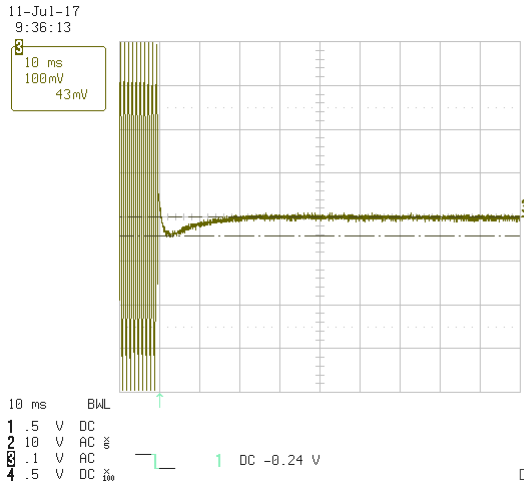




HERMON LABORATORIES

<b>Test specification:</b> Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-E, Section 2.2.19			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 10-Jul-17 - 11-Jul-17			
<b>Temperature:</b> 24.3 °C	<b>Relative Humidity:</b> 47 %	<b>Air Pressure:</b> 1009 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

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

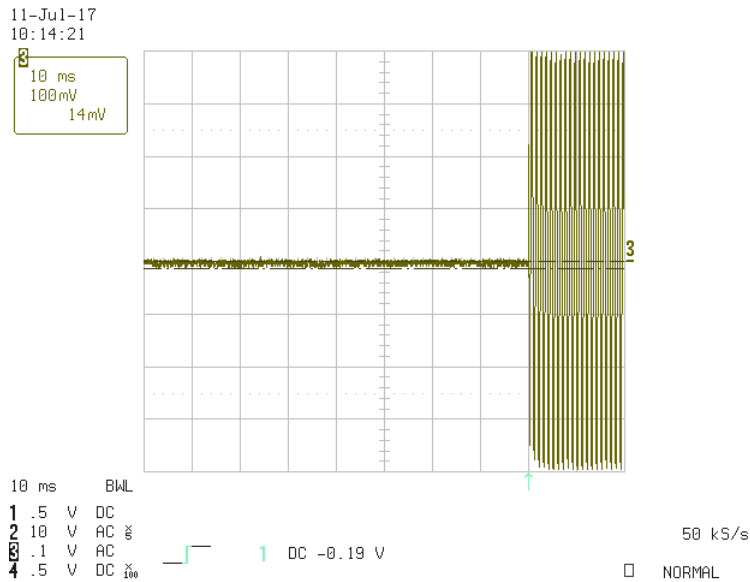




HERMON LABORATORIES

<b>Test specification:</b> Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
<b>Test procedure:</b> TIA/EIA-603-E, Section 2.2.19			
<b>Test mode:</b> Compliance		<b>Verdict:</b> PASS	
<b>Date(s):</b> 10-Jul-17 - 11-Jul-17			
<b>Temperature:</b> 24.3 °C	<b>Relative Humidity:</b> 47 %	<b>Air Pressure:</b> 1009 hPa	<b>Power:</b> 120 VAC, 60 Hz
<b>Remarks:</b>			

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



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

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	19-Jan-17	19-Jan-18
0521	EMI Receiver (Spectrum Analyzer) with RF filter section 9 kHz-6.5 GHz	Hewlett Packard	8546A	3617A 00319, 3448A002 53	27-Oct-16	27-Oct-17
0539	Generator Signal, 10 kHz - 1.2 GHz	Marconi Instruments	2023	112121/04 1	13-Oct-16	13-Oct-17
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	12-May-17	12-May-18
0614	Antenna, Dipole, Tunable, 200 - 500 MHz	Electro-Metrics	TDS-30-1	334	08-Feb-17	08-Feb-18
0661	Generator Swept Signal, 10 MHz to 40 GHz, + 10 dBm	Hewlett Packard	83640B	3614A002 66	10-May-17	10-May-18
0911	Coupler Dual Directional, 20 dB, 0.1 - 2.0 GHz	Hewlett Packard	778D	1144A078 27	07-Mar-16	07-Mar-19
1501	Cable RF, 6 m, BNC/BNC	Belden	M17/167 MIL-C-17	1501	15-Dec-16	15-Dec-17
1503	Cable RF, 6 m, BNC/BNC	Belden	M17/167 MIL-C-17	1503	30-Dec-16	30-Dec-17
1565	Antenna, Dipole, Tunable 500 - 1000 MHz	Electro-Metrics	TDS-30-2	334	08-Feb-17	08-Feb-18
1984	Antenna, Double-Ridged Waveguide Horn, 1 to 18 GHz, 300 W	EMC Test Systems	3115	9911-5964	13-Nov-16	13-Nov-17
2227	Crystal Detector 0.01-18 GHz, 100 mW	Hewlett Packard Co	8472A	NA	27-Oct-15	27-Oct-17
2432	Antenna, Double-Ridged Waveguide Horn 1 to 18 GHz	EMC Test Systems	3115	00027177	07-Feb-17	07-Feb-18
2784	Power Sensor 100 kHz-18.0 GHz, -50 to 30 dBm	Boonton Electronics Corp.	51013 (4e)	16741	30-Dec-16	30-Dec-17
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY414447 62	09-Mar-17	09-Mar-18
3300	Attenuator set, 0 to 81 dB, 1 dB step, DC-18 GHz	Agilent Technologies	8494B/84 95B	MY421469 11/MY421 43939	28-Aug-16	28-Aug-17
3333	Oscilloscope, 1 GHz, 4 channels	LeCroy Corporation	LC584AL	10239	18-Jan-17	18-Jan-18
3334	Filter, High Pass, 2.5 GHz	LORCH MICROWAVE	5HP7- 2500-SR	Z22	30-Dec-16	30-Dec-17
3339	High Pass Filter, 50 Ohm, 600 to 3000 MHz	Mini-Circuits	SHP- 600+	NA	14-May-17	14-May-18
3350	Low Pass Filter, 50 Ohm, DC to 270 MHz	Mini-Circuits	NLP-300+	NA	01-Oct-15	01-Oct-17
3433	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT- SMSM+	25679	27-Mar-17	27-Mar-18



HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
3632	Cable RF, 5.4 m, N type-N type, DC-6.5 GHz	Alpha Wire	RG 214/U	NA	04-Jun-17	04-Jun-18
3770	Attenuator, N-type, 20 dB, DC to 18 GHz, 5 W	Mini-Circuits	BW-N20W5+	NA	25-Aug-16	25-Aug-17
3787	Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz	Mini-Circuits	BW-S10W5+	NA	07-Dec-16	07-Dec-17
3810	Near-Field Probe Set, Hand held, 6 probes	EMC Test Systems	7405	9706-3927	30-Dec-16	30-Dec-17
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY48250288	07-May-17	07-May-18
4070	Attenuator, SMA, 30 dB, DC to 18 GHz, 5 W	Weinschel	WA7	NA	25-Aug-16	25-Aug-17
4071	Attenuator, SMA, 30 dB, DC to 18 GHz, 5 W	Weinschel	WA7	NA	25-Aug-16	25-Aug-17
4273	Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M	Mini-Circuits	CBL-6FT-SMNM+	70045	04-Jun-17	04-Jun-18
4275	Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M	Mini-Circuits	CBL-6FT-SMNM+	70050	27-Mar-17	27-Mar-18
4278	Test Cable , DC-18 GHz, 4.6 m, N/M - N/M	Mini-Circuits	APC-15FT-NMNM+	0755A	26-Sep-16	26-Sep-17
4339	High pass Filter, 50 Ohm, 1000 to 18000 MHz, SMA-FM / SMA-M	Micro-Tronics	HPM50115-02	001	14-May-17	14-May-18
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101003	15-Mar-17	15-Mar-18
4413	Resistive divider, DC to 1.5 GHz, 2 W	Microlab	DA-3FN	NA	20-Jul-17	20-Jul-19
5121	Microwave preamplifier, 500 MHz to 18 GHz, 40 dB Gain	Com-Power Corporation	PAM-118A	551119	01-Sep-16	01-Sep-17



9 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.



## 10 APPENDIX C Test laboratory description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, Radio, Safety, Environmental and Telecommunication testing facility.

Hermon Laboratories is recognized and accredited by the Federal Communications Commission (USA) for 1, 2, 15, 18 parts of Code of Federal Regulations 47 (CFR 47), Test Firm Registration Number is 927748, Designation Number is IL1001; registered by Industry Canada for electromagnetic emissions, file number IC 2186A-1 for OATS, certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-869 for RE measurements above 1 GHz, C-845 for conducted emissions site and T-1606 for conducted emissions at telecommunication ports).

The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing, environmental simulation and calibration (for exact scope please refer to Certificate No. 839.01, 839.03 and 839.04).

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Person for contact: Mr. Michael Nikishin, EMC&Radio group manager

## 11 APPENDIX D Specification references

FCC 47CFR part 90: 2019	Private land mobile radio services
FCC 47CFR part 2: 2019	Frequency allocations and radio treaty matters; general rules and regulations
ANSI/TIA/EIA-603-E:2016	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
RSS-119 Issue 12: 2015	Land Mobile and Fixed Equipment Operating in the Frequency Range 27.41-960 MHz
RSS-Gen Issue 5: 2019	General Requirements for Compliance of Radio Apparatus





## 12 APPENDIX E Test equipment correction factors

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

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

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



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

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

Antenna factor in dB(1/m) is to be added to receiver meter reading in dB( $\mu$ 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).



**Antenna factor**  
**Double-ridged guide horn antenna**  
**Model 3115, serial number: 00027177, HL 2432**

Frequency, MHz	Antenna factor. dB(1/m)
1000.0	24.7
1500.0	25.7
2000.0	27.8
2500.0	28.9
3000.0	30.7
3500.0	31.8
4000.0	33.0
4500.0	32.8
5000.0	34.2
5500.0	34.9
6000.0	35.2
6500.0	35.4
7000.0	36.3
7500.0	37.3
8000.0	37.5
8500.0	38.0
9000.0	38.3
9500.0	38.3
10000.0	38.7
10500.0	38.7
11000.0	38.9
11500.0	39.5
12000.0	39.5
12500.0	39.4
13000.0	40.5
13500.0	40.8
14000.0	41.5
14500.0	41.3
15000.0	40.2
15500.0	38.7
16000.0	38.5
16500.0	39.8
17000.0	41.9
17500.0	45.8
18000.0	49.1

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**  
**Test Cable, Mini-Circuits, CBL-5FT-SMSM+, SMA-SMA, 18 GHz, 1.5 m, S/N 25679**  
**Mini-Circuits, HL 3433**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10.0	0.06	9000	2.01
100	0.17	9500	2.06
500	0.41	10000	2.05
1000	0.58	10500	2.18
1500	0.72	11000	2.26
2000	0.86	11500	2.28
2500	0.96	12000	2.43
3000	1.04	12500	2.53
3500	1.13	13000	2.52
4000	1.23	13500	2.56
4500	1.31	14000	2.60
5000	1.41	14500	2.59
5500	1.49	15000	2.67
6000	1.55	15500	2.76
6500	1.63	16000	2.86
7000	1.71	16500	2.91
7500	1.78	17000	2.95
8000	1.86	17500	3.02
8500	1.92	18000	3.07



**Cable loss**  
**Cable coaxial, RG-214/U, N type-N type, 6 m**  
**Alpha Wire, HL 3622**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.13	2100	2.95	4400	4.99
30	0.24	2200	2.99	4500	5.00
50	0.32	2300	3.11	4600	5.17
100	0.47	2400	3.16	4700	5.18
200	0.70	2500	3.31	4800	5.33
300	0.88	2600	3.36	4900	5.34
400	1.05	2700	3.46	5000	5.50
500	1.21	2800	3.52	5100	5.56
600	1.36	2900	3.65	5200	5.76
700	1.49	3000	3.70	5300	5.76
800	1.63	3100	3.82	5400	5.85
900	1.72	3200	3.88	5500	5.88
1000	1.84	3300	3.99	5600	5.96
1100	1.96	3400	4.08	5700	6.02
1200	2.06	3500	4.19	5800	6.06
1300	2.15	3600	4.28	5900	6.14
1400	2.28	3700	4.42	6000	6.17
1500	2.35	3800	4.40	6100	6.28
1600	2.43	3900	4.51	6200	6.36
1700	2.57	4000	4.62	6300	6.47
1800	2.62	4100	4.70	6400	6.51
1900	2.75	4200	4.78	6500	6.65
2000	2.80	4300	4.83		



**Cable loss**  
**Test cable, Mini-Circuits, S/N 70045, 18 GHz, 1.8 m, SMA/M - N/M**  
**CBL-6FT-SMNM+, HL 4273**

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



**Cable loss**  
**Test cable, Mini-Circuits, S/N 70050, 18 GHz, 1.8 m, SMA/M - N/M**  
**CBL-6FT-SMNM+, HL 4275**

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.08	5000	1.71	10200	2.64	15400	3.46
30	0.11	5100	1.73	10300	2.65	15500	3.47
50	0.14	5200	1.75	10400	2.66	15600	3.52
100	0.21	5300	1.76	10500	2.67	15700	3.55
200	0.30	5400	1.77	10600	2.70	15800	3.55
300	0.37	5500	1.82	10700	2.71	15900	3.55
400	0.43	5600	1.84	10800	2.72	16000	3.61
500	0.49	5700	1.86	10900	2.73	16100	3.62
600	0.54	5800	1.86	11000	2.75	16200	3.63
700	0.58	5900	1.89	11100	2.77	16300	3.62
800	0.62	6000	1.94	11200	2.78	16400	3.66
900	0.66	6100	1.95	11300	2.80	16500	3.71
1000	0.70	6200	1.96	11400	2.82	16600	3.71
1100	0.74	6300	1.97	11500	2.83	16700	3.67
1200	0.78	6400	2.01	11600	2.84	16800	3.69
1300	0.81	6500	2.03	11700	2.86	16900	3.74
1400	0.84	6600	2.02	11800	2.88	17000	3.73
1500	0.88	6700	2.02	11900	2.89	17100	3.71
1600	0.91	6800	2.05	12000	2.90	17200	3.73
1700	0.94	6900	2.06	12100	2.92	17300	3.77
1800	0.97	7000	2.07	12200	2.93	17400	3.77
1900	1.00	7100	2.07	12300	2.94	17500	3.76
2000	1.02	7200	2.08	12400	2.96	17600	3.76
2100	1.05	7300	2.11	12500	2.98	17700	3.78
2200	1.07	7400	2.13	12600	2.99	17800	3.80
2300	1.10	7500	2.15	12700	3.01	17900	3.79
2400	1.13	7600	2.16	12800	3.03	18000	3.78
2500	1.15	7700	2.18	12900	3.05		
2600	1.18	7800	2.21	13000	3.07		
2700	1.20	7900	2.24	13100	3.09		
2800	1.24	8000	2.25	13200	3.12		
2900	1.26	8100	2.26	13300	3.13		
3000	1.28	8200	2.29	13400	3.14		
3100	1.30	8300	2.31	13500	3.16		
3200	1.33	8400	2.33	13600	3.18		
3300	1.36	8500	2.33	13700	3.19		
3400	1.37	8600	2.34	13800	3.21		
3500	1.39	8700	2.36	13900	3.23		
3600	1.42	8800	2.38	14000	3.25		
3700	1.45	8900	2.39	14100	3.26		
3800	1.46	9000	2.40	14200	3.27		
3900	1.48	9100	2.42	14300	3.30		
4000	1.50	9200	2.45	14400	3.32		
4100	1.53	9300	2.46	14500	3.33		
4200	1.55	9400	2.48	14600	3.34		
4300	1.57	9500	2.50	14700	3.36		
4400	1.59	9600	2.52	14800	3.39		
4500	1.61	9700	2.54	14900	3.40		
4600	1.64	9800	2.56	15000	3.41		
4700	1.66	9900	2.58	15100	3.41		
4800	1.67	10000	2.60	15200	3.44		
4900	1.69	10100	2.61	15300	3.46		





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

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



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

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		



## 13 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
AM	amplitude modulation
AVRG	average (detector)
BB	broad band
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB( $\mu$ V)	decibel referred to one microvolt
dB( $\mu$ V/m)	decibel referred to one microvolt per meter
dB( $\mu$ A)	decibel referred to one microampere
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
k	kilo
kHz	kilohertz
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
$\mu$ s	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
$\Omega$	Ohm
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