

TEST REPORT

ACCORDING TO: FCC CFR 47 Part 90, subpart I, and RSS-119 Issue 12:2015

FOR:

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

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Telephone: +972 3557 5767
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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: Telematics Wireless Ltd.
Address: 26 Hamelaha street, POB 1911, Holon, 58117, Israel
Telephone: +972 3557 5767
Fax: +972 3557 5753
E-Mail: itsikk@tlmw.com
Contact name: Mr. Itsik Kanner

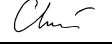
4 Test details

Project ID: 29794
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 part 90, subpart I; RSS-119 issue 12

5 Tests summary

Test	Status
Transmitter characteristics	
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

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.

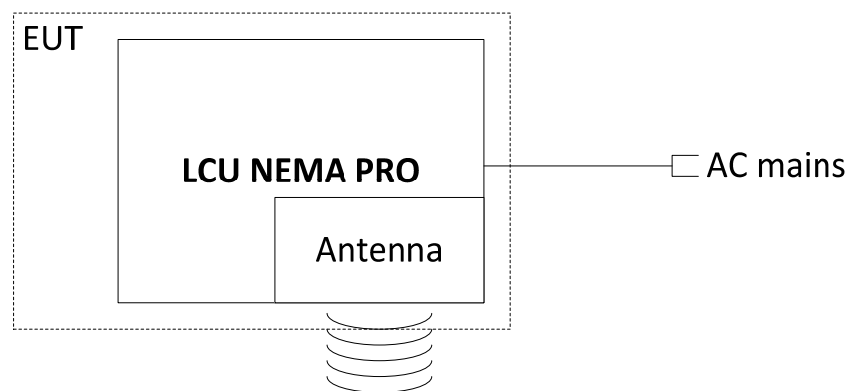
	Name and Title	Date	Signature
Tested by:	Mr. S. Samokha, test engineer	July 19, 2017	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	August 17, 2017	
Approved by:	Mr. M. Nikishin, EMC and radio group leader	November 6, 2017	

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

Type of equipment					
X	Stand-alone (Equipment with or without its own control provisions)				
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)				
	Plug-in card (Equipment intended for a variety of host systems)				
Intended use		Condition of use			
	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			
Assigned frequency ranges		450- 470 MHz			
Maximum rated output power		At transmitter 50 Ω RF output connector		35 dBm	
Is transmitter output power variable?		X	No		
		Yes		continuous variable	
				stepped variable with stepsize	
				dB	
				dBm	
			maximum RF power		dBm
Antenna connection					
X	unique coupling	standard connector	integral	with temporary RF connector	
				X without temporary RF connector	
Antenna/s technical characteristics					
Type	Manufacturer		Model number		Gain
Integral	Telematics Wireless		Printed		2 dBi
Transmitter aggregate data rate/s		4.8 kbps			
Type of modulation		4GFSK			
Modulating test signal (baseband)		PRBS			
Transmitter power source					
	Battery	Nominal rated voltage		Battery type	
	DC	Nominal rated voltage	3.6 V to module		
X	AC mains	Nominal rated voltage	120 AC	Frequency	60 Hz

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

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

7.1 Peak output power test

7.1.1 General

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

Table 7.1.1 Peak output power limits

Assigned frequency range, MHz	Maximum peak output power	
	W	dBm
450.0 – 470.0	6	37.78

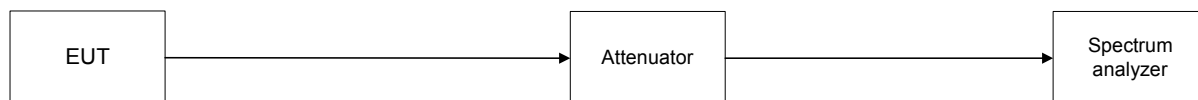
7.1.2 Test procedure

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





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

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

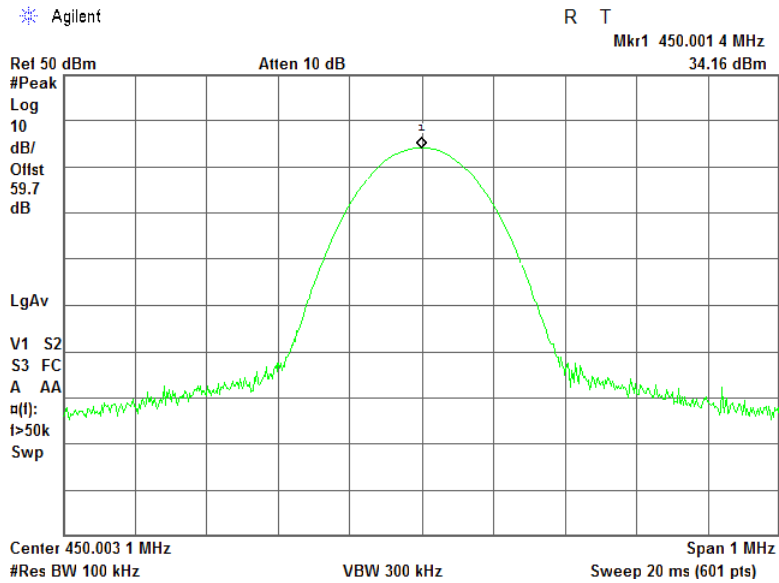
Reference numbers of test equipment used

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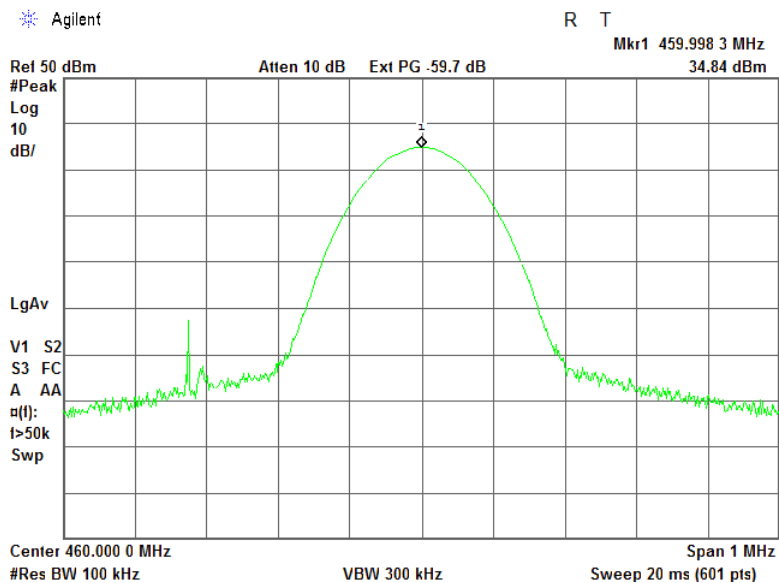
Full description is given in Appendix A.

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

Plot 7.1.1 Peak output power test results at low frequency



Plot 7.1.2 Peak output power test results at mid frequency

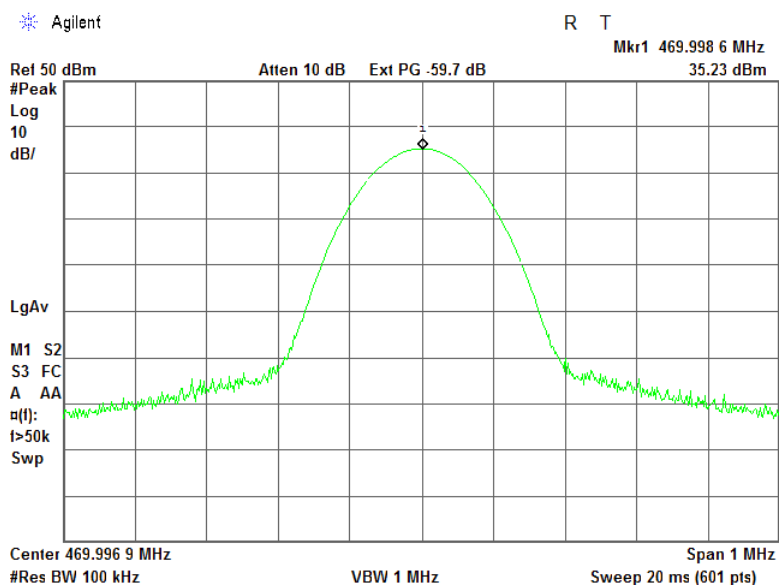




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Test specification:		Section 90.267 / RSS-119 Section 5.4, Maximum output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Verdict: PASS	
Date(s):			
04-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 43 %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

Plot 7.1.3 Peak output power test results at high frequency



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

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	6.25

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

7.2.2 Test procedure

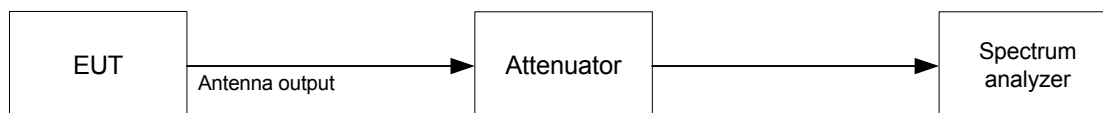
7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

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





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

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	6.2500	-2.7253	Pass
460.000000	3.5164	6.2500	-2.7336	Pass
469.996875	3.5055	6.2500	-2.7445	Pass
MODULATION ENVELOPE REFERENCE POINTS: 26 dBc				
450.003125	4.8160	6.2500	-1.434	Pass
460.000000	4.4710	6.2500	-1.779	Pass
469.996875	4.5910	6.2500	-1.659	Pass

Reference numbers of test equipment used

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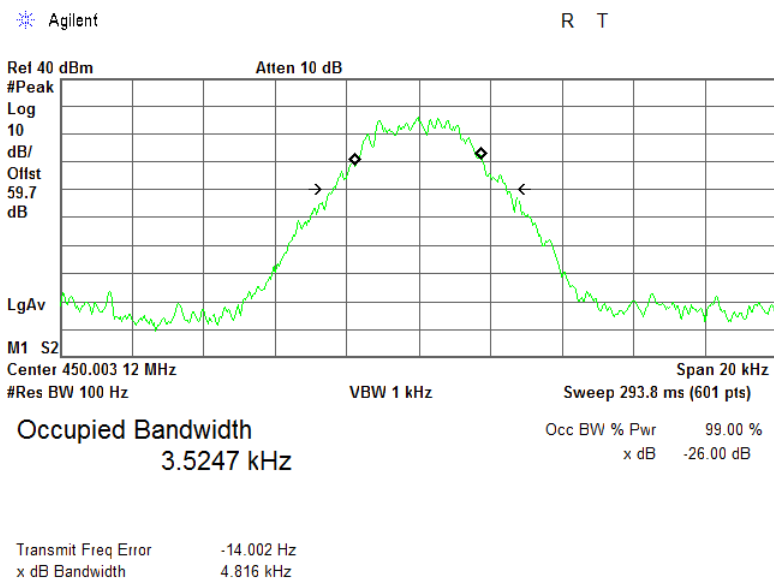
Full description is given in Appendix A.



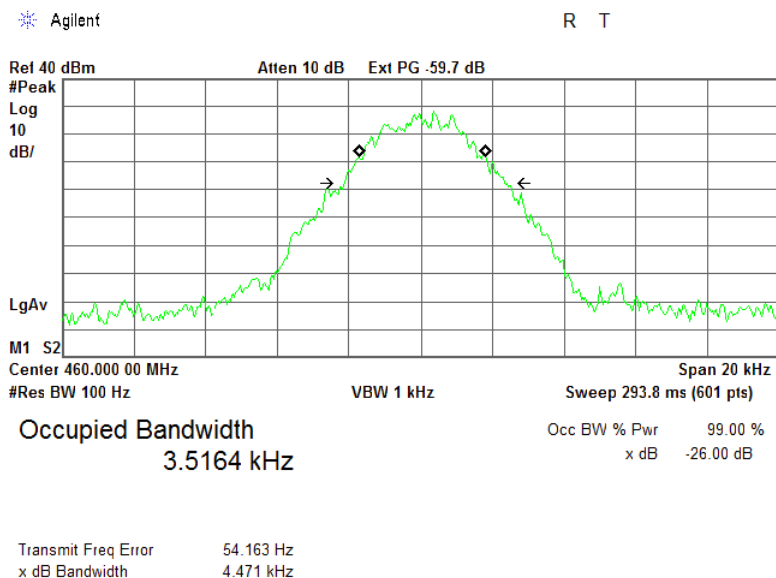
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Test specification: Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 04-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 42 %	Air Pressure: 1004 hPa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

Plot 7.2.1 Occupied bandwidth test result at low frequency



Plot 7.2.2 Occupied bandwidth test result at mid frequency

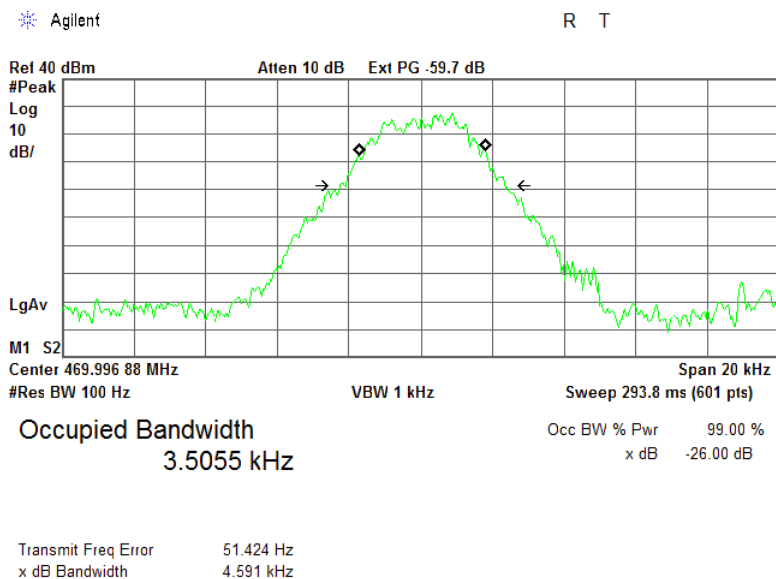




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Test specification: Section 90.209 / RSS-119 Section 5.5, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 04-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 42 %	Air Pressure: 1004 hPa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

Plot 7.2.3 Occupied bandwidth test result at high frequency



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

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	$30 + 16.67(f_d^{**} - 3 \text{ kHz})$ or $55 + 10\log P(W)$ whichever is the lesser
More than 4.6 kHz	$55 + 10\log P(W)$ or 57 whichever is the lesser (RSS-119) $55 + 10\log P(W)$ or 65 whichever is the lesser (FCC)

* - linearly increase with frequency

** - displacement frequency

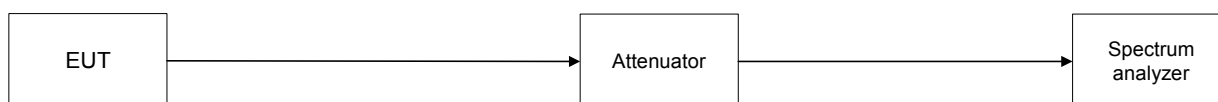
7.3.2 Test procedure

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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Report ID: TELRAD_FCC.29794.docx

Date of Issue: 6-Nov-17

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

Table 7.3.2 Emission mask test results

Carrier frequency, MHz	Limit	Verdict
450.003125	Emission mask E	Pass
460.000000		
459.996875		

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.

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

Plot 7.3.1 Emission mask test results at low carrier frequency

OPERATING FREQUENCY RANGE:

DETECTOR USED:

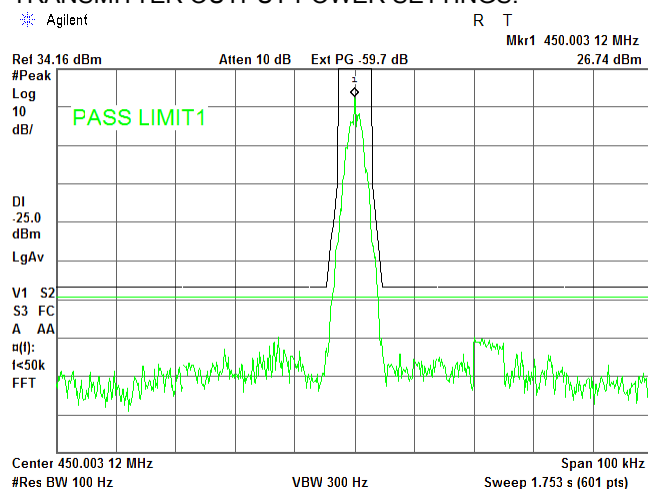
MODULATION:

MODULATING SIGNAL:

BIT RATE:

TRANSMITTER OUTPUT POWER SETTINGS:

Agilent



450.0 – 470.0 MHz

Peak

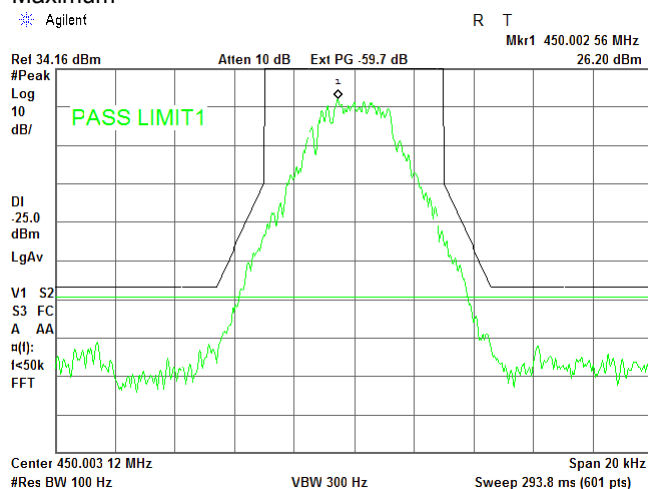
4GFSK

ID code

2.4 kbps

Maximum

Agilent



Plot 7.3.2 Emission mask test results at mid carrier frequency

OPERATING FREQUENCY RANGE:

DETECTOR USED:

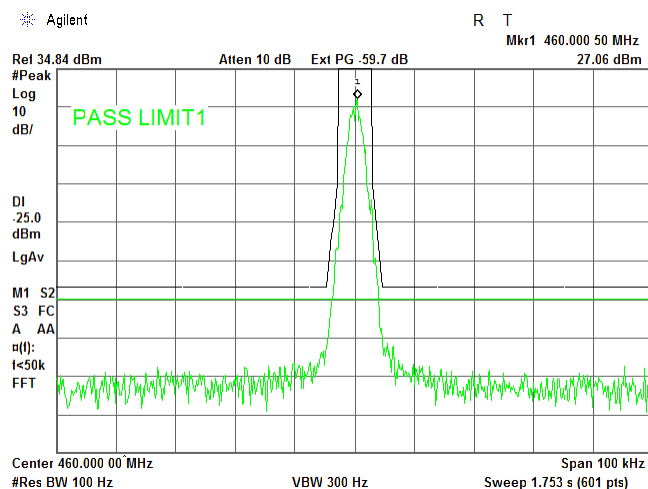
MODULATION:

MODULATING SIGNAL:

BIT RATE:

TRANSMITTER OUTPUT POWER SETTINGS:

Agilent



450.0 – 470.0 MHz

Peak

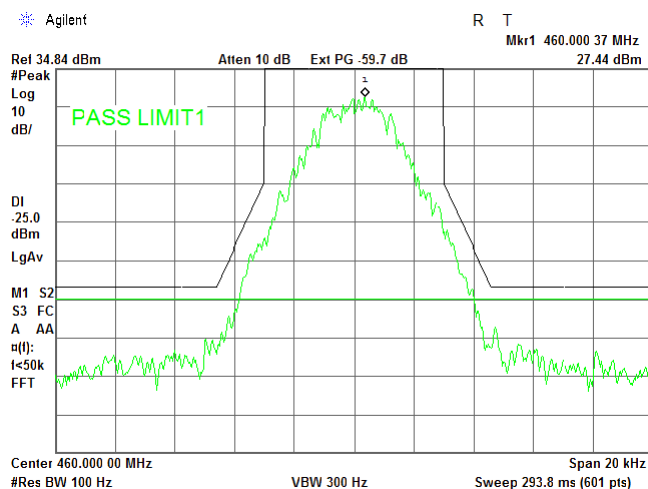
4GFSK

ID code

2.4 kbps

Maximum

Agilent





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

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:

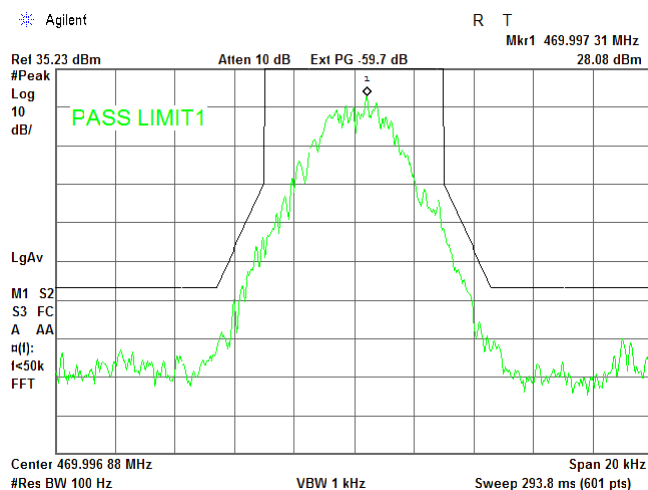
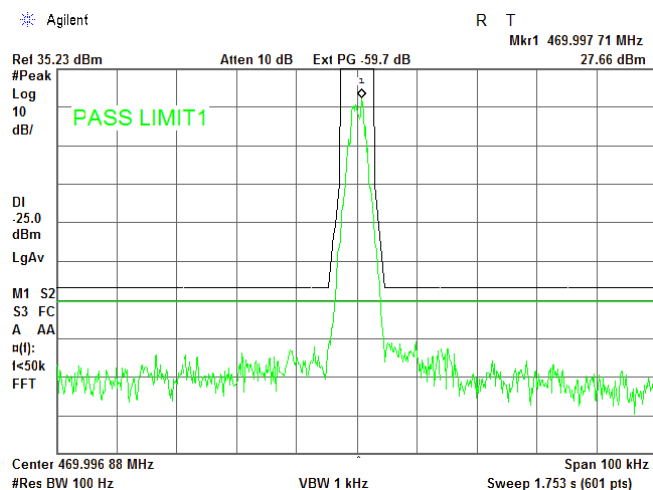
ID code

BIT RATE:

2.4 kbps

TRANSMITTER OUTPUT POWER SETTINGS:

Maximum



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

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)***
0.009 – 10th harmonic*	55+10logP**	-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.

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

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

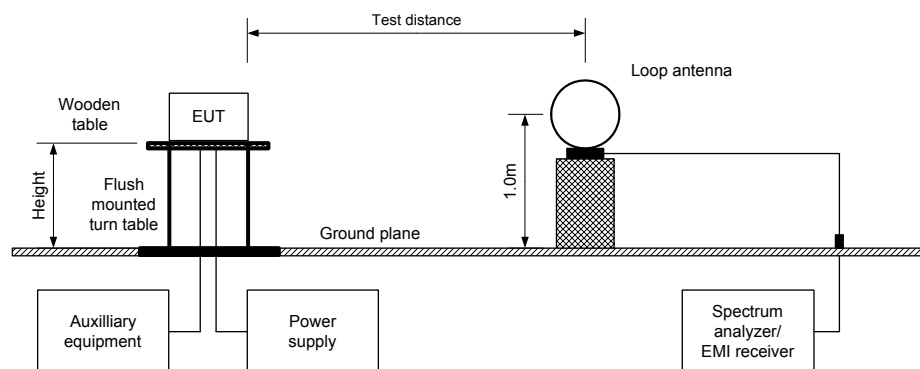
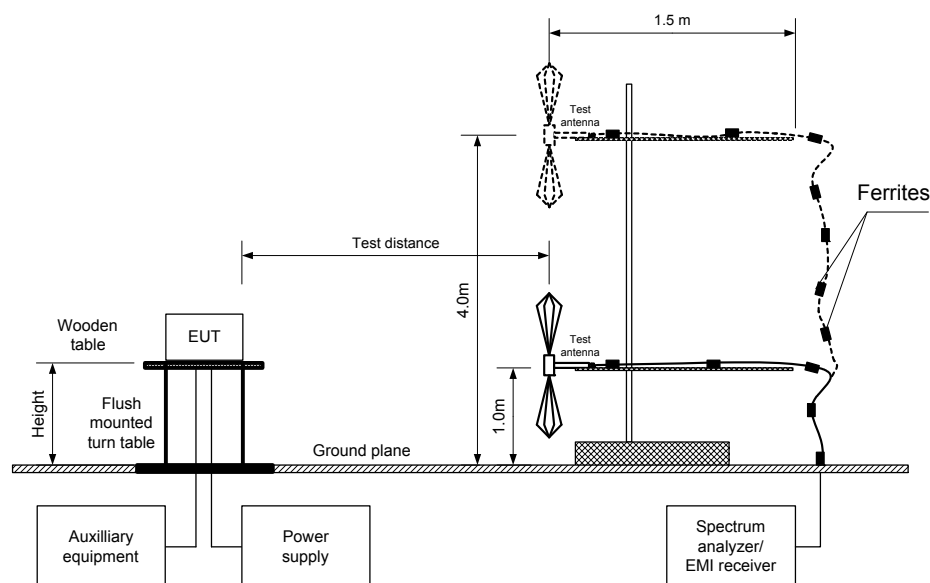
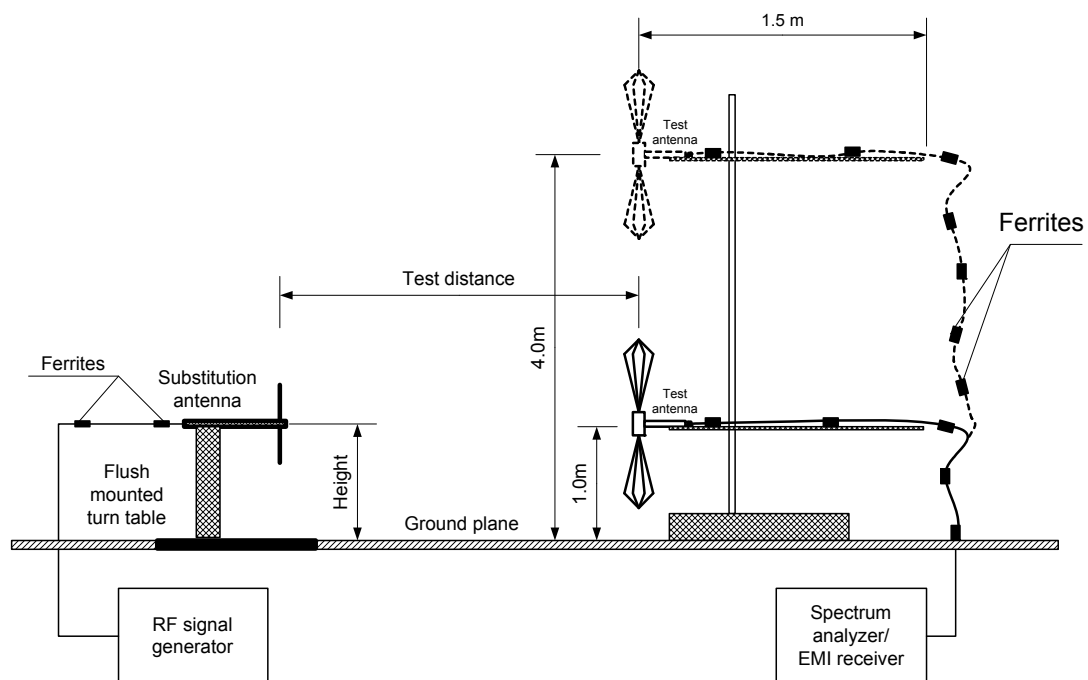


Figure 7.4.2 Setup for spurious emission field strength measurements above 30 MHz



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

Figure 7.4.3 Setup for substitution ERP measurements of spurious





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

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: 4.4 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
Low carrier frequency 450.003125 MHz							
899.991	67.69	72.35	-4.66	100	Vert	1.4	138
1350.050	63.68	72.35	-8.67	1000	Vert	1.5	340
1800.050	56.64	72.35	-15.71	1000	Hor	1.2	46
Mid carrier frequency 460.0 MHz							
920.013	70.28	72.35	-2.07	100	Vert	1.4	156
1379.950	65.71	72.35	-6.64	1000	Vert	1.5	343
1840.150	57.93	72.35	-14.42	1000	Hor	1.2	60
2300.000	54.95	72.35	-17.40	1000	Hor	1.3	294
High carrier frequency 469.996875 MHz							
940.031	66.16	72.35	-6.19	100	Vert	1.4	144
1409.990	67.45	72.35	-4.90	1000	Vert	1.5	339
1880.030	57.71	72.35	-14.64	1000	Hor	1.2	83
2350.030	54.77	72.35	-17.58	1000	Vert	1.3	304

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

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



HERMON LABORATORIES

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

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
Low carrier frequency 450.003125 MHz										
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
Mid carrier frequency 460.0 MHz										
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
High carrier frequency 469.996875 MHz										
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.

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

Plot 7.4.1 Radiated emission measurements in 9 - 150 kHz range

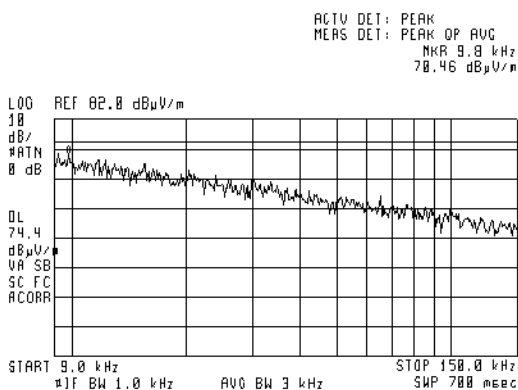
TEST SITE:
CARRIER FREQUENCY:
ANTENNA POLARIZATION:
TEST DISTANCE:
CARRIER FREQUENCY: Low

Semi anechoic chamber

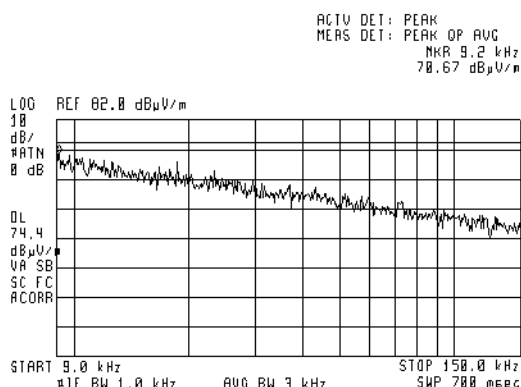
Vertical and Horizontal
3 m

CARRIER FREQUENCY: Mid

22:19:44 JUL 04, 2017

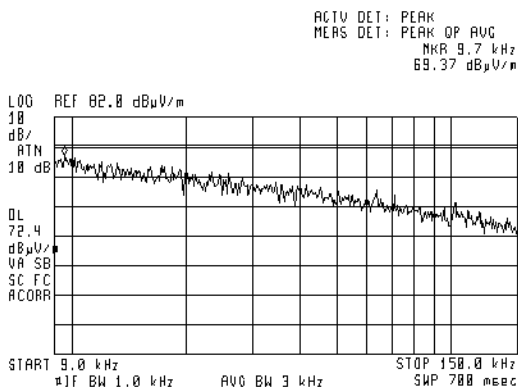


22:22:18 JUL 04, 2017



CARRIER FREQUENCY: High

22:27:48 JUL 04, 2017



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

Plot 7.4.2 Radiated emission measurements in 0.15 - 30 MHz range

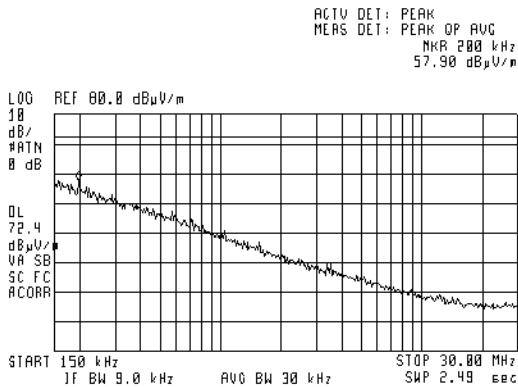
TEST SITE:
CARRIER FREQUENCY:
ANTENNA POLARIZATION:
TEST DISTANCE:
CARRIER FREQUENCY: Low

Semi anechoic chamber

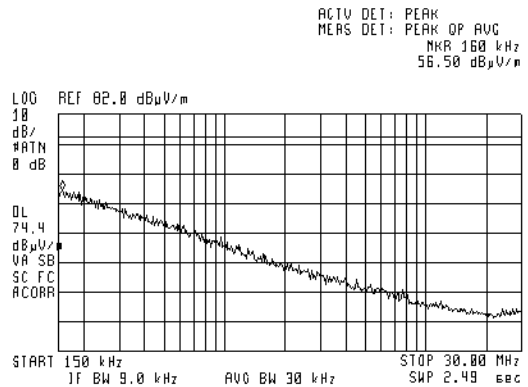
Vertical and Horizontal
3 m

CARRIER FREQUENCY: Mid

22:14:30 JUL 04, 2017

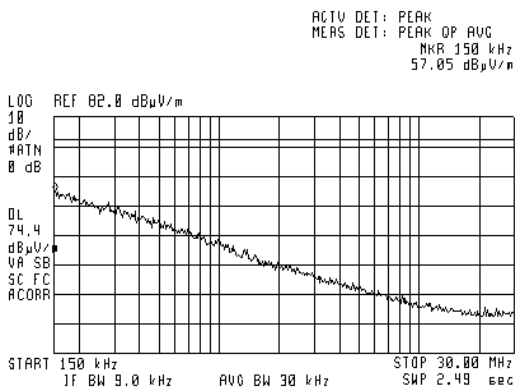


22:23:30 JUL 04, 2017



CARRIER FREQUENCY: High

22:25:21 JUL 04, 2017



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

Plot 7.4.3 Radiated emission measurements in 30 - 1000 MHz range

TEST SITE:

Semi anechoic chamber

ANTENNA POLARIZATION:

Vertical and Horizontal

TEST DISTANCE:

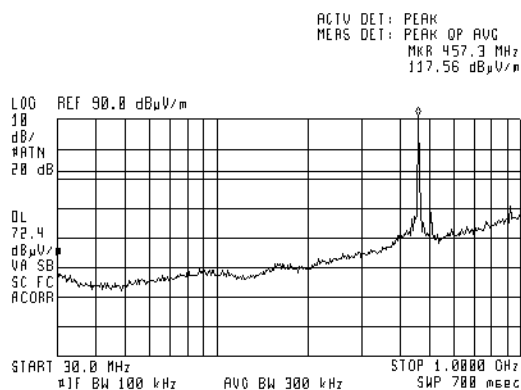
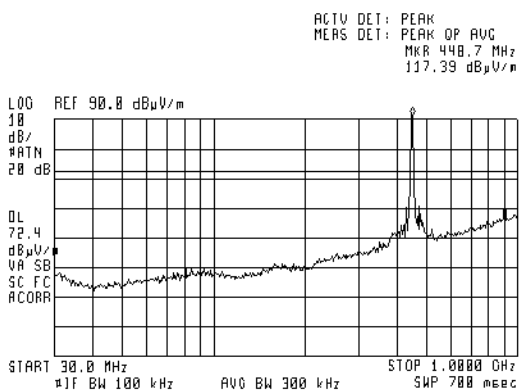
3 m

CARRIER FREQUENCY: Low

CARRIER FREQUENCY: Mid

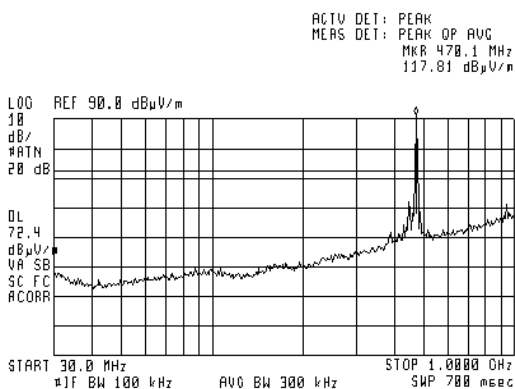
21:17:06 JUL 04, 2017

21:15:29 JUL 04, 2017



CARRIER FREQUENCY: High

21:18:16 JUL 04, 2017



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

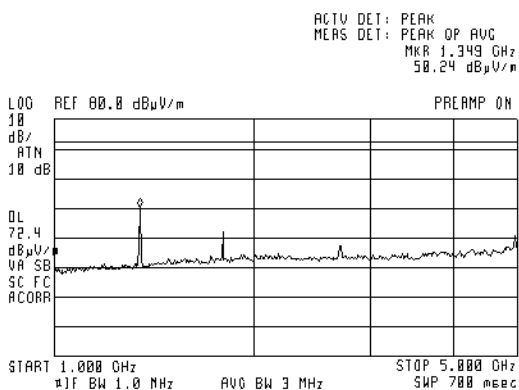
Plot 7.4.4 Radiated emission measurements in 1000 – 5000 MHz range

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

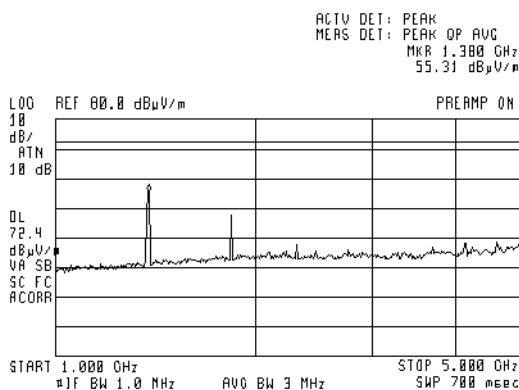
Semi anechoic chamber

Vertical and Horizontal
3 m
CARRIER FREQUENCY: Mid

22:52:18 JUL 04, 2017

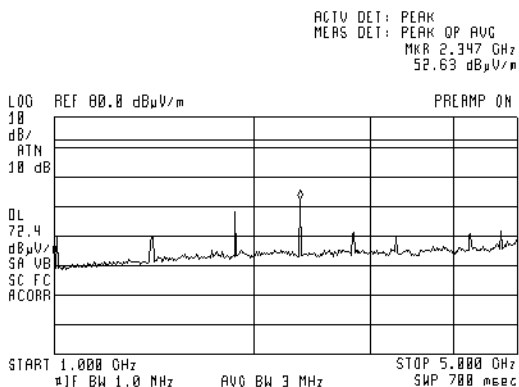


22:47:39 JUL 04, 2017



CARRIER FREQUENCY: High

22:43:56 JUL 04, 2017



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

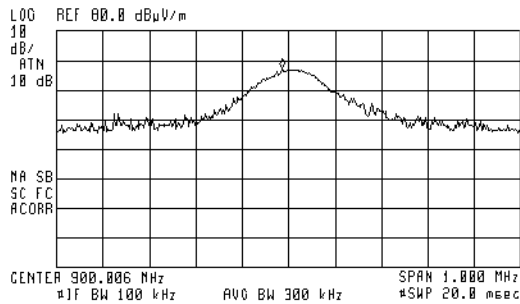
Plot 7.4.5 Radiated emission measurements at the 2nd harmonic

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

Semi anechoic chamber
Vertical
3 m
CARRIER FREQUENCY: Mid

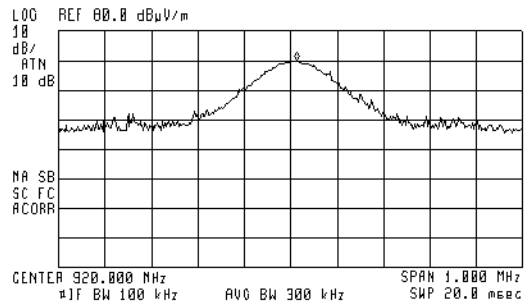
18:58:49 JUL 04, 2017

ACTV DET: PEAK
MERS DET: PEAK OP AVG
MKR 899.991 MHz
67.69 dBμV/m



19:06:39 JUL 04, 2017

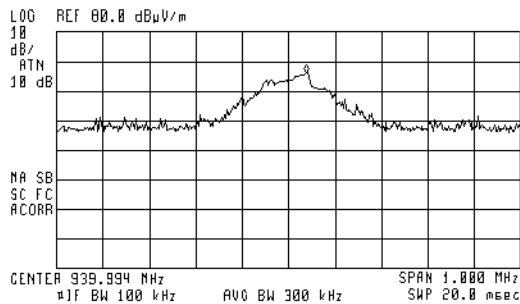
ACTV DET: PEAK
MERS DET: PEAK OP AVG
MKR 920.013 MHz
70.28 dBμV/m



CARRIER FREQUENCY: High

19:56:47 JUL 04, 2017

ACTV DET: PEAK
MERS DET: PEAK OP AVG
MKR 940.031 MHz
66.16 dBμV/m



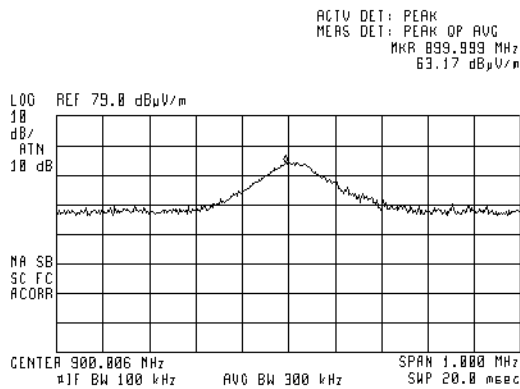
Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Jul-17 - 19-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: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

Plot 7.4.6 Radiated emission measurements at the 2nd harmonic

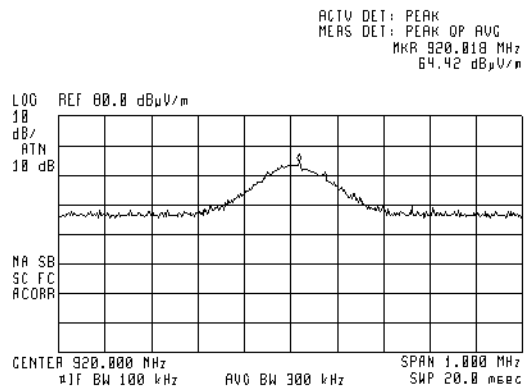
TEST SITE:
ANTENNA POLARIZATION:
TEST DISTANCE:
CARRIER FREQUENCY: Low

Semi anechoic chamber
Horizontal
3 m
CARRIER FREQUENCY: Mid

18:53:00 JUL 04, 2017

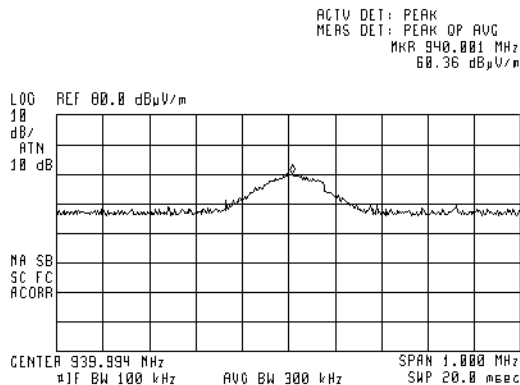


19:41:31 JUL 04, 2017



CARRIER FREQUENCY: High

19:48:28 JUL 04, 2017

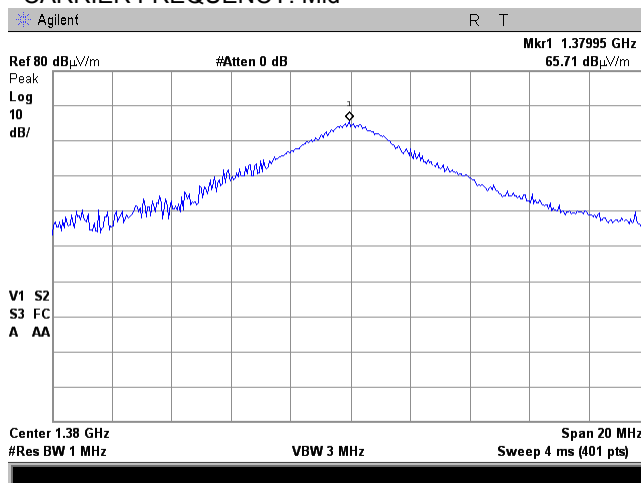
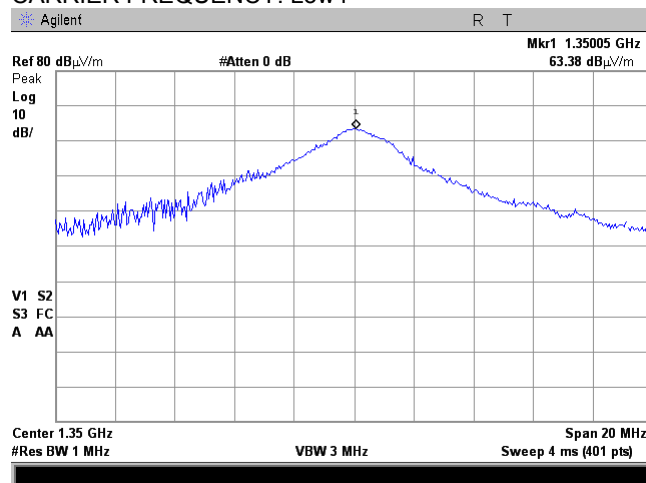


Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Jul-17 - 19-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: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

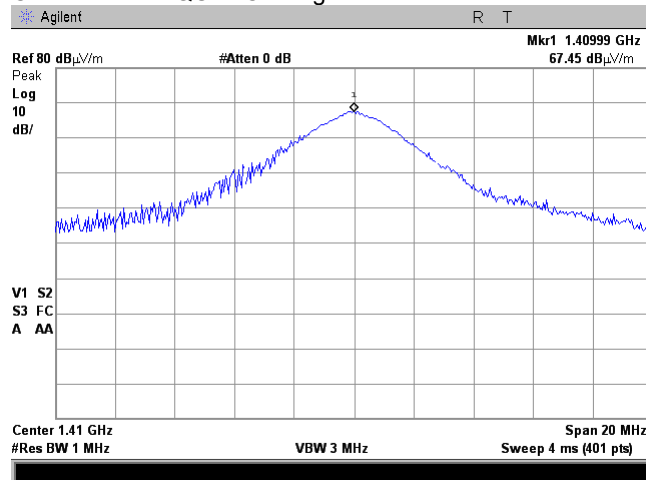
Plot 7.4.7 Radiated emission measurements at the 3rd harmonic

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

OATS
Vertical
3 m
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High

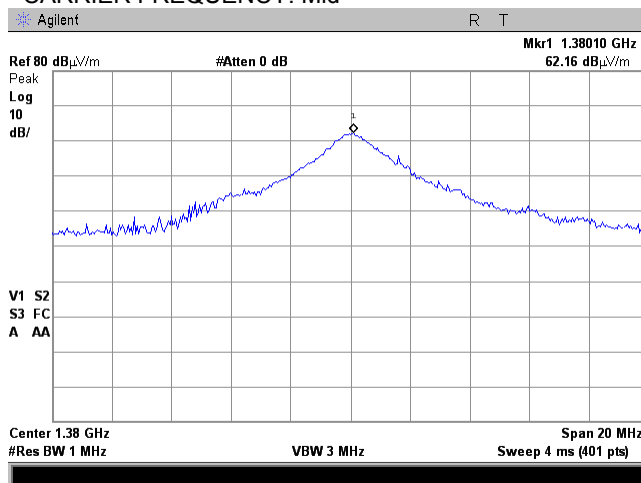
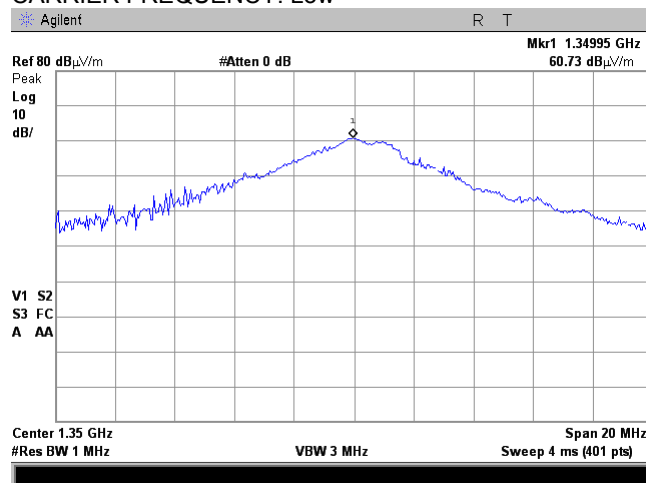


Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Jul-17 - 19-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: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

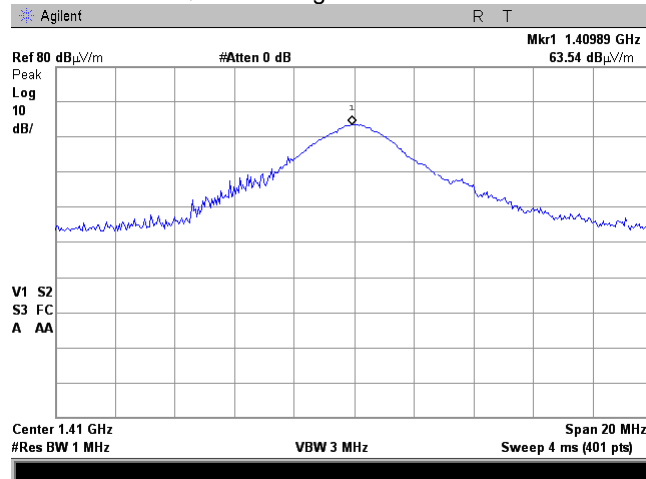
Plot 7.4.8 Radiated emission measurements at the 3rd harmonic

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

OATS
Horizontal
3 m
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



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

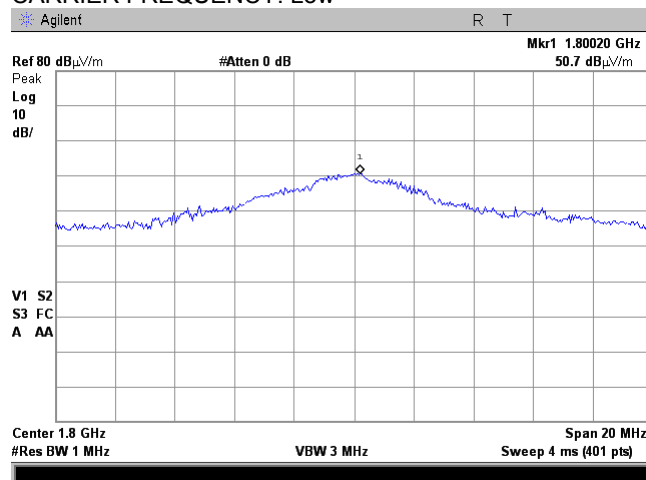
Plot 7.4.9 Radiated emission measurements at the 4th harmonic

TEST SITE:

ANTENNA POLARIZATION:

TEST DISTANCE:

CARRIER FREQUENCY: Low

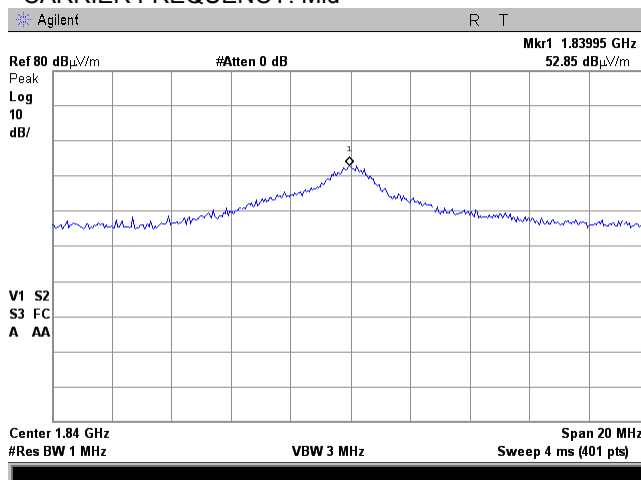


OATS

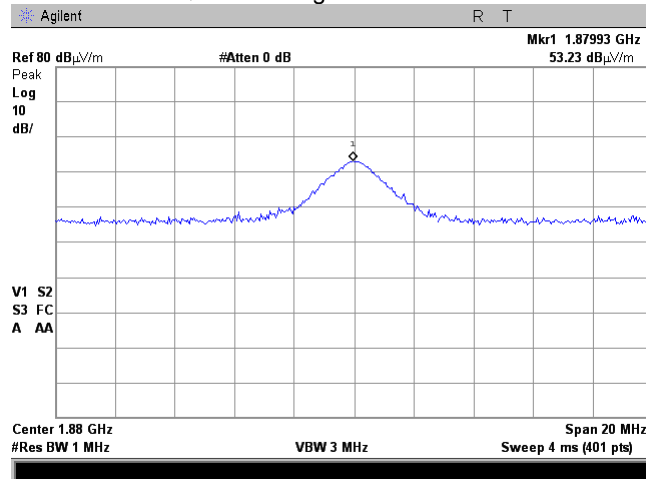
Vertical

3 m

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



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

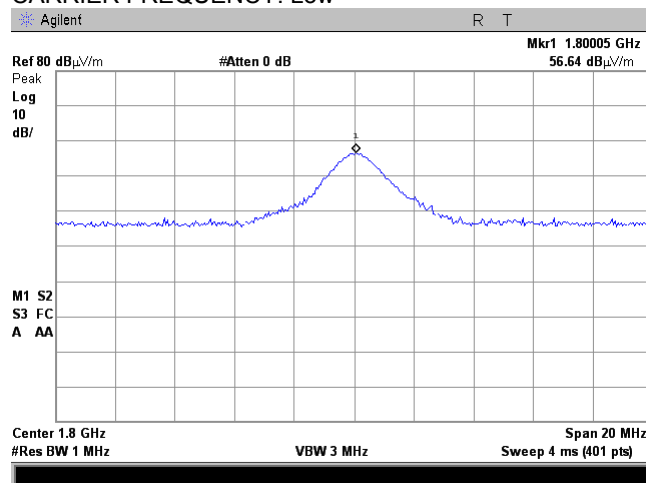
Plot 7.4.10 Radiated emission measurements at the 4th harmonic

TEST SITE:

ANTENNA POLARIZATION:

TEST DISTANCE:

CARRIER FREQUENCY: Low

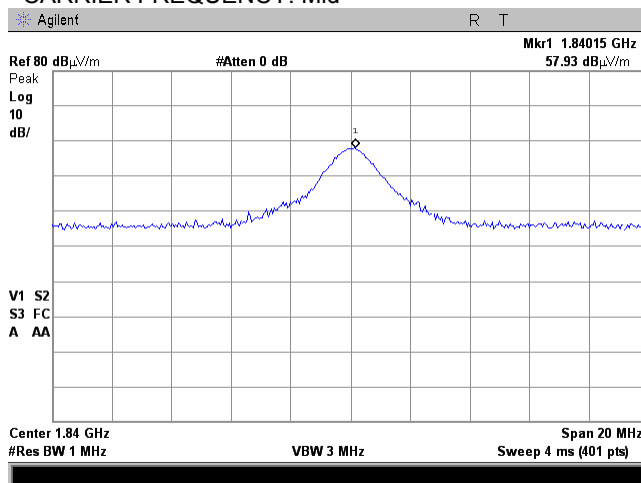


OATS

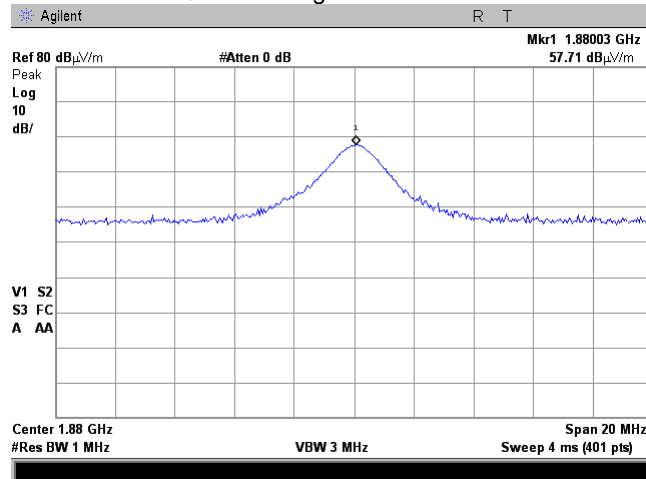
Horizontal

3 m

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



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

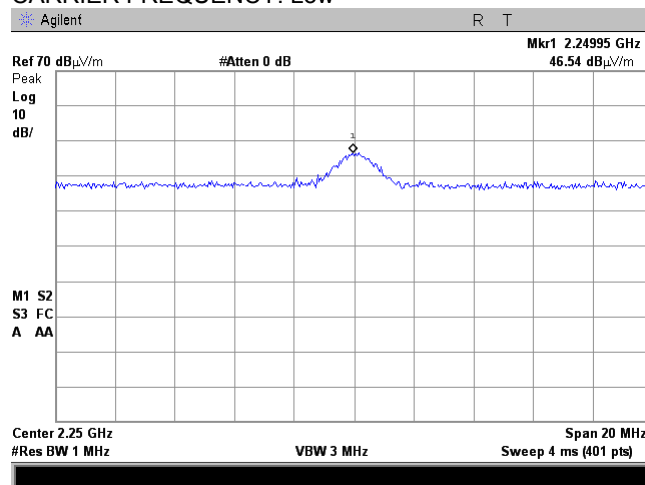
Plot 7.4.11 Radiated emission measurements at the 5th harmonic

TEST SITE:

ANTENNA POLARIZATION:

TEST DISTANCE:

CARRIER FREQUENCY: Low

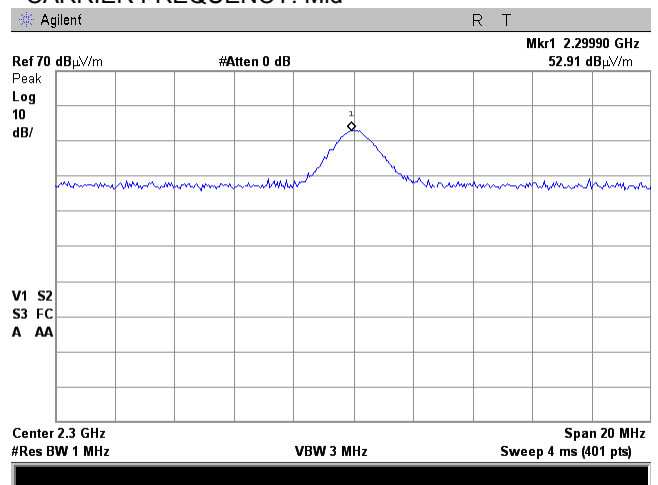


OATS

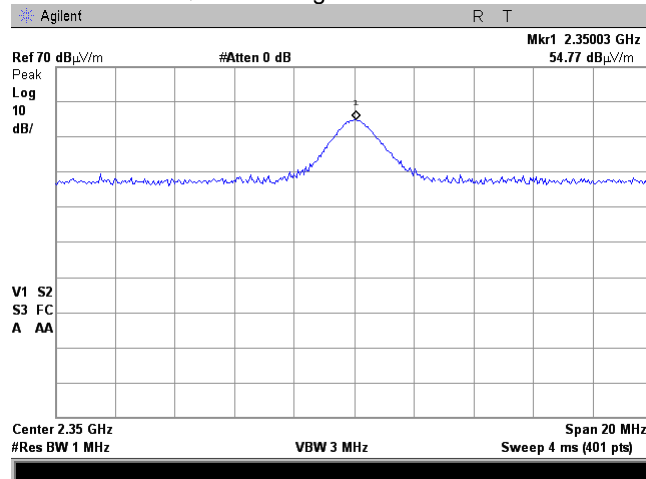
Vertical

3 m

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



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

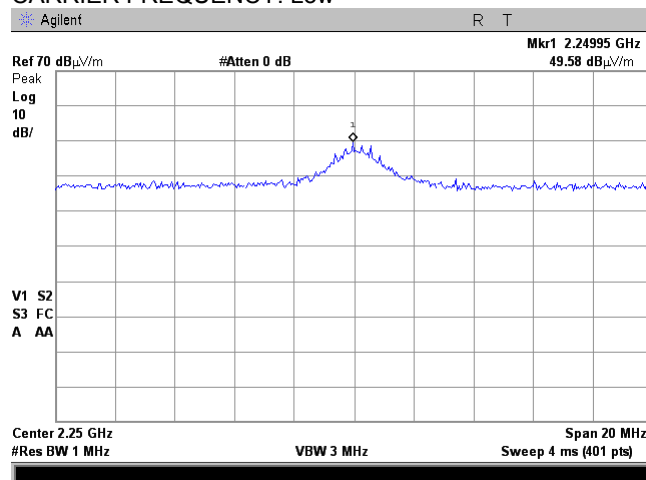
Plot 7.4.12 Radiated emission measurements at the 5th harmonic

TEST SITE:

ANTENNA POLARIZATION:

TEST DISTANCE:

CARRIER FREQUENCY: Low

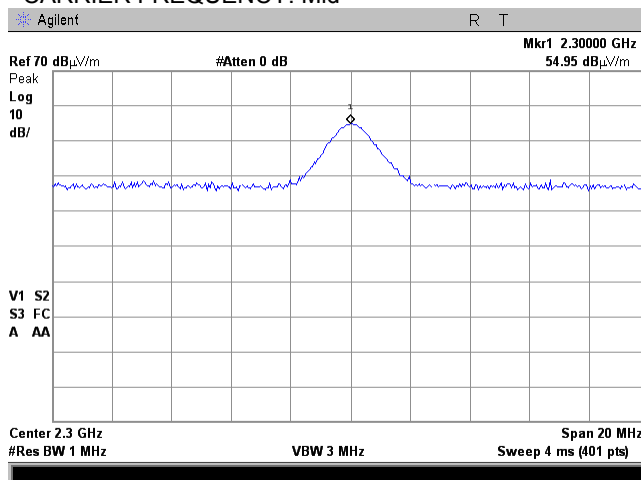


OATS

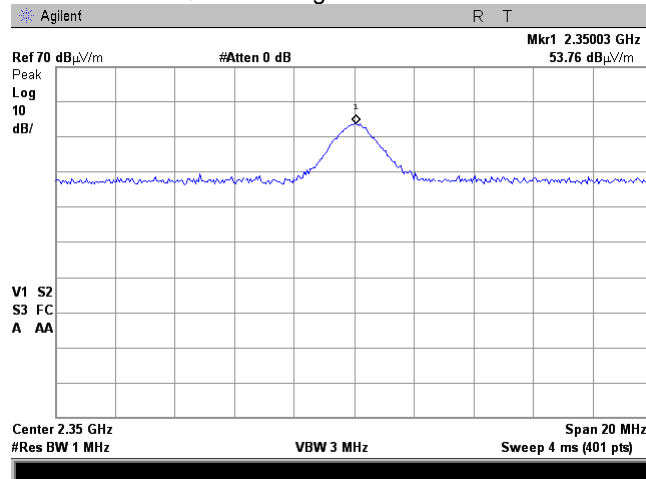
Horizontal

3 m

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High

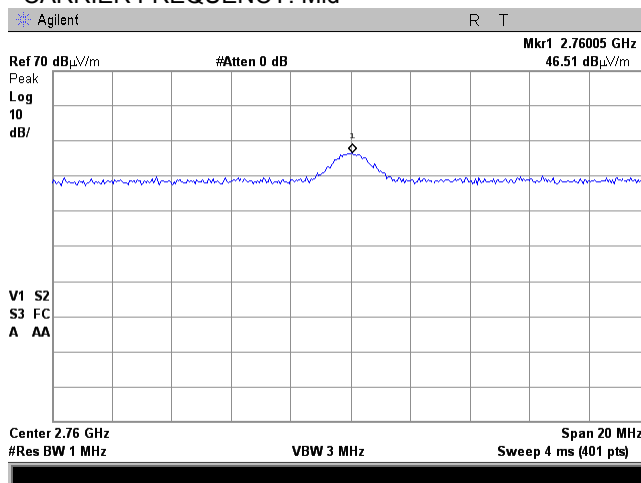
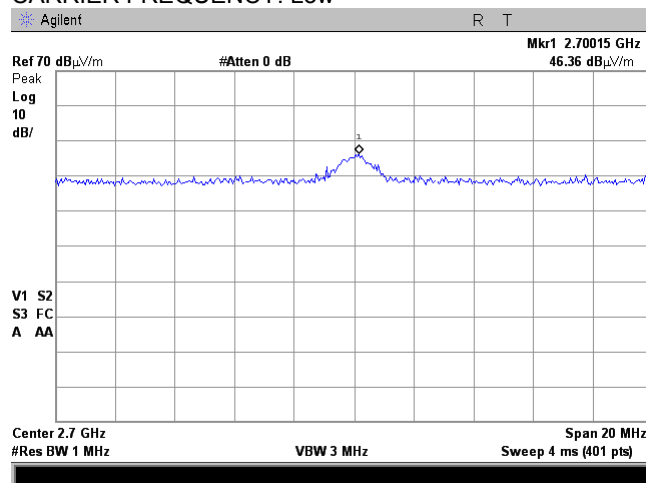


Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Jul-17 - 19-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: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

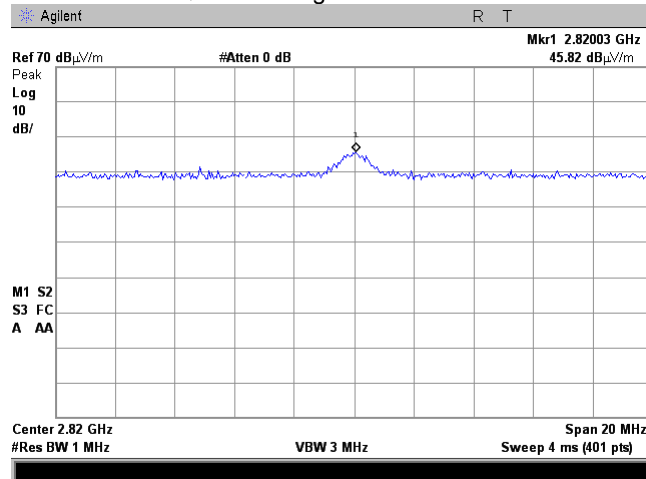
Plot 7.4.13 Radiated emission measurements at the 6th harmonic

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

OATS
Vertical
3 m
CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



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

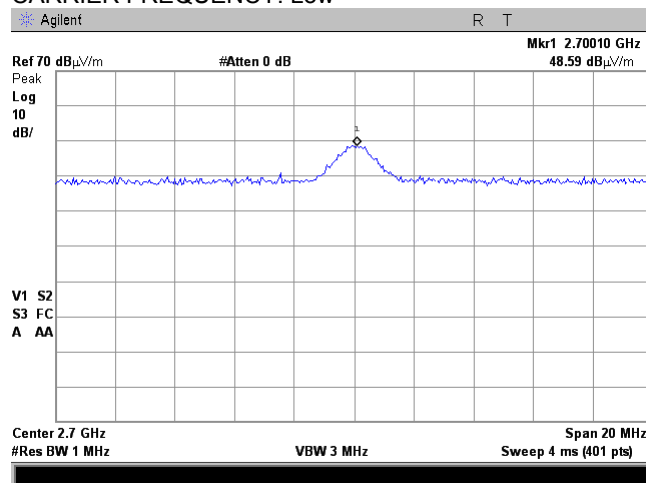
Plot 7.4.14 Radiated emission measurements at the 6th harmonic

TEST SITE:

ANTENNA POLARIZATION:

TEST DISTANCE:

CARRIER FREQUENCY: Low

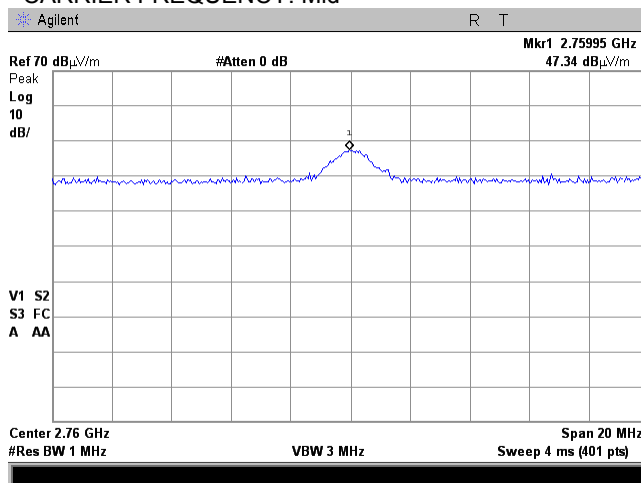


OATS

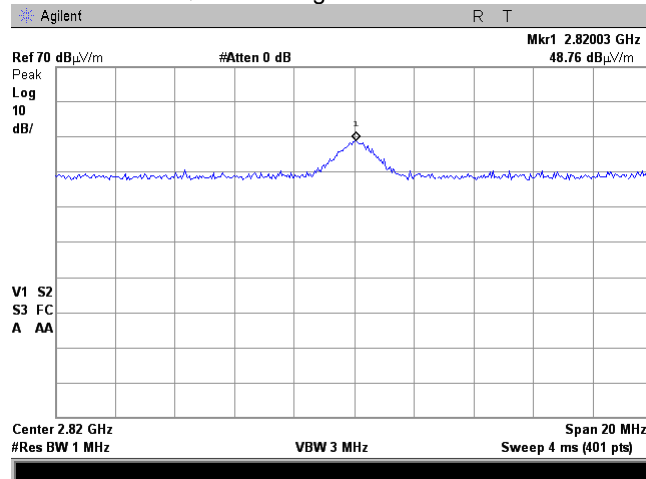
Horizontal

3 m

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High



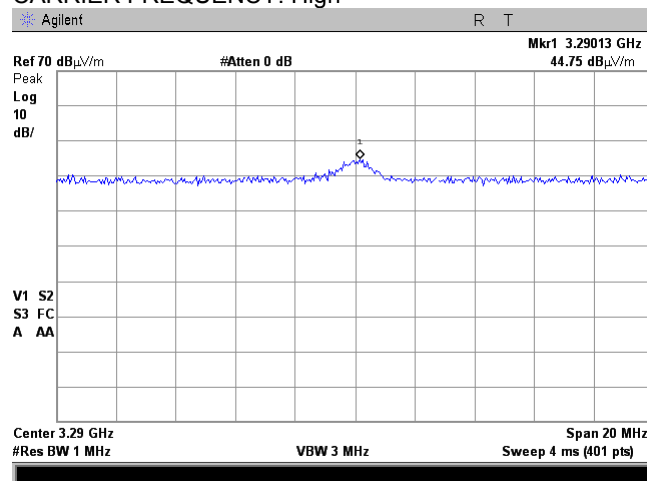
Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Jul-17 - 19-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: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

Plot 7.4.15 Radiated emission measurements at the 7th 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



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

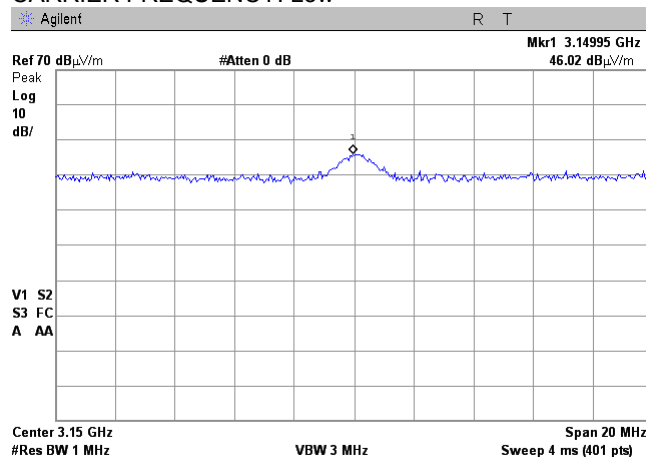
Plot 7.4.16 Radiated emission measurements at the 7th harmonic

TEST SITE:

ANTENNA POLARIZATION:

TEST DISTANCE:

CARRIER FREQUENCY: Low

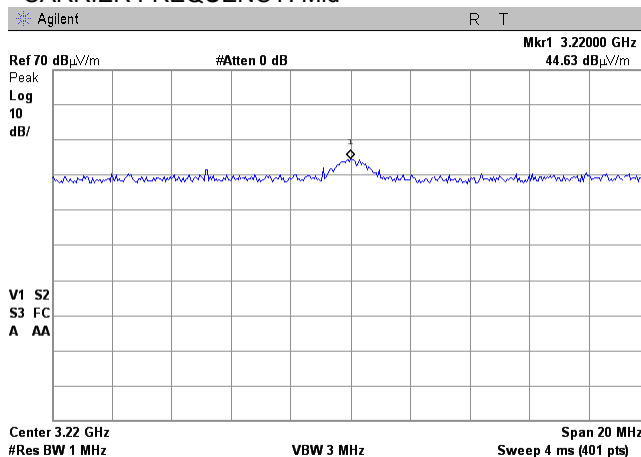


OATS

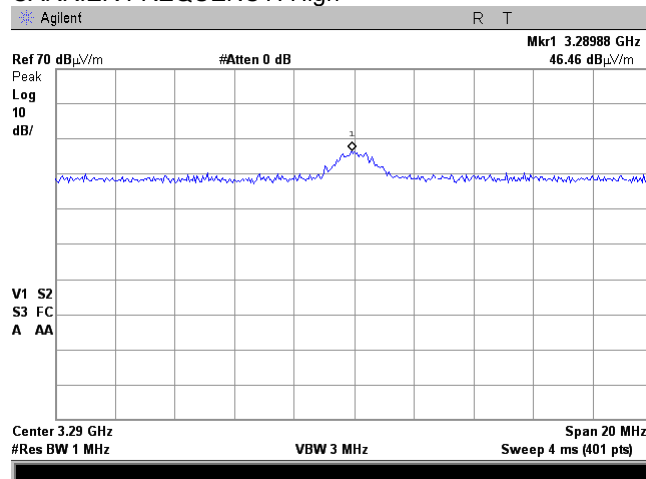
Horizontal

3 m

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





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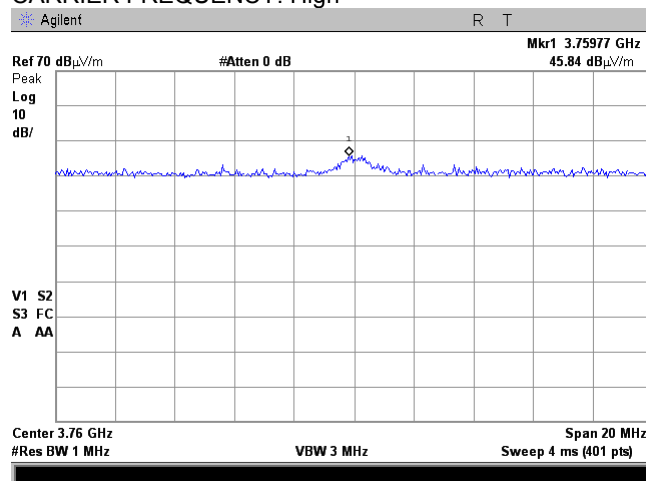
Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Jul-17 - 19-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: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

Plot 7.4.17 Radiated emission measurements at the 8th 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





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

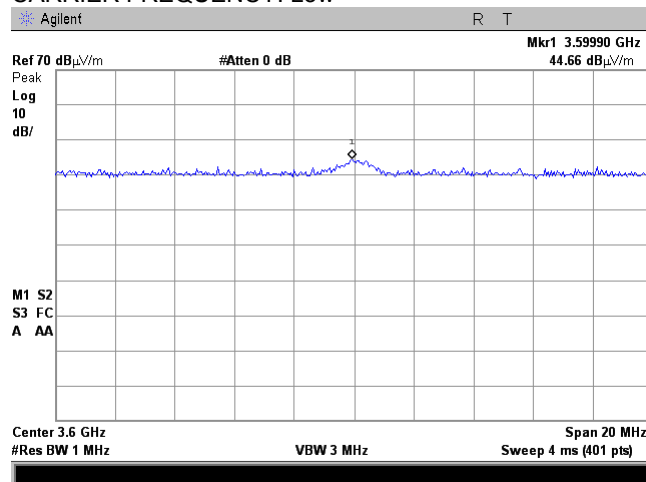
Plot 7.4.18 Radiated emission measurements at the 8th harmonic

TEST SITE:

ANTENNA POLARIZATION:

TEST DISTANCE:

CARRIER FREQUENCY: Low

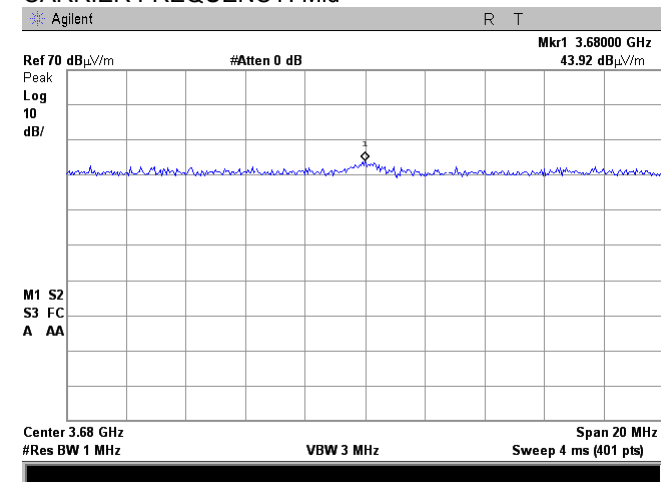


OATS

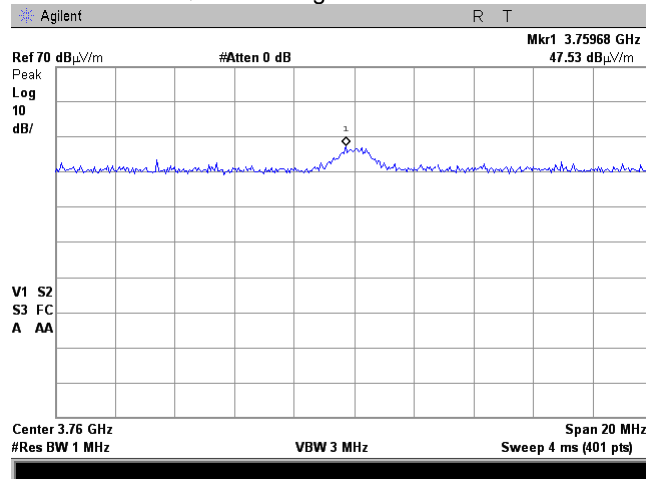
Horizontal

3 m

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





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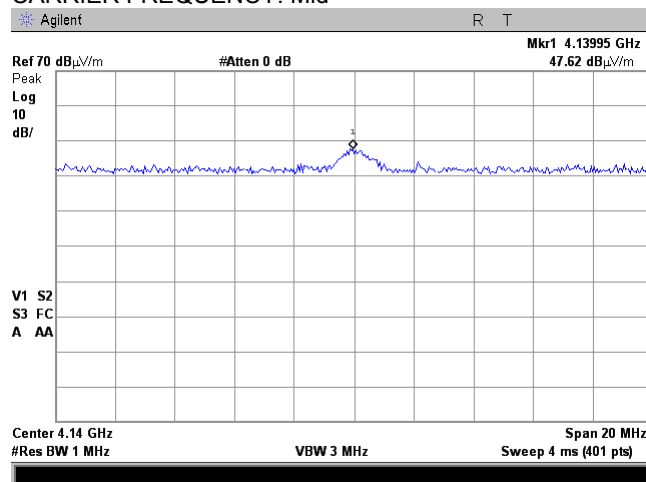
Test specification:		Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-D, Section 2.2.12	
Test mode:		Verdict: PASS	
Date(s):			
06-Jul-17 - 19-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: 1008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

Plot 7.4.19 Radiated emission measurements at the 9th harmonic

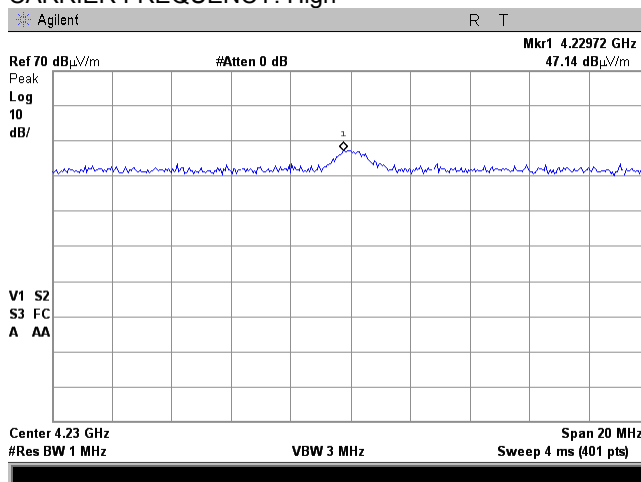
TEST SITE:
ANTENNA POLARIZATION:
TEST DISTANCE:
CARRIER FREQUENCY: Low
More than 20 dB below the limit

OATS
Vertical
3 m

CARRIER FREQUENCY: Mid



CARRIER FREQUENCY: High





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Report ID: TELRAD_FCC.29794.docx

Date of Issue: 6-Nov-17

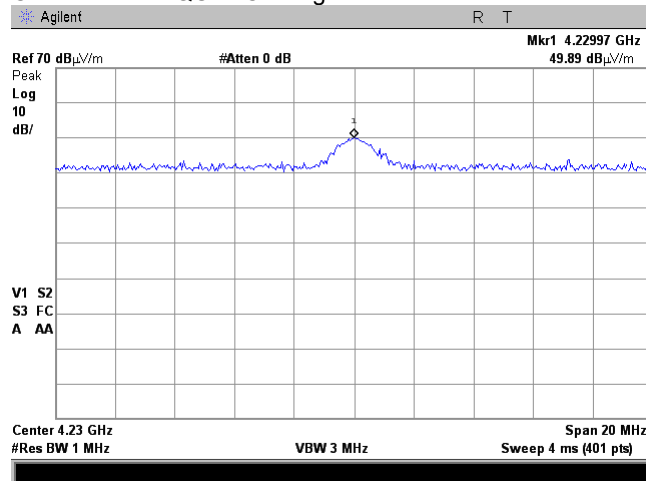
Test specification:		Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-D, Section 2.2.12	
Test mode:	Compliance	Verdict: PASS	
Date(s):	06-Jul-17 - 19-Jul-17		
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: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

Plot 7.4.20 Radiated emission measurements at the 9th 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



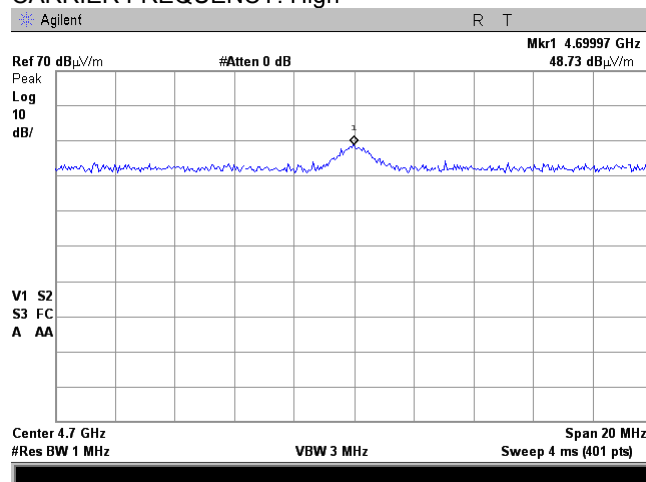
Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Jul-17 - 19-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: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

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



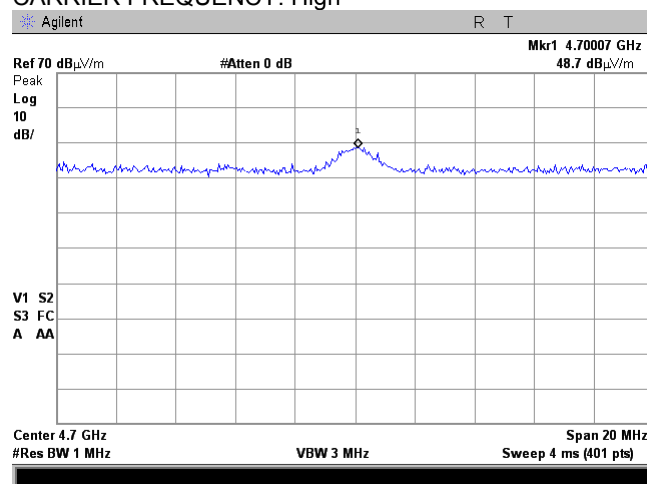
Test specification: Section 90.210 / RSS-119 Section 5.8.4, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053 and 90.210(e); TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 06-Jul-17 - 19-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: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

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



Test specification: Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-D, 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:			

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





Test specification: Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-D, 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:			

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
Low carrier frequency 450.003125 MHz					
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	-13.12	Pass
Mid carrier frequency 460.0 MHz					
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
High carrier frequency 469.996875 MHz					
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.



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Test specification: Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-D, 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:			

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

55.25 dBm at high frequency							
Frequency, MHz	Spurious emission, dBm	RBW, kHz	Fundamental emission, dBm	Attenuation below carrier, dBc	Limit, dBc	Margin, dB*	Verdict
Low carrier frequency 450.003125 MHz							
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	-39.55	100		73.71	57.0	16.71	Pass
Mid carrier frequency 460.0 MHz							
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	-28.28	100		63.11	57.0	6.11	Pass
High carrier frequency 469.996875 MHz							
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	-33.76	100		68.99	57.0	11.99	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

Test specification:		Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-D, 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:			

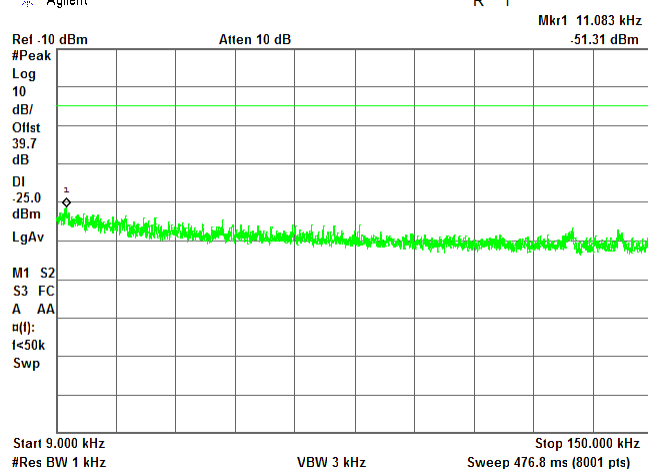
Plot 7.5.1 Spurious emission measurements in 9 - 150 kHz range

DETECTOR USED:

OPERATING FREQUENCY: Low

✱ Agilent

R T

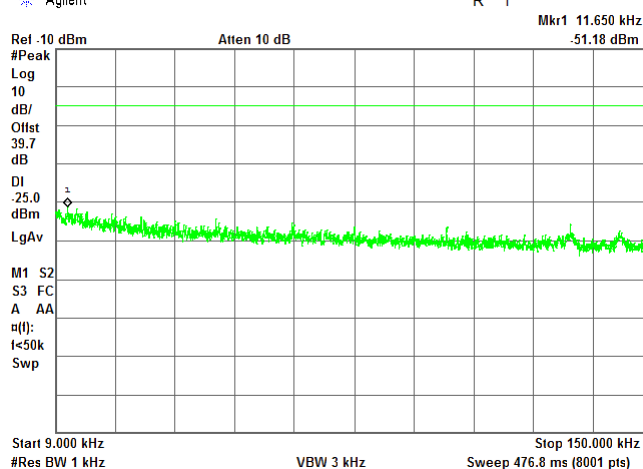


Peak

OPERATING FREQUENCY: Mid

✱ Agilent

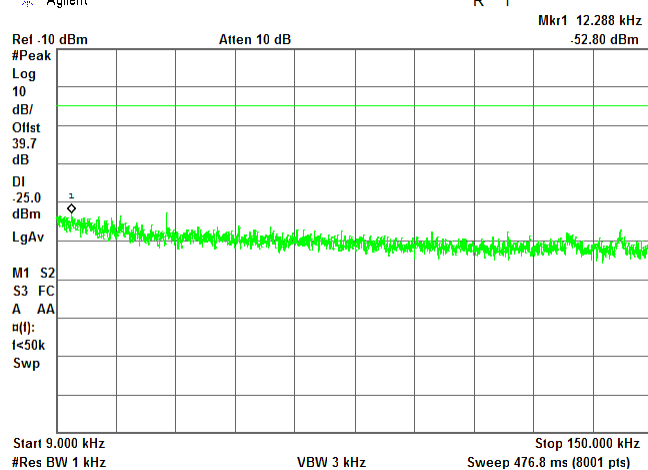
R T



OPERATING FREQUENCY: High

✱ Agilent

R T





HERMON LABORATORIES

Test specification:		Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-D, 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:			

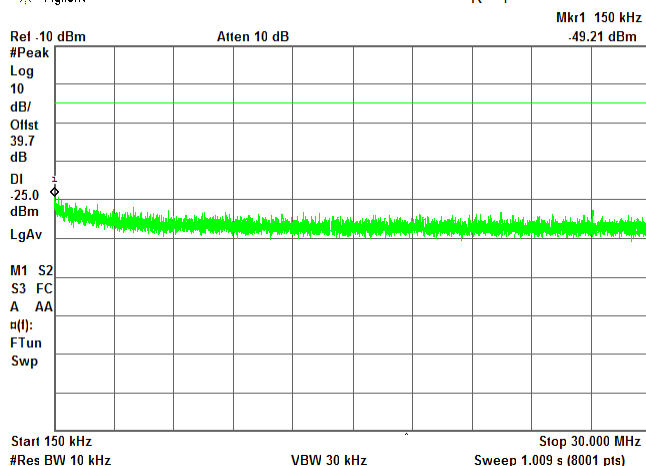
Plot 7.5.2 Spurious emission measurements in 0.150 - 30.0 MHz range

DETECTOR USED:

OPERATING FREQUENCY: Low

Agilent

R T

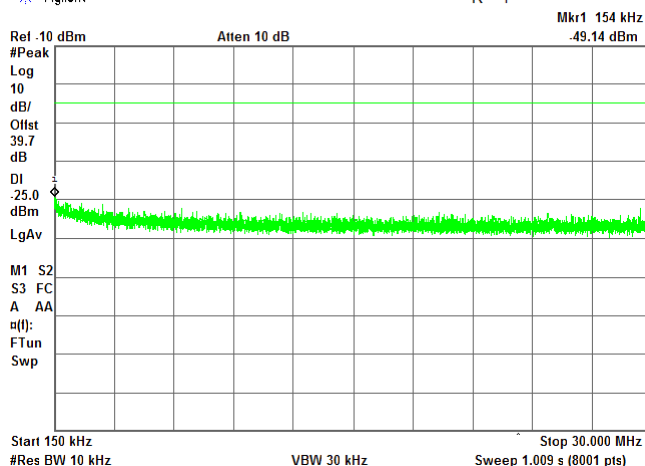


Peak

OPERATING FREQUENCY: Mid

Agilent

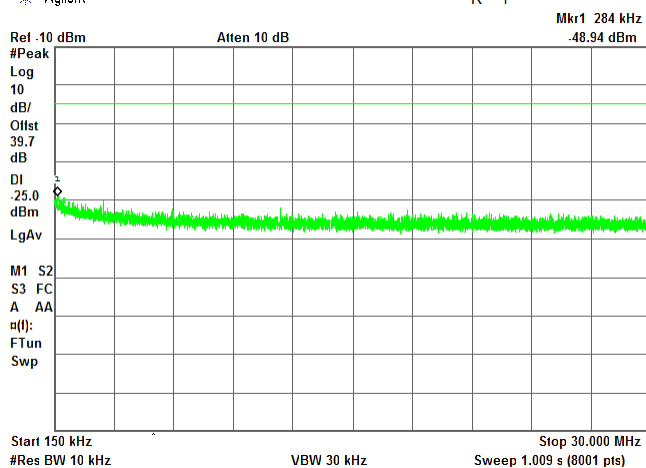
R T



OPERATING FREQUENCY: High

Agilent

R T



Test specification:		Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-D, 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:			

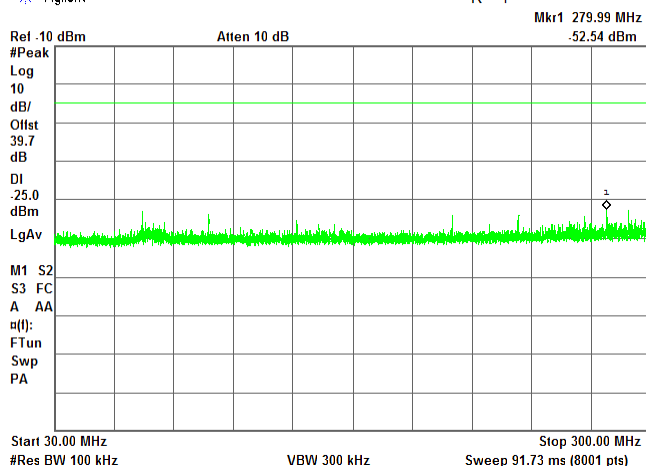
Plot 7.5.3 Spurious emission measurements in 30.0 - 300 MHz range

DETECTOR USED:

OPERATING FREQUENCY: Low

Agilent

R T

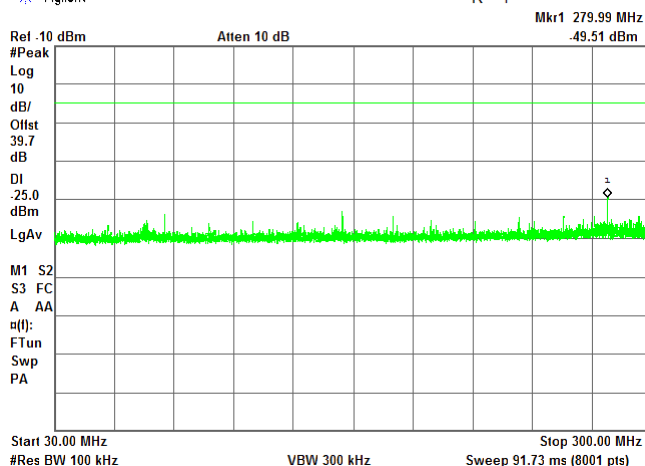


Peak

OPERATING FREQUENCY: Mid

Agilent

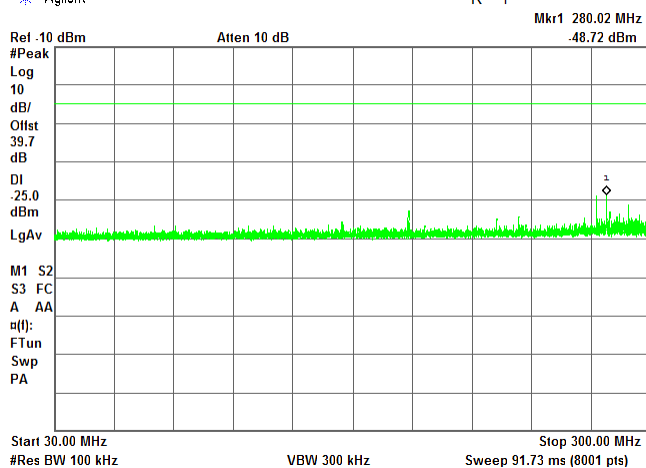
R T



OPERATING FREQUENCY: High

Agilent

R T



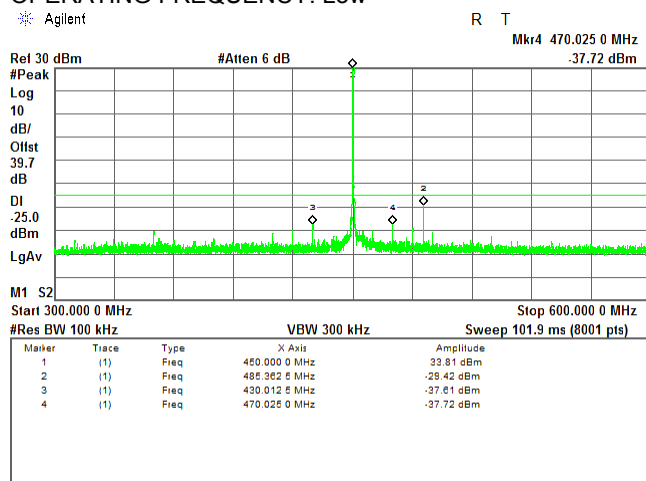
Test specification:		Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		11-Jul-17	
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: 1008 hPa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

Plot 7.5.4 Spurious emission measurements in 300.0 – 600.0 MHz range

DETECTOR USED:

OPERATING FREQUENCY: Low

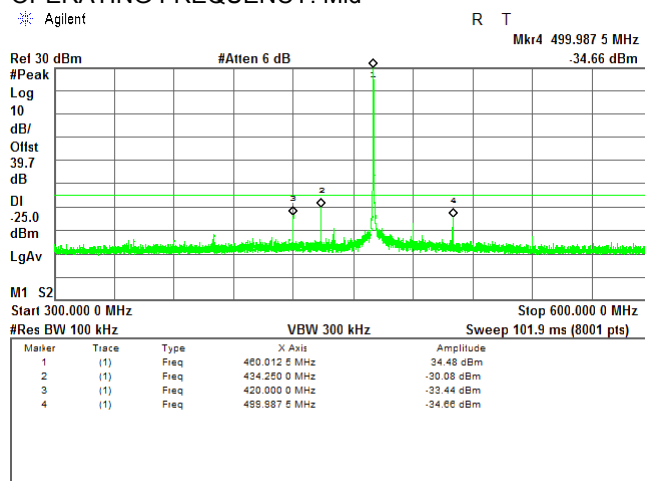
Agilent



Peak

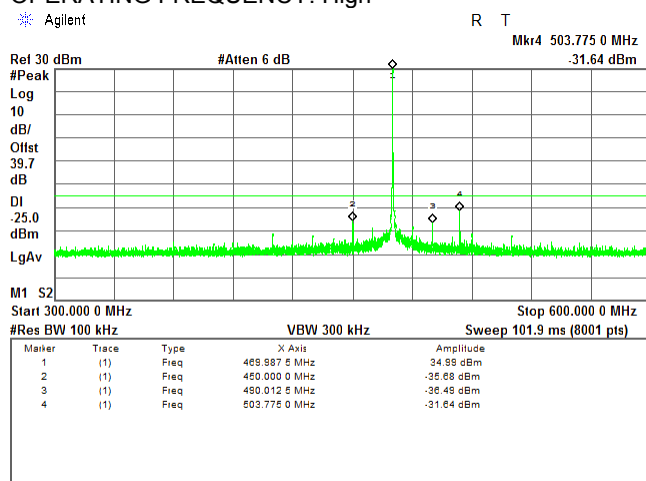
OPERATING FREQUENCY: Mid

Agilent



OPERATING FREQUENCY: High

Agilent



Test specification: Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-D, 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:			

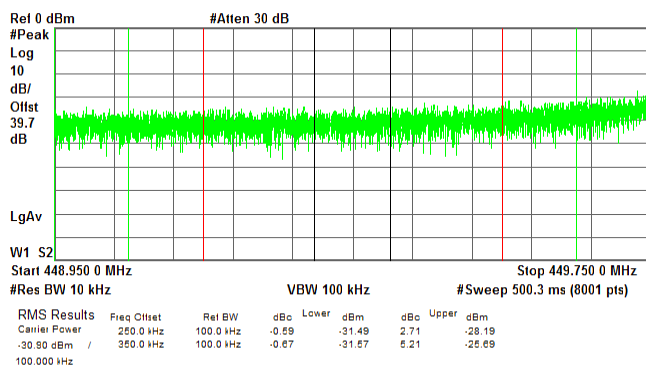
Plot 7.5.5 Spurious emission measurements in 300.0 – 600.0 MHz range

DETECTOR USED:

OPERATING FREQUENCY: Low

Agilent

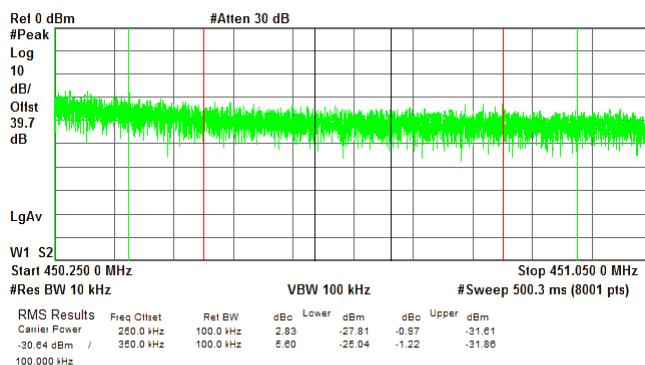
R T



Peak

Agilent

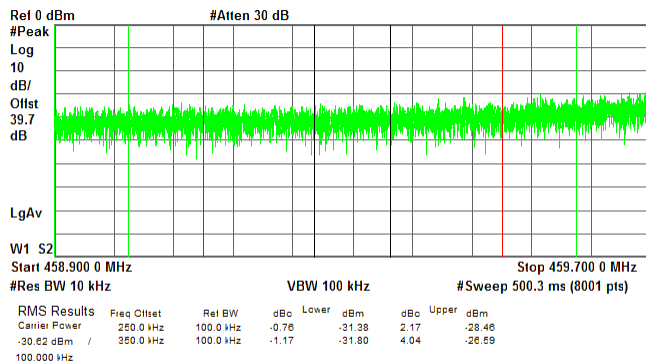
R T



OPERATING FREQUENCY: Mid

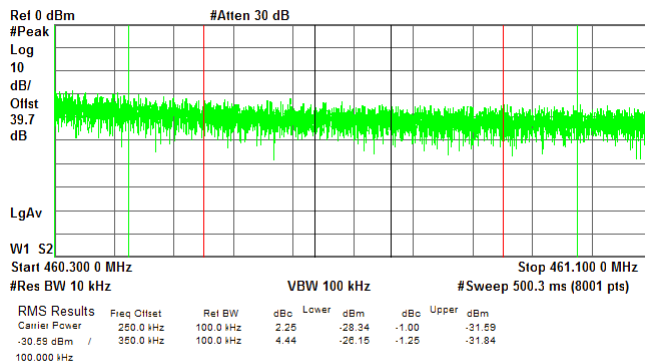
Agilent

R T



Agilent

R T



Test specification: Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions			
Test procedure: 47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-D, 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:			

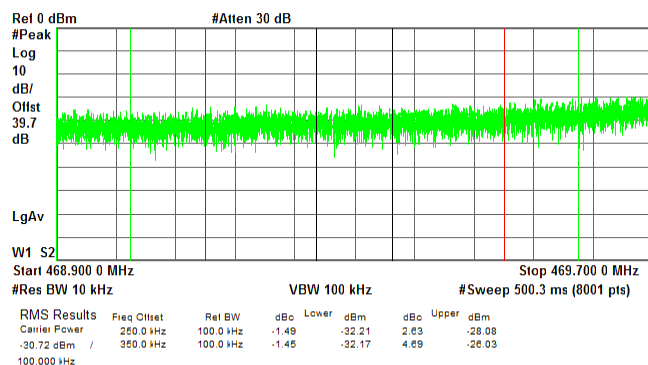
Plot 7.5.6 Spurious emission measurements in 300.0 – 600.0 MHz range

DETECTOR USED:

OPERATING FREQUENCY: High

Agilent

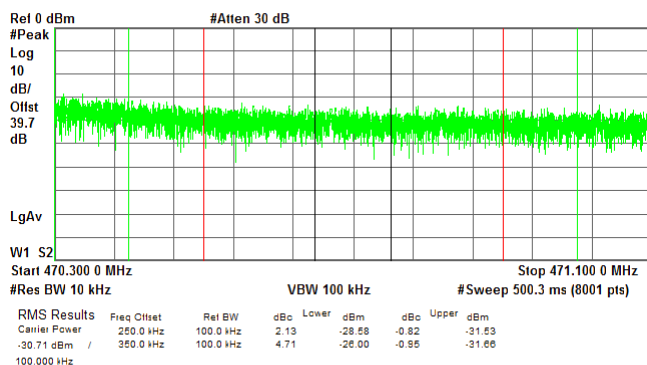
R T



Peak

Agilent

R T



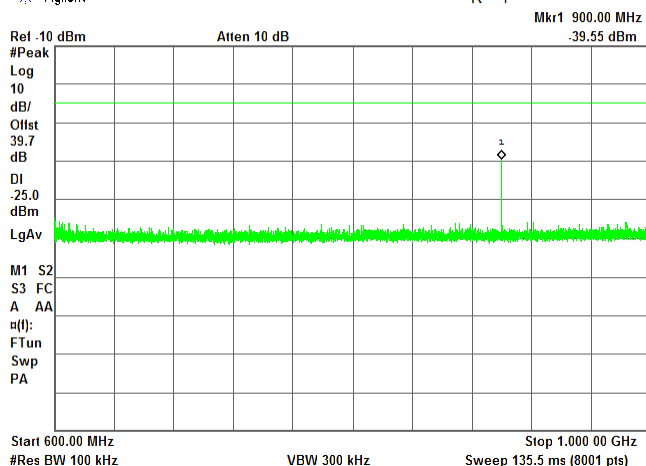
Test specification:		Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		11-Jul-17	
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: 1008 hPa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

Plot 7.5.7 Spurious emission measurements in 600.0 - 1000 MHz range

DETECTOR USED:

OPERATING FREQUENCY: Low

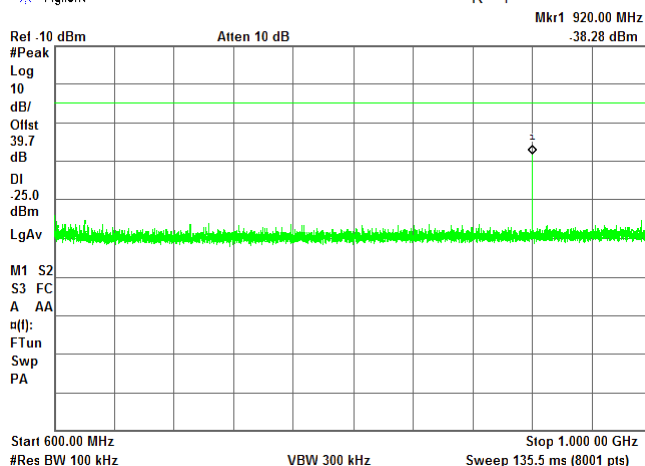
Agilent



Peak

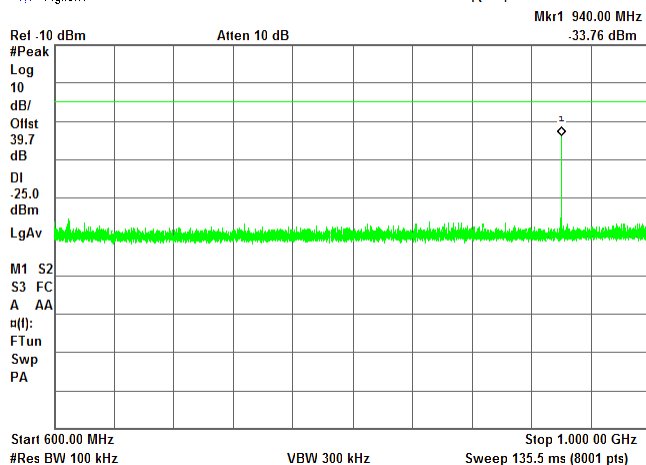
OPERATING FREQUENCY: Mid

Agilent



OPERATING FREQUENCY: High

Agilent



Test specification:		Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-D, 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:			

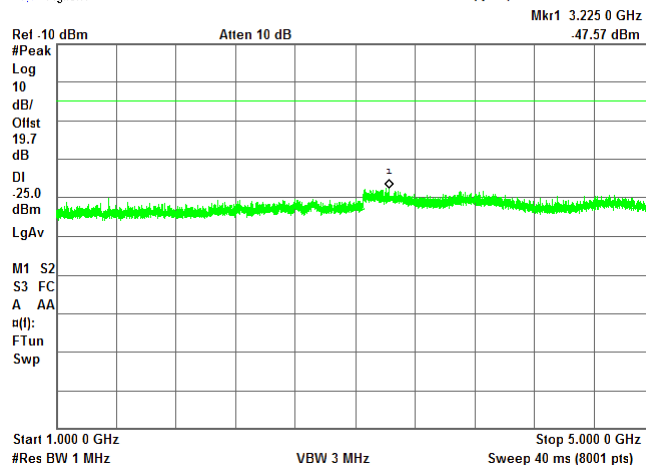
Plot 7.5.8 Spurious emission measurements in 1000 - 5000 MHz range

DETECTOR USED:

OPERATING FREQUENCY: Low

Agilent

R T

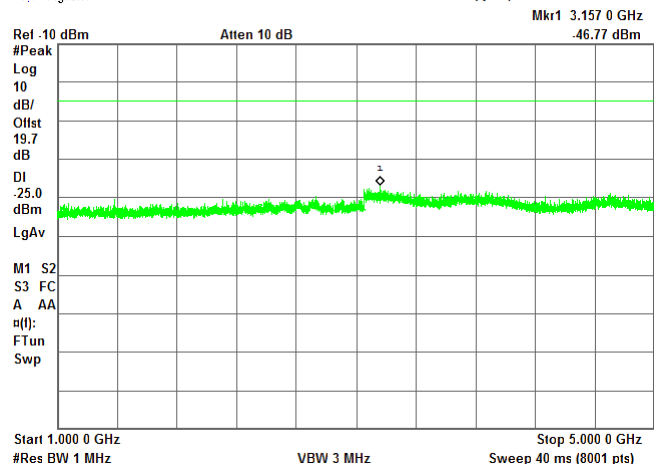


Peak

OPERATING FREQUENCY: Mid

Agilent

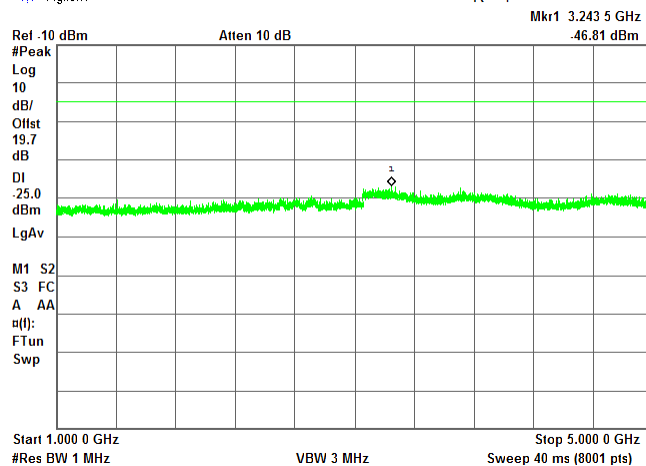
R T



OPERATING FREQUENCY: High

Agilent

R T



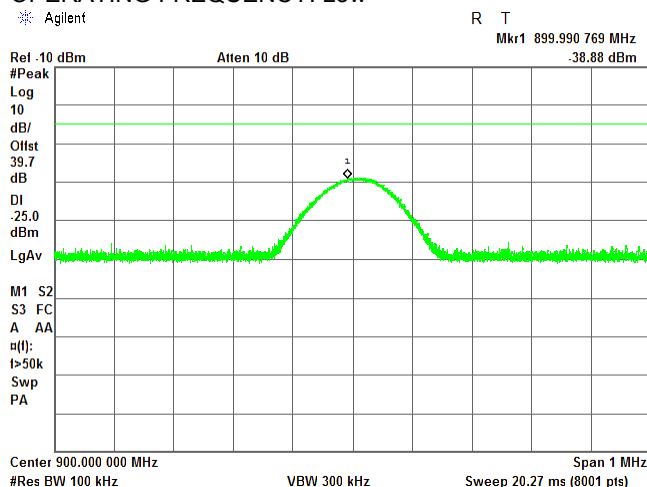
Test specification:		Section 90.210 / RSS-119 Section 5.8.4, Conducted spurious emissions	
Test procedure:		47 CFR, Sections 2.1051 and 90.210(e); TIA/EIA-603-D, Section 2.2.13	
Test mode:		Verdict: PASS	
Date(s):			
11-Jul-17			
Temperature: 25.2 °C	Relative Humidity: 43 %	Air Pressure: 1008 hPa	Power: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

Plot 7.5.9 Conducted spurious emission measurements at the 2nd harmonic

DETECTOR USED:

OPERATING FREQUENCY: Low

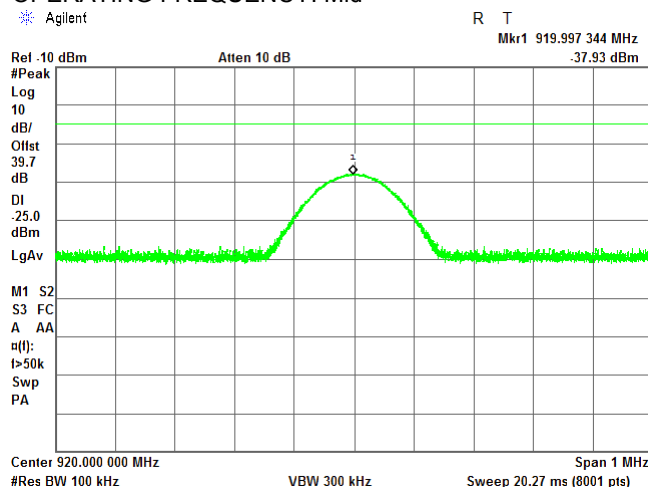
Agilent



Peak

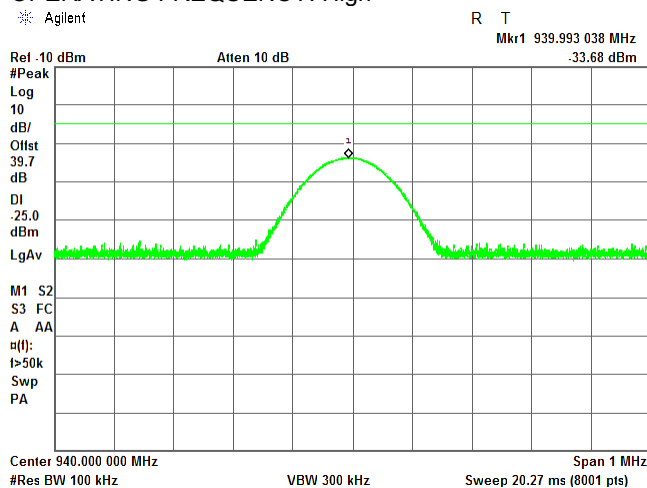
OPERATING FREQUENCY: Mid

Agilent



OPERATING FREQUENCY: High

Agilent





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

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

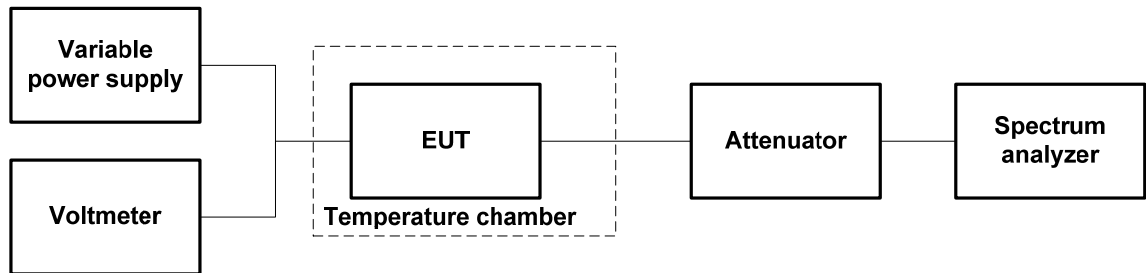
Assigned frequency, MHz	Maximum allowed frequency displacement	
	ppm	Hz
450.003125	1	450
460.000000		460
469.996875		470

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.

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

Figure 7.6.1 Frequency stability test setup



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

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 st min	2 nd min	3 rd min	4 th min	5 th min	10 th min	Positive	Negative			
Low frequency													
-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
Mid frequency													
-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
High frequency													
-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.



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

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*
421.0 – 512.0 MHz band			
6.25	± 6.25	10.0	t ₁
	± 3.125	25.0	t ₂
	± 6.25	10.0	t ₃

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

t₁ is the time period immediately following t_{on};

t₂ is the time period immediately following t₁;

t₃ 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.

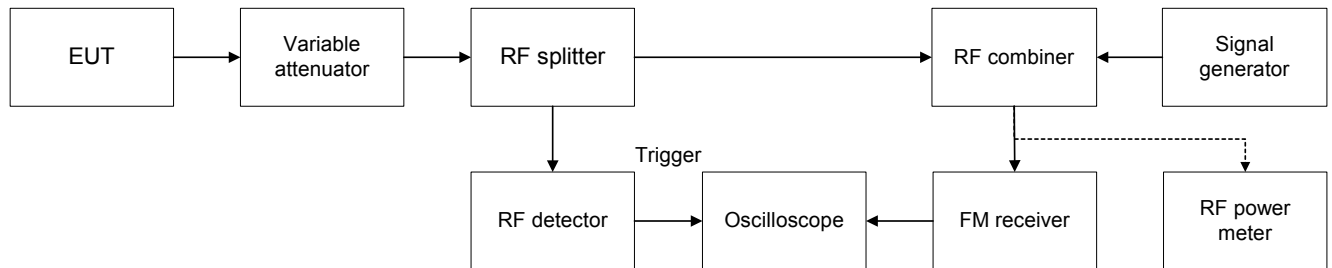
7.7.2.3 The storage oscilloscope was set to provide horizontal sweep rate 10 milliseconds per division. Amplitude control of the storage oscilloscope was adjusted to obtain 1 kHz sinusoidal signal vertically centered with ± 4 divisions amplitude.

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.

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

Figure 7.7.1 Transient frequency test setup





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

Table 7.7.2 Transient frequency behaviour test results

Carrier frequency, MHz	Time interval	Duration, ms	Frequency tolerance, kHz	Limit, kHz	Margin, kHz	Verdict
Channel bandwidth 6.25 kHz						
450.003125	t ₁	10.0	2.875	± 6.25	-3.375	Pass
	t ₂	25.0	1.312	± 3.125	-1.813	
	t ₃	10.0	3.687	± 6.25	-2.563	
460.000000	t ₁	10.0	3.250	± 6.25	-3.000	Pass
	t ₂	25.0	1.562	± 3.125	-1.563	
	t ₃	10.0	0.875	± 6.25	-5.375	
469.996875	t ₁	10.0	2.687	± 6.25	-3.563	Pass
	t ₂	25.0	1.437	± 3.125	-1.688	
	t ₃	10.0	3.875	± 6.25	-2.375	

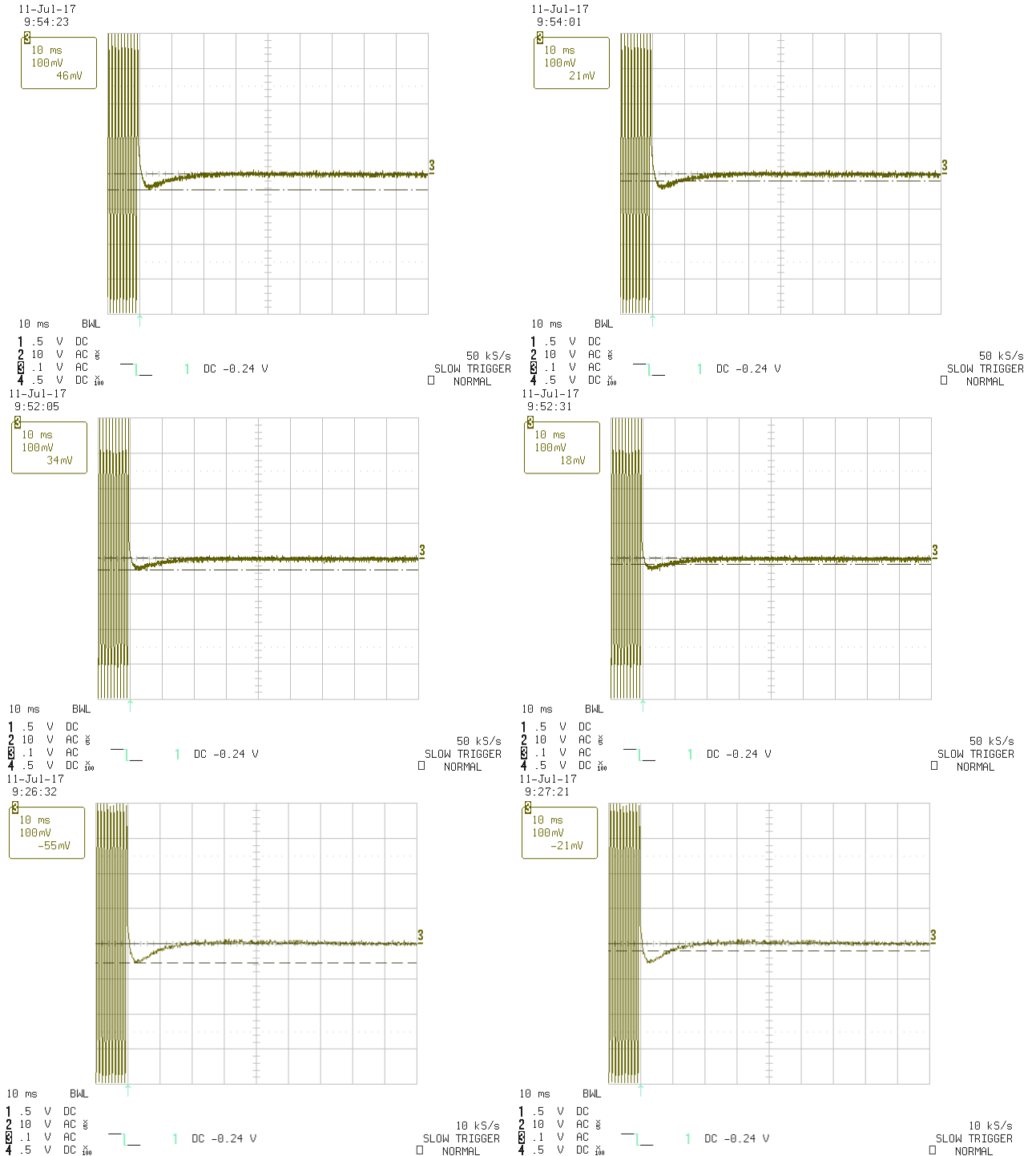
Reference numbers of test equipment used

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.

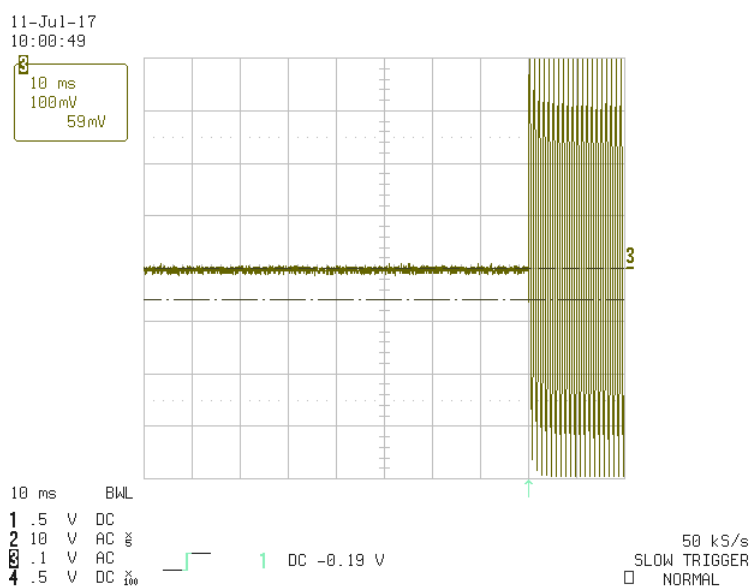
Test specification:		Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Verdict: PASS	
Date(s):			
10-Jul-17 - 11-Jul-17			
Temperature: 24.3 °C	Relative Humidity: 47 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

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



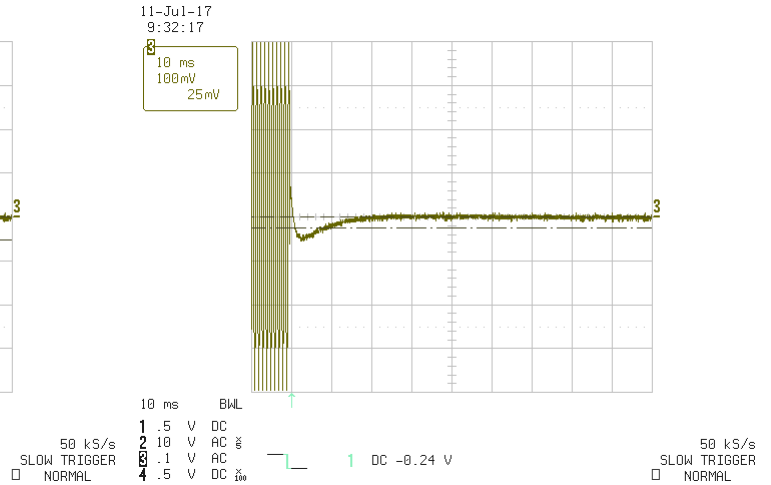
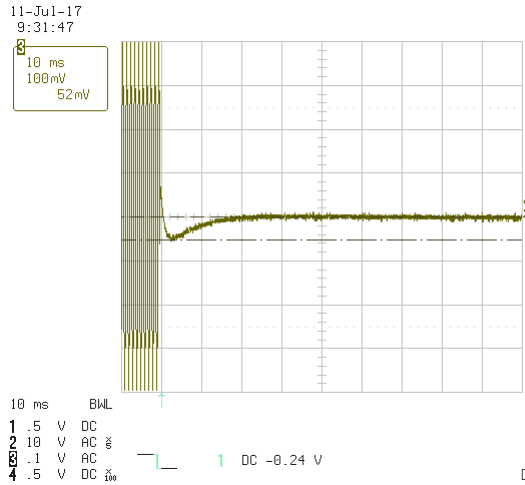
Test specification: Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour			
Test procedure: TIA/EIA-603-D, Section 2.2.19			
Test mode: Compliance		Verdict: PASS	
Date(s): 10-Jul-17 - 11-Jul-17			
Temperature: 24.3 °C	Relative Humidity: 47 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz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

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

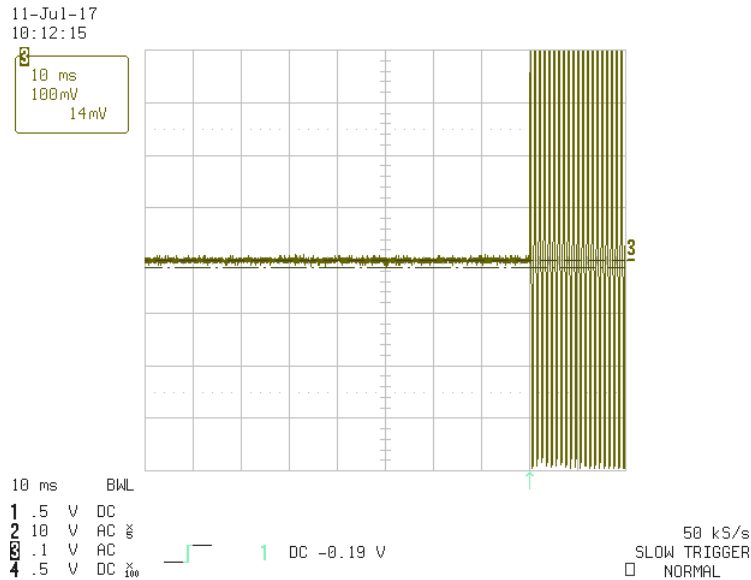


Test specification:		Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Verdict: PASS	
Date(s):			
10-Jul-17 - 11-Jul-17			
Temperature: 24.3 °C	Relative Humidity: 47 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

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





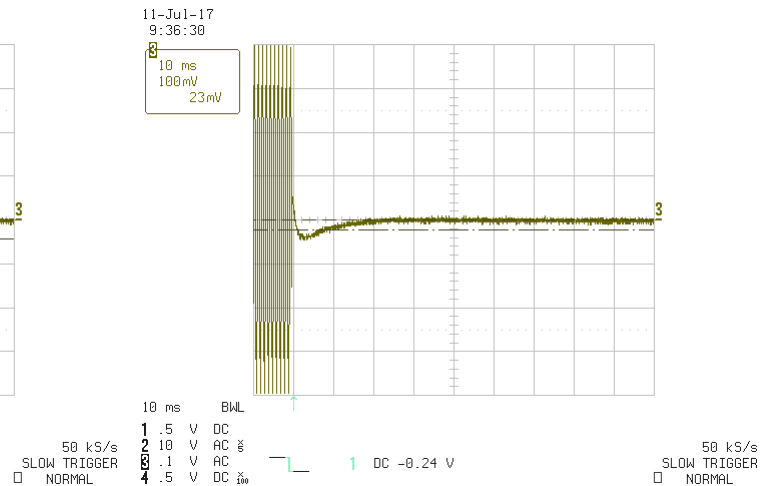
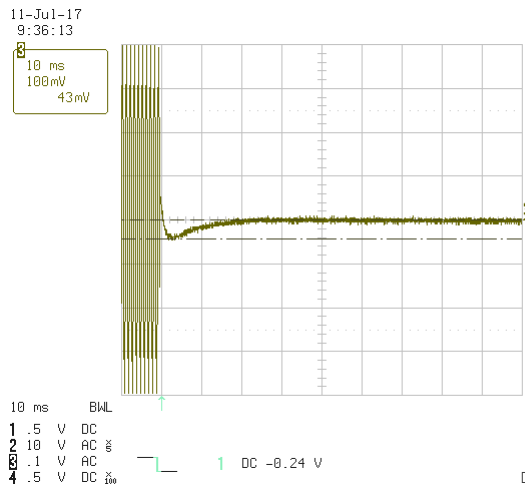
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Report ID: TELRAD_FCC.29794.docx

Date of Issue: 6-Nov-17

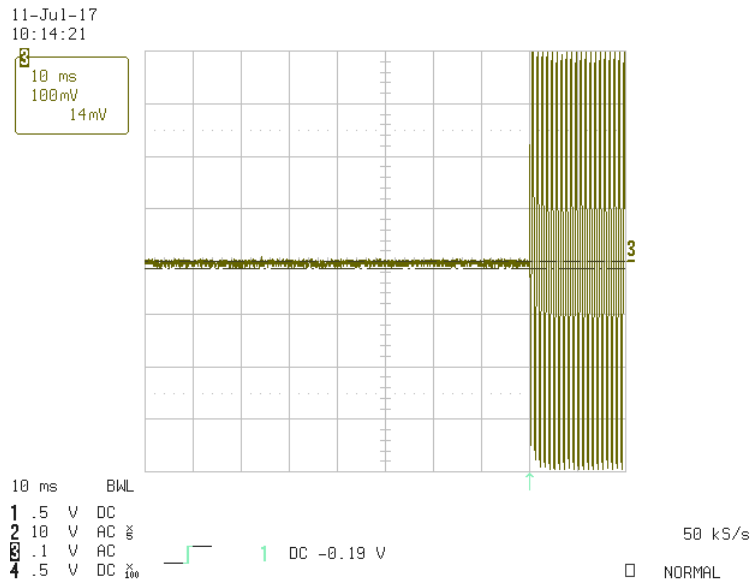
Test specification:		Section 90.214 / RSS-119 Section 5.9, Transient frequency behaviour	
Test procedure:		TIA/EIA-603-D, Section 2.2.19	
Test mode:		Compliance	Verdict: PASS
Date(s):		10-Jul-17 - 11-Jul-17	
Temperature: 24.3 °C	Relative Humidity: 47 %	Air Pressure: 1009 hPa	Power: 120 VAC, 60 Hz
Remarks:			

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



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

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
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



HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
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
Transmitter tests	
Carrier power conducted at antenna connector	± 1.7 dB
Carrier power radiated (substitution method)	± 4.5 dB
Occupied bandwidth	$\pm 8\%$
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 $\pm 13.9\%$
Duty cycle, timing (Tx ON / OFF) and average factor measurements	$\pm 1.0\%$
Unintentional radiator tests	
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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11 APPENDIX D Specification references

FCC 47CFR part 90: 2016	Private land mobile radio services
FCC 47CFR part 2: 2016	Frequency allocations and radio treaty matters; general rules and regulations
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI/TIA/EIA-603-D:2010	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
RSS-119 Issue 12: 2015	Land Mobile and Fixed Equipment Equipment Operating in the Frequency Range 27.41-960 MHz

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(μ V) to convert it into field strength in dB(μ 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(μ V) to convert it into field strength in dB(μ 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(μ V) to convert it into field strength in dB(μ 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(μ V) to convert it into field strength in dB(μ 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(μ V)	decibel referred to one microvolt
dB(μ V/m)	decibel referred to one microvolt per meter
dB(μ 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
μ s	microsecond
NA	not applicable
NB	narrow band
OATS	open area test site
Ω	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