

TEST REPORT

ACCORDING TO: FCC 47CFR part 27

FOR:

Airspan Networks Inc.

LTE Mobile Digital Station

Model: AirUnity 545 eNB 2.5GHz (B41)

FCC ID:PIDAU545ENB25

This report is in conformity with ISO/ IEC 17025. The "A2LA Accredited" symbol endorsement applies only to the tests and calibrations that are listed in the scope of Hermon Laboratories accreditation. The test results relate only to the items tested.
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1 Applicant information

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E-mail: zlevi@airspan.com
Contact name: Mr. Zion Levi

2 Equipment under test attributes

Product name: LTE Mobile Digital Station
Product type: Transceiver
Model(s): AirUnity 545 eNB 2.5 GHz (B41)
Serial number: B9E90C22F836A
Hardware version: B
Software release: 6.4.1.42
Receipt date: 19-Jan-17

3 Manufacturer information

Manufacturer name: Airspan Networks Inc.
Address: 777 Yamato, Road Suite 310 Boca Raton, FL 33431, USA
Telephone: +1 561 893 8670
Fax: +1 561 893 8671
E-Mail: zlevi@airspan.com
Contact name: Mr. Zion Levi

4 Test details




Project ID: 29170
Location: Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started: 19-Jan-17
Test completed: 29-Jan-17
Test specification(s): FCC 47CFR part 27

5 Tests summary

Test	Status
Transmitter characteristics	
Section 27.50(h)(2), Peak output power at RF antenna connector	Pass
Section 27.52, RF safety	Pass, exhibit provided in Application for certification
Section 27.53(m)(2), Spurious emissions at RF antenna connector	Pass
Section 27.53(m)(4), Band edge emissions at RF antenna connector	Pass
Section 27.53(m)(2), Radiated spurious emissions	Pass
Section 27.54, Frequency stability	Pass
Section 2.1049, Occupied bandwidth	Pass

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

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

	Name and Title	Date	Signature
Tested by:	Mr. K. Zushchuk, test engineer	January 29, 2017	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	January 30, 2017	
Approved by:	Mr. M. Nikishin, EMC and radio group leader	February 6, 2017	

6 EUT description

6.1 General information

The EUT, Mobile Digital station "AirUnity 545 eNB 2.5GHz (B41)", is part of a LTE broadband fixed cellular wireless access system. The system provides a radio link between an end-user (a subscriber) and a network to give high-speed data access. The AirUnity's transceiver/receiver (Up to 64 QAM modulation, data rate up to 95) equipped with

a 9 dBi external antenna. The maximum total RF output power (not including antenna gain) is 27.8 dBm for 9 dBi and it can be reduced by software.

The AirUnity is installed indoors. The Subscriber transmits and receives traffic to and from the base station respectively. The transceiver provides subscribers with "always-on" Internet, high speed data only, or data and voice (VoIP) services and is configured with a unique base station reference number, preventing the LTE UE from relocating to another subscriber premises without authorization.

6.2 Ports and lines

Port type	Port description	Connected from	Connected to	Qty.	Cable type	Cable length, m
Power	AC power	EUT	AC mains	1	Unshielded	3
Signal*	Serial*	Not connected	Not connected	1	NA	NA

*for maintenance only

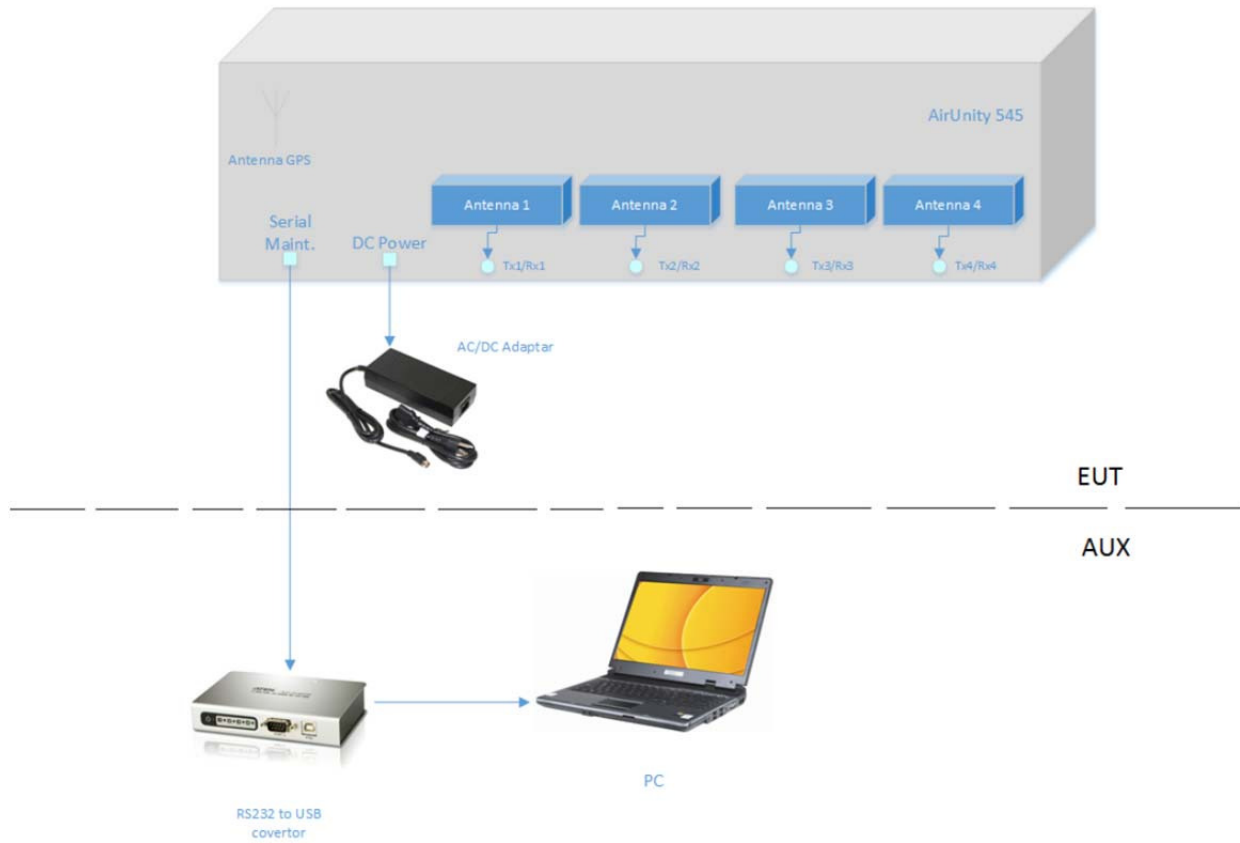
6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
Laptop	Dell	E7450	8TYRP32
USB to RS-232 Adapter	ATEN	UC2324	NA

6.4 Changes made in the EUT

No changes were implemented in the EUT during testing.

6.5 Test configuration



6.6 Transmitter characteristics

Type of equipment				
<input checked="" type="checkbox"/>	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		
<input checked="" type="checkbox"/>	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 range		2496.0 – 2690.0 MHz		
Operating frequency (full bands)		2506.0 – 2680.0 MHz for 20 MHz OBW		
RF channel spacing		20 MHz		
Maximum rated output power		At transmitter 50 Ω RF output connector (aggregate power of both RF chains) 27.75 dBm		
Is transmitter output power variable?		No		
		<input checked="" type="checkbox"/>	Yes	continuous variable
				<input checked="" type="checkbox"/> stepped variable with step size 0.25 dB
				minimum RF power -30 dBm
		maximum RF power at antenna connector 27.75 dBm		
Antenna connection				
unique coupling	<input checked="" type="checkbox"/> standard connector	Integral	<input checked="" type="checkbox"/> with temporary RF connector without temporary RF connector	
Antenna/s technical characteristics				
Type	Manufacturer	Model number	Gain	
Integral	Alpha Wireless	AW3509-1	9 dBi	
Integral	Alpha Wireless	AW3509-2	9 dBi	
Transmitter aggregate data rate/s, MBps				
Transmitter 26dBc power bandwidth 20 MHz		Type of modulation		
		QPSK 23.4	16QAM 45.4	64QAM 95.0
Type of multiplexing		TDD		
Modulating test signal (baseband)		PRBS		
Maximum transmitter duty cycle in normal use		75%		
Transmitter power source				
	Nominal rated voltage	Battery type		
	DC	Nominal rated voltage		
<input checked="" type="checkbox"/>	AC mains	Nominal rated voltage 120 VAC	Frequency	
Common power source for transmitter and receiver		<input checked="" type="checkbox"/> yes	no	

Test specification: Section 2.1049, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 19-Jan-17			
Temperature: 23 °C	Relative Humidity: 42 %	Air Pressure: 1016 hPa	Power: 120 VAC
Remarks:			

7 Transmitter tests according to 47CFR part 27

7.1 Occupied bandwidth test

7.1.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.1.1.

Table 7.1.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
2496.0 – 2690.0 MHz	26	NA

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

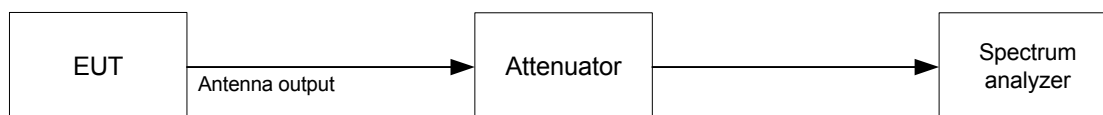
7.1.2 Test procedure

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

7.1.2.2 The EUT was set to transmit the normally modulated carrier.

7.1.2.3 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.1.2 and the associated plots.

Figure 7.1.1 Occupied bandwidth test setup





Test specification: Section 2.1049, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 19-Jan-17			
Temperature: 23 °C	Relative Humidity: 42 %	Air Pressure: 1016 hPa	Power: 120 VAC
Remarks:			

Table 7.1.2 Occupied bandwidth test results

ASSIGNED FREQUENCY RANGE: 2496.0 – 2690.0 MHz
 DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 300 kHz (0.5-2% of OBW)
 VIDEO BANDWIDTH: 3000 kHz
 MODULATION ENVELOPE REFERENCE POINTS: 26 dBc

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
MODULATION: QPSK				
2506.0	19216.0	NA	NA	Pass
2624.0	19109.0	NA	NA	Pass
2680.0	19153.0	NA	NA	Pass
MODULATION: 16QAM				
2506.0	19140.0	NA	NA	Pass
2624.0	19097.0	NA	NA	Pass
2680.0	19240.0	NA	NA	Pass
MODULATION: 64QAM				
2506.0	19192.0	NA	NA	Pass
2624.0	19125.0	NA	NA	Pass
2680.0	19084.0	NA	NA	Pass

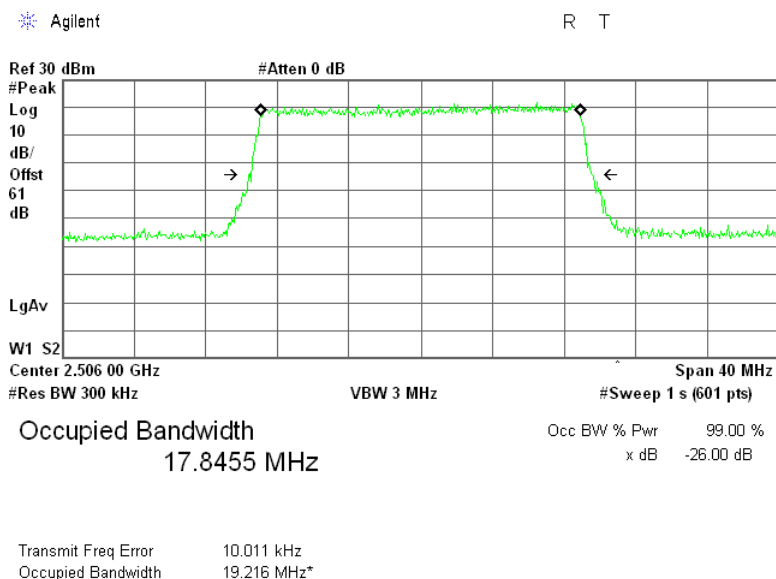
Reference numbers of test equipment used

HL 3433	HL 3434	HL 3818					
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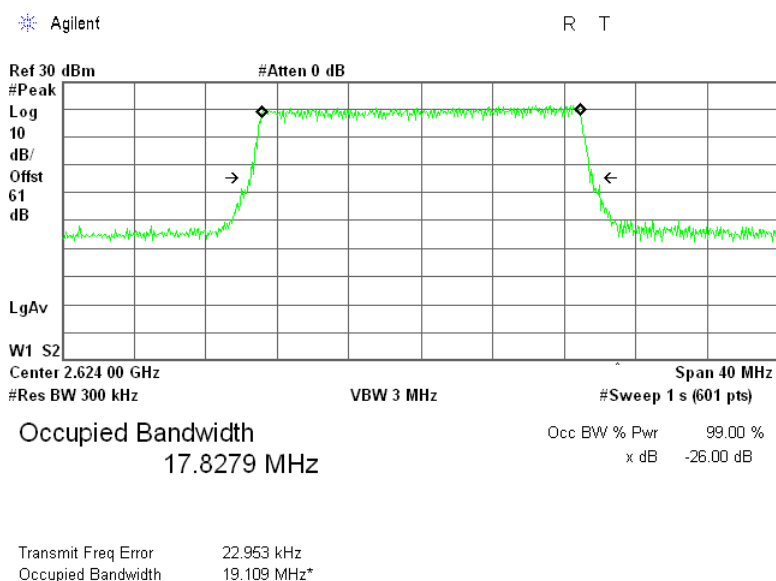
Full description is given in Appendix A.

Test specification: Section 2.1049, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 19-Jan-17			
Temperature: 23 °C	Relative Humidity: 42 %	Air Pressure: 1016 hPa	Power: 120 VAC
Remarks:			

Plot 7.1.1 Occupied bandwidth test result at low frequency, 20 MHz EBW, QPSK, RF chain #22

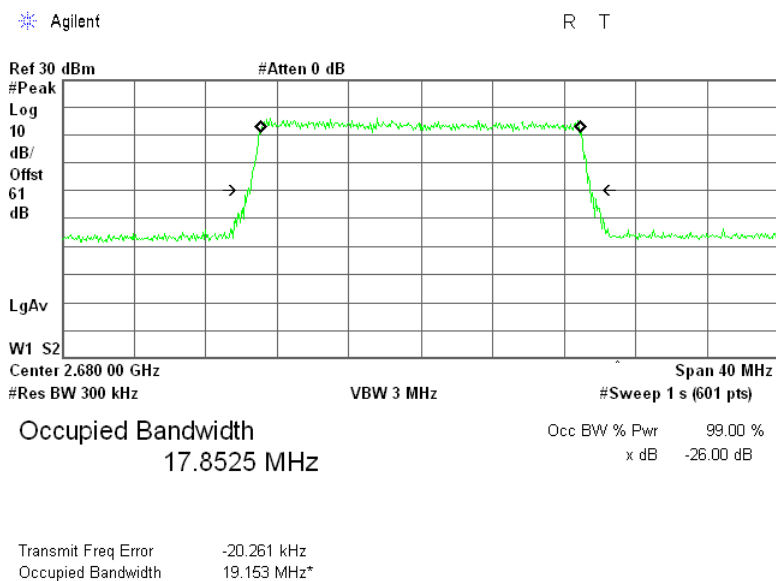


Plot 7.1.2 Occupied bandwidth test result at mid frequency, 20 MHz EBW, QPSK, RF chain #22

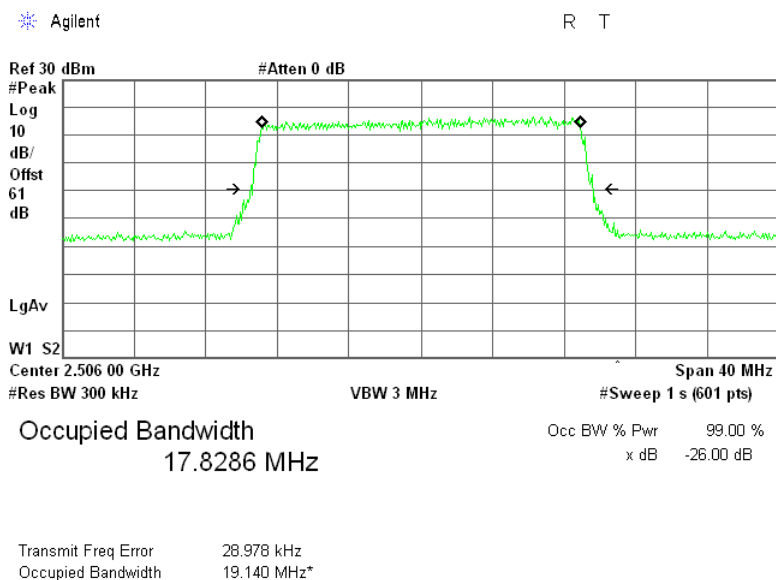


Test specification: Section 2.1049, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 19-Jan-17			
Temperature: 23 °C	Relative Humidity: 42 %	Air Pressure: 1016 hPa	Power: 120 VAC
Remarks:			

Plot 7.1.3 Occupied bandwidth test result at high frequency, 20 MHz EBW, QPSK, RF chain #22

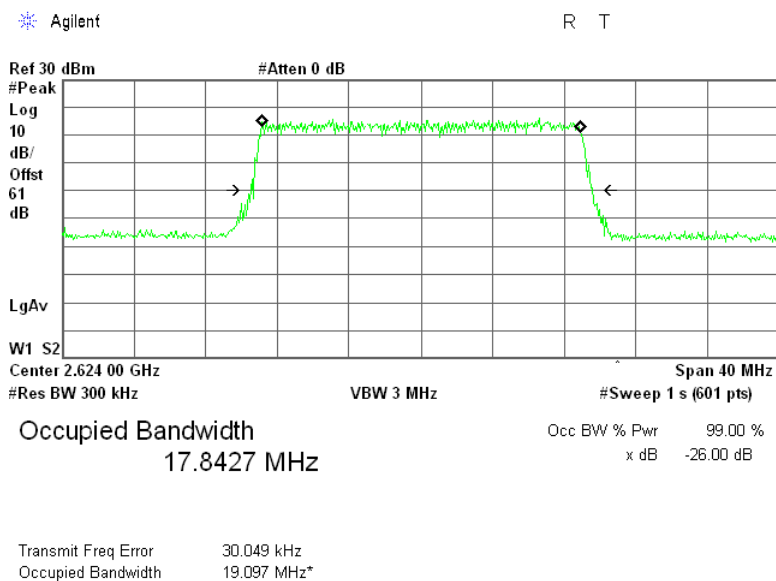


Plot 7.1.4 Occupied bandwidth test result at low frequency, 20 MHz EBW, 16QAM, RF chain #22

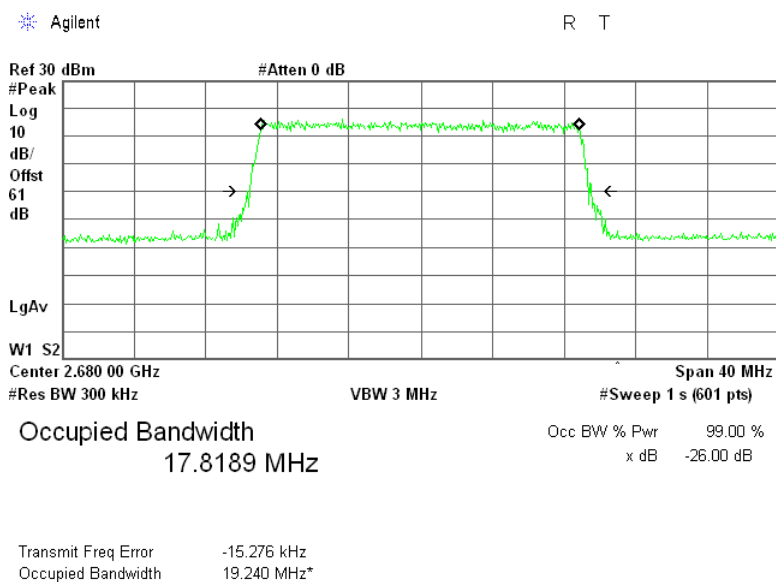


Test specification: Section 2.1049, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 19-Jan-17			
Temperature: 23 °C	Relative Humidity: 42 %	Air Pressure: 1016 hPa	Power: 120 VAC
Remarks:			

Plot 7.1.5 Occupied bandwidth test result at mid frequency, 20 MHz EBW, 16QAM, RF chain #22

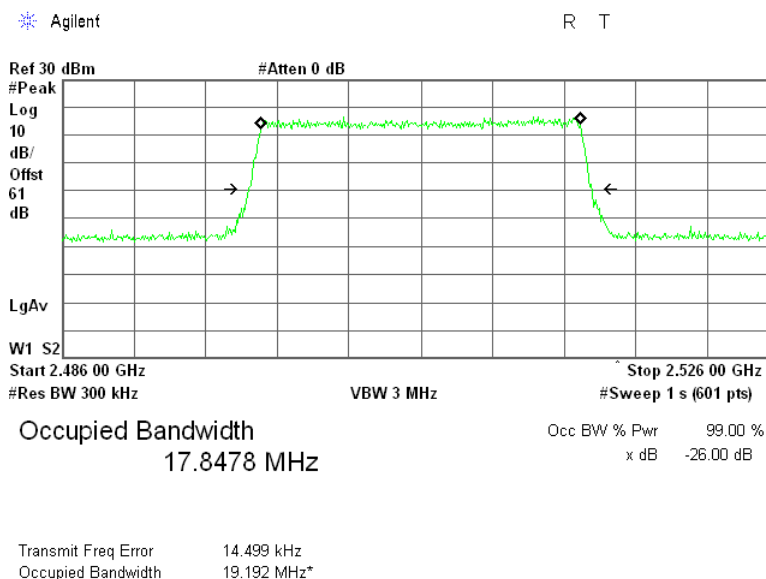


Plot 7.1.6 Occupied bandwidth test result at high frequency, 20 MHz EBW, 16QAM, RF chain #22

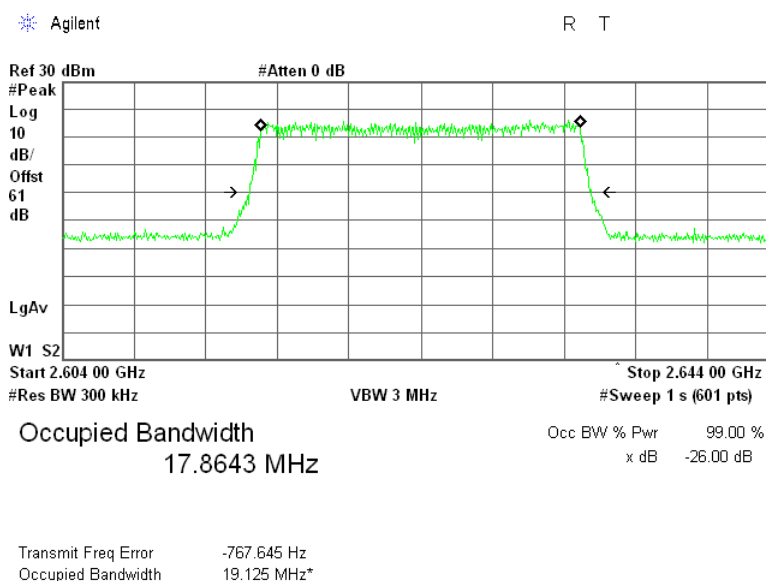


Test specification: Section 2.1049, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 19-Jan-17			
Temperature: 23 °C	Relative Humidity: 42 %	Air Pressure: 1016 hPa	Power: 120 VAC
Remarks:			

Plot 7.1.7 Occupied bandwidth test result at low frequency, 20 MHz EBW, 64QAM, RF chain #22

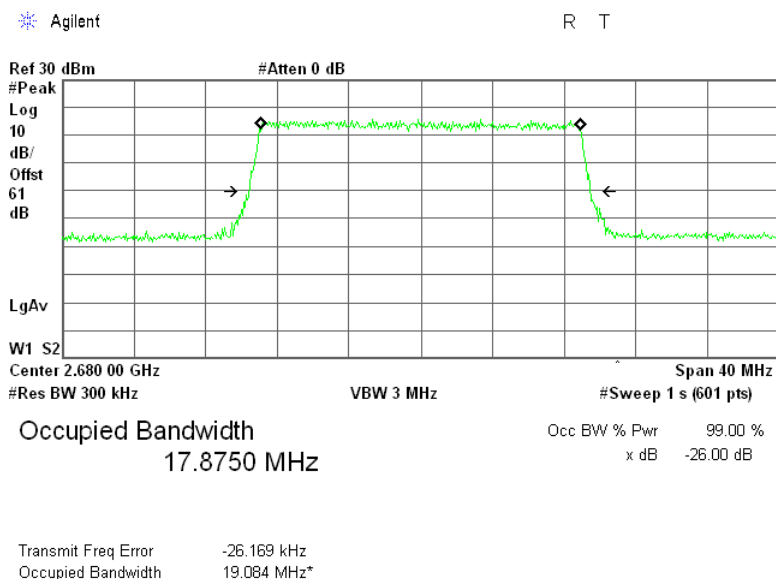


Plot 7.1.8 Occupied bandwidth test result at mid frequency, 20 MHz EBW, 64QAM, RF chain #22

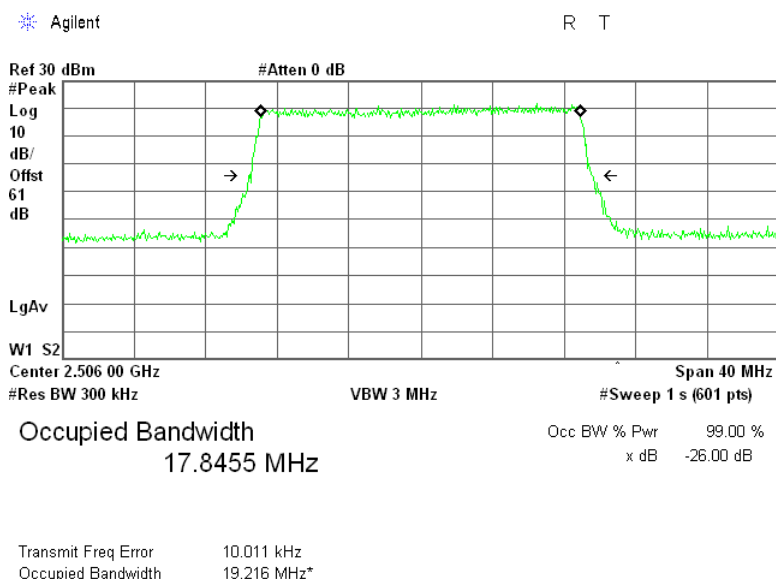


Test specification: Section 2.1049, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 19-Jan-17			
Temperature: 23 °C	Relative Humidity: 42 %	Air Pressure: 1016 hPa	Power: 120 VAC
Remarks:			

Plot 7.1.9 Occupied bandwidth test result at high frequency, 20 MHz EBW, 64QAM, RF chain #22

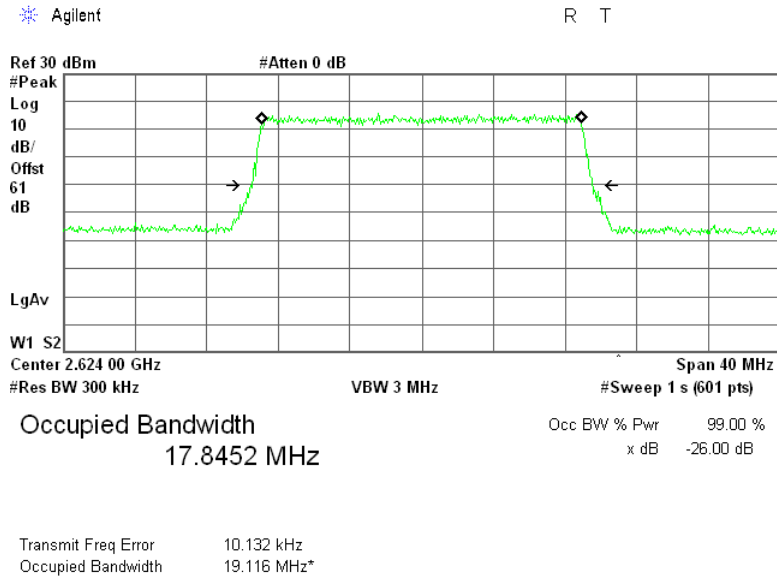


Plot 7.1.10 Occupied bandwidth test result at low frequency, 20 MHz EBW, QPSK, RF chain #12

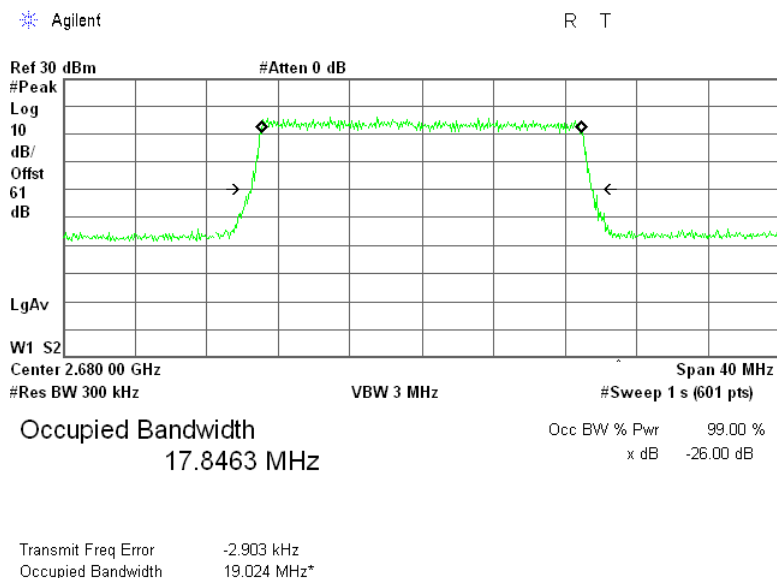


Test specification: Section 2.1049, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 19-Jan-17			
Temperature: 23 °C	Relative Humidity: 42 %	Air Pressure: 1016 hPa	Power: 120 VAC
Remarks:			

Plot 7.1.11 Occupied bandwidth test result at mid frequency, 20 MHz EBW, QPSK, RF chain #12

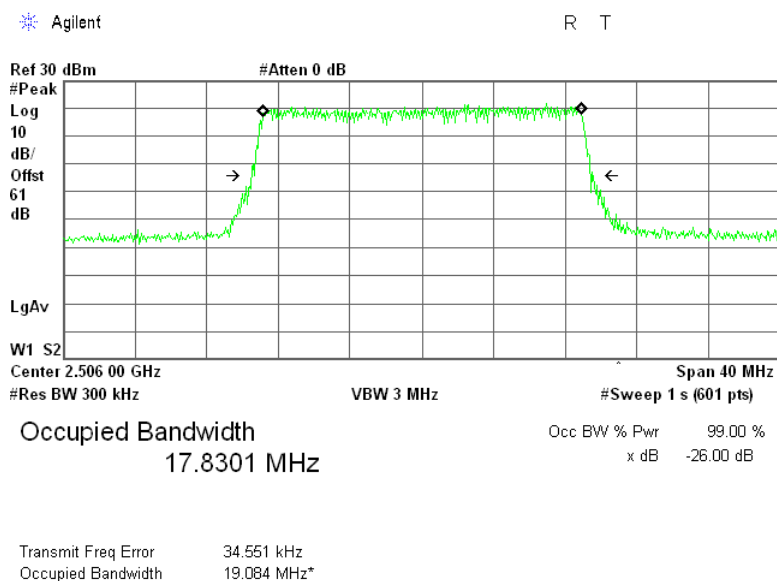


Plot 7.1.12 Occupied bandwidth test result at high frequency, 20 MHz EBW, QPSK, RF chain #12

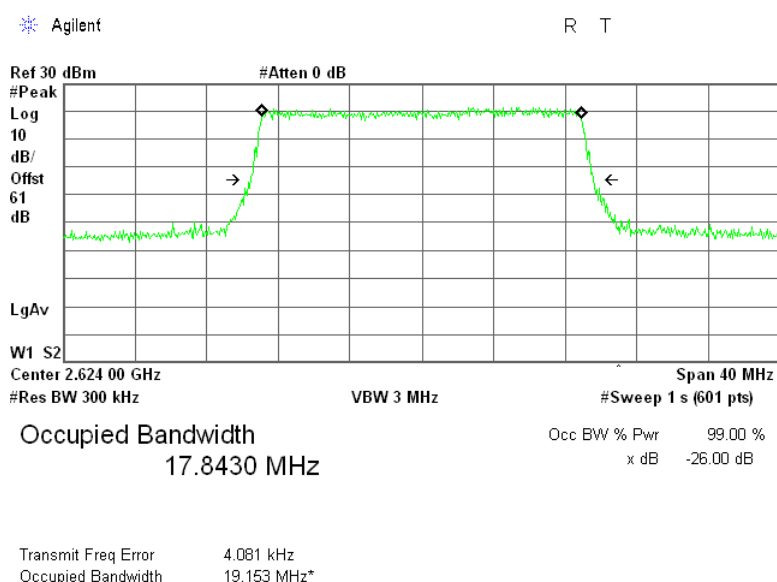


Test specification: Section 2.1049, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 19-Jan-17			
Temperature: 23 °C	Relative Humidity: 42 %	Air Pressure: 1016 hPa	Power: 120 VAC
Remarks:			

Plot 7.1.13 Occupied bandwidth test result at low frequency, 20 MHz EBW, 16QAM, RF chain #12

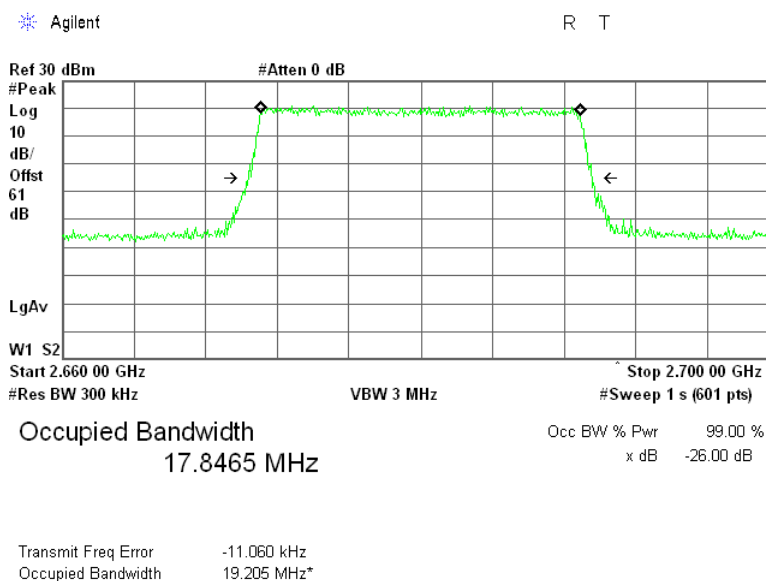


Plot 7.1.14 Occupied bandwidth test result at mid frequency, 20 MHz EBW, 16QAM, RF chain #12

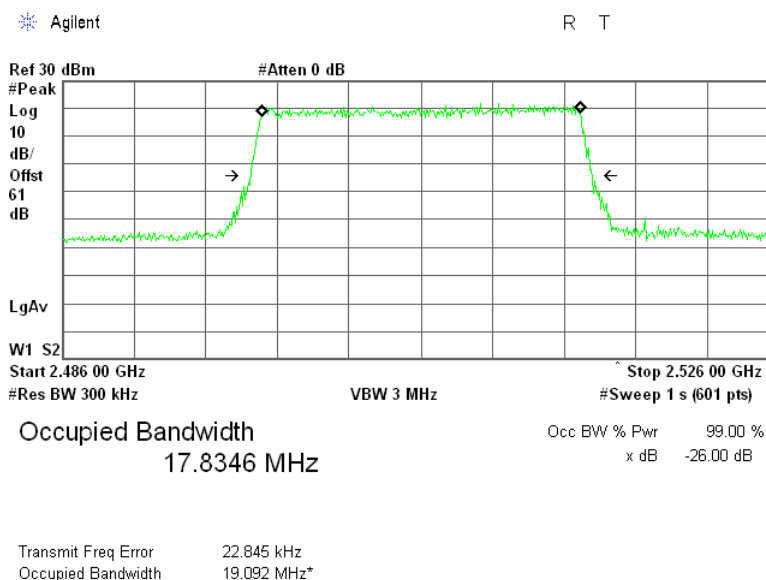


Test specification: Section 2.1049, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 19-Jan-17			
Temperature: 23 °C	Relative Humidity: 42 %	Air Pressure: 1016 hPa	Power: 120 VAC
Remarks:			

Plot 7.1.15 Occupied bandwidth test result at high frequency, 20 MHz EBW, 16QAM, RF chain #12

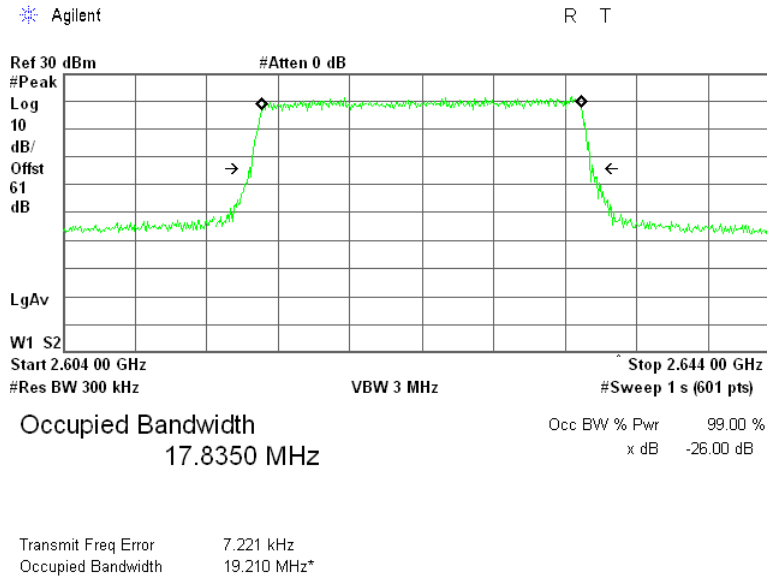


Plot 7.1.16 Occupied bandwidth test result at low frequency, 20 MHz EBW, 64QAM, RF chain #12

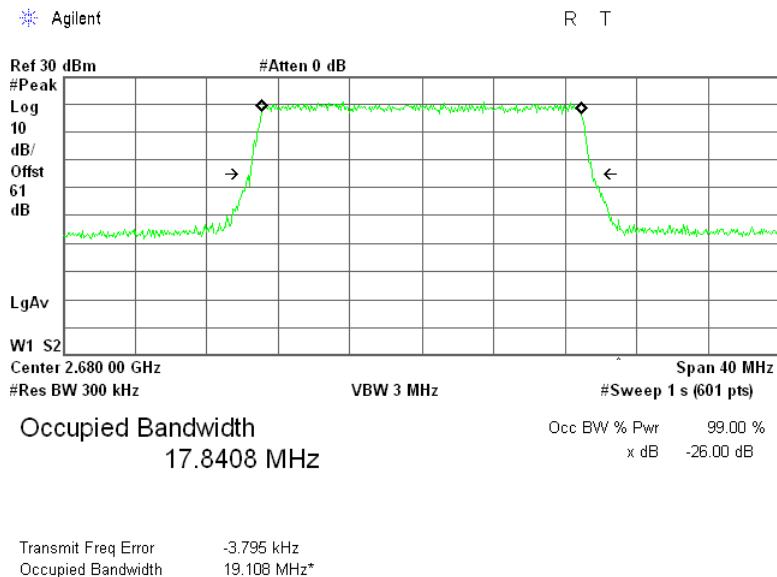


Test specification: Section 2.1049, Occupied bandwidth			
Test procedure: 47 CFR, Section 2.1049			
Test mode: Compliance		Verdict: PASS	
Date(s): 19-Jan-17			
Temperature: 23 °C	Relative Humidity: 42 %	Air Pressure: 1016 hPa	Power: 120 VAC
Remarks:			

Plot 7.1.17 Occupied bandwidth test result at mid frequency, 20 MHz EBW, 64QAM, RF chain #12



Plot 7.1.18 Occupied bandwidth test result at high frequency, 20 MHz EBW, 64QAM, RF chain #12



Test specification: Section 27.50 (h)(2), Peak output power			
Test procedure: 47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jan-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

7.2 Peak output power test

7.2.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Peak output power limits

Transmitter type	Assigned frequency range, MHz	Maximum peak output power, conducted	
		W	dBm
User stations	2496 – 2690	2.0	33.0

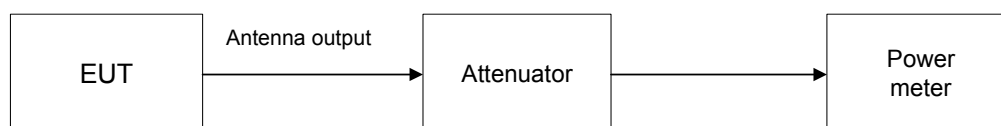
7.2.2 Test procedure

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

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

7.2.2.3 The peak output power was measured with power meter as provided in Table 7.2.2.

Figure 7.2.1 Peak output power test setup





HERMON LABORATORIES

Test specification: Section 27.50 (h)(2), Peak output power			
Test procedure: 47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jan-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Table 7.2.2 Peak output power test results for 20 MHz BW

ASSIGNED FREQUENCY RANGE: 2496.0 – 2690.0 MHz
 TEST METHOD: Wideband power meter
 DETECTOR USED: Average within RF burst
 MODULATING SIGNAL: PRBS
 DEDICATED ANTENNA: 9.0 dBi

Channel, MHz	Pmeas #11, dBm	Pmeas #12, dBm	Total output power #1*, dBm	Pmeas #21, dBm	Pmeas #22, dBm	Total output power #2**, dBm	Total output power***, dBm	Limit, dBm	Margin****, dB	Verdict
MODULATION: QPSK										
2506.00	21.10	21.05	24.09	24.80	24.67	27.75	29.30	33.00	-3.70	Pass
2624.00	21.07	21.08	24.09	24.70	24.61	27.67	29.25	33.00	-3.75	Pass
2680.00	21.15	21.06	24.12	24.71	24.62	27.68	29.27	33.00	-3.73	Pass
MODULATION: 16QAM										
2506.00	20.86	20.81	23.85	24.77	24.66	27.73	29.22	33.00	-3.78	Pass
2624.00	20.85	20.79	23.83	24.74	24.65	27.71	29.20	33.00	-3.80	Pass
2680.00	20.87	20.89	23.89	24.76	24.61	27.70	29.21	33.00	-3.79	Pass
MODULATION: 64QAM										
2506.00	20.86	20.80	23.84	24.77	24.60	27.70	29.20	33.00	-3.80	Pass
2624.00	20.75	20.85	23.81	24.79	24.57	27.69	29.18	33.00	-3.82	Pass
2680.00	20.78	20.91	23.86	24.75	24.59	27.68	29.19	33.00	-3.81	Pass

* - Total output power #1, dBm = $10 \cdot \log[10^{P_{\text{meas \#11}}/10} + 10^{P_{\text{meas \#12}}/10}]$ ** - Total output power #2, dBm = $10 \cdot \log[10^{P_{\text{meas \#21}}/10} + 10^{P_{\text{meas \#22}}/10}]$ *** - Total output power, dBm = $10 \cdot \log[10^{P_{\text{Total output power \#1}}/10} + 10^{P_{\text{Total output power \#2}}/10}]$

**** - Margin, dB = Total EIRP - Limit

Reference numbers of test equipment used

HL 3301	HL 3302	HL 3433	HL 3787	HL 3818	HL 4068	HL 4366	
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Full description is given in Appendix A.

Test specification: Section 27.53, Spurious emissions at RF antenna connector			
Test procedure: 47 CFR, Sections 2.1051, 27.53			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jan-17			
Temperature: 25 °C	Relative Humidity: 41 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

7.3 Spurious emissions at RF antenna connector test

7.3.1 General

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

Table 7.3.1 Spurious emission limits

Frequency, MHz	Attenuation below carrier, dBc	Spurious emissions, dBm
Mobile stations		
0.009 – 10th harmonic*	55+10logP(W)**	-25.0

* - spurious emission limits do not apply to the channel edge emission investigated in course of band edge emission testing

** - P is transmitter output power in watts

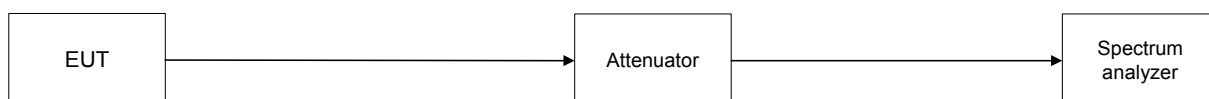
7.3.2 Test procedure

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

7.3.2.3 The spurious emission was measured with spectrum analyzer as provided in Table 7.3.2 and associated plots.

Figure 7.3.1 Spurious emission test setup, single output





Test specification: Section 27.53, Spurious emissions at RF antenna connector			
Test procedure: 47 CFR, Sections 2.1051, 27.53			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jan-17			
Temperature: 25 °C	Relative Humidity: 41 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Table 7.3.2 Spurious emission test results

ASSIGNED FREQUENCY RANGE: 2496-2690 MHz
 INVESTIGATED FREQUENCY RANGE: 0.009 – 27000 MHz
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 MODULATION: 64QAM
 MODULATING SIGNAL: PRBS
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 ANTENNA PORT: #11

Frequency, MHz	SA reading, dBm	Attenuation, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
Low carrier frequency								
No spurious emissions were found								
Mid carrier frequency								
No spurious emissions were found								
High carrier frequency								
No spurious emissions were found								

ANTENNA PORT: #21

Frequency, MHz	SA reading, dBm	Attenuation, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
Low carrier frequency								
No spurious emissions were found								
Mid carrier frequency								
No spurious emissions were found								
High carrier frequency								
No spurious emissions were found								

Verdict: Pass

*- Margin = Spurious emission – specification limit.

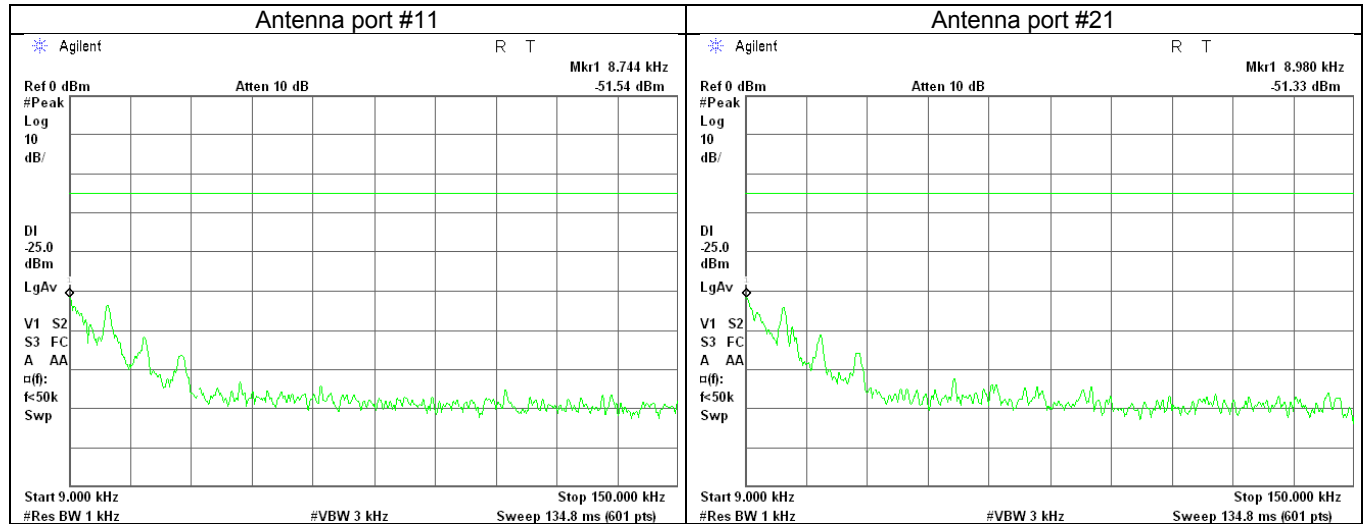
Reference numbers of test equipment used

HL 3301	HL 3302	HL 3433	HL 3787	HL 3818	HL 4068	HL 4366	
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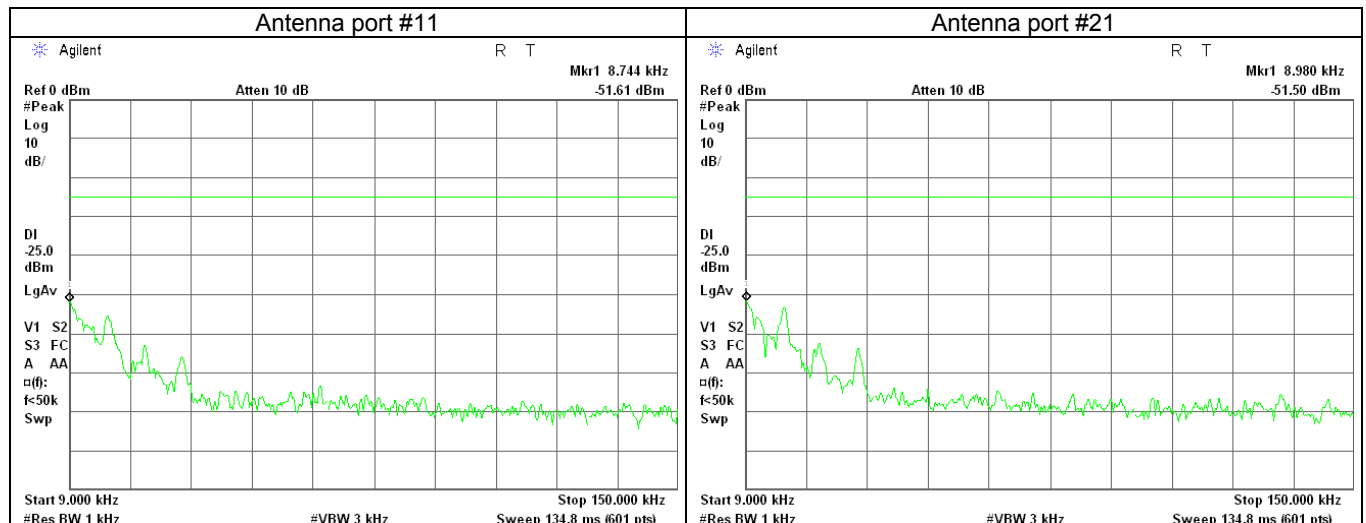
Full description is given in Appendix A.

Test specification:		Section 27.53, Spurious emissions at RF antenna connector	
Test procedure:		47 CFR, Sections 2.1051, 27.53	
Test mode:		Compliance	Verdict: PASS
Date(s):		22-Jan-17	
Temperature: 25 °C	Relative Humidity: 41 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.3.1 Spurious emission measurements in 9 - 150 kHz range at low carrier frequency

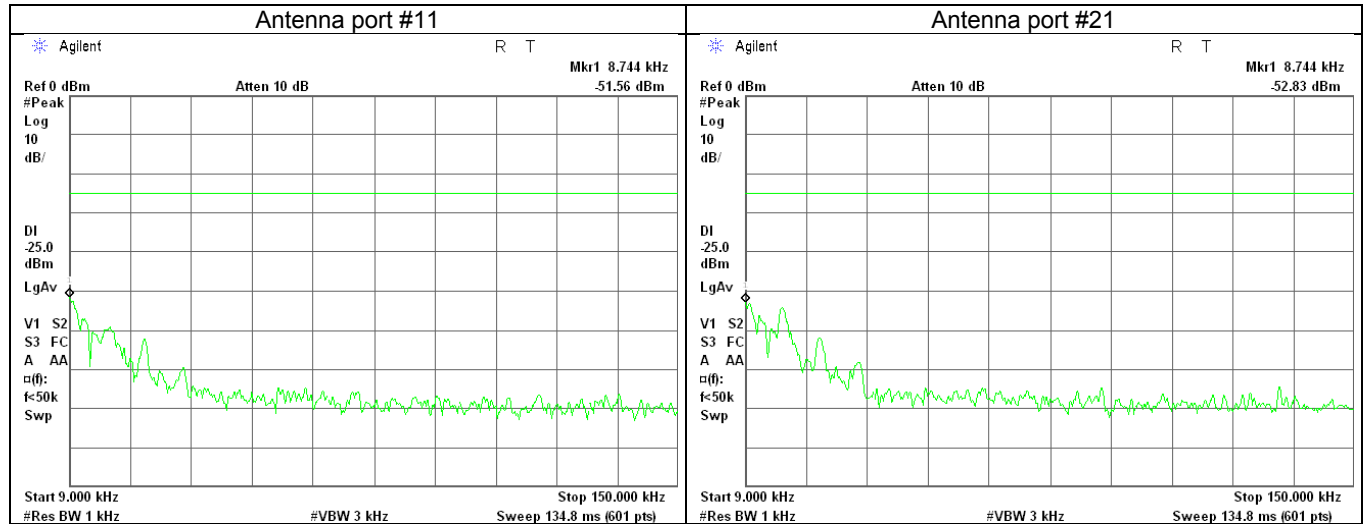


Plot 7.3.2 Spurious emission measurements in 9 - 150 kHz range at mid carrier frequency

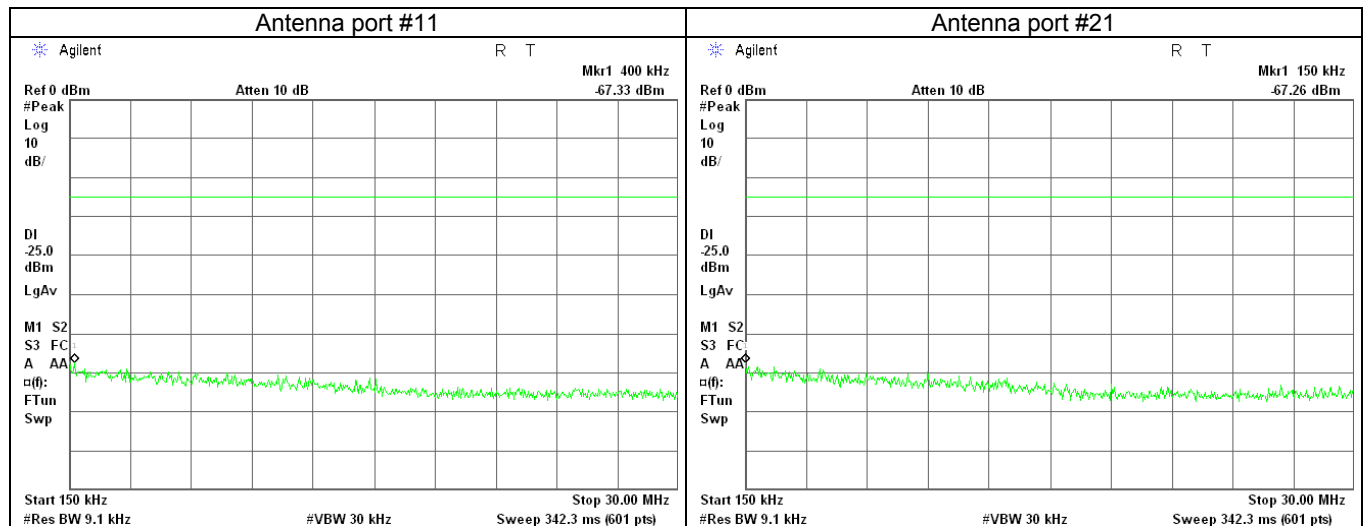


Test specification:		Section 27.53, Spurious emissions at RF antenna connector	
Test procedure:		47 CFR, Sections 2.1051, 27.53	
Test mode:		Compliance	Verdict: PASS
Date(s):		22-Jan-17	
Temperature: 25 °C	Relative Humidity: 41 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.3.3 Spurious emission measurements in 9 - 150 kHz range at high carrier frequency



Plot 7.3.4 Spurious emission measurements in 0.15 - 30.0 MHz range at low carrier frequency





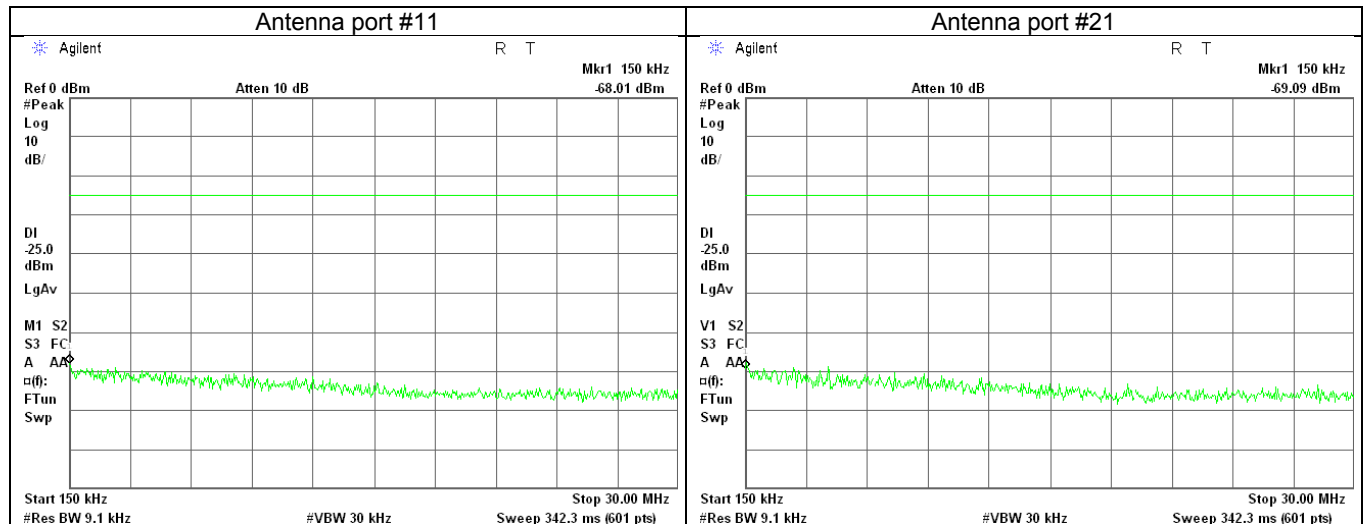
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Report ID: AIRRAD_FCC.29170.docx

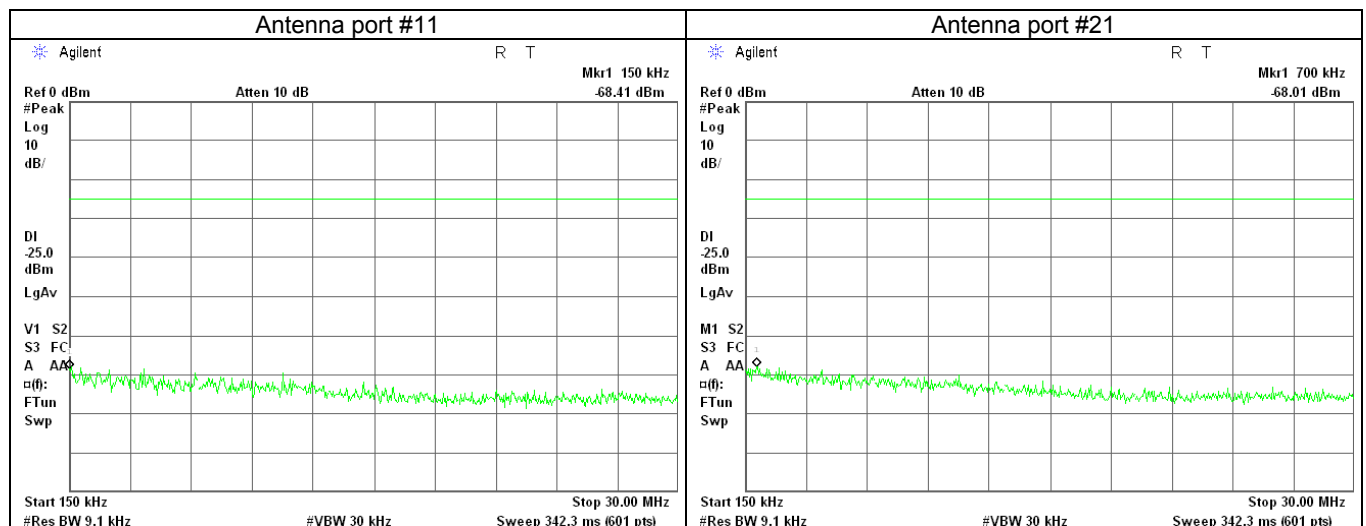
Date of Issue: 6-Feb-17

Test specification:		Section 27.53, Spurious emissions at RF antenna connector	
Test procedure:		47 CFR, Sections 2.1051, 27.53	
Test mode:		Compliance	Verdict: PASS
Date(s):		22-Jan-17	
Temperature: 25 °C	Relative Humidity: 41 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.3.5 Spurious emission measurements in 0.15 - 30.0 MHz range at mid carrier frequency

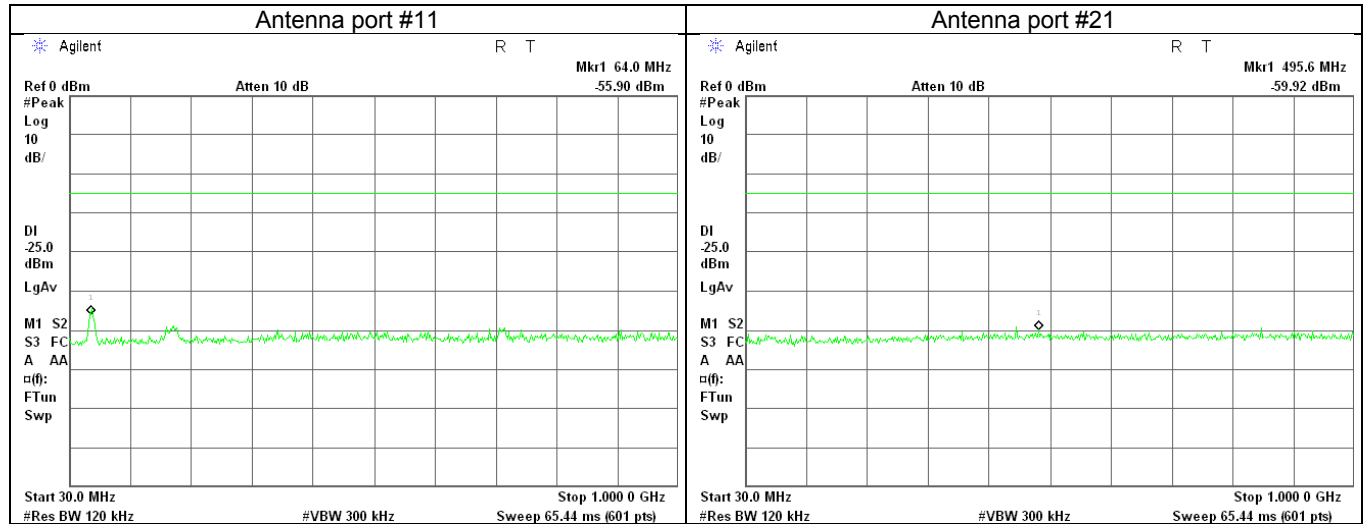


Plot 7.3.6 Spurious emission measurements in 0.15 - 30.0 MHz range at high carrier frequency

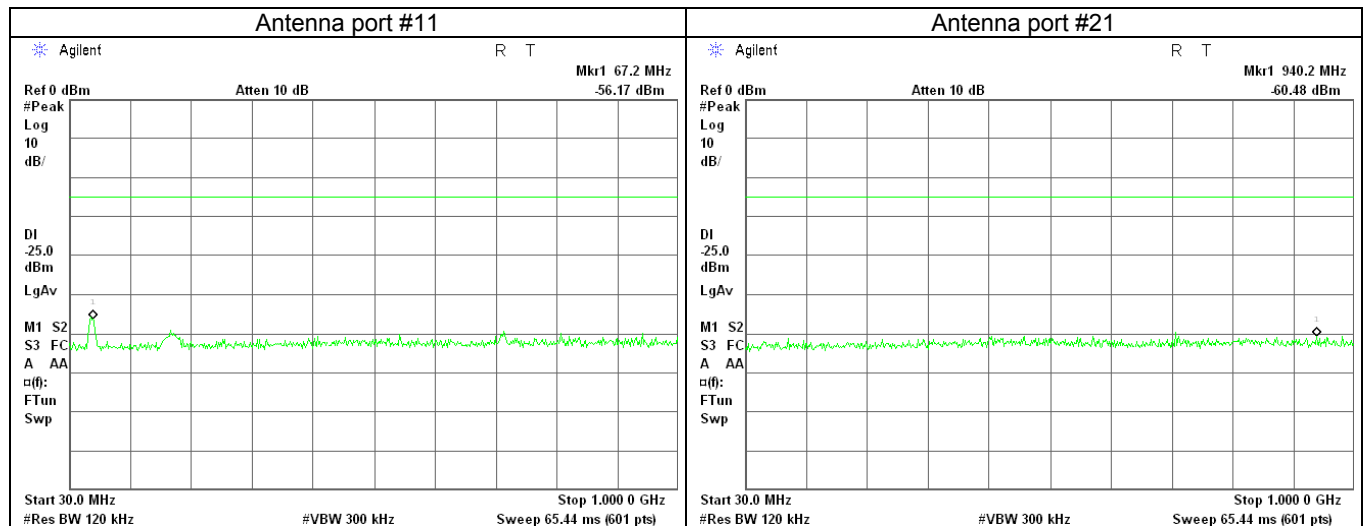


Test specification:		Section 27.53, Spurious emissions at RF antenna connector	
Test procedure:		47 CFR, Sections 2.1051, 27.53	
Test mode:		Compliance	Verdict: PASS
Date(s):		22-Jan-17	
Temperature: 25 °C	Relative Humidity: 41 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.3.7 Spurious emission measurements in 30 - 1000 MHz range at low carrier frequency

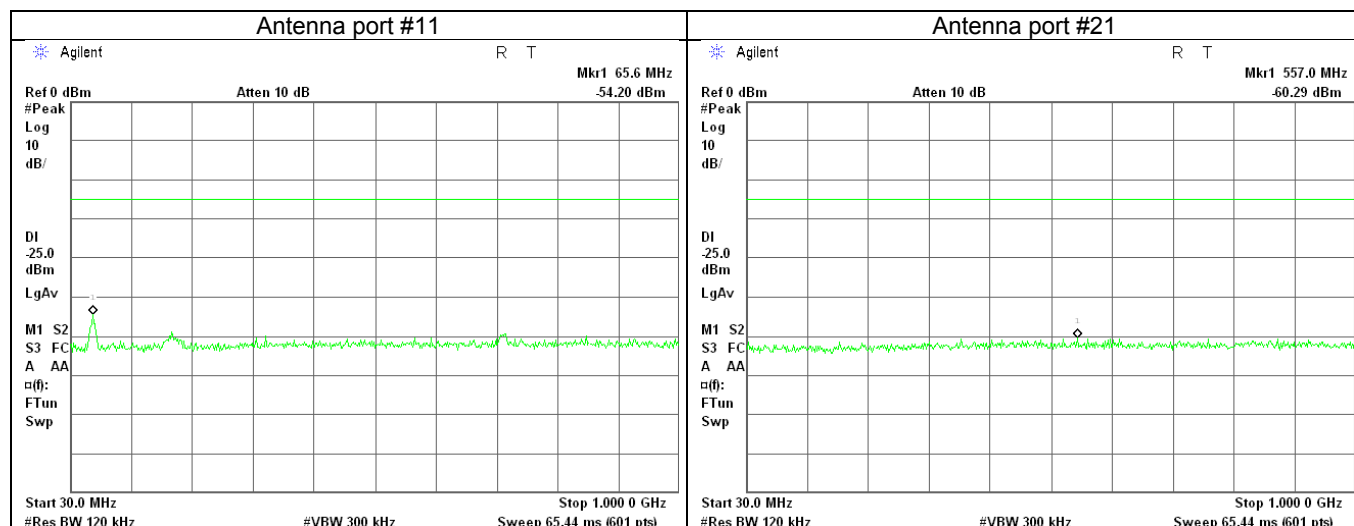


Plot 7.3.8 Spurious emission measurements in 30 - 1000 MHz range at mid carrier frequency

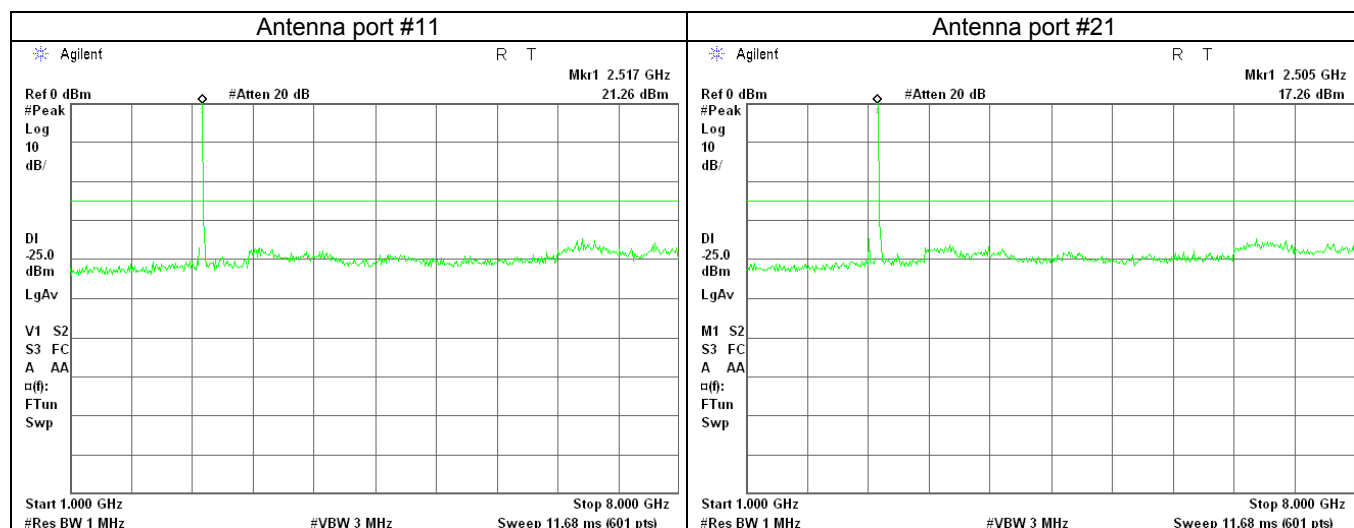


Test specification:		Section 27.53, Spurious emissions at RF antenna connector	
Test procedure:		47 CFR, Sections 2.1051, 27.53	
Test mode:		Compliance	Verdict: PASS
Date(s):		22-Jan-17	
Temperature: 25 °C	Relative Humidity: 41 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.3.9 Spurious emission measurements in 30 - 1000 MHz range at high carrier frequency

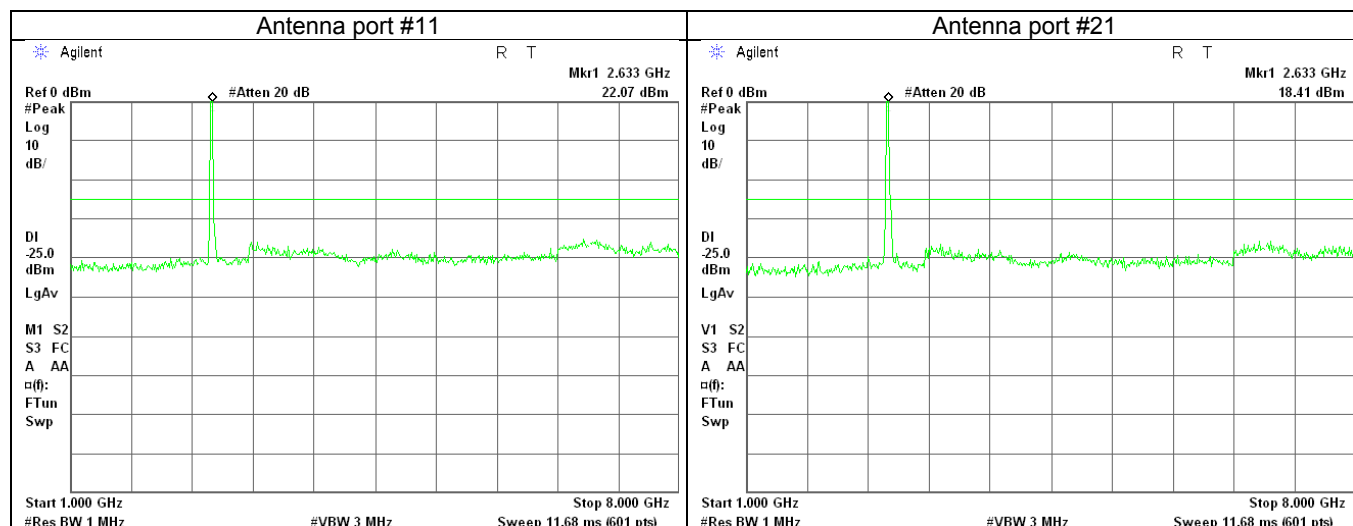


Plot 7.3.10 Spurious emission measurements in 1000 - 8000 MHz range at low carrier frequency

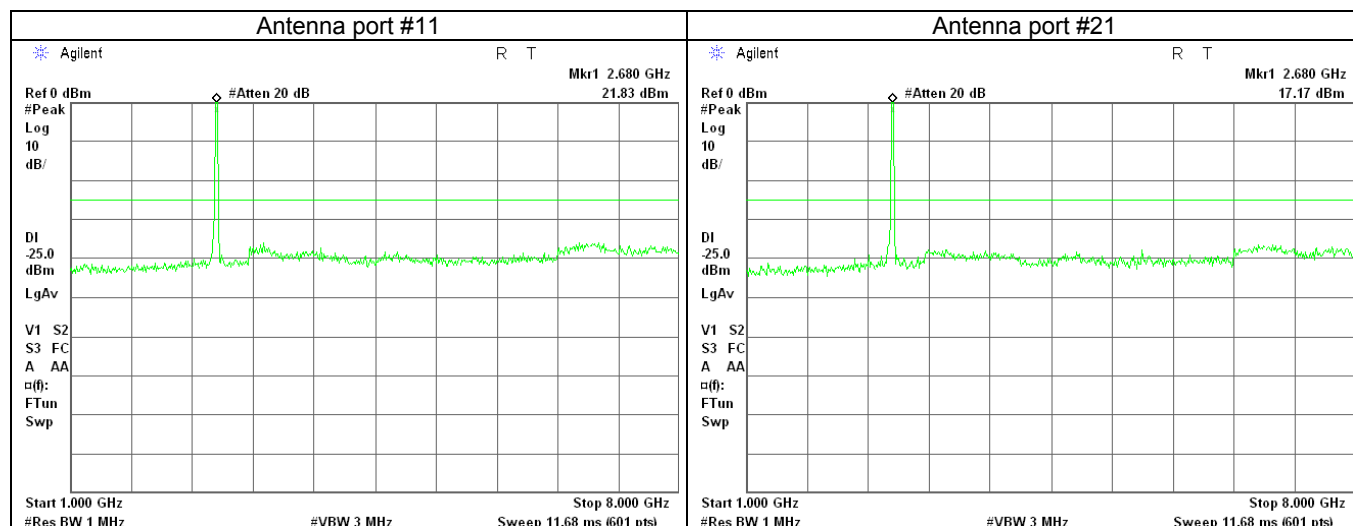


Test specification:		Section 27.53, Spurious emissions at RF antenna connector	
Test procedure:		47 CFR, Sections 2.1051, 27.53	
Test mode:		Compliance	Verdict: PASS
Date(s):		22-Jan-17	
Temperature: 25 °C	Relative Humidity: 41 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.3.11 Spurious emission measurements in 1000 - 8000 MHz range at mid carrier frequency

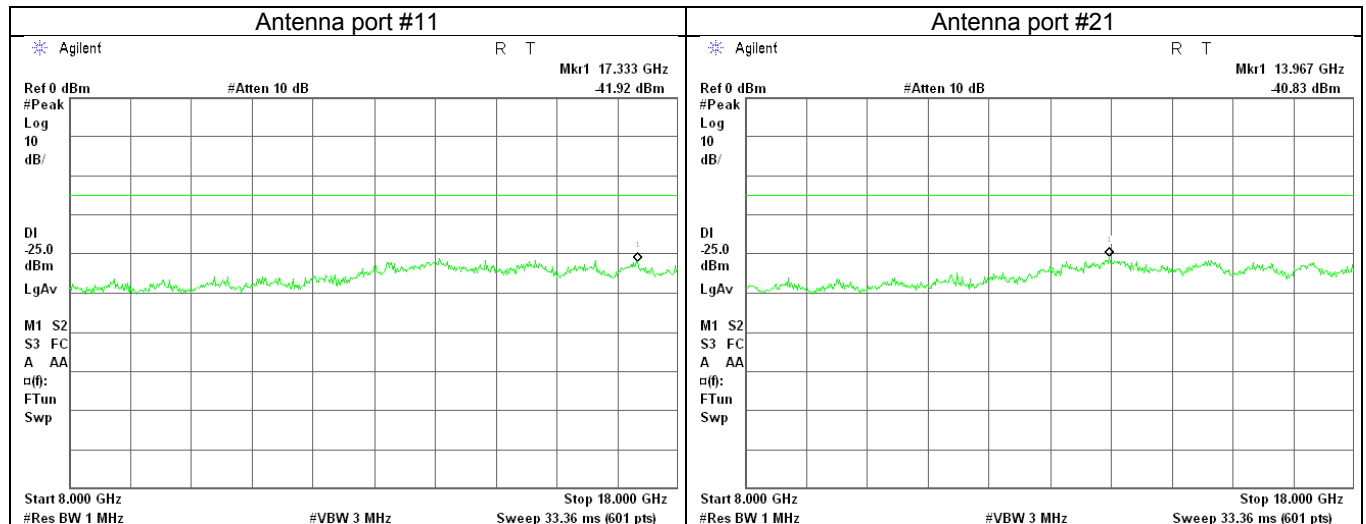


Plot 7.3.12 Spurious emission measurements in 1000 - 8000 MHz range at high carrier frequency

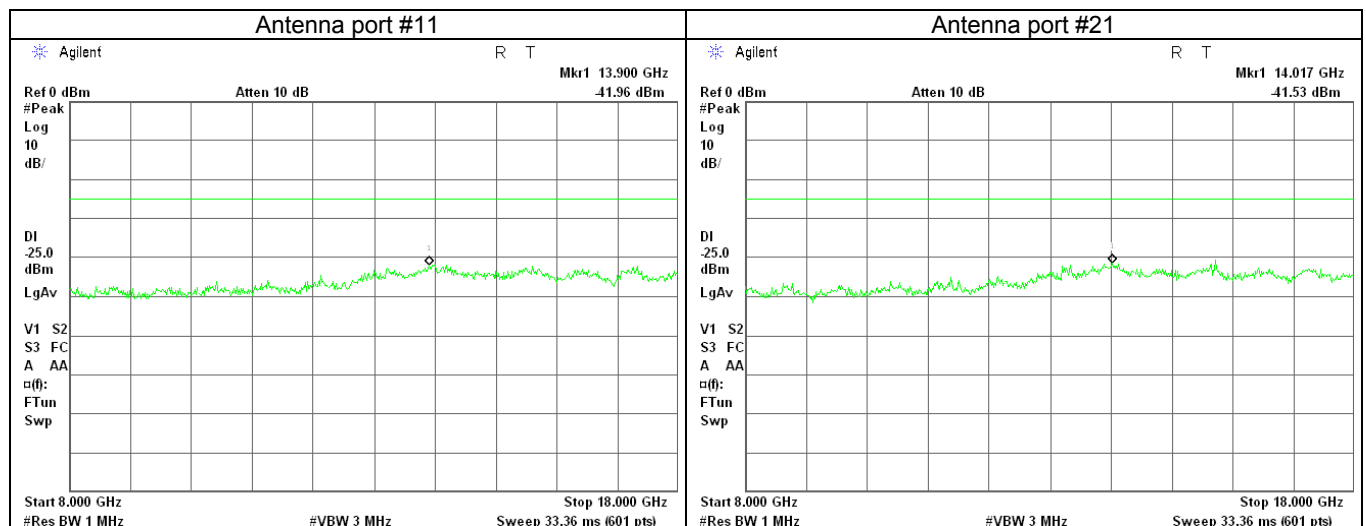


Test specification:		Section 27.53, Spurious emissions at RF antenna connector	
Test procedure:		47 CFR, Sections 2.1051, 27.53	
Test mode:		Compliance	Verdict: PASS
Date(s):		22-Jan-17	
Temperature: 25 °C	Relative Humidity: 41 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.3.13 Spurious emission measurements in 8000 - 18000 MHz range at low carrier frequency



Plot 7.3.14 Spurious emission measurements in 8000 - 18000 MHz at mid carrier frequency



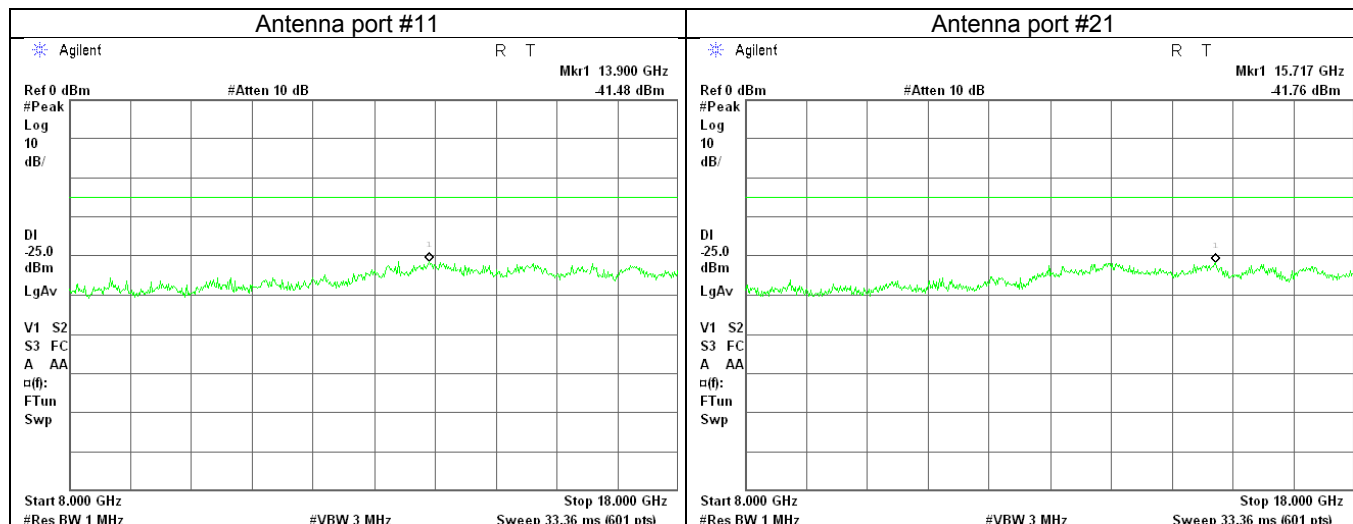


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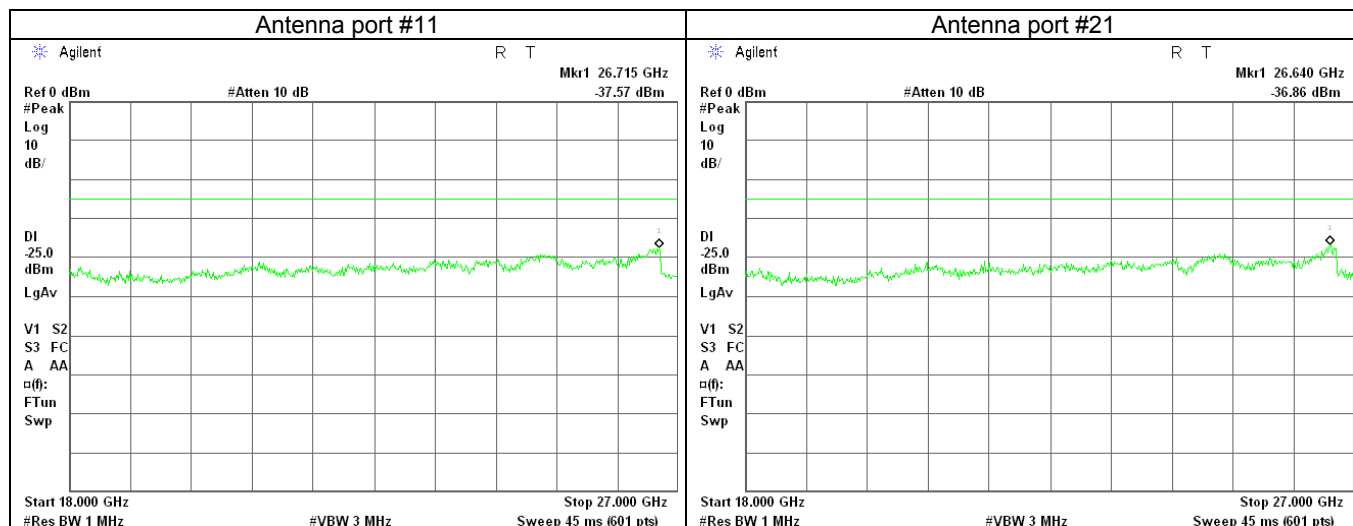
Report ID: AIRRAD_FCC.29170.docx
Date of Issue: 6-Feb-17

Test specification: Section 27.53, Spurious emissions at RF antenna connector	
Test procedure: 47 CFR, Sections 2.1051, 27.53	
Test mode: Compliance	Verdict: PASS
Date(s): 22-Jan-17	
Temperature: 25 °C	Relative Humidity: 41 %
Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:	

Plot 7.3.15 Spurious emission measurements in 8000 - 18000 MHz at high carrier frequency

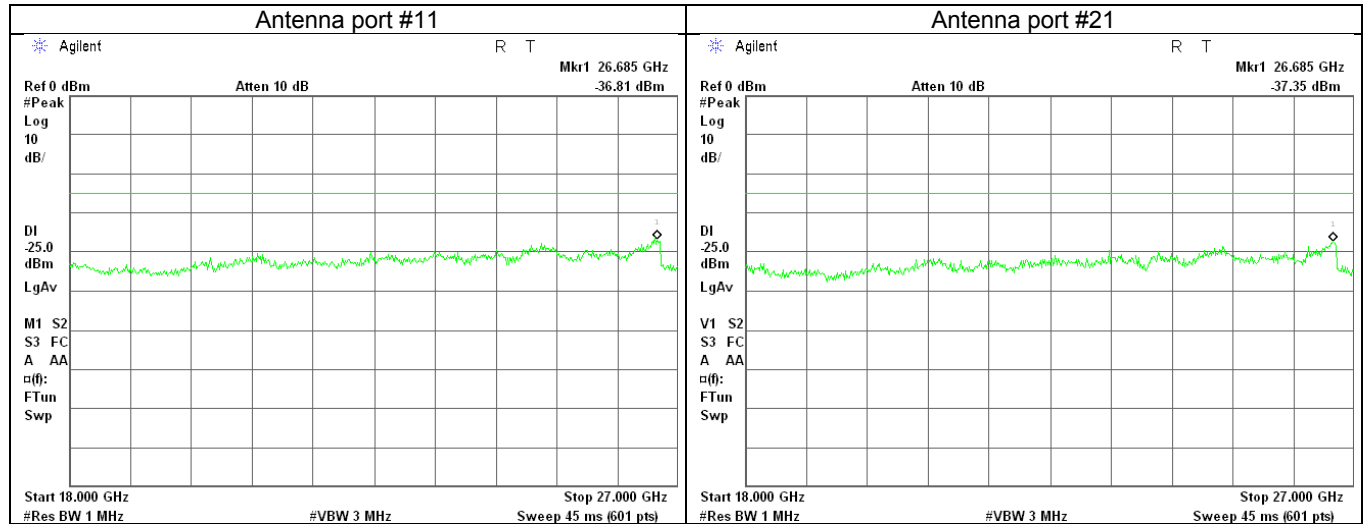


Plot 7.3.16 Spurious emission measurements in 18000 - 27000 MHz range at low carrier frequency

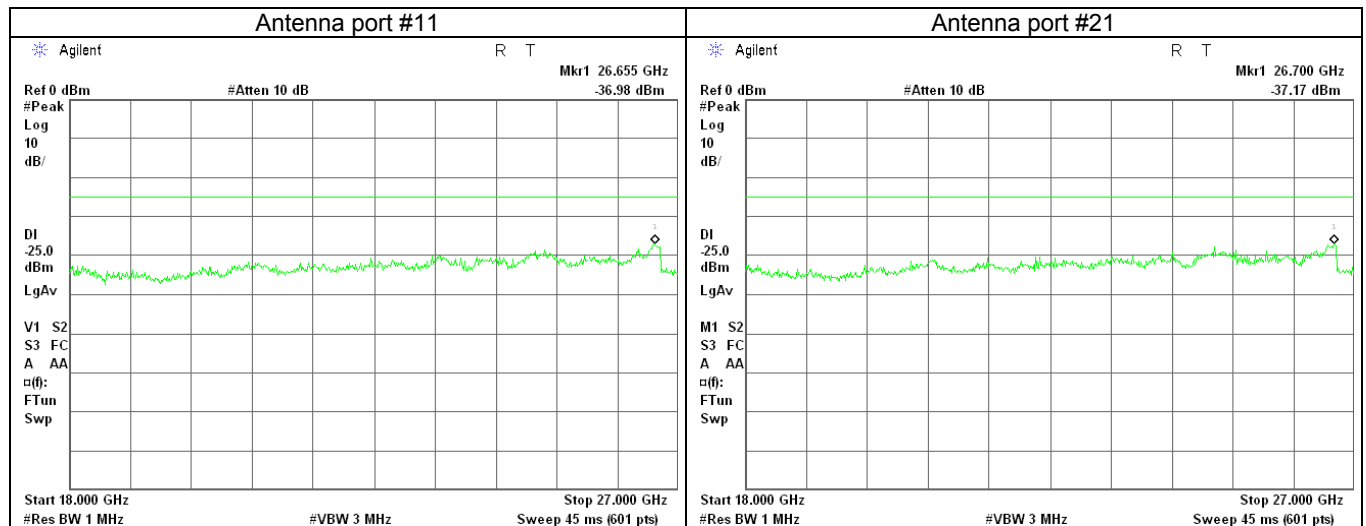


Test specification:		Section 27.53, Spurious emissions at RF antenna connector	
Test procedure:		47 CFR, Sections 2.1051, 27.53	
Test mode:		Compliance	Verdict: PASS
Date(s):		22-Jan-17	
Temperature: 25 °C	Relative Humidity: 41 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.3.17 Spurious emission measurements in 18000 - 27000 MHz at mid carrier frequency



Plot 7.3.18 Spurious emission measurements in 18000 - 27000 MHz at high carrier frequency



Test specification: Section 27.53(m)(4), Band edge emissions			
Test procedure: 47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jan-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

7.4 Band edge emissions at RF connector test

7.4.1 General

This test was performed to measure spurious emissions at the channel edge at the RF antenna connector. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Spurious emission limits at band edges

Channel, MHz	Frequency range, MHz	Attenuation below carrier, dBc ^{Note}
Channel bandwidth 20 MHz		
2506.0	2490.5 – 2496.0	43 + 10*Log (P*)
	2490.0 – 2490.5 & 2511.0 – 2512.0	55 + 10*Log (P*)
	2491.0 – 2496.0 & 2506.0 – 2511.0	43 + 10*Log (P*)
2624.0	2582.0 – 2583.0 & 2603.0 – 2604.0	55 + 10*Log (P*)
	2583.0 – 2588.0 & 2598.0 – 2603.0	43 + 10*Log (P*)
2680.0	2674.0 – 2675.0 & 2695.0 – 2696.0	55 + 10*Log (P*)
	2675.0 – 2680.0 & 2690.0 – 2695.0	43 + 10*Log (P*)

* - P is transmitter output power in Watts

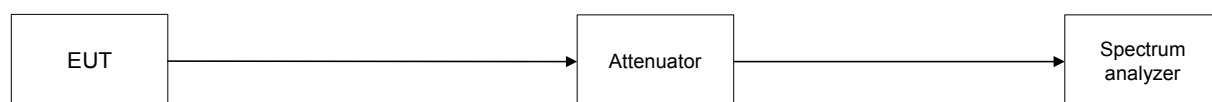
Note: For mobile digital stations, the attenuation factor shall be not less than 40 + 10 log (P) dB on all frequencies between the channel edge and 5 megahertz from the channel edge, 43 + 10 log (P) dB on all frequencies between 5 megahertz and X megahertz from the channel edge, and 55 + 10 log (P) dB on all frequencies more than X megahertz from the channel edge, where X is the greater of 6 megahertz or the actual emission bandwidth as defined in paragraph (m)(6) of this section. In addition, the attenuation factor shall not be less than 43 + 10 log (P) dB on all frequencies between 2490.5 MHz and 2496 MHz and 55 + 10 log (P) dB at or below 2490.5 MHz.

7.4.2 Test procedure

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

7.4.2.2 The spurious emission was measured with spectrum analyzer as provided in Table 7.4.2, Table 7.4.3 and the associated plots.

Figure 7.4.1 Spurious emission test setup for single output



Test specification: Section 27.53(m)(4), Band edge emissions			
Test procedure: 47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jan-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Table 7.4.2 Spurious emission at the low band edge test results

ASSIGNED FREQUENCY RANGE: 2496.0 – 2690.0 MHz
DETECTOR USED: Average (gated)
VIDEO BANDWIDTH: ≥ Resolution bandwidth
ANTENNA PORT: #12

Frequency MHz	Frequency offset, ± MHz	Low band edge (integrated over 2 channels), dBm	Low band edge (integrated over 4 channels)*, dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
QPSK							
2506.0	13.00	-31.78	-28.78	100	1000	-10.00	Pass
	18.00	-39.36	-36.36	100	1000	-13.00	
	31.50	-32.83	-29.83	100	1000	-25.00	
2624.0	11.50	-38.61	-35.61	100	1000	-10.00	Pass
	16.50	-40.52	-37.52	100	1000	-13.00	
	30.00	-36.31	-33.31	100	1000	-25.00	
2680.0	10.50	-38.46	-35.46	100	1000	-10.00	Pass
	15.50	-40.02	-37.02	100	1000	-13.00	
	29.00	-31.78	-28.78	100	1000	-25.00	
64QAM							
2506.0	13.00	-31.42	-28.42	100	1000	-10.00	Pass
	18.00	-39.12	-36.12	100	1000	-13.00	
	31.50	-32.38	-29.38	100	1000	-25.00	
2624.0	11.50	-38.44	-35.44	100	1000	-10.00	Pass
	16.50	-40.68	-37.68	100	1000	-13.00	
	30.00	-35.72	-32.72	100	1000	-25.00	
2680.0	10.50	-38.51	-35.51	100	1000	-10.00	Pass
	15.50	-39.89	-36.89	100	1000	-13.00	
	29.00	-31.42	-28.42	100	1000	-25.00	

ANTENNA PORT: #22

Frequency MHz	Frequency offset, ± MHz	Low band edge (integrated over 2 channels), dBm	Low band edge (integrated over 4 channels)*, dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
QPSK							
2506.0	13.00	-34.89	-31.89	100	1000	-10.00	Pass
	18.00	-40.20	-37.20	100	1000	-13.00	
	31.50	-35.23	-32.23	100	1000	-25.00	
2624.0	11.50	-39.25	-36.25	100	1000	-10.00	Pass
	16.50	-40.90	-37.90	100	1000	-13.00	
	30.00	-36.95	-33.95	100	1000	-25.00	
2680.0	10.50	-37.73	-34.73	100	1000	-10.00	Pass
	15.50	-40.72	-37.72	100	1000	-13.00	
	29.00	-34.89	-31.89	100	1000	-25.00	
64QAM							
2506.0	13.00	-34.54	-31.54	100	1000	-10.00	Pass
	18.00	-40.07	-37.07	100	1000	-13.00	
	31.50	-34.53	-31.53	100	1000	-25.00	
2624.0	11.50	-38.99	-35.99	100	1000	-10.00	Pass
	16.50	-40.68	-37.68	100	1000	-13.00	
	30.00	-36.71	-33.71	100	1000	-25.00	
2680.0	10.50	-37.67	-34.67	100	1000	-10.00	Pass
	15.50	-40.34	-37.34	100	1000	-13.00	
	29.00	-34.54	-31.54	100	1000	-25.00	

- Low band edge (integrated over 4 channels), dBm = Low band edge (integrated over 2 channels), dBm + 3 dB



Test specification: Section 27.53(m)(4), Band edge emissions			
Test procedure: 47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jan-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Table 7.4.3 Spurious emission at the high band edge test results

ASSIGNED FREQUENCY RANGE: 2496.0 – 2690.0 MHz
DETECTOR USED: Average (gated)
VIDEO BANDWIDTH: ≥ Resolution bandwidth
ANTENNA PORT: #11

Frequency MHz	Frequency offset, ± MHz	High band edge (integrated over 2 channels), dBm	High band edge (integrated over 4 channels)*, dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
QPSK							
2506.0	13.00	-36.60	-33.60	100	1000	-10.00	Pass
	18.00	-37.66	-34.66	100	1000	-13.00	
	31.50	-40.51	-37.51	100	1000	-25.00	
2624.0	11.50	-36.96	-33.96	100	1000	-10.00	Pass
	16.50	-38.57	-35.57	100	1000	-13.00	
	30.00	-40.80	-37.80	100	1000	-25.00	
2680.0	10.50	-31.25	-28.25	100	1000	-10.00	Pass
	15.50	-37.27	-34.27	100	1000	-13.00	
	29.00	-40.32	-37.32	100	1000	-25.00	
64QAM							
2506.0	13.00	-36.89	-33.89	100	1000	-10.00	Pass
	18.00	-37.91	-34.91	100	1000	-13.00	
	31.50	-40.42	-37.42	100	1000	-25.00	
2624.0	11.50	-36.42	-33.42	100	1000	-10.00	Pass
	16.50	-38.15	-35.15	100	1000	-13.00	
	30.00	-40.49	-37.49	100	1000	-25.00	
2680.0	10.50	-31.79	-28.79	100	1000	-10.00	Pass
	15.50	-38.16	-35.16	100	1000	-13.00	
	29.00	-40.22	-37.22	100	1000	-25.00	

ANTENNA PORT: #21

Frequency MHz	Frequency offset, ± MHz	High band edge (integrated over 2 channels), dBm	High band edge (integrated over 4 channels)*, dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
QPSK							
2506.0	13.00	-38.33	-35.33	100	1000	-10.00	Pass
	18.00	-39.55	-36.55	100	1000	-13.00	
	31.50	-40.77	-37.77	100	1000	-25.00	
2624.0	11.50	-37.30	-34.30	100	1000	-10.00	Pass
	16.50	-38.58	-35.58	100	1000	-13.00	
	30.00	-41.08	-38.08	100	1000	-25.00	
2680.0	10.50	-34.68	-31.68	100	1000	-10.00	Pass
	15.50	-38.47	-35.47	100	1000	-13.00	
	29.00	-40.32	-37.32	100	1000	-25.00	
64QAM							
2506.0	13.00	-37.77	-34.77	100	1000	-10.00	Pass
	18.00	-39.22	-36.22	100	1000	-13.00	
	31.50	-40.80	-37.80	100	1000	-25.00	
2624.0	11.50	-37.34	-34.34	100	1000	-10.00	Pass
	16.50	-38.36	-35.36	100	1000	-13.00	
	30.00	-40.76	-37.76	100	1000	-25.00	
2680.0	10.50	-35.01	-32.01	100	1000	-10.00	Pass
	15.50	-38.25	-35.25	100	1000	-13.00	
	29.00	-40.24	-37.24	100	1000	-25.00	

- High band edge (integrated over 4 channels), dBm = High band edge (integrated over 2 channels), dBm + 3 dB

Reference numbers of test equipment used

HL 2214	HL 3301	HL 3302	HL 3433	HL 3434	HL 3818	
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Full description is given in Appendix A.

Test specification: Section 27.53(m)(4), Band edge emissions			
Test procedure: 47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jan-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.4.1 Spurious emission at band edges test results at low carrier frequency, 20 MHz EBW

ASSIGNED FREQUENCY RANGE:

2496 – 2690 MHz

DETECTOR USED:

Average

MODULATION:

QPSK

MODULATING SIGNAL:

PRBS

TRANSMITTER OUTPUT POWER SETTINGS:

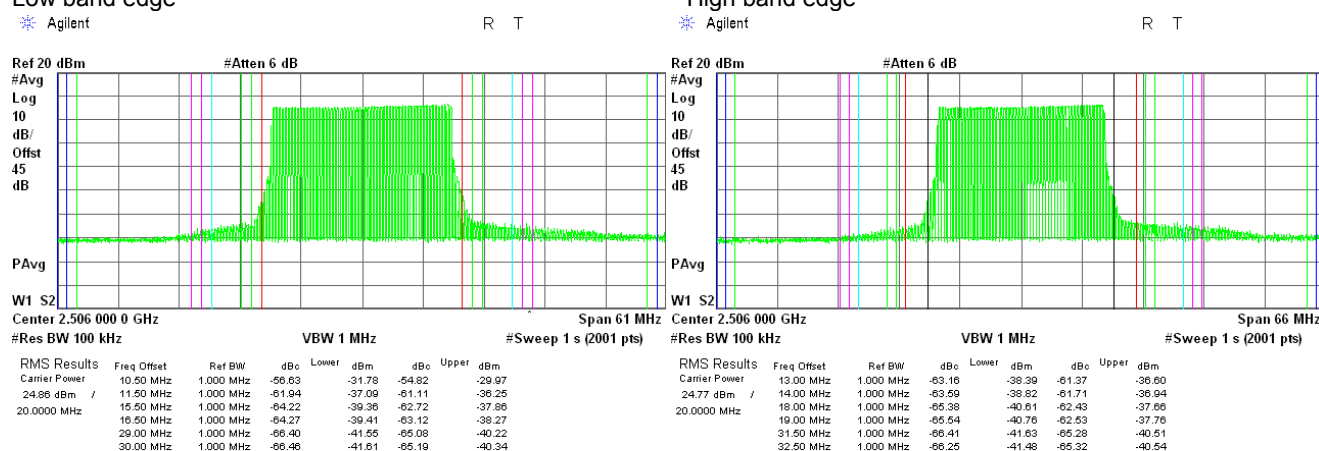
Maximum

ANTENNA PORT:

#11

Low band edge

High band edge



Plot 7.4.2 Spurious emission at band edges test results at mid carrier frequency, 20 MHz EBW

ASSIGNED FREQUENCY RANGE:

2496 – 2690 MHz

DETECTOR USED:

Average

MODULATION:

QPSK

MODULATING SIGNAL:

PRBS

TRANSMITTER OUTPUT POWER SETTINGS:

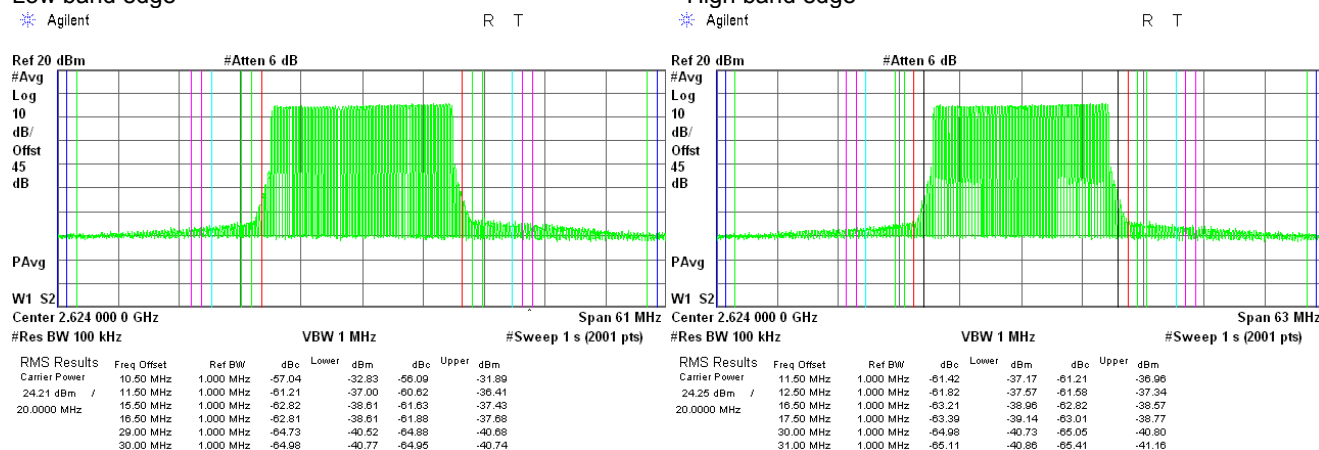
Maximum

ANTENNA PORT:

#11

Low band edge

High band edge



Test specification: Section 27.53(m)(4), Band edge emissions			
Test procedure: 47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jan-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.4.3 Spurious emission at band edges test results at high carrier frequency, 20 MHz EBW

ASSIGNED FREQUENCY RANGE:

2496 – 2690 MHz

DETECTOR USED:

Average

MODULATION:

QPSK

MODULATING SIGNAL:

PRBS

TRANSMITTER OUTPUT POWER SETTINGS:

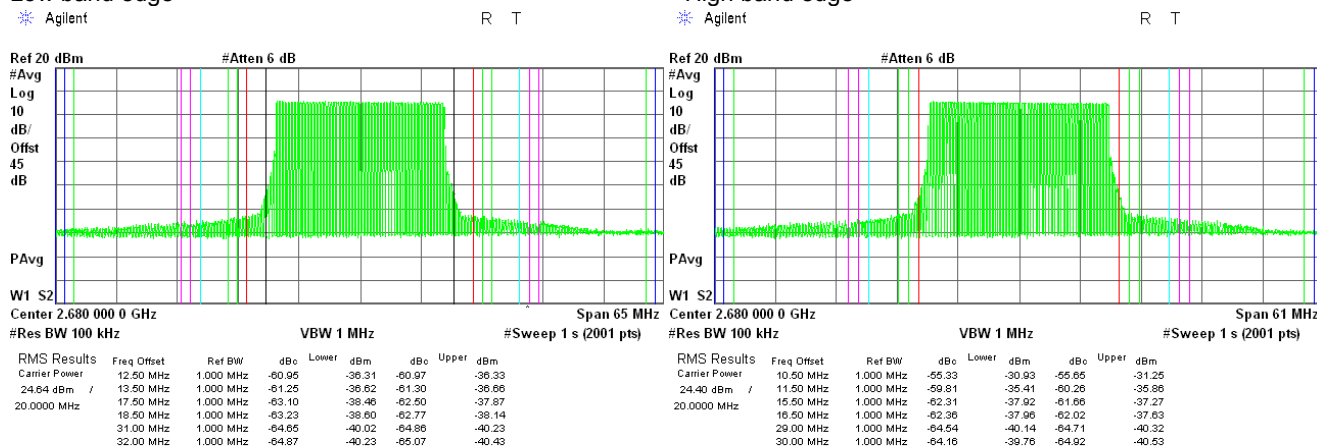
Maximum

ANTENNA PORT:

#11

Low band edge

High band edge



Plot 7.4.4 Spurious emission at band edges test results at low carrier frequency, 20 MHz EBW

ASSIGNED FREQUENCY RANGE:

2496 – 2690 MHz

DETECTOR USED:

Average

MODULATION:

64QAM

MODULATING SIGNAL:

PRBS

TRANSMITTER OUTPUT POWER SETTINGS:

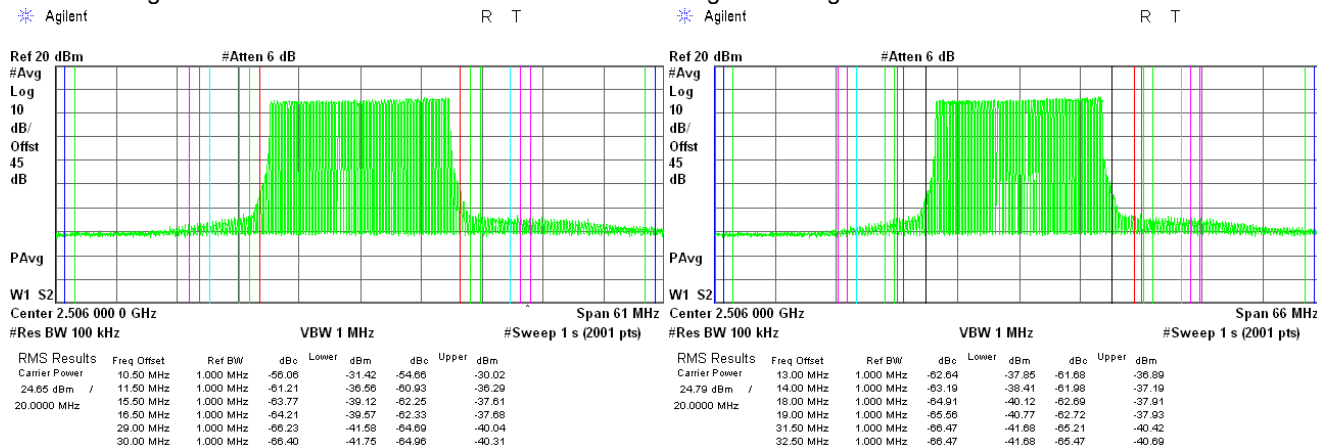
Maximum

ANTENNA PORT:

#11

Low band edge

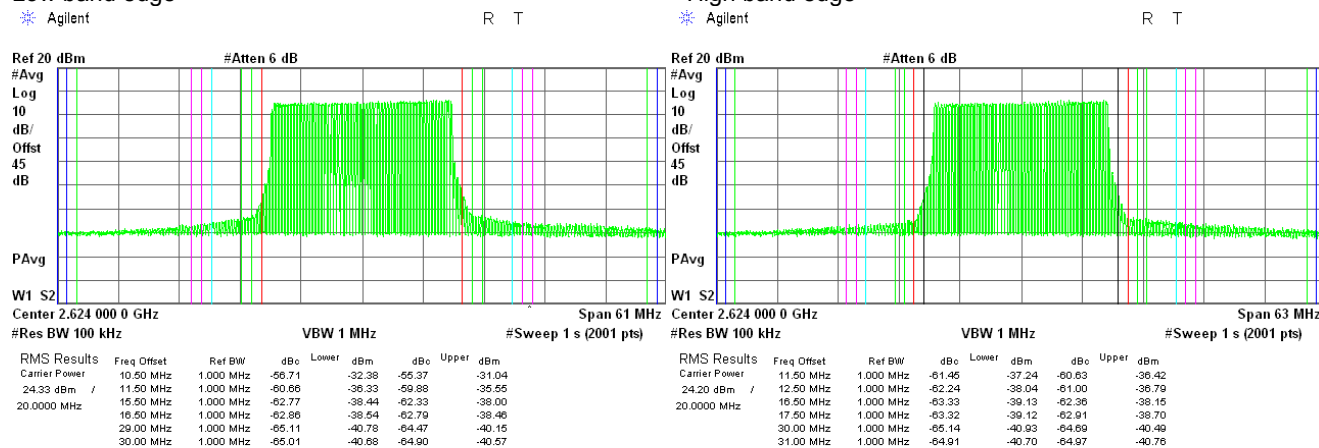
High band edge



Test specification: Section 27.53(m)(4), Band edge emissions			
Test procedure: 47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jan-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

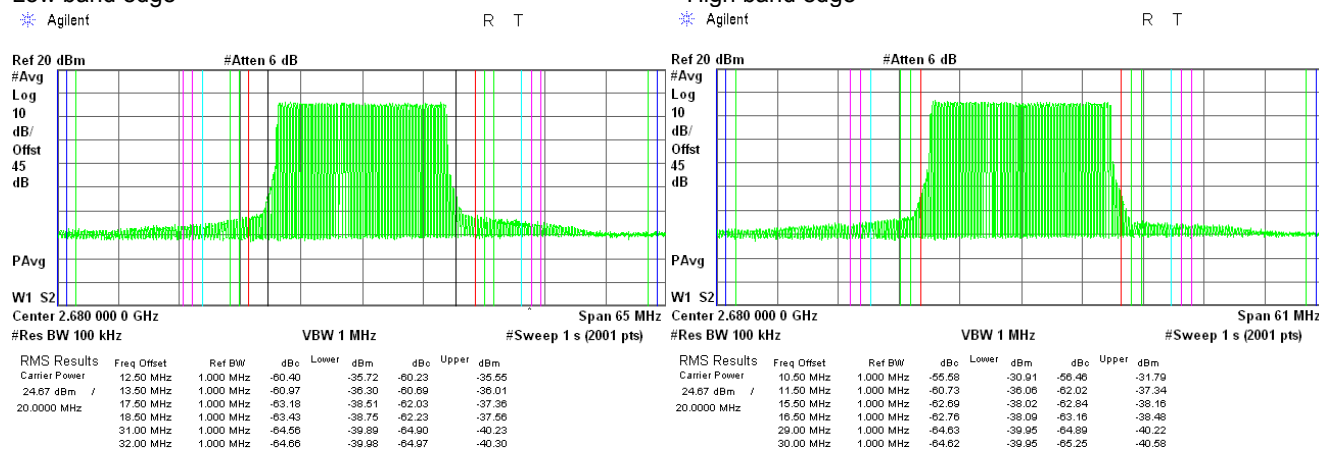
Plot 7.4.5 Spurious emission at band edges test results at mid carrier frequency, 20 MHz EBW

ASSIGNED FREQUENCY RANGE: 2496 – 2690 MHz
DETECTOR USED: Average
MODULATION: 64QAM
MODULATING SIGNAL: PRBS
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
ANTENNA PORT: #11
Low band edge High band edge



Plot 7.4.6 Spurious emission at band edges test results at high carrier frequency, 20 MHz EBW

ASSIGNED FREQUENCY RANGE: 2496 – 2690 MHz
DETECTOR USED: Average
MODULATION: 64QAM
MODULATING SIGNAL: PRBS
TRANSMITTER OUTPUT POWER SETTINGS: Maximum
ANTENNA PORT: #11
Low band edge High band edge



Test specification:		Section 27.53(m)(4), Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Verdict: PASS	
Date(s):			
22-Jan-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.4.7 Spurious emission at band edges test results at low carrier frequency, 20 MHz EBW

ASSIGNED FREQUENCY RANGE:

2496 – 2690 MHz

DETECTOR USED:

Average

MODULATION:

QPSK

MODULATING SIGNAL:

PRBS

TRANSMITTER OUTPUT POWER SETTINGS:

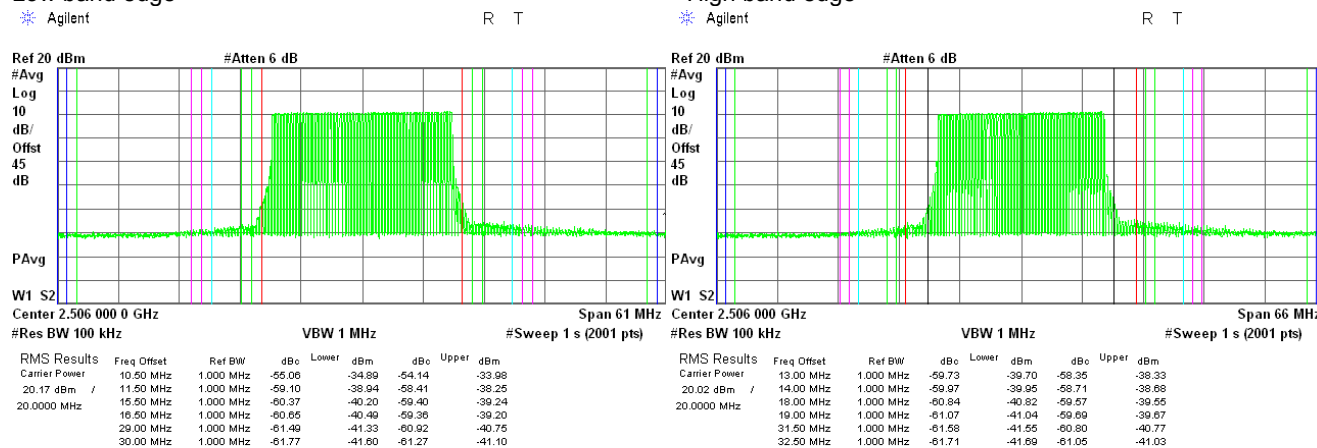
Maximum

ANTENNA PORT:

#21

Low band edge

High band edge



Plot 7.4.8 Spurious emission at band edges test results at mid carrier frequency, 20 MHz EBW

ASSIGNED FREQUENCY RANGE:

2496 – 2690 MHz

DETECTOR USED:

Average

MODULATION:

QPSK

MODULATING SIGNAL:

PRBS

TRANSMITTER OUTPUT POWER SETTINGS:

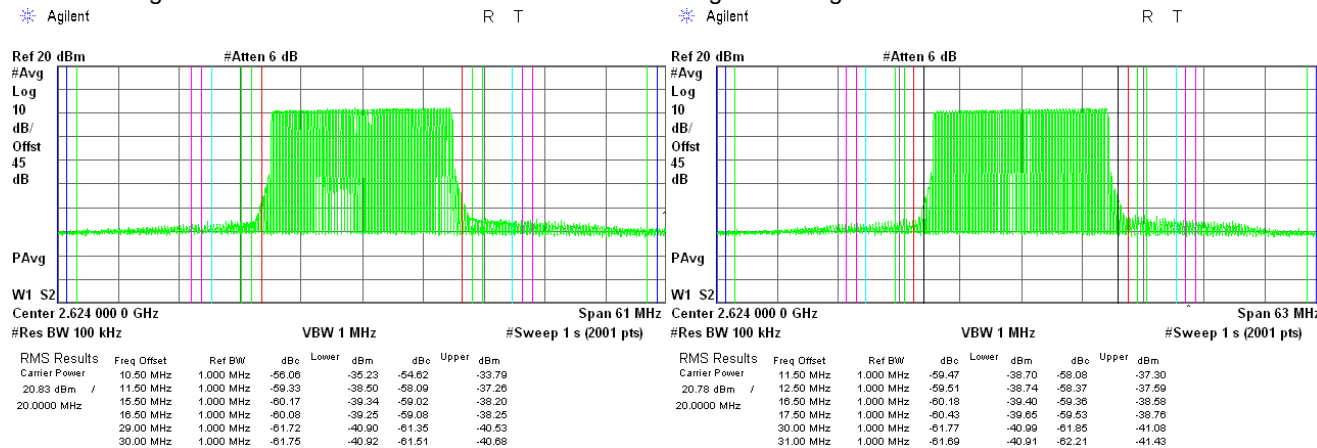
Maximum

ANTENNA PORT:

#21

Low band edge

High band edge



Test specification: Section 27.53(m)(4), Band edge emissions	
Test procedure: 47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode: Compliance	Verdict: PASS
Date(s): 22-Jan-17	
Temperature: 25 °C	Relative Humidity: 42 %
Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:	

Plot 7.4.9 Spurious emission at band edges test results at high carrier frequency, 20 MHz EBW

ASSIGNED FREQUENCY RANGE:

2496 – 2690 MHz

DETECTOR USED:

Average

MODULATION:

QPSK

MODULATING SIGNAL:

PRBS

TRANSMITTER OUTPUT POWER SETTINGS:

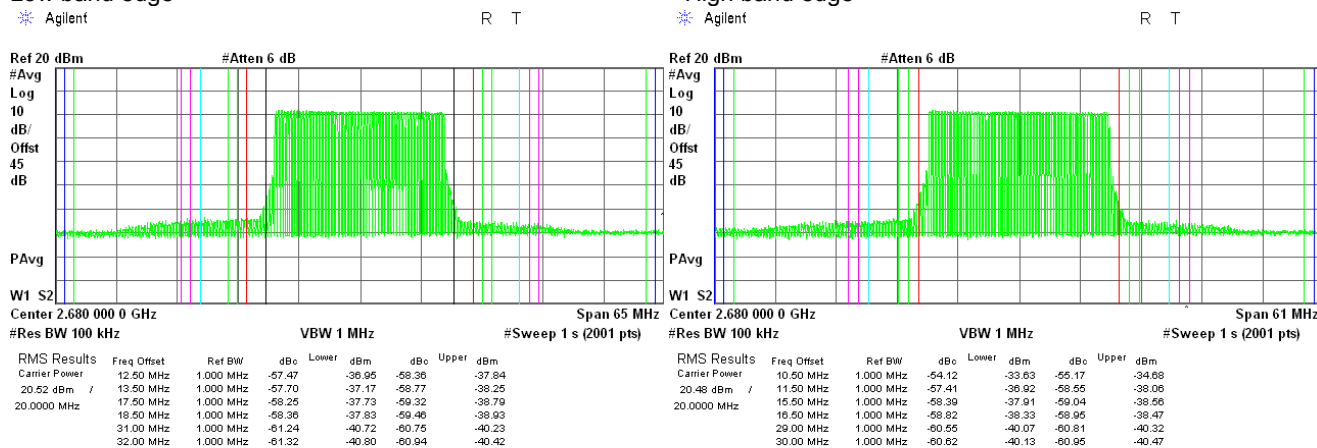
Maximum

ANTENNA PORT:

#21

Low band edge

High band edge



Plot 7.4.10 Spurious emission at band edges test results at low carrier frequency, 20 MHz EBW

ASSIGNED FREQUENCY RANGE:

2496 – 2690 MHz

DETECTOR USED:

Average

MODULATION:

64QAM

MODULATING SIGNAL:

PRBS

TRANSMITTER OUTPUT POWER SETTINGS:

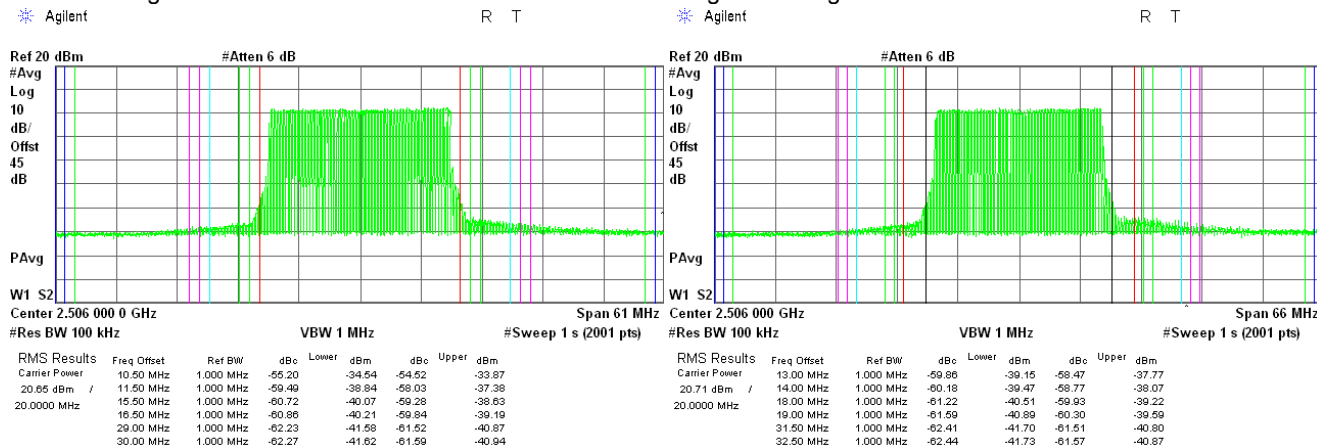
Maximum

ANTENNA PORT:

#21

Low band edge

High band edge



Test specification: Section 27.53(m)(4), Band edge emissions			
Test procedure: 47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13			
Test mode: Compliance		Verdict: PASS	
Date(s): 22-Jan-17			
Temperature: 25 °C	Relative Humidity: 42 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Plot 7.4.11 Spurious emission at band edges test results at mid carrier frequency, 20 MHz EBW

ASSIGNED FREQUENCY RANGE:

2496 – 2690 MHz

DETECTOR USED:

Average

MODULATION:

64QAM

MODULATING SIGNAL:

PRBS

TRANSMITTER OUTPUT POWER SETTINGS:

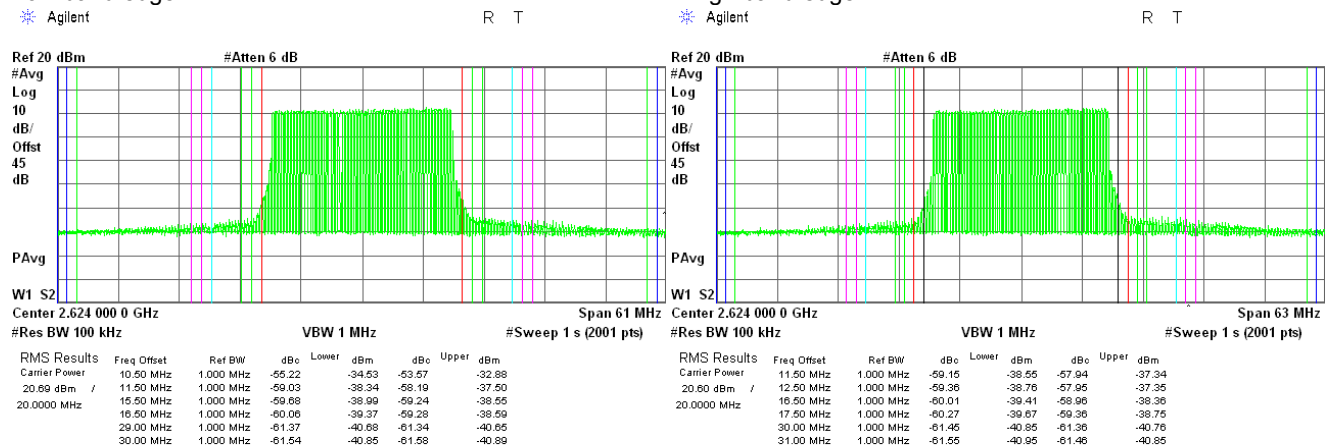
Maximum

ANTENNA PORT:

#21

Low band edge

High band edge



Plot 7.4.12 Spurious emission at band edges test results at high carrier frequency, 20 MHz EBW

ASSIGNED FREQUENCY RANGE:

2496 – 2690 MHz

DETECTOR USED:

Average

MODULATION:

64QAM

MODULATING SIGNAL:

PRBS

TRANSMITTER OUTPUT POWER SETTINGS:

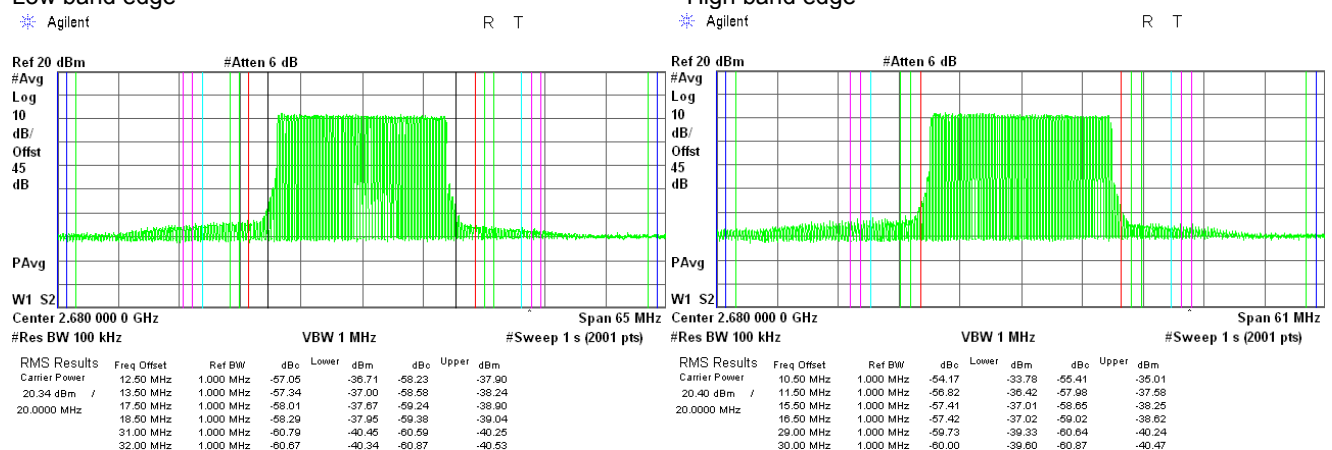
Maximum

ANTENNA PORT:

#21

Low band edge

High band edge





Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

7.5 Radiated spurious emission measurements

7.5.1 General

This test was performed to measure radiated spurious emissions from the EUT. Specification test limits are given in Table 7.5.1.

Table 7.5.1 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** mobile	-25	72.4

* - Excluding the band emission

** - 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

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

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

7.5.2.2 The 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.

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

7.5.3 Test procedure for spurious emission field strength measurements above 30 MHz

7.5.3.1 The EUT was set up as shown in Figure 7.5.2, energized and the performance check was conducted.

7.5.3.2 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.

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

7.5.4 Test procedure for substitution ERP measurements of spurious

7.5.4.1 The test equipment was set up as shown in Figure 7.5.3 and energized.

7.5.4.2 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.

7.5.4.3 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.

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

7.5.4.5 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.

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

7.5.4.7 The worst test results (the lowest margins) were recorded in Table 7.5.3 and shown in the associated plots.

Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

Figure 7.5.1 Setup for spurious emission field strength measurements in 9 kHz to 30 MHz band

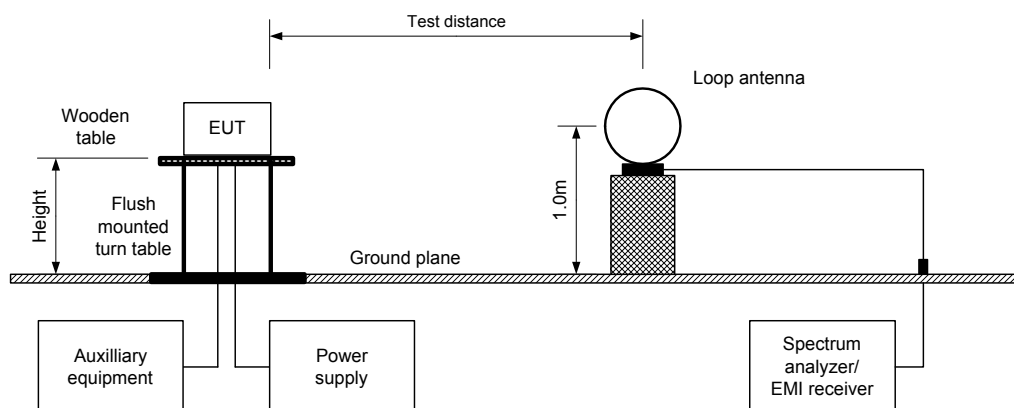
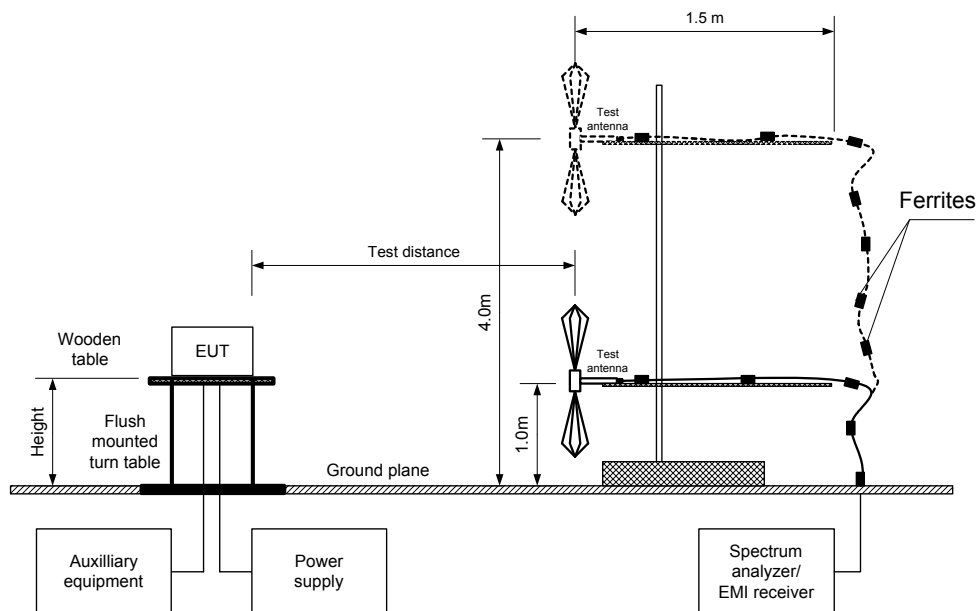
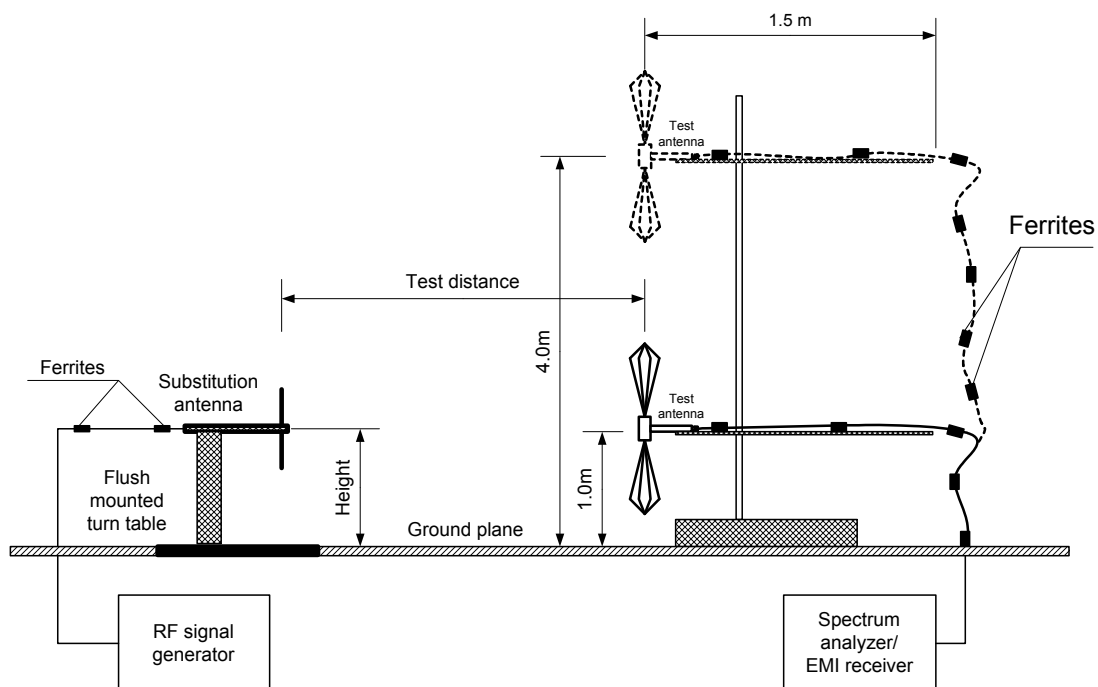


Figure 7.5.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

Figure 7.5.3 Setup for substitution ERP measurements of spurious





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Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

Table 7.5.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE: 2496-2690 MHz
 TEST DISTANCE: 3 m
 TEST SITE: Semi anechoic chamber
 EUT HEIGHT: 0.8 m
 INVESTIGATED FREQUENCY RANGE: 0.009 –27000 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: 64 QAM
 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 2506 MHz							
165	50.2	72.4	-22.2	120	Horizontal	1.5	256
495	55.1	72.4	-17.3	120	Horizontal	1.7	205
7518	51.2	72.4	-21.2	1000	Horizontal	1.4	90
Mid carrier frequency 2624 MHz							
165	50.2	72.4	-22.2	120	Horizontal	1.5	256
495	55.1	72.4	-17.3	120	Horizontal	1.7	205
7872	52.9	72.4	-19.5	1000	Horizontal	1.4	90
High carrier frequency 2680 MHz							
165	50.2	72.4	-22.2	120	Horizontal	1.5	256
199.7	52.7	72.4	-19.7	120	Horizontal	1.5	256
495	55.1	72.4	-17.3	120	Horizontal	1.7	205
8040	57.9	72.4	-14.5	1000	Horizontal	1.4	90

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

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



Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

Table 7.5.3 Substitution ERP of spurious test results

ASSIGNED FREQUENCY RANGE: 2496-2690 MHz
 TEST DISTANCE: 3 m
 TEST SITE: Semi anechoic chamber
 INVESTIGATED FREQUENCY RANGE: 0.009 –27000 MHz
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: > Resolution bandwidth

Frequency, MHz	Field strength, dB(μV/m)	RBW, kHz	Antenna polariz.	RF generator output, dBm	Ant gain, dBd	Cable loss, dB	ERP, dBm	Limit, dBm	Margin, dB*	Verdict
Low carrier frequency 2506 MHz										
165	50.2	120	Horizontal	-45.5	-2.1	0.4	-48.0	-25	-23.0	Pass
495	55.1	120	Horizontal	-40.5	-1.8	1.0	-43.3	-25	-18.3	Pass
7518	51.2	1000	Horizontal	-53.0	7.2	2.7	-48.5	-25	-23.5	Pass
Mid carrier frequency 2624 MHz										
165	50.2	120	Horizontal	-45.5	-2.1	0.4	-48.0	-25	-23.0	Pass
495	55.1	120	Horizontal	-40.5	-1.8	1.0	-43.3	-25	-18.3	Pass
7872	52.9	1000	Horizontal	-50.5	7.4	2.8	-45.9	-25	-20.9	Pass
High carrier frequency 2680 MHz										
165	50.2	120	Horizontal	-45.5	-2.1	0.4	-48.0	-25	-23.0	Pass
199.7	52.7	120	Horizontal	-44.5	-0.5	0.5	-45.5	-25	-20.5	Pass
495	55.1	120	Horizontal	-40.5	-1.8	1.0	-43.3	-25	-18.3	Pass
8040	57.9	1000	Horizontal	-45.5	7.4	2.9	-41.0	-25	-16.0	Pass

*- Margin = Spurious emission – specification limit.

Reference numbers of test equipment used

HL 0030	HL 0446	HL 0604	HL 0614	HL 0661	HL 1984	HL 3347	HL 4222
HL 4277	HL 4342	HL 4353	HL 4933	HL 4956	HL 5101		

Full description is given in Appendix A.



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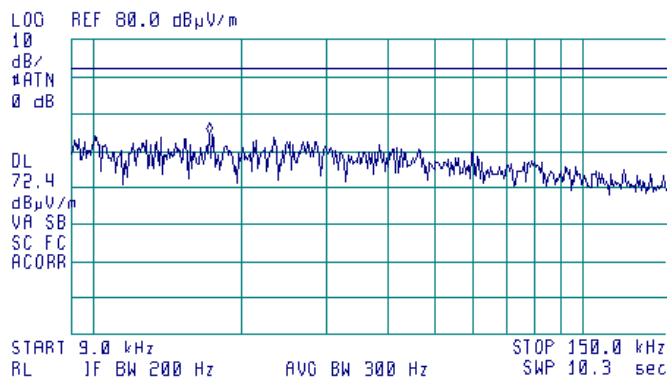
Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.1 Radiated emission measurements in 9 - 150 kHz range

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



ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 17.1 kHz
54.61 dBµV/m

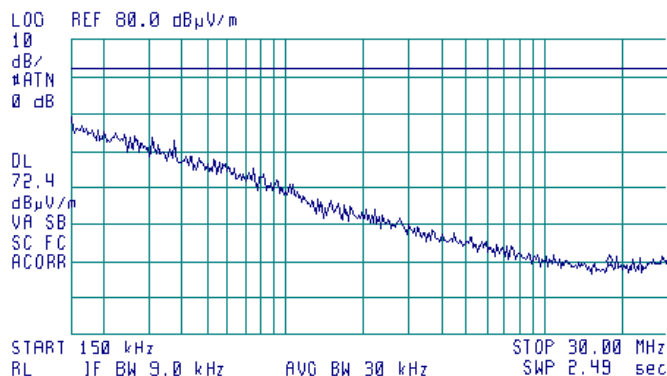


Plot 7.5.2 Radiated emission measurements in 0.15 - 30 MHz range

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



ACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 17.59 MHz
10.67 dBµV/m



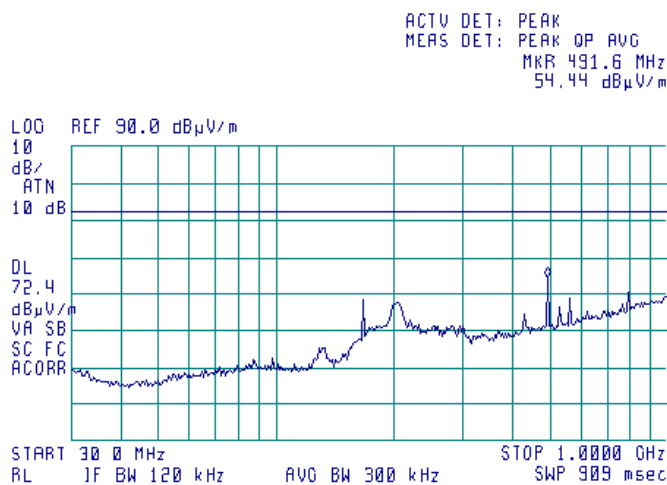


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Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

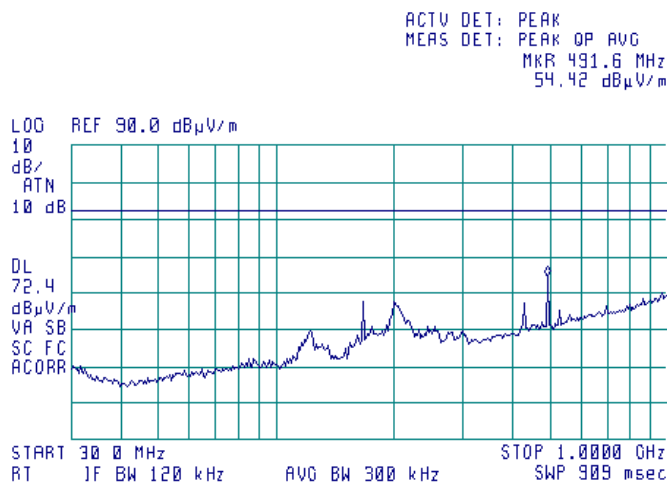
Plot 7.5.3 Radiated emission measurements in 30 - 1000 MHz range

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



Plot 7.5.4 Radiated emission measurements in 30 - 1000 MHz range

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





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Report ID: AIRRAD_FCC.29170.docx

Date of Issue: 6-Feb-17

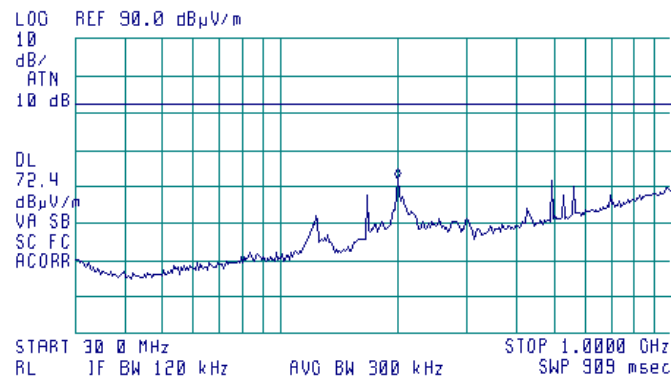
Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.5 Radiated emission measurements in 30 - 1000 MHz range

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



ACTV DET: PEAK
MEAS DET: PEAK OP AVG
MKR 199.5 MHz
52.09 dBμV/m



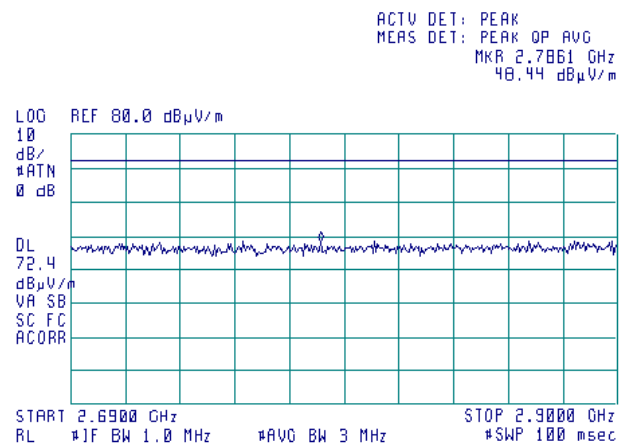
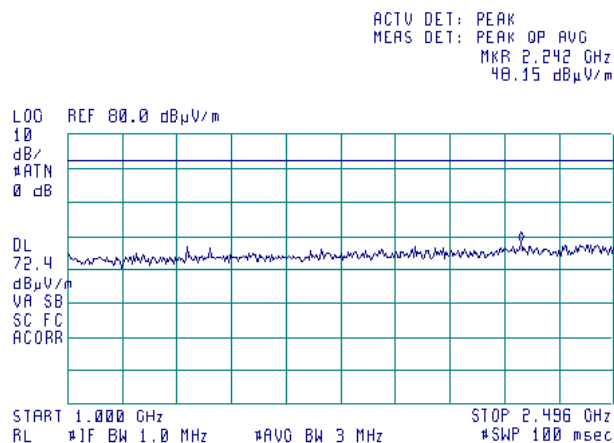
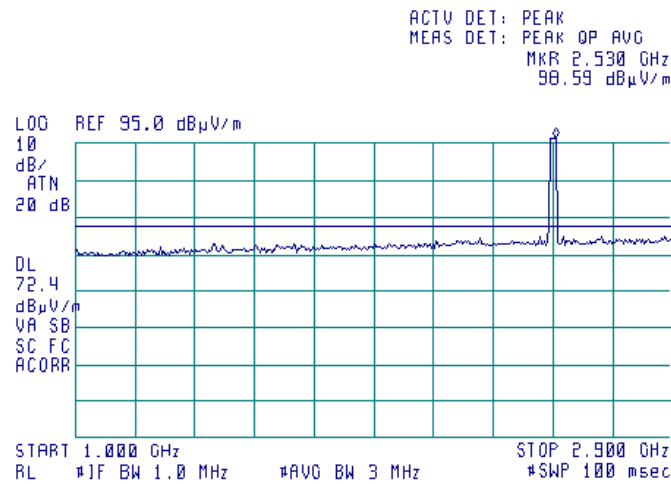


HERMON LABORATORIES

Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.6 Radiated emission measurements in 1000 – 2900 MHz range

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



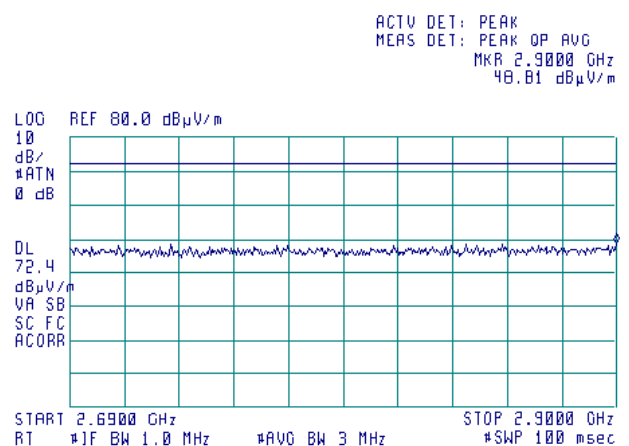
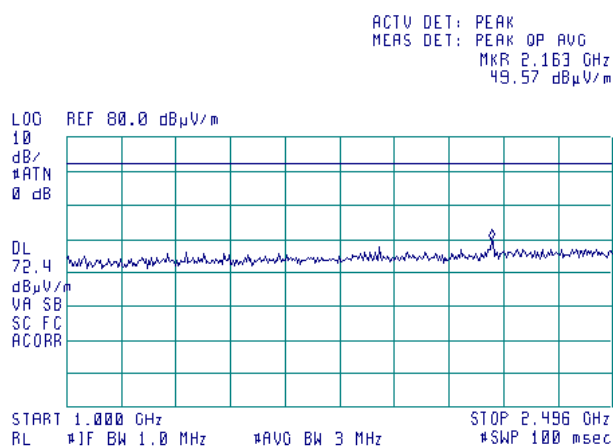
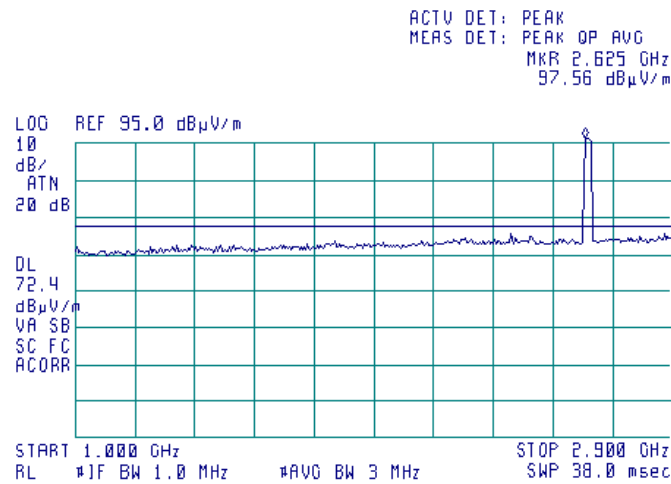


HERMON LABORATORIES

Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.7 Radiated emission measurements in 1000 – 2900 MHz range

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



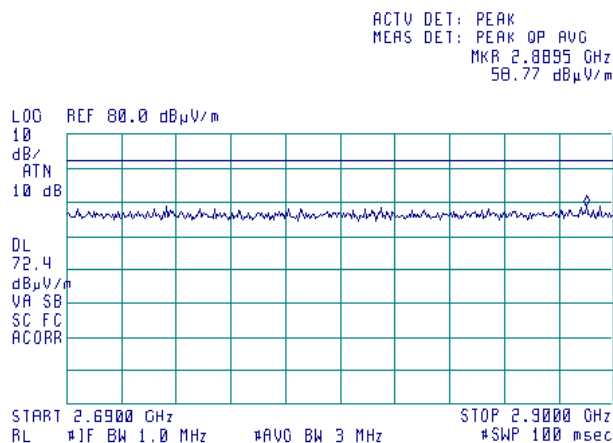
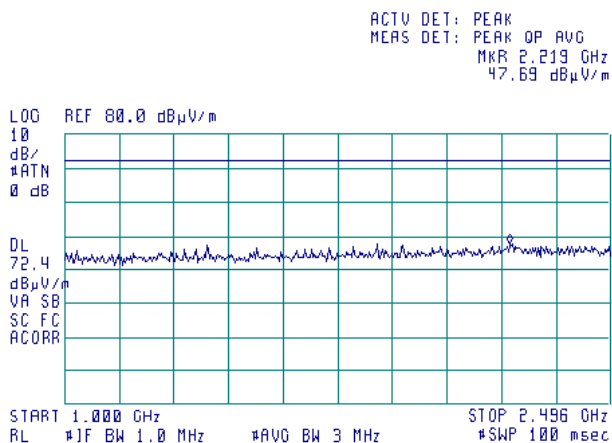
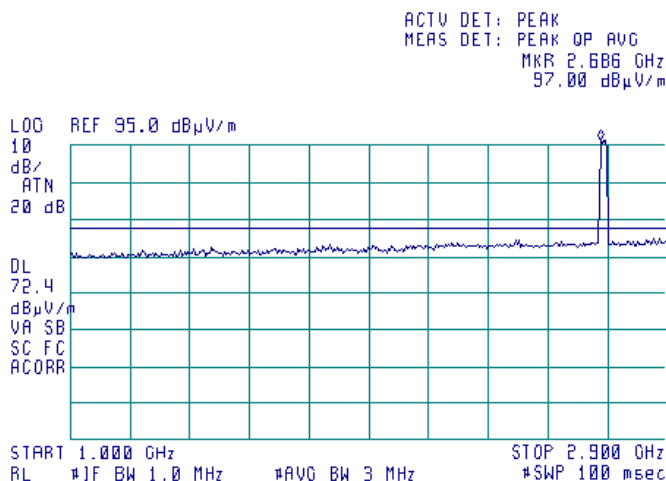


HERMON LABORATORIES

Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.8 Radiated emission measurements in 1000 – 2900 MHz range

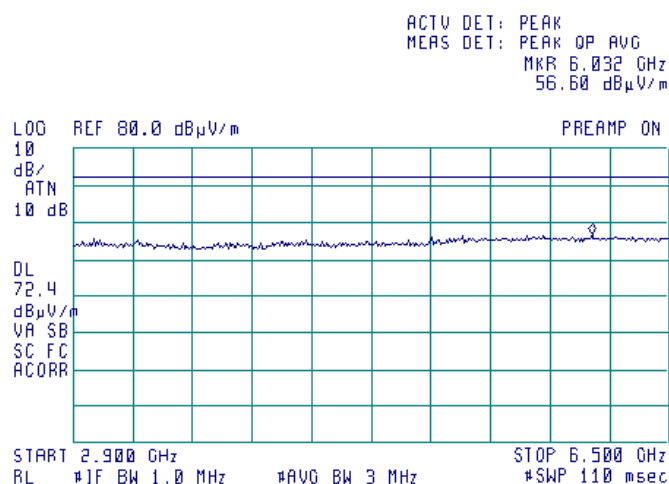
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

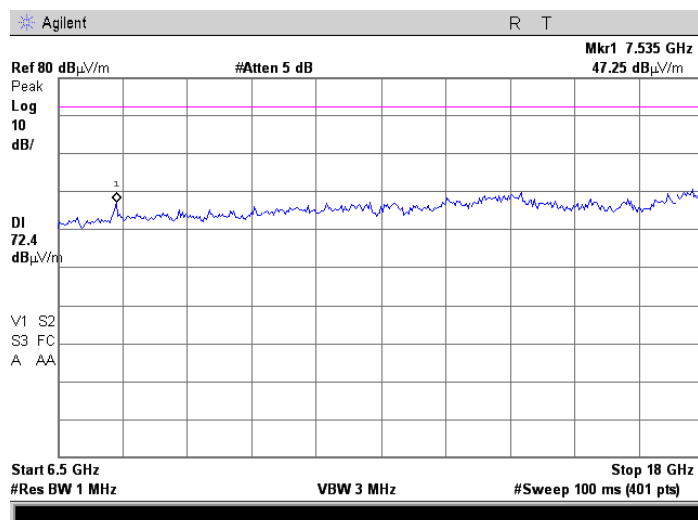
Plot 7.5.9 Radiated emission measurements in 2900 – 6500 MHz range

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



Plot 7.5.10 Radiated emission measurements in 6500 – 18000 MHz range

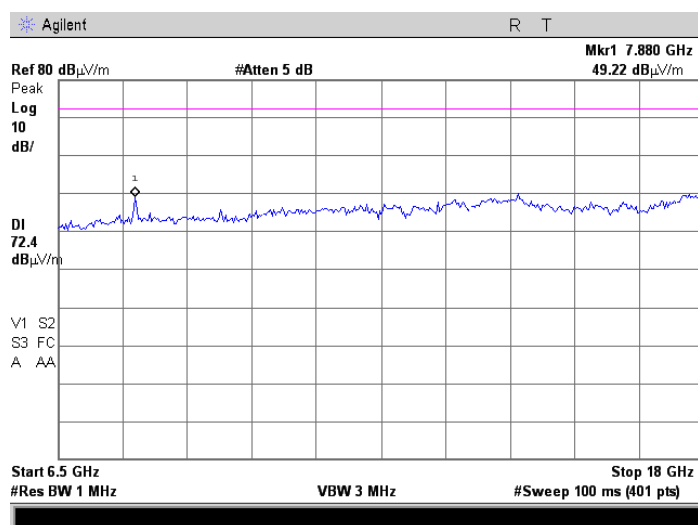
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Low
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

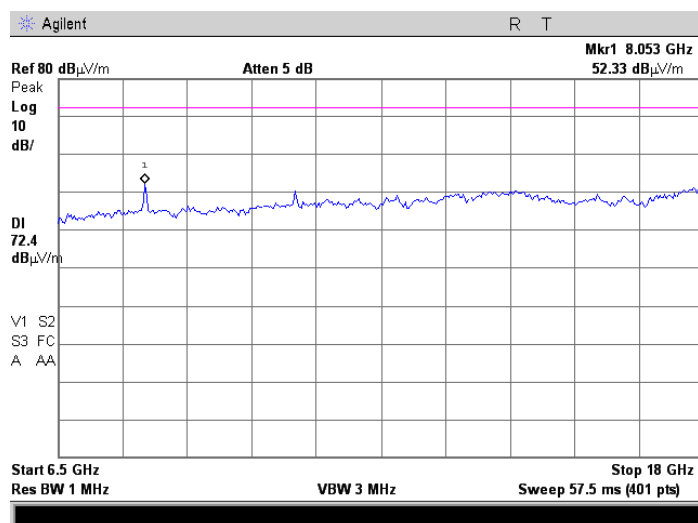
Plot 7.5.11 Radiated emission measurements in 6500 – 18000 MHz range

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



Plot 7.5.12 Radiated emission measurements in 6500 – 18000 MHz range

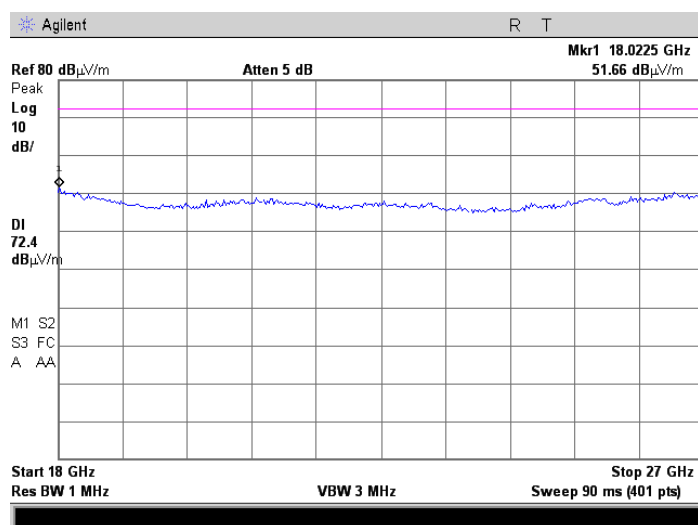
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.13 Radiated emission measurements in 18000 – 26500 MHz range

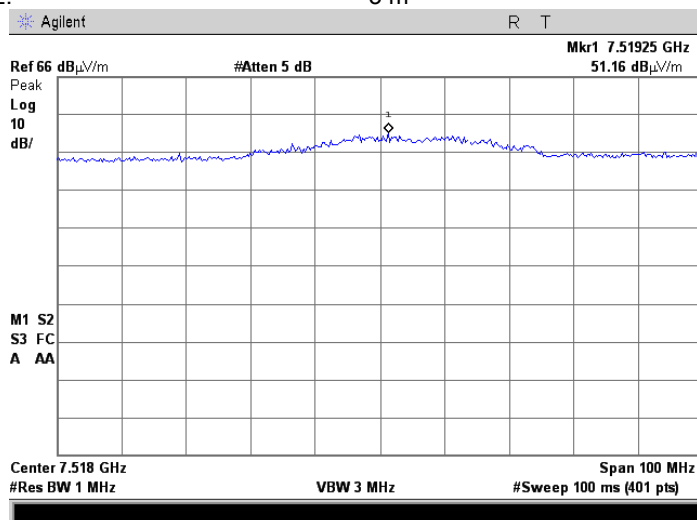
TEST SITE:	Semi anechoic chamber
CARRIER FREQUENCY:	Low, mid, high
ANTENNA POLARIZATION:	Vertical and Horizontal
TEST DISTANCE:	3 m



Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

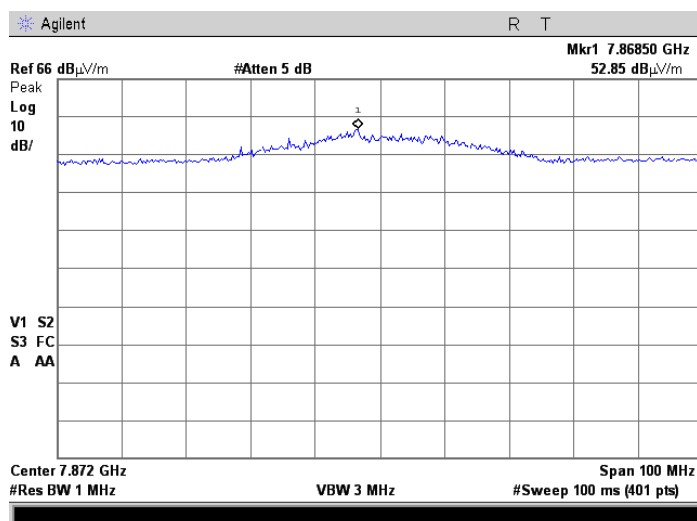
Plot 7.5.14 Radiated emission measurements at the 3rd harmonic

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



Plot 7.5.15 Radiated emission measurements at the 3rd harmonic

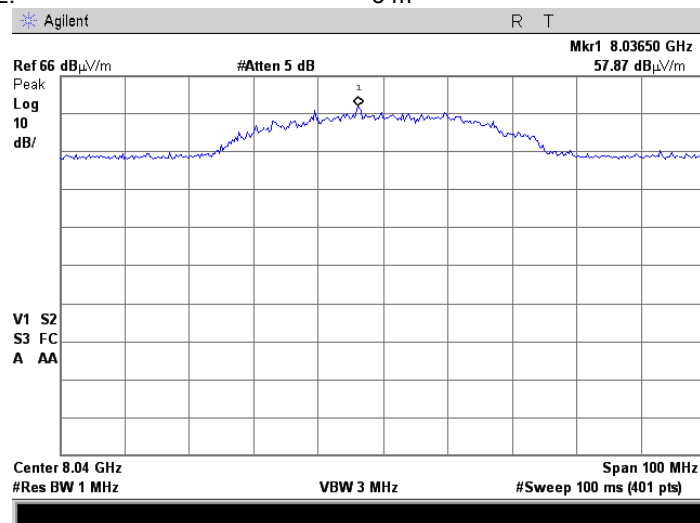
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical & Horizontal
TEST DISTANCE: 3 m



Test specification: Section 27.53, Radiated spurious emissions			
Test procedure: 47 CFR, Sections 2.1053; TIA/EIA-603-D, Section 2.2.12			
Test mode: Compliance		Verdict: PASS	
Date(s): 26-Jan-17 - 29-Jan-17			
Temperature: 22 °C	Relative Humidity: 49 %	Air Pressure: 1008 hPa	Power: 120 VAC
Remarks:			

Plot 7.5.16 Radiated emission measurements at the 3rd harmonic

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



Test specification:		Section 27.54, Frequency stability	
Test procedure:		47 CFR, Section 2.1055; TIA/EIA-603-D Section 2.2.2	
Test mode:		Verdict: PASS	
Date(s):			
23-Jan-17			
Temperature: 25 °C	Relative Humidity: 46 %	Air Pressure: 1022 hPa	Power: 120 VAC
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.

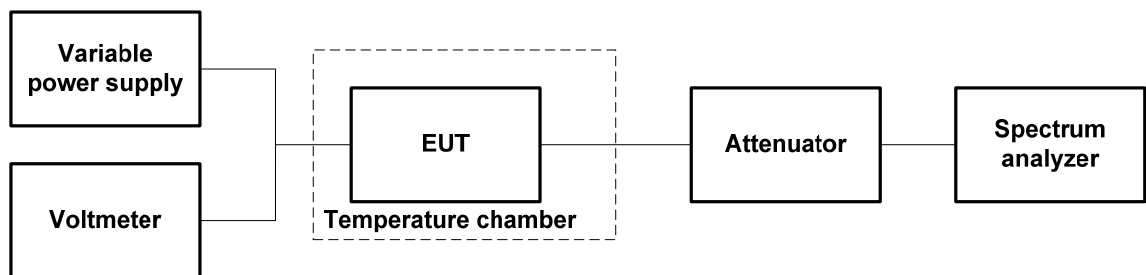
Table 7.6.1 Frequency stability limits

Assigned frequency, MHz	Maximum allowed frequency displacement
2496.0 – 2690.0	The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

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 provided in Table 7.6.2.
- 7.6.2.7 The test results recorded in Table 7.6.3, Table 7.6.4.

Figure 7.6.1 Frequency stability test setup



Test specification: Section 27.54, Frequency stability			
Test procedure: 47 CFR, Section 2.1055; TIA/EIA-603-D Section 2.2.2			
Test mode: Compliance		Verdict: PASS	
Date(s): 23-Jan-17			
Temperature: 25 °C	Relative Humidity: 46 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Table 7.6.2 Frequency stability test results

OPERATING FREQUENCY: 2496.0 – 2690.0 MHz
 NOMINAL POWER VOLTAGE: 120 V
 TEMPERATURE STABILIZATION PERIOD: 20 min
 POWER DURING TEMPERATURE TRANSITION: Off
 SPECTRUM ANALYZER MODE: Counter
 RESOLUTION BANDWIDTH: 1 kHz
 VIDEO BANDWIDTH: 3 kHz
 MODULATION: Unmodulated

T, °C	Voltage, V	Frequency, MHz							Max frequency drift, Hz	
		Start up	1 st min	2 nd min	3 rd min	4 th min	5 th min	10 th min	Positive	Negative
Low carrier frequency 2506										
-30	nominal	2506.001550	2506.001575	2506.001575	2506.001550	2506.001550	2506.001575	2506.001550	725	0
-20	nominal	2506.001450	NA	NA	NA	NA	NA	2506.001475	625	0
-10	nominal	2506.001350	NA	NA	NA	NA	NA	2506.001350	500	0
0	nominal	2506.001225	2506.001250	2506.001250	2506.001250	2506.001275	2506.001300	2506.001325	475	0
10	nominal	2506.000725	NA	NA	NA	NA	NA	2506.000925	75	125
20	15%	2506.000675	NA	NA	NA	NA	NA	2506.000875	25	175
20	nominal	2506.000650	NA	NA	NA	NA	NA	2506.000850*	0	200
20	-15%	2506.000650	NA	NA	NA	NA	NA	2506.000850	0	200
30	nominal	2505.999625	2505.999650	2505.999650	2505.999675	2505.999700	2505.999725	2505.999800	0	1225
40	nominal	2506.000250	NA	NA	NA	NA	NA	2506.000250	0	600
50	nominal	2506.000325	NA	NA	NA	NA	NA	2506.000300	0	550
Mid carrier frequency 2624										
-30	nominal	2624.001625	2624.001625	2624.001625	2624.001650	2624.001650	2624.001650	2624.001600	750	0
-20	nominal	2624.001500	NA	NA	NA	NA	NA	2624.001525	625	0
-10	nominal	2624.001400	NA	NA	NA	NA	NA	2624.001425	525	0
0	nominal	2624.001350	2624.001400	2624.001400	2624.001425	2624.001450	2624.001400	2624.001475	575	0
10	nominal	2624.000750	NA	NA	NA	NA	NA	2624.000950	50	150
20	15%	2624.000725	NA	NA	NA	NA	NA	2624.000900	0	175
20	nominal	2624.000725	NA	NA	NA	NA	NA	2624.000900*	0	175
20	-15%	2624.000775	NA	NA	NA	NA	NA	2624.000875	0	125
30	nominal	2623.999800	2623.999800	2623.999825	2623.999850	2623.999850	2623.999875	2623.999975	0	1100
40	nominal	2624.000250	NA	NA	NA	NA	NA	2624.000275	0	650
50	nominal	2624.000325	NA	NA	NA	NA	NA	2624.000300	0	600
High carrier frequency 2680										
-30	nominal	2680.001625	2680.001625	2680.001625	2680.001625	2680.001625	2680.001650	2680.001650	750	0
-20	nominal	2680.001550	NA	NA	NA	NA	NA	2680.001575	675	0
-10	nominal	2680.001450	NA	NA	NA	NA	NA	2680.001450	550	0
0	nominal	2680.001525	2680.001525	2680.001525	2680.001525	2680.001500	2680.001525	2680.001550	650	0
10	nominal	2680.000800	NA	NA	NA	NA	NA	2680.000925	25	100
20	15%	2680.000800	NA	NA	NA	NA	NA	2680.000875	0	100
20	nominal	2680.000800	NA	NA	NA	NA	NA	2680.000900*	0	100
20	-15%	2680.000775	NA	NA	NA	NA	NA	2680.000875	0	125
30	nominal	2679.999975	2679.999950	2680.000000	2680.000050	2680.000025	2680.000050	2680.000125	0	950
40	nominal	2680.000225	NA	NA	NA	NA	NA	2680.000300	0	675
50	nominal	2680.000350	NA	NA	NA	NA	NA	2680.000300	0	600

* - Reference frequency



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Test specification:		Section 27.54, Frequency stability	
Test procedure:		47 CFR, Section 2.1055; TIA/EIA-603-D Section 2.2.2	
Test mode:	Compliance	Verdict: PASS	
Date(s):	23-Jan-17		
Temperature: 25 °C	Relative Humidity: 46 %	Air Pressure: 1022 hPa	Power: 120 VAC
Remarks:			

Table 7.6.3 Maximum frequency displacement

Channel	Maximum frequency displacement			
	ppm		Hz	
	Negative	Positive	Negative	Positive
Low	0.4888	0.2893	1225	725
Mid	0.4192	0.2858	1100	750
High	0.3545	0.2799	950	750

Table 7.6.4 Transmission occupied bandwidth with frequency drift test results

Lower measured* band edge, MHz	Upper measured* band edge, MHz	Lower calculated** band edge, MHz	Upper calculated** band edge, MHz	Lower specified band edge, MHz	Upper specified band edge, MHz	Lower margin***, MHz	Upper margin***, MHz	Verdict
2496.392000	2515.608000	2496.390775	2515.608725	2496.000000	2516.000000	0.390775	-0.392725	Pass
2496.446000	2515.555000	2496.444900	2515.555750	2614.000000	2634.000000	0.436400	-0.438250	Pass
2496.424000	2515.577000	2496.423050	2515.577750	2670.000000	2690.000000	0.379050	-0.380750	Pass

* - Measured under normal test conditions at 26 dBc points

** - Measured band edge with proper drift addition

*** - Margin = Calculated band edge – specified band edge

Reference numbers of test equipment used

HL 3433	HL 3434	HL 3818					
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Full description is given in Appendix A.

8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
0030	Antenna, Dipole, Tunable, 30 - 200 MHz	Electro-Metrics	TDA-25/30	261	08-Feb-16	08-Feb-17
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	19-Jan-17	19-Jan-18
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	10-May-16	10-May-17
0614	Antenna, Dipole, Tunable, 200 - 500 MHz	Electro-Metrics	TDS-30-1	334	08-Feb-16	08-Feb-17
0661	Generator Swept Signal, 10 MHz to 40 GHz, + 10 dBm	Hewlett Packard	83640B	3614A00266	10-May-16	10-May-17
1984	Antenna, Double-Ridged Waveguide Horn, 1 to 18 GHz, 300 W	EMC Test Systems	3115	9911-5964	28-Mar-16	28-Mar-17
2214	Directional Coupler 1.7-26.5 GHz	Krytar	2616	31354	16-Sep-15	16-Sep-17
3301	Power Meter, P-series, 50 MHz to 40 GHz	Agilent Technologies	N1911A	MY45101057	26-Apr-16	26-Jul-17
3302	Power sensor, P-Series, 50 MHz to 40 GHz, -35/30 to 20 dBm	Agilent Technologies	N1922A	MY45240586	30-Jan-15	30-Apr-16
3347	High Pass Filter, 50 Ohm, 6000 to 11500 MHz.	Mini-Circuits	VHF-5500+	NA	01-Oct-15	01-Oct-17
3433	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25679	20-Mar-16	20-Mar-17
3434	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25683	20-Mar-16	20-Mar-17
3787	Precision Fixed Attenuator, 50 Ohm, 5 W, 10 dB, DC to 18 GHz	Mini-Circuits	BW-S10W5+	NA	07-Dec-16	07-Dec-17
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY48250288	03-May-16	03-May-17
4068	Attenuator, SMA, 30 dB, DC to 12.4 GHz	Midwest Microwave	ATT-0527-30-SMA-07	NA	17-Jul-16	17-Jul-17
4222	High Pass Filter, 50 Ohm, 3150 to 6500 MHz	Mini-Circuits	VHF-2700+	NA	01-Oct-15	01-Oct-17
4277	Test Cable , DC-18 GHz, 3.05 m, N/M - N/M	Mini-Circuits	APC-10FT-NMNM+	0748A	26-Sep-16	26-Sep-17
4342	High Pass Filter, 50 Ohm, 10.6 to 26.5 GHz,SMA-M / SMA-FM	RLC Electronics	F-5738A	8425	08-May-16	08-May-17
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-16	15-Mar-17
4366	Directional coupler, 1 GHz to 18 GHz, 10 dB, SMA Female	Tiger Micro-Electronics Institute	TGD-A1101-10	01e-JSDE805-007	26-May-16	26-May-18
4933	Active Horn Antenna, 1 GHz to 18 GHz	Com-Power Corporation	AHA-118	701046	14-Oct-16	14-Oct-17
4956	Active horn antenna, 18 to 40 GHz	Com-Power Corporation	AHA-840	105004	17-Jan-17	17-Jan-18
5101	RF cable, 18 GHz, 6 m, N-type	Huber-Suhner	SF106A/11N/11N/6000MM	500847/6A	26-Jul-16	26-Jul-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	±8%
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Spurious emissions radiated 30 MHz – 40 GHz (substitution method)	± 4.5 dB
Frequency error	30 – 300 MHz: ± 50.5 Hz (1.68 ppm) 300 – 1000 MHz: ± 168 Hz (0.56 ppm)
Transient frequency behaviour	187 Hz ± 13.9 %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %
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 facility description

Tests were performed at Hermon Laboratories Ltd., which is a fully independent, private, EMC, 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, 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 and environmental simulation (for exact scope please refer to Certificate No. 839.01).

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11 APPENDIX D Specification references

47CFR part 27: 2015	Private land mobile radio services
47CFR part 1: 2015	Practice and procedure
47CFR part 2: 2015	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 C63.4: 2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI/TIA/EIA-603-D:2010	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

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).



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Antenna factor, HL 4933

**Active Horn Antenna Factor Calibration**

1 GHz to 18 GHz

Equipment:			ACTIVE HORN ANTENNA		
Model:			AHA-118		
Serial Number:			701046		
Calibration Distance:			3 Meter		
Polarization:			Horizontal		
Calibration Date:			11/12/2014		
Frequency (GHz)	Preamplifier Gain (dB)	Antenna Factor with pre-amp (dB/m)	Frequency (GHz)	Preamplifier Gain (dB)	Antenna Factor with pre-amp (dB/m)
1	40.96	-16.47	10	40.94	-1.97
1.5	41.21	-14.53	10.5	40.63	-1.06
2	41.44	-13.30	11	40.74	-1.50
2.5	41.71	-12.87	11.5	40.65	-0.52
3	41.96	-12.26	12	40.76	-0.15
3.5	42.14	-11.77	12.5	41.03	-0.85
4	42.13	-10.91	13	41.37	-0.81
4.5	41.79	-9.41	13.5	41.18	0.05
5	41.44	-7.54	14	40.98	0.36
5.5	40.91	-6.47	14.5	40.81	1.26
6	40.69	-5.48	15	40.65	0.25
6.5	40.64	-5.53	15.5	40.93	-1.05
7	40.76	-4.12	16	41.31	-1.44
7.5	40.94	-3.12	16.5	40.96	-0.80
8	40.68	-1.69	17	40.64	-0.02
8.5	40.08	-1.71	17.5	40.57	1.81
9	40.41	-1.86	18	40.08	3.63
9.5	41.21	-2.73			
Calibration according to ARP 958					
Antenna Factor to be added to receiver reading: Meter Reading (dBuV) + Antenna Factor (dB/m) = Corrected Reading (dBuV/m)					



HERMON LABORATORIES

Antenna factor, HL 4956

**Active Horn Antenna Factor Calibration**

18 GHz to 40 GHz

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

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
Test Cable, Mini-Circuits, CBL-5FT-SMSM+, SMA-SMA, 18 GHz, 1.5 m, S/N 25683
Mini-Circuits, HL 3434

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10.0	0.06	9000	1.96
100	0.16	9500	2.01
500	0.40	10000	2.01
1000	0.57	10500	2.14
1500	0.72	11000	2.21
2000	0.85	11500	2.24
2500	0.95	12000	2.36
3000	1.03	12500	2.47
3500	1.11	13000	2.46
4000	1.21	13500	2.50
4500	1.29	14000	2.53
5000	1.39	14500	2.53
5500	1.46	15000	2.62
6000	1.52	15500	2.70
6500	1.60	16000	2.80
7000	1.68	16500	2.86
7500	1.75	17000	2.88
8000	1.83	17500	2.94
8500	1.88	18000	3.00

Cable loss
Test cable, Mini-Circuits, S/N 0748A, 18 GHz, 3.05 m, N/M - N/M
APC-10FT-NMNM+, HL 4277

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.12	4400	3.19	9000	4.82	13600	5.97
30	0.21	4500	3.24	9100	4.87	13700	6.01
50	0.28	4600	3.29	9200	4.90	13800	6.04
100	0.40	4700	3.34	9300	4.96	13900	6.09
200	0.59	4800	3.37	9400	4.99	14000	6.12
300	0.73	4900	3.41	9500	5.03	14100	6.16
400	0.86	5000	3.45	9600	5.07	14200	6.20
500	0.97	5100	3.48	9700	5.11	14300	6.22
600	1.07	5200	3.52	9800	5.13	14400	6.26
700	1.15	5300	3.56	9900	5.15	14500	6.29
800	1.23	5400	3.58	10000	5.17	14600	6.33
900	1.31	5500	3.62	10100	5.19	14700	6.33
1000	1.39	5600	3.65	10200	5.19	14800	6.35
1100	1.46	5700	3.69	10300	5.21	14900	6.38
1200	1.54	5800	3.72	10400	5.22	15000	6.38
1300	1.60	5900	3.76	10500	5.22	15100	6.40
1400	1.67	6000	3.80	10600	5.22	15200	6.42
1500	1.74	6100	3.84	10700	5.25	15300	6.46
1600	1.79	6200	3.89	10800	5.25	15400	6.51
1700	1.86	6300	3.92	10900	5.26	15500	6.55
1800	1.92	6400	3.96	11000	5.29	15600	6.56
1900	1.98	6500	4.00	11100	5.30	15700	6.59
2000	2.04	6600	4.04	11200	5.31	15800	6.60
2100	2.09	6700	4.07	11300	5.35	15900	6.64
2200	2.14	6800	4.11	11400	5.36	16000	6.65
2300	2.20	6900	4.14	11500	5.39	16100	6.65
2400	2.25	7000	4.17	11600	5.41	16200	6.67
2500	2.31	7100	4.21	11700	5.45	16300	6.69
2600	2.36	7200	4.23	11800	5.48	16400	6.71
2700	2.42	7300	4.27	11900	5.51	16500	6.72
2800	2.46	7400	4.30	12000	5.53	16600	6.73
2900	2.51	7500	4.34	12100	5.56	16700	6.75
3000	2.56	7600	4.37	12200	5.59	16800	6.80
3100	2.60	7700	4.40	12300	5.61	16900	6.82
3200	2.65	7800	4.44	12400	5.62	17000	6.85
3300	2.70	7900	4.47	12500	5.65	17100	6.90
3400	2.75	8000	4.49	12600	5.68	17200	6.96
3500	2.80	8100	4.53	12700	5.71	17300	7.02
3600	2.85	8200	4.57	12800	5.73	17400	7.07
3700	2.90	8300	4.60	12900	5.76	17500	7.06
3800	2.95	8400	4.63	13000	5.80	17600	7.06
3900	2.98	8500	4.67	13100	5.83	17700	7.08
4000	3.02	8600	4.69	13200	5.86	17800	7.09
4100	3.07	8700	4.73	13300	5.88	17900	7.07
4200	3.10	8800	4.76	13400	5.91	18000	7.08
4300	3.14	8900	4.79	13500	5.94		

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		

Cable loss
RF Cable, Huber-Suhner, 18 GHz, 6 m, N- type,
SF106A/11N/11N/6000MM, S/N 500847/6A
HL 5101

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
0.1	0.01	5500	2.42
50	0.22	6000	2.53
100	0.31	6500	2.65
200	0.43	7000	2.76
300	0.53	7500	2.86
400	0.62	8000	2.96
500	0.69	8500	3.06
600	0.76	9000	3.16
700	0.82	9500	3.26
800	0.87	10000	3.35
900	0.93	10500	3.44
1000	0.98	11000	3.54
1100	1.03	11500	3.62
1200	1.08	12000	3.70
1300	1.12	12500	3.80
1400	1.17	13000	3.88
1500	1.21	13500	3.97
1600	1.25	14000	4.04
1700	1.29	14500	4.13
1800	1.33	15000	4.22
1900	1.37	15500	4.31
2000	1.41	16000	4.39
2500	1.59	16500	4.47
3000	1.75	17000	4.54
3500	1.90	17500	4.61
4000	2.04	18000	4.68
4500	2.17		
5000	2.30		

13 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
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
dB Ω	decibel referred to one Ohm
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
ITE	information technology equipment
k	kilo
kHz	kilohertz
LISN	line impedance stabilization network
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μ s	microsecond
NA	not applicable
NB	narrow band
NT	not tested
OATS	open area test site
Ω	Ohm
QP	quasi-peak
PCB	printed circuit board
PM	pulse modulation
PS	power supply
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
VA	volt-ampere

END OF DOCUMENT