

TEST REPORT

ACCORDING TO: FCC CFR 47 PART 24 subpart E

FOR:

Airspan Networks Inc.

LTE Base Station

Model: Synergy 2000, 1.9 GHz (B2, B25)

FCC ID:PIDSYN1900

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.
This test report shall not be reproduced in any form except in full with the written approval of Hermon Laboratories Ltd.

Table of contents

1	Applicant information	3
2	Equipment under test attributes	3
3	Manufacturer information	3
4	Test details	3
5	Tests summary	4
6	EUT description	5
6.1	General information	5
6.2	Ports and lines	5
6.3	Support and test equipment	5
6.4	Operating frequencies	5
6.5	Changes made in the EUT	5
6.6	Test configuration	6
6.7	Transmitter characteristics	7
7	Transmitter tests according to 47CFR part 24 requirements	8
7.1	RF power output	8
7.2	Occupied bandwidth test	21
7.3	Spurious emissions at antenna terminal test	26
7.4	Band edge emission	39
7.5	Radiated spurious emission measurements	47
7.6	Frequency stability test	61
8	APPENDIX A Test equipment and ancillaries used for tests	64
9	APPENDIX B Measurement uncertainties	65
10	APPENDIX C Test facility description	66
11	APPENDIX D Specification references	66
12	APPENDIX E Test equipment correction factors	67
13	APPENDIX F Abbreviations and acronyms	76

1 Applicant information

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

2 Equipment under test attributes

Product name: LTE Base Station
Product type: Transceiver
Model(s): Synergy 2000, 1.9 GHz (B2, B25)
Serial number: 6FE1DB173878
Hardware version: D7
Software release: 14.13.10.33
Receipt date: 23-Jul-14

3 Manufacturer information

Manufacturer name: Airspan Networks Inc.
Address: 777 Yamato Rd, Suite 310, Boca Raton 33431, Florida, 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: 26038
Location: Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started: 23-Jul-14
Test completed: 03-Aug-14
Test specification(s): FCC 47CFR part 24 subpart E

5 Tests summary

Test	Status
Transmitter characteristics	
Section 24.232, RF power output and peak-to-average ratio (PAR)	Pass
Section 2.1091, RF exposure	Pass, Exhibit attached to Application for certification
Section 24.238(b), Occupied bandwidth	Pass
Section 24.238, Spurious emissions at antenna terminal	Pass
Section 24.238, Band edge emissions at antenna terminal	Pass
Section 24.238, Radiated spurious emissions	Pass
Section 24.235, Frequency stability	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. V. Einem, test engineer	August 3, 2014	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	August 11, 2014	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	August 17, 2014	

6 EUT description

6.1 General information

A Base station radio, Synergy 2000 - Band 2&25 TDD LTE, is a part of 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 Synergy's' transceiver/receiver (Up to 64 QAM modulation, data rate up to 150 Mbps) uses OFDM and operating in TDD mode, equipped with a 17dBi external antenna. The maximum total RF output power (not including antenna gain) is 35.53 dBm for 17 dBi and it can be reduced by software.

The Synergy is installed outdoors and typically is mounted on a pole. 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	DC power	DC power supply	EUT	1	Unshielded	10
Signal	Ethernet	ETH port	Laptop	1	Shielded	10
Signal	Antenna	EUT	GPS external antenna	1	Coax	5
RF	Antenna	EUT	Termination 50 Ohm	2	Coax	NA
Signal*	RS-232	EUT	Laptop	1	Unshielded	2

* For maintenance only

6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
DC power supply	Mean Well	PSP-600-48	RB29063683
GPS antenna	Tallysman Wireless	32-3030-0	20110606
Laptop	DELL	E6410	PO1038624
4 Port USB to RS-232 hub	ATEN INTERNATIONAL	UC2324	Z3CA2180AB40199

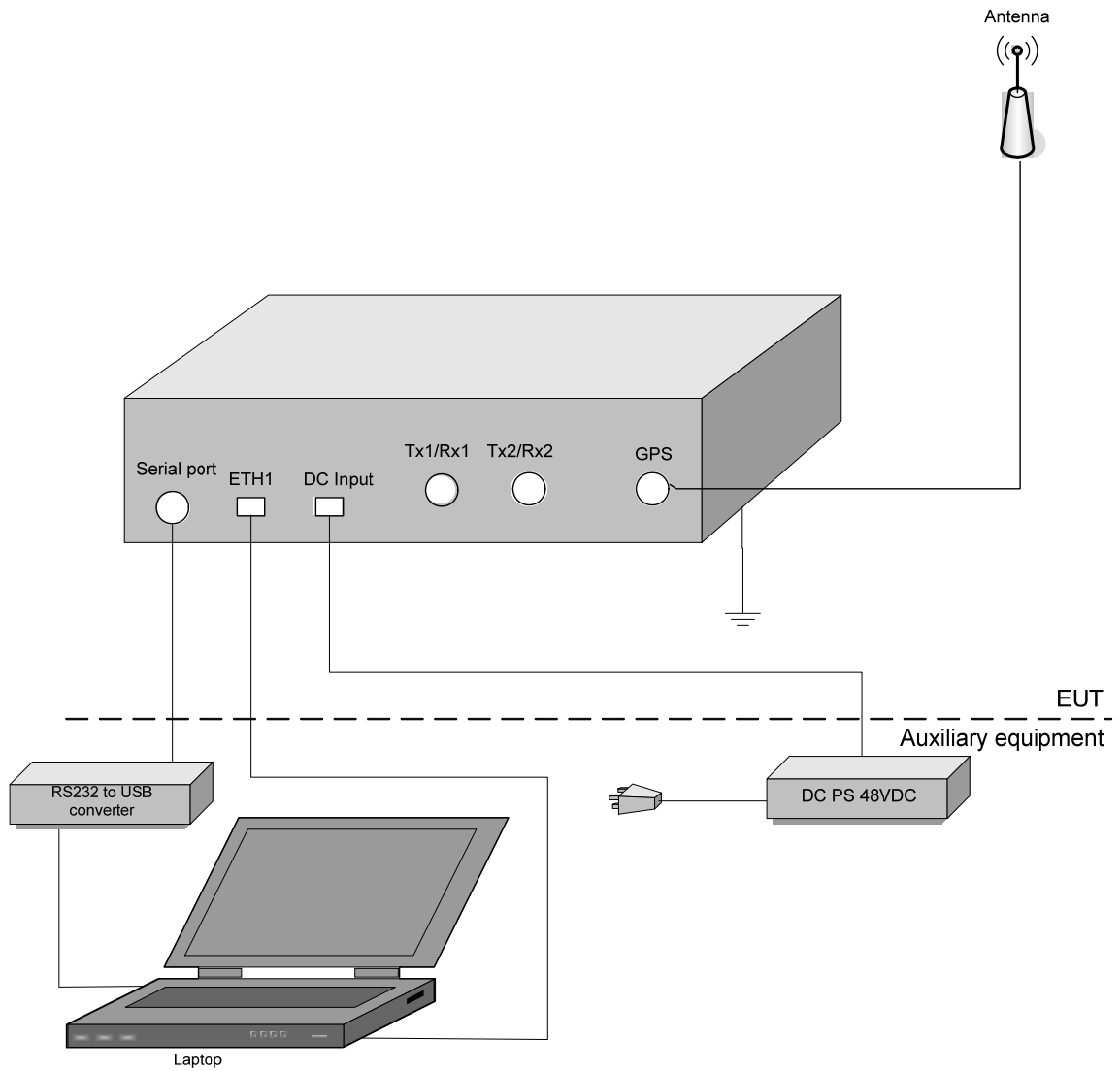
6.4 Operating frequencies

Source	Frequency, MHz
Tx	1930-1990
Rx	1850-1915

6.5 Changes made in the EUT

No changes were implemented in the EUT during testing.

6.6 Test configuration



6.7 Transmitter characteristics

Type of equipment						
V	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				
V	fixed	Always at a distance more than 2 m from all people				
	mobile	Always at a distance more than 20 cm from all people				
	portable	May operate at a distance closer than 20 cm to human body				
Assigned frequency range		1930.0 – 1990.0 MHz				
Operating frequency range		1935 – 1985 MHz for 10 MHz EBW 1940 – 1980 MHz for 20 MHz EBW				
RF channel spacing		10 MHz, 20 MHz				
Maximum rated output power		At transmitter 50 Ω RF output connector (aggregate power of both RF chains) 35.53 dBm – 10 MHz OBW 34.52 dBm – 20 MHz OBW				
Is transmitter output power variable?		No				
		V	Yes	continuous variable		
				V	stepped variable with stepsize	0.25 dB
				minimum RF power		0 dBm
				maximum RF power		35.53 dBm
Antenna connection						
unique coupling	V	standard connector	Integral	V	with temporary RF connector without temporary RF connector	
Antenna/s technical characteristics						
Type	Manufacturer		Model number		Gain	
External Sector antenna	Alpha Wireless		AW3083		17.0 dBi	
External Sector antenna	Alpha Wireless		AW3314		16.0 dBi	
Transmitter aggregate data rate/s, Mbps						
Transmitter 99% power bandwidth		Type of modulation				
		QPSK	16QAM	64QAM		
10 MHz		15.5	30.5	75		
20 MHz		31	61	150		
Type of multiplexing		OFDMA/TDD				
Modulating test signal (baseband)		PRBS				
Maximum transmitter duty cycle in normal use		100 %				
Transmitter power source						
V	DC	Nominal rated voltage	48 VDC			
Common power source for transmitter and receiver		V	yes	no		



Test specification:		Section 24.232, RF power output	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

7 Transmitter tests according to 47CFR part 24 requirements

7.1 RF power output

7.1.1 General

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

Table 7.1.1 RF power output limits

Assigned frequency range, MHz	Maximum peak power spectral density, EIRP	
	W	dBm
1930 - 1990	1640 watts/MHz	62 dBm/MHz

7.1.2 Test procedure

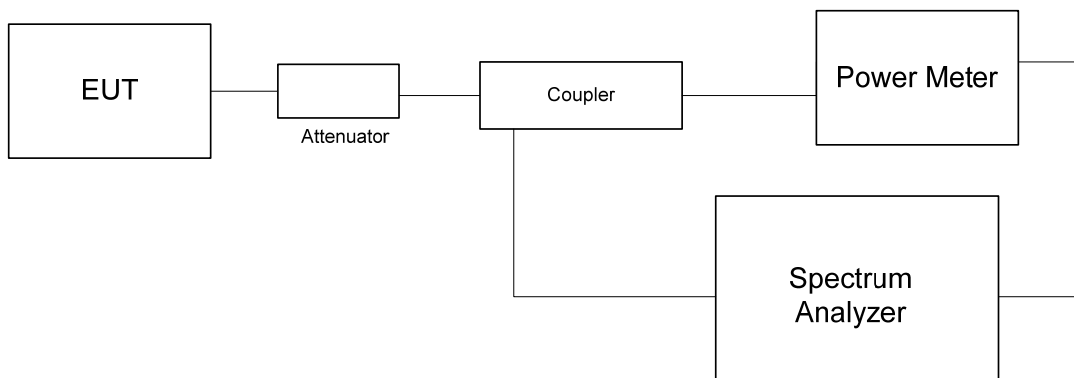
7.1.2.1 The EUT was set up as shown in Figure 7.1.1, energized and its proper operation was checked.

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 power meter as provided in Table 7.1.2 and associated plots.

7.1.2.4 The peak-to-average ratio was measured with power meter as provided in Table 7.1.4 and associated plots.

Figure 7.1.1 RF power output test setup





HERMON LABORATORIES

Test specification:		Section 24.232, RF power output	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Table 7.1.2 Peak EIRP power density test results

OPERATING FREQUENCY RANGE: 1930 – 1990 MHz
 DETECTOR USED: Average (RMS)
 RESOLUTION BANDWIDTH: 1 MHz
 VIDEO BANDWIDTH: 3 MHz
 MODULATION: QPSK/64QAM
 MODULATING SIGNAL: PRBS
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum (see Table 7.1.3)
 EBW: 10 MHz

Channel, MHz	Modulation	P _{meas} (RF#1), dBm/MHz	P _{meas} (RF#2), dBm/MHz	P _{meas} *, dBm/MHz	Antenna gain, dBi	EIRP total**, dBm/MHz	Limit, dBm/MHz	Margin, dB	Verdict
1935	QPSK	22.39	22.06	25.24	17.00	42.24	62.00	-19.76	Pass
1960	QPSK	21.24	22.53	24.94	17.00	41.94	62.00	-20.06	Pass
1985	QPSK	22.55	22.49	25.53	17.00	42.53	62.00	-19.47	Pass
1935	64QAM	22.45	21.76	25.13	17.00	42.13	62.00	-19.87	Pass
1960	64QAM	21.42	22.20	24.84	17.00	41.84	62.00	-20.16	Pass
1985	64QAM	22.46	21.93	25.21	17.00	42.21	62.00	-19.79	Pass

EBW: 20 MHz

Channel, MHz	Modulation	P _{meas} (RF#1), dBm/MHz	P _{meas} (RF#2), dBm/MHz	P _{meas} *, dBm/MHz	Antenna gain, dBi	EIRP total**, dBm/MHz	Limit, dBm/MHz	Margin, dB	Verdict
1940	QPSK	18.64	17.97	21.33	17.00	38.33	62.00	-23.67	Pass
1960	QPSK	18.68	18.18	21.45	17.00	38.45	62.00	-23.55	Pass
1980	QPSK	18.70	18.32	21.52	17.00	38.52	62.00	-23.48	Pass
1940	64QAM	18.54	18.04	21.31	17.00	38.31	62.00	-23.69	Pass
1960	64QAM	18.82	18.07	21.47	17.00	38.47	62.00	-23.53	Pass
1980	64QAM	18.63	18.16	21.41	17.00	38.41	62.00	-23.59	Pass

* - $P_{meas}, dBm = 10 \log(10^{(P(dBm/MHz, RF\#1)/10)} + 10^{(P(dBm/MHz, RF\#2)/10)})$

** - $EIRP\ total, dBm/MHz = P_{meas}, dBm/MHz + Antenna\ Gain, dBi$

Peak output power, dBm = Peak output power, dBm/MHz + 10log(BW occupied / BW receiver)

Max RF power is 25.53 dBm/MHz + 10 log (10 MHz/1 MHz) = **35.53 dBm** in 1935-1985 MHz;

in 1940-1980 MHz the max RF power is 21.52 dBm/MHz + 10 log (20 MHz/1 MHz) = 34.52 dBm.

NOTE: the EUT was configured to produce maximum conducted RF power for declared antenna gain of 17 dBi. The RF output power will vary depending on the antenna assembly gain to ensure that the total EIRP power and power limits withstand with EIRP limits. For actual settings of power levels with respect to actual antenna assembly used, please refer to the User's Manual.

Reference numbers of test equipment used

HL 2909	HL 3301	HL 3390	HL 3770	HL 4273	HL 4366		
---------	---------	---------	---------	---------	---------	--	--

Full description is given in Appendix A.



HERMON LABORATORIES

Report ID: AIRRAD_FCC.26038.docx
Date of Issue: 11-Aug-14

Test specification:	Section 24.232, RF power output		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict: PASS	
Date(s):	23-Jul-14		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Table 7.1.3 Power Settings (Hex)

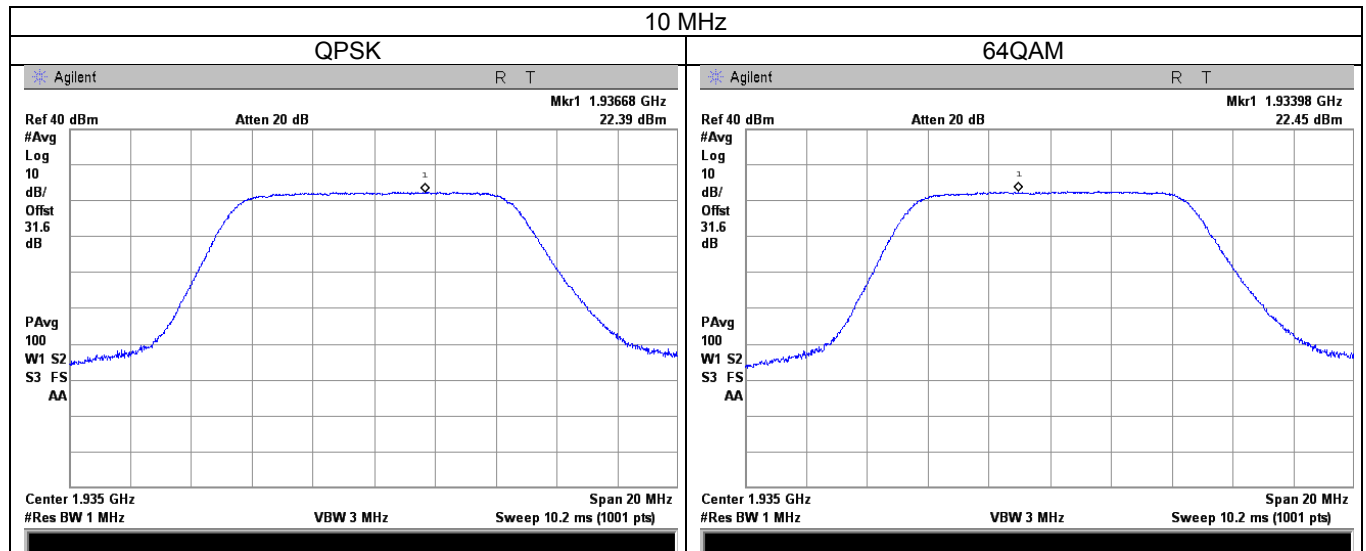
EBW	Frequency	RF Chain 1		RF Chain 2	
		QPSK	64QAM	QPSK	64QAM
10 MHz	Low	38	38	38	38
	Mid	40	40	38	38
	High	38	38	38	38
20 MHz	Low	30	30	30	29
	Mid	30	30	30	30
	High	30	30	30	30



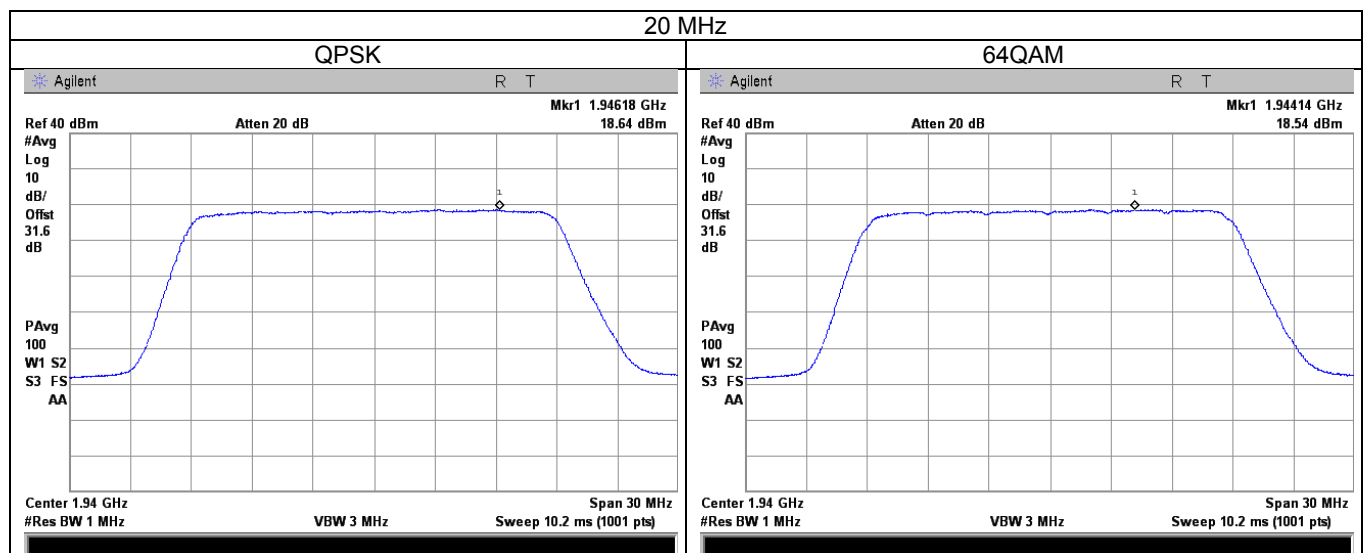
HERMON LABORATORIES

Test specification:	Section 24.232, RF power output		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict: PASS	
Date(s):	23-Jul-14		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.1 RF power output test results at low frequency, RF Chain 1



Plot 7.1.2 RF power output test results at low frequency, RF Chain 1

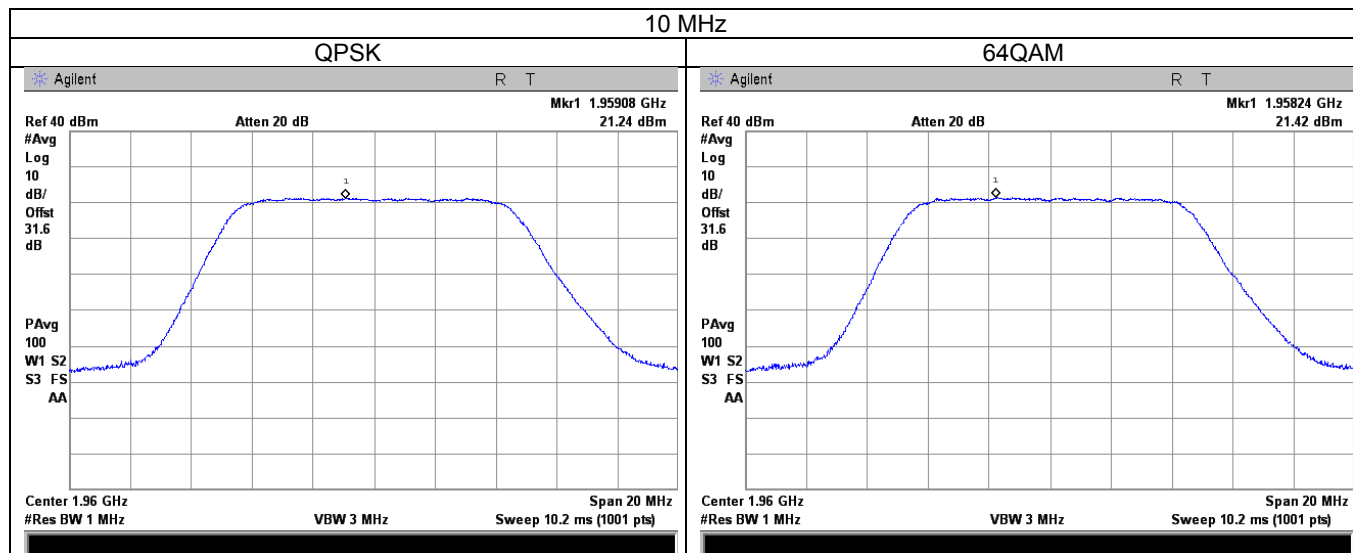




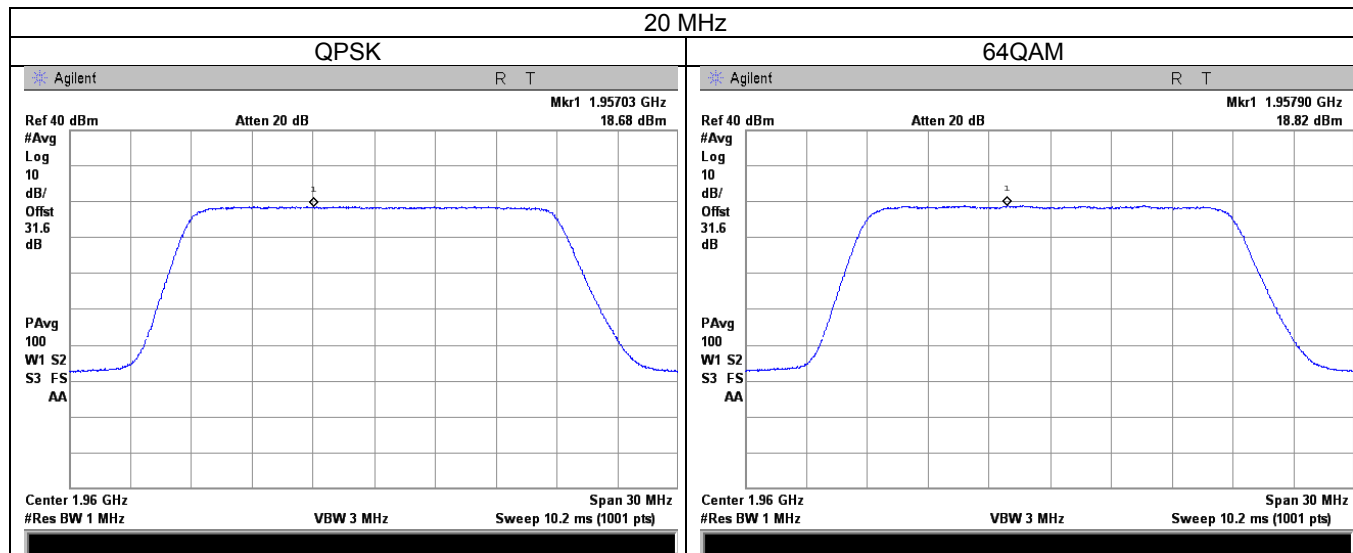
HERMON LABORATORIES

Test specification:		Section 24.232, RF power output	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1	
Test mode:	Compliance	Verdict: PASS	
Date(s):	23-Jul-14		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.3 RF power output test results at mid frequency, RF Chain 1



Plot 7.1.4 RF power output test results at mid frequency, RF Chain 1

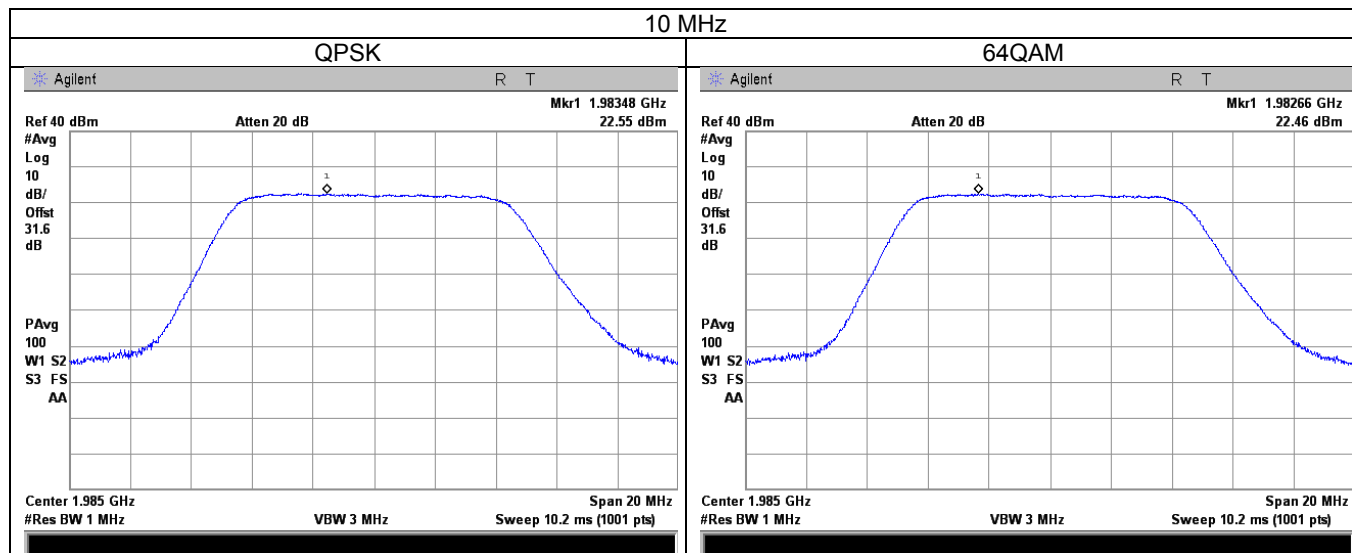




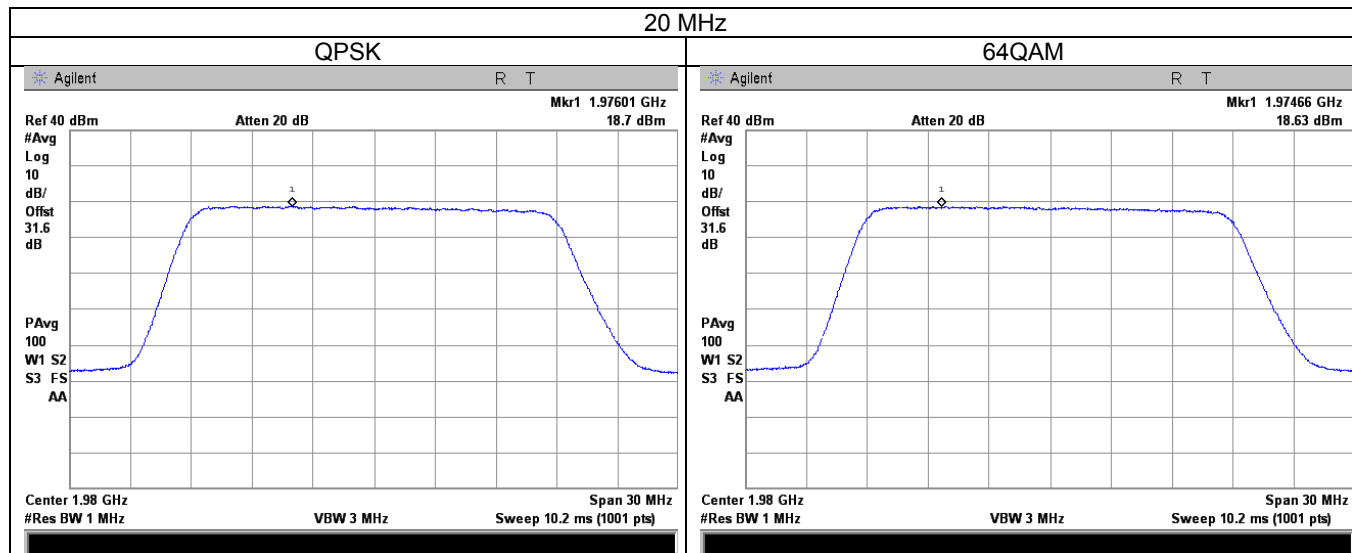
HERMON LABORATORIES

Test specification:		Section 24.232, RF power output	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1	
Test mode:		Verdict: PASS	
Date(s):			
23-Jul-14			
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.5 RF power output test results at high frequency, RF Chain 1



Plot 7.1.6 RF power output test results at high frequency, RF Chain 1



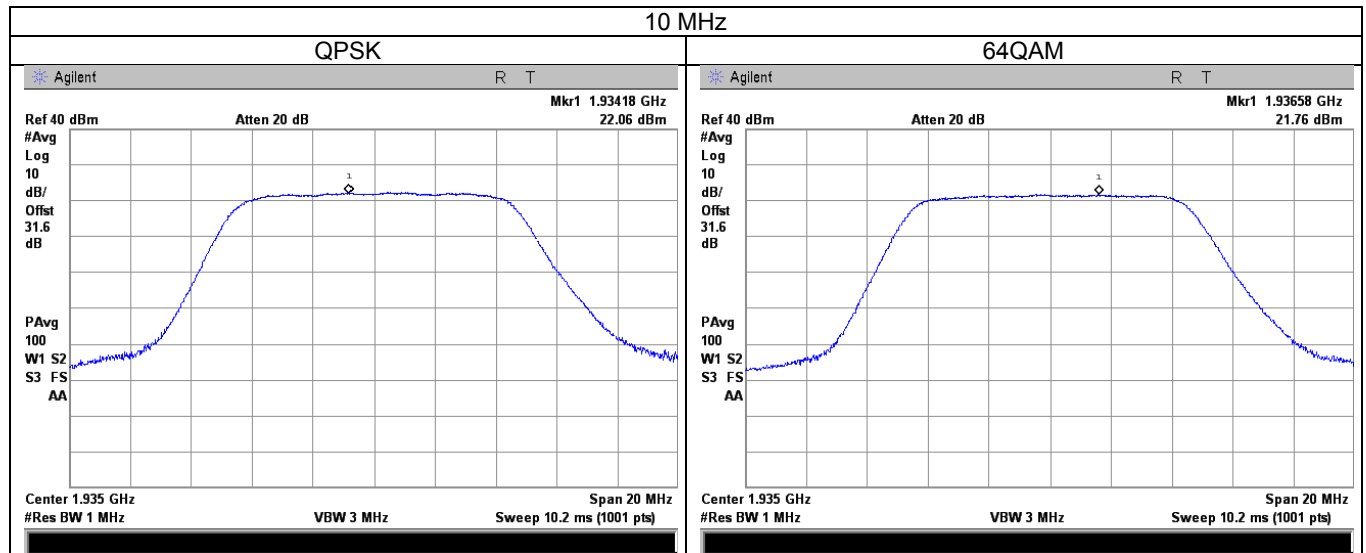


HERMON LABORATORIES

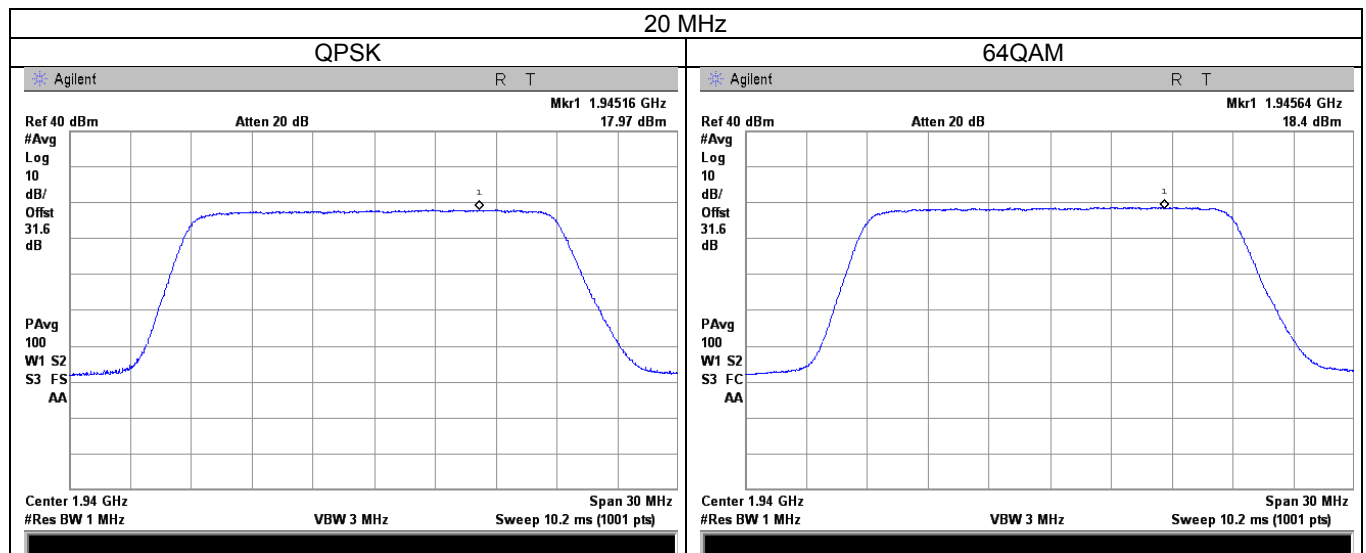
Report ID: AIRRAD_FCC.26038.docx
Date of Issue: 11-Aug-14

Test specification:		Section 24.232, RF power output	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1	
Test mode:	Compliance	Verdict: PASS	
Date(s):	23-Jul-14		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.7 RF power output test results at low frequency, RF Chain2



Plot 7.1.8 RF power output test results at low frequency, RF Chain2

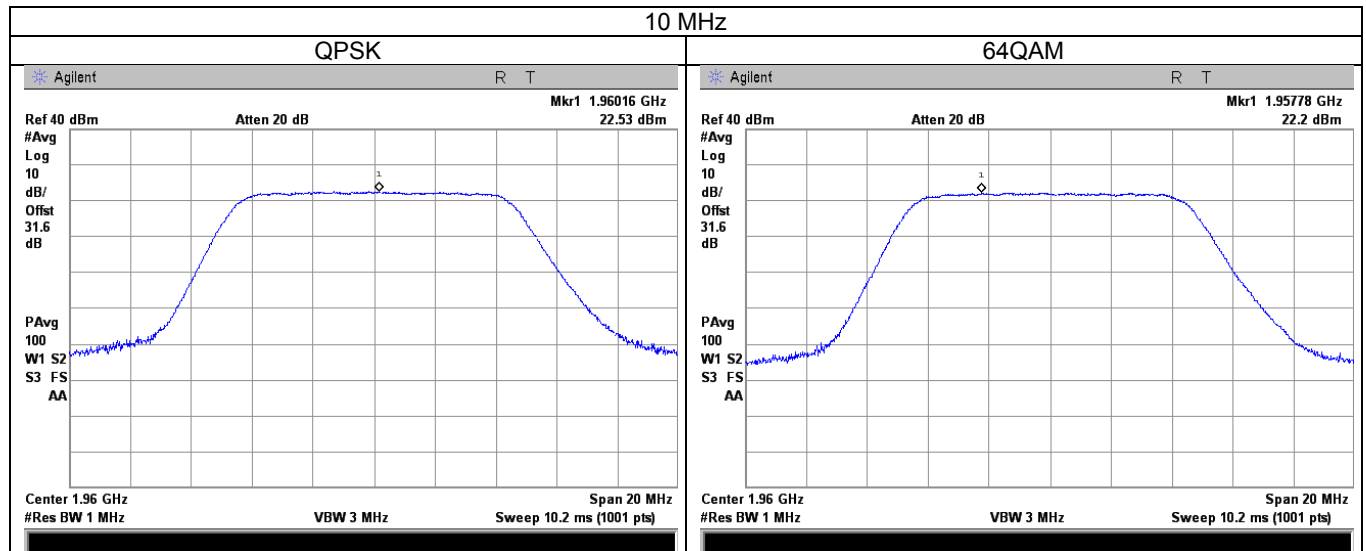




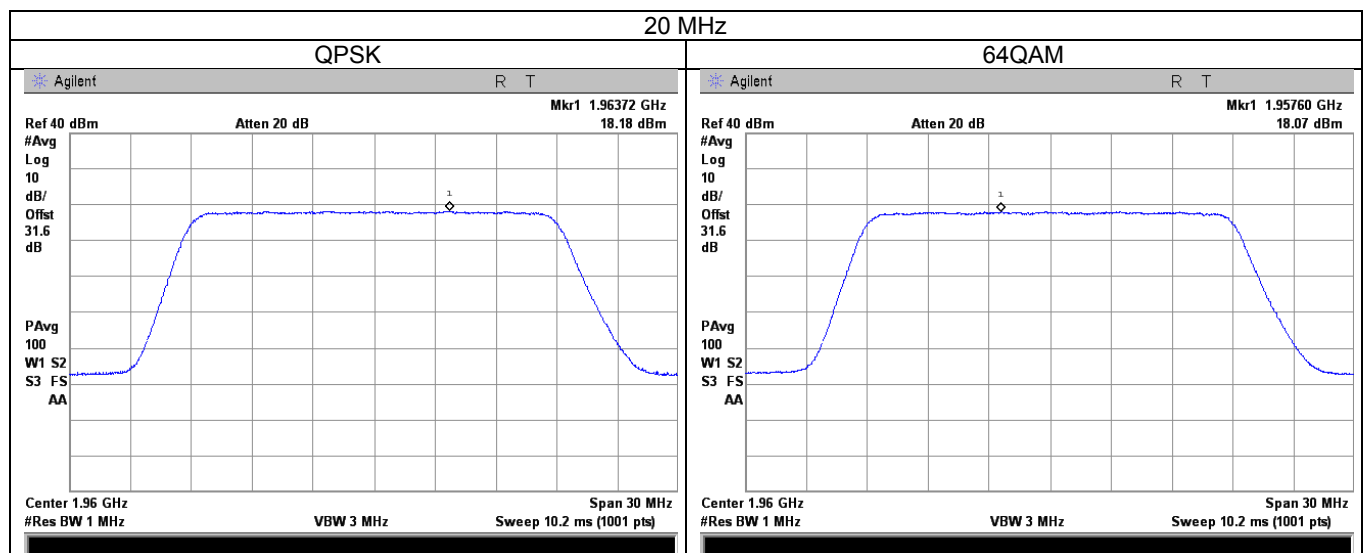
HERMON LABORATORIES

Test specification:	Section 24.232, RF power output		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict: PASS	
Date(s):	23-Jul-14		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.9 RF power output test results at mid frequency, RF Chain 2



Plot 7.1.10 RF power output test results at mid frequency, RF Chain 2

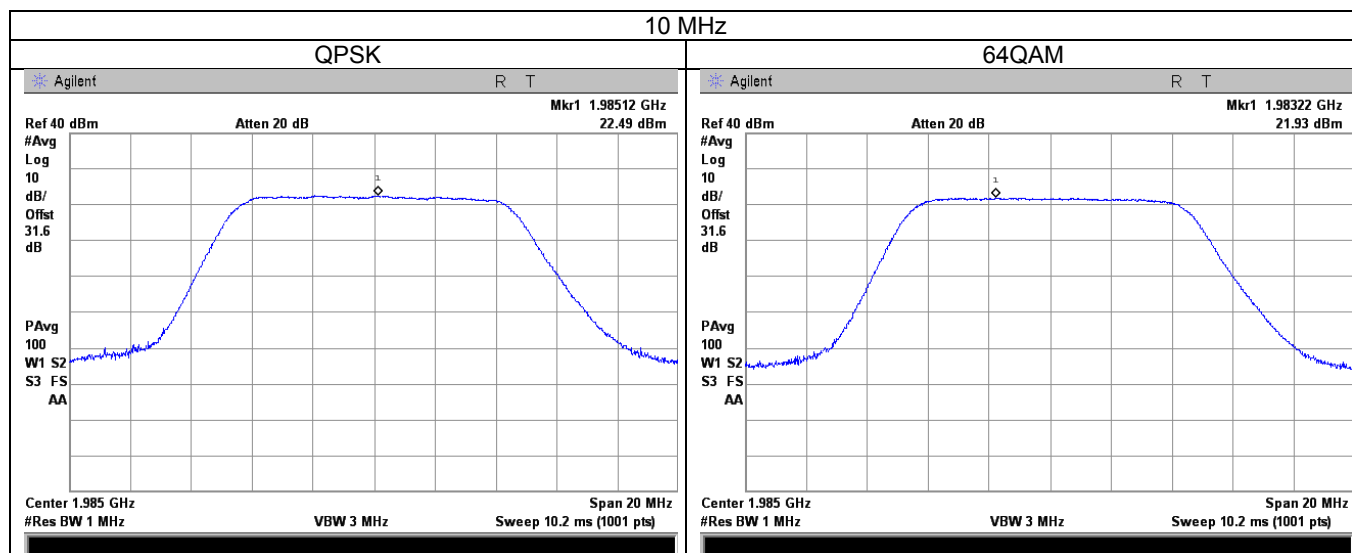




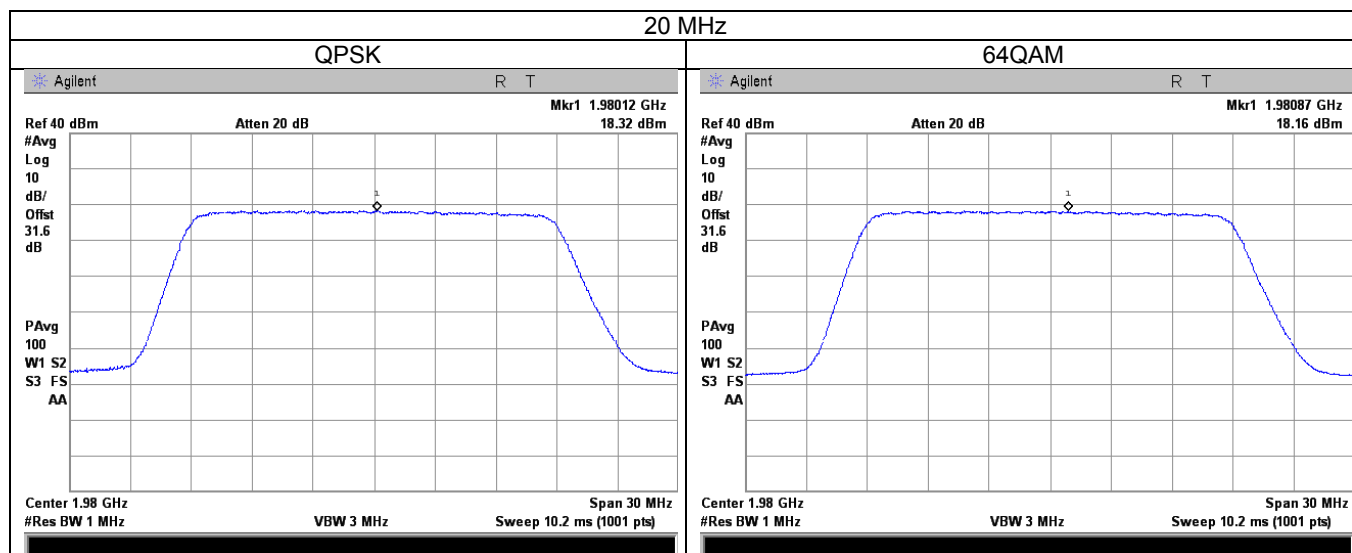
HERMON LABORATORIES

Test specification:		Section 24.232, RF power output	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.11 RF power output test results at high frequency, RF Chain 2



Plot 7.1.12 RF power output test results at high frequency, RF Chain 2





HERMON LABORATORIES

Report ID: AIRRAD_FCC.26038.docx
Date of Issue: 11-Aug-14

Test specification:		Section 24.232, RF power output	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C		Air Pressure: 1006 hPa	Relative Humidity: 43 %
Remarks:		Power Supply: 48 VDC	

Table 7.1.4 Peak to Average Ratio (PAR) test results

EBW	Frequency	PAR in RF Chain 1, dB		Limit, dB	Verdict
		QPSK	64QAM		
10 MHz	Low	8.41	8.42	13	Pass
	Mid	8.81	8.40		
	High	8.49	8.50		
20 MHz	Low	8.65	8.76		
	Mid	8.67	8.74		
	High	8.66	8.70		



HERMON LABORATORIES

Report ID: AIRRAD_FCC.26038.docx

Date of Issue: 11-Aug-14

Test specification:		Section 24.232, RF power output	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.13 PAR test results at low frequency, RF Chain 1

10 MHz	
QPSK	64QAM
RMT	RMT
A	
10%	3.82dB
1%	6.95dB
0.1%	8.41dB
0.01%	9.08dB
0.001%	9.50dB
0.0001%	9.75dB

Plot 7.1.14 PAR test results at low frequency, RF Chain 1

20 MHz	
QPSK	64QAM
RMT	RMT
A	
10%	3.84dB
1%	7.01dB
0.1%	8.65dB
0.01%	9.67dB
0.001%	10.62dB
0.0001%	11.05dB



HERMON LABORATORIES

Report ID: AIRRAD_FCC.26038.docx

Date of Issue: 11-Aug-14

Test specification:		Section 24.232, RF power output	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.15 PAR test results at mid frequency, RF Chain 1

10MHz		64QAM	
QPSK		RMT	
A		A	
10%	3.81dB	10%	3.81dB
1%	6.98dB	1%	6.98dB
0.1%	8.81dB	0.1%	8.40dB
0.01%	9.77dB	0.01%	8.88dB
0.001%	10.31dB	0.001%	9.16dB
0.0001%	10.49dB	0.0001%	9.28dB

Plot 7.1.16 PAR test results at mid frequency, RF Chain 1

20MHz		64QAM	
QPSK		RMT	
A		A	
10%	3.83dB	10%	3.82dB
1%	6.98dB	1%	6.99dB
0.1%	8.67dB	0.1%	8.74dB
0.01%	9.65dB	0.01%	9.73dB
0.001%	10.21dB	0.001%	10.21dB
0.0001%	10.44dB	0.0001%	10.33dB



HERMON LABORATORIES

Report ID: AIRRAD_FCC.26038.docx

Date of Issue: 11-Aug-14

Test specification:	Section 24.232, RF power output		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-A, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Jul-14		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.17 PAR test results at high frequency, RF Chain 1

10MHz			64QAM		
QPSK			RMT		
A	10%	3.82dB	A	10%	3.79dB
	1%	6.95dB		1%	6.97dB
	0.1%	8.49dB		0.1%	8.50dB
	0.01%	9.10dB		0.01%	9.12dB
	0.001%	9.34dB		0.001%	9.49dB
	0.0001%	9.45dB		0.0001%	9.68dB

Plot 7.1.18 PAR test results at high frequency, RF Chain 1

20MHz		64QAM	
QPSK		RMT	
A	10%	3.81dB	⊗
	1%	7.00dB	
	0.1%	8.66dB	
	0.01%	9.73dB	
	0.001%	10.41dB	
	0.0001%	10.62dB	

Test specification:		Section 24.238(b), Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
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
1930 - 1990	26

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

7.2.2 Test procedure

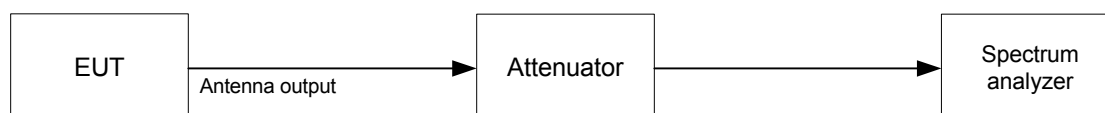
7.2.2.1 The EUT was set up as shown in Figure 7.2.1, energized and its proper operation was checked.

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 the results provided in Table 7.2.2 and the associated plots.

Figure 7.2.1 Occupied bandwidth test setup





HERMON LABORATORIES

Report ID: AIRRAD_FCC.26038.docx

Date of Issue: 11-Aug-14

Test specification:		Section 24.238(b), Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Table 7.2.2 Occupied bandwidth test results

DETECTOR USED: Average
 RESOLUTION BANDWIDTH: 100 kHz
 VIDEO BANDWIDTH: 300 kHz
 MODULATION ENVELOPE REFERENCE POINTS: 26 dBc
 MODULATING SIGNAL: PRBS
 EBW: 10 MHz

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
QPSK 15.1 Mbps				
1935	9700	NA	NA	Pass
1960	9708	NA	NA	Pass
1985	9674	NA	NA	Pass
64QAM 75.0 Mbps				
1935	9698	NA	NA	Pass
1960	9691	NA	NA	Pass
1985	9713	NA	NA	Pass

DETECTOR USED: Average
 RESOLUTION BANDWIDTH: 300 kHz
 VIDEO BANDWIDTH: 1000 kHz
 MODULATION ENVELOPE REFERENCE POINTS: 26 dBc
 MODULATING SIGNAL: PRBS
 EBW: 20 MHz

Carrier frequency, MHz	Occupied bandwidth, kHz	Limit, kHz	Margin, kHz	Verdict
QPSK 31.0 Mbps				
1940	19635	NA	NA	Pass
1960	19689	NA	NA	Pass
1980	19686	NA	NA	Pass
64QAM 150.0 Mbps				
1940	19712	NA	NA	Pass
1960	19723	NA	NA	Pass
1980	19711	NA	NA	Pass

Reference numbers of test equipment used

HL 2909	HL 3301	HL 3390	HL 3770	HL 4273	HL 4366	
---------	---------	---------	---------	---------	---------	--

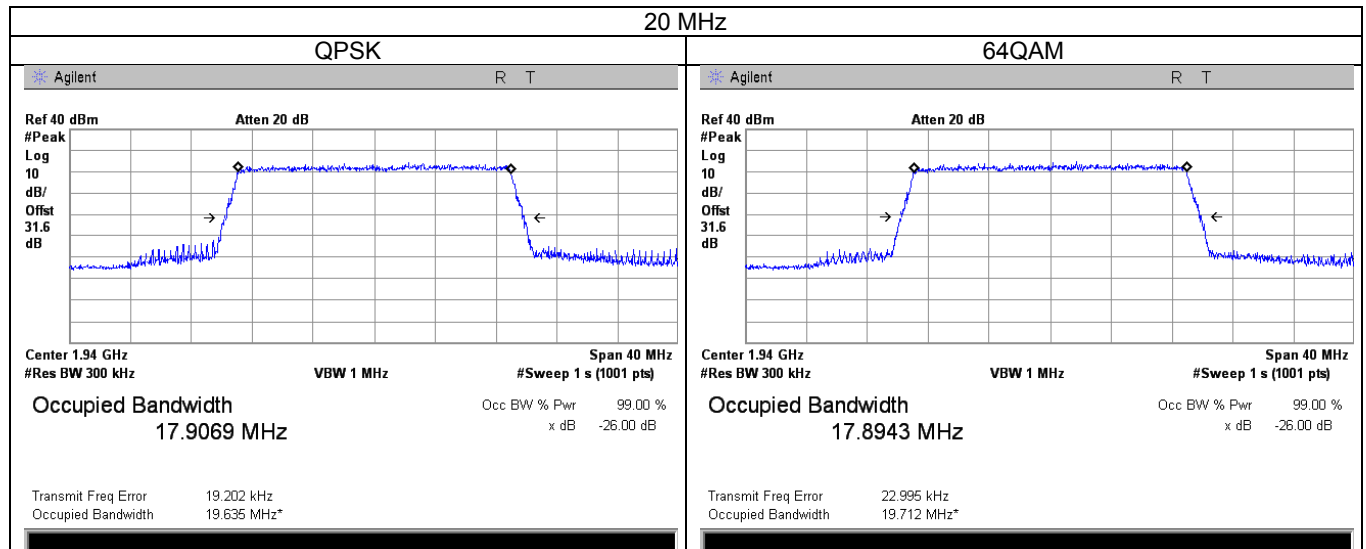
Full description is given in Appendix A.

Test specification:		Section 24.238(b), Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.2.1 Occupied bandwidth test result at low frequency

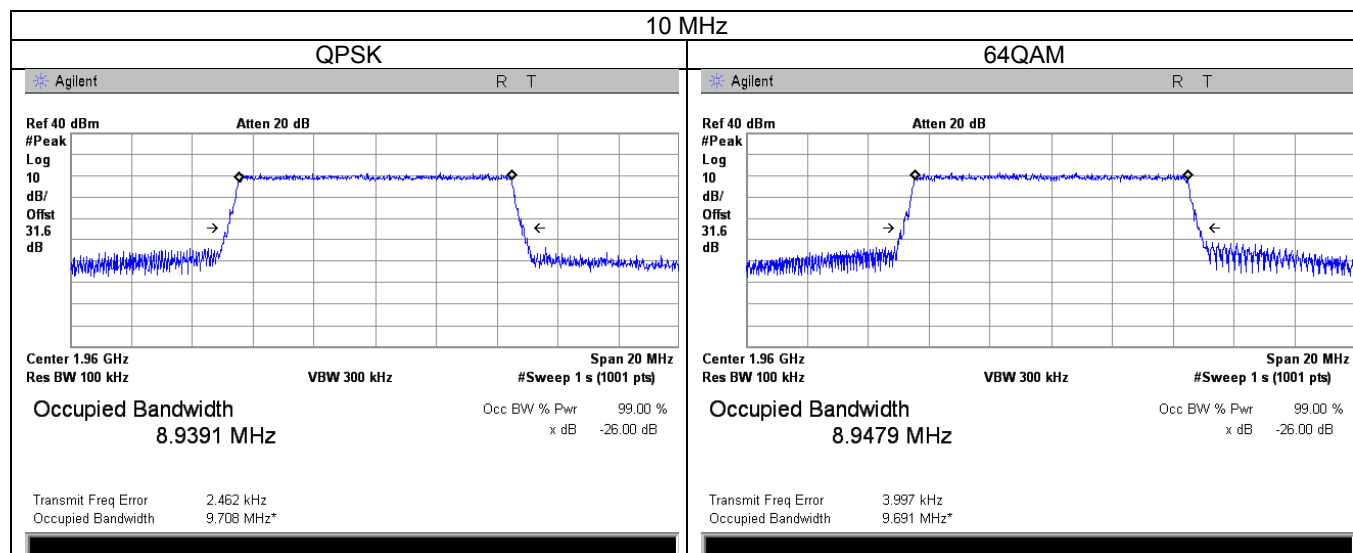


Plot 7.2.2 Occupied bandwidth test result at low frequency

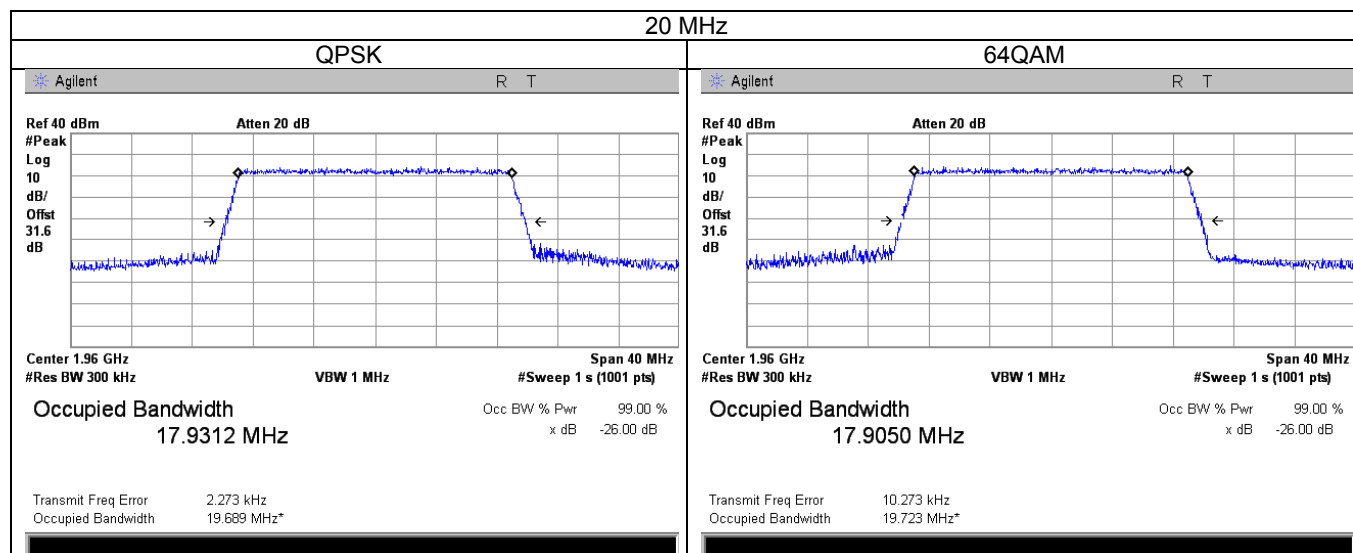


Test specification:		Section 24.238(b), Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.2.3 Occupied bandwidth test result at mid frequency

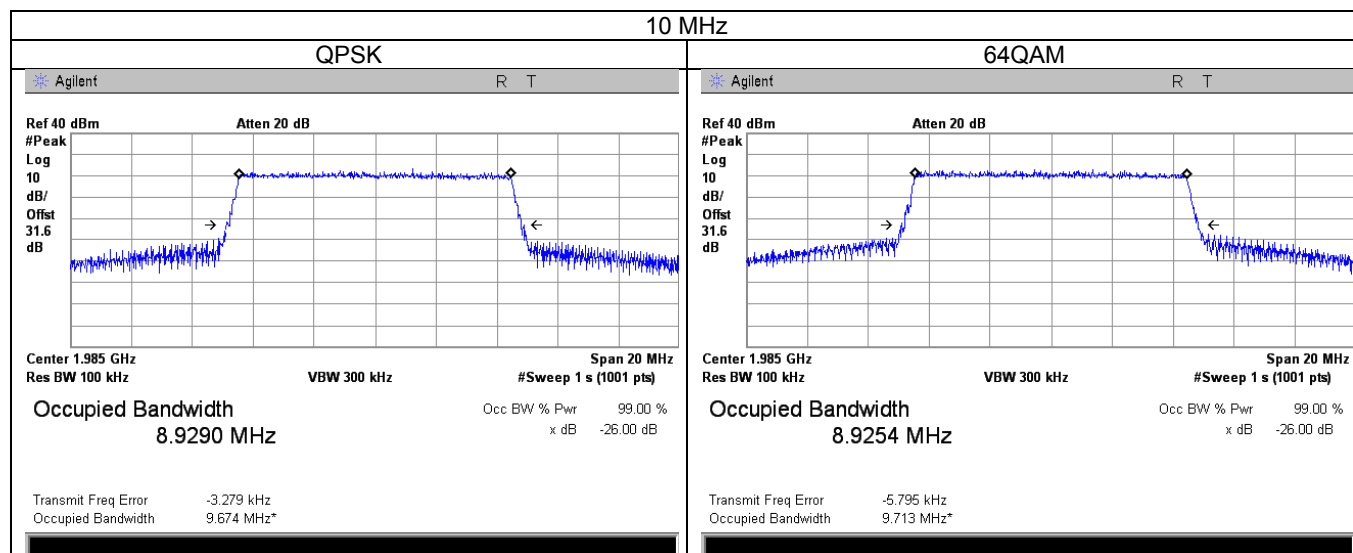


Plot 7.2.4 Occupied bandwidth test result at mid frequency

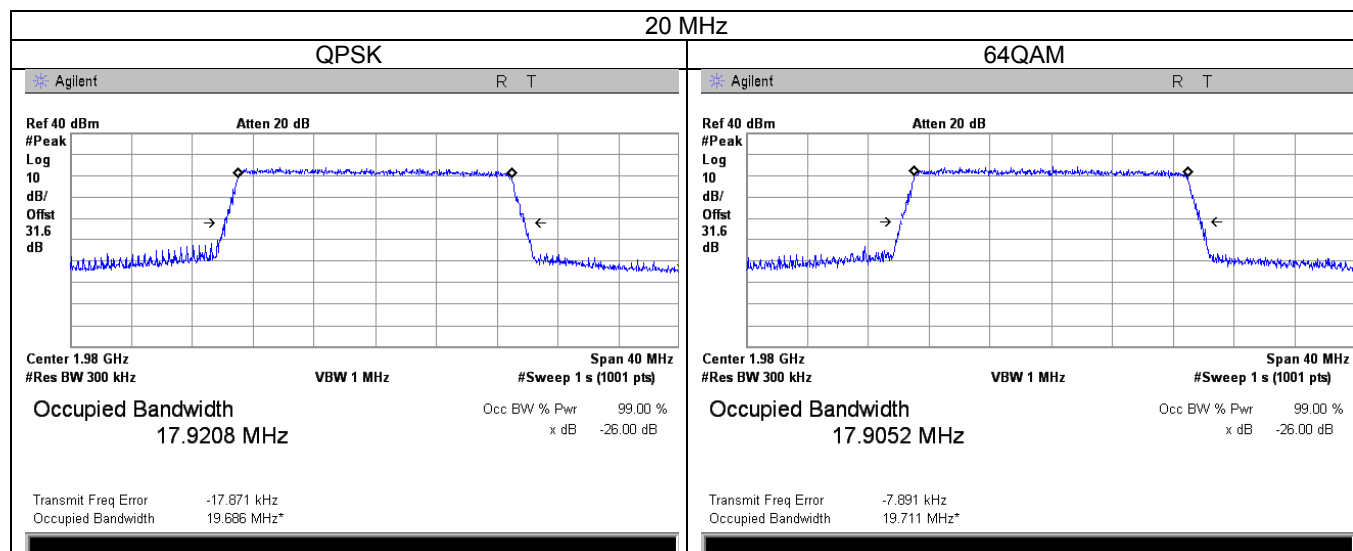


Test specification:		Section 24.238(b), Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:	Compliance	Verdict: PASS	
Date(s):	23-Jul-14		
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 43 %	Power Supply: 48 VDC
Remarks:			

Plot 7.2.5 Occupied bandwidth test result at high frequency



Plot 7.2.6 Occupied bandwidth test result at high frequency



Test specification:		Section 24.238, Spurious emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 47 %	Power Supply: 48 VDC
Remarks:			

7.3 Spurious emissions at antenna terminal 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	ERP of spurious, dBm
0.009 – 10 th harmonic*	43+10logP*	-13.0

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





Test specification: Section 24.238, Spurious emissions at antenna terminal			
Test procedure: 47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13			
Test mode:	Compliance	Verdict: PASS	
Date(s):	24-Jul-14		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 47 %	Power Supply: 48 VDC
Remarks:			

Table 7.3.2 Spurious emission test results

ASSIGNED FREQUENCY RANGE: 1930-1990MHz
 INVESTIGATED FREQUENCY RANGE: 0.009-19900MHz
 VIDEO BANDWIDTH: ≥ Resolution bandwidth
 MODULATION: QPSK*
 MODULATING SIGNAL: PRBS
 BIT RATE: 15.1 Mbps
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum

TESTED RF CHAIN: 1

Frequency, MHz	SA reading, dBm	Attenuation, dB	Detector Used	RBW, kHz	Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
Low carrier frequency								
1924.21	-23.63	included	RMS	1000	-20.63	-13	-7.63	Pass
1945.00	-18.17	included	RMS	1000	-15.17	-13	-2.17	Pass
Mid carrier frequency								
1949.65	-17.96	included	RMS	1000	-14.96	-13	-1.96	Pass
1971.50	-24.78	included	RMS	1000	-21.78	-13	-8.78	Pass
High carrier frequency								
1974.52	-17.59	included	RMS	1000	-14.59	-13	-1.59	Pass
2000.00	-27.61	included	RMS	1000	-24.61	-13	-11.61	Pass

TESTED RF CHAIN: 2

Frequency, MHz	SA reading, dBm	Attenuation, dB	Detector Used	RBW, kHz	Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
Low carrier frequency								
1924.66	-26.4	included	RMS	1000	-23.4	-13	-10.4	Pass
1946.00	-19.77	included	RMS	1000	-16.77	-13	-3.77	Pass
Mid carrier frequency								
1949.54	-18.49	included	RMS	1000	-15.49	-13	-2.49	Pass
1970.00	-20.54	included	RMS	1000	-17.54	-13	-4.54	Pass
High carrier frequency								
1972.86	-17.05	included	RMS	1000	-14.05	-13	-1.05	Pass
2000.00	-34.37	included	RMS	1000	-31.37	-13	-18.37	Pass

*Tested at the worst case according to max power density test.

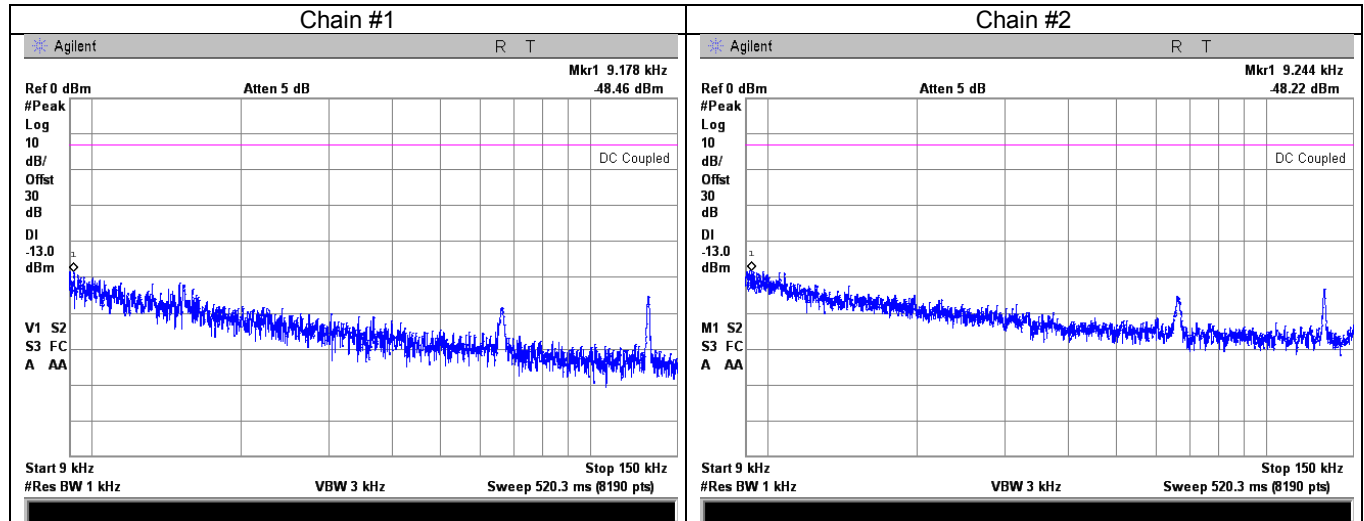
Reference numbers of test equipment used

HL 2909	HL 3455	HL 3770	HL 3903	HL 4229		
---------	---------	---------	---------	---------	--	--

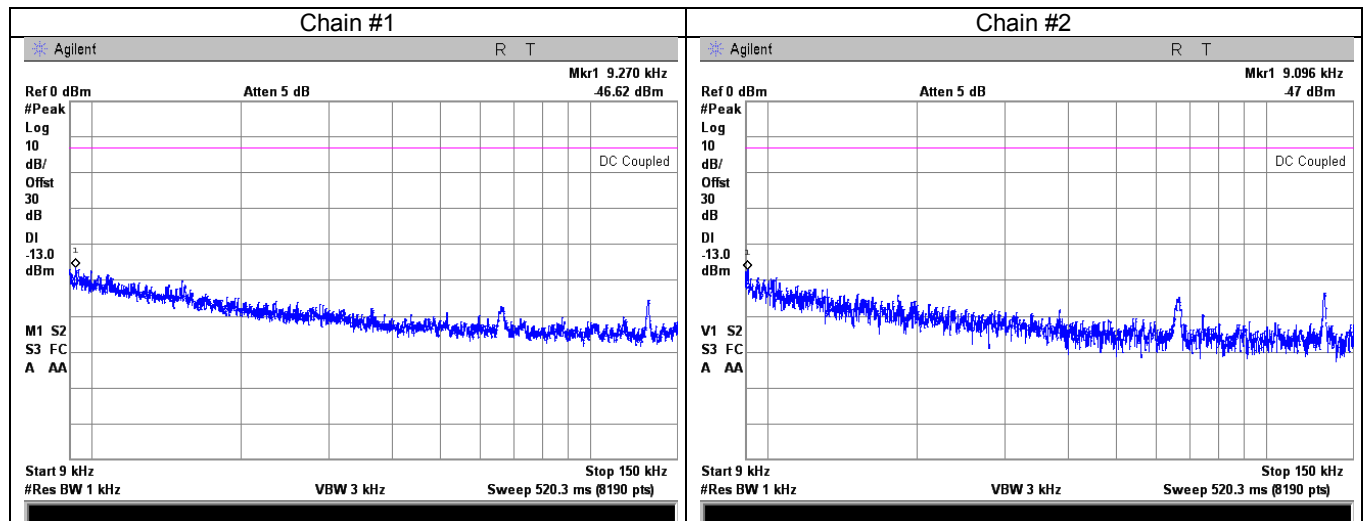
Full description is given in Appendix A.

Test specification:		Section 24.238, Spurious emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 47 %	Power Supply: 48 VDC
Remarks:			

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



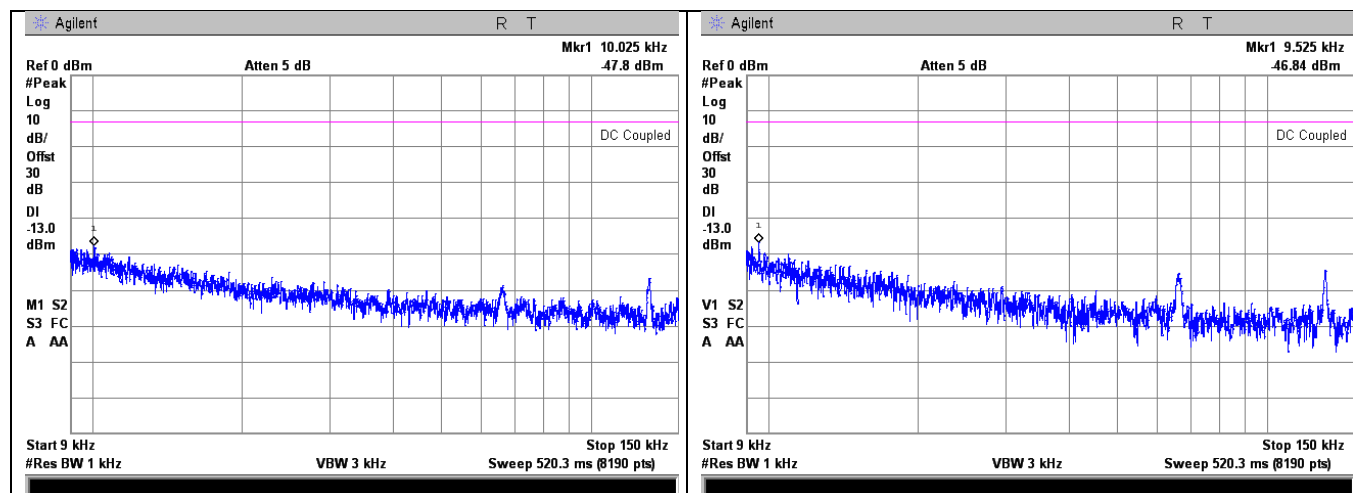
Plot 7.3.2 Spurious emission measurements in 9 - 150 kHz range at mid carrier frequency



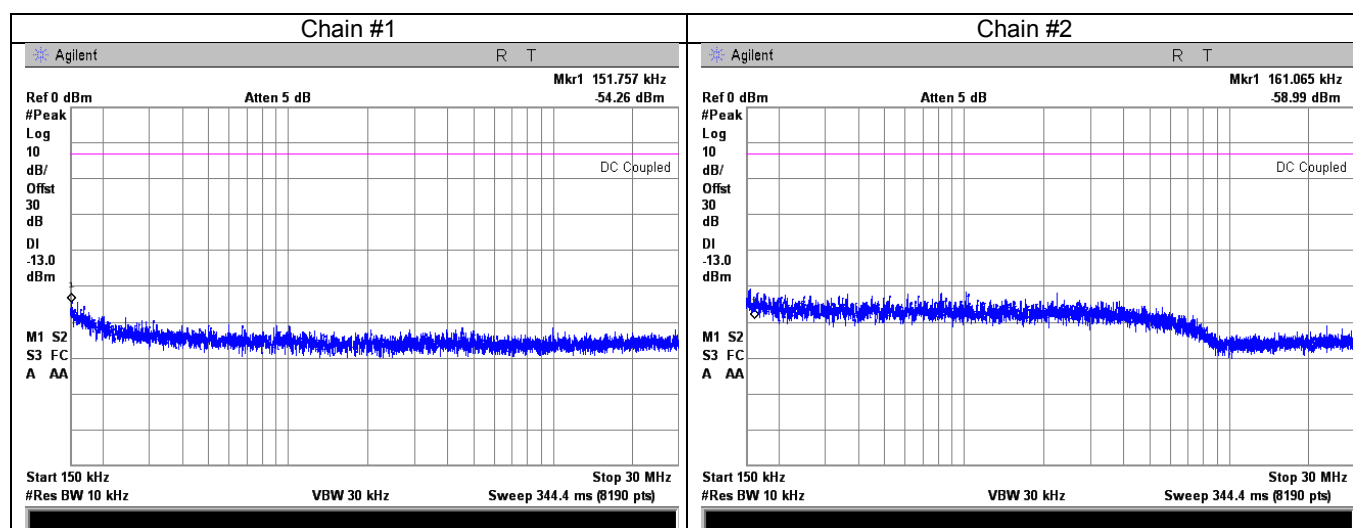
Plot 7.3.3 Spurious emission measurements in 9 - 150 kHz range at high carrier frequency

Chain #1	Chain #2
----------	----------

Test specification:		Section 24.238, Spurious emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 47 %	Power Supply: 48 VDC
Remarks:			

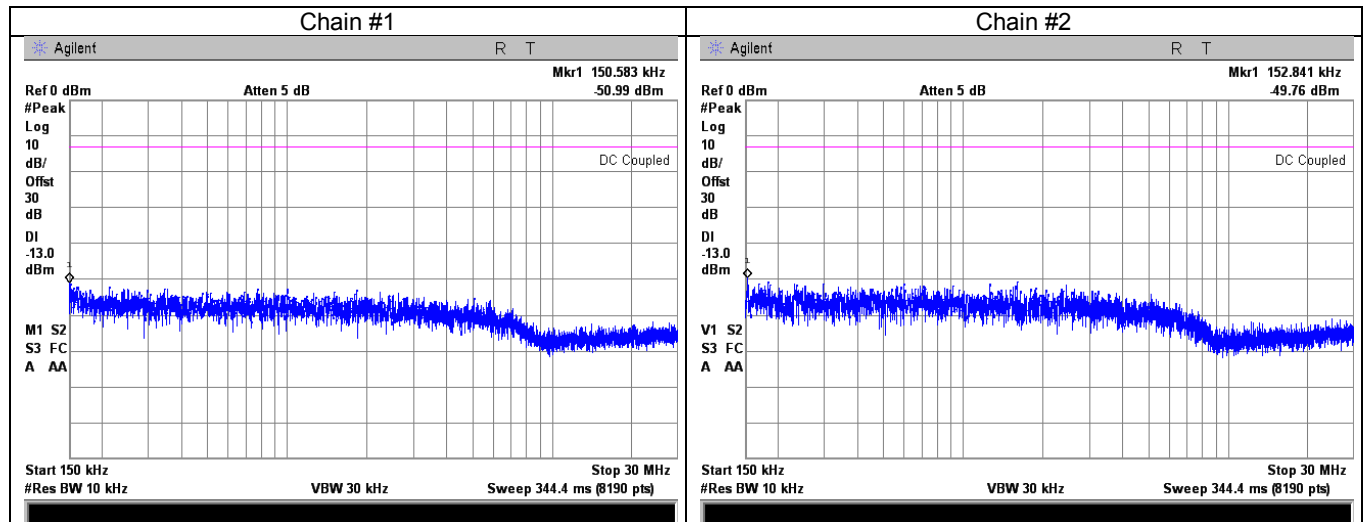


Plot 7.3.4 Spurious emission measurements in 0.15 - 30.0 MHz range at low carrier frequency

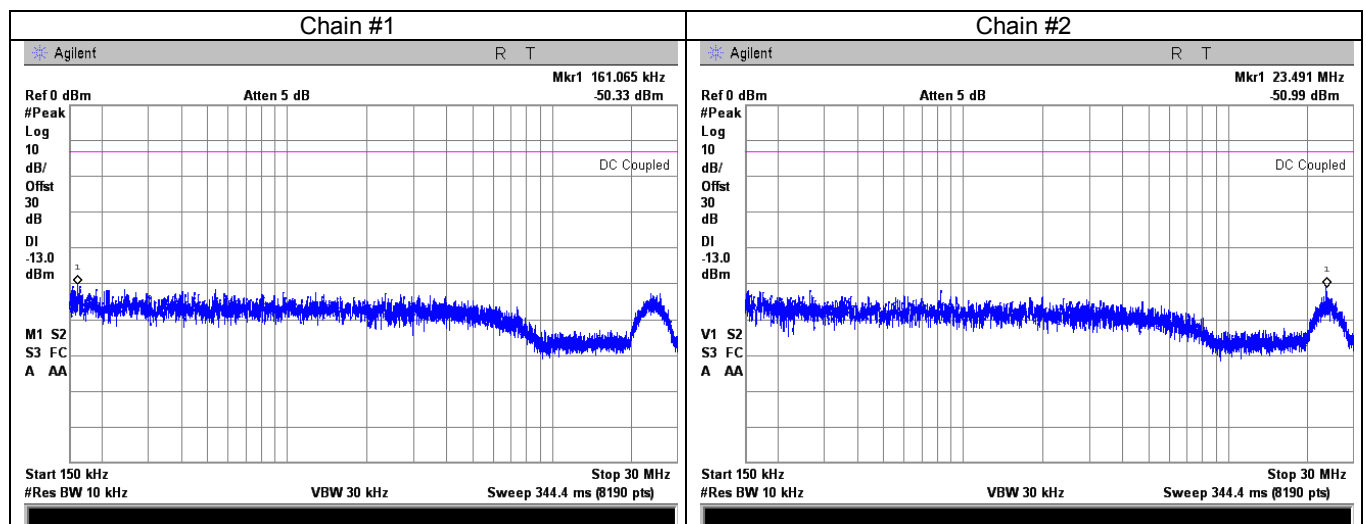


Test specification:		Section 24.238, Spurious emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 47 %	Power Supply: 48 VDC
Remarks:			

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

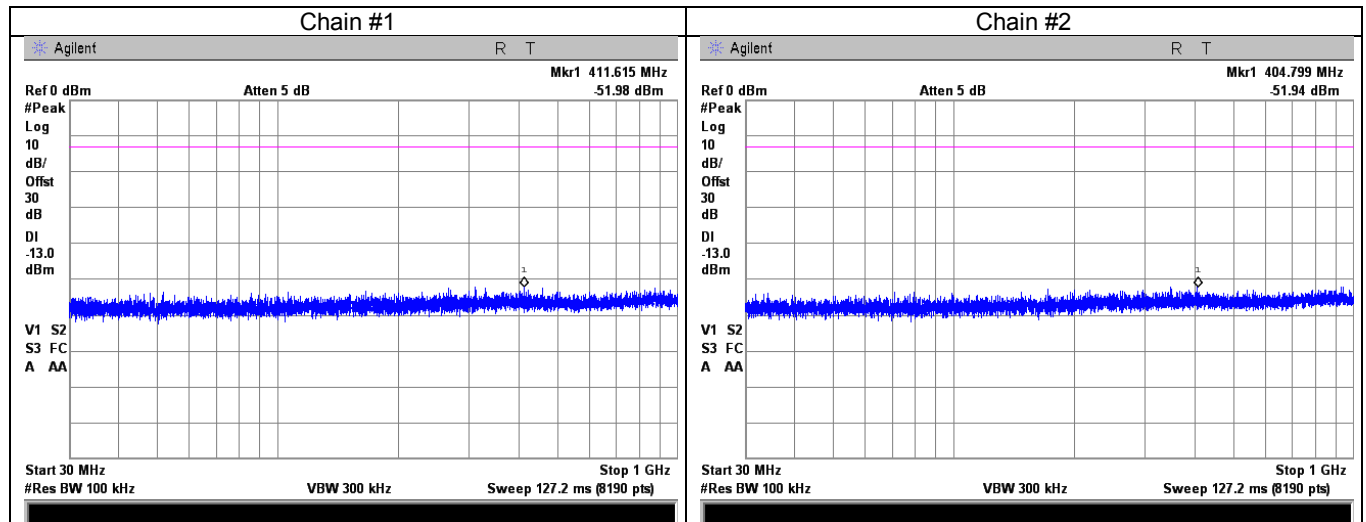


Plot 7.3.6 Spurious emission measurements in 0.15 – 30.0 MHz range at high carrier frequency

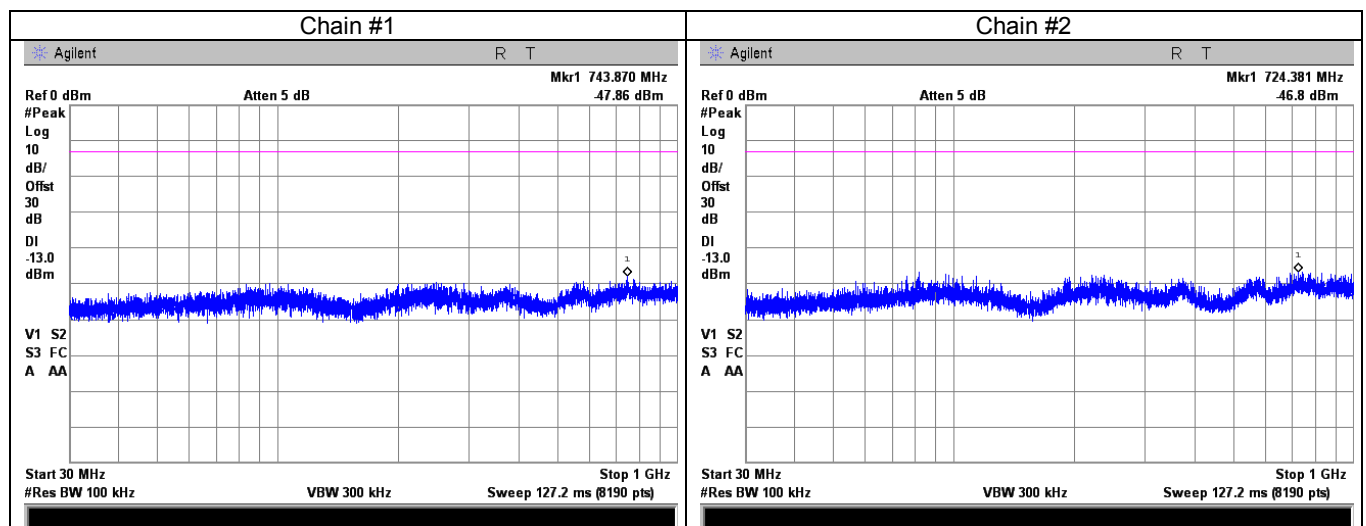


Test specification:		Section 24.238, Spurious emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 47 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.7 Spurious emission measurements in 30.0 - 1000 MHz range at low carrier frequency

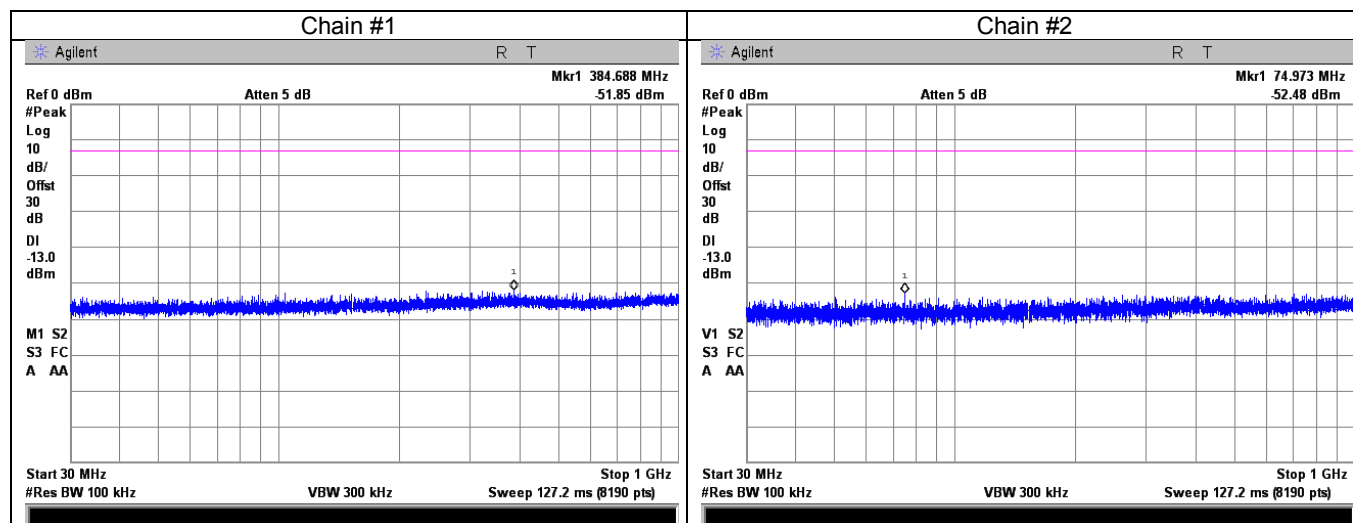


Plot 7.3.8 Spurious emission measurements in 30.0 - 1000 MHz range at mid carrier frequency

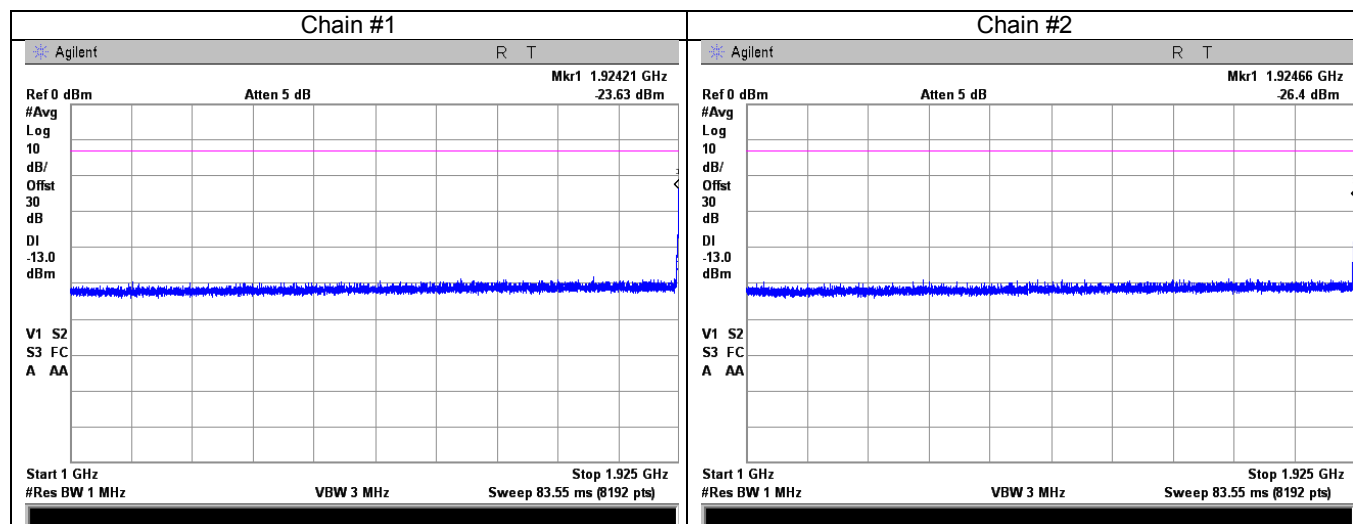


Test specification:		Section 24.238, Spurious emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 47 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.9 Spurious emission measurements in 30.0 - 1000 MHz range at high carrier frequency

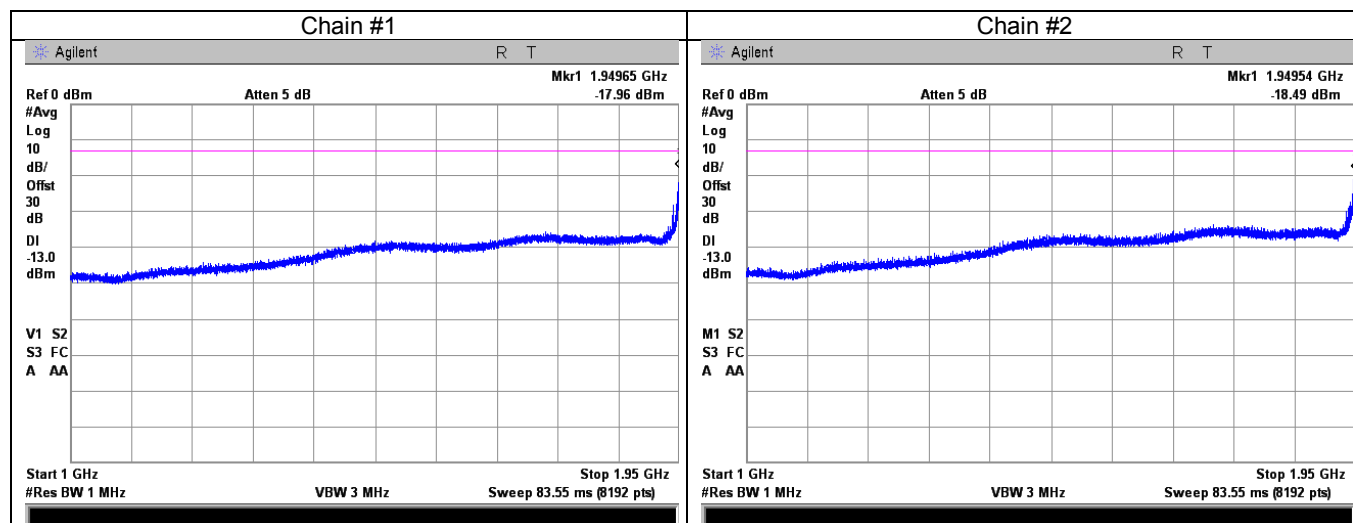


Plot 7.3.10 Spurious emission measurements in 1000 – 1925 MHz range at low carrier frequency

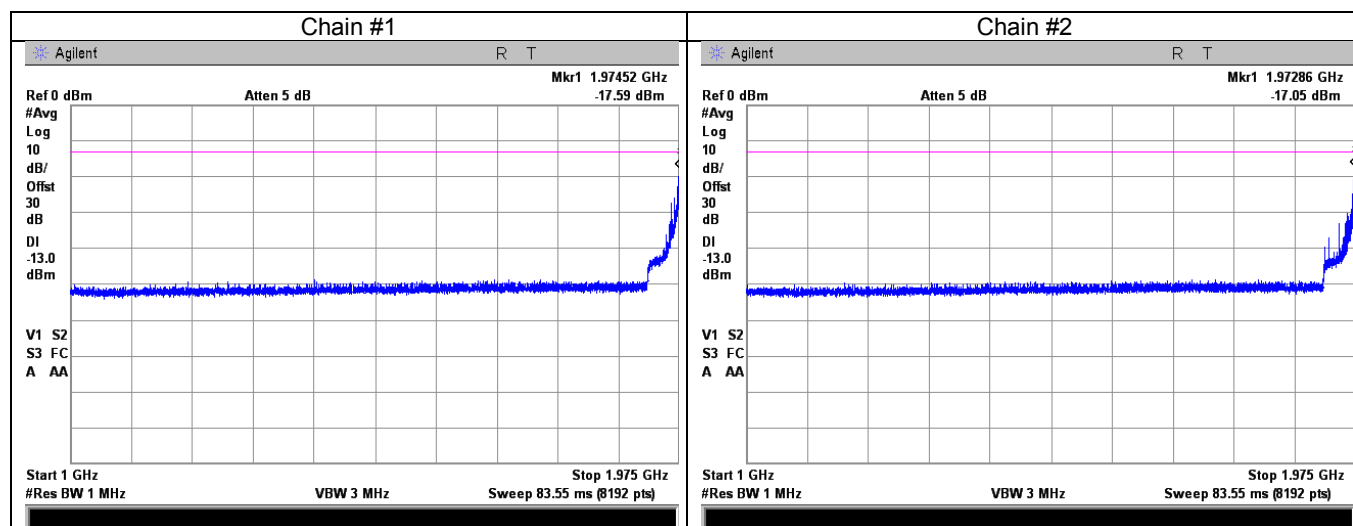


Test specification:		Section 24.238, Spurious emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 47 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.11 Spurious emission measurements in 1000 - 1950MHz range at mid carrier frequency

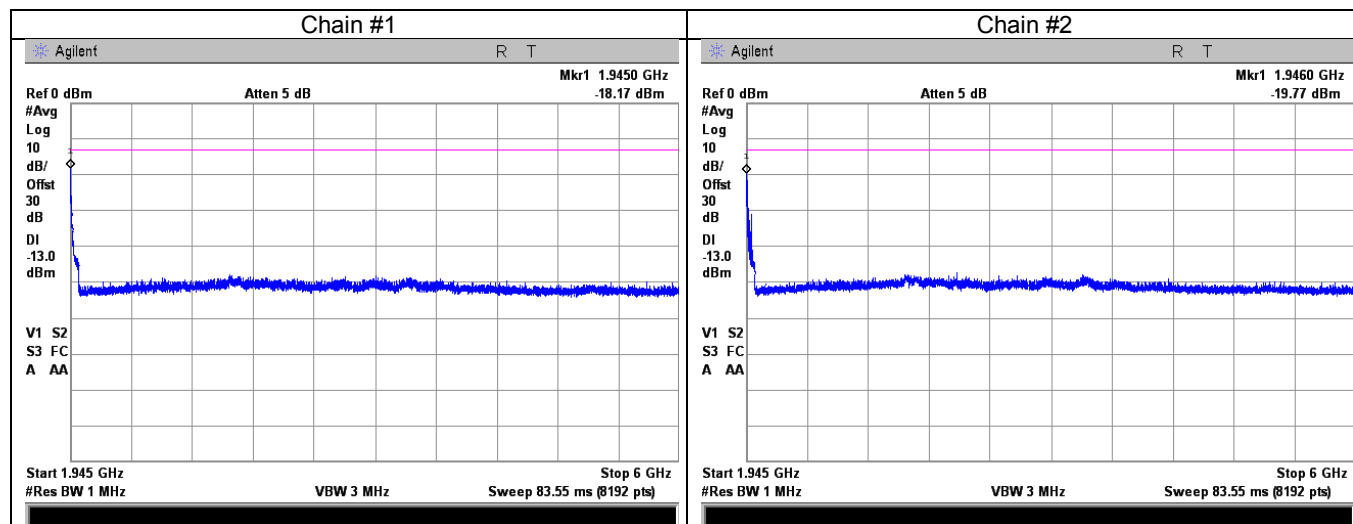


Plot 7.3.12 Spurious emission measurements in 1000 - 1975MHz range at high carrier frequency

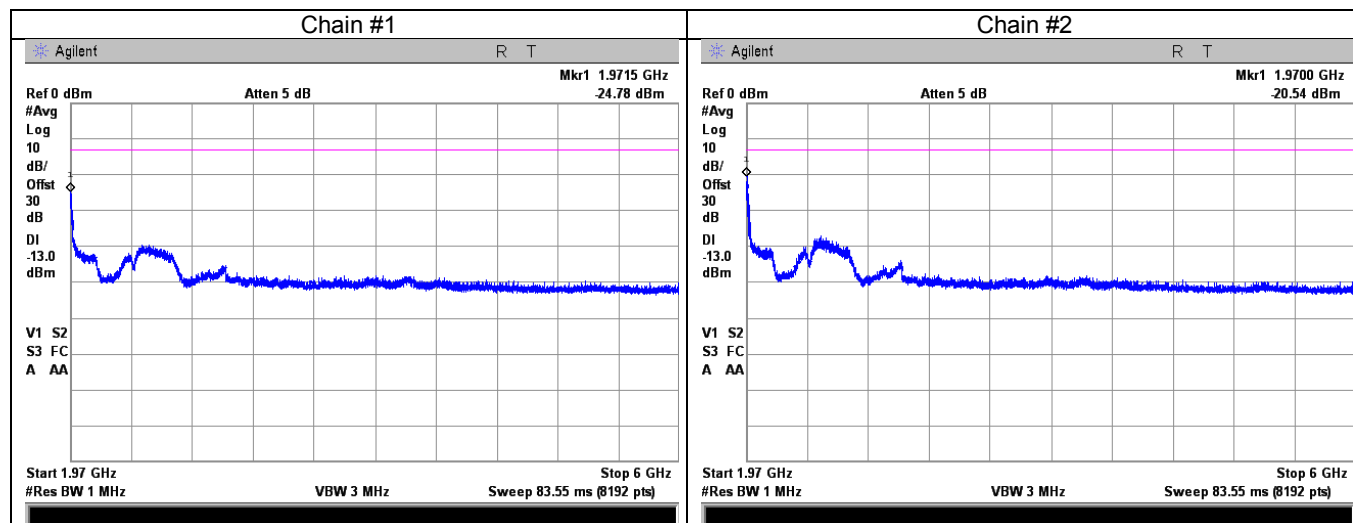


Test specification:		Section 24.238, Spurious emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 47 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.13 Spurious emission measurements in 1945 – 6000 MHz range at low carrier frequency

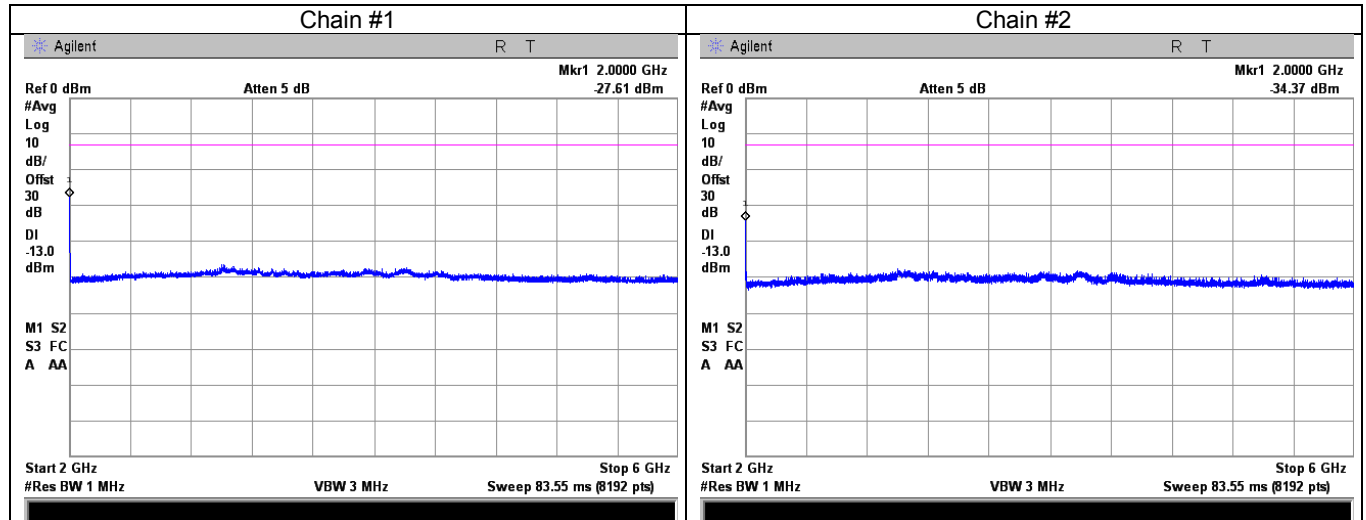


Plot 7.3.14 Spurious emission measurements in 1970 - 6000 MHz range at mid carrier frequency

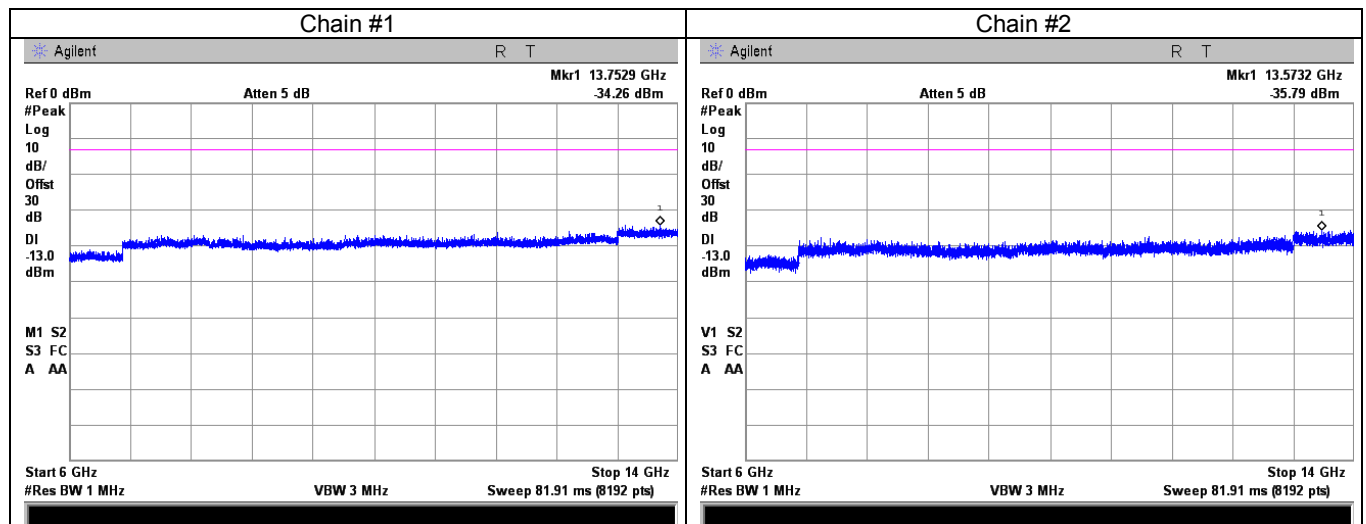


Test specification:		Section 24.238, Spurious emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 47 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.15 Spurious emission measurements in 2000 - 6000 MHz range at high carrier frequency

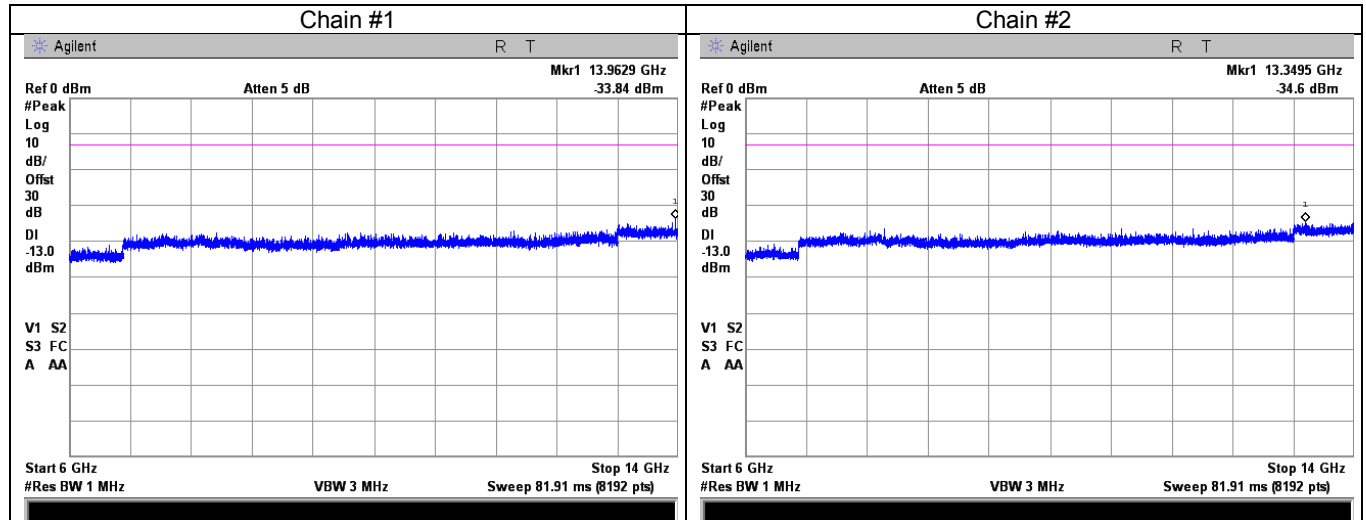


Plot 7.3.16 Spurious emission measurements in 6000 – 14000 MHz range at low carrier frequency

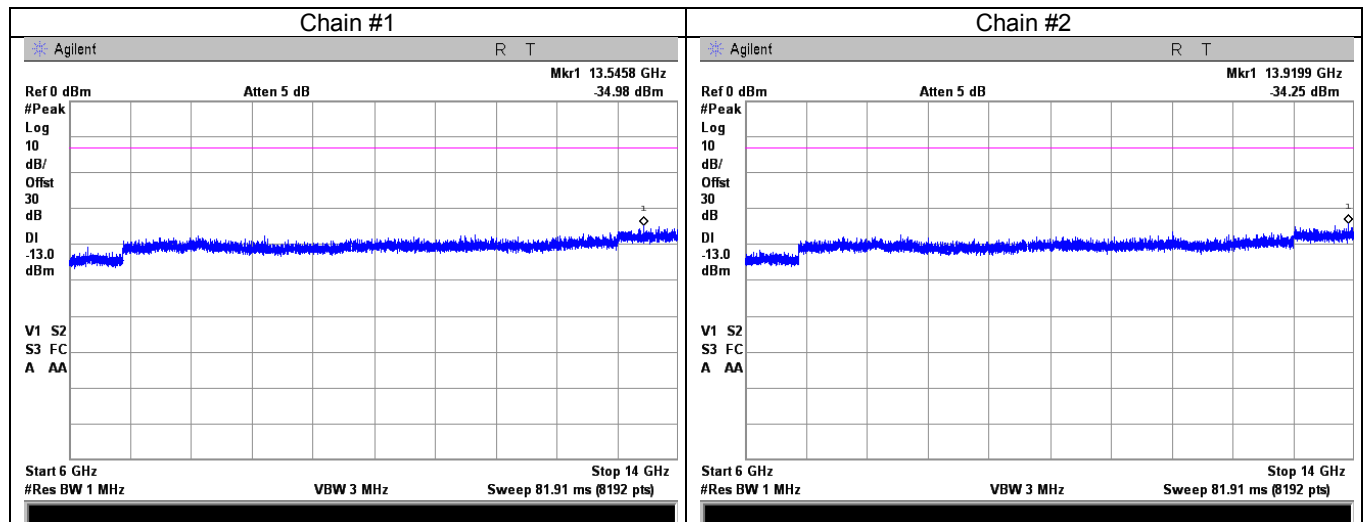


Test specification:		Section 24.238, Spurious emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 47 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.17 Spurious emission measurements in 6000 - 14000 MHz range at mid carrier frequency

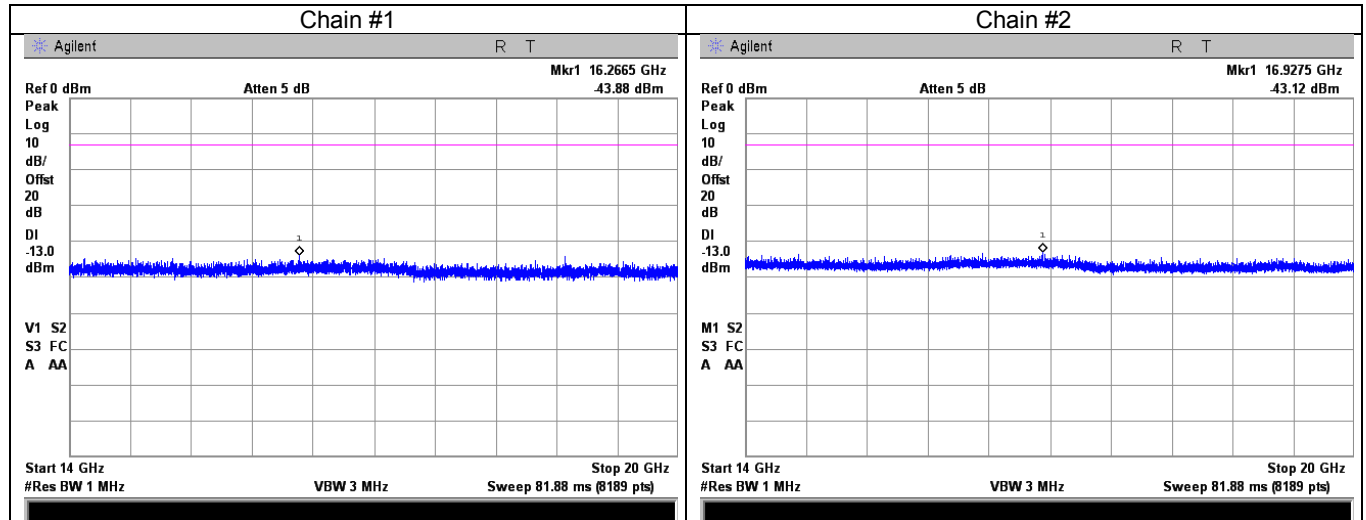


Plot 7.3.18 Spurious emission measurements in 6000 - 14000 MHz range at high carrier frequency

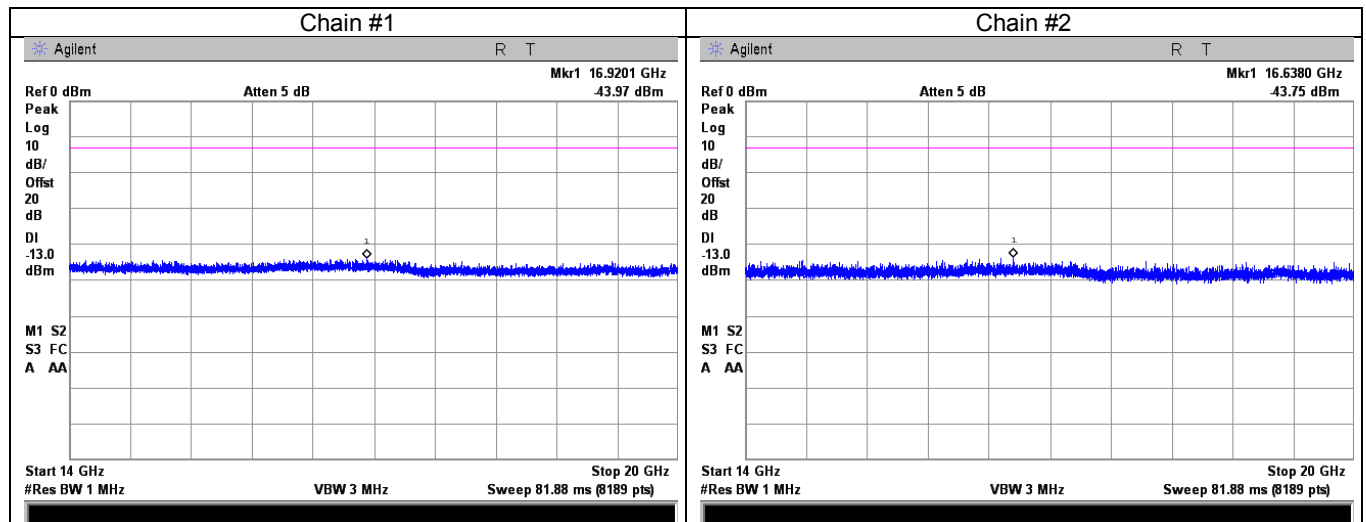


Test specification:		Section 24.238, Spurious emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 47 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.19 Spurious emission measurements in 14000 - 19900 MHz range at low carrier frequency

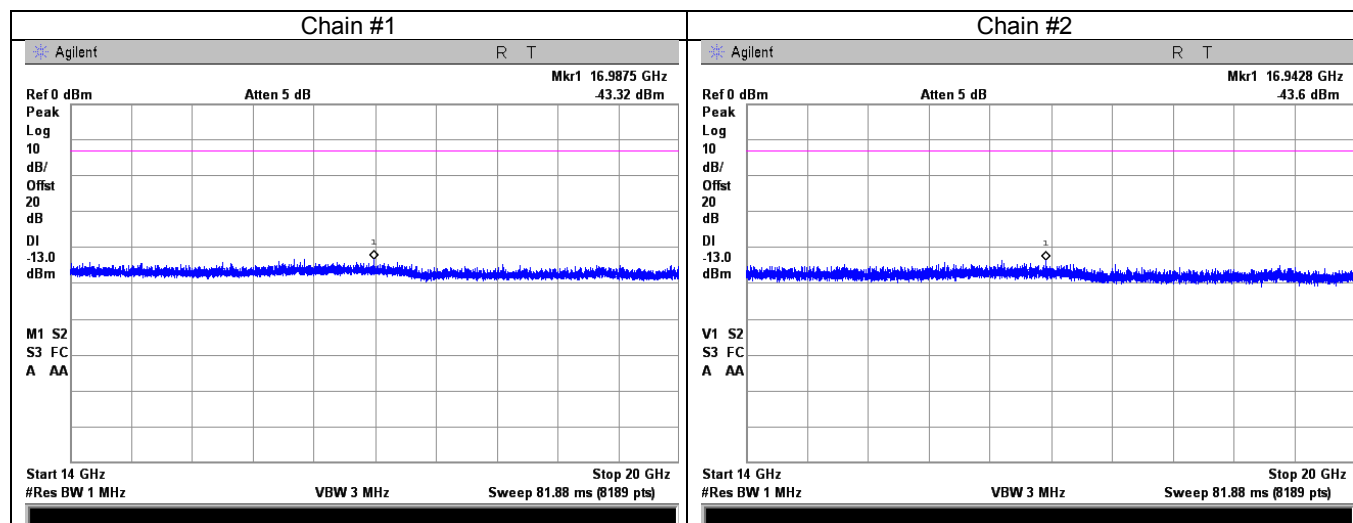


Plot 7.3.20 Spurious emission measurements in 14000 - 19900 MHz range at mid carrier frequency



Test specification:		Section 24.238, Spurious emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 47 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.21 Spurious emission measurements in 14000 - 19900 MHz range at high carrier frequency





Test specification:	Section 24.238, Band edge emissions at antenna terminal		
Test procedure:	47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13		
Test mode:	Compliance	Verdict: PASS	
Date(s):	23-Jul-14		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 40 %	Power Supply: 48 VDC
Remarks:			

7.4 Band edge emission

7.4.1 General

This test was performed to verify the EUT band edge emission including all associated side bands and was attenuated at least $43+10\log(P)$ below the unmodulated carrier level. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Band edge emission limits

Channel	Frequency range	Attenuation below carrier, dBc	Limit, dBm
Channel bandwidth 10 MHz			
1935	1925-1930 1940-1945	$43+10*\log(P^*)$	-13.0
1960	1950-1955 1965-1970	$43+10*\log(P^*)$	-13.0
1985	1975-1980 1990-1995	$43+10*\log(P^*)$	-13.0
Channel bandwidth 20 MHz			
1940	1920-1930 1950-1960	$43+10*\log(P^*)$	-13.0
1960	1940-1950 1970-1980	$43+10*\log(P^*)$	-13.0
1980	1960-1970 1990-2000	$43+10*\log(P^*)$	-13.0

7.4.2 Test procedure

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 spectrum analyzer frequency span was set to capture all major modulation sidebands of emission and sweep time was set sufficiently slow to ensure peak measurements. Spectrum analyzer was set in peak hold mode and time sufficient for trace stabilization was allowed.

7.4.2.3 The frequency of modulation envelope points beyond which power level drops below the band edge emission limit was measured.

7.4.2.4 The test results were recorded in Table 7.4.2 and shown in the associated plots.

Figure 7.4.1 Band edge emission measurement set up





Test specification:		Section 24.238, Band edge emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:	Compliance	Verdict:	PASS
Date(s):	23-Jul-14		
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 40 %	Power Supply: 48 VDC
Remarks:			

Table 7.4.2 Band edge emission test results at low band edge

ASSIGNED FREQUENCY RANGE: 1930-1990 MHz
 INVESTIGATED FREQUENCY RANGE: See below
 RBW: 100 kHz
 DETECTOR USED: Average
 VIDEO BANDWIDTH: $\geq$ Resolution bandwidth
 MODULATING SIGNAL: PRBS
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 MODULATION: QPSK, 64QAM
 NUMBER OF RF OUTPUTS: N = 2
 EBW: 10 MHz

Frequency offset, $\pm$ MHz	Low band edge SA reading, dBm	Low band edge result, dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
Low carrier frequency QPSK						
5.5	-20.80	-17.80	100	1000	-13.0	Pass
Low carrier frequency 64QAM						
5.5	-21.62	-18.62	100	1000	-13.0	Pass
Mid carrier frequency QPSK						
5.5	-24.59	-21.59	100	1000	-13.0	Pass
Mid carrier frequency 64QAM						
5.5	-22.47	-19.47	100	1000	-13.0	Pass
High carrier frequency QPSK						
5.5	-17.69	-14.69	100	1000	-13.0	Pass
High carrier frequency 64QAM						
5.5	-20.58	-17.58	100	1000	-13.0	Pass

* - Low band edge result = Low band edge SA Reading + $10\log(N)$

* - Measured frequency beyond which the emission dropped below the limit

** - Margin = Band edge limit – Band edge frequency



Test specification:		Section 24.238, Band edge emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 40 %	Power Supply: 48 VDC
Remarks:			

Table 7.4.3 Band edge emission test results at high band edge

ASSIGNED FREQUENCY RANGE: 1930-1990 MHz
 INVESTIGATED FREQUENCY RANGE: See below
 RBW: 100 kHz
 DETECTOR USED: Average
 VIDEO BANDWIDTH: $\geq$ Resolution bandwidth
 MODULATING SIGNAL: PRBS
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 MODULATION: QPSK, 64QAM
 NUMBER OF RF OUTPUTS: N = 2
 EBW: 10 MHz

Frequency offset, $\pm$ MHz	High band edge SA reading, dBm	High band edge result, dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
Low carrier frequency QPSK						
5.5	-20.53	-17.53	100	1000	-13.0	Pass
Low carrier frequency 64QAM						
5.5	-19.06	-16.06	100	1000	-13.0	Pass
Mid carrier frequency QPSK						
5.5	-23.00	-20.00	100	1000	-13.0	Pass
Mid carrier frequency 64QAM						
5.5	-25.70	-22.70	100	1000	-13.0	Pass
High carrier frequency QPSK						
5.5	-17.40	-14.40	100	1000	-13.0	Pass
High carrier frequency 64QAM						
5.5	-18.80	-15.80	100	1000	-13.0	Pass

* - Low band edge result = Low band edge SA Reading + $10\log(N)$

* - Measured frequency beyond which the emission dropped below the limit

** - Margin = Band edge limit – Band edge frequency



HERMON LABORATORIES

Test specification:		Section 24.238, Band edge emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 40 %	Power Supply: 48 VDC
Remarks:			

Table 7.4.4 Band edge emission test results at low band edge

ASSIGNED FREQUENCY RANGE: 1930-1990 MHz
 INVESTIGATED FREQUENCY RANGE: See below
 RBW: 100 kHz
 DETECTOR USED: Average
 VIDEO BANDWIDTH: $\geq$ Resolution bandwidth
 MODULATING SIGNAL: PRBS
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 MODULATION: QPSK, 64QAM
 NUMBER OF RF OUTPUTS: N = 2
 EBW: 20 MHz

Frequency offset, $\pm$ MHz	Low band edge SA reading, dBm	Low band edge result, dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
Low carrier frequency QPSK						
10.5	-24.08	-21.08	300	1000	-13.0	Pass
Low carrier frequency 64QAM						
10.5	-20.85	-17.85	300	1000	-13.0	Pass
Mid carrier frequency QPSK						
10.5	-24.81	-21.81	300	1000	-13.0	Pass
Mid carrier frequency 64QAM						
10.5	-23.09	-20.09	300	1000	-13.0	Pass
High carrier frequency QPSK						
10.5	-20.37	-17.37	300	1000	-13.0	Pass
High carrier frequency 64QAM						
10.5	-23.01	-20.01	300	1000	-13.0	Pass

* - Low band edge result = Low band edge SA Reading + $10\log(N)$

* - Measured frequency beyond which the emission dropped below the limit

** - Margin = Band edge limit – Band edge frequency



HERMON LABORATORIES

Test specification:		Section 24.238, Band edge emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 40 %	Power Supply: 48 VDC
Remarks:			

Table 7.4.5 Band edge emission test results at high band edge

ASSIGNED FREQUENCY RANGE: 1930-1990 MHz
 INVESTIGATED FREQUENCY RANGE: See below
 RBW: 100 kHz
 DETECTOR USED: Average
 VIDEO BANDWIDTH: $\geq$ Resolution bandwidth
 MODULATING SIGNAL: PRBS
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum
 MODULATION: QPSK, 64QAM
 NUMBER OF RF OUTPUTS: N = 2
 EBW: 20 MHz

Frequency offset, $\pm$ MHz	High band edge SA reading, dBm	High band edge result, dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
Low carrier frequency QPSK						
10.5	-22.62	-19.62	300	1000	-13.0	Pass
Low carrier frequency 64QAM						
10.5	-19.48	-16.48	300	1000	-13.0	Pass
Mid carrier frequency QPSK						
10.5	-24.62	-21.62	300	1000	-13.0	Pass
Mid carrier frequency 64QAM						
10.5	-22.21	-19.21	300	1000	-13.0	Pass
High carrier frequency QPSK						
10.5	-21.46	-18.46	300	1000	-13.0	Pass
High carrier frequency 64QAM						
10.5	-23.20	-20.20	300	1000	-13.0	Pass

* - Low band edge result = Low band edge SA Reading + $10\log(N)$

* - Measured frequency beyond which the emission dropped below the limit

** - Margin = Band edge limit – Band edge frequency

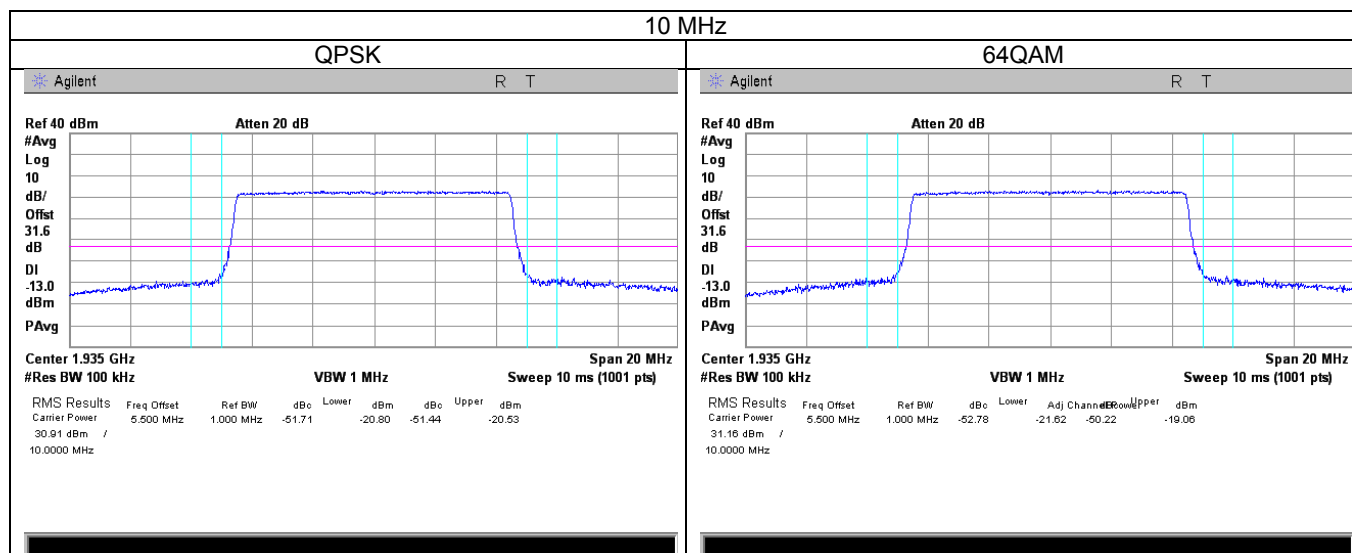
Reference numbers of test equipment used

HL 2909	HL 3301	HL 3390	HL 3770	HL 4273	HL 4366		
---------	---------	---------	---------	---------	---------	--	--

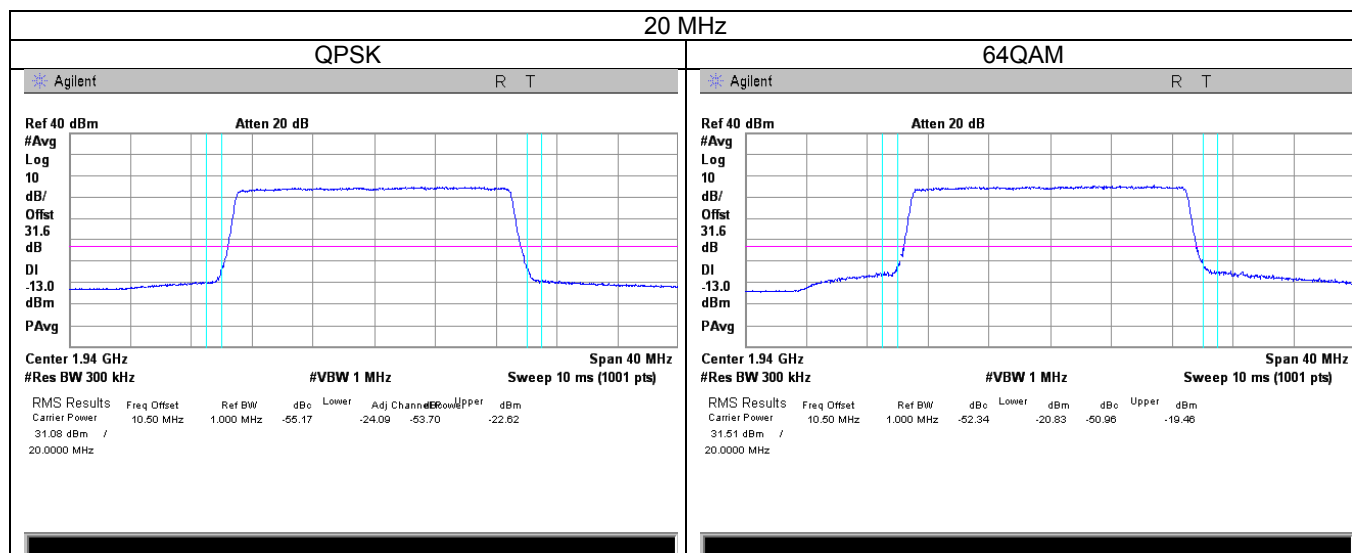
Full description is given in Appendix A.

Test specification:		Section 24.238, Band edge emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 40 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.1 Band edge emission test result at low frequency, RF Chain 1

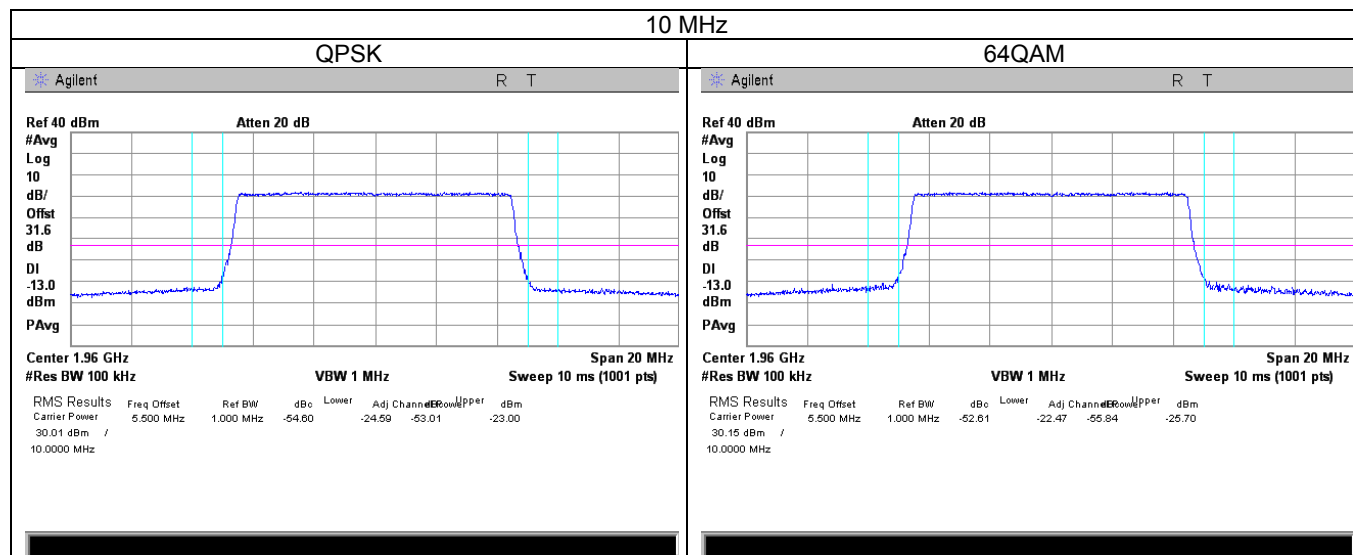


Plot 7.4.2 Band edge emission test result at low frequency, RF Chain 1

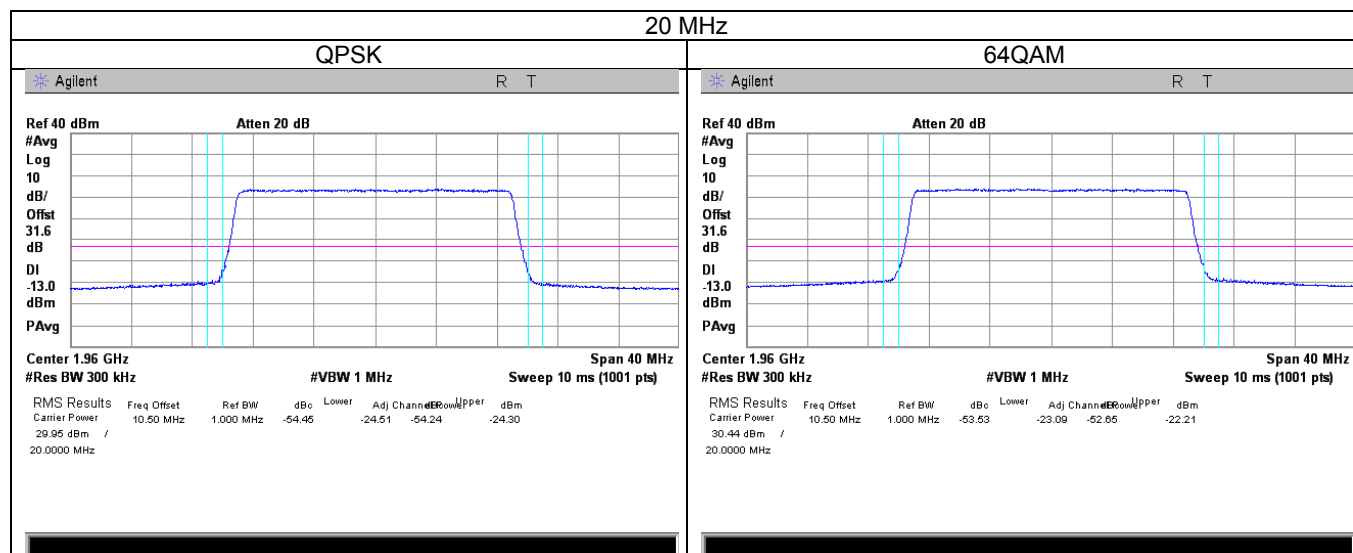


Test specification:		Section 24.238, Band edge emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 40 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.3 Band edge emission test result at mid frequency, RF Chain 1

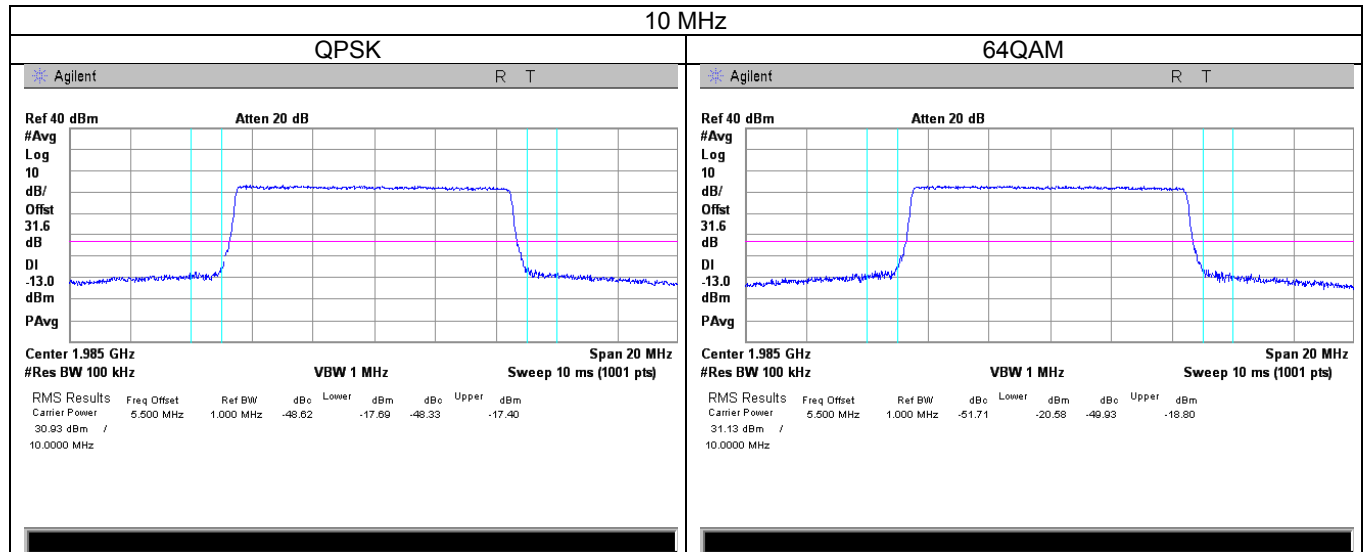


Plot 7.4.4 Band edge emission test result at mid frequency, RF Chain 1

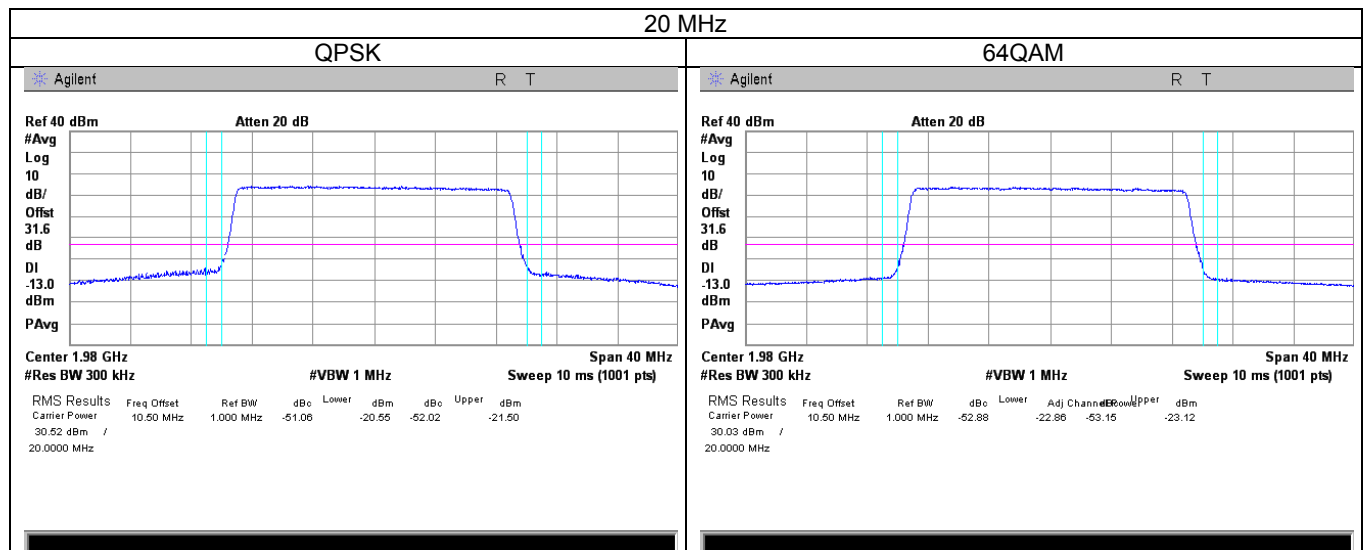


Test specification:		Section 24.238, Band edge emissions at antenna terminal	
Test procedure:		47 CFR, Sections 2.1051 and 24.238; TIA/EIA-603-A, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		23-Jul-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 40 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.5 Band edge emission test result at high frequency, RF Chain 1



Plot 7.4.6 Band edge emission test result at high frequency, RF Chain 1



Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
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 – 10 th harmonic*	43+10logP**	-13	84.4

* - 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

7.5.2 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

7.5.2.4 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.

Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
Remarks:			

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

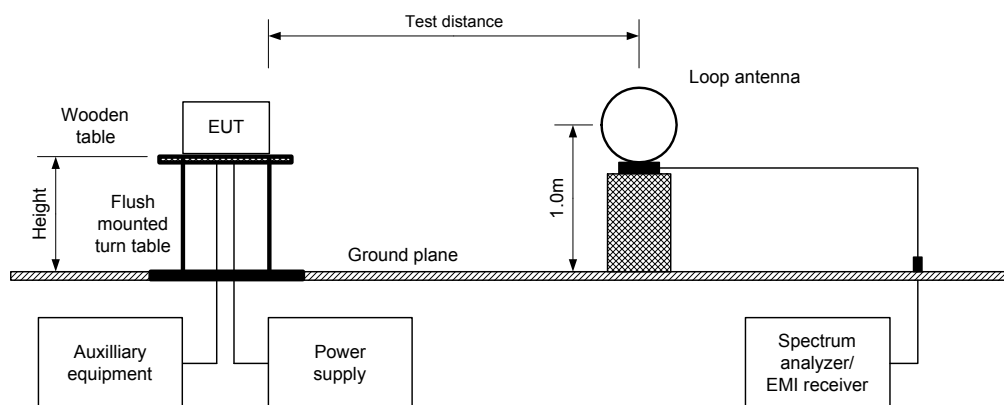
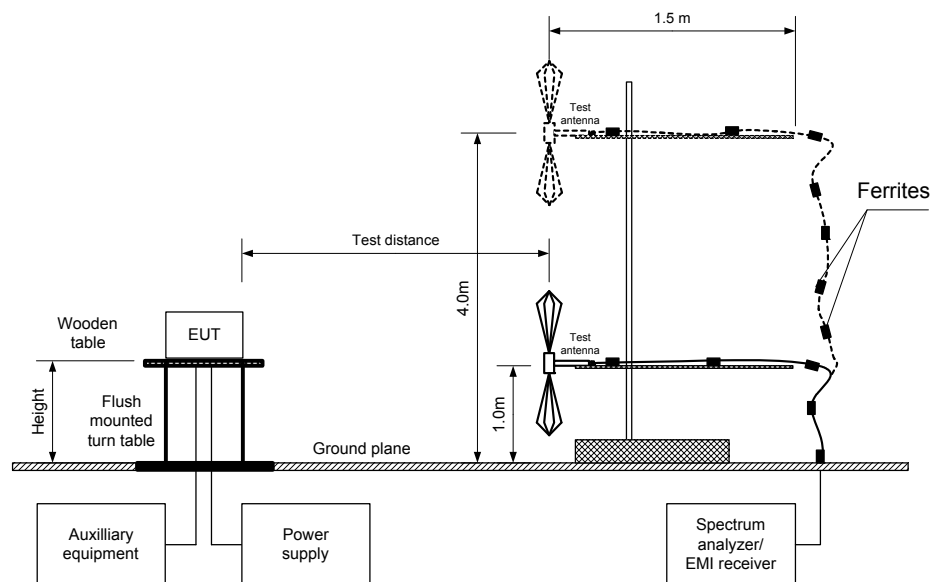


Figure 7.5.2 Setup for spurious emission field strength measurements above 30 MHz





Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
Remarks:			

Table 7.5.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE: 1930 – 1990 MHz
 TEST DISTANCE: 3 m
 TEST SITE: Fully anechoic chamber / OATS
 EUT HEIGHT: 0.8 m
 INVESTIGATED FREQUENCY RANGE: 0.009 – 20000 MHz
 DETECTOR USED: Peak
 VIDEO BANDWIDTH: > Resolution bandwidth
 TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
 Biconical (30 MHz – 200 MHz)
 Log periodic (200 MHz – 1000 MHz)
 Biconilog (30 MHz – 1000 MHz)
 Double ridged guide (above 1000 MHz)

MODULATION: QPSK
 MODULATING SIGNAL: PRBS
 BIT RATE: 15.1 Mbps
 BW: 10 MHz
 TRANSMITTER OUTPUT POWER SETTINGS: Maximum (see Table of Power Settings)

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							
All spurious emissions are at least 20 dB below the limit							
Mid carrier frequency							
All spurious emissions are at least 20 dB below the limit							
High carrier frequency							
All spurious emissions are at least 20 dB below the limit							

Verdict: Pass

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

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

Reference numbers of test equipment used

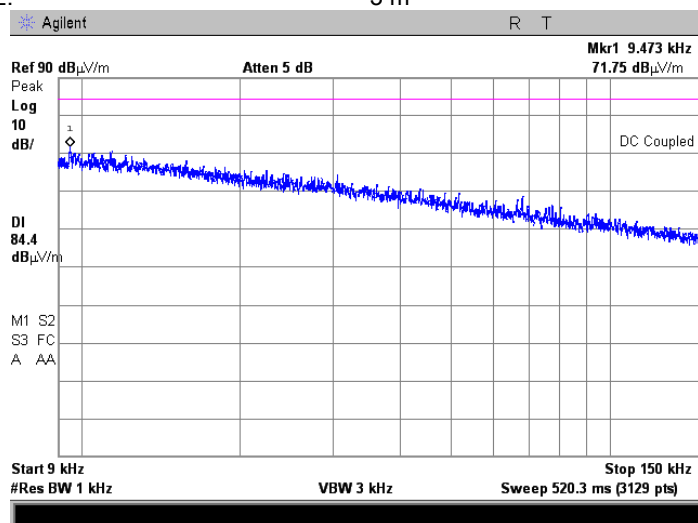
HL 0446	HL 0768	HL 2432	HL 2697	HL 2780	HL 3535	HL 3903	HL 4114
HL 4160	HL 4276	HL 4278					

Full description is given in Appendix A.

Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
Remarks:			

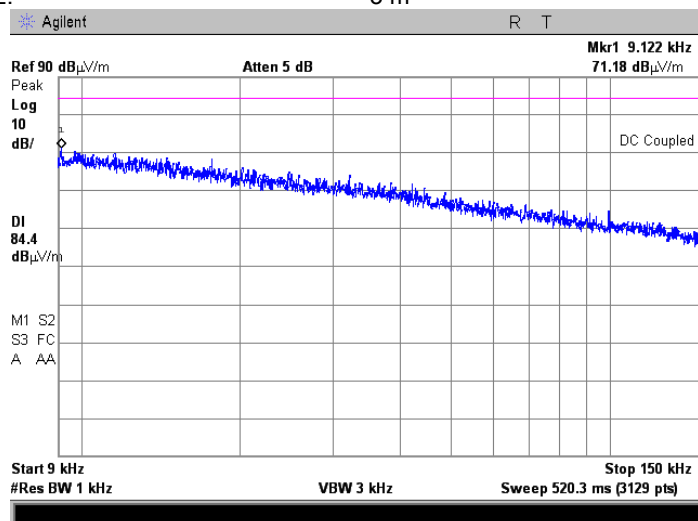
Plot 7.5.1 Radiated emission measurements in 9 - 150 kHz range

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



Plot 7.5.2 Radiated emission measurements in 9 - 150 kHz range

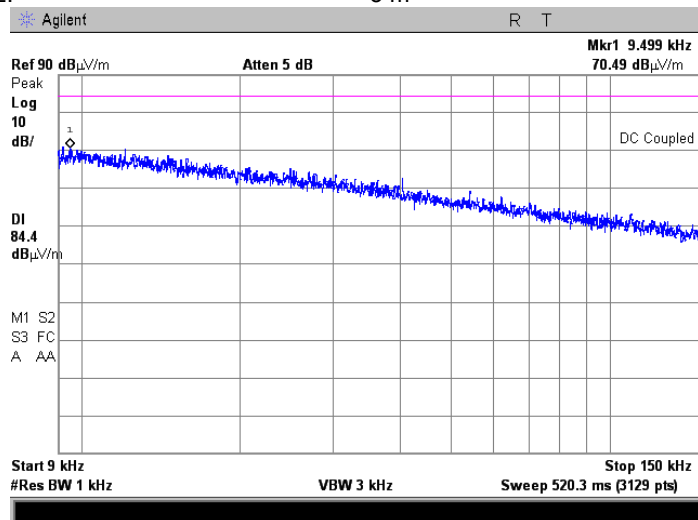
TEST SITE: Fully anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
Remarks:			

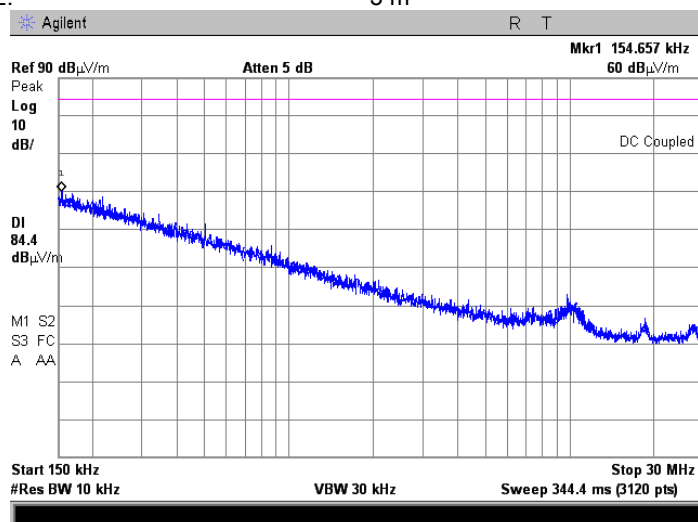
Plot 7.5.3 Radiated emission measurements in 9 - 150 kHz range

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



Plot 7.5.4 Radiated emission measurements in 0.15 - 30 MHz range

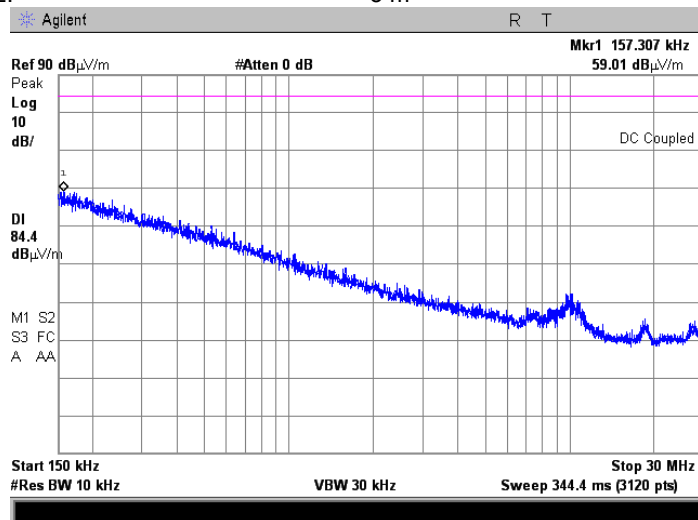
TEST SITE: Fully anechoic chamber
CARRIER FREQUENCY: Low
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
Remarks:			

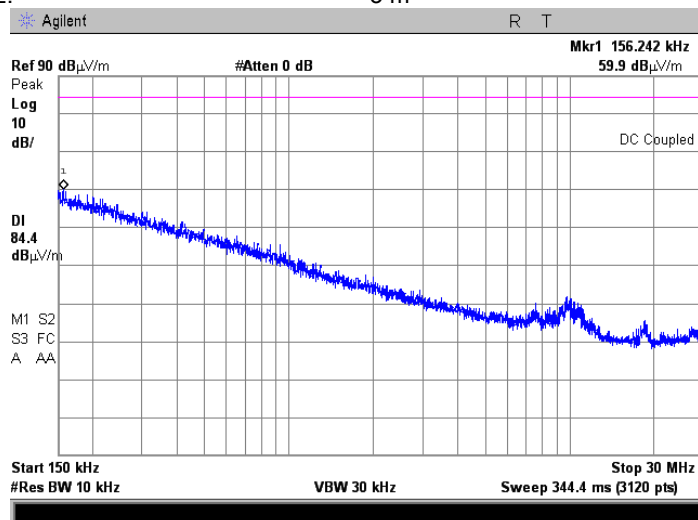
Plot 7.5.5 Radiated emission measurements in 0.15 - 30 MHz range

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



Plot 7.5.6 Radiated emission measurements in 0.15 - 30 MHz range

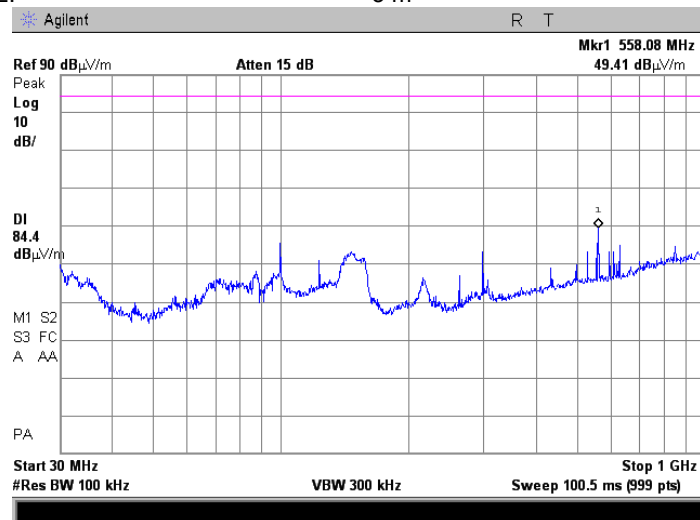
TEST SITE: Fully anechoic chamber
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
Remarks:			

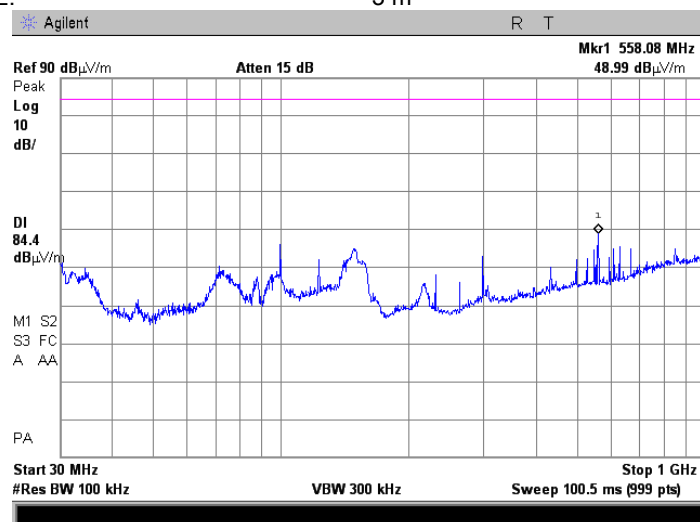
Plot 7.5.7 Radiated emission measurements in 30 - 1000 MHz range

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



Plot 7.5.8 Radiated emission measurements in 30 - 1000 MHz range

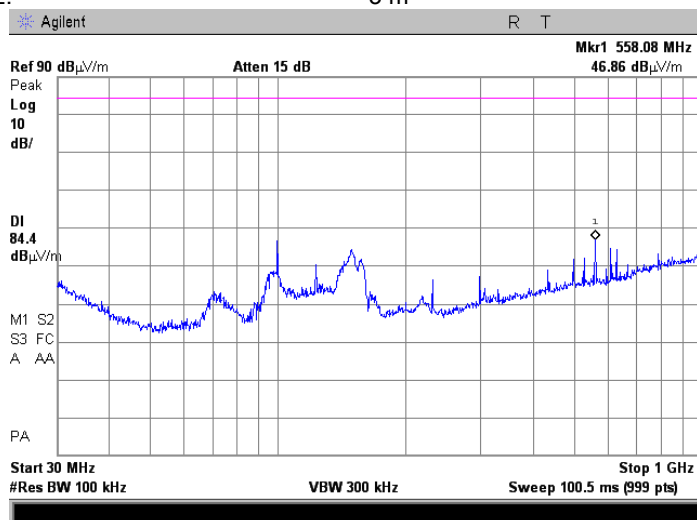
TEST SITE: Fully anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
Remarks:			

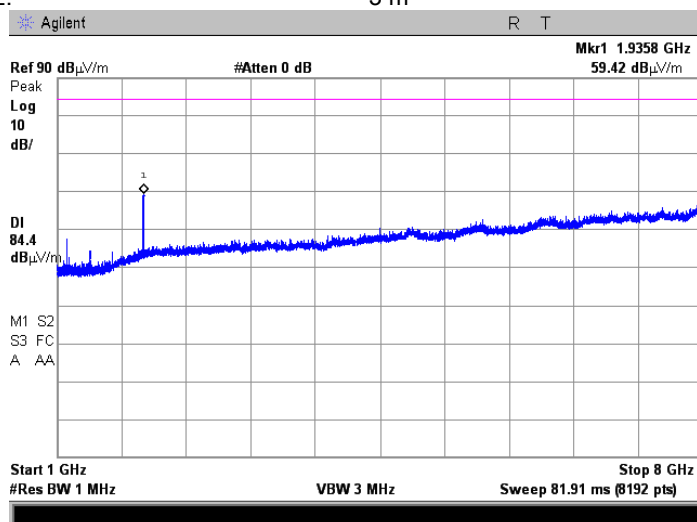
Plot 7.5.9 Radiated emission measurements in 30 - 1000 MHz range

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



Plot 7.5.10 Radiated emission measurements in 1000 – 8000 MHz range

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

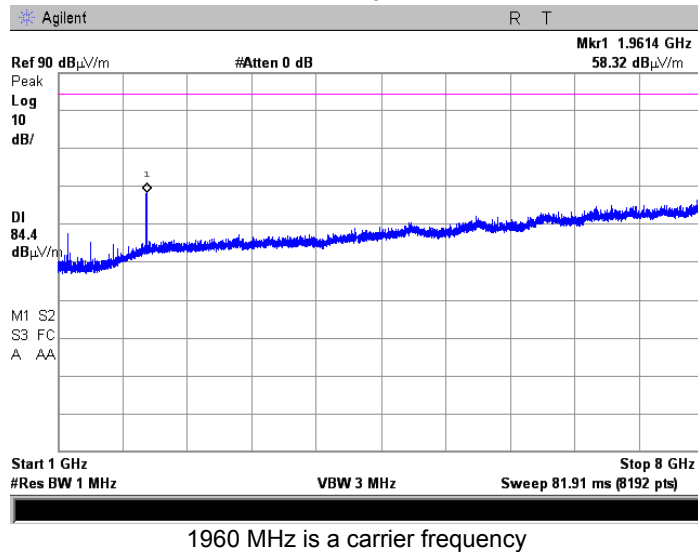


1935 MHz is a carrier frequency

Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
Remarks:			

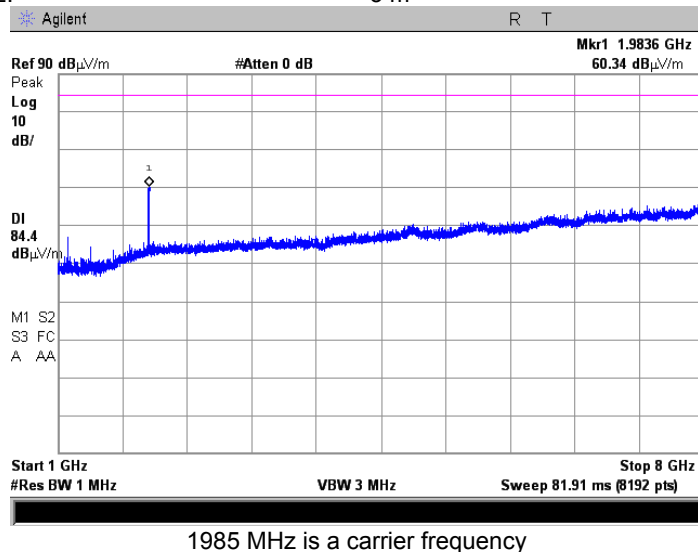
Plot 7.5.11 Radiated emission measurements in 1000 – 8000 MHz range

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



Plot 7.5.12 Radiated emission measurements in 1000 – 8000 MHz range

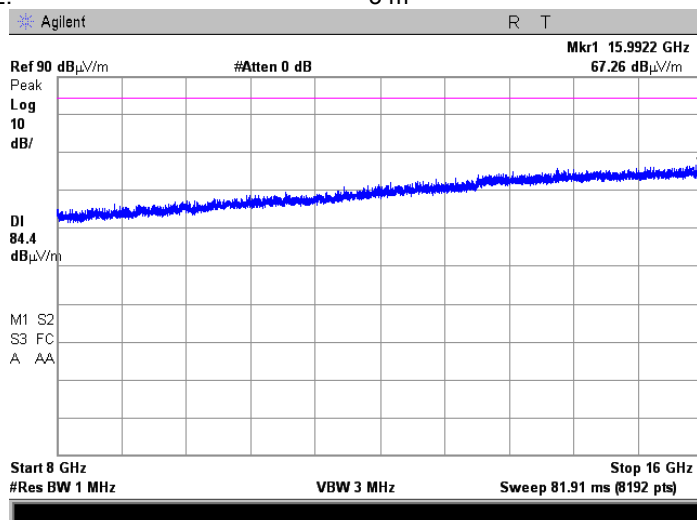
TEST SITE: Fully anechoic chamber
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
Remarks:			

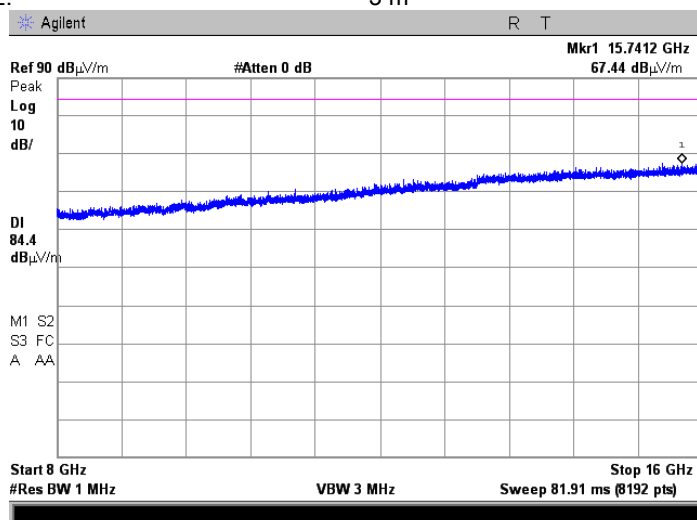
Plot 7.5.13 Radiated emission measurements in 8000 – 16000 MHz range

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



Plot 7.5.14 Radiated emission measurements in 8000 – 16000 MHz range

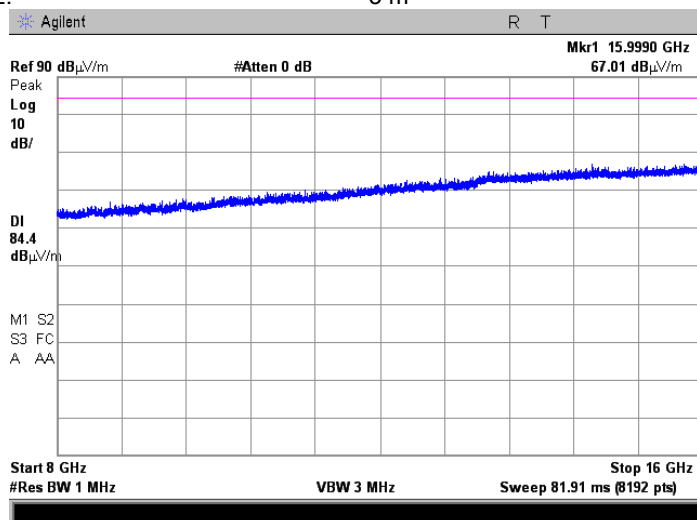
TEST SITE: Fully anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
Remarks:			

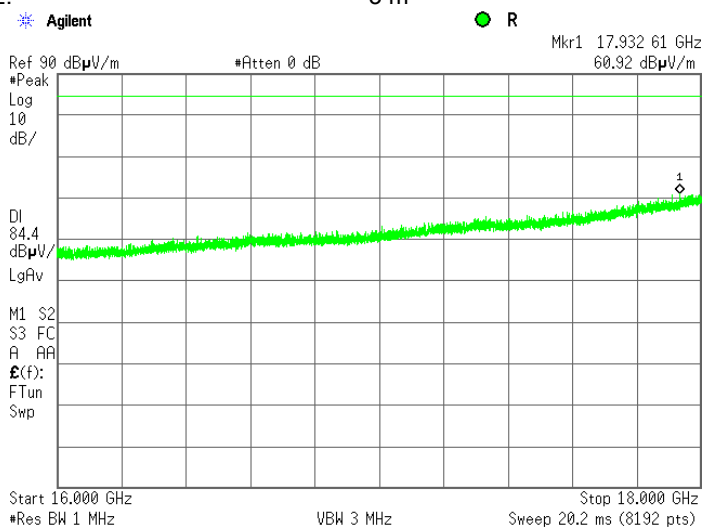
Plot 7.5.15 Radiated emission measurements in 8000 – 16000 MHz range

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



Plot 7.5.16 Radiated emission measurements in 16000 – 18000 MHz range

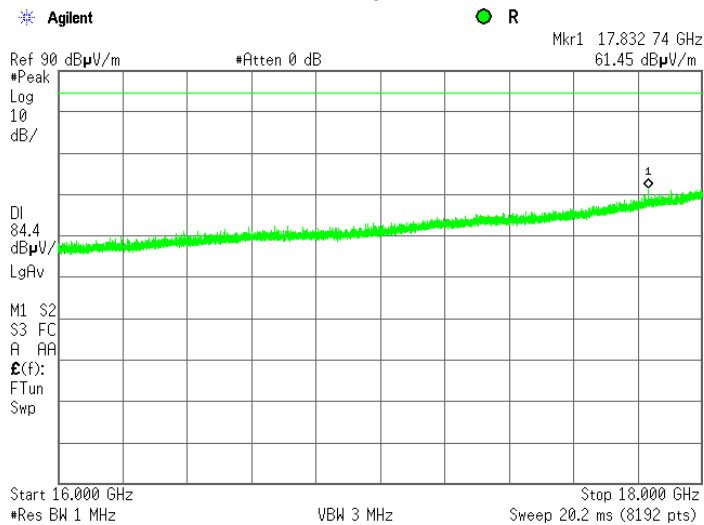
TEST SITE: OATS
CARRIER FREQUENCY: Low
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
Remarks:			

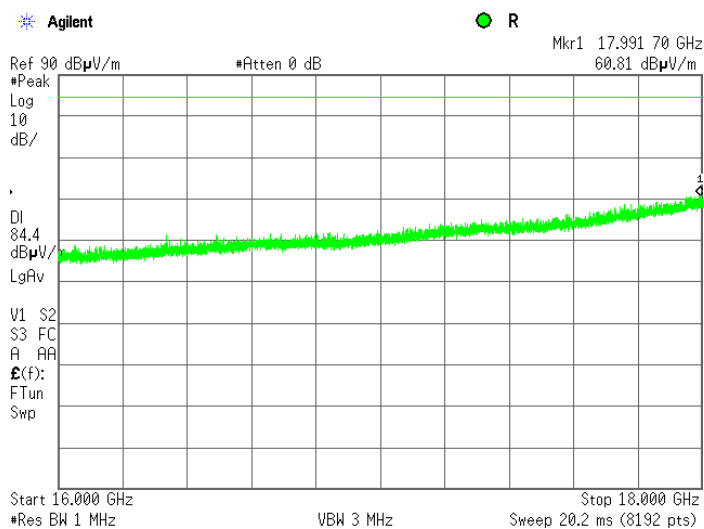
Plot 7.5.17 Radiated emission measurements in 16000 – 18000 MHz range

TEST SITE: OATS
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Plot 7.5.18 Radiated emission measurements in 16000 – 18000 MHz range

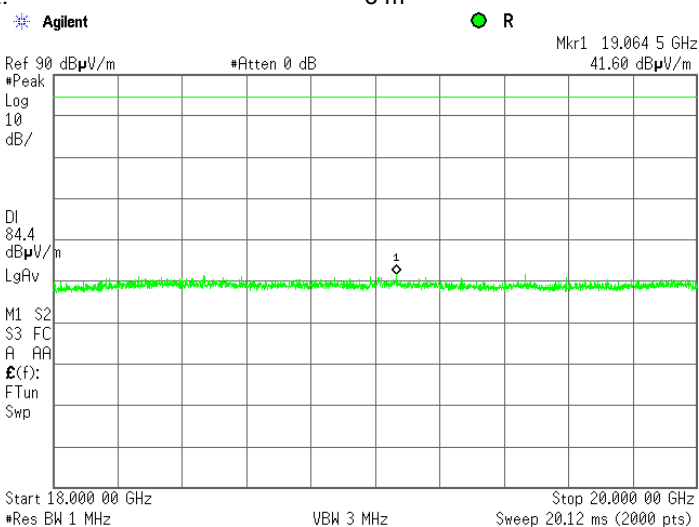
TEST SITE: OATS
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
Remarks:			

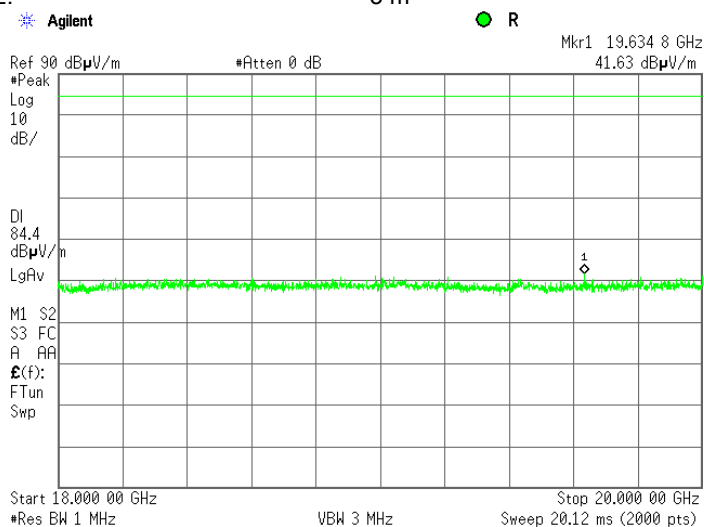
Plot 7.5.19 Radiated emission measurements in 18000 – 20000 MHz range

TEST SITE: OATS
CARRIER FREQUENCY: Low
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Plot 7.5.20 Radiated emission measurements in 18000 – 20000 MHz range

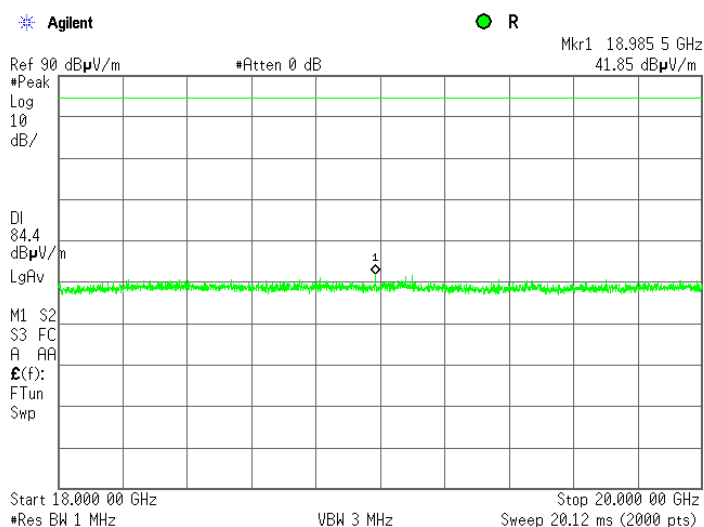
TEST SITE: OATS
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:		Section 24.238, Radiated spurious emissions	
Test procedure:		47 CFR, Sections 2.1053 and 24.238; TIA/EIA-603-A, Section 2.2.12	
Test mode:		Compliance	Verdict: PASS
Date(s):		31-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1005 hPa	Relative Humidity: 56 %	Power Supply: 48 VDC
Remarks:			

Plot 7.5.21 Radiated emission measurements in 18000 – 20000 MHz range

TEST SITE: OATS
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:		Section 24.235, Frequency stability	
Test procedure:		47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 45 %	Power Supply: 48 VDC
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.

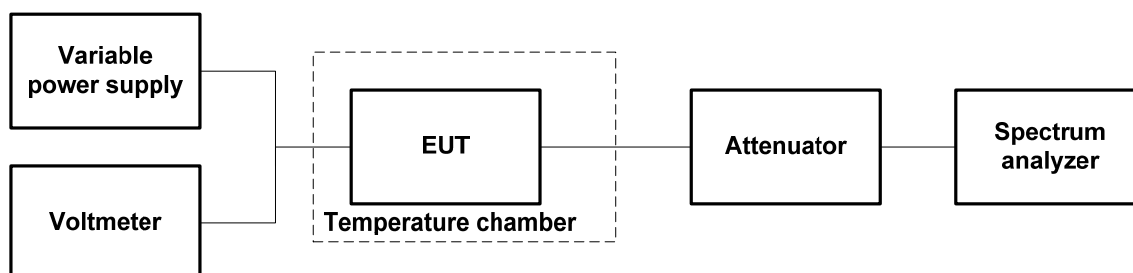
Table 7.6.1 Frequency stability limits

Assigned frequency, MHz	Limits
1930-1990	26 dBc points including frequency tolerance shall remain within the authorized frequency block

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, Table 7.6.3.

Figure 7.6.1 Frequency stability test setup



Test specification:	Section 24.235, Frequency stability				
Test procedure:	47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2				
Test mode:	Compliance	Verdict:			PASS
Date(s):	24-Jul-14 - 03-Aug-14				
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 45 %	Power Supply: 48 VDC		
Remarks:					

Table 7.6.2 Frequency stability test results

OPERATING FREQUENCY: 1930 – 1990 MHz
 NOMINAL POWER VOLTAGE: 48 VDC
 TEMPERATURE STABILIZATION PERIOD: 20 min
 POWER DURING TEMPERATURE TRANSITION: Off
 SPECTRUM ANALYZER MODE: Max Hold
 RESOLUTION BANDWIDTH: 10 Hz
 VIDEO BANDWIDTH: 30 Hz
 MODULATION: Unmodulated

MODULATION:												UNMODULATED	
T, °C	Voltage, V	Frequency, MHz							Max frequency drift, Hz		Limit, 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	1935.00007	1935.000065	1935.000065	1935.000065	1935.000063	1935.000063	1935.00006	0	30	NA	Pass	
-20	nominal	1935.000078	NA	NA	NA	NA	NA	1935.000068	0	22			
-10	nominal	1935.00008	NA	NA	NA	NA	NA	1935.00008	0	10			
0	nominal	1935.000084	1935.000084	1935.000084	1935.000083	1935.000083	1935.000083	1935.000083	0	7			
10	nominal	1935.000086	NA	NA	NA	NA	NA	1935.000086	0	4			
20	15%	1935.000092	NA	NA	NA	NA	NA	1935.00009	0	0			
20	nominal	1935.000092	NA	NA	NA	NA	NA	1935.00009	0	0			
20	-15%	1935.000092	NA	NA	NA	NA	NA	1935.00009	0	0			
30	nominal	1935.000091	1935.000091	1935.000091	1935.000091	1935.000091	1935.000091	1935.00009	1	0			
40	nominal	1935.000097	NA	NA	NA	NA	NA	1935.000094	4	0			
50	nominal	1935.00009	NA	NA	NA	NA	NA	1935.000094	4	0			
Mid frequency													
-30	nominal	1960.000099	1960.000087	1960.000092	1960.000089	1960.000092	1960.000094	1960.000092	2	5	NA	Pass	
-20	nominal	1960.000107	NA	NA	NA	NA	NA	1960.000092	0	0			
-10	nominal	1960.000082	NA	NA	NA	NA	NA	1960.000081	0	11			
0	nominal	1960.000084	1960.000084	1960.000084	1960.000084	1960.000084	1960.000084	1960.000084	0	8			
10	nominal	1960.000088	NA	NA	NA	NA	NA	1960.000087	0	5			
20	15%	1960.960092	NA	NA	NA	NA	NA	1960.000092	0	0			
20	nominal	1960.960092	NA	NA	NA	NA	NA	1960.000092	0	0			
20	-15%	1960.960092	NA	NA	NA	NA	NA	1960.000092	0	0			
30	nominal	1960.000092	1960.000092	1960.000092	1960.000092	1960.000092	1960.000092	1960.000091	0	1			
40	nominal	1985.000098	NA	NA	NA	NA	NA	1960.000096	4	0			
50	nominal	1985.000096	NA	NA	NA	NA	NA	1960.000094	2	0			
High frequency													
-30	nominal	1985.000069	1985.000069	1985.000071	1985.000071	1985.000066	1985.000069	1985.000069	0	30	NA	Pass	
-20	nominal	1985.000079						1985.000079	0	17			
-10	nominal	1985.000084	NA	NA	NA	NA	NA	1985.000084	0	12			
0	nominal	1985.000087	1985.000087	1985.000087	1985.000087	1985.000087	1985.000087	1985.000086	0	10			
10	nominal	1985.000091	NA	NA	NA	NA	NA	1985.00009	0	6			
20	15%	1985.000096	NA	NA	NA	NA	NA	1985.000096	0	0			
20	nominal	1985.000096	NA	NA	NA	NA	NA	1985.000096	0	0			
20	-15%	1985.000096	NA	NA	NA	NA	NA	1985.000096	0	0			
30	nominal	1985.000094	1985.000094	1985.000094	1985.000094	1985.000094	1985.000094	1985.000094	0	2			
40	nominal	1985.000101	NA	NA	NA	NA	NA	1985.000099	3	0			
50	nominal	1985.000098	NA	NA	NA	NA	NA	1985.000098	2	0			

* - Reference frequency

** - Battery operating end point specified by the manufacturer.



HERMON LABORATORIES

Report ID: AIRRAD_FCC.26038.docx
Date of Issue: 11-Aug-14

Test specification:		Section 24.235, Frequency stability	
Test procedure:		47 CFR, Section 2.1055; TIA/EIA-603-A Section 2.2.2	
Test mode:		Compliance	Verdict: PASS
Date(s):		24-Jul-14 - 03-Aug-14	
Temperature: 25 °C	Air Pressure: 1006 hPa	Relative Humidity: 45 %	Power Supply: 48 VDC
Remarks:			

Table 7.6.3 Frequency displacement

Channel	Maximum frequency displacement			
	ppm		Hz	
	Positive	Negative	Positive	Negative
Low	0.01	0.06	4.00	30.00
Mid	0.01	0.02	4.00	11.00
High	0.01	0.06	3.00	30.00

Reference numbers of test equipment used

HL 2909	HL 3210						
---------	---------	--	--	--	--	--	--

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
0446	Antenna, Loop, Active, 10 kHz - 30 MHz	EMCO	6502	2857	21-Jan-14	21-Jan-15
0768	Antenna Standard Gain Horn, 18-26.5 GHz, WR-42, 25 dB gain	Quinstar Technology	QWH-4200-BA	110	12-Dec-12	12-Dec-15
2432	Antenna, Double-Ridged Waveguide Horn 1-18 GHz	EMC Test Systems	3115	00027177	03-Jan-14	03-Jan-15
2697	Antenna, 30 MHz - 3.0 GHz	Sunol Sciences. Corp. Pleasanton, California USA	JB3	A022805	22-May-14	22-May-15
2780	EMC analyzer, 100 Hz to 26.5 GHz	Agilent Technologies	E7405A	MY451024 62	10-Jul-13	10-Aug-14
2909	Spectrum analyzer, ESA-E, 100 Hz to 26.5 GHz	Agilent Technologies	E4407B	MY414447 62	23-Dec-13	23-Dec-14
3210	Temperature Chamber, (-50...+100) °C	Associated Environmental Systems	NA	NA	01-Oct-13	01-Oct-14
3301	Power Meter, P-series, 50 MHz to 40 GHz	Agilent Technologies	N1911A	MY451010 57	12-Feb-14	12-Feb-15
3390	Microwave Cable Assembly, 26.5 GHz, 1.0 m, N type/N type	Suhner Sucoflex	104EA	3390	06-Feb-14	06-Feb-15
3455	Medium Power Fixed Coaxial Attenuator DC to 40 GHz, 20 dB, 5 W	Aeroflex / Weinschel	75A-20-12	1182	09-Mar-14	09-Mar-15
3535	Amplifier, low noise, 18 to 40 GHz	Quinstar Technology	QLJ-18404537 -J0	111590030 01	8-Oct-13	8-Oct-14
3770	Attenuator, N-type, 20 dB, DC to 18 GHz, 5 W	Mini-Circuits	BW-N20W5+	NA	25-Aug-13	25-Aug-14
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFLE X 102A	1226/2A	06-Feb-14	06-Feb-15
4114	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz	ETS Lindgren	3117	00123515	27-Dec-13	27-Dec-14
4160	Preamplifier, 0.1 to 18 GHz, Gain 25 dB, N-type(f) in, N-type(m) out.	Agilent Technologies	87405C	MY470105 94	11-Aug-13	11-Aug-14
4229	Precision Fixed Attenuator, 50 Ohm, 5W, 10dB, DC to 18000 MHz	Mini-Circuits	BW-N10W5+	NA	07-Mar-13	07-Mar-14
4273	Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M	Mini-Circuits	CBL-6FT-SMNM+	70045	27-Nov-13	27-Nov-14
4276	Test Cable , DC-18 GHz, 3.05 m, N/M - N/M	Mini-Circuits	APC-10FT-NMNM+	0747A	27-Nov-13	27-Nov-14
4278	Test Cable , DC-18 GHz, 4.6 m, N/M - N/M	Mini-Circuits	APC-15FT-NMNM+	0755A	27-Nov-13	27-Nov-14
4366	Directional coupler, 1 GHz to 18 GHz, 10 dB, SMA Female	Tiger Micro-Electronics Institute	TGD-A1101-10	01e-JSDE805-007	18-May-14	18-May-16

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 stability	30 – 300 MHz: ± 50.5 Hz (1.68 ppm) 300 – 1000 MHz: ± 168 Hz (0.56 ppm)
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 Vertical polarization	Biconilog antenna: ± 5.3 dB Biconical antenna: ± 5.0 dB Log periodic antenna: ± 5.3 dB Double ridged horn antenna: ± 5.3 dB 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 listed by the Federal Communications Commission (USA) for all parts of Code of Federal Regulations 47 (CFR 47), Registration Numbers 90624 for OATS and 90623 for the anechoic chamber; by Industry Canada for electromagnetic emissions (file numbers IC 2186A-1 for OATS, IC 2186A-2 for anechoic chamber, IC 2186A-3 for full-anechoic chamber for RE measurements above 1 GHz), certified by VCCI, Japan (the registration numbers are R-808 for OATS, R-1082 for anechoic chamber, G-27 for full-anechoic chamber for RE measurements above 1 GHz, C-845 for conducted emissions site, T-1606 for conducted emissions at telecommunication ports), has a status of a Telefication - Listed Testing Laboratory, Certificate No. L138/00. The laboratory is accredited by American Association for Laboratory Accreditation (USA) according to ISO/IEC 17025 for electromagnetic compatibility, product safety, telecommunications testing and environmental simulation (for exact scope please refer to Certificate No. 839.01). The FCC Designation Number is US1003.

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

Person for contact: Mr. Alex Usoskin, CEO.

11 APPENDIX D Specification references

47CFR part 24: 2013	Personal communications services
47CFR part 1: 2013	Practice and procedure
47CFR part 2: 2013	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: 2003	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI/TIA/EIA-603-C:2004	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

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
Standard gain horn antenna
Quinstar Technology
Model QWH
Ser.No.112, HL 0768, 0769, 0770, 0771, 0772

Frequency min, GHz	Frequency max, GHz	Antenna factor, dB(1/m)
18.000	26.500	32.01
26.500	40.000	35.48
40.000	60.000	39.03
60.000	90.000	42.55
90.000	140.000	46.23
140.000	220.000	50.11

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).

Antenna calibration
Sunol Sciences Inc., model JB3, serial number A022805, HL 2697

Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain	Frequency, MHz	ACF, dB	Gain, dBi	Num gain
30	-22.2	-22.5	0.01	620	19.7	6.3	4.27	1215	24.9	7.0	5.05	1810	28.3	7.1	5.08	2405	30.9	6.9	4.93
35	-18.5	-17.4	0.02	625	19.7	6.5	4.42	1220	24.9	7.0	4.99	1815	28.5	6.9	4.91	2410	30.9	6.9	4.89
40	-14.7	-12.5	0.06	630	19.6	6.6	4.57	1225	25.1	6.9	4.91	1820	28.6	6.8	4.74	2415	31.0	6.9	4.85
45	-11.3	-8.1	0.16	635	19.7	6.5	4.48	1230	25.2	6.8	4.82	1825	28.7	6.8	4.75	2420	31.0	6.8	4.82
45	-11.3	-8.1	0.16	640	19.9	6.4	4.40	1235	25.1	7.0	4.96	1830	28.7	6.8	4.76	2425	31.1	6.8	4.81
50	-8.9	-4.7	0.34	645	19.9	6.5	4.45	1240	25.0	7.1	5.09	1835	28.7	6.7	4.72	2430	31.0	6.9	4.87
55	-7.9	-2.8	0.52	650	19.9	6.5	4.51	1245	25.0	7.1	5.12	1840	28.8	6.7	4.69	2435	31.0	6.9	4.86
60	-7.5	-2.1	0.62	655	19.9	6.6	4.60	1250	25.0	7.1	5.15	1845	28.6	6.9	4.90	2440	31.2	6.8	4.74
65	-8.5	-2.0	0.63	660	19.9	6.7	4.69	1255	25.0	7.2	5.25	1850	28.4	7.1	5.12	2445	31.1	6.9	4.91
70	-9.0	-1.9	0.64	665	19.9	6.7	4.70	1260	24.9	7.3	5.36	1855	28.5	7.0	5.07	2450	31.0	7.0	4.96
75	-8.8	-1.1	0.78	670	20.0	6.7	4.71	1265	25.0	7.3	5.31	1860	28.6	7.0	5.01	2455	31.0	7.0	5.01
80	-8.4	-0.2	0.97	675	20.1	6.7	4.71	1270	25.1	7.2	5.26	1865	28.5	7.1	5.17	2460	30.9	7.2	5.19
85	-8.0	0.6	1.20	680	20.1	6.7	4.71	1275	25.3	7.0	5.05	1870	28.4	7.3	5.33	2465	31.1	6.9	4.95
90	-8.2	1.1	1.29	685	20.1	6.8	4.79	1280	25.5	6.8	4.94	1875	28.4	7.2	5.28	2470	31.3	6.8	4.76
95	-9.2	0.5	1.13	690	20.1	6.9	4.88	1285	25.4	7.0	4.97	1880	28.5	7.2	5.22	2475	31.4	6.7	4.69
100	-10.6	-0.4	0.92	695	20.2	6.8	4.82	1290	25.3	7.1	5.10	1885	28.5	7.2	5.22	2480	31.3	6.8	4.79
110	-12.6	-1.6	0.70	705	20.4	6.8	4.75	1300	25.2	7.3	5.33	1895	28.6	7.2	5.24	2490	31.1	7.0	4.99
120	-13.9	-2.1	0.62	715	20.5	6.8	4.80	1310	25.5	7.1	5.09	1905	28.5	7.3	5.36	2500	30.9	7.2	5.27
125	-14.2	-2.0	0.63	720	20.5	6.9	4.85	1315	25.4	7.2	5.23	1910	28.5	7.4	5.45	2505	31.1	7.1	5.15
130	-14.2	-1.7	0.68	725	20.6	6.8	4.81	1320	25.3	7.3	5.36	1915	28.5	7.3	5.38	2510	31.0	7.2	5.22
140	-13.4	-0.3	0.94	735	20.9	6.7	4.55	1330	25.6	7.0	5.06	1925	28.6	7.3	5.39	2520	31.2	7.0	5.05
150	-12.9	0.8	1.21	745	21.0	6.6	4.59	1340	25.7	7.1	5.09	1935	28.5	7.4	5.54	2530	31.0	7.3	5.37
160	-12.7	1.6	1.44	755	21.0	6.8	4.74	1350	25.7	7.1	5.17	1945	28.5	7.5	5.59	2540	31.2	7.1	5.09
165	-12.5	2.0	1.59	760	21.0	6.8	4.83	1355	25.8	7.0	5.06	1950	28.6	7.4	5.48	2545	31.0	7.3	5.43
170	-12.2	2.6	1.83	765	21.1	6.8	4.73	1360	25.9	6.9	4.95	1955	28.6	7.5	5.57	2550	31.0	7.3	5.39
175	-11.8	3.3	2.13	770	21.3	6.7	4.64	1365	26.0	6.9	4.95	1960	28.6	7.5	5.65	2555	31.1	7.2	5.30
180	-11.6	3.7	2.36	775	21.3	6.7	4.68	1370	26.0	7.0	4.98	1965	28.7	7.4	5.75	2560	31.0	7.4	5.47
185	-11.5	4.0	2.54	780	21.3	6.7	4.72	1375	26.0	7.0	5.01	1970	28.5	7.2	5.29	2565	30.8	7.6	5.70
190	-11.6	4.2	2.61	785	21.3	6.8	4.77	1380	26.0	7.0	5.06	1975	28.9	7.2	5.22	2570	31.1	7.3	5.37
200	-13.1	3.2	2.07	795	21.4	6.8	4.79	1390	26.1	6.9	4.92	1985	29.1	7.1	5.11	2580	31.6	6.9	4.87
205	-12.0	4.4	2.76	800	21.5	6.8	4.77	1395	26.2	6.9	4.94	1990	29.1	7.0	5.06	2585	31.6	6.8	4.79
210	-11.0	5.6	3.66	805	21.6	6.7	4.71	1400	26.2	7.0	4.96	1995	29.1	7.1	5.09	2590	31.6	6.9	4.88
215	-11.3	5.6	3.59	810	21.7	6.7	4.65	1405	26.1	7.0	5.02	2000	29.1	7.1	5.11	2595	31.5	7.0	4.97
220	-11.6	5.5	3.52	815	21.7	6.7	4.72	1410	26.1	7.1	5.09	2005	29.1	7.1	5.16	2600	31.6	6.9	4.86
225	-11.7	5.5	3.45	820	21.7	6.8	4.80	1415	26.2	7.0	5.02	2010	29.1	7.1	5.15	2605	31.3	7.2	5.30
230	-11.9	5.5	3.57	825	21.7	6.8	4.82	1420	26.3	7.0	5.06	2015	29.2	7.1	5.13	2610	31.4	7.1	5.15
235	-12.1	5.5	3.56	830	21.7	6.9	4.85	1425	26.2	7.1	5.10	2020	29.2	7.1	5.18	2615	31.7	6.9	4.88
240	-12.3	5.5	3.54	835	21.8	6.8	4.82	1430	26.1	7.2	5.25	2025	29.3	7.1	5.08	2620	31.6	7.0	4.97
245	-12.3	5.7	3.71	840	21.9	6.8	4.80	1435	26.1	7.2	5.24	2030	29.3	7.0	5.05	2625	31.4	7.1	5.17
250	-12.3	5.9	3.88	845	21.9	6.8	4.83	1440	26.2	7.2	5.24	2035	29.3	7.1	5.07	2630	31.6	7.0	5.00
255	-12.5	5.9	3.85	850	21.9	6.9	4.86	1445	26.3	1	5.11	2040	29.3	7.1	5.13	2635	31.8	6.8	4.82
260	-12.7	5.8	3.83	855	22.0	6.8	4.80	1450	26.5	7.0	4.98	2045	29.2	7.2	5.23	2640	31.7	7.0	4.98
265	-13.2	5.5	3.54	860	22.1	6.8	4.74	1455	26.4	7.1	5.07	2050	29.2	7.2	5.27	2645	31.7	6.9	4.93
270	-13.7	5.2	3.27	865	22.1	6.9	4.82	1460	26.4	7.1	5.17	2055	29.3	7.2	5.21	2650	31.8	6.9	4.85
275	-13.7	5.3	3.39	870	21.9	7.1	5.11	1465	26.4	7.2	5.19	2060	29.5	7.0	5.02	2655	31.8	6.9	4.85
280	-13.7	5.4	3.50	875	22.0	7.1	5.08	1470	26.4	7.2	5.22	2065	29.4	7.1	5.08	2660	31.7	7.0	5.02
285	-13.7	5.6	3.61	880	22.1	7.0	5.05	1475	26.4	7.1	5.17	2070	29.4	7.1	5.01	2665	32.0	6.7	4.71
290	-13.7	5.7	3.72	885	22.1	7.0	5.06	1480	26.5	7.1	5.12	2075	29.5	7.0	5.01	2670	32.0	6.7	4.67
295	-13.8	5.8	3.77	890	22.1	7.0	5.06	1485	26.5	7.1	5.14	2080	29.8	6.8	4.76	2675	31.9	6.8	4.81
300	-13.9	5.8	3.81	895	22.2	7.1	5.09	1490	26.5	7.1	5.17	2085	29.7	6.9	4.89	2680	31.7	7.0	5.04
305	-14.0	5.9	3.85	900	22.2	7.1	5.12	1495	26.5	7.2	5.24	2090	29.7	6.9	4.86	2685	31.9	6.8	4.83
310	-14.1	5.9	3.88	905	22.3	7.1	5.09	1500	26.5	7.2	5.31	2095	29.8	6.8	4.78	2690	32.1	6.7	4.72
315	-14.3	5.8	3.88	910	22.3	7.0	5.05	1505	26.5	7.2	5.27	2100	29.8	6.8	4.75	2695	32.1	6.7	4.71
320	-14.4	5.9	3.90	915	22.4	7.0	5.05	1510	26.5	7.2	5.23	2105	29.8	6.8	4.81	2700	32.0	6.8	4.81
325	-14.5	5.9	3.92	920	22.6	6.9	4.92	1515	26.6	7.2	5.30	2110	29.9	6.8	4.78	2705	32.0	6.8	4.80
330	-14.6	5.9	3.93	925	22.7	6.9	4.85	1520	26.5	7.3	5.38	2115	29.9	6.8	4.76	2710	32.1	6.8	4.79
335	-14.7	6.0	4.02	930	22.8	6.8	4.77	1525	26.6	7.3	5.37	2120	29.9	6.8	4.84	2715	32.1	6.7	4.71
340	-14.7	6.2	4.12	935	22.8	6.8	4.83	1530	26.6	7.3	5.36	2125	29.9	6.9	4.89	2720	32.4	6.5	4.47
345	-14.9	6.1	4.06	940	22.8	6.9	4.89	1535	26.6	7.4	5.44	2130	29.9	6.9	4.90	2725	32.2	6.7	4.63
350	-15.1	6.0	3.99	945	22.8	6.9	4.87	1540	26.5	7.4	5.53	2135	29.8	6.9	4.94	2730	31.9	7.0	5.05
355	-15.3	5.9	3.88	950	22.9	6.9	4.85	1545	26.5	7.5	5.58	2140	29.8	7.1	5.08	2735	31.6	7.4	5.44
360	-15.8	5.8	3.78	955	23.0	6.8	4.81	1550	26.6	7.5	5.63	2145	29.8	6.9	4.92	2740	31.6	7.1	5.40
365	-15.5	5.9	3.89	960	23.1	6.8	4.77	1555	26.7	7.3	5.39	2150	29.9	7.0	4.98	2745	31.9	7.0	5.06
370	-15.5	6.0	4.01	965	23.1	6.7	4.73	1560	26.9	7.1	5.18	2155	29.8	7.1	5.10	2750	32.0	6.9	4.94
375	-15.6	6.1	4.03	970	23.2	6.7	4.69	1565	26.9	7.2	5.23	2160	29.8	7.1	5.09	2755	32.0	7.0	4.98
380	-15.7	6.1	4.05	975	23.3	6.6	4.62	1570	26.9	7.2	5.30	2165	29.9	7.0	5.00	2760	32.0	7.0	5.06
385	-15.7	6.2	4.15	980	23.5	6.6	4.54	1575	27.0	7.2	5.23	2170	29.9	7.1	5.07	2765	32.2	6.8	4.80
390	-15.7	6.3	4.25	985	23.5	6.6	4.52	1580	27.0	7.1	5.17	2175	29.8	7.2	5.20	2770	32.3		

Antenna factor
Double-ridged waveguide horn antenna
ETS Lindgren, Model 3117, serial number: 00123515, HL 4114

Frequency, MHz	Antenna factor, dB/m		
	Measured	Manufacturer	Deviation
1000	28.0	28.4	-0.4
1500	28.0	27.4	0.6
2000	31.2	30.9	0.3
2500	32.5	33.4	-0.9
3000	32.9	32.6	0.3
3500	32.7	32.8	-0.1
4000	33.1	33.4	-0.3
4500	33.8	33.9	-0.1
5000	33.8	34.1	-0.3
5500	34.4	34.5	-0.1
6000	35.0	35.2	-0.2
6500	35.4	35.5	-0.1
7000	35.7	35.7	0.0
7500	35.9	35.7	0.2
8000	35.8	35.8	0.0
8500	35.9	35.8	0.1
9000	36.3	36.2	0.1
9500	36.6	36.6	0.0
10000	37.1	37.1	0.0
10500	37.6	37.5	0.1
11000	37.9	37.7	0.2
11500	38.5	38.1	0.4
12000	39.2	38.7	0.5
12500	39.0	38.9	0.1
13000	39.1	39.1	0.0
13500	38.9	38.8	0.1
14000	39.0	38.8	0.2
14500	39.6	39.9	-0.3
15000	39.9	39.7	0.2
15500	39.9	40.1	-0.2
16000	40.7	40.8	-0.1
16500	41.3	41.8	-0.5
17000	42.5	42.1	0.4
17500	41.3	41.2	0.1
18000	41.4	40.9	0.5

Antenna factor is to be added to receiver meter reading in dB(μ V) to convert to field strength in dB(μ V/meter)

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

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

Cable loss
Microwave Cable Assembly, Huber-Suhner, 40 GHz, 1.5 m, SMA-SMA, S/N 1226/2A
HL 3903

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	-0.02	9500	1.84	21000	2.98
100	0.15	10000	1.86	22000	3.07
500	0.38	10500	1.93	23000	3.13
1000	0.56	11000	1.99	24000	3.21
1500	0.69	11500	2.04	25000	3.26
2000	0.82	12000	2.10	26000	3.48
2500	0.90	12500	2.15	27000	3.44
3000	0.98	13000	2.21	28000	3.53
3500	1.06	13500	2.25	29000	3.59
4000	1.11	14000	2.29	30000	3.66
4500	1.17	14500	2.34	31000	3.70
5000	1.24	15000	2.36	32000	3.79
5500	1.32	15500	2.40	33000	3.88
6000	1.40	16000	2.45	34000	3.94
6500	1.50	16500	2.48	35000	3.91
7000	1.56	17000	2.56	36000	4.05
7500	1.62	17500	2.58	37000	4.22
8000	1.68	18000	2.60	38000	4.25
8500	1.74	19000	2.84	39000	4.27
9000	1.78	20000	2.88	40000	4.33

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 0747A, 18 GHz, 3.05 m, N/M - N/M
APC-10FT-NMNM+, HL 4276

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.11	4500	2.81	9300	4.30	14100	5.59
30	0.19	4600	2.85	9400	4.33	14200	5.61
50	0.25	4700	2.88	9500	4.36	14300	5.63
100	0.36	4800	2.92	9600	4.39	14400	5.66
150	0.44	4900	2.95	9700	4.42	14500	5.68
200	0.52	5000	3.00	9800	4.46	14600	5.70
300	0.64	5100	3.03	9900	4.49	14700	5.72
400	0.75	5200	3.08	10000	4.53	14800	5.75
500	0.84	5300	3.11	10100	4.56	14900	5.77
600	0.93	5400	3.13	10200	4.60	15000	5.80
700	1.01	5500	3.16	10300	4.64	15100	5.82
800	1.08	5600	3.20	10400	4.66	15200	5.85
900	1.15	5700	3.22	10500	4.68	15300	5.88
1000	1.22	5800	3.26	10600	4.70	15400	5.91
1100	1.28	5900	3.30	10700	4.73	15500	5.93
1200	1.34	6000	3.34	10800	4.75	15600	5.97
1300	1.40	6100	3.39	10900	4.77	15700	5.99
1400	1.46	6200	3.42	11000	4.80	15800	6.02
1500	1.51	6300	3.47	11100	4.83	15900	6.07
1600	1.57	6400	3.50	11200	4.86	16000	6.08
1700	1.62	6500	3.52	11300	4.88	16100	6.11
1800	1.68	6600	3.55	11400	4.90	16200	6.12
1900	1.72	6700	3.58	11500	4.92	16300	6.14
2000	1.77	6800	3.60	11600	4.94	16400	6.17
2100	1.82	6900	3.62	11700	4.96	16500	6.19
2200	1.87	7000	3.64	11800	4.98	16600	6.21
2300	1.92	7100	3.66	11900	5.01	16700	6.22
2400	1.96	7200	3.68	12000	5.03	16800	6.24
2500	2.01	7300	3.71	12100	5.06	16900	6.26
2600	2.05	7400	3.74	12200	5.09	17000	6.28
2700	2.10	7500	3.78	12300	5.12	17100	6.31
2800	2.14	7600	3.81	12400	5.15	17200	6.33
2900	2.18	7700	3.84	12500	5.17	17300	6.36
3000	2.23	7800	3.87	12600	5.20	17400	6.39
3100	2.27	7900	3.90	12700	5.22	17500	6.42
3200	2.31	8000	3.93	12800	5.25	17600	6.45
3300	2.35	8100	3.96	12900	5.28	17700	6.48
3400	2.39	8200	4.00	13000	5.32	17800	6.50
3500	2.42	8300	4.03	13100	5.35	17900	6.52
3600	2.46	8400	4.06	13200	5.38	18000	6.55
3700	2.50	8500	4.08	13300	5.40		
3800	2.54	8600	4.11	13400	5.42		
3900	2.58	8700	4.13	13500	5.44		
4000	2.61	8800	4.16	13600	5.46		
4100	2.65	8900	4.18	13700	5.48		
4200	2.69	9000	4.21	13800	5.51		
4300	2.73	9100	4.24	13900	5.53		
4400	2.77	9200	4.27	14000	5.56		

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		

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