HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

Hermon Laboratories Ltd.
Harakevet Industrial Zone, Binyamina 30500,
Israel
Tel. +972-4-6288001
Fax. +972-4-6288277
E-mail: mail@hermonlabs.com

TEST REPORT

ACCORDING TO: FCC 47CFR part 27

FOR:

Airspan Networks Inc.
LTE Base Station
Model: Synergy 2000 2.1GHz (B4/B10)
FCC ID:PIDSYN2110

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 Changes made in the EUT 5
6.5 Test configuration 6
6.6 Transmitter characteristics 7
7 Transmitter tests according to 47CFR part 27 8
7.1 Occupied bandwidth test 8
7.2 Peak output power test 16
7.3 Band edge emissions at RF connector test 25
7.4 Spurious emissions at RF antenna connector test 36
7.5 Radiated spurious emission measurements 52
7.6 Frequency stability test 66
8 APPENDIX A Test equipment and ancillaries used for tests 76
9 APPENDIX B Measurement uncertainties 77
10 APPENDIX C Test facility description 78
11 APPENDIX D Specification references 78
12 APPENDIX E Test equipment correction factors 79
13 APPENDIX F Abbreviations and acronyms 86

1 Applicant information

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

2 Equipment under test attributes

Product name:	LTE Base Station
Product type:	Transceiver
Model(s):	Synergy 2000 2.1 GHz (B4/B10)
Serial number:	70E1D7193080
Hardware version:	C2
Software release:	14.12.10.041
Receipt date	9/12/2013

3 Manufacturer information

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

4 Test details

Project ID:	24749
Location:	Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started:	9/12/2013
Test completed:	9/30/2013
Test specification(s):	FCC 47CFR part 27

5 Tests summary

Test	Status
Transmitter characteristics	
Section 27.50(d)(2), Peak output power at RF antenna connector	Pass
Section 27.50(d)(2), Spectral power density	Pass
Section 2.1091, 27.52, RF safety	Pass, exhibit provided in Application for certification
Section 27.53(h), Spurious emissions at RF antenna connector	Pass
Section 27.53(h), Band edge emissions at RF antenna connector	Pass
Section 27.53(h), Radiated spurious emissions	Pass
Section 27.54, Frequency stability	Pass
Section 2.1049, Occupied bandwidth	Pass

Testing was completed against all relevant requirements of the test standard. The results obtained indicate that the product under test complies in full with the requirements tested.
The test results relate only to the items tested. Pass/ fail decision was based on nominal values.

	Name and Title	Date	Signature
Tested by:	Mr. V. Einem, test engineer	September 30, 2013	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	October 2, 2013	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	October , 2013	

6 EUT description

6.1 General information

A base station radio, Synergy 2000 2.1 GHz, is a part of a LTE broadband fixed cellular wireless access system. The system provides a radio link between an end-user (a subscriber) and a network to give high-speed data access. The Synergy's' transceiver/receiver (Up to 64 QAM modulation, data rate up to 150 Mbps) uses OFDM and operating in FDD mode, equipped with a 17 dBi external antenna.
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	ETH1 port	PC 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 maintance only

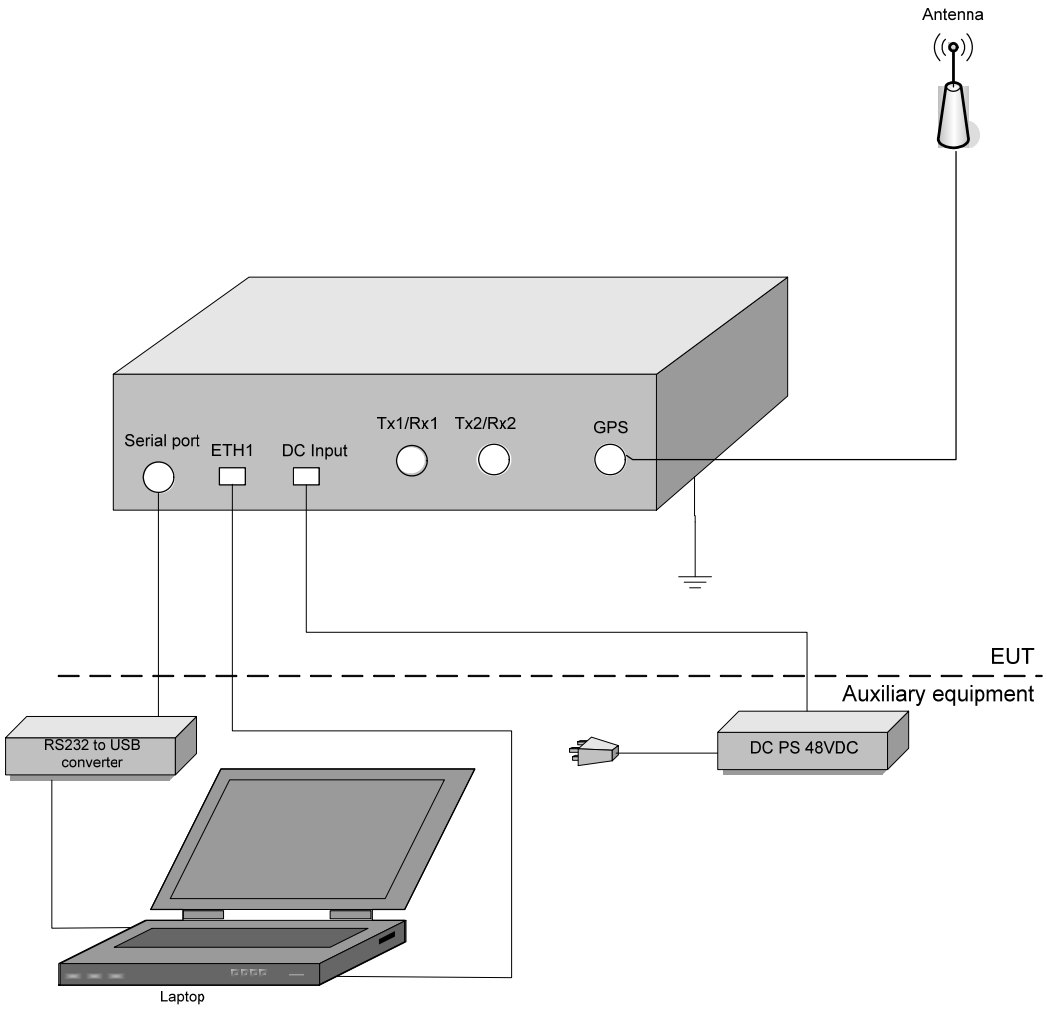
6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
DC power supply	Dell	DA90PM111	AO2
Laptop	DELL	E6420	6045
AC/DC adaptor	MW	PSD-600-48	1249
RS-232 to USB converter	ATEN	UC-2324	0199

6.4 Changes made in the EUT

No changes were implemented in the EUT during testing.

6.5 Test configuration



6.6 Transmitter characteristics

Type of equipment	
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	2110.0 – 2155.0 MHz
Operating frequency	2115.0 – 2150.0 MHz for 10 MHz OBW 2120.0 – 2145.0 MHz for 20 MHz OBW
RF channel spacing	10 MHz, 20MHz
Maximum rated output power	At transmitter 50 Ω RF output connector (aggregate power of both RF chains) — 33.52 dBm

Is transmitter output power variable?				
	No			
V	Yes		continuous variable	
		V	stepped variable with stepsize	0.5 dB
			minimum RF power	-30 dBm
			maximum RF power at antenna connector	33.52 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	ALPHA Wireless Ltd	AW3083	17 dBi

Transmitter aggregate data rate/s, MBps

Transmitter 99% power bandwidth	Type of modulation		
	QPSK	16QAM	64QAM
10 MHz	15.5	30.5	75.0
20 MHz	31.0	61.0	150.0

Type of multiplexing	FDD
Modulating test signal (baseband)	PRBS
Maximum transmitter duty cycle in normal use	100%

Transmitter power source

		Nominal rated voltage		Battery type	
V	DC	**Nominal rated voltage**	48 VDC via SDA		
	AC mains	**Nominal rated voltage**	120 V	Frequency	60 Hz

Common power source for transmitter and receiver	**V**	yes	no

Test specification:	Section 2.1049, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/15/2013		
Temperature: 26 ºC	Air Pressure: 1010 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

7 Transmitter tests according to 47CFR part 27

7.1 Occupied bandwidth test

7.1.1 General

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

Table 7.1.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
2110 – 2155	26	NA

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

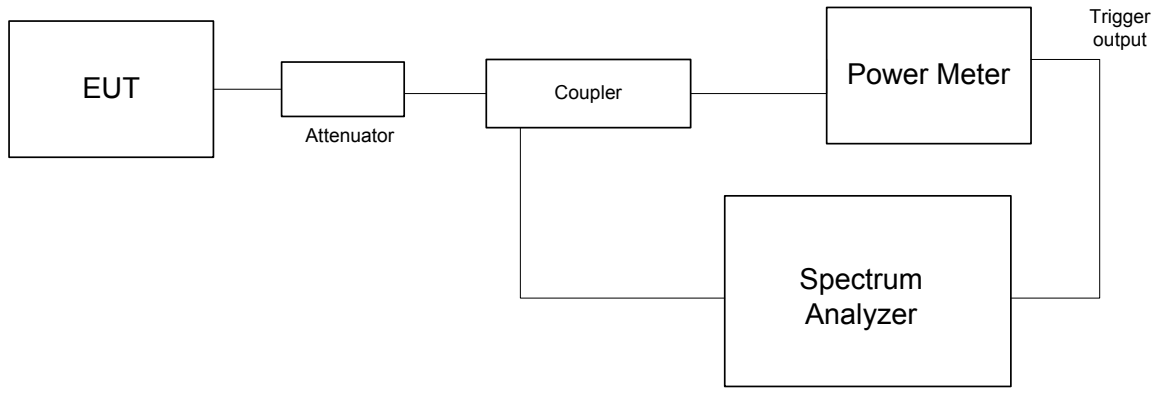
7.1.2 Test procedure

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

7.1.2.2 The EUT was set to transmit the normal modulated signal and actual channel width was measured at the 26 dBc modulation envelope reference points.

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

Figure 7.1.1 Occupied bandwidth test setup



Test specification:	**Section 2.1049, Occupied bandwidth**		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	9/15/2013		
Temperature: 26 ºC	**Air Pressure:** 1010 hPa	**Relative Humidity:** 42 %	**Power Supply:** 48 VDC
Remarks:			

Table 7.1.2 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
QPSK15.5 Mbps				
2115	9420	NA	NA	Pass
2135	9330	NA	NA	
2150	9323	NA	NA	
64QAM 75 Mbps				
2115	9361	NA	NA	Pass
2135	9292	NA	NA	
2150	9340	NA	NA	

DETECTOR USED: Average
RESOLUTION BANDWIDTH: 200 kHz
VIDEO BANDWIDTH: 620 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 Mbps				
2120	18891	NA	NA	Pass
2130	18653	NA	NA	
2145	18905	NA	NA	
64QAM 150 Mbps				
2120	18907	NA	NA	Pass
2130	18709	NA	NA	
2145	18475	NA	NA	

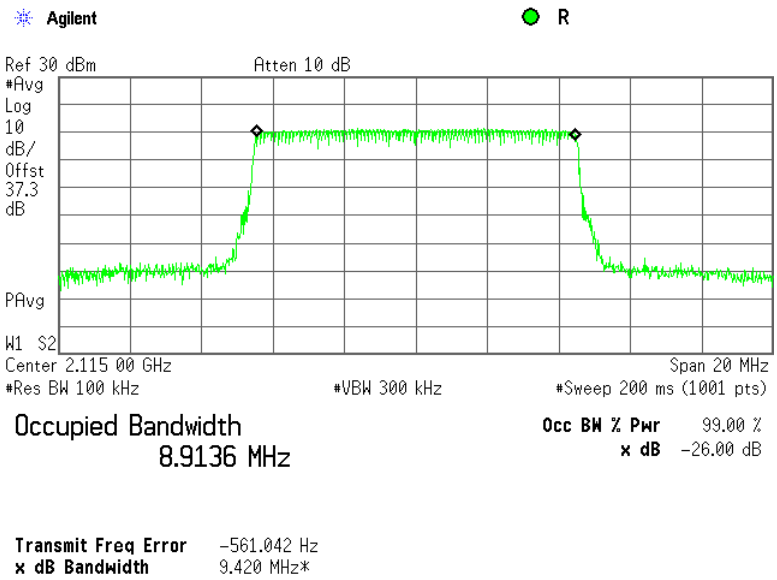
Reference numbers of test equipment used

HL 1809	HL 2214	HL 3301	HL 3302	HL 3818	HL 3433	HL 3455	HL 4367

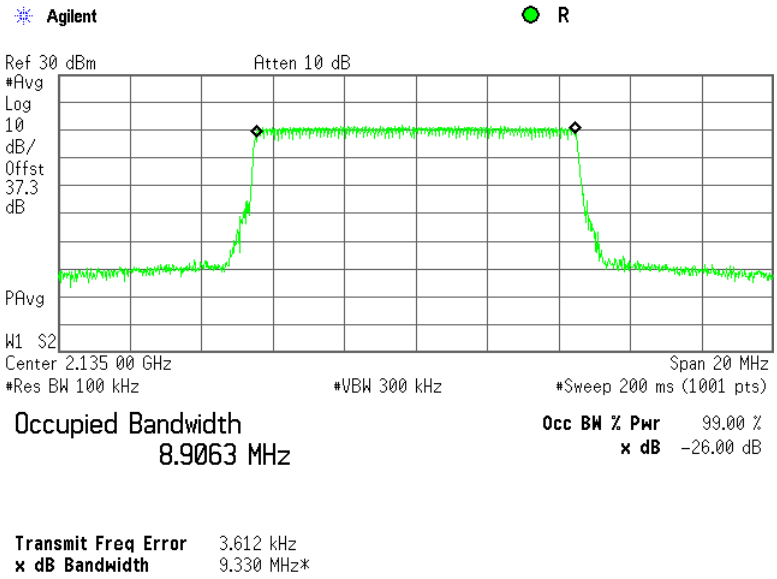
Full description is given in Appendix A.

Test specification:	Section 2.1049, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/15/2013		
Temperature: 26 ºC	Air Pressure: 1010 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.1 Occupied bandwidth test results at low frequency, 10 MHz EBW, QPSK

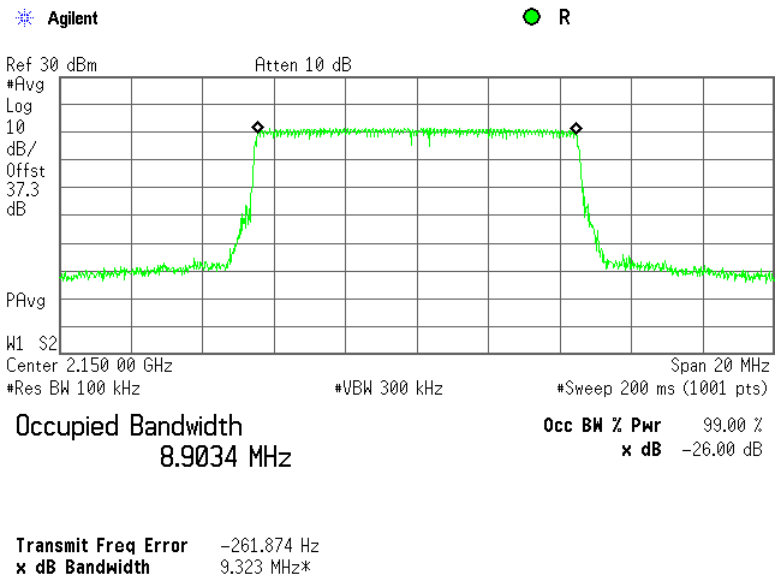


Plot 7.1.2 Occupied bandwidth test results at mid frequency, 10 MHz EBW, QPSK

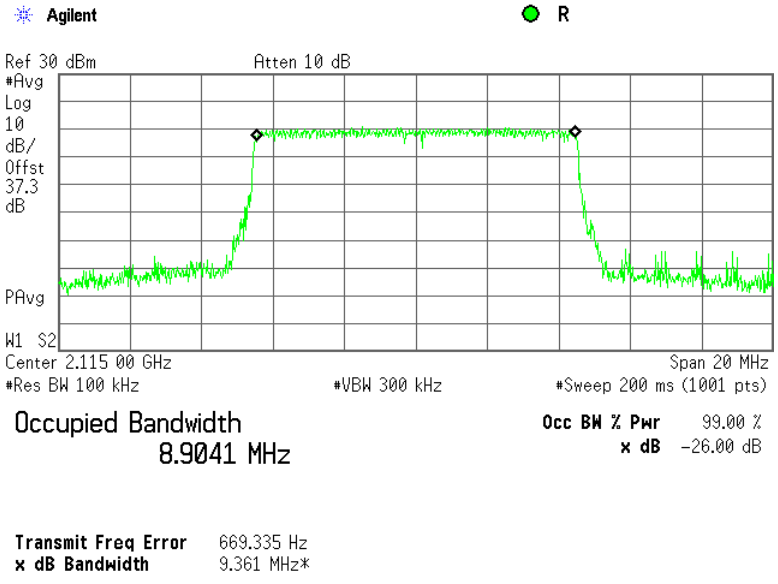


Test specification:	Section 2.1049, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/15/2013		
Temperature: 26 ºC	Air Pressure: 1010 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.3 Occupied bandwidth test results at high frequency, 10 MHz EBW, QPSK

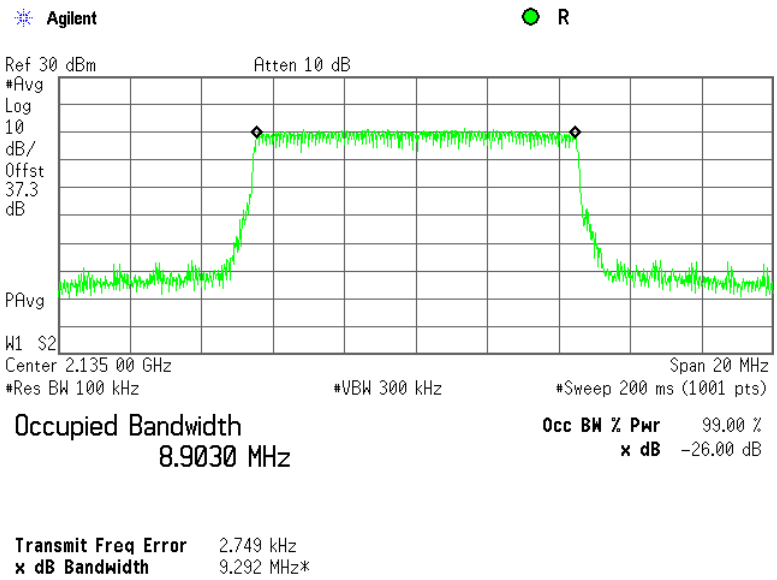


Plot 7.1.4 Occupied bandwidth test results at low frequency, 10 MHz EBW, 64QAM

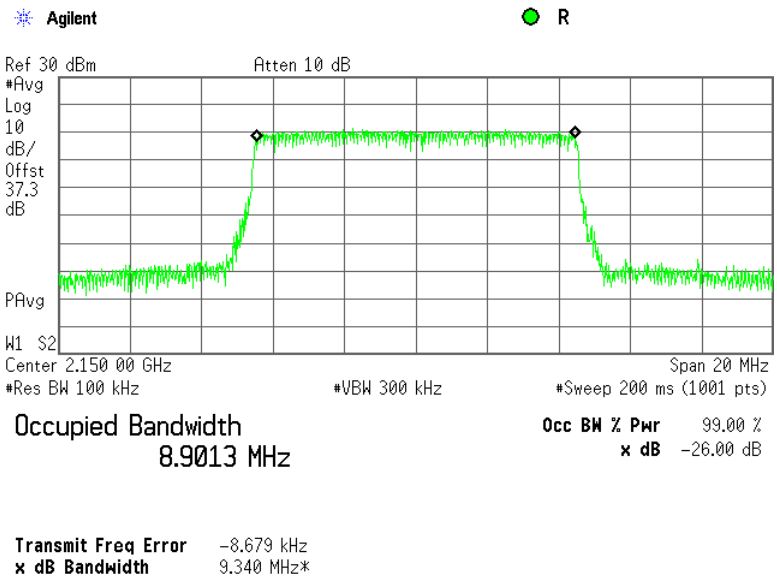


Test specification:	Section 2.1049, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/15/2013		
Temperature: 26 ºC	Air Pressure: 1010 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.5 Occupied bandwidth test results at mid frequency, 10 MHz EBW, 64QAM

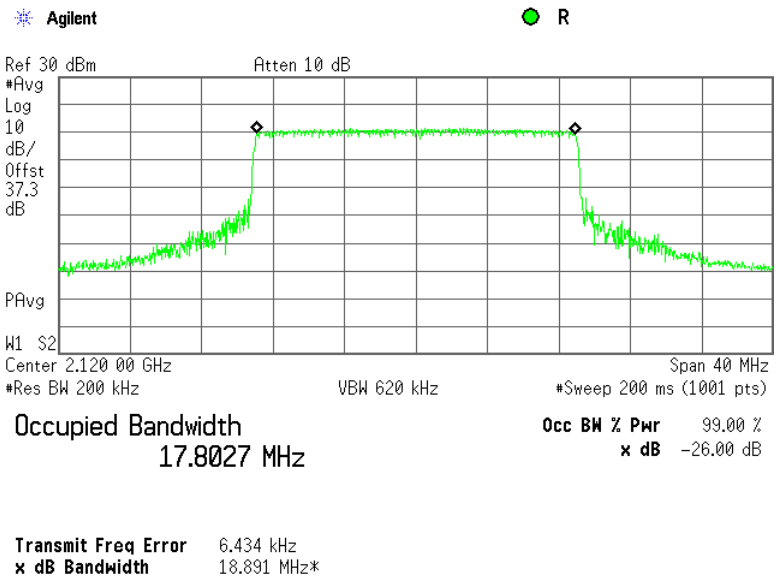


Plot 7.1.6 Occupied bandwidth test results at high frequency, 10 MHz EBW, 64QAM

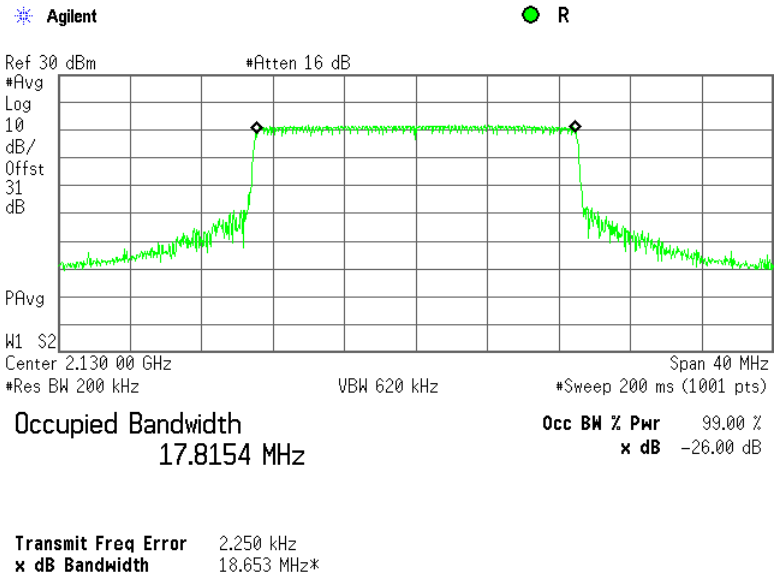


Test specification:	Section 2.1049, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/15/2013		
Temperature: 26 ºC	Air Pressure: 1010 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.7 Occupied bandwidth test results at low frequency, 20 MHz EBW, QPSK

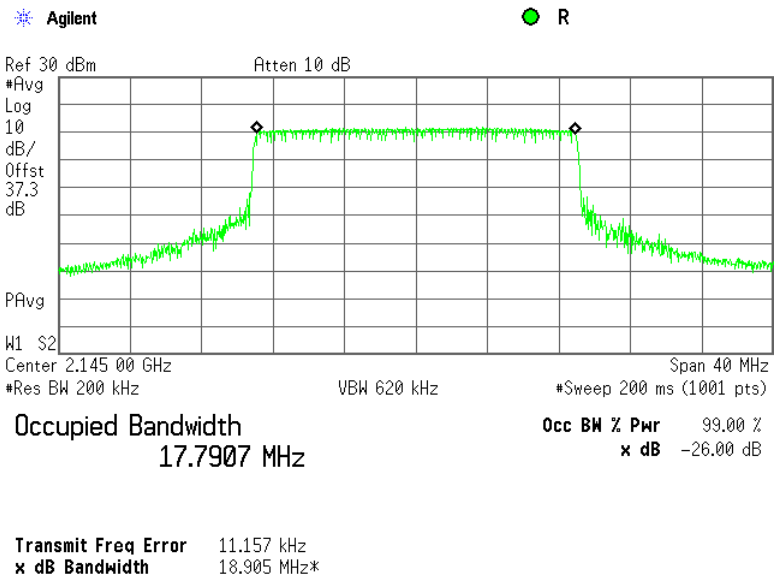


Plot 7.1.8 Occupied bandwidth test results at mid frequency, 20 MHz EBW, QPSK

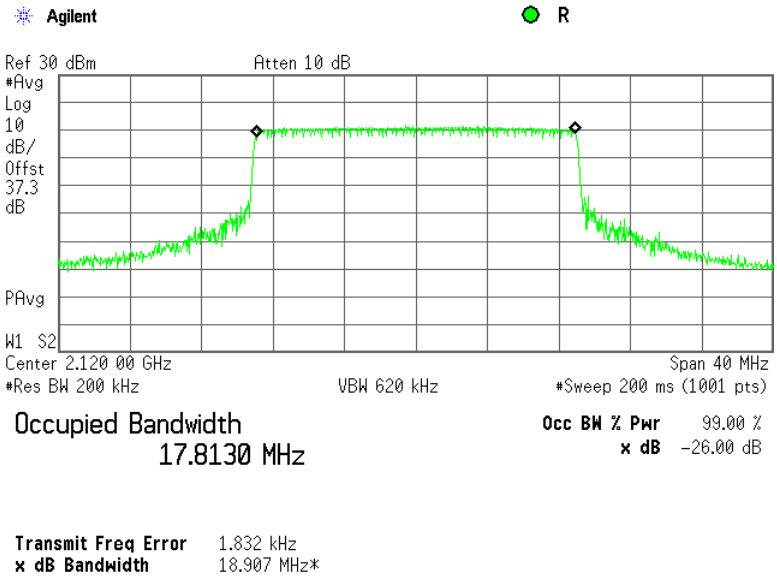


Test specification:	Section 2.1049, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/15/2013		
Temperature: 26 ºC	Air Pressure: 1010 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.9 Occupied bandwidth test results at high frequency, 20 MHz EBW, QPSK

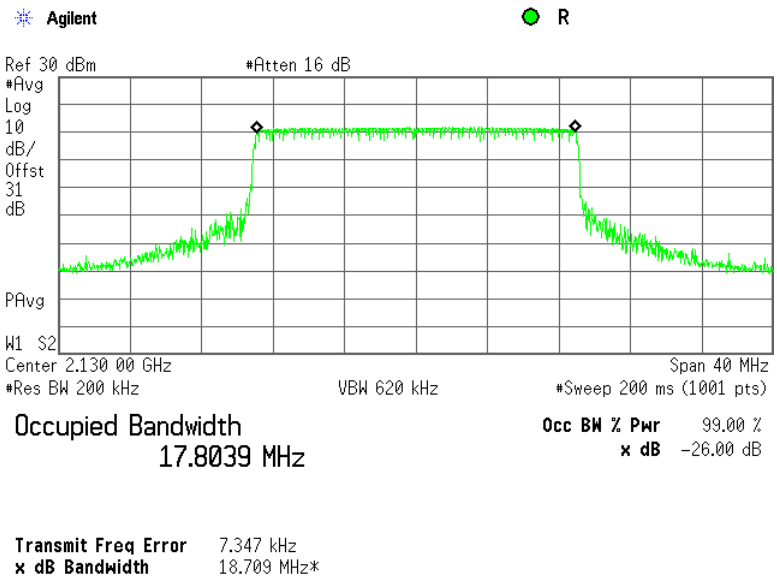


Plot 7.1.10 Occupied bandwidth test results at low frequency, 20 MHz EBW, 64QAM

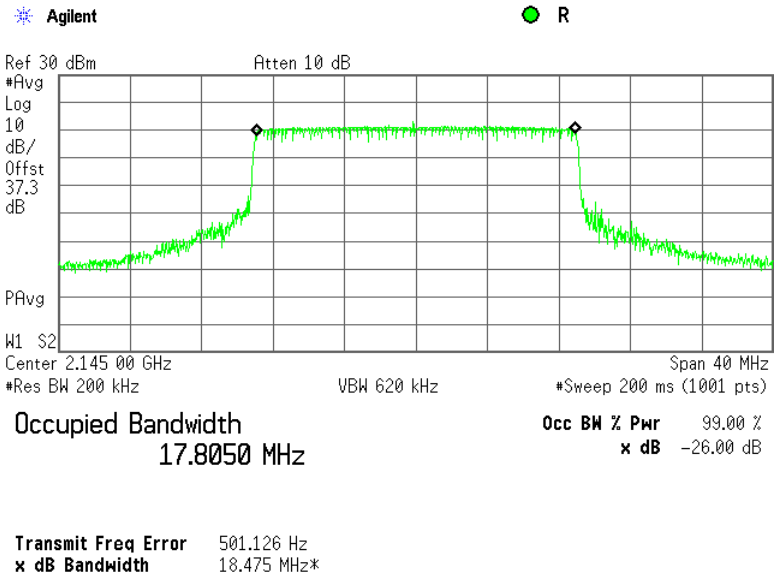


Test specification:	Section 2.1049, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/15/2013		
Temperature: 26 ºC	Air Pressure: 1010 hPa	Relative Humidity: 42 %	Power Supply: 48 VDC
Remarks:			

Plot 7.1.11 Occupied bandwidth test results at mid frequency, 20 MHz EBW, 64QAM



Plot 7.1.12 Occupied bandwidth test results at high frequency, 20 MHz EBW, 64QAM



Test specification:	Section 27.50(d), Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/12/2013		
Temperature: 23.5 ºC	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

7.2 Peak output power test

7.2.1 General

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

Table 7.2.1 Peak output power limits

Transmitter type	Assigned frequency range, MHz	Maximum EIRP, dBm
Fixed and base stations	2110 – 2155	62.14
		Maximum peak power density (EIRP), dBm/1 MHz
		62.14

7.2.2 Test procedure

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

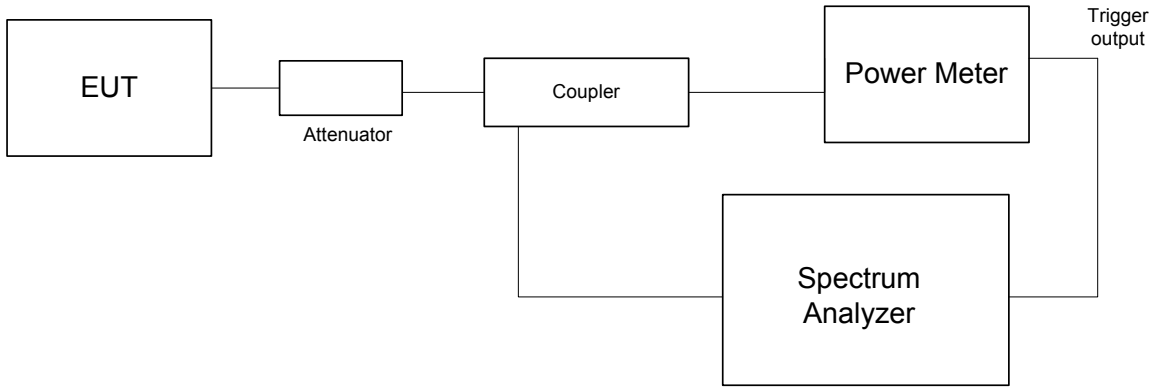
7.2.2.2 The EUT was adjusted to produce maximum available to the end user RF output power.

7.2.2.3 The average output power was measured with power meter as provided in Table 7.2.2, Table 7.2.3.

7.2.2.4 The resolution bandwidth was changed to 1 MHz and power spectral density was measured as provided in Table 7.2.4, Table 7.2.5.

7.2.2.5 The test results are provided in the tables below and associated plots.

Figure 7.2.1 Peak output power test setup



Test specification:	Section 27.50(d), Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/12/2013		
Temperature: 23.5 ºC	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Table 7.2.2 Peak output power test results

ASSIGNED FREQUENCY RANGE: 2110.0 – 2155 MHz
DETECTOR USED: Average
MODULATING SIGNAL: PRBS
TRANSMITTER OUTPUT POWER: Maximum
DUTY CYCLE: 100%
EBW: 10 MHz
NUMBER OF RF OUTPUTS: N = 2

Carrier frequency, MHz	Power Meter reading RF#1, dBm	Power Meter reading RF#2, dBm	Total RF power**, dBm	Antenna gain, dBi	Total EIRP*, dBm	Limit, dBm	Margin, dB	Verdict
QPSK 15.5 Mbps								
2115	29.94	30.44	33.21	17.00	50.21	62.14	-11.93	Pass
2135	29.90	30.66	33.31	17.00	50.31	62.14	-11.83	
2150	30.12	30.86	33.52	17.00	50.52	62.14	-11.62	
64QAM 75.0 Mbps								
2115	30.10	30.52	33.33	17.00	50.33	62.14	-11.81	Pass
2135	30.10	30.74	33.44	17.00	50.44	62.14	-11.70	
2150	30.06	30.64	33.37	17.00	50.37	62.14	-11.77	

* - EIRP total, dBm = Total RF power**, dBm + Antenna gain, dBi
** - Total RF power, dBm = 10 log{10^[P(dBm,RF#1)/10]+ 10^([P(dBm, RF#2)/10]}

Table 7.2.3 Peak output power test results

ASSIGNED FREQUENCY RANGE: 2110.0 – 2155 MHz
DETECTOR USED: Average
MODULATING SIGNAL: PRBS
TRANSMITTER OUTPUT POWER: Maximum
DUTY CYCLE: 100%
EBW: 20 MHz
NUMBER OF RF OUTPUTS: N = 2

Carrier frequency, MHz	Power Meter reading RF#1, dBm	Power Meter reading RF#2, dBm	Total RF power**, dBm	Antenna gain, dBi	Total EIRP*, dBm	Limit, dBm	Margin, dB	Verdict
QPSK 31.0 Mbps								
2120	30.28	30.25	33.28	17.00	50.28	62.14	-11.86	Pass
2130	30.33	30.35	33.35	17.00	50.35	62.14	-11.79	
2145	30.44	30.50	33.48	17.00	50.48	62.14	-11.66	
64QAM 150.0 Mbps								
2120	30.18	30.28	33.24	17.00	50.24	62.14	-11.90	Pass
2130	30.30	30.33	33.33	17.00	50.33	62.14	-11.81	
2145	30.33	30.53	33.44	17.00	50.44	62.14	-11.70	

* - EIRP total, dBm = Total RF power**, dBm + Antenna gain, dBi
** - Total RF power, dBm = 10 log{10^[P(dBm,RF#1)/10]+ 10^([P(dBm, RF#2)/10]}

Reference numbers of test equipment used

HL 2214	HL 3301	HL 3302	HL 3433	HL 3455	HL 3818	HL 3903	HL 4367

Full description is given in Appendix A.

Test specification:	Section 27.50(d), Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/12/2013		
Temperature: 23.5 ºC	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Table 7.2.4 Power spectral density test results

ASSIGNED FREQUENCY RANGE: 2110.0 – 2155 MHz
DETECTOR USED: Average
RESOLUTION BANDWIDTH: 1 MHz
VIDEO BANDWIDTH: 3 MHz
MODULATING SIGNAL: PRBS
CHANNEL BANDWIDTH: 10 MHz
TRANSMITTER OUTPUT POWER SETTINGS: Set to 30 dBm
DUTY CYCLE: 100%
NUMBER OF RF OUTPUTS: N = 2

Carrier frequency, MHz	SA reading, RF #2 dBm/1MHz	PSD result**, dBm/1MHz	Antenna gain, dBi	Total PSD*, dBm/1 MHz	Limit***, dBm	Margin, dB	Verdict
QPSK 15.5 Mbps							
2115	20.69	23.69	17.00	40.69	62.14	-21.45	Pass
2135	20.60	23.60	17.00	40.60	62.14	-21.54	
2150	20.63	23.63	17.00	40.63	62.14	-21.51	
64QAM 75.0 Mbps							
2115	21.15	24.15	17.00	41.15	62.14	-20.99	Pass
2135	21.46	24.46	17.00	41.46	62.14	-20.68	
2150	21.50	24.50	17.00	41.50	62.14	-20.64	

* - Total PSD, dBm/1 MHz = PSD result**, dBm/1 MHz + Antenna gain, dBi
** - PSD result, dBm/1 MHz = SA reading + 10*log(N)

Table 7.2.5 Power spectral density test results

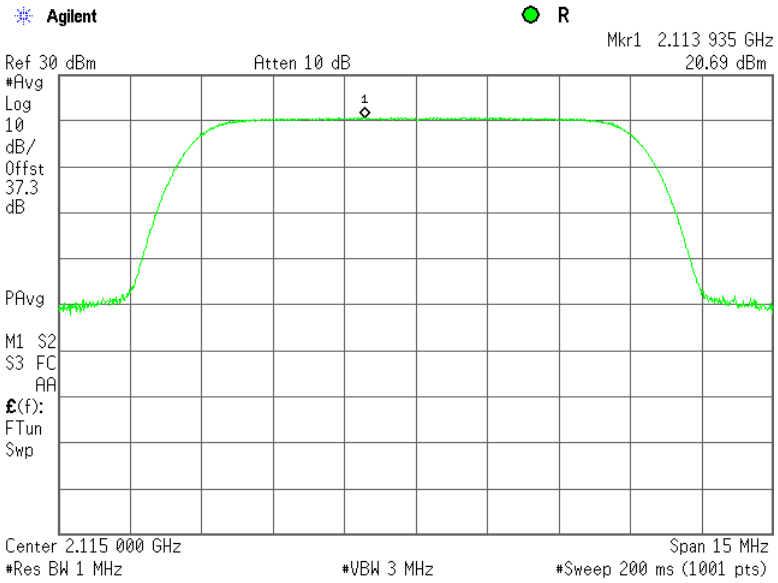
ASSIGNED FREQUENCY RANGE: 2110.0 – 2155 MHz
DETECTOR USED: Average
RESOLUTION BANDWIDTH: 1 MHz
VIDEO BANDWIDTH: 3 MHz
MODULATING SIGNAL: PRBS
CHANNEL BANDWIDTH: 20 MHz
TRANSMITTER OUTPUT POWER SETTINGS: Set to 30 dBm
DUTY CYCLE: 100%
NUMBER OF RF OUTPUTS: N = 2

Carrier frequency, MHz	SA reading, RF #2 dBm/1 MHz	PSD result**, dBm/1 MHz	Antenna gain, dBi	Total PSD*, dBm/1 MHz	Limit***, dBm	Margin, dB	Verdict
QPSK 31.0 Mbps							
2120	19.71	22.71	17.00	39.71	62.14	-22.43	Pass
2130	20.35	23.35	17.00	40.35	62.14	-21.79	
2145	19.74	22.74	17.00	39.74	62.14	-22.40	
64QAM 150.0 Mbps							
2120	19.54	22.54	17.00	39.54	62.14	-22.60	Pass
2130	20.26	23.26	17.00	40.26	62.14	-21.88	
2145	19.65	22.65	17.00	39.65	62.14	-22.49	

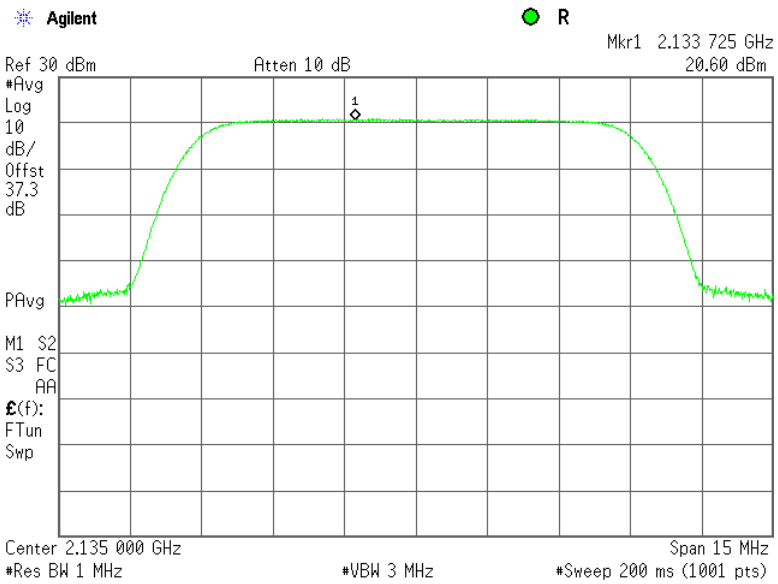
* - Total PSD, dBm/1 MHz = PSD result**, dBm/1 MHz + Antenna gain, dBi
** - PSD result, dBm/1 MHz = SA reading + 10*log(N)

Test specification:	Section 27.50(d), Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/12/2013		
Temperature: 23.5 °C	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Plot 7.2.1 Power spectral density test results at low frequency, QPSK, 10 MHz EBW

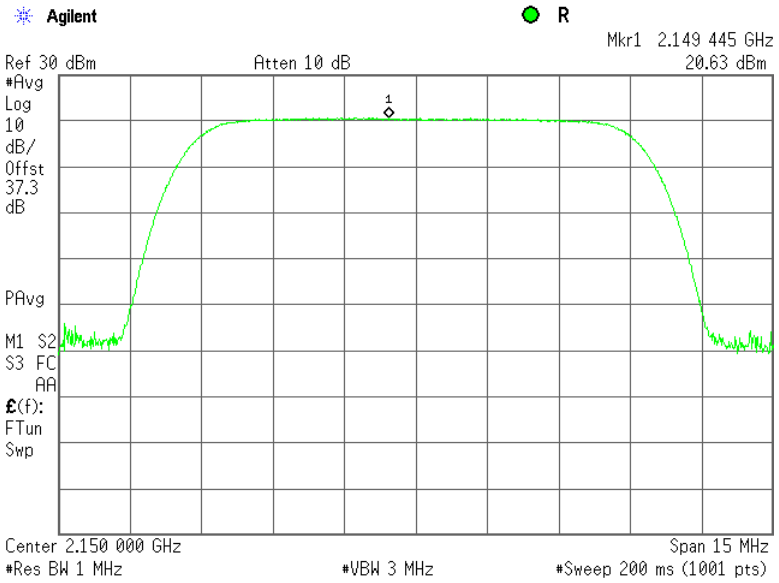


Plot 7.2.2 Power spectral density test results at mid frequency, QPSK, 10 MHz EBW

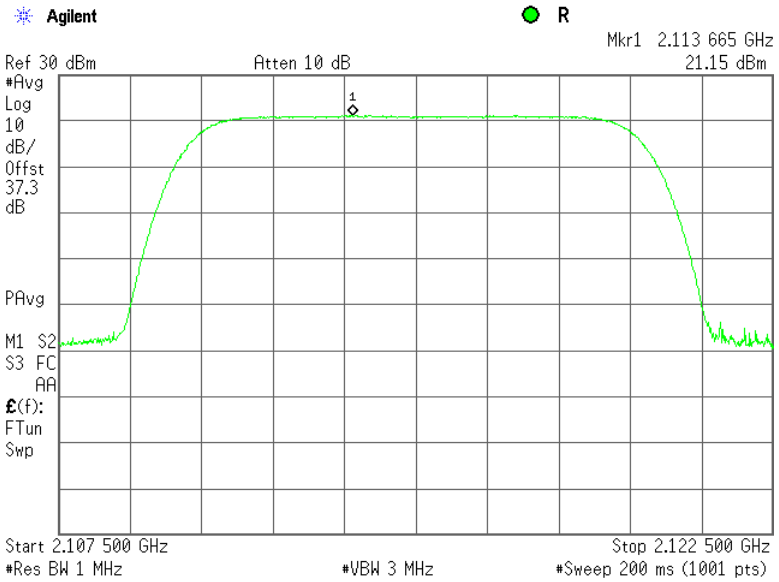


Test specification:	Section 27.50(d), Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/12/2013		
Temperature: 23.5 °C	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Plot 7.2.3 Power spectral density test results at high frequency, QPSK, 10 MHz EBW

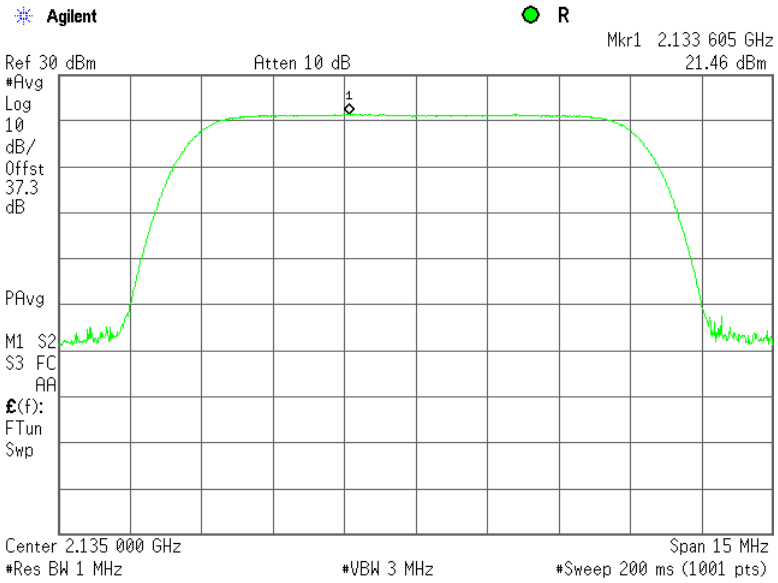


Plot 7.2.4 Power spectral density test results at low frequency, 64QAM, 10 MHz EBW

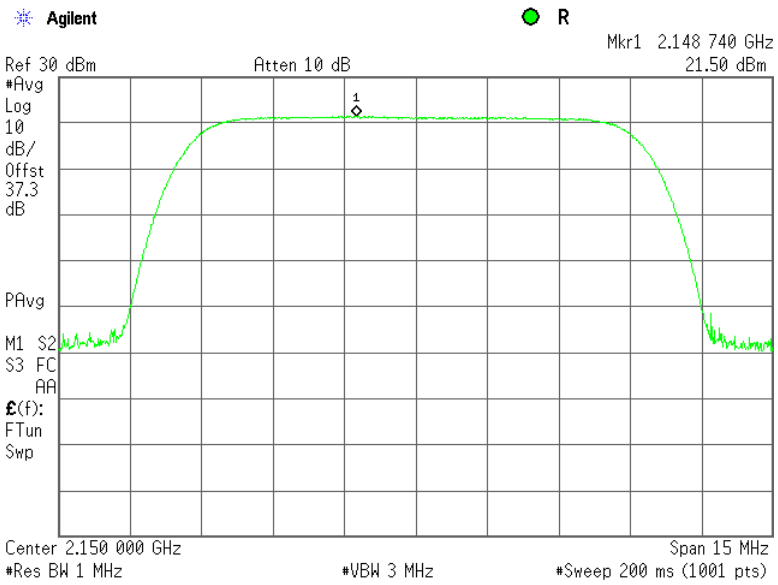


Test specification:	Section 27.50(d), Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/12/2013		
Temperature: 23.5 °C	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Plot 7.2.5 Power spectral density test results at mid frequency, 64QAM, 10 MHz EBW

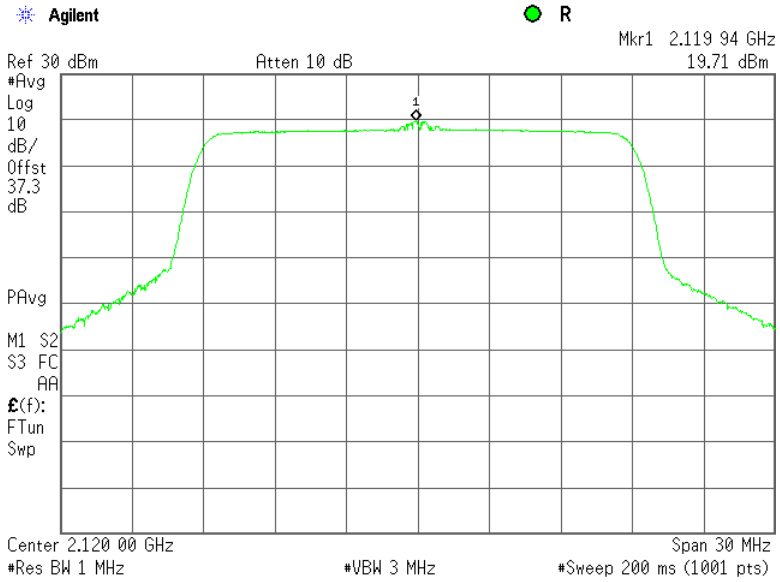


Plot 7.2.6 Power spectral density test results at high frequency, 64QAM, 10 MHz EBW

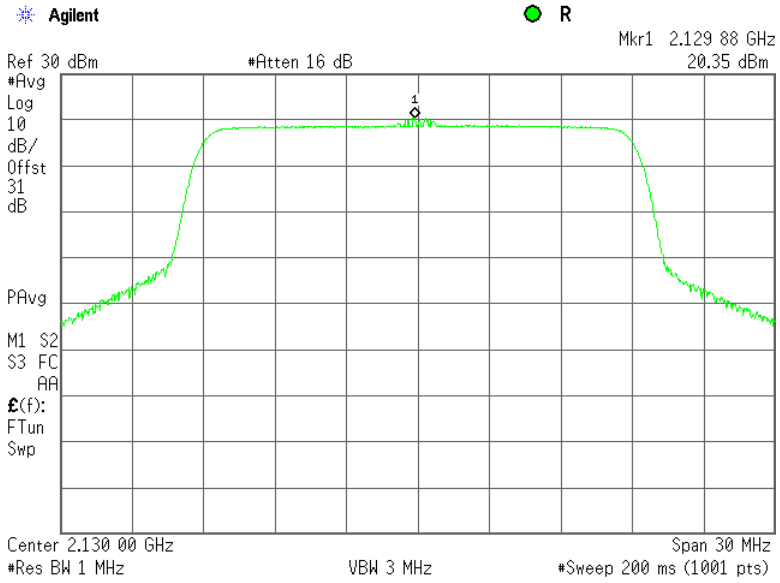


Test specification:	Section 27.50(d), Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/12/2013		
Temperature: 23.5 °C	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Plot 7.2.7 Power spectral density test results at low frequency, QPSK, 20 MHz EBW

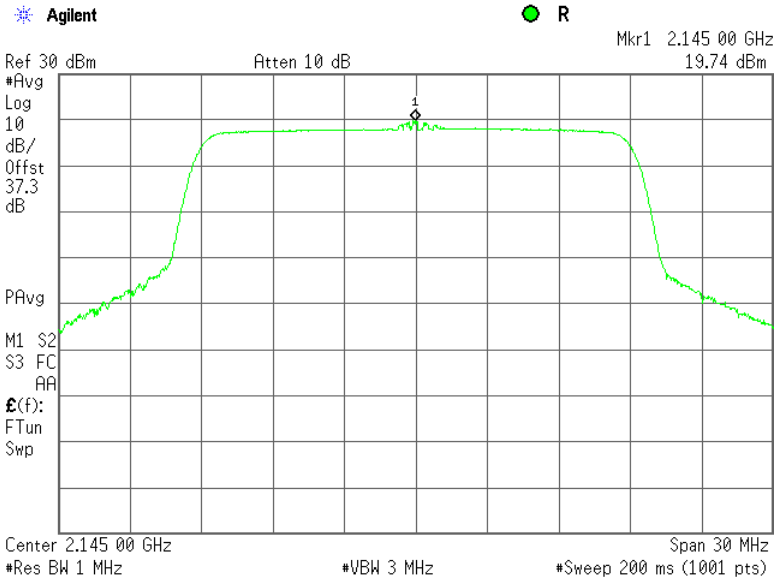


Plot 7.2.8 Power spectral density test results at mid frequency, QPSK, 20 MHz EBW

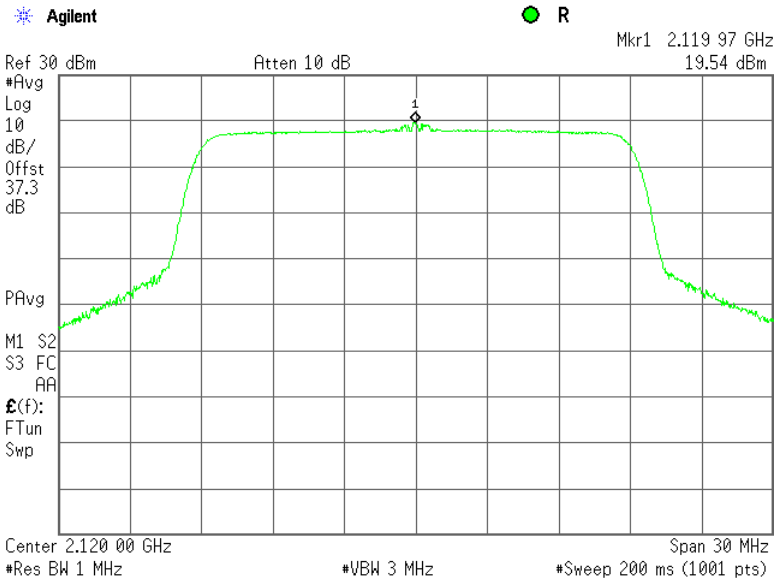


Test specification:	Section 27.50(d), Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/12/2013		
Temperature: 23.5 °C	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Plot 7.2.9 Power spectral density test results at high frequency, QPSK, 20 MHz EBW

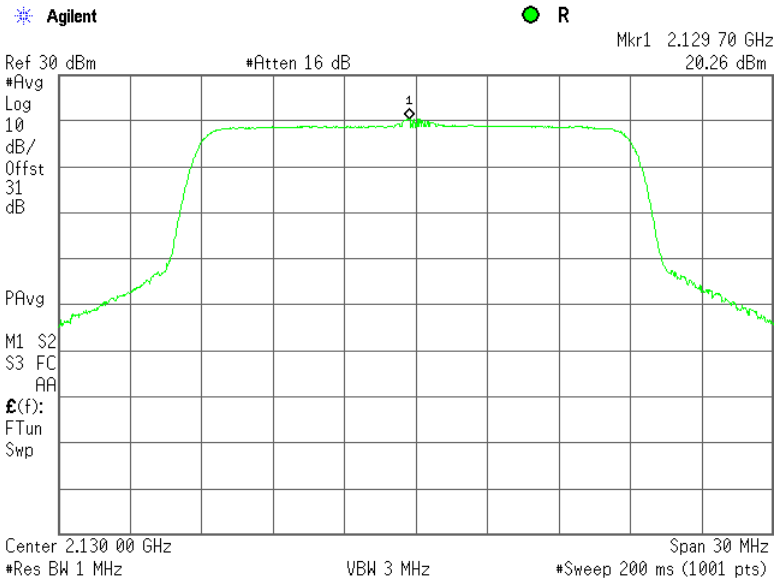


Plot 7.2.10 Power spectral density test results at low frequency, 64QAM, 20 MHz EBW

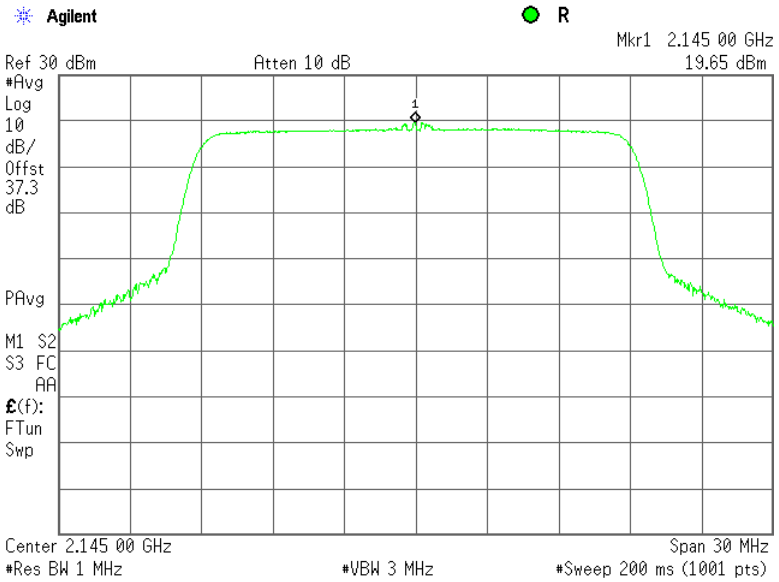


Test specification:	Section 27.50(d), Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-C, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/12/2013		
Temperature: 23.5 °C	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Plot 7.2.11 Power spectral density test results at mid frequency, 64QAM, 20 MHz EBW



Plot 7.2.12 Power spectral density test results at high frequency, 64QAM, 20 MHz EBW



Test specification:	Section 27.53(h), Band edge emissions		
Test procedure:	47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/30/2013		
Temperature: 25.2 ºC	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

7.3 Band edge emissions at RF connector test

7.3.1 General

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

Table 7.3.1 Spurious emission limits at band edges

Channel	Frequency range	Attenuation below carrier, dBc	RBW	Limit, dBm
Channel bandwidth 10 MHz				
2115	2109-2110 2120-2121	43+ 10*Log (P*)	100 kHz	-13.0
	2109>Freq>2121	43+ 10*Log (P*)	1 MHz	-13.0
2135	2129-2130 2140-2141	43+ 10*Log (P*)	100 kHz	-13.0
	2129>Freq>2141	43+ 10*Log (P*)	1 MHz	-13.0
2150	2144-2145 2155-2156	43+ 10*Log (P*)	100 kHz	-13.0
	2144>Freq>2156	43+ 10*Log (P*)	1 MHz	-13.0
Channel bandwidth 20 MHz				
2120	2109-2110 2130-2131	43+ 10*Log (P*)	200 kHz	-13.0
	2109>Freq>2131	43+ 10*Log (P*)	1 MHz	-13.0
2130	2119-2120 2140-2141	43+ 10*Log (P*)	200 kHz	-13.0
	2119>Freq>2141	43+ 10*Log (P*)	1 MHz	-13.0
2145	2134-2135 2155-2156	43+ 10*Log (P*)	200 kHz	-13.0
	2134>Freq>2156	43+ 10*Log (P*)	1 MHz	-13.0

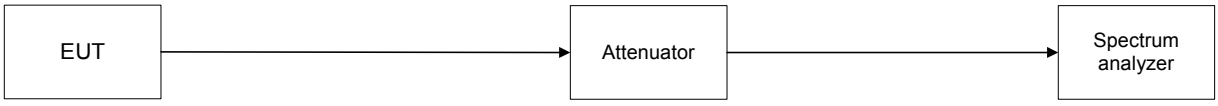
* - P is transmitter output power in Watts

7.3.2 Test procedure

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

7.3.2.2 The spurious emission was measured with spectrum analyzer as provided in the associated tables and shown the associated plots.

Figure 7.3.1 Spurious emission test setup for single output



Test specification:	Section 27.53(h), Band edge emissions		
Test procedure:	47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/30/2013		
Temperature: 25.2 ºC	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Table 7.3.2 Spurious emission at the low band edge test results

ASSIGNED FREQUENCY RANGE:	2110.0 – 2155.0 MHz
INVESTIGATED FREQUENCY RANGE:	See Table 7.3.1
RBW:	100 kHz
DETECTOR USED:	Average
VIDEO BANDWIDTH:	≥ Resolution bandwidth
MODULATING SIGNAL:	PRBS
DUTY CICLE	100%
TRANSMITTER OUTPUT POWER SETTINGS:	Set to 30 dBm
MODULATION:	QPSK, 64QAM
EBW:	10 MHz
NUMBER OF RF OUTPUTS:	N = 2

Frequency offset, ± MHz	Low band edge SA reading, dBm	Low band edge result, dBm*	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
Low carrier frequency 2115.0 MHz QPSK (Output power = 30.44 dBm)						
6.5	-29.53	-26.53	100	1000	-13.0	Pass
7.5	-31.08	-28.08	100	1000	-13.0	
8.5	-32.39	-29.39	100	1000	-13.0	
9.5	-33.61	-30.61	100	1000	-13.0	
Low carrier frequency 2115..0 MHz 64QAM (Output power = 30.52 dBm)						
6.5	-28.65	-25.65	100	1000	-13.0	Pass
7.5	-29.46	-26.46	100	1000	-13.0	
8.5	-30.99	-27.99	100	1000	-13.0	
9.5	-31.03	-27.03	100	1000	-13.0	
Mid carrier frequency 2135.0 MHz QPSK (Output power = 30.66 dBm)						
6.5	-30.41	-27.41	100	1000	-13.0	Pass
7.5	-31.31	-28.31	100	1000	-13.0	
8.5	-32.42	-29.42	100	1000	-13.0	
9.5	-33.48	-30.48	100	1000	-13.0	
Mid carrier frequency 2135.0 MHz 64QAM (Output power = 30.74 dBm)						
6.5	-23.76	-20.76	100	1000	-13.0	Pass
7.5	-24.13	-21.13	100	1000	-13.0	
8.5	-25.91	-22.91	100	1000	-13.0	
9.5	-28.03	-25.03	100	1000	-13.0	
High carrier frequency 2150.0 MHz QPSK (Output power = 30.86 dBm)						
6.5	-29.28	-26.28	300	1000	-13.0	Pass
7.5	-30.55	-27.55	300	1000	-13.0	
8.5	-31.83	-28.83	300	1000	-13.0	
9.5	-32.78	-29.78	300	1000	-13.0	
High carrier frequency 2150.0 MHz 64QAM (Output power = 30.64 dBm)						
6.5	-30.32	-27.32	100	1000	-13.0	Pass
7.5	-30.24	-27.24	100	1000	-13.0	
8.5	-31.90	-28.90	100	1000	-13.0	
9.5	-32.73	-29.73	100	1000	-13.0	

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

Test specification:	**Section 27.53(h), Band edge emissions**		
Test procedure:	47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	9/30/2013		
Temperature: 25.2 ºC	**Air Pressure:** 1010 hPa	**Relative Humidity:** 38 %	**Power Supply:** 48 VDC
Remarks:			

Table 7.3.3 Spurious emission at the high band edge test results

ASSIGNED FREQUENCY RANGE:	2110.0 – 2155.0 MHz
INVESTIGATED FREQUENCY RANGE:	See Table 7.3.1
RBW:	100 kHz
DETECTOR USED:	Average
VIDEO BANDWIDTH:	≥ Resolution bandwidth
MODULATING SIGNAL:	PRBS
DUTY CICLE	100%
TRANSMITTER OUTPUT POWER SETTINGS:	Set to 30 dBm
MODULATION:	QPSK, 64QAM
EBW:	10 MHz
NUMBER OF RF OUTPUTS:	N = 2

Frequency offset, ± MHz	High band edge SA reading, dBm	High band edge result, dBm*	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
Low carrier frequency 2115.0 MHz QPSK (Output power = 30.44 dBm)						
6.5	-30.40	-27.4	100	1000	-13.0	Pass
7.5	-31.22	-28.22	100	1000	-13.0	
8.5	-32.32	-29.32	100	1000	-13.0	
9.5	-32.76	-29.76	100	1000	-13.0	
Low carrier frequency 2115..0 MHz 64QAM (Output power = 30.52 dBm)						
6.5	-30.26	-27.26	100	1000	-13.0	Pass
7.5	-30.17	-27.17	100	1000	-13.0	
8.5	-29.59	-26.59	100	1000	-13.0	
9.5	-31.99	-28.99	100	1000	-13.0	
Mid carrier frequency 2135.0 MHz QPSK (Output power = 30.66 dBm)						
6.5	-30.59	-27.59	100	1000	-13.0	Pass
7.5	-31.47	-28.47	100	1000	-13.0	
8.5	-31.81	-28.81	100	1000	-13.0	
9.5	-32.04	-29.04	100	1000	-13.0	
Mid carrier frequency 2135.0 MHz 64QAM (Output power = 30.74 dBm)						
6.5	-28.66	-25.66	100	1000	-13.0	Pass
7.5	-29.31	-26.31	100	1000	-13.0	
8.5	-29.31	-26.31	100	1000	-13.0	
9.5	-30.51	-27.51	100	1000	-13.0	
High carrier frequency 2150.0 MHz QPSK (Output power = 30.86 dBm)						
6.5	-30.58	-27.58	300	1000	-13.0	Pass
7.5	-31.15	-28.15	300	1000	-13.0	
8.5	-30.95	-27.95	300	1000	-13.0	
9.5	-32.65	-29.65	300	1000	-13.0	
High carrier frequency 2150.0 MHz 64QAM (Output power = 30.64 dBm)						
6.5	-30.78	-27.78	100	1000	-13.0	Pass
7.5	-31.56	-28.56	100	1000	-13.0	
8.5	-31.18	-28.18	100	1000	-13.0	
9.5	-32.41	-29.41	100	1000	-13.0	

* - High band edge result = High band edge SA Reading + 10log(N)

Test specification:	Section 27.53(h), Band edge emissions		
Test procedure:	47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/30/2013		
Temperature: 25.2 ºC	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Table 7.3.4 Spurious emission at the low band edge test results

ASSIGNED FREQUENCY RANGE:	2110.0 – 2155.0 MHz
INVESTIGATED FREQUENCY RANGE:	See Table 7.3.1
RBW:	200 kHz
DETECTOR USED:	Average
VIDEO BANDWIDTH:	≥ Resolution bandwidth
MODULATING SIGNAL:	PRBS
DUTY CICLE	100%
TRANSMITTER OUTPUT POWER SETTINGS:	Set to 30 dBm
MODULATION:	QPSK, 64QAM
EBW:	20 MHz
NUMBER OF RF OUTPUTS:	N = 2

Frequency offset, ± MHz	Low band edge SA reading, dBm	Low band edge result, dBm*	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
Low carrier frequency 2120 MHz QPSK (Output power = 30.25 dBm)						
11.5	-23.92	-20.92	200	1000	-13.0	Pass
12.5	-22.93	-19.93	200	1000	-13.0	
13.5	-26.61	-23.61	200	1000	-13.0	
14.5	-28.71	-25.71	200	1000	-13.0	
Low carrier frequency 2120.0 MHz 64QAM (Output power = 30.28 dBm)						
11.5	-20.90	-17.9	200	1000	-13.0	Pass
12.5	-20.35	-17.35	200	1000	-13.0	
13.5	-25.69	-22.69	200	1000	-13.0	
14.5	-26.34	-23.34	200	1000	-13.0	
Mid carrier frequency 2130.0 MHz QPSK (Output power = 30.35 dBm)						
11.5	-21.23	-18.23	200	1000	-13.0	Pass
12.5	-25.37	-22.37	200	1000	-13.0	
13.5	-26.00	-23.00	200	1000	-13.0	
14.5	-28.18	-25.18	200	1000	-13.0	
Mid carrier frequency 2130.0 MHz 64QAM (Output power = 30.33 dBm)						
11.5	-22.93	-19.93	200	1000	-13.0	Pass
12.5	-22.57	-19.57	200	1000	-13.0	
13.5	-22.81	-19.81	200	1000	-13.0	
14.5	-24.10	-21.10	200	1000	-13.0	
High carrier frequency 2145 MHz QPSK (Output power = 30.35 dBm)						
11.5	-20.00	-17.00	200	1000	-13.0	Pass
12.5	-21.73	-18.73	200	1000	-13.0	
13.5	-25.97	-22.97	200	1000	-13.0	
14.5	-27.30	-24.30	200	1000	-13.0	
Mid carrier frequency 2145.0 MHz 64QAM (Output power = 30.53 dBm)						
11.5	-22.99	-19.99	200	1000	-13.0	Pass
12.5	-24.50	-21.50	200	1000	-13.0	
13.5	-24.40	-21.40	200	1000	-13.0	
14.5	-27.12	-24.12	200	1000	-13.0	

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

Test specification:	**Section 27.53(h), Band edge emissions**		
Test procedure:	47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	9/30/2013		
Temperature: 25.2 ºC	**Air Pressure:** 1010 hPa	**Relative Humidity:** 38 %	**Power Supply:** 48 VDC
Remarks:			

Table 7.3.5 Spurious emission at the high band edge test results

ASSIGNED FREQUENCY RANGE:	2110.0 – 2155.0 MHz
INVESTIGATED FREQUENCY RANGE:	See Table 7.3.1
RBW:	100 kHz
DETECTOR USED:	Average
VIDEO BANDWIDTH:	≥ Resolution bandwidth
MODULATING SIGNAL:	PRBS
DUTY CICLE	100%
TRANSMITTER OUTPUT POWER SETTINGS:	Set to 30 dBm
MODULATION:	QPSK, 64QAM
EBW:	20 MHz
NUMBER OF RF OUTPUTS:	N = 2

Frequency offset, ± MHz	High band edge SA reading, dBm	High band edge result, dBm*	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
Low carrier frequency 2120 MHz QPSK (Output power = 30.25 dBm)						
11.5	-23.92	-20.92	200	1000	-13.0	Pass
12.5	-22.93	-19.93	200	1000	-13.0	
13.5	-26.61	-23.61	200	1000	-13.0	
14.5	-26.53	-23.53	200	1000	-13.0	
Low carrier frequency 2120.0 MHz 64QAM (Output power = 30.28 dBm)						
11.5	-20.92	-17.92	200	1000	-13.0	Pass
12.5	-22.23	-19.23	200	1000	-13.0	
13.5	-25.99	-22.99	200	1000	-13.0	
14.5	-27.68	-24.68	200	1000	-13.0	
Mid carrier frequency 2130.0 MHz QPSK (Output power = 30.35 dBm)						
11.5	-19.84	-16.84	200	1000	-13.0	Pass
12.5	-22.87	-19.87	200	1000	-13.0	
13.5	-23.72	-20.72	200	1000	-13.0	
14.5	-26.12	-26.12	200	1000	-13.0	
Mid carrier frequency 2130.0 MHz 64QAM (Output power = 30.33 dBm)						
11.5	-19.73	-16.73	200	1000	-13.0	Pass
12.5	-21.09	-18.09	200	1000	-13.0	
13.5	-24.39	-21.39	200	1000	-13.0	
14.5	-23.99	-20.99	200	1000	-13.0	
High carrier frequency 2145 MHz QPSK (Output power = 30.35 dBm)						
11.5	-20.80	-17.8	200	1000	-13.0	Pass
12.5	-21.73	-18.73	200	1000	-13.0	
13.5	-25.79	-22.79	200	1000	-13.0	
14.5	-26.34	-23.34	200	1000	-13.0	
Mid carrier frequency 2145.0 MHz 64QAM (Output power = 30.53 dBm)						
11.5	-22.99	-19.99	200	1000	-13.0	Pass
12.5	-24.50	-21.5	200	1000	-13.0	
13.5	-24.48	-21.48	200	1000	-13.0	
14.5	-28.17	-25.17	200	1000	-13.0	

* - High band edge result = High band edge SA Reading + 10log(N)

Reference numbers of test equipment used

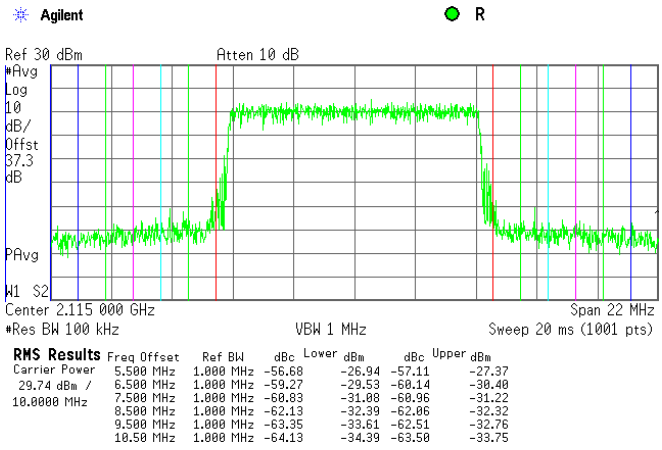
HL 2214	HL 3301	HL 3302	HL 3433	HL 3455	HL 3818	HL 3903	HL 4367

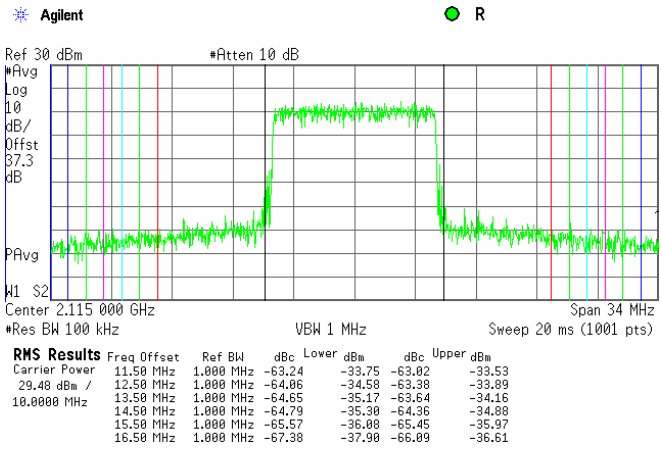
Full description is given in Appendix A.

Test specification:	Section 27.53(h), Band edge emissions		
Test procedure:	47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/30/2013		
Temperature: 25.2 °C	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.1 Spurious emission at band edges test results at low carrier frequency, 10 MHz EBW

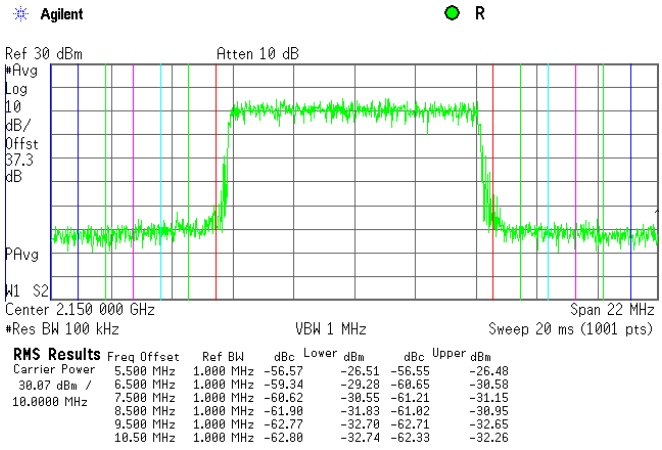
OPERATING FREQUENCY RANGE:	2110.0 – 2155.0 MHz
DETECTOR USED:	Average
MODULATION:	QPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	15.5 Mbps

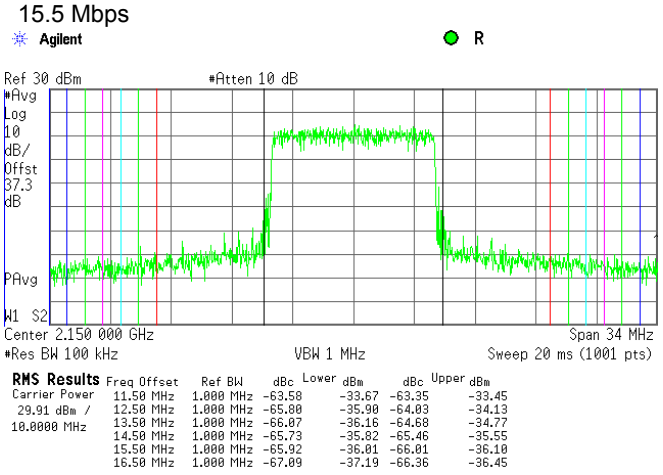




Plot 7.3.2 Spurious emission at band edges test results at high carrier frequency, 10 MHz EBW

OPERATING FREQUENCY RANGE:	2110.0 – 2155.0 MHz
DETECTOR USED:	Average
MODULATION:	QPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	15.5 Mbps

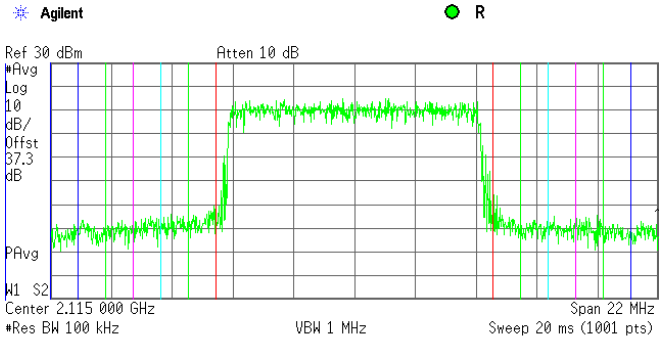




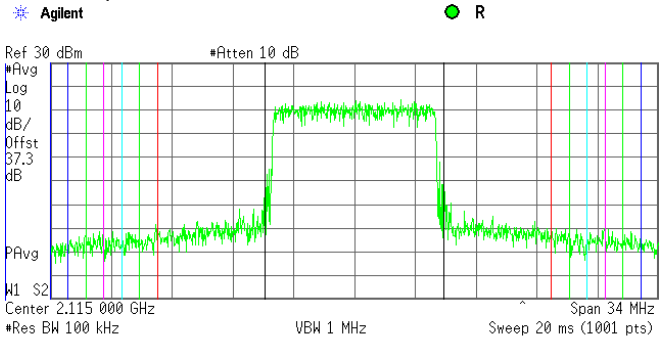
Test specification:	Section 27.53(h), Band edge emissions		
Test procedure:	47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/30/2013		
Temperature: 25.2 °C	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.3 Spurious emission at band edges test results at low carrier frequency, 10 MHz EBW

OPERATING FREQUENCY RANGE:	2110.0 – 2155.0 MHz
DETECTOR USED:	Average
MODULATION:	64QAM
MODULATING SIGNAL:	PRBS
BIT RATE:	75.0 Mbps



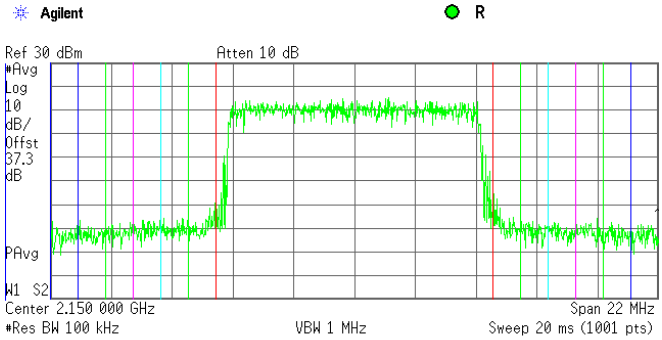
RMS Results	Freq Offset	Ref BW	dBc Lower dBm	dBc Upper dBm
Carrier Power	5.500 MHz	1.000 MHz	-55.27	-25.78 -55.46 -25.97
29.49 dBm /	6.500 MHz	1.000 MHz	-58.14	-28.65 -59.74 -30.26
10.0000 MHz	7.500 MHz	1.000 MHz	-58.94	-29.45 -59.66 -30.17
	8.500 MHz	1.000 MHz	-60.48	-30.99 -59.08 -29.59
	9.500 MHz	1.000 MHz	-60.52	-31.03 -61.48 -31.99
	10.50 MHz	1.000 MHz	-62.18	-32.69 -61.20 -31.71



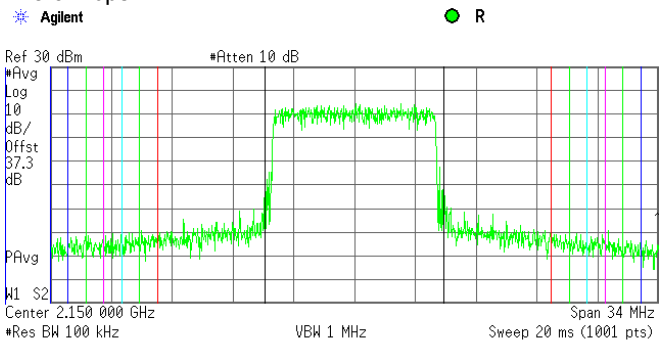
RMS Results	Freq Offset	Ref BW	dBc Lower dBm	dBc Upper dBm
Carrier Power	11.50 MHz	1.000 MHz	-64.53	-35.21 -63.21 -33.90
29.32 dBm /	12.50 MHz	1.000 MHz	-64.68	-35.37 -65.11 -35.79
10.0000 MHz	13.50 MHz	1.000 MHz	-65.88	-36.56 -63.90 -34.58
	14.50 MHz	1.000 MHz	-65.22	-35.90 -65.32 -36.01
	15.50 MHz	1.000 MHz	-66.45	-37.13 -65.37 -36.05
	16.50 MHz	1.000 MHz	-68.64	-39.33 -67.40 -38.09

Plot 7.3.4 Spurious emission at band edges test results at high carrier frequency, 10 MHz EBW

OPERATING FREQUENCY RANGE:	2110.0 – 2155.0 MHz
DETECTOR USED:	Average
MODULATION:	64QAM
MODULATING SIGNAL:	PRBS
BIT RATE:	75.0 Mbps



RMS Results	Freq Offset	Ref BW	dBc Lower dBm	dBc Upper dBm
Carrier Power	5.500 MHz	1.000 MHz	-57.58	-27.89 -56.20 -26.52
29.69 dBm /	6.500 MHz	1.000 MHz	-60.01	-30.32 -60.46 -30.78
10.0000 MHz	7.500 MHz	1.000 MHz	-59.93	-30.24 -61.25 -31.56
	8.500 MHz	1.000 MHz	-61.58	-31.90 -60.87 -31.18
	9.500 MHz	1.000 MHz	-62.41	-32.73 -62.10 -32.41
	10.50 MHz	1.000 MHz	-62.94	-33.26 -62.48 -32.79

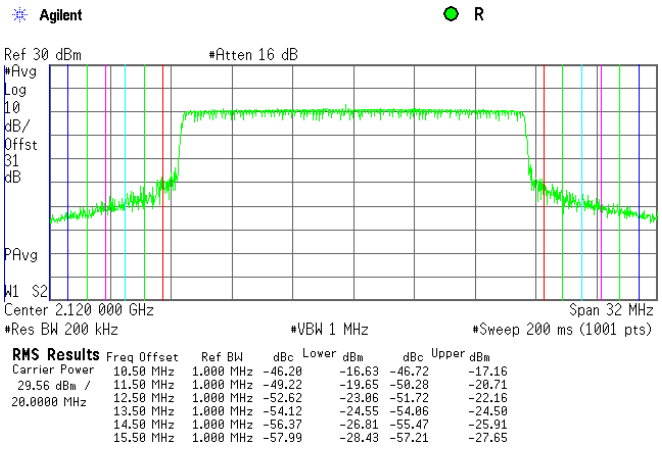


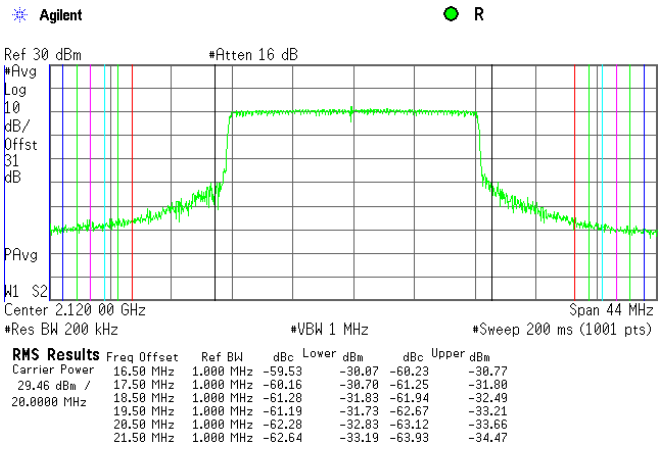
RMS Results	Freq Offset	Ref BW	dBc Lower dBm	dBc Upper dBm
Carrier Power	11.50 MHz	1.000 MHz	-63.35	-33.76 -63.72 -34.13
29.59 dBm /	12.50 MHz	1.000 MHz	-64.26	-34.67 -64.57 -34.97
10.0000 MHz	13.50 MHz	1.000 MHz	-65.14	-35.55 -64.64 -35.04
	14.50 MHz	1.000 MHz	-65.45	-35.85 -65.60 -36.01
	15.50 MHz	1.000 MHz	-65.25	-35.66 -66.64 -37.04
	16.50 MHz	1.000 MHz	-66.75	-37.15 -68.05 -38.45

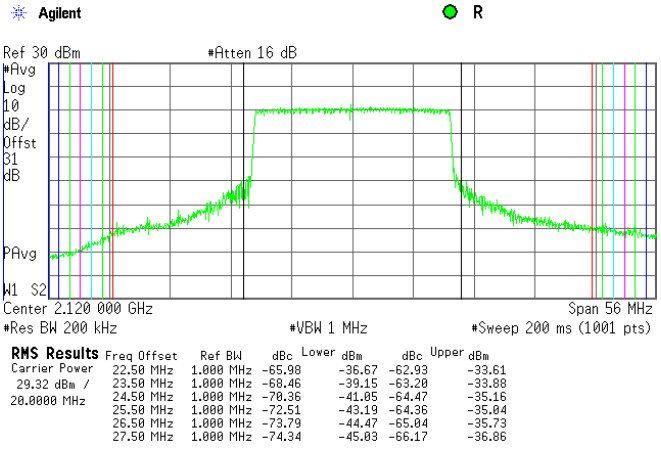
Test specification:	Section 27.53(h), Band edge emissions		
Test procedure:	47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/30/2013		
Temperature: 25.2 °C	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.5 Spurious emission at band edges test results at low carrier frequency, 20 MHz EBW

OPERATING FREQUENCY RANGE:	2110.0 – 2155.0 MHz
DETECTOR USED:	Average
MODULATION:	QPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	31 Mbps



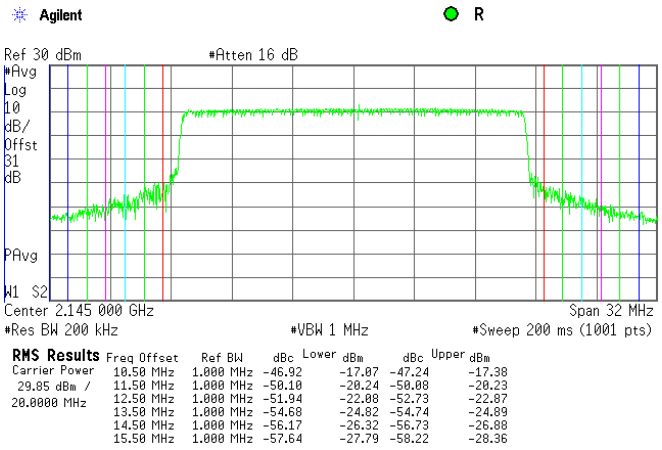


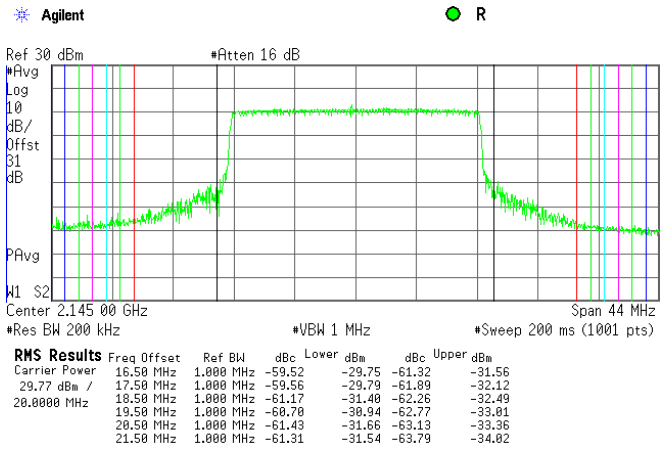


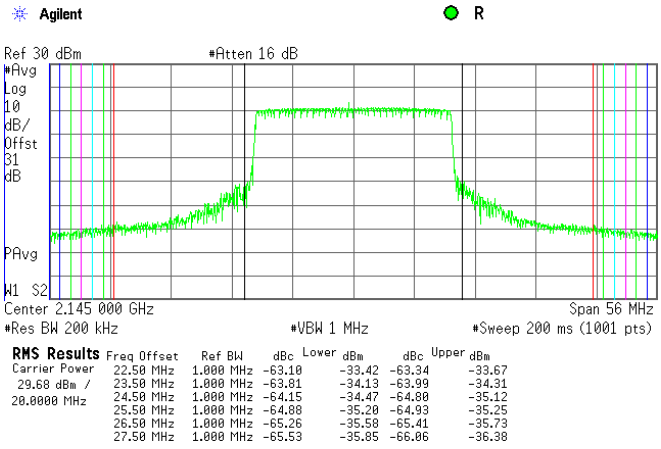
Test specification:	Section 27.53(h), Band edge emissions		
Test procedure:	47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/30/2013		
Temperature: 25.2 °C	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.6 Spurious emission at band edges test results at high carrier frequency, 20 MHz EBW

OPERATING FREQUENCY RANGE:	2110.0 – 2155.0 MHz
DETECTOR USED:	Average
MODULATION:	QPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	31 Mbps



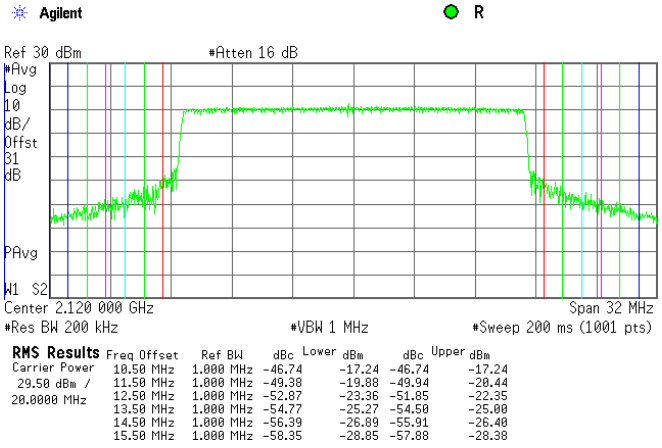


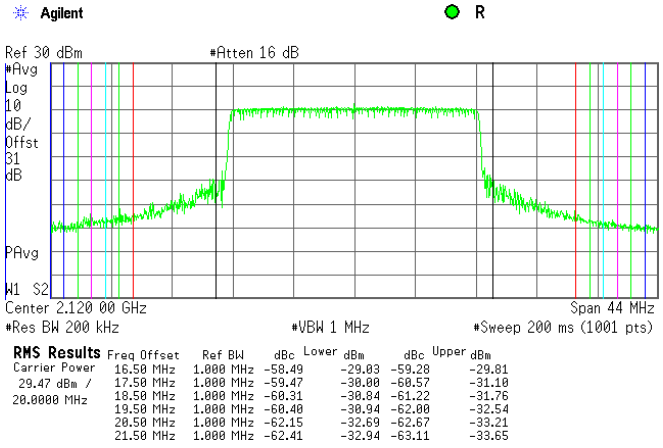


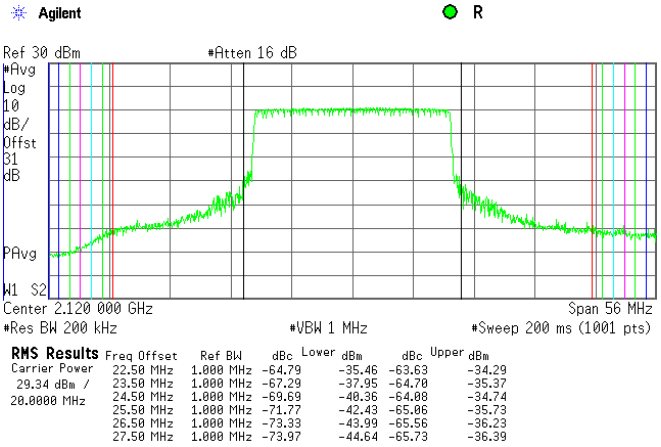
Test specification:	Section 27.53(h), Band edge emissions		
Test procedure:	47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/30/2013		
Temperature: 25.2 °C	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.7 Spurious emission at band edges test results at low carrier frequency, 20 MHz EBW

OPERATING FREQUENCY RANGE:	2110.0 – 2155.0 MHz
DETECTOR USED:	Average
MODULATION:	64QAM
MODULATING SIGNAL:	PRBS
BIT RATE:	150 Mbps



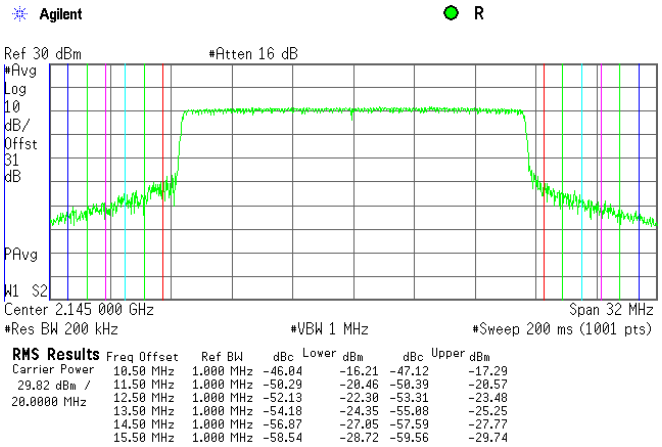


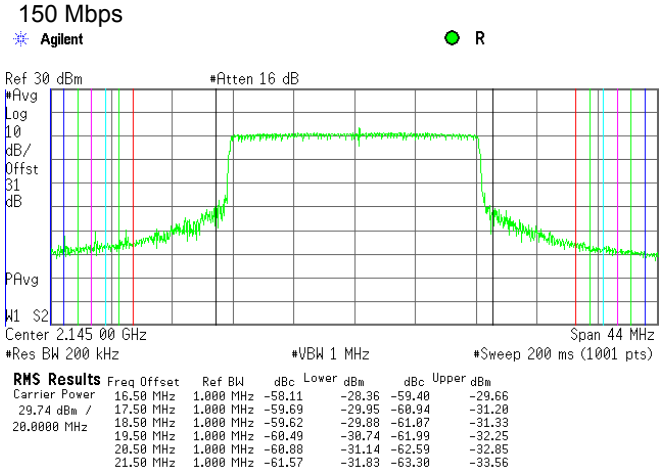


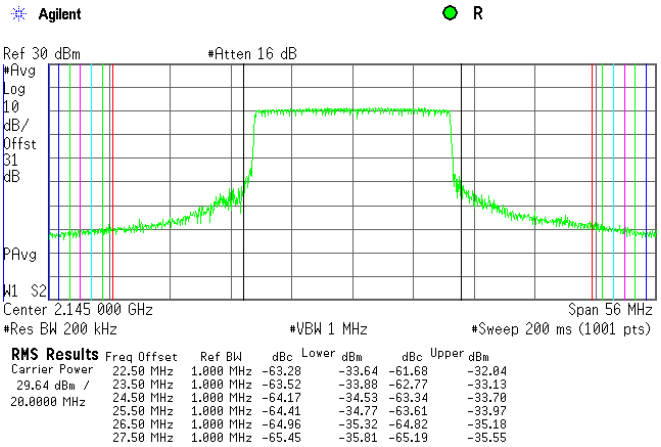
Test specification:	Section 27.53(h), Band edge emissions		
Test procedure:	47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-C, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/30/2013		
Temperature: 25.2 °C	Air Pressure: 1010 hPa	Relative Humidity: 38 %	Power Supply: 48 VDC
Remarks:			

Plot 7.3.8 Spurious emission at band edges test results at high carrier frequency, 20 MHz EBW

OPERATING FREQUENCY RANGE:	2110.0 – 2155.0 MHz
DETECTOR USED:	Average
MODULATION:	64QAM
MODULATING SIGNAL:	PRBS
BIT RATE:	150 Mbps







Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

7.4 Spurious emissions at RF antenna connector test

7.4.1 General

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

Table 7.4.1 Spurious emission limits

Frequency, MHz	Attenuation below carrier, dBc	Spurious emissions, dBm
Base and fixed user stations		
0.009 – 10th harmonic	43+10logP(W)**	-13.0

* - spurious emission limits do not apply to the channel edge emission investigated in course of band edge emission testing
** - P is transmitter output power in watts

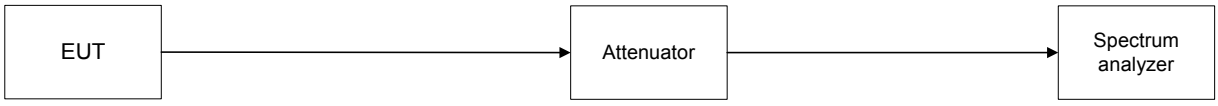
7.4.2 Test procedure

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

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

7.4.2.3 The spurious emission was measured with spectrum analyzer as provided in Table 7.4.1 and the associated plots.

Figure 7.4.1 Spurious emission test setup, single output



Test specification:	**Section 27.53(h), Spurious emissions at RF antenna connector**		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	9/25/2013		
Temperature: 25.3 ºC	**Air Pressure:** 1009 hPa	**Relative Humidity:** 41 %	**Power Supply:** 48 VDC
Remarks:			

Table 7.4.2 Spurious emission test results

ASSIGNED FREQUENCY RANGE: 2110 – 2155 MHz
INVESTIGATED FREQUENCY RANGE: 0.009 – 22000 MHz
DETECTOR USED: Peak
VIDEO BANDWIDTH: ≥ Resolution bandwidth
MODULATION: 64QAM
MODULATING SIGNAL: PRBS
BIT RATE: 75 Mbps
TRANSMITTER OUTPUT POWER SETTINGS: Set to 30 dBm
NUMBER OF RF OUTPUTS: N = 1

Frequency, MHz	SA reading, dBm	Attenuation, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
Low carrier frequency								
All spurious were found at least 20 dB below the specified limit								Pass
Mid carrier frequency								
All spurious were found at least 20 dB below the specified limit								Pass
High carrier frequency								
All spurious were found at least 20 dB below the specified limit								Pass

NUMBER OF RF OUTPUTS: N = 2

Frequency, MHz	SA reading, dBm	Attenuation, dB	Cable loss, dB	RBW, kHz	Spurious emission, dBm	Limit, dBm	Margin, dB*	Verdict
Low carrier frequency								
All spurious were found at least 20 dB below the specified limit								Pass
Mid carrier frequency								
All spurious were found at least 20 dB below the specified limit								Pass
High carrier frequency								
All spurious were found at least 20 dB below the specified limit								Pass

*****- Margin = Spurious emission – specification limit.

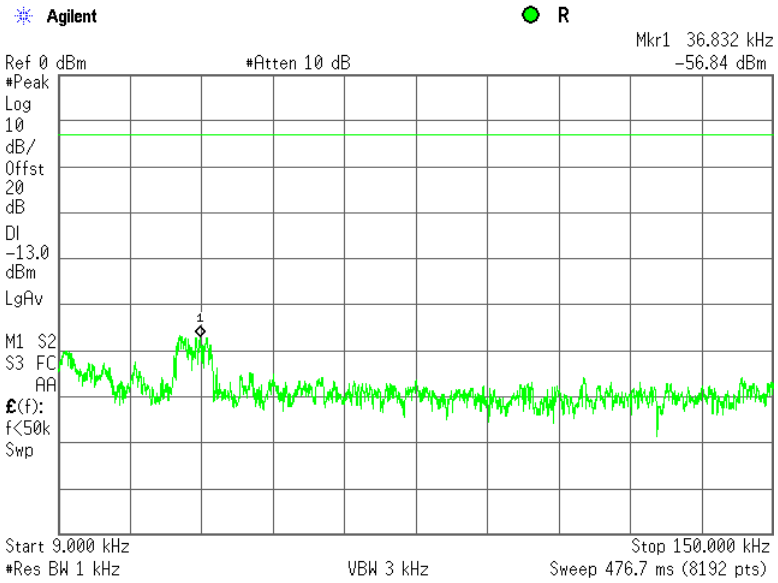
Reference numbers of test equipment used

HL 1809	HL 3455	HL 3818	HL 3903				

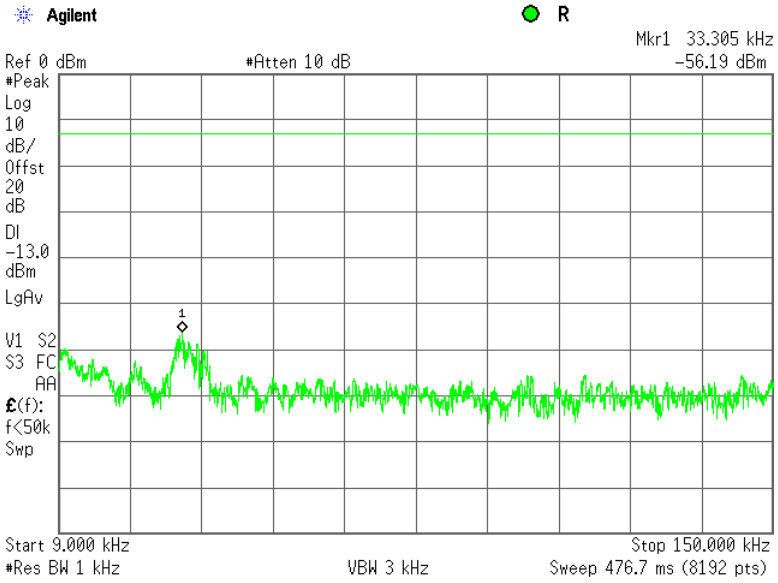
Full description is given in Appendix A.

Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.1 Spurious emission measurements in 9 - 150 kHz range at low carrier frequency

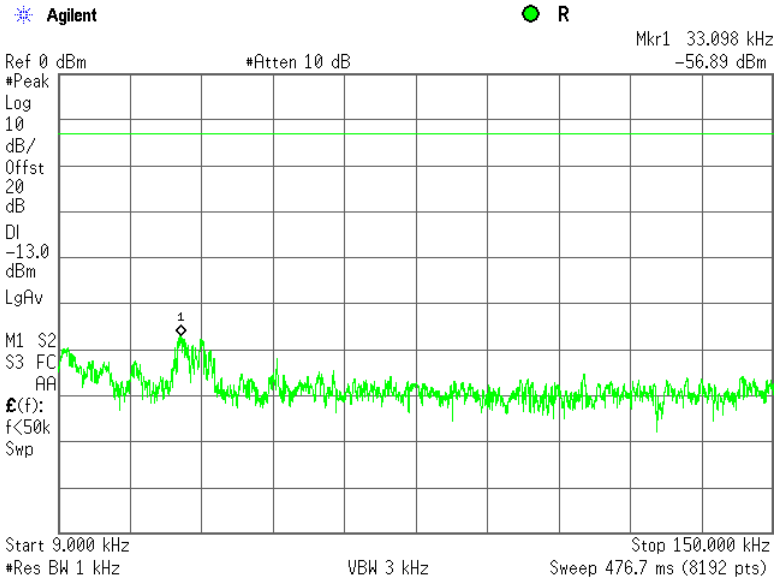


Plot 7.4.2 Spurious emission measurements in 9 - 150 kHz range at mid carrier frequency

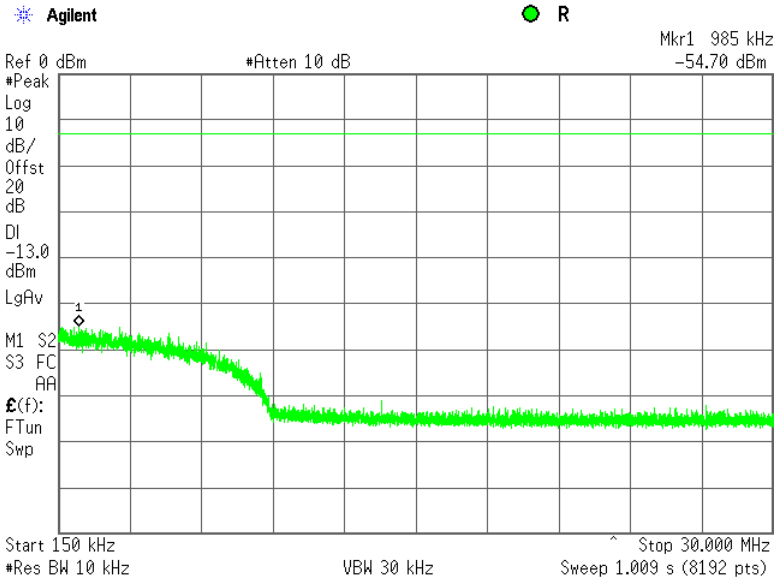


Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.3 Spurious emission measurements in 9 - 150 kHz range at high carrier frequency

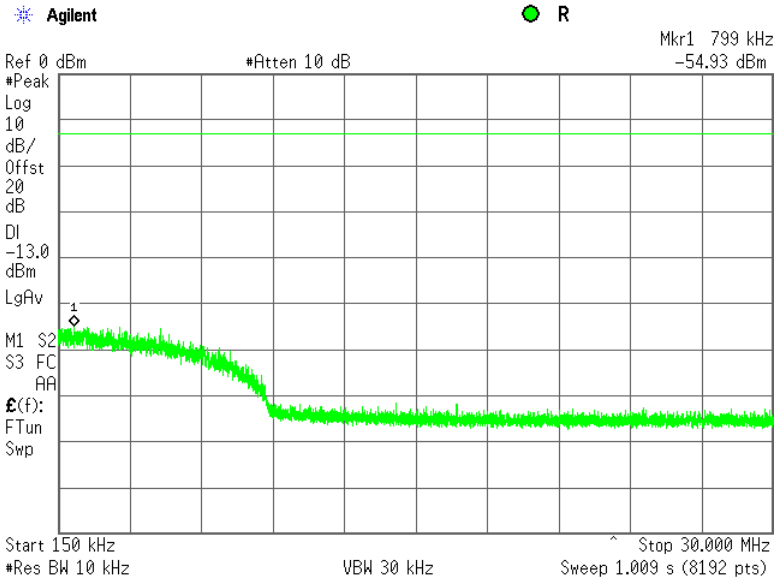


Plot 7.4.4 Spurious emission measurements in 0.15 - 30.0 MHz range at low carrier frequency

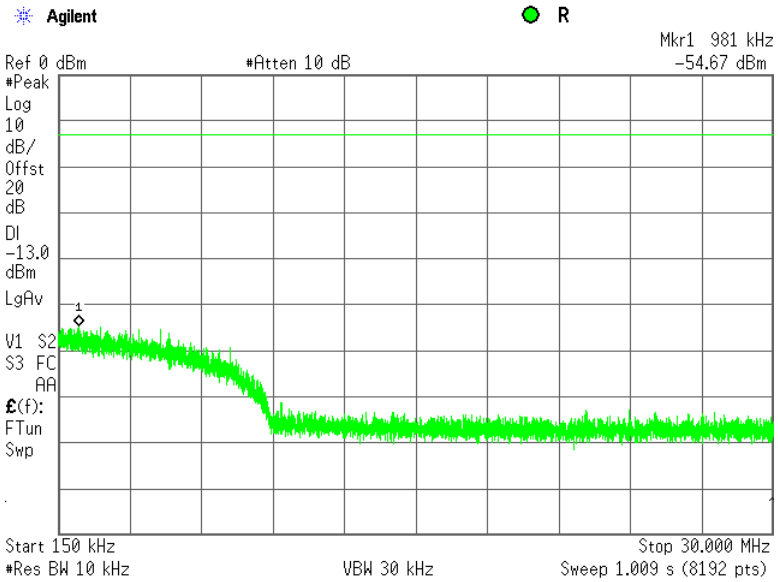


Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.5 Spurious emission measurements in 0.15 - 30.0 MHz range at mid carrier frequency

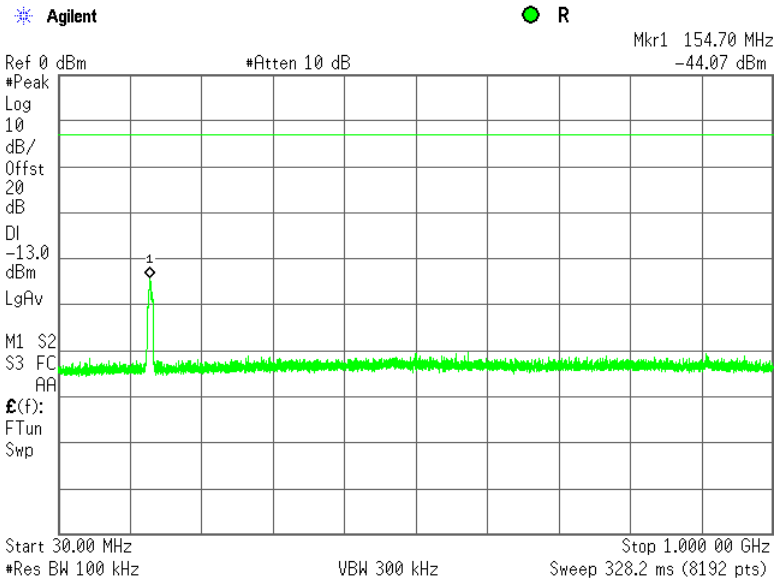


Plot 7.4.6 Spurious emission measurements in 0.15 - 30.0 MHz range at high carrier frequency

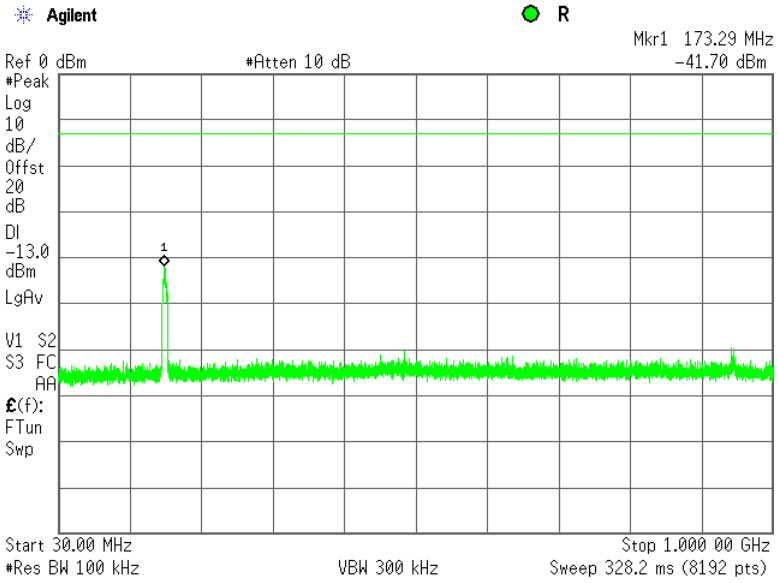


Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.7 Spurious emission measurements in 30 - 1000 MHz range at low carrier frequency

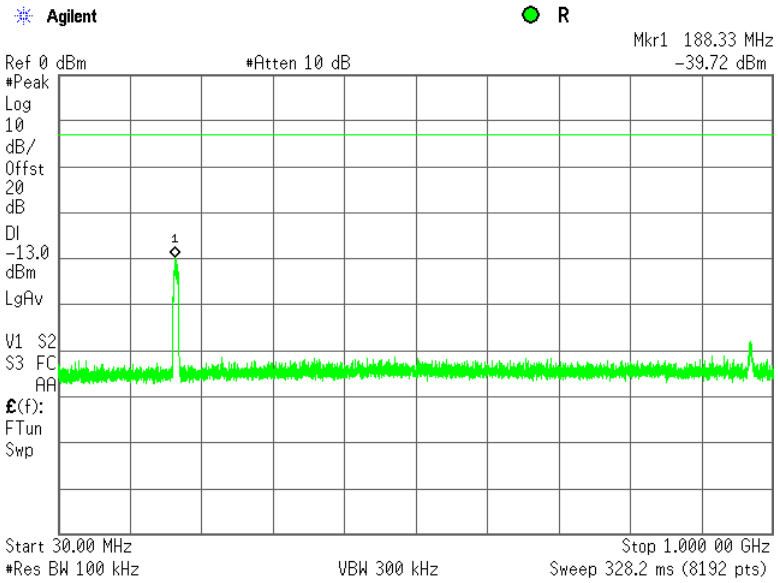


Plot 7.4.8 Spurious emission measurements in 30 - 1000 MHz range at mid carrier frequency

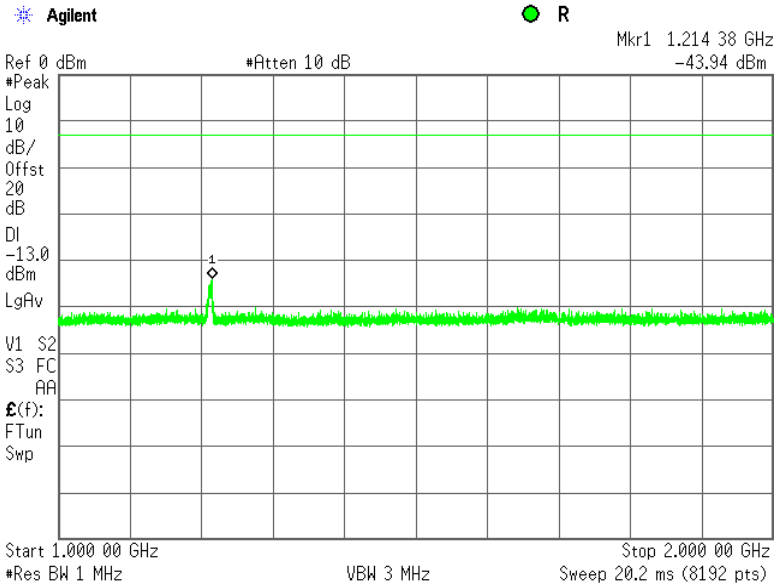


Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.9 Spurious emission measurements in 30 - 1000 MHz range at high carrier frequency

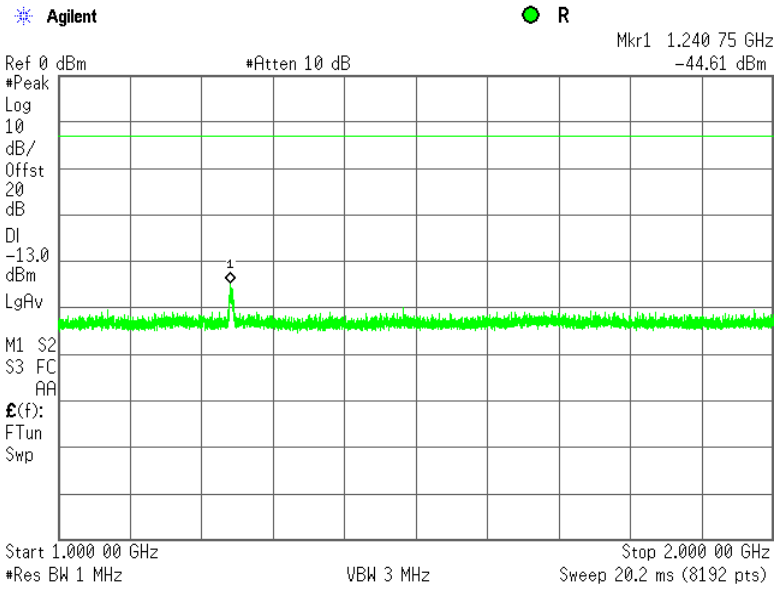


Plot 7.4.10 Spurious emission measurements in 1000 – 2000 MHz range at low carrier frequency

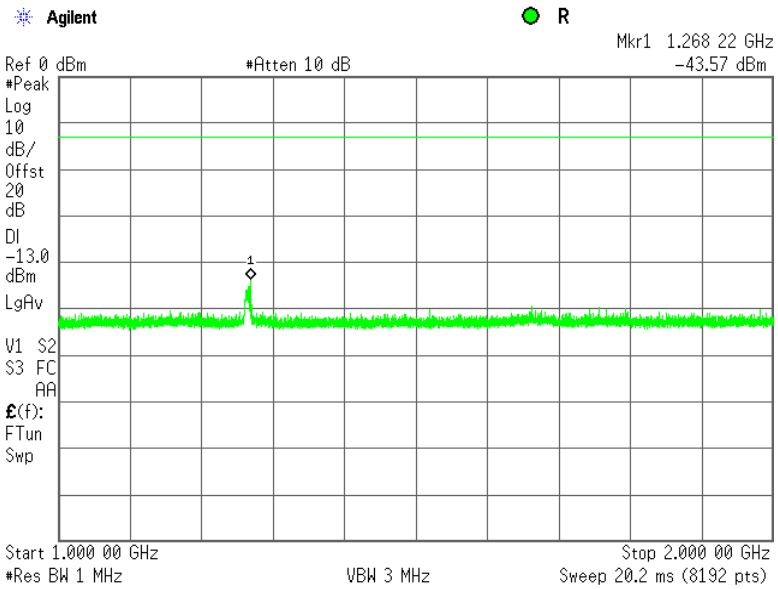


Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.11 Spurious emission measurements in 1000 – 2000 MHz at mid carrier frequency

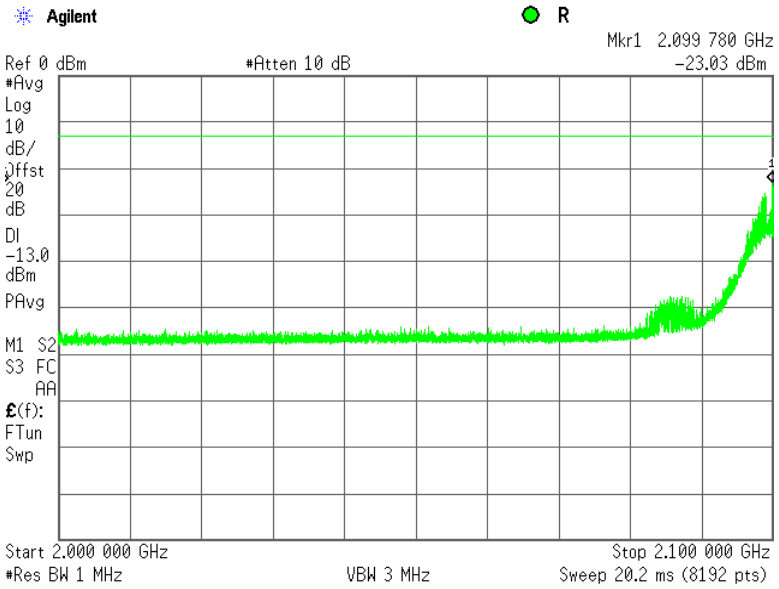


Plot 7.4.12 Spurious emission measurements in 1000 – 2000 MHz at high carrier frequency

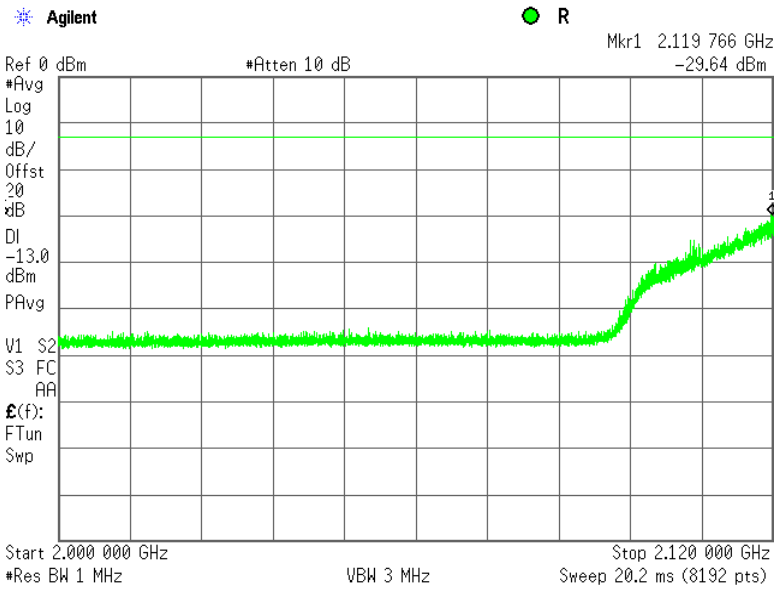


Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 °C	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.13 Spurious emission measurements in 2000 - 2100 MHz range at low carrier frequency

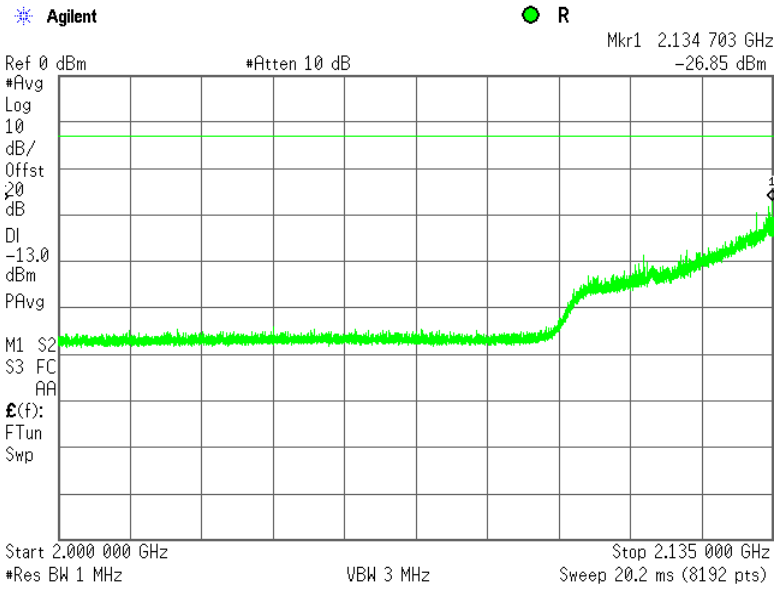


Plot 7.4.14 Spurious emission measurements in 2000 - 2120 MHz at mid carrier frequency

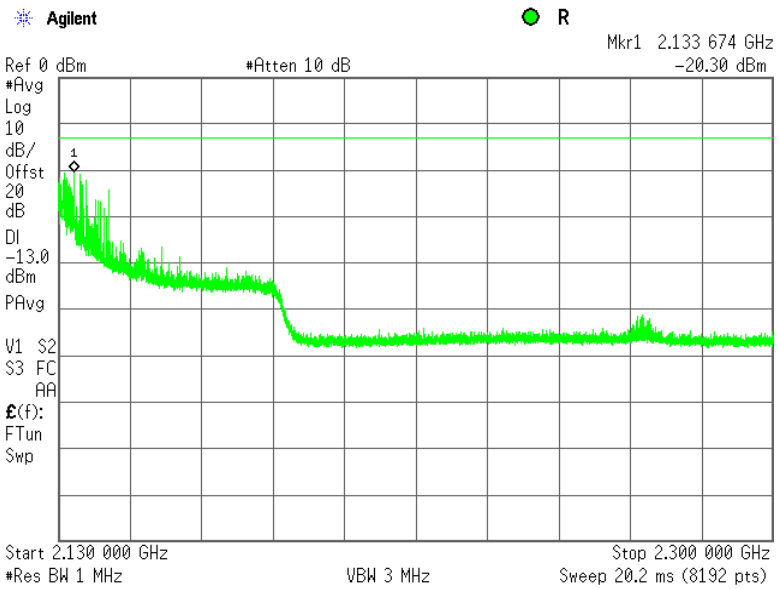


Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 °C	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.15 Spurious emission measurements in 2000 - 2135 MHz at high carrier frequency

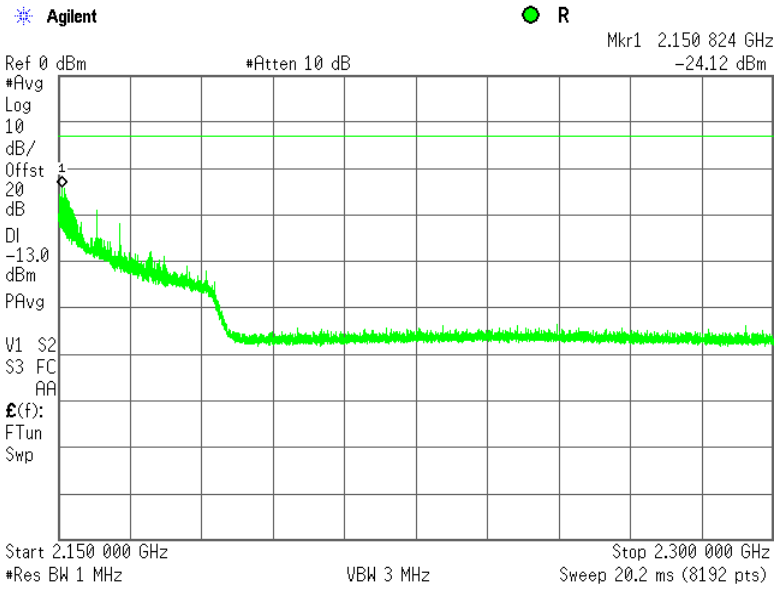


Plot 7.4.16 Spurious emission measurements in 2130 - 2300 MHz range at low carrier frequency

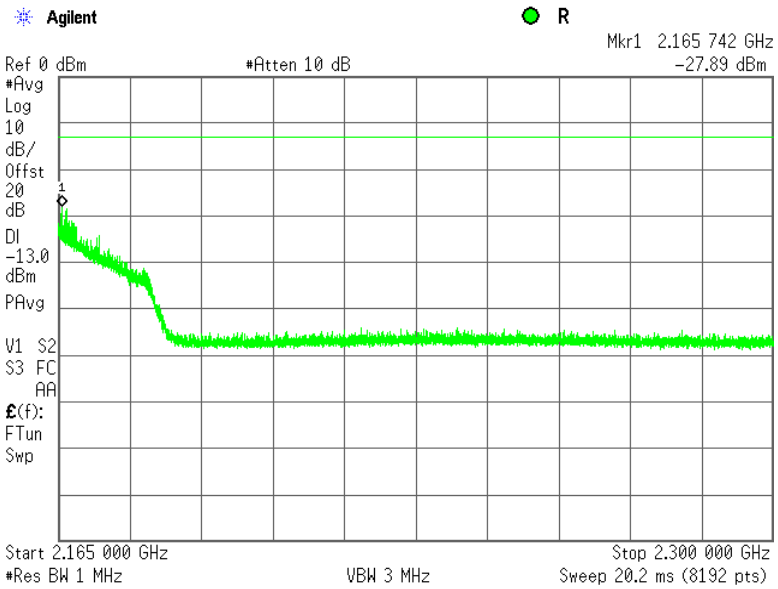


Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.17 Spurious emission measurements in 2150 - 2300 MHz at mid carrier frequency

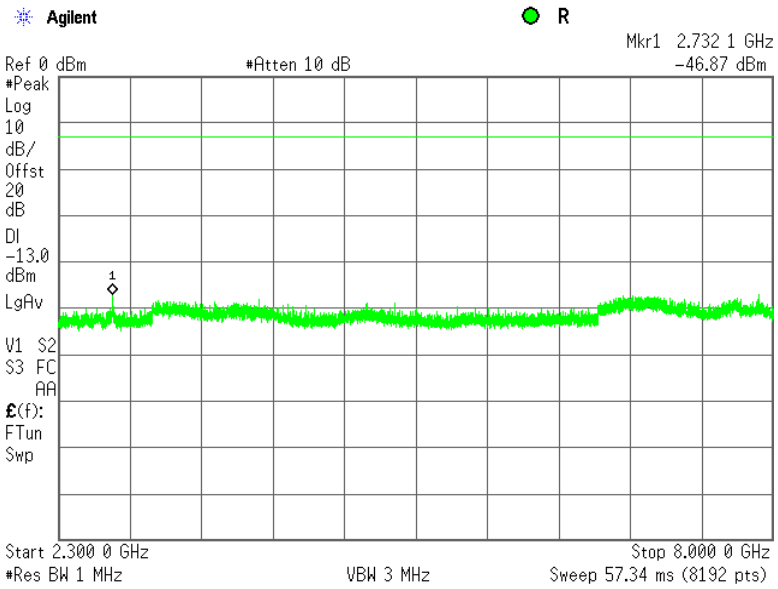


Plot 7.4.18 Spurious emission measurements in 2165 - 2300 MHz at high carrier frequency

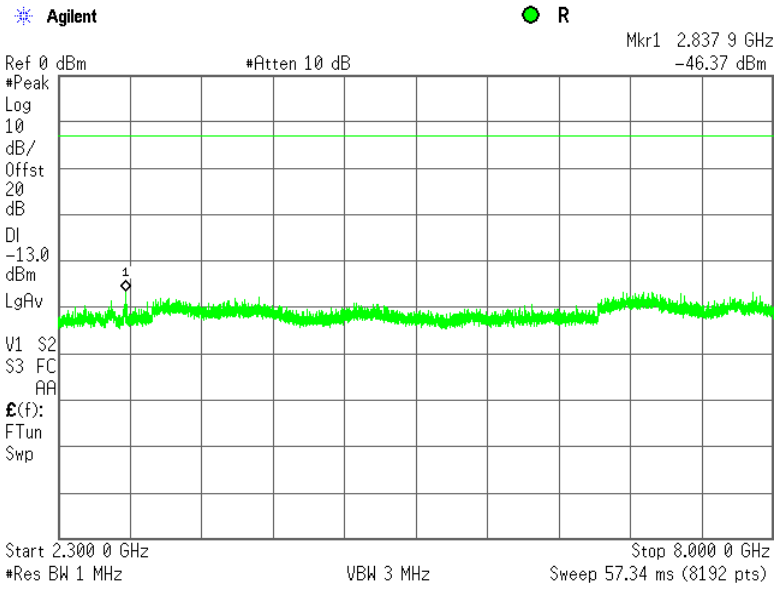


Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.19 Spurious emission measurements in 2300 - 8000 MHz range at low carrier frequency

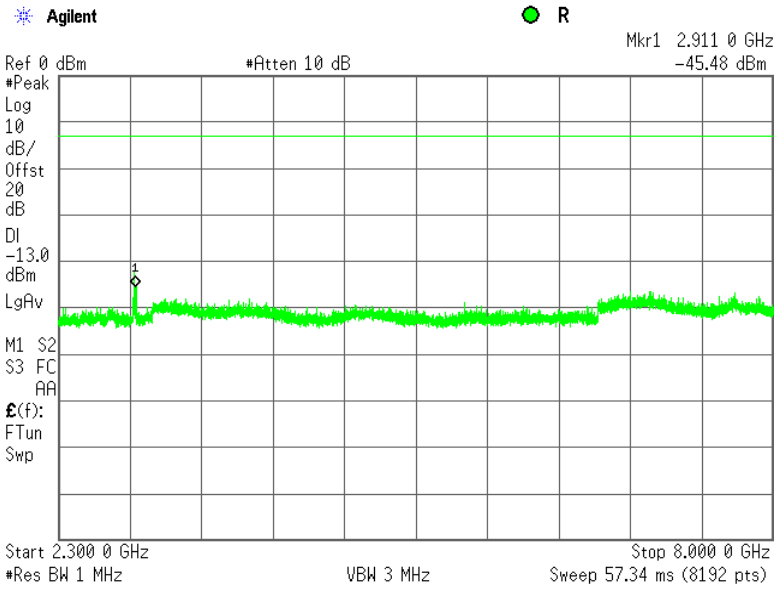


Plot 7.4.20 Spurious emission measurements in 2300 - 8000 MHz at mid carrier frequency

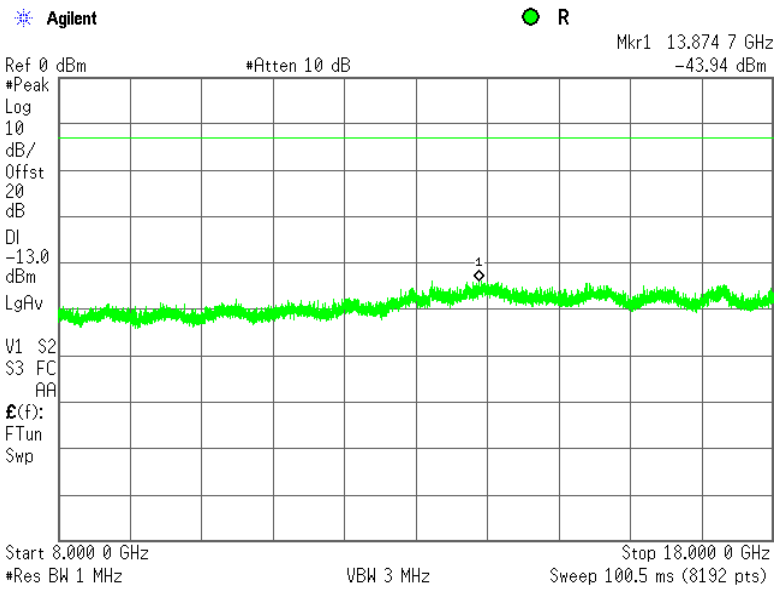


Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.21 Spurious emission measurements in 2300 - 8000 MHz at high carrier frequency

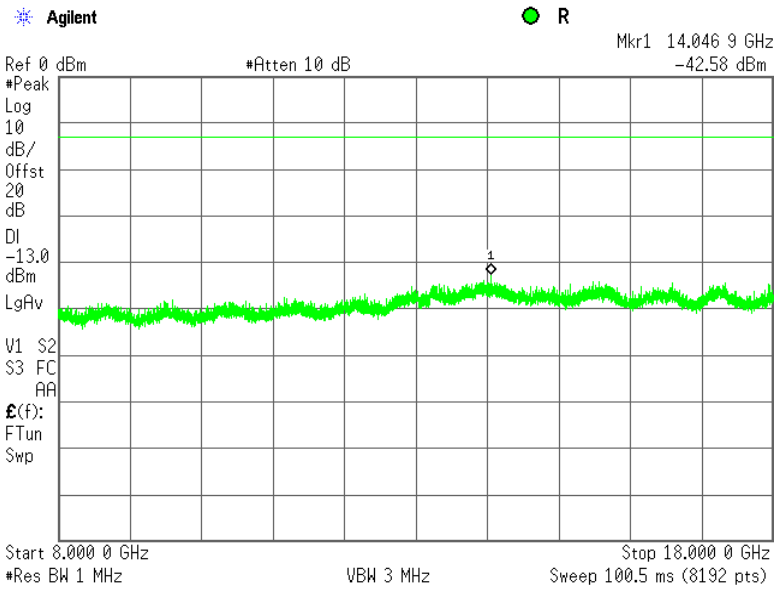


Plot 7.4.22 Spurious emission measurements in 8000 - 18000 MHz range at low carrier frequency

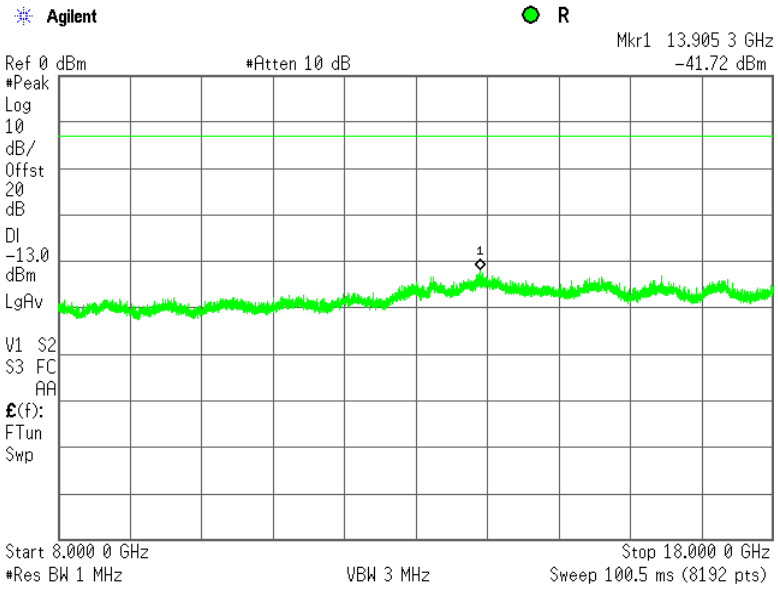


Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 °C	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.23 Spurious emission measurements in 8000 - 18000 MHz at mid carrier frequency

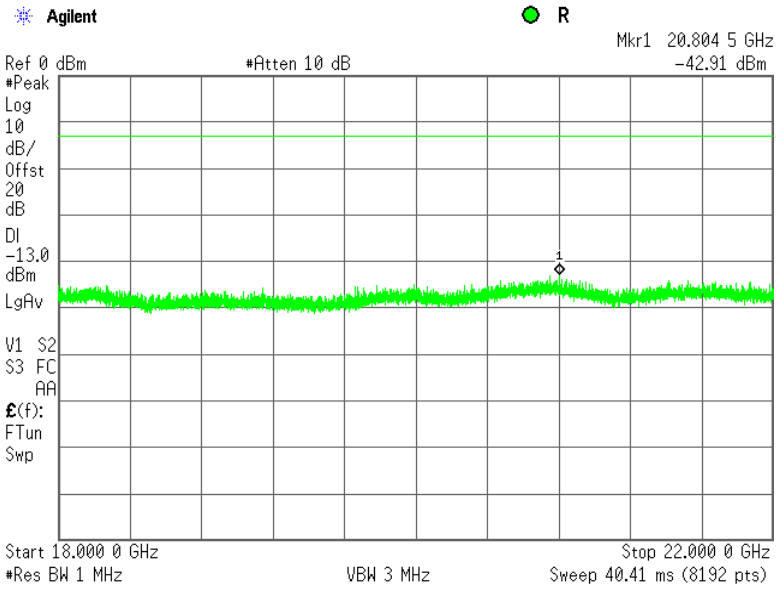


Plot 7.4.24 Spurious emission measurements in 8000 - 18000 MHz at high carrier frequency

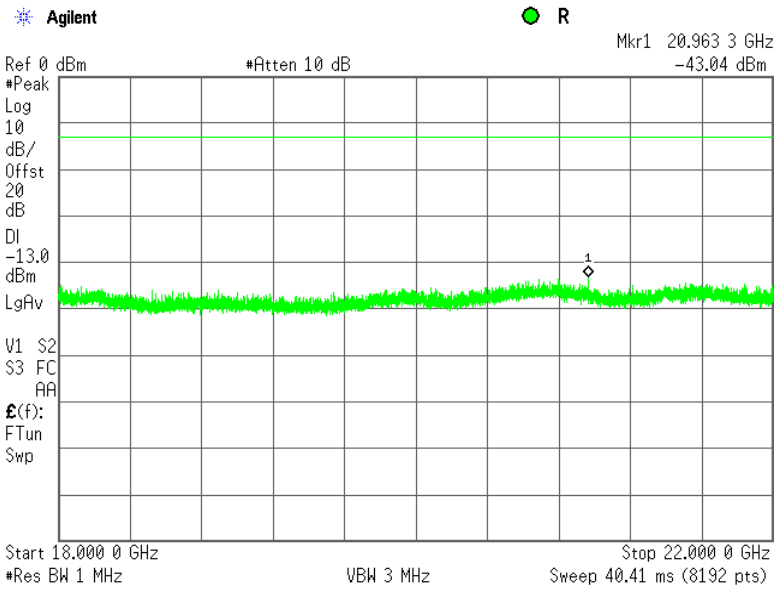


Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.25 Spurious emission measurements in 18000 - 22000 MHz range at low carrier frequency

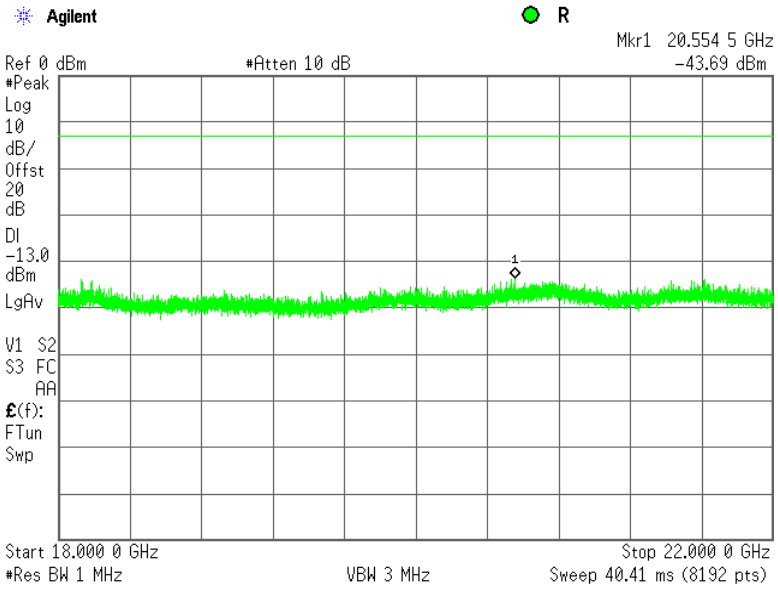


Plot 7.4.26 Spurious emission measurements in 18000 - 22000 MHz at mid carrier frequency



Test specification:	Section 27.53(h), Spurious emissions at RF antenna connector		
Test procedure:	47 CFR, Sections 2.1051, 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25.3 °C	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.4.27 Spurious emission measurements in 18000 - 22000 MHz at high carrier frequency



Test specification:	Section 27.53(h), Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	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 – 10th harmonic*	43+10logP** fixed	-13	84.4

* - Excluding the band emission
** - P is transmitter output power in Watts
*** - Equivalent field strength limit was calculated from maximum allowed ERP of spurious as follows: E=sqrt(30×P×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 360^0 and the measuring antenna was rotated around its vertical axis.

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

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

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

7.5.3.2 The specified frequency range was investigated with antenna connected to spectrum analyzer. To find maximum radiation the turntable was rotated 360^0 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 27.53(h), Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

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

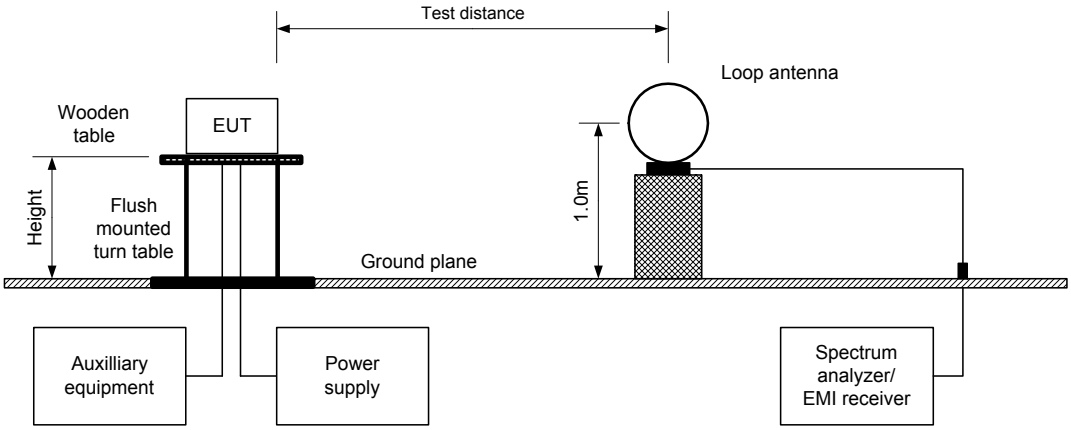
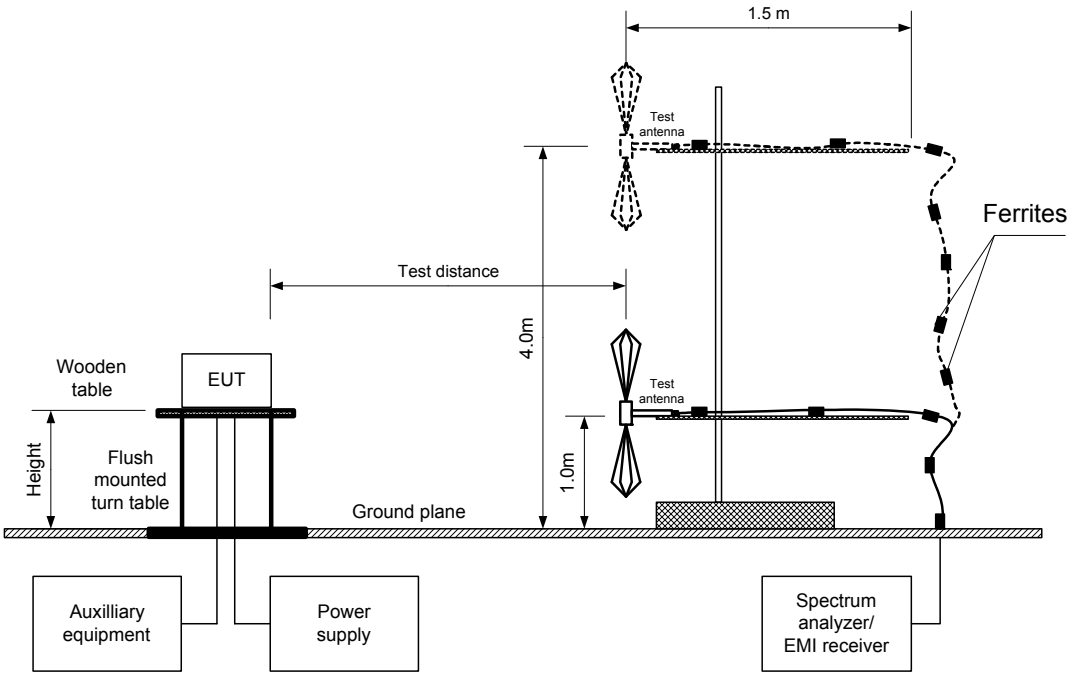


Figure 7.5.2 Setup for spurious emission field strength measurements above 30 MHz



Test specification:	**Section 27.53(h), Radiated spurious emissions**		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	**Verdict:**	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	**Air Pressure:** 1009 hPa	**Relative Humidity:** 41 %	**Power Supply:** 48 VDC
Remarks:			

Table 7.5.2 Spurious emission field strength test results

ASSIGNED FREQUENCY RANGE: 2110 – 2155 MHz
TEST DISTANCE: 3 m
TEST SITE: Semi anechoic chamber
EUT HEIGHT: 0.8 m
INVESTIGATED FREQUENCY RANGE: 0.009 – 22000 MHz
DETECTOR USED: Peak
VIDEO BANDWIDTH: > Resolution bandwidth
TEST ANTENNA TYPE: Active loop (9 kHz – 30 MHz)
Biconilog (30 MHz – 1000 MHz)
Double ridged guide (above 1000 MHz)
MODULATION: 64 QAM
MODULATING SIGNAL: PRBS
EBW: 10 MHz
BIT RATE: 75 Mbps
TRANSMITTER OUTPUT POWER SETTINGS: Set to 30 dBm

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							
No emissions were found							
Mid carrier frequency							
No emissions were found							
High carrier frequency							
No emissions were found							

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

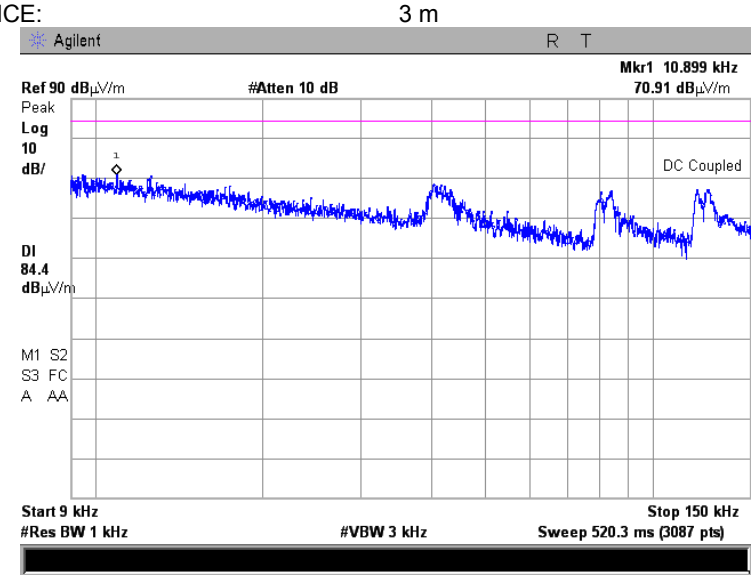
HL 0446	HL 0604	HL 0768	HL 1293	HL 2780	HL 2871	HL 3533	HL 3903
HL 4114	HL 4160	HL 4353					

Full description is given in Appendix A.

Test specification:	Section 27.53(h), Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

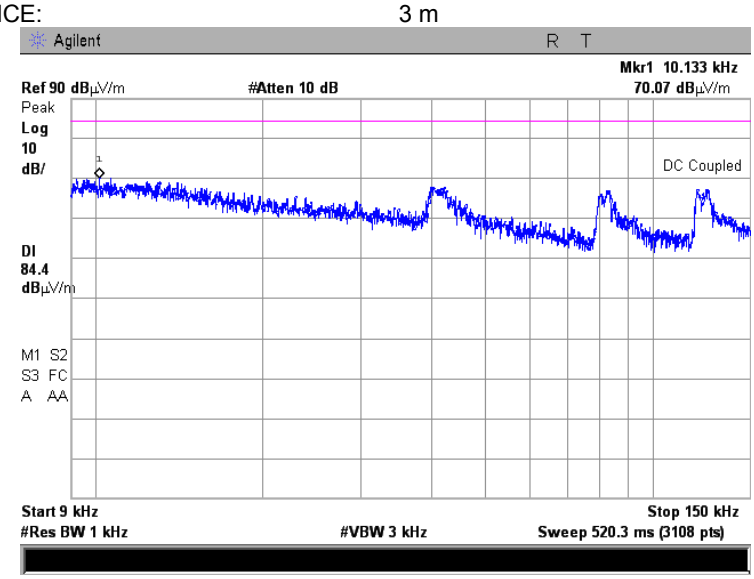
Plot 7.5.1 Radiated emission measurements in 9 - 150 kHz range

TEST SITE: Semi 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

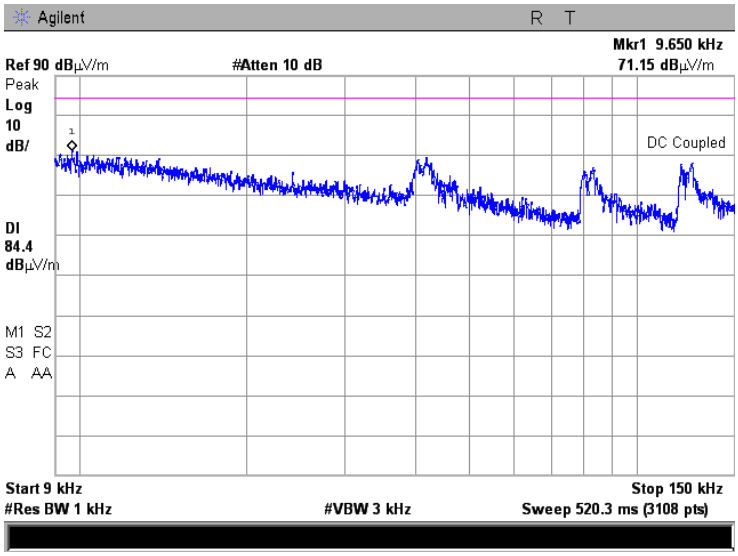
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 27.53(h), Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

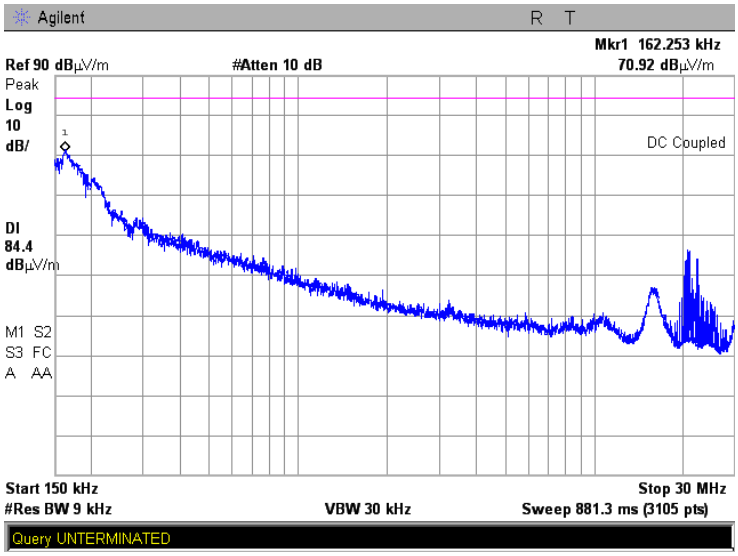
Plot 7.5.3 Radiated emission measurements in 9 - 150 kHz range

TEST SITE: Semi 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

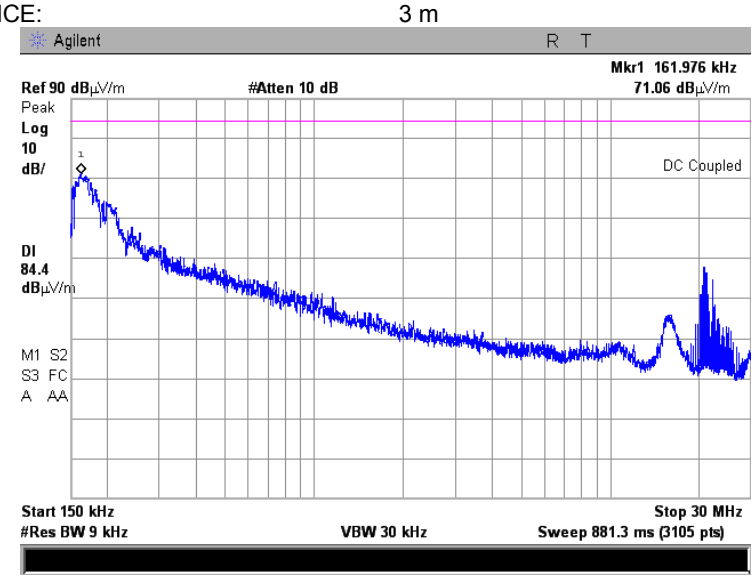
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Low
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 27.53(h), Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

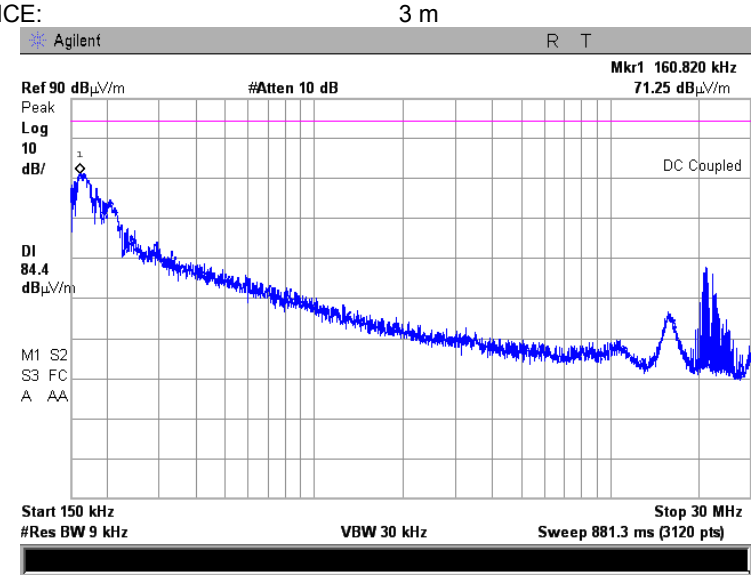
Plot 7.5.5 Radiated emission measurements in 0.15 - 30 MHz range

TEST SITE: Semi 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

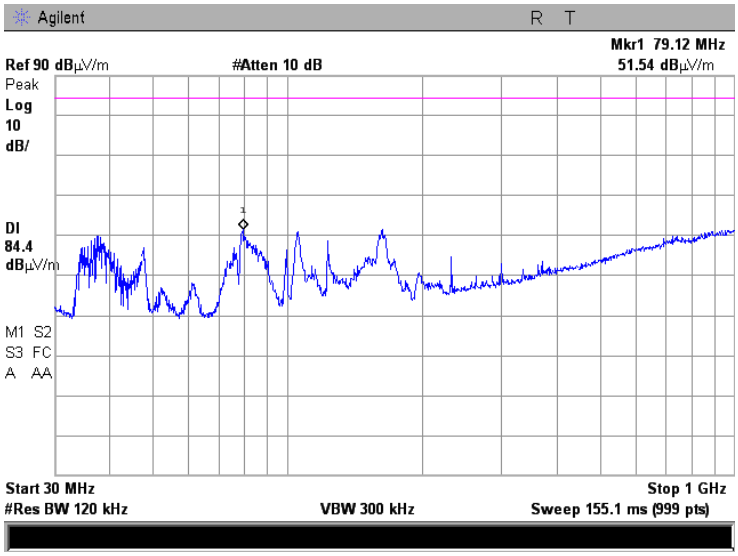
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 27.53(h), Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

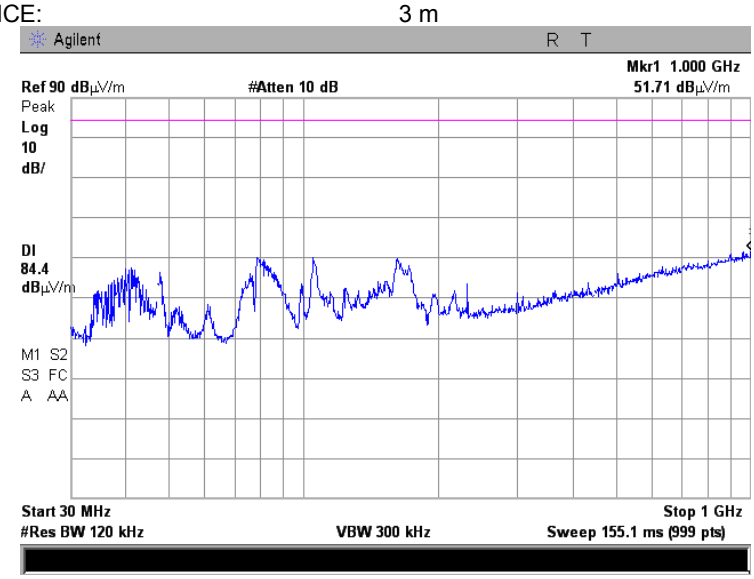
Plot 7.5.7 Radiated emission measurements in 30 - 1000 MHz range

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



Plot 7.5.8 Radiated emission measurements in 30 - 1000 MHz range

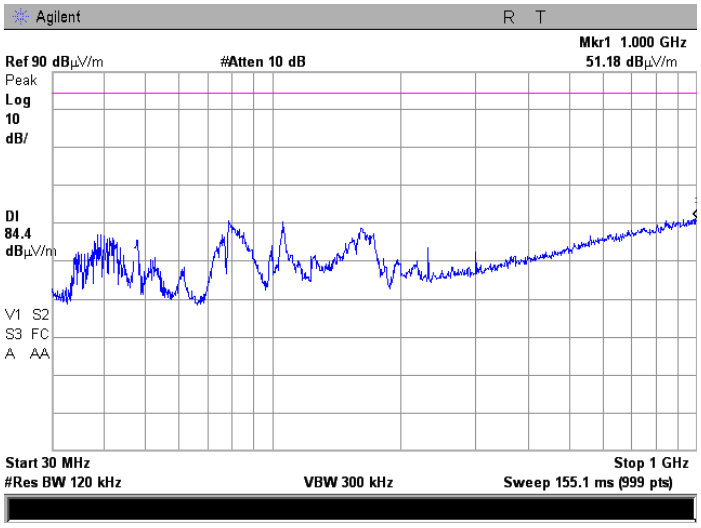
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 27.53(h), Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

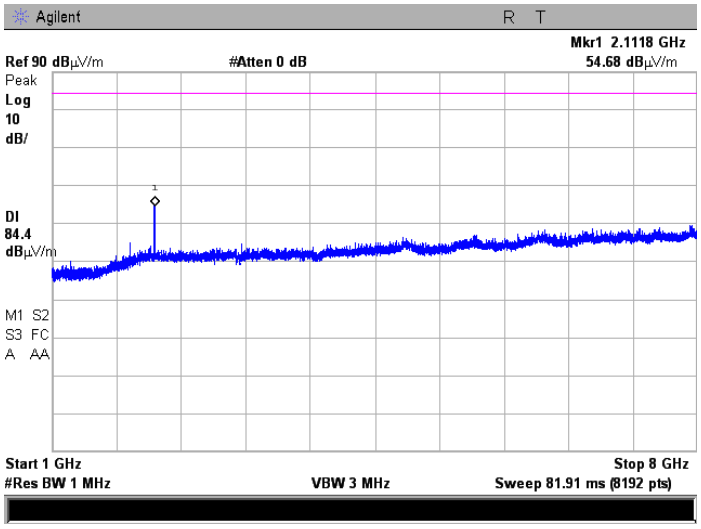
Plot 7.5.9 Radiated emission measurements in 30 - 1000 MHz range

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



Plot 7.5.10 Radiated emission measurements in 1000 – 8000 MHz range

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

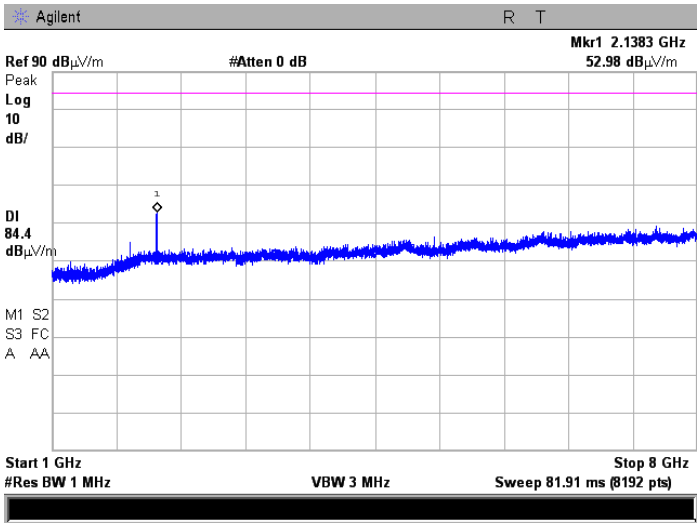


NOTE: 2115 MHz - carrier frequency

Test specification:	Section 27.53(h), Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.5.11 Radiated emission measurements in 1000 – 8000 MHz range

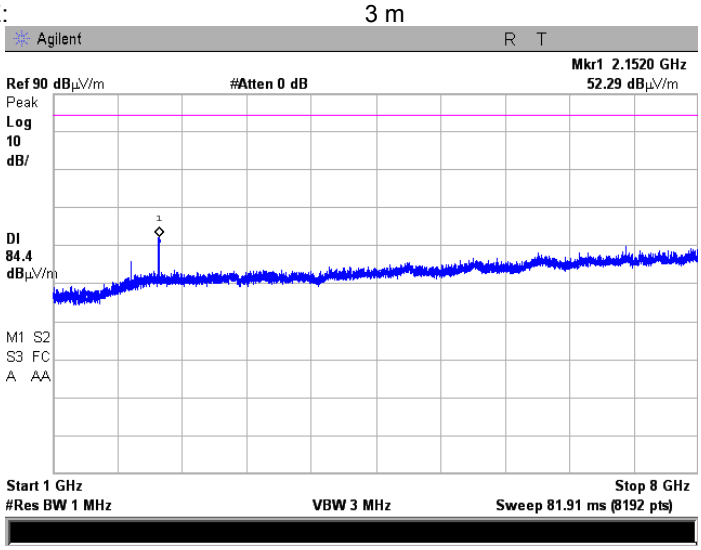
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



NOTE: 2135 MHz - carrier frequency

Plot 7.5.12 Radiated emission measurements in 1000 – 8000 MHz range

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

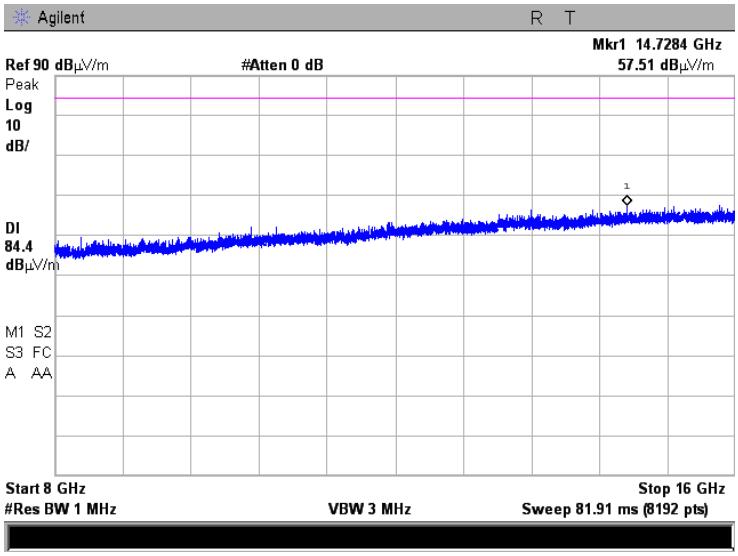


NOTE: 2150 MHz - carrier frequency

Test specification:	Section 27.53(h), Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

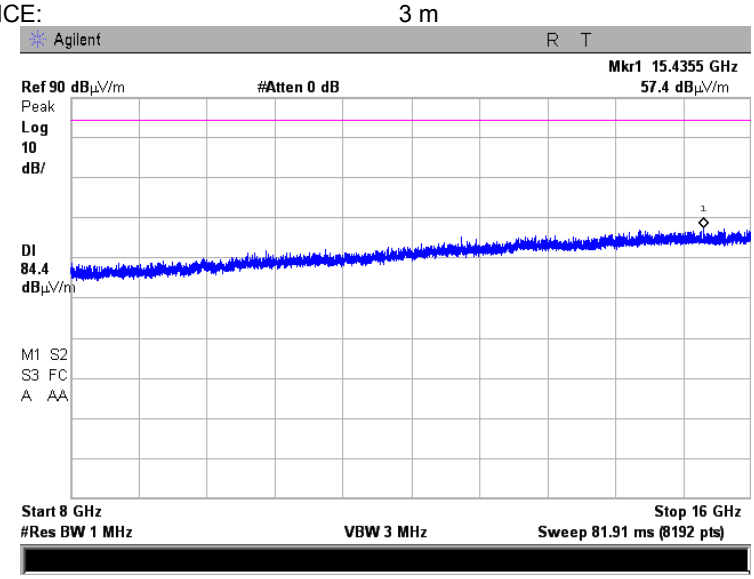
Plot 7.5.13 Radiated emission measurements in 8000 – 16000 MHz range

TEST SITE: Semi 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

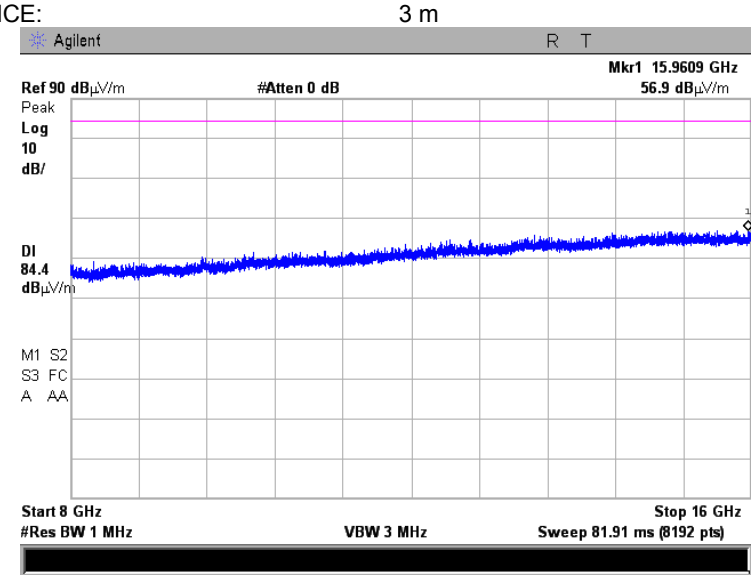
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 27.53(h), Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

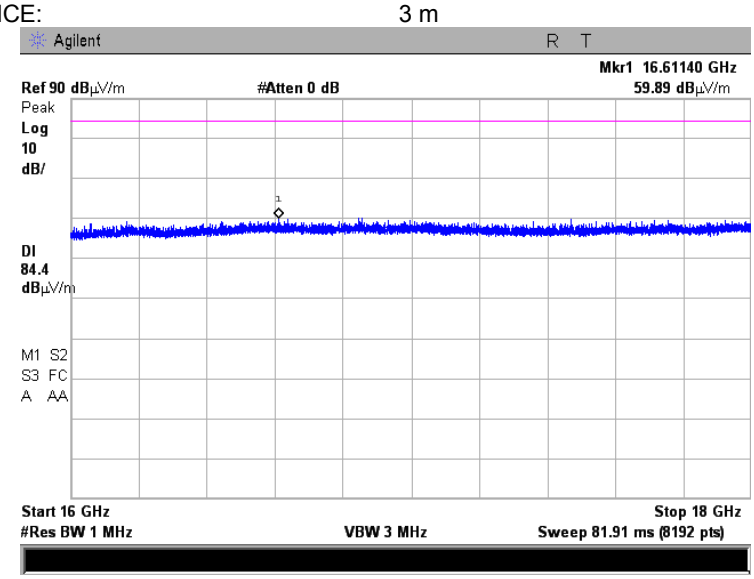
Plot 7.5.15 Radiated emission measurements in 8000 – 16000 MHz range

TEST SITE: Semi 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

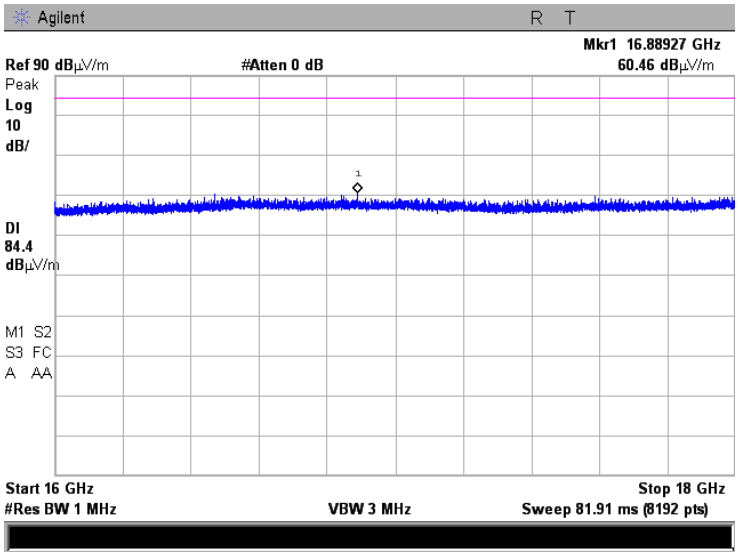
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Low
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 27.53(h), Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

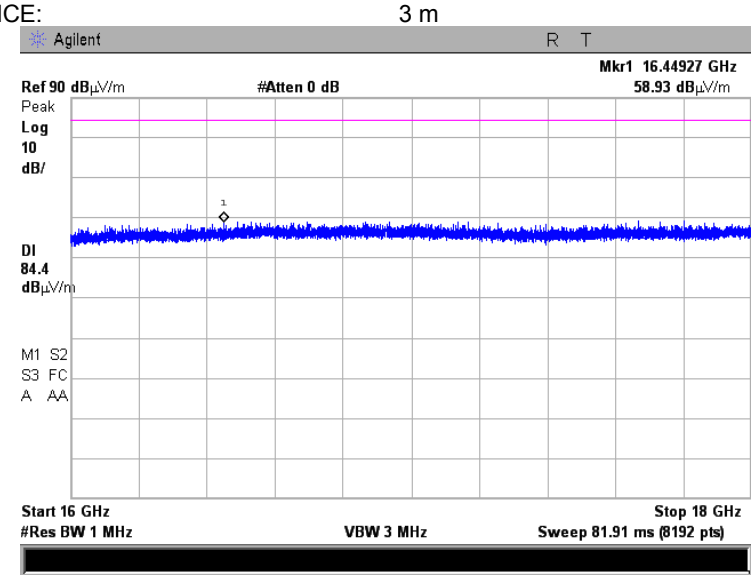
Plot 7.5.17 Radiated emission measurements in 16000 – 18000 MHz range

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



Plot 7.5.18 Radiated emission measurements in 16000 – 18000 MHz range

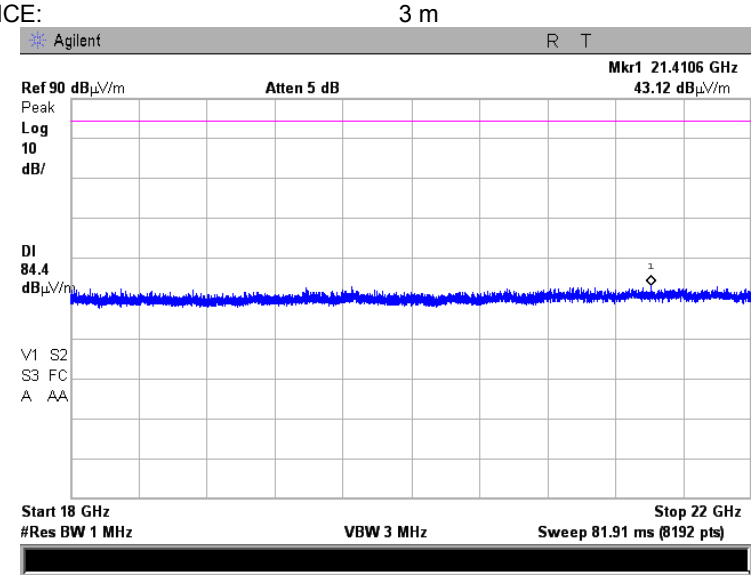
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: High
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 27.53(h), Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

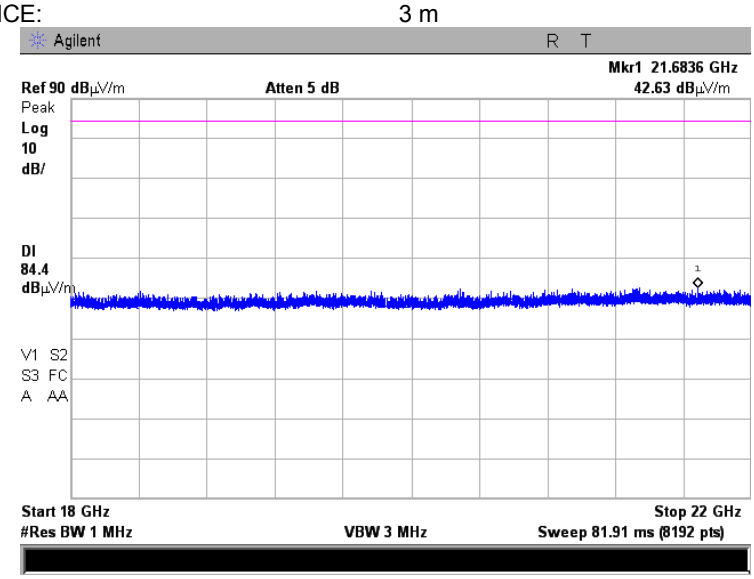
Plot 7.5.19 Radiated emission measurements in 18000 – 22000 MHz range

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



Plot 7.5.20 Radiated emission measurements in 18000 – 22000 MHz range

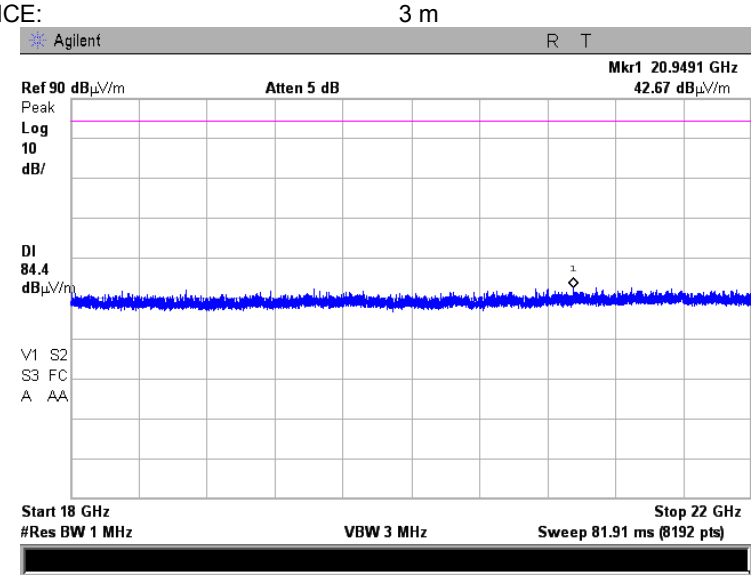
TEST SITE: Semi anechoic chamber
CARRIER FREQUENCY: Mid
ANTENNA POLARIZATION: Vertical and Horizontal
TEST DISTANCE: 3 m



Test specification:	Section 27.53(h), Radiated spurious emissions		
Test procedure:	47 CFR, Sections 2.1053; Section 27.53(h)		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 24.6 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41 %	Power Supply: 48 VDC
Remarks:			

Plot 7.5.21 Radiated emission measurements in 18000 – 22000 MHz range

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



Test specification:	Section 27.54, Frequency stability		
Test procedure:	47 CFR, Section 2.1055		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41%	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	Maximum allowed frequency displacement
2110 - 2155	The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

7.6.2 Test procedure

7.6.2.1 The EUT was set up as shown in Figure 7.6.1, energized and its proper operation was checked.

7.6.2.2 The EUT power was turned off. Temperature within test chamber was set to +30˚C and a period of time sufficient to stabilize all of the oscillator circuit components was allowed.

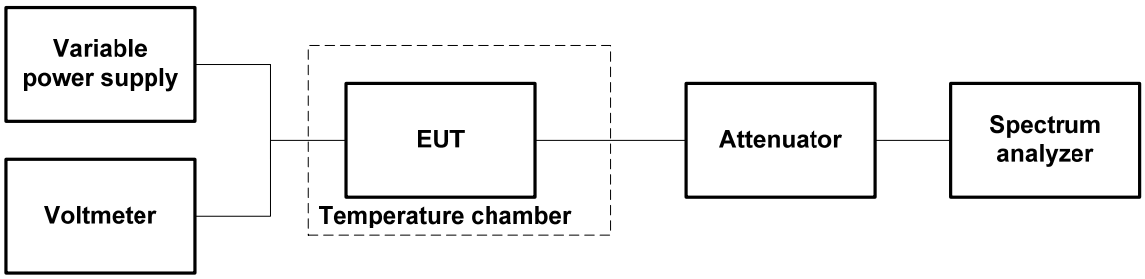
7.6.2.3 The EUT was powered on and carrier frequency was measured at start up moment and then every minute until frequency had been stabilized or 10 minutes elapsed whichever reached the last. The EUT was powered off.

7.6.2.4 The above procedure was repeated at 0˚C and at the lowest test temperature.

7.6.2.5 The EUT was powered on and carrier frequency was measured at start up moment and at the end of stabilization period at the rest of test temperatures and voltages. The EUT was powered off.

7.6.2.6 Frequency displacement was calculated and provided in Table 7.6.2, Table 7.6.3, Table 7.6.4.

Figure 7.6.1 Frequency stability test setup



Test specification:	Section 27.54, Frequency stability		
Test procedure:	47 CFR, Section 2.1055		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41%	Power Supply: 48 VDC
Remarks:			

Table 7.6.2 Frequency stability test results

OPERATING FREQUENCY: 2110-2155 MHz
NOMINAL POWER VOLTAGE: 48 VDC
TEMPERATURE STABILIZATION PERIOD: 20 min
POWER DURING TEMPERATURE TRANSITION: Off
SPECTRUM ANALYZER MODE: Counter
RESOLUTION BANDWIDTH: 3kHz
VIDEO BANDWIDTH: 10kHz
MODULATION: Unmodulated

T, ºC	Voltage, V	Frequency, MHz							Max frequency drift, Hz	
		Start up	1st min	2nd min	3rd min	4th min	5th min	10th min	Positive	Negative
Low carrier frequency 2115										
-30	nominal	2114.99993	2115.00003	2115.00007	2114.99993	2114.99980	2114.99997	2114.99980	140.00	130.00
-20	nominal	2114.99993	NA	NA	NA	NA	NA	2115.00010	170.00	0.00
-10	nominal	2114.99977	NA	NA	NA	NA	NA	2115.00000	230.00	0.00
0	nominal	2115.00017	2114.99980	2114.99987	2114.99987	2114.99997	2115.00007	2114.99993	0.00	370.00
10	nominal	2115.00013	NA	NA	NA	NA	NA	2114.99983	0.00	300.00
20	15%	2115.00025	NA	NA	NA	NA	NA	2114.99992	0.00	330.00
20	nominal	2115.00008	NA	NA	NA	NA	NA	2115.00000*	0.00	80.00
20	-15%	2115.00033	NA	NA	NA	NA	NA	2115.00000	0.00	330.00
30	nominal	2115.00010	2115.00003	2114.99997	2115.00010	2115.00017	2114.99973	2114.99987	70.00	370.00
40	nominal	2115.00008	NA	NA	NA	NA	NA	2115.00025	170.00	0.00
50	nominal	2115.00008	NA	NA	NA	NA	NA	2114.99992	0.00	160.00
Mid carrier frequency 2135										
-30	nominal	2135.00007	2135.00017	2134.99993	2135.000000	2135.00007	2134.99983	2134.99987	100.00	240.00
-20	nominal	2135.00010	NA	NA	NA	NA	NA	2134.99980	0.00	300.00
-10	nominal	2134.99983	NA	NA	NA	NA	NA	2135.00010	270.00	0.00
0	nominal	2134.99980	2134.99957	2134.99980	2134.99993	2134.99983	2134.99993	2134.99990	130.00	230.00
10	nominal	2135.00007	NA	NA	NA	NA	NA	2134.99963	0.00	440.00
20	15%	2135.00000	NA	NA	NA	NA	NA	2135.000000	0.00	0.00
20	nominal	2135.00025	NA	NA	NA	NA	NA	2135.000000*	0.00	250.00
20	-15%	2135.00017	NA	NA	NA	NA	NA	2134.99992	0.00	250.00
30	nominal	2135.00000	2134.99997	2135.00010	2134.99987	2135.00017	2134.99997	2134.99977	170.00	230.00
40	nominal	2135.00008	NA	NA	NA	NA	NA	2134.99992	0.00	160.00
50	nominal	2135.00008	NA	NA	NA	NA	NA	2135.00000	0.00	80.00
High carrier frequency 2150										
-30	nominal	2150.00013	2150.00013	2150.00002	2150.00010	2149.99990	2149.99990	2149.99993	0.00	230.00
-20	nominal	2149.99987	NA	NA	NA	NA	NA	2149.99990	30.00	0.00
-10	nominal	2150.00003	NA	NA	NA	NA	NA	2150.00000	0.00	30.00
0	nominal	2149.99973	2149.99997	2149.99997	2150.00013	2149.99990	2149.99977	2149.99987	400.00	0.00
10	nominal	2149.99993	NA	NA	NA	NA	NA	2150.00023	300.00	0.00
20	15%	2150.00017	NA	NA	NA	NA	NA	2150.00008	0.00	90.00
20	nominal	2149.99992	NA	NA	NA	NA	NA	2150.00000*	80.00	0.00
20	-15%	2150.00008	NA	NA	NA	NA	NA	2150.00000	0.00	80.00
30	nominal	2150.000000	2149.99950	2149.99990	2149.99977	2150.00007	2150.00033	2150.00003	330.00	500.00
40	nominal	2150.000000	NA	NA	NA	NA	NA	2149.99992	0.00	80.00
50	nominal	2149.999992	NA	NA	NA	NA	NA	2150.00000	8.00	0.00

* - Reference frequency

Test specification:	Section 27.54, Frequency stability		
Test procedure:	47 CFR, Section 2.1055		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41%	Power Supply: 48 VDC
Remarks:			

Table 7.6.3 Maximum frequency displacement

Channel	Maximum frequency displacement			
	ppm		Hz	
	Positive	Negative	Positive	Negative
Low	0.49	0.78	230.00	370.00
Mid	0.58	0.94	270.00	440.00
High	0.86	1.08	400.00	500.00

Table 7.6.4 Transmission occupied bandwidth with frequency drift test results

Lower measured* band edge, MHz	Upper measured* band edge, MHz	Lower calculated** band edge, MHz	Upper calculated** band edge, MHz	Lower specified band edge, MHz	Upper specified band edge, MHz	Lower margin***, MHz	Upper margin***, MHz	Verdict
10 MHz BW								
QPSK								
2110.05	2119.94	2110.04963	2119.94023	2110	2120	-0.05	-0.06	Pass
2130.07	2139.94	2130.06956	2139.94027	2130	2140	-0.07	-0.06	Pass
2145.09	2154.94	2145.0895	2154.9404	2145	2155	-0.09	-0.06	Pass
64QAM								
2110.09	2119.88	2110.08963	2119.88023	2110	2120	-0.09	-0.12	Pass
2130.09	2139.84	2130.08956	2139.84027	2130	2140	-0.09	-0.16	Pass
2145.05	2154.90	2145.0495	2154.9004	2145	2155	-0.05	-0.10	Pass
20 MHz BW								
QPSK								
2110.47	2129.48	2110.46963	2129.48023	2110	2130	-0.47	-0.52	Pass
2120.47	2139.56	2120.46956	2139.56027	2120	2140	-0.47	-0.44	Pass
2135.47	2154.56	2135.4695	2154.5604	2135	2155	-0.47	-0.44	Pass
64QAM								
2110.28	2129.52	2110.27963	2129.52023	2110	2130	-0.28	-0.48	Pass
2120.24	2139.52	2120.23956	2139.52027	2120	2140	-0.24	-0.48	Pass
2135.48	2154.40	2135.4795	2154.4004	2135	2155	-0.48	-0.60	Pass

* - Measured under normal test conditions at 26 dBc points
** - Measured band edge with proper drift addition
*** - Margin = Calculated band edge – specified band edge

Reference numbers of test equipment used

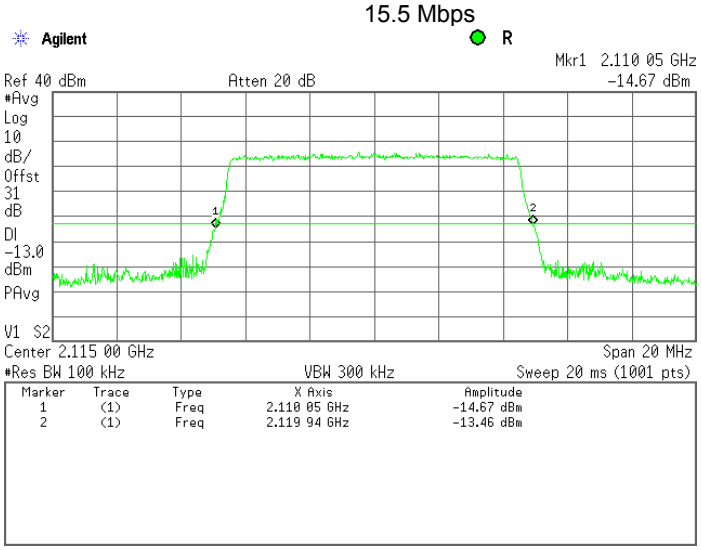
HL 1424	HL 3286	HL 3310	HL 3818	HL 3903	HL 4164		

Full description is given in Appendix A.

Test specification:	Section 27.54, Frequency stability		
Test procedure:	47 CFR, Section 2.1055		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41%	Power Supply: 48 VDC
Remarks:			

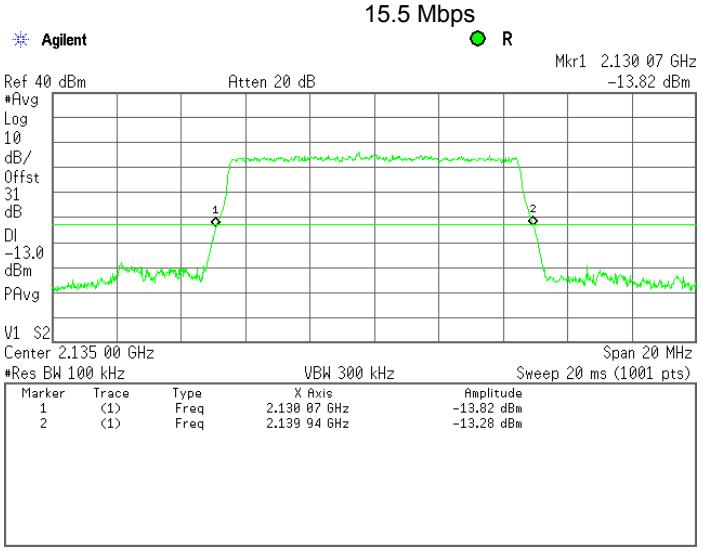
Plot 7.6.1 Spurious emission at band edges test results at low carrier frequency, 10 MHz EBW

OPERATING FREQUENCY RANGE:	2110-2155 MHz
DETECTOR USED:	Average
MODULATION:	QPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	15.5 Mbps



Plot 7.6.2 Spurious emission at band edges test results at mid carrier frequency, 10 MHz EBW

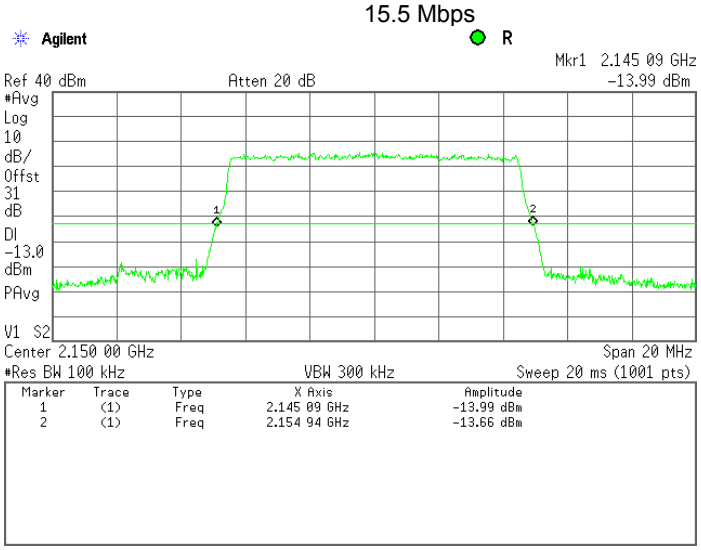
OPERATING FREQUENCY RANGE:	2110-2155 MHz
DETECTOR USED:	Average
MODULATION:	QPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	15.5 Mbps



Test specification:	Section 27.54, Frequency stability		
Test procedure:	47 CFR, Section 2.1055		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41%	Power Supply: 48 VDC
Remarks:			

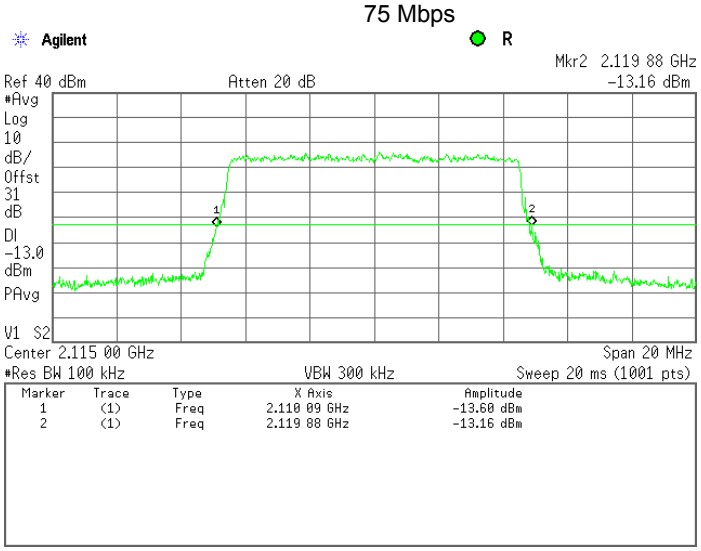
Plot 7.6.3 Spurious emission at band edges test results at high carrier frequency, 10 MHz EBW

OPERATING FREQUENCY RANGE:	2110-2155 MHz
DETECTOR USED:	Average
MODULATION:	QPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	15.5 Mbps



Plot 7.6.4 Spurious emission at band edges test results at low carrier frequency, 10 MHz EBW

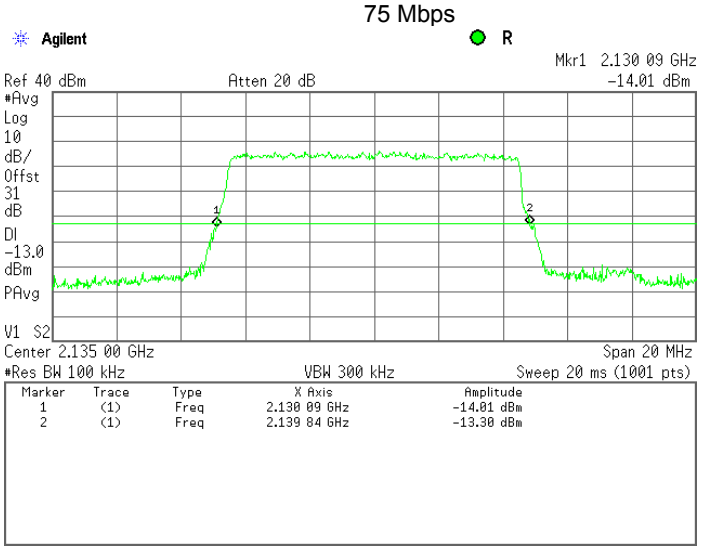
OPERATING FREQUENCY RANGE:	2110-2155 MHz
DETECTOR USED:	Average
MODULATION:	64QAM
MODULATING SIGNAL:	PRBS
BIT RATE:	75 Mbps



Test specification:	Section 27.54, Frequency stability		
Test procedure:	47 CFR, Section 2.1055		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41%	Power Supply: 48 VDC
Remarks:			

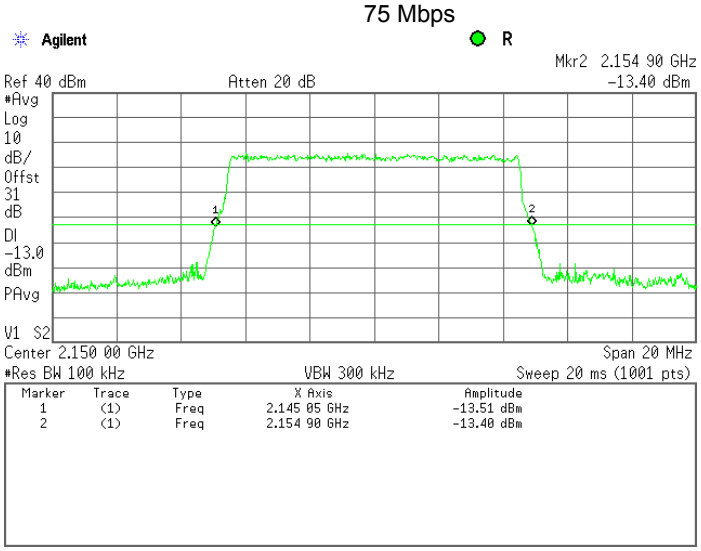
Plot 7.6.5 Spurious emission at band edges test results at mid carrier frequency, 10 MHz EBW

OPERATING FREQUENCY RANGE:	2110-2155 MHz
DETECTOR USED:	Average
MODULATION:	64QAM
MODULATING SIGNAL:	PRBS
BIT RATE:	75 Mbps



Plot 7.6.6 Spurious emission at band edges test results at high carrier frequency, 10 MHz EBW

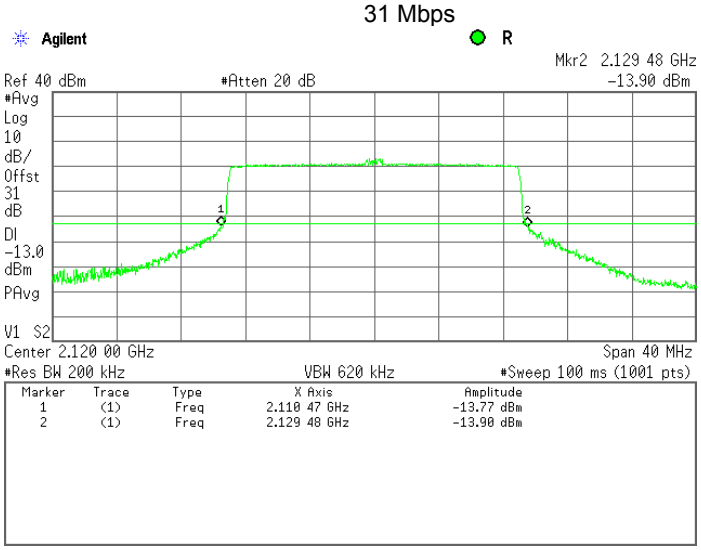
OPERATING FREQUENCY RANGE:	2110-2155 MHz
DETECTOR USED:	Average
MODULATION:	64QAM
MODULATING SIGNAL:	PRBS
BIT RATE:	75 Mbps



Test specification:	Section 27.54, Frequency stability		
Test procedure:	47 CFR, Section 2.1055		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41%	Power Supply: 48 VDC
Remarks:			

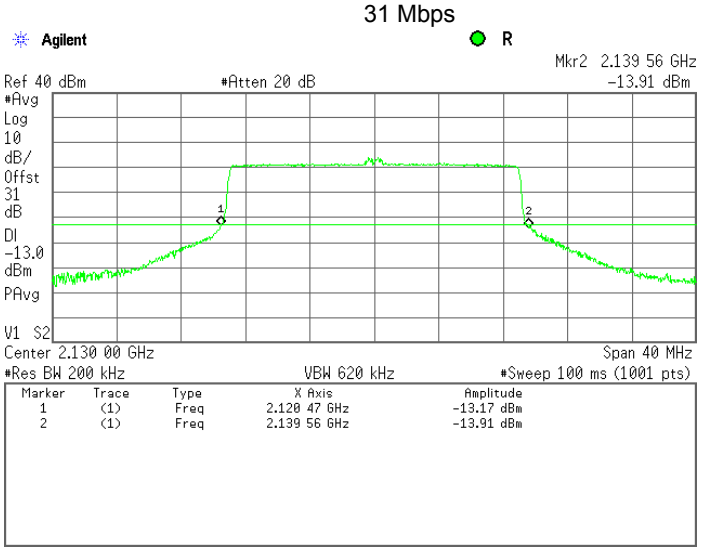
Plot 7.6.7 Spurious emission at band edges test results at low carrier frequency, 20 MHz EBW

OPERATING FREQUENCY RANGE:	2110-2155 MHz
DETECTOR USED:	Average
MODULATION:	QPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	31 Mbps



Plot 7.6.8 Spurious emission at band edges test results at mid carrier frequency, 20 MHz EBW

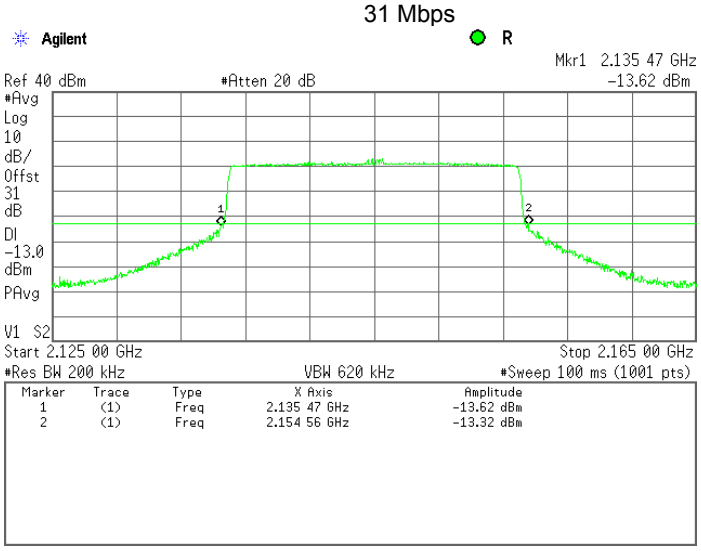
OPERATING FREQUENCY RANGE:	2110-2155 MHz
DETECTOR USED:	Average
MODULATION:	QPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	31 Mbps



Test specification:	Section 27.54, Frequency stability		
Test procedure:	47 CFR, Section 2.1055		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41%	Power Supply: 48 VDC
Remarks:			

Plot 7.6.9 Spurious emission at band edges test results at high carrier frequency, 20 MHz EBW

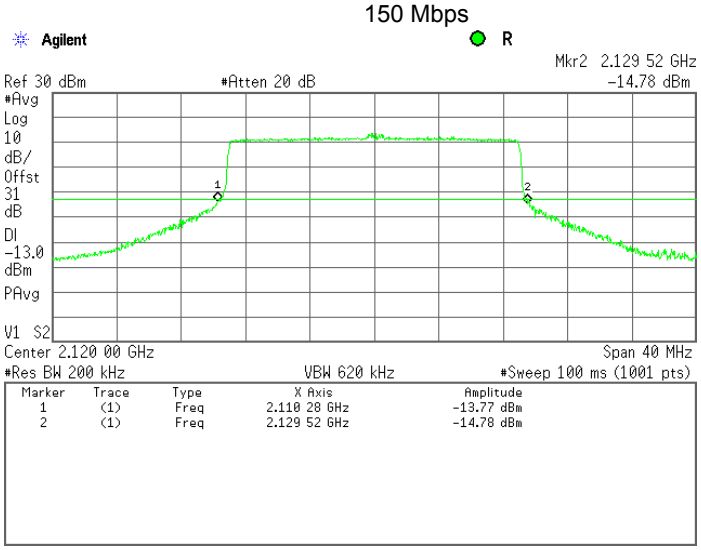
OPERATING FREQUENCY RANGE:	2110-2155 MHz
DETECTOR USED:	Average
MODULATION:	QPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	31 Mbps



Test specification:	Section 27.54, Frequency stability		
Test procedure:	47 CFR, Section 2.1055		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41%	Power Supply: 48 VDC
Remarks:			

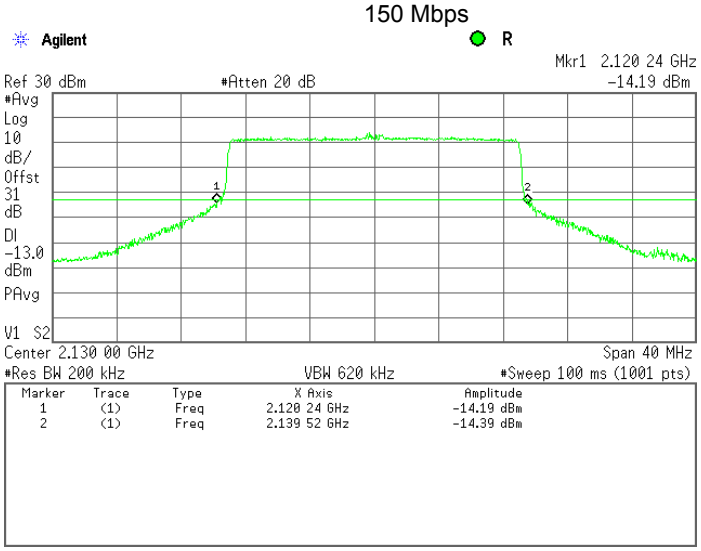
Plot 7.6.10 Spurious emission at band edges test results at low carrier frequency, 20 MHz EBW

OPERATING FREQUENCY RANGE: 2110-2155 MHz
DETECTOR USED: Average
MODULATION: 64QAM
MODULATING SIGNAL: PRBS
BIT RATE: 150 Mbps



Plot 7.6.11 Spurious emission at band edges test results at mid carrier frequency, 20 MHz EBW

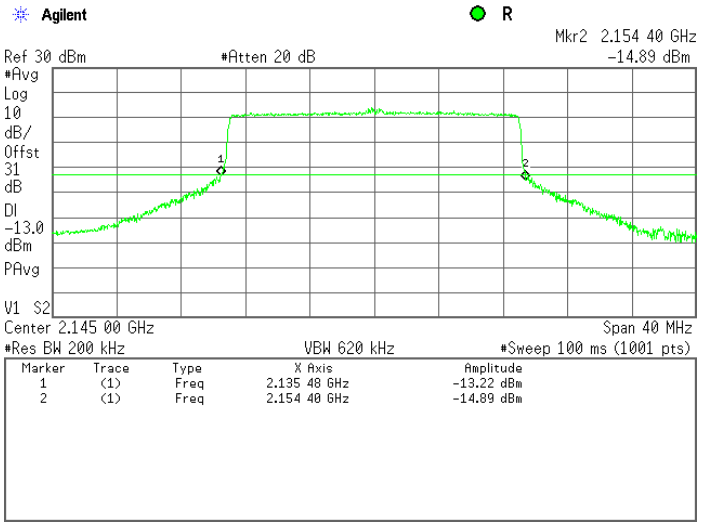
OPERATING FREQUENCY RANGE: 2110-2155 MHz
DETECTOR USED: Average
MODULATION: 64QAM
MODULATING SIGNAL: PRBS
BIT RATE: 150 Mbps



Test specification:	Section 27.54, Frequency stability		
Test procedure:	47 CFR, Section 2.1055		
Test mode:	Compliance	Verdict:	PASS
Date(s):	9/25/2013		
Temperature: 25 ºC	Air Pressure: 1009 hPa	Relative Humidity: 41%	Power Supply: 48 VDC
Remarks:			

Plot 7.6.12 Spurious emission at band edges test results at high carrier frequency, 20 MHz EBW

OPERATING FREQUENCY RANGE:	2110-2155 MHz
DETECTOR USED:	Peak
MODULATION:	64QAM
MODULATING SIGNAL:	PRBS
BIT RATE:	150 Mbps



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	03-Jul-12	03-Jul-14
0604	Antenna BiconiLog Log-Periodic/T Bow-TIE, 26 - 2000 MHz	EMCO	3141	9611-1011	04-Jun-13	04-Jun-14
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
1293	Adapter 35WR42Kf, 18 - 26.5 GHz	Getronics	35WR42KF	1293	03-Sep-13	03-Sep-15
1424	Spectrum Analyzer, 30 Hz- 40 GHz	Agilent Technologies	8564EC	3946A00219	04-Oct-12	04-Oct-13
1809	HygroThermometer, Min/Max Memory	Delta TRAK	13301	NA	13-May-13	13-May-14
2214	Directional Coupler 1.7-26.5 GHz	Krytar	2616	31354	03-Sep-13	03-Sep-15
2780	EMC analyzer, 100 Hz to 26.5 GHz	Agilent Technologies	E7405A	MY45102462	10-Jul-13	10-Jul-14
2871	Microwave Cable Assembly, 18 GHz, 6.4 m, SMA - SMA	Huber-Suhner	198-8155-00	2871	04-Dec-12	04-Dec-13
3286	Temperature Chamber, (-50 to +170) °C	Thermotron	EL-8-CH-1-1-CO2	21-9048	30-Sep-13	30-Sep-14
3301	Power Meter, P-series, 50 MHz to 40 GHz	Agilent Technologies	N1911A	MY45101057	19-Dec-12	19-Dec-13
3302	Power sensor, P-Series, 50 MHz to 40 GHz, -35/30 to 20 dBm	Agilent Technologies	N1922A	MY45240586	19-Dec-12	19-Dec-13
3310	Multimeter	Fluke	115C	94321810	14-Jul-13	14-Jul-14
3433	Test Cable , DC-18 GHz, 1.5 m, SMA - SMA	Mini-Circuits	CBL-5FT-SMSM+	25679	07-Mar-13	07-Mar-14
3455	Medium Power Fixed Coaxial Attenuator DC to 40 GHz, 20 dB, 5 W	Aeroflex / Weinschel	75A-20-12	1182	18-Mar-13	18-Mar-14
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY48250288	24-Apr-13	24-Apr-14
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFLEX 102A	1226/2A	06-Feb-13	06-Feb-14
4114	Antenna, Double-Ridged Waveguide Horn, 1-18 GHz	ETS Lindgren	3117	00123515	07-Dec-12	07-Dec-13
4160	Preamplifier, 0.1 to 18 GHz, Gain 25 dB, N-type(f) in, N-type(m) out.	Agilent Technologies	87405C	MY47010594	11-Aug-13	11-Aug-14
4164	DC Power Supply, 60V, 5A	Standig	605D	NA	17-Jan-13	17-Jan-14
4353	Low Loss Armored Test Cable, DC - 18 GHz, 6.2 m, N type-M/N type-M	MegaPhase	NC29-N1N1-244	12025101003	06-Mar-13	06-Mar-14
4367	Directional coupler, 1 GHz to 18 GHz, 10 dB, SMA Female	Tiger Micro-Electronics Institute	TGD-A1101-10	01e-JSDE805-006	17-Apr-12	17-Apr-14

9 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Transmitter tests	
Carrier power conducted at antenna connector	± 1.7 dB
Carrier power radiated (substitution method)	± 4.5 dB
Occupied bandwidth	±8%
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Spurious emissions radiated 30 MHz – 40 GHz (substitution method)	± 4.5 dB
Frequency error	30 – 300 MHz: ± 50.5 Hz (1.68 ppm) 300 – 1000 MHz: ± 168 Hz (0.56 ppm)

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 27: 2012	Private land mobile radio services
47CFR part 1: 2012	Practice and procedure
47CFR part 2: 2012	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(μV) to convert it into field strength in dB(μV/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(μV) to convert it into field strength in dB(μV/m).

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

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

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

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(μV) to convert to field strength in dB(μV/meter)

Cable loss
Cable coaxial, Huber-Suhner, 18 GHz, 6.4 m, SMA - SMA, model 198-8155-00, HL 2871

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.12	5750	2.34	12000	3.55
30	0.14	6000	2.39	12250	3.61
100	0.27	6250	2.46	12500	3.67
250	0.45	6500	2.52	12750	3.74
500	0.63	6750	2.58	13000	3.79
750	0.76	7000	2.64	13250	3.82
1000	0.89	7250	2.68	13500	3.83
1250	1.01	7500	2.73	13750	3.83
1500	1.12	7750	2.78	14000	3.88
1750	1.23	8000	2.83	14250	3.93
2000	1.32	8250	2.88	14500	3.96
2250	1.41	8500	2.94	14750	4.01
2500	1.49	8750	2.97	15000	4.00
2750	1.58	9000	3.02	15250	4.01
3000	1.66	9250	3.07	15500	4.00
3250	1.73	9500	3.13	15750	4.13
3500	1.80	9750	3.18	16000	4.22
3750	1.87	10000	3.21	16250	4.29
4000	1.93	10250	3.26	16500	4.29
4250	2.01	10500	3.30	16750	4.32
4500	2.06	10750	3.36	17000	4.37
4750	2.12	11000	3.39	17250	4.45
5000	2.17	11250	3.44	17500	4.49
5250	2.24	11500	3.48	17750	4.53
5500	2.29	11750	3.52	18000	4.55

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

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

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

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

13 APPENDIX F Abbreviations and acronyms

A	ampere
AC	alternating current
A/m	ampere per meter
AM	amplitude modulation
AVRG	average (detector)
BB	broad band
cm	centimeter
dB	decibel
dBm	decibel referred to one milliwatt
dB(μV)	decibel referred to one microvolt
dB(μV/m)	decibel referred to one microvolt per meter
dB(μA)	decibel referred to one microampere
dBΩ	decibel referred to one Ohm
DC	direct current
EIRP	equivalent isotropically radiated power
ERP	effective radiated power
EUT	equipment under test
F	frequency
GHz	gigahertz
GND	ground
H	height
HL	Hermon laboratories
Hz	hertz
ITE	information technology equipment
k	kilo
kHz	kilohertz
LISN	line impedance stabilization network
LO	local oscillator
m	meter
MHz	megahertz
min	minute
mm	millimeter
ms	millisecond
μs	microsecond
NA	not applicable
NB	narrow band
NT	not tested
OATS	open area test site
Ω	Ohm
QP	quasi-peak
PCB	printed circuit board
PM	pulse modulation
PS	power supply
RE	radiated emission
RF	radio frequency
rms	root mean square
Rx	receive
s	second
T	temperature
Tx	transmit
V	volt
VA	volt-ampere

END OF DOCUMENT