

TEST REPORT

ACCORDING TO: FCC 47CFR part 27

FOR:

Airspan Networks Inc.

LTE Base Station

Model: AirHarmony 4000, 2.5 GHz (B41)

FCC ID:PIDH4K25

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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 in 2516 – 2670 MHz band	8
7.2	Occupied bandwidth test in 2538 – 2670 MHz band	13
7.3	Occupied bandwidth test in 2516 – 2548 MHz band	18
7.4	Peak output power test in 2516 – 2670 MHz band	23
7.5	Peak output power test in 2538 – 2670 MHz band	35
7.6	Peak output power test in 2516 – 2548 MHz band	47
7.7	Band edge emissions at RF connector test in 2516 – 2670 MHz band	59
7.8	Band edge emissions at RF connector test in 2538 – 2670 MHz band	65
7.9	Band edge emissions at RF connector test in 2516 – 2548 MHz band	71
7.10	Frequency stability test	77
8	APPENDIX A Test equipment and ancillaries used for tests	83
9	APPENDIX B Measurement uncertainties	84
10	APPENDIX C Test facility description	85
11	APPENDIX D Specification references	85
13	APPENDIX E Test equipment correction factors	86
14	APPENDIX F Abbreviations and acronyms	88

1 Applicant information

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

2 Equipment under test attributes

Product name: LTE Base Station
Product type: Transceiver
Model(s): AirHarmony 4000, 2.5 GHz (B41)
Serial number: D05F01CCE074
Hardware version: B0
Software release: 14-14-51-002
Receipt date 27-Mar-16

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: 28223
Location: Hermon Laboratories Ltd. Hefetz-Haim 10, Tel Aviv 6744124, Israel
Test started: 27-Mar-16
Test completed: 30-Mar-16
Test specification(s): FCC 47CFR part 27

5 Tests summary

Test	Status
Transmitter characteristics	
Section 27.50(h), Peak output power at RF antenna connector	Pass
Section 27.50(h)(4), Spectral power density	Pass
Section 27.53(m)(2), Band edge emissions at RF antenna connector	Pass
Section 27.54, Frequency stability	Pass
Section 2.1049, Occupied bandwidth	Pass

The product was approved under FCC ID: PIDH4K25 for operation in 2496.0 – 2690.0 MHz band with 5 MHz, 10 MHz and 20 MHz channel bandwidth. The relevant tests to support 40 MHz channel bandwidth and submit Application for Class II permissive changes certification were done.
The bandwidth change is software controlled, no hardware change was made.

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

	Name and Title	Date	Signature
Tested by:	Mr. S. Shkolnik, test engineer	March 30, 2016	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	April 5, 2016	
Approved by:	Mr. M. Nikishin, EMC and Radio group manager	April 12, 2016	

6 EUT description

6.1 General information

The EUT, Base station radio, AirHarmony 4000, 2.5 GHz (B41), is part of a LTE broadband fixed cellular wireless access system. The system provides a radio link between an end-user (a subscriber) and a network to give high-speed data access. The AirHarmony's transceiver/receiver (Up to 64 QAM modulation, data rate up to 95 Mbps) uses OFDM and operating in TDD mode, equipped with a 18 dBi external antenna. Advanced Antenna Techniques 2x2 MIMO are supported (the detailed description provided in the Operational description exhibit in Application for certification). The maximum total RF output power (not including antenna gain) is 46.19 dBm for 18 dBi antenna and it can be reduced by software.

The AirHarmony 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.

The EUT, AirHarmony 4000 2.5GHz (B41), comes in range of three frequency band variants that can be installed with different external Cavity filters. Frequency bands are 2496 – 2690 MHz, 2618 – 2690 MHz and 2496 – 2568 MHz. The external Cavity filters are designed specifically for AirHarmony 4000 deployments. The installation and replacement of the external filters can be performed by licensed installer only according installation procedure.

6.2 Ports and lines

Port Type	Port description	Connected from	Connected to	Qty.	Cable type	Cable length, m
Power	AC power	EUT	AC mains	1	Unshielded	3
Signal	GPS	EUT	GPS external antenna	1	Coax	3
Signal	Eth. POE	EUT	Laptop	1	FTP	3
Signal	Eth. POE	EUT	Open circuit	1	FTP	3
Signal	Eth.	EUT	Open circuit	2	FTP	3
RF	RF Link (Tx/Rx)	EUT	Antenna (via filter)	2	Coax	0.5
Signal*	Serial*	Not connected	Not connected	1	NA	NA

*for maintenance only

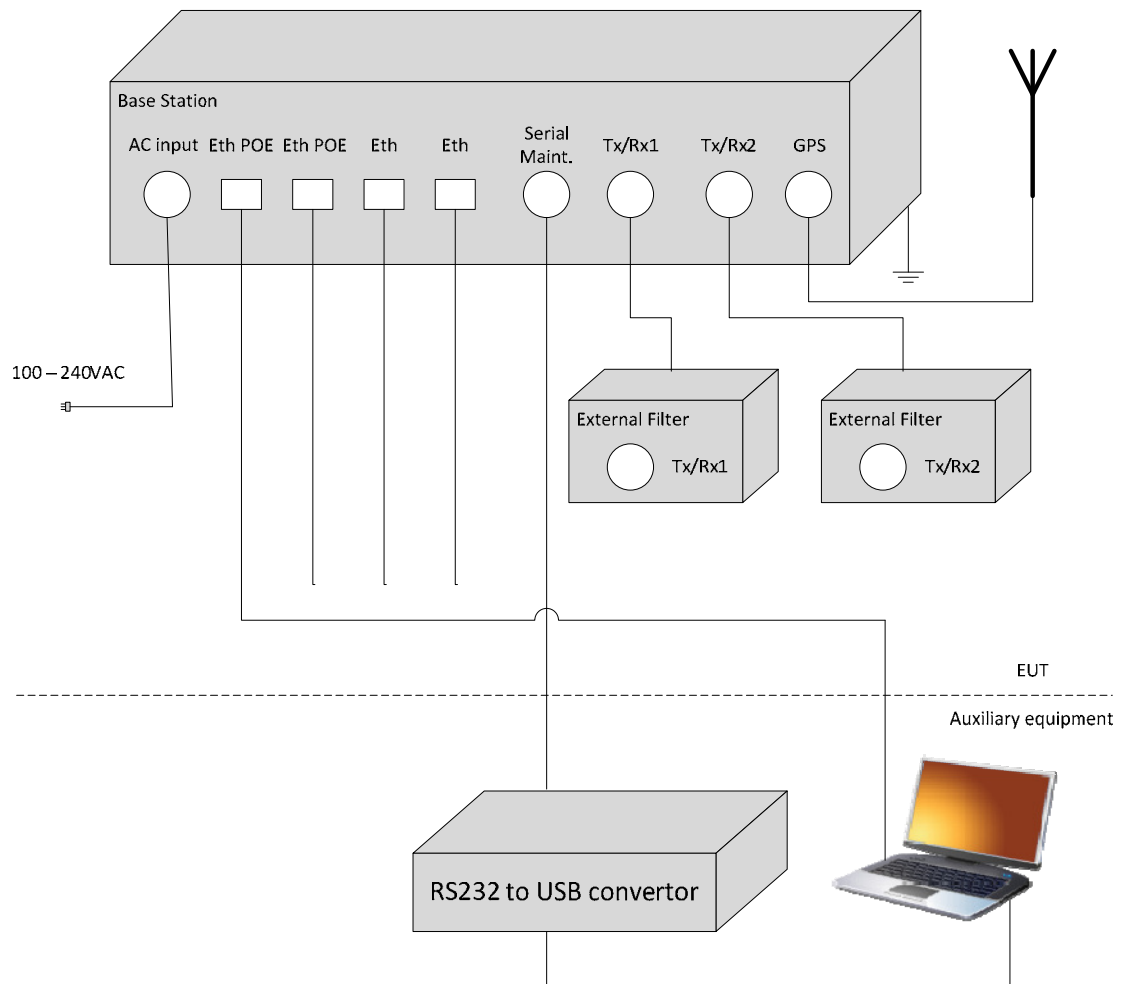
6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
Laptop	Dell	E7450	8TYRP32

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			
☒	Stand-alone (Equipment with or without its own control provisions)		
☐	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)		
☐	Plug-in card (Equipment intended for a variety of host systems)		
Intended use		Condition of use	
☒	fixed	Always at a distance more than 2 m from all people	
☐	mobile	Always at a distance more than 20 cm from all people	
☐	portable	May operate at a distance closer than 20 cm to human body	
Assigned frequency range		2496.0 – 2690.0 MHz	
Operating frequency (full bands)		2516.0 – 2670.0 MHz for 40 MHz OBW	
RF channel spacing		40 MHz	
Maximum rated output power		At transmitter 50 Ω RF output connector (aggregate power of both RF chains)	
		46.17 dBm	
Is transmitter output power variable?		☐ No	
		☒ Yes	☐ continuous variable
			☒ stepped variable with step size
			0.25 dB
		minimum RF power	
		-30 dBm	
		maximum RF power at antenna connector	
		43.00 dBm	
Antenna connection			
☒	unique coupling, DIN 4.1/9.5 Female Connector	standard connector	Integral
☒	with temporary RF connector		without temporary RF connector
Antenna/s technical characteristics			
Type	Manufacturer	Model number	Gain
External	ALPHA Wireless Ltd	AW3007	18 dBi
External	ALPHA Wireless Ltd	AW3008	17 dBi
External sector	Cobham Antenna Systems	SA12-2.5-DS/1915	11 dBi
Transmitter aggregate data rate/s			
Transmitter 26dBc power bandwidth 40 MHz		Type of modulation	
		QPSK	16QAM
		46.8 MBps	90.8 MBps
		64QAM	190 MBps
Type of multiplexing		TDD	
Modulating test signal (baseband)		PRBS	
Maximum transmitter duty cycle in normal use		75%	
Transmitter power source			
	Nominal rated voltage	Battery type	
DC	Nominal rated voltage		
☒	AC mains	120VAC	Frequency
Common power source for transmitter and receiver		☒ yes	☐ no

Test specification:		Section 2.1049, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

7 Transmitter tests according to 47CFR part 27

7.1 Occupied bandwidth test in 2498.5 – 2687.5 MHz band

7.1.1 General

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

Table 7.1.1 Occupied bandwidth limits

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

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

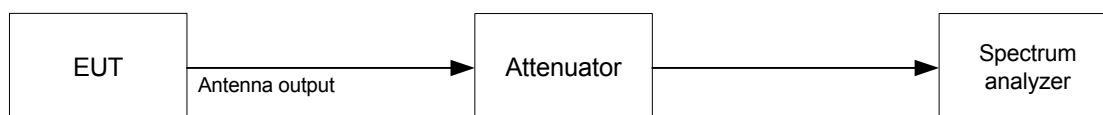
7.1.2 Test procedure

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

7.1.2.2 The EUT was set to transmit the 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):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Table 7.1.2 Occupied bandwidth test results

DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 430 kHz
MODULATION ENVELOPE REFERENCE POINTS: 26 dBc
EBW: 40 MHz

Carrier frequency, MHz	OBW 26 dBc, MHz	OBW 99%, MHz	Limit, kHz	Verdict
QPSK				
2516	38.760	37.240	NA	Pass
2594	38.750	37.278	NA	Pass
2670	38.720	37.235	NA	Pass
64QAM				
2516	38.660	37.137	NA	Pass
2594	38.720	37.173	NA	Pass
2670	38.770	37.135	NA	Pass

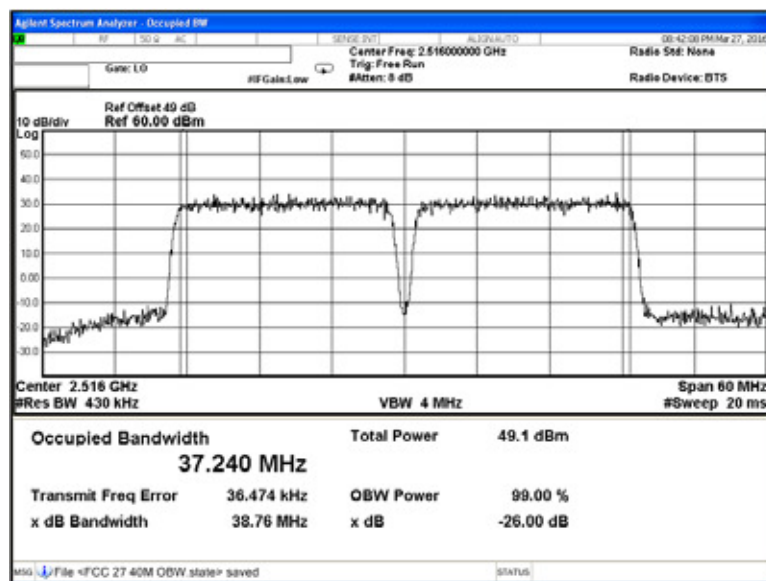
Reference numbers of test equipment used

HL 2214	HL 3301	HL 3302	HL 4274	HL 4575			
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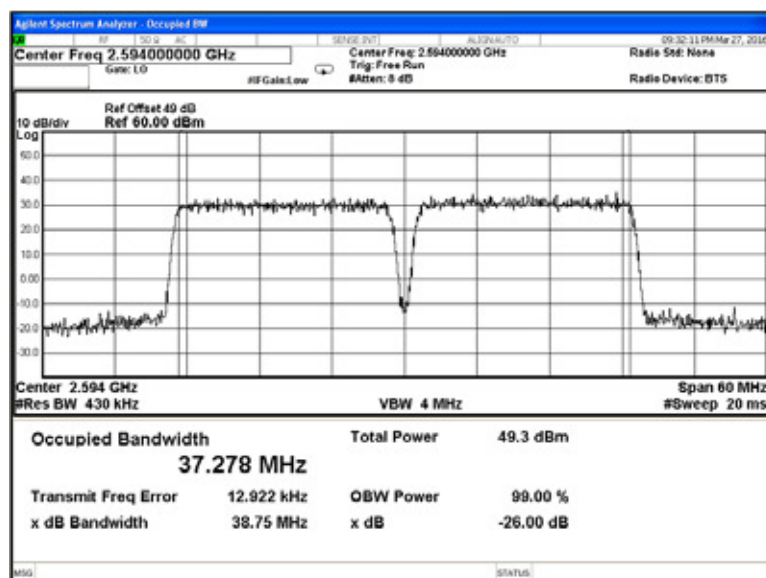
Full description is given in Appendix A.

Test specification:		Section 2.1049, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.1.1 Occupied bandwidth test results at low frequency, 40 MHz EBW, QPSK

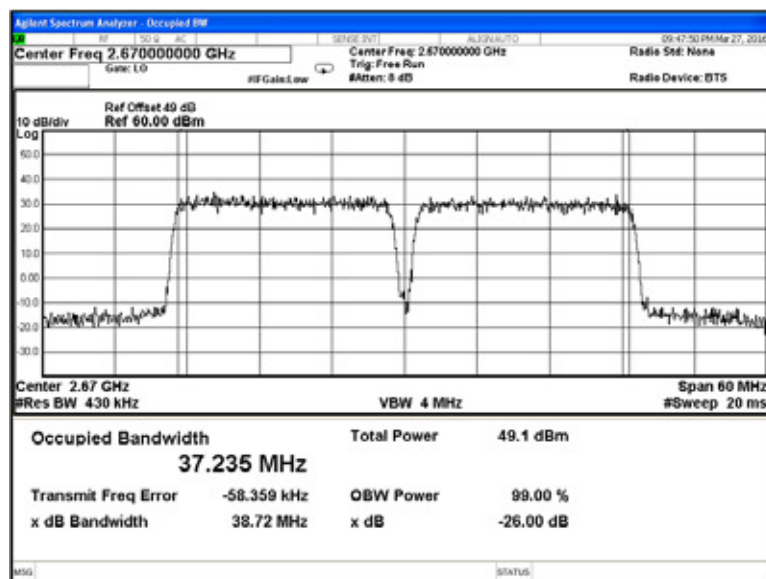


Plot 7.1.2 Occupied bandwidth test results at mid frequency, 40 MHz EBW, QPSK

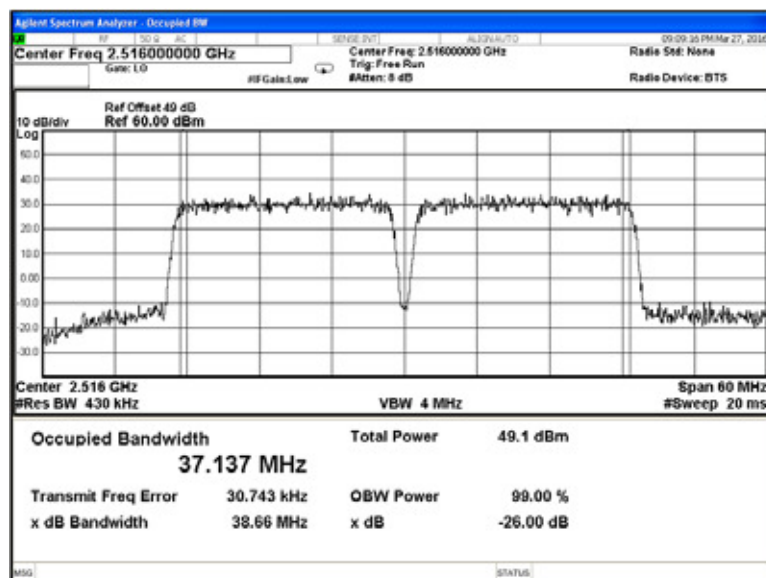


Test specification:		Section 2.1049, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.1.3 Occupied bandwidth test results at high frequency, 40 MHz EBW, QPSK

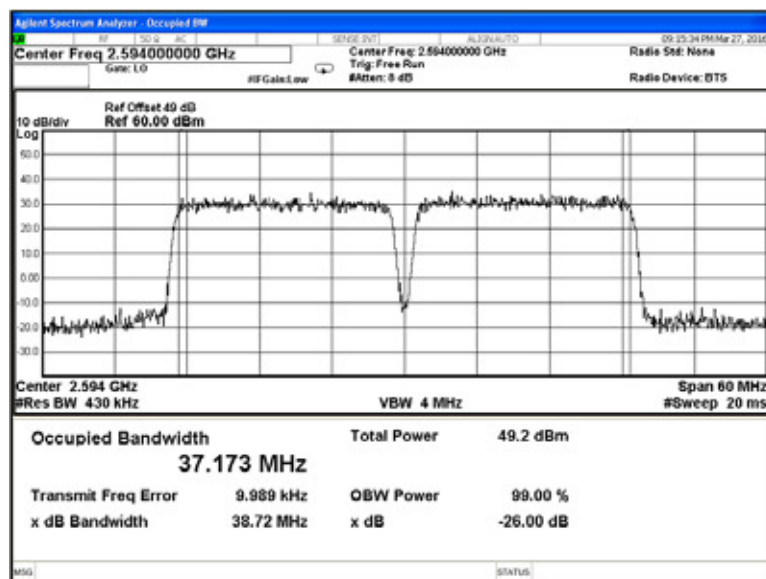


Plot 7.1.4 Occupied bandwidth test results at low frequency, 40 MHz EBW, 64QAM

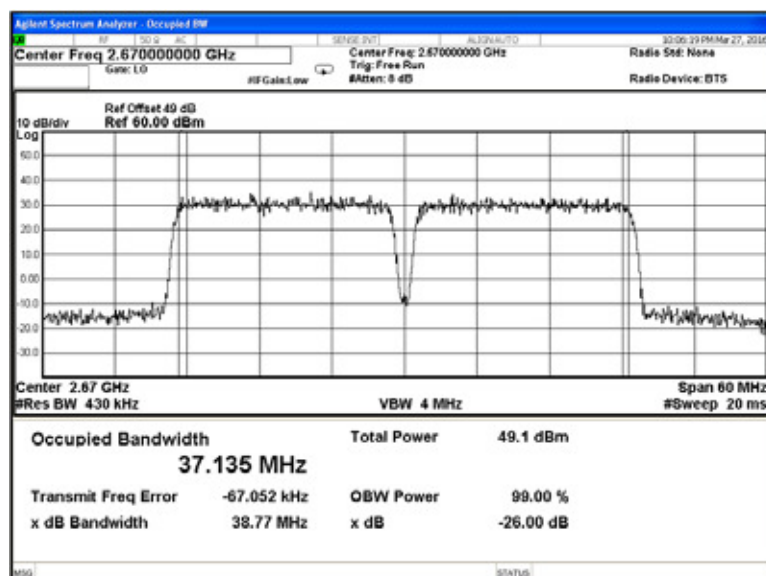


Test specification:		Section 2.1049, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.1.5 Occupied bandwidth test results at mid frequency, 40 MHz EBW, 64QAM



Plot 7.1.6 Occupied bandwidth test results at high frequency, 40 MHz EBW, 64QAM



Test specification:		Section 2.1049, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

7.2 Occupied bandwidth test in 2618 – 2690 MHz band

7.2.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.2.1.

Table 7.2.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
2618.0 – 2690.0 MHz	26	NA

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

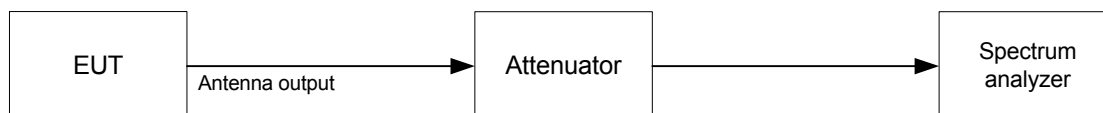
7.2.2 Test procedure

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

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

7.2.2.3 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.2.2 and the associated plots.

Figure 7.2.1 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):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Table 7.2.2 Occupied bandwidth test results

DETECTOR USED: Peak
RESOLUTION BANDWIDTH: 430 kHz
MODULATION ENVELOPE REFERENCE POINTS: 26 dBc
EBW: 40 MHz

Carrier frequency, MHz	OBW 26 dBc, MHz	OBW 99%, MHz	Limit, kHz	Verdict
QPSK				
2638.0	38.670	37.249	NA	Pass
2653.5	38.710	37.252	NA	Pass
2670.0	38.780	37.242	NA	Pass
64QAM				
2638.0	38.740	37.216	NA	Pass
2653.5	38.790	37.254	NA	Pass
2670.0	38.740	37.277	NA	Pass

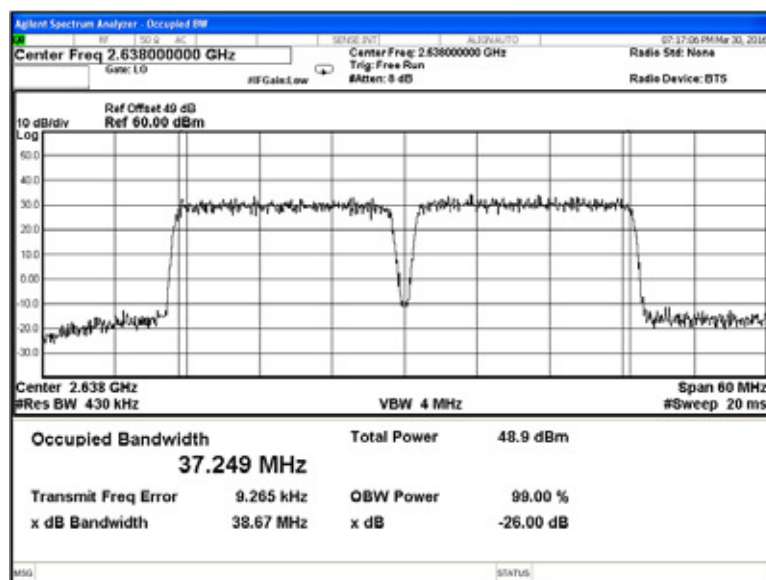
Reference numbers of test equipment used

HL 2214	HL 3301	HL 3302	HL 4274	HL 4575			
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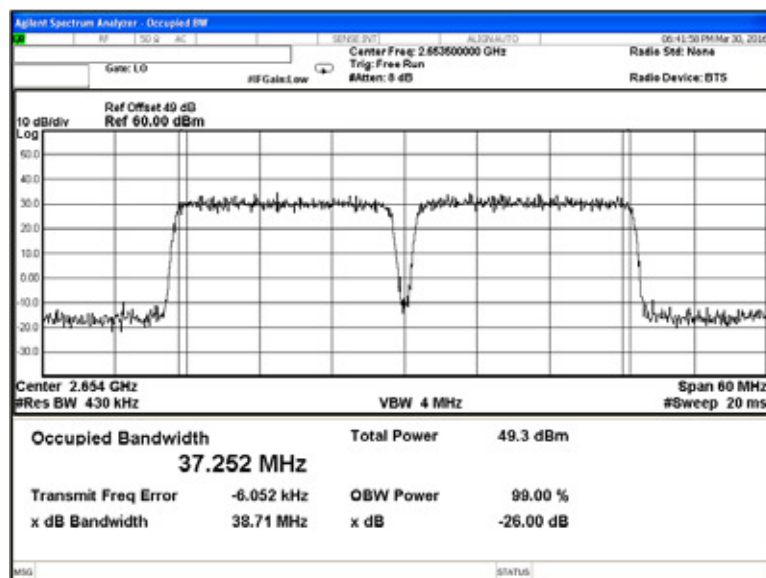
Full description is given in Appendix A.

Test specification:		Section 2.1049, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Plot 7.2.1 Occupied bandwidth test results at low frequency, 40 MHz EBW, QPSK

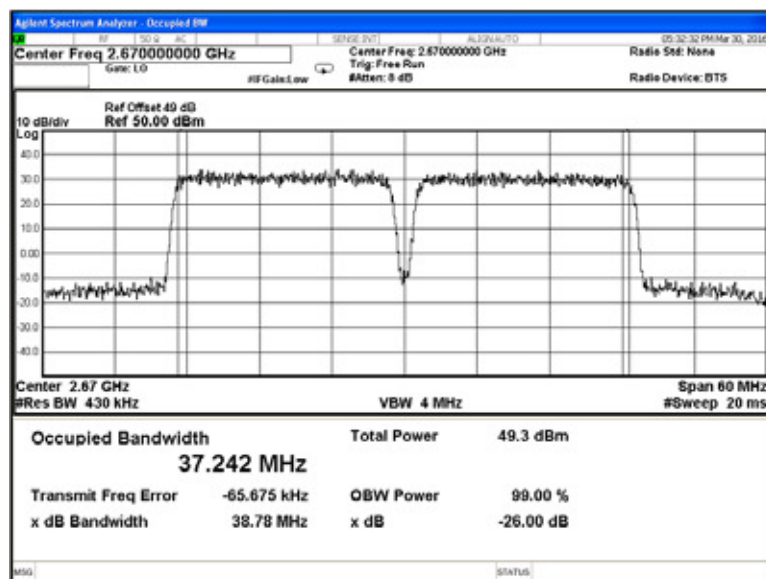


Plot 7.2.2 Occupied bandwidth test results at mid frequency, 40 MHz EBW, QPSK

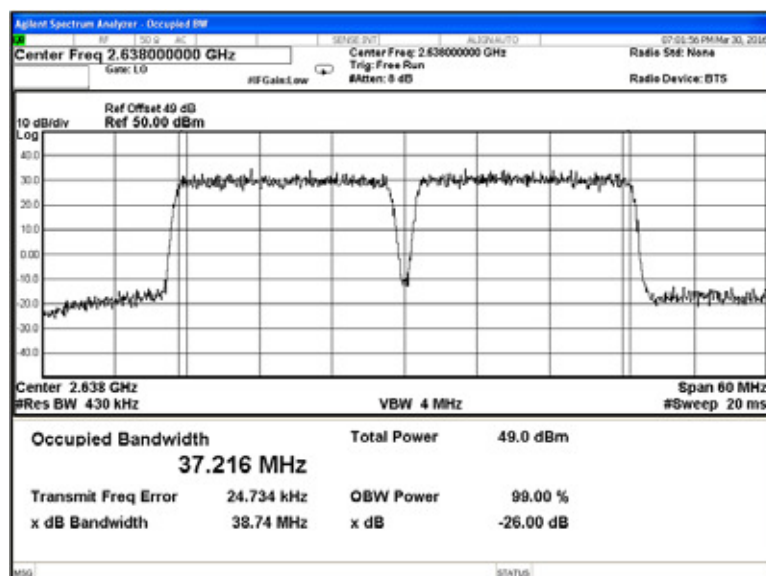


Test specification:		Section 2.1049, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Plot 7.2.3 Occupied bandwidth test results at high frequency, 40 MHz EBW, QPSK

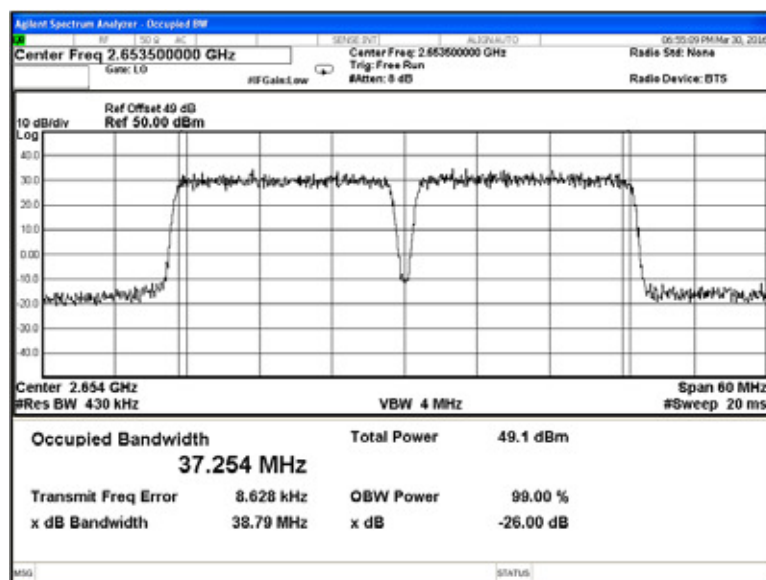


Plot 7.2.4 Occupied bandwidth test results at low frequency, 40 MHz EBW, 64QAM

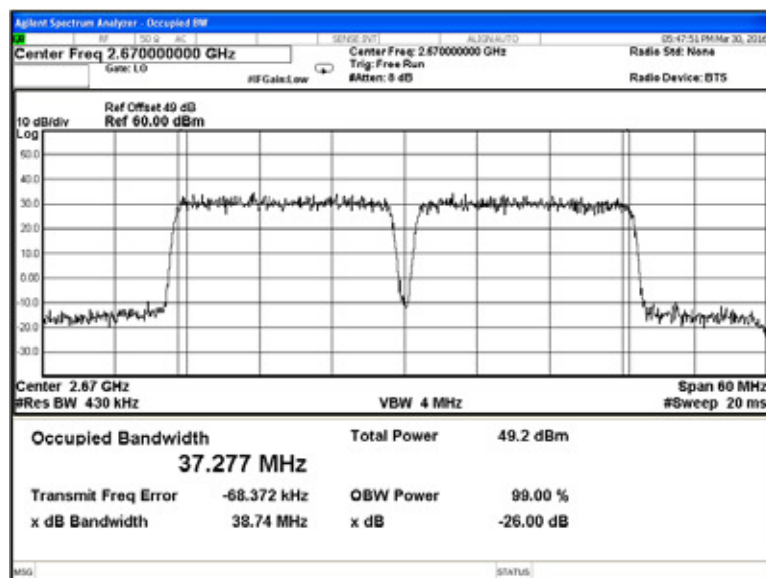


Test specification:		Section 2.1049, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Plot 7.2.5 Occupied bandwidth test results at mid frequency, 40 MHz EBW, 64QAM



Plot 7.2.6 Occupied bandwidth test results at high frequency, 40 MHz EBW, 64QAM



Test specification:		Section 2.1049, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

7.3 Occupied bandwidth test in 2496 – 2568 MHz band

7.3.1 General

This test was performed to measure transmitter occupied bandwidth. Specification test limits are given in Table 7.3.1.

Table 7.3.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
2496.0 – 2568.0 MHz	26	NA

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

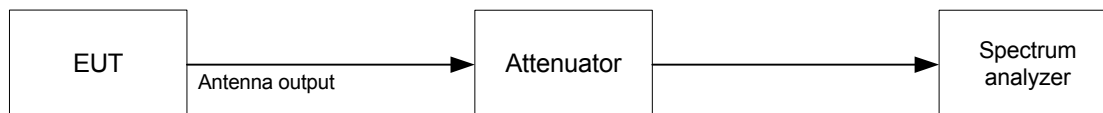
7.3.2 Test procedure

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

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

7.3.2.3 The transmitter occupied bandwidth was measured with spectrum analyzer as a frequency delta between the reference points on modulation envelope and provided in Table 7.3.2 and the associated plots.

Figure 7.3.1 Occupied bandwidth test setup





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Test specification:	Section 2.1049, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Mar-16 - 30-Mar-16		
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Table 7.3.2 Occupied bandwidth test results

DETECTOR USED: Peak
 RESOLUTION BANDWIDTH: 430 kHz
 MODULATION ENVELOPE REFERENCE POINTS: 26 dBc
 EBW: 40 MHz

Carrier frequency, MHz	OBW 26 dBc, MHz	OBW 99%, MHz	Limit, kHz	Verdict
QPSK				
2516	38.760	37.236	NA	Pass
2537	38.710	37.183	NA	Pass
2548	38.760	37.244	NA	Pass
64QAM				
2516	38.660	37.162	NA	Pass
2537	38.810	37.237	NA	Pass
2548	38.660	37.197	NA	Pass

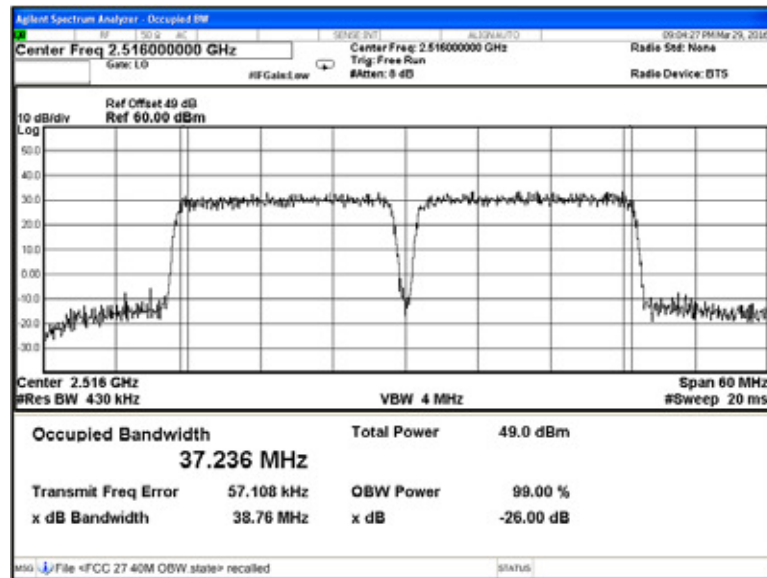
Reference numbers of test equipment used

HL 2214	HL 3301	HL 3302	HL 4274	HL 4575			
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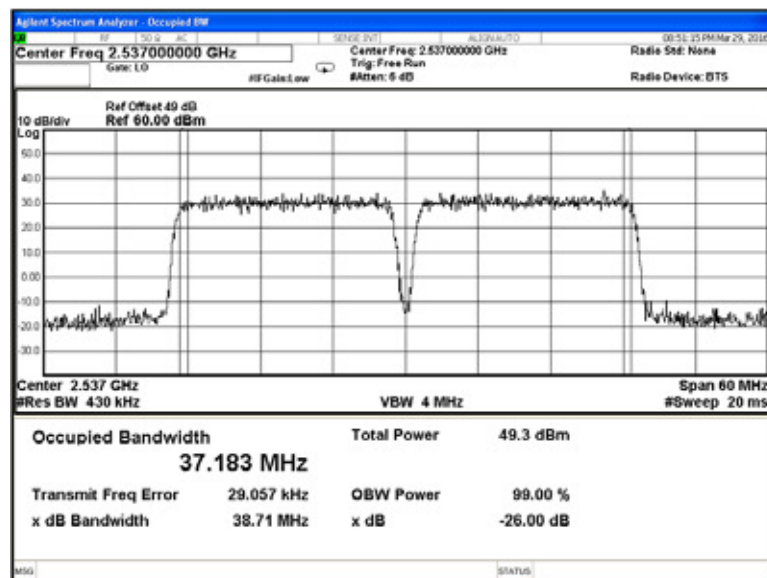
Full description is given in Appendix A.

Test specification:		Section 2.1049, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Plot 7.3.1 Occupied bandwidth test results at low frequency, 40 MHz EBW, QPSK

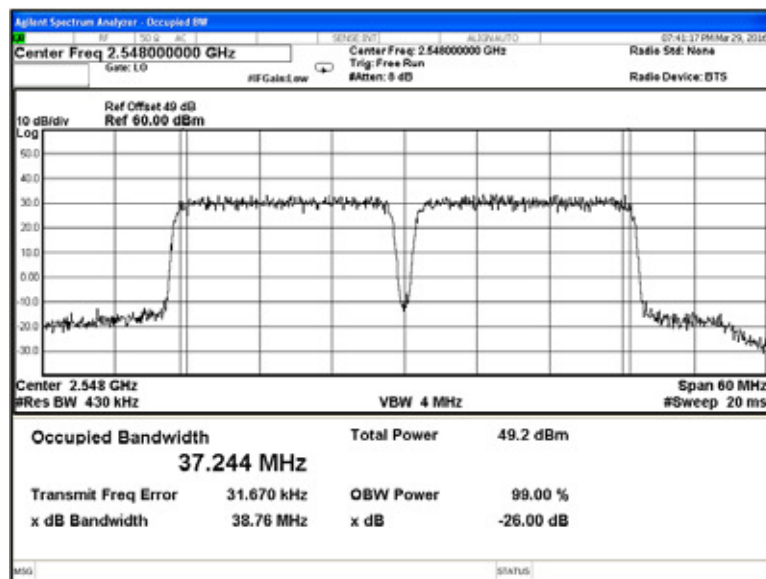


Plot 7.3.2 Occupied bandwidth test results at mid frequency, 40 MHz EBW, QPSK

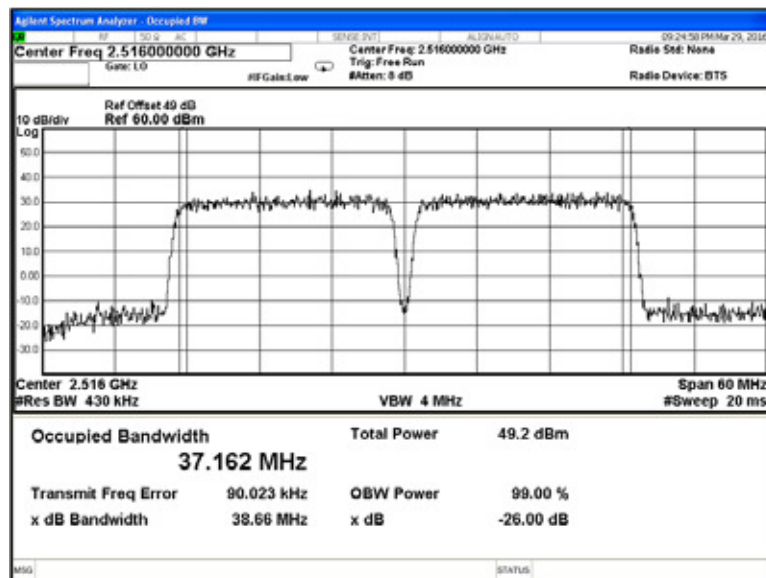


Test specification:		Section 2.1049, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Plot 7.3.3 Occupied bandwidth test results at high frequency, 40 MHz EBW, QPSK

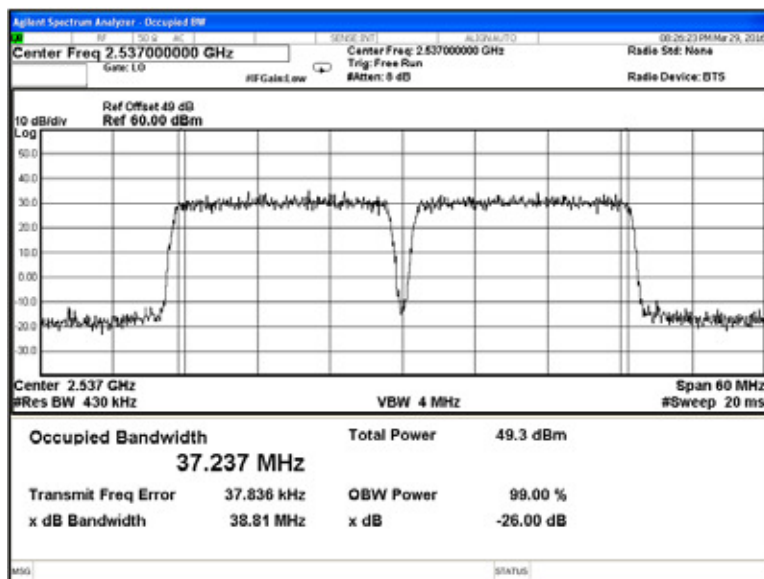


Plot 7.3.4 Occupied bandwidth test results at low frequency, 40 MHz EBW, 64QAM

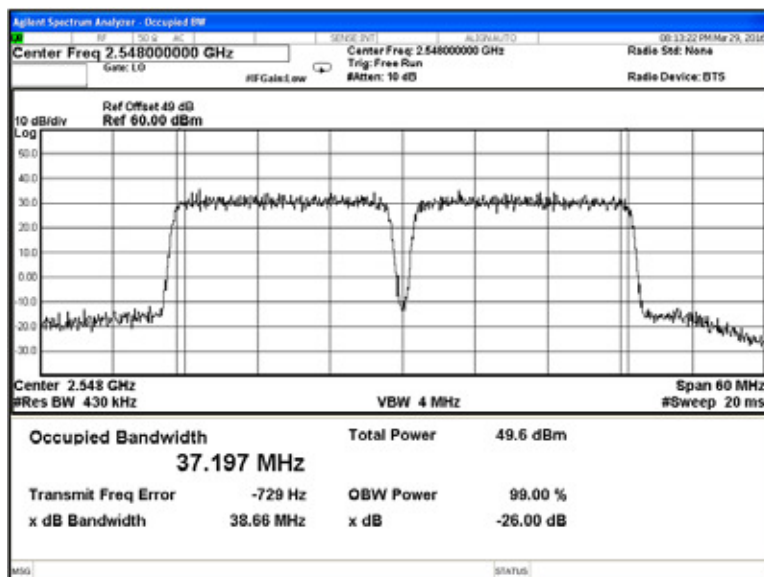


Test specification:		Section 2.1049, Occupied bandwidth	
Test procedure:		47 CFR, Section 2.1049	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Plot 7.3.5 Occupied bandwidth test results at mid frequency, 40 MHz EBW, 64QAM



Plot 7.3.6 Occupied bandwidth test results at high frequency, 40 MHz EBW, 64QAM



Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

7.4 Peak output power test in 2498.5 – 2687.5 MHz band

7.4.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.4.1.

Table 7.4.1 Peak output power limits

Transmitter type	Assigned frequency range, MHz	Maximum peak output power dBm
Main, booster and base stations	2496 – 2690	$63 + 10\log(X/Y) + 10\log(360/\text{beamwidth})$
		Maximum peak power density dBm/100 kHz
		$\text{EIRP} + 10\log(0.1/Y)$

X is the actual channel width in MHz (occupied bandwidth)

Y is either Frequency assignment for the BRS/EBS band

Beamwidth is the total horizontal plane beam width of the individual transmitting antenna for the station or any sector measured at the half-power points.

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.

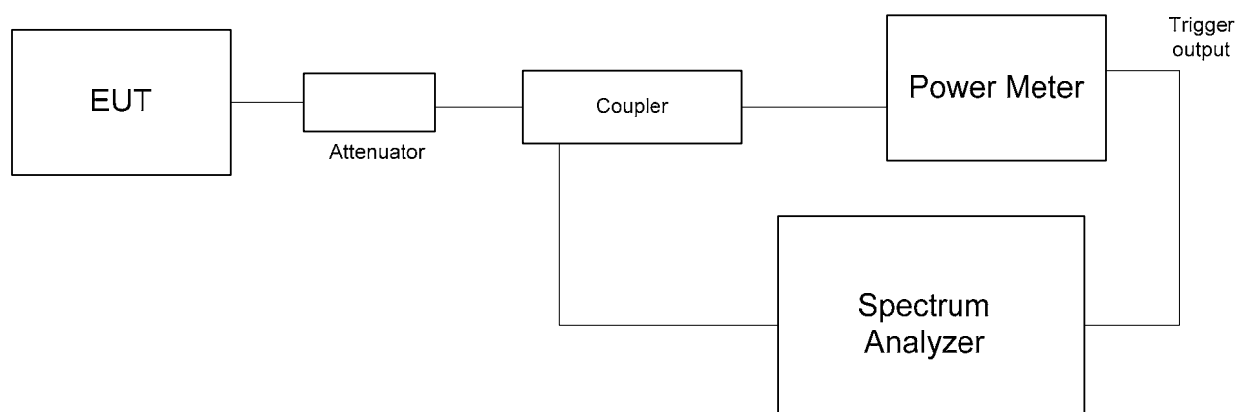
7.4.2.2 The EUT was adjusted to produce maximum available to the end user RF output power.

7.4.2.3 The average output power was measured with power meter as provided in Table 7.4.2.

7.4.2.4 The power spectral density was measured with spectrum analyzer as provided in Table 7.4.3 and the associated plots.

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

Figure 7.4.1 Peak output power test setup



Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Table 7.4.2 Peak output power test results

DETECTOR USED: Average within Tx burst
DUTY CYCLE: 75%
EBW: 40 MHz

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								
2516	42.90	42.89	45.91	18.00	63.91	69.83	-5.93	Pass
2594	43.18	43.11	46.16	18.00	64.16	70.08	-5.93	Pass
2670	43.17	43.15	46.17	18.00	64.17	69.88	-5.71	Pass
64QAM								
2516	42.85	42.75	45.81	18.00	63.81	69.82	-6.01	Pass
2594	43.04	43.02	46.04	18.00	64.04	70.08	-6.04	Pass
2670	43.08	43.05	46.08	18.00	64.08	69.88	-5.81	Pass
QPSK								
2516	42.90	42.89	45.91	17.00	62.91	68.42	-5.52	Pass
2594	43.18	43.11	46.16	17.00	63.16	68.67	-5.52	Pass
2670	43.17	43.15	46.17	17.00	63.17	68.47	-5.30	Pass
64QAM								
2516	42.85	42.75	45.81	17.00	62.81	68.41	-5.60	Pass
2594	43.04	43.02	46.04	17.00	63.04	68.67	-5.63	Pass
2670	43.08	43.05	46.08	17.00	63.08	68.47	-5.40	Pass

* - EIRP total, dBm = Total RF power**, dBm + Antenna Gain, dBi

** - Total RF power, dBm = $10 \log\{10^{P(\text{dBm}, \text{RF}\#1)/10} + 10^{P(\text{dBm}, \text{RF}\#2)/10}\}$

*** - See Table 7.4.5

Reference numbers of test equipment used

HL 2214	HL 3301	HL 3302	HL 4274	HL 4575			
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Full description is given in Appendix A.

Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Table 7.4.3 Power spectral density test results

DETECTOR USED: Average gated
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: 300 kHz
CHANNEL BANDWIDTH: 40 MHz
DUTY CYCLE: 75%

Carrier frequency, MHz	SA reading, RF #1 dBm/100kHz	SA reading, RF #2 dBm/100kHz	Antenna gain, dBi	Total PSD*, dBm/100kHz	Limit**, dBm	Margin, dB	Verdict
QPSK							
2516	20.81	20.05	18	41.46	43.35	-1.89	Pass
2594	20.67	20.62	18	41.66	43.85	-2.20	Pass
2670	20.32	20.26	18	41.30	43.44	-2.14	Pass
64QAM							
2516	20.60	20.12	18	41.38	43.34	-1.96	Pass
2594	20.92	20.85	18	41.90	43.85	-1.95	Pass
2670	20.85	20.43	18	41.66	43.45	-1.79	Pass
QPSK							
2516	20.81	20.05	17	40.46	41.94	-1.48	Pass
2594	20.67	20.62	17	40.66	42.44	-1.78	Pass
2670	20.32	20.26	17	40.30	42.03	-1.73	Pass
64QAM							
2516	20.60	20.12	17	40.38	41.93	-1.55	Pass
2594	20.92	20.85	17	40.90	42.43	-1.54	Pass
2670	20.85	20.43	17	40.66	42.04	-1.38	Pass

* Total PSD, dBm/100kHz = $10 \log\{10^{\text{[PSD(dBm/100kHz, RF\#1)]/10}} + 10^{\text{([P(dBm/100kHz, RF\#2)]/10)}} + \text{Antenna Gain, dBi}$

** - See Table 7.4.6

Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Table 7.4.4 Post - transition frequency channels assignment

Channel	OBW, MHz	Peak power limit, dBm	Power density limit, dBm/100kHz
40 MHz 4 Channels QPSK			
2516.0 MHz BRS Ch.1 + EBS Ch.A1+A2+A3+B1+B2+B3+C1	38.760	$63+10\log(\text{OBW}/44.5)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.5)$
2594.0 MHz EBS Ch.A4+B4+C4+D4+G4+F4+E4	38.750	$63+10\log(\text{OBW}/42.0)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/42.0)$
2670.0 MHz BRS Ch.F2+F3 H1+H2+H3 + EBS Ch.G1+G2+G3	38.720	$63+10\log(\text{OBW}/44.0)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.0)$
40 MHz 4 Channels 64QAM			
2516.0 MHz BRS Ch.1 + EBS Ch.A1+A2+A3+B1+B2+B3+C1	38.660	$63+10\log(\text{OBW}/44.5)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.5)$
2594.0 MHz EBS Ch.A4+B4+C4+D4+G4+F4+E4	38.720	$63+10\log(\text{OBW}/42.0)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/42.0)$
2670.0 MHz BRS Ch.F2+F3 H1+H2+H3 + EBS Ch.G1+G2+G3	38.770	$63+10\log(\text{OBW}/44.0)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.0)$

Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Table 7.4.5 EIRP limits

Channel	Channel BW, MHz	Peak power limit, dBm	
		17 dBi, 90° beamwidth	18 dBi, 65°beamwidth
40 MHz Dual Channel QPSK			
2516.0 MHz BRS Ch.1 + EBS Ch.A1+A2+A3+B1+B2+B3+C1	44.5	68.42	69.83
2594.0 MHz EBS Ch.A4+B4+C4+D4+G4+F4+E4	42.0	68.67	70.08
2670.0 MHz BRS Ch.F2+F3 H1+H2+H3 + EBS Ch.G1+G2+G3	44.0	68.47	69.88
40 MHz Dual Channel 64 QAM			
2516.0 MHz BRS Ch.1 + EBS Ch.A1+A2+A3+B1+B2+B3+C1	44.5	68.41	69.82
2594.0 MHz EBS Ch.A4+B4+C4+D4+G4+F4+E4	42.0	68.67	70.08
2670.0 MHz BRS Ch.F2+F3 H1+H2+H3 + EBS Ch.G1+G2+G3	44.0	68.47	69.88

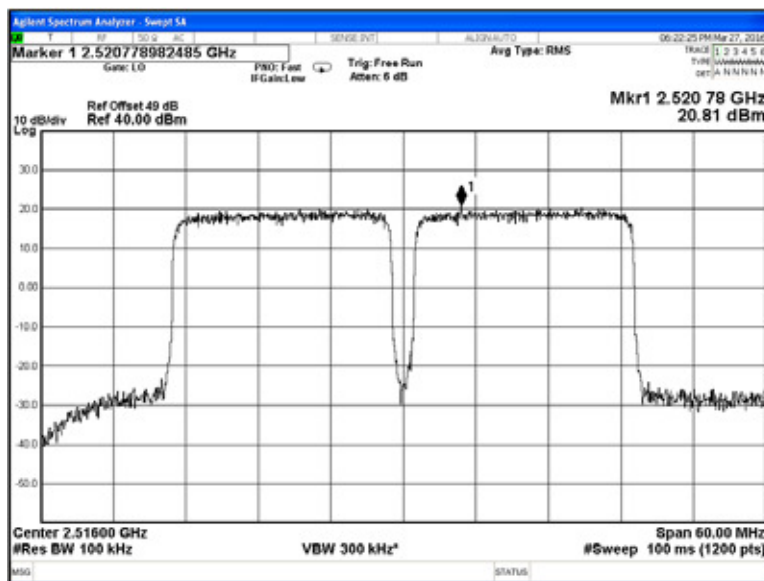
Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Table 7.4.6 Peak power density limits

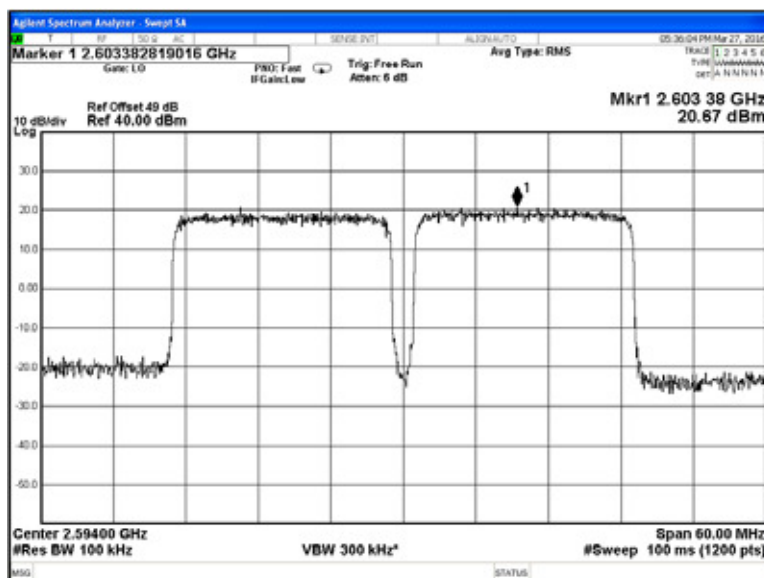
Channel	Channel BW, MHz	Peak power density, dBm/100kHz	
		17 dBi, 90º beamwidth	18 dBi, 65ºbeamwidth
40 MHz Dual Channel QPSK			
2516.0 MHz BRS Ch.1 + EBS Ch.A1+A2+A3+B1+B2+B3+C1	44.5	41.94	43.35
2594.0 MHz EBS Ch.A4+B4+C4+D4+G4+F4+E4	42.0	42.44	43.85
2670.0 MHz BRS Ch.F2+F3 H1+H2+H3 + EBS Ch.G1+G2+G3	44.0	42.03	43.44
40 MHz Dual Channel 64 QAM			
2516.0 MHz BRS Ch.1 + EBS Ch.A1+A2+A3+B1+B2+B3+C1	44.5	41.93	43.34
2594.0 MHz EBS Ch.A4+B4+C4+D4+G4+F4+E4	42.0	42.43	43.85
2670.0 MHz BRS Ch.F2+F3 H1+H2+H3 + EBS Ch.G1+G2+G3	44.0	42.04	43.45

Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.4.1 Power spectral density test results at low frequency, QPSK, 40 MHz EBW RF # 1

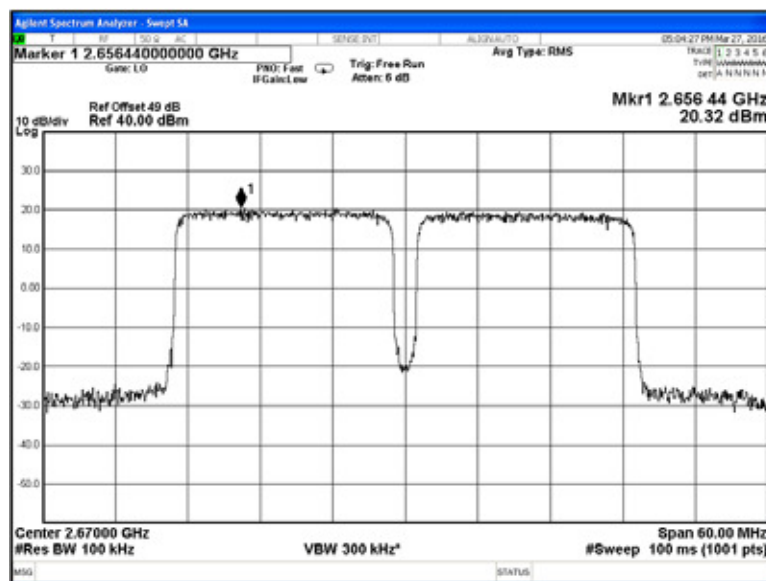


Plot 7.4.2 Power spectral density test results at mid frequency, QPSK, 40 MHz EBW RF # 1

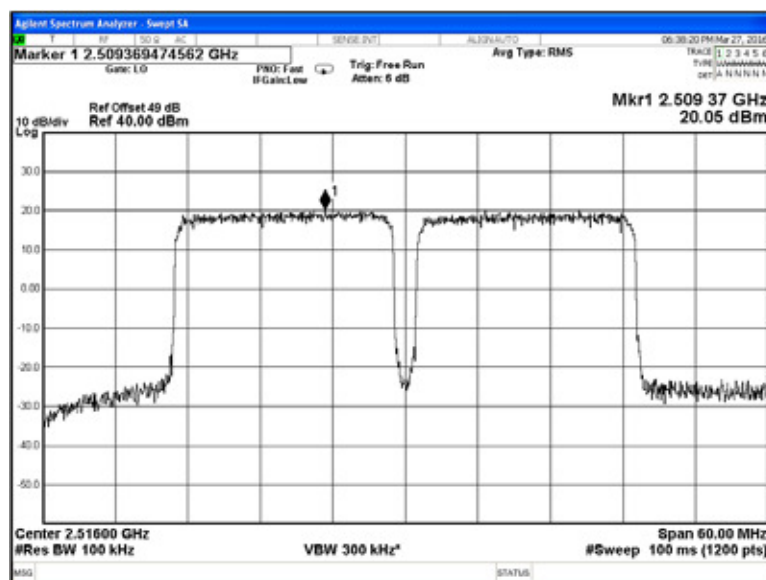


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.4.3 Power spectral density test results at high frequency, QPSK, 40 MHz EBW RF # 1

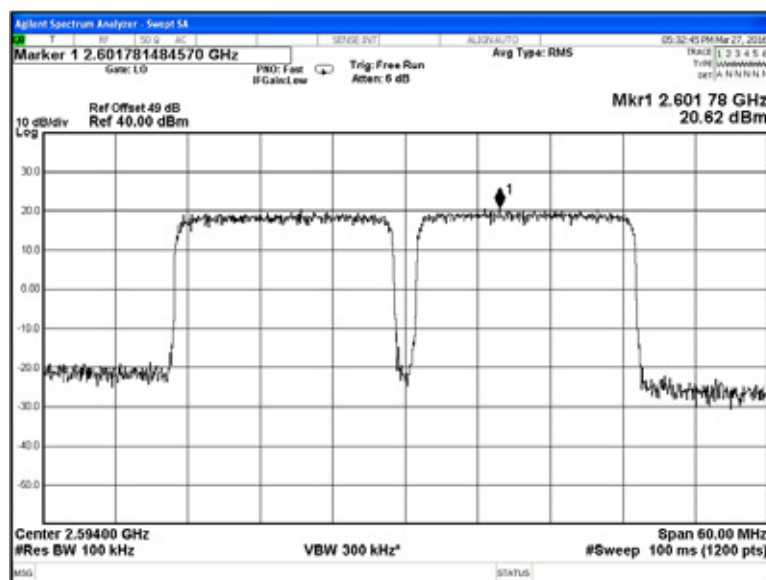


Plot 7.4.4 Power spectral density test results at low frequency, QPSK, 40 MHz EBW RF # 2

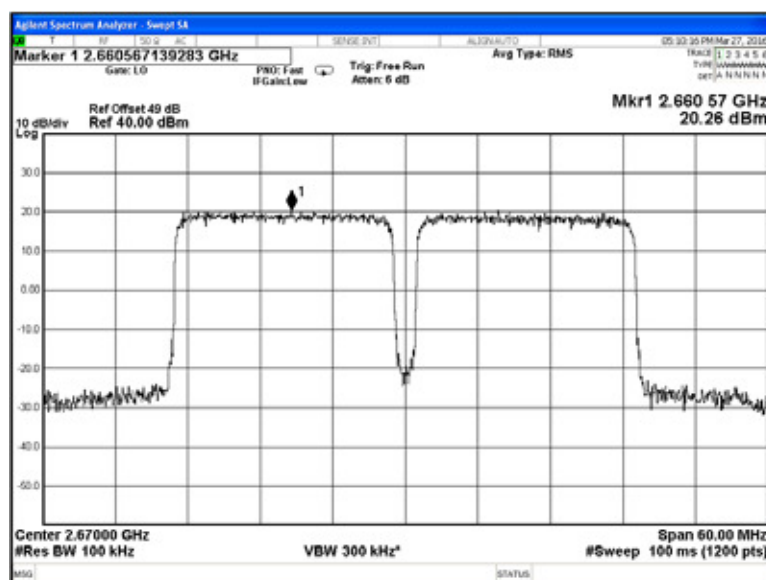


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.4.5 Power spectral density test results at mid frequency, QPSK, 40 MHz EBW RF # 2

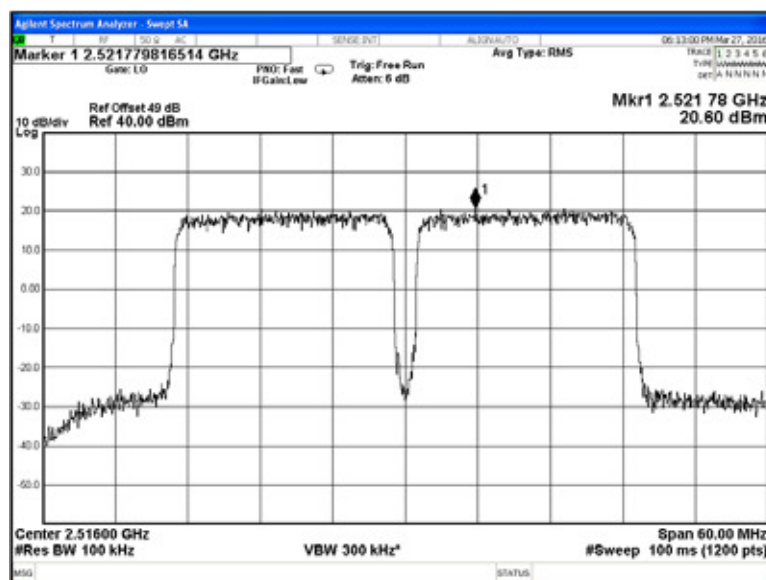


Plot 7.4.6 Power spectral density test results at high frequency, QPSK, 40 MHz EBW RF # 2

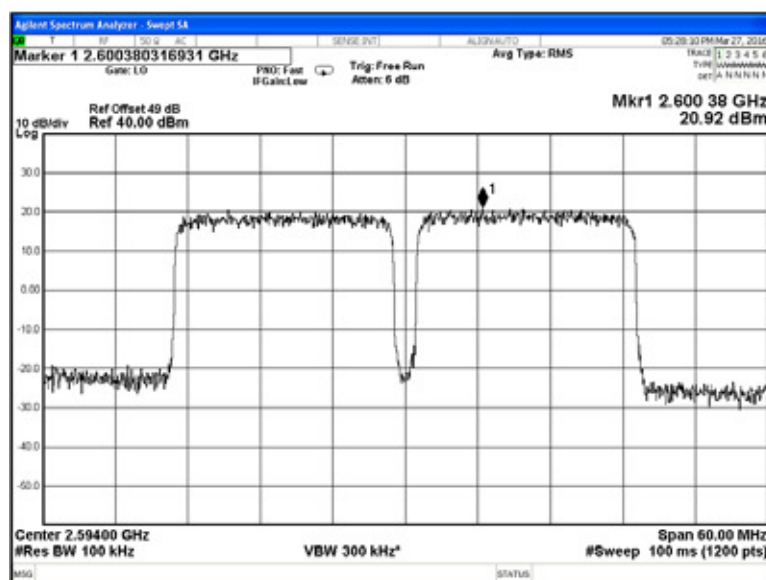


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.4.7 Power spectral density test results at low frequency, 64QAM, 40 MHz EBW RF # 1

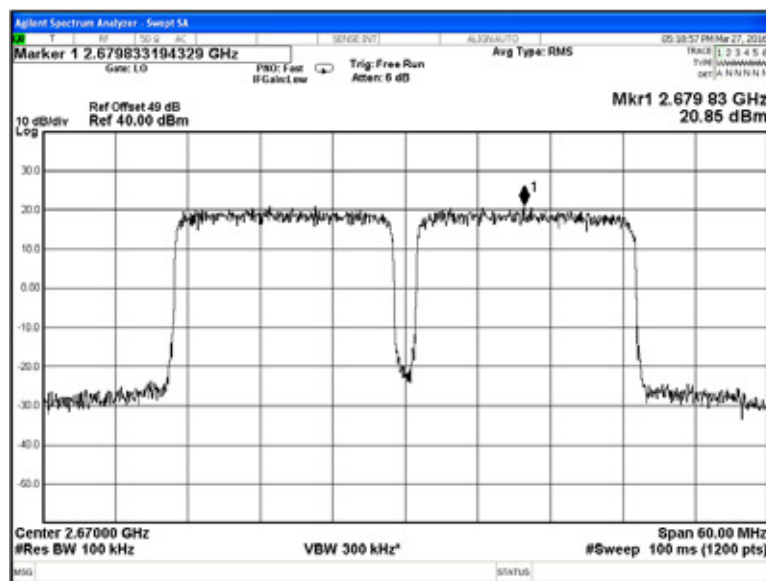


Plot 7.4.8 Power spectral density test results at mid frequency, 64QAM, 40 MHz EBW RF # 1

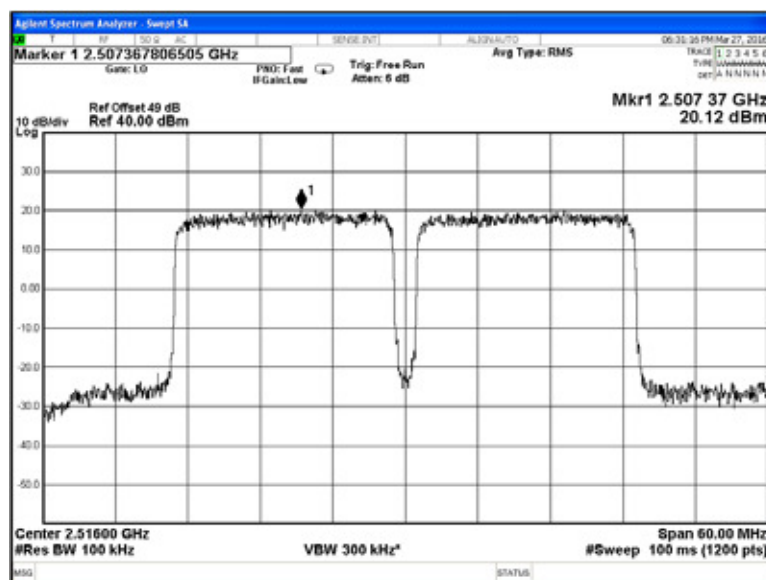


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.4.9 Power spectral density test results at high frequency, 64QAM, 40 MHz EBW RF # 1

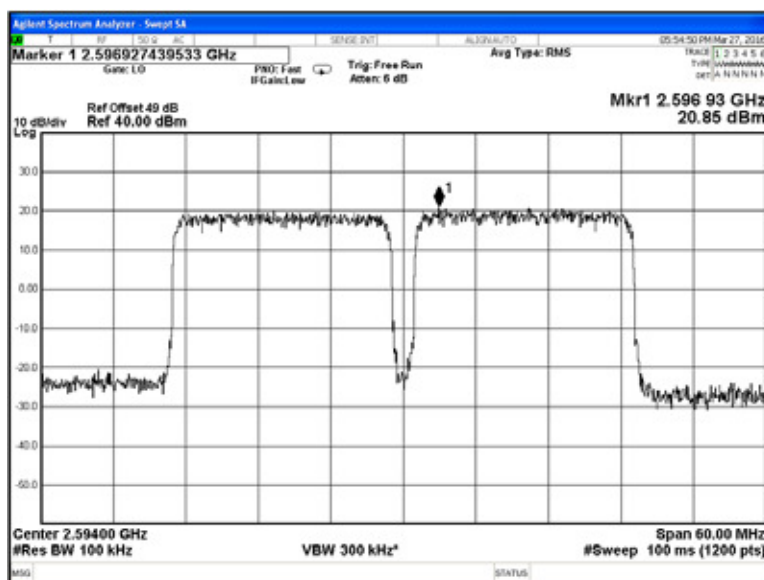


Plot 7.4.10 Power spectral density test results at low frequency, 64QAM, 40 MHz EBW RF # 2

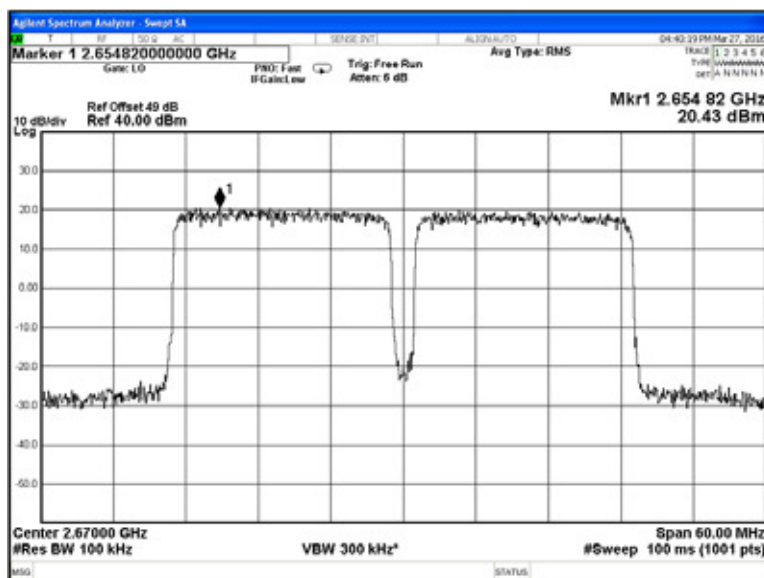


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.4.11 Power spectral density test results at mid frequency, 64QAM, 40 MHz EBW RF # 2



Plot 7.4.12 Power spectral density test results at high frequency, 64QAM, 40 MHz EBW RF # 2



Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

7.5 Peak output power test in 2618 – 2690 MHz band

7.5.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.5.1.

Table 7.5.1 Peak output power limits

Transmitter type	Assigned frequency range, MHz	Maximum peak output power dBm
Main, booster and base stations	2618 – 2690	$63 + 10\log(X/Y) + 10\log(360/\text{beamwidth})$
		Maximum peak power density dBm/100 kHz
		$\text{EIRP} + 10\log(0.1/Y)$

X is the actual channel width in MHz (occupied bandwidth),

Y is frequency assignments for the BRS/EBS band

Beamwidth is the total horizontal plane beam width of the individual transmitting antenna for the station or any sector measured at the half-power points.

7.5.2 Test procedure

7.5.2.1 The EUT was set up as shown in Figure 7.5.1, energized and its proper operation was checked.

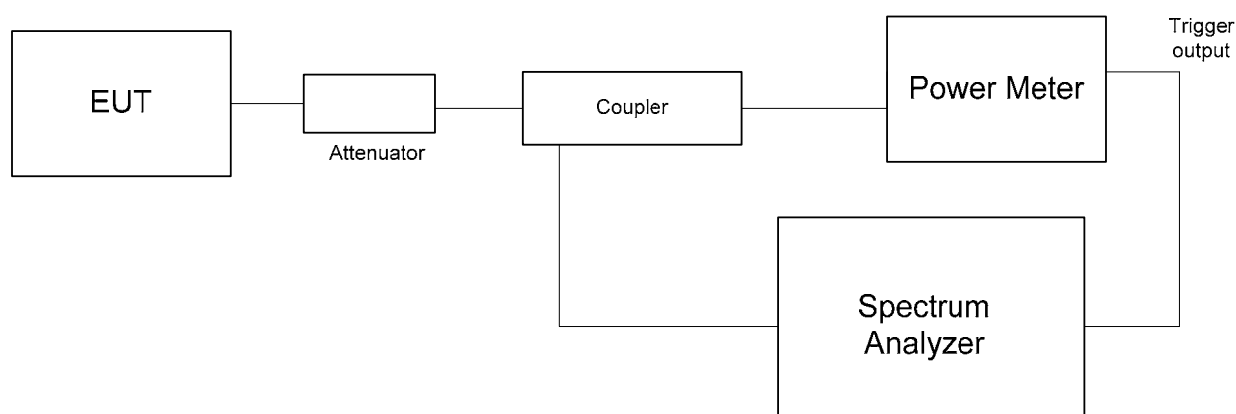
7.5.2.2 The EUT was adjusted to produce maximum available to the end user RF output power.

7.5.2.3 The average output power was measured with power meter as provided in Table 7.5.2.

7.5.2.4 The power spectral density was measured with spectrum analyzer as provided in Table 7.5.3 and the associated plots.

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

Figure 7.5.1 Peak output power test setup



Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Table 7.5.2 Peak output power test results

DETECTOR USED: Average within Tx burst
DUTY CYCLE: 75%
EBW: 40 MHz

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								
2638.0	43.06	43.00	46.04	18.00	64.04	69.82	-5.78	Pass
2653.5	43.15	43.05	46.11	18.00	64.11	69.88	-5.77	Pass
2670.0	43.12	43.11	46.13	18.00	64.13	69.89	-5.76	Pass
64QAM								
2638.0	43.04	43.03	46.05	18.00	64.05	69.83	-5.79	Pass
2653.5	43.09	43.07	46.09	18.00	64.09	69.89	-5.80	Pass
2670.0	43.19	43.05	46.13	18.00	64.13	69.88	-5.75	Pass
QPSK								
2638.0	43.06	43.00	46.04	17.00	63.04	68.41	-5.37	Pass
2653.5	43.15	43.05	46.11	17.00	63.11	68.46	-5.35	Pass
2670.0	43.12	43.11	46.13	17.00	63.13	68.47	-5.35	Pass
64QAM								
2638.0	43.04	43.03	46.05	17.00	63.05	68.42	-5.37	Pass
2653.5	43.09	43.07	46.09	17.00	63.09	68.47	-5.38	Pass
2670.0	43.19	43.05	46.13	17.00	63.13	68.47	-5.34	Pass

* - EIRP total, dBm = Total RF power**, dBm + Antenna Gain, dBi

** - Total RF power , dBm = $10 \log\{10^{[P(\text{dBm}, \text{RF}\#1)/10]} + 10^{[P(\text{dBm}, \text{RF}\#2)/10]}\}$

*** - See Table 7.5.5.

Reference numbers of test equipment used

HL 2214	HL 3301	HL 3302	HL 4274	HL 4575			
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Full description is given in Appendix A.

Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Table 7.5.3 Power spectral density test results

DETECTOR USED: Average gated
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: 300 kHz
CHANNEL BANDWIDTH: 40 MHz
DUTY CYCLE: 75%

Carrier frequency, MHz	SA reading, RF #1 dBm/100kHz	SA reading, RF #2 dBm/100kHz	Antenna gain, dBi	Total PSD*, dBm/100kHz	Limit**, dBm	Margin, dB	Verdict
QPSK							
2638.0	20.66	20.03	18.00	41.37	43.34	-1.97	Pass
2653.5	20.73	20.31	18.00	41.54	43.44	-1.91	Pass
2670.0	20.73	20.83	18.00	41.79	43.45	-1.66	Pass
64QAM							
2638.0	20.70	20.65	18.00	41.69	43.35	-1.66	Pass
2653.5	20.83	20.86	18.00	41.86	43.45	-1.60	Pass
2670.0	20.94	20.75	18.00	41.86	43.45	-1.59	Pass
QPSK							
2638.0	20.66	20.03	17.00	40.37	41.93	-1.56	Pass
2653.5	20.73	20.31	17.00	40.54	42.03	-1.49	Pass
2670.0	20.73	20.83	17.00	40.79	42.04	-1.25	Pass
64QAM							
2638.0	20.70	20.65	17.00	40.69	41.93	-1.25	Pass
2653.5	20.83	20.86	17.00	40.86	42.04	-1.18	Pass
2670.0	20.94	20.75	17.00	40.86	42.03	-1.18	Pass

* Total PSD, dBm/100kHz = $10 \log\{10^{[PSD(dBm/100kHz, RF\#1)/10]} + 10^{[P(dBm/100kHz, RF\#2)/10]}\} + \text{Antenna Gain, dBi}$

** - See Table 7.5.6

Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Table 7.5.4 Post - transition frequency channels assignment

Channel	OBW, MHz	Peak power limit, dBm	Power density limit, dBm/100kHz
40 MHz 4 Channels QPSK			
2638.0 MHz BRS Ch.2+E1+E2+E3+F1+F2+F3+H1	38.670	$63+10\log(\text{OBW}/44.5)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.5)$
2653.5 MHz BRS Ch.E2+E3+F1+F2+F3+H1+H2+H3	38.710	$63+10\log(\text{OBW}/44.0)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.0)$
2670.0 MHz BRS Ch.F2+F3+H1+H2+H3 + EBS Ch. G1 + G2 + G3	38.780	$63+10\log(\text{OBW}/44.0)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.0)$
40 MHz 4 Channels 64QAM			
2638.0 MHz BRS Ch.2+E1+E2+E3+F1+F2+F3+H1	38.740	$63+10\log(\text{OBW}/44.5)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.5)$
2653.5 MHz BRS Ch.E2+E3+F1+F2+F3+H1+H2+H3	38.790	$63+10\log(\text{OBW}/44.0)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.0)$
2670.0 MHz BRS Ch.F2+F3+H1+H2+H3 + EBS Ch. G1 + G2 + G3	38.740	$63+10\log(\text{OBW}/44.0)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.0)$

Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Table 7.5.5 EIRP limits

Channel	Channel BW, MHz	Peak power limit, dBm	
		17 dBi, 90° beamwidth	18 dBi, 65°beamwidth
40 MHz Dual Channel QPSK			
2638.0 MHz BRS Ch.2+E1+E2+E3+F1+F2+F3+H1	44.5	68.41	69.82
2653.5 MHz BRS Ch.E2+E3+F1+F2+F3+H1+H2+H3	44.0	68.46	69.88
2670.0 MHz BRS Ch.F2+F3+H1+H2+H3 + EBS Ch. G1 + G2 + G3	44.0	68.47	69.89
40 MHz Dual Channel 64 QAM			
2638.0 MHz BRS Ch.2+E1+E2+E3+F1+F2+F3+H1	44.5	68.42	69.83
2653.5 MHz BRS Ch.E2+E3+F1+F2+F3+H1+H2+H3	44.0	68.47	69.89
2670.0 MHz BRS Ch.F2+F3+H1+H2+H3 + EBS Ch. G1 + G2 + G3	44.0	68.47	69.88

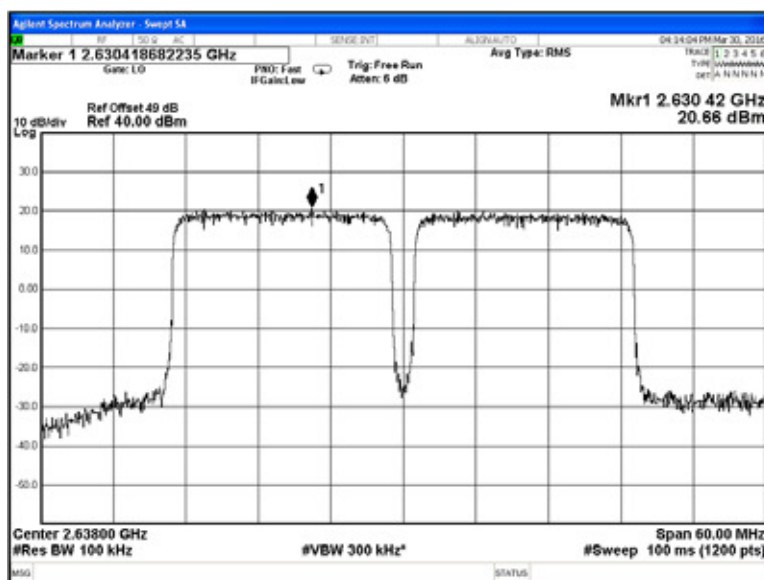
Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Table 7.5.6 Peak power density limits

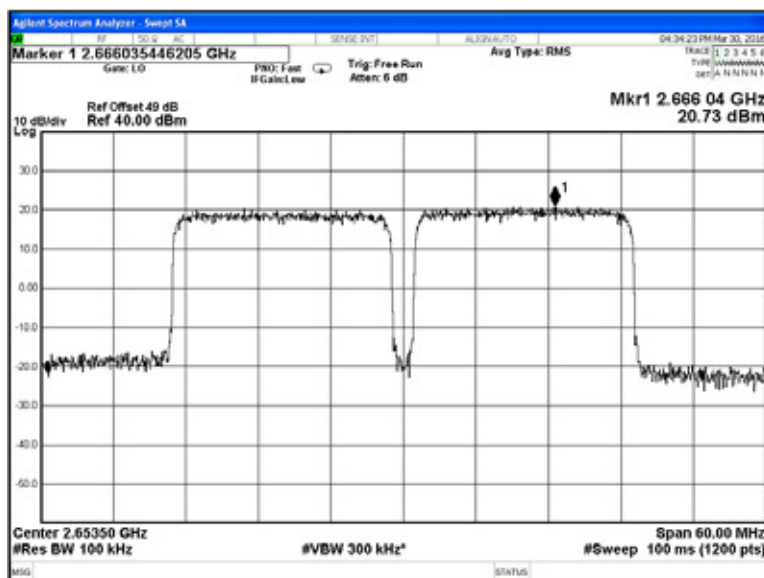
Channel	Channel BW, MHz	Peak power density, dBm/100kHz	
		17 dBi, 90º beamwidth	18 dBi, 65ºbeamwidth
40 MHz Dual Channel QPSK			
2638.0 MHz BRS Ch.2+E1+E2+E3+F1+F2+F3+H1	44.5	41.93	43.34
2653.5 MHz BRS Ch.E2+E3+F1+F2+F3+H1+H2+H3	44.0	42.03	43.44
2670.0 MHz BRS Ch.F2+F3+H1+H2+H3 + EBS Ch. G1 + G2 + G3	44.0	42.04	43.45
40 MHz Dual Channel 64 QAM			
2638.0 MHz BRS Ch.2+E1+E2+E3+F1+F2+F3+H1	44.5	41.93	43.35
2653.5 MHz BRS Ch.E2+E3+F1+F2+F3+H1+H2+H3	44.0	42.04	43.45
2670.0 MHz BRS Ch.F2+F3+H1+H2+H3 + EBS Ch. G1 + G2 + G3	44.0	42.03	43.45

Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Plot 7.5.1 Power spectral density test results at low frequency, QPSK, 40 MHz EBW RF # 1

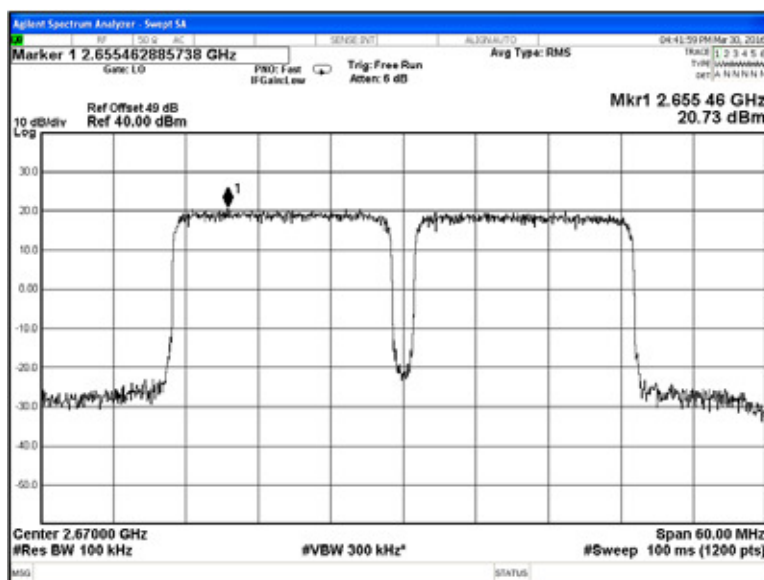


Plot 7.5.2 Power spectral density test results at mid frequency, QPSK, 40 MHz EBW RF # 1

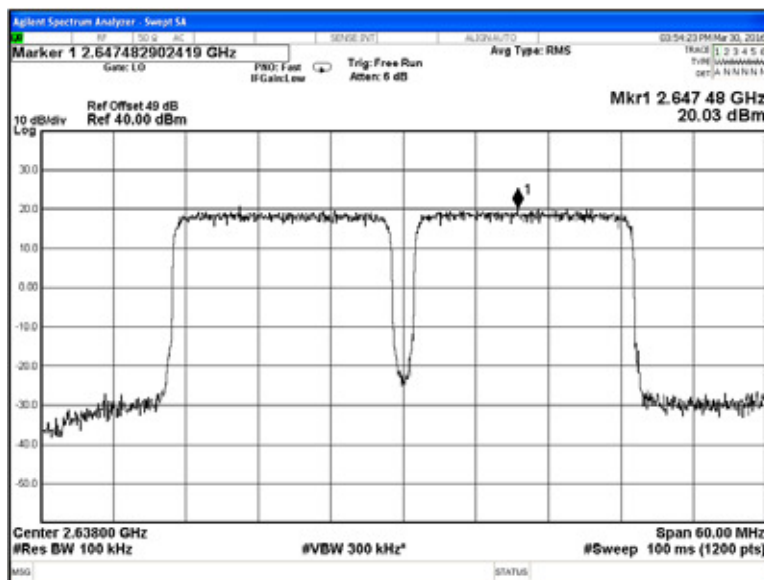


Test specification: Section 27.50, Peak output power	
Test procedure: 47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode: Compliance	Verdict: PASS
Date(s): 27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa
	Relative Humidity: 43 %
	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz	

Plot 7.5.3 Power spectral density test results at high frequency, QPSK, 40 MHz EBW RF # 1

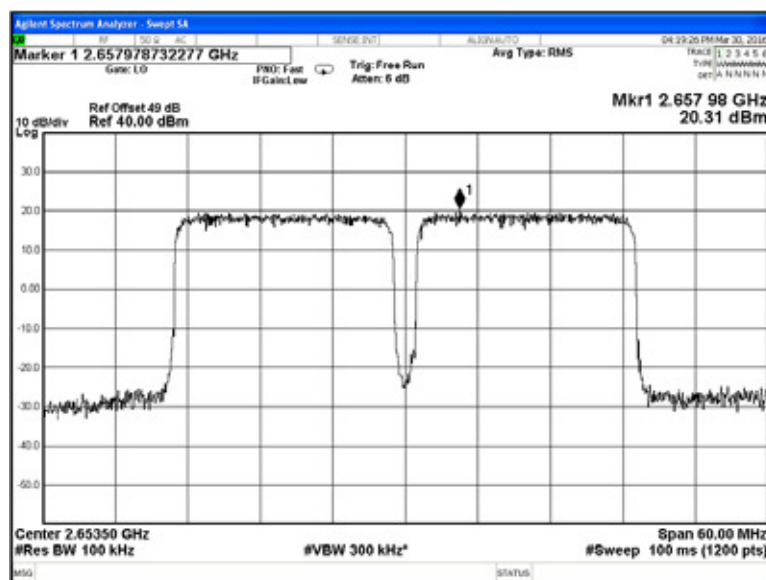


Plot 7.5.4 Power spectral density test results at low frequency, QPSK, 40 MHz EBW RF # 2

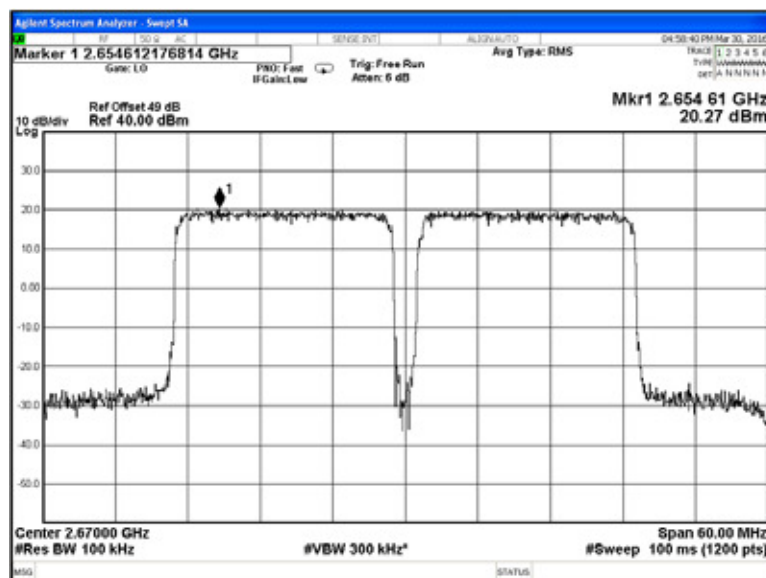


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Plot 7.5.5 Power spectral density test results at mid frequency, QPSK, 40 MHz EBW RF # 2

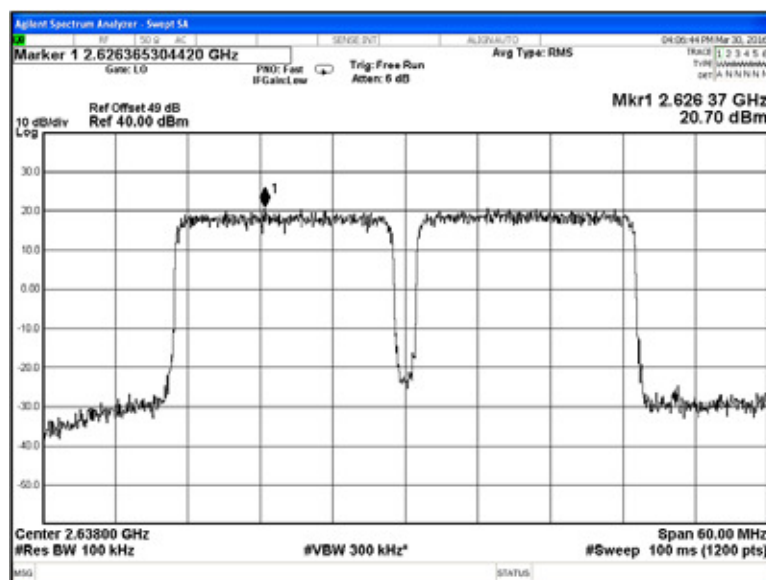


Plot 7.5.6 Power spectral density test results at high frequency, QPSK, 40 MHz EBW RF # 2

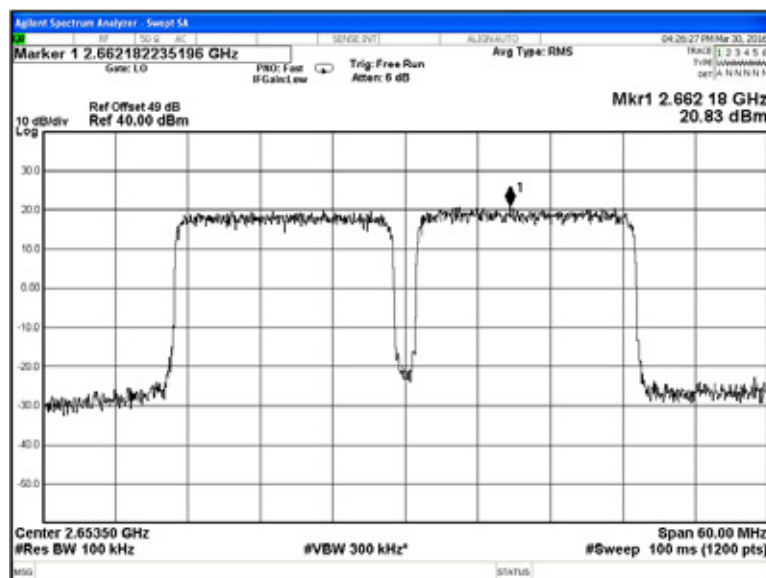


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Plot 7.5.7 Power spectral density test results at low frequency, 64QAM, 40 MHz EBW RF # 1

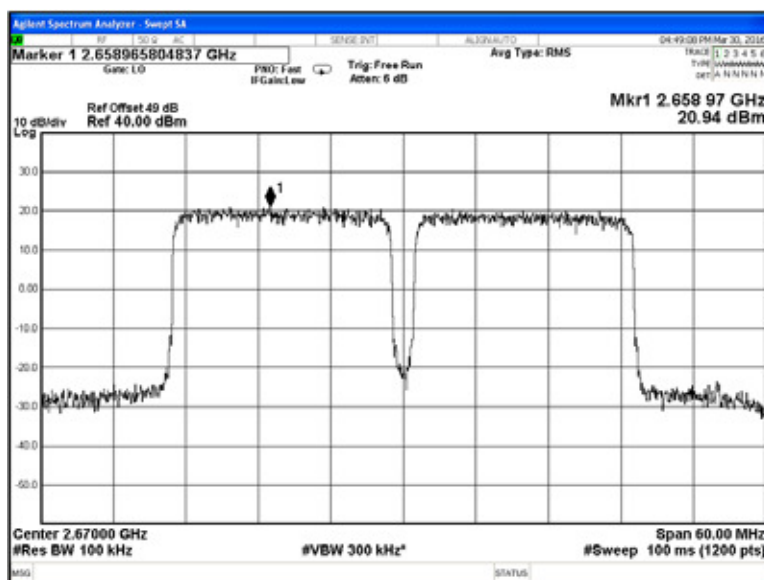


Plot 7.5.8 Power spectral density test results at mid frequency, 64QAM, 40 MHz EBW RF # 1

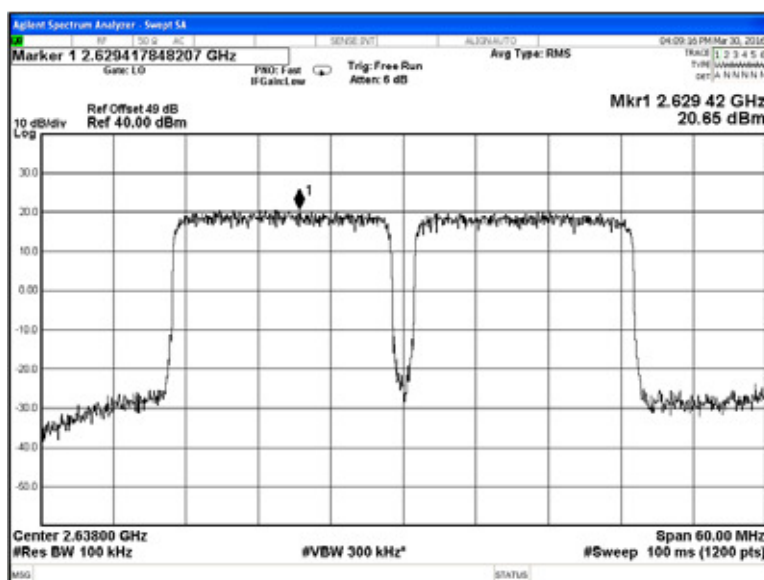


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Plot 7.5.9 Power spectral density test results at high frequency, 64QAM, 40 MHz EBW RF # 1

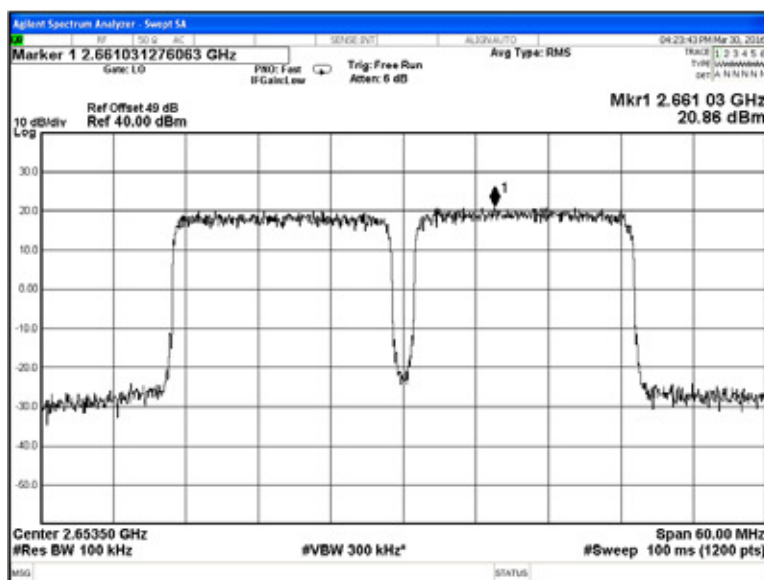


Plot 7.5.10 Power spectral density test results at low frequency, 64QAM, 40 MHz EBW RF # 2

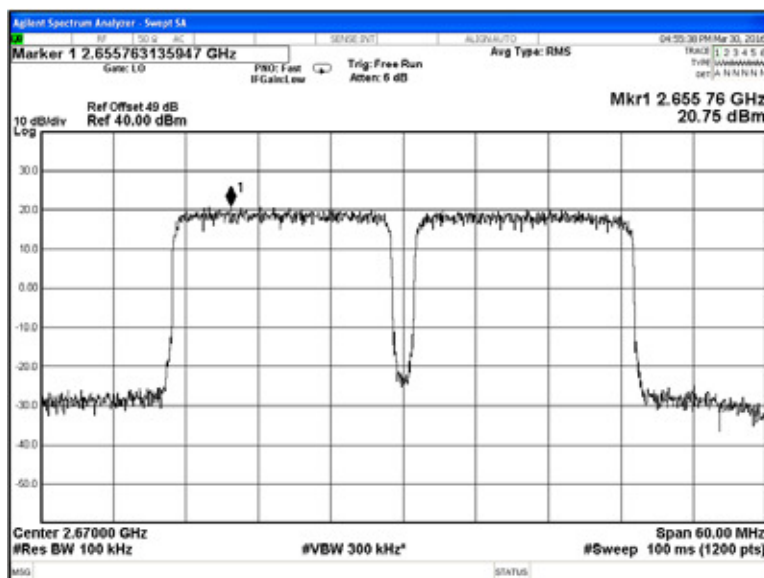


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Plot 7.5.11 Power spectral density test results at mid frequency, 64QAM, 40 MHz EBW RF # 2



Plot 7.5.12 Power spectral density test results at high frequency, 64QAM, 40 MHz EBW RF # 2



Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

7.6 Peak output power test in 2496 – 2568 MHz band

7.6.1 General

This test was performed to measure the peak output power at RF antenna connector. Specification test limits are given in Table 7.6.1.

Table 7.6.1 Peak output power limits

Transmitter type	Assigned frequency range, MHz	Maximum peak output power dBm
Main, booster and base stations	2496 – 2568	$63 + 10\log(X/Y) + 10\log(360/\text{beamwidth})$
		Maximum peak power density dBm/100 kHz
		$\text{EIRP} + 10\log(0.1/Y)$

X is the actual channel width in MHz (occupied bandwidth)

Y is either Frequency assignment for the BRS/EBS band

Beamwidth is the total horizontal plane beam width of the individual transmitting antenna for the station or any sector measured at the half-power points.

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.

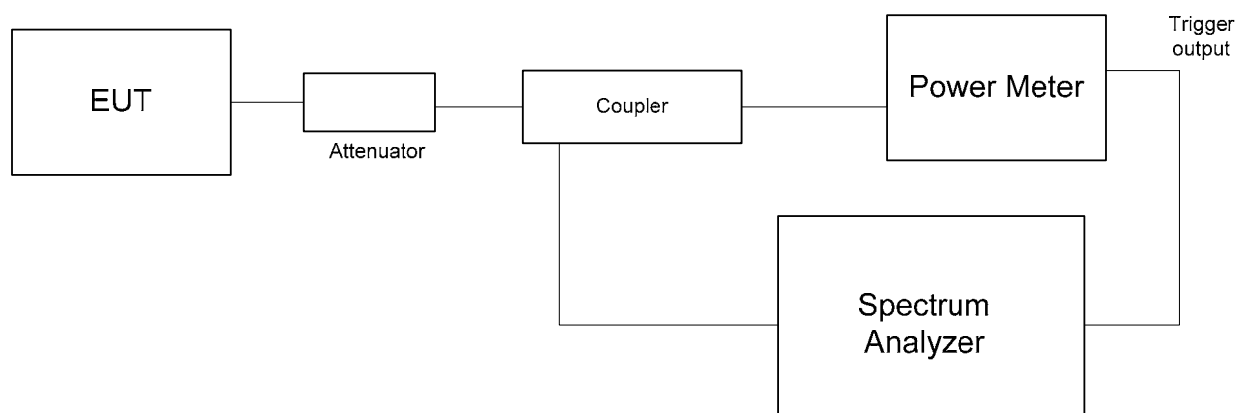
7.6.2.2 The EUT was adjusted to produce maximum available to the end user RF output power.

7.6.2.3 The average output power was measured with power meter as provided in Table 7.6.2.

7.6.2.4 The power spectral density was measured with spectrum analyzer as provided in Table 7.6.3 and the associated plots.

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

Figure 7.6.1 Peak output power test setup



Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Table 7.6.2 Peak output power test results

DETECTOR USED: Average within Tx burst
DUTY CYCLE: 75%
EBW: 40 MHz

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								
2516	43.08	43.02	46.06	18.00	64.06	69.83	-5.77	Pass
2537	43.12	43.00	46.07	18.00	64.07	69.88	-5.81	Pass
2548	43.10	43.06	46.09	18.00	64.09	69.88	-5.79	Pass
64QAM								
2516	43.05	43.03	46.05	18.00	64.05	69.82	-5.77	Pass
2537	43.20	43.01	46.12	18.00	64.12	69.89	-5.77	Pass
2548	43.05	43.04	46.06	18.00	64.06	69.87	-5.82	Pass
QPSK								
2516	43.08	43.02	46.06	17.00	63.06	68.42	-5.36	Pass
2537	43.12	43.00	46.07	17.00	63.07	68.46	-5.39	Pass
2548	43.10	43.06	46.09	17.00	63.09	68.47	-5.38	Pass
64QAM								
2516	43.05	43.03	46.05	17.00	63.05	68.41	-5.36	Pass
2537	43.20	43.01	46.12	17.00	63.12	68.48	-5.36	Pass
2548	43.05	43.04	46.06	17.00	63.06	68.46	-5.40	Pass

* - EIRP total, dBm = Total RF power**, dBm + Antenna Gain, dBi

** - Total RF power, dBm = $10 \log\{10^{[P(\text{dBm}, \text{RF}\#1)/10]} + 10^{[P(\text{dBm}, \text{RF}\#2)/10]}\}$

*** - See Table 7.6.5

Reference numbers of test equipment used

HL 2214	HL 3301	HL 3302	HL 4274	HL 4575			
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Full description is given in Appendix A.

Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Table 7.6.3 Power spectral density test results

DETECTOR USED: Average gated
RESOLUTION BANDWIDTH: 100 kHz
VIDEO BANDWIDTH: 300 kHz
CHANNEL BANDWIDTH: 40 MHz
DUTY CYCLE: 75%

Carrier frequency, MHz	SA reading, RF #1 dBm/100kHz	SA reading, RF #2 dBm/100kHz	Antenna gain, dBi	Total PSD*, dBm/100kHz	Limit**, dBm	Margin, dB	Verdict
QPSK							
2516	20.75	20.79	18.00	41.78	43.35	-1.57	Pass
2537	20.69	20.82	18.00	41.77	43.44	-1.68	Pass
2548	20.46	20.95	18.00	41.72	43.45	-1.73	Pass
64QAM							
2516	20.37	20.42	18.00	41.41	43.34	-1.93	Pass
2537	20.56	20.36	18.00	41.47	43.45	-1.98	Pass
2548	20.79	20.54	18.00	41.68	43.44	-1.76	Pass
QPSK							
2516	20.75	20.79	17.00	40.78	41.94	-1.16	Pass
2537	20.69	20.82	17.00	40.77	42.03	-1.26	Pass
2548	20.46	20.95	17.00	40.72	42.04	-1.31	Pass
64QAM							
2516	20.37	20.42	17.00	40.41	41.93	-1.52	Pass
2537	20.56	20.36	17.00	40.47	42.04	-1.57	Pass
2548	20.79	20.54	17.00	40.68	42.02	-1.35	Pass

* Total PSD, dBm/100kHz = $10 \log\{10^{[PSD(dBm/100kHz, RF\#1)/10]} + 10^{[P(dBm/100kHz, RF\#2)/10]}\} + \text{Antenna Gain, dBi}$

** - See Table 7.6.6

Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Table 7.6.4 Post - transition frequency channels assignment

Channel	OBW, MHz	Peak power limit, dBm	Power density limit, dBm/100kHz
40 MHz 4 Channels QPSK			
2516.0 MHz BRS Ch.1 + EBS Ch. A1 +A2+A3+B1+B2+B3+C1	38.76	$63+10\log(\text{OBW}/44.5)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.5)$
2537.0 MHz EBS Ch.A3+B1+B2+B3 +C1+C2+C3+D1	38.71	$63+10\log(\text{OBW}/44.0)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.0)$
2548.0 MHz EBS CH.B2+B3 +C1+C2+C3+D1+D2+D3	38.76	$63+10\log(\text{OBW}/44.0)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.0)$
40 MHz 4 Channels 64QAM			
2516.0 MHz BRS Ch.1 + EBS Ch. A1 +A2+A3+B1+B2+B3+C1	38.66	$63+10\log(\text{OBW}/44.5)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.5)$
2537.0 MHz EBS Ch.A3+B1+B2+B3 +C1+C2+C3+D1	38.81	$63+10\log(\text{OBW}/44.0)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.0)$
2548.0 MHz EBS CH.B2+B3 +C1+C2+C3+D1+D2+D3	38.66	$63+10\log(\text{OBW}/44.0)+10\log(360/\text{beamwidth})$	$\text{EIRP}+10\log(0.1/44.0)$

Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Table 7.6.5 EIRP limits

Channel	Channel BW, MHz	Peak power limit, dBm	
		17 dBi, 90° beamwidth	11 dBi/18 dBi, 65°beamwidth
40 MHz Dual Channel QPSK			
2516.0 MHz BRS Ch.1 + EBS Ch. A1 +A2+A3+B1+B2+B3+C1	44.5	68.42	69.83
2537.0 MHz EBS Ch.A3+B1+B2+B3 +C1+C2+C3+D1	44.0	68.46	69.88
2548.0 MHz EBS CH.B2+B3 +C1+C2+C3+D1+D2+D3	44.0	68.47	69.88
40 MHz Dual Channel 64 QAM			
2516.0 MHz BRS Ch.1 + EBS Ch. A1 +A2+A3+B1+B2+B3+C1	44.5	68.41	69.82
2537.0 MHz EBS Ch.A3+B1+B2+B3 +C1+C2+C3+D1	44.0	68.48	69.89
2548.0 MHz EBS CH.B2+B3 +C1+C2+C3+D1+D2+D3	44.0	68.46	69.87

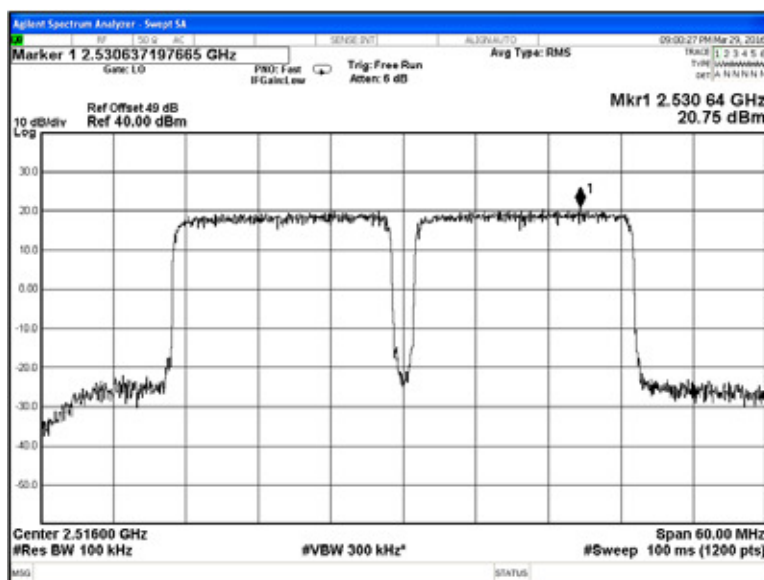
Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Table 7.6.6 Peak power density limits

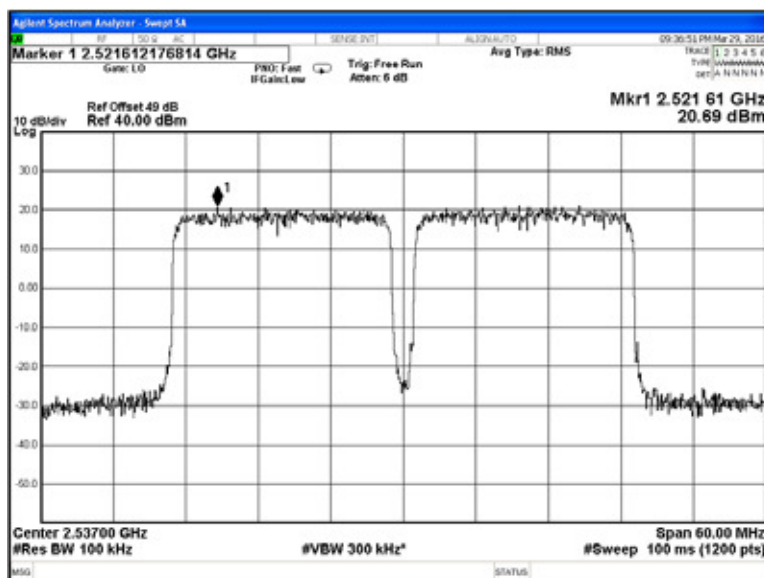
Channel	Channel BW, MHz	Peak power density, dBm/100kHz	
		17 dBi, 90° beamwidth	18 dBi, 65°beamwidth
40 MHz Dual Channel QPSK			
2516.0 MHz BRS Ch.1 + EBS Ch. A1 +A2+A3+B1+B2+B3+C1	44.5	41.94	43.35
2537.0 MHz EBS Ch.A3+B1+B2+B3 +C1+C2+C3+D1	44.0	42.03	43.44
2548.0 MHz EBS CH.B2+B3 +C1+C2+C3+D1+D2+D3	44.0	42.04	43.45
40 MHz Dual Channel 64 QAM			
2516.0 MHz BRS Ch.1 + EBS Ch. A1 +A2+A3+B1+B2+B3+C1	44.5	41.93	43.34
2537.0 MHz EBS Ch.A3+B1+B2+B3 +C1+C2+C3+D1	44.0	42.04	43.45
2548.0 MHz EBS CH.B2+B3 +C1+C2+C3+D1+D2+D3	44.0	42.02	43.44

Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Plot 7.6.1 Power spectral density test results at low frequency, QPSK, 40 MHz EBW RF # 1

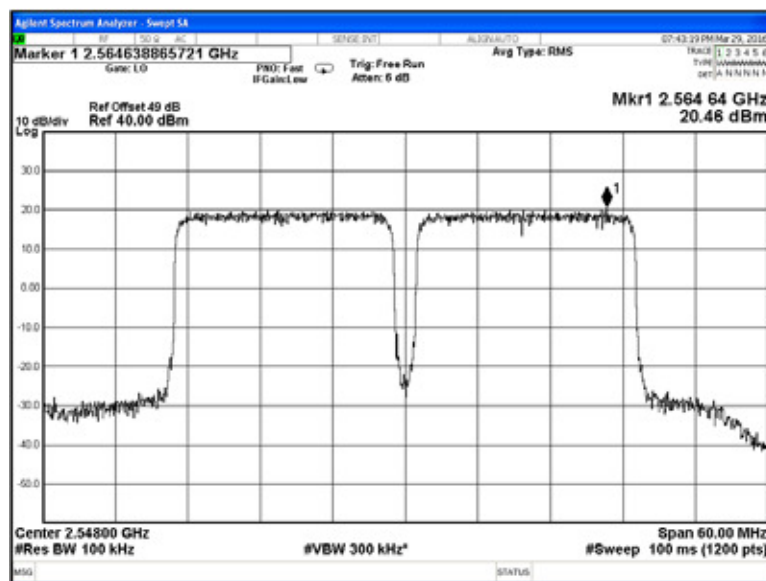


Plot 7.6.2 Power spectral density test results at mid frequency, QPSK, 40 MHz EBW RF # 1

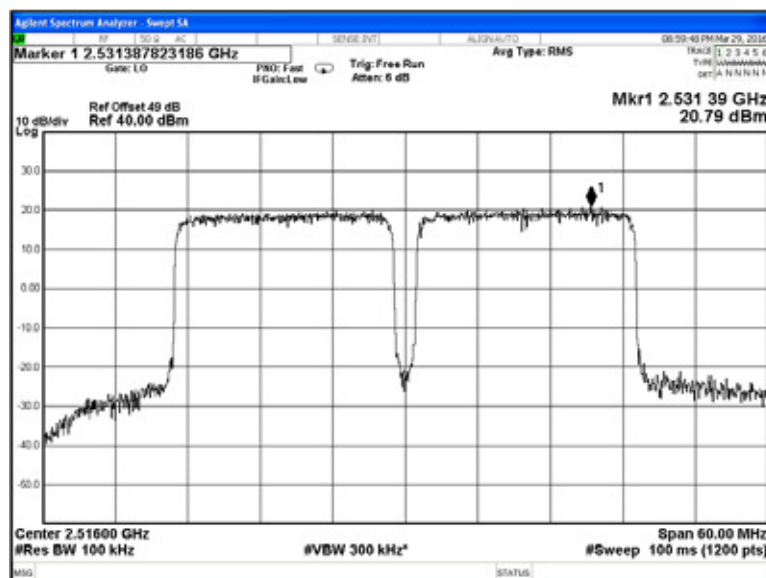


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Plot 7.6.3 Power spectral density test results at high frequency, QPSK, 40 MHz EBW RF # 1

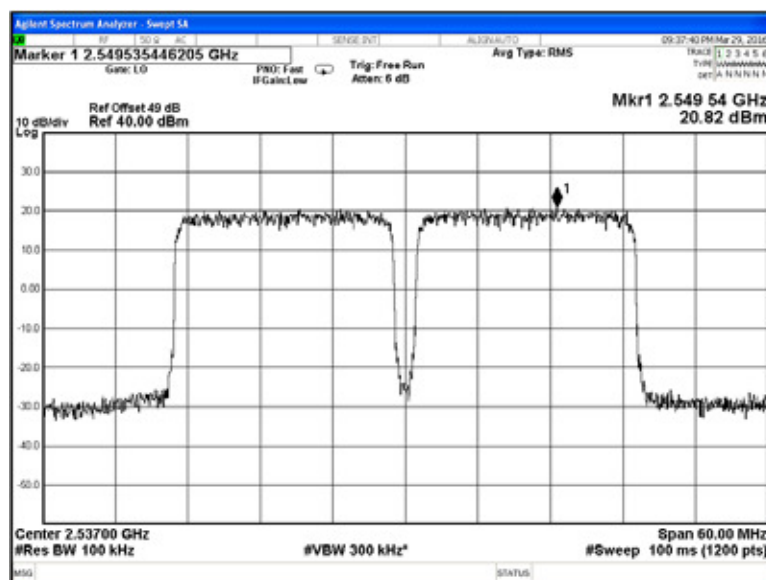


Plot 7.6.4 Power spectral density test results at low frequency, QPSK, 40 MHz EBW RF # 2

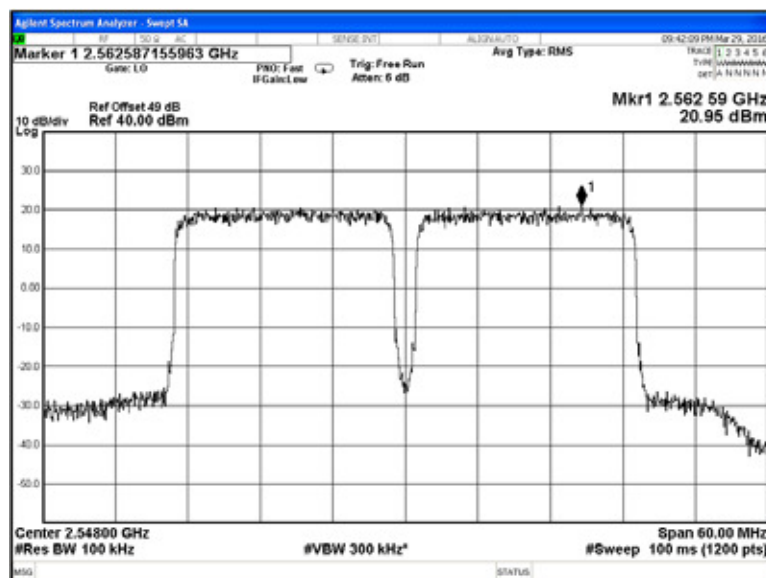


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Plot 7.6.5 Power spectral density test results at mid frequency, QPSK, 40 MHz EBW RF # 2

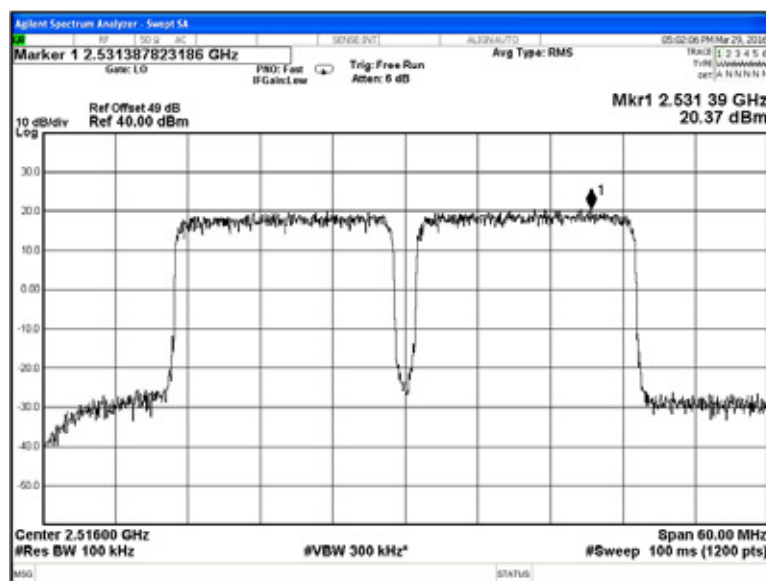


Plot 7.6.6 Power spectral density test results at high frequency, QPSK, 40 MHz EBW RF # 2

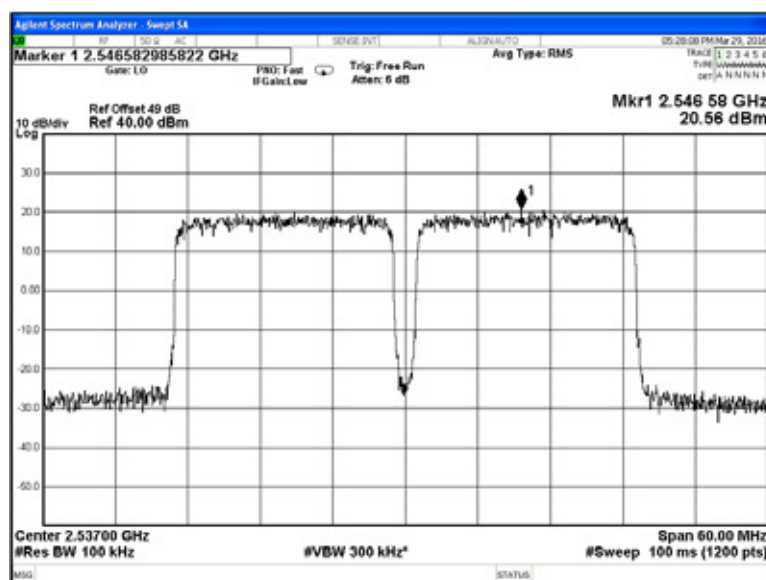


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Plot 7.6.7 Power spectral density test results at low frequency, 64QAM, 40 MHz EBW RF # 1

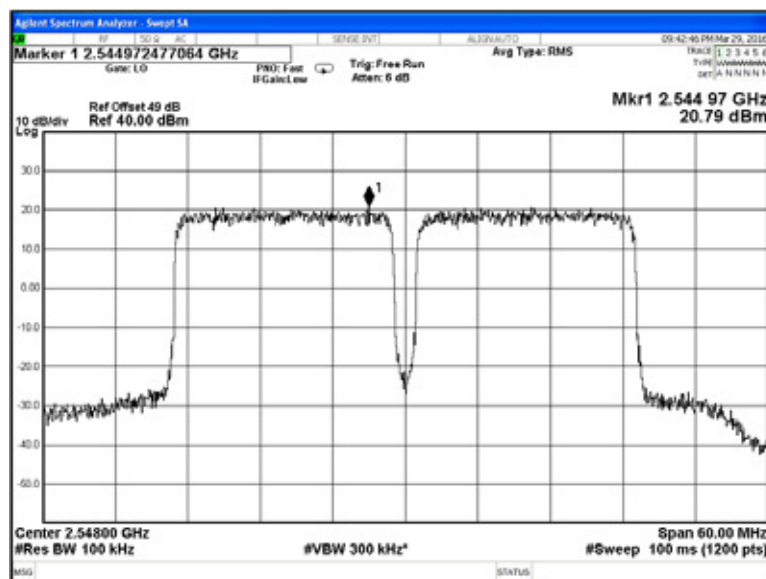


Plot 7.6.8 Power spectral density test results at mid frequency, 64QAM, 40 MHz EBW RF # 1

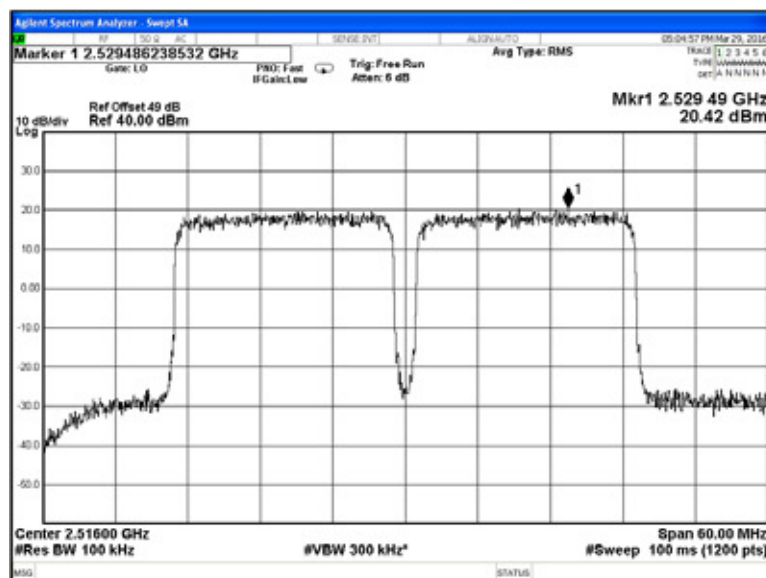


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Plot 7.6.9 Power spectral density test results at high frequency, 64QAM, 40 MHz EBW RF # 1

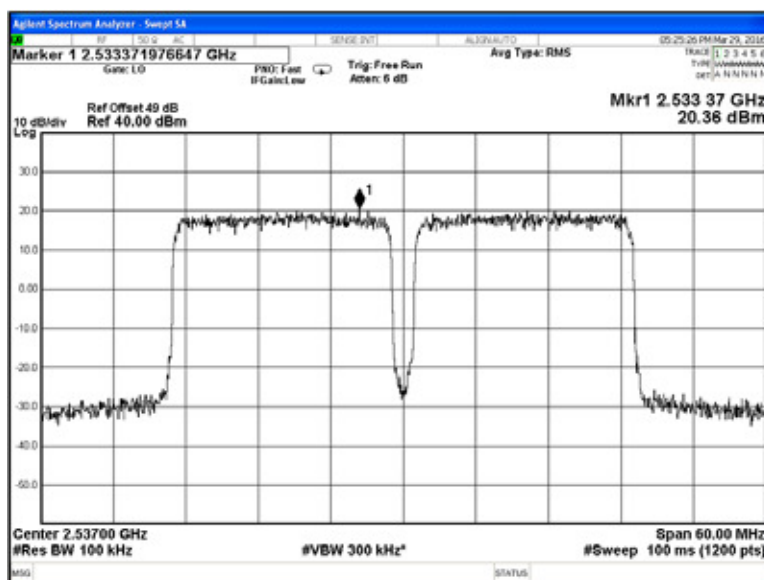


Plot 7.6.10 Power spectral density test results at low frequency, 64QAM, 40 MHz EBW RF # 2

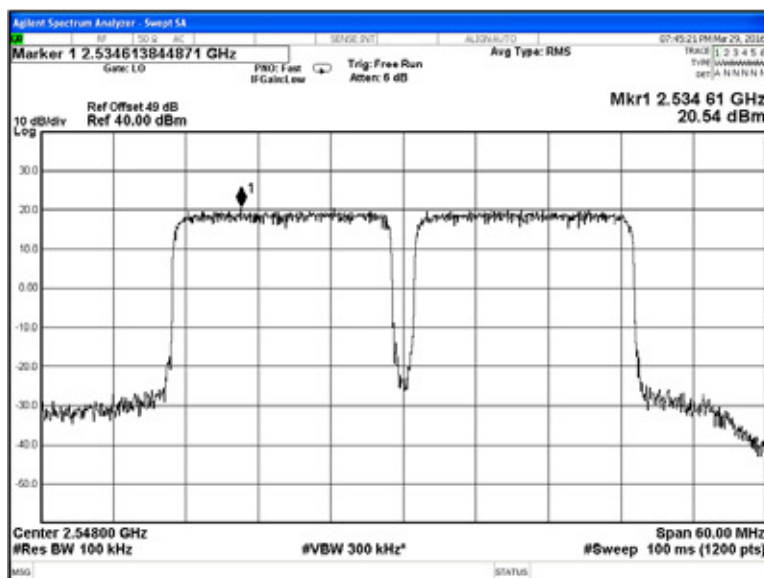


Test specification:		Section 27.50, Peak output power	
Test procedure:		47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Plot 7.6.11 Power spectral density test results at mid frequency, 64QAM, 40 MHz EBW RF # 2



Plot 7.6.12 Power spectral density test results at high frequency, 64QAM, 40 MHz EBW RF # 2



Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

7.7 Band edge emissions at RF connector test in 2498.5 – 2687.5 MHz band

7.7.1 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 7.7.1.

Table 7.7.1 Spurious emission limits at band edges

Channel	Frequency range	Attenuation below carrier, dBc	Limit, dBm
Channel bandwidth 40 MHz			
2516	2496.0 - 2502.0	43+ 10*Log (P*)	-13.0
	2502.0 - 2507.5		
	2507.5 - 2513.0		
	2513.0 - 2518.5		
	2518.5 - 2524.0		
	2524.0 - 2529.5		
	2529.5 - 2535.0		
2594	2535.0 - 2540.5	43+ 10*Log (P*)	-13.0
	2572.0 - 2578.0		
	2578.0 - 2584.0		
	2584.0 - 2590.0		
	2590.0 - 2596.0		
	2596.0 - 2602.0		
	2602.0 - 2608.0		
2670	2608.0 - 2614.0	43+ 10*Log (P*)	-13.0
	2646.0 - 2651.5		
	2651.5 - 2657.0		
	2657.0 - 2662.5		
	2662.5 - 2668.0		
	2668.0 - 2673.5		
	2673.5 - 2679.0		
	2679.0 - 2684.5		
	2684.5 - 2690.0		

* - P is transmitter output power in Watts

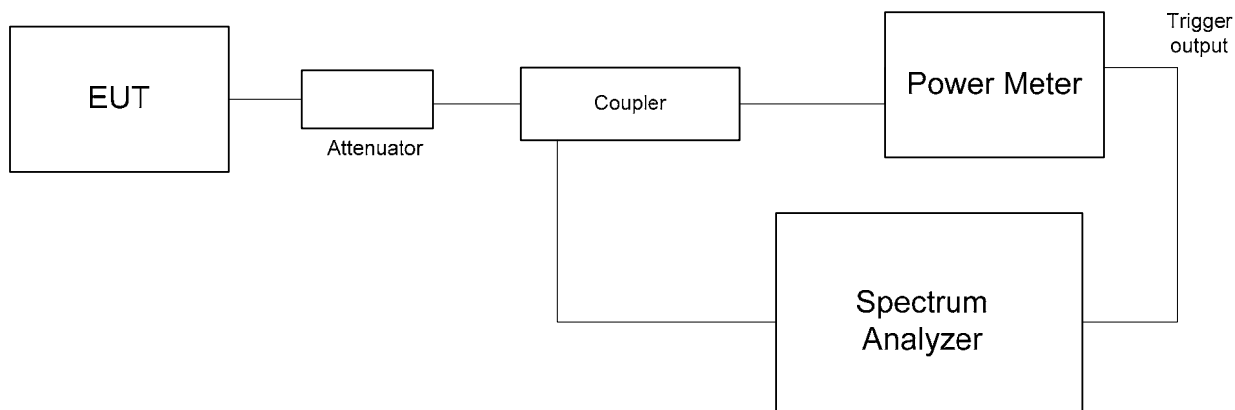
7.7.2 Test procedure

7.7.2.1 The EUT was set up as shown in Figure 7.7.1, energized and its proper operation was checked.

7.7.2.2 The spurious emission was measured with spectrum analyzer as provided in Table 7.7.2, Table 7.7.3 and the associated plots.

Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Figure 7.7.1 Spurious emission test setup for single output



Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Table 7.7.2 Spurious emission at the low band edge test results

ASSIGNED FREQUENCY RANGE: 2496.0 – 2690.0 MHz
DETECTOR USED: Average
VIDEO BANDWIDTH: ≥ Resolution bandwidth
EBW: 40 MHz

LDV:

40 MHz

Frequency MHz	Frequency offset, ± MHz	Low band edge dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
QPSK						
2516	20.5	-14.44	430	NA	-13.0	Pass
	21.5	-14.91	430	1000	-13.0	
2594	20.5	-14.40	430	NA	-13.0	Pass
	21.5	-15.72	430	1000	-13.0	
2670	20.5	-13.80	430	NA	-13.0	Pass
	21.5	-13.57	430	1000	-13.0	
64QAM						
2516	20.5	-15.07	430	NA	-13.0	Pass
	21.5	-14.05	430	1000	-13.0	
2594	20.5	-15.39	430	NA	-13.0	Pass
	21.5	-16.94	430	1000	-13.0	
2670	20.5	-13.16	430	NA	-13.0	Pass
	21.5	-13.78	430	1000	-13.0	

Table 7.7.3 Spurious emission at the high band edge test results

DETECTOR USED: Average
VIDEO BANDWIDTH: ≥ Resolution bandwidth
EBW: 40MHz

EDW:

40 MHz

Frequency MHz	Frequency offset, ± MHz	High band edge dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
QPSK						
2516	20.5	-14.16	430	NA	-13.0	Pass
	21.5	-14.64	430	1000	-13.0	
2594	20.5	-14.08	430	NA	-13.0	Pass
	21.5	-17.50	430	1000	-13.0	
2670	20.5	-13.40	430	NA	-13.0	Pass
	21.5	-13.66	430	1000	-13.0	
64QAM						
2516	20.5	-15.14	430	NA	-13.0	Pass
	21.5	-14.20	430	1000	-13.0	
2594	20.5	-13.42	430	NA	-13.0	Pass
	21.5	-17.23	430	1000	-13.0	
2670	20.5	-13.77	430	NA	-13.0	Pass
	21.5	-13.74	430	1000	-13.0	

Reference numbers of test equipment used

HL 2214	HL 3301	HL 3302	HL 4274	HL 4575			
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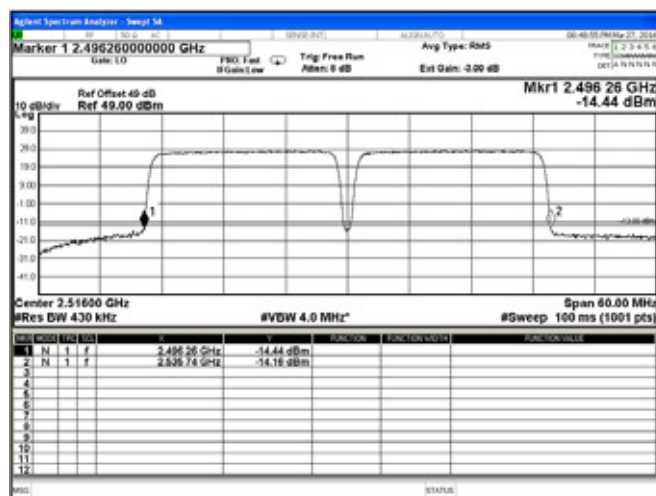
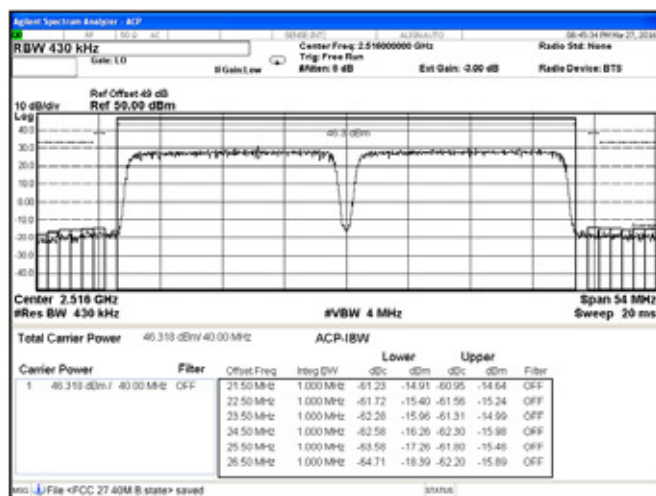
Full description is given in Appendix A.

Test specification:	Section 27.53, Band edge emissions		
Test procedure:	47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Mar-16 - 30-Mar-16		
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.7.1 Spurious emission at band edges test results at low carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

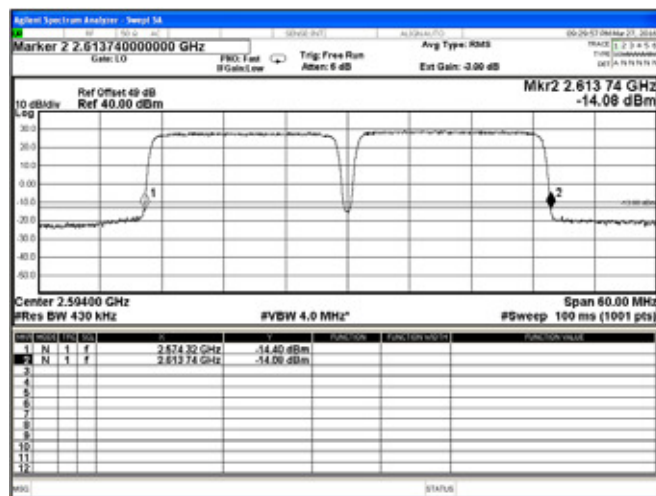
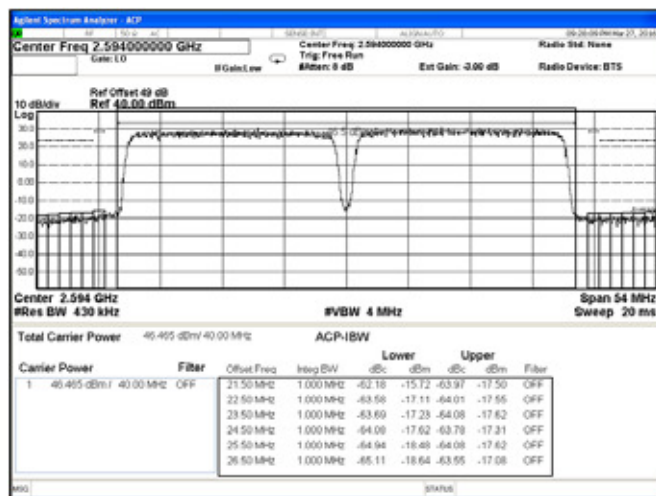
Average
QPSK
PRBS
46.8 Mbps



Plot 7.7.2 Spurious emission at band edges test results at mid carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

Average
QPSK
PRBS
46.8 Mbps

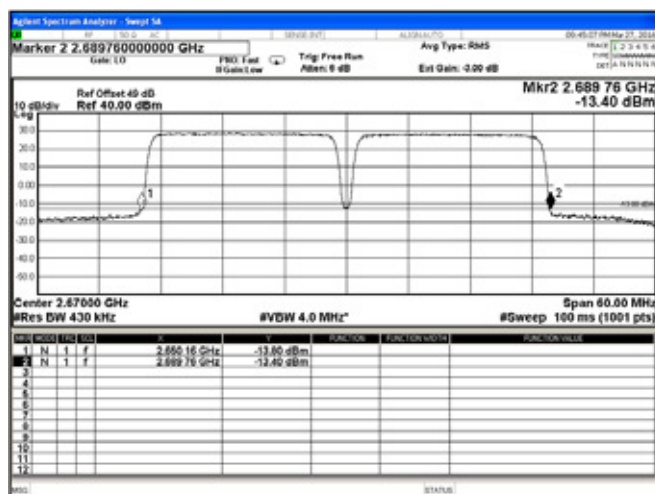
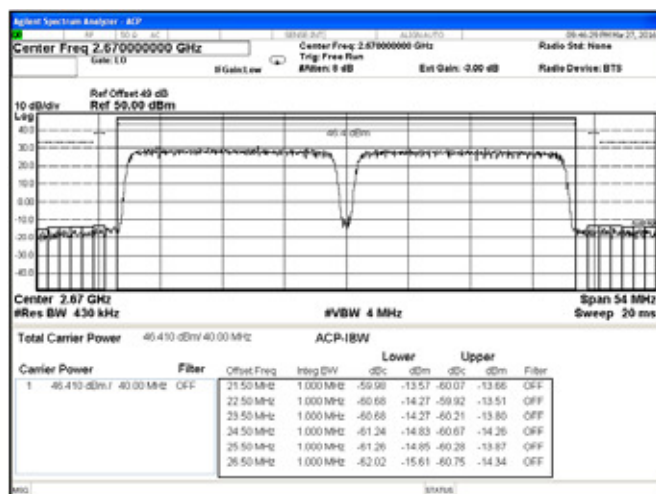


Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.7.3 Spurious emission at band edges test results at high carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

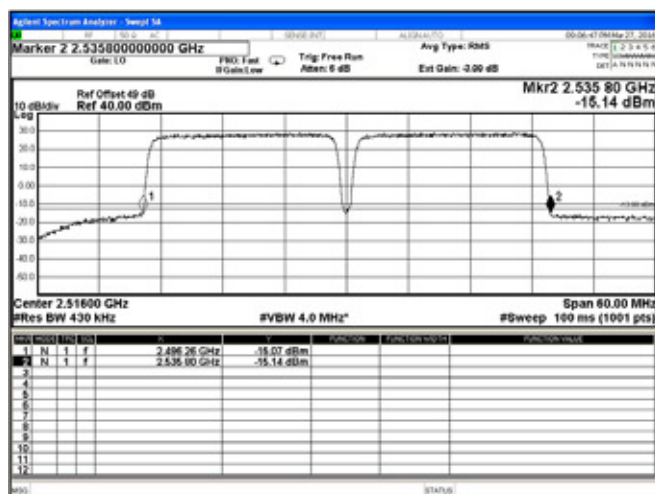
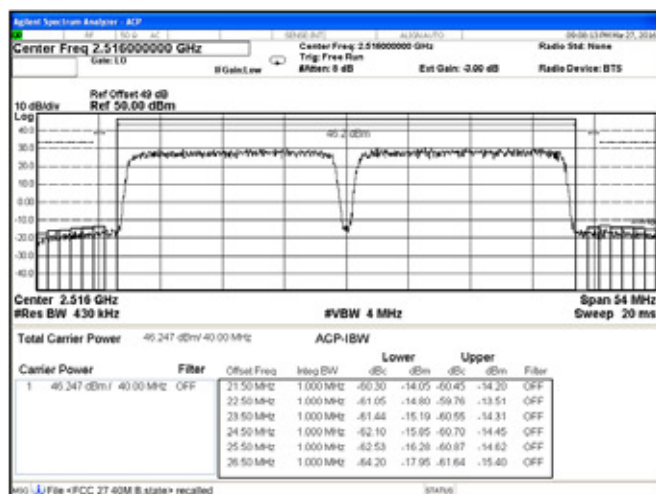
Average
QPSK
PRBS
46.8 Mbps



Plot 7.7.4 Spurious emission at band edges test results at low carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

Average
64QAM
PRBS
190 Mbps

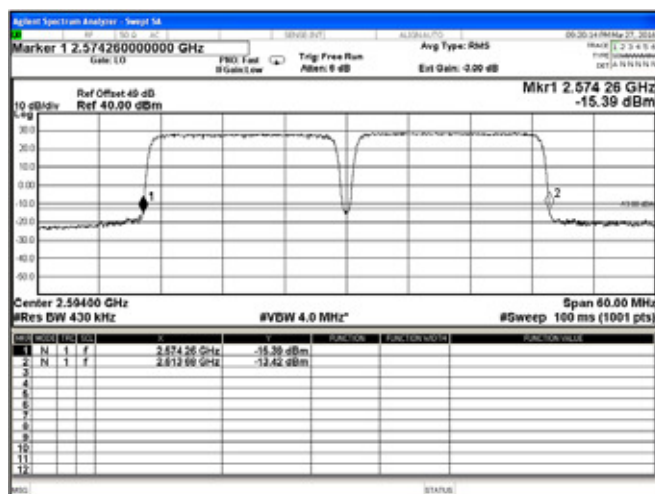
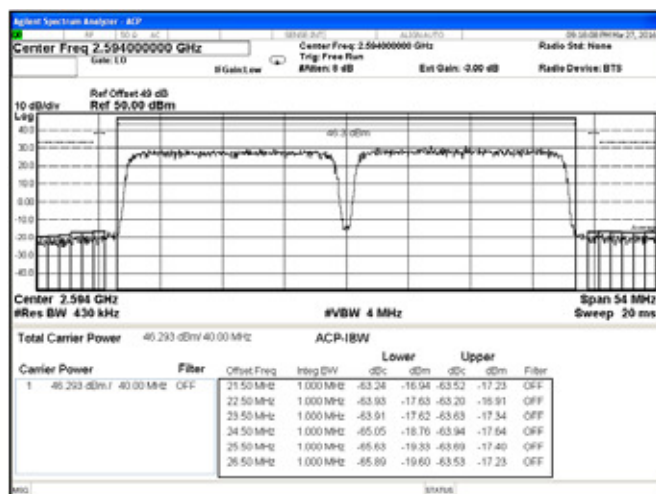


Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.7.5 Spurious emission at band edges test results at mid carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

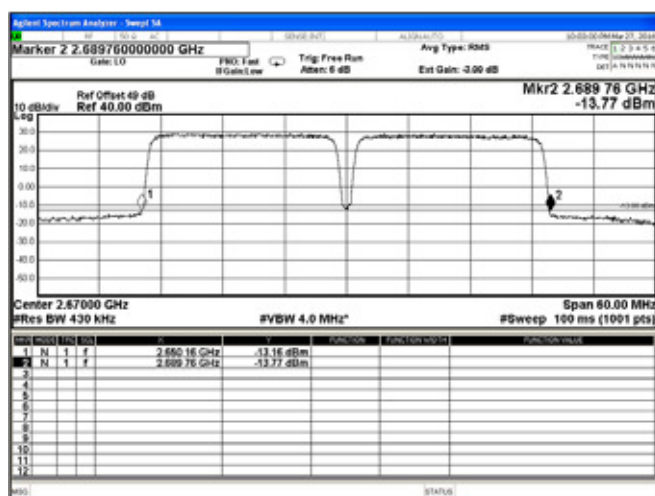
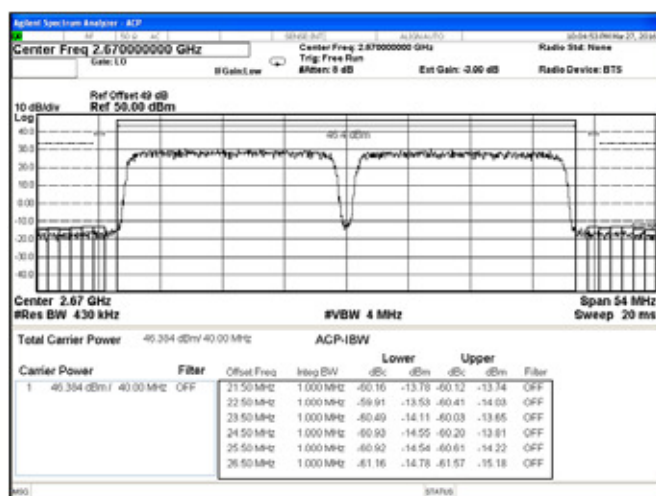
Average
64QAM
PRBS
190 Mbps



Plot 7.7.6 Spurious emission at band edges test results at high carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

Average
64QAM
PRBS
190 Mbps



Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

7.8 Band edge emissions at RF connector test in 2618 – 2690 MHz band

7.8.1 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 7.8.1.

Table 7.8.1 Spurious emission limits at band edges

Channel	Frequency range	Attenuation below carrier, dBc	Limit, dBm
Channel bandwidth 20 MHz			
2638.0	2618.0 - 2624.0 2624.0 - 2629.5 2629.5 - 2635.0 2635.0 - 2640.5 2640.5 - 2646.0 2646.0 - 2651.5 2651.5 - 2657.0 2657.0 - 2662.5	43+ 10*Log (P*)	-13.0
2653.5	2629.5 - 2635.0 2635.0 - 2640.5 2640.5 - 2646.0 2646.0 - 2651.5 2651.5 - 2657.0 2657.0 - 2662.5 2662.5 - 2668.0 2668.0 - 2673.5	43+ 10*Log (P*)	-13.0
2670.0	2646.0 - 2651.5 2651.5 - 2657.0 2657.0 - 2662.5 2662.5 - 2668.0 2668.0 - 2673.5 2673.5 - 2679.0 2679.0 - 2684.5 2684.5 - 2690.0	43+ 10*Log (P*)	-13.0

* - P is transmitter output power in Watts

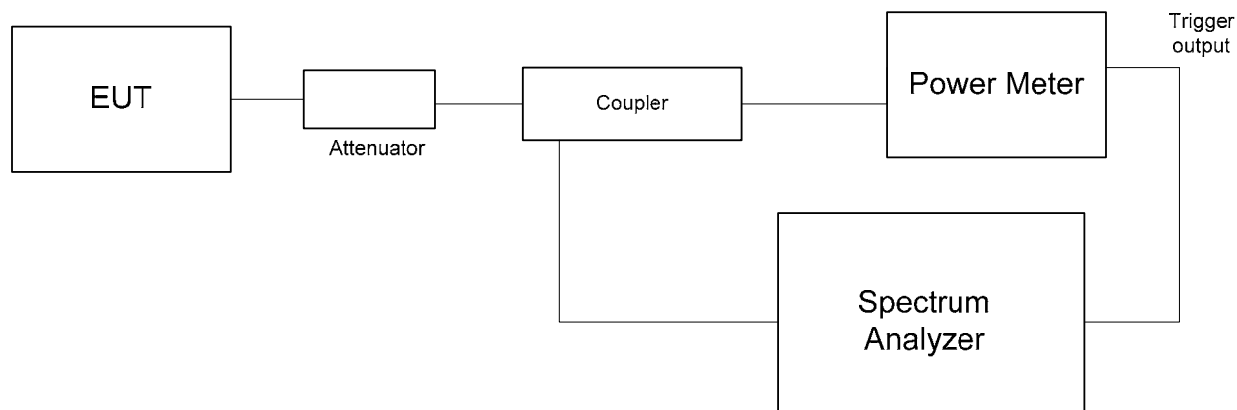
7.8.2 Test procedure

7.8.2.1 The EUT was set up as shown in Figure 7.8.1, energized and its proper operation was checked.

7.8.2.2 The spurious emission was measured with spectrum analyzer as provided in Table 7.8.2, Table 7.8.3 and the associated plots.

Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Figure 7.8.1 Spurious emission test setup for single output



Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Table 7.8.2 Spurious emission at the low band edge test results

ASSIGNED FREQUENCY RANGE: 2618.0 – 2690.0 MHz
DETECTOR USED: Average
VIDEO BANDWIDTH: ≥ Resolution bandwidth
EBW: 40 MHz

EDV: 40 MHz						
Frequency MHz	Frequency offset, ± MHz	Low band edge dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
QPSK						
2638.0	20.5	-13.63	430	NA	-13.0	Pass
	21.5	-15.05	430	1000	-13.0	
2653.5	20.5	-13.23	430	NA	-13.0	Pass
	21.5	-15.59	430	1000	-13.0	
2670.0	20.5	-13.76	430	NA	-13.0	Pass
	21.5	-14.16	430	1000	-13.0	
64QAM						
2638.0	20.5	-14.84	430	NA	-13.0	Pass
	21.5	-15.66	430	1000	-13.0	
2653.5	20.5	-13.81	430	NA	-13.0	Pass
	21.5	-15.02	430	1000	-13.0	
2670.0	20.5	-13.09	430	NA	-13.0	Pass
	21.5	-14.03	430	1000	-13.0	

Table 7.8.3 Spurious emission at the high band edge test results

DETECTOR USED: Average
VIDEO BANDWIDTH: ≥ Resolution bandwidth
EBW: 40MHz

EDW:

40 MHz

Frequency MHz	Frequency offset, ± MHz	High band edge dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
QPSK						
2638.0	20.5	-14.88	430	NA	-13.0	Pass
	21.5	-13.85	430	1000	-13.0	
2653.5	20.5	-15.74	430	NA	-13.0	Pass
	21.5	-15.74	430	1000	-13.0	
2670.0	20.5	-15.65	430	NA	-13.0	Pass
	21.5	-14.10	430	1000	-13.0	
64QAM						
2638.0	20.5	-14.26	430	NA	-13.0	Pass
	21.5	-15.70	430	1000	-13.0	
2653.5	20.5	-13.33	430	NA	-13.0	Pass
	21.5	-14.56	430	1000	-13.0	
2670.0	20.5	-13.71	430	NA	-13.0	Pass
	21.5	-13.90	430	1000	-13.0	

Reference numbers of test equipment used

HL 2214	HL 3301	HL 3302	HL 4274	HL 4575			
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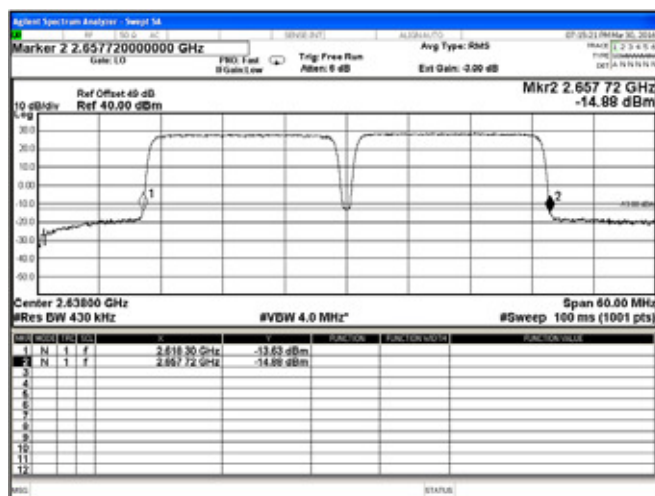
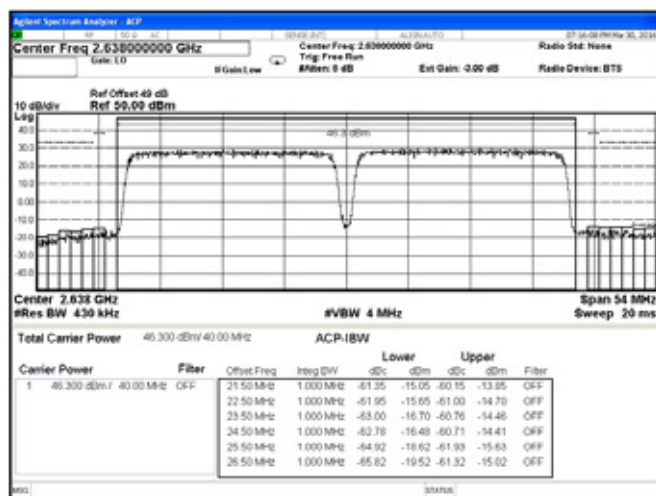
Full description is given in Appendix A.

Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Plot 7.8.1 Spurious emission at band edges test results at low carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

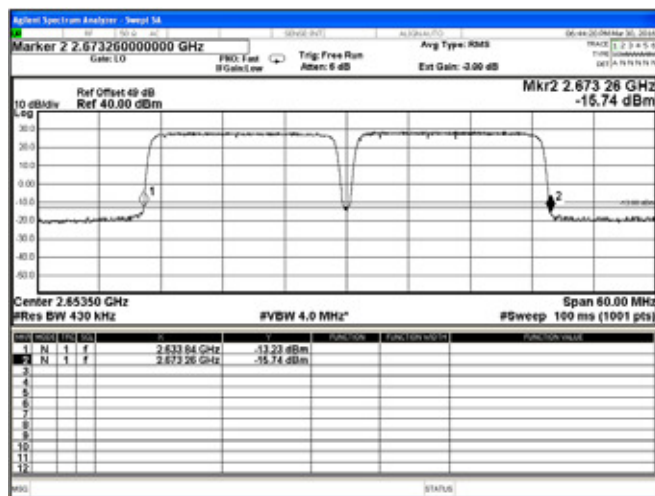
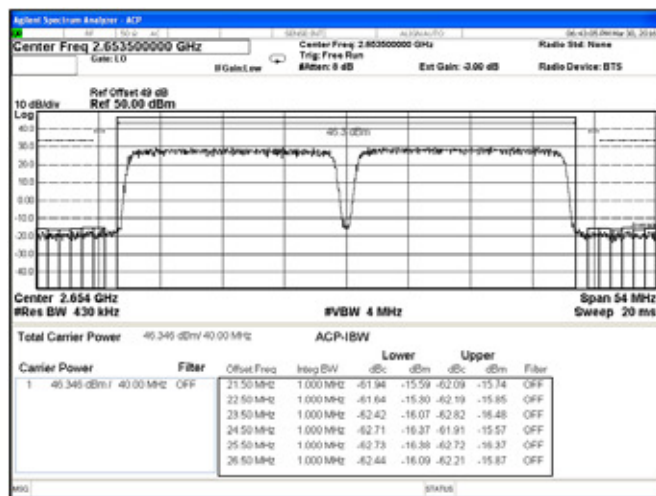
Average
QPSK
PRBS
46.8 Mbps



Plot 7.8.2 Spurious emission at band edges test results at mid carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

Average
QPSK
PRBS
46.8 Mbps

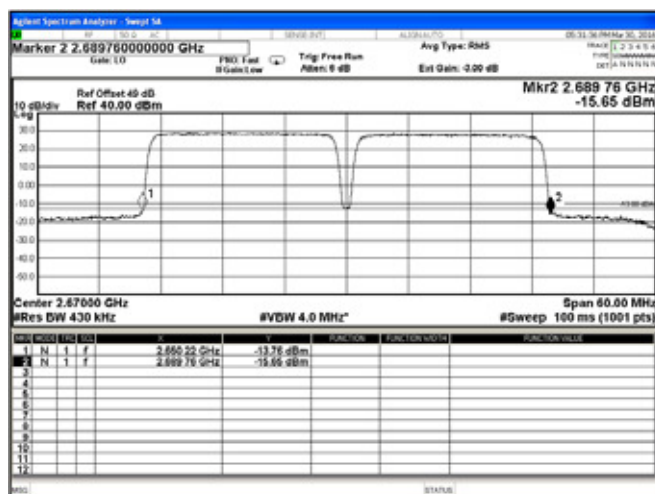
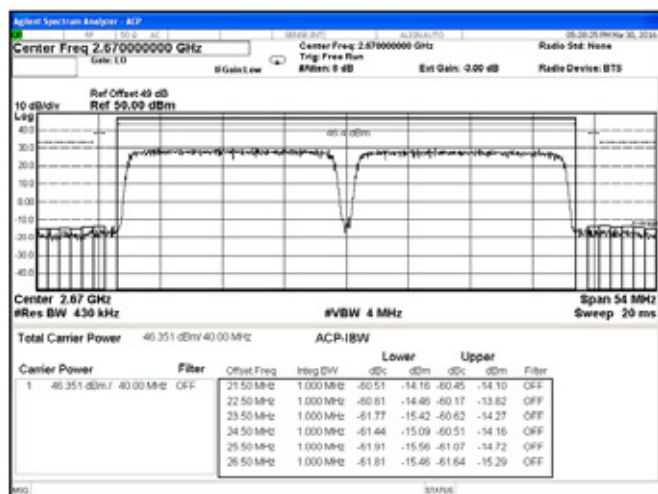


Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Plot 7.8.3 Spurious emission at band edges test results at high carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

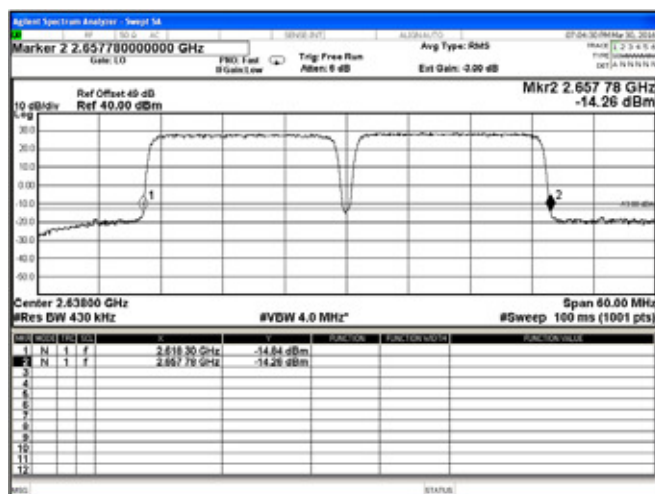
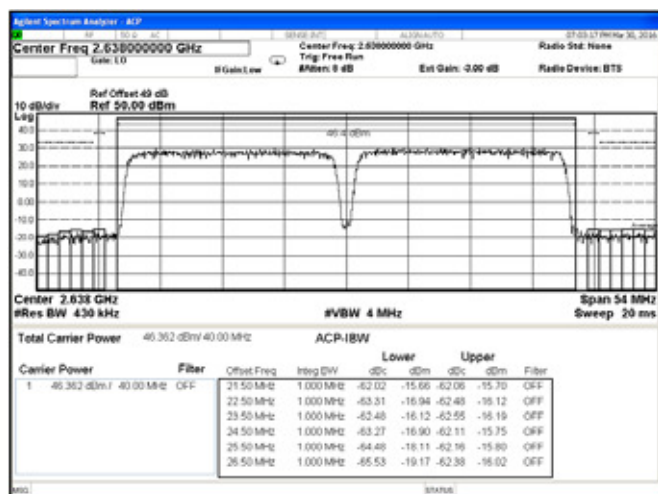
Average
QPSK
PRBS
46.8 Mbps



Plot 7.8.4 Spurious emission at band edges test results at low carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

Average
64QAM
PRBS
190 Mbps

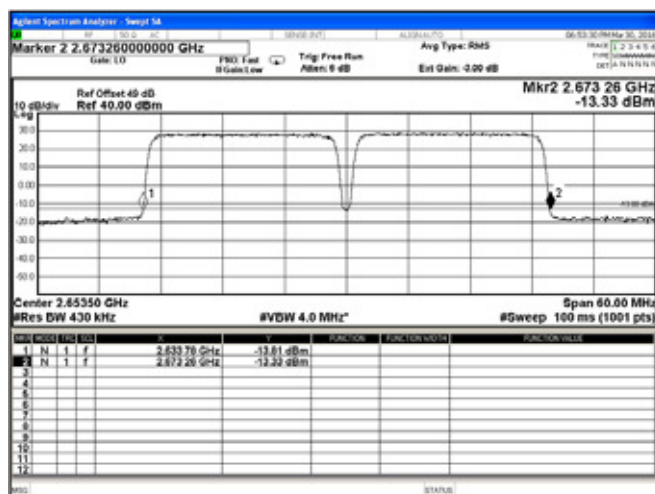
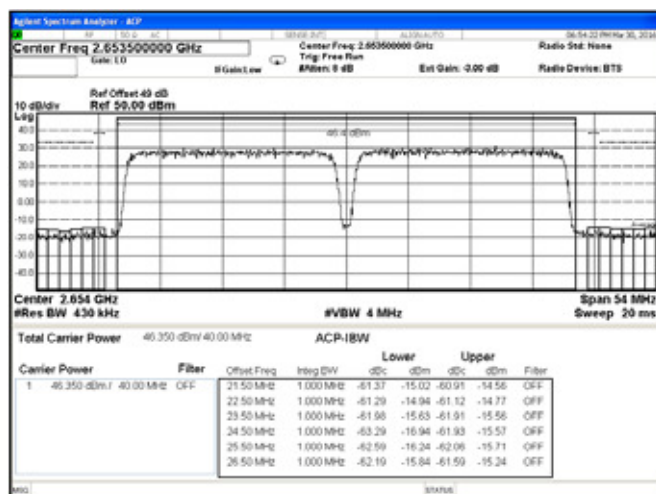


Test specification:	Section 27.53, Band edge emissions		
Test procedure:	47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13		
Test mode:	Compliance	Verdict:	PASS
Date(s):	27-Mar-16 - 30-Mar-16		
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in high band 2638-2670 MHz			

Plot 7.8.5 Spurious emission at band edges test results at mid carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

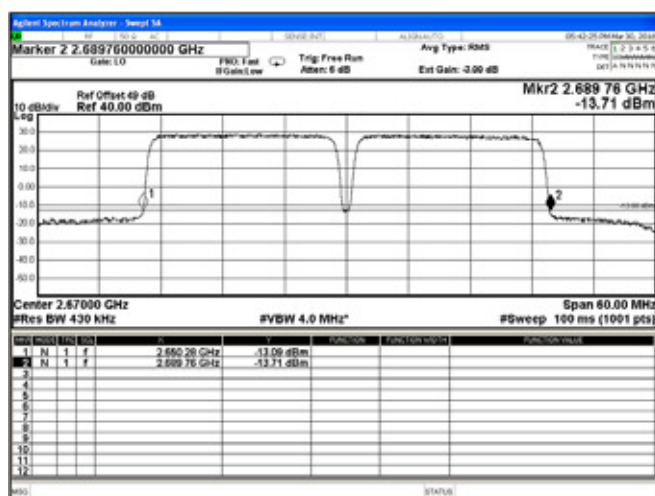
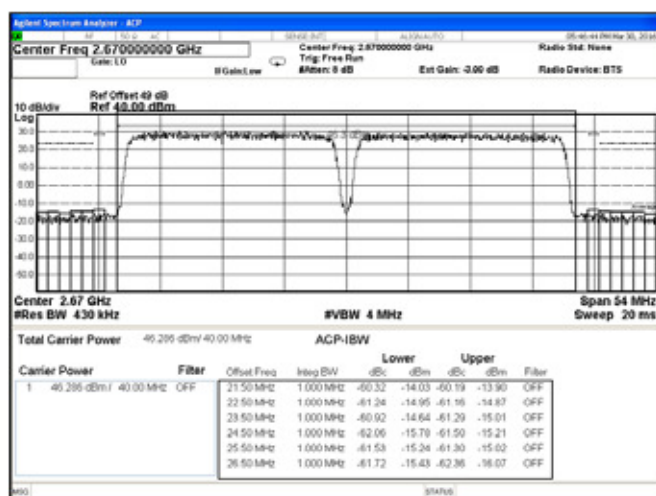
Average
64QAM
PRBS
190 Mbps



Plot 7.8.6 Spurious emission at band edges test results at high carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

Average
64QAM
PRBS
190 Mbps



Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

7.9 Band edge emissions at RF connector test in 2496 – 2568 MHz band

7.9.1 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 7.9.1.

Table 7.9.1 Spurious emission limits at band edges

Channel	Frequency range	Attenuation below carrier, dBc	Limit, dBm
Channel bandwidth 40 MHz			
2516	2496.0 - 2502.0	43+ 10*Log (P*)	-13.0
	2502.0 - 2507.5		
	2507.5 - 2513.0		
	2513.0 - 2518.5		
	2518.5 - 2524.0		
	2524.0 - 2529.5		
	2529.5 - 2535.0		
2537	2535.0 - 2540.5	43+ 10*Log (P*)	-13.0
	2513.0 - 2518.5		
	2518.5 - 2524.0		
	2524.0 - 2529.5		
	2529.5 - 2535.0		
	2535.0 - 2540.5		
	2540.5 - 2546.0		
2548	2546.0 - 2551.5	43+ 10*Log (P*)	-13.0
	2551.5 - 2557.0		
	2524.0 - 2529.5		
	2529.5 - 2535.0		
	2535.0 - 2540.5		
	2540.5 - 2546.0		
	2546.0 - 2551.5		
	2551.5 - 2557.0		
	2557.0 - 2562.5		
	2562.5 - 2568.0		

* - P is transmitter output power in Watts

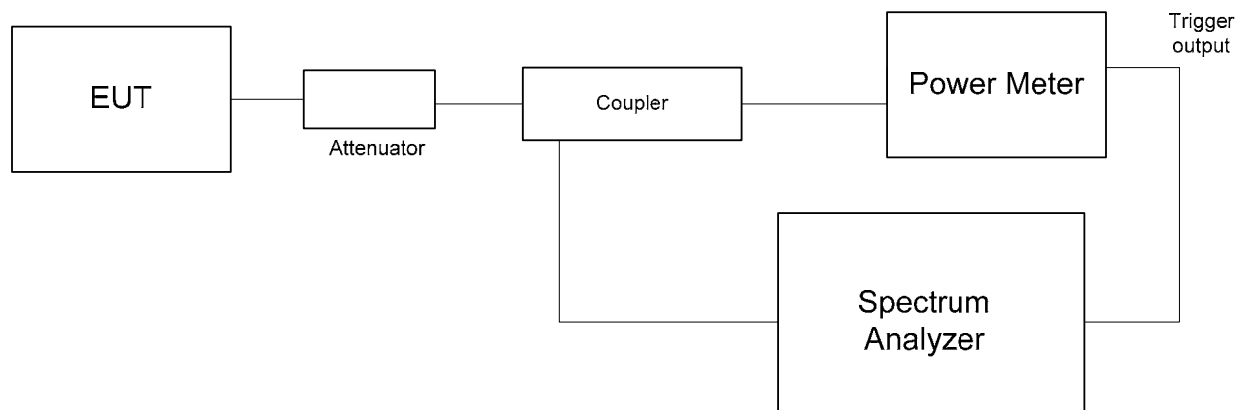
7.9.2 Test procedure

7.9.2.1 The EUT was set up as shown in Figure 7.9.1, energized and its proper operation was checked.

7.9.2.2 The spurious emission was measured with spectrum analyzer as provided in Table 7.9.2, Table 7.9.3 and the associated plots.

Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Figure 7.9.1 Spurious emission test setup for single output



Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Table 7.9.2 Spurious emission at the low band edge test results

ASSIGNED FREQUENCY RANGE: 2496.0 – 2568.0 MHz
DETECTOR USED: Average
VIDEO BANDWIDTH: ≥ Resolution bandwidth
EBW: 40 MHz

LDV: 40 MHz

Frequency MHz	Frequency offset, ± MHz	Low band edge dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
QPSK						
2516	20.5	-13.83	430	NA	-13.0	Pass
	21.5	-14.79	430	1000	-13.0	
2537	20.5	-14.99	430	NA	-13.0	Pass
	21.5	-15.17	430	1000	-13.0	
2548	20.5	-13.36	430	NA	-13.0	Pass
	21.5	-15.50	430	1000	-13.0	
64QAM						
2516	20.5	-15.50	430	NA	-13.0	Pass
	21.5	-14.41	430	1000	-13.0	
2537	20.5	-13.59	430	NA	-13.0	Pass
	21.5	-14.91	430	1000	-13.0	
2548	20.5	-15.54	430	NA	-13.0	Pass
	21.5	-15.96	430	1000	-13.0	

Table 7.9.3 Spurious emission at the high band edge test results

DETECTOR USED: Average
VIDEO BANDWIDTH: ≥ Resolution bandwidth
EBW: 40MHz

EDW: 40MHz

Frequency MHz	Frequency offset, ± MHz	High band edge dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Verdict
QPSK						
2516	20.5	-14.63	430	NA	-13.0	Pass
	21.5	-14.25	430	1000	-13.0	
2537	20.5	-13.94	430	NA	-13.0	Pass
	21.5	-16.18	430	1000	-13.0	
2548	20.5	-14.35	430	NA	-13.0	Pass
	21.5	-15.99	430	1000	-13.0	
64QAM						
2516	20.5	-14.29	430	NA	-13.0	Pass
	21.5	-15.10	430	1000	-13.0	
2537	20.5	-13.20	430	NA	-13.0	Pass
	21.5	-14.82	430	1000	-13.0	
2548	20.5	-13.60	430	NA	-13.0	Pass
	21.5	-13.86	430	1000	-13.0	

Reference numbers of test equipment used

HL 2214	HL 3301	HL 3302	HL 4274	HL 4575			
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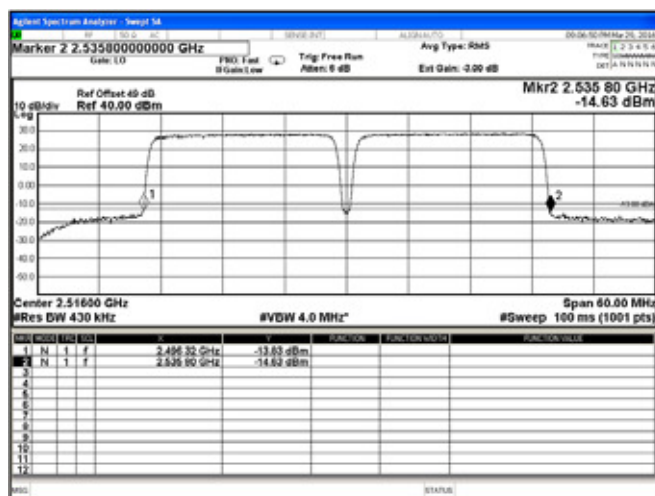
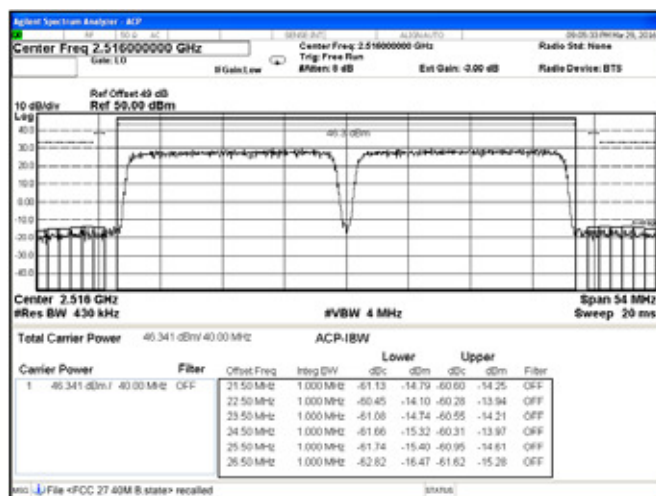
Full description is given in Appendix A.

Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Plot 7.9.1 Spurious emission at band edges test results at low carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

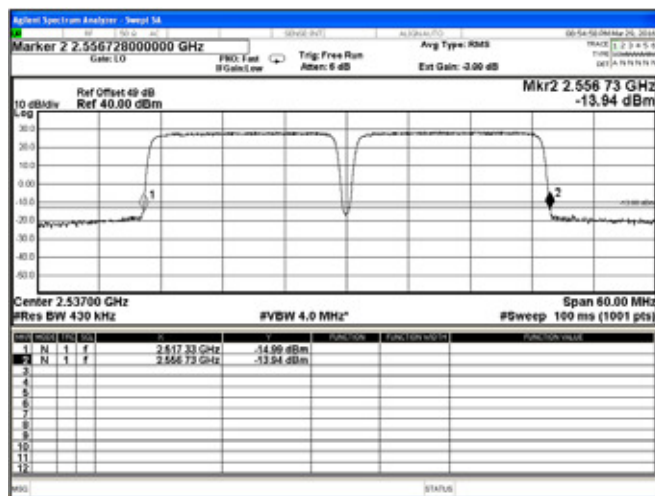
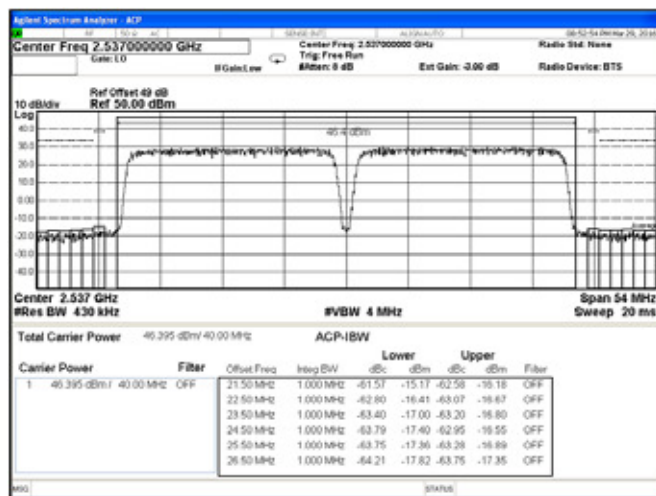
Average
QPSK
PRBS
46.8 Mbps



Plot 7.9.2 Spurious emission at band edges test results at mid carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

Average
QPSK
PRBS
46.8 Mbps

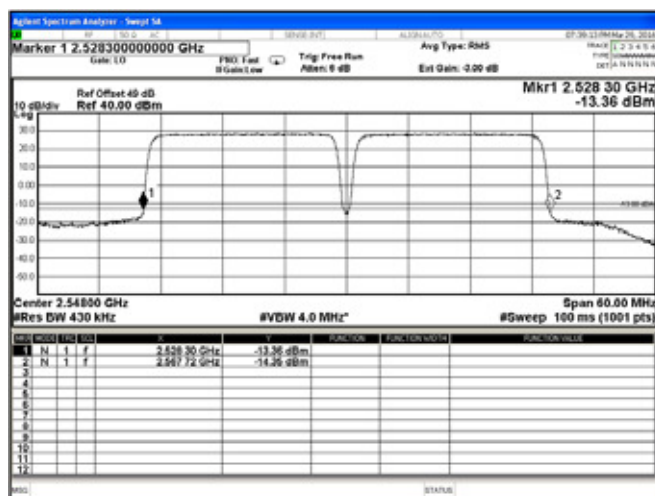
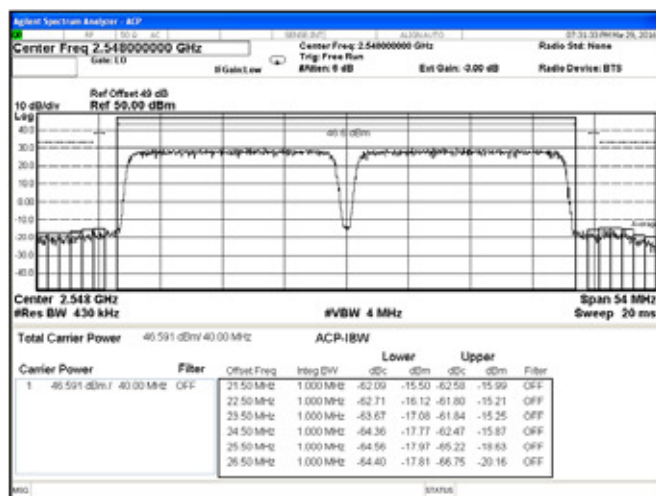


Test specification:		Section 27.53, Band edge emissions	
Test procedure:		47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz			

Plot 7.9.3 Spurious emission at band edges test results at high carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

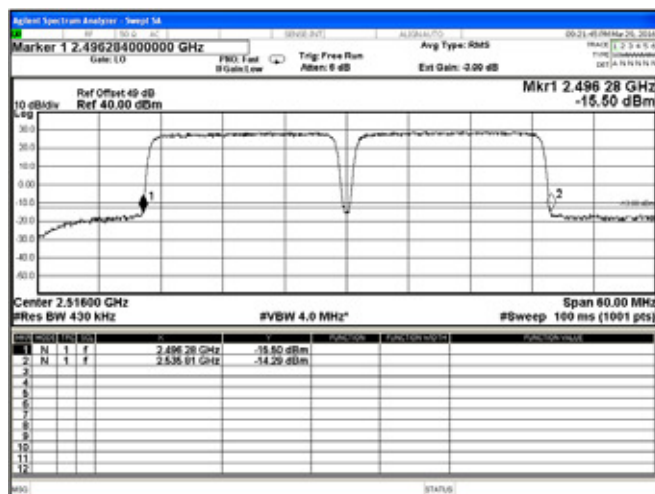
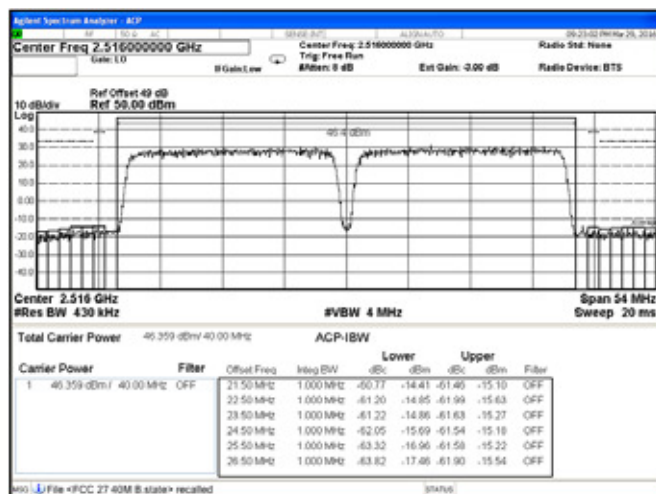
Average
QPSK
PRBS
46.8 Mbps



Plot 7.9.4 Spurious emission at band edges test results at low carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

Average
64QAM
PRBS
190 Mbps

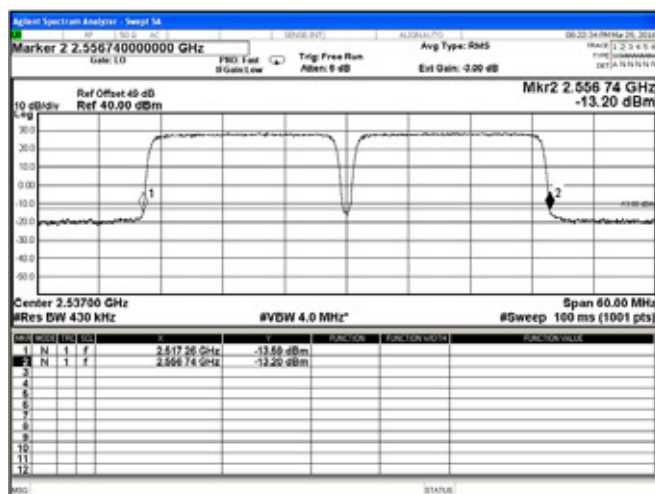
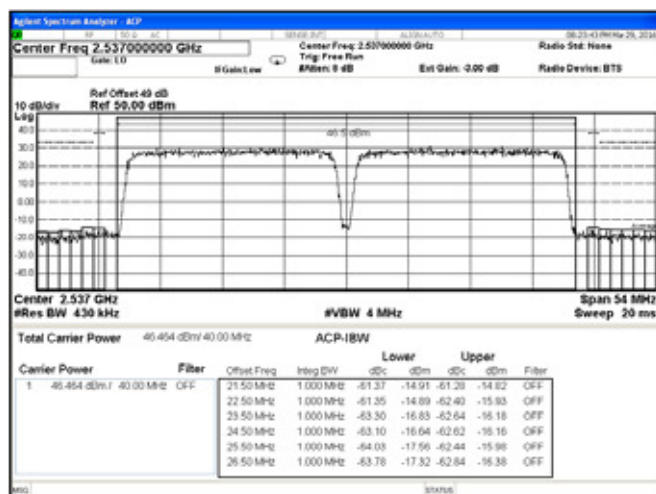


Test specification: Section 27.53, Band edge emissions	
Test procedure: 47 CFR, Sections 2.1051, 27.53; TIA/EIA-603-D, Section 2.2.13	
Test mode: Compliance	Verdict: PASS
Date(s): 27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa
Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in low band 2516-2548 MHz	

Plot 7.9.5 Spurious emission at band edges test results at mid carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

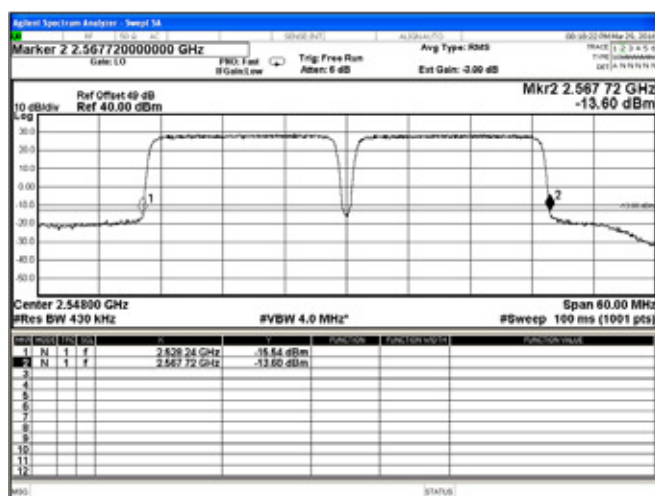
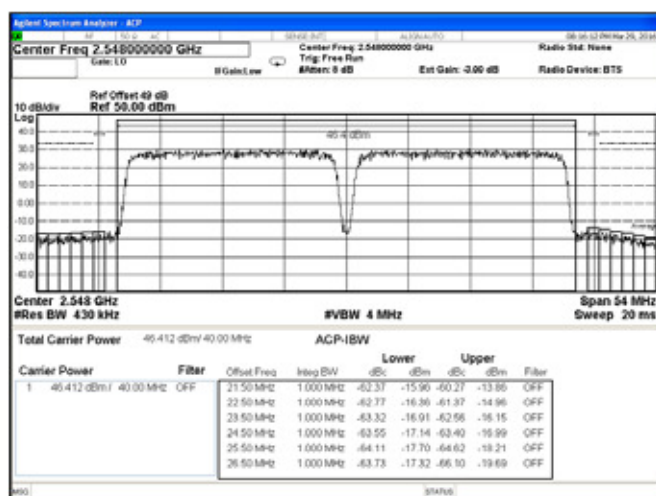
Average
64QAM
PRBS
190 Mbps



Plot 7.9.6 Spurious emission at band edges test results at high carrier frequency, 40 MHz EBW

DETECTOR USED:
MODULATION:
MODULATING SIGNAL:
BIT RATE:

Average
64QAM
PRBS
190 Mbps



Test specification:		Section 27.54, Frequency stability	
Test procedure:		47 CFR, Section 2.1055; TIA/EIA-603-D Section 2.2.2	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

7.10 Frequency stability test

7.10.1 General

This test was performed to measure frequency stability of transmitter RF carrier. Specification test limits are given in Table 7.10.1.

Table 7.10.1 Frequency stability limits

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

7.10.2 Test procedure

7.10.2.1 The EUT was set up as shown in Figure 7.10.1, energized and its proper operation was checked.

7.10.2.2 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.

7.10.2.3 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.

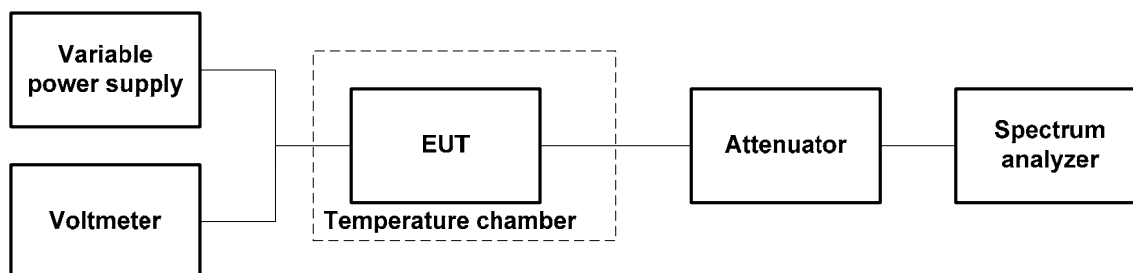
7.10.2.4 The above procedure was repeated at 0°C and at the lowest test temperature.

7.10.2.5 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.

7.10.2.6 Frequency displacement was calculated and provided in Table 7.10.2.

7.10.2.7 The test results provided in Table 7.10.3, Table 7.10.4 and the associated plots.

Figure 7.10.1 Frequency stability test setup



Test specification:		Section 27.54, Frequency stability	
Test procedure:		47 CFR, Section 2.1055; TIA/EIA-603-D Section 2.2.2	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Table 7.10.2 Frequency stability test results

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

T, °C	Voltage, V	Frequency, MHz							Max frequency drift, Hz	
		Start up	1 st min	2 nd min	3 rd min	4 th min	5 th min	10 th min	Positive	Negative
Low carrier frequency 2498.5 MHz										
-30	120	2498.500133	2498.500183	2498.500167	2498.500158	2498.500133	2498.500142	2498.500167	17	33
-20	120	2498.500150	NA	NA	NA	NA	NA	2498.500142	0	24
-10	120	2498.500150	NA	NA	NA	NA	NA	2498.500158	0	16
0	120	2498.500167	2498.500142	2498.500150	2498.500142	2498.500133	2498.500142	2498.500167	0	33
10	120	2498.500133	NA	NA	NA	NA	NA	2498.500158	0	33
20	138	2498.500175	NA	NA	NA	NA	NA	2498.500175	9	0
20	120	2498.500166	NA	NA	NA	NA	NA	2498.500166*	0	0
20	102	2498.500160	NA	NA	NA	NA	NA	2498.500160	0	6
30	120	2498.500125	2498.500125	2498.500133	2498.500142	2498.500125	2498.500125	2498.500125	0	41
40	120	2498.500167	NA	NA	NA	NA	NA	2498.500150	1	16
50	120	2498.500133	NA	NA	NA	NA	NA	2498.500175	9	33
Mid carrier frequency 2593.0 MHz										
-30	120	2593.000167	2593.000158	2593.000142	2593.000167	2593.000150	2593.000183	2593.000175	0	41
-20	120	2593.000150	NA	NA	NA	NA	NA	2593.000187	4	33
-10	120	2593.000158	NA	NA	NA	NA	NA	2593.000175	0	25
0	120	2593.000150	2593.000142	2593.000175	2593.000142	2593.000167	2593.000142	2593.000175	0	41
10	120	2593.000175	NA	NA	NA	NA	NA	2593.000192	9	8
20	138	2593.000183	NA	NA	NA	NA	NA	2593.000183*	0	0
20	120	2593.000175	NA	NA	NA	NA	NA	2593.000175	0	8
20	102	2593.000167	NA	NA	NA	NA	NA	2593.000167	0	16
30	120	2593.000158	2593.000142	2593.000158	2593.000192	2593.000175	2593.000200	2593.000183	17	41
40	120	2593.000175	NA	NA	NA	NA	NA	2593.000175	0	8
50	120	2593.000167	NA	NA	NA	NA	NA	2593.000175	0	16
High carrier frequency 2687.5 MHz										
-30	120	2687.500183	2687.500167	2687.500200	2687.500192	2687.500175	2687.500183	2687.500167	8	25
-20	120	2687.500183	NA	NA	NA	NA	NA	2687.500175	0	18
-10	120	2687.500167	NA	NA	NA	NA	NA	2687.500192	0	25
0	120	2687.500142	2687.500167	2687.500192	2687.500183	2687.500158	2687.500175	2687.500183	0	52
10	120	2687.500183	NA	NA	NA	NA	NA	2687.500158	0	34
20	138	2687.500183	NA	NA	NA	NA	NA	2687.500175	0	17
20	120	2687.500192	NA	NA	NA	NA	NA	2687.500192*	0	0
20	102	2687.500183	NA	NA	NA	NA	NA	2687.500183	0	9
30	120	2687.500158	2687.500142	2687.500125	2687.500125	2687.500133	2687.500142	2687.500158	0	67
40	120	2687.500175	NA	NA	NA	NA	NA	2687.500167	0	25
50	120	2687.500175	NA	NA	NA	NA	NA	2687.500183	0	17

* - Reference frequency

Test specification:		Section 27.54, Frequency stability	
Test procedure:		47 CFR, Section 2.1055; TIA/EIA-603-D Section 2.2.2	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Table 7.10.3 Maximum frequency displacement

Channel	Maximum frequency displacement			
	ppm		Hz	
	Negative	Positive	Negative	Positive
Low	0.020	0.007	41	17
Mid	0.020	0.007	41	17
High	0.025	0.003	67	8

Table 7.10.4 Transmission occupied bandwidth with frequency drift test results

64 QAM

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
40 MHz BW								
2496.26	2535.80	2496.259959	2535.800017	2496.00	2540.50	-0.26	-4.70	Pass
2574.26	2613.68	2574.259959	2613.680017	2572.00	2614.00	-2.26	-0.32	Pass
2650.16	2689.76	2650.159933	2689.760008	2646.00	2690.00	-4.16	-0.24	Pass

QPSK

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
40 MHz BW								
2496.26	2535.74	2496.259959	2535.740017	2496.00	2540.50	-0.26	-4.76	Pass
2574.32	2613.74	2574.319959	2613.740017	2572.00	2614.00	-2.32	-0.26	Pass
2650.16	2689.76	2650.159933	2689.760008	2646.00	2690.00	-4.16	-0.24	Pass

* - Measured under normal test conditions

** - Measured band edge with proper drift addition

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

Reference numbers of test equipment used

HL 1424	HL 1194	HL 3210	HL 3310	HL 4276	HL 4575		
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Full description is given in Appendix A.

Test specification:		Section 27.54, Frequency stability	
Test procedure:		47 CFR, Section 2.1055; TIA/EIA-603-D Section 2.2.2	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.10.1 Emission mask test results at low carrier frequency, 40 MHz EBW

ASSIGNMENT FREQUENCY BANDS:

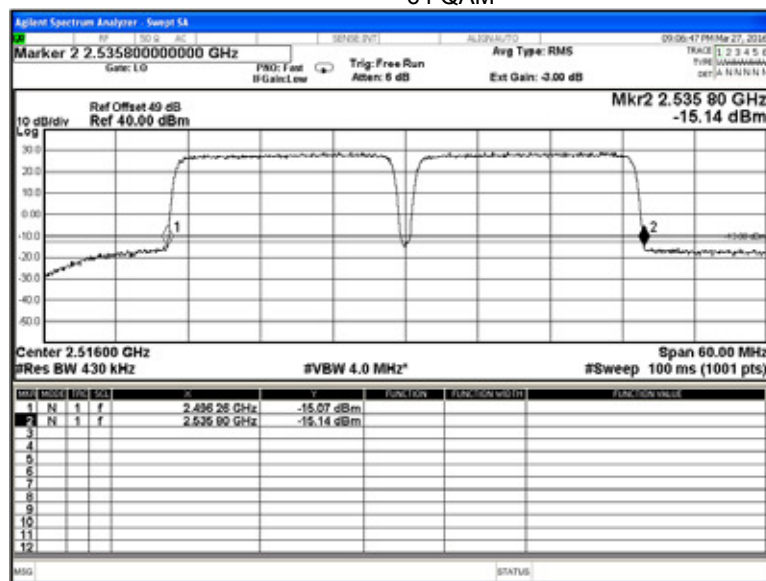
2496.0 – 2540.5 MHz

DETECTOR USED:

Average

MODULATION:

64 QAM



Plot 7.10.2 Emission mask test results at mid carrier frequency, 40 MHz EBW

ASSIGNMENT FREQUENCY BANDS:

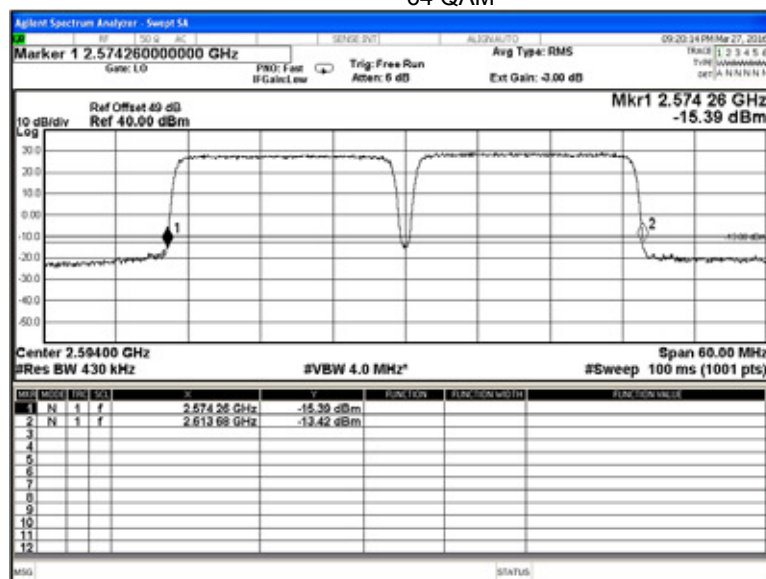
2572.0 – 2614.0 MHz

DETECTOR USED:

Average

MODULATION:

64 QAM

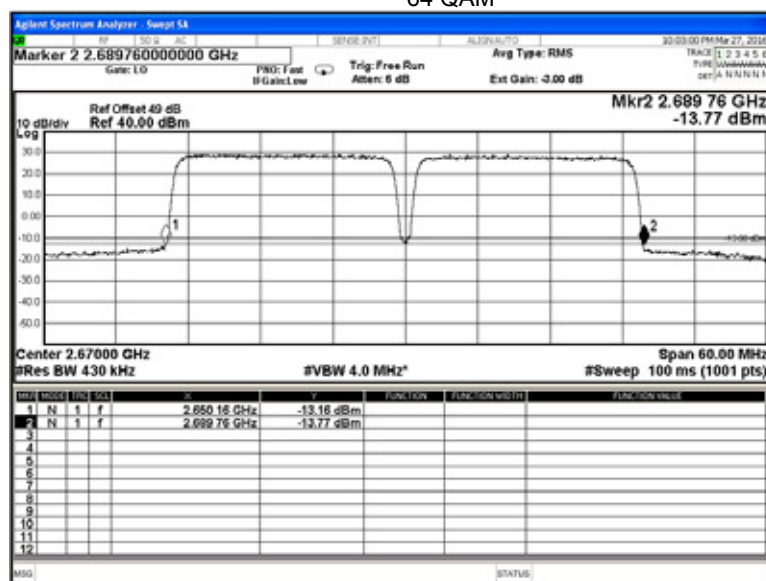


Test specification: Section 27.54, Frequency stability	
Test procedure: 47 CFR, Section 2.1055; TIA/EIA-603-D Section 2.2.2	
Test mode: Compliance	Verdict: PASS
Date(s): 27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa
	Relative Humidity: 43 %
	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz	

Plot 7.10.3 Emission mask test results at high carrier frequency, 40 MHz EBW

ASSIGNMENT FREQUENCY BANDS:
DETECTOR USED:
MODULATION:

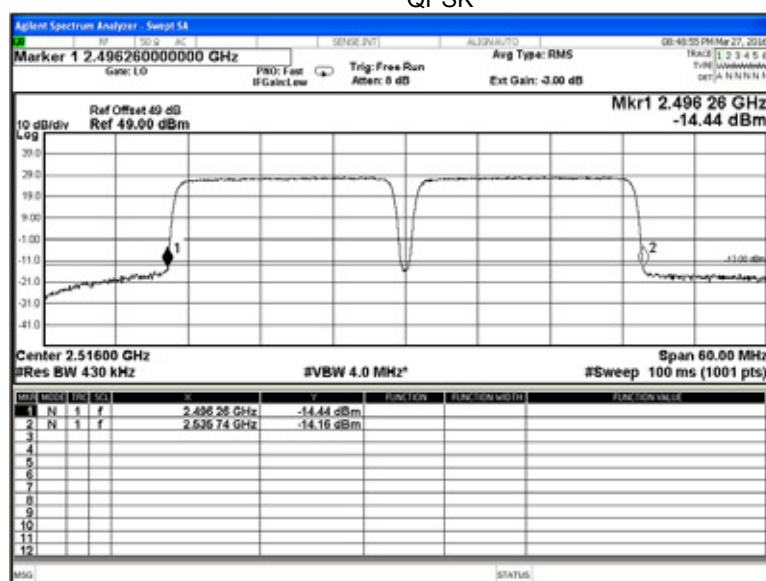
2646.0 – 2690.0 MHz
Average
64 QAM



Plot 7.10.4 Emission mask test results at low carrier frequency, 40 MHz EBW

ASSIGNMENT FREQUENCY BANDS:
DETECTOR USED:
MODULATION:

2496.0 – 2540.5 MHz
Average
QPSK

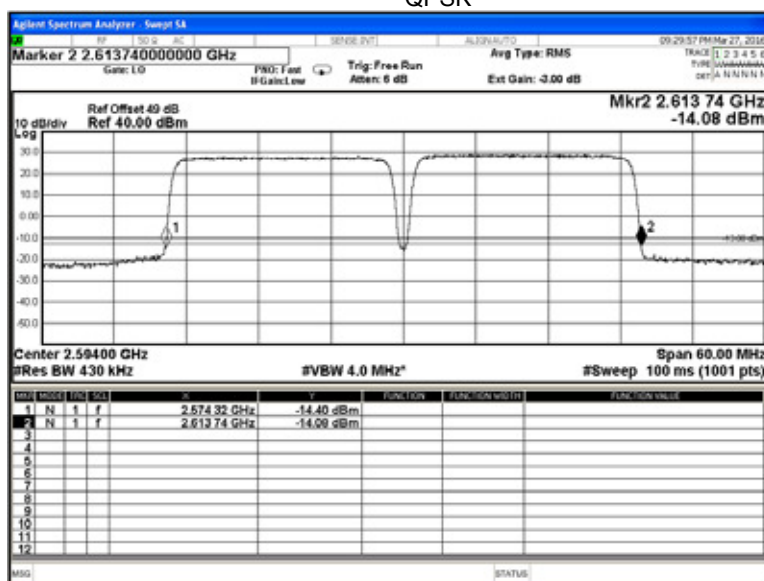


Test specification:		Section 27.54, Frequency stability	
Test procedure:		47 CFR, Section 2.1055; TIA/EIA-603-D Section 2.2.2	
Test mode:		Compliance	Verdict: PASS
Date(s):		27-Mar-16 - 30-Mar-16	
Temperature: 25 °C	Air Pressure: 1008 hPa	Relative Humidity: 43 %	Power Supply: 120 VAC
Remarks: Operation in full band 2516-2670 MHz			

Plot 7.10.5 Emission mask test results at mid carrier frequency, 40 MHz EBW

ASSIGNMENT FREQUENCY BANDS:
DETECTOR USED:
MODULATION:

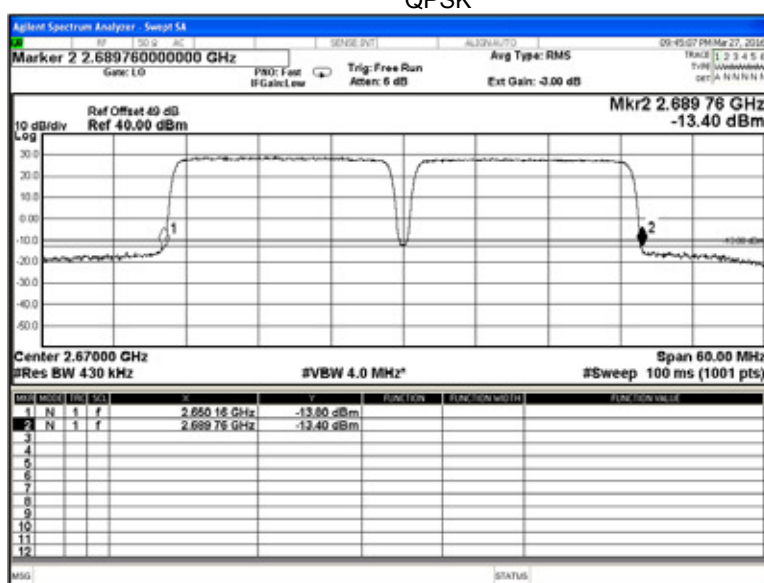
2572.0 – 2614.0 MHz
Average
QPSK



Plot 7.10.6 Emission mask test results at high carrier frequency, 40 MHz EBW

ASSIGNMENT FREQUENCY BANDS:
DETECTOR USED:
MODULATION:

2646.0 – 2690.0 MHz
Average
QPSK



8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
1194	Variac, 220 V/ 2.5 A	Matsunaga	NA	2962	28-May-15	28-May-16
1424	Spectrum Analyzer, 30 Hz- 40 GHz	Agilent Technologies	8564EC	3946A002 19	12-Apr-15	12-Apr-16
2214	Directional Coupler 1.7-26.5 GHz	Krytar	2616	31354	16-Sep-15	16-Sep-17
3210	Temperature Chamber, (-50...+100) °C	Associated Environmental Systems	NA	NA	09-Sep-15	09-Sep-16
3301	Power Meter, P-series, 50 MHz to 40 GHz	Agilent Technologies	N1911A	MY451010 57	30-Jan-15	30-Apr-16
3302	Power sensor, P-Series, 50 MHz to 40 GHz, -35/30 to 20 dBm	Agilent Technologies	N1922A	MY452405 86	30-Jan-15	30-Apr-16
3310	Multimeter	Fluke	115C	94321810	13-Jul-15	13-Jul-16
4274	Test Cable , DC-18 GHz, 1.8 m, SMA/M - N/M	Mini-Circuits	CBL-6FT-SMNM+	70047	28-May-15	28-May-16
4276	Test Cable , DC-18 GHz, 3.05 m, N/M - N/M	Mini-Circuits	APC-10FT-NMNM+	0747A	22-Nov-15	22-Nov-16
4575	EXA Signal Analyzer, 9 kHz - 26.5 GHz	Agilent Technologies	N9010A	MY480301 10	17-Feb-16	17-Mar-17

9 APPENDIX B Measurement uncertainties

Expanded uncertainty at 95% confidence in Hermon Labs EMC measurements

Test description	Expanded uncertainty
Transmitter tests	
Carrier power conducted at antenna connector	± 1.7 dB
Carrier power radiated (substitution method)	± 4.5 dB
Occupied bandwidth	±8%
Conducted emissions at RF antenna connector	9 kHz to 2.9 GHz: ± 2.6 dB 2.9 GHz to 6.46 GHz: ± 3.5 dB 6.46 GHz to 13.2 GHz: ± 4.3 dB 13.2 GHz to 22.0 GHz: ± 5.0 dB 22.0 GHz to 26.8 GHz: ± 5.5 dB 26.8 GHz to 40.0 GHz: ± 4.8 dB
Spurious emissions radiated 30 MHz – 40 GHz (substitution method)	± 4.5 dB
Frequency error	30 – 300 MHz: ± 50.5 Hz (1.68 ppm) 300 – 1000 MHz: ± 168 Hz (0.56 ppm)
Transient frequency behaviour	187 Hz ± 13.9 %
Duty cycle, timing (Tx ON / OFF) and average factor measurements	± 1.0 %

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 number IC 2186A-1 for OATS), 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 IL1001

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11 APPENDIX D Specification references

47CFR part 27: 2015	Private land mobile radio services
47CFR part 1: 2015	Practice and procedure
47CFR part 2: 2015	Frequency allocations and radio treaty matters; general rules and regulations
ANSI C63.2: 1996	American National Standard for Instrumentation-Electromagnetic Noise and Field Strength, 10 kHz to 40 GHz-Specifications.
ANSI C63.4: 2009	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.
ANSI/TIA/EIA-603-D:2010	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards

13 APPENDIX E Test equipment correction factors

Cable loss
Test cable, Mini-Circuits, S/N 70047, 18 GHz, 1.8 m, SMA/M - N/M
CBL-6FT-SMNM+, HL 4274

Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB	Frequency, MHz	Cable loss, dB
10	0.07	4800	1.69	9800	2.62	14800	3.42
30	0.11	4900	1.70	9900	2.63	14900	3.39
50	0.14	5000	1.72	10000	2.64	15000	3.38
100	0.21	5100	1.75	10100	2.64	15100	3.40
200	0.26	5200	1.76	10200	2.66	15200	3.41
300	0.30	5300	1.77	10300	2.67	15300	3.40
400	0.37	5400	1.79	10400	2.68	15400	3.39
500	0.44	5500	1.82	10500	2.68	15500	3.41
600	0.49	5600	1.85	10600	2.70	15600	3.44
700	0.54	5700	1.86	10700	2.71	15700	3.46
800	0.58	5800	1.87	10800	2.73	15800	3.45
900	0.63	5900	1.91	10900	2.74	15900	3.47
1000	0.67	6000	1.94	11000	2.76	16000	3.51
1100	0.71	6100	1.97	11100	2.77	16100	3.56
1200	0.75	6200	1.98	11200	2.78	16200	3.55
1300	0.78	6300	1.99	11300	2.79	16300	3.54
1400	0.81	6400	2.02	11400	2.80	16400	3.57
1500	0.85	6500	2.05	11500	2.82	16500	3.62
1600	0.88	6600	2.06	11600	2.83	16600	3.61
1700	0.91	6700	2.06	11700	2.84	16700	3.60
1800	0.94	6800	2.08	11800	2.85	16800	3.62
1900	0.97	6900	2.10	11900	2.87	16900	3.68
2000	1.00	7000	2.12	12000	2.88	17000	3.70
2100	1.03	7100	2.12	12100	2.89	17100	3.68
2200	1.06	7200	2.13	12200	2.90	17200	3.70
2300	1.08	7300	2.16	12300	2.92	17300	3.80
2400	1.11	7400	2.19	12400	2.94	17400	3.84
2500	1.14	7500	2.22	12500	2.95	17500	3.83
2600	1.16	7600	2.23	12600	2.96	17600	3.83
2700	1.19	7700	2.26	12700	2.98	17700	3.86
2800	1.21	7800	2.30	12800	3.00	17800	3.86
2900	1.27	7900	2.33	12900	3.02	17900	3.80
3000	1.29	8000	2.35	13000	3.03	18000	3.79
3100	1.32	8100	2.37	13100	3.06		
3200	1.35	8200	2.41	13200	3.08		
3300	1.37	8300	2.44	13300	3.09		
3400	1.38	8400	2.47	13400	3.10		
3500	1.41	8500	2.48	13500	3.13		
3600	1.43	8600	2.51	13600	3.17		
3700	1.46	8700	2.53	13700	3.17		
3800	1.47	8800	2.55	13800	3.18		
3900	1.49	8900	2.56	13900	3.22		
4000	1.52	9000	2.57	14000	3.26		
4100	1.55	9100	2.58	14100	3.28		
4200	1.56	9200	2.59	14200	3.30		
4300	1.58	9300	2.59	14300	3.35		
4400	1.60	9400	2.60	14400	3.39		
4500	1.63	9500	2.60	14500	3.39		
4600	1.65	9600	2.61	14600	3.39		
4700	1.67	9700	2.61	14700	3.41		

Cable loss
Test cable, Mini-Circuits, S/N 0747A, 18 GHz, 3.05 m, N/M - N/M
APC-10FT-NMNM+, HL 4276

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

14 APPENDIX F Abbreviations and acronyms

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

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