HERMON LABORATORIES

ELECTRICAL TESTING
0839.01

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TEST REPORT

ACCORDING TO: FCC 47CFR part 27

FOR:

Airspan Networks Inc.
LTE Base Station
Model: AirHarmony 1000D 2.49-2.56 GHz (B41L)
FCC ID:PIDH1KD25L

Table of contents

1 Applicant information

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

2 Equipment under test attributes

Product name:	LTE Base Station
Product type:	Transceiver
Model(s):	AirHarmony 1000D 2.49-2.56 GHz (B41L)
Serial number:	7CEFFACCB400
Hardware version:	C0
Software release:	14.14.50.116
Receipt date	08-May-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:	28365
Location:	Hermon Laboratories Ltd. Harakevet Industrial Zone, Binyamina 30500, Israel
Test started:	08-May-16
Test completed:	10-May-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 2.1049, Occupied bandwidth	Pass

The product was approved under FCC ID:PIDH1KD25L for operation in 2496.0 – 2568.0 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. The same units were used for the 40 MHz CBW testing. The RF circuitry remained exactly the same including the RF filter (no hardware change was done) therefore there is no any impact from the amplifier stages.

The output power of the device remained the same while the bandwidth is twice wider. That results in the reduction of power spectral density by approximately 3 dB [10log(BWs ratio)]. Taking into account that the hardware is the same and the power spectral density is lower, the narrower bandwidth represents the worst case scenario for spurious emissions as it is measured within RBW narrower than the emission BW - the higher PSD yields higher results. Band edge emissions were retested for the wider BW.

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.

This test report supersedes the previously issued test report identified by Doc ID:AIRRAD_FCC.28365_LB.

	Name and Title	Date	Signature
Tested by:	Mr. K. Zushchyk, test engineer	May 10, 2016	
Reviewed by:	Mrs. M. Cherniavsky, certification engineer	June 16, 2016	
Approved by:	Mr. M. Nikishin, EMC and radio group leader	June 16, 2016	

6 EUT description

6.1 General information

The EUT, Base station radio, AirHarmony 1000D 2.49-2.56 GHz (B41L), 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 190 Mbps) uses OFDM and operating in TDD mode, equipped with a 18 dBi external antenna. The maximum total RF output power (not including antenna gain) is 40.36 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.

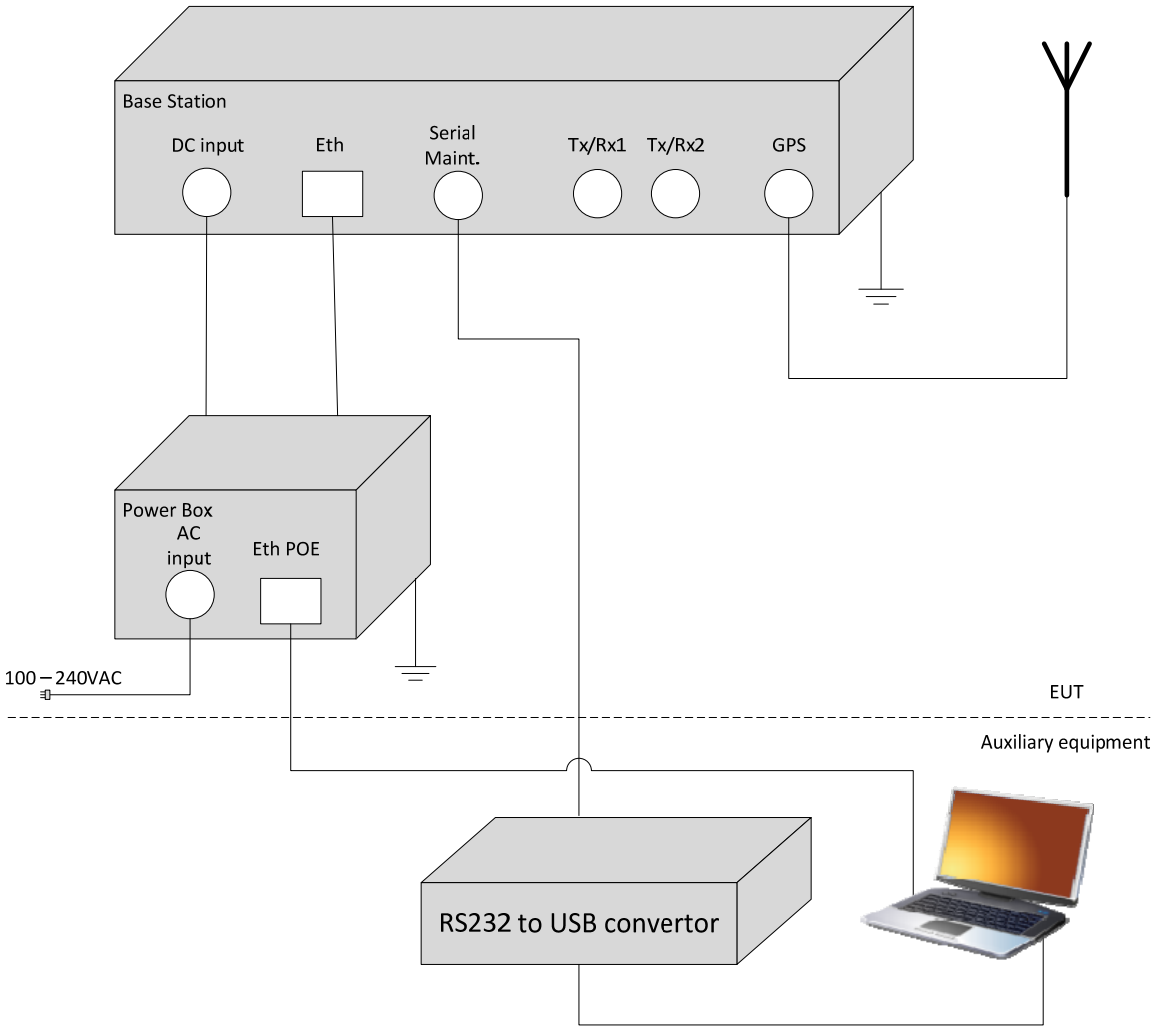
6.2 Ports and lines

Port type	Port description	Connected from	Connected to	Qty.	Cable type	Cable length, m
Power	AC power	AC mains	Power Box	1	Unshielded	3
Power	DC power	Power Box	EUT	1	Unshielded	3
Signal	GPS	EUT	GPS external antenna	1	Coax	3
Signal	Ethernet	EUT	Power Box	1	FTP	3
Signal	Ethernet	Power Box	Laptop	1	NA	NA
RF	RF Link (Tx/Rx	EUT	Anntena	2	Coax	0.5
Signal*	Serial*	Not connected	Not connected	1	NA	NA

6.3 Support and test equipment

Description	Manufacturer	Model number	Serial number
Laptop	DELL	Latitude E7440	DWW5M12

6.4 Test configuration



6.5 Transmitter characteristics

Type of equipment	
V	Stand-alone (Equipment with or without its own control provisions)
	Combined equipment (Equipment where the radio part is fully integrated within another type of equipment)
	Plug-in card (Equipment intended for a variety of host systems)

Intended use		**Condition of use**
V	fixed	Always at a distance more than 2 m from all people
	mobile	Always at a distance more than 20 cm from all people
	portable	May operate at a distance closer than 20 cm to human body

Assigned frequency range	2496.0 – 2572.0 MHz
Operating frequency	2516.0 – 2548.0 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)			40.36 dBm
Is transmitter output power variable?		No		
	V	Yes		continuous variable
			V	stepped variable with step size: 0.25 dB
				minimum RF power: -30 dBm
				maximum RF power at antenna connector: 37.00 dBm

Antenna connection					
unique coupling	**V**	standard connector	Integral	**V**	with temporary RF connector
					without temporary RF connector

Antenna/s technical characteristics

Type	Manufacturer	Model number	Gain
External	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, MBps

Transmitter 26dBc power bandwidth	Type of modulation		
	QPSK	16QAM	64QAM
40 MHz	46.8 MBps	90.8 MBps	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**			
V	AC mains	**Nominal rated voltage**	120VAC	Frequency	

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

Test specification:	Section 2.1049, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	08-May-16		
Temperature: 23 ºC	Air Pressure: 1015 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

7 Transmitter tests according to 47CFR part 27

7.1 Occupied bandwidth test

7.1.1 General

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

Table 7.1.1 Occupied bandwidth limits

Assigned frequency, MHz	Modulation envelope reference points*, dBc	Maximum allowed bandwidth, kHz
2496.0 – 2572.0	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):	08-May-16		
Temperature: 23 ºC	**Air Pressure:** 1015 hPa	**Relative Humidity:** 45 %	**Power Supply:** 120 VAC
Remarks:			

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	38.815	36.901	NA	Pass
2537	38.835	36.873	NA	Pass
2548	38.873	36.840	NA	Pass
64QAM				
2516	38.834	36.864	NA	Pass
2537	38.909	36.903	NA	Pass
2548	38.828	36.842	NA	Pass

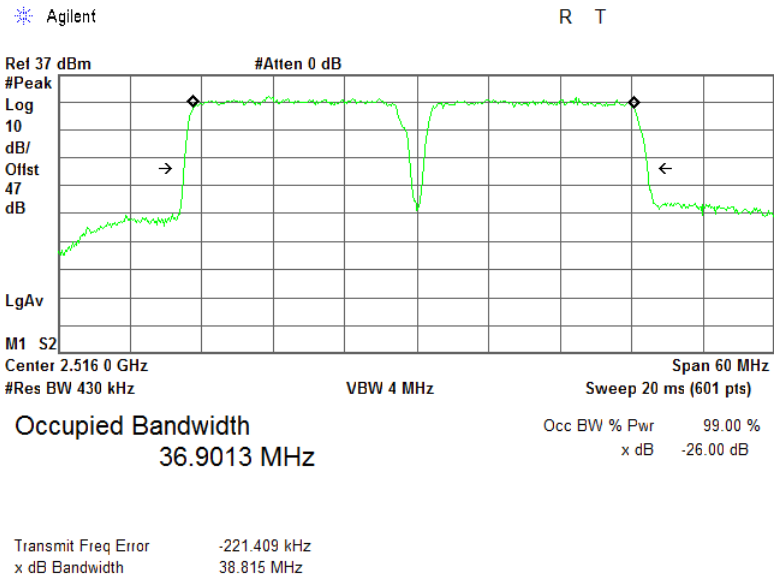
Reference numbers of test equipment used

HL 2214	HL 3301	HL 3302	HL 3818	HL 3903			

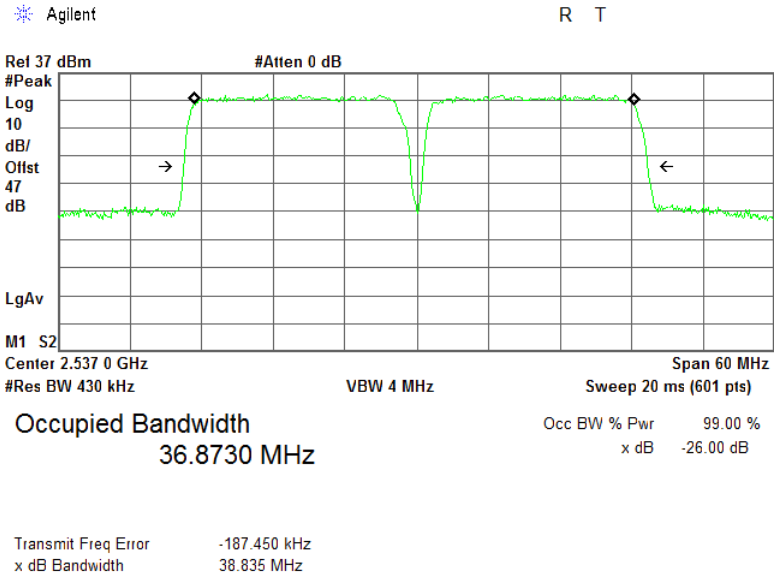
Full description is given in Appendix A.

Test specification:	Section 2.1049, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	08-May-16		
Temperature: 23 ºC	Air Pressure: 1015 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

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

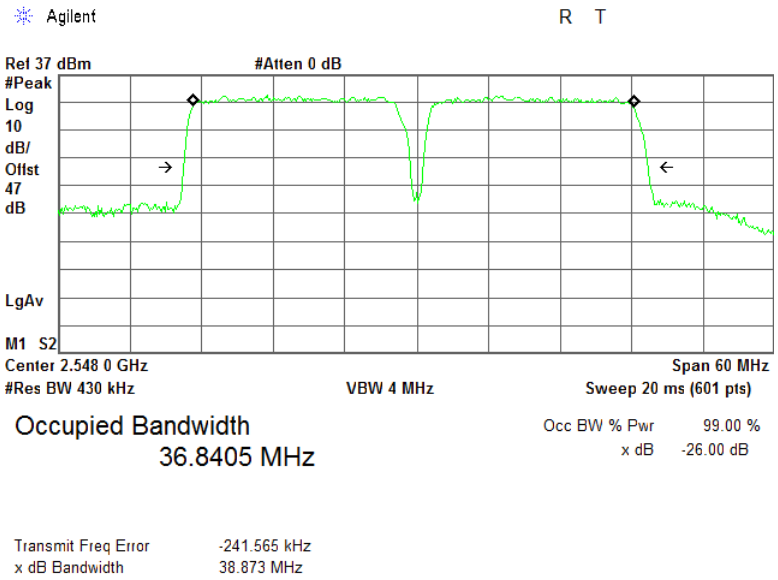


Plot 7.1.2 Occupied bandwidth test results at mid frequency, 40 MHz EBW, QPSK

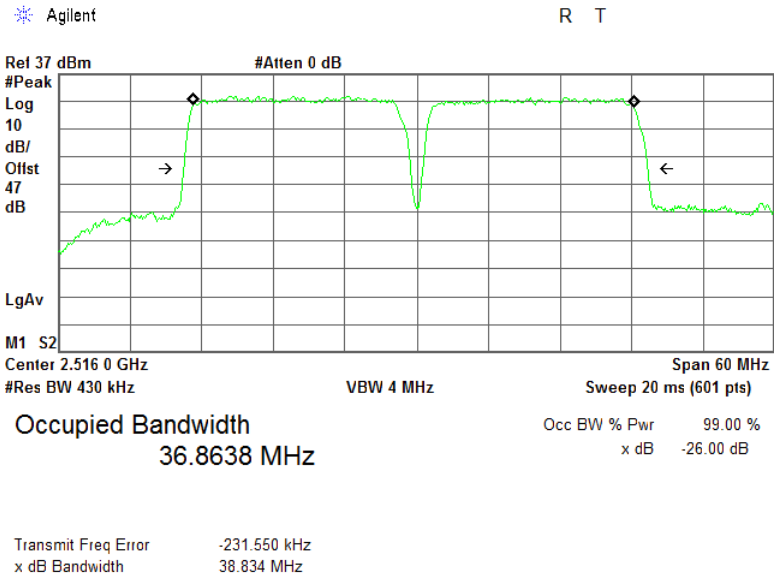


Test specification:	Section 2.1049, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	08-May-16		
Temperature: 23 ºC	Air Pressure: 1015 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

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

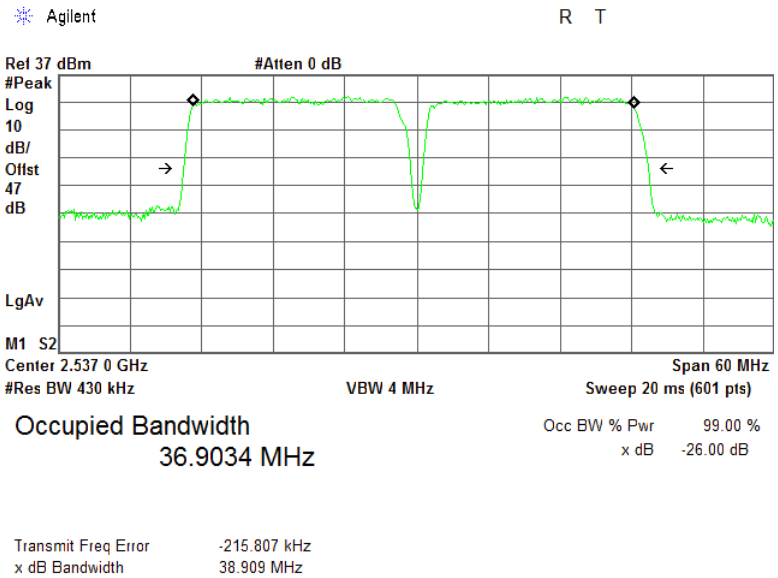


Plot 7.1.4 Occupied bandwidth test results at low frequency, 40 MHz EBW, 64QAM

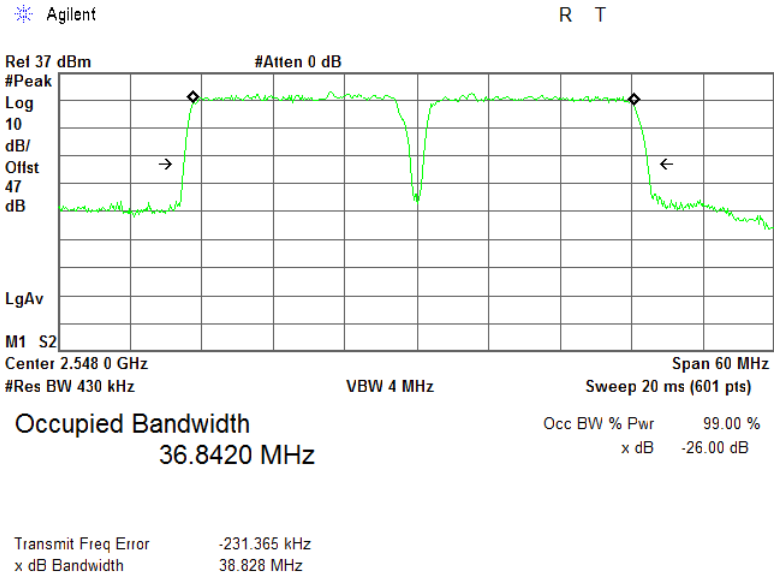


Test specification:	Section 2.1049, Occupied bandwidth		
Test procedure:	47 CFR, Section 2.1049		
Test mode:	Compliance	Verdict:	PASS
Date(s):	08-May-16		
Temperature: 23 ºC	Air Pressure: 1015 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

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 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):	09-May-16		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

7.2 Peak output power test

7.2.1 General

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

Table 7.2.1 Peak output power limits

Transmitter type	Assigned frequency range, MHz	Maximum peak output power dBm
Main, booster and base stations	2496 – 2572	63+10log(X/Y)+10log(360/beamwidth)
		Maximum peak power density dBm/100 kHz
		EIRP+10log(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.

7.2.2 Test procedure

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

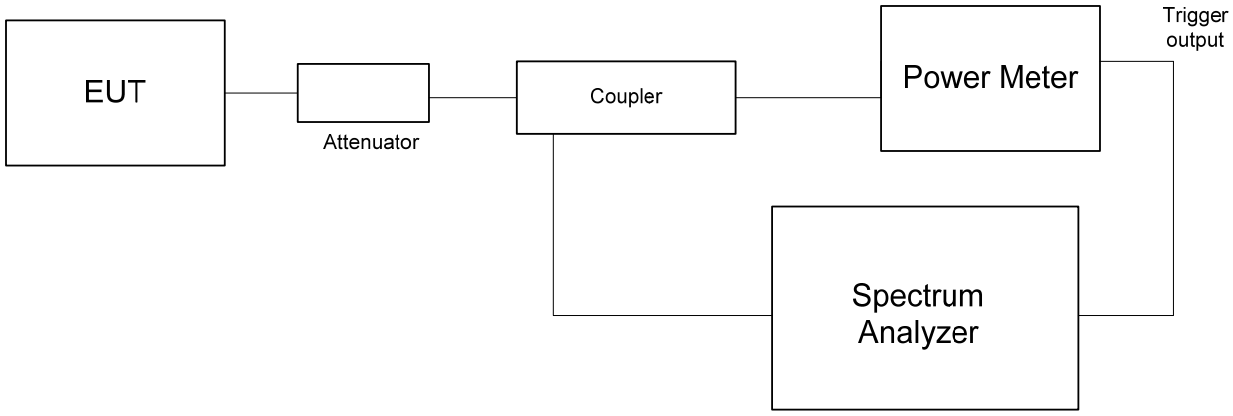
7.2.2.2 The EUT was adjusted to produce maximum available to the end user RF output power.

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

7.2.2.4 The power spectral density was measured with spectrum analyzer as provided in Table 7.2.3 and the associated plots.

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

Figure 7.2.1 Peak output power test setup



Test specification:	Section 27.50, 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):	09-May-16		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

Table 7.2.2 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	37.03	37.05	40.05	18.00	58.05	69.84	-11.79	Pass
2537	37.07	37.10	40.10	18.00	58.10	69.89	-11.79	Pass
2548	37.05	37.04	40.05	18.00	58.05	69.90	-11.85	Pass
64QAM								
2516	37.08	37.02	40.08	18.00	58.08	69.84	-11.76	Pass
2537	37.01	37.07	40.07	18.00	58.07	69.90	-11.83	Pass
2548	37.02	37.05	40.05	18.00	58.05	69.89	-11.84	Pass
QPSK								
2516	37.03	37.05	40.05	17.00	57.05	68.43	-11.38	Pass
2537	37.07	37.10	40.10	17.00	57.10	68.48	-11.38	Pass
2548	37.05	37.04	40.05	17.00	57.05	68.48	-11.43	Pass
64QAM								
2516	37.08	37.02	40.08	17.00	57.08	68.43	-11.35	Pass
2537	37.01	37.07	40.07	17.00	57.07	68.49	-11.42	Pass
2548	37.02	37.05	40.05	17.00	57.05	68.48	-11.43	Pass

* - EIRP total, dBm = Total RF power**, dBm + Antenna Gain, dBi
** - Total RF power , dBm = P(dBm, RFmax of #1 or #2) + 3 dB
*** - See Table 7.2.5

Reference numbers of test equipment used

HL 2214	HL 3301	HL 3302	HL 3818	HL 3903			

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):	09-May-16		
Temperature: 24 ºC	**Air Pressure:** 1014 hPa	**Relative Humidity:** 50 %	**Power Supply:** 120 VAC
Remarks:			

Table 7.2.3 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	15.93	17.86	18.00	38.86	43.36	-4.50	Pass
2537	16.24	17.56	18.00	38.56	43.46	-4.90	Pass
2548	15.80	17.16	18.00	38.16	43.46	-5.30	Pass
64QAM							
2516	15.93	17.86	18.00	38.86	43.36	-4.50	Pass
2537	16.24	17.56	18.00	38.56	43.46	-4.90	Pass
2548	15.80	17.16	18.00	38.16	43.46	-5.30	Pass
QPSK							
2516	15.93	17.86	17.00	37.86	41.94	-4.08	Pass
2537	16.24	17.56	17.00	37.56	42.04	-4.48	Pass
2548	15.80	17.16	17.00	37.16	42.05	-4.89	Pass
64QAM							
2516	15.93	17.86	17.00	37.22	41.95	-4.73	Pass
2537	16.24	17.56	17.00	36.76	42.05	-5.29	Pass
2548	15.80	17.16	17.00	36.62	42.04	-5.42	Pass

* Total PSD, dBm/100kHz = PSD(dBm/100kHz,RFmax of #1 or #2)+ 3 dB + Antenna Gain, dBi
** - See Table 7.2.6

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):	09-May-16		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

Table 7.2.4 Pre transition frequency channels assignment

Channel	OBW, MHz	Peak power limit, dBm	Power density limit, dBm/100kHz
40 MHz 4 Channels QPSK 46.8 Mbps			
2516.0 MHz Ch.1, 2 ,2A, A1, B1, A2, B2, A1, B3	38.815	63+10log(OBW/44.5)+10log(360/beamwidth)	EIRP+10log(0.1/44.5)
2537.0 MHz A2, B2, A3, B3, A4, B4, C1, D1	38.835	63+10log(OBW/44.0)+10log(360/beamwidth)	EIRP+10log(0.1/44.0)
2548.0 MHz A3, B3, A4, B4, C1, D1, C2, D2	38.873	63+10log(OBW/44.0)+10log(360/beamwidth)	EIRP+10log(0.1/44.0)
40 MHz 4 Channels 64QAM 190 Mbps			
2516.0 MHz Ch.1, 2 ,2A, A1, B1, A2, B2, A1, B3	38.834	63+10log(OBW/44.5)+10log(360/beamwidth)	EIRP+10log(0.1/44.5)
2537.0 MHz A2, B2, A3, B3, A4, B4, C1, D1	38.909	63+10log(OBW/44.0)+10log(360/beamwidth)	EIRP+10log(0.1/44.0)
2548.0 MHz A3, B3, A4, B4, C1, D1, C2, D2	38.828	63+10log(OBW/44.0)+10log(360/beamwidth)	EIRP+10log(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):	09-May-16		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

Table 7.2.5 EIRP limits

Channel	Channel BW, MHz	Peak power limit, dBm	
		17 dBi, 90º beamwidth	18 dBi, 65ºbeamwidth
40 MHz Dual Channel QPSK			
2516.0 MHz Ch.1, 2 ,2A, A1, B1, A2, B2, A1, B3	44.5	68.43	69.84
2537.0 MHz A2, B2, A3, B3, A4, B4, C1, D1	44.0	68.48	69.89
2548.0 MHz A3, B3, A4, B4, C1, D1, C2, D2	44.0	68.48	69.90
40 MHz Dual Channel 64 QAM			
2516.0 MHz Ch.1, 2 ,2A, A1, B1, A2, B2, A1, B3	44.5	68.43	69.84
2537.0 MHz A2, B2, A3, B3, A4, B4, C1, D1	44.0	68.49	69.90
2548.0 MHz A3, B3, A4, B4, C1, D1, C2, D2	44.0	68.48	69.89

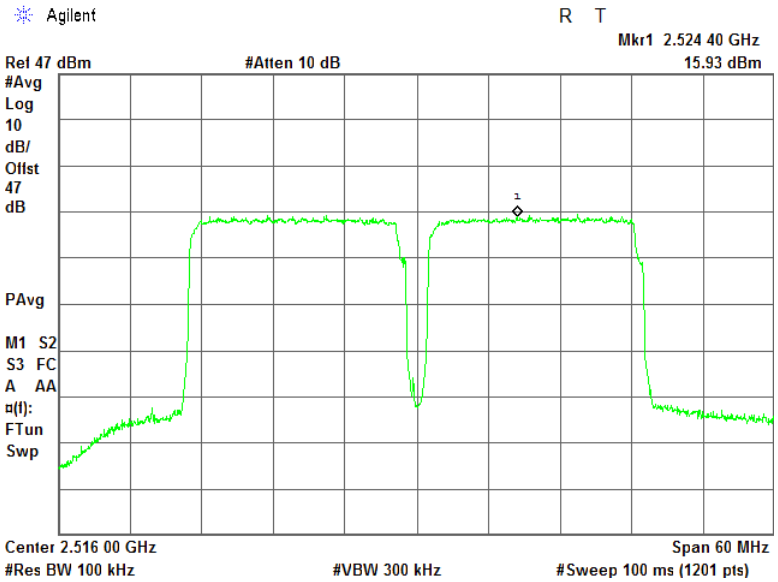
Test specification:	Section 27.50, Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	09-May-16		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

Table 7.2.6 Peak power density limits

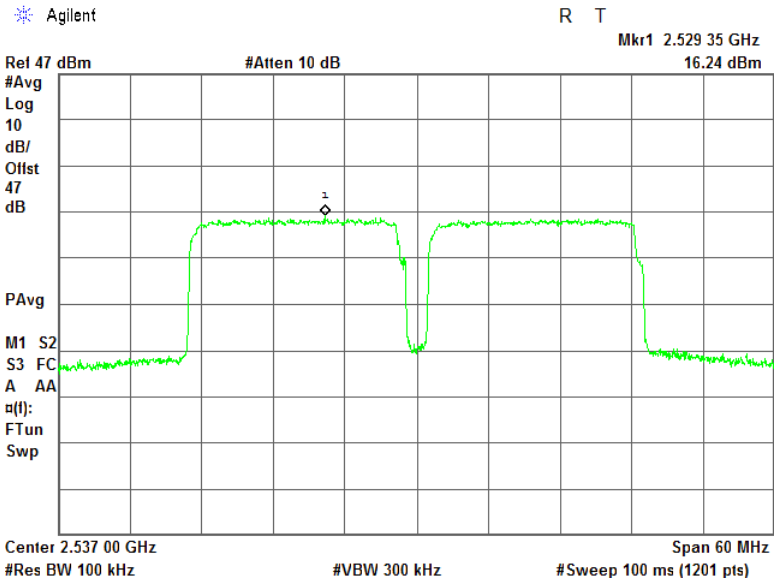
Channel	Channel BW, MHz	Peak power density, dBm/100kHz	
		17 dBi, 90º beamwidth	18 dBi, 65ºbeamwidth
40 MHz Dual Channel QPSK			
2516.0 MHz Ch.1, 2 ,2A, A1, B1, A2, B2, A1, B3	44.5	41.94	43.36
2537.0 MHz A2, B2, A3, B3, A4, B4, C1, D1	44.0	42.04	43.46
2548.0 MHz A3, B3, A4, B4, C1, D1, C2, D2	44.0	42.05	43.46
40 MHz Dual Channel 64 QAM			
2516.0 MHz Ch.1, 2 ,2A, A1, B1, A2, B2, A1, B3	44.5	41.95	43.36
2537.0 MHz A2, B2, A3, B3, A4, B4, C1, D1	44.0	42.05	43.47
2548.0 MHz A3, B3, A4, B4, C1, D1, C2, D2	44.0	42.04	43.46

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):	09-May-16		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.1 Power spectral density test results at low frequency, QPSK, 40 MHz EBW RF # 1

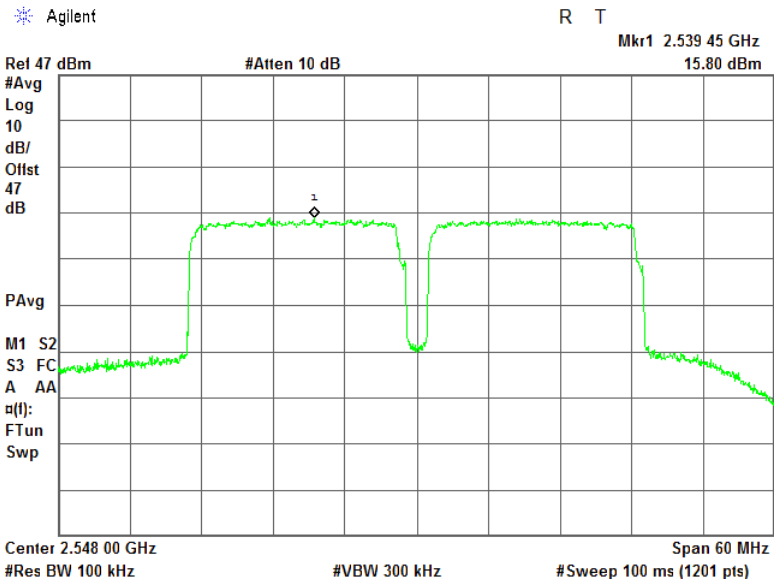


Plot 7.2.2 Power spectral density test results at mid frequency, QPSK, 40 MHz EBW RF # 1

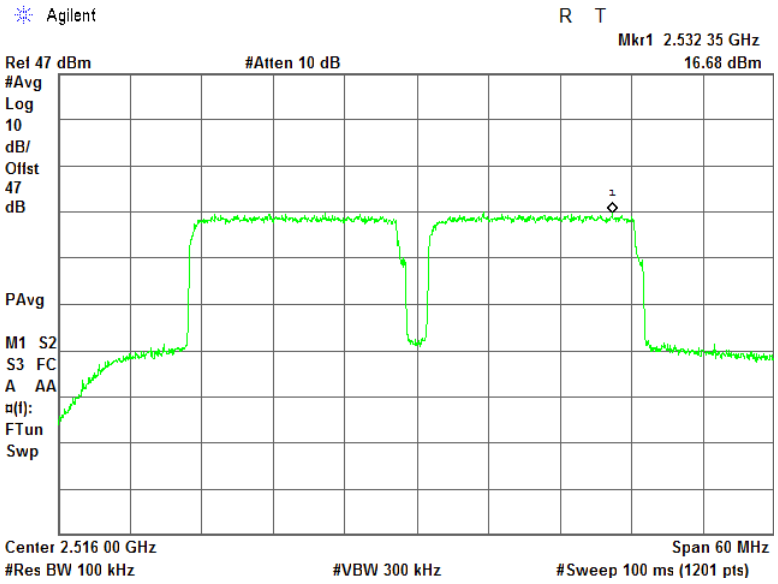


Test specification:	Section 27.50, Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	09-May-16		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.3 Power spectral density test results at high frequency, QPSK, 40 MHz EBW RF # 1

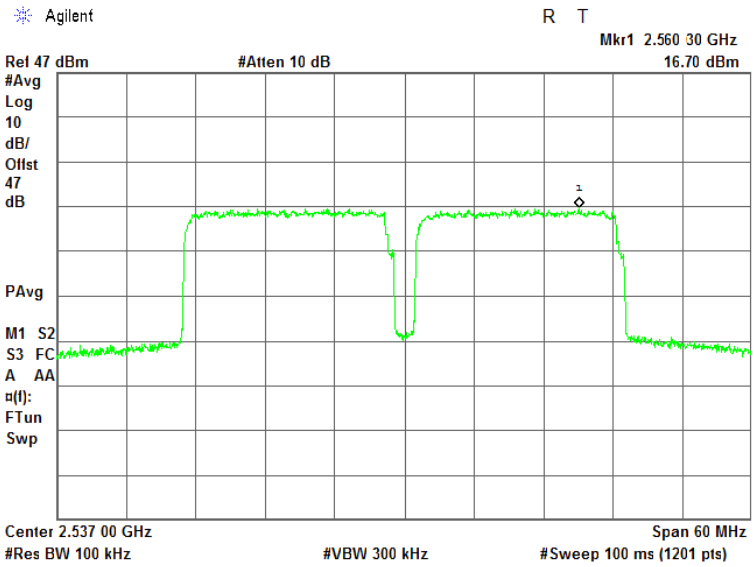


Plot 7.2.4 Power spectral density test results at low frequency, 64QAM, 40 MHz EBW RF # 1

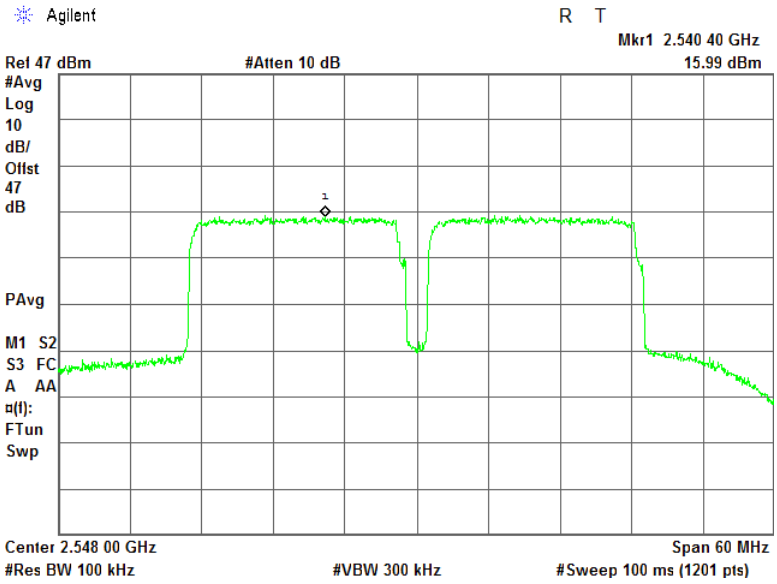


Test specification:	Section 27.50, Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	09-May-16		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.5 Power spectral density test results at mid frequency, 64QAM, 40 MHz EBW RF # 1

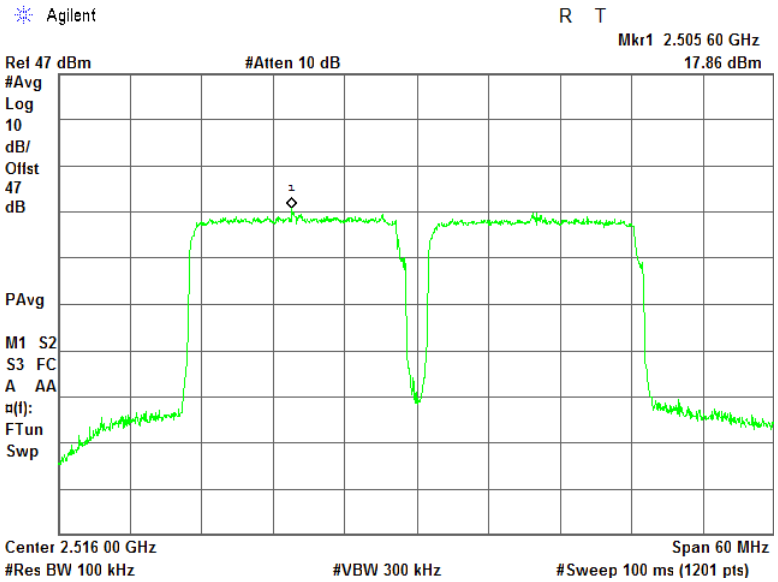


Plot 7.2.6 Power spectral density test results at high frequency, 64QAM, 40 MHz EBW RF # 1

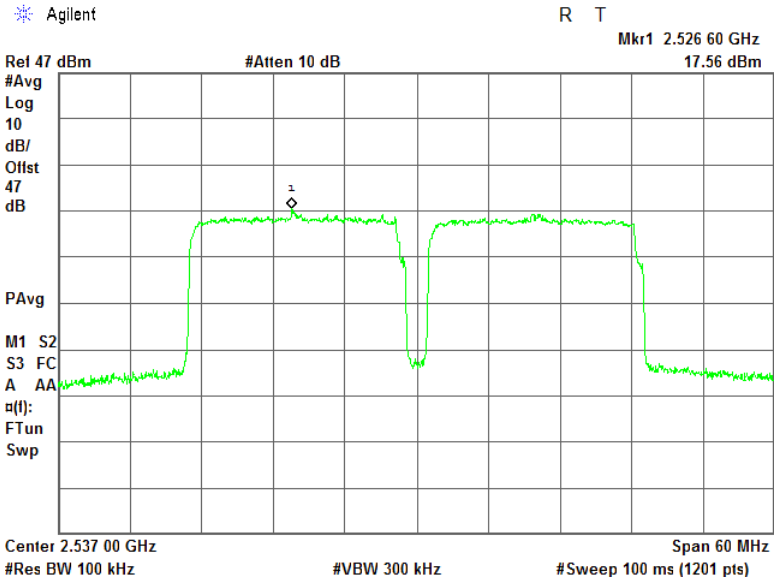


Test specification:	Section 27.50, Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	09-May-16		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.7 Power spectral density test results at low frequency, QPSK, 40 MHz EBW RF # 2

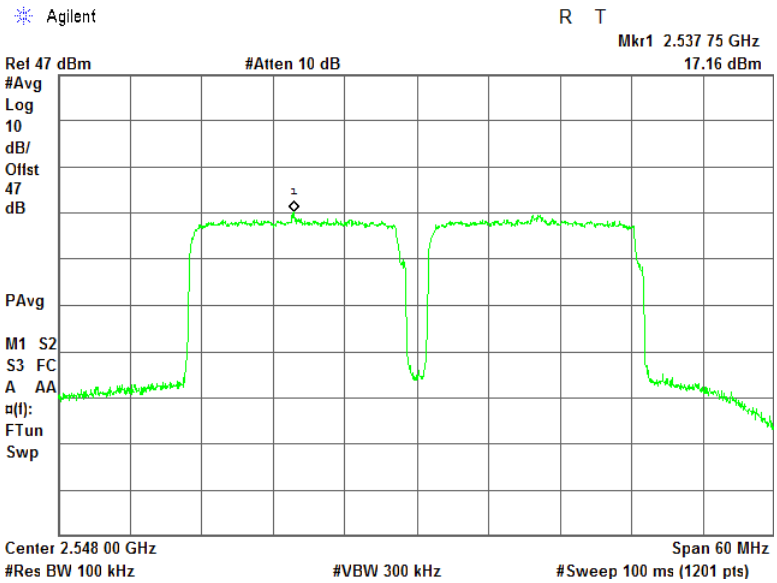


Plot 7.2.8 Power spectral density test results at mid frequency, QPSK, 40 MHz EBW RF # 2

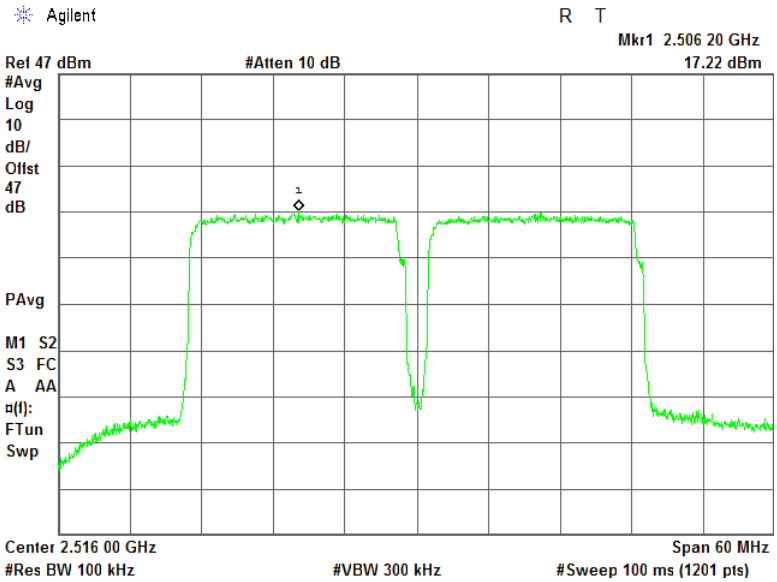


Test specification:	Section 27.50, Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	09-May-16		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.9 Power spectral density test results at high frequency, QPSK, 40 MHz EBW RF # 2

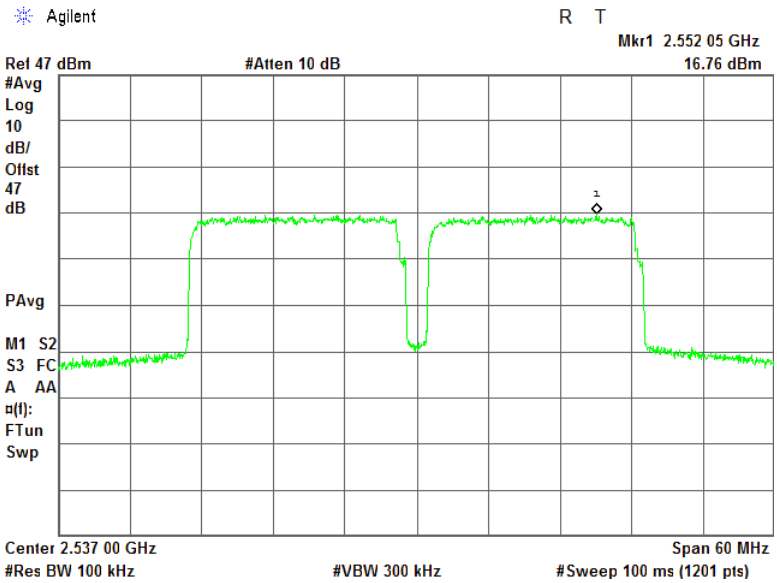


Plot 7.2.10 Power spectral density test results at low frequency, 64QAM, 40 MHz EBW RF # 2

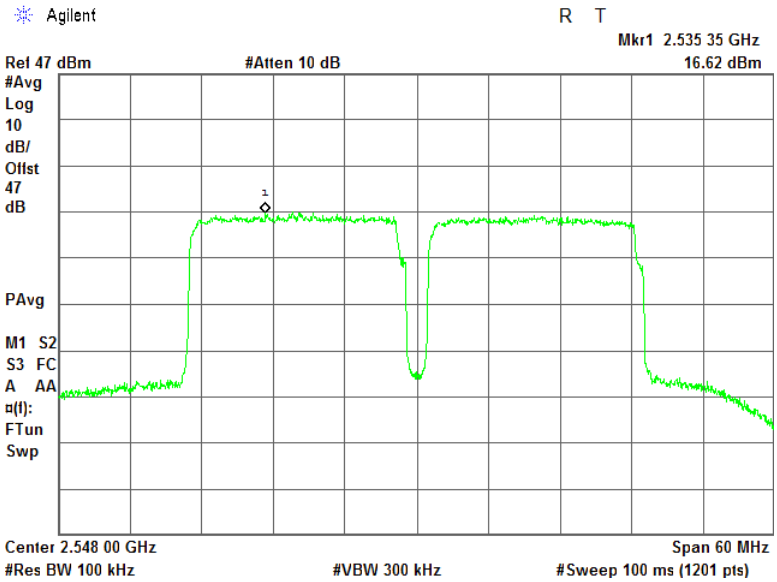


Test specification:	Section 27.50, Peak output power		
Test procedure:	47 CFR, Section 2.1046; TIA/EIA-603-D, Section 2.2.1		
Test mode:	Compliance	Verdict:	PASS
Date(s):	09-May-16		
Temperature: 24 ºC	Air Pressure: 1014 hPa	Relative Humidity: 50 %	Power Supply: 120 VAC
Remarks:			

Plot 7.2.11 Power spectral density test results at mid frequency, 64QAM, 40 MHz EBW RF # 2



Plot 7.2.12 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):	10-May-16		
Temperature: 25 ºC	Air Pressure: 1011 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

7.3 Band edge emissions at RF connector test

7.3.1 General

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

Table 7.3.1 Spurious emission limits at band edges

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

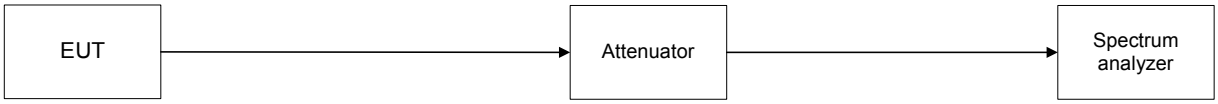
* - P is transmitter output power in Watts

7.3.2 Test procedure

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

7.3.2.2 The spurious emission was measured with spectrum analyzer as provided in Table 7.3.2, Table 7.3.3 and the associated plots.

Figure 7.3.1 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):	10-May-16		
Temperature: 25 ºC	Air Pressure: 1011 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

Table 7.3.2 Spurious emission at the low band edge test results

ASSIGNED FREQUENCY RANGE: 2496.0 – 2572.0 MHz
DETECTOR USED: Average
VIDEO BANDWIDTH: ≥ Resolution bandwidth
EBW: 40 MHz

Frequency, MHz	Frequency offset, ± MHz	Low band edge, dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Margin, dBm	Verdict
QPSK							
2516.0	20.5	-23.03	1000	1000	-13.0	-10.03	Pass
	21.5	-23.42	1000	1000	-13.0	-10.42	
2537.0	20.5	-22.19	1000	1000	-13.0	-9.19	Pass
	21.5	-22.54	1000	1000	-13.0	-9.54	
2548.0	20.5	-22.64	1000	1000	-13.0	-9.64	Pass
	21.5	-22.97	1000	1000	-13.0	-9.97	
64QAM							
2516.0	20.5	-22.40	1000	1000	-13.0	-9.40	Pass
	22.5	-22.80	1000	1000	-13.0	-9.80	
2537.0	20.5	-20.92	1000	1000	-13.0	-7.92	Pass
	21.5	-21.29	1000	1000	-13.0	-8.29	
2548.0	20.5	-23.26	1000	1000	-13.0	-10.26	Pass
	21.5	-23.52	1000	1000	-13.0	-10.52	

Table 7.3.3 Spurious emission at the high band edge test results

ASSIGNED FREQUENCY RANGE: 2496.0 – 2572.0 MHz
DETECTOR USED: Average
VIDEO BANDWIDTH: ≥ Resolution bandwidth
EBW: 40 MHz

Frequency MHz	Frequency offset, ± MHz	High band edge, dBm	RBW, kHz	Integration BW, kHz	Limit, dBm	Margin, dBm	Verdict
QPSK							
2516.0	20.5	-21.16	1000	1000	-13.0	-8.16	Pass
	21.5	-21.52	1000	1000	-13.0	-8.52	
2537.0	20.5	-21.05	1000	1000	-13.0	-8.05	Pass
	21.5	-21.47	1000	1000	-13.0	-8.47	
2548.0	20.5	-19.63	1000	1000	-13.0	-6.63	Pass
	21.5	-20.04	1000	1000	-13.0	-7.04	
64QAM							
2516.0	20.5	-20.11	1000	1000	-13.0	-7.11	Pass
	21.5	-20.54	1000	1000	-13.0	-7.54	
2537.0	20.5	-18.29	1000	1000	-13.0	-5.29	Pass
	21.5	-18.71	1000	1000	-13.0	-5.71	
2548.0	20.5	-20.93	1000	1000	-13.0	-7.93	Pass
	21.5	-21.42	1000	1000	-13.0	-8.42	

Reference numbers of test equipment used

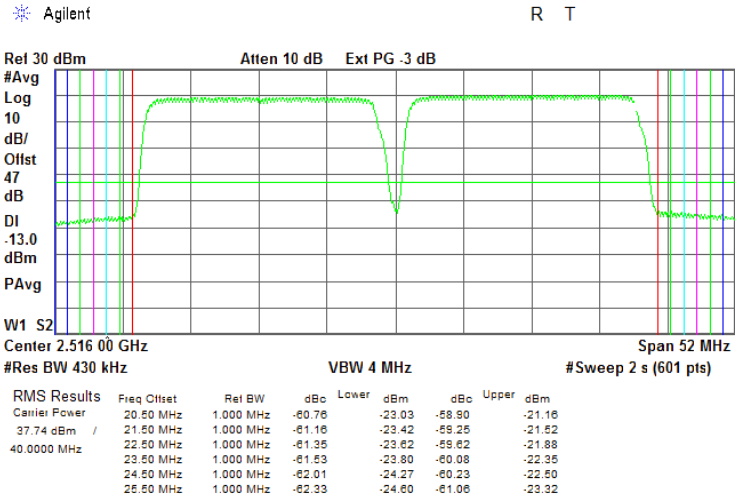
HL 2214	HL 3301	HL 3302	HL 3818	HL 3903			

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):	10-May-16		
Temperature: 25 ºC	Air Pressure: 1011 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

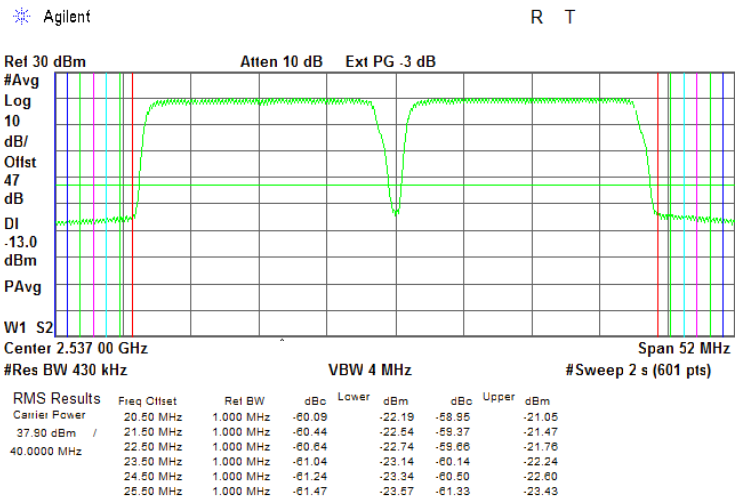
Plot 7.3.1 Spurious emission at band edges test results at low carrier frequency, 40 MHz EBW

DETECTOR USED:	Average
MODULATION:	QPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	46.8 Mbps



Plot 7.3.2 Spurious emission at band edges test results at mid carrier frequency, 40 MHz EBW

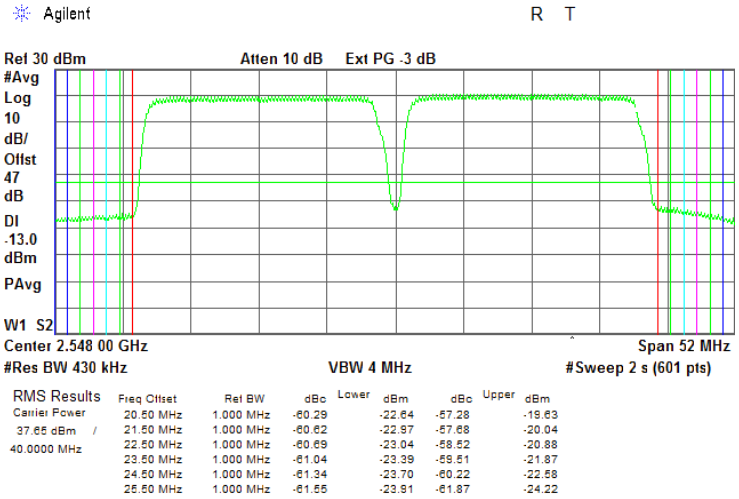
DETECTOR USED:	Average
MODULATION:	QPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	46.8 Mbps



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):	10-May-16		
Temperature: 25 ºC	Air Pressure: 1011 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

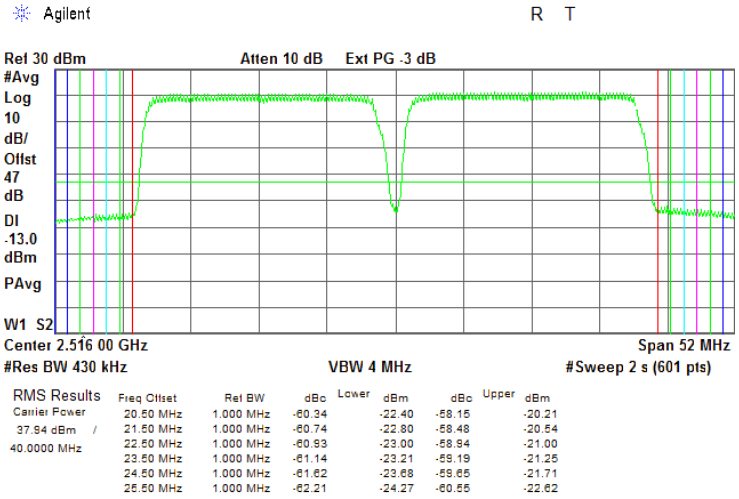
Plot 7.3.3 Spurious emission at band edges test results at high carrier frequency, 40 MHz EBW

DETECTOR USED:	Average
MODULATION:	QPSK
MODULATING SIGNAL:	PRBS
BIT RATE:	46.8 Mbps



Plot 7.3.4 Spurious emission at band edges test results at low carrier frequency, 40 MHz EBW

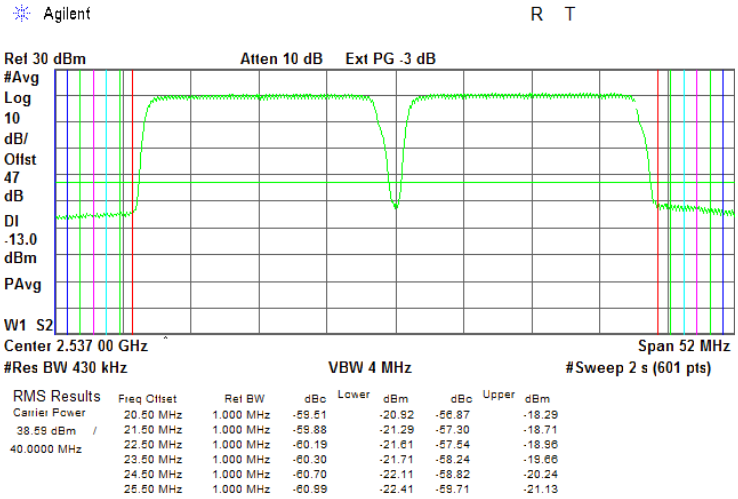
DETECTOR USED:	Average
MODULATION:	64QAM
MODULATING SIGNAL:	PRBS
BIT RATE:	190 Mbps



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):	10-May-16		
Temperature: 25 ºC	Air Pressure: 1011 hPa	Relative Humidity: 45 %	Power Supply: 120 VAC
Remarks:			

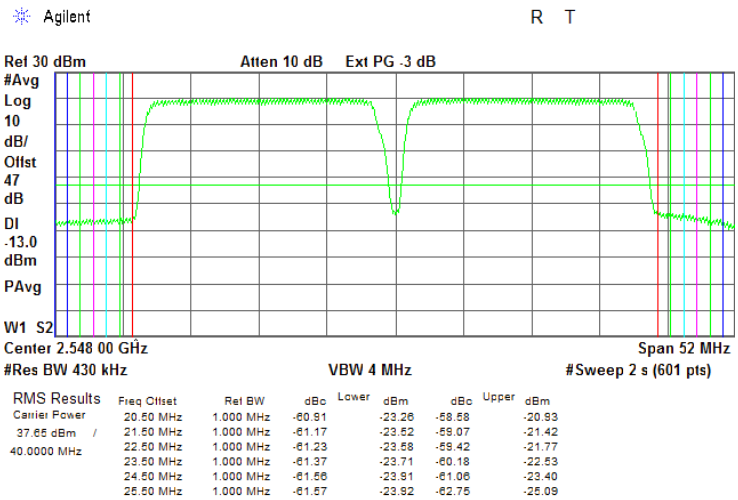
Plot 7.3.5 Spurious emission at band edges test results at mid carrier frequency, 40 MHz EBW

DETECTOR USED:	Average
MODULATION:	64QAM
MODULATING SIGNAL:	PRBS
BIT RATE:	190 Mbps



Plot 7.3.6 Spurious emission at band edges test results at high carrier frequency, 40 MHz EBW

DETECTOR USED:	Average
MODULATION:	64QAM
MODULATING SIGNAL:	PRBS
BIT RATE:	190 Mbps



8 APPENDIX A Test equipment and ancillaries used for tests

HL No	Description	Manufacturer	Model	Ser. No.	Last Cal./ Check	Due Cal./ Check
2214	Directional Coupler 1.7-26.5 GHz	Krytar	2616	31354	16-Sep-15	16-Sep-17
3301	Power Meter, P-series, 50 MHz to 40 GHz	Agilent Technologies	N1911A	MY45101057	26-Apr-16	26-Jul-17
3302	Power sensor, P-Series, 50 MHz to 40 GHz, -35/30 to 20 dBm	Agilent Technologies	N1922A	MY45240586	30-Jan-15	30-Apr-16
3818	PSA Series Spectrum Analyzer, 3 Hz- 44 GHz	Agilent Technologies	E4446A	MY48250288	03-May-16	03-May-17
3903	Microwave Cable Assembly, 40.0 GHz, 1.5 m, SMA/SMA	Huber-Suhner	SUCOFLEX 102A	1226/2A	15-Feb-16	15-Feb-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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Person for contact: Mr. Alex Usoskin, CEO.

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

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

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

END OF DOCUMENT