Test Report No. 9112340871

Applicant: Ruggedcom Inc.

Equipment Under Test:

WiMax Transceiver

Compact Base Station (cBST).
Model: RuggedMax™ WIN7023

From The Standards Institution
Of Israel
Industry Division
Electronics & Telematics Laboratory
EMC Section

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Title: WiMax Transceiver	
Model: WIN7023	**FCC ID: WQEWIN7023**

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1. Applicant information

Applicant:	Ruggedcom Inc.
Address:	32 Maskit str, Herzlia, 12412, Israel
Sample for test selected by:	The applicant
The date of test:	14 November, 26 December 2011

Equipment under test information

Description of Equipment Under Test (EUT):	WiMax Transceiver
Model:	WIN7023
Serial Number:	NA
Software version of radio unit	4.2
Hardware version of radio unit	ID = 15
Manufactured by:	Ruggedcom Inc.

2. Test performance

Location:	SII EMC Section
Purpose of test:	Apparatus compliance verification in accordance with emission requirements
Test specifications:	47CFR part 27 Subpart C, D, part 2 §§ 2.1049, 2.1053, part 1 §1.1310

3. Summary of test:

The EUT was found to be in compliance with requirements of: 47CFR part 27, §§ 27.50, 27.53, 27.54 and part 2 §§ 2.1049

Transmitter characteristics	Subclasses
Transmitter characteristics	
Occupied bandwidth	2.1049
Peak output power	27.50
Peak-to-average power ratio (PAPR)	27.50
Spurious emissions at antenna terminal	27.53
Spurious emissions radiated	27.53
Frequency stability	27.54

Telematics Laboratory
27 December 2011

Test performed by: Mr. Michael Feldman test technician

Test report prepared by: Mr. Michael Feldman test technician

Test report approved by: Mr. Yuri Rozenberg Head of EMC Branch

Measurement uncertainty.

Were relevant, the following measurement uncertainty level have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:
This uncertainty represents an expended uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Test description	Expanded uncertainty
Radiated emissions in the open field test site at 3 m measuring distance:	
30 MHz – 1.0 GHz	2 Uc (E) = ± 4.32 dB
1.0 GHz – 18 GHz	2 Uc (E) = ± 4.47 dB

4. Equipment under test description.

*The customer provided description.

4.1 General description

The RuggedMax™ WIN7023 (hereinafter: EUT) is a WiMax compact base station Unit (cBST) that used in SM-MIMO uncorrelated mode and intended for outdoors installations. The EUT is a pole or wall mounted. Appliance with one 10/100 PoE port, fiber-optic and two antenna ports for two external antennas. The EUT inserted in a metallic enclosure without ventilation opening and two output connected to antennas via different type of external cavity filters: for Block A+B and for Block C+D. EUT includes the following sub-units: one internal DC-DC power supply board, two radio modules and digital Modem Board.
The equipment provided in a DC configuration.

EUT technical characteristics

Technical characteristics of transmitter.			Note
Stand-alone/fixed use	Always at distance at least 3.6 m from the people and public area.		
Assigned frequency range	2305 – 2320 MHz and 2345 – 2360 MHz		
Declare frequency range	2305 – 2320 MHz, 2345 – 2360 MHz		
Operating frequencies	2316.75 MHz, 2348.25 MHz.		3.5 MHz EBW
	2307.5, 2312.5; 2352.5, 2357.5 MHz		5 MHz EBW
	2310, 2355 MHz		10 MHz EBW
Antenna connection	N-Type connector		Professional installation
Transmitter 99% power bandwidth	3.5 MHz, 5 MHz, 10 MHz		
Type of modulation	4QAM, 16QAM, 64QAM		
Type of multiplexing	TDMA		
Modulating test signal (baseband)	PRBS		
Maximum transmitter duty cycle in normal use	75 %		
Transmitter duty cycle supplied for test	75 %		
Antenna information			
Antenna Type	Manufacturer	Model	Gain, dBi
Omni 2.3-2.7 GHz	MARS	MA-WO25-9	9
Sector X-Pol 2.3-2.7 GHz	KENBOTONG	KBT90DP16-2327	16

Environmental evaluation and exposure limit according to FCC CFR 47 part 1, §1.1307, §1.1310.

Limit for power density for general population/uncontrolled exposure is 1(mW/cm^2) or 10 (W/m^2).
The power density calculation S = (Pt /4π r^2).
Where
Pt - The transmitted power (EIRP) (mW)
r - The distance from the unit. (cm)
The 1(mW/cm^2) limit can be calculated from the above based on the following data:
Pt- the transmitted power whish is equal to the maximum EIRP = 62.1 dBm = 1621810 mW.
Minimum allowed distance r from the antenna were FCC RF exposure limit may not be exceeded = SQRT(1621810/4π) > 3.6 m.

4.2 EUT configuration.

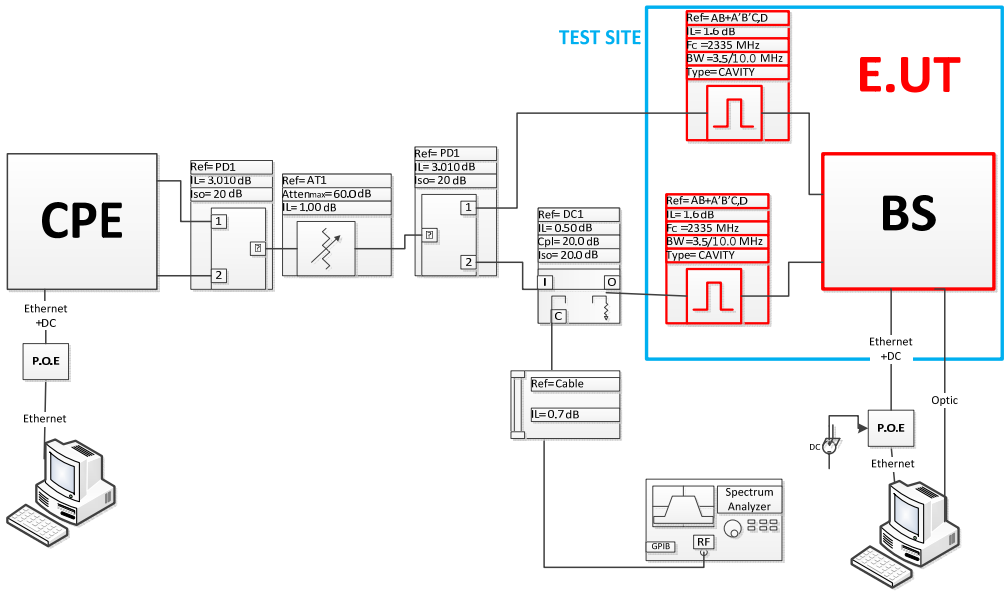


Fig. 1. The RuggedMax™ WIN7023 setup configuration.

5. Test results

5.1. Transmitter characteristics

5.1.1. Occupied bandwidth according to § 2.1049.

Method of measurement § 2.1049, ANSI 63.4 § 13.7
Operating Frequency Range 2305 – 2320 MHz, 2345 – 2360 MHz
Ambient Temperature 21^0 C Relative Humidity 47% Air Pressure 1006 hPa

EBW, MHz	Carrier frequency, MHz	99% power emission bandwidth MHz	Reference to plot #
3.5	2316.75	3.1	1
	2348.25	3.1	2
5.0	2307.5	4.50	3
	2312.5	4.50	4
	2352.5	4.50	5
	2357.5	4.99	6
10	2310.0	9.1	7
	2355.0	9.1	8

TEST PROCEDURE

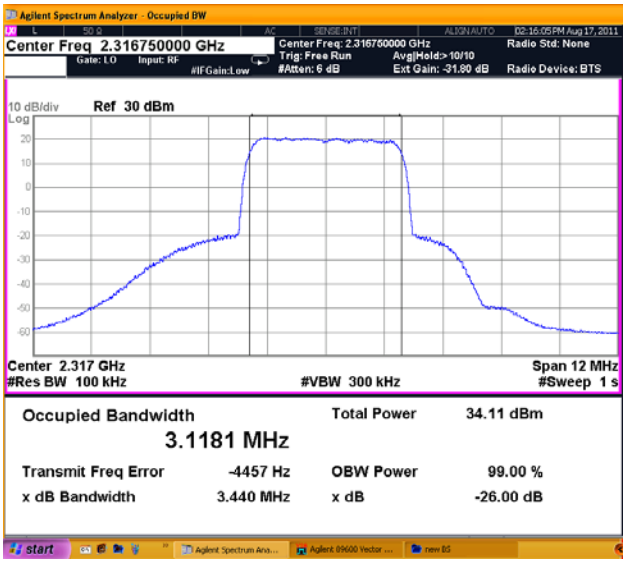
The measurements were performed in normal (transmitting) mode at all transmitted carrier (channel) frequencies of the 2305 – 2320 MHz, 2345 – 2360 MHz frequency ranges under 64 QAM modulation as worse case. RBW = 1-3 % of emission bandwidth VBW= 3 x RBW. Detector RMS and power average function. The EUT RF output was connected to the Spectrum Analyzer through appropriate attenuator and accounted with cable loss in SA settings.

TEST EQUIPMENT USED:

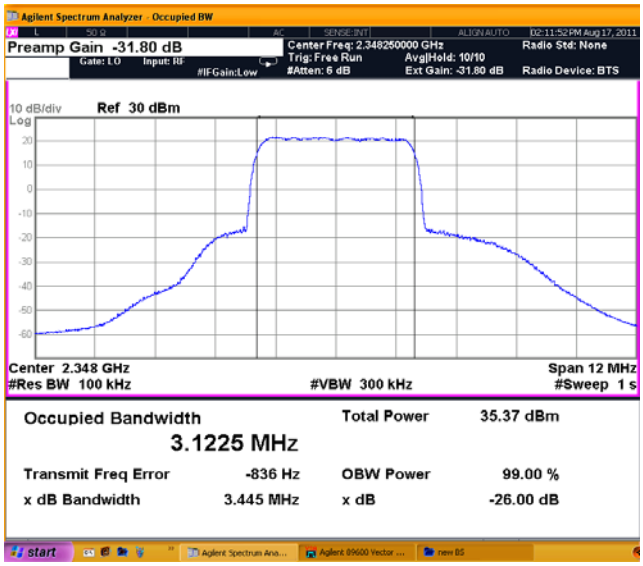
2	3	4	5			

Occupied bandwidth test.

3.5 MHz EBW option, 99% bandwidth



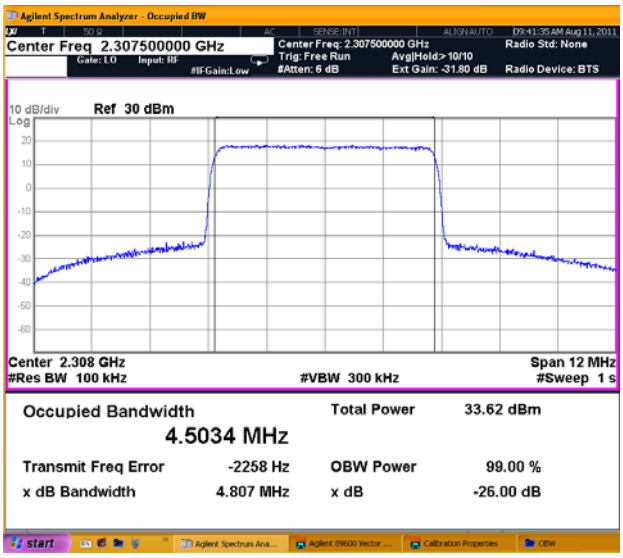
Plot # 1



Plot # 2

Insertion loss of external attenuator, directional coupler and cable = 31.8 dB.

5 MHz EBW option, 99% bandwidth



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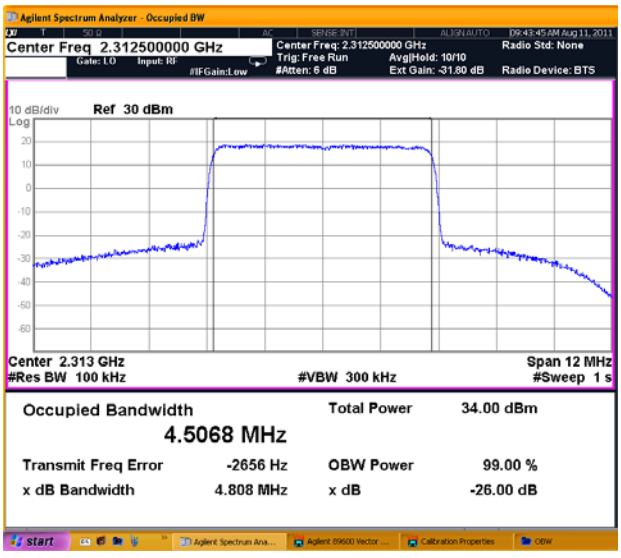
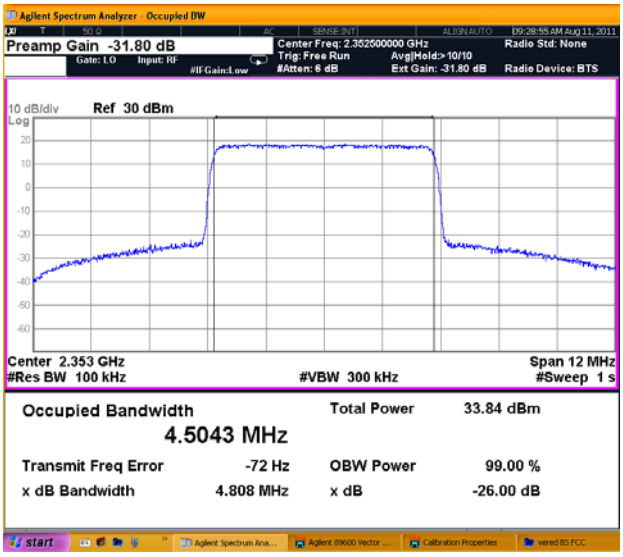
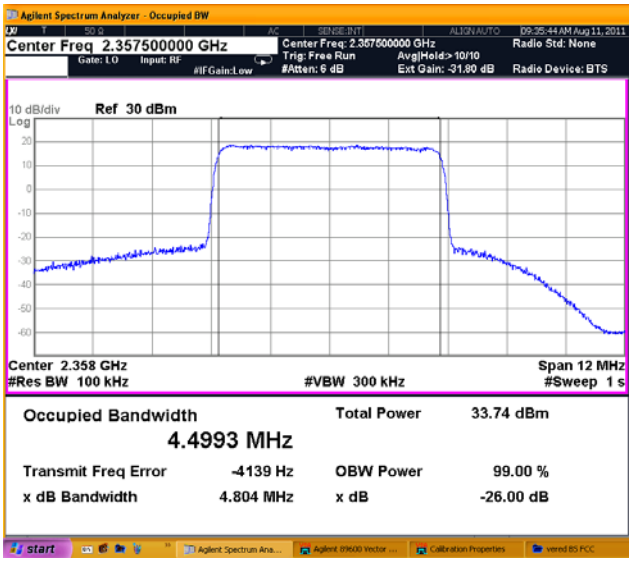


Plot # 4

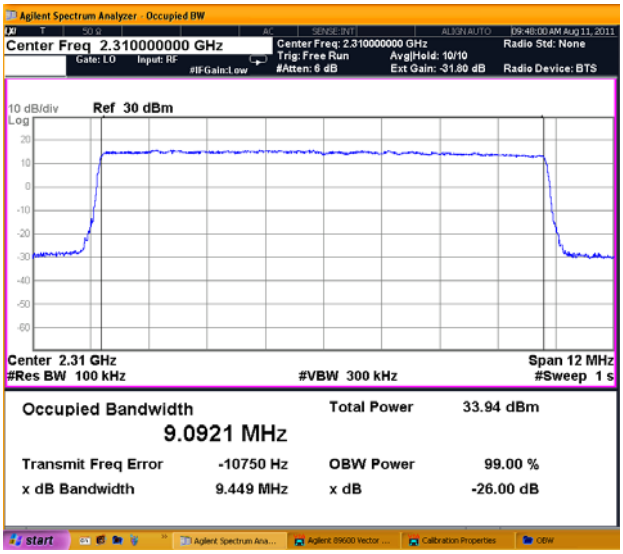


Plot # 5

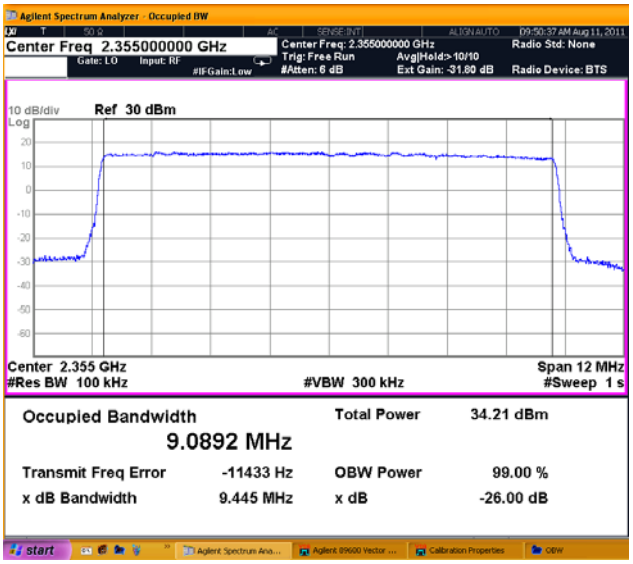


Plot # 6

10 MHz EBW option, 99% bandwidth



Plot # 7



Plot # 8

5.1.2. EIRP output power test § 27.50 (1)(A)

Operating Frequency Range 2305 – 2320 MHz , 2345 – 2360 MHz
Ambient Temperature 21^0 C Relative Humidity 47% Air Pressure 1006 hPa

EBW, MHz	Carrier frequency, MHz	Ch.1 output power, dBm	Ch.2 output power, dBm	**EIRP Ch.1 dBm	**EIRP Ch.2 dBm	***Total EIRP power, dBm	EIRP limit, dBm	Margin, dB	Reference to plots #
3.5	2316.75	*35.2 +8.1	*34.9+8.1	59.3	59.0	62.2	63.0	0.8	9, 11
	2348.25	*35.2+8.0	*35.0+8.0	59.2	59.0	62.1	63.0	0.9	10, 12
5.0	2307.5	35.1	35.2	51.1	51.2	54.2	63.0	8.8	13, 17
	2312.5	35.0	34.8	51.0	50.8	53.9	63.0	9.1	14, 18
	2352.5	35.3	35.4	51.3	51.4	54.4	63.0	8.6	15, 19
	2357.5	35.2	35.2	51.2	51.2	54.2	63.0	8.8	16, 20
10	2310.0	35.4	35.8	51.4	51.8	54.6	63.0	8.4	21, 23
	2355.0	35.0	35.0	51.0	51.0	54.0	63.0	9.0	22, 24

*Peak output power = average output power + PAPR ratio.
**The EIRP = Output power + Antenna gain (16 dBi).
***The total EIRP power is sum of Chain 1+Chain 2 EIR powers.

The following power limits apply to the 2305 – 2315 MHz and 2350 – 2360 MHz bands:
The average equivalent isotropically radiated power (EIRP) must not exceed 2,000 watts (63 dBm) within any 5 megahertz of authorized bandwidth and must not exceed 400 watts (56 dBm) within any 1 megahertz of authorized bandwidth.
For base and fixed stations transmitting in the 2315–2320 MHz band or in the 2345–2350 MHz band, the peak EIRP shall not exceed 2,000 watts.

TEST PROCEDURE

The measurements were performed in normal (transmitting) mode at all transmitted carrier (channel) frequencies of the 2305 – 2320 MHz, 2345 – 2360 MHz frequency ranges under 64 QAM modulation as worse case. RBW = 1-3 % of emission bandwidth VBW= 3 x RBW. Detector RMS and power average function. The EUT RF output was connected to the Spectrum Analyzer through appropriate attenuator and accounted with cable loss in SA settings. Test setup for measurements in 3.5 MHz EBW bands include additionally HP/LP cavity filter.

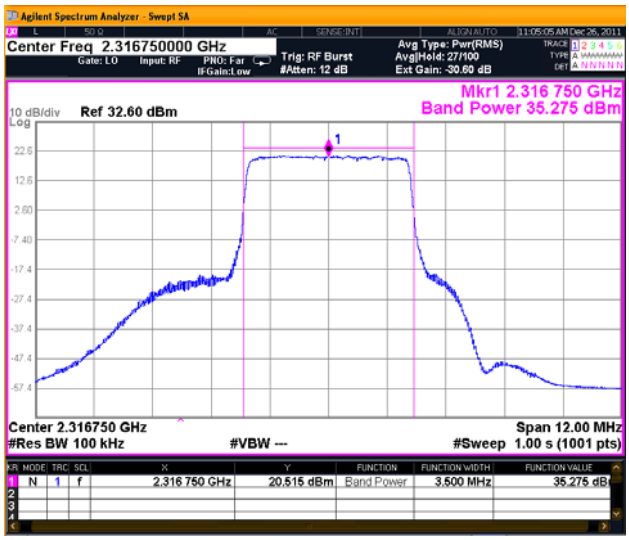
TEST EQUIPMENT USED:

2	3	4	5			

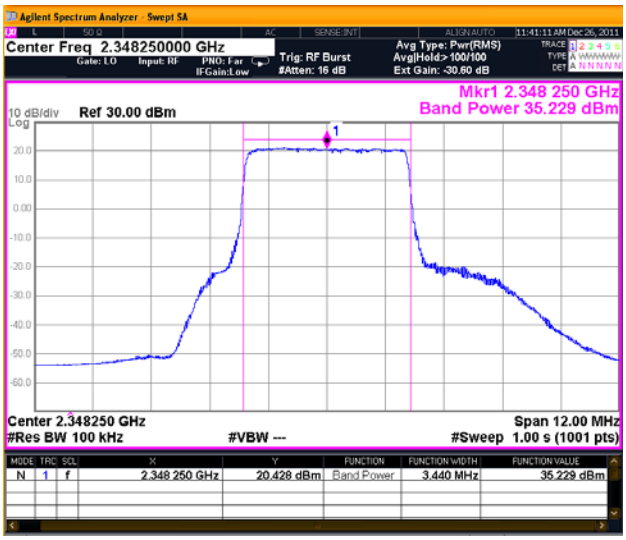
Output power test results.

3.5 MHz EBW option

Chain 1

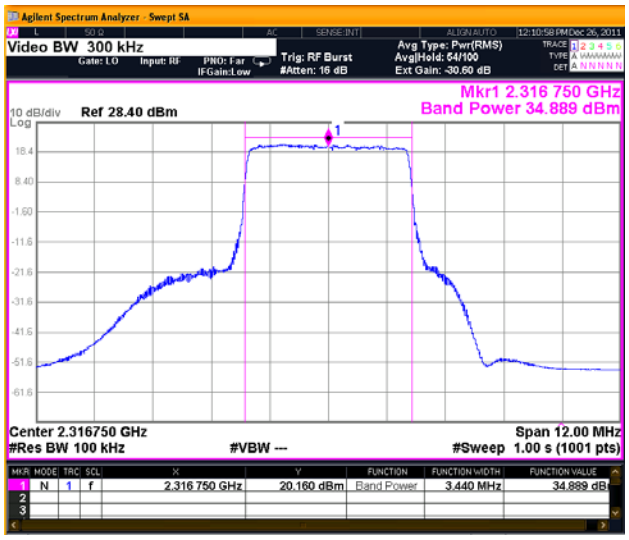


Plot # 9

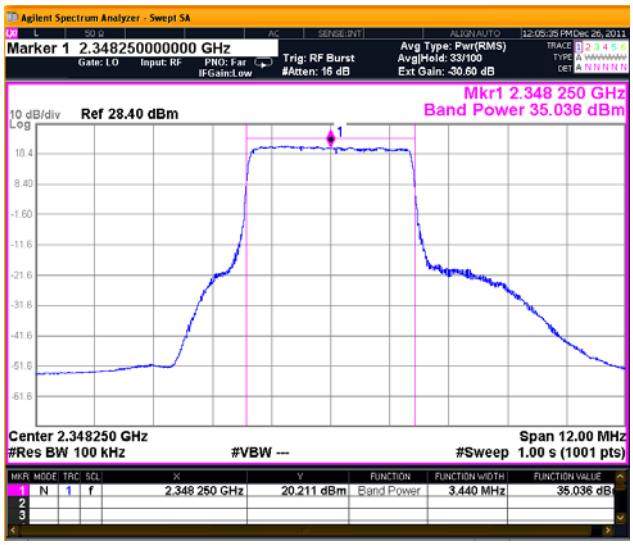


Plot # 10

Chain 2



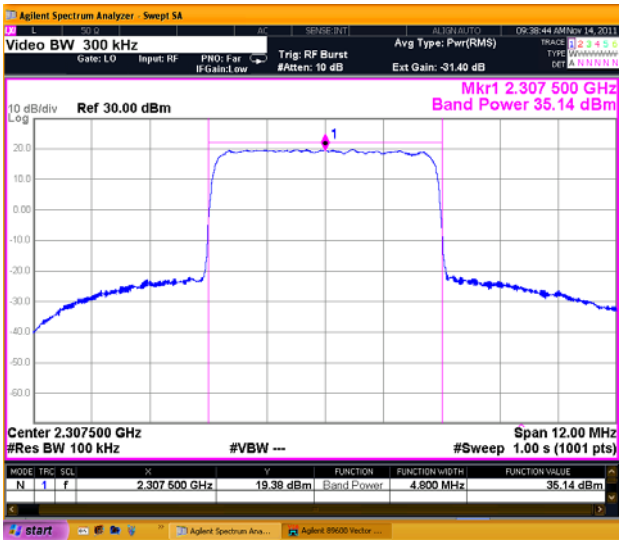
Plot # 11



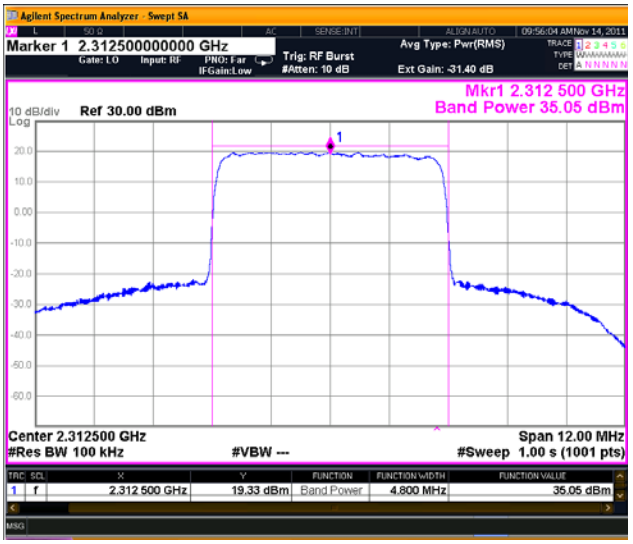
Plot # 12

5 MHz EBW option,

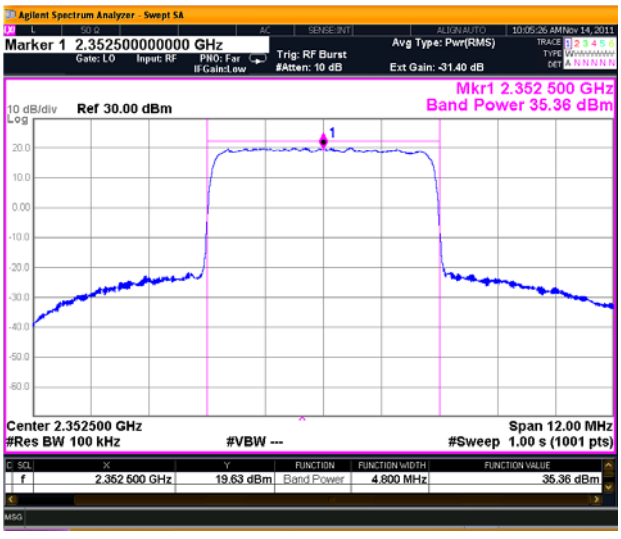
Chain 1



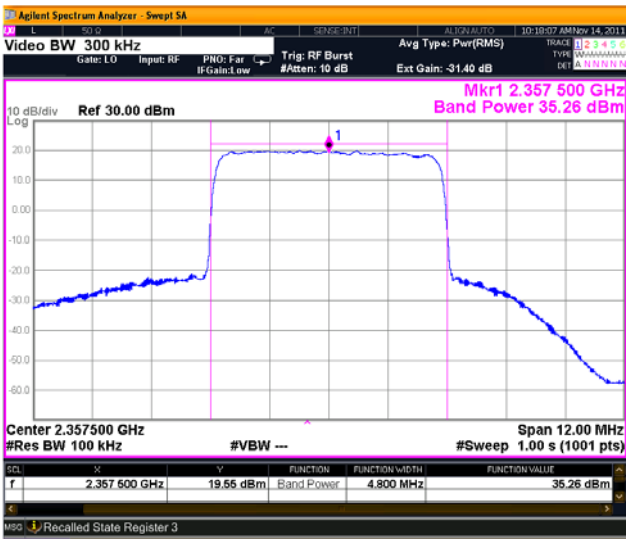
Plot # 13



Plot # 14



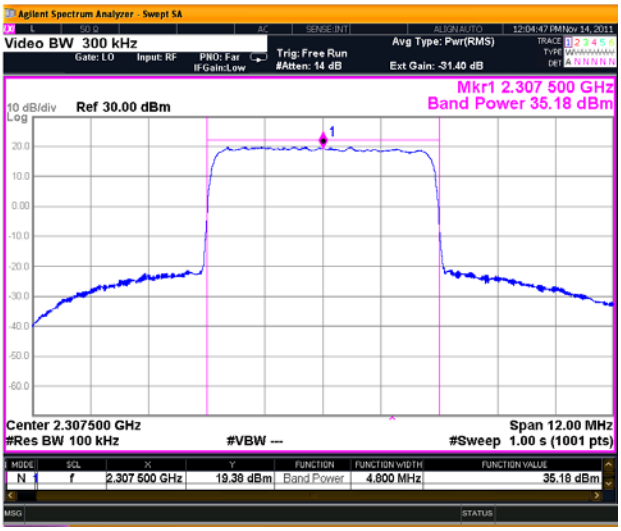
Plot # 15



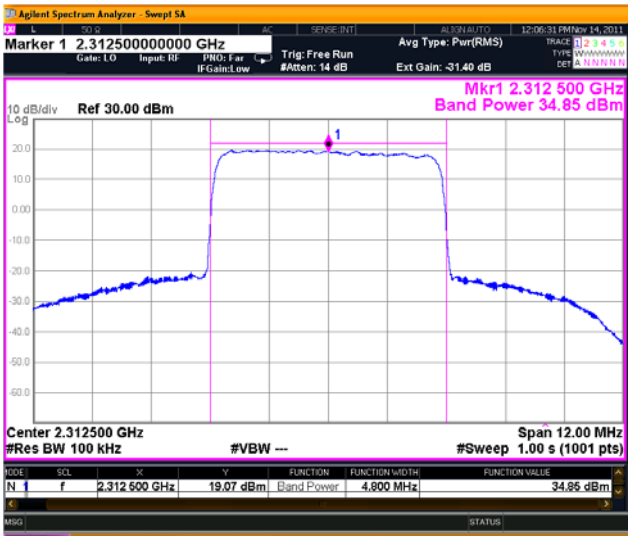
Plot # 16

Insertion loss of external attenuator, directional coupler and cable = 31.4 dB.

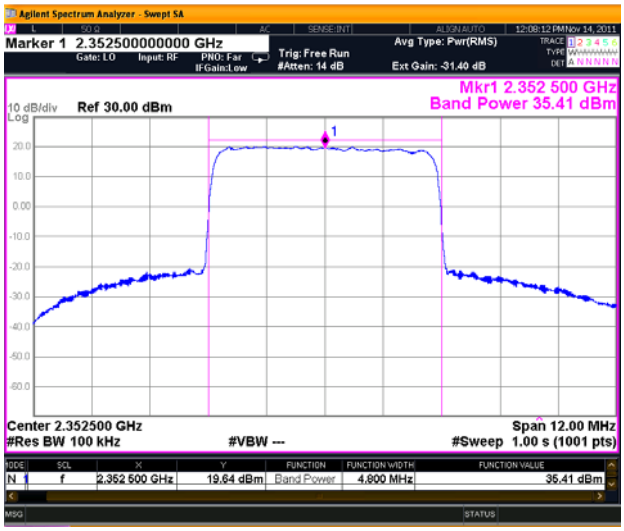
Chain 2



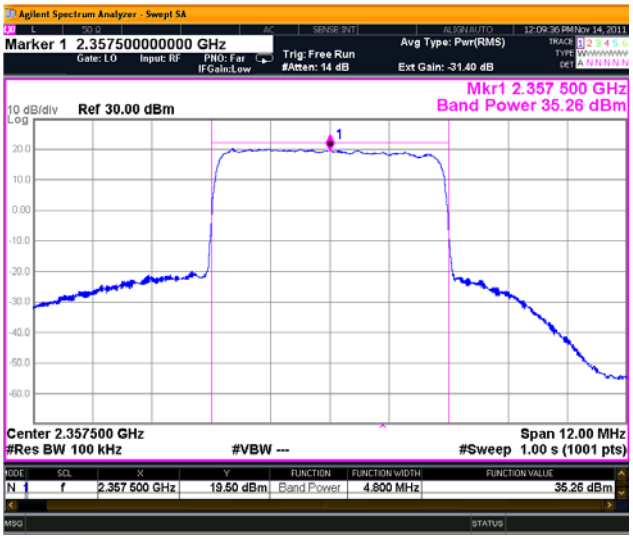
Plot # 17



Plot # 18



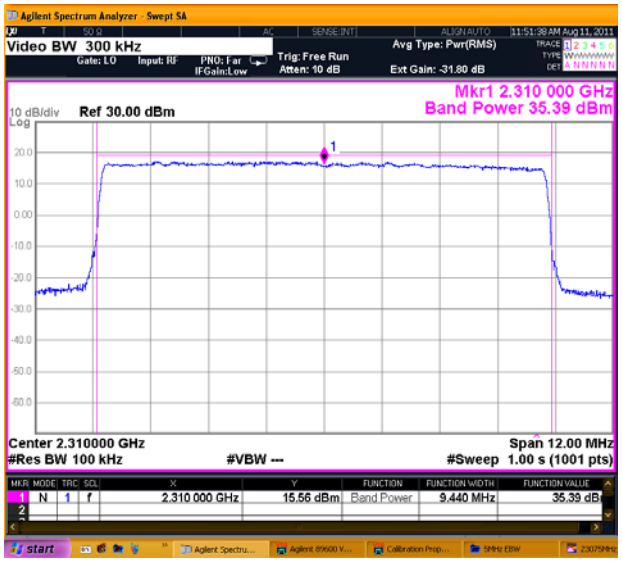
Plot # 19



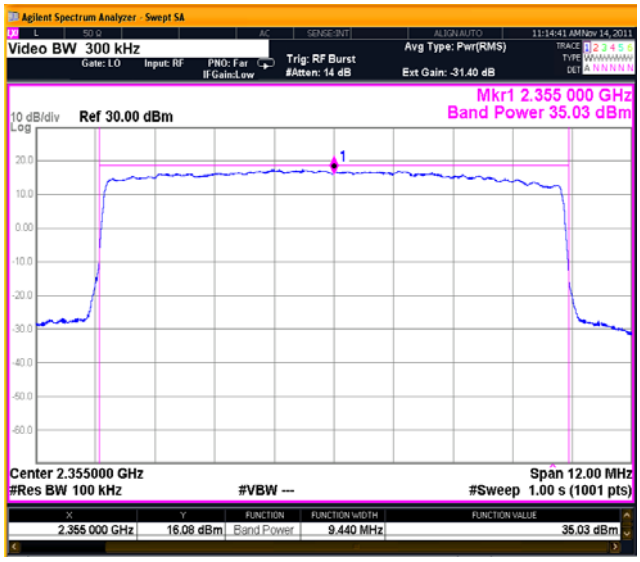
Plot # 20

10 MHz EBW option,

Chain 1

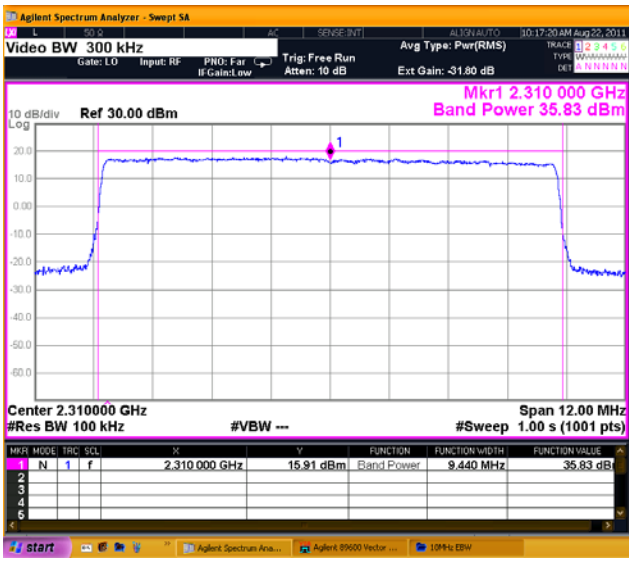


Plot # 21

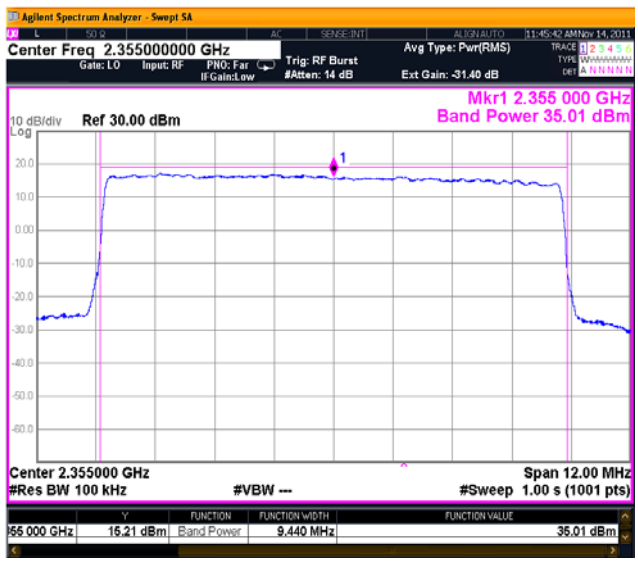


Plot # 22

Chain 2



Plot # 23



Plot # 24

5.1.3. Peak - to - average power ratio test § 27.50 (1)(B).

Operating Frequency Range 2305 – 2320 MHz , 2345 – 2360 MHz
Ambient Temperature 21^0 C Relative Humidity 47% Air Pressure 1006 hPa

EBW, MHz	Carrier frequency, MHz	PAPR ratio at 0.1 percent of time	PAPR limit, dB	Margin, dB	Reference to plots #
3.5	2316.75	8.13	13	4.9	25
	2348.25	8.03	13	5.0	26
5.0	2307.5	7.46	13	5.5	27
	2357.5	7.74	13	5.3	28
10	2310.0	7.61	13	5.4	29
	2355.0	7.93	13	5.1	30

The peak-to-average power ratio (PAPR) of the transmitter output power must not exceed 13 dB. The PAPR measurements should be made using either an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR will not exceed 13 dB for more than 0.1 percent of the time.

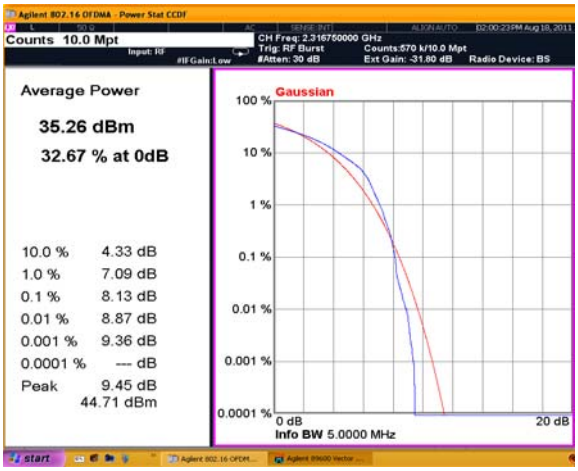
TEST PROCEDURE

The PAPR measurements made using an instrument with complementary cumulative distribution function (CCDF) capabilities to determine that PAPR that not exceed 13 dB for more than 0.1 percent of the time. The measurement performed using a signal corresponding to the highest PAPR expected during periods of continuous transmission**.**
Test was conducted in normal (transmitting) mode at all transmitted carrier (channel) frequencies of the 2305 – 2320 MHz, 2345 – 2360 MHz frequency ranges under 64 QAM modulation as worse case. The EUT RF output was connected to the Spectrum Analyzer through appropriate attenuator and accounted with cable loss in SA settings.

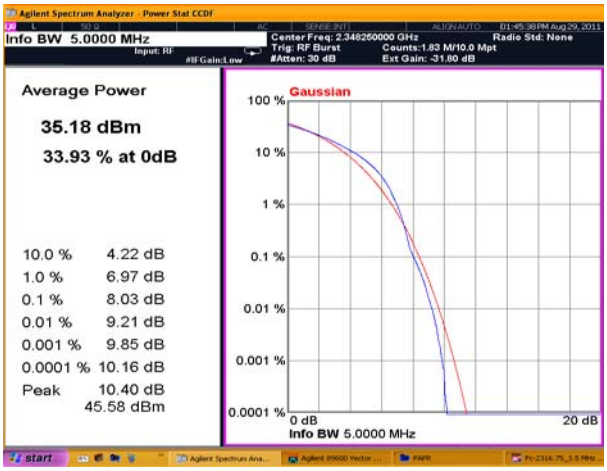
TEST EQUIPMENT USED:

2	3	4	5			

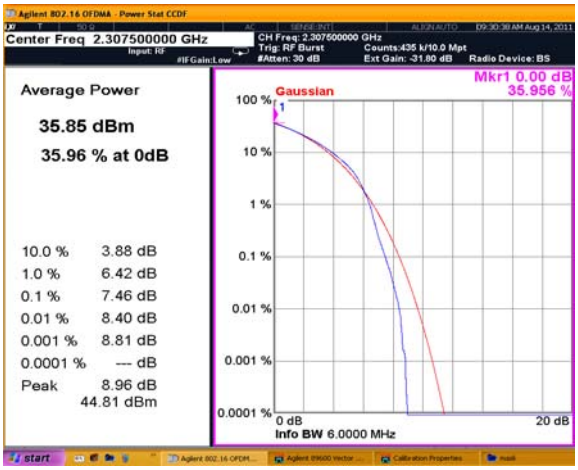
PAPR test results.



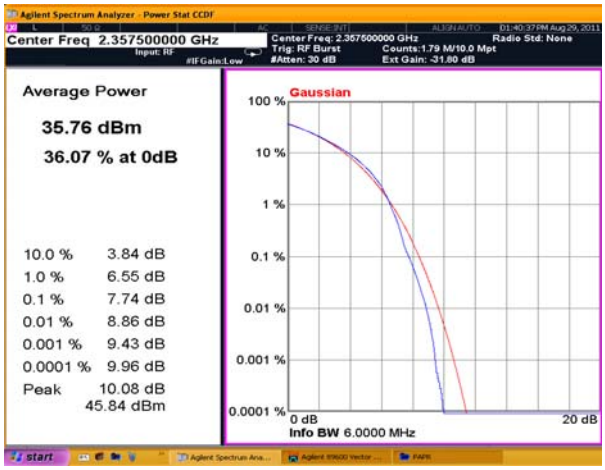
Plot # 25. 3.5 MHz EBW.



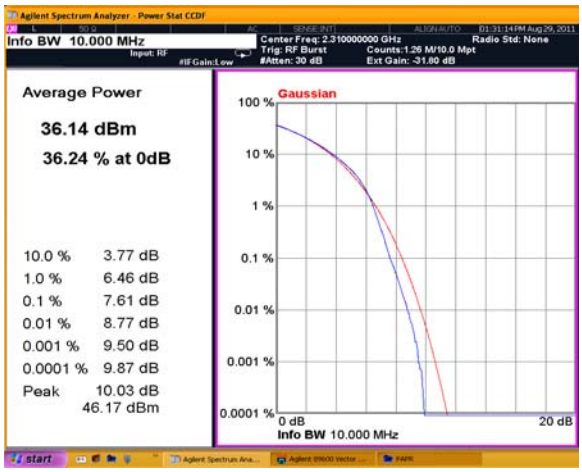
Plot # 26. 3.5 MHz EBW.



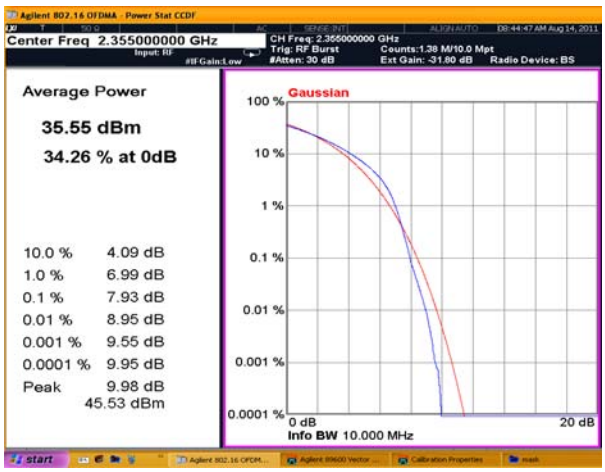
Plot # 27. 5 MHz EBW.



Plot # 28. 5 MHz EBW.



Plot # 29. 10 MHz EBW.



Plot # 30. 10 MHz EBW.

5.1.4. Spurious emissions and band edge mask at antenna terminal § 27.53 (1)

Operating Frequency Range 2305 – 2320 MHz , 2345 – 2360 MHz
Ambient Temperature 21^0 C Relative Humidity 47% Air Pressure 1006 hPa

The frequency spectrum was investigated from the lowest radio frequency signal generated in the equipment up to the tenth harmonic of the highest fundamental frequency. No emissions except at band-edge points were found. Emission with level more than 15 dB below the limit and noise floor results not inserted in the table below. Additional results present in plots of the section.

EBW, MHz	Carrier frequency, MHz	Frequency, MHz	*Measured level, dBm	Resolution BW, kHz	Integration BW, kHz	Specified limit, dBm	Result	Reference to plot #
3.5	2316.75	2288	-52.5	1000	-	-45.0	PASS	31
		2315	-14.1	36.0	1000	-13.0		33
		2320	-45.7	36.0	1000	-45.0		35
		6449	-46.5	1000	-	-45.0		37
	2348.25	2293	-50.9	1000	-	-45.0	PASS	39
		2345	-45.7	36.0	1000	-45.0		42
		2350	-14.6	36.0	1000	-13.0		44
		5851	49.2	1000	-	-45.0		45
5.0	2307.5	2305	-13.7	51.0	1000	-13.0	PASS	49
		2310	-13.6	51.0	1000	-13.0		51
		2334	-54.6	1000	-	-45.0		52
	2312.5	2310	-14.0	51.0	1000	-13.0	PASS	58
		2315	-14.5	100.0	1000	-13.0		60
		2334	-51.6	1000	-	-45.0		61
	2352.5	2345	-47.6	100.0	1000	-45.0	PASS	68
		2350	-13.9	100.0	1000	-13.0		70
		2355	-13.7	100.0	1000	-13.0		72
	2357.5	2337	-50.7	1000	-	-45.0	PASS	78
		2355	-13.4	100.0	1000	-13.0		80
		2360	-15.1	100.0	1000	-13.0		82
		2362.5	-29.5	1000	-	-25.0		83
10.0	2310	2305	-14.1	100.0	1000	-13.0	PASS	88
		2315	-13.4	100.0	1000	-13.0		90
		2320	-49.5	1000	-	-45.0		91
	2355	2345	-48.5	1000	-	-45.0	PASS	98
		2350	-15.5	100.0	1000	-13.0		100
		2360	-19.4	100.0	1000	-13.0		102
		2362.5	-31.0	1000	-	-25.0		
		2365	-46.3	1000	-	-45.0		104

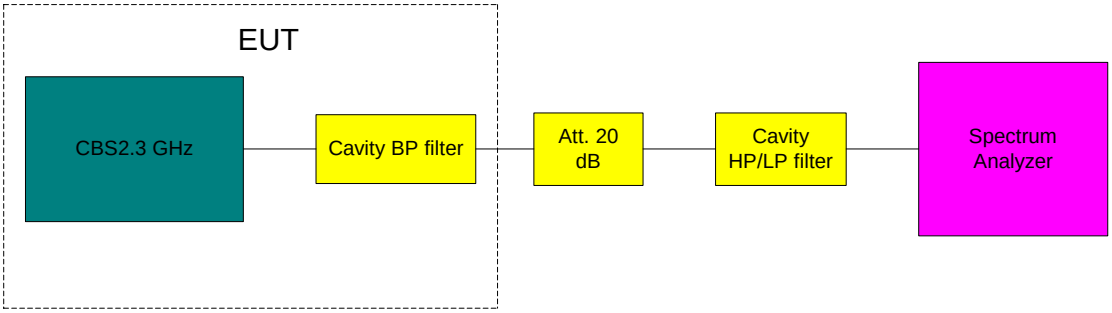
*Adjusted by 10log (2) = 3 dB

LIMIT

For operation in the bands 2305 –2320 MHz and 2345 – 2360 MHz, the power of any emissions outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by the following amounts: Below 2285 MHz and above 2370 MHz and on all frequencies from 2320 to 2345 MHz by factor of not less then 75+10Log (P) dB (-45 dBm). On all frequencies from 2305 to 2320 MHz and on all frequencies from 2345 to 2360 MHz by factor of not less then 43+10Log (P) dB (-13 dBm).
By a factor of not less than: 43 + 10 log (P) dB at 2305 MHz, 70 + 10 log (P) dB (-40 dBm) at 2300 MHz, 72 + 10 log (P) dB (-42 dBm) at 2287.5 MHz.
By a factor of not less than: 43 + 10 log (P) dB at 2360 MHz, 55 + 10 log (P) dB (-25 dBm) at 2362.5 MHz, 70 + 10 log (P) dB at 2365 MHz, 72 + 10 log (P) dB at 2367.5 MHz.

TEST PROCEDURE

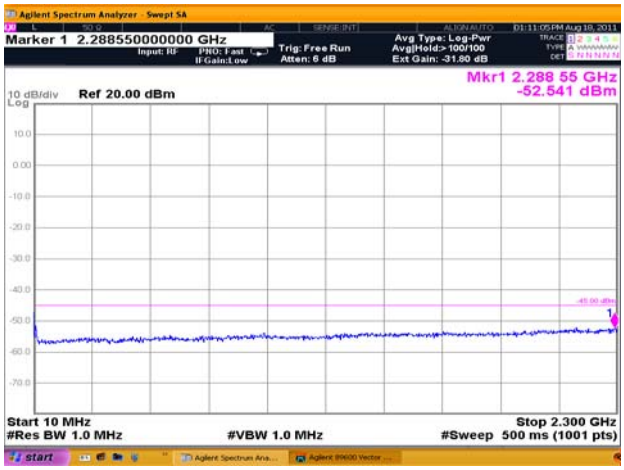
The test was conducted according to FCC part 27.53 (5) measurement procedure.
The measurements were performed in normal (transmitting) mode at all transmitted carrier (channel) frequencies of the 2305 – 2320 MHz, 2345 – 2360 MHz frequency ranges under QAM 64 modulation as worse case. RBW = 1-3 % of emission bandwidth VBW= 3 x RBW. Detector RMS and power average function. The EUT RF output was connected to the Spectrum Analyzer through appropriate attenuator and accounted with cable loss in SA settings. In 3.5 MHz EBW band test was conducted with external preselection, with the cavity High Pass/Low Pass (HP/LP) filter for improving SA dynamic range.



TEST EQUIPMENT USED:

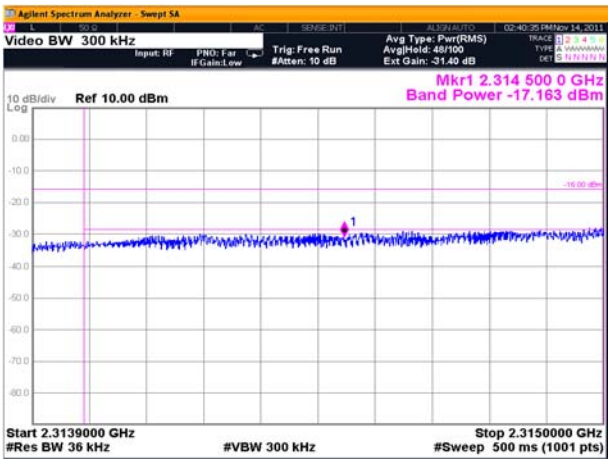
1	3	5	9	**16**		

Spurious emissions at antenna terminal.
3.5 MHz EBW. **Carrier frequency 2316.75 MHz**.

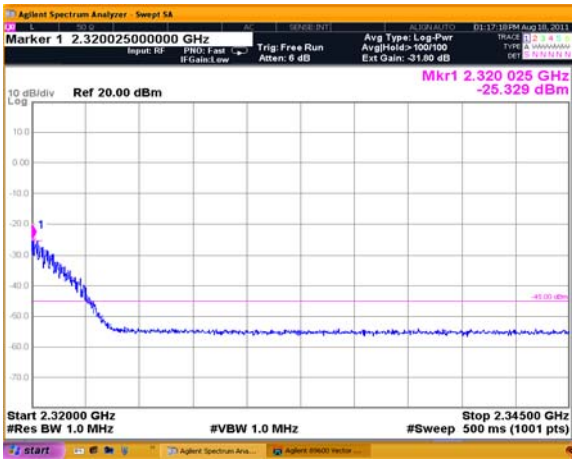


Plot # 31

Plot # 32

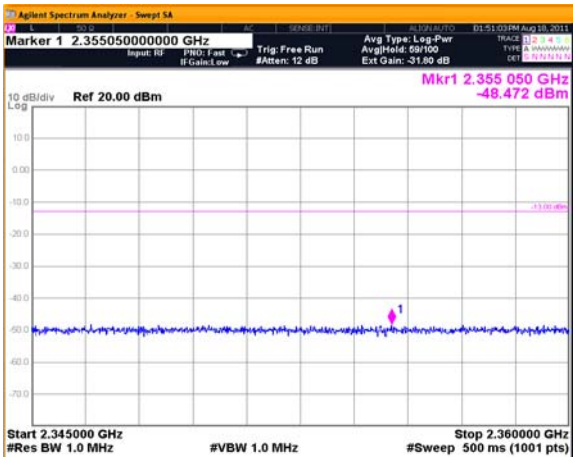


Plot # 33

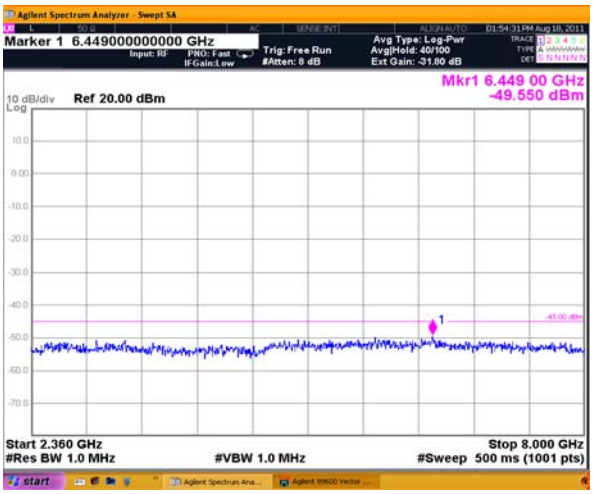


Plot # 34.

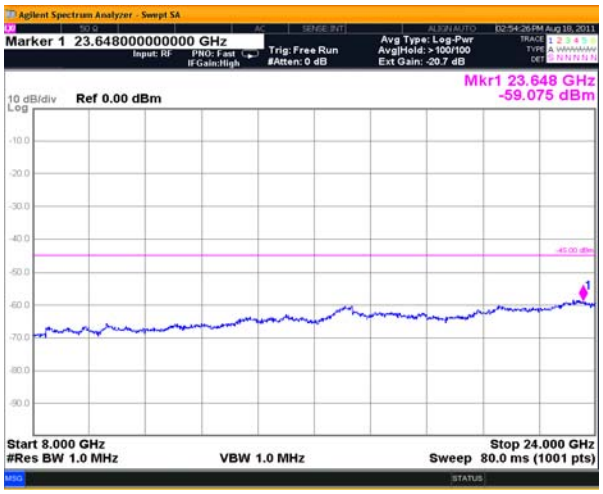
Plot # 35.



Plot # 36.

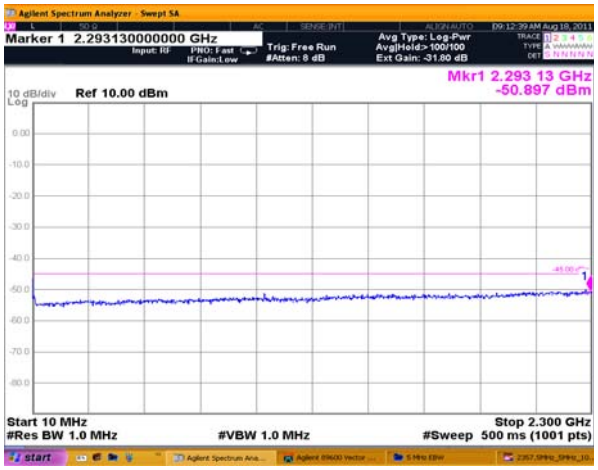


Plot # 37

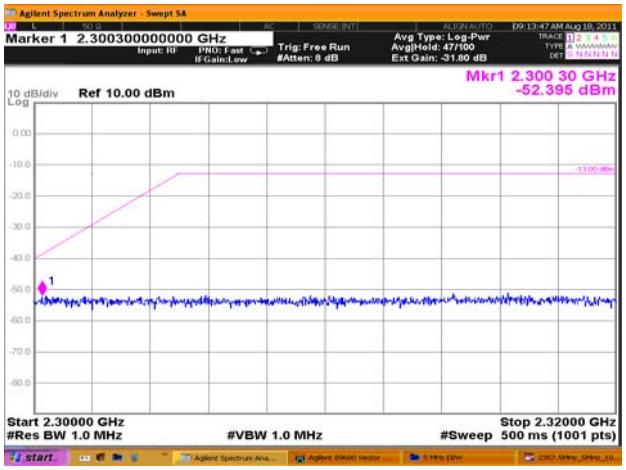


Plot # 38

Carrier frequency 2348.25 MHz.

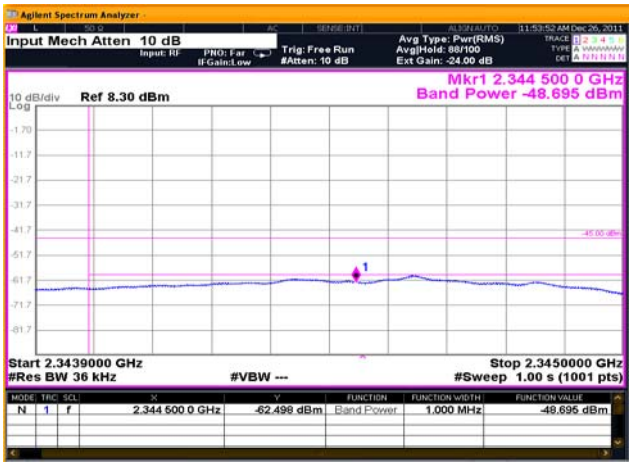


Plot # 39



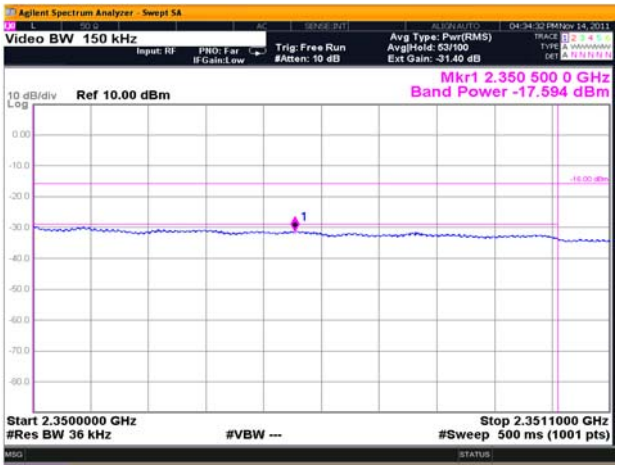
Plot # 40.

Plot # 41.

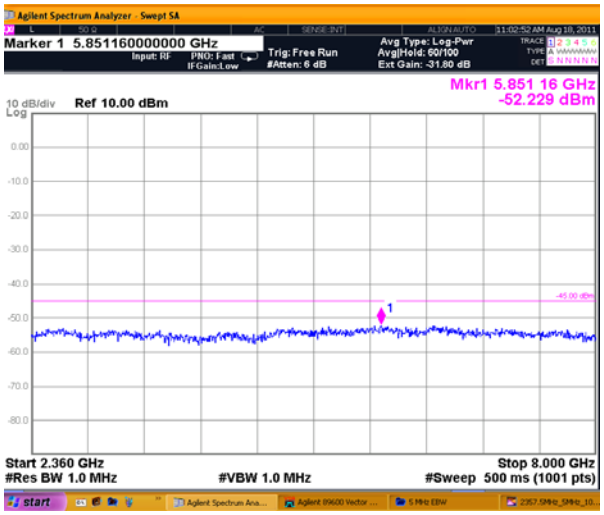


Plot # 42.

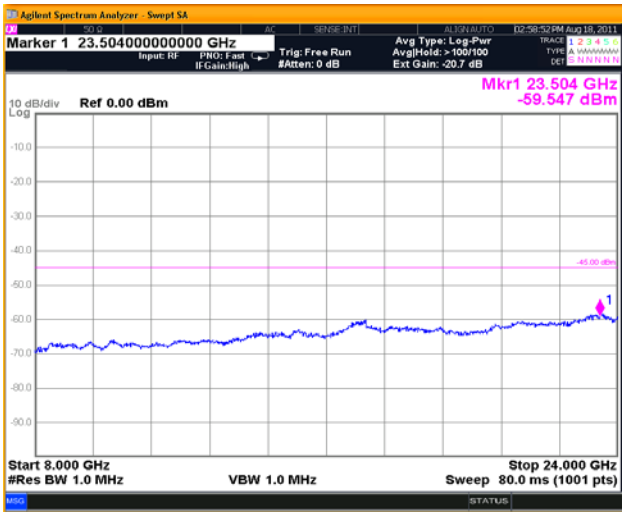
Plot # 43.



Plot # 44



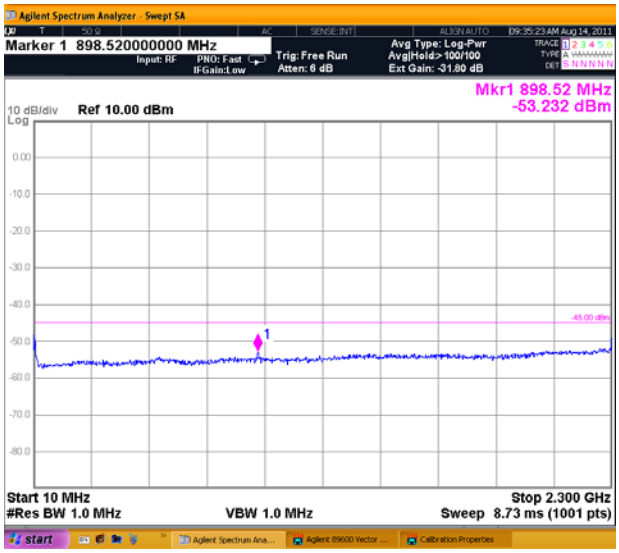
Plot # 45



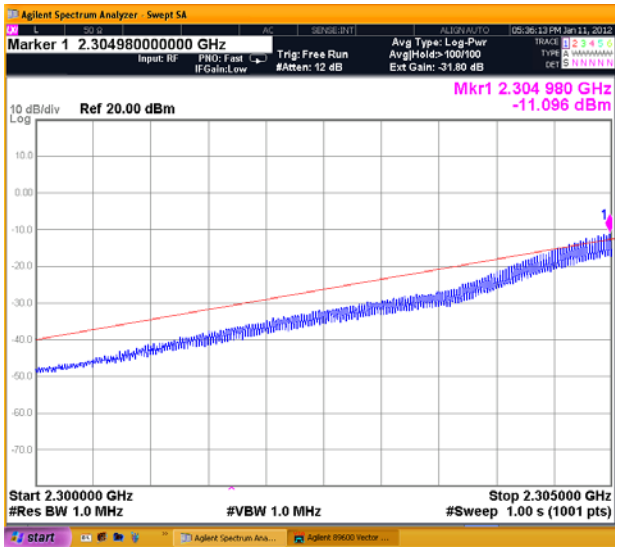
Plot # 46

5 MHz EBW

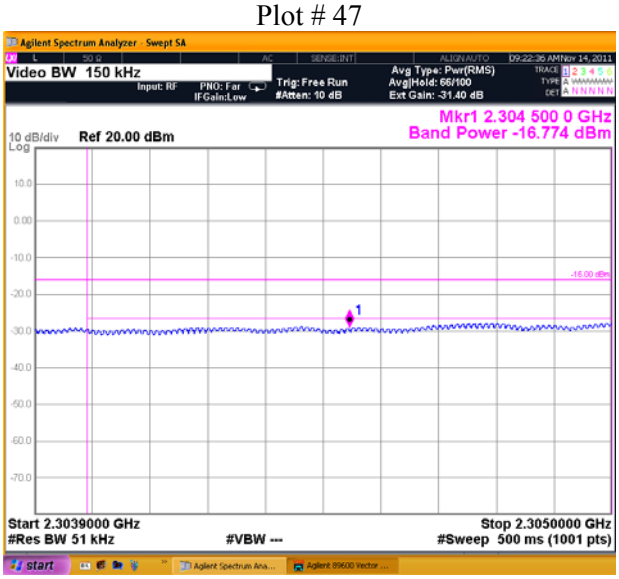
Carrier frequency 2307.5 MHz.



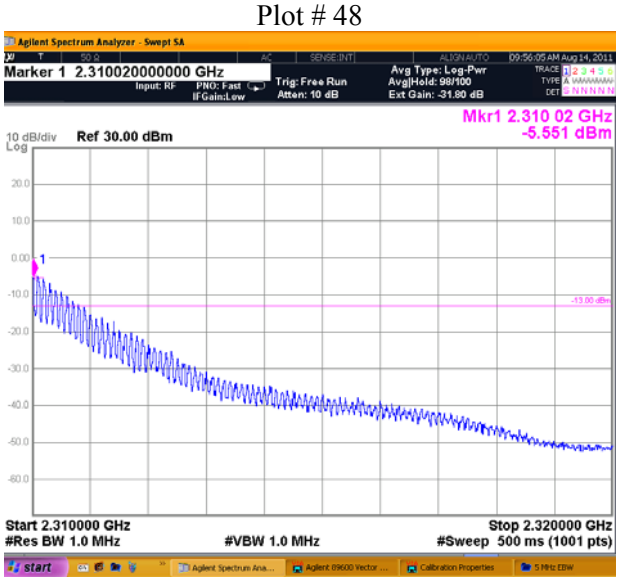
Plot # 47



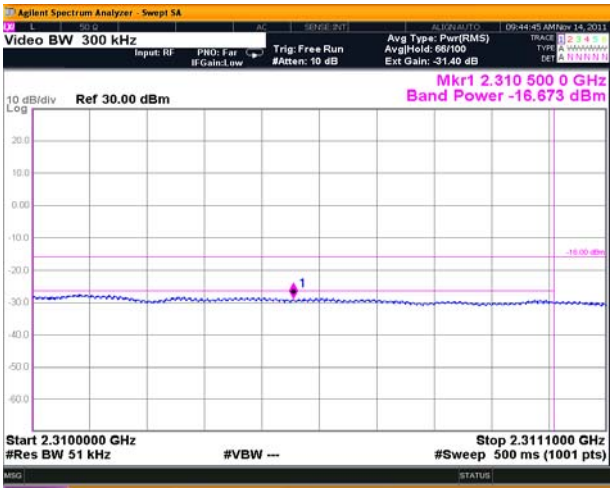
Plot # 48



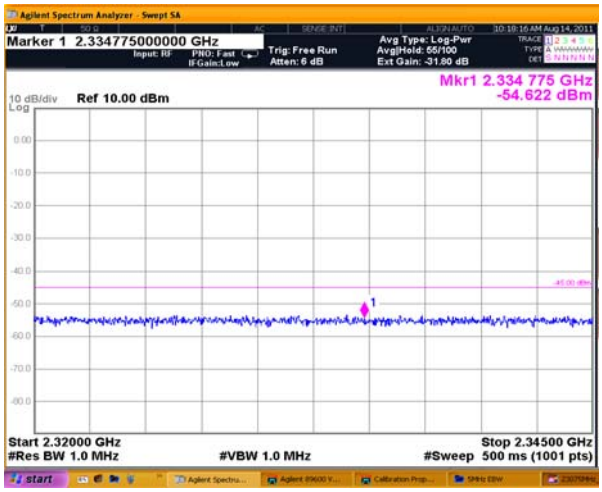
Plot # 49.



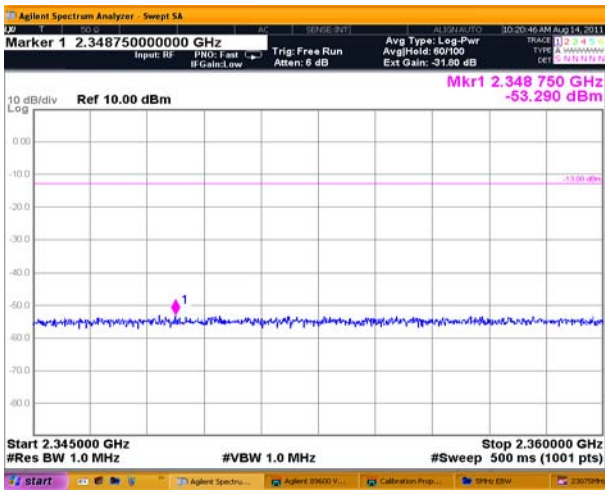
Plot # 50



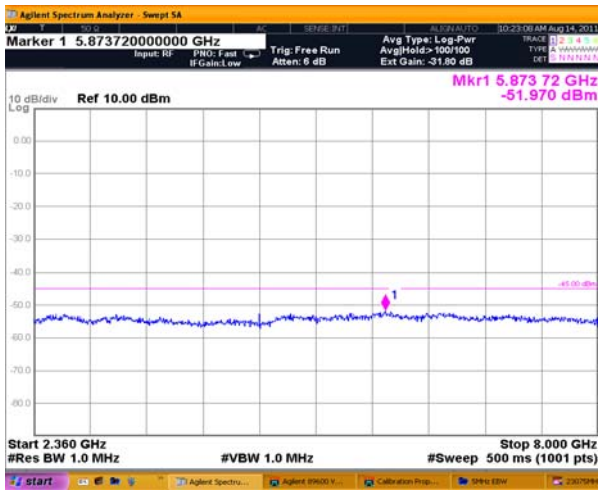
Plot # 51.



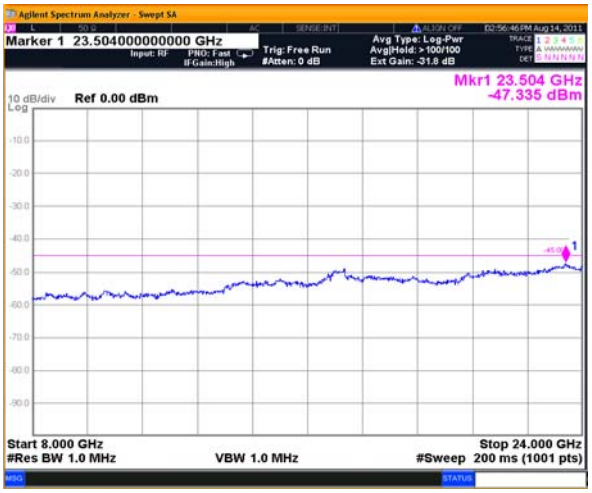
Plot # 52



Plot # 53



Plot # 54



Plot # 55