



***Test Report No. 9112346881***

***Applicant: Ruggedcom Inc.***

***Equipment Under Test:***

***WiMax Transceiver***

***Customer premises equipment (CPE).***

***Model: RuggedMax™ WIN5123/WIN5223***

***From The Standards Institution  
Of Israel***

***Industry Division***

***Electronics & Telematics Laboratory***

***EMC Section***



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**Model:** WIN5123/WIN5223

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## 1. Applicant information

<b>Applicant:</b>	Ruggedcom Inc.
<b>Address:</b>	32 Maskit str, Herzlia, 12412, Israel
<b>Sample for test selected by:</b>	The applicant
<b>The date of test:</b>	15 – 18 August , 21 November 2011

## Equipment under test information

<b>Description of Equipment Under Test (EUT):</b>	WiMax Transceiver
<b>Model:</b>	WIN5123/WIN5223
<b>Serial Number:</b>	NA
<b>Software version of radio unit</b>	4.2
<b>Hardware version of radio unit</b>	ID = 23
<b>Manufactured by:</b>	Ruggedcom Inc.

## 2. Test performance

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

This Test Report contains 56 pages and may be used only in full.

This Test Report applies only to the specimen tested and may not be applied to other specimens of the same product.



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**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 (a)(2)
Peak-to-average power ratio (PAPR)	27.50 (a)(1)(B)
Spurious emissions at antenna terminal	27.53 (a)(2)
Spurious emissions radiated	27.53 (a)(2)
Frequency stability	27.54

Telematics Laboratory  
 22 November 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
<b>Radiated emissions</b> 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

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#### 4. Equipment under test description.

\*The customer provided description.

##### 4.1 General description

The RuggedMax™ WIN5123/WIN5223 (hereinafter: EUT) is a WiMax Subscriber Unit (CPE) intended for outdoors installations. The EUT is a wall mounted appliance with one 10/100 PoE port and two antenna options - integrated with EUT enclosure RF antenna (WIN5223) or optional interface for two external antennas (WIN5123). One of external antennas intended for transmission and second for receives only.

The EUT inserted in a metallic enclosure without ventilation opening.

EUT includes the following sub-units: One internal DC-DC power supply board, internal Radio board 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 2 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 (5/6)		
Type of multiplexing	TDMA		
Modulating test signal (baseband)	PRBS		
Maximum duty cycle supplied for test.	33 %		
Antenna information			
Antenna Type	Manufacturer	Model	Gain, dBi
Dual Slant Plate 2.3-2.7 GHz	MTI	MT-344048/ND	16
Dual Slant Plate 2.3-2.7 GHz	MTI	MT-344048/CD	16

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**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<sup>2</sup>) or 10 (W/m<sup>2</sup>).

The power density calculation  $S = (Pt / 4\pi r^2)$ .

Where

Pt - The transmitted power (EIRP) (mW)

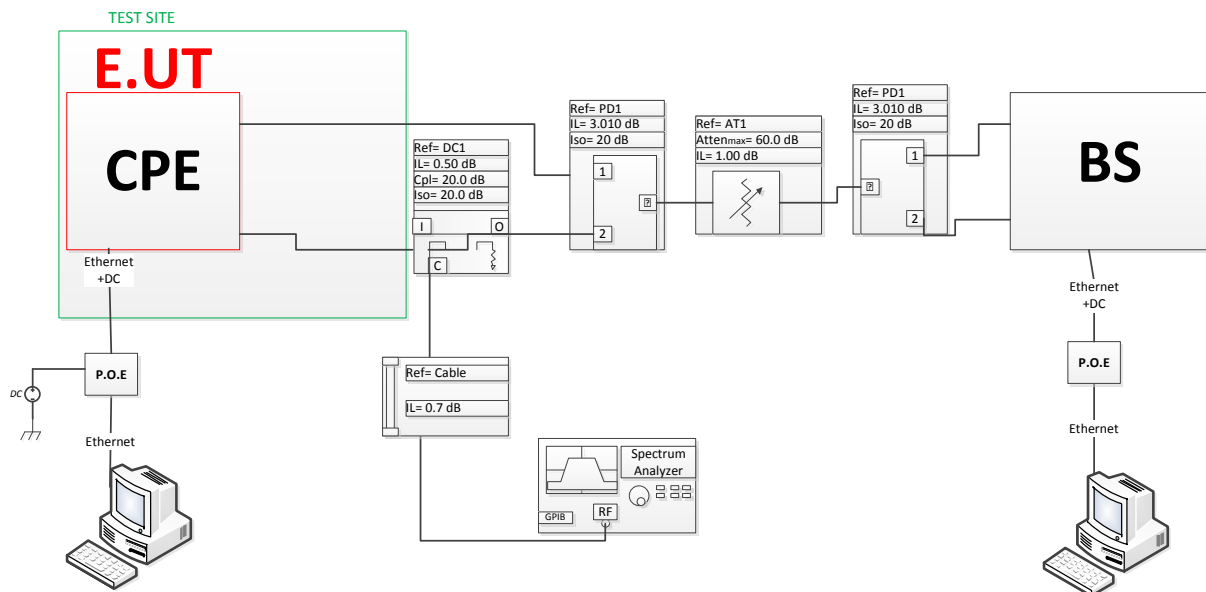
r - The distance from the unit. (m)

The 1(mW/cm<sup>2</sup>) limit can be calculated from the above based on the following data:

Pt- the transmitted power which is equal to the maximum EIRP = 42.9 dBm = 16218 mW

Minimum allowed distance r from the antenna were FCC RF exposure limit may not be exceeded =  $SQRT(16218/4\pi) > 0.39$  m.

**4.2 EUT configuration.**



**Fig. 1. The RuggedMax™ WIN5123 setup configuration.**



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**5. Test results**

**5.1. Transmitter characteristics**

**5.1.1. Occupied bandwidth test 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<sup>0</sup> C            Relative Humidity            47%            Air Pressure            1006 hPa

EBW, MHz	Carrier frequency, MHz	99% power EBW MHz	Reference to plot #
3.5	2316.75	3.2	1, 9
	2348.25	3.2	2, 10
5.0	2307.5	4.44	3, 11
	2312.5	4.44	4, 12
	2352.5	4.44	5, 13
	2357.5	4.44	6, 14
10	2310.0	9.1	7, 15
	2355.0	9.1	8, 16

**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 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.

**TEST EQUIPMENT USED:**

2	3	4	5			
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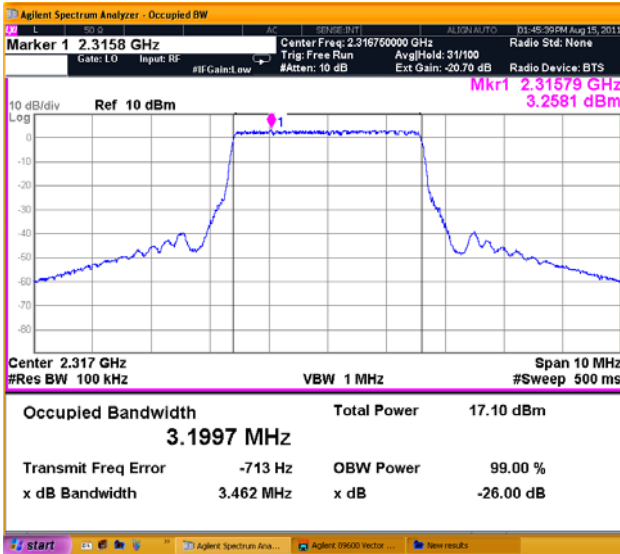
Model: WIN5123/WIN5223

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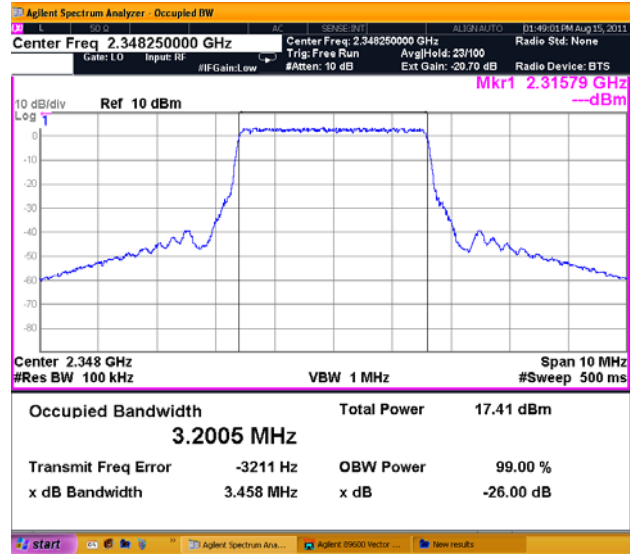
FCC ID: VG5WIN5223

Occupied bandwidth test.

3.5 MHz EBW option, 99% bandwidth



Plot # 1



Plot # 2

Insertion loss of external attenuator, directional coupler and cable = 20.7 dB.



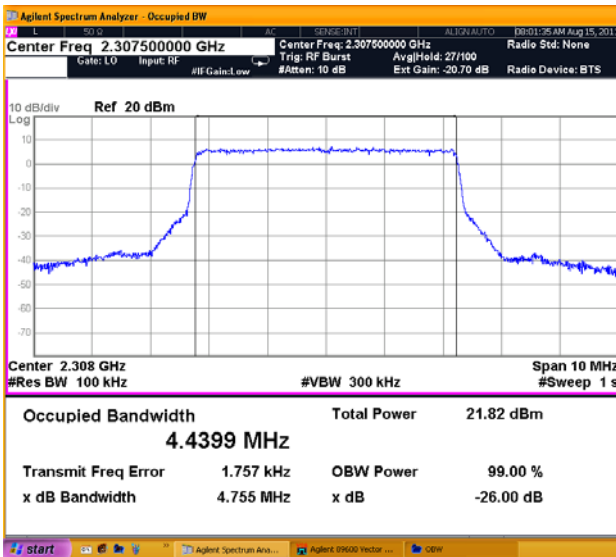


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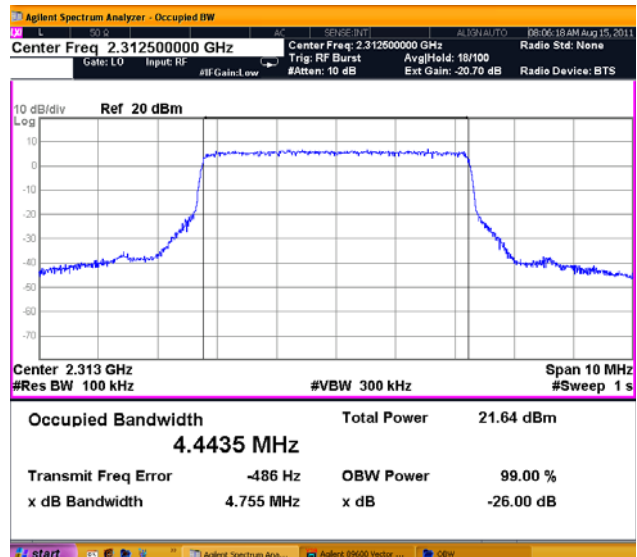
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FCC ID: VG5WIN5223

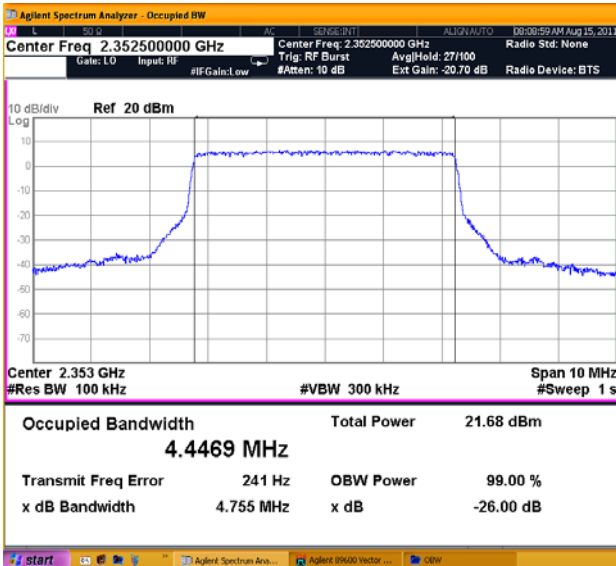
5 MHz EBW option, 99% bandwidth



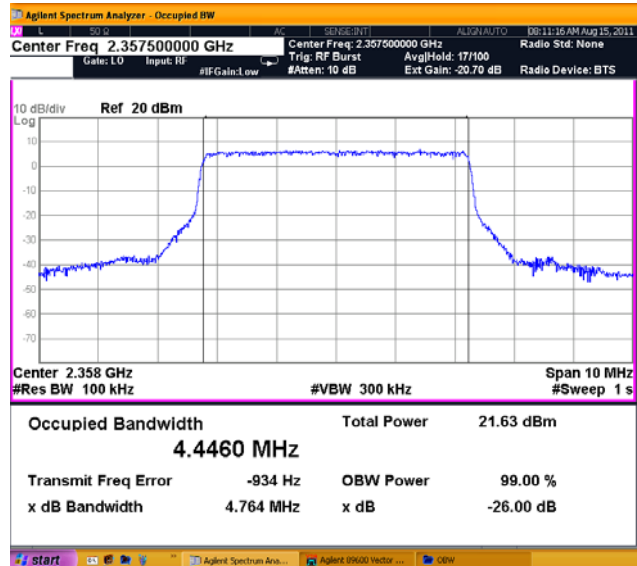
Plot # 3



Plot # 4



Plot # 5



Plot # 6

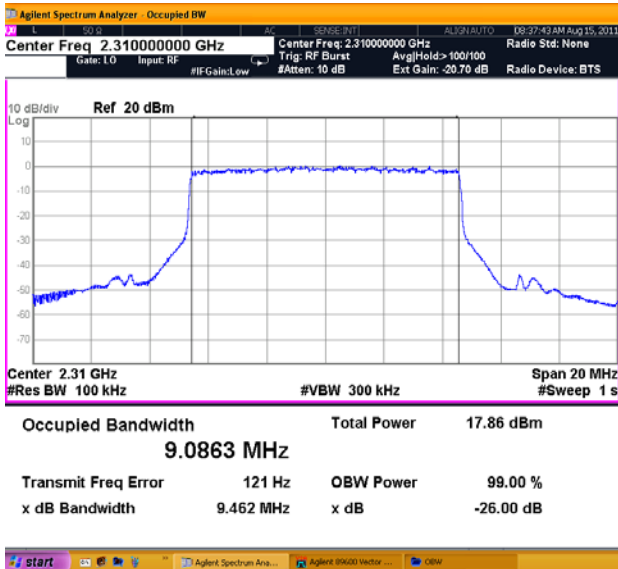


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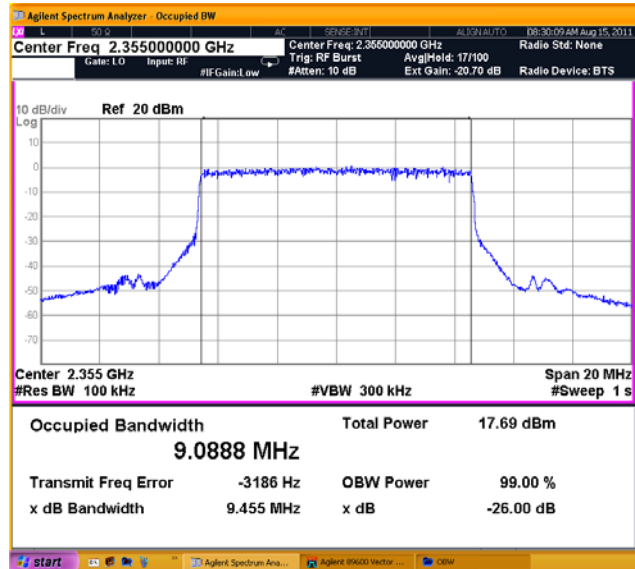
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10 MHz EBW option, 99% bandwidth



Plot # 7



Plot # 8



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5.1.2. Peak output power test § 27.50 (a)(2).

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

Table with 9 columns: EBW, MHz; Carrier frequency, MHz; Output power, dBm; \*Avg. EIRP dBm; PAPR ratio dB; \*\*Peak EIRP dBm; Peak EIRP limit, dBm; Result; Reference to plots #. Rows include test results for 3.5, 5.0, and 10 MHz bandwidths.

\*The Average EIRP power = Output power + Antenna gain (16 dBi).
\*\* The Peak EIRP power = Output power + PAPR ratio + Antenna gain (16 dBi).

For fixed customer premises equipment (CPE) stations transmitting in the 2305–2320 MHz band or in the 2345–2360 MHz band, the peak EIRP must not exceed 20 watts (43 dBm) within any 5 megahertz of authorized bandwidth.

TEST PROCEDURE

Measuring of required Duty Cycle presented in this section below. 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.

TEST EQUIPMENT USED:

Table with 7 empty cells for listing test equipment.



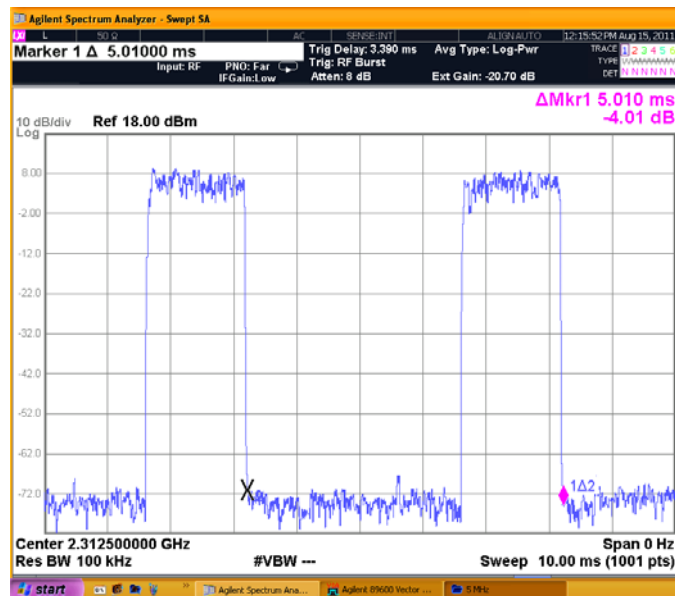
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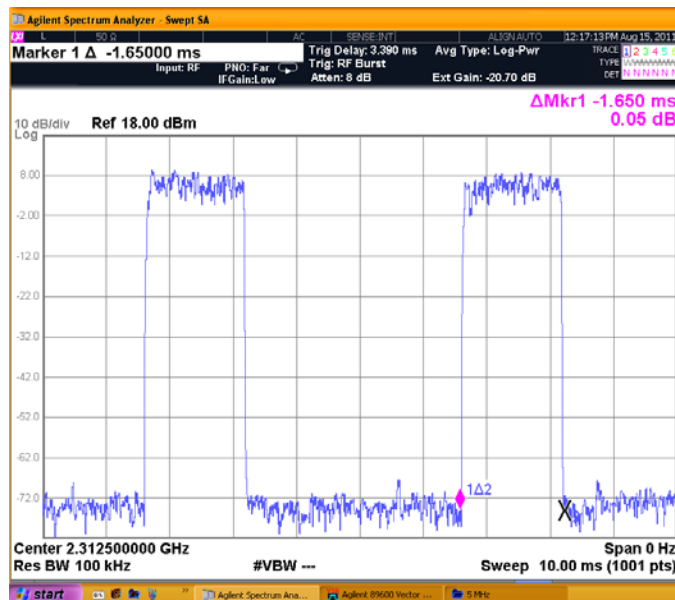
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Duration of the transmission train.



Transmission time duration.

Duty cycle was calculated from above recorded transmission times as follow:

$$\text{Duty cycle} = (\text{Tx on} / \text{Tx on} + \text{Tx off}) \times 100\% = (1.65 / 5) \times 100\% = 33\%$$



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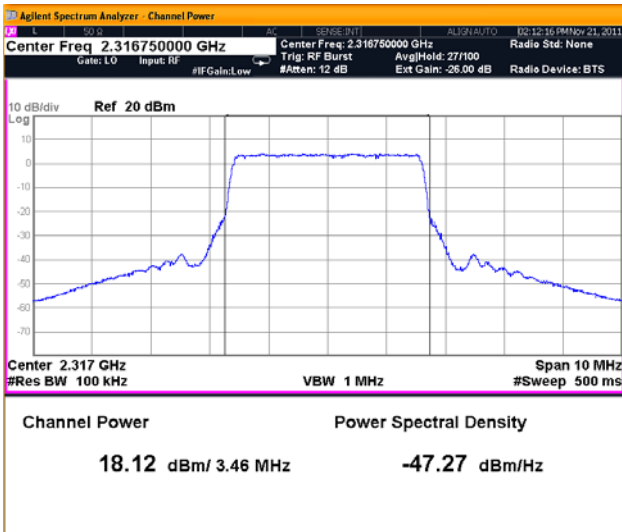
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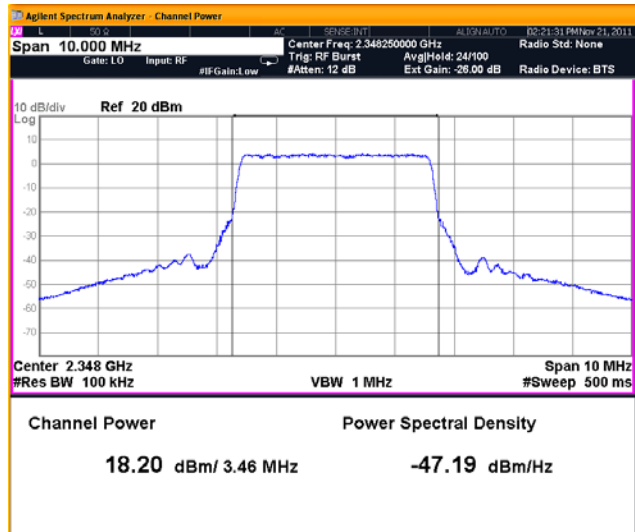
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### Output power test results.

#### 3.5 MHz EBW option



Plot # 9



Plot # 10

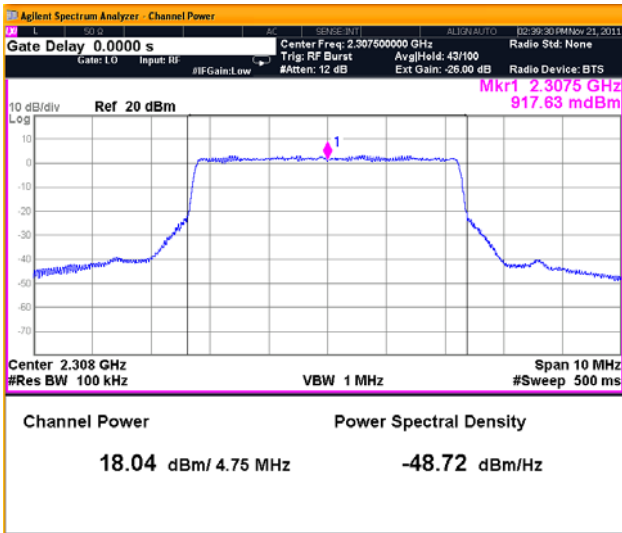


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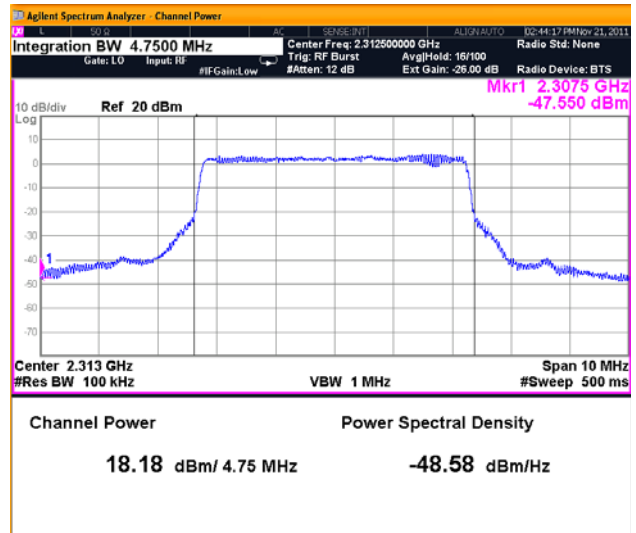
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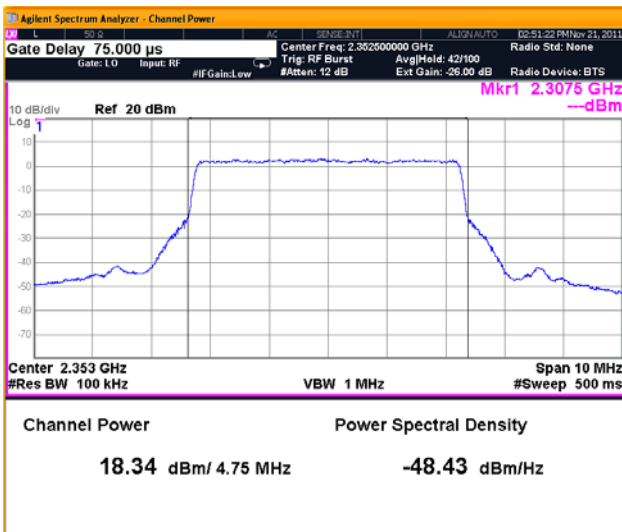
5 MHz EBW option.



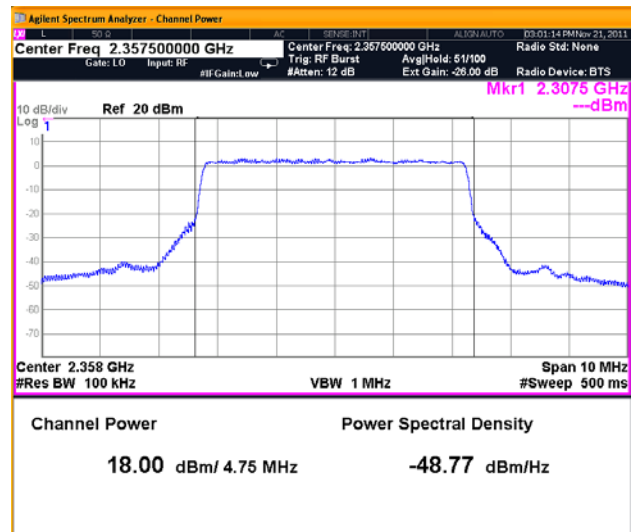
Plot # 11



Plot # 12



Plot # 13



Plot # 14

Insertion loss of external attenuator, directional coupler and cable = 26.0 dB.



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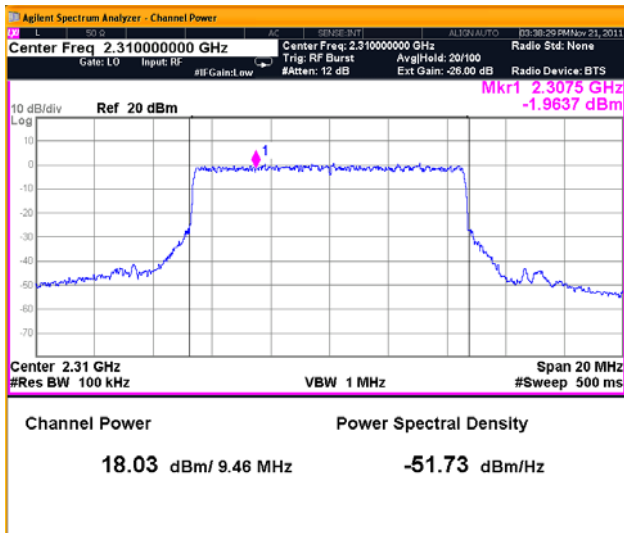
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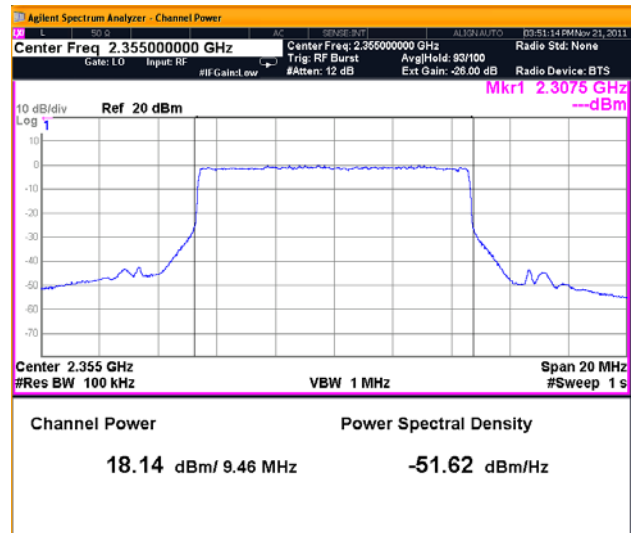
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10 MHz EBW option.



Plot # 15



Plot # 16



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

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

Table with 6 columns: EBW, MHz; Carrier frequency, MHz; PAPR ratio at 0.1 percent of time; PAPR limit, dB; Result; Reference to plots #. Rows show test results for 3.5, 5.0, and 10 MHz bandwidths.

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. 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 (5/6) 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 that accounted with cable loss in SA settings.

TEST EQUIPMENT USED:

Table with 7 columns and 1 row, containing numbers 2, 3, 4, 5 and empty cells.



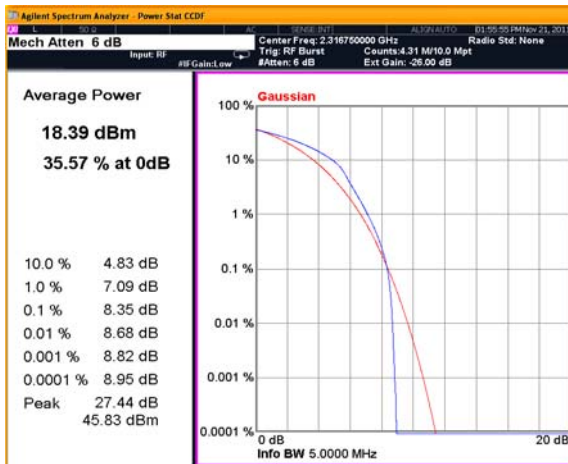


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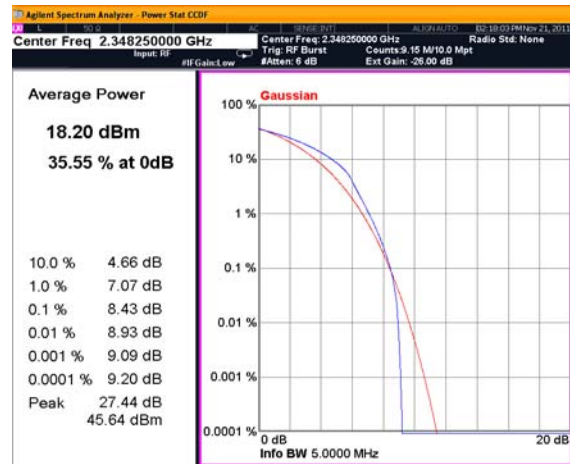
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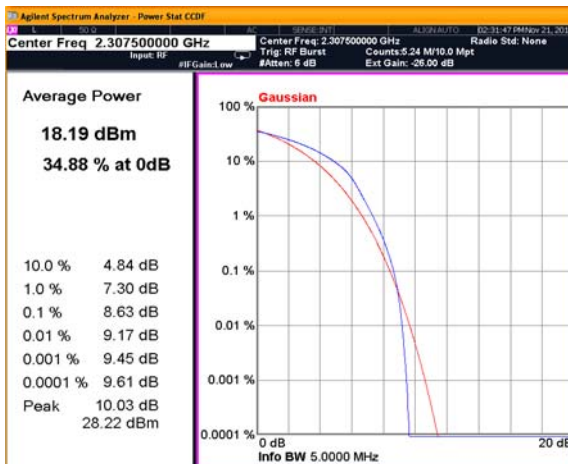
PAPR test results.



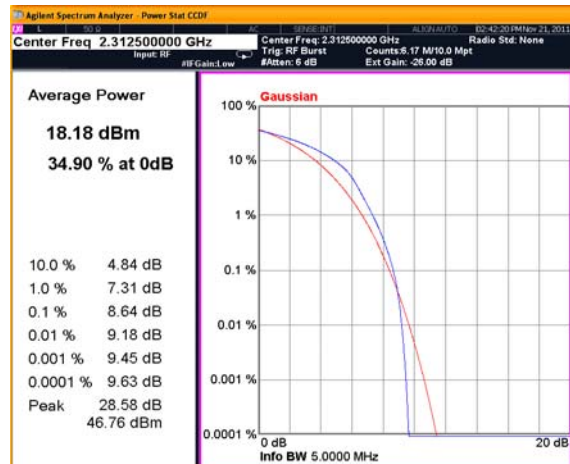
Plot # 17. 3.5 MHz EBW.



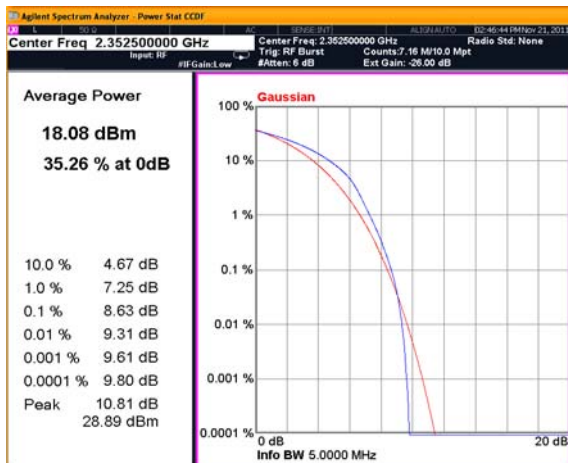
Plot # 18. 3.5 MHz EBW.



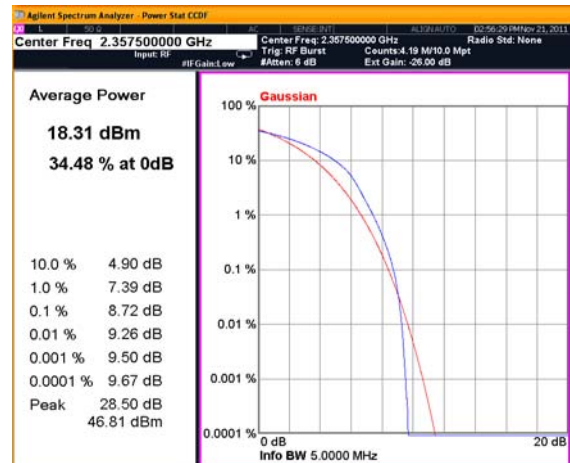
Plot # 19. 5 MHz EBW.



Plot # 20. 5 MHz EBW.



Plot # 21. 5 MHz EBW.



Plot # 22. 5 MHz EBW.



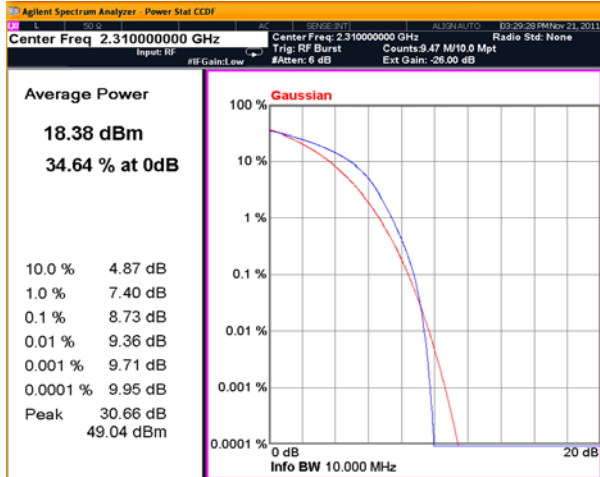
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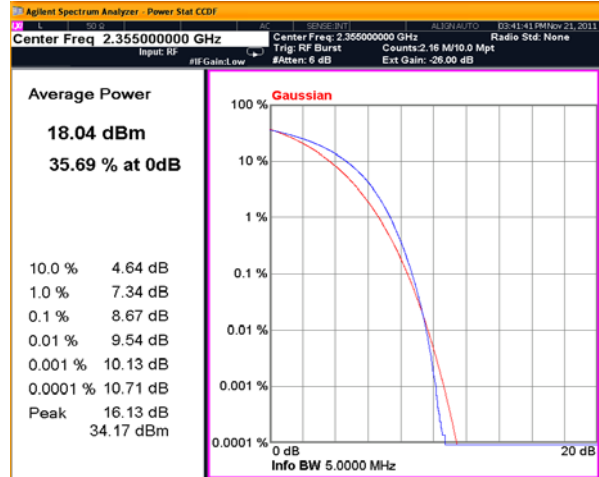
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Plot # 23. 10 MHz EBW.



Plot # 24. 10 MHz EBW.



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**5.1.4. Spurious emissions and band edge mask at antenna terminal § 27.53 (a)(2)**

Operating Frequency Range      2305 – 2320 MHz, 2345 – 2360 MHz  
 Ambient Temperature    21<sup>0</sup> 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 for at band-edge points were found. The undesired emissions lower than 20 dB under the specified limit and SA noise floor results at used settings were not recorded in the table.

The worse case results were found:

EBW, MHz	Carrier frequency, MHz	Measured frequency, MHz	Measured level, dBm	Specified limit, dBm	Margin, dB	Reference to plot #
3.5	2316.75	2300	-56.6	-45.0	11.6	25
		2320	-52.2	-45.0	7.2	28
	2348.25	2345	-51.7	-45.0	6.7	34
		5749	-57.7	-45.0	12.7	37
5.0	2307.5	2300	-61.2	-45.0	16.2	39
		2329	-61.9	-45.0	16.9	42
	2312.5	2272	-61.1	-45.0	16.1	46
		2320	-60.7	-45.0	15.7	49
	2352.5	2240	-61.9	-45.0	13.1	53
		2344	-55.0	-45.0	10.0	55
		5879	-58.9	-45.0	13.9	58
	2357.5	2339	-58.7	-45.0	12.7	62
6455		-59.3	-45.0	14.3	65	
10.0	2310	2300	-59.8	-45.0	14.8	67
		2320	-59.7	-45.0	14.7	70
	2355	2345	-59.3	-45.0	14.3	76
		5846	-62.4	-45.0	17.4	79



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**LIMIT**

For fixed customer premises equipment (CPE) stations operating in the bands 2305 –2320 MHz and 2345 – 2360 MHz transmitting with more than 2 watts per 5 megahertz average EIRP 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  $75+10\text{Log}(P)$  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  $43+10\text{Log}(P)$  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.

**TEST EQUIPMENT USED:**

1	3	5	9			
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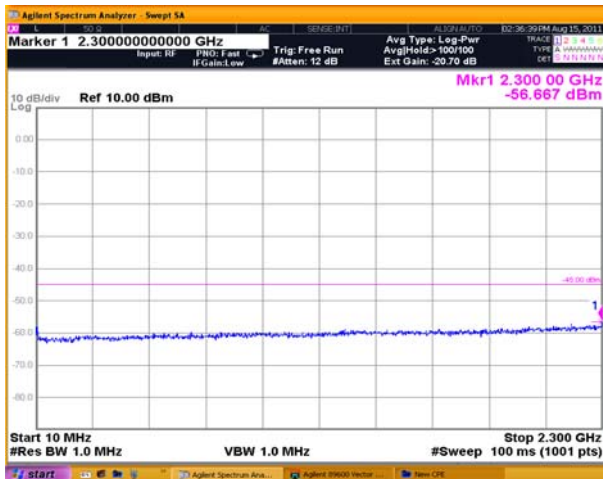
Model: WIN5123/WIN5223

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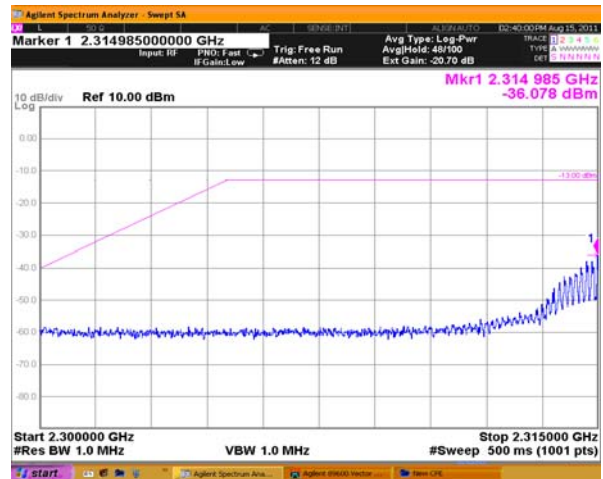
FCC ID: VG5WIN5223

Spurious emissions at antenna terminal.  
3.5 MHz EBW.

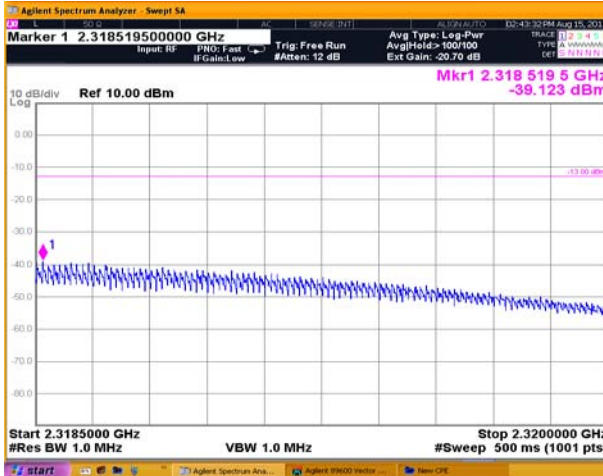
Carrier frequency 2316.75 MHz.



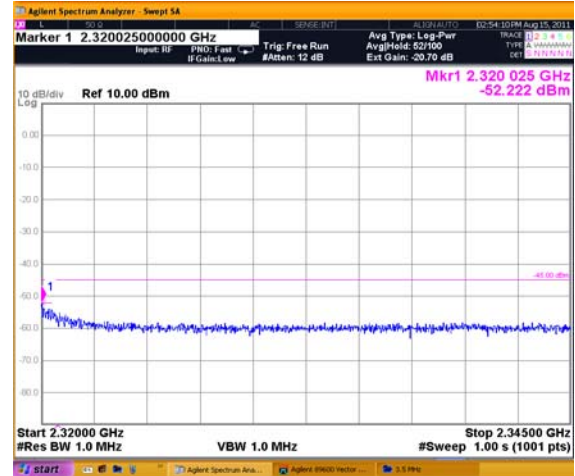
Plot # 25



Plot # 26



Plot # 27



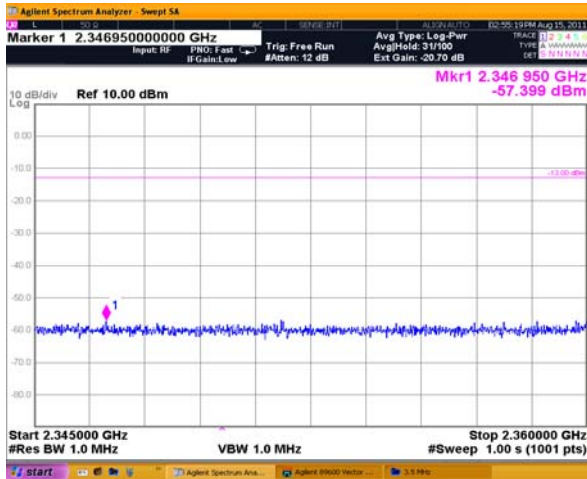
Plot # 28



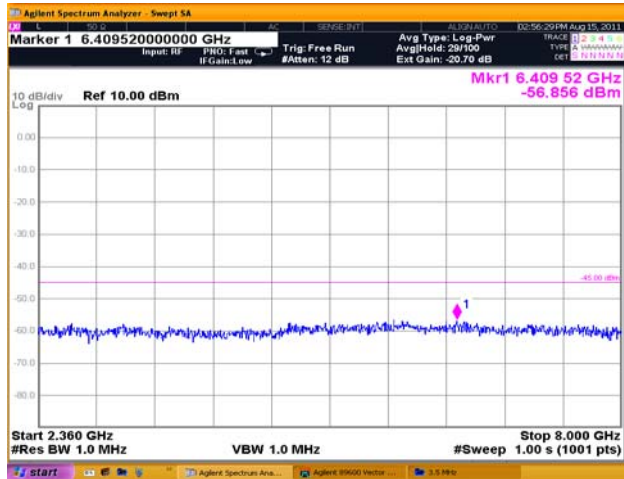
**Test report No: 9112346881**  
**Title: WiMax Transceiver**  
**Model: WIN5123/WIN5223**

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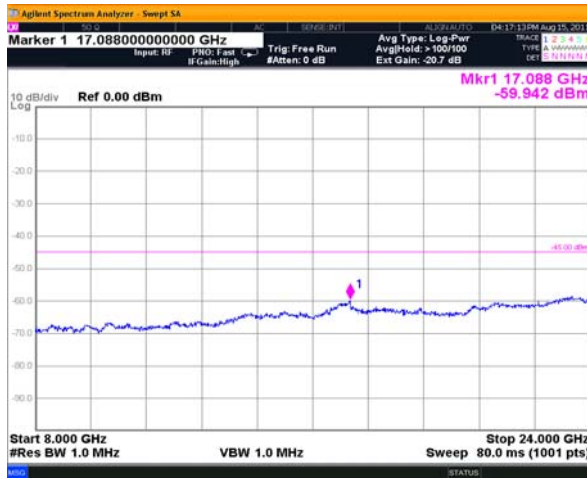
FCC ID: VG5WIN5223



Plot # 29



Plot # 30



Plot # 31.

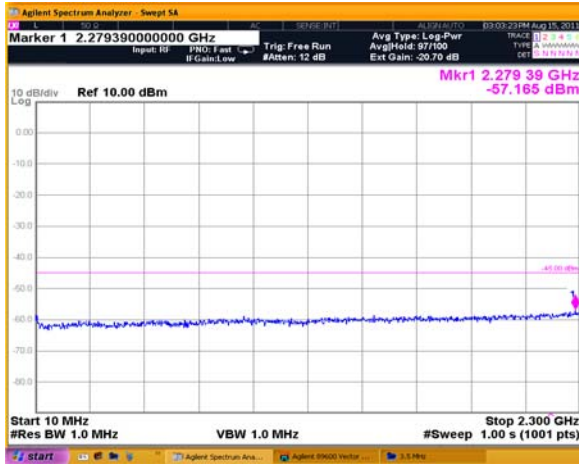


**Test report No: 9112346881**  
**Title: WiMax Transceiver**  
**Model: WIN5123/WIN5223**

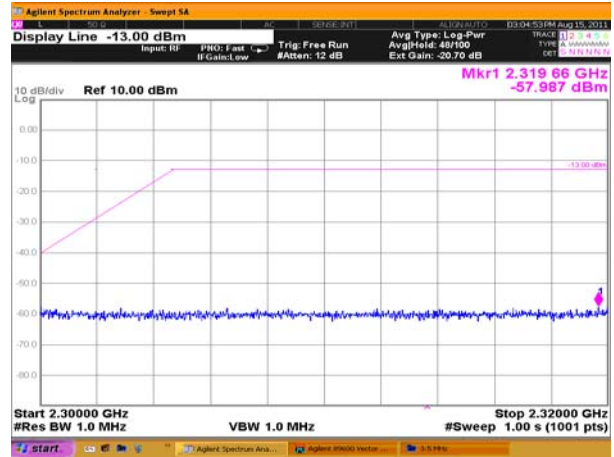
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FCC ID: VG5WIN5223

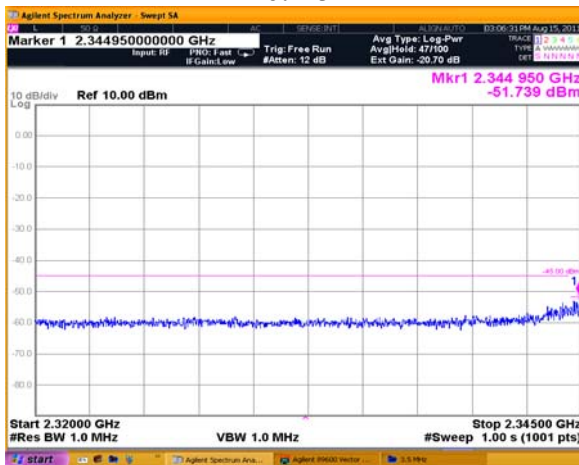
Carrier frequency 2348.25 MHz.



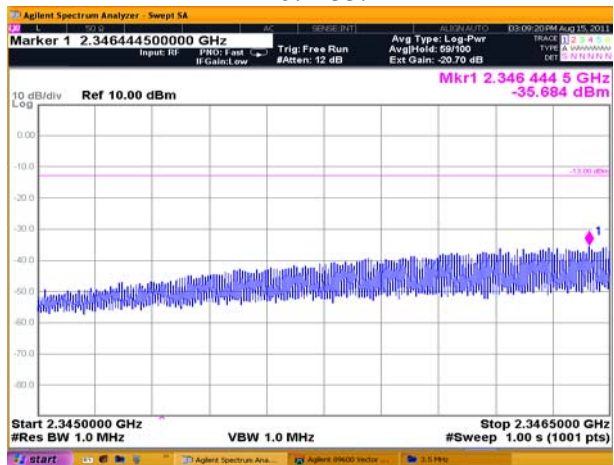
Plot # 32



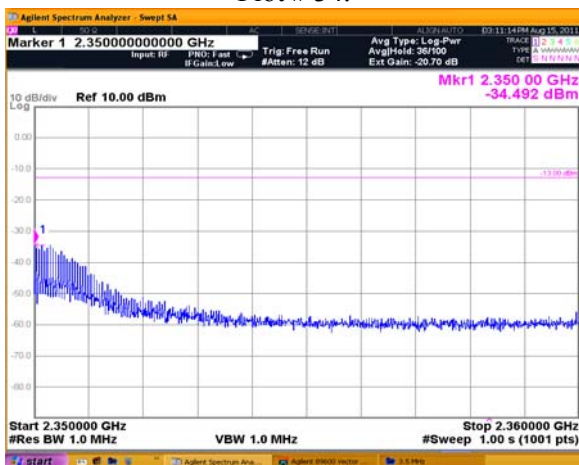
Plot # 33.



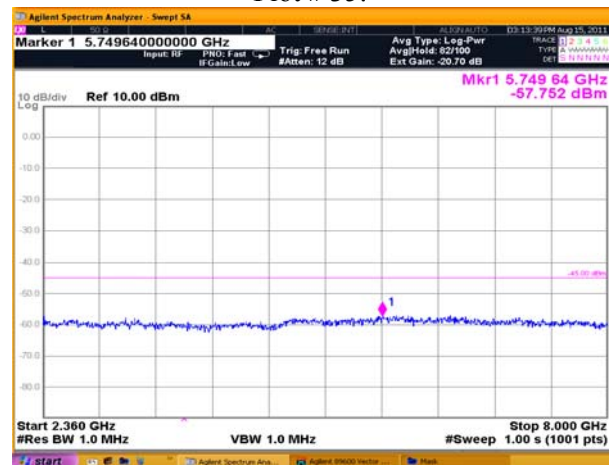
Plot # 34.



Plot # 35.



Plot # 36.



Plot # 37



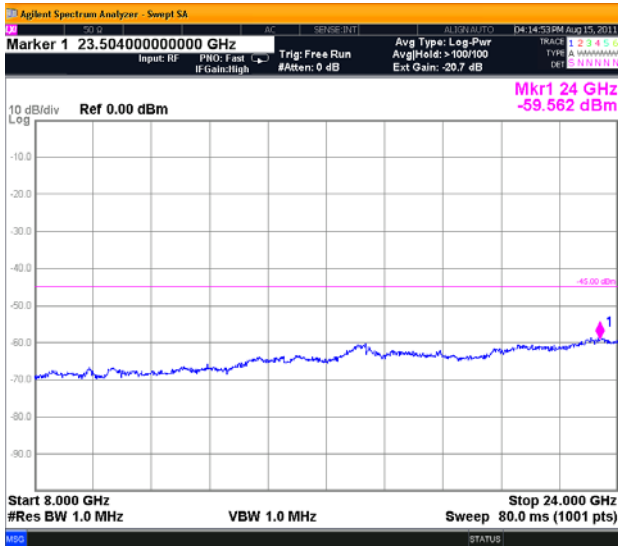
**Test report No: 9112346881**

**Title: WiMax Transceiver**

**Model: WIN5123/WIN5223**

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**FCC ID: VG5WIN5223**



Plot # 38





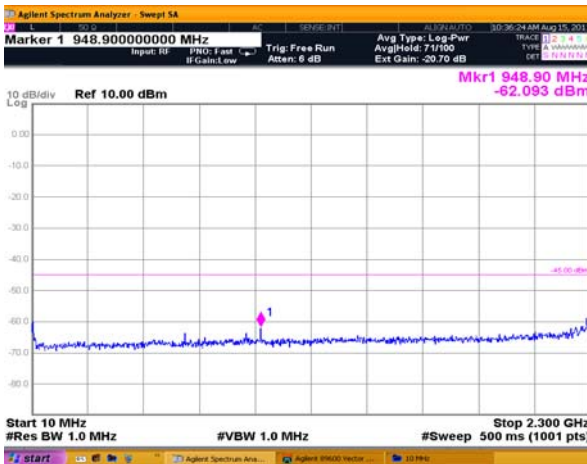
Test report No: 9112346881  
Title: WiMax Transceiver  
Model: WIN5123/WIN5223

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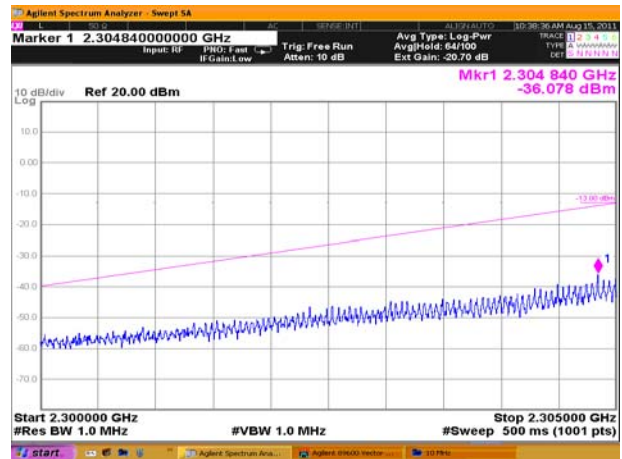
FCC ID: VG5WIN5223

5 MHz EBW.

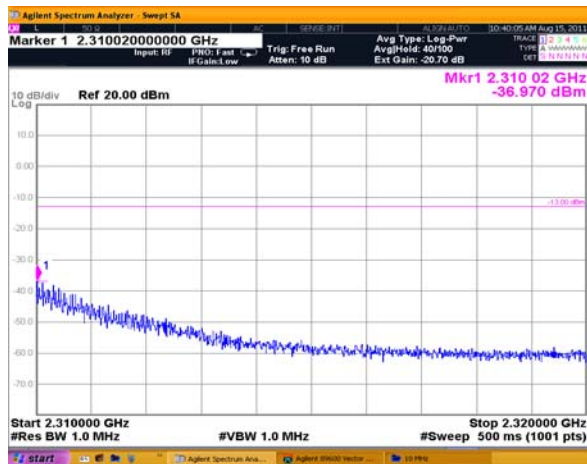
Carrier frequency 2307.5 MHz.



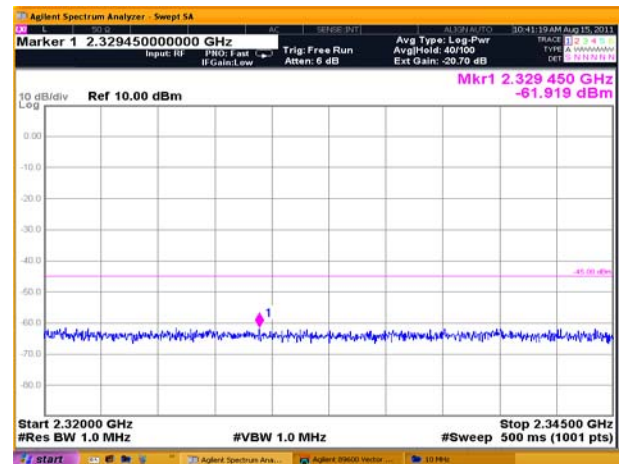
Plot # 39



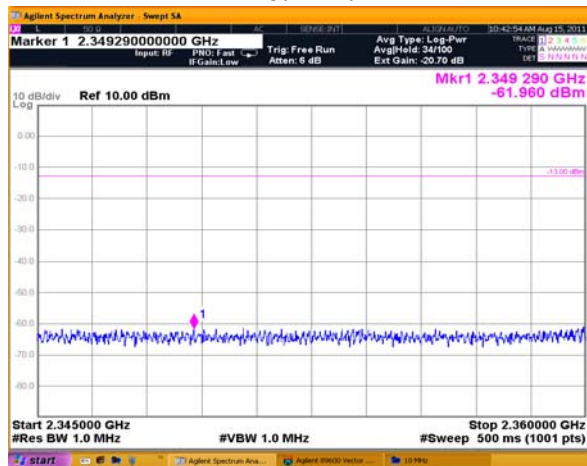
Plot # 40



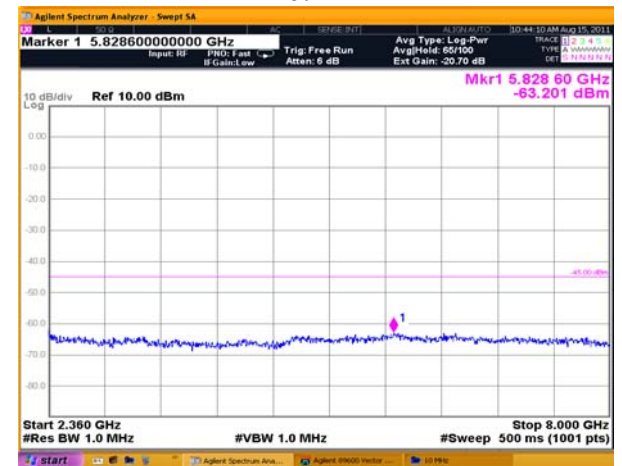
Plot # 41.



Plot # 42



Plot # 43.



Plot # 44