# *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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| | |
|---|---|
| **Test report No: 9112346881** | **Page 1 of 56 Pages** |
| **Title: WiMax Transceiver** | |
| **Model: WIN5123/WIN5223** | **FCC ID: VG5WIN5223** |

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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:** | 15 – 18 August , 21 November 2011 |

**Equipment under test information**

| | |
|---|---|
| **Description of Equipment Under Test (EUT):** | WiMax Transceiver |
| **Model:** | WIN5123/WIN5223 |
| **Serial Number:** | NA |
| **Software version of radio unit** | 4.2 |
| **Hardware version of radio unit** | ID = 23 |
| **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, 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 (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 |
|---|---|
| **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™ 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 |

## 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. (m)
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 = 42.9 dBm = 16218 mW
Minimum allowed distance r from the antenna were FCC RF exposure limit may not be exceeded = SQRT(16218/4π) > 0.39 m.

### 4.2 EUT configuration.

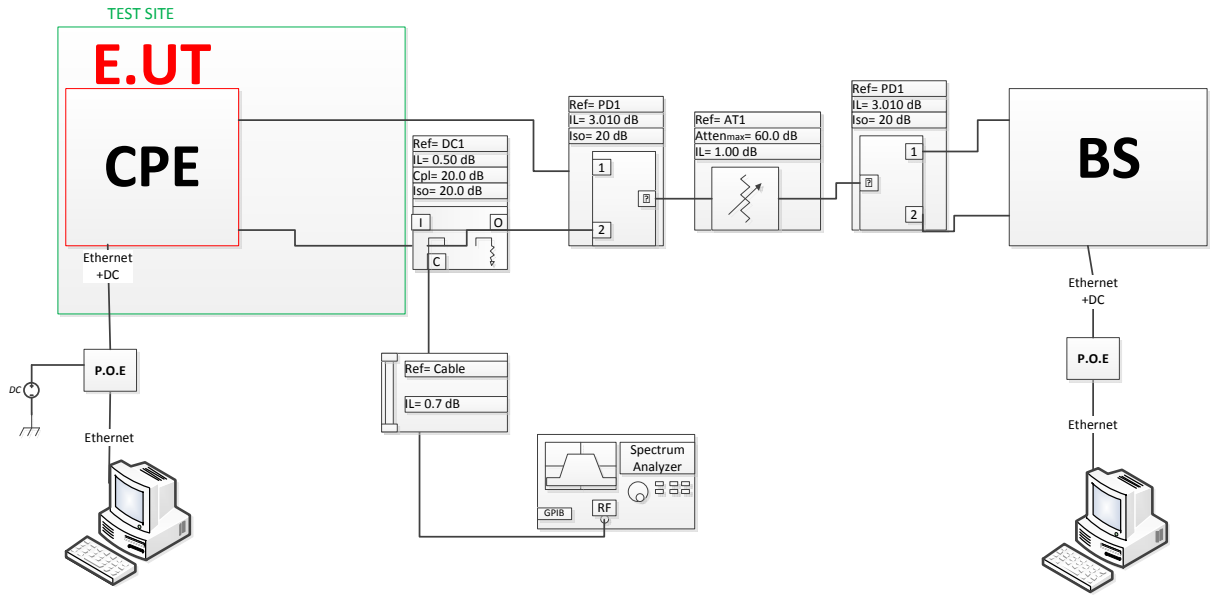



**Fig. 1. The RuggedMax™ WIN5123 setup configuration.**

# 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 $21^0$ 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**

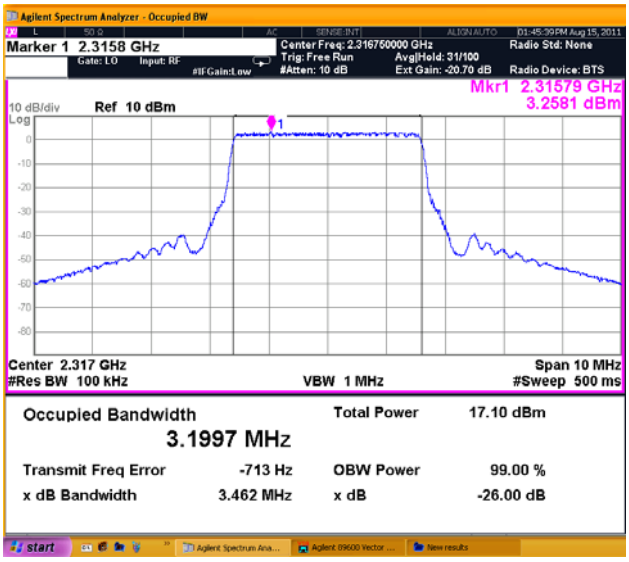
The measurements were performed in normal (transmitting) mode at all transmitted carrier (channel) frequencies of the 2305 – 2320 MHz, 2345 – 2360 MHz frequency ranges under QAM 64 modulation as worse case.. RBW = 1-3 % of emission bandwidth VBW= 3 x RBW. Detector RMS and power average function. The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

**TEST EQUIPMENT USED:**

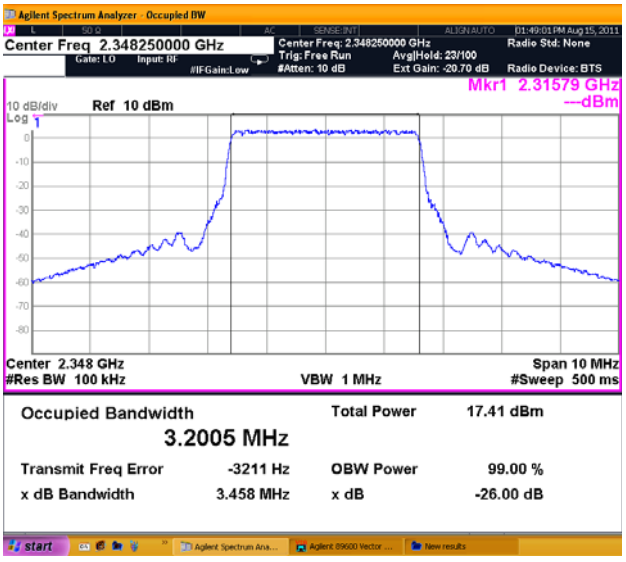
| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | 3 | 4 | 5 | | | |

**Occupied bandwidth test.**

3.5 MHz EBW option, 99% bandwidth



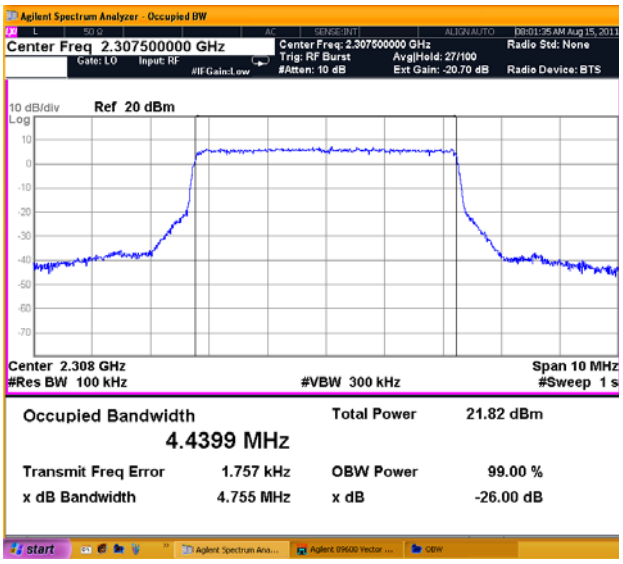
Plot # 1



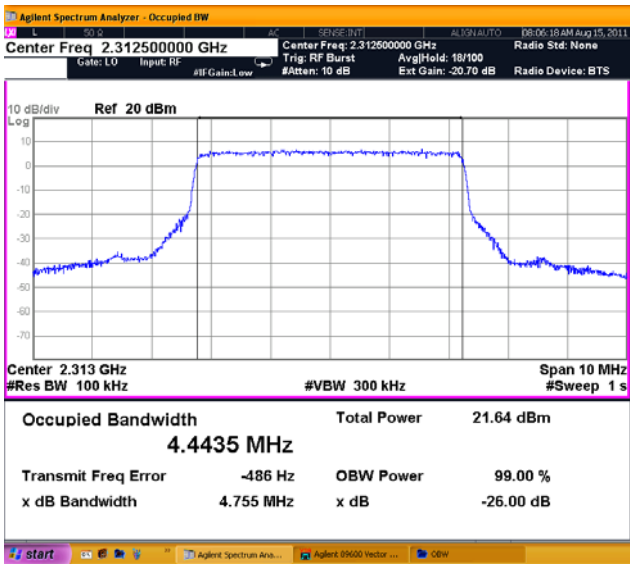
Plot # 2

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

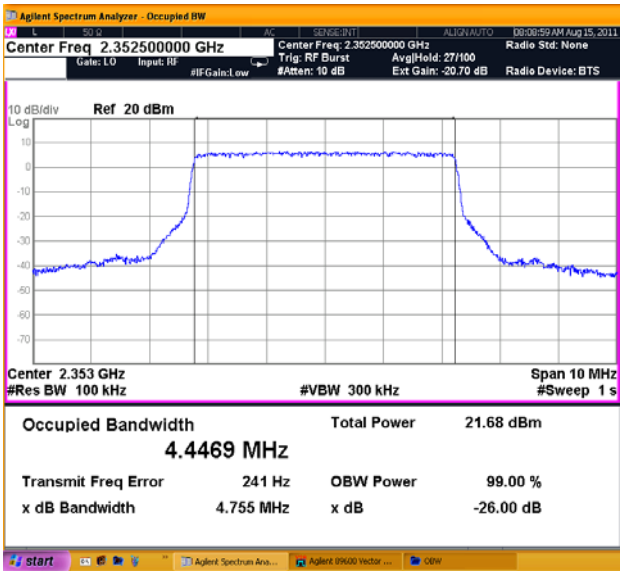
5 MHz EBW option, 99% bandwidth



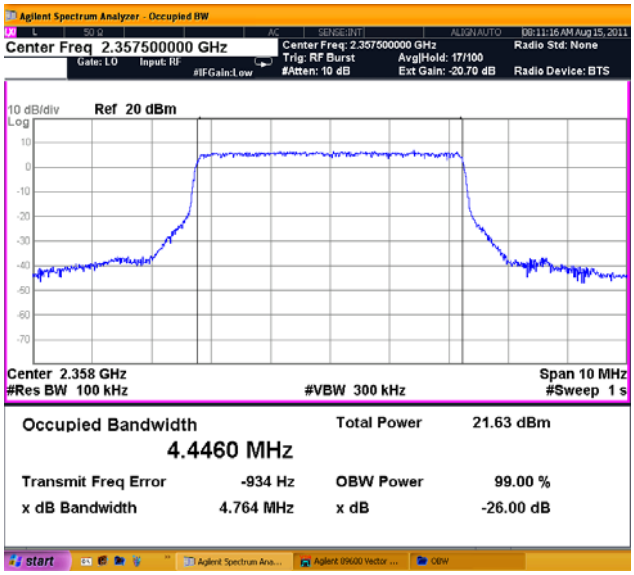

Plot # 3




Plot # 4

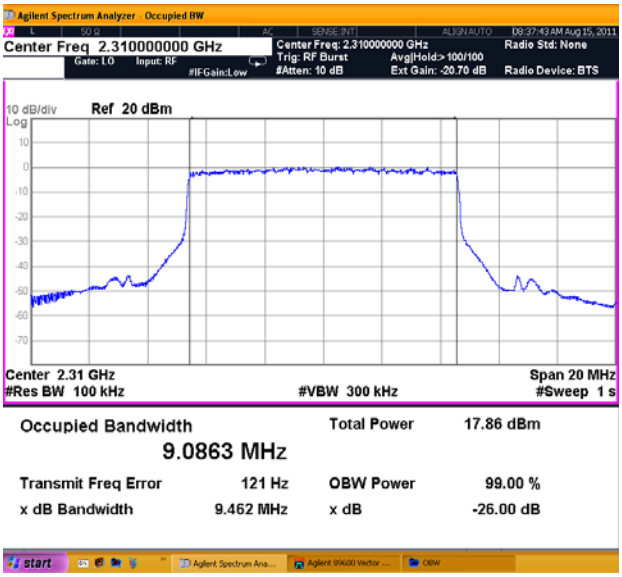



Plot # 5

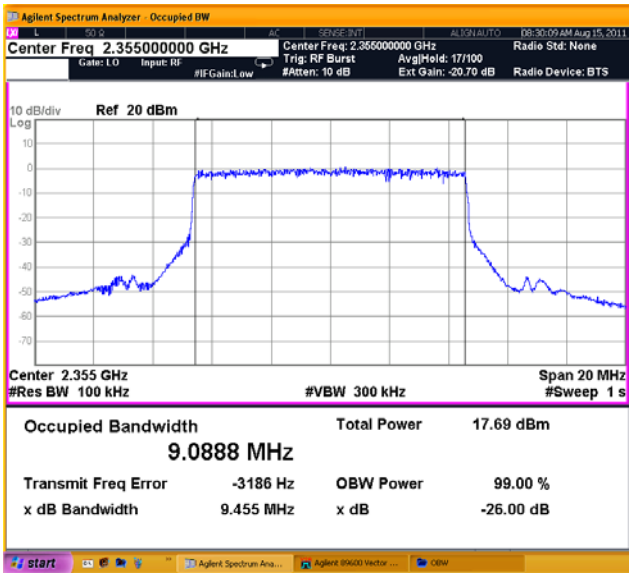



Plot # 6

10 MHz EBW option, 99% bandwidth




Plot # 7




Plot # 8

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

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 | Output power, dBm | *Avg. EIRP dBm | PAPR ratio dB | **Peak EIRP dBm | Peak EIRP limit, dBm | Result | Reference to plots # |
|---|---|---|---|---|---|---|---|---|
| 3.5 | 2316.75 | 18.1 | 34.1 | 8.3 | 42.4 | 43.0 | PASS | 9, 17 |
| | 2348.25 | 18.2 | 34.2 | 8.4 | 42.6 | 43.0 | | 10, 18 |
| 5.0 | 2307.5 | 18.0 | 34.0 | 8.6 | 42.6 | 43.0 | PASS | 11, 19 |
| | 2312.5 | 18.2 | 34.2 | 8.6 | 42.8 | 43.0 | | 12, 20 |
| | 2352.5 | 18.3 | 34.3 | 8.6 | 42.9 | 43.0 | | 13, 21 |
| | 2357.5 | 18.0 | 34.0 | 8.7 | 42.7 | 43.0 | | 14, 22 |
| 10 | 2310.0 | 18.0 | 34.0 | 8.7 | 42.7 | 43.0 | PASS | 15, 23 |
| | 2355.0 | 18.1 | 34.1 | 8.7 | 42.8 | 43.0 | | 16, 24 |

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

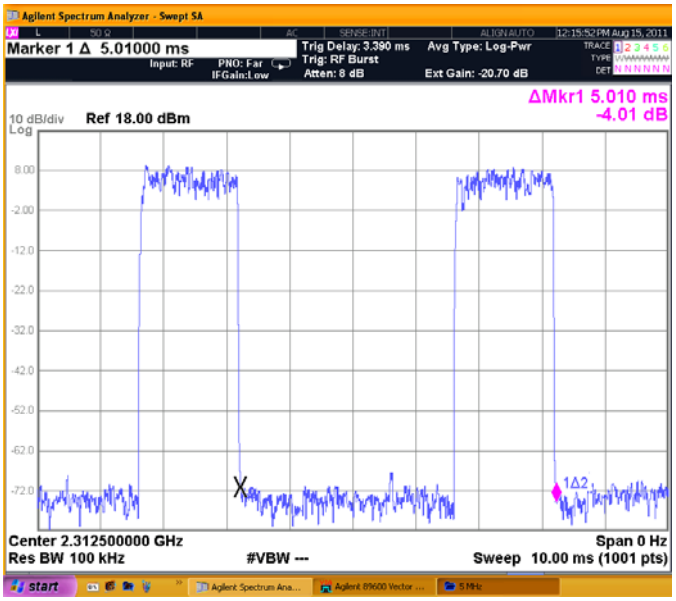
For fixed customer premises equipment (CPE) stations transmitting in the 2305–2320 MHz band or in the 2345–2360 MHz band, the peak EIRP must not exceed 20 watts (43 dBm) within any 5 megahertz of authorized bandwidth. The outdoor CPE station installations should operates with 2 watts (33 dBm) per 5 megahertz average EIRP or more. For WCS CPE using TDD technology, the duty cycle must not exceed 38 percent.

**TEST PROCEDURE**

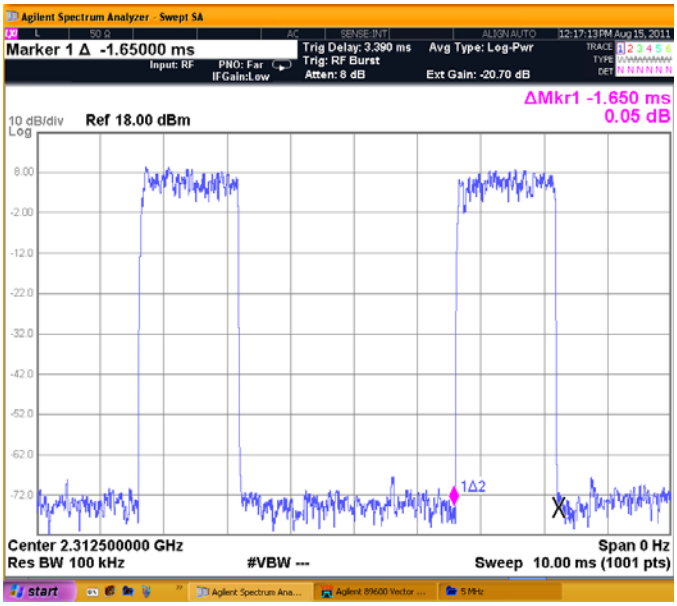
Measuring of required Duty Cycle presented in this section below.
The measurements were performed in normal (transmitting) mode at all transmitted carrier (channel) frequencies of the 2305 – 2320 MHz, 2345 – 2360 MHz frequency ranges under QAM 64 modulation as worse case. RBW = 1-3 % of emission bandwidth 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:**

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | 3 | 4 | 5 | | | |




Duration of the transmission train.

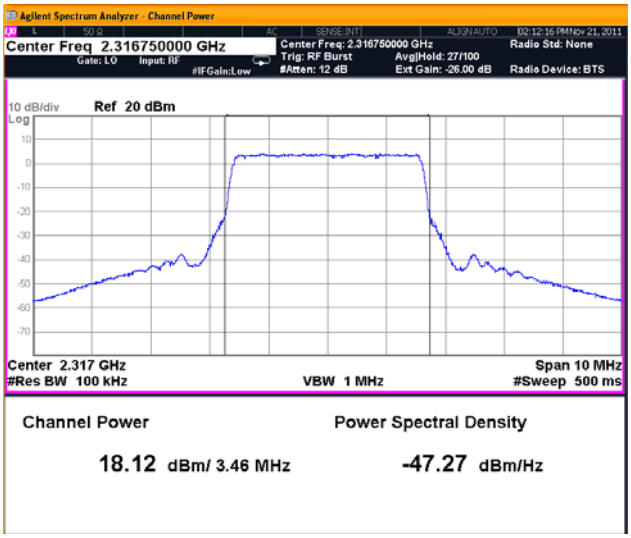



Transmission time duration.

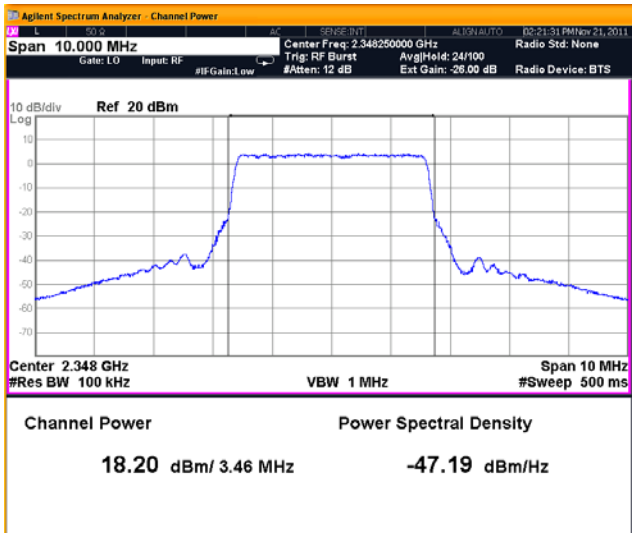
Duty cycle was calculated from above recorded transmission times as follow:
Duty cycle = (Tx on/Tx on + Tx off) x 100% = (1.65/5) x 100% = 33%

**Output power test results.**

3.5 MHz EBW option

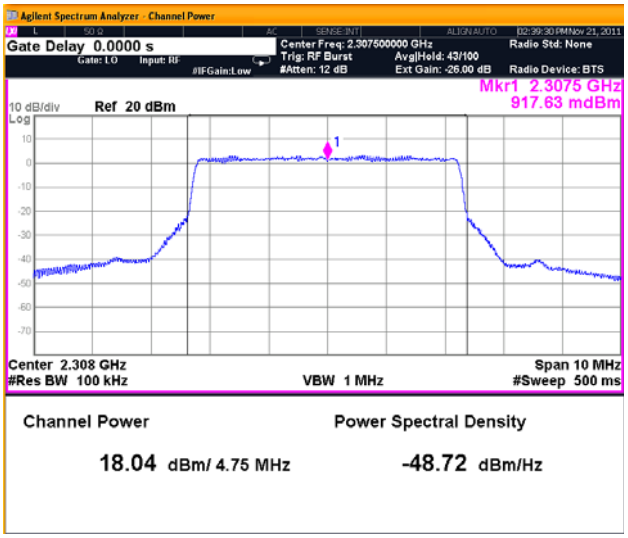



Plot # 9

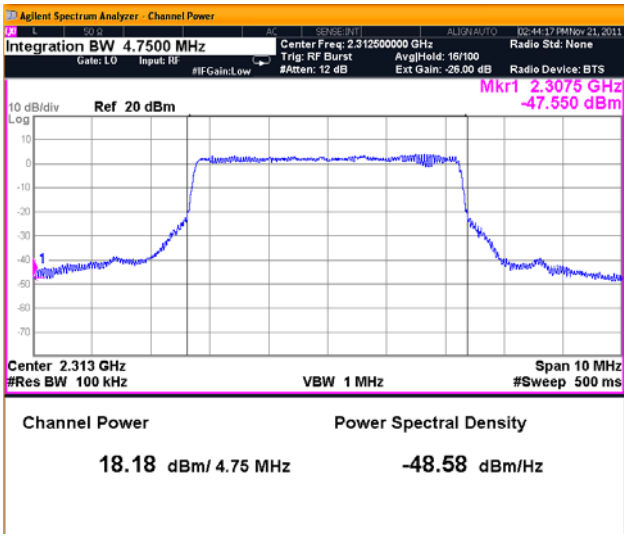



Plot # 10

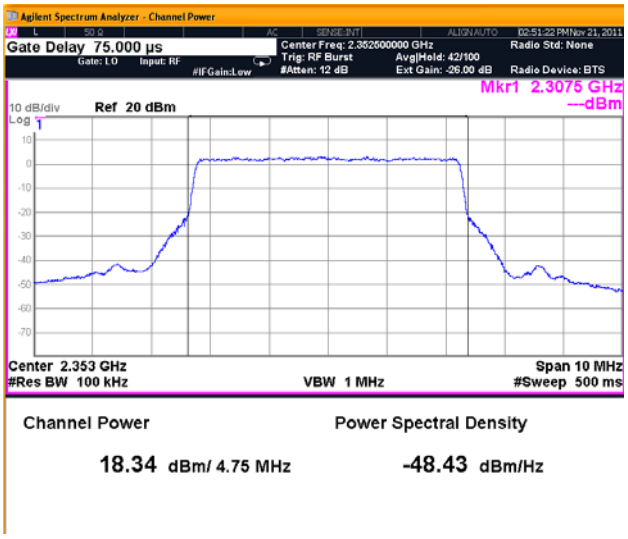
5 MHz EBW option,



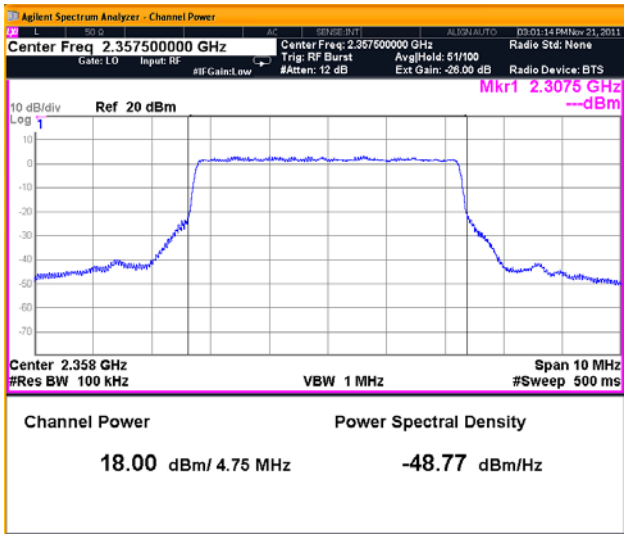

Plot # 11




Plot # 12



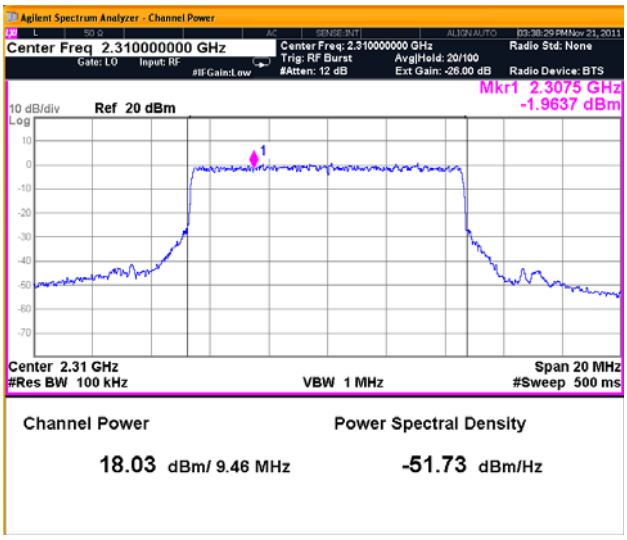

Plot # 13



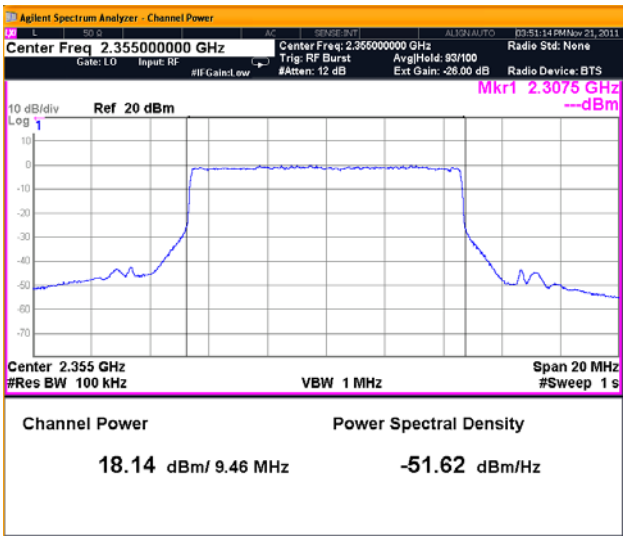

Plot # 14

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

10 MHz EBW option,




Plot # 15




Plot # 16

## 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 $21^0$ C Relative Humidity 47% Air Pressure 1006 hPa

| EBW, MHz | Carrier frequency, MHz | PAPR ratio at 0.1 percent of time | PAPR limit, dB | Result | Reference to plots # |
|---|---|---|---|---|---|
| 3.5 | 2316.75 | 8.3 | 13 | PASS | 17 |
| | 2348.25 | 8.4 | 13 | | 18 |
| 5.0 | 2307.5 | 8.6 | 13 | PASS | 19 |
| | 2312.5 | 8.6 | 13 | | 20 |
| | 2352.5 | 8.6 | 13 | | 21 |
| | 2357.5 | 8.7 | 13 | | 22 |
| 10 | 2310.0 | 8.7 | 13 | PASS | 23 |
| | 2355.0 | 8.7 | 13 | | 24 |

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.

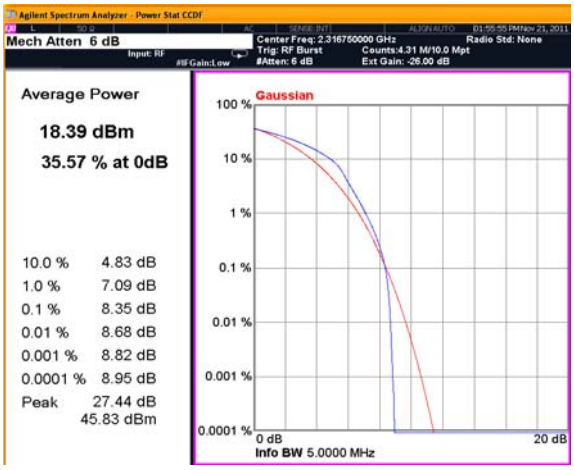
**TEST PROCEDURE**

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.

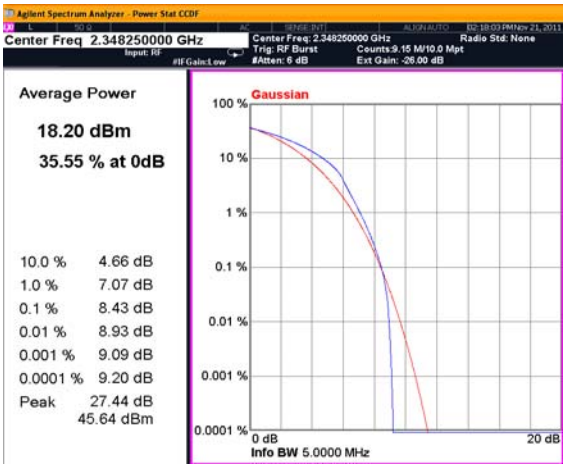
**TEST EQUIPMENT USED:**

| | | | | | | |
|---|---|---|---|---|---|---|
| 2 | 3 | 4 | 5 | | | |

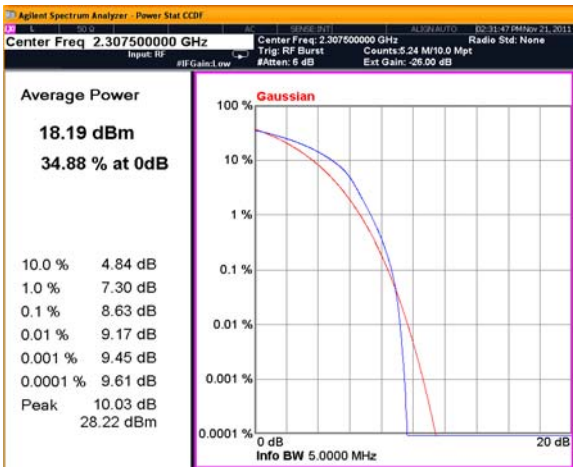
**PAPR test results.**



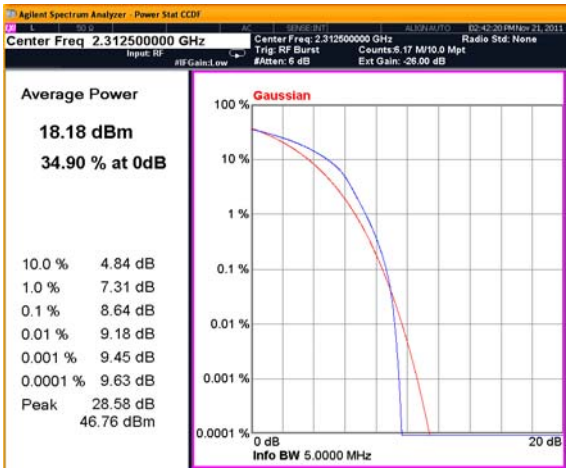

Plot # 17. 3.5 MHz EBW.



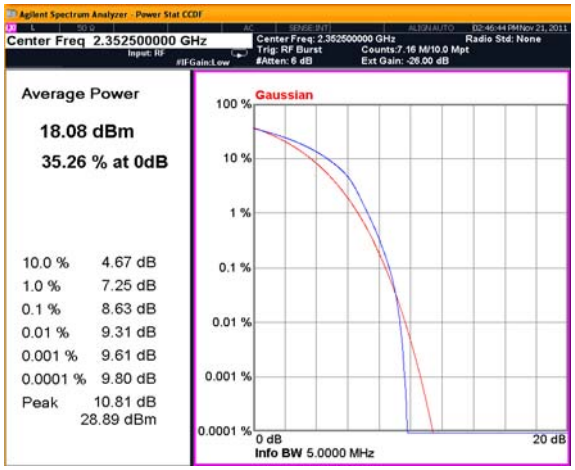

Plot # 18. 3.5 MHz EBW.



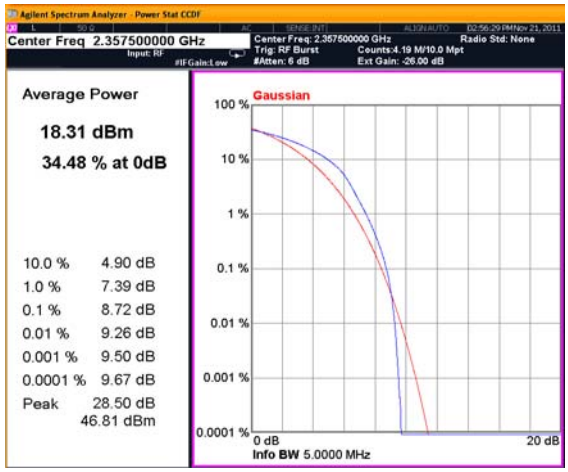

Plot # 19. 5 MHz EBW.



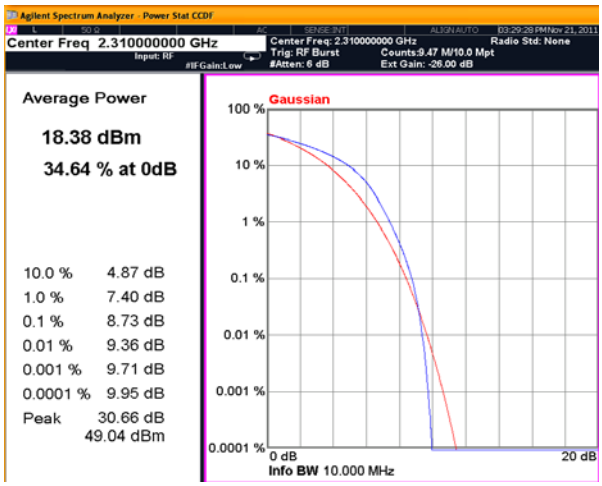

Plot # 20. 5 MHz EBW.



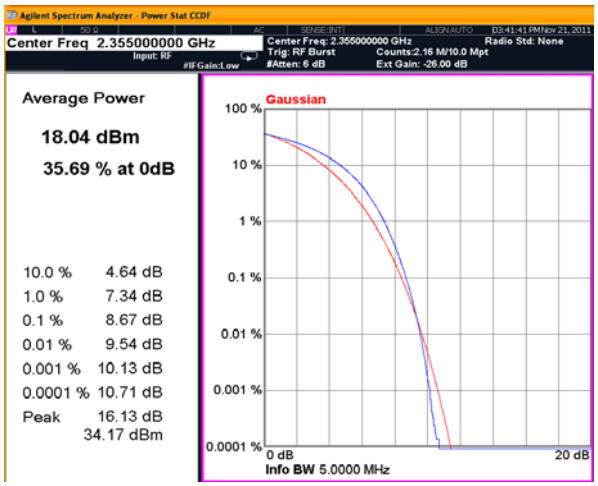

Plot # 21. 5 MHz EBW.




Plot # 22. 5 MHz EBW.




Plot # 23. 10 MHz EBW.




Plot # 24. 10 MHz EBW.

### 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 $21^0$ 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 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 |

**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+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**

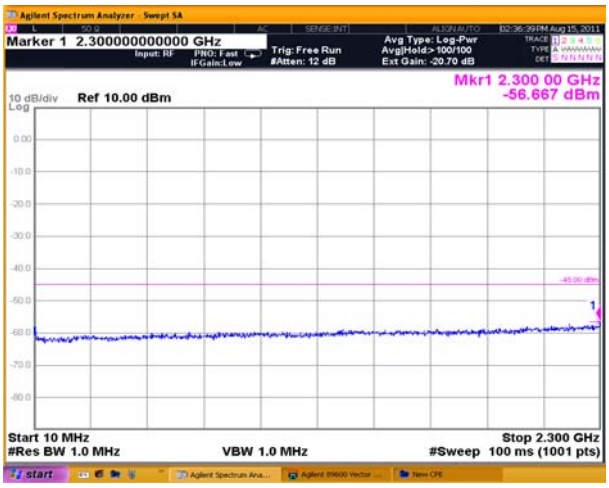
The test was conducted according to FCC part 27.53 (5) measurement procedure.
The measurements were performed in normal (transmitting) mode at all transmitted carrier (channel) frequencies of the 2305 – 2320 MHz, 2345 – 2360 MHz frequency ranges under QAM 64 modulation as worse case. RBW = 1-3 % of emission 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.

**TEST EQUIPMENT USED:**

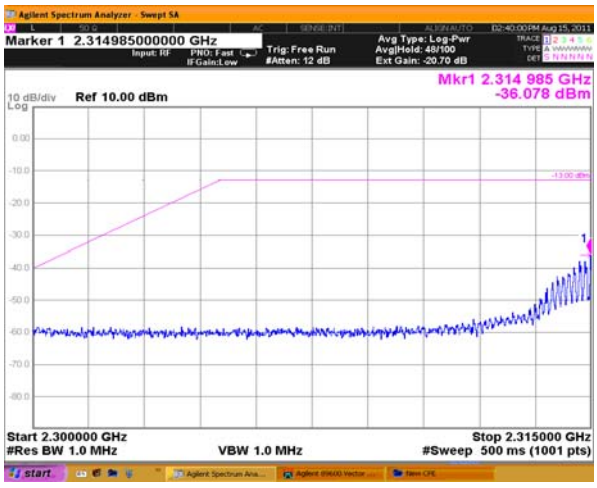
| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | 3 | 5 | 9 | | | |

**Spurious emissions at antenna terminal.**
3.5 MHz EBW.

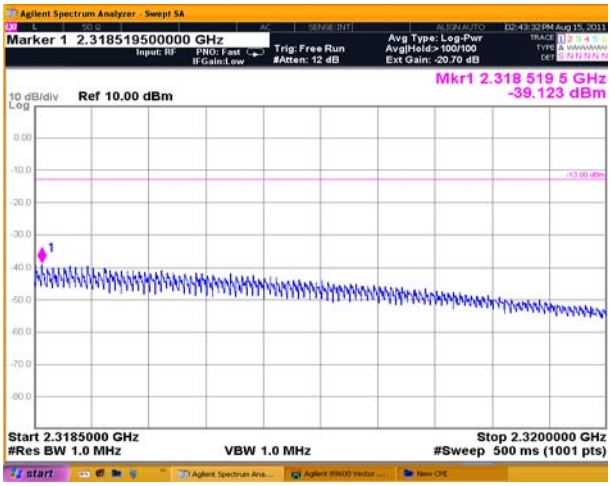
Carrier frequency 2316.75 MHz.



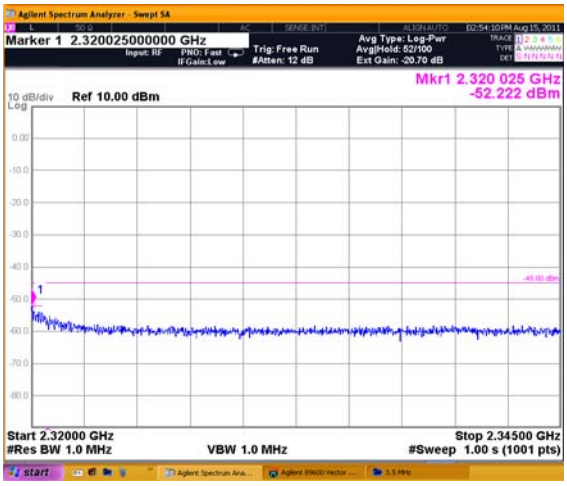

Plot # 25



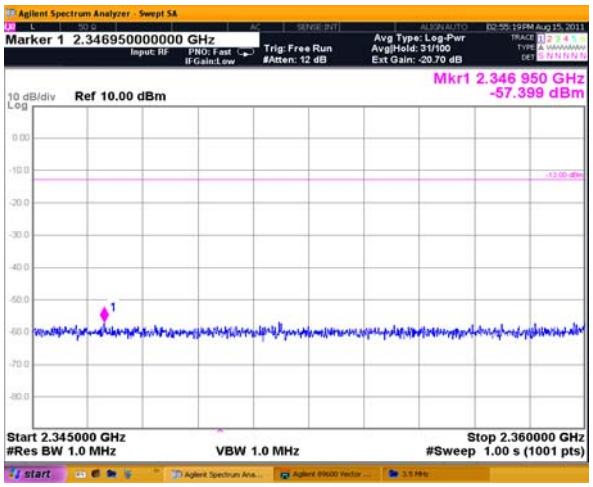

Plot # 26



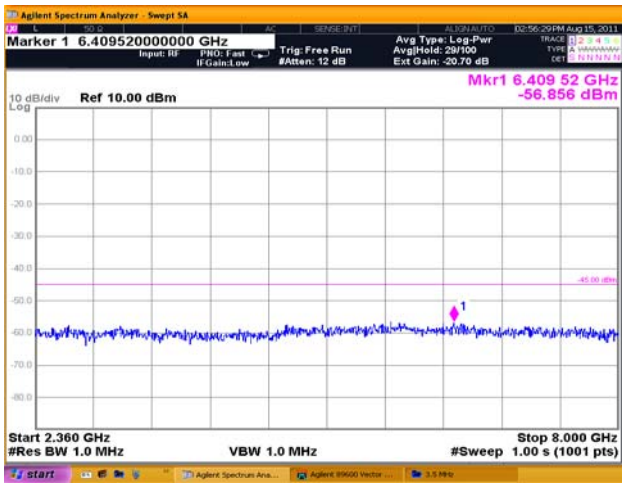

Plot # 27



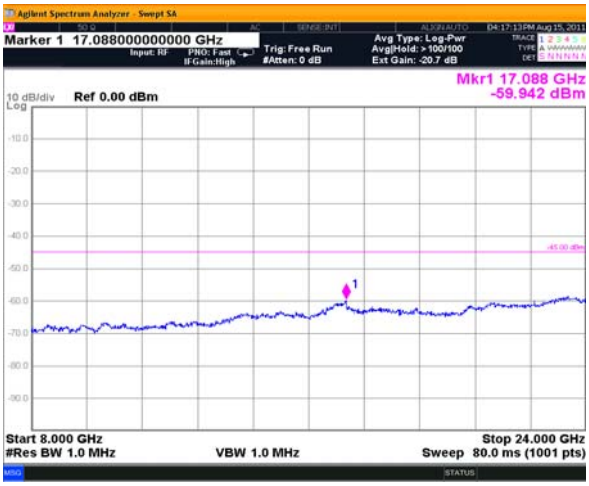

Plot # 28




Plot # 29

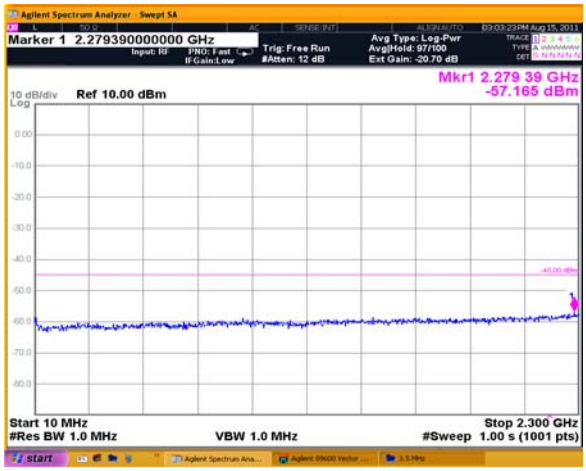



Plot # 30

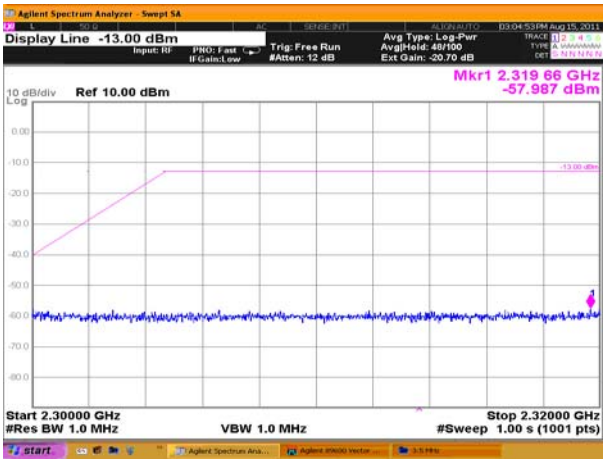



Plot # 31.

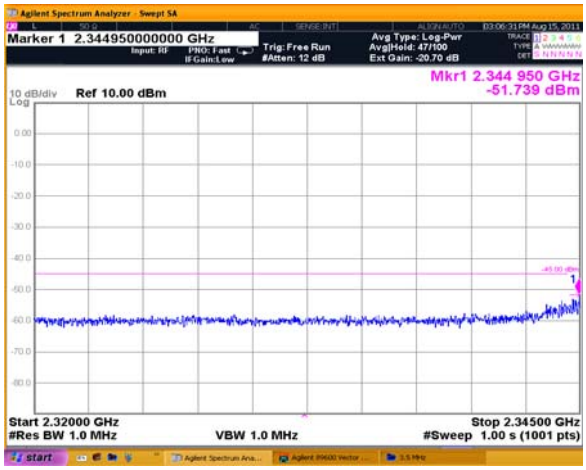
Carrier frequency 2348.25 MHz.



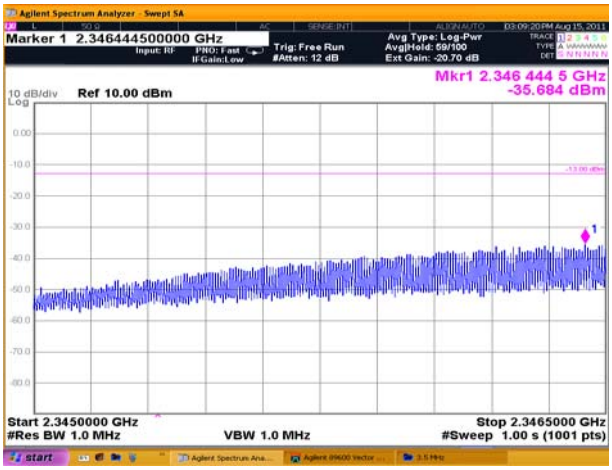

Plot # 32



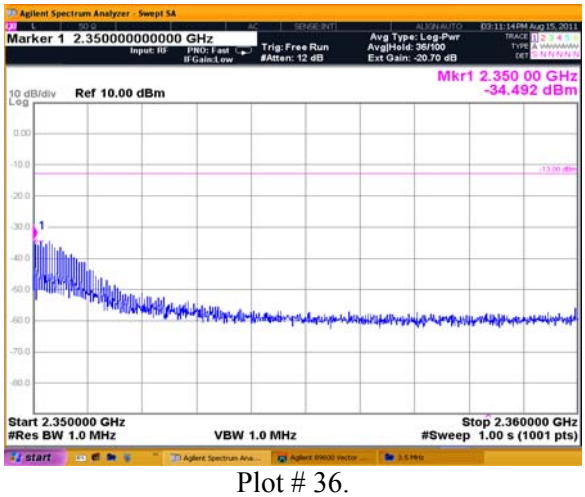

Plot # 33.



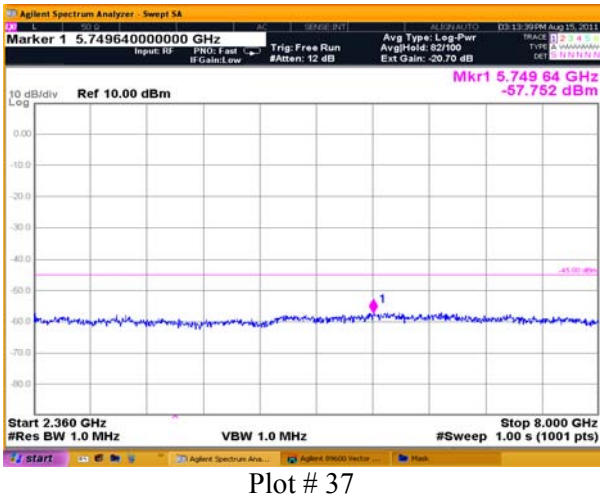

Plot # 34.



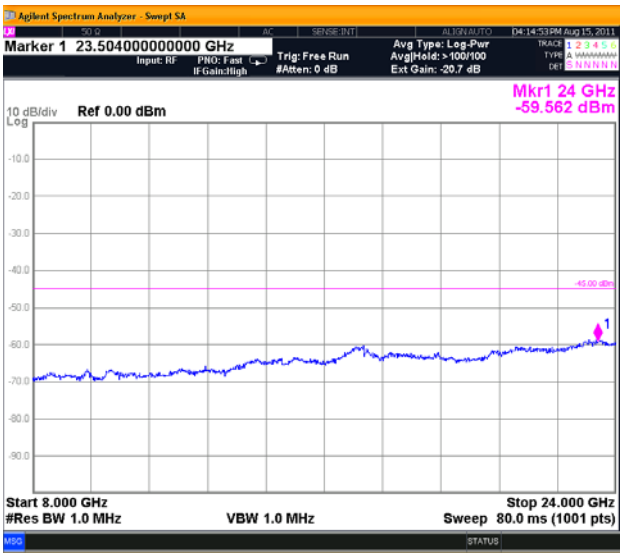

Plot # 35.




Plot # 36.



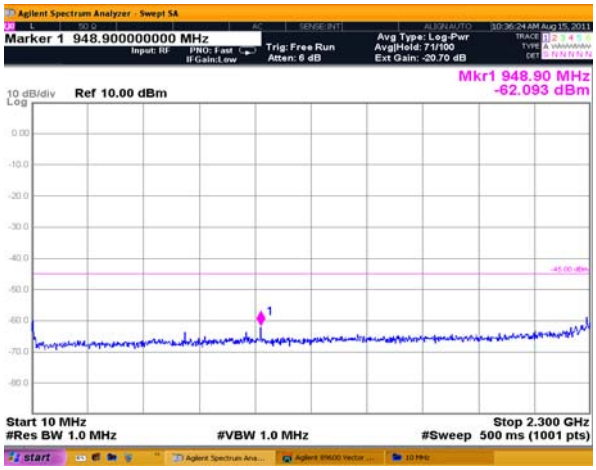

Plot # 37


Agilent Spectrum Analyzer - Swept SA
Marker 1 23.504000000000 GHz
Trig: Free Run
#Atten: 0 dB
Avg Type: Log-Pwr
Avg|Hold: >100/100
Ext Gain: -20.7 dB
Mkr1 24 GHz
-59.562 dBm
10 dB/div
Log
Ref 0.00 dBm
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-45.00 dBm
Start 8.000 GHz
#Res BW 1.0 MHz
VBW 1.0 MHz
Stop 24.000 GHz
Sweep 80.0 ms (1001 pts)

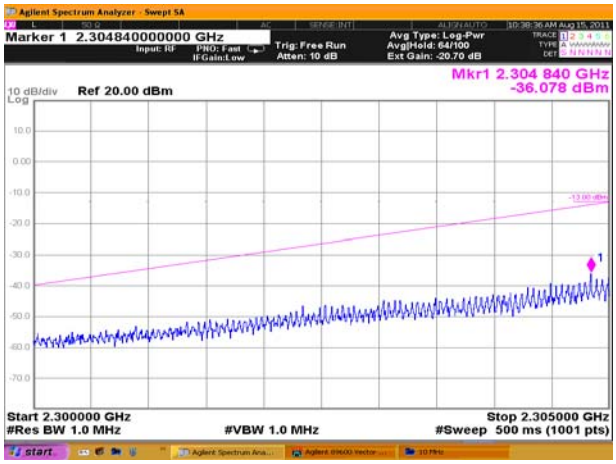
Plot # 38

5 MHz EBW.

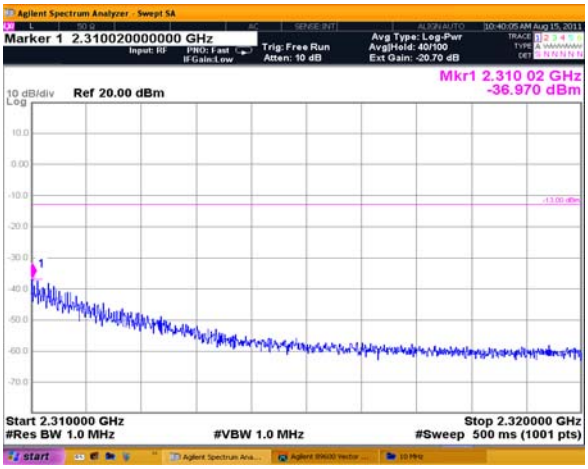
Carrier frequency 2307.5 MHz.



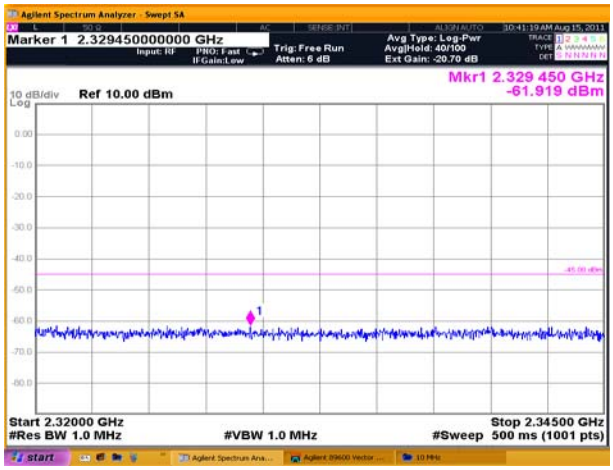

Plot # 39



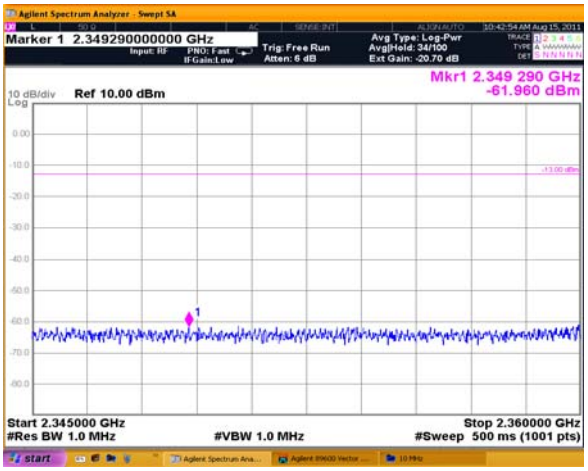

Plot # 40



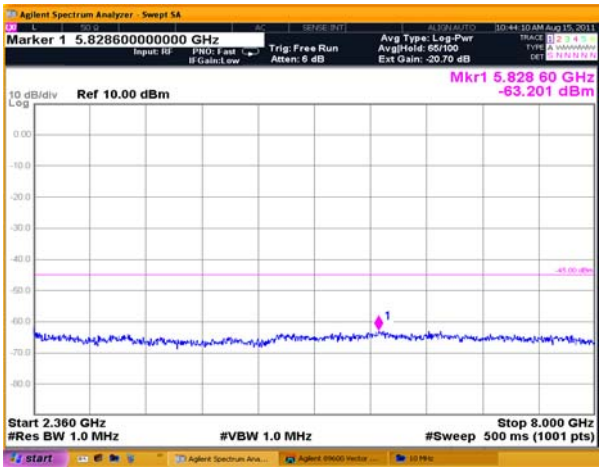

Plot # 41.




Plot # 42




Plot # 43.




Plot # 44