MET Laboratories, Inc. *Safety Certification - EMI – Telecom Environmental Simulation*
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April 10, 2009

Ubiquiti Networks
495-499 Montague Expressway
Milpitas, CA 95035

Dear Robert Pera,

Enclosed is the EMC test report for compliance testing of the Ubiquiti Networks, B5 tested to the requirements of ETSI EN 301 893 V1.4.1 (2007-07) (Article 3.2 of R&TTE Directive).

Thank you for using the services of MET Laboratories, Inc. If you have any questions regarding these results or if MET can be of further service to you, please feel free to contact me.

Sincerely yours,
MET LABORATORIES, INC.

Jennifer Sanchez
Documentation Department

Reference: (\Ubiquiti Networks\EMCS81543B-EN893_Rev1)

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Electromagnetic Compatibility Criteria Test Report

For the

Ubiquiti Networks
Model B5

Tested under

ETSI EN 301 893 V1.4.1 (2007-07)

(Article 3.2 of R&TTE Directive)

MET Report: EMCS81543B-EN893_Rev1

April 10, 2009

Prepared For:

Ubiquiti Networks
495-499 Montague Expressway
Milpitas, CA 95035

Prepared By:
MET Laboratories, Inc.
3162 Belick St.
Santa Clara, CA 95054

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MET Report: EMCS81543B-EN893_Rev1

Anderson Soungpanya, Project Engineer
Electromagnetic Compatibility Lab

Jennifer Sanchez
Documentation Department

Engineering Statement: The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of ETSI EN 301 893 V1.4.1 (2007-07) of the EU Rules under normal use and maintenance.

Shawn McMillen, Manager
Electromagnetic Compatibility Lab

Report Status Sheet

Revision	Report Date	Reason for Revision
∅	April 10, 2009	Initial Issue.
1	April 30, 2009	Revision 1

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List of Terms and Abbreviations

AC	**A**lternating **C**urrent
ACF	**A**ntenna **C**orrection **F**actor
Cal	**Cal**ibration
d	**M**easurement **D**istance
dB	**D**eci**b**els
dBµA	**D**eci**b**els above one **micro**amp
dBµV	**D**eci**b**els above one **micro**volt
dBµA/m	**D**eci**b**els above one **micro**amp **per m**eter
dBµV/m	**D**eci**b**els above one **micro**volt **per m**eter
DC	**D**irect **C**urrent
E	**E**lectric Field
DSL	**D**igital **S**ubscriber **L**ine
ESD	**E**lectro**s**tatic **D**ischarge
EUT	**E**quipment **U**nder **T**est
fc	**C**arrier **F**requency
CISPR	**C**omite **I**nternational **S**pecial des **P**erturbations **R**adioelectriques (International Special Committee on Radio Interference)
GRP	**G**round **R**eference **P**lane
H	Magnetic Field
HCP	**H**orizontal **C**oupling **P**lane
Hz	**H**er**z**
IEC	**I**nternational **E**lectrotechnical **C**ommission
kHz	**k**ilo**Hz**
kPa	**k**ilo**Pa**scal
kV	**k**ilo**v**olt
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
MHz	**M**ega**H**ertz
µH	**micro**Henry
µF	**micro**Farad
µs	**micros**econds
PRF	**P**ulse **R**epetition **F**requency
RF	**R**adio **F**requency
RMS	**R**oot-**M**ean-**S**quare
V/m	**V**olts **per m**eter
VCP	**V**ertical **C**oupling **P**lane

I. Requirements Summary

A. Requirements Summary

ETSI EN 301 893 Section Number	Descriptive Name	Compliance			Comments
		Yes	No	N/A	
Sections 4.2	Carrier Frequencies	√			Compliant
Sections 4.3	Nominal Channel Bandwidth and Occupied Channel Bandwidth	√			Compliant
Sections 4.4	RF Output Power, Transmit Power Control (TPC) and Power Density	√			Compliant
Sections 4.5	Transmitter Unwanted Emissions	√			Compliant
Sections 4.6	Receiver Spurious Emissions	√			Compliant
Sections 4.7	Dynamic Frequency Selection (DFS)	√			Compliant
Sections 4.8	Medium Access Protocol	√			Compliant
Sections 4.9	User Access Restrictions	√			Compliant

Table 1. Summary of EMC ETSI EN 301 893 V1.4.1 (2007-07) Compliance Testing

II. Equipment Configuration

A. Overview

MET Laboratories, Inc. was contracted by Ubiquiti Networks to perform testing on a B5.

This document describes the test setups, test methods, required test equipment, and the test limit criteria used to perform compliance testing of the Ubiquiti Networks model B5.

The results obtained relate only to the item(s) tested.

Model(s) Tested:	B5
Model(s) Number:	B5
EUT Specifications:	Primary Power from Laptop: 120/230VAC, 60/50Hz
	Secondary Power: N/A
Lab Ambient (Normal) Test Conditions:	Temperature: 15-35º C
	Relative Humidity: 30-60%
	Atmospheric Pressure: 860-1060 mbar
Extreme Test Conditions:	Voltage:
	Temperature: -20 to +55º C
	Relative Humidity: 30-60%
Evaluated by:	Anderson Soungpanya
Report Date:	April 10, 2009

Table 2. EUT Specifications

B. References

ETSI EN 301.893 V1.4.1 (2007-07)	Broadband Radio Access Networks (BRAN); 5GHz high performance RLAN; Harmonized EN covering essential requirements of article 3.2 of the R&TTE Directive.

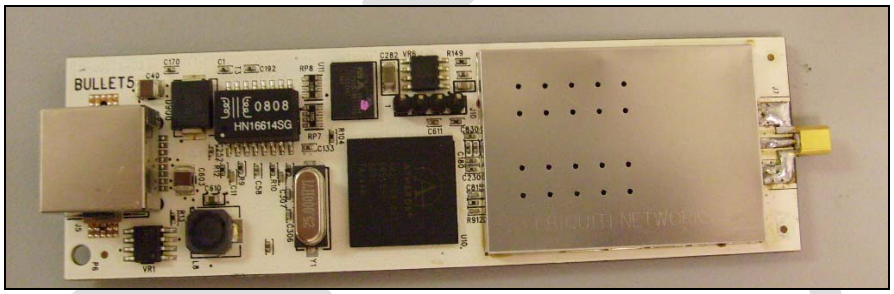
Table 3. Test References

C. Test Site

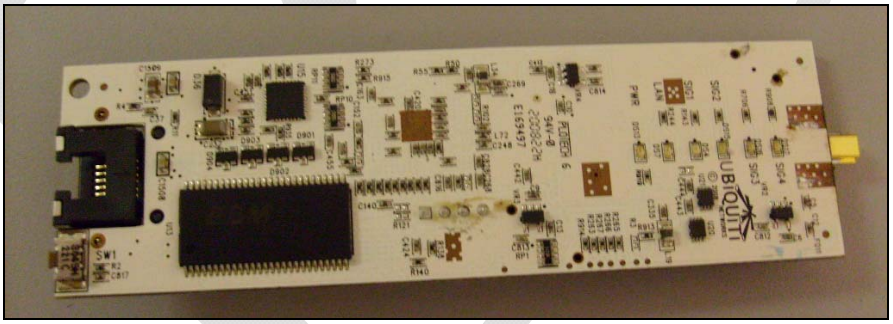
All testing was performed at MET Laboratories, Inc., 3162 Belick Street, Santa Clara, CA 95054. All equipment used in making physical determinations is accurate and bears recent traceability to the National Institute of Standards and Technology.

D. Description of Test Sample

The Ubiquiti Networks b5 (5 GHz), is a high performance 802.11 outdoor point to point bridge device specifically designed for optimized performance at 5 GHz.



Photograph 1. EUT Front View



Photograph 2. EUT Rear View

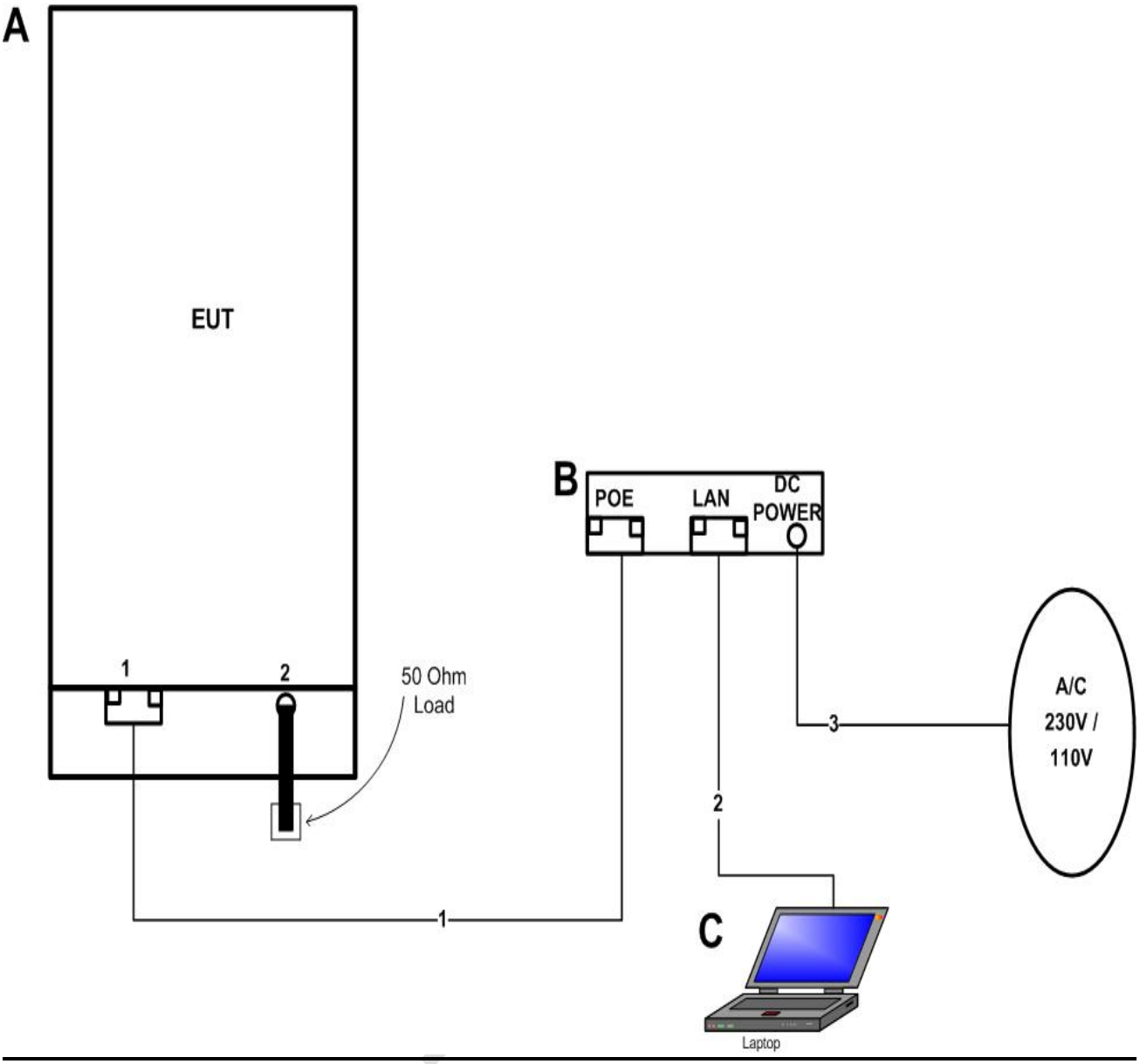


Figure 1. Radiated Test Configuration

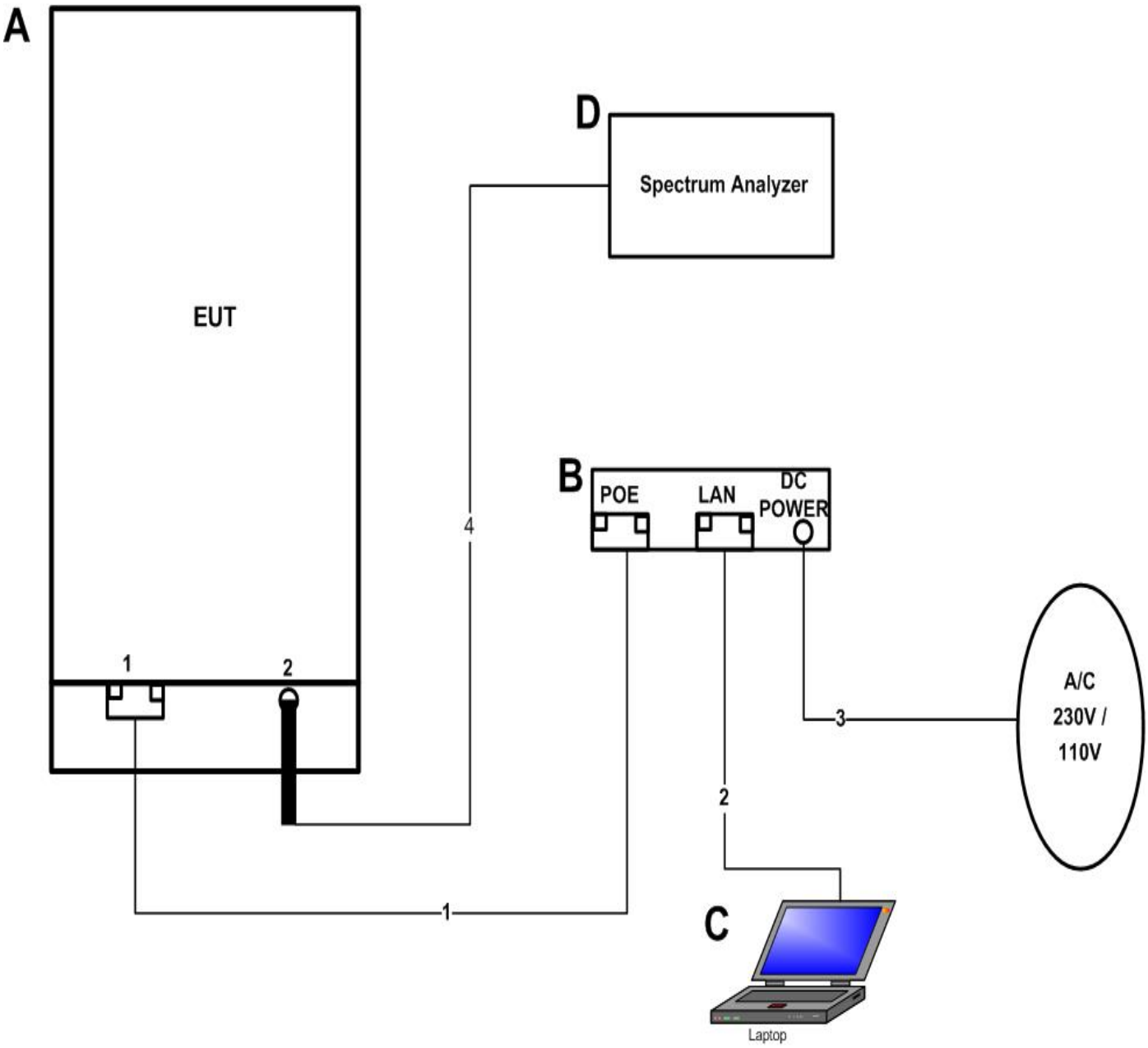


Figure 2. Conducted Test Configuration

E. Equipment Configuration

The EUT was set up as outlined in Figure 1, Block Diagram of Test Setup. All cards, racks, etc., incorporated as part of the EUT is included in the following list.

Ref. ID	Name / Description	Model Number	Serial Number
A	B5	BULLET-5	11-00075-02
B	AC/DC ADAPTOR (B5)	GFP1210-1210B	0711-0012761

Table 4. Equipment Configuration

F. Support Equipment

Ubiquiti Networks supplied support equipment necessary for the operation and testing of the B5. All support equipment supplied is listed in the following Support Equipment List.

Ref. ID	Name / Description	Manufacturer	Model Number
C	Lap Top	DELL	Inspiron/1501
D	Spectrum Analyzer	Agilent	E4407B

Table 5. Support Equipment

G. Ports and Cabling Information

Ref. ID	Port Name on EUT	Cable Description	Qty.	Length (m)	Shielded (Y/N)	Termination Point
Conducted Measurements						
1	A, 1	Cat 5	1	3m	Y	B, poe
2	B, lan	Cat 5	1	3m	Y	C, laptop
3	B, dc power	Power chord	1	2m	N	Ac 110v/230v
4	A, 2	Coaxial cable	1	3m	Y	D, Spectrum Analyzer
Radiated Measurements						
1	A, 1	Cat 5	1	3m	Y	B, poe
2	B, lan	Cat 5	1	3m	Y	C, laptop
3	B, dc power	Power chord	1	2m	N	Ac 110v/230v
4	A, 2	Coaxial cable	1	3m	Y	D, omni antenna 6dbi

Table 6. Ports and Cabling Information

H. Mode of Operation

The EUT operates in OFDM mode.

I. Method of Monitoring EUT Operation

A Spectrum Analyzer was used to monitor the EUT's transmitter channel and power output.

J. Modifications

a) Modifications to EUT
No modifications were made to the EUT.

b) Modifications to Test Standard
No modifications were made to the EUT.

K. Disposition of EUT

The test sample including all support equipment submitted to the Electro-Magnetic Compatibility Lab for testing was returned to Ubiquiti Networks upon completion of testing.

III. Conformance Requirements

Conformance Requirements

4.2. Carrier Frequencies

Test Requirement(s): **ETSI EN 301 893, Clause 5.3.2:**

4.2.1 Definition
The equipment is required to operate on the applicable specific carrier centre frequencies that correspond to the nominal carrier frequencies f_c of 5180MHz and 5350MHz for the lower Sub-Bands and 5500MHz and 5700MHz for the Higher Sub-band.

4.2.2 Limits
The actual carrier centre frequency for any given channel given in table 1 shall be maintained within the range $f_c \pm 20$ ppm.

Test Procedure: The EUT was placed in an environmental chamber and the RF port was connected directly to a spectrum analyzer through an attenuator. Depending on which band was being investigated, the EUT was set to transmit at the f_c indicated above at a normal power level. If the EUT was capable of transmitting a CW carrier then the spectrum analyzer's frequency counting function was used to measure the actual frequency. If only a modulated carrier was available then the frequency relative to -10dBc above and below the carrier was measured and the carrier frequency was determined using (f1+f2)/2. The frequency of the carrier was measured at normal and extreme conditions. The resulting carrier frequencies were tabulated below and the frequency error determined.

Test Results: The EUT was found to be compliant with the limits set forth in Clause 4.2

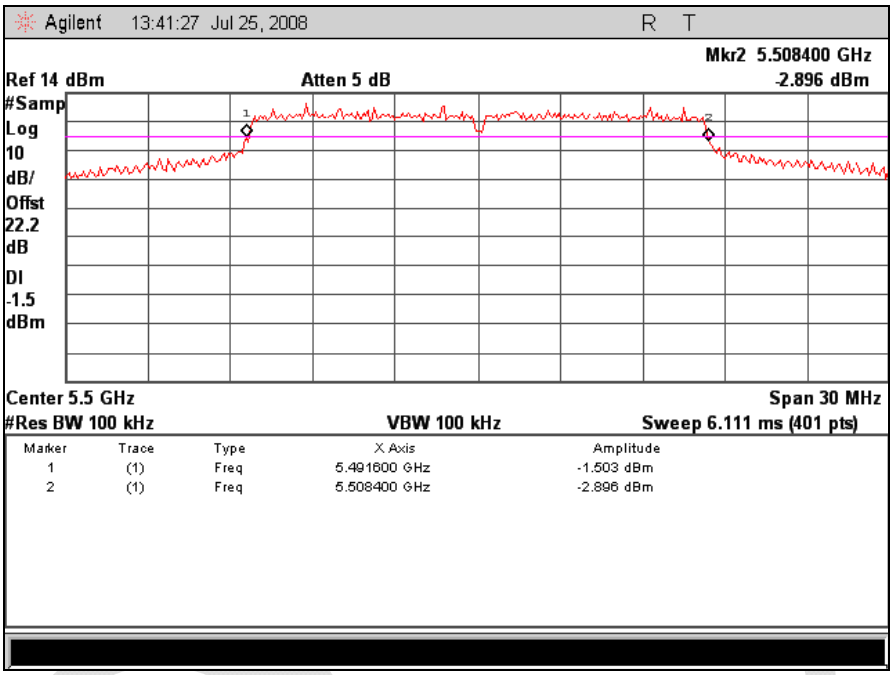
Target Frequency (MHz)	Normal Conditions 20 °C @230V (MHz)	Extreme Conditions (MHz)				Maximum Frequency Error (ppm)
		-20 °C		+55 °C		
		207V	253V	207V	253V	
5500.0	5500.075	5500.000	5500.037	5500.150	5500.112	13.6
5700.0	5700.075	5700.0375	5700.037	5700.187	5700.075	19.6

Table 7. Carrier Frequencies Test Results

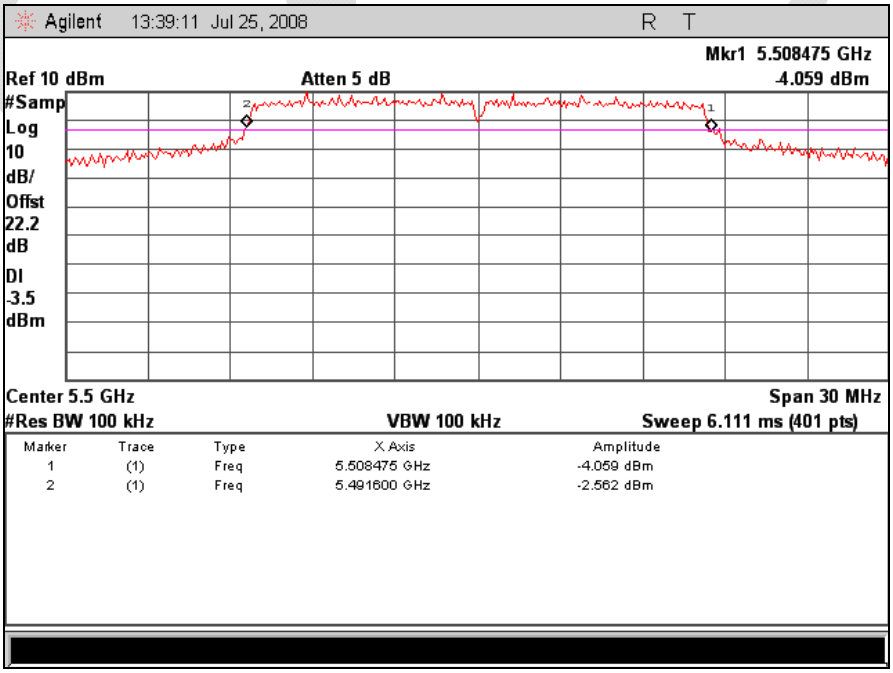
Test Engineer: Anderson Soungpanya

Test Date: September 17, 2008

Conformance Requirements – Carrier Frequencies

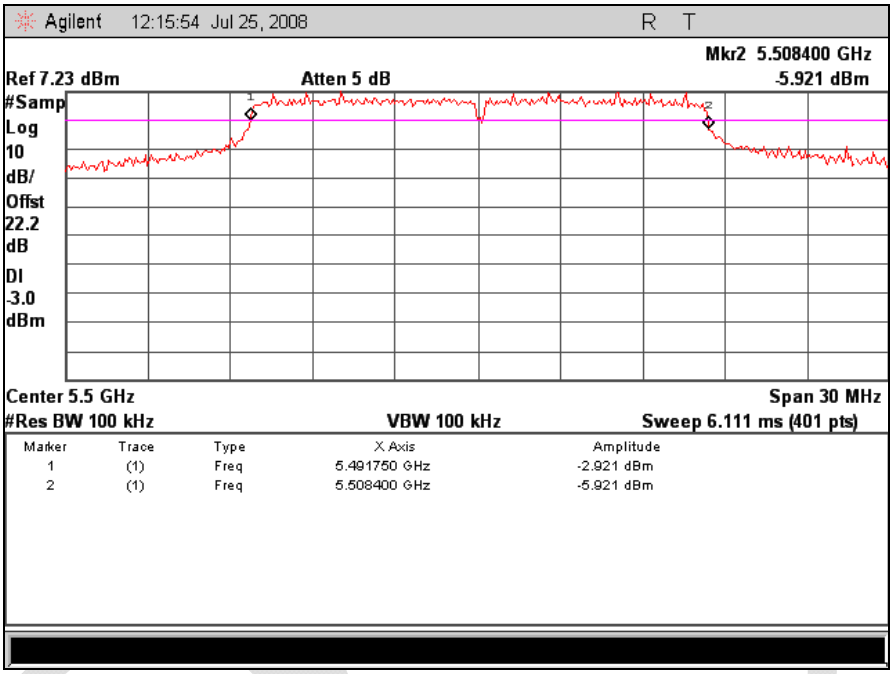


Plot 1. Carrier Frequency, 5500 Low Temperature, Low Voltage

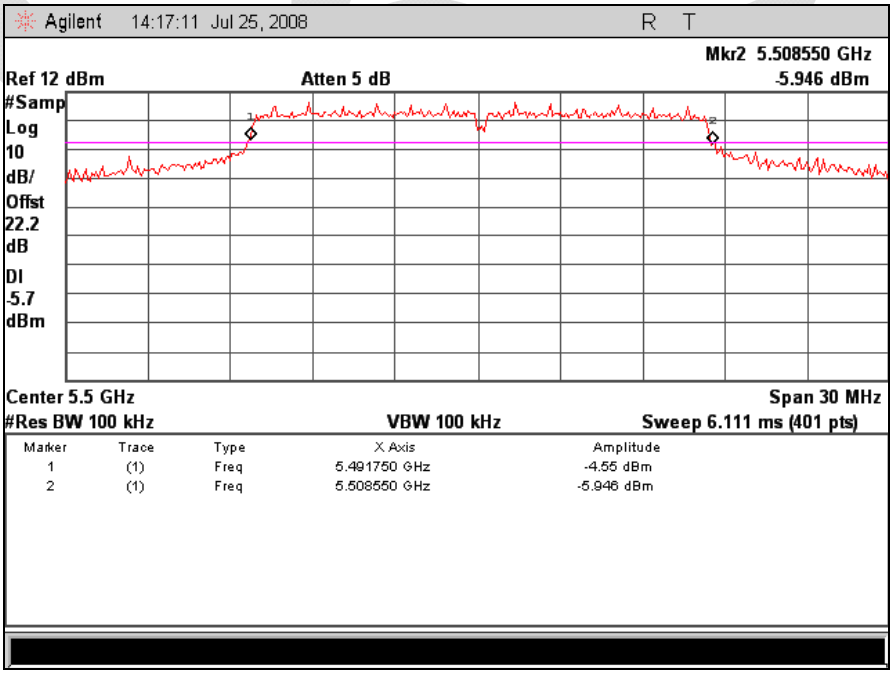


Plot 2. Carrier Frequency, 5500 Low Temperature, High Voltage

Conformance Requirements – Carrier Frequencies

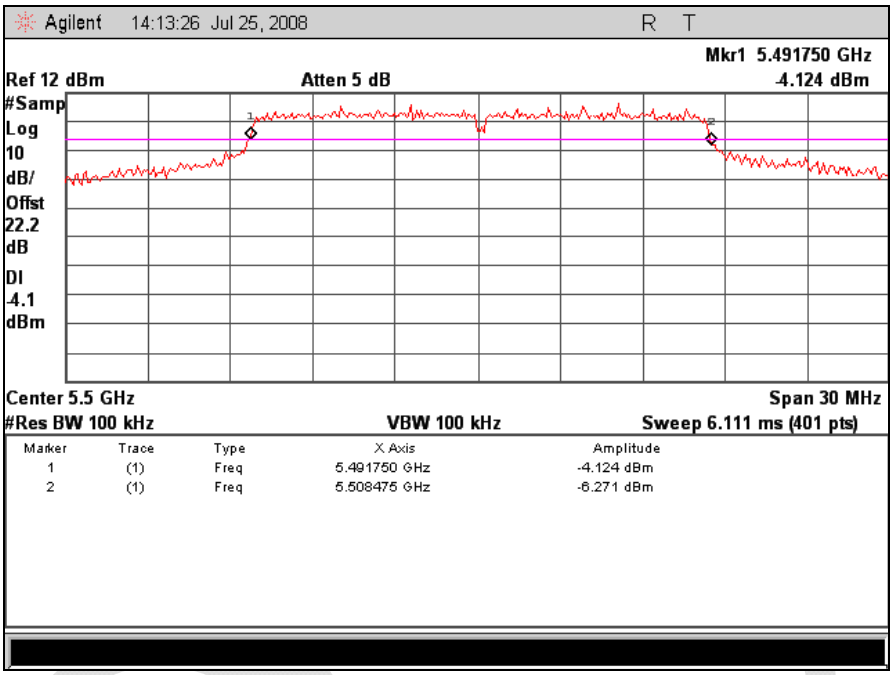


Plot 3. Carrier Frequency, 5500 Normal Temperature, Normal Voltage

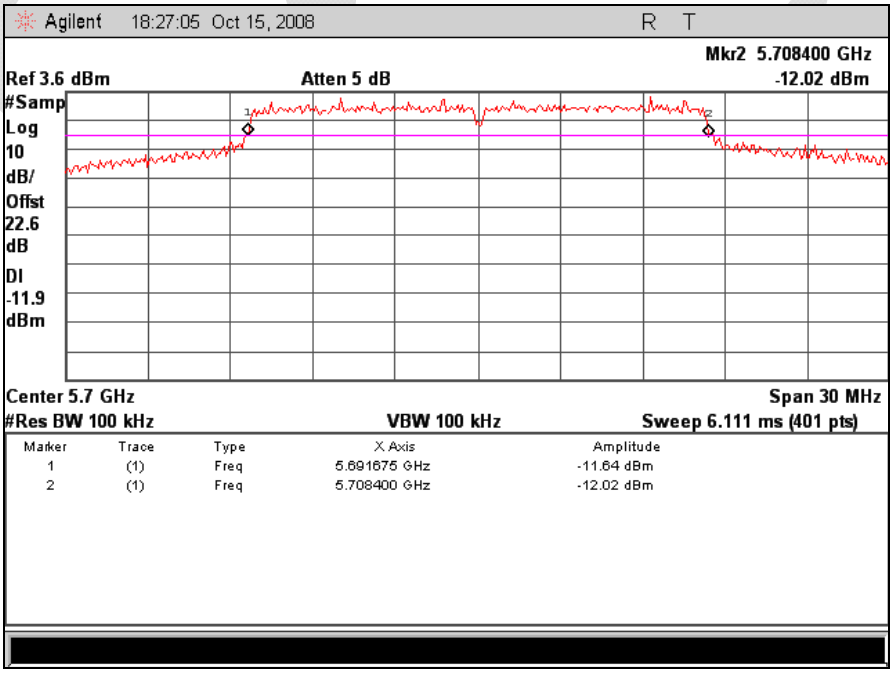


Plot 4. Carrier Frequency, 5500 High Temperature, Low Voltage

Conformance Requirements – Carrier Frequencies

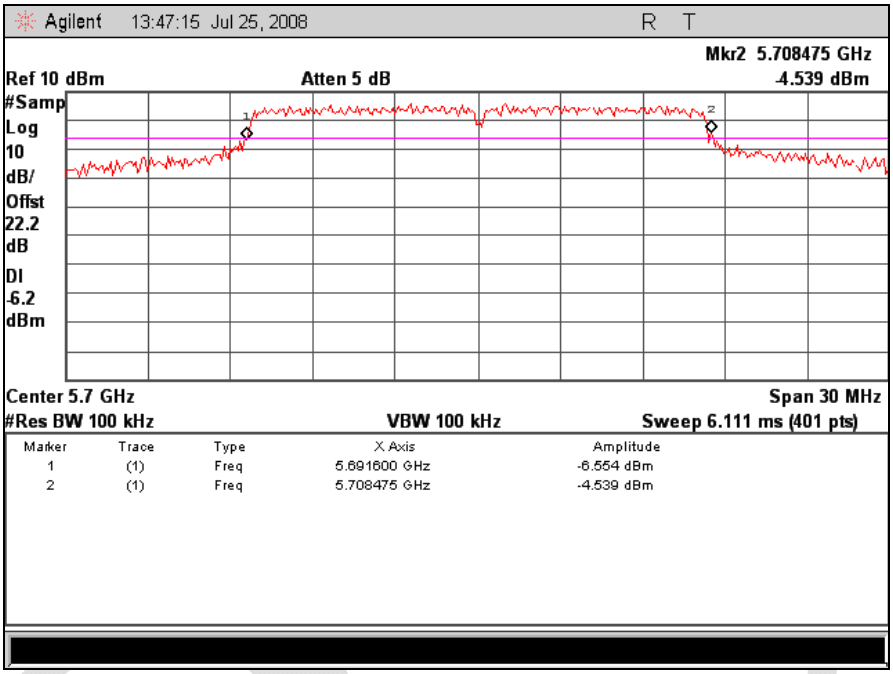


Plot 5. Carrier Frequency, 5500 High Temperature, High Voltage

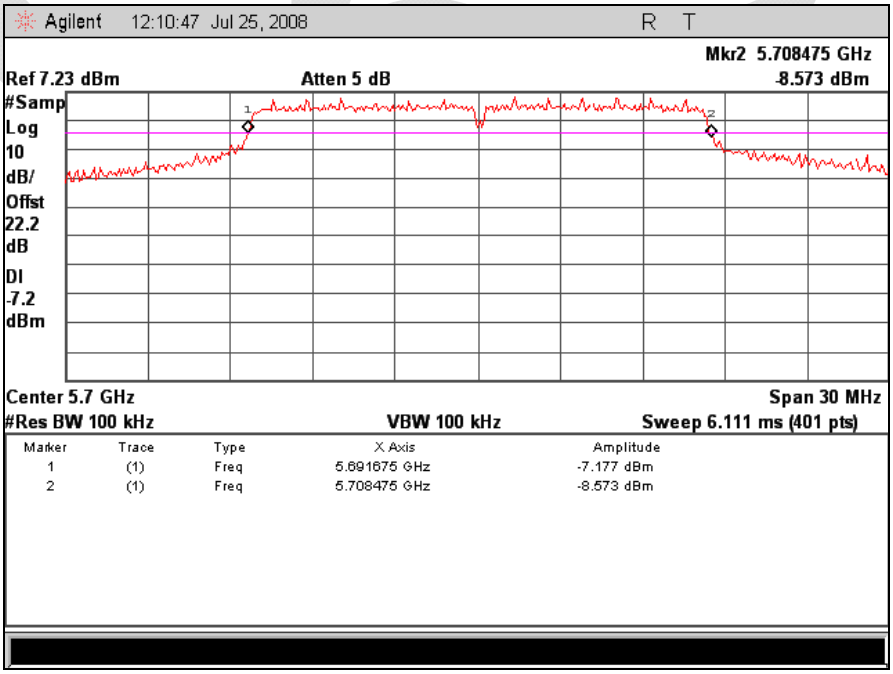


Plot 6. Carrier Frequency, 5700 Low Temperature, Low Voltage

Conformance Requirements – Carrier Frequencies

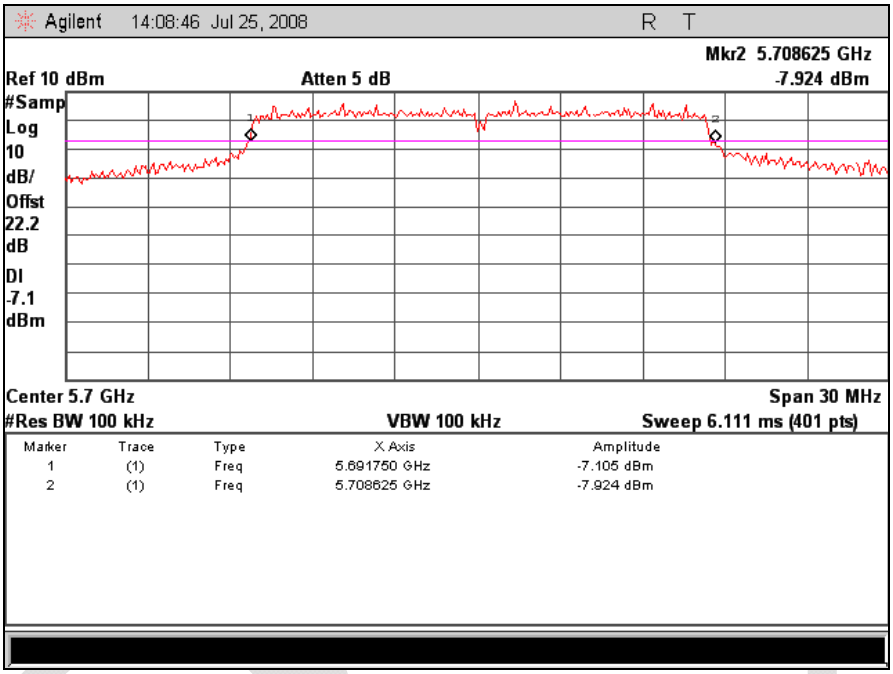


Plot 7. Carrier Frequency, 5700 Low Temperature, High Voltage

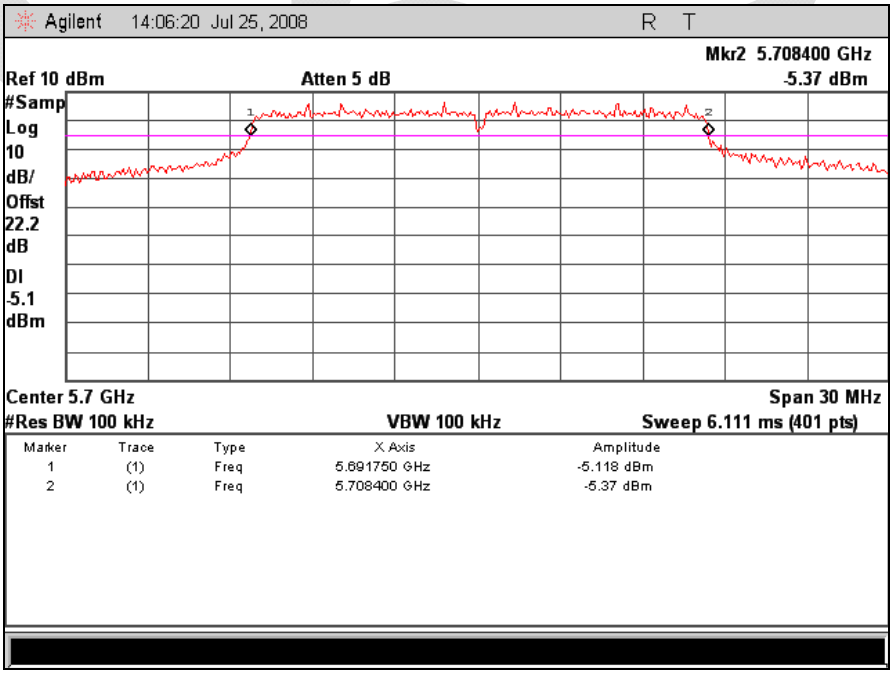


Plot 8. Carrier Frequency, 5700 Normal Temperature, Normal Voltage

Conformance Requirements – Carrier Frequencies



Plot 9. Carrier Frequency, 5700 High Temperature, Low Voltage



Plot 10. Carrier Frequency, 5700 High Temperature, High Voltage

Conformance Requirements

4.3 Nominal Channel Bandwidth and Occupied Channel Bandwidth

Test Requirement(s): **ETSI EN 301 893, Clause 5.3.3:**

4.3.1.Definition

The nominal channel bandwidth is the widest band of frequencies, inclusive of guard bands, assigned to a single channel. The occupied channel bandwidth is the frequency bandwidth of the signal power at the -6 dBc points when measured with a 100 kHz resolution bandwidth.

NOTE: dBc is the spectral density relative to the maximum spectral power density of the transmitted signal.

4.3.2 Limit

The nominal bandwidth shall be in the range from 10 MHz to 40 MHz. The occupied channel bandwidth shall be between 80 % and 100 % of the declared nominal channel bandwidth. In case of smart antenna systems (devices with multiple transmit chains) each of the transmit chains shall meet this requirement. NOTE: The limit for occupied bandwidth is not applicable for devices with a nominal bandwidth of 40 MHz when temporarily operating in a mode in which they transmit only in the upper or lower 20 MHz part of a 40 MHz channel. (e.g. to transmit a packet in the upper or lower 20 MHz part of a 40 MHz channel).

Test Procedure: The EUT was connected directly to a power meter capable of measuring the average RF power of a modulated carrier. Measurements were carried out in all modulations available and at f_c of 5150MHz and 5350MHz for the lower Sub-Bands and 5500MHz and 5700MHz for the Higher Sub-band. Both normal and extreme test conditions were observed.

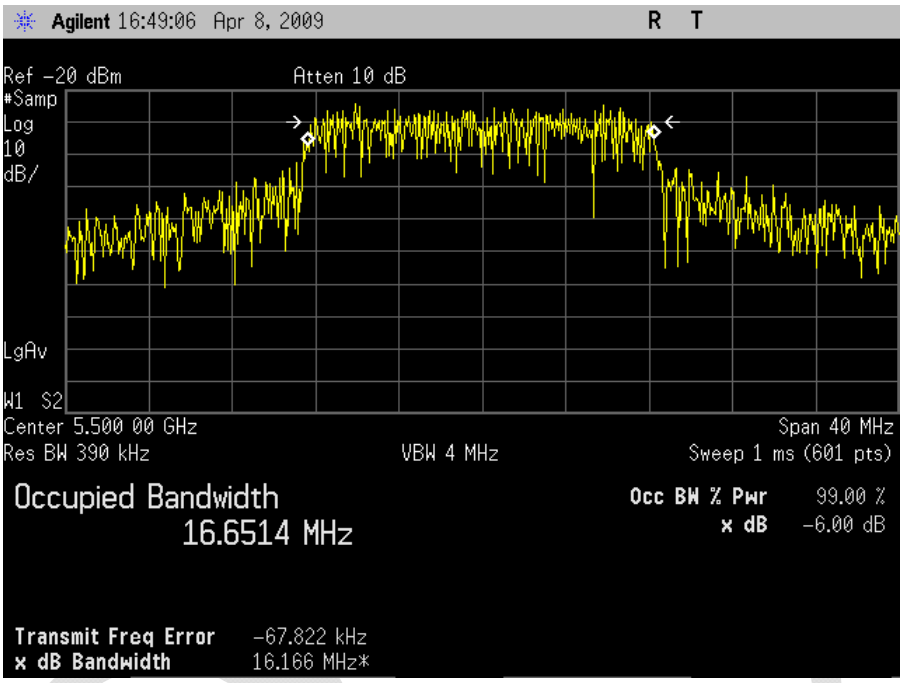
The EIRP was determined from the equation P = A + G + 10 log (1/x); where A is the measured power, x is the duty cycle and G is the antenna assembly gain.

Test Results: The EUT as tested was found compliant with the specified limits in clause 4.3.

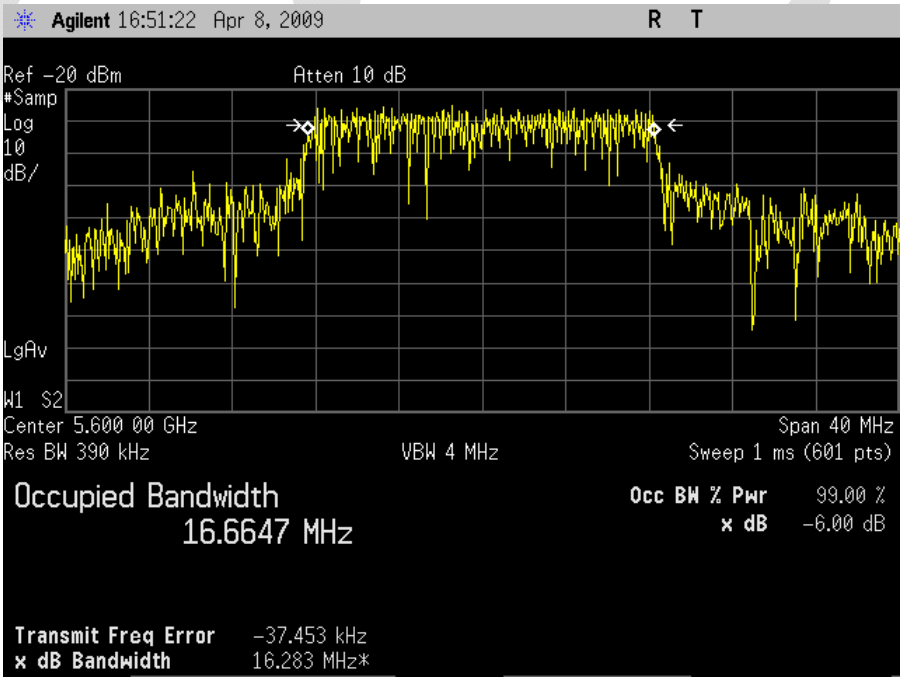
Test Engineer: Anderson Soungpanya

Test Date: April 8, 2009

Conformance Requirements – Occupied Bandwidth

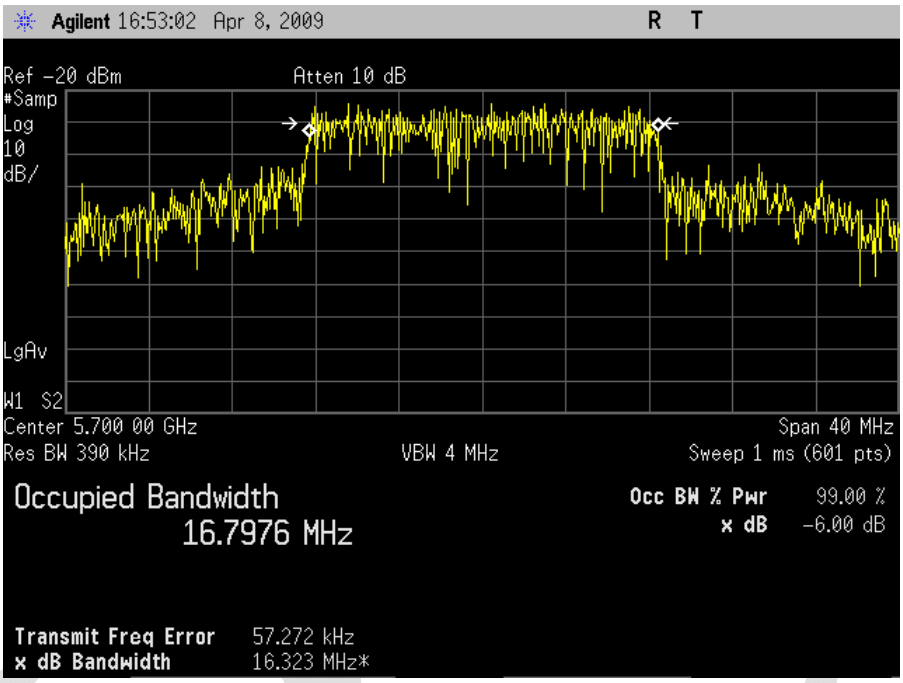


Plot 11. Occupied Bandwidth – 5500MHz



Plot 12. Occupied Bandwidth – 5600MHz

Conformance Requirements – Occupied Bandwidth



Plot 13. Occupied Bandwidth – 5700MHz

Conformance Requirements

4.4 RF Output Power

Test Requirement(s): **ETSI EN 301 893, Clause 5.3.4:**

4.4.1.1 Definition

The RF output power is the mean equivalent isotropically radiated power (EIRP) during a transmission burst.

4.4.2.1 Limit: RF output power and power density at the highest power level

For devices with TPC, the RF output power and the power density when configured to operate at the highest stated power level of the TPC range shall not exceed the levels given in Table 8.

For devices without TPC, the limits in Table 8 shall be reduced by 3 dB, except when operating on channels whose nominal bandwidth falls completely within the band 5 150 MHz to 5 250 MHz.

Frequency range	Mean EIRP limit	Mean EIRP Density limit
5 150 MHz to 5 350 MHz	23 dBm	10 dBm/MHz
5 470 MHz to 5 725 MHz	30 dBm (see Note)	17 dBm/MHz (see note)

Table 8. Mean EIRP limits for RF output power and power density at the highest power level

Note: For Slave devices without a Radar Interference Detection function the mean EIRP shall be less than 23 dBm and the mean EIRP density shall be less than 10 dBm/MHz.

4.4.2.2 Limit: RF output power at the lowest power level of the TPC range

For devices using TPC, the RF output power during a transmission burst when configured to operate at the lowest stated power level of the TPC range shall not exceed the levels given in .

Frequency range	Mean EIRP limit
5 250 MHz to 5 350 MHz	17 dBm
5 470 MHz to 5 725 MHz	24 dBm (see Note)

Table 9. Mean EIRP limits for RF output power at the lowest power level of the TPC range

Note: For Slave devices without a Radar Interference Detection function the mean EIRP shall be less than 17 dBm.

This limit shall apply for any combination of power level and intended antenna assembly.

Test Procedure: The EUT was connected directly to a power meter capable of measuring the average RF power of a modulated carrier. Measurements were carried out in all modulations available and at f_c of 5150MHz and 5350MHz for the lower Sub-Bands and 5500MHz and 5700MHz for the Higher Sub-band. Both normal and extreme test conditions were observed.

The EIRP was determined from the equation P = A + G + 10 log (1/x); where A is the measured power, x is the duty cycle and G is the antenna assembly gain.

Test Results: The EUT as tested was found compliant with the specified limits in clause 5.3.4.

Test Engineer: Anderson Soungpanya

Test Date: July 29, 2008

Conformance Requirements

Effective Isotropic Radiated Power Results

Maximum Average Power Under Normal and Extreme Conditions						
Frequency (MHz)	**Temperature (C)**	**Voltage (V)**	**Conducted Power (dBm)**	**Antenna Gain (dBi)**	**EIRP**	**Limit**
5500	22	230	-0.17	30	29.83	30
5500	-20	207	-0.11	30	29.89	30
5500	-20	253	-0.34	30	29.66	30
5500	55	207	-0.61	30	29.39	30
5500	55	253	-0.56	30	29.44	30
5700	22	230	-0.47	30	29.53	30
5700	-20	207	-0.52	30	29.48	30
5700	-20	253	-0.44	30	29.56	30
5700	55	207	-1.71	30	28.29	30
5700	55	253	-1.82	30	28.18	30

Table 10. Maximum Average – RF Output Power Test Results

Conformance Requirements

4.4 Transmit Power Control

Test Requirement(s): **ETSI EN 301 893 Section 4.4.1.2:**

4.4.1.2 Definition
The Transmit Power Control (TPC) is a mechanism to be used by the EUT to ensure a mitigation factor of at least 3dB on the aggregate power from a large number of devices. This requires the EUT to have a TPC range from which the lowest value is at least 6 dB below the values for the mean EIRP given in the table below. TPC is not required in the band 5150MHz- 5250MHz.

4.4.2.2 Limit

Frequency range	Mean EIRP limit
5 250 MHz to 5 350 MHz	17 dBm
5 470 MHz to 5 725 MHz	24 dBm

Mean EIRP for RF Output Power at the Lowest TPC level

Test Procedure: The EUT was connected directly to a power meter capable of measuring the average RF power of a modulated carrier. Measurements were carried out in all modulations available and at f_c of 5250MHz and 5350MHz for the lower Sub-Bands and 5500MHz and 5700MHz for the Higher Sub-band. Both normal and extreme test conditions were observed.

Test Results: The EUT was found to be compliant with the limits set forth in Clause 5.3.4.

Test Engineer: Anderson Soungpanya

Test Date: July 29, 2008

Conformance Requirements

Effective Isotropic Radiated Power Results

Minimum Average Power Under Normal and Extreme Conditions						
Frequency (MHz)	**Temperature (C)**	**Voltage (V)**	**Conducted Power (dBm)**	**Antenna Gain (dBi)**	**EIRP**	**Limit**
5500	22	230	-6.2	30	23.8	24
5500	-20	207	-6.11	30	23.89	24
5500	-20	253	-6.08	30	23.92	24
5500	55	207	-6.3	30	23.7	24
5500	55	253	-6.16	30	23.84	24
5700	22	230	-6.04	30	23.96	24
5700	-20	207	-8.2	30	21.8	24
5700	-20	253	-10.4	30	19.6	24
5700	55	207	-6.1	30	23.9	24
5700	55	253	-6.2	30	23.8	24

Table 11. Minimum Average – RF Output Power Test Results

Conformance Requirements

4.4 Power Density

Test Requirement(s): **ETSI EN 301 893 Section 4.4.1.3**

4.4.1.3 Definition
The Power Density is the mean equivalent isotropically radiated power (EIRP) during a transmission burst

4.4.2.1 Limit
For Devices with TPC, the Power Density when configured to operate at the highest stated power level shall not exceed the levels below.

Frequency range	Mean EIRP Density limit
5 250 MHz to 5 350 MHz	10 dBm/MHz
5 470 MHz to 5 725 MHz	17 dBm/MHz

Test Procedure: The EUT was connected directly to a Spectrum Analyzer through an attenuator. Measurements were carried out in all modulations available and at f_c of 5150MHz and 5350MHz for the lower Sub-Bands and 5500MHz and 5700MHz for the Higher Sub-band. The spectrum analyzer was initially set with a RBW and VBW of 1MHz and a span 3 times that of the carrier width. The max hold function was used to determine the frequency which gave the maximum value across the occupied band of the carrier. The spectrum analyzer was reset to use the power density function at the frequency found previously. The power density was then measured over 1MHz resolution.

Test Results: The EUT was found to be compliant with the limits set forth in Clause 5.3.4.

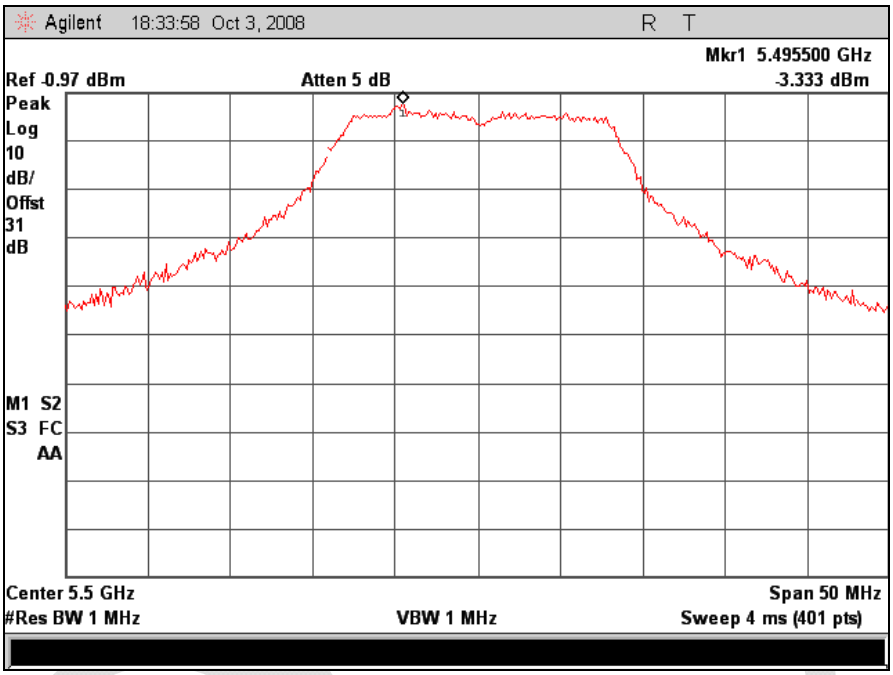
Frequency (MHz)	Mode	Measured Maximum Spectral Power Density (dBm)	Maximum Spectral Power Density (dBm)	Antenna Gain	Maximum SPD Limit (dBm)	Margin dB
5500	OFDM	-13.39	16.61	30	17	0.39
5700	OFDM	-13.42	16.58	30	17	0.42

Table 12. Power Spectral Density Test Results

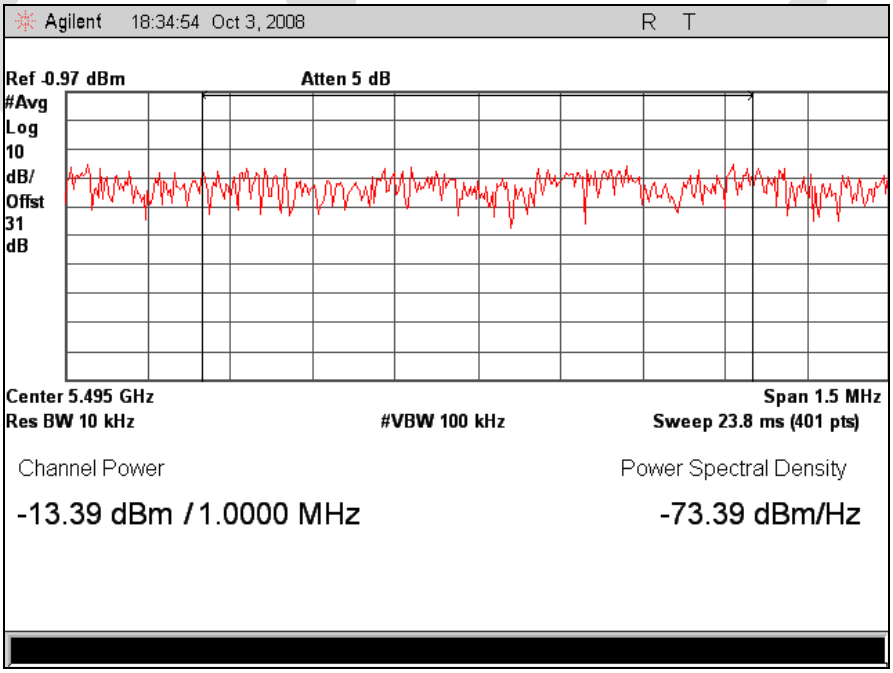
Test Engineer: Anderson Soungpanya

Test Date: July 25, 2008

Conformance Requirements – Power Density

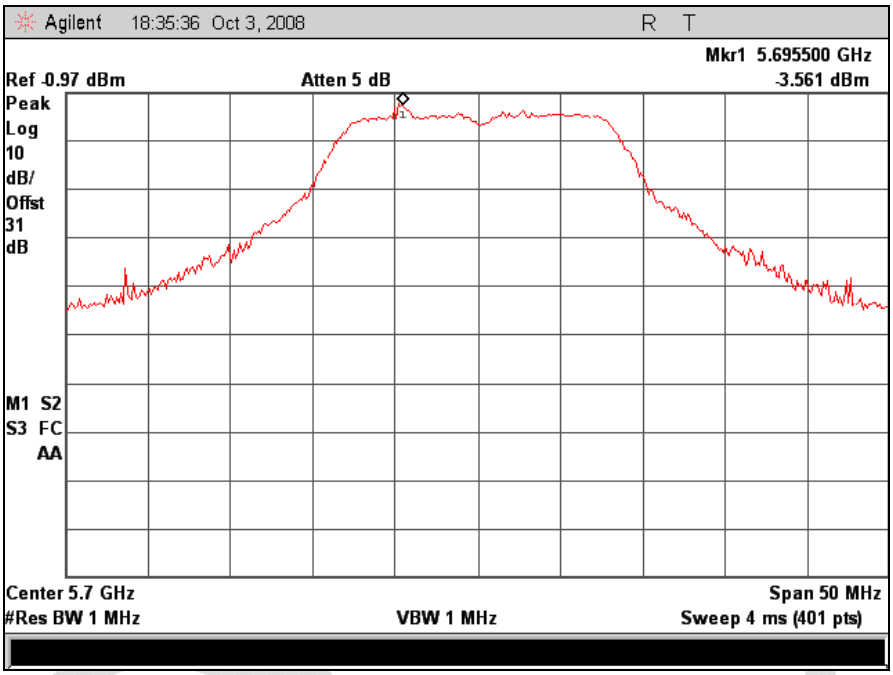


Plot 14. 5500 Power Spectral Density Determination

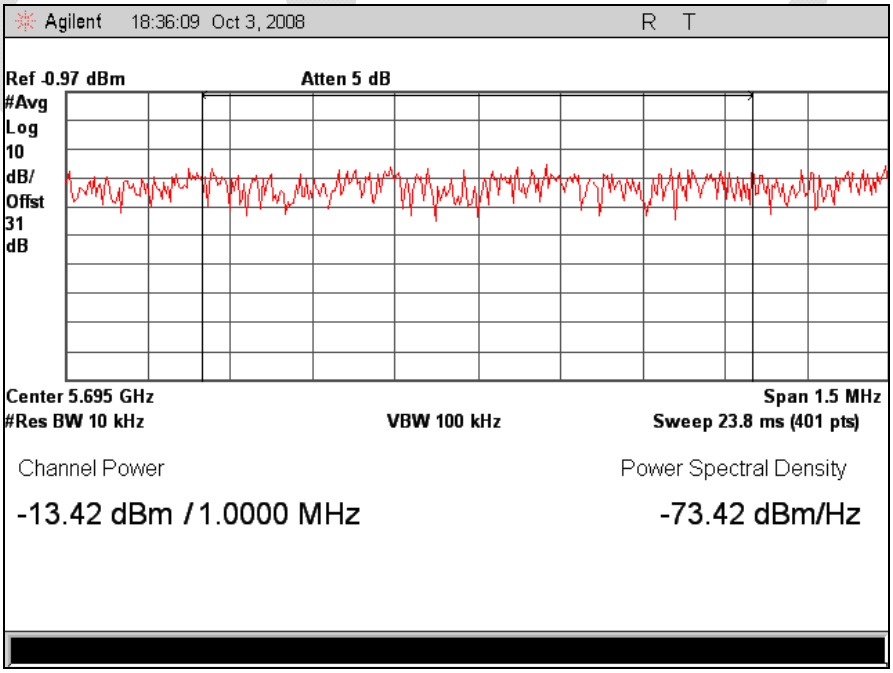


Plot 15. 5500 Power Spectral Density

Conformance Requirements – Power Density



Plot 16. 5700 Power Spectral Density Determination



Plot 17. 5700 Power Spectral Density

4.5.1 Transmitter Unwanted Emissions Outside the 5GHz RLAN Bands (conducted)

Test Requirement(s): **EN 301 893, Section 4.5.1:**

4.5.1.1 Definition
These are conducted radio frequency emissions outside the 5GHz RLAN bands when the RF output port is connected to a spectrum analyzer.

4.5.1.2 Limit
The level of unwanted emissions shall not exceed the limits given below.

Frequency range	Maximum power ERP	Resolution Bandwidth
30 MHz to 47 MHz	-36dBm	100KHz
47 MHz to 74 MHz	-54dBm	100KHz
74 MHz to 87,5 MHz	-36dBm	100KHz
87,5 MHz to 118 MHz	-54dBm	100KHz
118 MHz to 174 MHz	-36dBm	100KHz
174 MHz to 230 MHz	-54dBm	100KHz
230 MHz to 470 MHz	-36dBm	100KHz
470 MHz to 862 MHz	-54dBm	100KHz
862 MHz to 1 GHz	-36dBm	100KHz
1 GHz to 5,15 GHz	-30dBm	1MHz
5,35 GHz to 5,47 GHz	-30dBm	1MHz
5,725 GHz to 26,5 GHz	-30dBm	1MHz

Test Procedure: The EUT was connected directly to a spectrum analyzer through an attenuator. The RBW and VBW of the spectrum analyzer was initially set to 1MHz using the peak hold function or video averaging. Emissions were investigated from 25MHz up to 1GHz. If any emission exceeded the limits in the table above then the spectrum analyzer was reset with a resolution of 100KHz, zero span, and the spectrum investigate at 11 frequencies spaced 100KHz in a band ± 0.5MHz centered on the failing frequency. The spectrum also was investigated from 1GHz to 5.15GHz, 5.35GHz to 5.47GHz and 5.725GHz to 26.5GHz using a resolution of 1MHz and a peak hold function or video averaging. Measurements were carried out in all modulations available and at f_c of 5150MHz and 5350MHz for the lower Sub-Bands and 5500MHz and 5700MHz for the Higher Sub-band.

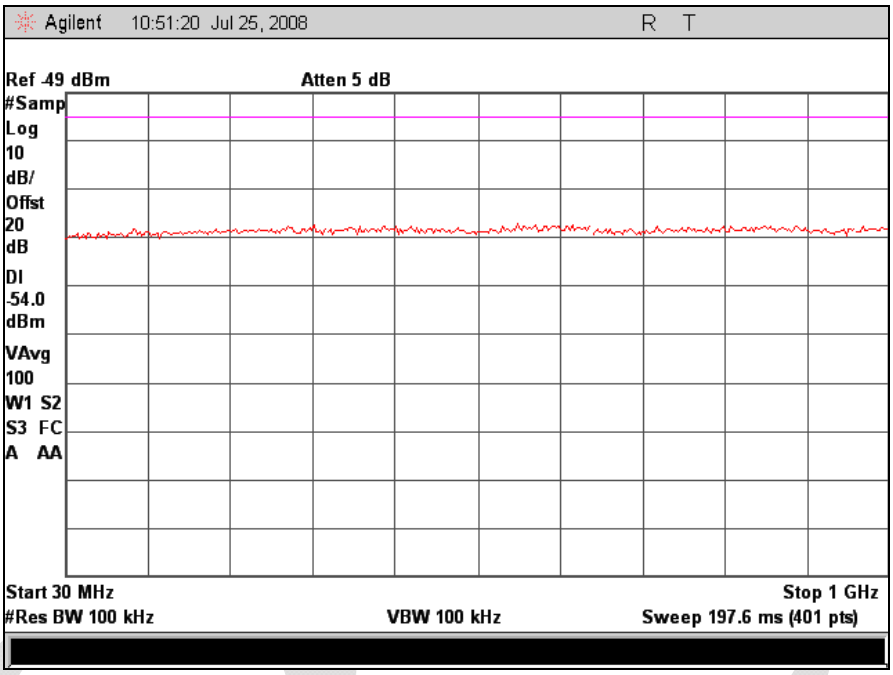
Test Results: The EUT as tested was found compliant with the specified requirements of Clause 5.3.5.

Test Engineer: Anderson Soungpanya

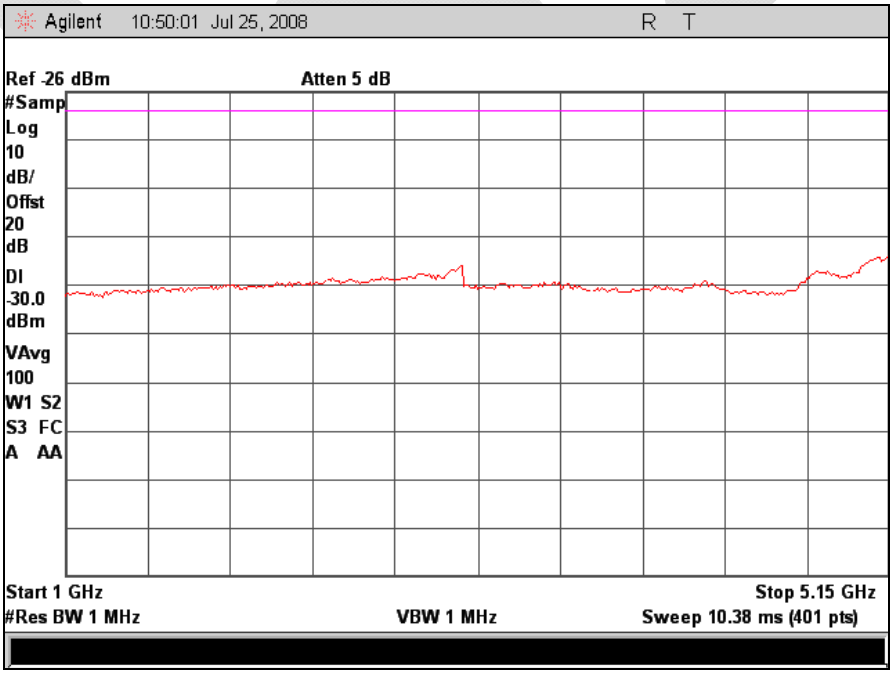
Test Date: July 25, 2008

Conformance Requirements

4.5.1 Transmitter Unwanted Emissions Outside the 5GHz RLAN Bands (conducted)

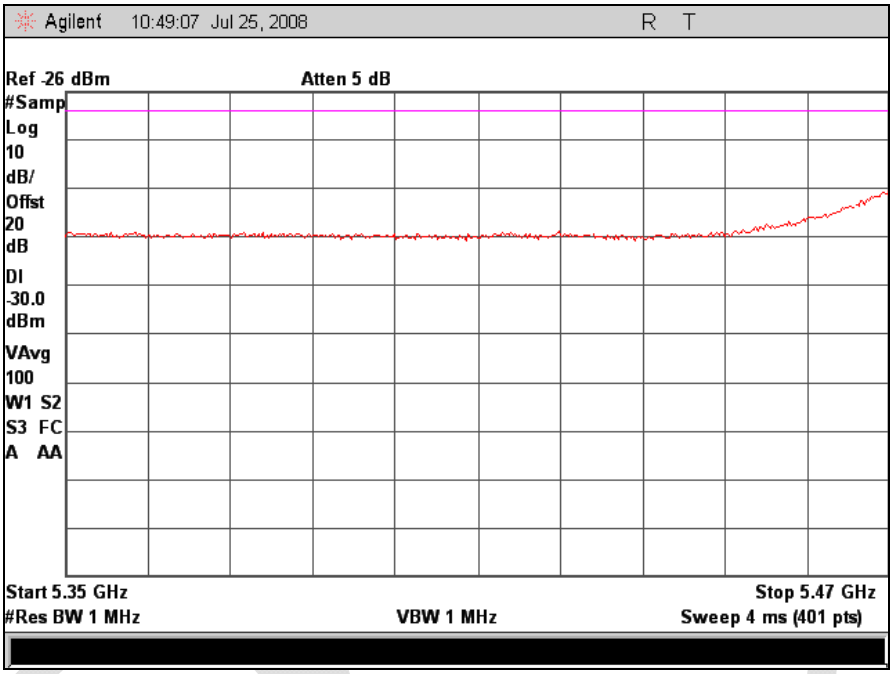


Plot 18. Low Channel (5500 MHz) Spurious Emission 30 MHz - 1GHz

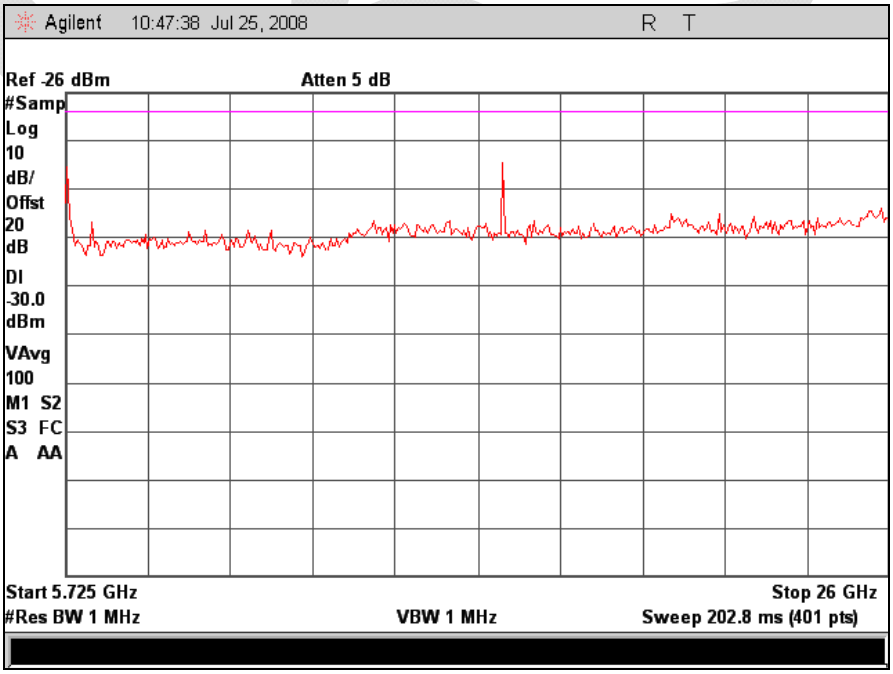


Plot 19. Low Channel (5500 MHz) Spurious Emission 1 GHz – 5.15 GHz

Conformance Requirements - Transmitter Unwanted Emissions Outside the 5GHz RLAN Bands (Conducted)

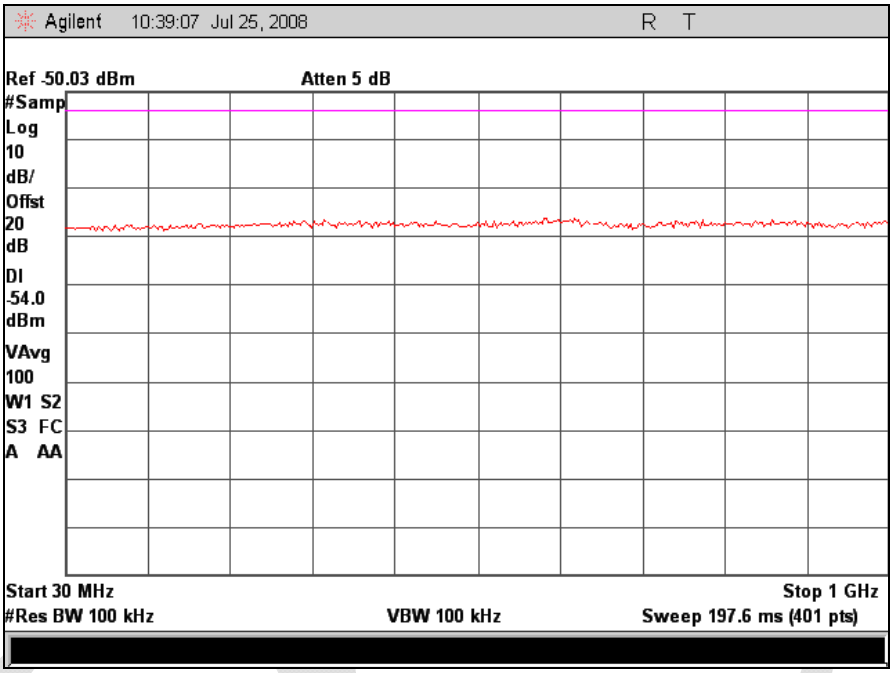


Plot 20. Low Channel (5500 MHz) Spurious Emission 5.35 GHz – 5.47 GHz

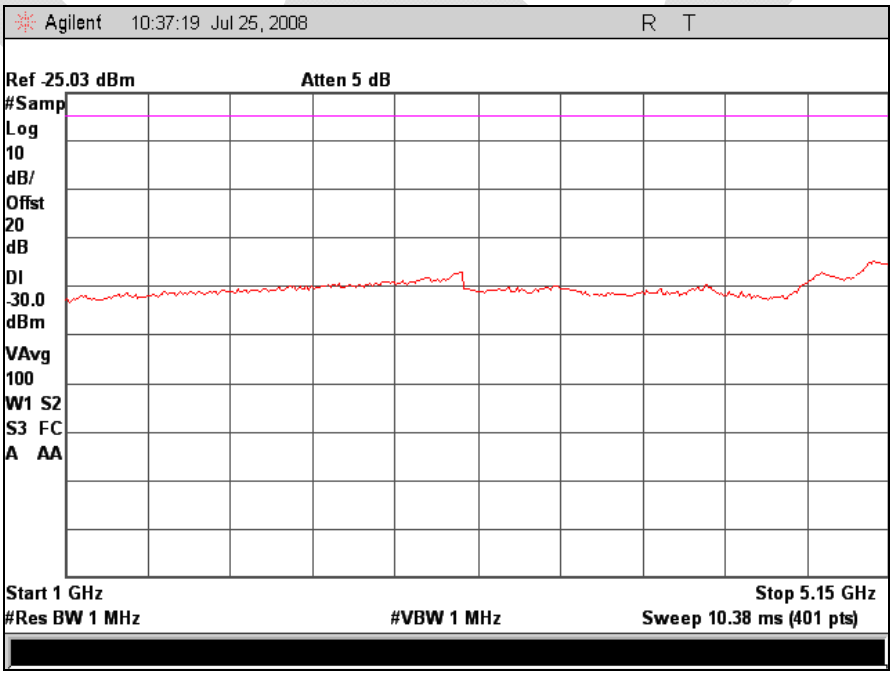


Plot 21. Low Channel (5500 MHz) Spurious Emission 5.725 GHz - 26 GHz

Conformance Requirements - Transmitter Unwanted Emissions Outside the 5GHz RLAN Bands (Conducted)

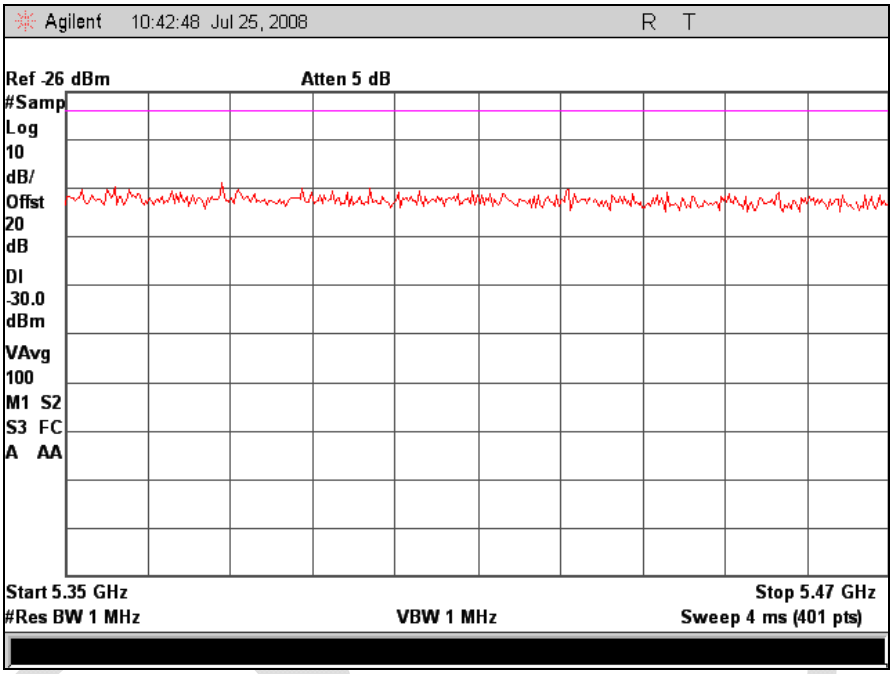


Plot 22. High Channel (5700 MHz) Spurious Emission 30 MHz - 1GHz

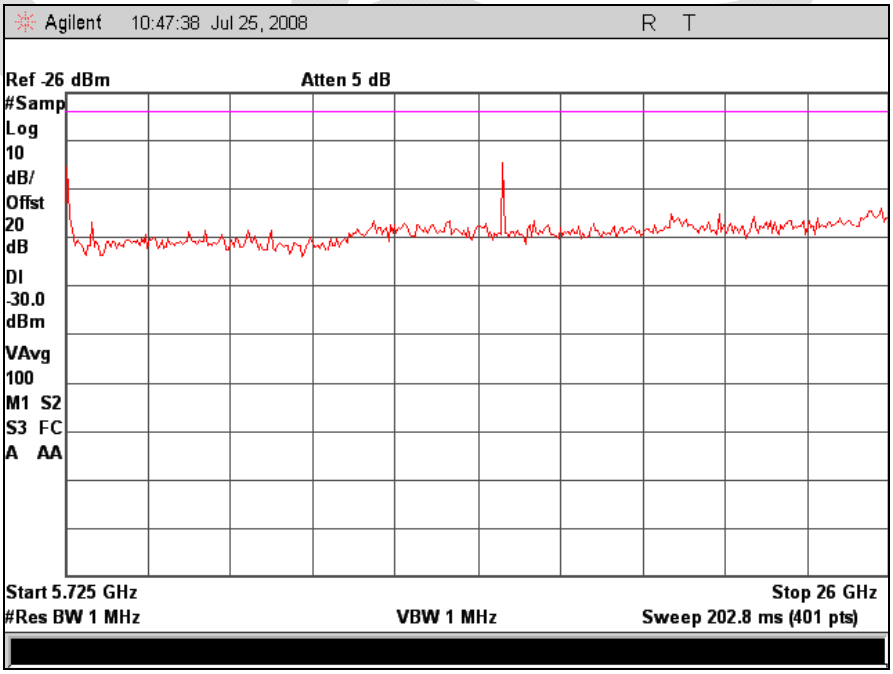


Plot 23. High Channel (5700 MHz) Spurious Emission 1 GHz – 5.15 GHz

Conformance Requirements - Transmitter Unwanted Emissions Outside the 5GHz RLAN Bands (Conducted)



Plot 24. High Channel (5700 MHz) Spurious Emission 5.35 GHz – 5.47 GHz



Plot 25. High Channel (5700 MHz) Spurious Emission 5.725 GHz – 26 GHz

4.5.1 Transmitter Unwanted Emissions Outside the 5GHz RLAN Bands (Radiated)

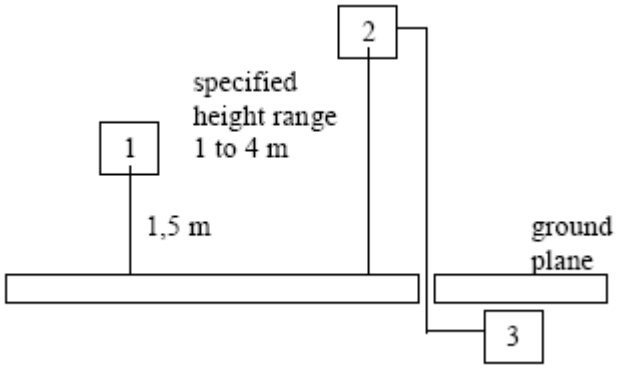
Test Requirement(s): **EN 301 893, Section 4.5.1**

4.5.1.1 Definition
These are radiated radio frequency emissions outside the 5GHz RLAN bands when the RF output port is connected to a spectrum analyzer.

4.5.1.2 Limit
The level of unwanted emissions shall not exceed the limits given

Frequency range	Maximum power ERP	Bandwidth
30 MHz to 47 MHz	-36dBm	100KHz
47 MHz to 74 MHz	-54dBm	100KHz
74 MHz to 87,5 MHz	-36dBm	100KHz
87,5 MHz to 118 MHz	-54dBm	100KHz
118 MHz to 174 MHz	-36dBm	100KHz
174 MHz to 230 MHz	-54dBm	100KHz
230 MHz to 470 MHz	-36dBm	100KHz
470 MHz to 862 MHz	-54dBm	100KHz
862 MHz to 1 GHz	-36dBm	100KHz
1 GHz to 5,15 GHz	-30dBm	1MHz
5,35 GHz to 5,47 GHz	-30dBm	1MHz
5,725 GHz to 26,5 GHz	-30dBm	1MHz

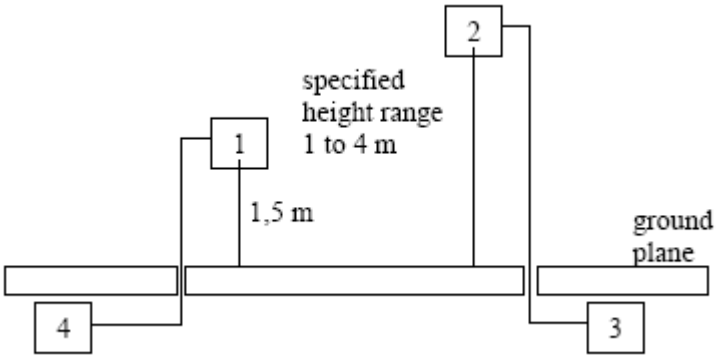
Test Procedure: The EUT was setup as per the specifications set out in Annex B of 301 893 and is shown below.



1. Equipment Under Test
2. Test Antenna
3. Spectrum Analyzer

The antenna ports were terminated into a 50Ω load. The receiving antenna was connected directly to a spectrum analyzer through an RF pre-amplifier. The RBW and VBW of the spectrum analyzer were initially set to 1MHz using the peak hold function or video averaging. Emissions were investigated from 25MHz up to 1GHz. If any emission exceeded the limits in the table above then the spectrum analyzer was reset with a resolution of 100KHz, zero span, and the spectrum investigate at 11 frequencies spaced 100KHz in a band ± 0.5MHz centered on the failing frequency. The spectrum also was investigated from 1GHz to 5.15GHz, 5.35GHz to 5.47GHz and 5.725GHz to 26.5GHz using a resolution of 1MHz and a peak hold function or video averaging. The turntable was rotated about 360^0 and the receiving antenna raised and lowered 1-4m in order to determine the maximum emissions. Measurements were carried out in all modulations available and at f_c of 5150MHz and 5350MHz for the lower Sub-Bands and 5500MHz and 5700MHz for the Higher Sub-band.

The levels of emissions were then determined using a signal substitution method and the setup is shown below.



1. Substitution Antenna
2. Test Antenna
3. Spectrum Analyzer
4. Signal Generator

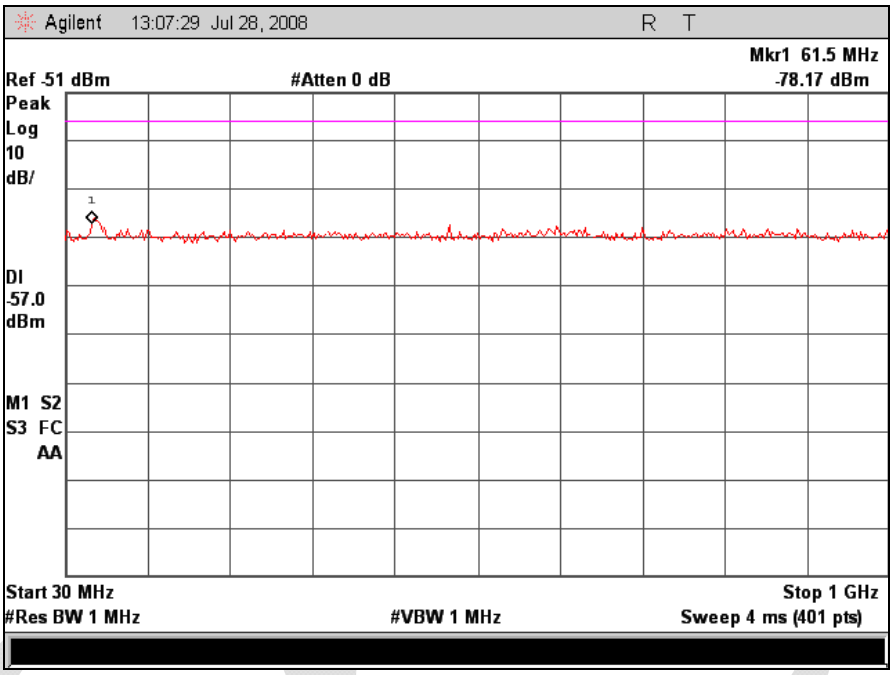
Test Results: The EUT as tested was found compliant with the specified requirements of Clause 5.3.5.

Test Engineer: Anderson Soungpanya

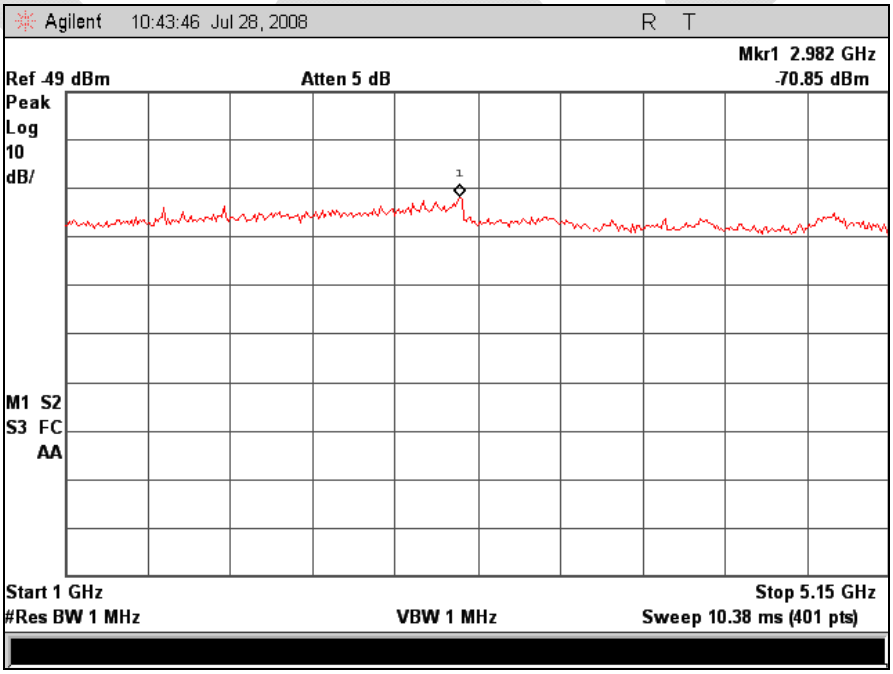
Test Date: July 25, 2008

Conformance Requirements

4.5.1 Transmitter Unwanted Emissions Outside the 5GHz RLAN Bands (Radiated)

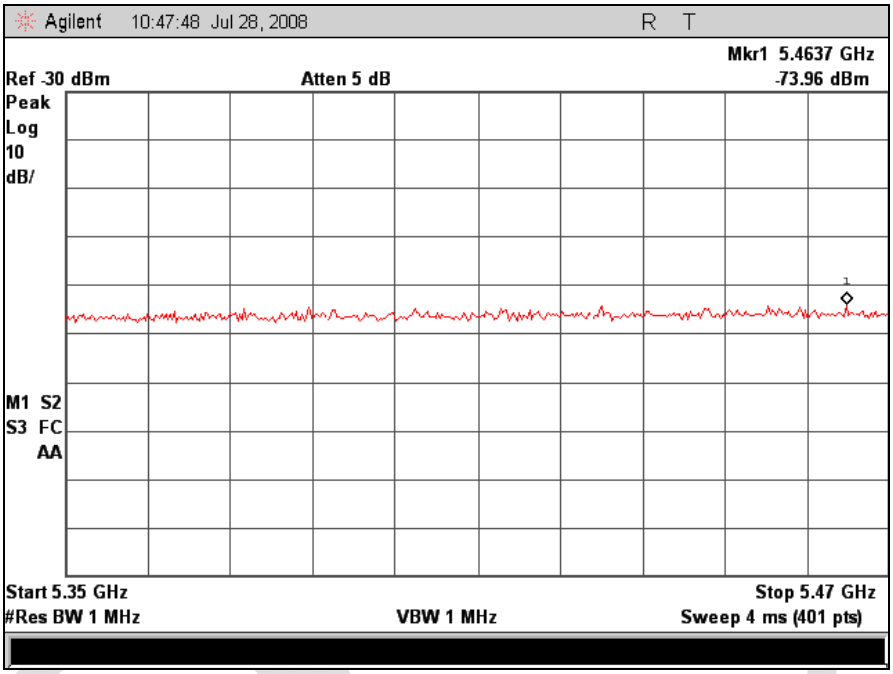


Plot 26. Low Channel (5500 MHz) Spurious Emission 30 MHz - 1GHz

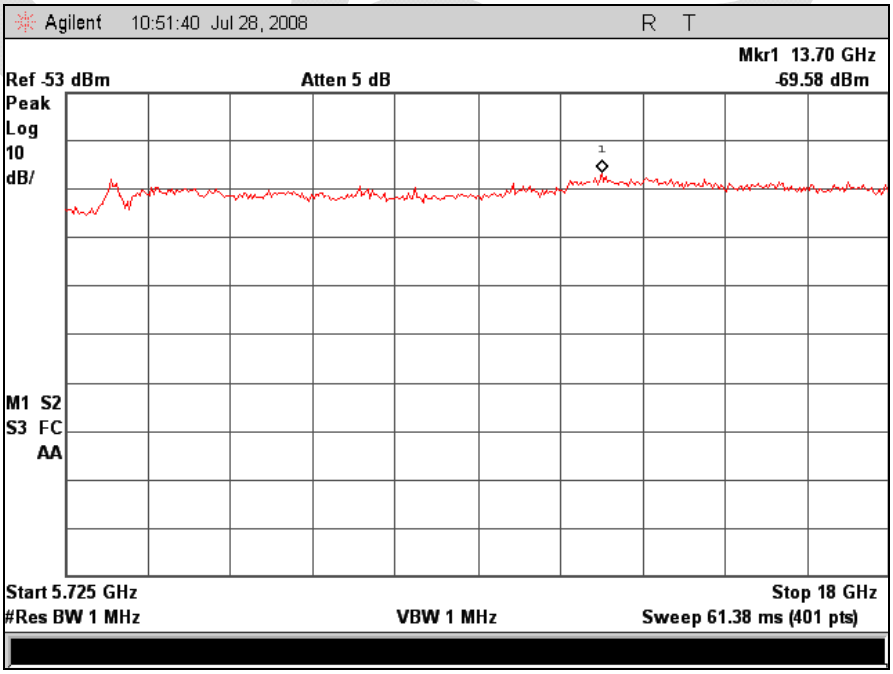


Plot 27. Low channel (5500 MHz) Spurious Emission 1 GHz – 5.15 GHz

Conformance Requirements - Transmitter Unwanted Emissions Outside the 5GHz RLAN Bands (Radiated)

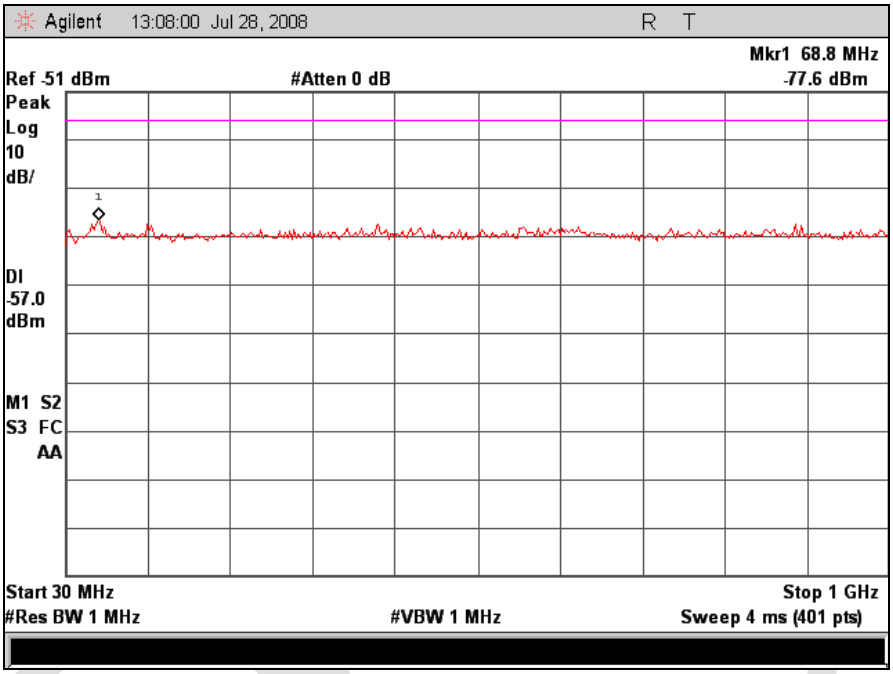


Plot 28. Low Channel (5500 MHz) Spurious Emission 5.35 GHz – 5.47 GHz

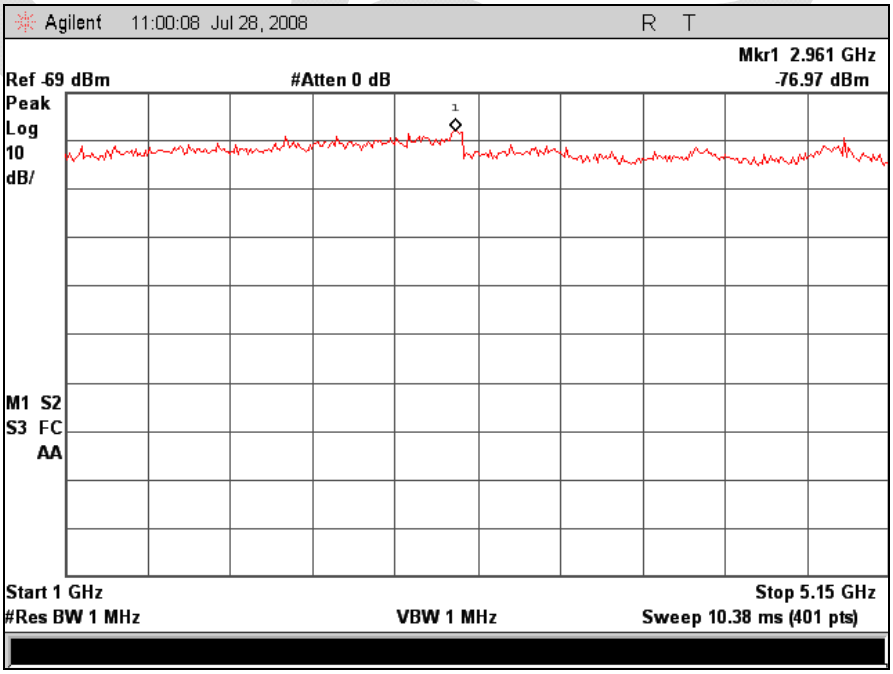


Plot 29. Low Channel (5500 MHz) Spurious Emission 5.725 GHz - 18 GHz

Conformance Requirements - Transmitter Unwanted Emissions Outside the 5GHz RLAN Bands (Radiated)

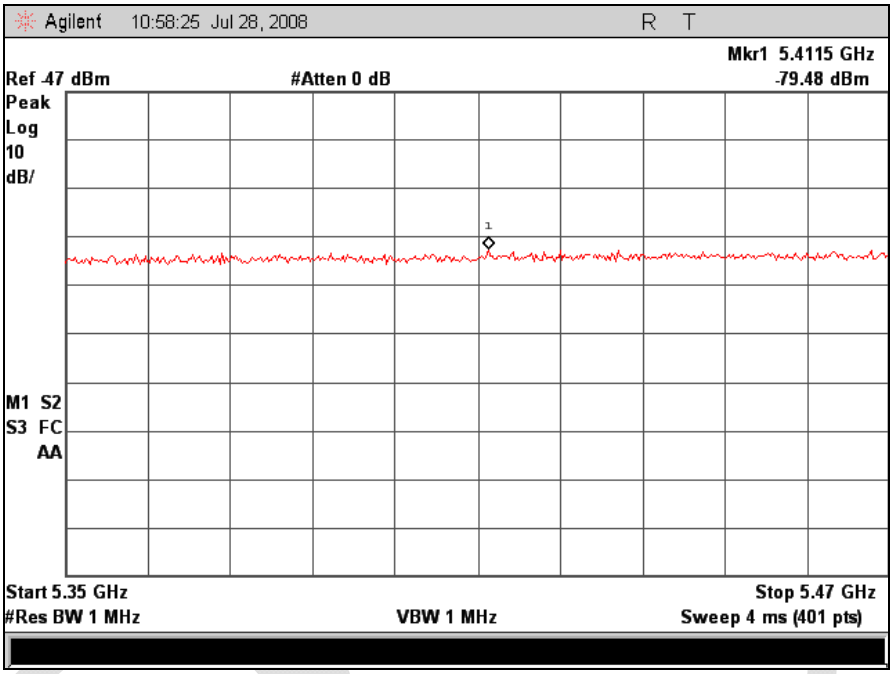


Plot 30. High Channel (5700 MHz) Spurious Emission 30 MHz - 1GHz

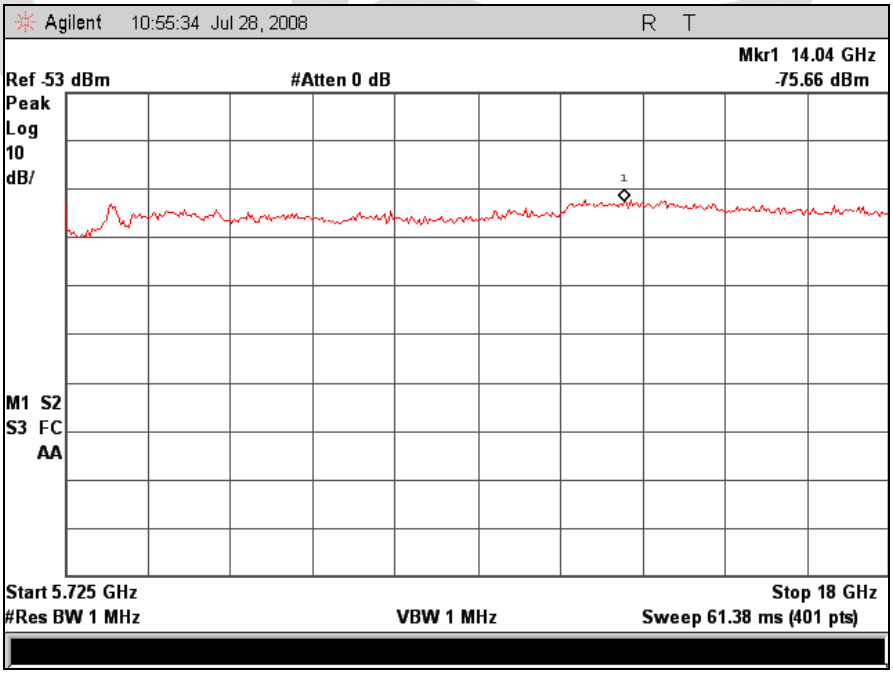


Plot 31. High Channel (5700 MHz) Spurious Emission 1 GHz – 5.15 GHz

Conformance Requirements - Transmitter Unwanted Emissions Outside the 5GHz RLAN Bands (Radiated)



Plot 32. High Channel (5700 MHz) Spurious Emission 5.35 GHz – 5.47 GHz



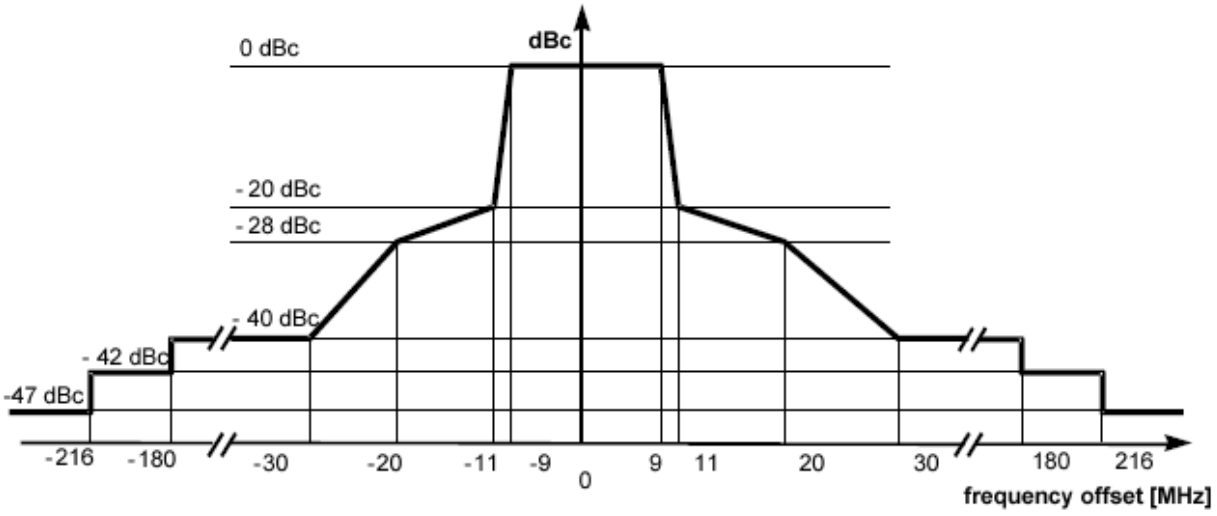
Plot 33. High Channel (5700 MHz) Spurious Emission 5.725 GHz – 18 GHz

4.5.2 Transmitter Unwanted Emissions Within the 5GHz RLAN Bands (Conducted)

Test Requirement(s): **EN 301 893, Section 4.5.2:**

4.5.2.1 Definition
These are conducted radio frequency emissions within the 5GHz RLAN bands when the RF output port is connected to a spectrum analyzer.

4.5.2.2 Limit
The average level of the transmitted spectrum within the 5GHz RLAN bands shall not exceed the limits given below.



Note: dBc is the spectral density relative to the maximum spectral power density of the transmitted signal**.**

Test Procedure: The maximum spectral power density of the EUT's transmitted signal was determined using a broadband power meter capable of measuring the average power of a modulated carrier. The EUT was then connected to a spectrum analyzer with a RBW of 1MHz, a VBW of 30 KHz and with video averaging on. The level of the power density measured previously was then used to set the emission mask relative to the 0 dB reference level of the modulated carrier. Measurements were carried out in all modulations available and at f_c of 5250MHz and 5350MHz for the lower Sub-Bands and 5500MHz and 5700MHz for the Higher Sub-band. The spectrum under the mask was examined both in a relatively narrow span and a broader span in order to determine compliance.

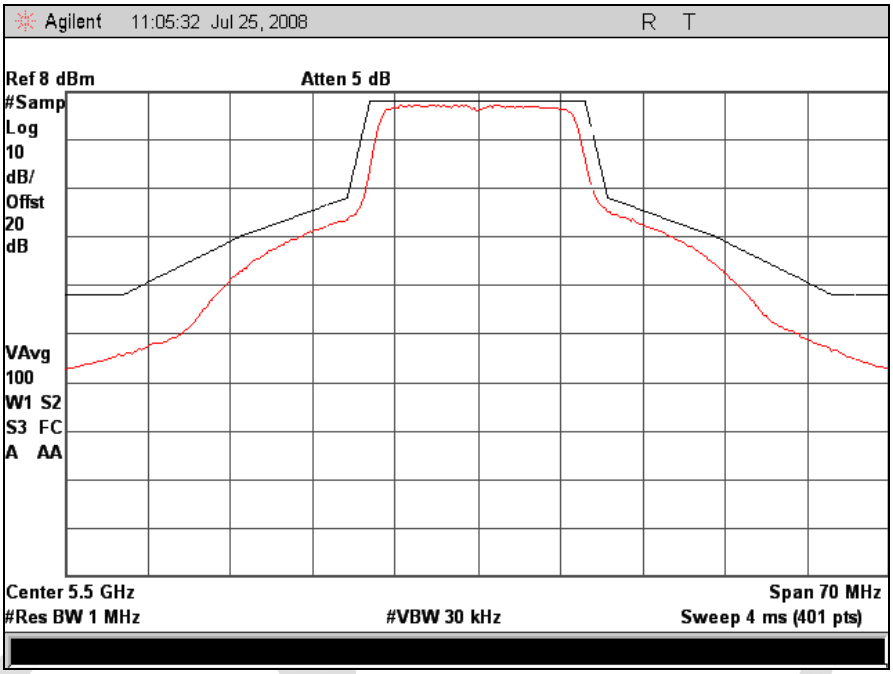
Test Results: The EUT as tested was found compliant with the specified requirements of Clause 5.3.6.

Test Engineer: Anderson Soungpanya

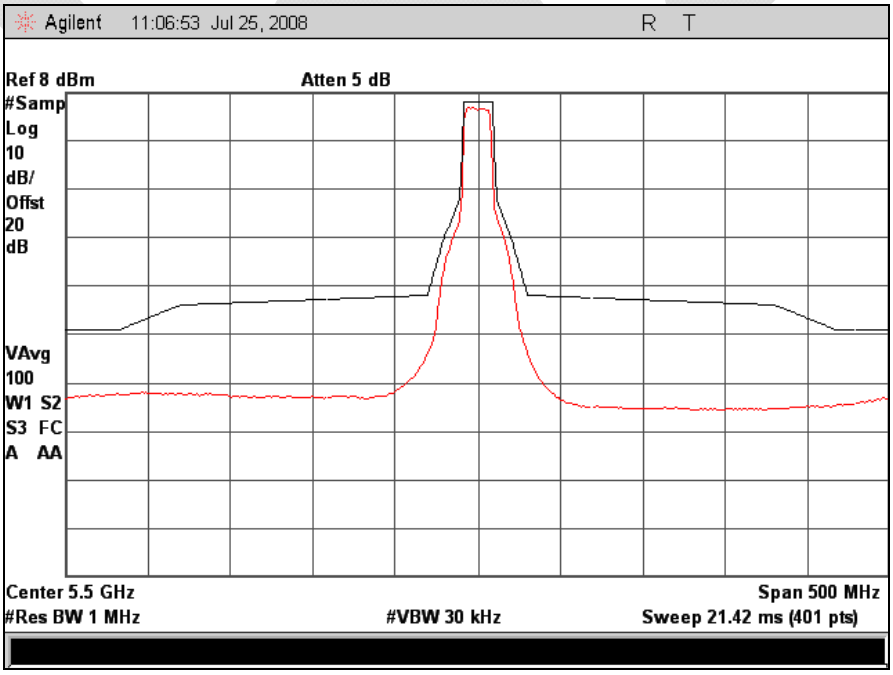
Test Date: July 25, 2008

Conformance Requirements

4.5.2 Transmitter Unwanted Emissions Within the 5GHz RLAN Bands (Conducted)

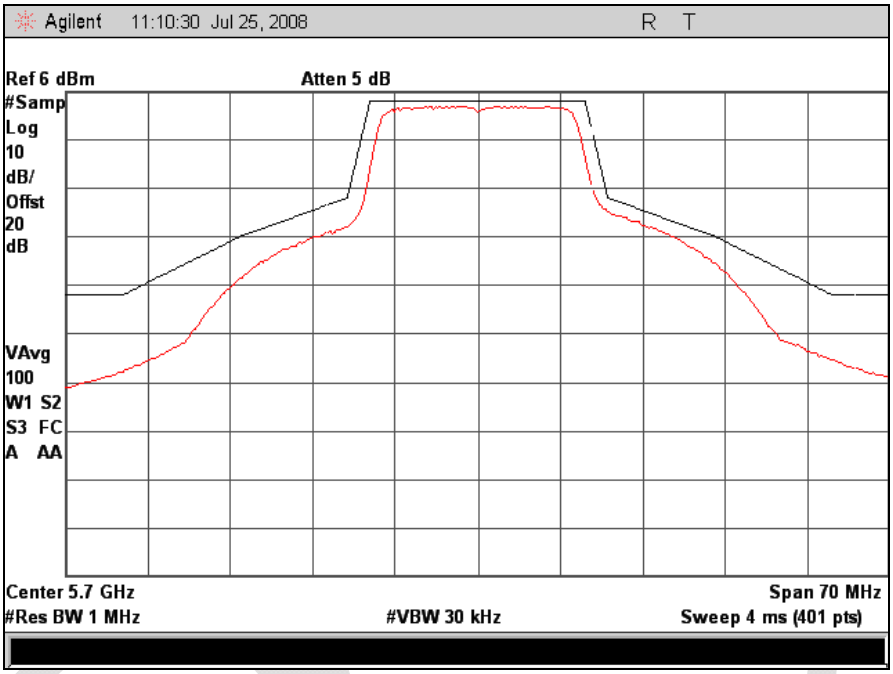


Plot 34. Low Channel (5500 MHz) In Band Spurious Emission, 70MHz Span

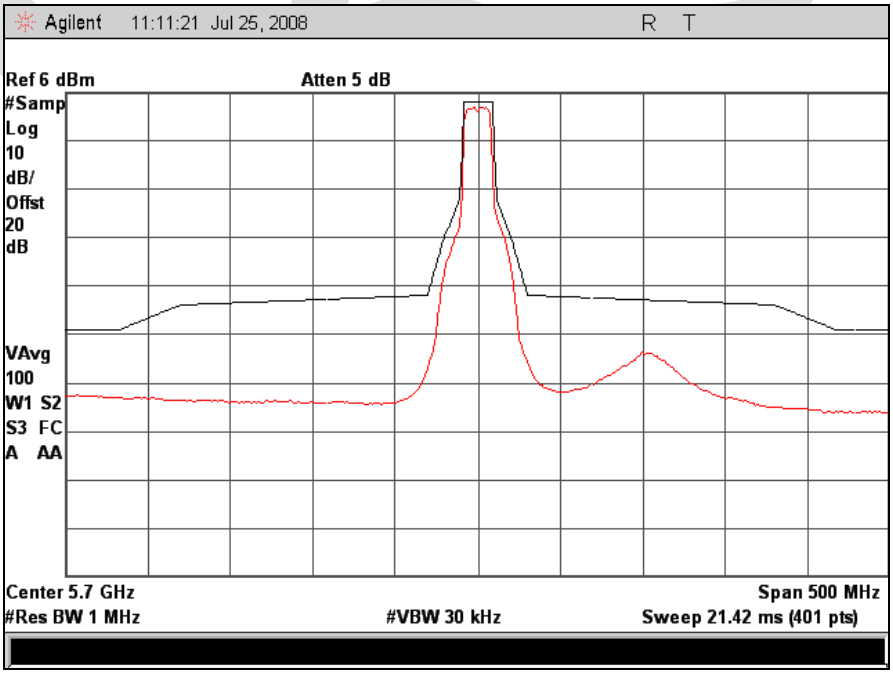


Plot 35. Low channel (5500 MHz) In Band Spurious Emission, 500 MHz Span

Conformance Requirements - Transmitter Unwanted Emissions Within the 5GHz RLAN Bands (Conducted)



Plot 36. High channel (5700 MHz) In Band Spurious Emission, 70 MHz Span



Plot 37. High channel (5700 MHz) In Band Spurious Emission, 500 MHz Span

4.5.2 Transmitter Unwanted Emissions Within the 5GHz RLAN Bands (Radiated)

Test Requirement(s): **EN 301 893, Section 4.5.2:**

4.5.2.1 Definition
These are radiated radio frequency emissions within the 5GHz RLAN bands from the cabinet or structure when the EUT is in receive mode.

4.5.2.2 Limit

Frequency Range	Maximum Power, ERP	Measurement Bandwidth
5.470GHz to 5.725GHz	-47 dBm	1MHz

Test Procedure: The EUT was setup as per section 4.4 above for measuring out of band radiated emissions. The spectrum within the 5GHz RLAN band was investigated for spurious emissions. Measurements were carried out in all modulations available and at f_c of 5150MHz and 5350MHz for the lower Sub-Bands and 5500MHz and 5700MHz for the Higher Sub-band.

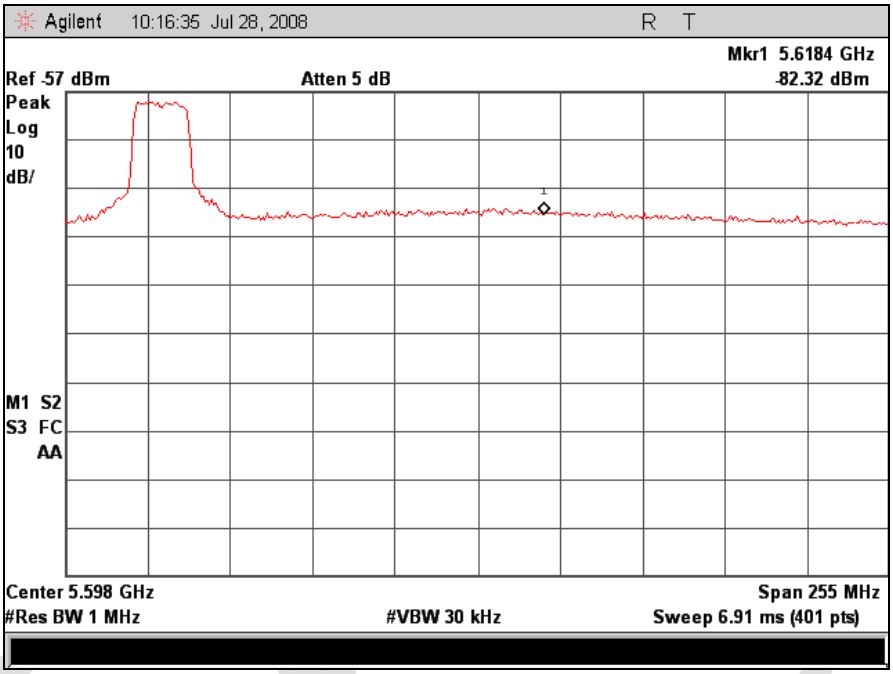
Test Results: The EUT as tested was found compliant with the specified requirements of Clause 5.3.6.

Test Engineer: Anderson Soungpanya

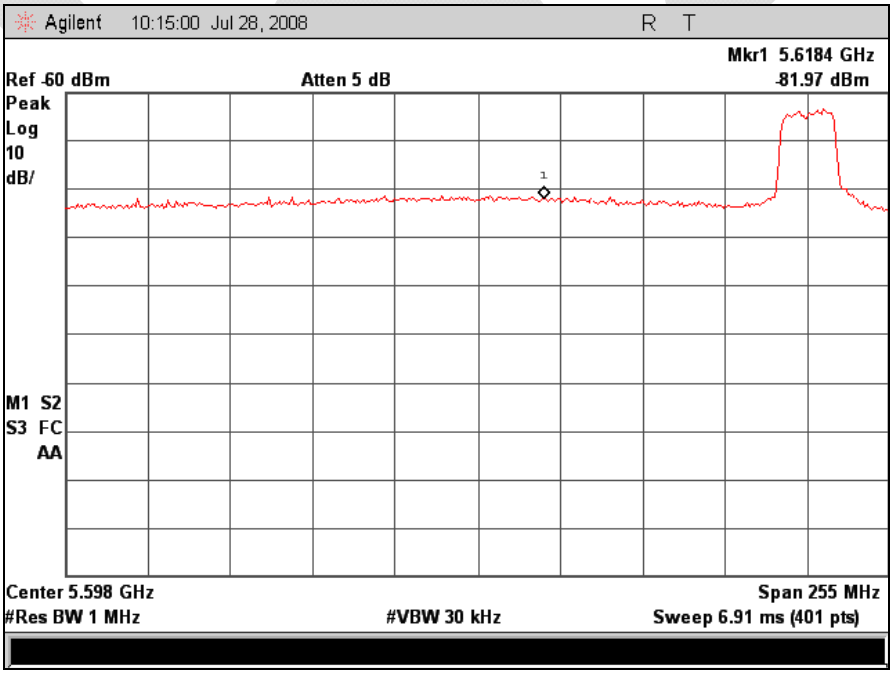
Test Date: July 25, 2008

Conformance Requirements

4.5.2 Transmitter Unwanted Emissions Within the 5GHz RLAN Bands (Radiated)



Plot 38. Low Channel (5500 MHz) In Band Radiated Spurious Emission



Plot 39. High Channel (5700 MHz) In Band Radiated Spurious Emission

Conformance Requirements

4.6 Receiver Spurious Emissions (Conducted)

Test Requirement(s): **EN 301 893V1.4.1, Section 4.6**

4.6.1 Definition

Receiver spurious emissions are emissions at any frequency when the equipment is in received mode.

4.6.2 Limit

The spurious emissions of the receiver shall not exceed the values in table below.

Frequency Range	Maximum Power, ERP	Measurement Bandwidth
30 MHz to 1 GHz	-57 dBm	100KHz
above 1 GHz to 26.5 GHz	-47 dBm	1MHz

Test Procedure: Two EUTs were setup to communicate with each other. A test transmission sequence as shown below was used to send data between the two units. A directional coupler was used to isolate the emission measurements from the test data signal while the EUT received test data. The spectrum analyzer was initially set with a RBW of 1MHz or 100KHz and a VBW of 1MHZ using video averaging or peak hold. The Frequency was scanned from 30MHz to 26.5GHz. Measurements were carried out in all modulations available and at f_c of 5250MHz and 5350MHz for the lower Sub-Bands and 5500MHz and 5700MHz for the Higher Sub-band.

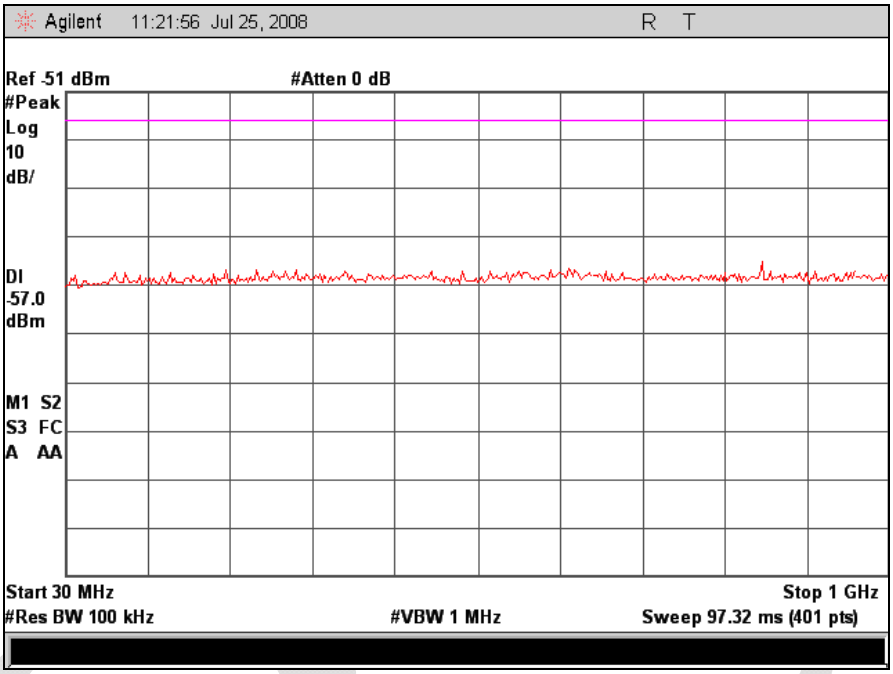
Test Results: The EUT as tested was found compliant with the specified limits of Clause 5.3.7.

Test Engineer: Anderson Soungpanya

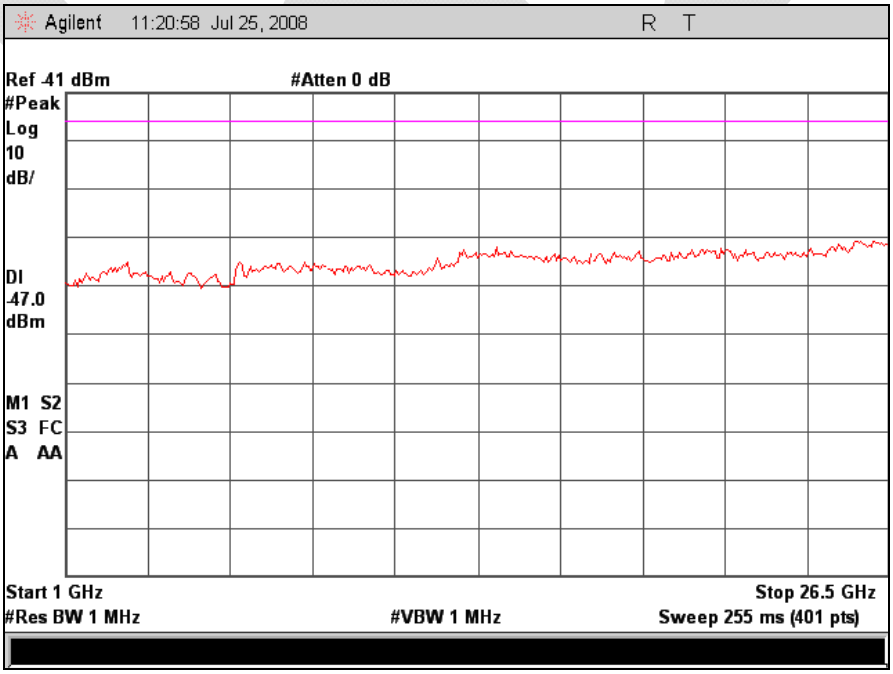
Test Date: July 25, 2008

Conformance Requirements

4.6 Receiver Spurious Emissions (Conducted)



Plot 40. Receiver Spurious Emission 30 MHz - 1GHz



Plot 41. Receiver Mode Spurious Emission 1 GHz - 26.5 GHz

Conformance Requirements

4.6 Receiver Spurious Emissions (Radiated)

Test Requirement(s): **EN 301 893V1.4.1, Section 4.6**

4.6.1 Definition

Receiver spurious emissions are emissions at any frequency when the equipment is in received mode.

4.6.2 Limit

The spurious emissions of the receiver shall not exceed the values in table below.

Frequency Range	Maximum Power, ERP	Measurement Bandwidth
30 MHz to 1 GHz	-57 dBm	100KHz
above 1 GHz to 26.5 GHz	-47 dBm	1MHz

Test Procedure: The EUT was setup as per section 4.4 above for measuring out of band radiated emissions. The EUT was set up to receive data. The spectrum within the 5GHz RLAN band was investigated for spurious emissions.

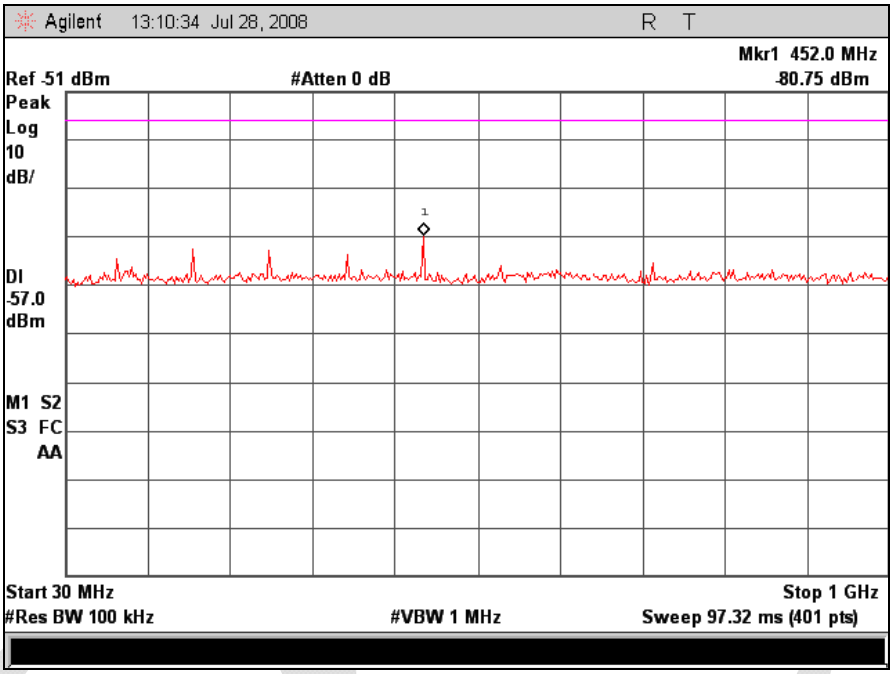
Test Results: The EUT as tested was found compliant with the specified limits of Clause 5.3.7.

Test Engineer: Anderson Soungpanya

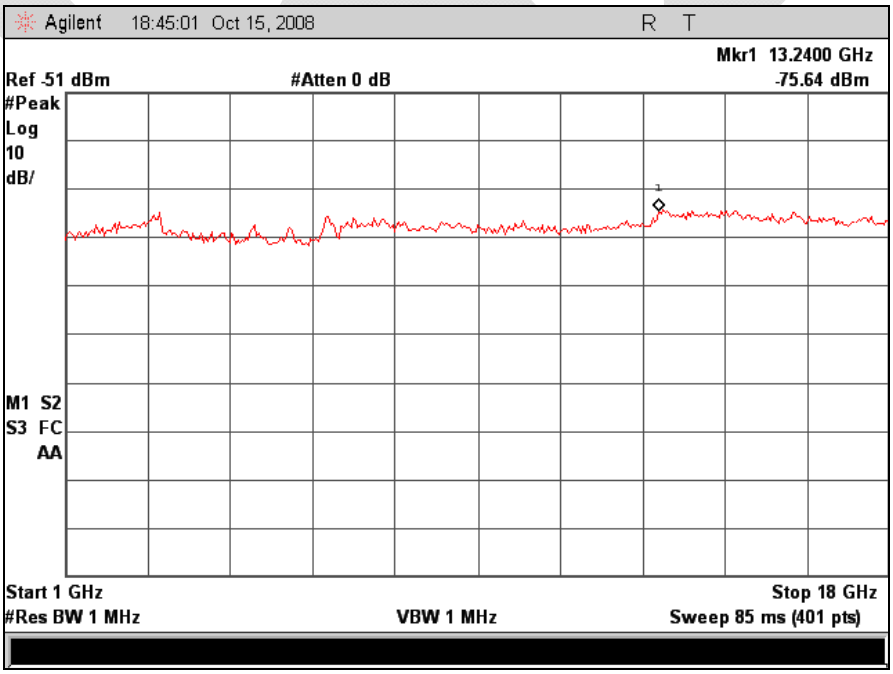
Test Date: July 25, 2008

Conformance Requirements

4.6 Receiver Spurious Emissions (Radiated)

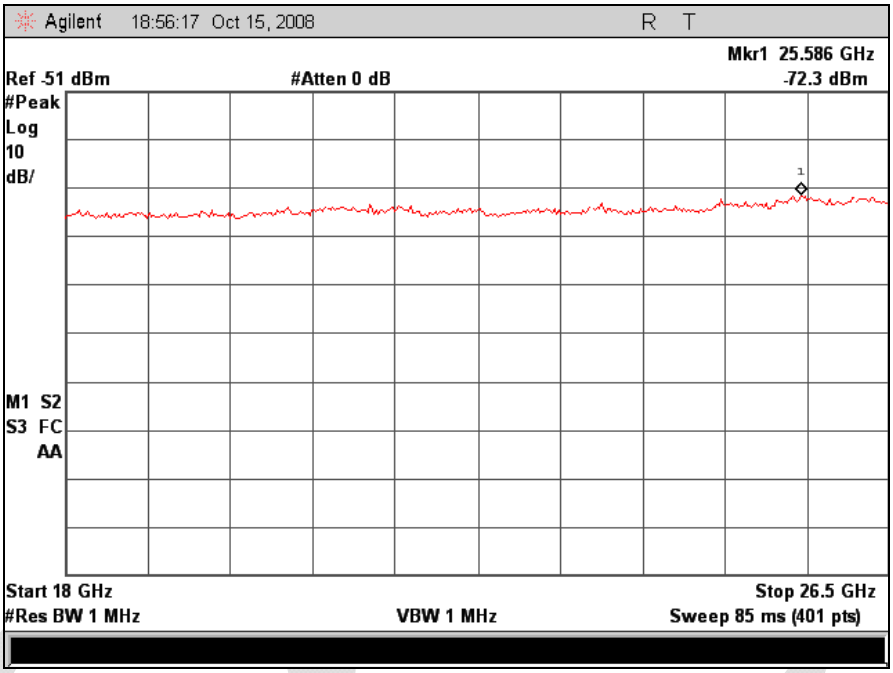


Plot 42. Receiver Spurious Emission 30 MHz - 1GHz



Plot 43. Receiver Mode Spurious Emission 1 GHz - 18 GHz

Conformance Requirements - Receiver Spurious Emissions (Radiated)



Plot 44. Receiver Spurious Emission 18 GHz – 26.5 GHz

Conformance Requirements

4.8 Medium Access Protocol

Test Requirement(s): **EN 301 893V1.4.1, Section 4.8**

4.8.1 Definition

A medium access protocol is a mechanism designed to facilitate spectrum sharing with other devices in the wireless network.

4.8.2 Requirement
A medium access protocol shall be implemented by the equipment and shall be active under all circumstances.

Test Results: The EUT as tested was found compliant with the specified limits.

Test Engineer: Anderson Soungpanya

Test Date: April 8, 2009

Conformance Requirements

4.9 User Access Restrictions

Test Requirement(s): **EN 301 893V1.4.1, Section 4.9**

4.9.1 Definition

User Access Restrictions are restraints implemented in the RLAN to restrict access for the user to certain hardware and/or software settings of the equipment.

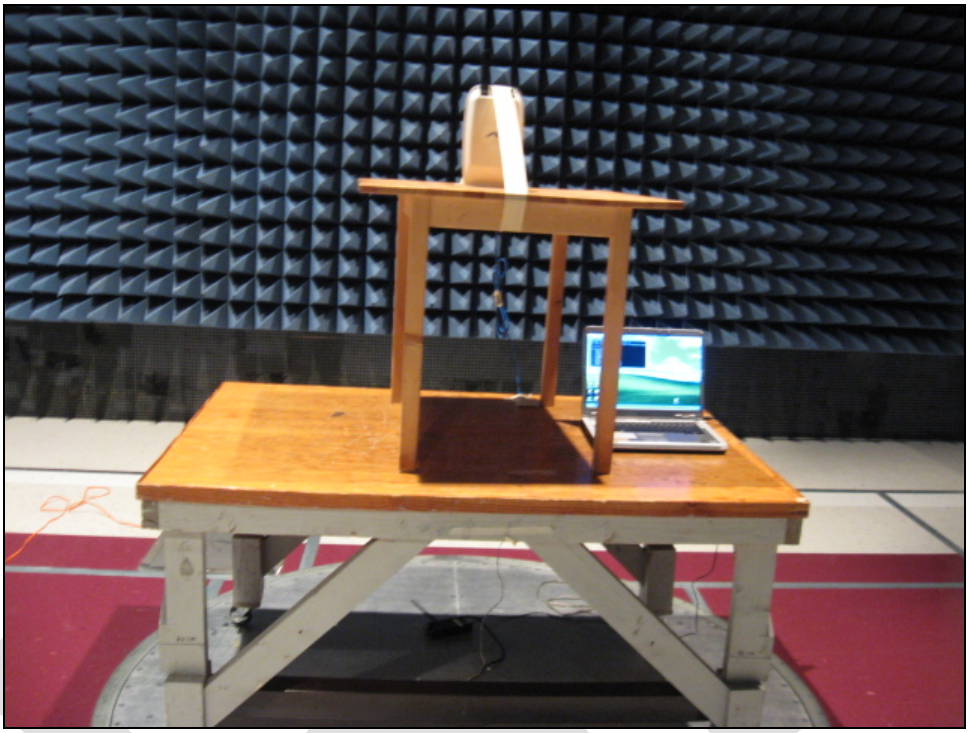
4.9.2 Requirement
DFS controls (hardware or software) related to radar detection shall not be accessible to the user so that the DFS requirements described in clauses 4.7.2.1 to 4.7.2.4 can neither be disabled nor altered.

Test Results: The EUT as tested was found compliant with the specified limits.

Test Engineer: Anderson Soungpanya

Test Date: April 8, 2009

Test Setup Photograph



Photograph 3. Radiated Test Setup

IV. DFS Requirements

4.7 Dynamic Frequency Selection (DFS)

4.7.1 Introduction

An RLAN shall employ a Dynamic Frequency Selection (DFS) function to:

- detect interference from other systems and to avoid co-channel operation with these systems, notably radar systems (radar detection);
- provide on aggregate a uniform loading of the spectrum across all devices.

Radar detection is required when operating on channels whose nominal bandwidth falls partly or completely within the frequency ranges 5 250 MHz to 5 350 MHz or 5 470 MHz to 5 725 MHz. This requirement applies to all types of RLAN devices and to any type of communication between these devices.

In addition, equipment transmitting in the band 5600 - 5650MHz must also be able to detect meteorological radars employing non-constant pulse interval times. These are often referred to as staggered or interleaved PRFs (Pulse Repetition Frequencies) by which up to 3 different PRF values are used. The staggered PRF radar bins from 301 893 v 1.5.1 were used to demonstrate compliance.

The DFS function as described in the present document is not tested for its ability to detect frequency hopping radar signals.

4.7.1.1 DFS operational modes

Within the context of the operation of the DFS function, an RLAN device shall operate in either master mode or slave mode. RLAN devices operating in slave mode (slave device) shall only operate in a network controlled by a RLAN device operating in master mode (master device).

Some RLAN devices are capable of communicating in ad-hoc manner without being attached to a network. Devices operating in this manner on channels whose nominal bandwidth falls partly or completely within the range 5 250 MHz to 5 350 MHz or 5 470 MHz to 5 725 MHz shall employ DFS and should be tested against the requirements applicable to a master.

4.7.1.2 DFS operation

The operational behaviour and individual DFS requirements that are associated with master and slave devices are as follows:

Master devices:

a)The master device shall use a Radar Interference Detection function in order to detect radar signals. b) Before initiating a network on a channel, which has not been identified as an Available Channel, the master device shall perform a Channel Availability Check to ensure that there is no radar operating on the channel. c) During normal operation, the master device shall monitor the Operating Channel (In-Service Monitoring) to ensure that there is no radar operating on the channel. d) If the master device has detected a radar signal during In-Service Monitoring, the Operating Channel is made unavailable. The master device shall instruct all its associated slave devices to stop transmitting on this (to become unavailable) channel. e) The master device shall not resume any transmissions on this Unavailable Channel during a period of time after a radar signal was detected. This period is referred as the Non-Occupancy Period.

Slave devices:

f) A slave device shall not transmit before receiving an appropriate enabling signal from a master device. g) A slave device shall stop all its transmissions whenever instructed by a master device to which it is associated. The device shall not resume any transmissions until it has again received an appropriate enabling signal from a master device. h) A slave device which is required to perform radar detection (see table D.3), shall stop its own transmissions if it has detected a radar. The Operating Channel is made unavailable for the slave device. It shall not resume any transmissions on this Unavailable Channel for a period of time equal to the Non-Occupancy Period.

See Table 13 for the applicability of DFS requirements for each of the above mentioned operational modes. The master device may implement the Radar Interference Detection function referred to under a) using another device associated with the master. In such a case, the combination shall be tested against the requirements applicable to the master. The maximum power level of a slave device will define whether or not the device needs to have a Radar Interference Detection function. (see table D.3)

4.7.2 DFS technical requirements specifications

Table 13 lists the DFS related technical requirements and their applicability for each of the operational modes described in clause 4.7.1. If the RLAN device is capable of operating in more than one operational mode described in clause 4.7.1 then each operating mode shall be assessed separately.

Requirement	DFS Operational mode		
	Master	Slave without radar detection	Slave with radar detection
Channel Availability Check	√	Not required	Not required
In-Service Monitoring	√	Not required	√
Channel Shutdown	√	√	√
Non-Occupancy Period	√	Not required	√
Uniform Spreading	√	Not required	Not required

Table 13. Applicability of DFS requirements

DFS Detection Thresholds

Interference Threshold values, Master or Client incorporating In-Service Monitoring

Maximum Transmit Power	Value
≥ 200 milliwatt	-64 dBm
< 200 milliwatt	-62 dBm
Note 1: This is the level at the input of the receiver assuming a 0 dBi receive antenna **Note 2:** Throughout these test procedures an additional 1 dB has been added to the amplitude of the test transmission waveforms to account for variations in measurement equipment. This will ensure that the test signal is at or above the detection threshold level to trigger a DFS response.	

DFS Response requirement values

Parameter	Value
Non-occupancy period	Minimum 30 minutes
Channel Availability Check Time	60 seconds
Channel Move Time	10 seconds See Note 1
Channel Closing Transmission Time	200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period. See Notes 1 and 2

Required Radar Test Waveforms

Radar Test Signal	Pulse Width W µs	Pulse Repetition Frequency	Pulses Per Burst	Detection probability with 30% channel load
1- Fixed	1	750	15	$P_d > 60\%$
2- Variable	1, 2, 5	200, 300, 500, 800, 1000	10	$P_d > 60\%$
3- Variable	10, 15	200, 300, 500, 800, 1000	15	$P_d > 60\%$
4- Variable	1, 2, 5, 10, 15	1200, 1500, 1600	15	$P_d > 60\%$
5- Variable	1, 2, 5, 10, 15	2300, 3000, 3500, 4000	25	$P_d > 60\%$
6- Variable Modulated see note	20,30	2000, 3000, 4000	20	$P_d > 60\%$

NOTE: The modulation to be used for the radar test signal 6 is a chirp modulation with a ±2,5MHz frequency deviation which is described below.

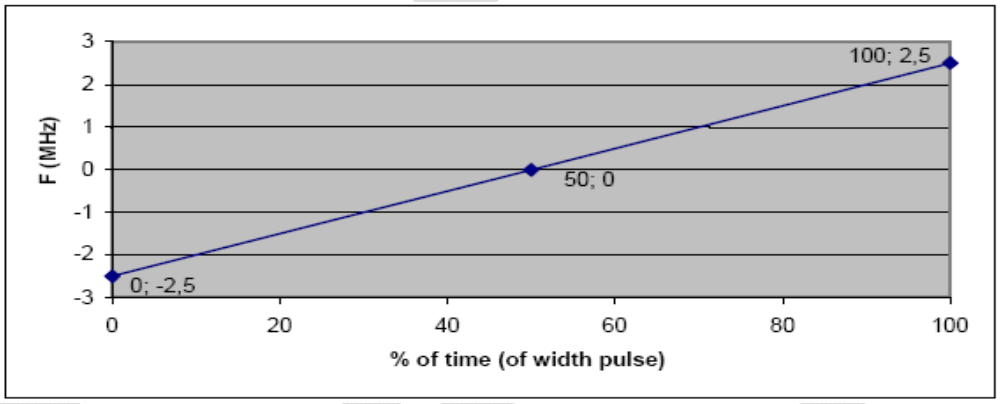
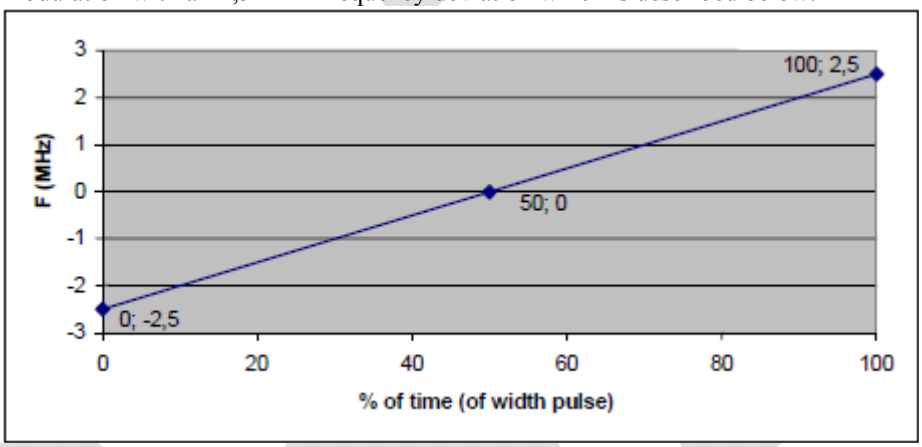


Table 14. EN 301 893 1.4.1 Radar Test Waveforms

Radar Test Signal (See Notes 1 to 3	Pulse Width W µs		Pulse Repetition Frequency PRF (PPS)		Number of different PRFs	Pulses per burst for each PRF (PPB) (see note 5)
	Min	Max	Min	Max		
1	0,8	5	200	1000	1	10 (See note 6)
2	0,8	15	200	1600	1	15 (See note 6)
3	0,8	15	2300	4000	1	25
4	20	30	2000	4000	1	20
5	0,8	2	300	400	2/3	10 (See note 6)
6	0,8	2	400	1200	2/3	15 (See note 6)

NOTE 1: Radar test signals 1 to 4 are constant PRF based signals. These radar test signals are intended to simulate also radars using a packet based Staggered PRF.

NOTE 2: Radar test signal 4 is a modulated radar test signal. The modulation to be used is a chirp modulation with a ±2,5 MHz frequency deviation which is described below.



NOTE 3: Radar test signals 5 and 6 are single pulse based Staggered PRF radar test signals using 2 or 3 different PRF values. For radar test signal 5, the difference between the PRF values chosen shall be between 20 pps and 50 pps. For radar test signal 6, the difference between the PRF values chosen shall be between 80 pps and 400 pps.

NOTE 4: Apart for the Off-Channel CAC testing, the radar test signals above shall only contain a single burst of pulses. For the Off-Channel CAC testing, repetitive bursts shall be used for the total duration of the test. See figures D.2 and D.5. See also clause 4.7.2.2.

NOTE 5: The total number of pulses in a burst is equal to the number of pulses for a single PRF multiplied by the number of different PRFs used.

NOTE 6: For the CAC and Off-Channel CAC requirements, the minimum number of pulses (for each PRF) for any of the radar test signals to be detected in the band 5 600 MHz to 5 650 MHz shall be 18.

Table 15. EN 301 893 1.5.1 Radar Test Waveforms

Radar Waveform Calibration

The following equipment setup was used to calibrate the conducted Radar Waveform See Figure 3. A spectrum analyzer was used to establish the test signal level for each radar type. During this process there were no transmissions by either the Master or Client Device. The spectrum analyzer was switched to the zero span (Time Domain) mode at the frequency of the Radar Waveform generator. Peak detection was utilized. The spectrum analyzer's resolution bandwidth (RBW) was set to 1MHz and the video bandwidth (VBW) was set to MHz. A 30dB preamplifier was used in during the calibration procedure

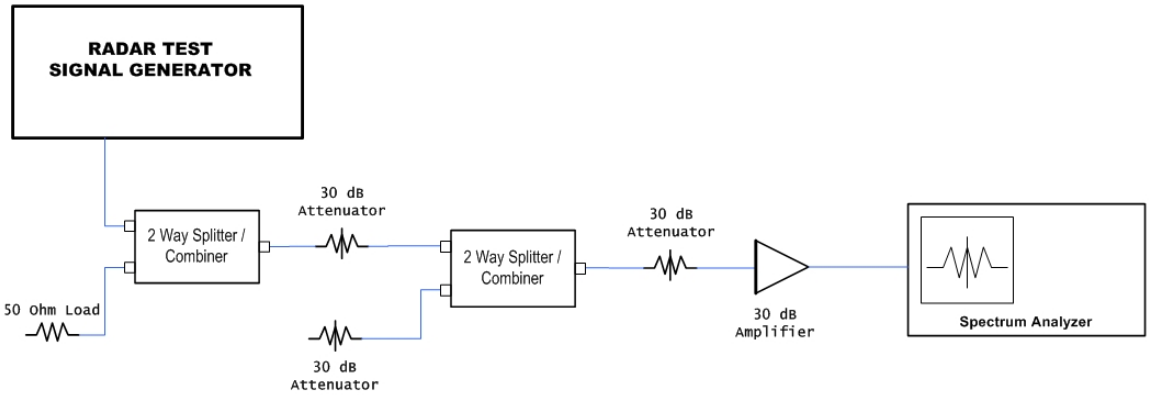
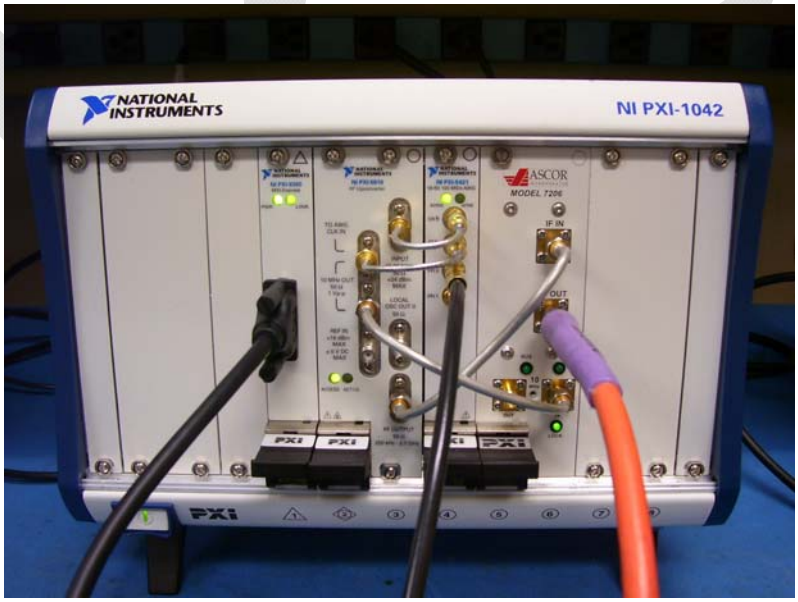
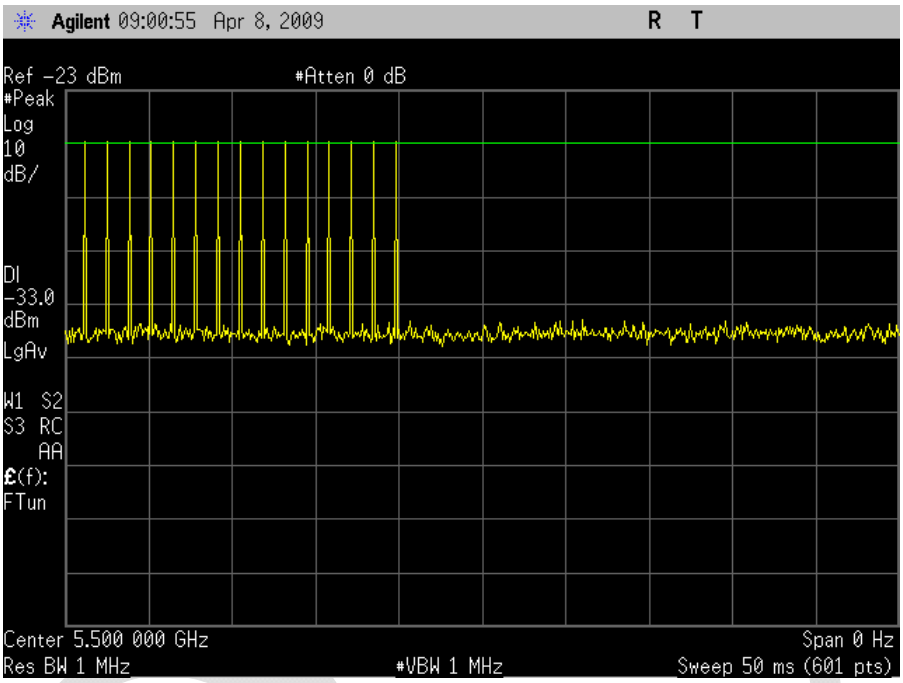


Figure 3. Radar Waveform Calibration Setup

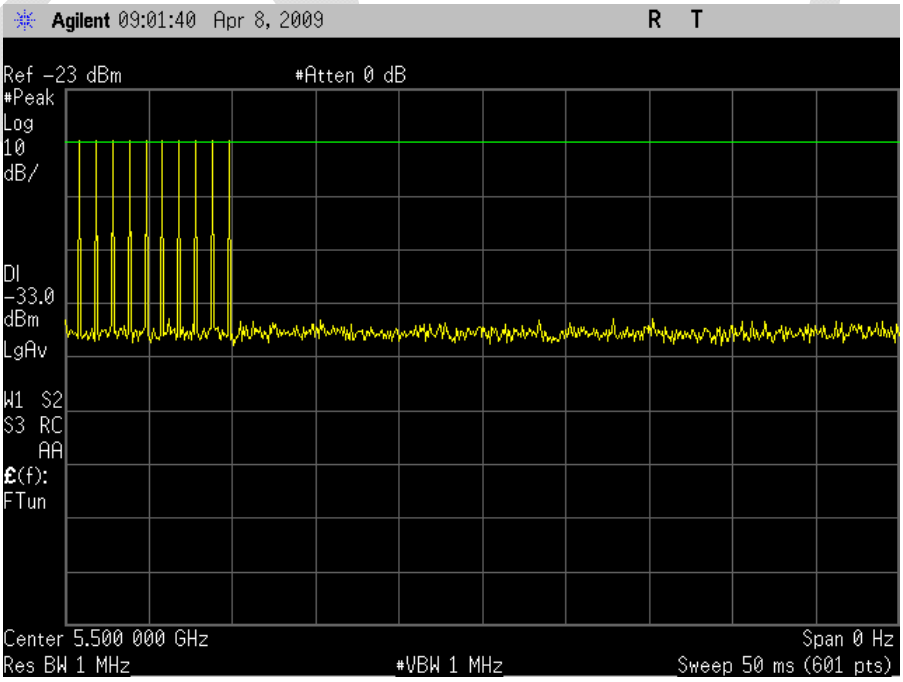


Photograph 4. Radar Test Signal Generator

Radar Calibration, 5500MHz

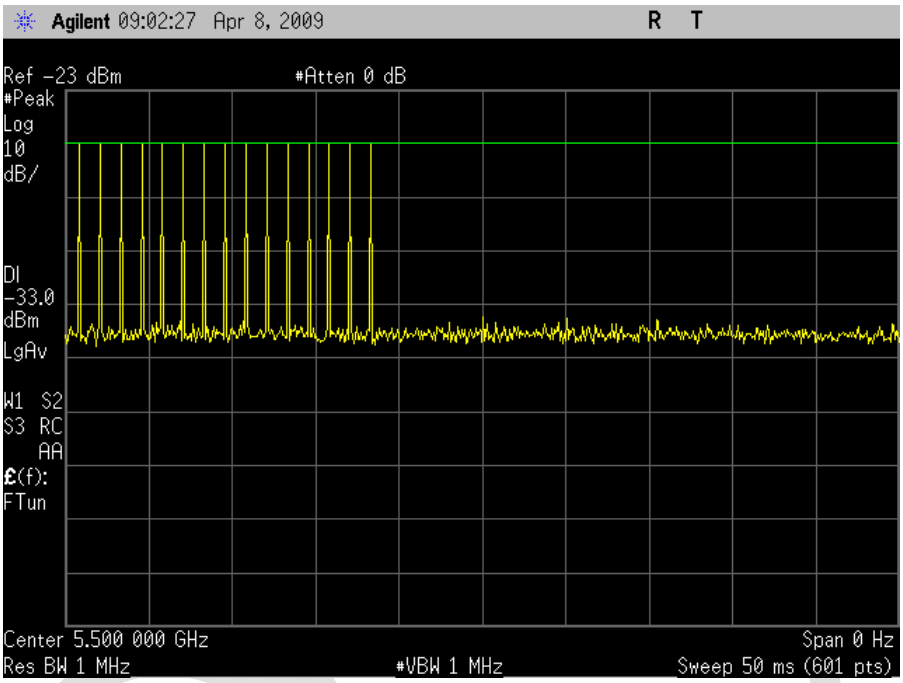


Plot 45. Bin 1 radar calibration

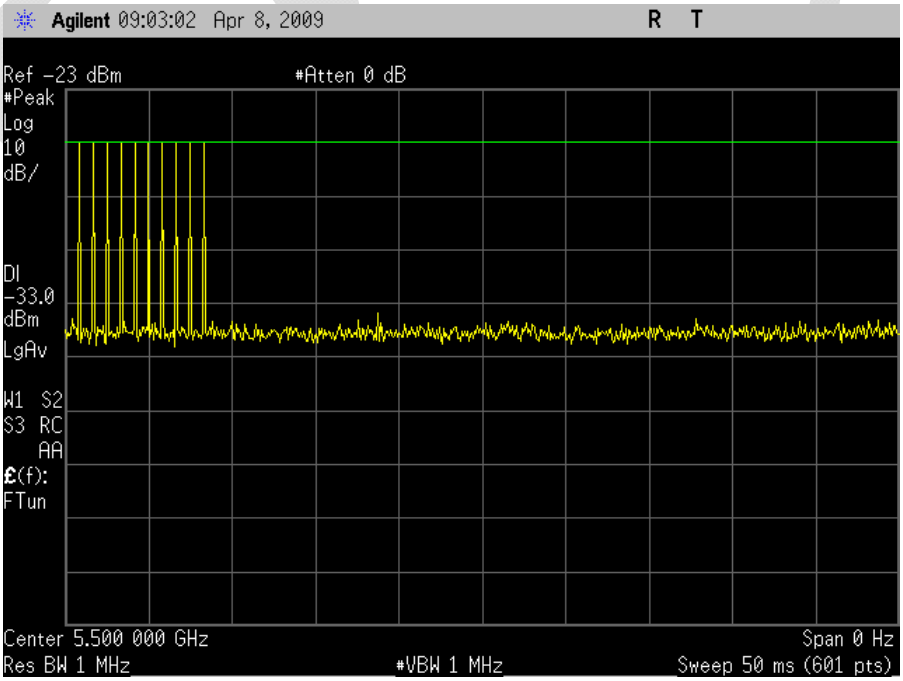


Plot 46. Bin 2 radar calibration

Radar Calibration, 5500MHz

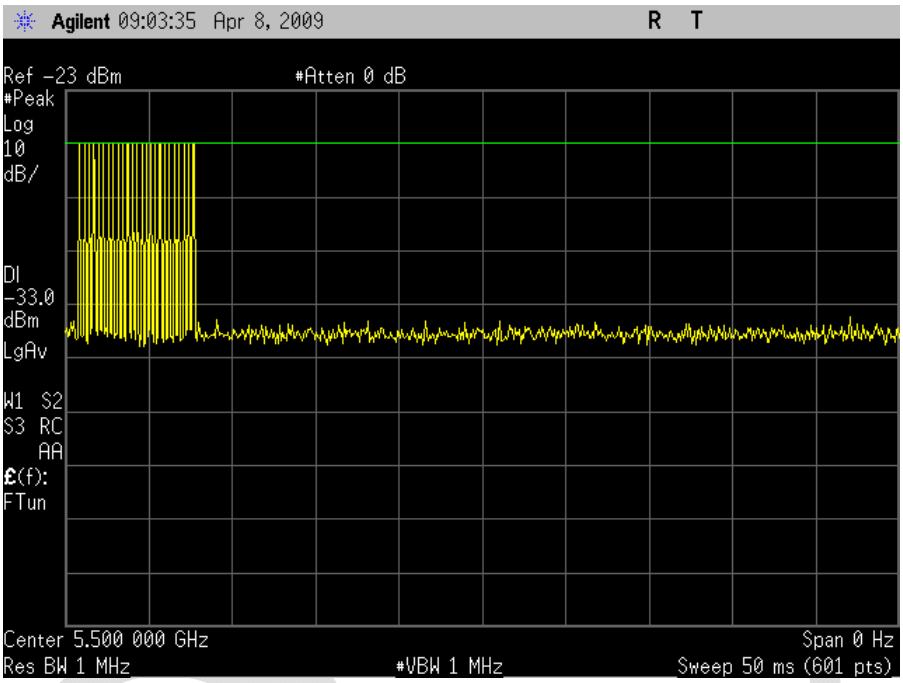


Plot 47. Bin 3 radar calibration

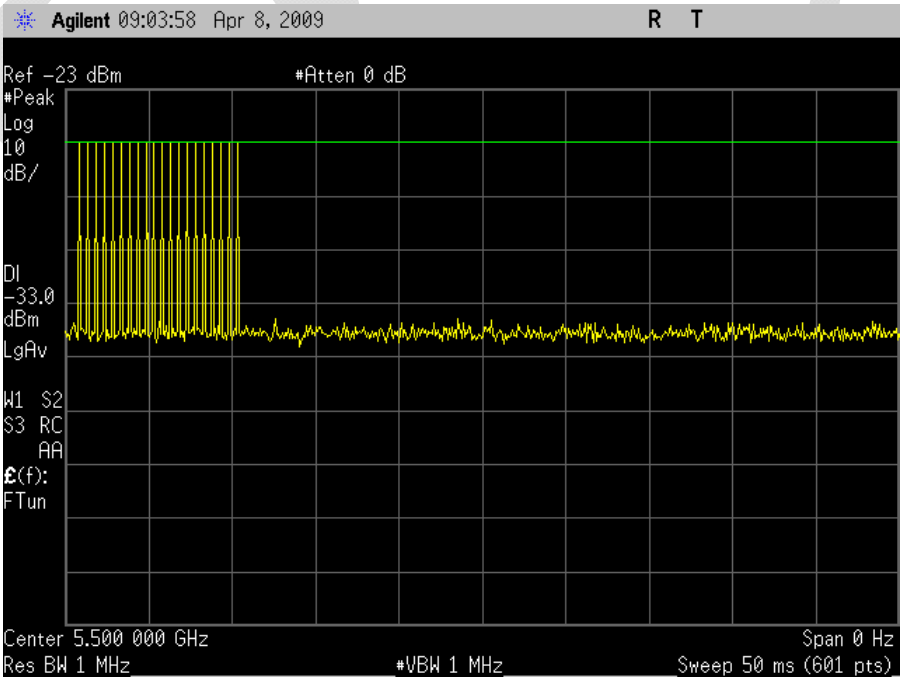


Plot 48. Bin 4 radar calibration

Radar Calibration, 5500MHz

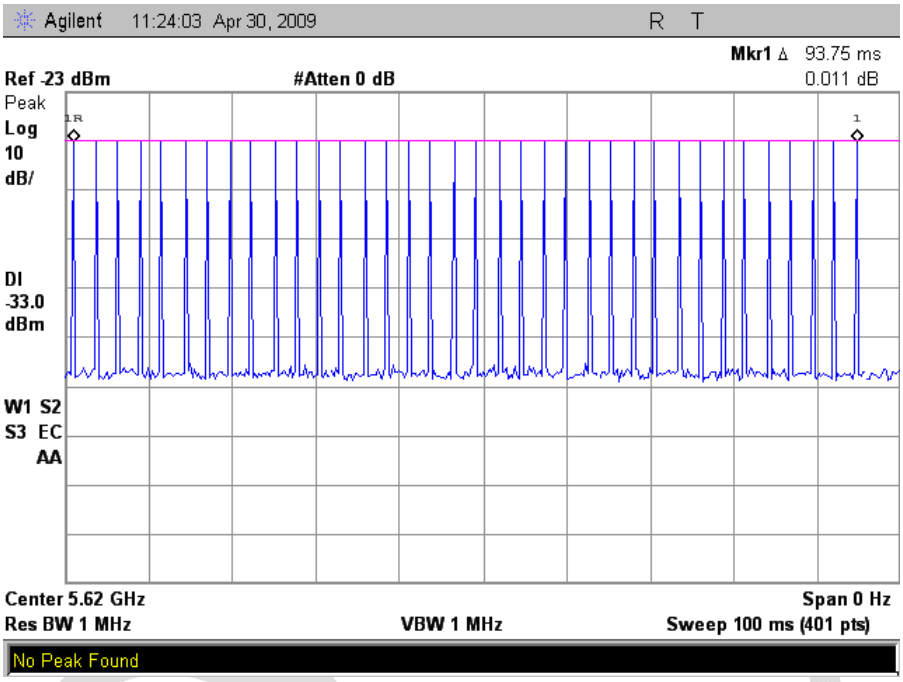


Plot 49. Bin 5 radar calibration, EN 301 893 1.4.1 Version

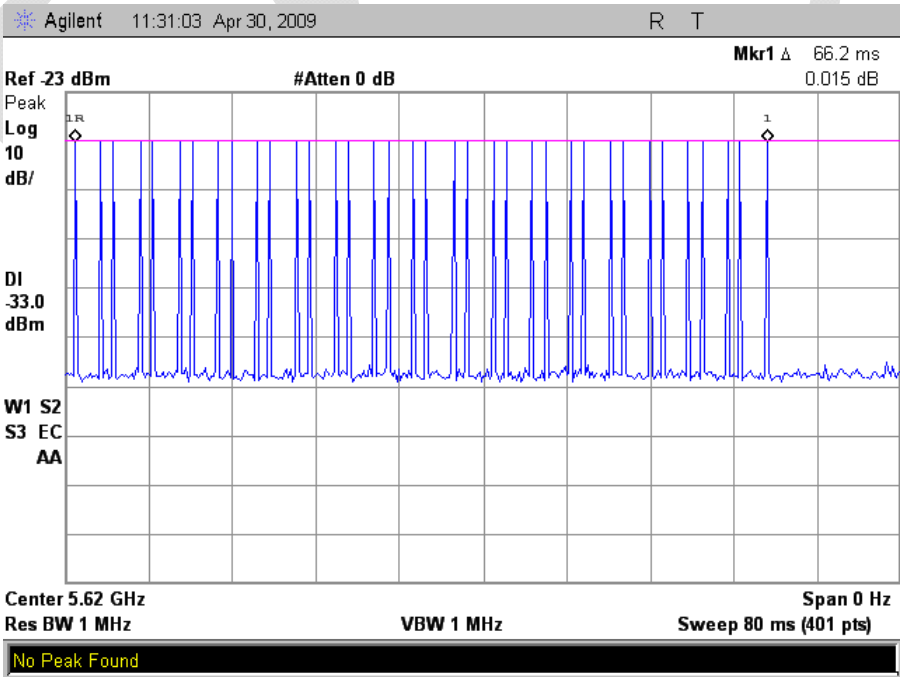


Plot 50. Bin 6 radar calibration, EN 301 893 1.4.1 Version

Radar Calibration, 5500MHz



Plot 51. Bin 5 radar calibration, EN 301 893 1.5.1 Version



Plot 52. Bin 6 radar calibration, EN 301 893 1.5.1 Version

Test Setup for EUT

1. A spectrum analyzer is used as a monitor to verify that the UUT has vacated the Channel within the (Channel Closing Transmission Time and Channel Move Time, and does not transmit on a Channel during the Non-Occupancy Period after the detection and Channel move. It is also used to monitor UUT transmissions during the Channel Availability Check Time.
2. Figure shows the test setup used for injection of radar waveforms in to a master device.

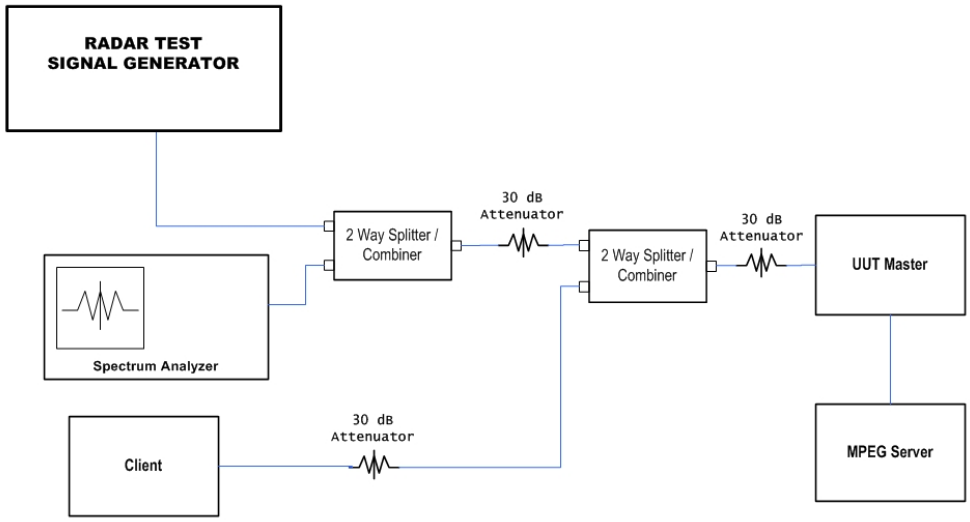
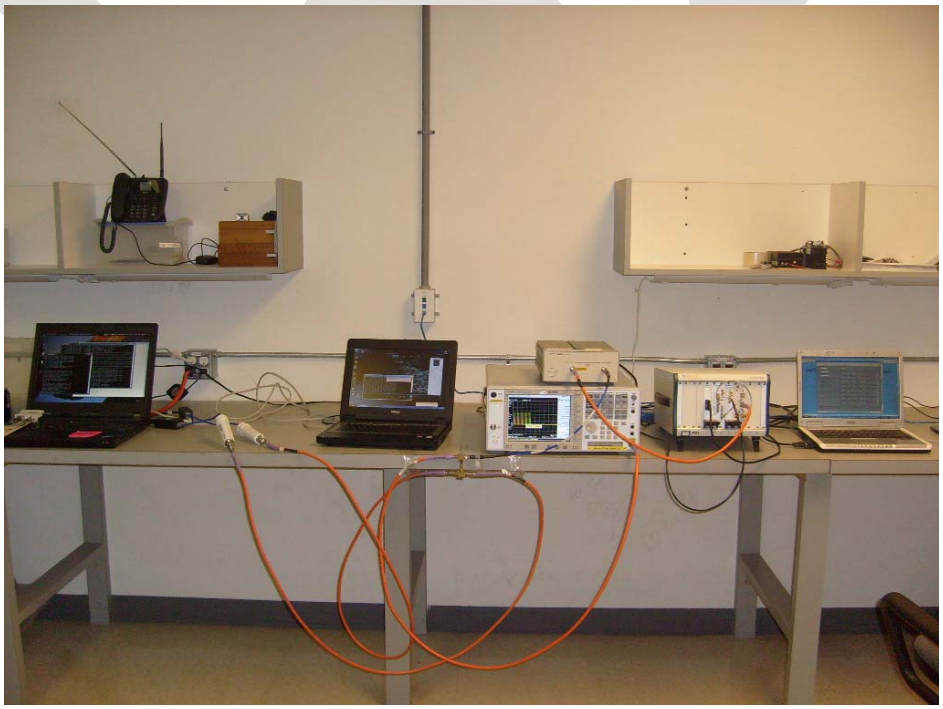


Figure 2. Test Setup for Master Device



Photograph 5. EUT Test Setup Photograph

Channel Availability Check

Test Requirement(s): **ETSI EN 301 893 V1.4.1, Section 4.7.2.1, Clause 5.3.8**

Definition: **4.7.2.1.1**
The Channel Availability Check is defined as the mechanism by which an RLAN device checks a channel for the presence of radar signals.

Limit(s): **4.7.2.1.2**

Parameter	Value
Channel Availability Check Time (CACT)	60s

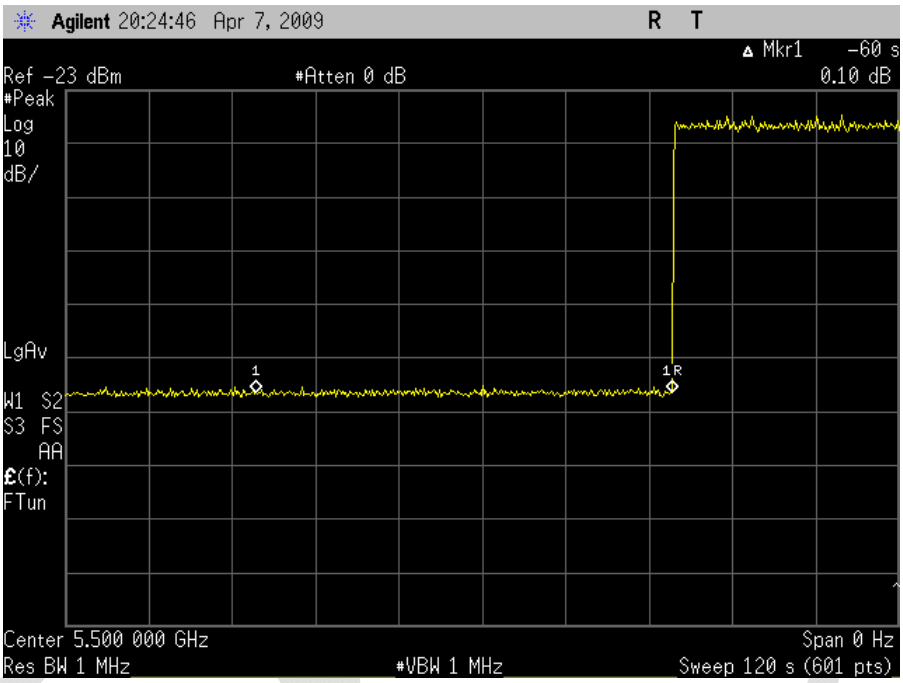
Test Procedure: The EUT was connected as in Figure #2. The measurement was performed using normal operation of the equipment. The EUT was switched on at time T_o. Once the EUT has completed its power up routine, that time is marked as T_1. A simulated radar burst consisting of 15 pulses, 1µs in width, at a pulse repetition frequency of 750, and at a conducted level 10dB greater than conducted power + antenna gain of the EUT, was injected into the master within 2 seconds after time T_1. This test was repeated with the injection of the simulated radar signal at the end of the Channel Availability Check time less 2 seconds.

Test Results: The master EUT did detect the presence of the Radar Signals at the beginning and end of the CACT and did not establish communication with a client at the end of the CACT and is therefore compliant with the specified requirements.

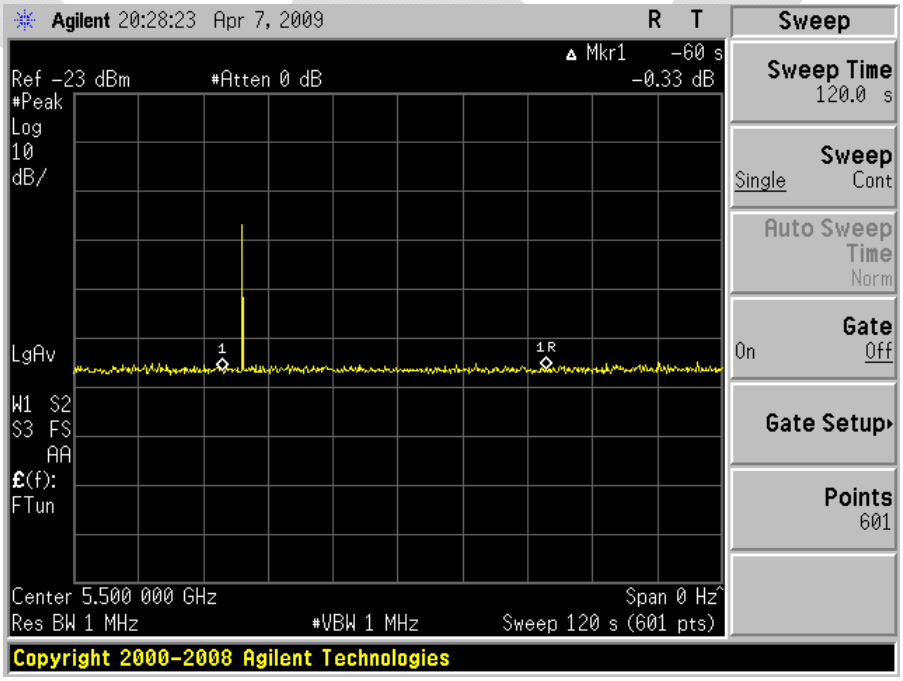
Test Engineer: Anderson Soungpanya

Test Date: April 8, 2009

Conformance Requirements – CACT

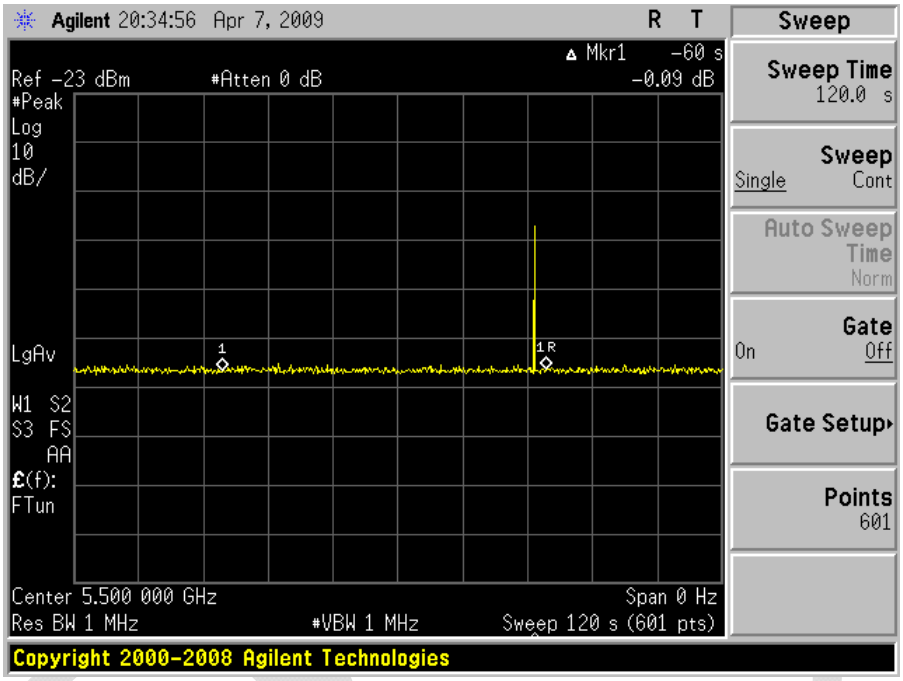


Plot 53. Channel Availability Check Time (CACT), 5500MHz



Plot 54. Burst at beginning of CACT, 5500MHz

Conformance Requirements – CACT



Plot 55. Burst at end of CACT, 5500MHz

4.7.2.1 Radar Detection Threshold During the Channel Availability Check Time

Test Requirement(s): **ETSI EN 301 893 V1.4.1, Section 4.7.2.1, Clause 5.3.8**

Definition:

4.7.2.1.1
The Interference Detection Threshold is the probability of the Master EUT to detect Radar Bursts during the Channel Availability Check time. For channels outside the band 5600-5650 MHz Bin 1 of 301 893 v.1.4.1 are used. Where the declared channel plan includes channels whose nominal bandwidth falls completely or partly within the 5 600-5 650 MHz band staggered PRF bins from 301 893 v1.5.1 are used.

Test Procedure:

4.7.2.1.2
The EUT was connected as in Figure #2. A channel outside the band 5600-5650 MHz was selected. The measurement was performed using normal operation of the equipment. The EUT was switched on at time T_o. Once the EUT has completed it's powered up routine, that time is marked as T_1. A simulated radar burst consisting of 15 pulses, 1µs in width, at a pulse repetition frequency of 750, and at a conducted level indicated above + the antenna gain of the EUT, was injected into the master at approximately 10 seconds after time T_1. This procedure was repeated 20 times in order to determine the detection probability for each selected radar test signal in the table below.

A channel within the band 5600-5650 MHz was selected from the declared channel plan and the above procedure was carried out using the staggered PRF bins from 301 893 v1.5.1

Test Results: The master EUT did detect the presence of the Radar Signals during the CACT within the allowable limits and is therefore compliant with the specified requirements.

Test Engineer: Anderson Soungpanya

Test Date: April 8, 2009

Test Results:

EUT Frequency - 5500 MHz using Bin # 1			
DFS Detection Trials (1 = Detection, 0 = No Detection)			
Trial	**Detection**	**Trial**	**Detection**
1	1	11	1
2	1	12	1
3	1	13	1
4	1	14	1
5	0	15	1
6	1	16	1
7	0	17	1
8	0	18	1
9	0	19	1
10	1	20	1
Detection Probability			80%

Table 16. Interference Detection Threshold Bin 1 Results, 5500MHz

Radar Type	Trial	Pulse Width (usec)	PRF (pps)	PRF (pps)	PRF (pps)	Detection 1 = Yes, 0 = No
5	1	0.8	300	350	400	1
	2	0.8	350	400		1
	3	0.8	330	350	380	1
	4	0.8	330	380	400	1
	5	1.0	315	350	385	1
	6	0.8	320	340		1
	7	2.0	315	350		1
	8	1.0	300	350	400	1
	9	1.0	300	335	370	1
	10	2.0	330	365	400	1
	11	2.0	330	350		1
	12	1.0	360	380		1
	13	1.0	320	340		1
	14	1.0	330	350	400	1
	15	1.0	315	350		1
	16	0.8	300	350	370	1
	17	0.8	330	350	400	1
	18	2.0	300	350	400	1
	19	0.8	330	365	400	1
	20	2.0	350	380		1
				Detection Probability		**100%**

Table 17. Interference Detection Threshold using staggered PRF 5620MHz

4.7.2.2 In-Service Monitoring

Test Requirement(s): **ETSI EN 301 893 V1.4.1, Section 4.7.2.2, Clause 5.3.8**

Definition: **4.7.2.2.1**
The *In-Service Monitoring* is defined as the process by which an RLAN monitors the *Operating Channel* for the presence of radar signals.

Limit(s): **4.7.2.2.2**

Maximum Transmit Power (EIRP)	Antenna Gain	Value
≥ 200mW	0dBi	-64 dBm
< 200mW	0dBi	N/A

Test Procedure: The EUT was setup as in Figure #2. The measurement was performed using normal operation of the equipment. Simulated radar bursts from bins 1-6 were injected into the master during the In-service operation. This procedure was repeated 20 times in order to determine the detection probability for each selected radar test signal in the table below.

Test Results: The master EUT did detect the presence of the Radar Signals during in-service monitoring to within the allowable limits and is therefore compliant with the specified requirements.

Test Engineer: Anderson Soungpanya

Test Date: April 8, 2009

Conformance Requirements – In Service Monitoring

EUT Frequency - 5500 MHz using Bin # 1			
DFS Detection Trials (1 = Detection, 0 = No Detection)			
Trial	**Detection**	**Trial**	**Detection**
1	1	11	1
2	1	12	1
3	1	13	1
4	1	14	1
5	1	15	1
6	1	16	1
7	1	17	1
8	1	18	1
9	1	19	1
10	1	20	1
Detection Probability			100%

Table 18. In Service Monitoring Bin 1 Results, 5500 MHz

EUT Frequency - 5500 MHz using Bin # 2			
DFS Detection Trials (1 = Detection, 0 = No Detection)			
Trial	**Detection**	**Trial**	**Detection**
1	1	11	1
2	1	12	1
3	1	13	1
4	0	14	1
5	1	15	1
6	1	16	0
7	0	17	0
8	1	18	1
9	1	19	0
10	1	20	0
Detection Probability			70%

Table 19. In Service Monitoring Bin 2 Results, 5500 MHz

Conformance Requirements – In Service Monitoring

EUT Frequency - 5500 MHz using Bin # 3			
DFS Detection Trials (1 = Detection, 0 = No Detection)			
Trial	**Detection**	**Trial**	**Detection**
1	1	11	1
2	1	12	1
3	1	13	1
4	1	14	1
5	1	15	1
6	1	16	1
7	1	17	1
8	1	18	1
9	1	19	1
10	1	20	1
Detection Probability			100%

Table 20. In Service Monitoring Bin 3 Results, 5500 MHz

EUT Frequency - 5500 MHz using Bin # 4			
DFS Detection Trials (1 = Detection, 0 = No Detection)			
Trial	**Detection**	**Trial**	**Detection**
1	1	11	1
2	1	12	1
3	1	13	0
4	1	14	1
5	1	15	1
6	1	16	1
7	1	17	1
8	1	18	1
9	1	19	0
10	1	20	1
Detection Probability			90%

Table 21. In Service Monitoring Bin 4 Results, 5500 MHz

Conformance Requirements – In Service Monitoring

EUT Frequency - 5500 MHz using Bin # 5			
DFS Detection Trials (1 = Detection, 0 = No Detection)			
Trial	**Detection**	**Trial**	**Detection**
1	1	11	1
2	0	12	0
3	1	13	1
4	1	14	1
5	1	15	1
6	0	16	0
7	1	17	0
8	1	18	1
9	0	19	0
10	1	20	1
Detection Probability			65%

Table 22. In Service Monitoring Bin 5 Results, 5500 MHz

EUT Frequency - 5500 MHz using Bin # 6			
DFS Detection Trials (1 = Detection, 0 = No Detection)			
Trial	**Detection**	**Trial**	**Detection**
1	1	11	1
2	1	12	1
3	1	13	1
4	1	14	1
5	1	15	1
6	1	16	1
7	1	17	1
8	1	18	1
9	1	19	0
10	1	20	1
Detection Probability			100%

Table 23. In Service Monitoring Bin 6 Results, 5500 MHz

4.7.2.3 Channel Shutdown and 4.7.2.4 Non-Occupancy Period

Test Requirement(s): **ETSI EN 301 893 V1.4.1, Sections 4.7.2.3 & 4.7.2.4, Clause 5.3.8**

Definition:

4.7.2.3.1
The *Channel Shutdown* is defined as the process initiated by the RLAN device immediately after a radar signal has been detected on an *Operating Channel*.

4.7.2.4.1
The *Non-Occupancy Period* is defined as the time during which the RLAN device shall not make any transmissions on a channel after a radar signal was detected on that channel by either the *Channel Availability Check* or the *In-Service Monitoring*.

Limit(s): **4.7.2.3.2 & 4.7.2.4.2**

Parameter	Limit
Channel Move Time	10s
Channel Closing Transmission Time	260ms
Non-Occupancy Period	30min

Test Procedure: The EUT was connected as in Figure #2. The channel selection mechanism for the Uniform Spreading requirement is disabled on the master .

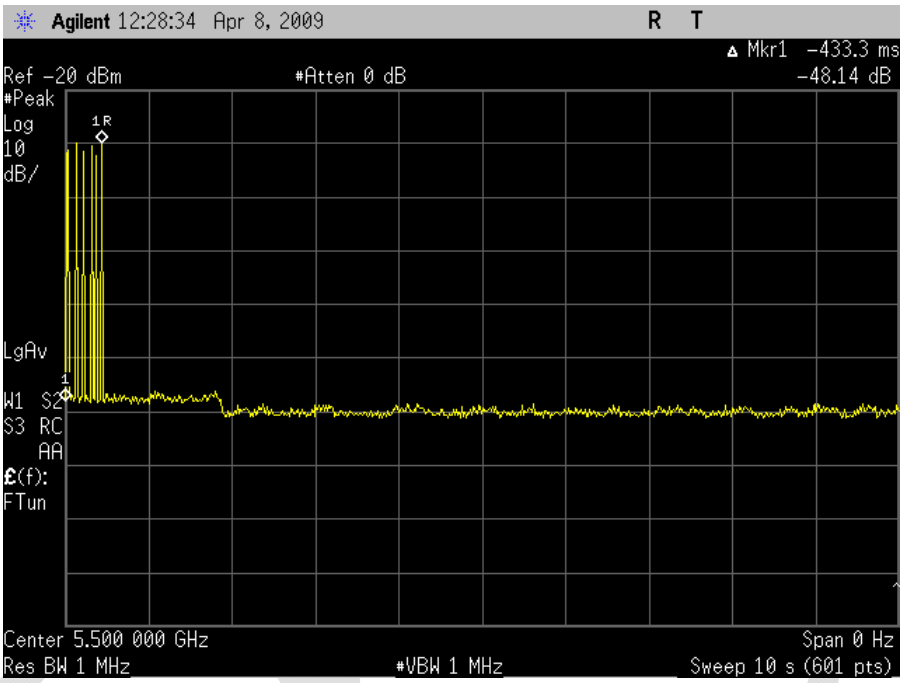
The measurement was performed using normal operation of the equipment. A simulated radar burst consisting of 15 pulses, 1µs in width, at a pulse repetition frequency of 750, and at a level above 10dB above the level of the EUT, was injected into the EUT at time T_o. The time $T_1 - T_o$ was recorded as the duration of the radar burst. At the end of time T_1 the EUT was monitored for a period ≥ 10s and the aggregate duration of all transmissions from the EUT were recorded. The difference between T_2, indicating the EUT had ceased all transmission, and T_1 was recorded. If the EUT was a Master then the selected channel was observed for a period of 30min to insure no transmissions reoccurred on that channel.

Test Results: The master EUT did detect the presence of the Radar Signal and did close the channel in the appropriate time allowed. The channel close occurred in 433 ms. The calculation of the total aggregate within this time period was performed by measuring the off time rather than the on time. See the 600ms plot below. Once the channel moved it did not resume communication again on that channel in the 30 minute measurement period.

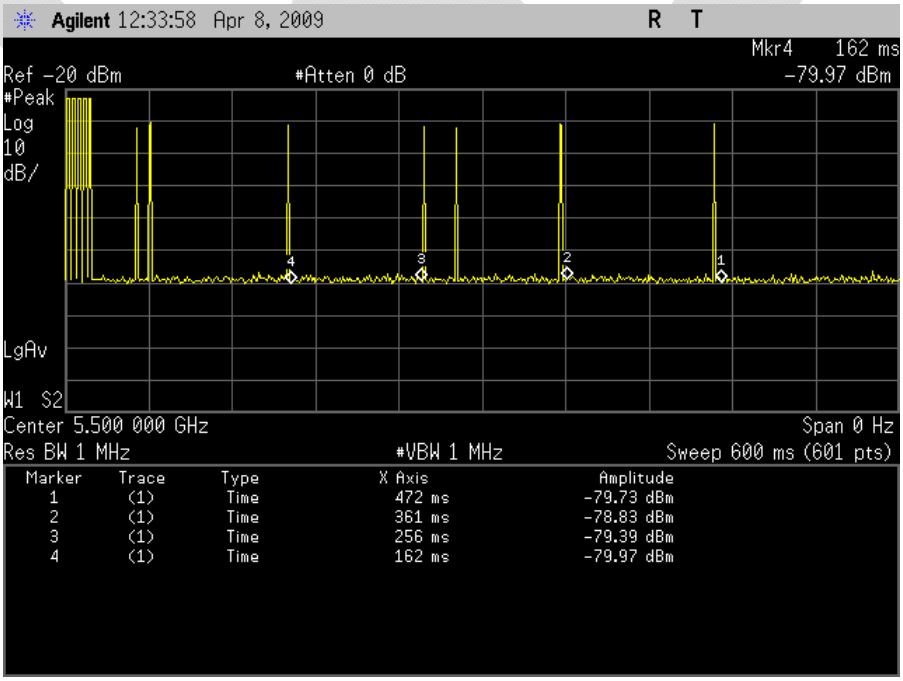
Test Engineer: Anderson Soungpanya

Test Date(s): April 8, 2009

Conformance Requirements – Channel Closing Time

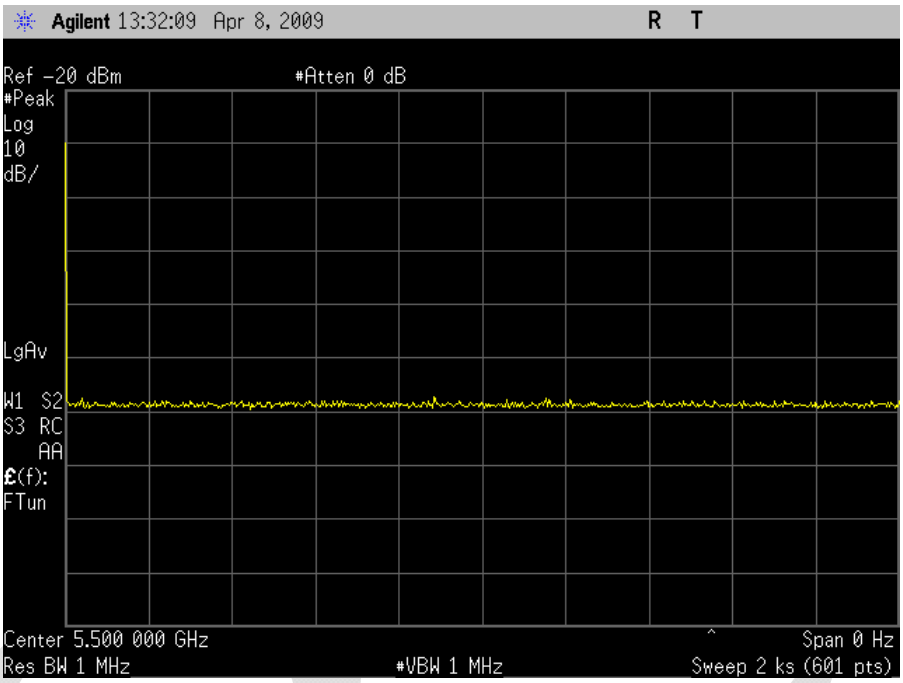


Plot 56. Channel closing time in a 10 sec frame, 5500 MHz



Plot 57. Channel closing time in 600msec, 5500 MHz

Conformance Requirements –Non Occupancy



Plot 58. 30 Minute Non-Occupancy

4.7.2.5 Uniform Spreading

Test Requirement(s): **ETSI EN 301 893 V1.4.1, Sections 4.7.2.5, Clause 5.3.8**

Definition:

4.7.2.5.1

The *Uniform Spreading* is a mechanism to be used by the RLAN to provide, on aggregate, a uniform loading of the spectrum across all devices.

This requires that a RLAN device shall select a channel out of the list of *Usable Channels* so that the probability of selecting a given channel shall be the same for all channels.

When implementing a frequency re-use plan across a planned network, the selection of the *Operating Channel* may be under control of the network.

Limit(s):

4.7.2.5.2

Each of the declared channel plans (combination of centre frequencies and declared nominal bandwidths) shall make use of at least 80% of the spectrum available in the applicable sub-band(s).

The probability of selecting each of the *Usable Channels* shall be within 10% of the theoretical probability. For "n" *Usable Channels*, the theoretical probability is 1/n.

Test Results: The EUT implements uniform spreading and therefore has been found to be compliant with the specified limits.

Test Engineer: Anderson Soungpanya

V. Test Equipment

Test Equipment

Calibrated test equipment utilized during testing was maintained in a current state of calibration per the requirements of ANSI/NCSL Z540-1-1994 and ANSI/ISO/IEC 17025:2000.

MET Asset #	Equipment	Manufacturer	Model	Last Cal Date	Cal Due Date
1S2421	EMI RECEIVER	ROHDE&SCHWARZ	ESIB 7	04/18/2008	04/18/2009
1S2484	BILOG ANTENNA	TESEQ	CBL6112D	1/21/2008	1/21/2009
1S2121	PRE-AMPLIFIER	HEWLETT PACKARD	8449B	10/25/2007	10/25/2008
1S2198	ANTENNA, HORN	EMCO	3115	08/31/2008	08/31/2009
1S2202	ANTENNA, HORN, 1 METER	EMCO	3116	04/10/2007	04/10/2010
N/A	HIGH PASS FILTER	MICRO-TRONICS	HPM13146	SEE NOTE	
1S2482	SHIELDED TEST CHAMBER	ETS-LINDGREN	DKE8X8DBL	12/26/2007	12/26/2008
1S2482	SHIELDED TEST CHAMBER	PANASHIELD	5 METER SEMI-ANECHOIC CHAMBER	11/18/2007	11/18/2009
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
1S2583	ANALYZER, SPECTRUM 3HZ-42.98GHZ	AGILENT	E4447A	7/12/2009	7/12/2010
1S2460	ANALYZER, SPECTRUM 9 KHZ-40GHZ	AGILENT	E4407B	03/24/2008	03/24/2009
1S2034	COUPLER, DIRECTIONAL 1-20 GHZ	KRYTAR	101020020	SEE NOTE	
1S2041	COUPLER, BI DIRECTIONALCOAXIAL	NARDA	N/A	SEE NOTE	
1S2128	HARMONIC MIXER	HEWLETT PACKARD	11970A	10/26/2006	10/26/2008
1S2129	HARMONIC MIXER	HEWLETT PACKARD	11970K	10/26/2006	10/26/2008

Table 24. Test Equipment List

Note: Functionally verified test equipment is verified using calibrated instrumentation at the time of testing.

Description	Manufacturer	Model	Serial No.	Cal date	Cal due
Laptop computer	Dell	Inspiron 630m	4WVH891	See Note	
MXI-Express controller	National Instruments	PXI-8360	-	See Note	
Arbitrary Waveform Generator 16-Bit 100 MS/s	National Instruments	PXI-5421	-	See Note	
RF Upconverter 250 kHz to 2.7 GHz	National Instruments	PXI-5610	-	See Note	
RF Upconverter 4.9 to 6 GHz	ASCOR	7206	-	See Note	
ANALYZER, SPECTRUM 3HZ-42.98GHZ	AGILENT	E4447A	MY48250027	7/12/2009	7/12/2010
Pre-amplifier 30 dB 1 to 26.5 GHz	Hewlett-Packard	8449B	3008A01981	See Note	
Power Splitter 2.95 to 7.1 GHz	Mini-Circuits	ZX10-2-71	-	See Note	
Attenuator 10 dB DC to 18 GHz	Pasternack Enterprises	PE7005-10	-	See Note	
Attenuator 30 dB DC to 18 GHz	Pasternack Enterprises	PE7005-30	-	See Note	

Table 25. DFS Equipment List

Note: Functionally verified test equipment is verified using calibrated instrumentation at the time of testing.

End of Report