Test of SP-5230-A
This covers the following Product Series:

SP-5230-XX
To: FCC 47 CFR Part 15.407 & IC RSS-210

Test Report Serial No.: TRIL12-U3 Rev A

# TEST REPORT

FROM

Test of SP-5230-A
This covers the following Product Series:
SP-5230-XX

To FCC 47 CFR Part 15.407 & IC RSS-210

Test Report Serial No.: TRIL12-U3 Rev A

Note: this report contains data with regard to the 5,150 to 5,350 MHz and 5470 to 5725 MHz bands for Trilliant Wireless Mesh Backhaul Node. 5.8 GHz test data is reported in MiCOM Labs test report TRIL12-U1.

This report supersedes None

Applicant: Trilliant Networks, Inc
1100 Island Drive
Redwood City
CA 94065

Product Function: Wireless WAN 5 GHz Mesh Backhaul

Copy No: pdf Issue Date: 19th March 2013

**This Test Report is Issued Under the Authority of;**

**MiCOM Labs, Inc.**
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ACCREDITED
TEST CERTIFICATE #2381.01

**MiCOM Labs is an ISO 17025 Accredited Testing Laboratory**

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# ACCREDITATION, LISTINGS & RECOGNITION

## TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard EN ISO/IEC 17025. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-01.pdf

ilac-MRA

A2LA World Class Accreditation

The American Association for Laboratory Accreditation

*Accredited Laboratory*

A2LA has accredited

**MICOM LABS**

*Pleasanton, CA*

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General Requirements for the Competence of Testing and Calibration Laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

Presented this 27th day of March 2012.

President & CEO
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2013

*For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.*

## RECOGNITION

MiCOM Labs, Inc has widely recognized Electrical testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA** countries. Our test reports are widely accepted for global type approvals.

| Country | Recognition Body | Status | Phase | Identification No. |
|---|---|---|---|---|
| USA | Federal Communications Commission (FCC) | TCB | - | US0159 Listing #: 102167 |
| Canada | Industry Canada (IC) | FCB | APEC MRA 2 | US0159 Listing #: 4143A-2 |
| Japan | MIC (Ministry of Internal Affairs and Communication) | CAB | APEC MRA 2 | RCB 210 |
| | VCCI | -- | -- | A-0012 |
| Europe | European Commission | NB | EU MRA | NB 2280 |
| Australia | Australian Communications and Media Authority (ACMA) | CAB | APEC MRA 1 | US0159 |
| Hong Kong | Office of the Telecommunication Authority (OFTA) | CAB | APEC MRA 1 | |
| Korea | Ministry of Information and Communication Radio Research Laboratory (RRL) | CAB | APEC MRA 1 | |
| Singapore | Infocomm Development Authority (IDA) | CAB | APEC MRA 1 | |
| Taiwan | National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI) | CAB | APEC MRA 1 | |
| Vietnam | Ministry of Communication (MIC) | CAB | APEC MRA 1 | |

**APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.
Phase I - recognition for product testing
Phase II – recognition for both product testing and certification
N/A – Not Applicable

**EU MRA – European Union Mutual Recognition Agreement.
Is a recognition agreement under which test lab is accredited to regulatory standards of the EU member countries.

**NB – Notified Body

## PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard EN ISO/IEC Guide 65. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; http://www.a2la.org/scopepdf/2381-02.pdf


**USA Telecommunication Certification Body (TCB)** - TCB Identifier – US0159

**Industry Canada Certification Body** - CAB Identifier – US0159

**European Notified Body** - Notified Body Identifier - 2280

**Japan – Recognized Certification Body (RCB)** - RCB Identifier - 210

# DOCUMENT HISTORY

| Document History | | |
|---|---|---|
| **Revision** | **Date** | **Comments** |
| Draft | | |
| Rev A | 19th March 2013 | Initial release. |
| | | |
| | | |

# 1. TEST RESULT CERTIFICATE

| | | | |
|---|---|---|---|
| Applicant: | Trilliant Networks, Inc<br>1100 Island Drive<br>Redwood City<br>CA 94065 | Tested By: | MiCOM Labs, Inc.<br>440 Boulder Court<br>Suite 200<br>Pleasanton<br>California, 94566, USA |
| EUT: | 802.11a Wireless WAN Mesh Node | Tel: | +1 925 462 0304 |
| Model: | SP-5230-A<br>The results of testing reported in this report cover the following Product Series: SP-5230-XX | Fax: | +1 925 462 0306 |
| S/N: | F011200004 | | |
| Test Date(s): | May 24th to 12th June 2012 and 10th January 2013 | Website: | www.micomlabs.com |

| STANDARD(S) | TEST RESULTS |
|---|---|
| FCC 47 CFR Part 15.407 & IC RSS-210<br>The SP-5230-A does not operate in the weather radar band 5600 -5650 MHz | EQUIPMENT COMPLIES |

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

**Notes:**

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

**Approved & Released for MiCOM Labs, Inc. by:**

ACCREDITED
TESTING CERTIFICATE #2381.01

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

## 2. REFERENCES AND MEASUREMENT UNCERTAINTY

### Normative References

| Ref. | Publication | Year | Title |
|---|---|---|---|
| i. | FCC 47 CFR Part 15.407 | 2012 | Code of Federal Regulations |
| ii. | FCC 06-96 | June 2006 | Memorandum Opinion and Order |
| iii. | FCC OET KDB 662911 | 4th April 2011 | Emissions Testing of Transmitters with Multiple Outputs in the Same Band |
| iv. | Industry Canada RSS-210 | 2010 | Low Power License-Exempt Radiocommunication Devices (All Frequency Bands): Category 1 Equipment |
| v. | FCC OET KDB 662911 | 4th April 2011 | Emissions Testing of Transmitters with Multiple Outputs in the Same Band |
| vi. | FCC 47 CFR Part 15, Subpart B | 2010 | 47 CFR Part 15, SubPart B; Unintentional Radiators |
| vii. | ICES-003 | 2004 | Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard Digital Apparatus; Issue 4 |
| viii. | ANSI C63.4 | 2009 | American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| ix. | CISPR 22/ EN 55022 | 2008 2006+A1: 2007 | Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment |
| x. | M 3003 | Edition 2 Jan. 2007 | Expression of Uncertainty and Confidence in Measurements |
| xi. | LAB34 | Edition 1 Aug 2002 | The expression of uncertainty in EMC Testing |
| xii. | ETSI TR 100 028 | 2001 | Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics |
| xiii. | A2LA | July 2012 | Reference to A2LA Accreditation Status – A2LA Advertising Policy |

## 2.1. Test and Uncertainty Procedures

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

# 3. PRODUCT DETAILS AND TEST CONFIGURATIONS

## 3.1. Technical Details

| Details | Description |
|---|---|
| Purpose: | Test of the SP-5230-A in the frequency ranges 5,150 to 5,250 MHz, 5250 to 5350 MHz and 5470 to 5725 MHz to FCC Part 15.407 and Industry Canada RSS-210 regulations. The SP-5230-A does not operate in the weather radar band 5600 -5650 MHz. |
| Applicant: | Trilliant Networks, Inc<br>1100 Island Drive<br>Redwood City<br>CA 94065 |
| Manufacturer: | Extron Logistics Inc |
| Laboratory performing the tests: | MiCOM Labs, Inc.<br>440 Boulder Court, Suite 200<br>Pleasanton, California 94566 USA |
| Test report reference number: | TRIL12-U3 Rev A |
| Date EUT received: | 24th May 2012 |
| Standard(s) applied: | FCC 47 CFR Part 15.407 & IC RSS-210 |
| Dates of test (from - to): | May 24th to 12th June 2012 and 10th January 2013 |
| No of Units Tested: | One |
| Type of Equipment: | 802.11a Wireless WAN 5 GHz Mesh Node |
| Product Name: | Gateway Pro |
| Model: | SP-5230-A |
| Hardware Release | Rev 7 |
| Software Release | 1.8Beta1 |
| Declared Frequency Range(s): | 5150 - 5250 MHz, 5250 to 5350 MHz and 5470 to 5725 MHz |
| Type of Modulation: | Per 802.11 – CCK, BPSK, QPSK, DSSS, OFDM |
| Declared Nominal Average Output Power: | 802.11a:Legacy 5150 - 5250 MHz;. +2.18 dBm<br>5250 - 5350 MHz; +5.70 dBm<br>5470 - 5725 MHz; -1.09 dBm |
| EUT Modes of Operation: | Legacy 802.11a |
| Transmit/Receive Operation: | Half Duplex |
| Rated Input Voltage and Current: | POE Adaptor<br>Input Rated: 90 – 264V Current: 0.3Amps max,<br>Output Rated 40 – 56Vdc 0.6 Amps max. |
| EUT Clock frequencies | 66.66 MHz, 50 MHz |
| Operating Temperature Range: | Declared range -40° to +60°C |
| ITU Emission Designator: | 5150 – 5250 MHz 802.11a 16M8D1D<br>5250 - 5350 MHz 802.11a 16M7D1D<br>5470 - 5725 MHz 802.11a 16M8D1D |
| Equipment Dimensions: | 21.0” X 11.8” X 6.0” |
| Weight: | 11 lbs |
| Primary function of equipment: | Wireless WAN 5 GHz Mesh Backhaul |

## 3.2. Scope of Test Program

The scope of the test program was to test the Trilliant Networks Inc SP-5230-A Wireless WAN Mesh Node in the frequency ranges of 5150 – 5250 MHz, 5250 to 5350 MHz and 5470 to 5725 MHz for compliance against FCC 47 CFR Part 15.407 and Industry Canada RSS-210 specifications.

## EUT

Trilliant Inc. supplied a SecureMesh™ Wireless WAN SP-5230-A device that contains an 802.11a 5 GHz Mesh backhaul radio as being representative of operation in the 5 GHz bands for all of the SP-5230-XX Series products.

The UUT was tested in 802.11a mode at 5500 MHz from the operating channels of the UUT within the 5,470 – 5,725 MHz band for DFS testing per the requirements of FCC specification “Memorandum Opinion and Order FCC 06-96”, Section 7.8 “DFS Conformance Test Procedures”.

U-NII devices operating in the 5,250 – 5,350 MHz and 5,470 - 5,725 MHz bands shall employ a DFS radar detection mechanism to detect the presence of radar systems and to avoid co-channel operation with radar systems.

The SP-5230-A product operates as a Master device with full radar detection and Dynamic Frequency Selection (DFS) capability.

The Master device provides, on aggregate, uniform loading of the spectrum across all devices by selecting an operating channel among the available channels using a random algorithm.

The SP-5230-A does not operate in the weather radar band 5600 -5650 MHz

**Trilliant Networks Inc**

**802.11a Wireless WAN 5 GHz Mesh Backhaul**

The customer supplied the following information about the products that are represented by the radio product.

There are no hardware differences between the 802.11a 5 GHz Mesh radios. Differences between models are country specific, regulatory settings that are incorporated in the software.

| Summary Table of Model Numbers |
|---|
| **Gateway Pros;** |
| **SP-5230-XX** |
| SP-5230-A |
| SP-5230-N |
| SP-5230-E |
| SP-5230-S |
| SP-5230-C |
| SP-5230-P |
| SP-5230-H |
| SP-5230-I |
| SP-5230-J |
| SP-5230-B |
| SP-5230-XX (where X is 0 to 9, A to Z or blank) |

Explanation of Model Numbers

**Product Name:** Wireless WAN Gateway Pro Series
**Model Numbers:** SP-5230-XX Series
The Wireless WAN Gateway Pro Series consist of the following models: SP-5230-A, SP-5230-N, SP-5230-E, SP-5230-S, SP-5230-C, SP-5230-P, SP-5230-H, SP-5230-I, SP-5230-J, SP-5230-B, SP-5230-XX
(where X is 0 to 9, A to Z or blank)

## 3.3. Equipment Model(s) and Serial Number(s)

The following is a description of supporting equipment used with the EUT, see diagram below for the test set-up.

| Type (EUT/ Support) | Equipment Description (Including Brand Name) | Mfr | Model No. | Unique ID or Serial No. |
|---|---|---|---|---|
| EUT | Wireless WAN 5 GHz Mesh Backhaul | Trilliant Networks Inc | SP-5230-A | F011200004 |
| Support | Laptop Computer | Dell | | |

## 3.4. Antenna Details

| Antenna Type: | Manufacturer | Model | Gain (dBi) | Frequency Range (MHz) |
|---|---|---|---|---|
| Directional Panel | Trilliant Networks Inc | Integral Panel | 20.0 | 5150 - 5250 |
| | | | 24.0 | 5250 - 5350 |
| | | | 31.0 | 5470 - 5725 |

## 3.5. Cabling and I/O Ports

Number and type of I/O ports

1. RJ45 10/100 Ethernet with PoE (x1)
2. RS232 Serial Port (Console)

## 3.6. Test Configurations

Testing was performed to determine the highest power level versus bit rate. The variant with the highest power was used to exercise the product.

| Operational Mode | Variant | Data Rates with Highest Power | Frequencies (MHz) |
|---|---|---|---|
| 802.11a | Legacy | 6 MBit/s | 5,180 / 5,200 / 5,240<br>5,260 / 5,300 / 5,320<br>5,500 / 5,580 / 5,700 |

**Spurious Emission and Band-Edge Test Strategy Band 5,150 – 5,250 MHz, 5250 – 5350 MHz and 5470 – 5725 MHz**

| 11a |
|---|
| SE 5180 |
| SE 5200 |
| SE 5240 |
| BE 5150 |
| SE 5260 |
| SE 5300 |
| SE 5320 |
| SE 5500 |
| SE 5580 |
| SE 5700 |
| BE 5350 |
| BE 5460 |

KEY:-

SE – Spurious Emissions

BE – Band-Edge

PK - Peak Emission

## 3.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:

1. Radiated emissions above 1GHz.

   Removed non conductive coating from array backplane flanges and used foil to connect to case.

2. Radiated emissions below 1GHz , and AC Line Emissions

   C 201 new cap value.

## 3.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

## 3.9. Subcontracted Testing or Third Party Data

1. NONE

# 4. TEST SUMMARY

## List of Measurements

The following table represents the list of measurements required under the **FCC CFR47 Part 15.407** and **Industry Canada RSS-210**.and **Industry Canada RSS-Gen**.

| Section(s) | Test Items | Description | Condition | Result | Test Report Section |
|---|---|---|---|---|---|
| **15.407(a)**<br>**A9.2(2)**<br>**4.4** | 26dB and 99% Emission BW | Emission bandwidth measurement | Conducted | Complies | 5.1.1 |
| **15.407(a)**<br>**A9.2(2)**<br>**4.6** | Transmit Output Power | Power Measurement | Conducted | Complies | 5.1.2 |
| **15.407(a)**<br>**A9.2(2)** | Peak Power Spectral Density | PPSD | Conducted | Complies | 5.1.3 |
| **15.407(a)(6)** | Peak Excursion Ratio | <13dB in any 1MHz bandwidth | Conducted | Complies | 5.1.4 |
| **15.407(g)**<br>**15.31**<br>**2.1**<br>**4.5** | Frequency Stability | Limits: contained within band of operation at all times. | Applicant declaration | Complies | 5.1.5 |
| **15.407(f)**<br>**5.5** | Radio Frequency Radiation Exposure | Exposure to radio frequency energy levels, Maximum Permissible Exposure (MPE) | Conducted | Complies | 5.1.6 |

## List of Measurements (continued)

The following table represents the list of measurements required under the **FCC CFR47 Part 15.407** and **Industry Canada RSS-210** and **Industry Canada RSS-Gen**.

| Section(s) | Test Items | Description | Condition | Result | Test Report Section |
|---|---|---|---|---|---|
| **15.407(b)(2)**<br>**15.205(a)**<br>**15.209(a)**<br>**2.2**<br>**2.6**<br>**A9.3(2)**<br>**4.7** | Radiated Emissions | | Radiated | | 5.1.7 |
| | Transmitter Radiated Spurious Emissions | Emissions above 1 GHz | | Complies | *5.1.7.1* |
| | Radiated Band Edge | Band edge results | | Complies | *5.1.7.1* |
| Industry Canada only<br>**RSS-Gen §4.10, §6** | Receiver Radiated Spurious Emissions | Emissions above 1 GHz | | Complies | *5.1.7.2* |
| **15.407(b)(6)**<br>**15.205(a)**<br>**15.209(a)**<br>**2.2** | Radiated Emissions | Emissions <1 GHz (30M-1 GHz) | | Complies | *5.1.7.3* |
| **15.407(b)(6)**<br>**15.207**<br>**7.2.2** | AC Wireline Conducted Emissions 150 kHz–30 MHz | Conducted Emissions | Conducted | Complies | 5.1.8 |

## List of Measurements (continued)

**Dynamic Frequency Selection (DFS)**
The following table represents the list of measurements required under the **FCC CFR47 Part 15.407(h)(2)** and **FCC Memorandum Opinion and Order FCC 06-96 (Compliance Measurement procedures for Unlicensed National Information Infrastructure devices operating in the 5250-5350 MHz and 5470-5725 MHz bands incorporating dynamic frequency selection).**

**Tests performed on Master Device**

| Section | Test Items | Description | Condition | Result | Test Report Section |
|---|---|---|---|---|---|
| 7.8.1 | Detection Bandwidth | UNII Detection Bandwidth | Conducted | Complies | 6.2.1 |
| 7.8.2.1 | Performance Requirements Check | Initial Channel Availability Check Time | Conducted | Complies | 6.2.2 |
| 7.8.2.2 | | Radar Burst at the Beginning of the Channel Availability Check Time | Conducted | Complies | 6.2.3 |
| 7.8.2.3 | | Radar Burst at the End of the Channel Availability Check Time | Conducted | Complies | 6.2.4 |
| 7.8.3 | In-Service Monitoring | In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period | Conducted | Complies | 6.2.5 |
| 7.8.4 | Radar Detection | Statistical Performance Check | Conducted | Complies | 6.2.6 |

***Note 1:*** *Test results reported in this document relate only to the items tested.*
**Note 2:** *The required tests demonstrated compliance as per client declaration of test configuration, monitoring methodology and associated pass/fail criteria.*

# 5. TEST RESULTS

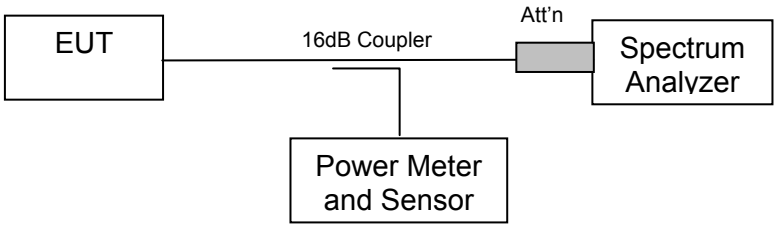
## 5.1. Device Characteristics

### 5.1.1. 26 dB and 99 % Bandwidth

**FCC, Part 15 Subpart C §15.407(a)**
**Industry Canada RSS-210 § A9.2(2)**
**Industry Canada RSS-Gen 4.4**

**Test Procedure**
The bandwidth at 26 dB and 99 % is measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.

**Test Measurement Set up**




Measurement set up for 26 dB and 99 % bandwidth test

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier
Power: Maximum Default Power

## Measurement Results for 26 dB and 99 % Operational Bandwidth(s)

Ambient conditions.
Temperature: 17 to 23 °C  Relative humidity: 31 to 57 %  Pressure: 999 to 1012 mbar

TABLE OF RESULTS – **802.11a Legacy 5150 – 5250 MHz**

| | | | |
|---|---|---|---|
| **Test Conditions:** | 15.247 (a)(2) | **Rel. Humidity (%):** | 35 to 42 |
| **Variant:** | 802.11a | **Ambient Temp. (ºC):** | 19 to 22 |
| **TPC:** | HIGH | **Pressure (mBars):** | 998 to 1003 |
| **Modulation:** | ON | **Duty Cycle (x):** | 100 |
| **Beam Forming Gain (Y):** | N/A dB | **Antenna Gain:** | 20 dBi |
| **Applied Voltage:** | 48.0 Vdc | | |
| **Notes 1:** | | | |
| **Notes 2:** | | | |

***26 dB Bandwidth***

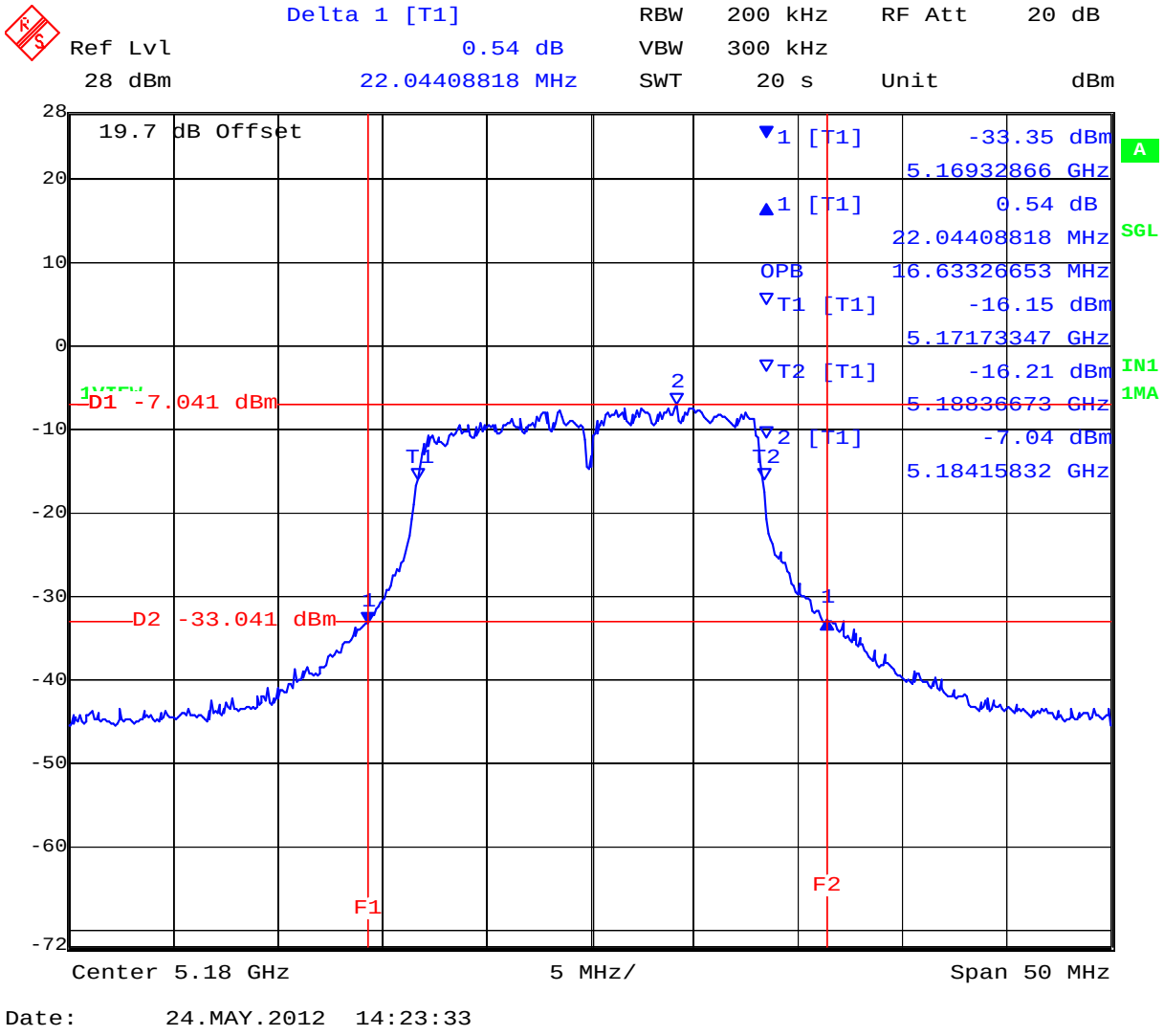
| Test Frequency | 26 dB Bandwidth MHz | | | | Minimum 6dB Bandwidth Limit | | Margin |
|---|---|---|---|---|---|---|---|
| **MHz** | **a** | **b** | **c** | **d** | **kHz** | **MHz** | **MHz** |
| 5180 | 22.044000 | -- | -- | -- | 500 | 0.5 | -21.544000 |
| 5200 | 22.445000 | -- | -- | -- | | | -21.945000 |
| 5240 | 22.545000 | -- | -- | -- | | | -22.045000 |

***99% Bandwidth***

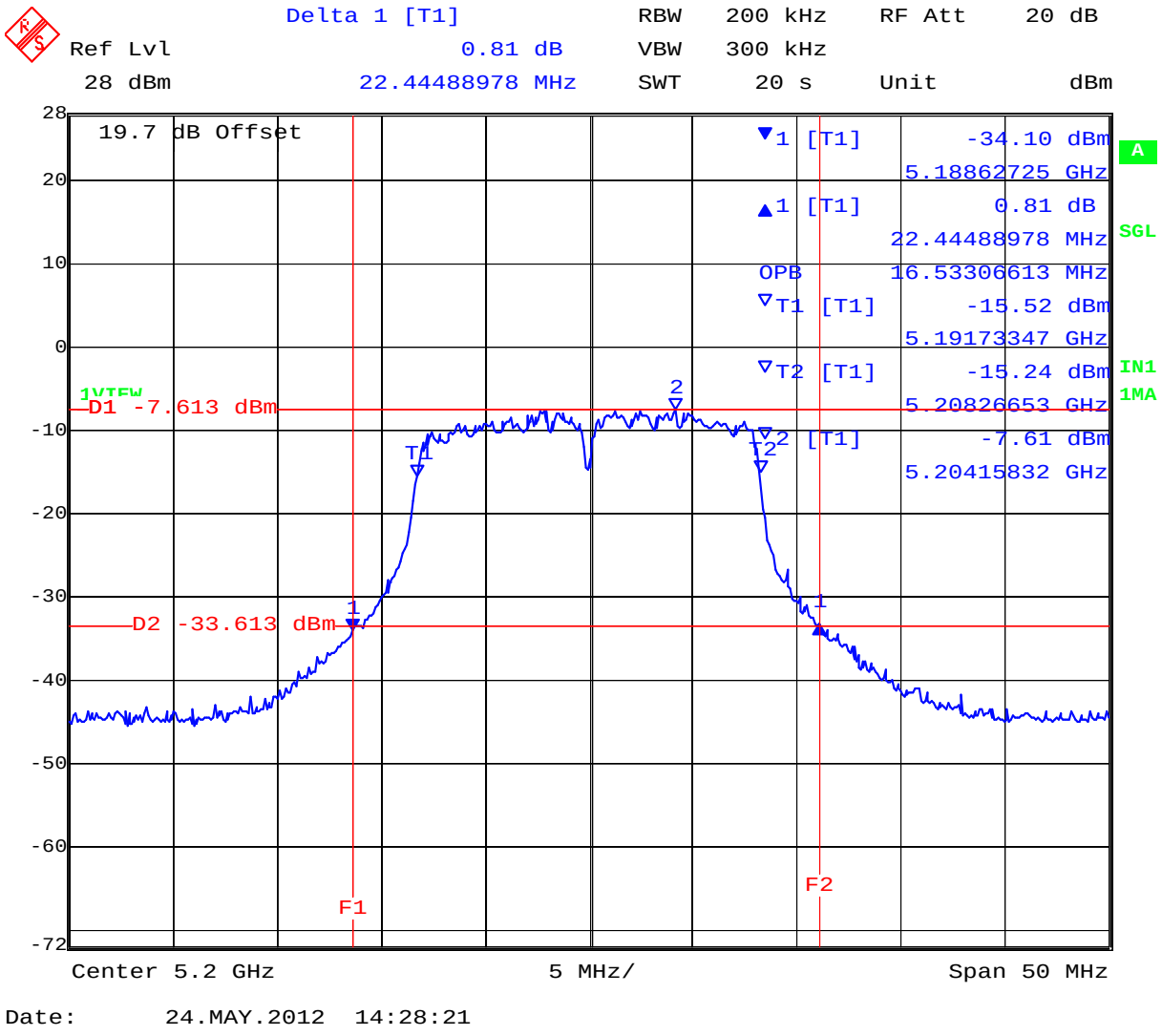
| Test Frequency | 99 % Bandwidth MHz | | | | | | |
|---|---|---|---|---|---|---|---|
| **MHz** | **a** | **b** | **c** | **d** | | | |
| 5180 | 16.633000 | -- | -- | -- | | | |
| 5200 | 16.533000 | -- | -- | -- | | | |
| 5240 | 16.633000 | -- | -- | -- | | | |

| | |
|---|---|
| **Measurement uncertainty:** | ±2.81 dB |

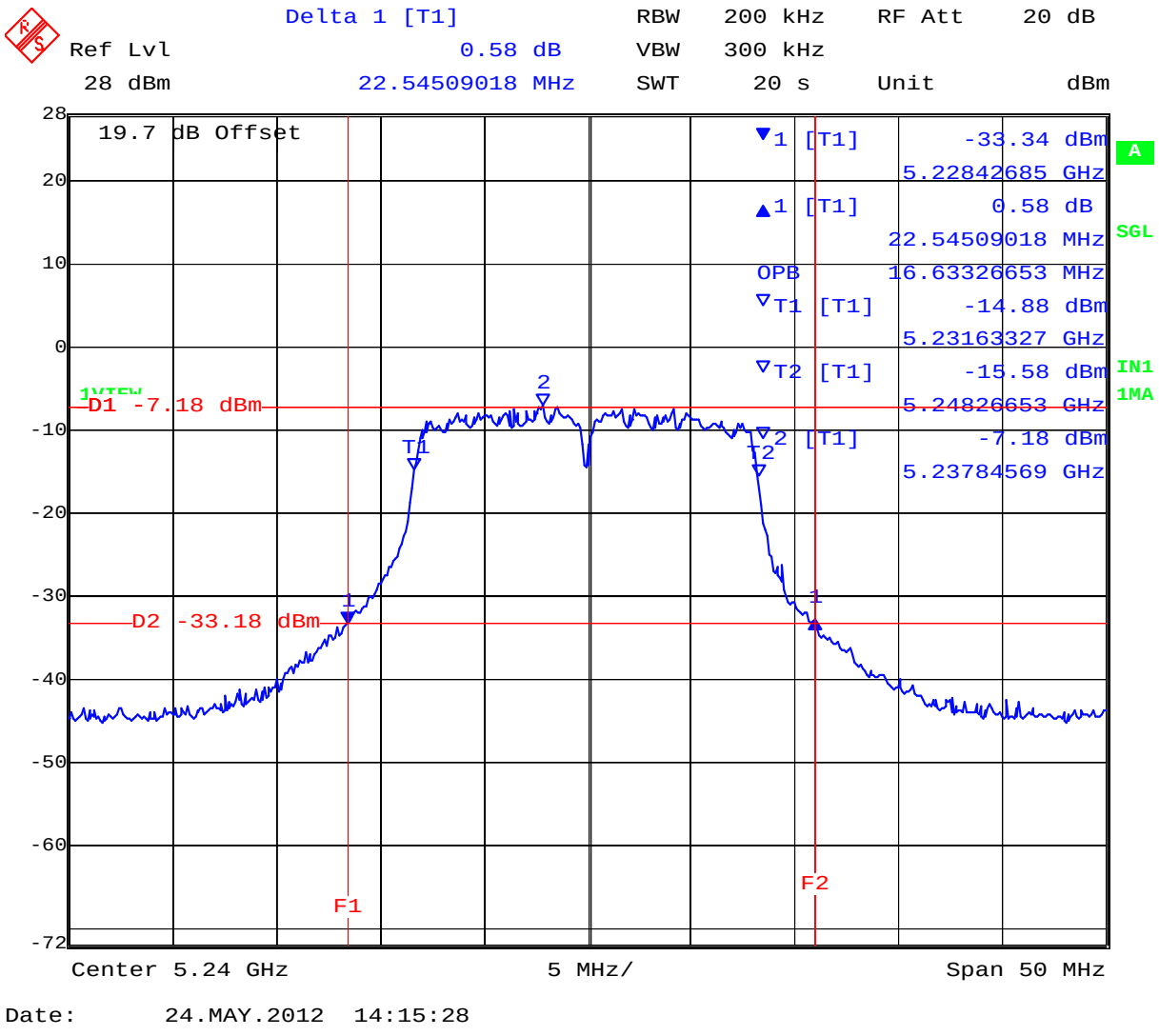
## PORT A 5,180 MHz 802.11a Legacy 26 dB and 99 % Bandwidth



## PORT A 5,200 MHz 802.11a Legacy 26 dB and 99 % Bandwidth



## PORT A 5,240 MHz 802.11a Legacy 26 dB and 99 % Bandwidth




The EUT was observed to meet the 20dB bandwidth requirement of Section 15.215(c) of the standard at the 5250 MHz band edge.

TABLE OF RESULTS – **802.11a Legacy 5250 – 5350 MHz**

| | | | |
|---|---|---|---|
| **Test Conditions:** | 15.247 (a)(2) | **Rel. Humidity (%):** | 35 to 42 |
| **Variant:** | 802.11a | **Ambient Temp. (ºC):** | 19 to 22 |
| **TPC:** | HIGH | **Pressure (mBars):** | 998 to 1003 |
| **Modulation:** | ON | **Duty Cycle (x):** | 100 |
| **Beam Forming Gain (Y):** | N/A dB | **Antenna Gain:** | 24 dBi |
| **Applied Voltage:** | 48.0 Vdc | | |
| **Notes 1:** | | | |
| **Notes 2:** | | | |

***26 dB Bandwidth***

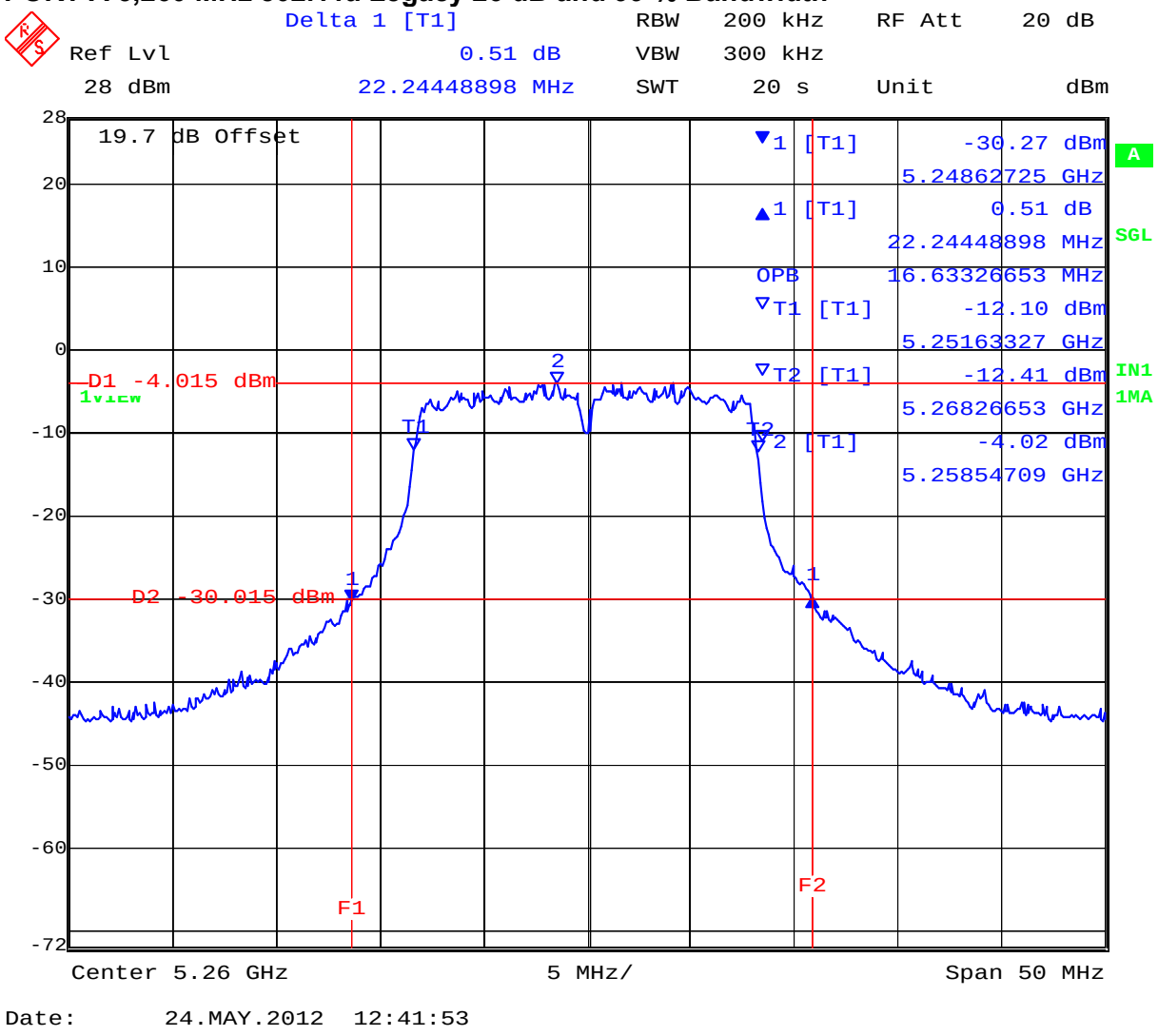
| Test Frequency | 26 dB Bandwidth | | | | Minimum 6dB Bandwidth Limit | | Margin |
|---|---|---|---|---|---|---|---|
| | MHz | | | | | | |
| **MHz** | **a** | **b** | **c** | **d** | **kHz** | **MHz** | **MHz** |
| 5260 | 22.244000 | -- | -- | -- | 500 | 0.5 | -21.744000 |
| 5300 | 22.144000 | -- | -- | -- | | | -21.644000 |
| 5320 | 21.643000 | -- | -- | -- | | | -21.143000 |

***99% Bandwidth***

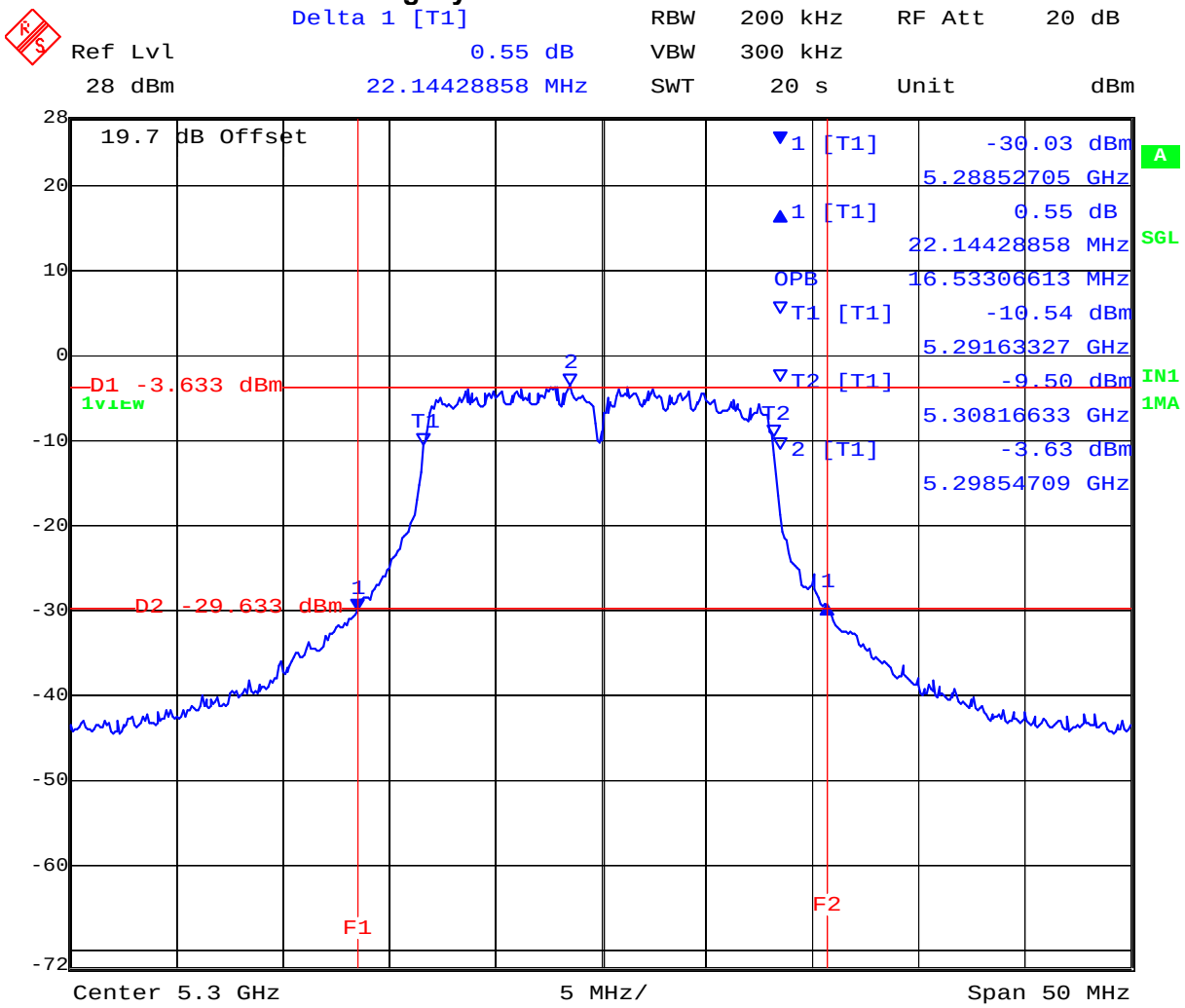
| Test Frequency | 99 % Bandwidth | | | | | | |
|---|---|---|---|---|---|---|---|
| | MHz | | | | | | |
| **MHz** | **a** | **b** | **c** | **d** | | | |
| 5260 | 16.633000 | -- | -- | -- | | | |
| 5300 | 16.533000 | -- | -- | -- | | | |
| 5320 | 16.633000 | -- | -- | -- | | | |

| | |
|---|---|
| **Measurement uncertainty:** | ±2.81 dB |

## PORT A 5,260 MHz 802.11a Legacy 26 dB and 99 % Bandwidth



## PORT A 5300 MHz 802.11a Legacy 26 dB and 99 % Bandwidth



## PORT A 5,320 MHz 802.11a Legacy 26 dB and 99 % Bandwidth

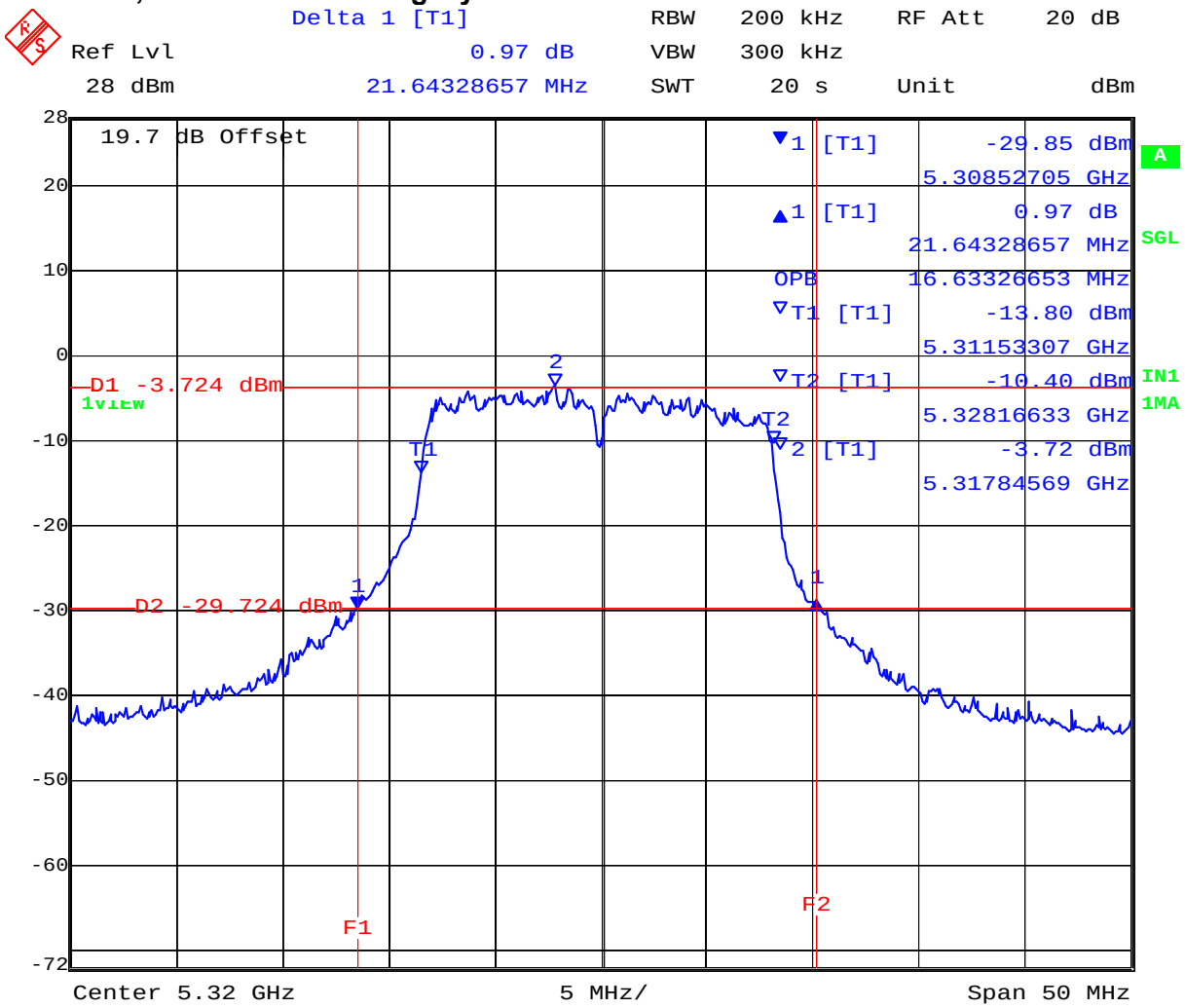


TABLE OF RESULTS – **802.11a Legacy 5500 – 5700 MHz**

| | | | |
|---|---|---|---|
| **Test Conditions:** | 15.247 (a)(2) | **Rel. Humidity (%):** | 35 to 42 |
| **Variant:** | 802.11a | **Ambient Temp. (ºC):** | 19 to 22 |
| **TPC:** | HIGH | **Pressure (mBars):** | 998 to 1003 |
| **Modulation:** | ON | **Duty Cycle (x):** | 100 |
| **Beam Forming Gain (Y):** | N/A dB | **Antenna Gain:** | 31 dBi |
| **Applied Voltage:** | 48.0 Vdc | | |
| **Notes 1:** | | | |
| **Notes 2:** | | | |

***26 dB Bandwidth***

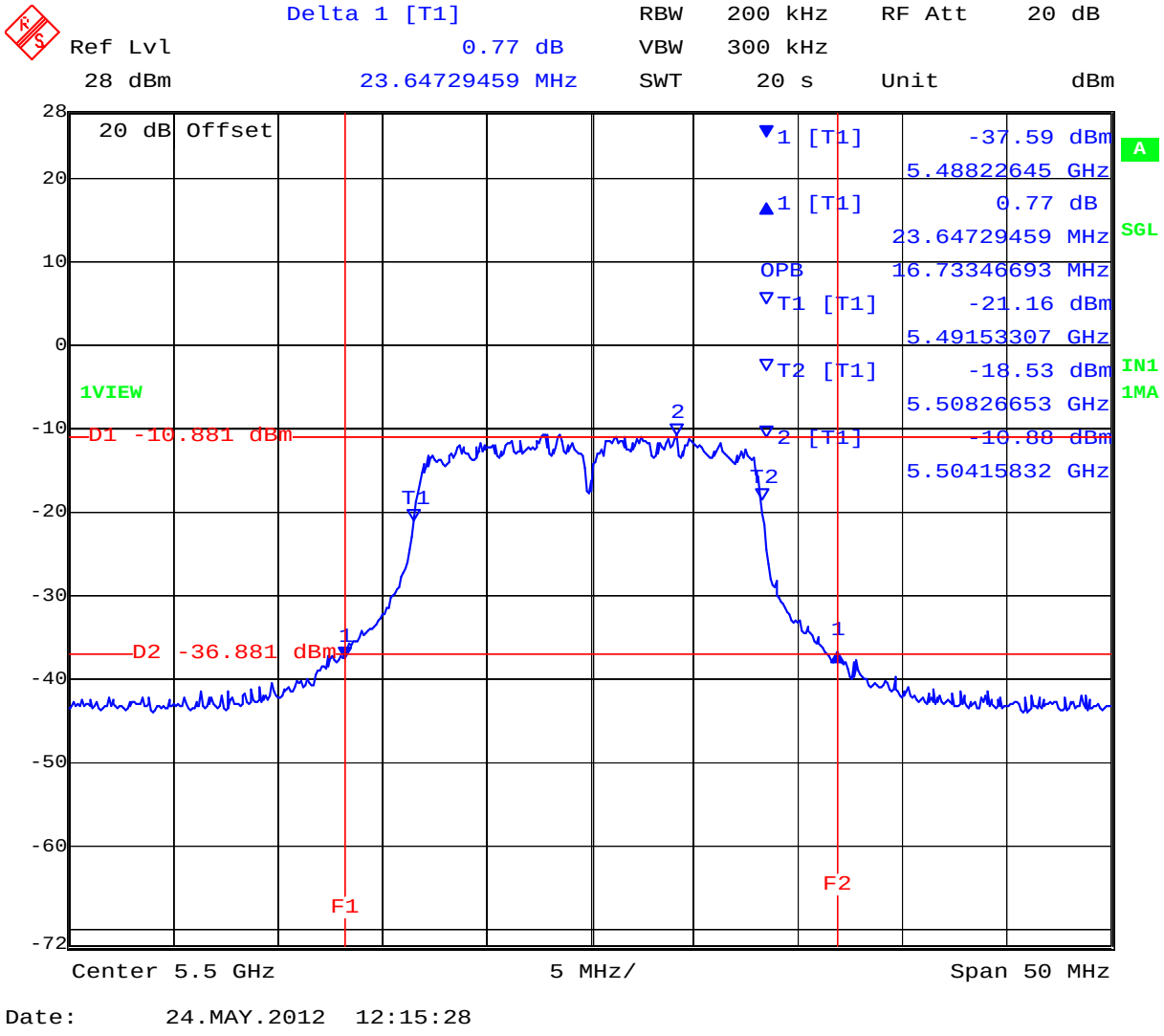
| Test Frequency | 26 dB Bandwidth | | | | Minimum 6dB Bandwidth Limit | | Margin |
|---|---|---|---|---|---|---|---|
| | MHz | | | | | | |
| **MHz** | **a** | **b** | **c** | **d** | **kHz** | **MHz** | **MHz** |
| 5500 | 23.647000 | -- | -- | -- | 500 | 0.5 | -23.147000 |
| 5580 | 22.846000 | -- | -- | -- | | | -22.346000 |
| 5700 | 23.146000 | -- | -- | -- | | | -22.646000 |

***99% Bandwidth***

| Test Frequency | 99 % Bandwidth | | | | | | |
|---|---|---|---|---|---|---|---|
| | MHz | | | | | | |
| **MHz** | **a** | **b** | **c** | **d** | | | |
| 5500 | 16.733000 | -- | -- | -- | | | |
| 5580 | 16.733000 | -- | -- | -- | | | |
| 5700 | 16.733000 | -- | -- | -- | | | |

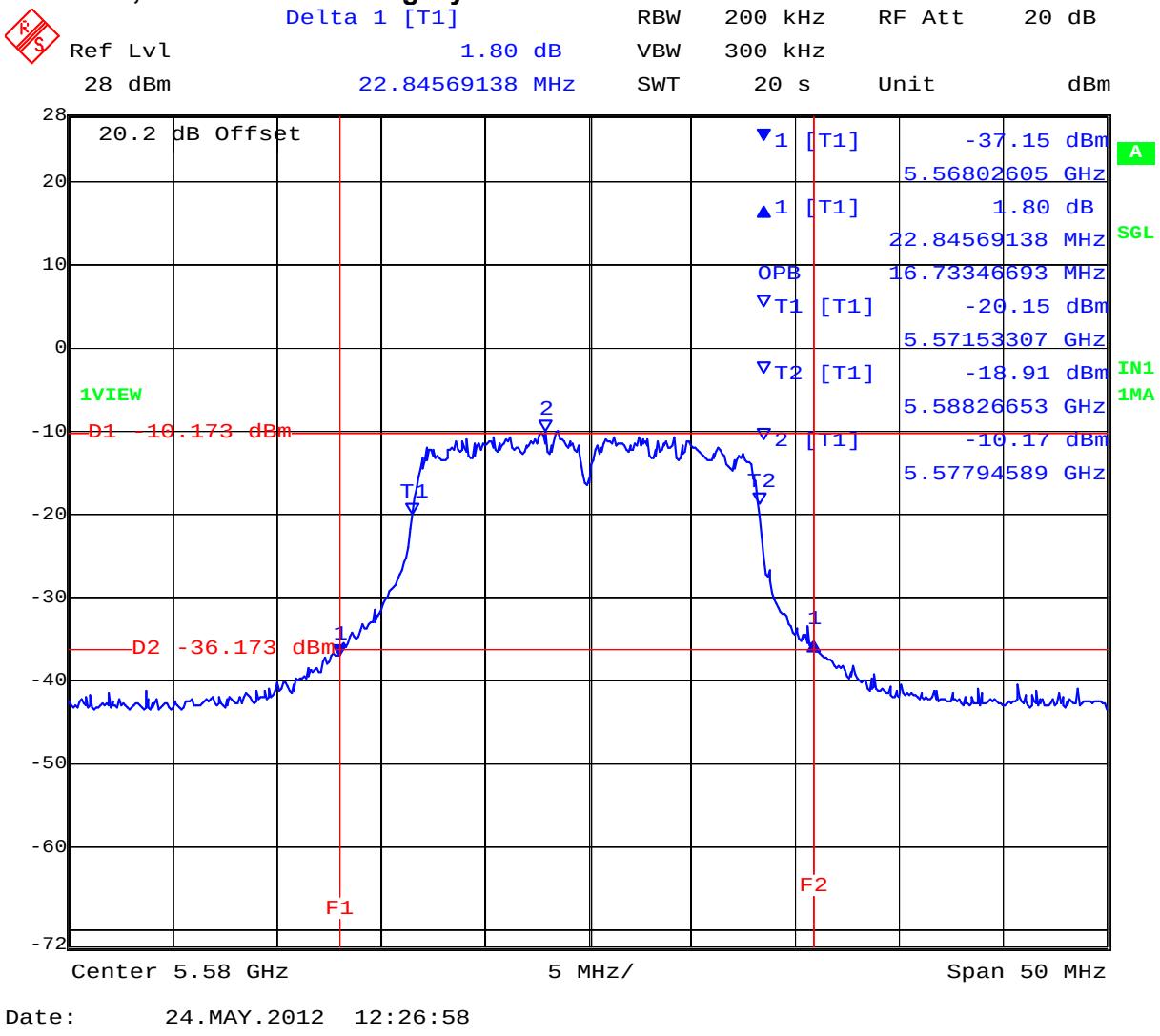
| | |
|---|---|
| **Measurement uncertainty:** | ±2.81 dB |

## PORT A 5,500 MHz 802.11a Legacy 26 dB and 99 % Bandwidth

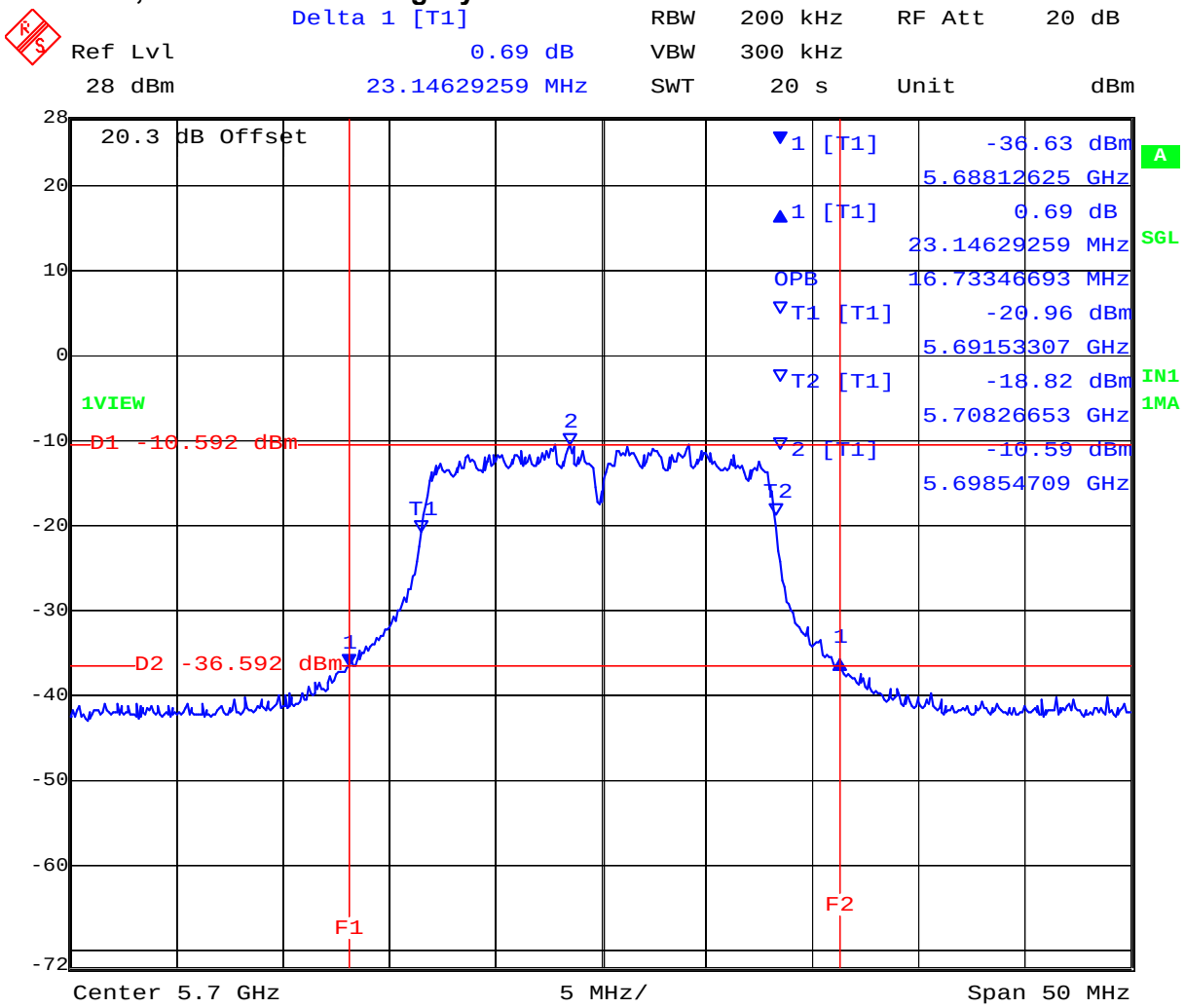



Date: 24.MAY.2012 12:15:28

## PORT A 5,580 MHz 802.11a Legacy 26 dB and 99 % Bandwidth



## PORT A 5,700 MHz 802.11a Legacy 26 dB and 99 % Bandwidth




Date: 24.MAY.2012 12:31:40

## Specification

## Limits

**FCC, Part 15 §15.407 (a)(1), (a)(2) and Industry Canada RSS-210 § A9.2(2)**

**(a)(1)** For the band 5.15-5.25 GHz the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or +4 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed +4 dBm in any 1 megahertz band.

**(a)(2)** For the 5.25-5.35 GHz band the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or +11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed +11 dBm in any 1 megahertz band.

**Industry Canada RSS-Gen 4.4**

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

### Laboratory Measurement Uncertainty for Spectrum Measurement

| | |
|---|---|
| Measurement uncertainty | ±2.81 dB |

### Traceability

| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask' | 0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117 |

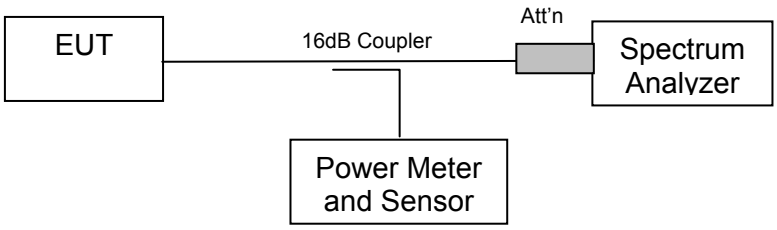
### 5.1.2. Transmit Output Power

**FCC, Part 15 Subpart C §15.407(a)**
**Industry Canada RSS-210 §9.9(2)**
**Industry Canada RSS-Gen 4.6**

**Test Procedure**

The transmitter terminal of EUT was connected to the input of an average power meter. Measurements were made while EUT was operating in a continuous transmission mode i.e. 100 % duty cycle at the appropriate center frequency. All cable losses and offsets were taken into consideration in the measured result.

**Test Measurement Set up**




Measurement set up for Transmitter Output Power

**Maximum Transmit (Conducted) Power with respect to measured transmitter bandwidth.**

**FCC Limits and Industry Canada Limits**

**Bands 5150 – 5250 MHz**

**FCC Limits**

Conducted Power Limit lesser of: 50 mW or 4 dBm + 10 log (B) dBm where B is the 26dB bandwidth.

| Mode | Frequency Range (MHz) | Maximum 26 dB Bandwidth (MHz) | 4 + 10 Log (B) (dBm) | Limit (dBm) |
|---|---|---|---|---|
| a | 5150 – 5250 | 22.545 | +17.53 | +17.00 |

**FCC Limits Bands 5250 – 5350 and 5470 – 5725 MHz**

Conducted Power Limit lesser of: 250 mW or 11 dBm + 10 log (B) dBm. B is the 26 dB emission bandwidth in MHz.

| Mode | Frequency Range (MHz) | Maximum 26 dB Bandwidth (MHz) | 11 + 10 Log (B) (dBm) | Conducted Power Limit (dBm) |
|---|---|---|---|---|
| a | 5250 – 5350 | 22.244 | +24.47 | +24.00 |

| Mode | Frequency Range (MHz) | Maximum 26 dB Bandwidth (MHz) | 11 + 10 Log (B) (dBm) | Conducted Power Limit (dBm) |
|---|---|---|---|---|
| a | 5470 – 5725 | 23.647 | +23.73 | +23.73 |

## Industry Canada Limits

EIRP Limit 5150 – 5250 MHz: Lesser of 200 mW or 10 + 10 Log (B) dBm where B is the 99% bandwidth.

| Mode | Frequency Range (MHz) | Maximum 99% Bandwidth (MHz) | 10 + 10 Log (B) (dBm) | EIRP Limit (dBm) |
|---|---|---|---|---|
| a | 5150 – 5250 | 16.633 | +22.21 | +22.21 |

## Industry Canada Limits

**Bands 5250 – 5350 and 5470 – 5600 MHz and 5650 - 5725 MHz**

Conducted Power Limit lesser of: 250 mW or 11 dBm + 10 log (B) dBm. B is the 99% emission bandwidth in MHz.

| Mode | Frequency Range (MHz) | Maximum 26 dB Bandwidth (MHz) | 11 + 10 Log (B) (dBm) | Limit (dBm) |
|---|---|---|---|---|
| a | 5250 – 5350 | 16.633 | +22.21 | +22.21 |

| Mode | Frequency Range (MHz) | Maximum 26 dB Bandwidth (MHz) | 11 + 10 Log (B) (dBm) | Limit (dBm) |
|---|---|---|---|---|
| a | 5470 – 5725 | 16.733 | +23.23 | +23.23 |

**Maximum allowable conducted power with respect to EIRP requirements.**

15. 407 a) Power limits:

(1) **For the band 5.15–5.25 GHz**, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or 4 dBm + 10 log B, where B is the 26–dB emission bandwidth in MHz. In addition, the peak power spectral density shall not exceed 4 dBm in any 1–MHz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

**Operating Frequency Band 5150-5250 MHz**

| Antenna | Gain (dBi) | Max. Allowable Conducted Peak Power (dBm) | Maximum EIRP (dBm) |
|---|---|---|---|
| Integral Panel | 20.0 | +3.0 | +23.0 |

(2) **For the 5.25–5.35 GHz and 5.47–5.725 GHz bands**, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or 11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed 11 dBm in any 1 megahertz band. If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

**Operating Frequency Bands 5250-5350 MHz and 5470 -5725 MHz**

| Frequency Band (MHz) | Antenna | Gain (dBi) | Max. Allowable Conducted Peak Power (dBm) | Maximum EIRP (dBm) |
|---|---|---|---|---|
| 5250 – 5350 | Integral Panel | 24.0 | +6.0 | +30.0 |
| 5470 - 5725 | Integral Panel | 31.0 | -1.0 | +30.0 |

**Measurement Results for Transmit Output Power**
Ambient conditions.
Temperature: 17 to 23 °C  Relative humidity: 31 to 57 %  Pressure: 999 to 1012 mbar

EUT parameters.
Power Level: Maximum
Duty Cycle: 100%
Temperature: Ambient

TABLE OF RESULTS – **802.11a Legacy**

| | | | |
|---|---|---|---|
| **Test Conditions:** | 15.407 (a)(1) | **Rel. Humidity (%):** | 35 to 42 |
| **Variant:** | 802.11a | **Ambient Temp. (ºC):** | 19 to 22 |
| **TPC:** | HIGH | **Pressure (mBars):** | 998 to 1003 |
| **Modulation:** | ON | **Duty Cycle (x):** | 100 |
| **Beam Forming Gain (Y):** | N/A dB | **Antenna Gain:** | 0 dBi |
| **Applied Voltage:** | 48.0 Vdc | | |
| **Notes 1:** | | | |
| **Notes 2:** | | | |

| Test Frequency | Measured Peak Power RF Port (dBm) | | | | Total Power (dBm) | | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| **MHz** | **a** | **b** | **c** | **d** | **Combined** | **Calculated** | **dBm** | **dB** |
| 5180 | 2.10 | -- | -- | -- | N/A | 2.10 | 17.00 | -14.90 |
| 5200 | 1.87 | -- | -- | -- | N/A | 1.87 | 17.00 | -15.13 |
| 5240 | 2.18 | -- | -- | -- | N/A | 2.18 | 17.00 | -14.82 |

| | |
|---|---|
| **Measurement uncertainty:** | ±1.33 dB |

| | | | |
|---|---|---|---|
| **Test Conditions:** | 15.407 (a)(1) | **Rel. Humidity (%):** | 35 to 42 |
| **Variant:** | 802.11a | **Ambient Temp. (ºC):** | 19 to 22 |
| **TPC:** | HIGH | **Pressure (mBars):** | 998 to 1003 |
| **Modulation:** | ON | **Duty Cycle (x):** | 100 |
| **Beam Forming Gain (Y):** | N/A dB | **Antenna Gain:** | 0 dBi |
| **Applied Voltage:** | 48.0 Vdc | | |
| **Notes 1:** | | | |
| **Notes 2:** | | | |

| Test Frequency | Measured Peak Power RF Port (dBm) | | | | Total Power (dBm) | | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| **MHz** | **a** | **b** | **c** | **d** | **Combined** | **Calculated** | **dBm** | **dB** |
| 5260 | 5.10 | -- | -- | -- | N/A | 5.10 | 24.00 | -18.90 |
| 5300 | 5.70 | -- | -- | -- | N/A | 5.70 | 24.00 | -18.30 |
| 5320 | 5.02 | -- | -- | -- | N/A | 5.02 | 24.00 | -18.98 |

| | |
|---|---|
| **Measurement uncertainty:** | ±1.33 dB |

| | | | | | |
|---|---|---|---|---|---|
| **Test Conditions:** | 15.407 (a)(1) | | **Rel. Humidity (%):** | 35 to 42 | |
| **Variant:** | 802.11a | | **Ambient Temp. (ºC):** | 19 to 22 | |
| **TPC:** | HIGH | | **Pressure (mBars):** | 998 to 1003 | |
| **Modulation:** | ON | | **Duty Cycle (x):** | 100 | |
| **Beam Forming Gain (Y):** | N/A | dB | **Antenna Gain:** | 0 dBi | |
| **Applied Voltage:** | 48.0 | Vdc | | | |
| **Notes 1:** | | | | | |
| **Notes 2:** | | | | | |

| **Test Frequency** | **Measured Peak Power RF Port (dBm)** | | | | **Total Power (dBm)** | | **Limit** | **Margin** |
|---|---|---|---|---|---|---|---|---|
| **MHz** | **a** | **b** | **c** | **d** | **Combined** | **Calculated** | **dBm** | **dB** |
| 5500 | -1.25 | -- | -- | -- | N/A | -1.25 | 24.00 | -25.25 |
| 5580 | -1.14 | -- | -- | -- | N/A | -1.14 | 24.00 | -25.14 |
| 5700 | -1.09 | -- | -- | -- | N/A | -1.09 | 24.00 | -25.09 |

| | |
|---|---|
| **Measurement uncertainty:** | ±1.33 dB |

## Specification

### Limits

**FCC, Part 15 §15.407 (a)(1), (a)(2) and Industry Canada RSS-210 § A9.2(2)**

**(a)(1)** For the band 5.15-5.25 GHz the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW or +4 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed +4 dBm in any 1 megahertz band.

**(a)(2)** For the 5.25-5.35 and 5470-5725 MHz GHz band the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 250 mW or +11 dBm + 10 log B, where B is the 26 dB emission bandwidth in megahertz. In addition, the peak power spectral density shall not exceed +11 dBm in any 1 megahertz band.

**Industry Canada RSS-210 §A9.2(2)**

For the band 5150-5250 MHz, the maximum equivalent isotropically radiated power (e.i.r.p.) shall not exceed 200 mW or 10 + 10 log10 B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz. The e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

For the band 5250-5350 MHz and 5470-5725 MHz, the maximum conducted output power shall not exceed 250 mW or 11 + 10 log10 B, dBm, whichever power is less. The power spectral density shall not exceed 11 dBm in any 1.0 MHz band. The maximum e.i.r.p. shall not exceed 1.0 W or 17 + 10 log10 B, dBm, whichever power is less. B is the 99% emission bandwidth in MHz.

**Industry Canada RSS-Gen 4.4**

When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

### Laboratory Measurement Uncertainty for Power Measurements

| | |
|---|---|
| Measurement uncertainty | ±1.33 dB |

### Traceability

| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-01 'Measuring RF Output Power' | 0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117 |

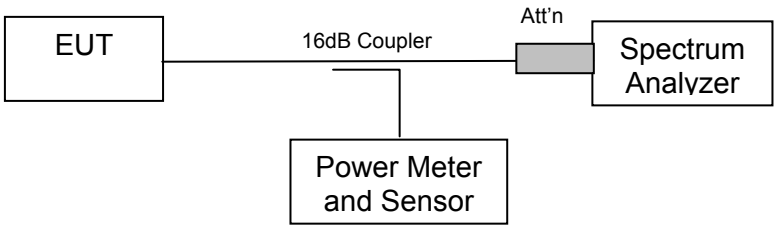
### 5.1.3. Peak Power Spectral Density

**FCC, Part 15 Subpart C §15.407(a)**
**Industry Canada RSS-210 § A9.2(2)**

**Test Procedure**

The transmitter output was connected to a spectrum analyzer and the peak power spectral density measured. Method 2 Sample Detection and power averaging, specified in FCC document DA 02-2138 (Normative Reference (ix) Section 2.1 "Guidelines for Assessing Unlicensed National Information Infrastructure (U-NII) Devices") was used to determine the peak power spectral density of the emission. The Peak Power Spectral Density is the highest level found across the emission in a 1 MHz resolution bandwidth.

**Test Measurement Set up**




Measurement set up for Peak Power Spectral Density

**Measurement Results for Peak Power Spectral Density**

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier
Power: Maximum Default Power

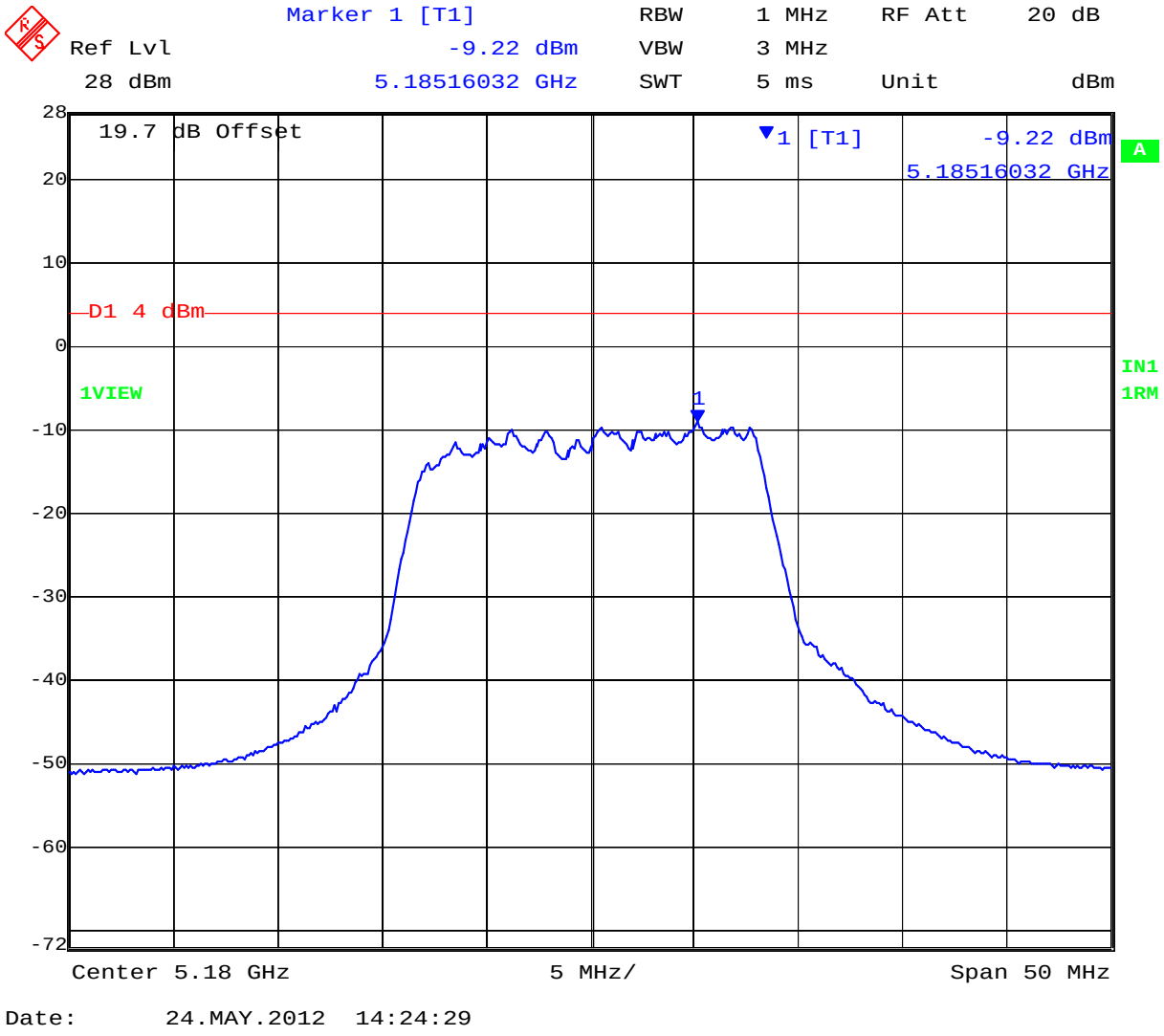
TABLE OF RESULTS – **802.11a Legacy 5150 – 5250 MHz**

| | | | |
|---|---|---|---|
| **Test Conditions:** | 15.407 (a) | **Rel. Humidity (%):** | 35 to 42 |
| **Variant:** | 802.11a | **Ambient Temp. (ºC):** | 19 to 22 |
| **TPC:** | HIGH | **Pressure (mBars):** | 998 to 1003 |
| **Modulation:** | ON | **Duty Cycle (%):** | 100 |
| **Beam Forming Gain (Y):** | N/A dB | **Antenna Gain:** | 20 dBi |
| **Applied Voltage:** | 48.0 Vdc | **Antenna Ports (N):** | 1 |
| **Notes 1:** | | | |
| **Notes 2:** | | | |

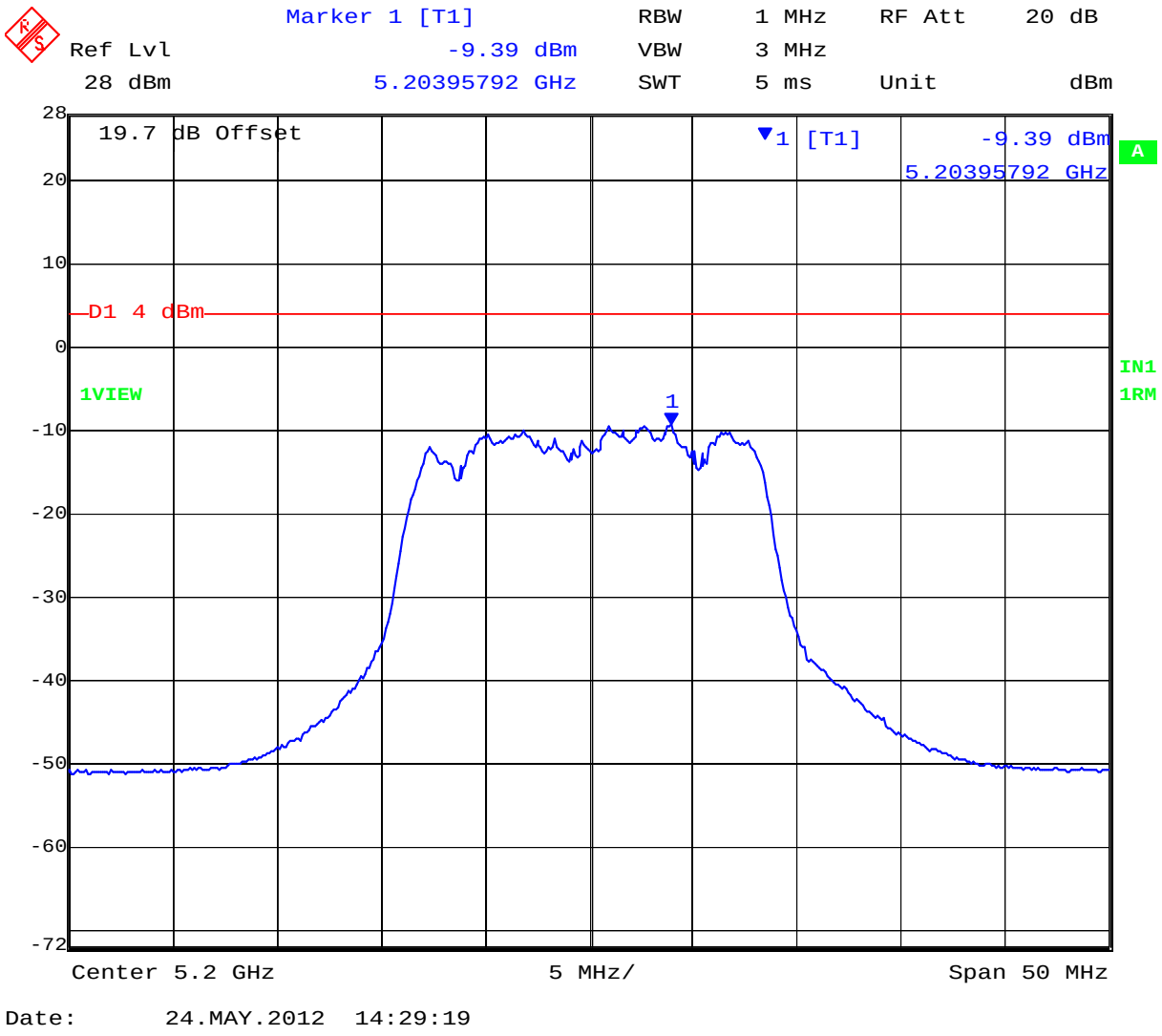
| Test Frequency | Measured Peak Power RF Port (dBm) | | | | Correction factor | Peak Power Spectral Density | Limit | Margin |
|---|---|---|---|---|---|---|---|---|
| **MHz** | **a** | **b** | **c** | **d** | **10Log(N)** | **dBm** | **dBm** | **dB** |
| 5180 | -9.22 | -- | -- | -- | 0.00 | -9.22 | 4.00 | -13.22 |
| 5200 | -9.39 | -- | -- | -- | 0.00 | -9.39 | 4.00 | -13.39 |
| 5240 | -9.24 | -- | -- | -- | 0.00 | -9.24 | 4.00 | -13.24 |

| | |
|---|---|
| **Measurement uncertainty:** | ±1.33 dB |

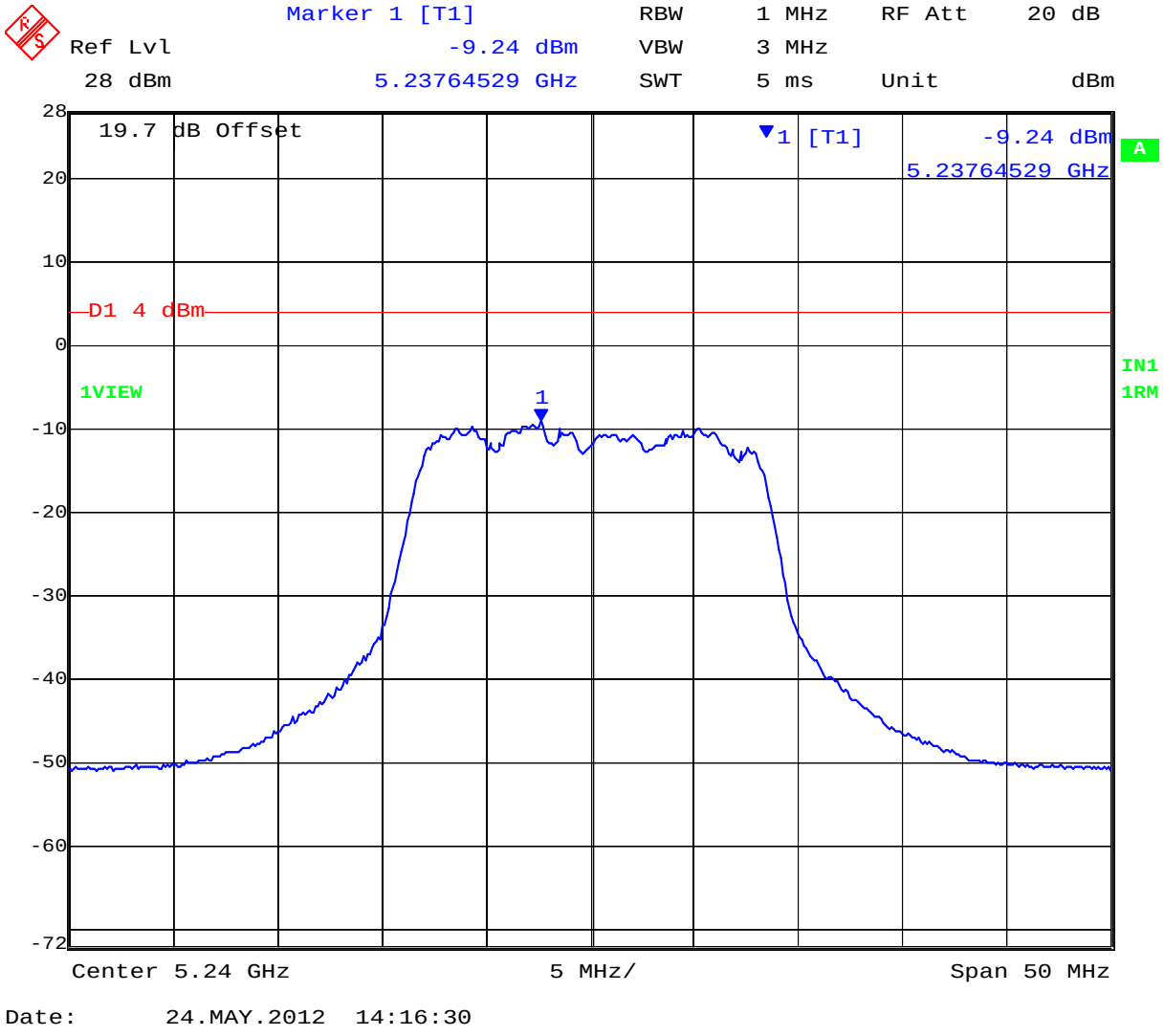
## PORT A 5,180 MHz 802.11a Legacy Power Spectral Density



## PORT A 5,200 MHz 802.11a Legacy Power Spectral Density



## PORT A 5,240 MHz 802.11a Legacy Power Spectral Density

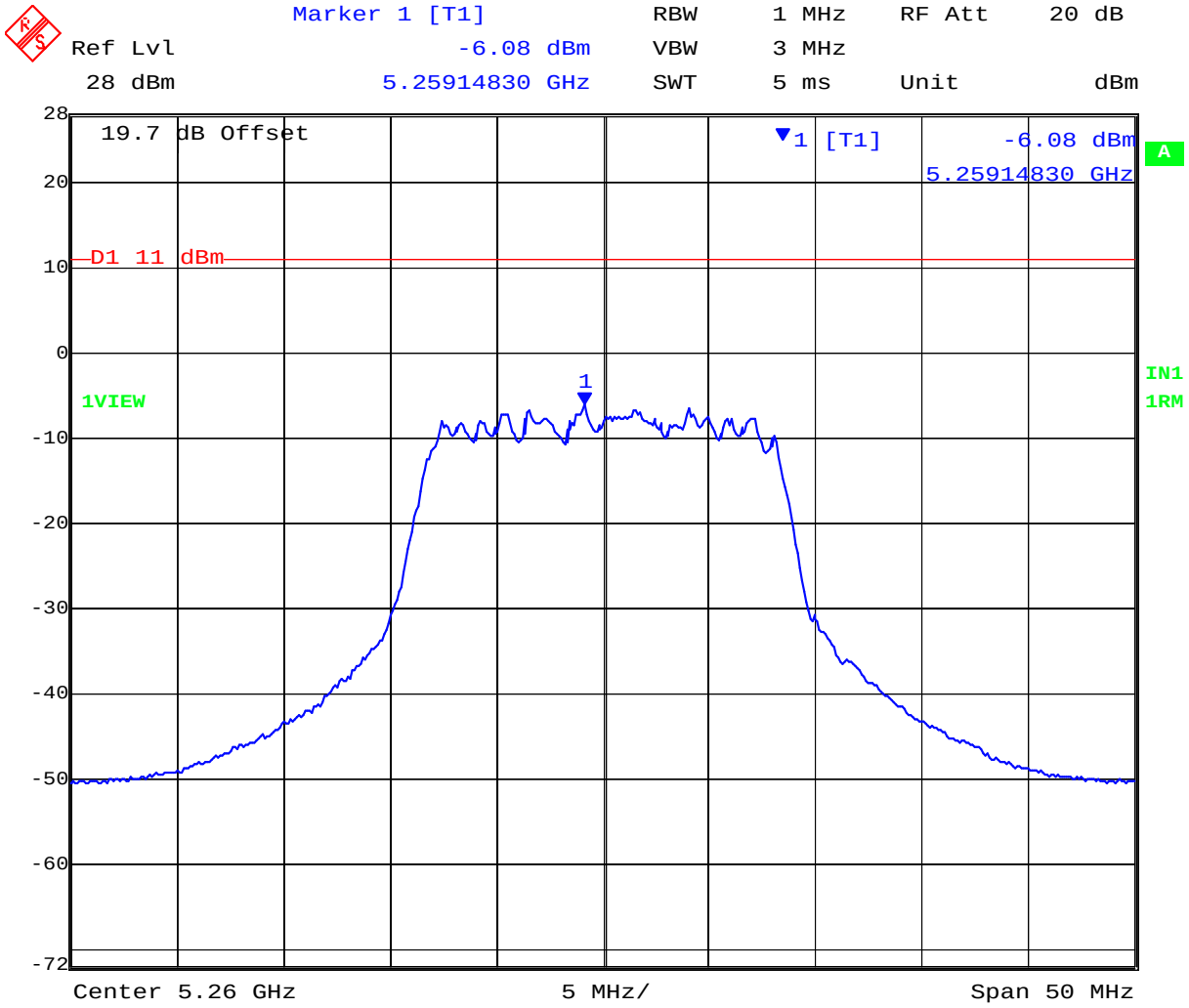


| | | | | | | |
|---|---|---|---|---|---|---|
| **Test Conditions:** | 15.407 (a) | | **Rel. Humidity (%):** | 35 | to | 42 |
| **Variant:** | 802.11a | | **Ambient Temp. (ºC):** | 19 | to | 22 |
| **TPC:** | HIGH | | **Pressure (mBars):** | 998 | to | 1003 |
| **Modulation:** | ON | | **Duty Cycle (%):** | 100 | | |
| **Beam Forming Gain (Y):** | N/A | dB | **Antenna Gain:** | 24 | dBi | |
| **Applied Voltage:** | 48.0 | Vdc | **Antenna Ports (N):** | 1 | | |
| **Notes 1:** | | | | | | |
| **Notes 2:** | | | | | | |

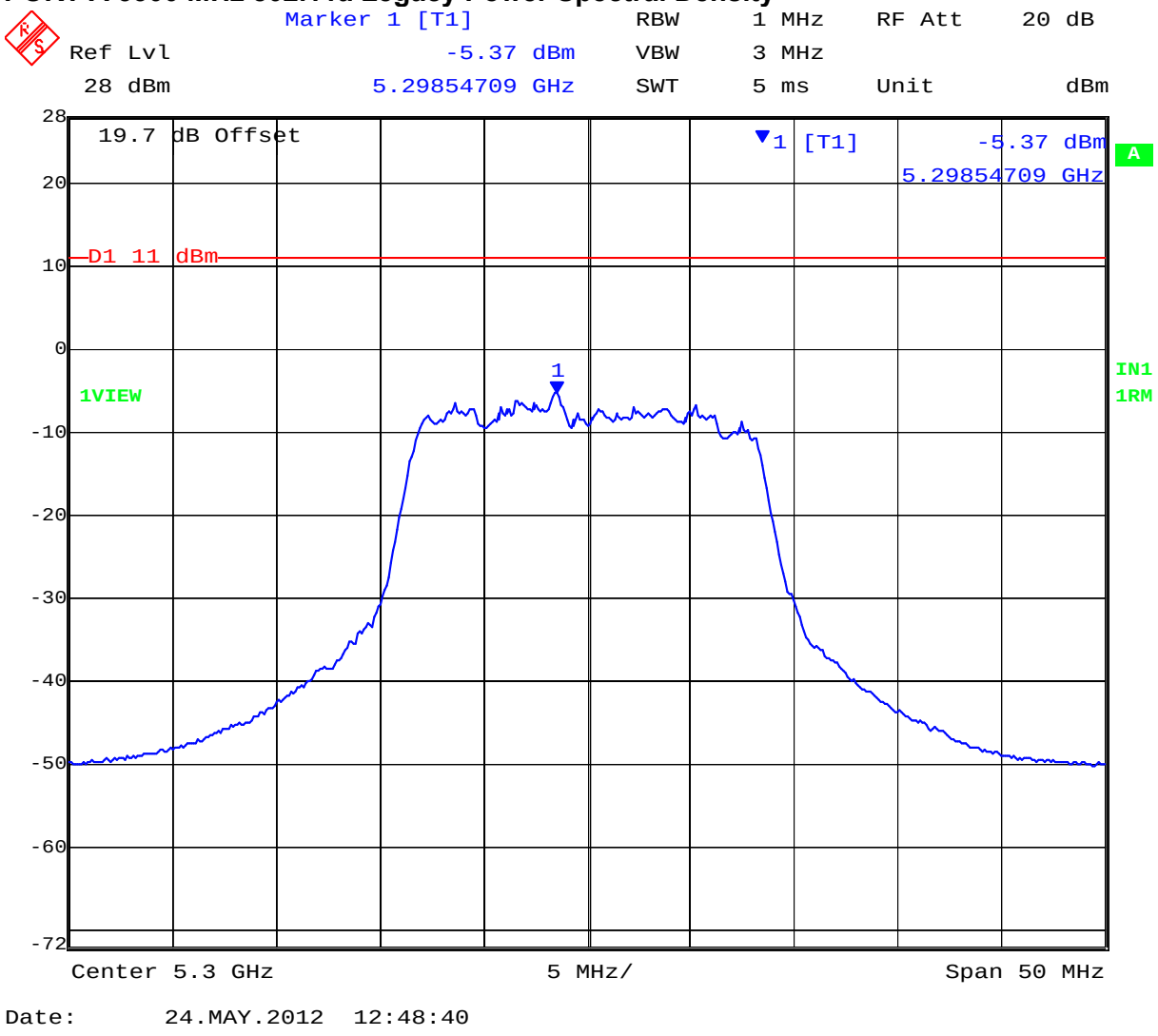
| **Test Frequency** | **Measured Peak Power RF Port (dBm)** | | | | **Correction factor** | **Peak Power Spectral Density** | **Limit** | **Margin** |
|---|---|---|---|---|---|---|---|---|
| **MHz** | **a** | **b** | **c** | **d** | **10Log(N)** | **dBm** | **dBm** | **dB** |
| 5260 | -6.08 | -- | -- | -- | 0.00 | -6.08 | 11.00 | -17.08 |
| 5300 | -5.37 | -- | -- | -- | 0.00 | -5.37 | 11.00 | -16.37 |
| 5320 | -6.17 | -- | -- | -- | 0.00 | -6.17 | 11.00 | -17.17 |

| | |
|---|---|
| **Measurement uncertainty:** | ±1.33 dB |

## PORT A 5,260 MHZ 802.11A LEGACY POWER SPECTRAL DENSITY



## PORT A 5300 MHz 802.11a Legacy Power Spectral Density



## PORT A 5,320 MHz 802.11a Legacy Power Spectral Density

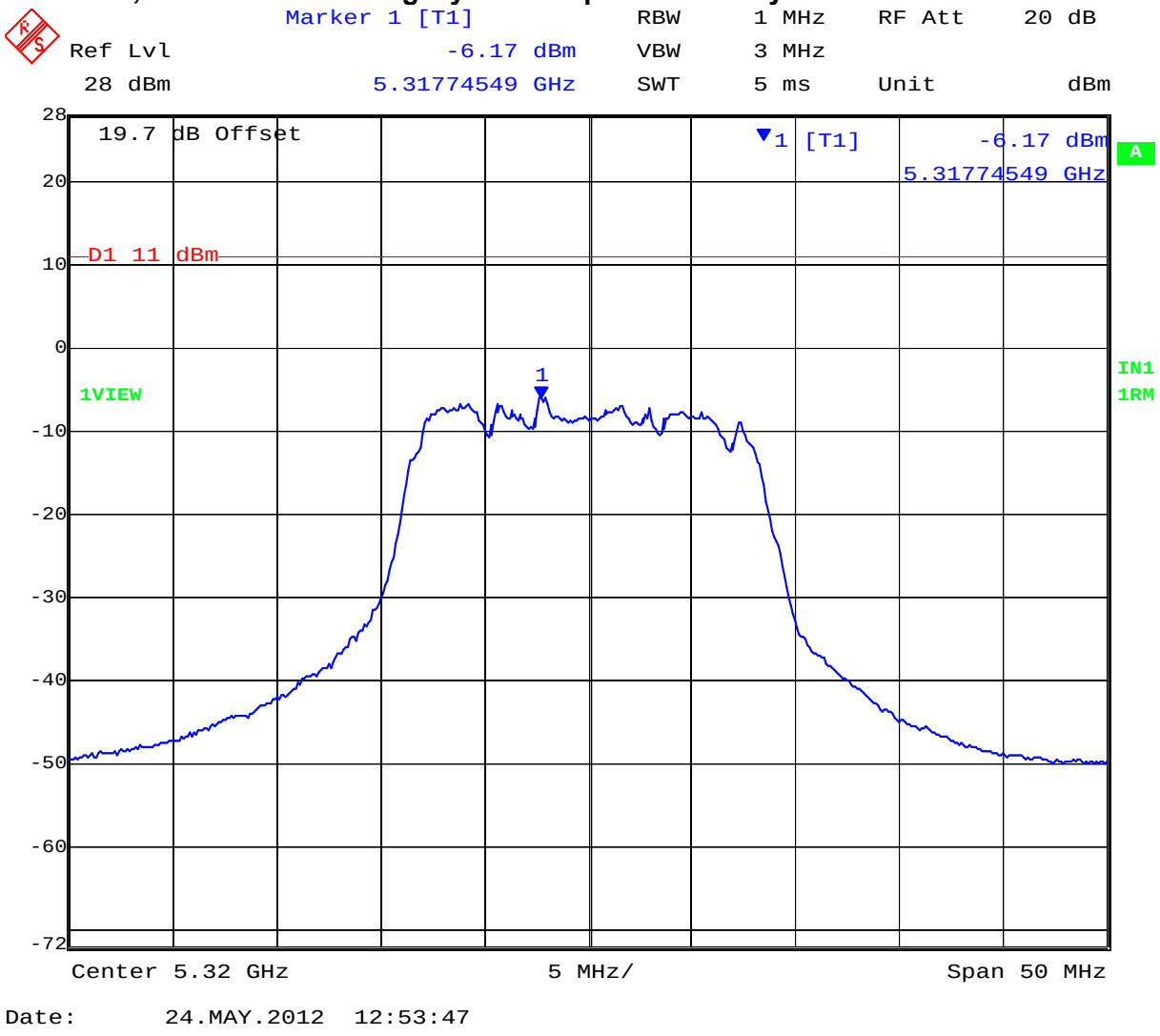


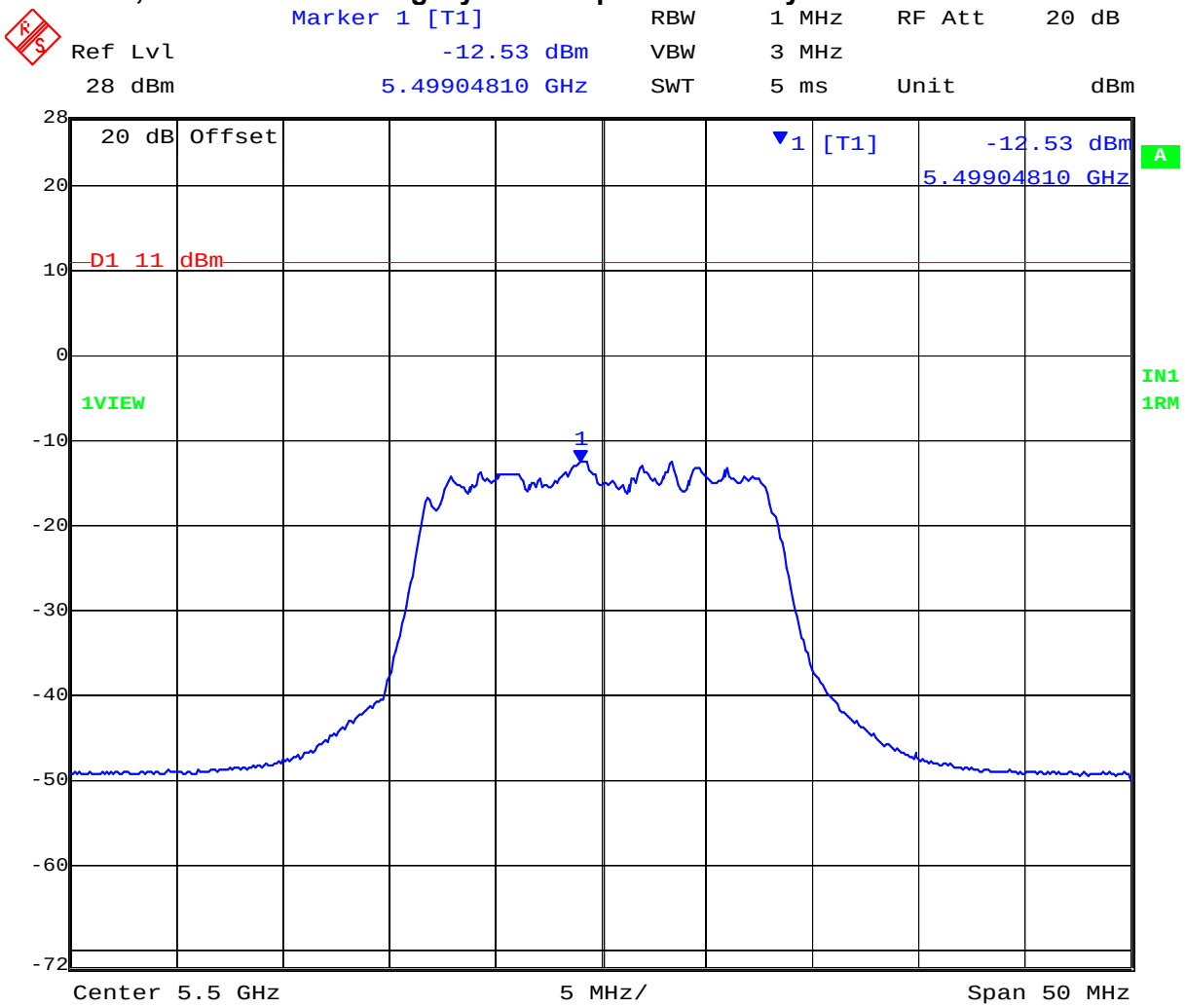
TABLE OF RESULTS – **802.11a Legacy 5470 - 5725 MHz**

| | | | | | |
|---|---|---|---|---|---|
| **Test Conditions:** | 15.407 (a) | | **Rel. Humidity (%):** | 35 to 42 | |
| **Variant:** | 802.11a | | **Ambient Temp. (ºC):** | 19 to 22 | |
| **TPC:** | HIGH | | **Pressure (mBars):** | 998 to 1003 | |
| **Modulation:** | ON | | **Duty Cycle (%):** | 100 | |
| **Beam Forming Gain (Y):** | N/A | dB | **Antenna Gain:** | 31 dBi | |
| **Applied Voltage:** | 48.0 | Vdc | **Antenna Ports (N):** | 1 | |
| **Notes 1:** | | | | | |
| **Notes 2:** | | | | | |

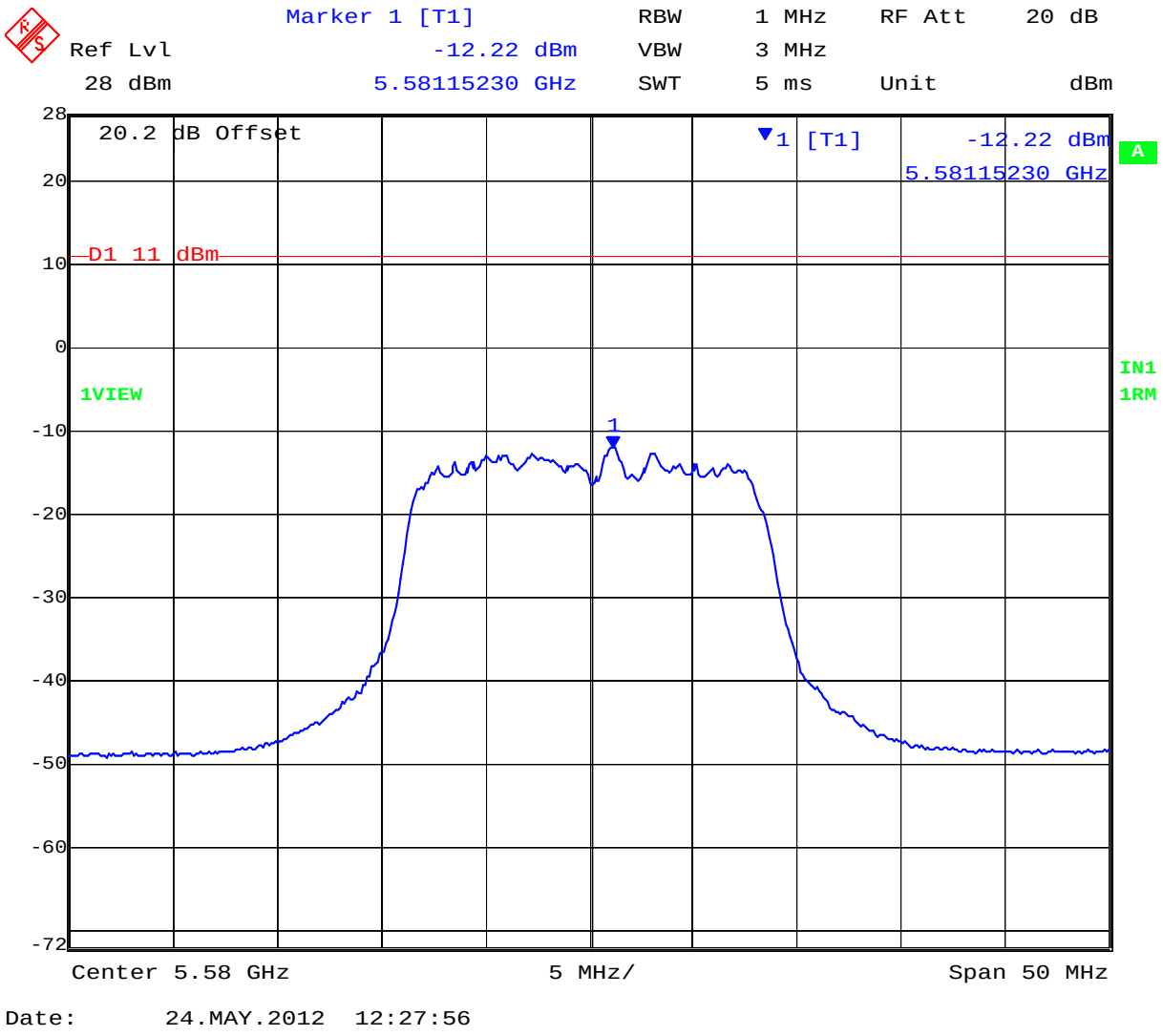
| **Test Frequency** | **Measured Peak Power** | | | | **Correction factor** | **Peak Power Spectral Density** | **Limit** | **Margin** |
|---|---|---|---|---|---|---|---|---|
| | **RF Port (dBm)** | | | | | | | |
| **MHz** | **a** | **b** | **c** | **d** | **10Log(N)** | **dBm** | **dBm** | **dB** |
| 5500 | -12.53 | -- | -- | -- | 0.00 | -12.53 | 11.00 | -23.53 |
| 5580 | -12.22 | -- | -- | -- | 0.00 | -12.22 | 11.00 | -23.22 |
| 5700 | -12.78 | -- | -- | -- | 0.00 | -12.78 | 11.00 | -23.78 |

| | |
|---|---|
| **Measurement uncertainty:** | ±1.33 dB |

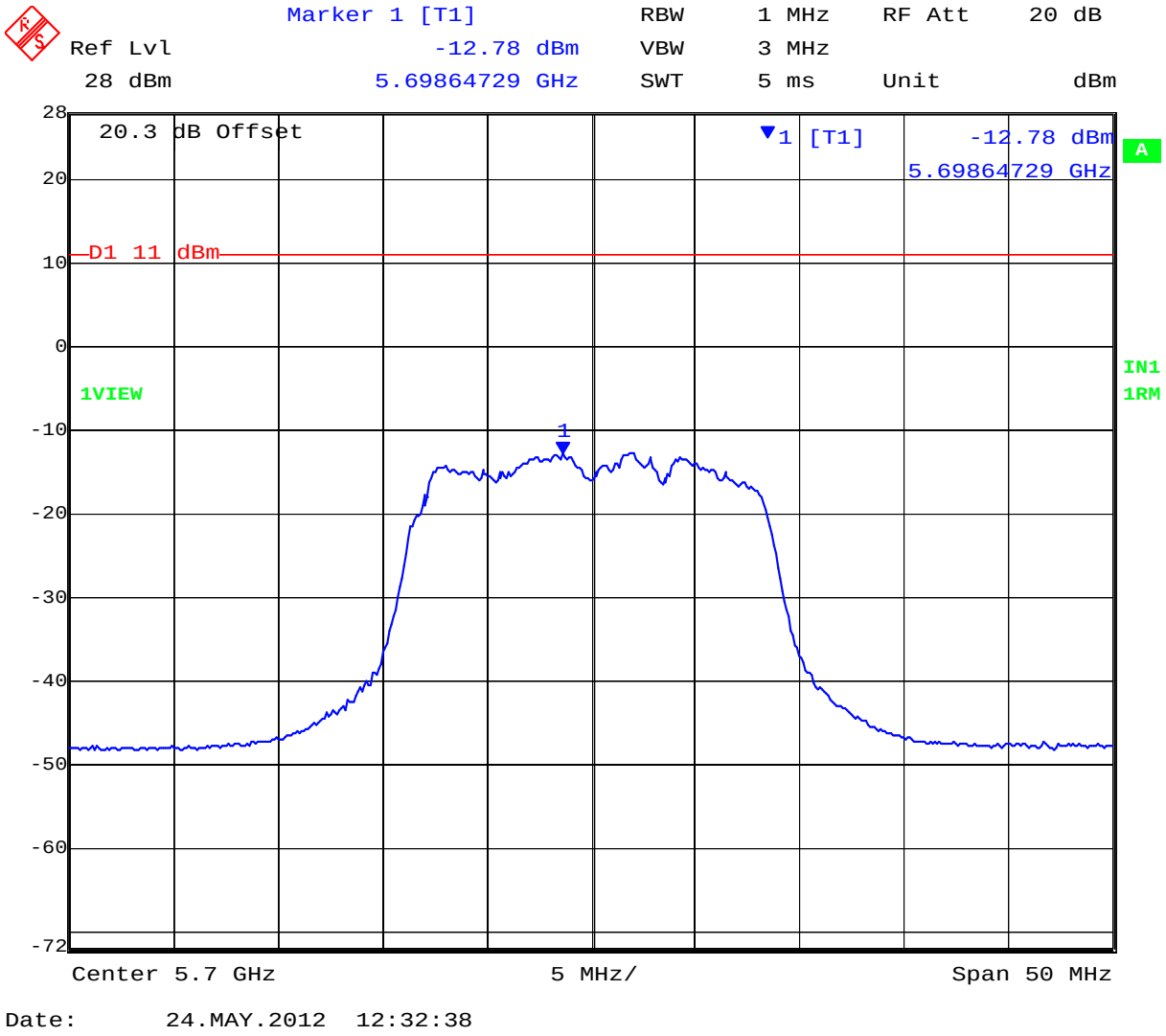
## PORT A 5,500 MHz 802.11a Legacy Power Spectral Density



## PORT A 5,580 MHz 802.11a Legacy Power Spectral Density



## PORT A 5,700 MHz 802.11a Legacy Power Spectral Density



## Specification

**FCC, Part 15 §15.407 (a)(1), (a)(2)**
**5150 – 5250 MHz**
**(a)(1)** The peak power spectral density shall not exceed +4 dBm in any 1 megahertz band.

**5250 – 5350 MHz & 5470 – 5725 MHz**
**(a)(2)** The peak power spectral density shall not exceed +11 dBm in any 1 megahertz band.

**Industry Canada RSS-210** § **A9.2(1), A9.2(2)**
**5150 – 5250 MHz**
§ **A9.2(1)** The eirp spectral density shall not exceed +10 dBm in any 1 MHz band

**5250 – 5350 MHz & 5470 – 5725 MHz**
§ **A9.2(2)** The power spectral density shall not exceed +11 dBm in any 1 MHz band

## Laboratory Measurement Uncertainty for Spectral Density

| | |
|---|---|
| Measurement uncertainty | ±1.33 dB |

## Traceability

| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-01 'Measuring RF Output Power' | 0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117 |

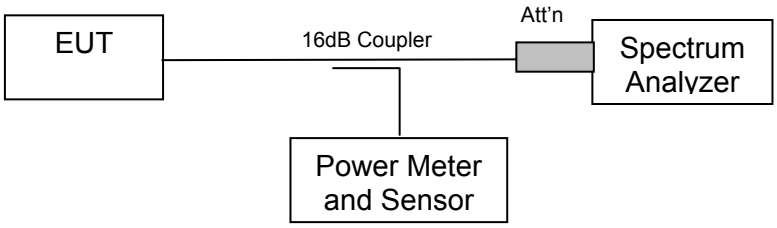
### 5.1.4. Peak Excursion Ratio

**FCC, Part 15 Subpart C §15.407(a)(6)**

**Test Procedure**

Normative Reference (xi) Section 2.1 Measurement Procedure DA 02-2138 "Measurement Procedure Updated for Peak Transmit Power in the UNII Bands" was implemented to determine the Peak Excursion Ratio. This is a conducted measurement using a spectrum analyzer. The Peak Excursion Ratio is the difference in amplitude (dB) between the two traces.

**Test Measurement Set up**




Measurement set up for Peak Excursion Ratio

**Measurement Results for Peak Excursion Ratio**

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57% Pressure: 999 to 1012 mbar

Radio Parameters
Duty Cycle: 100%
Output: Modulated Carrier
Power: Maximum Default Power

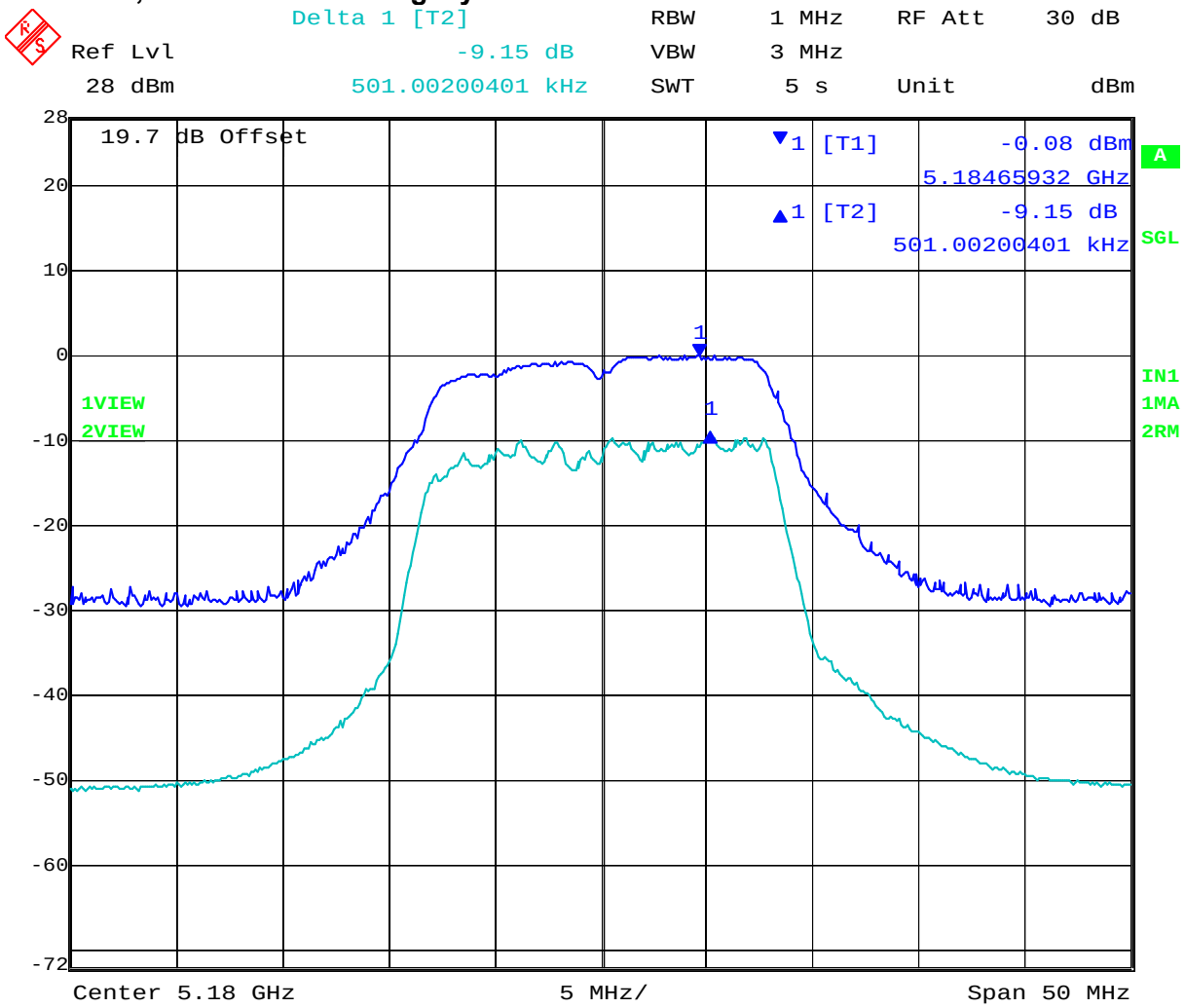
TABLE OF RESULTS – **802.11a Legacy 5150 – 5250 MHz**

| | | | |
|---|---|---|---|
| **Test Conditions:** | 15.407 (a) | **Rel. Humidity (%):** | 35 to 42 |
| **Variant:** | 802.11a | **Ambient Temp. (ºC):** | 19 to 22 |
| **TPC:** | HIGH | **Pressure (mBars):** | 998 to 1003 |
| **Modulation:** | ON | **Duty Cycle (%):** | 100 |
| **Beam Forming Gain (Y):** | N/A dB | **Antenna Gain:** | 20 dBi |
| **Applied Voltage:** | 48.0 Vdc | | |
| **Notes 1:** | | | |
| **Notes 2:** | | | |

| Test Frequency | Trace Δ Marker | | | | Limit | Margin |
|---|---|---|---|---|---|---|
| | Port A | Port B | Port C | Port D | | |
| MHz | dB | dB | dB | dB | dB | dB |
| 5180 | -9.15 | -- | -- | -- | -13.00 | -3.86 |
| 5200 | -9.11 | -- | -- | -- | | -3.90 |
| 5240 | -8.96 | -- | -- | -- | | -4.04 |

| | |
|---|---|
| **Measurement uncertainty:** | ±1.33 dB |

## PORT A 5,180 MHz 802.11a Legacy Peak Excursion Ratio

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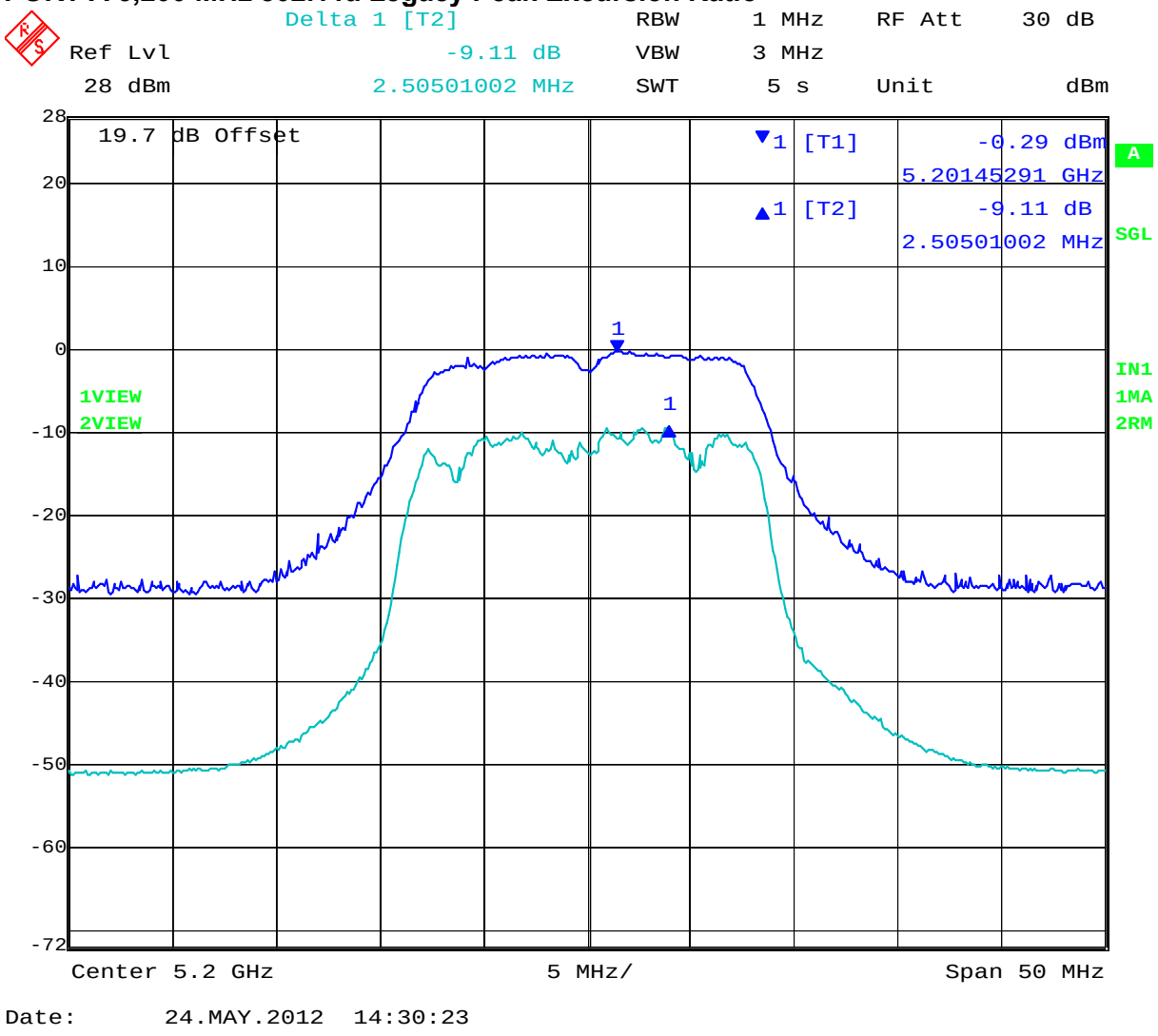
## PORT A 5,200 MHz 802.11a Legacy Peak Excursion Ratio



## PORT A 5,240 MHz 802.11a Legacy Peak Excursion Ratio

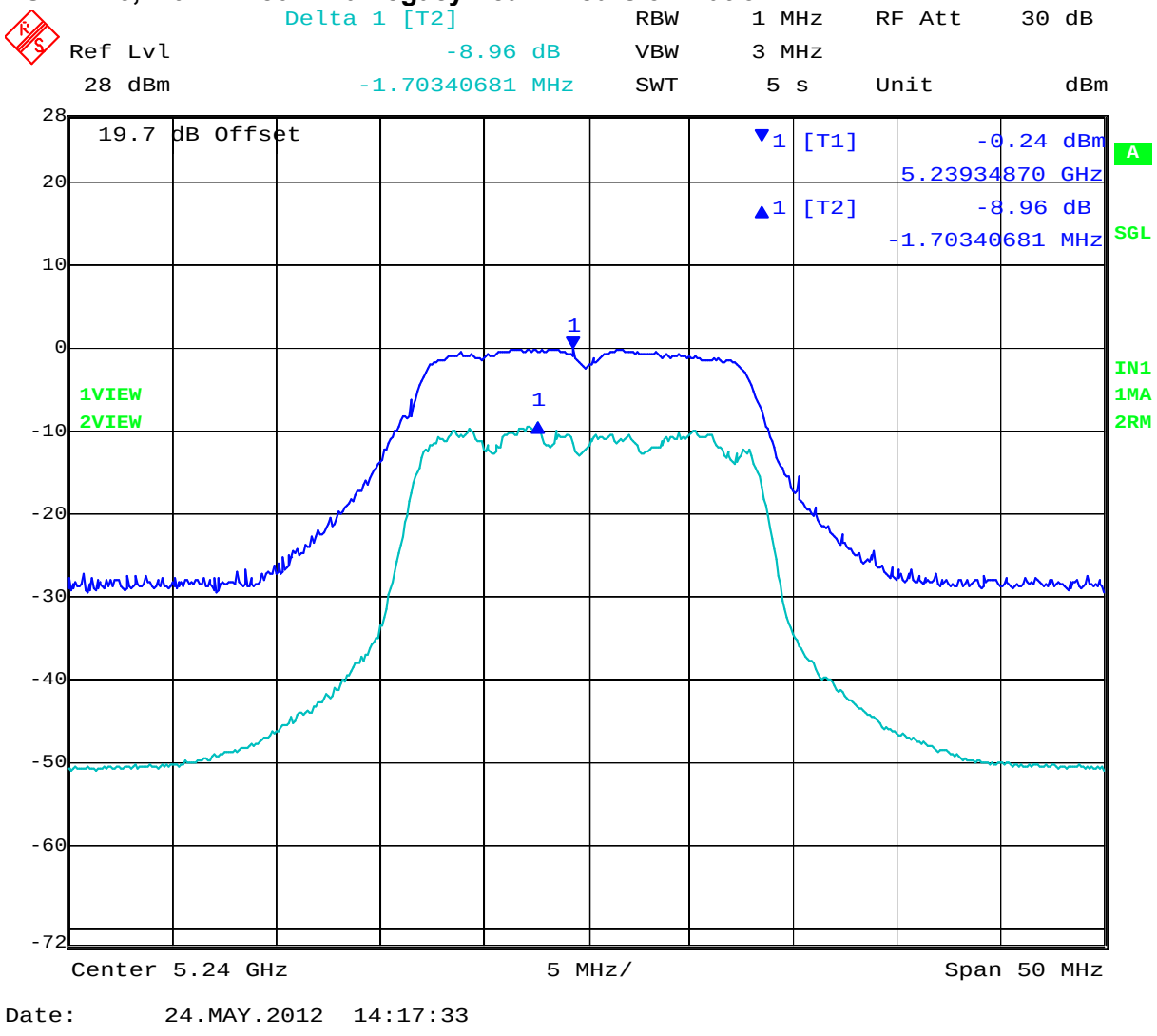


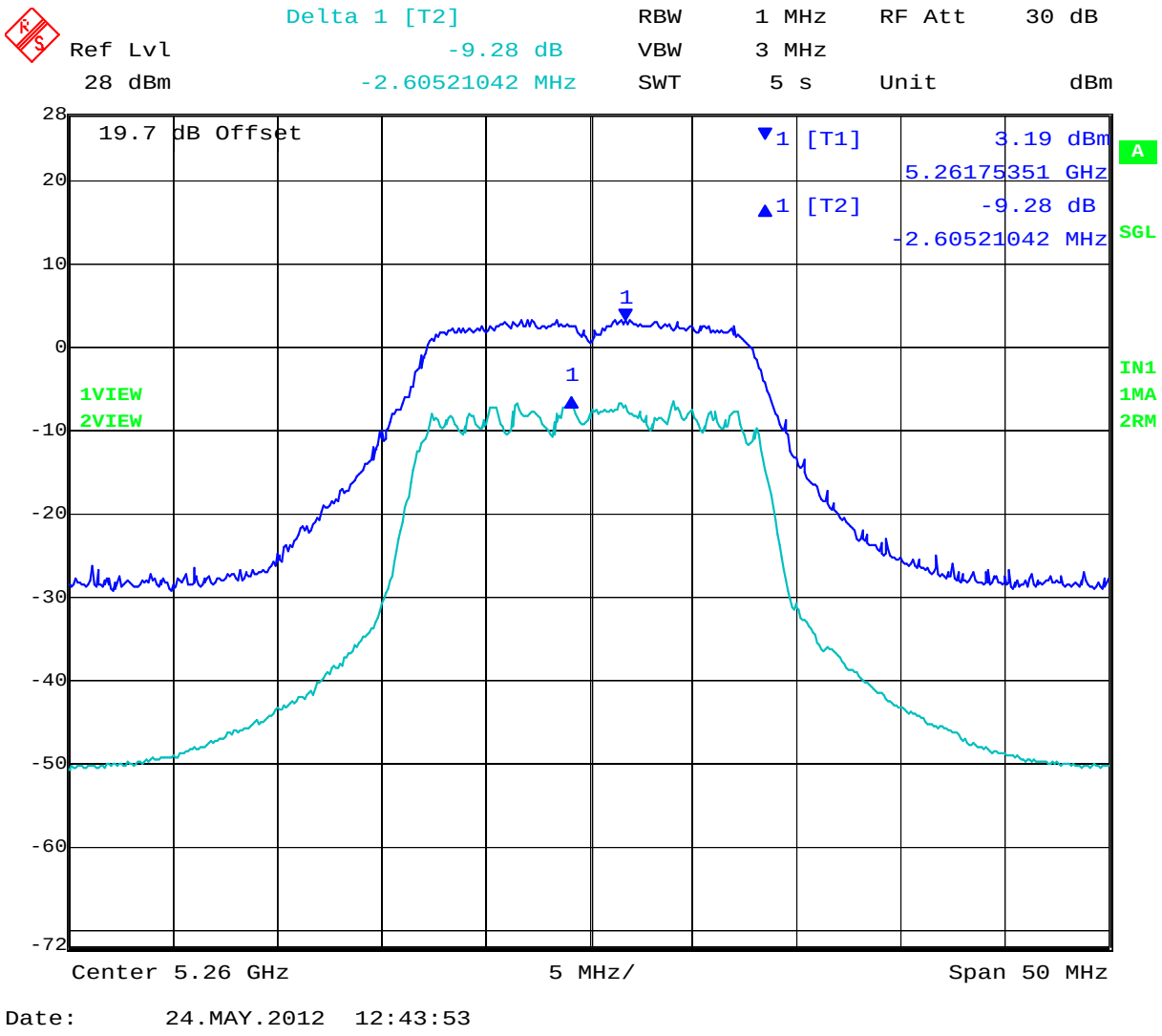
TABLE OF RESULTS – **802.11a Legacy 5250 -5350 MHz**

| | | | |
|---|---|---|---|
| **Test Conditions:** | 15.407 (a) | **Rel. Humidity (%):** | 35 to 42 |
| **Variant:** | 802.11a | **Ambient Temp. (ºC):** | 19 to 22 |
| **TPC:** | HIGH | **Pressure (mBars):** | 998 to 1003 |
| **Modulation:** | ON | **Duty Cycle (%):** | 100 |
| **Beam Forming Gain (Y):** | N/A dB | **Antenna Gain:** | 24 dBi |
| **Applied Voltage:** | 48.0 Vdc | | |
| **Notes 1:** | | | |
| **Notes 2:** | | | |

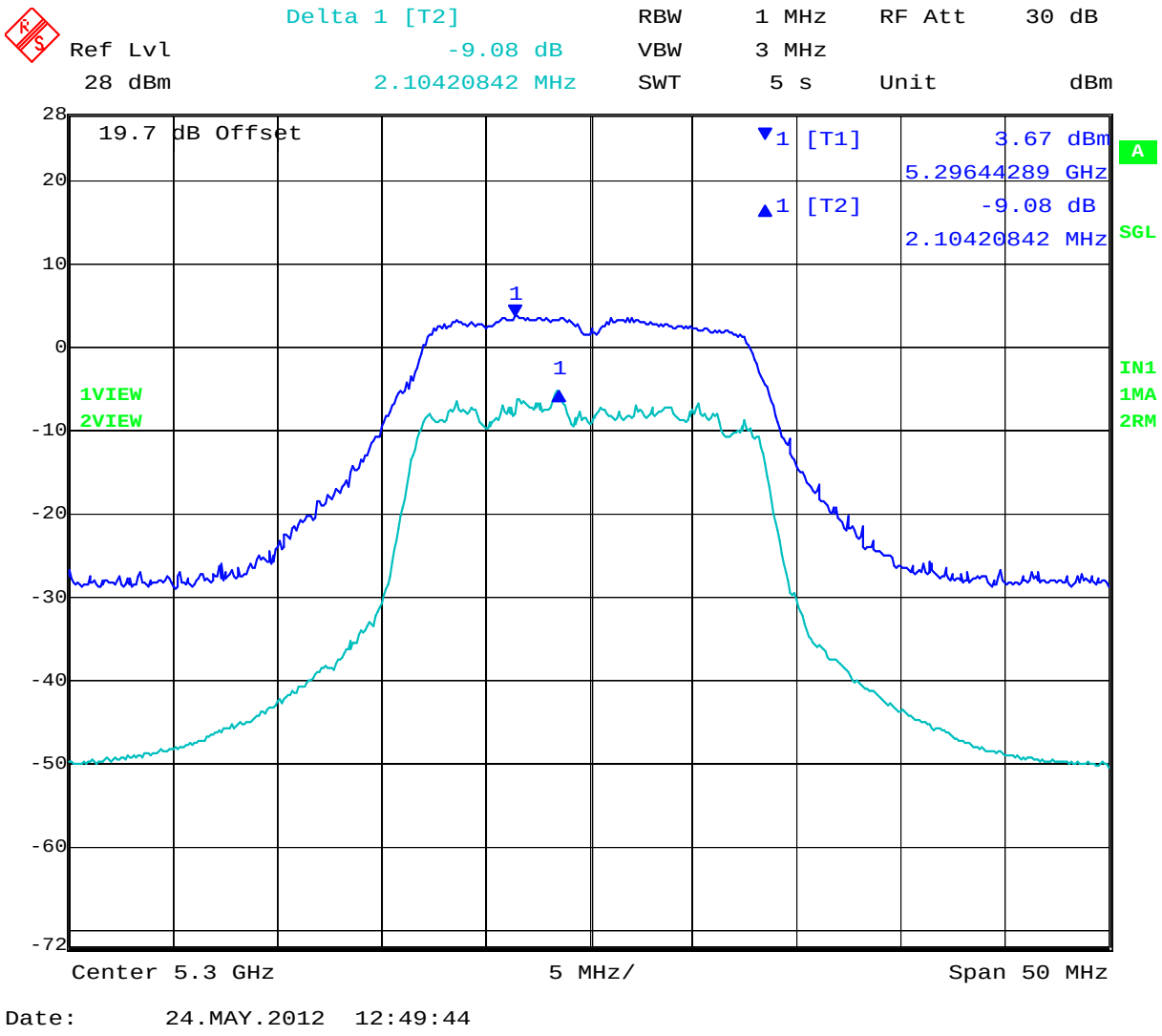
| Test Frequency | Trace Δ Marker | | | | Limit | Margin |
|---|---|---|---|---|---|---|
| | Port A | Port B | Port C | Port D | | |
| MHz | dB | dB | dB | dB | dB | dB |
| 5260 | -9.28 | -- | -- | -- | -13.00 | -3.72 |
| 5300 | -9.08 | -- | -- | -- | | -3.92 |
| 5320 | -9.37 | -- | -- | -- | | -3.63 |

| | |
|---|---|
| **Measurement uncertainty:** | ±1.33 dB |

## PORT A 5,260 MHz 802.11a Legacy Peak Excursion Ratio



## PORT A 5300 MHz 802.11a Legacy Peak Excursion Ratio



## PORT A 5,320 MHz 802.11a Legacy Peak Excursion Ratio

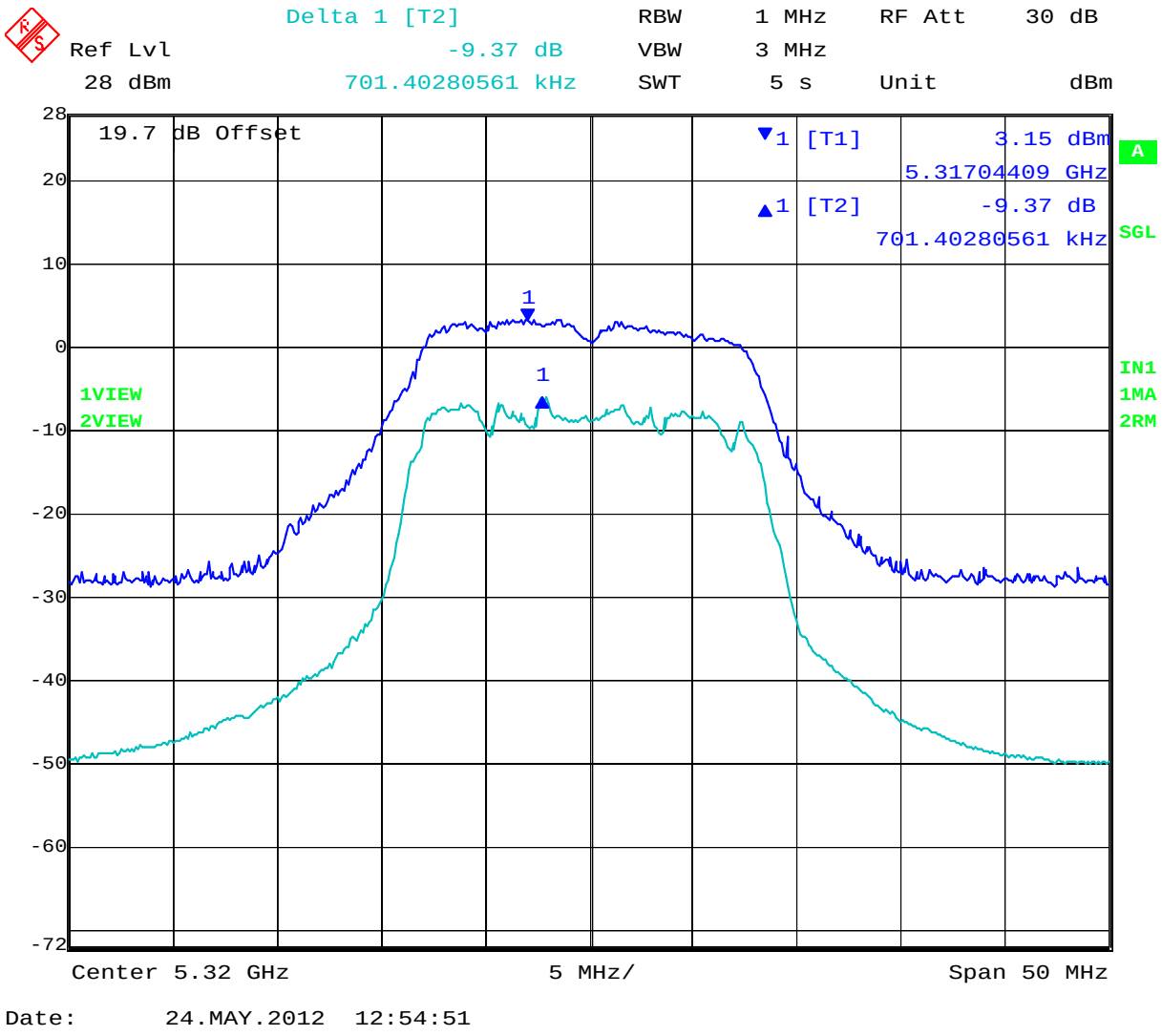


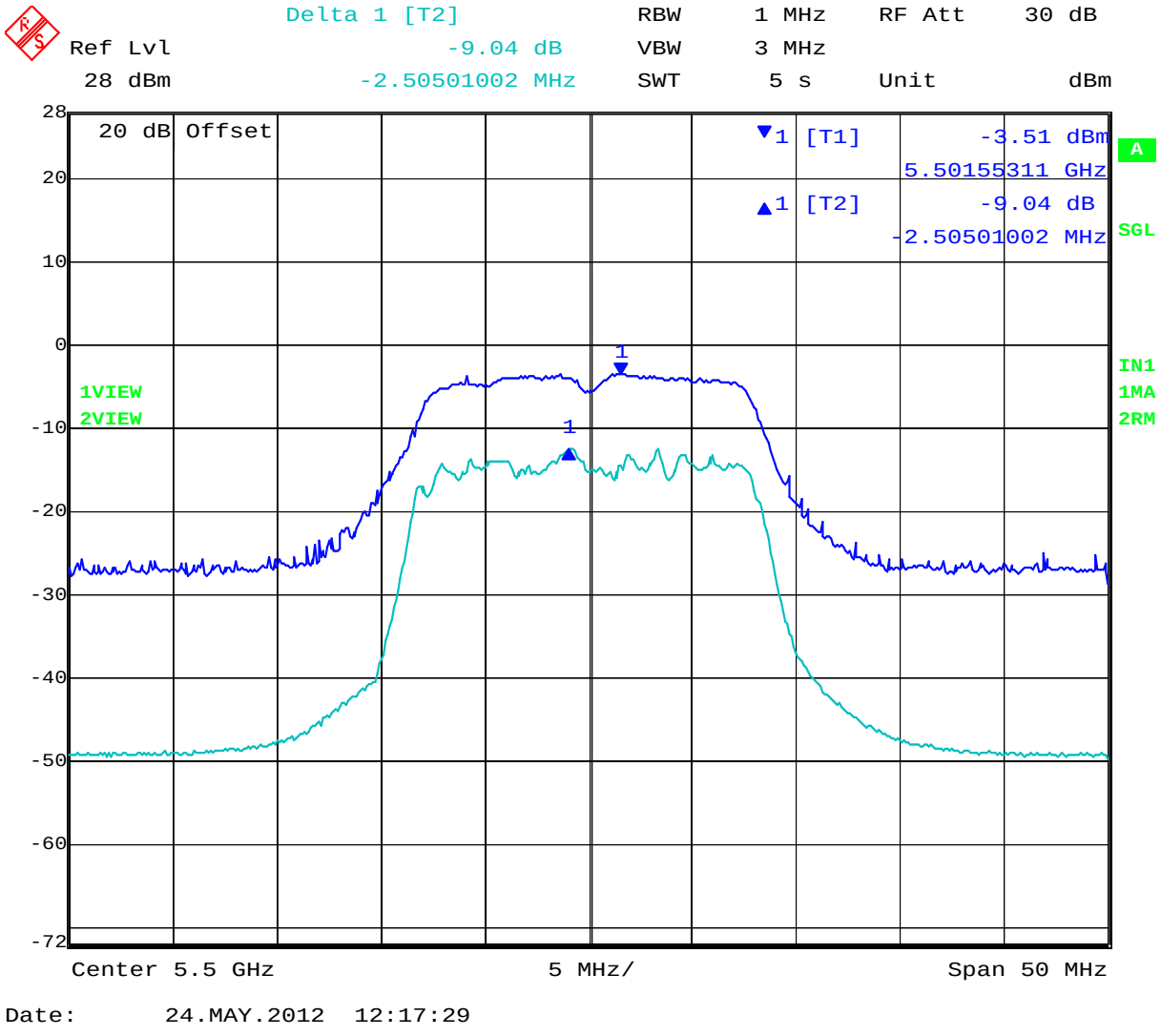
TABLE OF RESULTS – **802.11a Legacy 5470 - 5725 MHz**

| | | | |
|---|---|---|---|
| **Test Conditions:** | 15.407 (a) | **Rel. Humidity (%):** | 35 to 42 |
| **Variant:** | 802.11a | **Ambient Temp. (ºC):** | 19 to 22 |
| **TPC:** | HIGH | **Pressure (mBars):** | 998 to 1003 |
| **Modulation:** | ON | **Duty Cycle (%):** | 100 |
| **Beam Forming Gain (Y):** | N/A dB | **Antenna Gain:** | 31 dBi |
| **Applied Voltage:** | 48.0 Vdc | | |
| **Notes 1:** | | | |
| **Notes 2:** | | | |

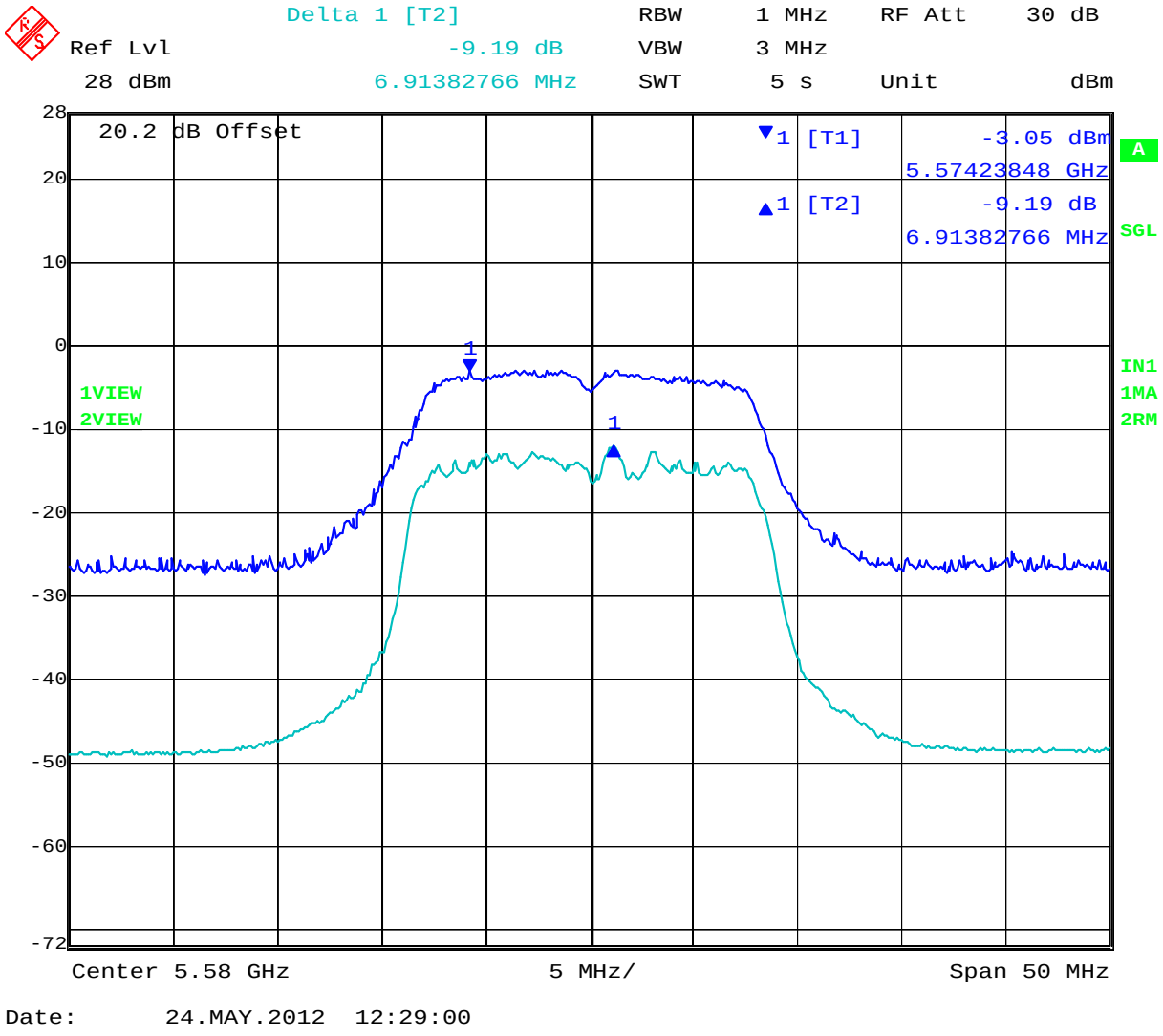
| Test Frequency | Trace Δ Marker | | | | Limit | Margin |
|---|---|---|---|---|---|---|
| | Port A | Port B | Port C | Port D | | |
| MHz | dB | dB | dB | dB | dB | dB |
| 5500 | -9.04 | -- | -- | -- | -13.00 | -3.96 |
| 5580 | -9.19 | -- | -- | -- | | -3.81 |
| 5700 | -9.38 | -- | -- | -- | | -3.62 |

| | |
|---|---|
| **Measurement uncertainty:** | ±1.33 dB |

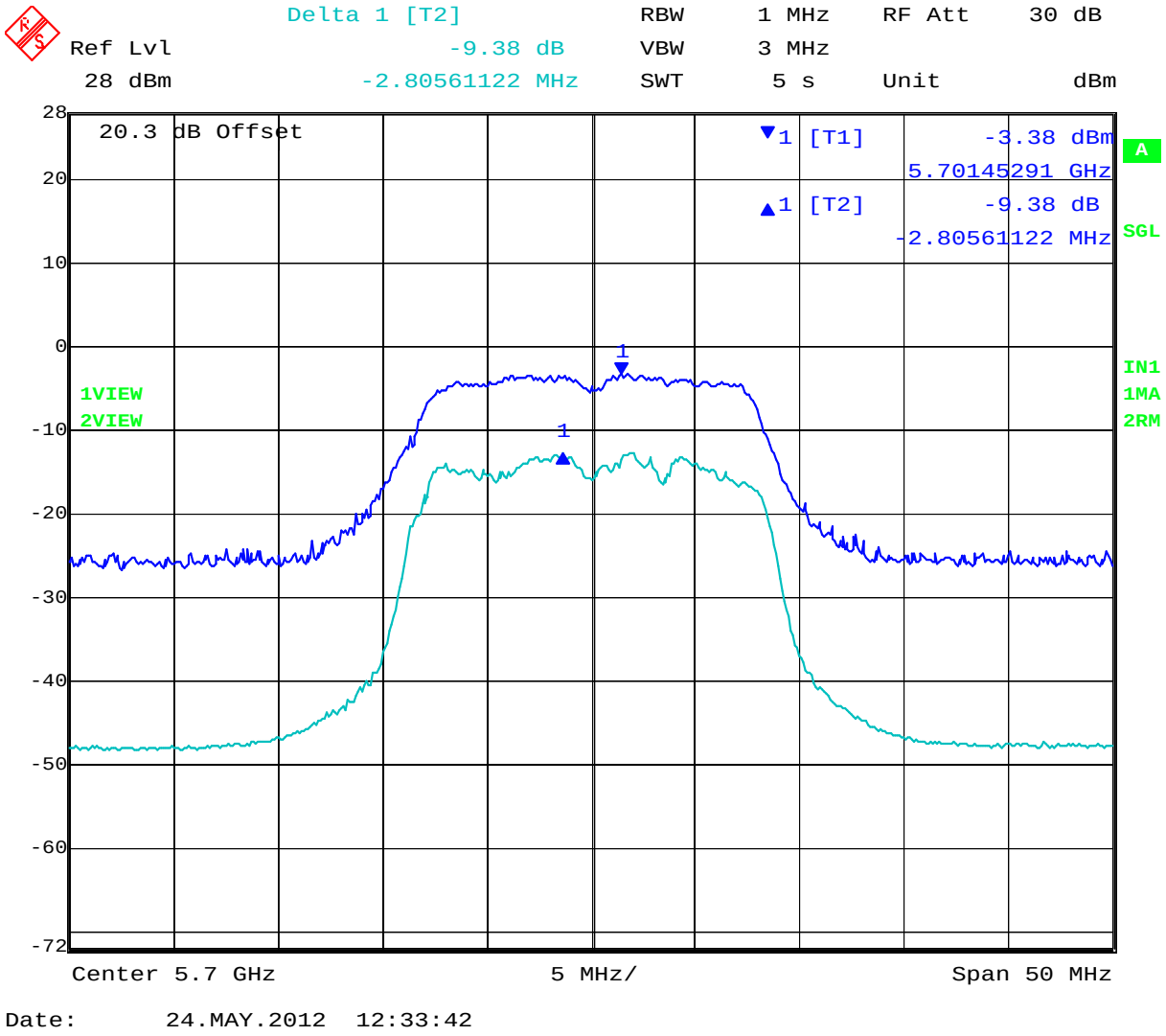
## PORT A 5,500 MHz 802.11a Legacy Peak Excursion Ratio



## PORT A 5,580 MHz 802.11a Legacy Peak Excursion Ratio



## PORT A 5,700 MHz 802.11a Legacy Peak Excursion Ratio



## Specification

## Limits

| |
|---|
| **§15.407 (a)(6)** The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the peak transmit power (measured as specified in this paragraph) shall not exceed 13dB across any 1MHz bandwidth or the emission bandwidth whichever is less |

## Laboratory Measurement Uncertainty for Spectrum Measurement

| | |
|---|---|
| Measurement uncertainty | ± 2.81dB |

## Traceability

| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask' | 0158, 0287, 0252, 0313, 0314, 0070, 0116, 0117 |

### 5.1.5. Frequency Stability

**FCC, Part 15 Subpart C §15.407(g)**
**Industry Canada RSS-210 §2.1**

**Test Procedure**

The manufacturer of the equipment is responsible for ensuring that the frequency stability is such that emissions are always maintained within the band of operation under all conditions.

**Manufacturer Declaration**

The frequency stability of the reference oscillator sets the frequency stability of the RF transceiver signals. Therefore all of the RF signals should have ±20ppm stability.
This stability accounts for room temp tolerance of the crystal oscillator circuit, frequency variation across temperature, and crystal ageing.

±20ppm at 5.250 GHz translates to a maximum frequency shift of ±105 KHz. As the edge of the channels is at least one MHz from either of the band edges, ±105 KHz is more than sufficient to guarantee that the intentional emission will remain in the band over the entire operating range of the EUT.

## Specification

## Limits

| |
|---|
| **§15.407 (g)** Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual. |

### 5.1.6. Maximum Permissible Exposure

**FCC, Part 15 Subpart C §15.407(f)**
**Industry Canada RSS-Gen §5.5**

**Calculations for Maximum Permissible Exposure Levels**

Power Density = Pd (mW/cm$^2$) = EIRP/(4πd$^2$)

EIRP = P * G

P = Peak output power (mW)

G = Antenna numeric gain (numeric)

d = Separation distance (cm)

Numeric Gain = 10 ^ (G (dBi)/10)

The Trilliant Gateway has a single transmitter.

Because the EUT belongs to the General Population/Uncontrolled Exposure the limit of power density is 1.0 mW/cm$^2$

| Freq. Band (MHz) | Antenna Gain (dBi) | Numeric Gain (numeric) | Peak Output Power (dBm) | Peak Output Power (mW) | Calculated Safe Distance @ 1mW/cm$^2$ Limit(cm) | Minimum Separation Distance (cm) |
|---|---|---|---|---|---|---|
| 5150 - 5250 | 20.0 | 100.0 | +2.18 | 1.65 | 3.6 | 20 |
| 5250 - 5350 | 24.0 | 251.2 | +5.70 | 3.71 | 8.6 | 20 |
| 5470 - 5725 | 31.0 | 1258.9 | -1.09 | 0.78 | 8.8 | 20 |

**Note:** for mobile or fixed location transmitters the minimum separation distance is 20cm, even if calculations indicate the MPE distance to be less.

**Specification**
**Maximum Permissible Exposure Limits**

**FCC §1.1310** Limit = 1mW / cm$^2$ from 1.310 Table 1

**RSS-Gen §5.5** Before equipment certification is granted, the application requirements of RSS-102 shall be met.

**Laboratory Measurement Uncertainty for Power Measurements**

| | |
|---|---|
| Measurement uncertainty | ±1.33 dB |

### 5.1.7. Radiated Emissions

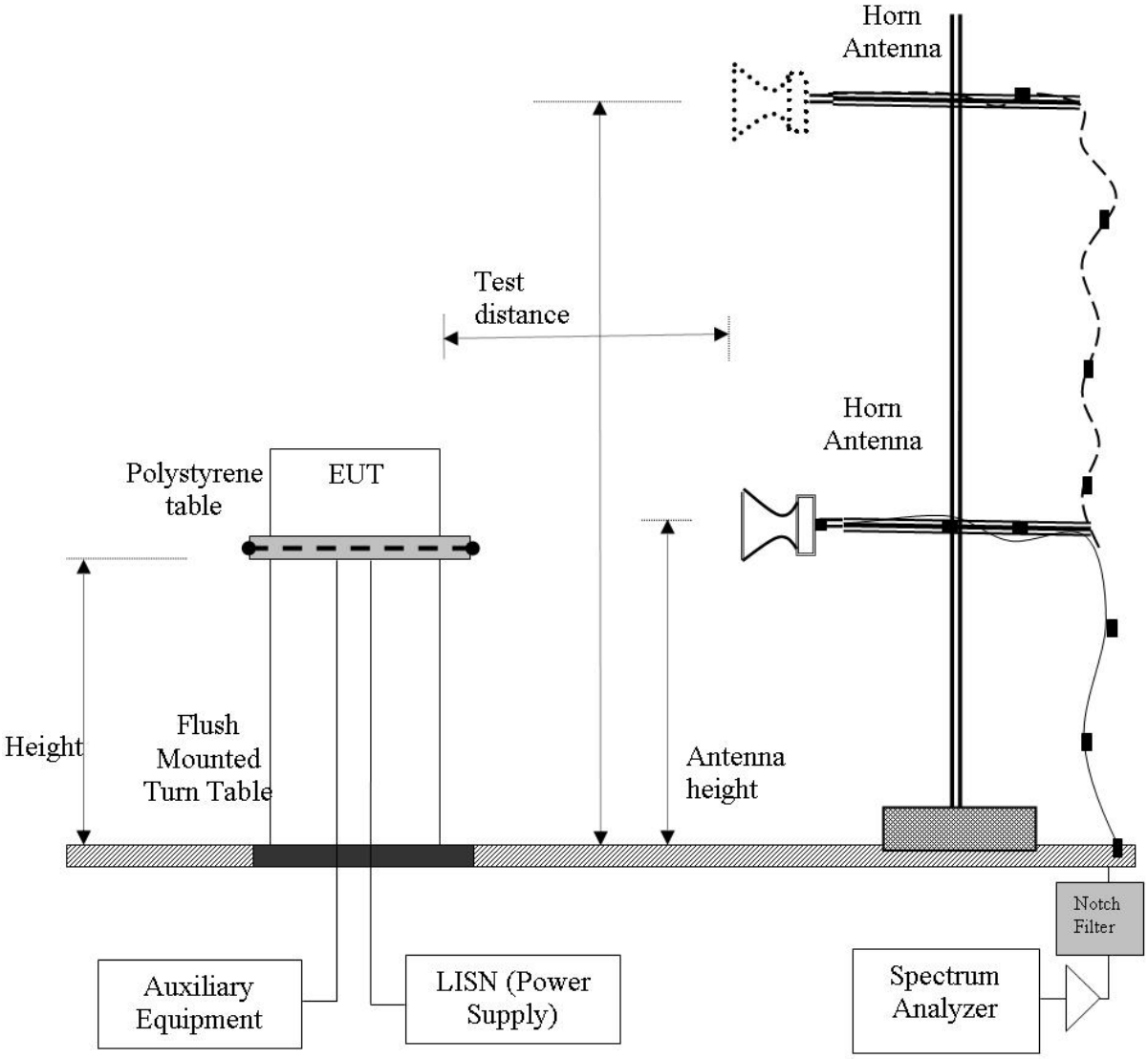
**FCC, Part 15 Subpart C §15.407(b)(2), §15.205(a)/15.209(a)**
**Industry Canada RSS-210 §A9.3(2); §2.2; §2.6; RSS-Gen §4.7**

**Test Procedure**

Testing was performed in a 3-meter anechoic chamber. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. Preliminary emissions were recorded with in Spectrum Analyzer mode, using a maximum peak detector while in peak hold mode. Depending on the frequency band spanned a notch filter and/or waveguide filter was used to remove the fundamental frequency.

All measurements on any frequency or frequencies over 1 MHz are based on the use of measurement instrumentation employing an average detector function. All measurements above 1 GHz were performed using a minimum resolution bandwidth of 1 MHz.

**Radiated Emission Measurement Setup – Above 1 GHz**



**Field Strength Calculation**
The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.

**FS = R + AF + CORR – FO**

FS = Field Strength
R = Measured Spectrum analyzer Input Amplitude
AF = Antenna Factor
**CORR = Correction Factor = CL – AG + NFL**

CL = Cable Loss
AG = Amplifier Gain
FO = Distance Falloff Factor
NFL = Notch Filter Loss or Waveguide Loss

Field Strength Calculation Example:

Given receiver input reading of 51.5 dBμV; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBμV/m

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

Level (dBμV/m) = 20 * Log (level (μV/m))

40 dBμV/m = 100 μV/m
48 dBμV/m = 250 μV/m

The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength (dBμV/m);

$$E = \frac{1000000 \times \sqrt{30P}}{3} \ \mu V/m$$

where P is the EIRP in Watts

Therefore: -27 dBm/MHz = 68.23 dBuV/m

**Note:** The data in this Section identifies that the EUT is in compliance with the -27dBm/MHz EIRP limit (68.23 dBμV/m) for out of band emissions. All out of band emissions are less than 68.23 dB μV/m.

**Specification**

**Radiated Spurious Emissions**

**15.407 (b)(2).** All emissions outside of the 5,150-5,350MHz band shall not exceed an EIRP of -27dBm/MHz.

**FCC §15.205 (a)** Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

**FCC §15.205 (a)** Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

**FCC §15.209 (a)** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

**RSS-210 §A9.3(2)** For transmitters operating in the 5250-5350 MHz band, all emissions outside the 5150-5350 MHz band shall not exceed -27 dBm/MHz e.i.r.p. Devices operating in the 5250-5350 MHz band that generate emissions in the 5150-5250 MHz band shall not exceed out of band emission limit of 27 dBm/MHz e.i.r.p. in the 5150-5250 MHz band in order to operate indoor/outdoor, or alternatively shall comply with the spectral power density for operation within the 5150-5250 MHz band and shall be labeled “for indoor use only”.

**RSS-Gen §4.7** The search for unwanted emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate of carrier frequency), or from 30 MHz , whichever is the lowest frequency, to the 5$^{th}$ harmonic of the highest frequency generated without exceeding 40 GHz.

**RSS-Gen §6** Receiver Spurious Emission Standard
If a radiated measurement is made, all spurious emissions shall comply with the limits of the following Table. The resolution bandwidth of the spectrum analyzer shall be 100 kHz for spurious emission measurements below 1.0 GHz and 1.0 MHz for measurements above 1.0 GHz

**Laboratory Measurement Uncertainty for Spectrum Measurement**

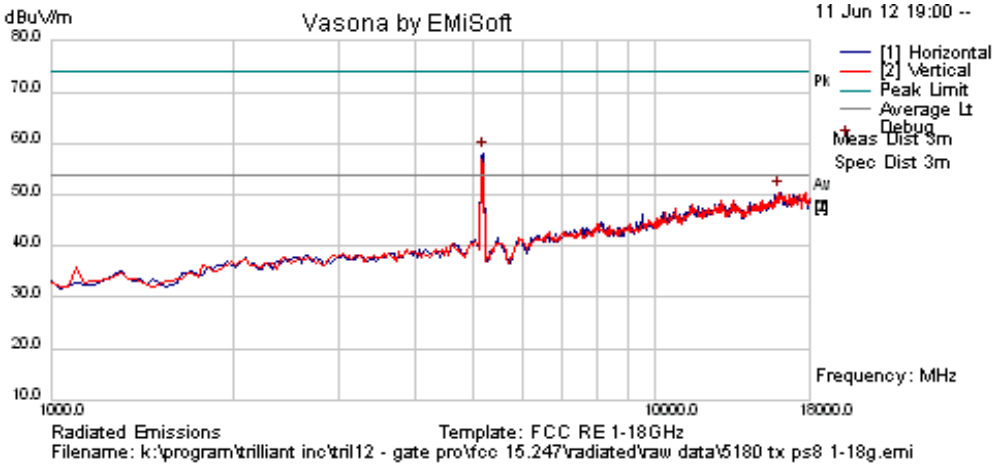
| | |
|---|---|
| **Measurement Uncertainty** | +5.6/ -4.5 dB |

**Traceability:**

| Method | Test Equipment Used |
|---|---|
| Work instruction WI-03 | 0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312 |

### 5.1.7.1. Integral Antenna

| | | | |
|---|---|---|---|
| **Test Freq.** | 5180 MHz | **Engineer** | JMH |
| **Variant** | 802.11a; 6 MB/s | **Temp (ºC)** | 26 |
| **Freq. Range** | 1-18 GHz | **Rel. Hum.(%)** | 30 |
| **Power Setting** | 8 | **Press. (mBars)** | 999 |
| **Antenna** | 20 dBi | | |
| **Test Notes 1** | TX Mode, Tx Gain = 0, PWR = 1/4 | | |
| **Test Notes 2** | Removed non conductive coating from array backplane flanges and used foil to connect to case | | |



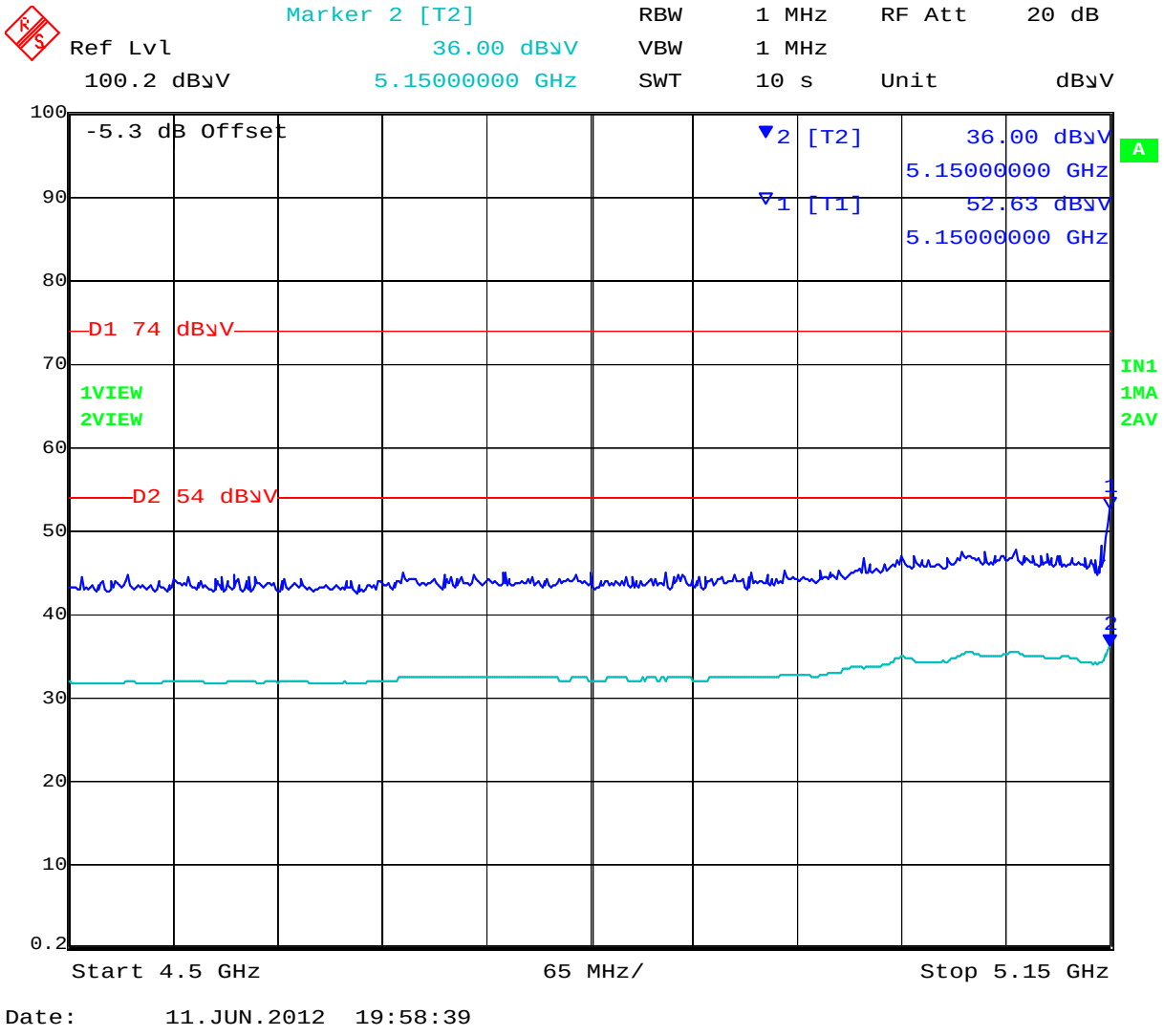

**Formally measured emission peaks**

| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5180.802 | 63.5 | 4.6 | -9.9 | 58.2 | Peak [Scan] | H | 100 | 0 | | | | FUND |
| 16024.048 | 41.2 | 9.0 | 0.2 | 50.5 | Peak [Scan] | V | 150 | 0 | | | | Noise |

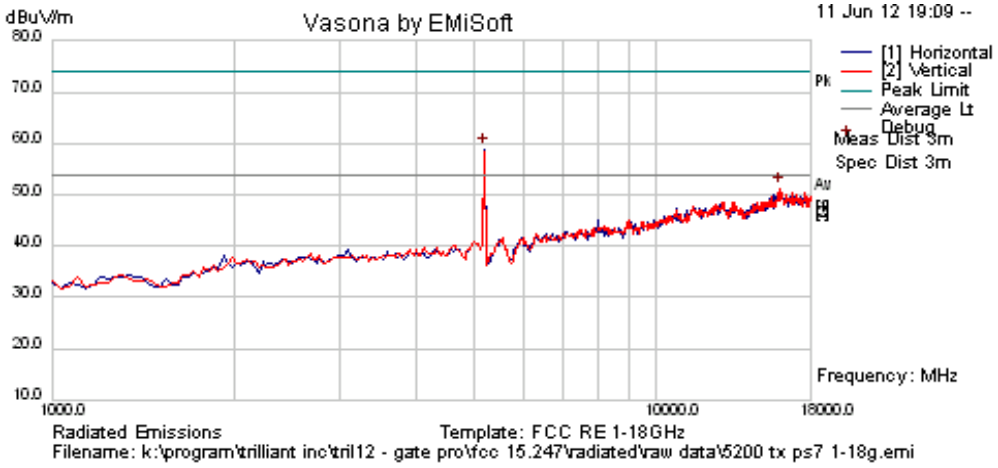
| | |
|---|---|
| Legend: | TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission |
| | RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak |

The above plot shows peak emissions.

5150 MHz Band Edge ; Power = 8



| | | | |
|---|---|---|---|
| **Test Freq.** | 5200 MHz | **Engineer** | JMH |
| **Variant** | 802.11a; 6 MB/s | **Temp (ºC)** | 26 |
| **Freq. Range** | 1-18 GHz | **Rel. Hum.(%)** | 30 |
| **Power Setting** | 7 | **Press. (mBars)** | 999 |
| **Antenna** | 20 dBi | **Duty Cycle (%)** | 0 |
| **Test Notes 1** | TX Mode, Tx Gain = 0, PWR = 1/4 | | |
| **Test Notes 2** | Removed non conductive coating from array backplane flanges and used foil to connect to case | | |



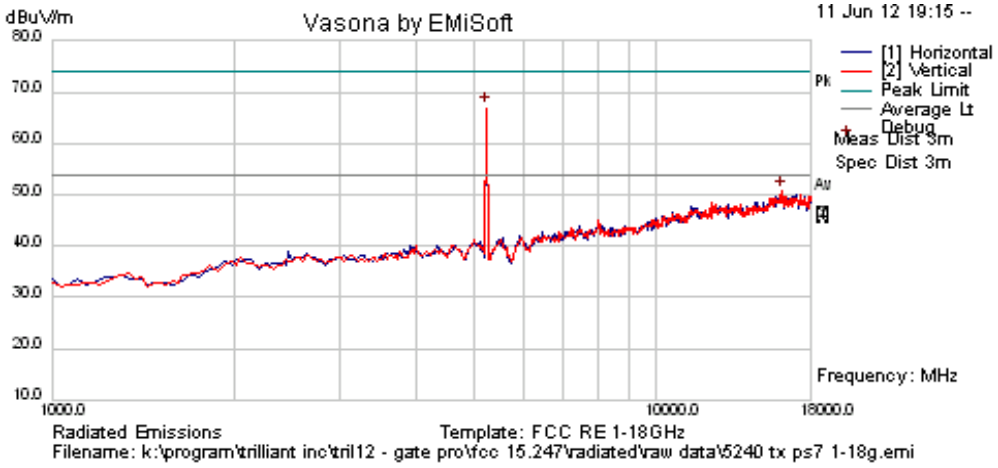

## Formally measured emission peaks

| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5192.986 | 64.2 | 4.6 | -9.9 | 58.9 | Peak [Scan] | H | 200 | 0 | | | | FUND |
| 16024.048 | 41.8 | 9.0 | 0.2 | 51.0 | Peak [Scan] | V | 100 | 0 | | | | Noise |

| | |
|---|---|
| Legend: | TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission |
| | RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak |

The above plot shows peak emissions.

| | | | |
|---|---|---|---|
| **Test Freq.** | 5240 MHz | **Engineer** | JMH |
| **Variant** | 802.11a; 6 MB/s | **Temp (ºC)** | 26 |
| **Freq. Range** | 1-18 GHz | **Rel. Hum.(%)** | 30 |
| **Power Setting** | 7 | **Press. (mBars)** | 999 |
| **Antenna** | 20 dBi | **Duty Cycle (%)** | 0 |
| **Test Notes 1** | TX Mode, Tx Gain = 0, PWR = 1/4 | | |
| **Test Notes 2** | Removed non conductive coating from array backplane flanges and used foil to connect to case | | |



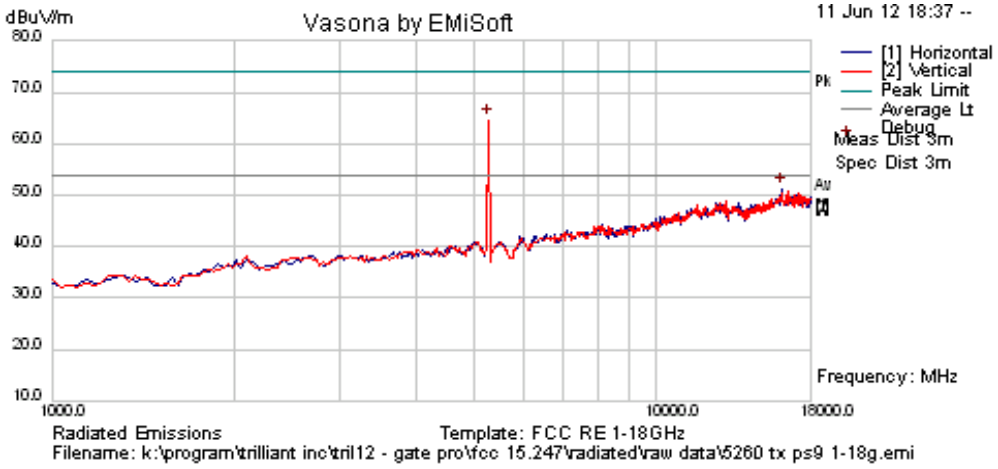

## Formally measured emission peaks

| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5239.198 | 71.9 | 4.6 | -9.8 | 66.7 | Peak [Scan] | V | 150 | 0 | | | | FUND |
| 16058.116 | 41.4 | 9.0 | 0.3 | 50.6 | Peak [Scan] | V | 150 | 0 | | | | Noise |

| | |
|---|---|
| Legend: | TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission |
| | RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak |

The above plot shows peak emissions.

| | | | |
|---|---|---|---|
| **Test Freq.** | 5260 MHz | **Engineer** | JMH |
| **Variant** | 802.11a; 6 MB/s | **Temp (ºC)** | 26 |
| **Freq. Range** | 1-18 GHz | **Rel. Hum.(%)** | 30 |
| **Power Setting** | 9 | **Press. (mBars)** | 999 |
| **Antenna** | 24 dBi | | |
| **Test Notes 1** | TX Mode, Tx Gain = 0, PWR = 1/4 | | |
| **Test Notes 2** | Removed non conductive coating from array backplane flanges and used foil to connect to case | | |



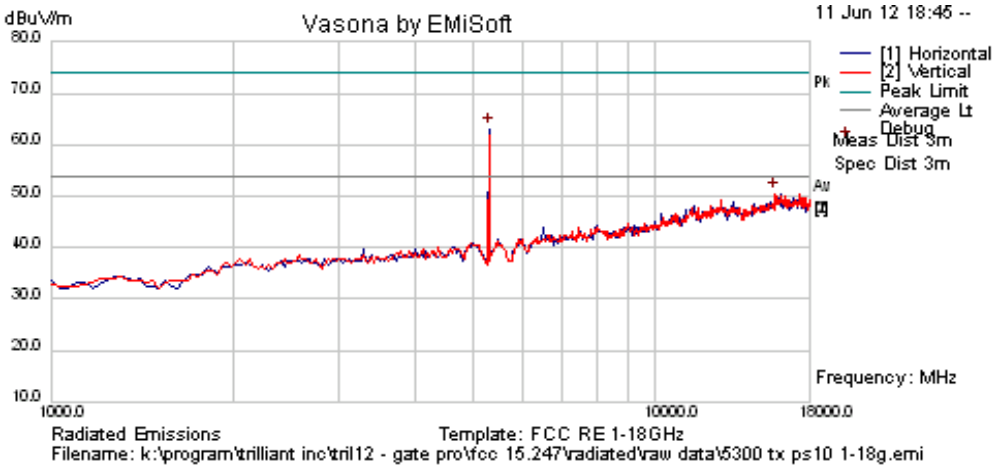

## Formally measured emission peaks

| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5258.517 | 69.6 | 4.6 | -9.7 | 64.5 | Peak [Scan] | V | 100 | 0 | | | | FUND |
| 16126.253 | 41.9 | 9.0 | 0.2 | 51.1 | Peak [Scan] | H | 200 | 0 | | | | Noise |

| | |
|---|---|
| Legend: | TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission |
| | RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak |

The above plot shows peak emissions.

| | | | |
|---|---|---|---|
| **Test Freq.** | 5300 MHz | **Engineer** | JMH |
| **Variant** | 802.11a; 6 MB/s | **Temp (ºC)** | 26 |
| **Freq. Range** | 1-18 GHz | **Rel. Hum.(%)** | 30 |
| **Power Setting** | 10 | **Press. (mBars)** | 999 |
| **Antenna** | 24 dBi | **Duty Cycle (%)** | 0 |
| **Test Notes 1** | TX Mode, Tx Gain = 0, PWR = 1/4 | | |
| **Test Notes 2** | Removed non conductive coating from array backplane flanges and used foil to connect to case | | |



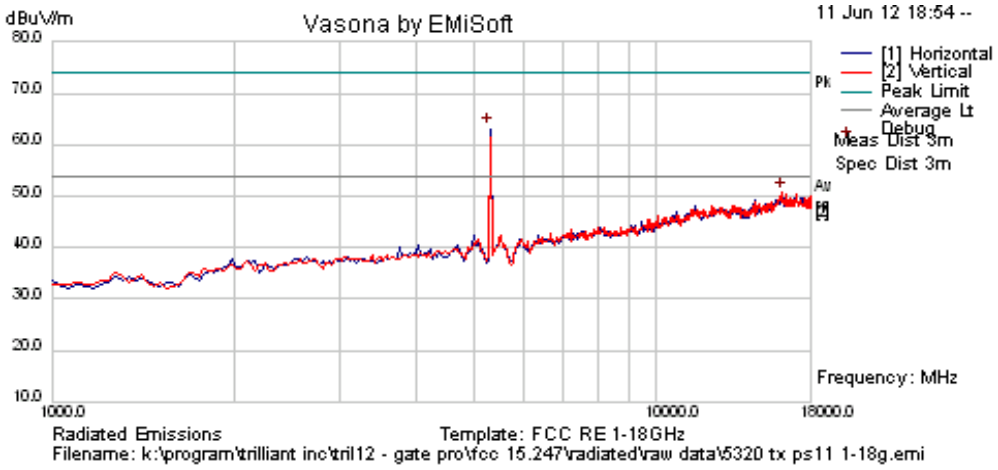

**Formally measured emission peaks**

| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5297.265 | 68.1 | 4.6 | -9.6 | 63.1 | Peak [Scan] | H | 200 | 0 | | | | FUND |
| 15751.503 | 42.1 | 8.6 | -0.3 | 50.4 | Peak [Scan] | V | 200 | 0 | | | | Noise |

| | |
|---|---|
| Legend: | TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission |
| | RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak |

The above plot shows peak emissions.

| | | | |
|---|---|---|---|
| **Test Freq.** | 5320 MHz | **Engineer** | JMH |
| **Variant** | 802.11a; 6 MB/s | **Temp (ºC)** | 26 |
| **Freq. Range** | 1-18 GHz | **Rel. Hum.(%)** | 30 |
| **Power Setting** | 11 | **Press. (mBars)** | 999 |
| **Antenna** | 24 dBi | **Duty Cycle (%)** | 0 |
| **Test Notes 1** | TX Mode, Tx Gain = 0, PWR = 1/4 | | |
| **Test Notes 2** | Removed non conductive coating from array backplane flanges and used foil to connect to case | | |



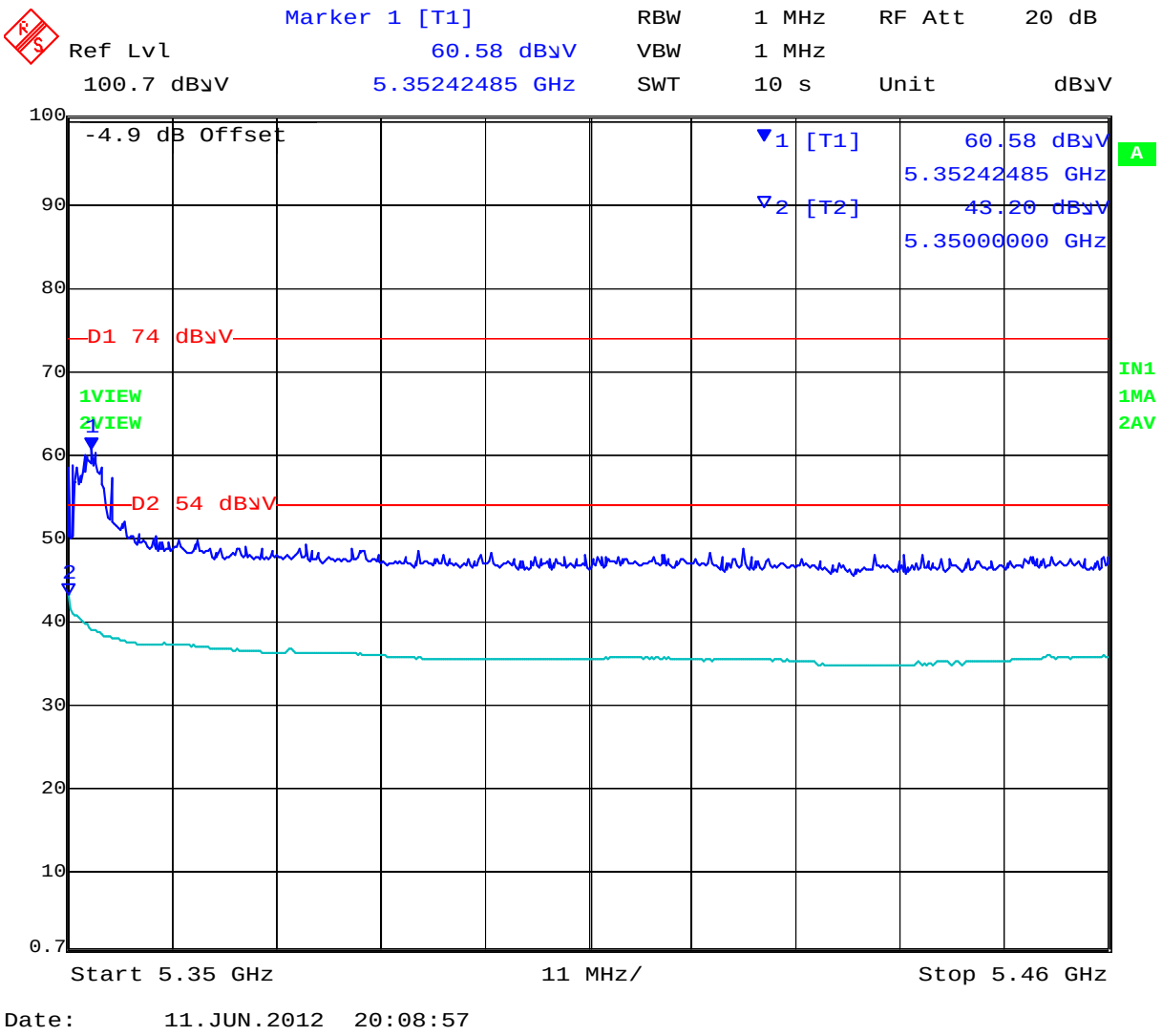

**Formally measured emission peaks**

| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5292.585 | 68.0 | 4.6 | -9.6 | 63.0 | Peak [Scan] | H | 200 | 0 | | | | FUND |
| 16058.116 | 41.4 | 9.0 | 0.3 | 50.6 | Peak [Scan] | V | 150 | 0 | | | | Noise |

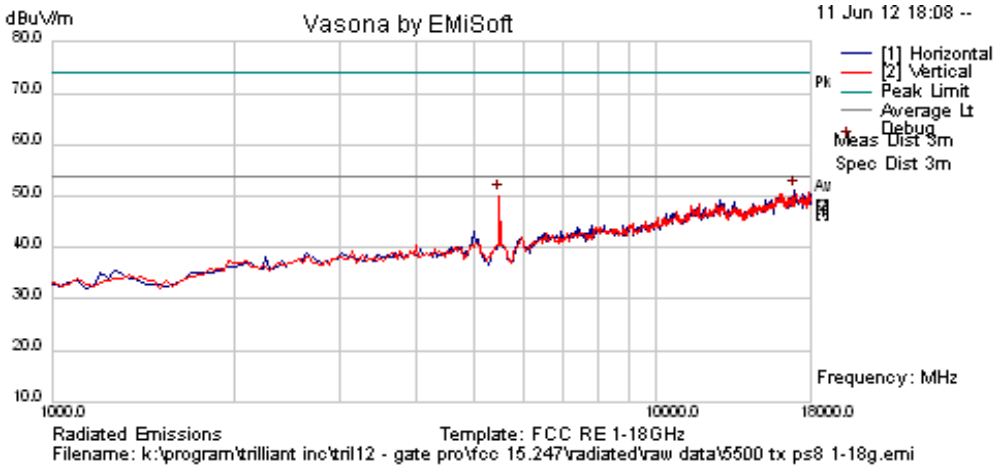
| | |
|---|---|
| Legend: | TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission |
| | RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak |

The above plot shows peak emissions.

5350 MHz Band Edge ; Pwr = 11



| | | | |
|---|---|---|---|
| **Test Freq.** | 5500 MHz | **Engineer** | JMH |
| **Variant** | 802.11a; 6 MB/s | **Temp (ºC)** | 26 |
| **Freq. Range** | 1-18 GHz | **Rel. Hum.(%)** | 30 |
| **Power Setting** | 8 | **Press. (mBars)** | 999 |
| **Antenna** | 31 dBi | | |
| **Test Notes 1** | TX Mode, Tx Gain = 0, PWR = 1/4 | | |
| **Test Notes 2** | Removed non conductive coating from array backplane flanges and used foil to connect to case | | |



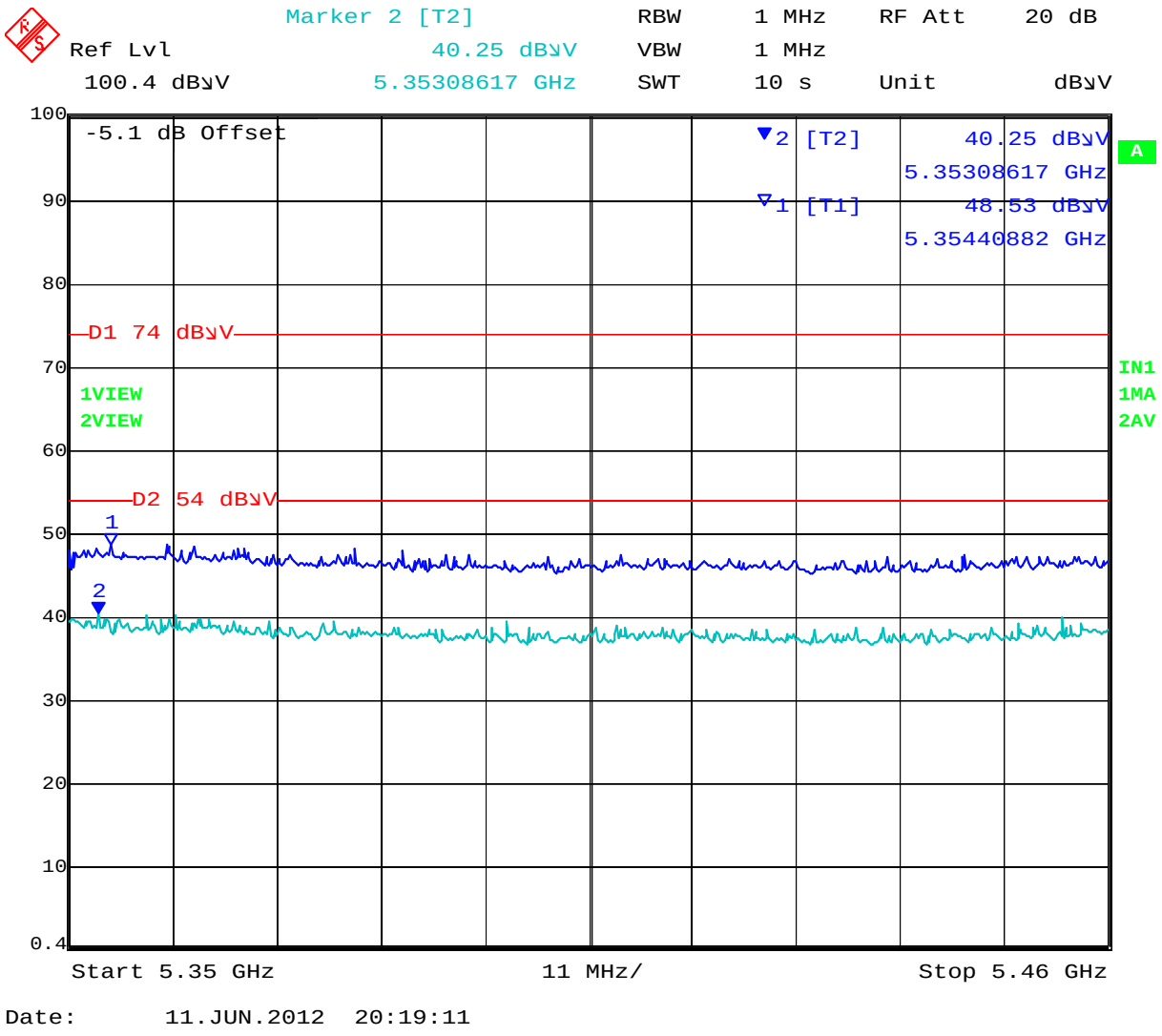

## Formally measured emission peaks

| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 16943.888 | 42.0 | 8.5 | 0.5 | 51.0 | Peak [Scan] | H | 200 | 0 | | | | Noise |
| 5496.993988 | 55.1 | 4.6 | -9.6 | 50.1 | Peak [Scan] | V | 150 | 0 | | | | FUND |

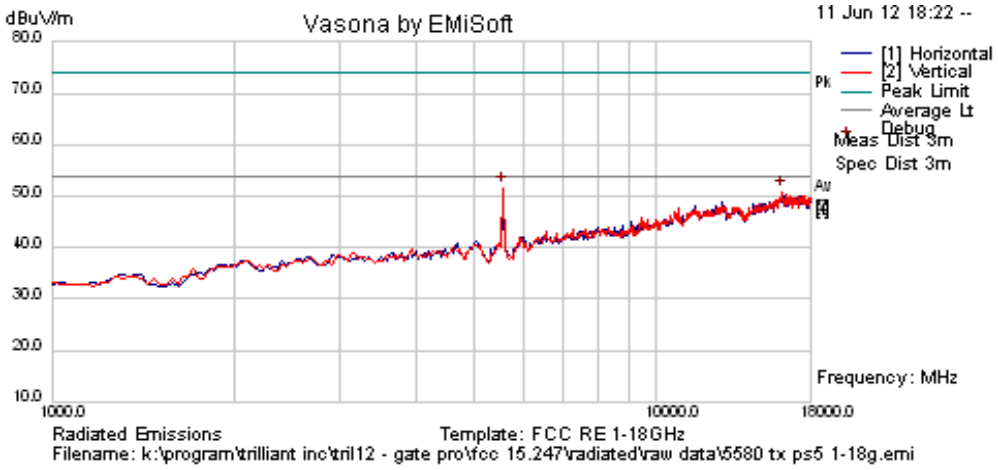
| | |
|---|---|
| Legend: | TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission |
| | RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak |

The above plot shows peak emissions.

5460 MHz Band Edge ; Pwr= 11



| | | | |
|---|---|---|---|
| **Test Freq.** | 5580 MHz | **Engineer** | JMH |
| **Variant** | 802.11a; 6 MB/s | **Temp (ºC)** | 26 |
| **Freq. Range** | 1-18 GHz | **Rel. Hum.(%)** | 30 |
| **Power Setting** | 5 | **Press. (mBars)** | 999 |
| **Antenna** | 31 dBi | **Duty Cycle (%)** | 0 |
| **Test Notes 1** | TX Mode, Tx Gain = 0, PWR = 1/4 | | |
| **Test Notes 2** | Removed non conductive coating from array backplane flanges and used foil to connect to case | | |



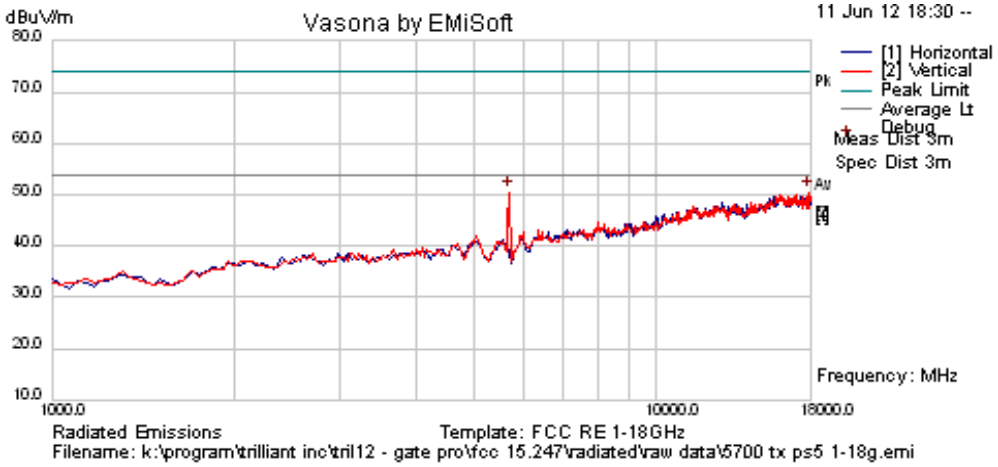

## Formally measured emission peaks

| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5576.513 | 56.5 | 4.7 | -9.7 | 51.5 | Peak [Scan] | V | 100 | 0 | | | | FUND |
| 16092.184 | 41.5 | 9.0 | 0.3 | 50.7 | Peak [Scan] | V | 100 | 0 | | | | Noise |

| | |
|---|---|
| Legend: | TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission |
| | RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak |

The above plot shows peak emissions.

| | | | |
|---|---|---|---|
| **Test Freq.** | 5700 MHz | **Engineer** | JMH |
| **Variant** | 802.11a; 6 MB/s | **Temp (ºC)** | 26 |
| **Freq. Range** | 1-18 GHz | **Rel. Hum.(%)** | 30 |
| **Power Setting** | 5 | **Press. (mBars)** | 999 |
| **Antenna** | 31 dBi | **Duty Cycle (%)** | 0 |
| **Test Notes 1** | TX Mode, Tx Gain = 0, PWR = 1/4 | | |
| **Test Notes 2** | Removed non conductive coating from array backplane flanges and used foil to connect to case | | |




## Formally measured emission peaks

| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 5701.403 | 55.4 | 4.7 | -9.6 | 50.6 | Peak [Scan] | V | 100 | 0 | | | | FUND |
| 17897.796 | 41.0 | 8.8 | 0.5 | 50.3 | Peak [Scan] | V | 150 | 0 | | | | Noise |

| | |
|---|---|
| Legend: | TX = Transmitter Emissions; DIG = Digital Emissions; FUND = Fundamental; WB = Wideband Emission |
| | RB = Restricted Band (15.209 Limits); NRB = Non Restricted Band, Limit is 20dB below fundamental peak |

The above plot shows peak emissions.

### 5.1.7.2. Radiated Spurious Emissions – 30MHz – 1000MHz

**FCC, Part 15 Subpart C §15.205/ §15.209**
**Industry Canada RSS-210 §2.2**

**Test Procedure**

Testing 30M-1 GHz was performed in a 3-meter anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed. The anechoic chamber test set-up is identified in Section 6 Test Set-Up Photographs.

The EUT had two methods of powering on ac/dc converter and Power over Ethernet (POE). Both modes were tested for emissions below 1GHz.

**Field Strength Calculation**

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

$$FS = R + AF + CORR$$

where:

FS = Field Strength
R = Measured Receiver Input Amplitude
AF = Antenna Factor
CORR = Correction Factor = CL – AG + NFL
CL = Cable Loss
AG = Amplifier Gain

For example:
Given a Receiver input reading of 51.5dBμV; Antenna Factor of 8.5dB; Cable Loss of 1.3dB; Falloff Factor of 0dB, an Amplifier Gain of 26dB and Notch Filter Loss of 1dB. The Field Strength of the measured emission is:

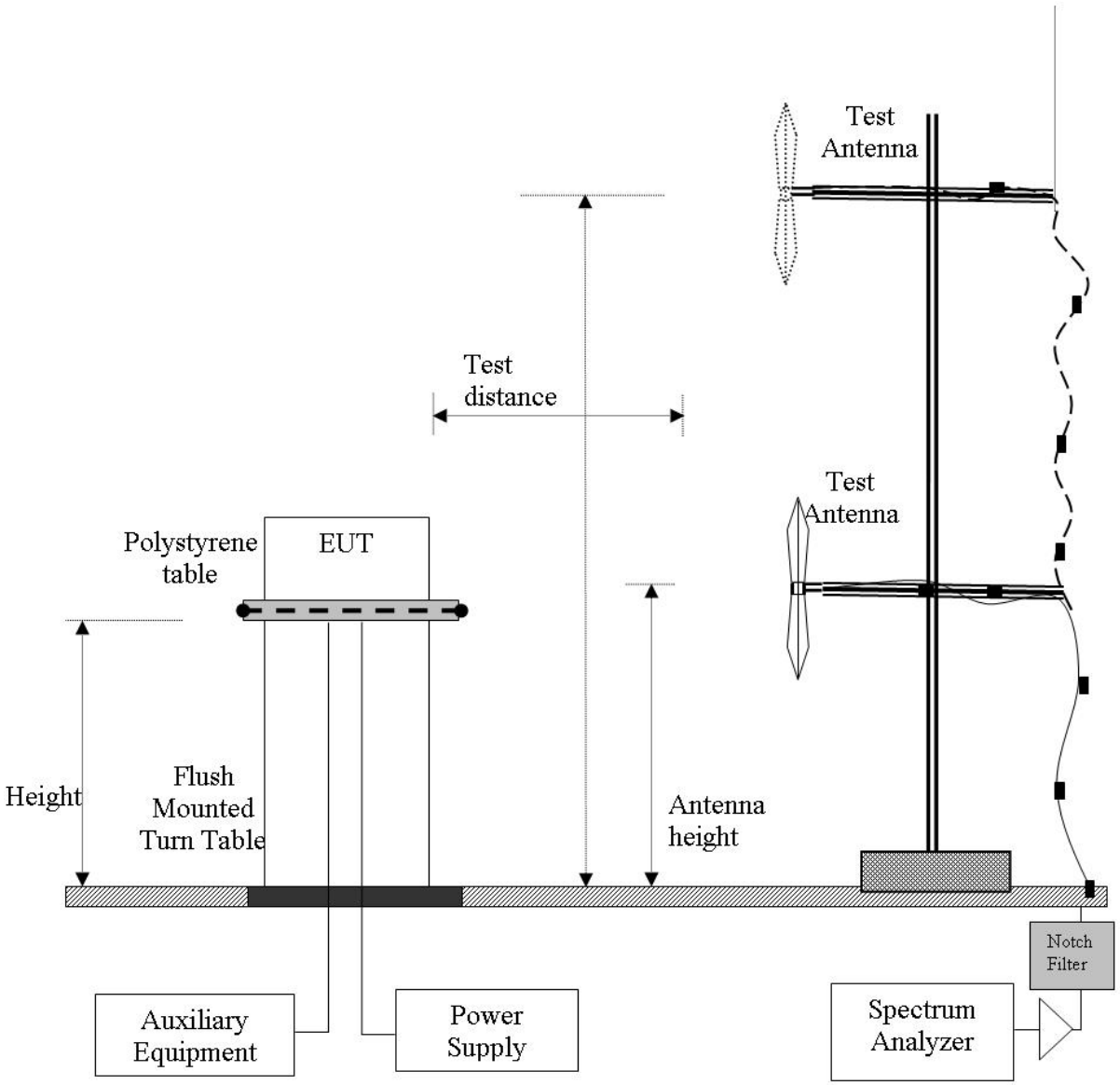
$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 dB\mu V/m$$

Conversion between dBμV/m (or dBμV) and μV/m (or μV) are done as:

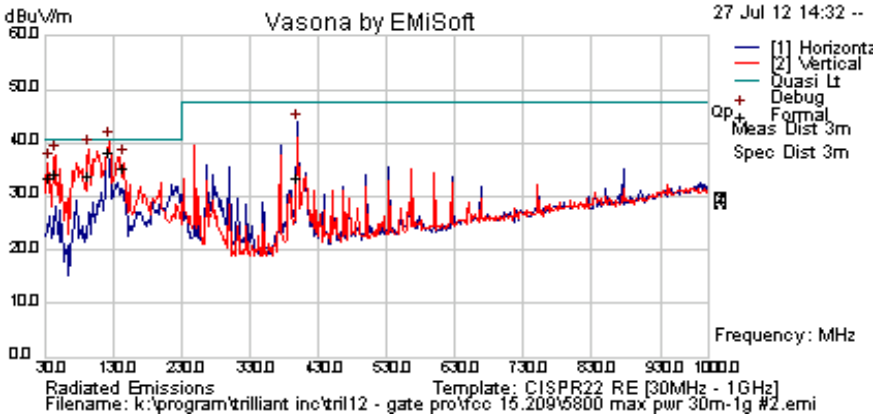
$$Level\ (dB\mu V/m) = 20 * Log\ (level\ (\mu V/m))$$

40 dBμV/m = 100μV/m
48 dBμV/m = 250μV/m

**Radiated Emission Measurement Setup – Below 1 GHz**



| | | | |
|---|---|---|---|
| **Test Freq.** | N/A | **Engineer** | SB |
| **Variant** | Digital Emissions | **Temp (ºC)** | 26.3 |
| **Freq. Range** | 30 MHz - 1000 MHz | **Rel. Hum.(%)** | 33 |
| **Power Setting** | Max | **Press. (mBars)** | 1008 |
| **Antenna** | | | |
| **Test Notes 1** | Packet Mode;New Cap Value C201; | | |
| **Test Notes 2** | 48VDC POE PSU;230V to POE PSU;Ground cable from EUT to turntable | | |




## Formally measured emission peaks

| Frequency MHz | Raw dBuV | Cable Loss | AF dB | Level dBuV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBuV/m | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 125.014 | 51.4 | 4.2 | -17.3 | 38.3 | Quasi Max | V | 110 | 43 | 40.5 | -2.2 | Pass | |
| 94.363 | 52.6 | 4.0 | -22.9 | 33.7 | Quasi Max | V | 121 | 0 | 40.5 | -6.8 | Pass | |
| 45.733 | 51.8 | 3.7 | -21.3 | 34.2 | Quasi Max | V | 96 | 47 | 40.5 | -6.3 | Pass | |
| 145.275 | 49.6 | 4.3 | -18.6 | 35.3 | Quasi Max | V | 97 | 349 | 40.5 | -5.2 | Pass | |
| 400.002 | 42.8 | 5.5 | -14.8 | 33.5 | Quasi Max | H | 138 | -2 | 47.5 | -14.0 | Pass | |
| 35.323 | 43.7 | 3.6 | -13.8 | 33.5 | Quasi Max | V | 98 | 242 | 40.5 | -7.0 | Pass | |

| | |
|---|---|
| Legend: | DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency |
| | NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band |

## Specification

### Limits

**§15.205 (a)** Except as shown in paragraph (d) of 15.205 (a), only spurious emissions are permitted in any of the frequency bands listed.

**§15.205 (a)** Except as shown in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

**§15.209 (a)** Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table.

**§15.209 (a)** and **RSS-Gen §2.2** Limit Matrix

| Frequency(MHz) | Field Strength (μV/m) | Field Strength (dBμV/m) | Measurement Distance (meters) |
|---|---|---|---|
| 30-88 | 100 | 40.0 | 3 |
| 88-216 | 150 | 43.5 | 3 |
| 216-960 | 200 | 46.0 | 3 |
| Above 960 | 500 | 54.0 | 3 |

### Laboratory Measurement Uncertainty for Radiated Emissions

| | |
|---|---|
| Measurement uncertainty | +5.6/ -4.5 dB |

### Traceability

| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions' | 0088, 0158, 0134, 0304, 0311, 0315, 0310, 0312 |

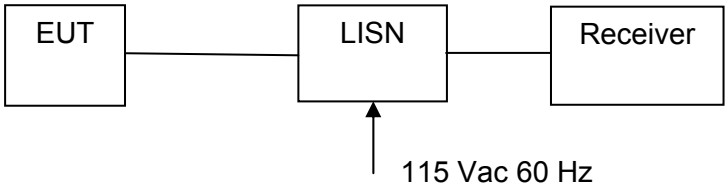
### 5.1.8. AC Wireline Conducted Emissions (150 kHz – 30 MHz)

**FCC, Part 15 Subpart C §15.207**
**Industry Canada RSS-Gen §7.2.2**

**Test Procedure**

The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

**Test Measurement Set up**

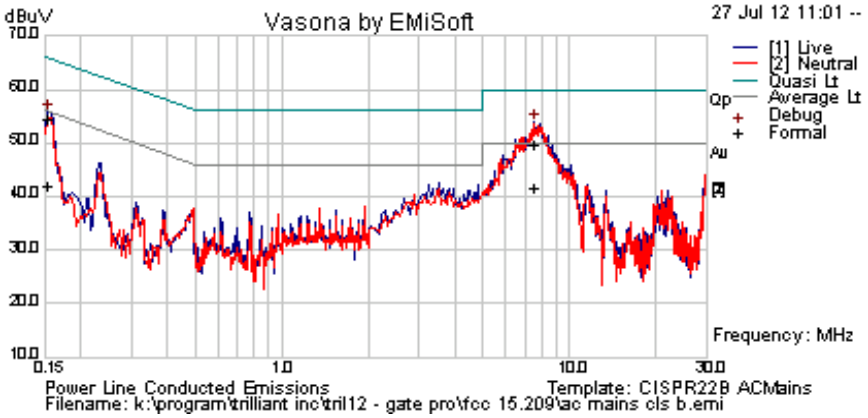



Measurement set up for AC Wireline Conducted Emissions Test

**Measurement Results for AC Wireline Conducted Emissions (150 kHz – 30 MHz)**

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

| | | | |
|---|---|---|---|
| **Test Freq.** | N/A | **Engineer** | SB |
| **Variant** | AC Line Emissions | **Temp (ºC)** | 26.3 |
| **Freq. Range** | 0.150 MHz - 30 MHz | **Rel. Hum.(%)** | 33 |
| **Power Setting** | | **Press. (mBars)** | 1008 |
| **Antenna** | | | |
| **Test Notes 1** | Packet Mode;New Cap Value C201; | | |
| **Test Notes 2** | 48VDC POE PSU;110V to POE PSU;Ground cable from EUT to turntable | | |




## Formally measured emission peaks

| Frequency MHz | Raw dBuV | Cable Loss | Factors dB | Level dBuV | Measurement Type | Line | Limit dBuV | Margin dB | Pass /Fail | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| 7.655 | 39.2 | 10.3 | 0.3 | 49.8 | Quasi Peak | Live | 60.0 | -10.2 | Pass | |
| 0.155 | 44.7 | 9.9 | 0.1 | 54.6 | Quasi Peak | Live | 65.7 | -11.1 | Pass | |
| 7.655 | 31.0 | 10.3 | 0.3 | 41.6 | Average | Live | 50.0 | -8.4 | Pass | |
| 0.155 | 32.1 | 9.9 | 0.1 | 42.1 | Average | Live | 55.7 | -13.7 | Pass | |

| | |
|---|---|
| Legend: | DIG = Digital Device Emission; TX = Transmitter Emission; FUND = Fundamental Frequency |
| | NRB = Non-Restricted Band, Limit is 20 dB below Fundamental; RB = Restricted Band |

## Specification

### Limit

**§15.207 (a)** Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μΩ line impedance stabilization network (LISN), see §15.207 (a) matrix below. Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

**RSS-Gen §7.2.2**
The radio frequency voltage that is conducted back into the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table below. The tighter limit applies at the frequency range boundaries.

**§15.207 (a)** and **RSS-Gen §7.2.2** Limit Matrix
The lower limit applies at the boundary between frequency ranges

| Frequency of Emission (MHz) | Conducted Limit (dBμV) | |
|---|---|---|
| | Quasi-peak | Average |
| 0.15-0.5 | 66 to 56* | 56 to 46* |
| 0.5-5 | 56 | 46 |
| 5-30 | 60 | 50 |

* Decreases with the logarithm of the frequency

### Laboratory Measurement Uncertainty for Conducted Emissions

| | |
|---|---|
| Measurement uncertainty | ±2.64 dB |

### Traceability

| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions' | 0158, 0184, 0287, 0190, 0293, 0307 |

# 6. Dynamic Frequency Selection (DFS)

## 6.1. Test Procedure and Setup

**FCC, Part 15 Subpart C §15.407(h)**
**FCC 06-96 Memorandum Opinion and Order**
**Industry Canada RSS-210 A9.4**

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

| Maximum Transmit Power | Value (see note) |
|---|---|
| ≥ 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 | |

### 6.1.2. DFS Response requirement values

| Parameter | Value |
|---|---|
| *Non-occupancy period* | Minimum 30 minutes |
| *Channel Availability Check Time* | 60 seconds |
| *Channel Move Time* | 10 seconds<br>See Note 1. |
| *Channel Closing Transmission Time* | 200 milliseconds + an aggregate of 60 milliseconds over remaining 10 second period.<br>See Notes 1 and 2. |
| *U-NII Detection Bandwidth* | Minimum 80% of the 99% power bandwidth See Note 3. |

Note 1: The instant that the *Channel Move Time* and the *Channel Closing Transmission Time* begins is as follows:

- For the Short pulse radar Test Signals this instant is the end of the *Burst*.
- For the Frequency Hopping radar Test Signal, this instant is the end of the last radar *Burst* generated.
- For the Long Pulse radar Test Signal this instant is the end of the 12 second period defining the radar transmission.

Note 2: The *Channel Closing Transmission Time* is comprised of 200 milliseconds starting at the beginning of the *Channel Move Time* plus any additional intermittent control signals required to facilitate *Channel* changes (an aggregate of 60 milliseconds) during the remainder of the 10 second period. The aggregate duration of control signals will not count quiet periods in between transmissions.

Note 3: During the *U-NII Detection Bandwidth* detection test, radar type 1 is used and for each frequency step the minimum percentage of detection is 90%. Measurements are performed with no data traffic.

### 6.1.3. Radar Test Waveforms

This section provides the parameters for required test waveforms, minimum percentage of successful detections, and the minimum number of trials that must be used for determining DFS conformance. Step intervals of 0.1 microsecond for Pulse Width, 1 microsecond for PRI, 1 MHz for chirp width and 1 for the number of pulses will be utilized for the random determination of specific test waveforms.

**Short Pulse Radar Test Waveforms**

| Radar Type | Pulse Width (µsec) | PRI (µsec) | Number of Pulses | Minimum Percentage of Successful Detection | Minimum Trials |
|---|---|---|---|---|---|
| 1 | 1 | 1428 | 18 | 60% | 30 |
| 2 | 1-5 | 150-230 | 23-29 | 60% | 30 |
| 3 | 6-10 | 200-500 | 16-18 | 60% | 30 |
| 4 | 11-20 | 200-500 | 12-16 | 60% | 30 |
| Aggregate (Radar Types 1-4) | | | | 80% | 120 |

A minimum of 30 unique waveforms are required for each of the short pulse radar types 2 through 4. For short pulse radar type 1, the same waveform is used a minimum of 30 times. If more than 30 waveforms are used for short pulse radar types 2 through 4, then each additional waveform must also be unique and not repeated from the previous waveforms. The aggregate is the average of the percentage of successful detections of short pulse radar types 1-4.

**Long Pulse Radar Test Waveform**

| Radar Type | Pulse Width (µsec) | Chirp Width (MHz) | PRI (µsec) | Number of Pulses per *Burst* | Number of *Bursts* | Minimum Percentage of Successful Detection | Minimum Trials |
|---|---|---|---|---|---|---|---|
| 5 | 50-100 | 5-20 | 1000-2000 | 1-3 | 8-20 | 80% | 30 |

The parameters for this waveform are randomly chosen. Thirty unique waveforms are required for the Long Pulse radar test signal. If more than 30 waveforms are used for the Long Pulse radar test signal, then each additional waveform must also be unique and not repeated from the previous waveforms.

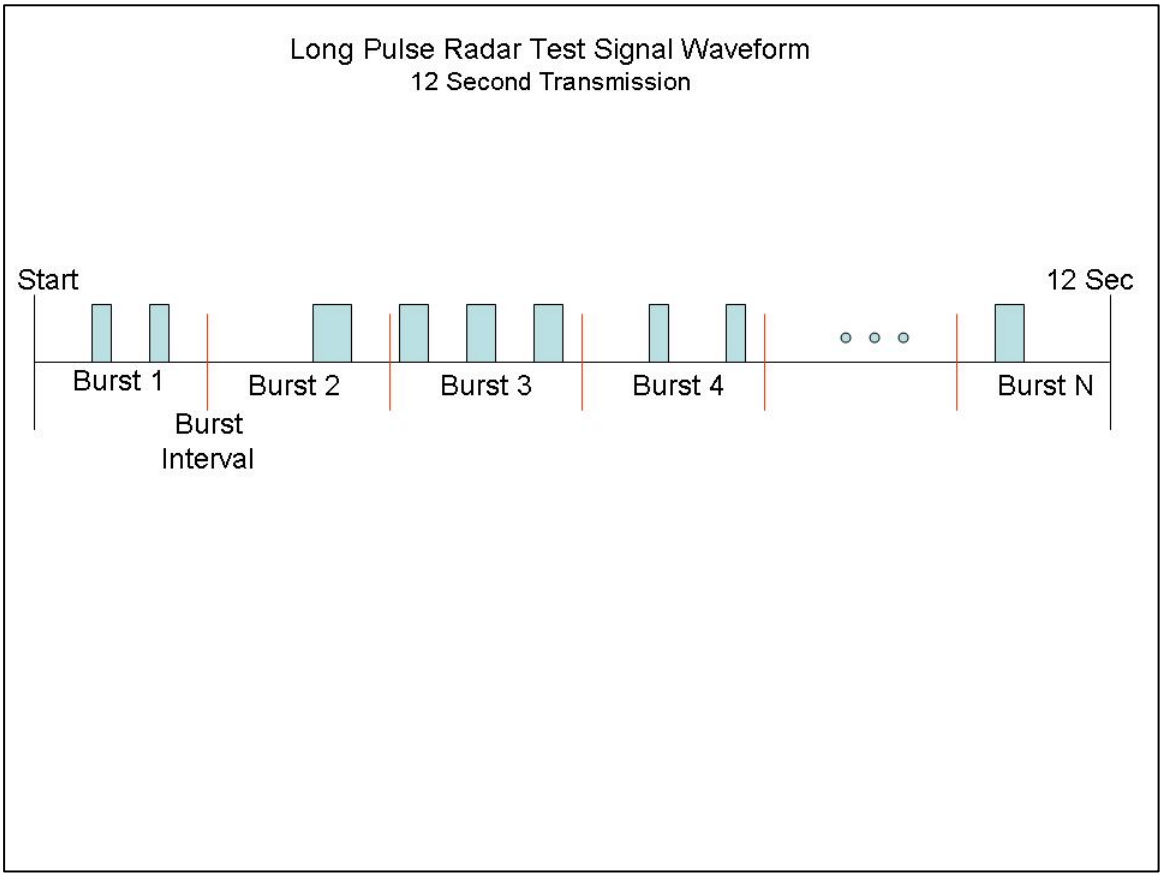
Each waveform is defined as follows:

1) The transmission period for the Long Pulse Radar test signal is 12 seconds.
2) There are a total of 8 to 20 *Bursts* in the 12 second period, with the number of *Bursts* being randomly chosen. This number is *Burst Count*.
3) Each *Burst* consists of 1 to 3 pulses, with the number of pulses being randomly chosen. Each *Burst* within the 12 second sequence may have a different number of pulses.
4) The pulse width is between 50 and 100 microseconds, with the pulse width being randomly chosen. Each pulse within a *Burst* will have the same pulse width. Pulses in different *Bursts* may have different pulse widths.
5) Each pulse has a linear FM chirp between 5 and 20 MHz, with the chirp width being randomly chosen. Each pulse within a *Burst* will have the same chirp width. Pulses in different *Bursts* may have different chirp widths. The chirp is centered on the pulse. For example, with a radar frequency of 5300 MHz and a 20 MHz chirped signal, the chirp starts at 5290 MHz and ends at 5310 MHz.
6) If more than one pulse is present in a *Burst*, the time between the pulses will be between 1000 and 2000 microseconds, with the time being randomly chosen. If three pulses are present in a *Burst*, the time between the first and second pulses is chosen independently of the time between the second and third pulses.
7) The 12 second transmission period is divided into even intervals. The number of intervals is equal to *Burst_Count*. Each interval is of length (12,000,000 / *Burst_Count*) microseconds. Each interval contains one *Burst*. The start time for the *Burst*, relative to the beginning of the interval, is between 1 and [(12,000,000 / *Burst_Count*) – (Total *Burst* Length) + (One Random PRI Interval)] microseconds, with the start time being randomly chosen. The step interval for the start time is 1 microsecond. The start time for each *Burst* is chosen independently.

**A representative example of a Long Pulse radar test waveform:**

1) The total test signal length is 12 seconds.
2) 8 *Bursts* are randomly generated for the *Burst_Count*.
3) *Burst* 1 has 2 randomly generated pulses.
4) The pulse width (for both pulses) is randomly selected to be 75 microseconds.
5) The PRI is randomly selected to be at 1213 microseconds.
6) *Bursts* 2 through 8 are generated using steps 3 – 5.
7) Each *Burst* is contained in even intervals of 1,500,000 microseconds. The starting location for Pulse 1, *Burst* 1 is randomly generated (1 to 1,500,000 minus the total *Burst* 1 length + 1 random PRI interval) at the 325,001 microsecond step. *Bursts* 2 through 8 randomly fall in successive 1,500,000 microsecond intervals (i.e. *Burst* 2 falls in the 1,500,001 – 3,000,000 microsecond range).

**Graphical representation of the Long Pulse radar Test Waveform.**



### 6.1.4. Frequency Hopping Radar Test Waveform

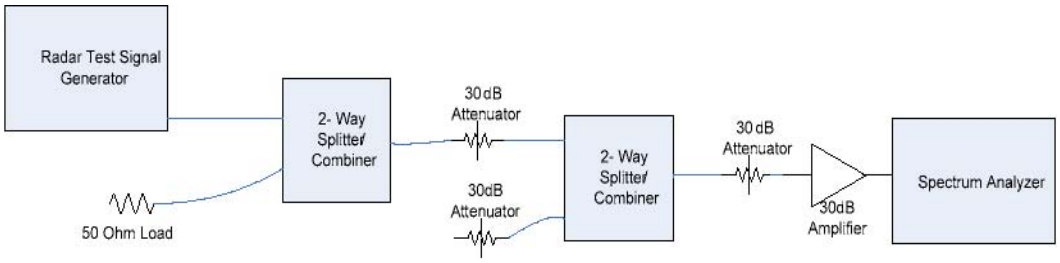
**Frequency Hopping Radar Test Waveform**

| Radar Type | Pulse Width (µsec) | PRI (µsec) | Pulses per Hop | Hopping Rate (kHz) | Hopping Sequence Length (msec) | Minimum Percentage of Successful Detection | Minimum Trials |
|---|---|---|---|---|---|---|---|
| 6 | 1 | 333 | 9 | .333 | 300 | 70% | 30 |

For the Frequency Hopping Radar Type, the same *Burst* parameters are used for each waveform. The hopping sequence is different for each waveform and a 100-length segment is selected from the hopping sequence defined by the following algorithm:

### 6.1.5. Radar Waveform Calibration

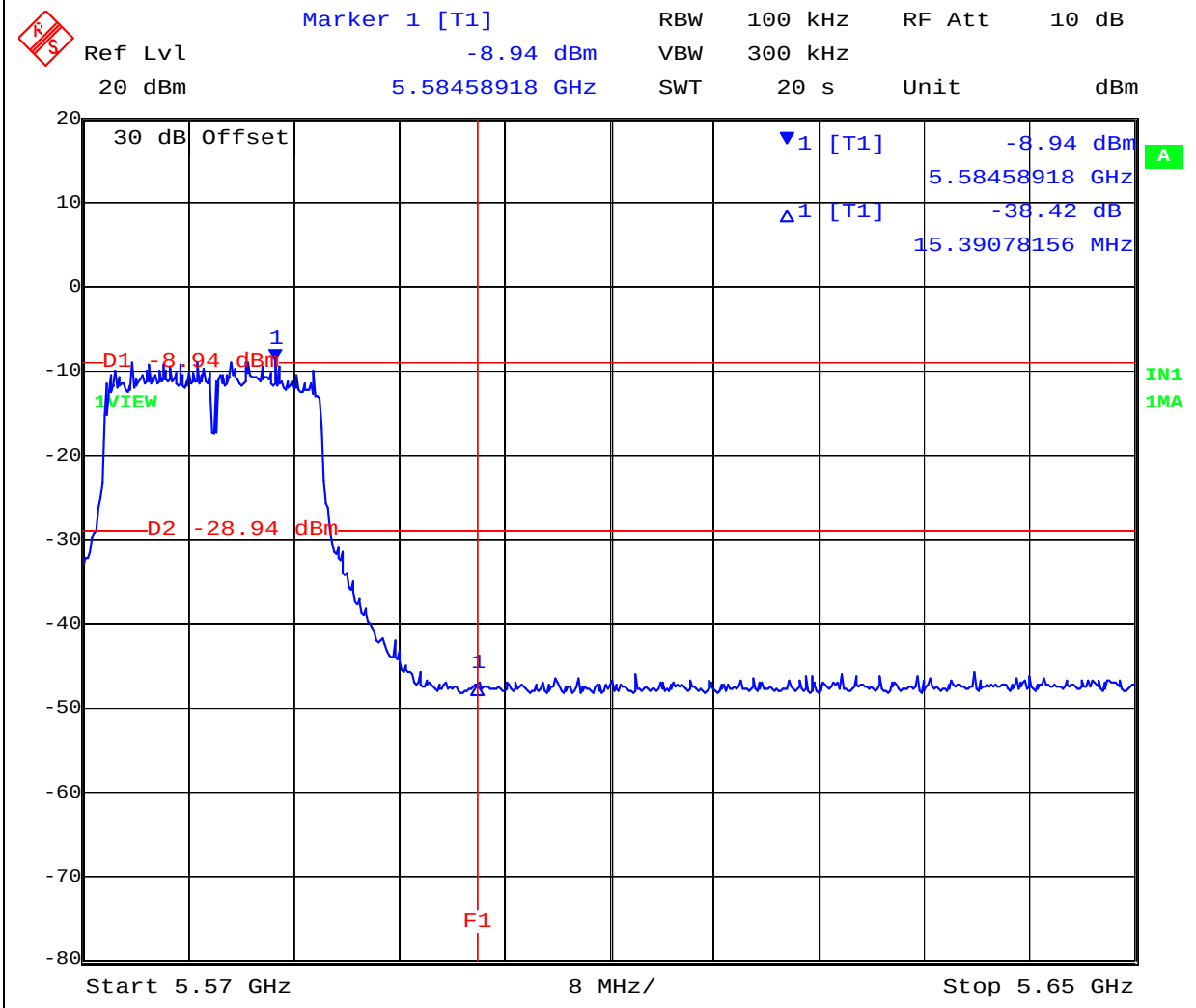
The following equipment setup was used to calibrate the conducted Radar Waveform. A spectrum analyzer was used to establish the test signal level for each radar type. During this process there were no transmissions by either the Master or Client Device. The spectrum analyzer was switched to the zero span (Time Domain) mode at the frequency of the Radar Waveform generator. Peak detection was utilized. The spectrum analyzer resolution bandwidth (RBW) and video bandwidth (VBW) were set to 3 MHz.
The signal generator amplitude was set so that the power level measured at the spectrum analyzer was -61dBm (Ref Section 5.1). The 30dB amplifier gain was entered as an amplitude offset on the spectrum analyzer.



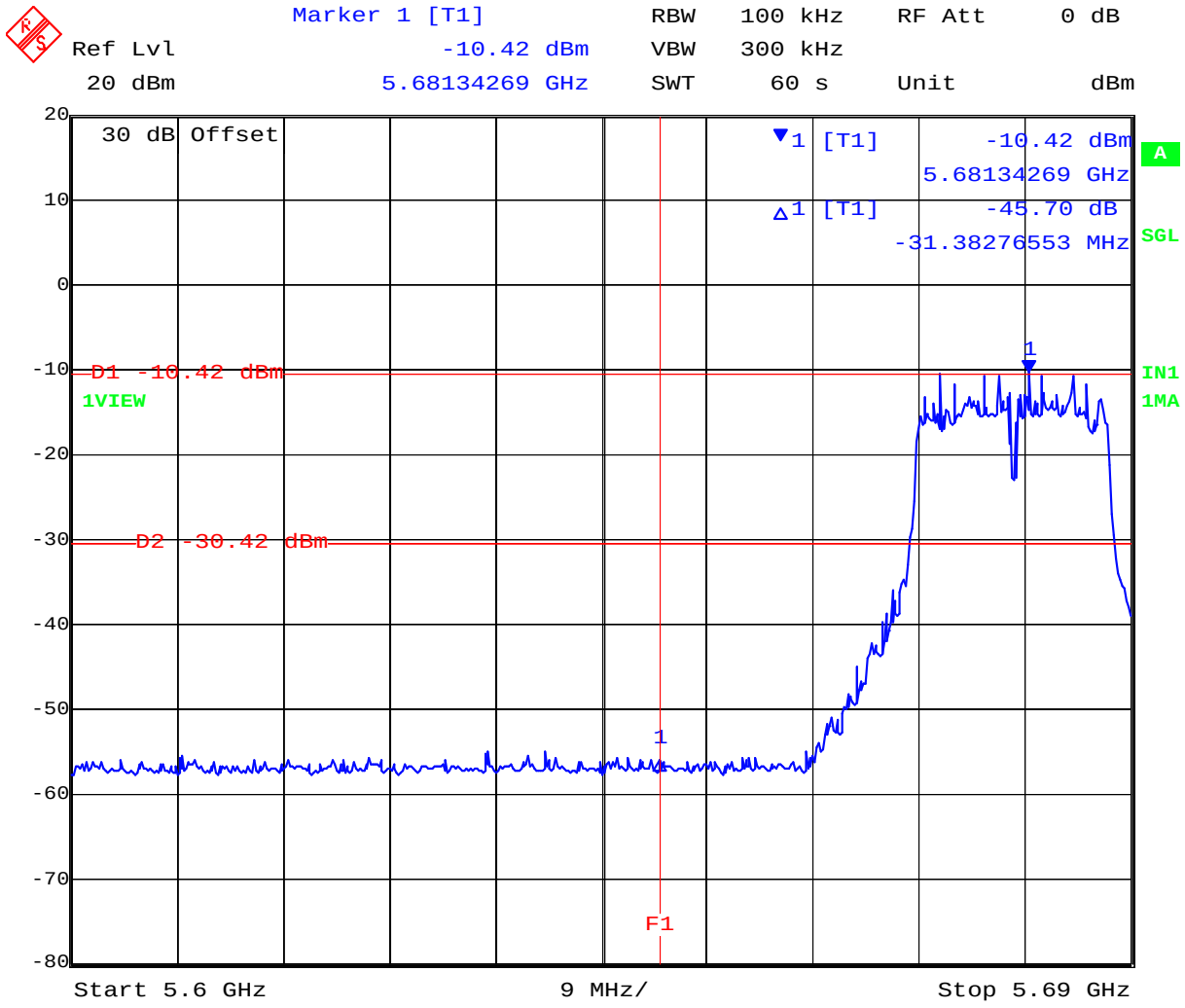

***Conducted Calibration Setup***

### 6.1.6. Weather Radar Band Edge Plots

Center Frequency 5,580MHz 802.11a



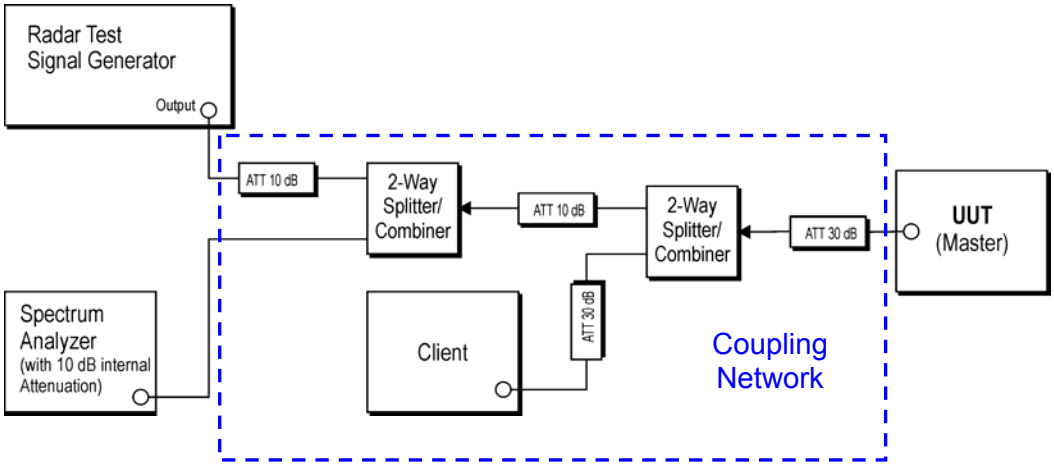
Center Frequency 5,680MHz 802.11a



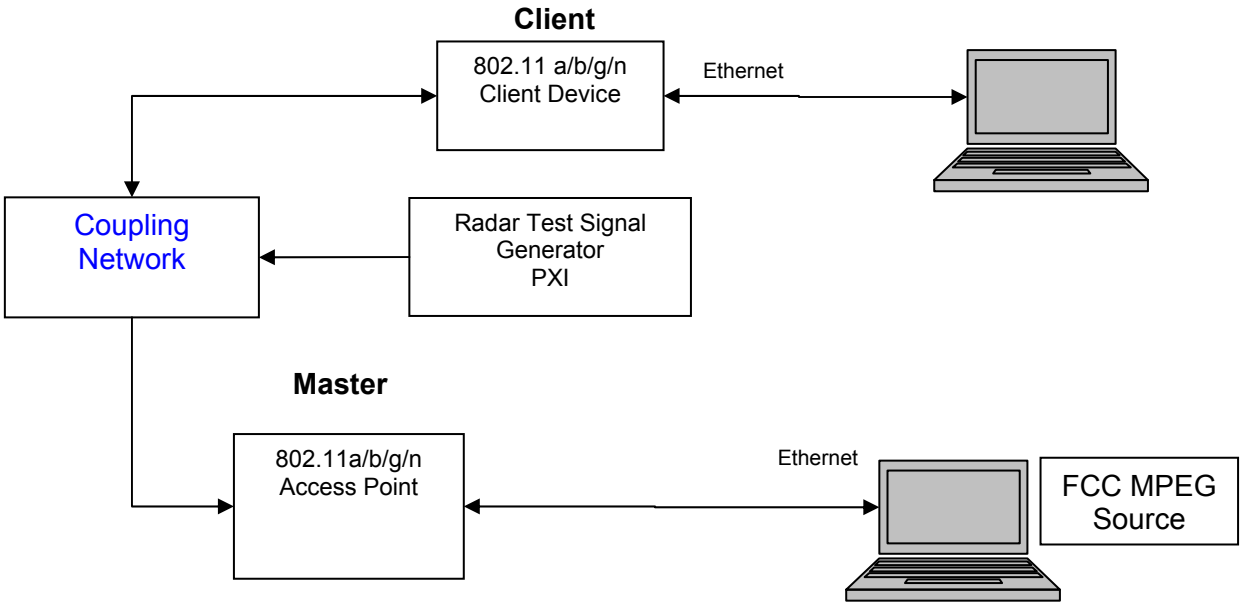
### 6.1.7. Test Set Up:

## Block Diagram(s) of Test Setup

Setup for Conducted Measurements where the EUT is the Master with injection of Radar Test Waveforms at the Master.




## Support Equipment Configuration



The EUT is a Master Device with radar detection.

**Applicability of DFS Requirements Prior to Use of a Channel**

**(Ref Table 1 of FCC 06-96)**

| Requirement | Operational Mode | | |
|---|---|---|---|
| | Master | Client Without Radar Detection | Client With Radar Detection |
| *Non-Occupancy Period* | Yes | Not required | Yes |
| *DFS Detection Threshold* | Yes | Not required | Yes |
| *Channel Availability Check Time* | Yes | Not required | Not required |
| *Uniform Spreading* | Yes | Not required | Not required |
| *U-NII Detection Bandwidth* | Yes | Not required | Yes |

**Applicability of DFS requirements during normal operation**

**(Ref Table 2 of FCC 06-96)**

| Requirement | Operational Mode | | |
|---|---|---|---|
| | Master | Client Without Radar Detection | Client With Radar Detection |
| *DFS Detection Threshold* | Yes | Not required | Yes |
| *Channel Closing Transmission Time* | Yes | Yes | Yes |
| *Channel Move Time* | Yes | Yes | Yes |
| *U-NII Detection Bandwidth* | Yes | Not required | Yes |

For the frequency band 5,470 – 5,725 MHz, the Master device provides, on aggregate, uniform loading of the spectrum across all devices by selecting an operating channel among the available channels using a random algorithm. The EUT was tested in HT-40 mode.

Declared minimum antenna gain 27 dBi.

Radar receive signal level = -62 dBm + minimum antenna gain + 1 dB

Radar receive signal level = -35 dBm

**Measurement Results - Dynamic Frequency Selection (DFS)**

Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57% Pressure: 999 to 1012 mbar

Radio parameters.
Test methodology: Conducted
Device Type: Master
Transmit Power: Maximum

**Operational Details - Dynamic Frequency Selection (DFS)**

Operational Modes: 802.11a

Data Rates: 24mpbs 802.11a/

**Note* No video pixilation was observed during the video stream at these rates. Video frames per second were noted to be at 30fps.*

**Video Streaming Method - Dynamic Frequency Selection (DFS)**

Using the VideoLan player a video stream was setup on the master laptop with the destination being the client laptop. The video profile chosen for the video stream is “MPEG-2 + MPGA (TS)”. On the client laptop the VideoLan player was setup to listen to an incoming video stream from the master device.

The requisite MPEG video file (“TestFile.mpg” available on the NTIA website at the following link http://ntiacsd.ntia.doc.gov/dfs/) is used during this video stream.

## 6.2. Dynamic Frequency Selection (DFS) Test Results

### 6.2.1. UNII Detection Bandwidth:

All UNII channels for this device have identical channel bandwidths and DFS testing was completed on channel 5,500 MHz (802.11a).

The generating equipment is configured as shown in the Conducted Test Setup above. A single Burst of the short pulse radar Type 1 through 6 was produced at 5,500 MHz (802.11a) at a level of 47 dBm (Ref Section 5.1). The EUT is set up as a standalone device (no associated Client and no traffic).

A single radar Burst is generated for a minimum of 10 trials, and the response of the EUT is noted. The EUT must detect the Radar Waveform 90% or more of the time.

The radar frequency is increased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The highest frequency at which detection is greater than or equal to 90% is denoted as $F_H$.

The radar frequency is decreased in 1 MHz steps, repeating the above test sequence, until the detection rate falls below 90%. The lowest frequency at which detection is greater than or equal to 90% is denoted as $F_L$.

The U-NII Detection Bandwidth is calculated as follows:

U-NII Detection Bandwidth = $F_H - F_L$

The U-NII Detection Bandwidth must be at least 80% of the EUT transmitter 99% power
Table of results are continued on the next page.

| EUT Frequency= 5,500 MHz 802.11a (Detection = √, No Detection = 0) | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Radar Frequency (MHz)** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **Detection Rate (%)** |
| -20 | | | | | | | | | | | % |
| -19 | | | | | | | | | | | % |
| -18 | | | | | | | | | | | % |
| -17 | | | | | | | | | | | % |
| -16 | | | | | | | | | | | % |
| -15 | | | | | | | | | | | % |
| -14 | | | | | | | | | | | % |
| -13 | | | | | | | | | | | % |
| -12 | | | | | | | | | | | % |
| -11 | √ | 0 | 0 | | | | | | | | <90% |
| -10 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| -9 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| -8 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| -7 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| -6 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| -5 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| -4 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| -3 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| -2 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| -1 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| $F_0$ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| +1 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| +2 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| +3 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| +4 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| +5 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| +6 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| +7 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| +8 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| +9 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| +10 | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | 100% |
| +11 | 0 | √ | 0 | | | | | | | | <90% |
| +12 | | | | | | | | | | | % |
| +13 | | | | | | | | | | | % |
| +14 | | | | | | | | | | | % |
| +15 | | | | | | | | | | | % |
| +16 | | | | | | | | | | | % |
| +17 | | | | | | | | | | | % |
| Detection Bandwidth = $F_H$-$F_L$ = 5490-5510 = 20 MHz | | | | | | | | | | | |
| EUT 99% Bandwidth = 16.7 MHz (ref. bandwidth channel 5500 MHz) | | | | | | | | | | | |
| 16.7 MHz * 80% = 13.36MHz | | | | | | | | | | | |
| For each frequency step the minimum percentage detection is 90% | | | | | | | | | | | |

### 6.2.2. Initial Channel Availability Check Time

This test verifies that the EUT does not emit pulse, control, or data signals on the test Channel until the power-up sequence has been completed and the U-NII device checks for Radar Waveforms for one minute on the test Channel. This test does not use any Radar Waveforms.

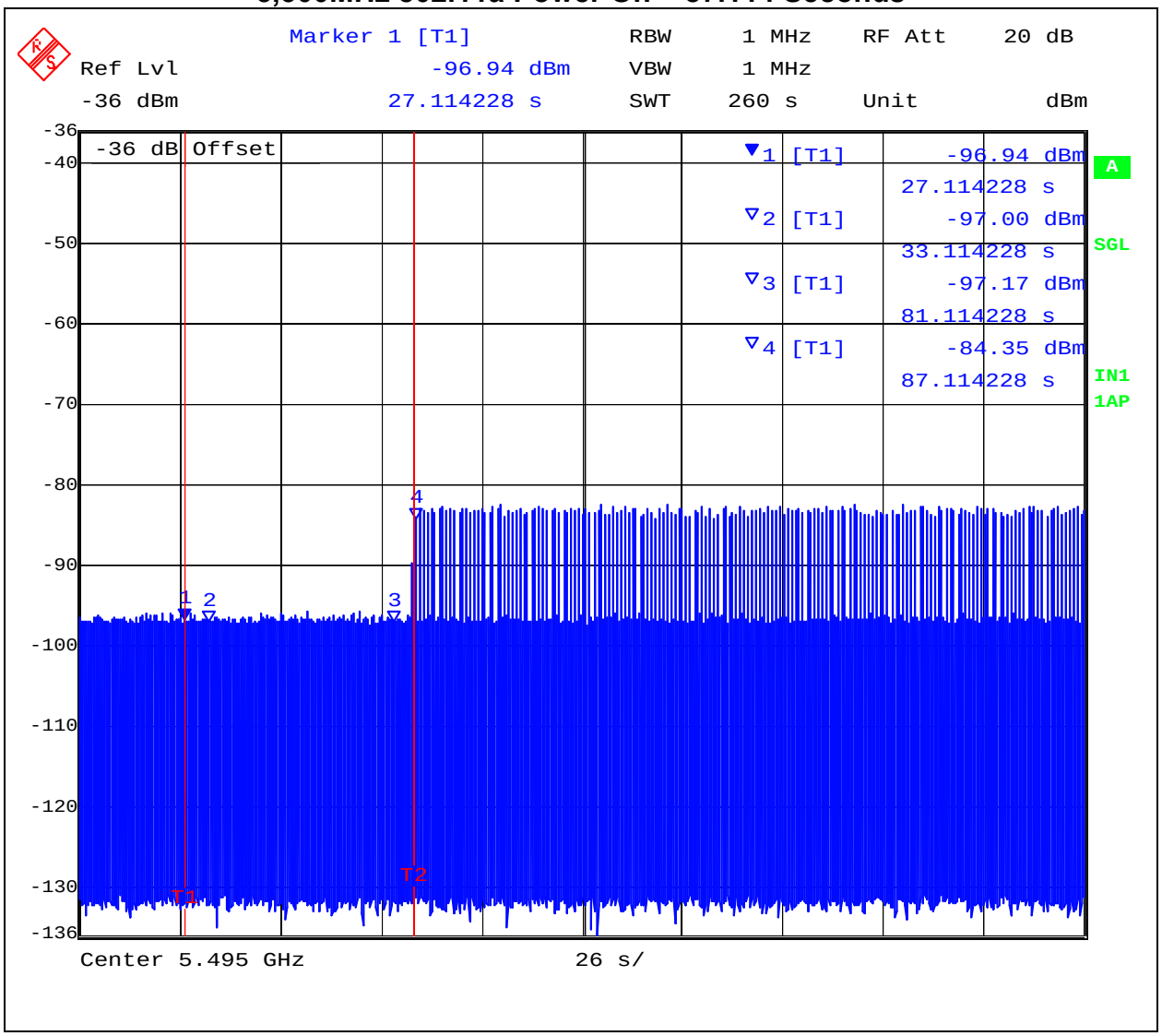
The U-NII device is powered on and be instructed to operate at 5,500MHz 802.11a. At the same time the EUT is powered on, the spectrum analyzer is set for zero span with a 1 MHz resolution bandwidth at 5,500 MHz with a 260 second sweep time. The analyzer's sweep will be started the same time power is applied to the U-NII device.

The EUT should not transmit any pulse or data transmissions until at least 1 minute after the completion of the power-on cycle.

The first red marker line shown on the following plot denotes the instant when the EUT starts its power-up sequence i.e. $T_0$ (as defined within the FCC's MO&O 06-96 Normative Reference 2 ). The power-up reference $T_0$ is determined by the time it takes for the EUT to start "beaconing" i.e. initial beacon – 60 secs = end of power-up.

The Channel Availability Check Time commences at instant $T_0$ and will end no sooner than $T_0$ + 60 seconds.

## EUT power up and Initial Channel Availability Check Time
## 5,500MHz 802.11a Power On = 87.114 Seconds



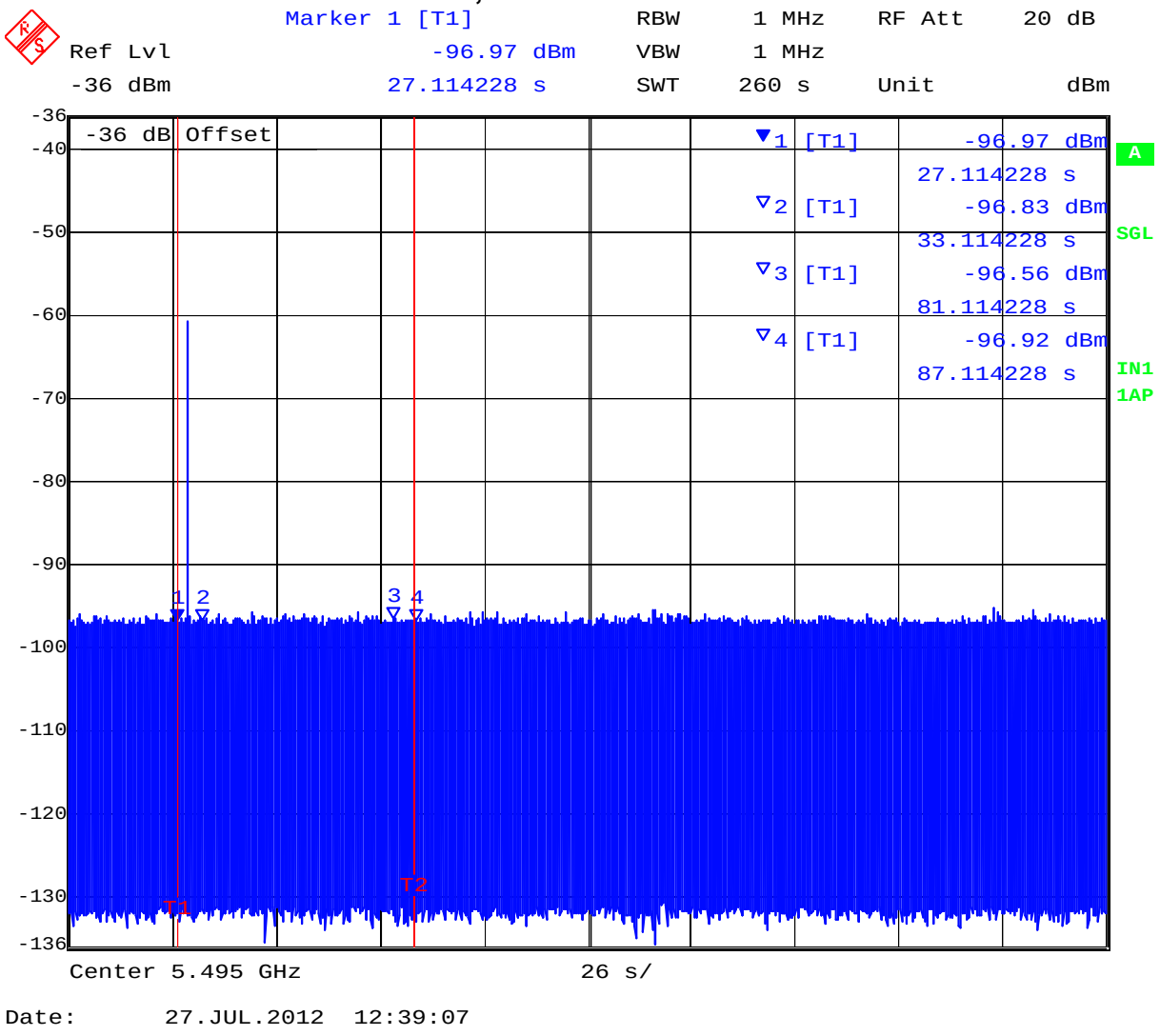
### 6.2.3. Radar Burst at the Beginning of the Channel Availability Check Time:

The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold (Ref Section 6.1.7) occurs at the beginning of the Channel Availability Check Time.

A single Burst of short pulse of radar Type 1 will commence within a 6 second window starting at $T_0$ (first red marker line on the following plot).

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5,500MHz 802.11a will continue for 2.5 minutes after the radar burst has been generated.

## Channel Availability Check Time at the start T0 + 6 seconds Check Time 5,500MHz 802.11a



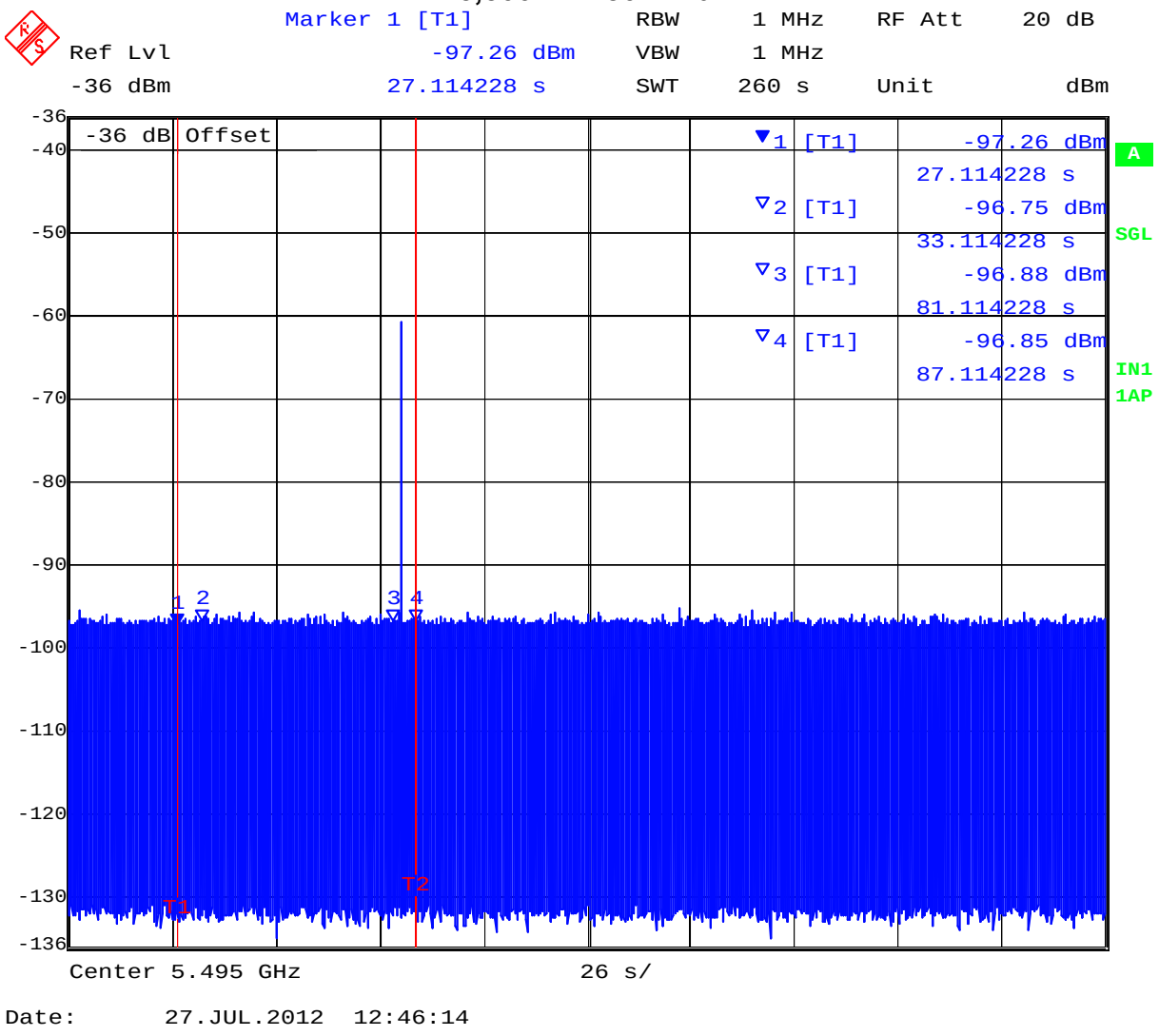
### 6.2.4. Radar Burst at the End of the Channel Availability Check Time:

The steps below define the procedure to verify successful radar detection on the selected Channel during a period equal to the Channel Availability Check Time and avoidance of operation on that Channel when a radar Burst with a level equal to the DFS Detection Threshold occurs at the end of the Channel Availability Check Time.

A single Burst of short pulse of radar type 1 will commence within a 6 second window starting at $T_0$+ 54 seconds. The window will commence at marker 2 and end at the red frequency line $T_2$.

Visual indication on the EUT of successful detection of the radar Burst will be recorded and reported. Observation of emissions at 5,500MHz 802.11a will continue for 2.5 minutes after the radar burst has been generated.

## Channel Availability Check Time at T0 + 54 seconds Check Time 5,500MHz 802.11a



### 6.2.5. In-Service Monitoring for Channel Move Time, Channel Closing Transmission Time and Non-Occupancy Period

**FCC §15.407(h)(2)(iii)**

The steps below define the procedure to determine the above mentioned parameters when a radar Burst with a level equal to the DFS Detection Threshold is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Client Device will associate with the EUT (Master). The requisite MPEG video file ("TestFile.mpg" available on the NTIA website at the following link http://ntiacsd.ntia.doc.gov/dfs/) is streamed from the master device (AP) to the client.

**Channel Closing Transmission Time - Measurement**

A Type 1 waveform was introduced to the EUT, from which a 12 second transmission record was digitally captured, collecting nearly 250M samples of data, which included in excess of 600 ms of pre-trigger data. This Type 1 waveform had an integral marker built into its construction, marking the start of the radar waveform play, which directly triggered the PXI digitizer's data capture via the PXI backplane trigger bus.

The test system was set-up to capture all transmission data for access point events above a threshold level of -50 dBm. The test equipment time stamps all captured events with respect to $T_0$ (zero time indicating the start of the measurements sequence) starting the 612.1 ms pre-trigger period followed by the radar type 1 burst period.

Radar (Type 1) Pre-trigger period 612.1 ms

Type 1 burst period 25.70 ms

(The period of the 18 pulse burst includes [18 pulses *1.428mS PRI] = 25.704 ms. Then add 1 µs pulse width for the final pulse.)

Channel Closing Transmission Time starts immediately after the last radar pulse is transmitted i.e. 637.8 ms after the start of the trace capture period.

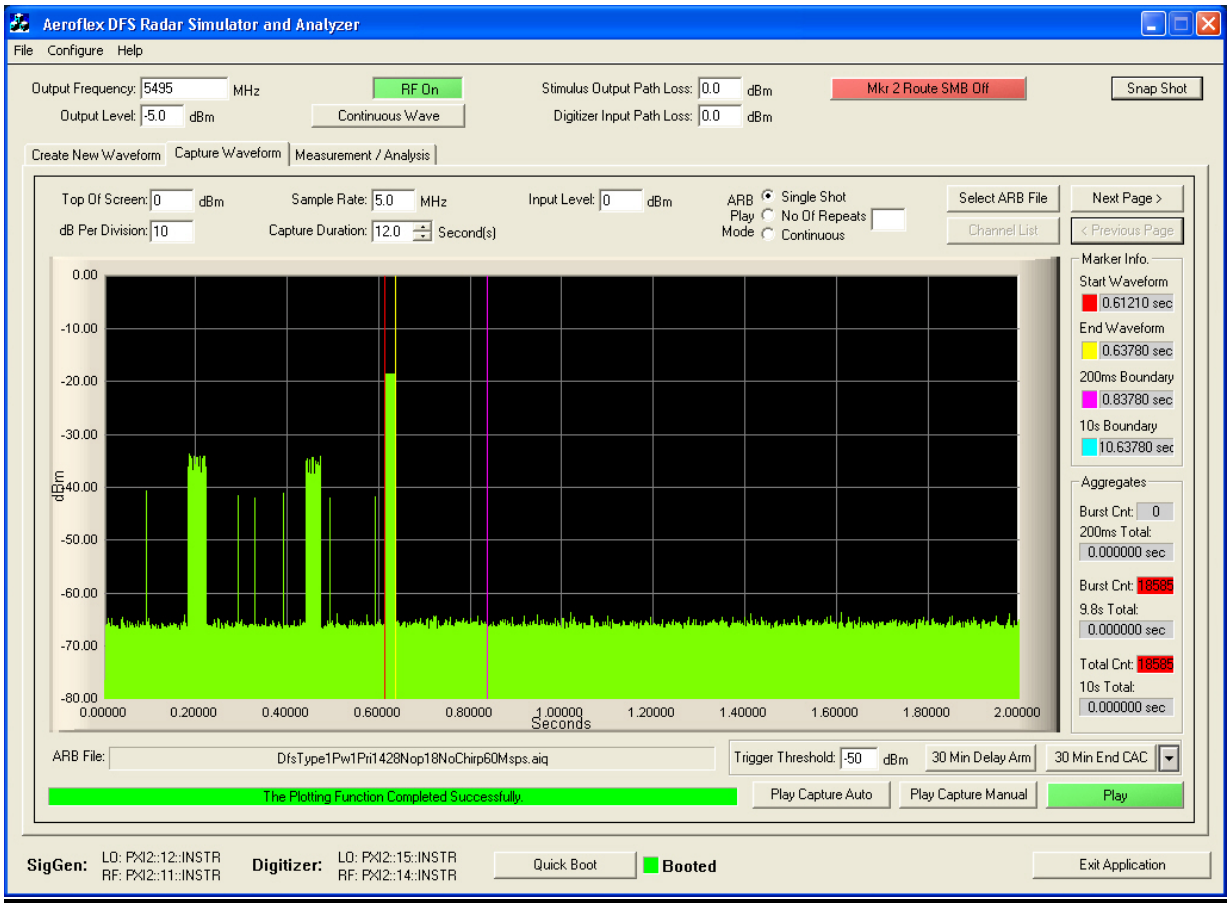
Therefore, pulses seen after this 637.8 ms boundary are identified and totaled to provide an aggregate total of transmissions in order to determine whether the EUT is compliant with the Channel Closing Transmission Time requirements as described in MO&O FCC 06-96. In this case, it was found that an aggregate total of 0.00 ms of transmission time accrued. This value is found at the right hand side at the foot of the following plot (10s Total).

**5,500 MHz (802.11a)**

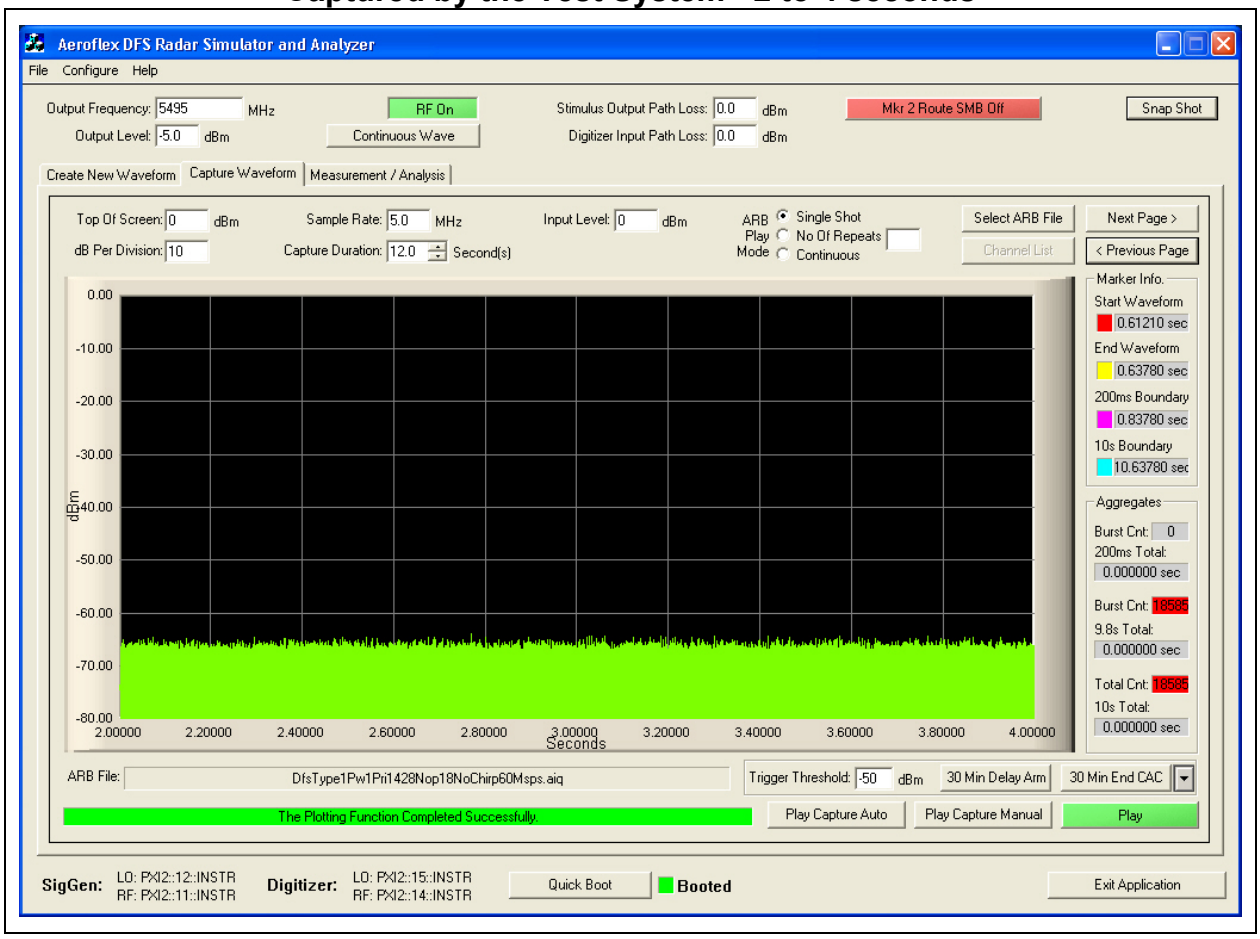
**Channel Closing Transmission Time = 0.00 mSecs (limit 260 mSecs)**

**Channel Move Time = 0.00 Secs (limit 10 Secs)**

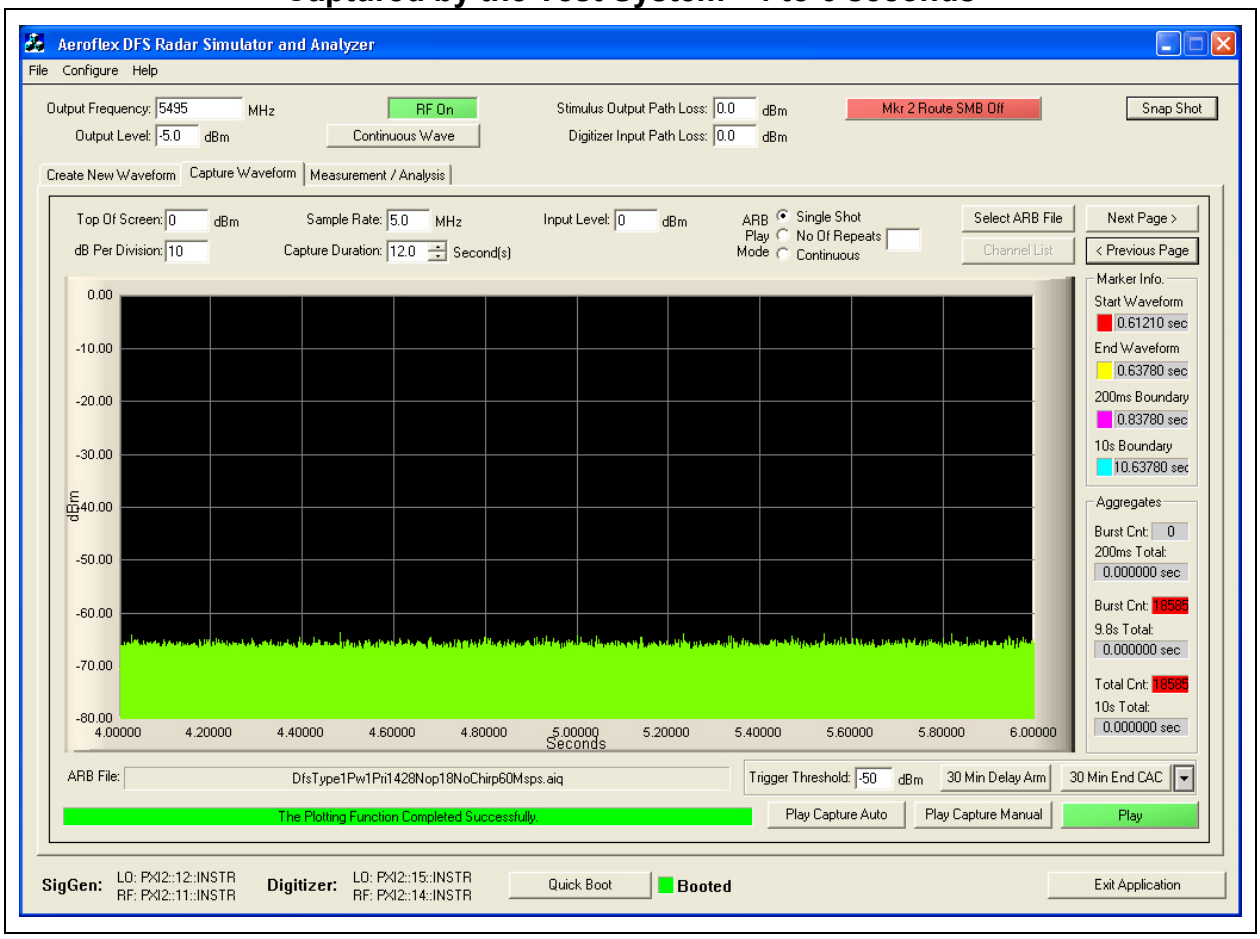
**Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 0 to 2 seconds**



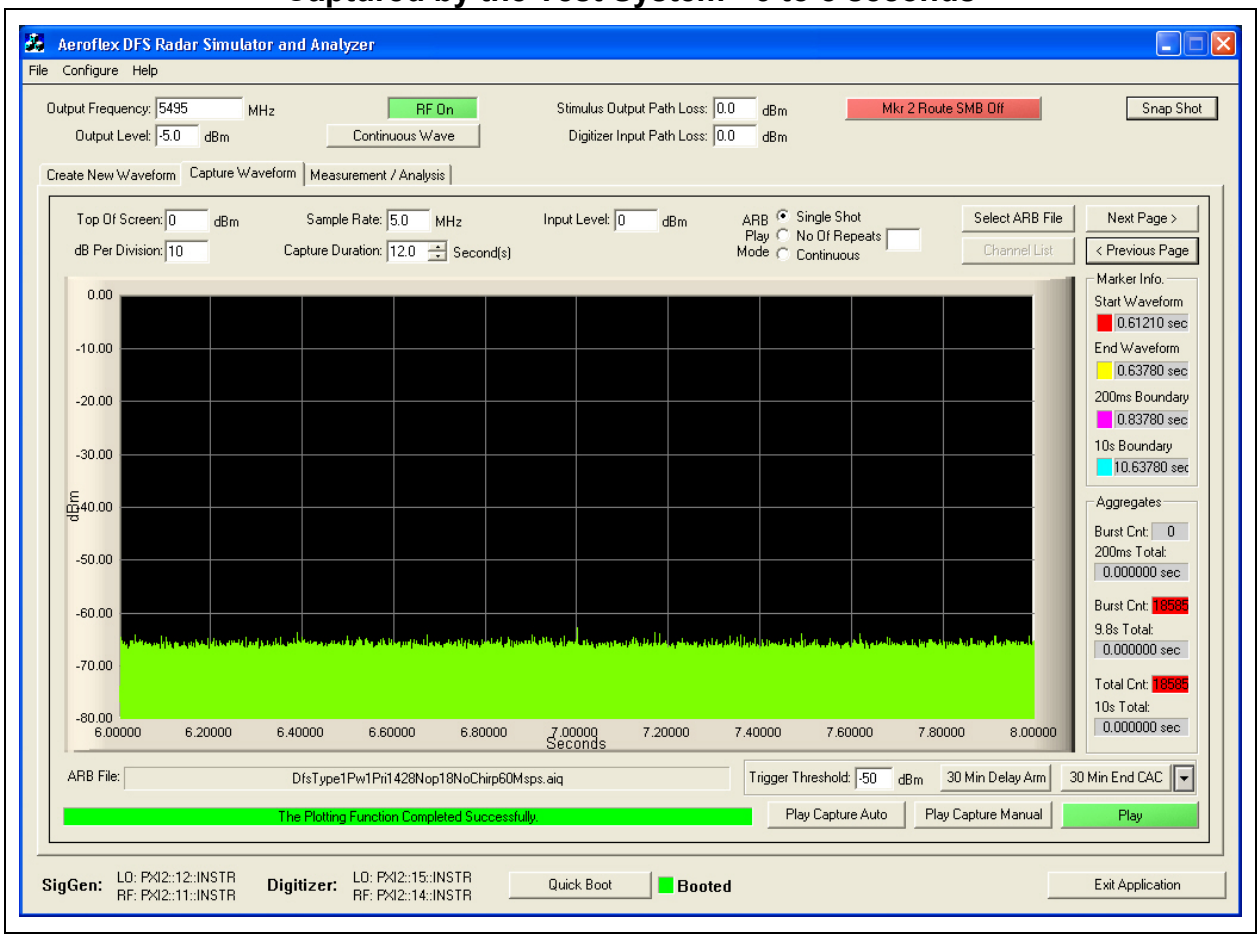
## Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 2 to 4 seconds



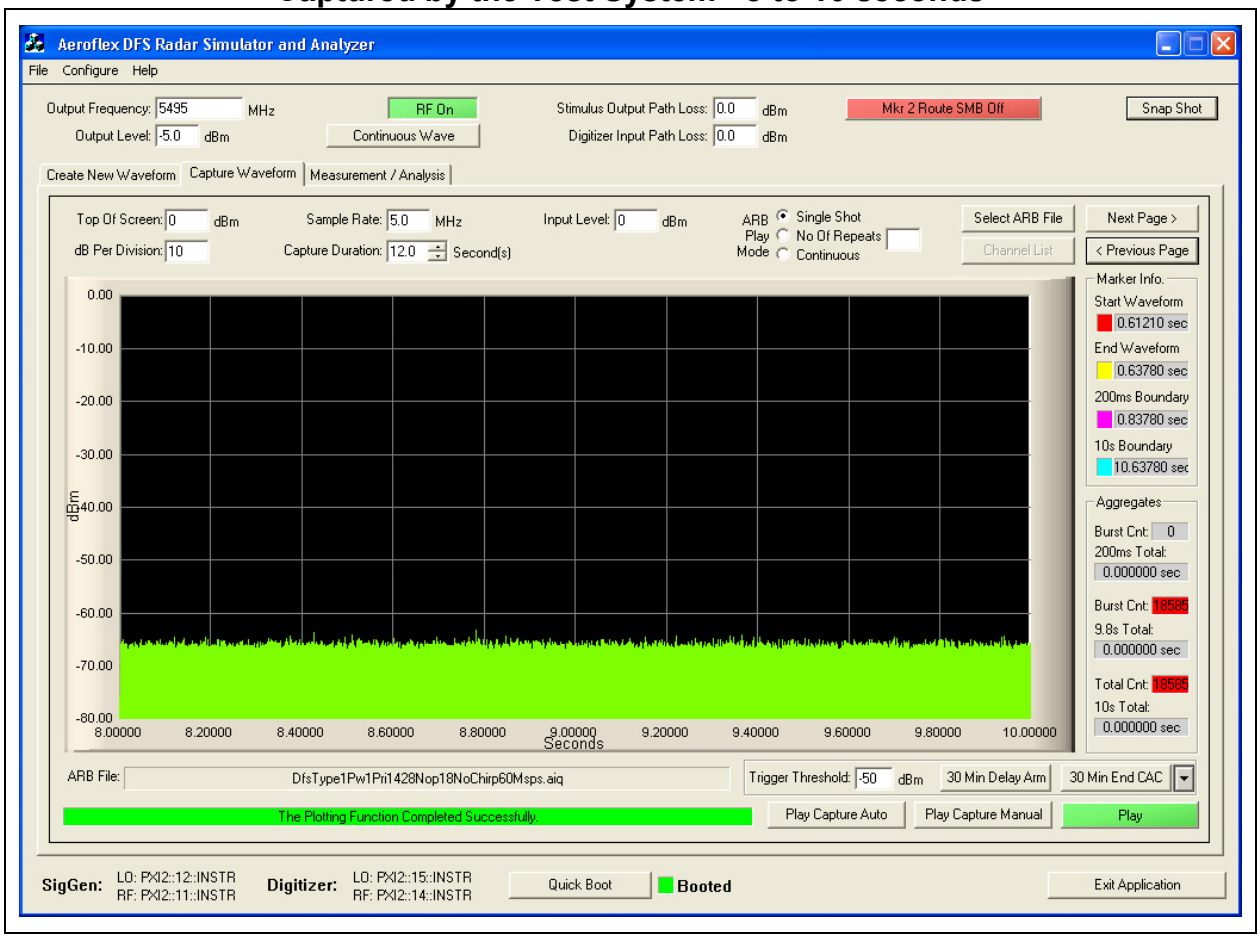
## Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 4 to 6 seconds



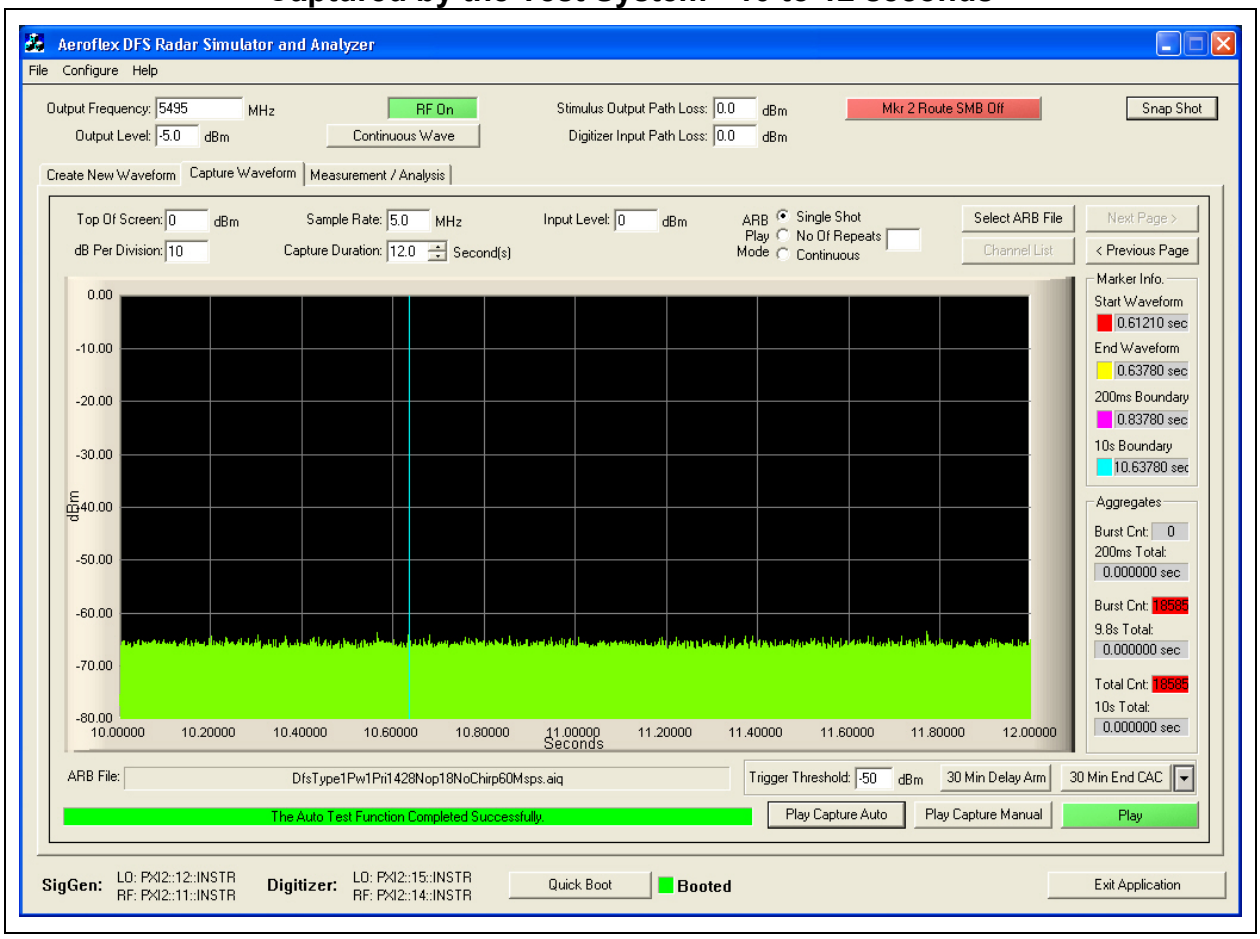
## Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 6 to 8 seconds



## Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 8 to 10 seconds



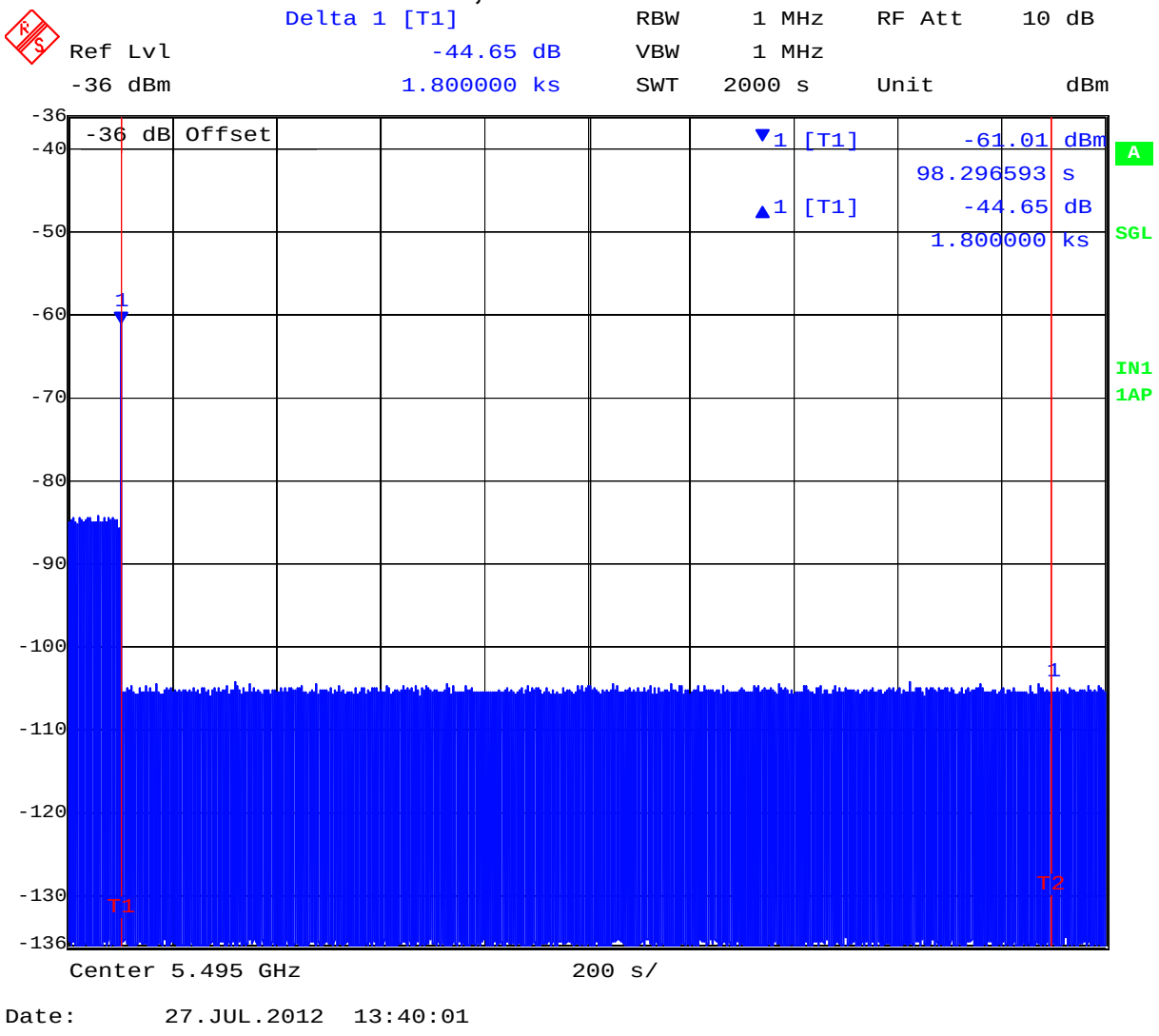
## Channel Move Time, Channel Closing Transmission Time for Type 1 Radar Captured by the Test System - 10 to 12 seconds



## 30 Minute Non-Occupancy Period

The EUT is monitored for more than 30 minutes following the channel close/move time to verify no transmissions resume on this Channel.

**30 Minute Non-Occupancy Period Type 1 Radar**
**5,500MHz 802.11a**



### 6.2.6. Statistical Performance Check

The steps below define the procedure to determine the minimum percentage of detection when a radar burst with a level equal to the DFS Detection Threshold is generated on the Operating Channel of the U-NII device.

A U-NII device operating as a Client Device will associate with the UUT (Master) at 5,500MHz 802.11a.

The Radar Waveform generator sends the individual waveform for each of the radar types 1-6. Statistical data will be gathered to determine the ability of the device to detect the radar test waveforms. The device can utilize a test mode to demonstrate when detection occurs to prevent the need to reset the device between trial runs. The percentage of successful detection is calculated by:

Total # of detections ÷ Total # of Trials × 100 = Probability of Detection

The Minimum number of trails, minimum percentage of successful detection and the average minimum percentage of successful detection are found in the Radar Test Waveforms section.

**Verification of Detection 5,497MHz 802.11a**

| Trial # | Detection = √, No Detection = 0 | | | | | |
|---|---|---|---|---|---|---|
| | Type 1 | Type 2 | Type 3 | Type 4 | Type 5 | Type 6 |
| 1 | √ | √ | √ | √ | v | √ |
| 2 | √ | √ | √ | 0 | v | √ |
| 3 | √ | √ | 0 | √ | v | √ |
| 4 | √ | √ | 0 | √ | 0 | √ |
| 5 | √ | √ | 0 | 0 | 0 | √ |
| 6 | √ | √ | √ | √ | v | √ |
| 7 | √ | √ | √ | √ | v | √ |
| 8 | √ | √ | √ | 0 | v | √ |
| 9 | √ | 0 | √ | √ | v | √ |
| 10 | √ | √ | √ | 0 | v | √ |
| 11 | √ | √ | √ | √ | 0 | √ |
| 12 | √ | √ | √ | √ | v | √ |
| 13 | √ | √ | √ | √ | v | √ |
| 14 | √ | √ | √ | √ | 0 | √ |
| 15 | √ | √ | 0 | 0 | v | √ |
| 16 | √ | √ | √ | 0 | v | √ |
| 17 | √ | √ | √ | √ | v | √ |
| 18 | √ | √ | √ | √ | v | √ |
| 19 | √ | √ | 0 | 0 | v | √ |
| 20 | √ | √ | 0 | 0 | v | √ |
| 21 | √ | √ | 0 | √ | v | √ |
| 22 | √ | √ | √ | √ | 0 | √ |
| 23 | √ | √ | √ | √ | v | √ |
| 24 | √ | √ | √ | √ | v | √ |
| 25 | √ | √ | √ | √ | v | √ |
| 26 | √ | √ | 0 | 0 | 0 | √ |
| 27 | √ | √ | 0 | √ | v | √ |
| 28 | √ | √ | 0 | √ | v | √ |
| 29 | √ | √ | √ | 0 | v | √ |
| 30 | √ | √ | √ | 0 | v | √ |
| **Detection Percentage** | 100% (>60%) | 96.6% (>60%) | 66.6% (>60%) | 63.3% (>60%) | 80% (>80%) | 100.0% (>70%) |

In addition an average minimum percentage of successful detection across all four Short pulse radar test waveforms is required and calculated as follows;

$(P_d1 + P_d2 + P_d3 + P_d4) / 4 = 100\% + 96.6\% + 66.6\% + 63.3\%) / 4 = 81.6\ \%\ (> 80\%)$

**Measurement Uncertainty Time/Power**

| | |
|---|---|
| Measurement uncertainty | |
| - Time | 4% |
| - Power | 1.33dB |

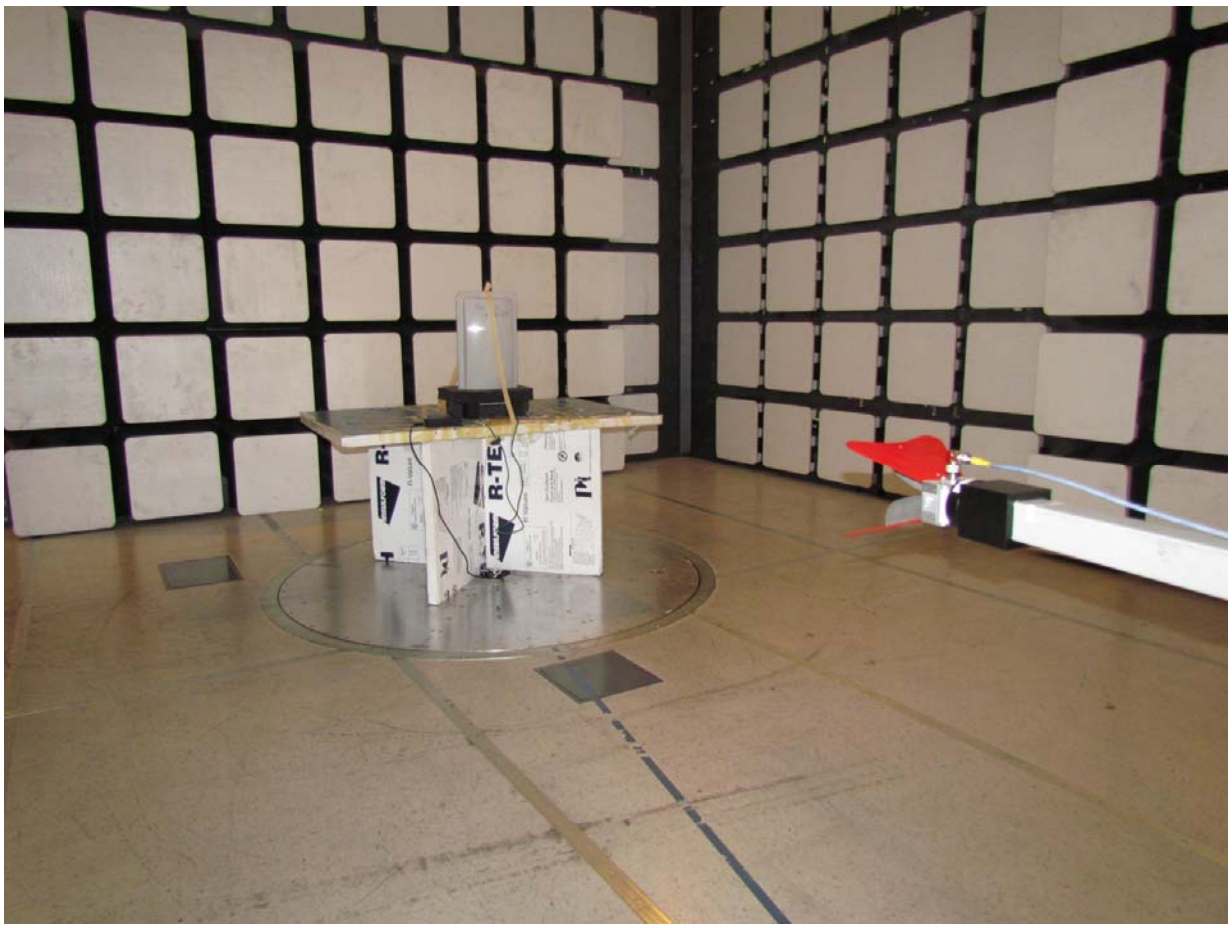
**Traceability**

| **Test Equipment Used** |
|---|
| 0072, 0083, 0098, 0116, 0132, 0158, 0313, 0314, 0193, 0223, 0252, 0253, 0251, 0256, 0328, 0329 |

# 7. PHOTOGRAPHS

## 7.1. Radiated Test Setup Below 1 GHz - Test Setup

## 7.2. Radiated Emissions Above 1 GHz - Test Setup



## 7.3. Dynamic Frequency Selection Test Set-Up

**General DFS Test Setup**

## 8. TEST EQUIPMENT DETAILS

| Asset # | Instrument | Manufacturer | Part # | Serial # | Calibration Due Date |
|---|---|---|---|---|---|
| 0070 | Power Meter | Hewlett Packard | 437B | 3125U11552 | 28th Nov 13 |
| 0117 | Power Sensor | Hewlett Packard | 8487D | 3318A00371 | 15th Nov 13 |
| 0223 | Power Meter | Hewlett Packard | EPM-442A | US37480256 | 15th Nov 13 |
| 0374 | Power Sensor | Hewlett Packard | 8485A | 3318A19694 | 29th Nov 13 |
| 0158 | Barometer /Thermometer | Control Co. | 4196 | E2846 | 8th Dec 13 |
| 0193 | EMI Receiver | Rhode & Schwartz | ESI 7 | 838496/007 | 2nd Dec 13 |
| 0287 | EMI Receiver | Rhode & Schwartz | ESIB40 | 100201 | 16th Nov 13 |
| 0338 | 30 - 3000 MHz Antenna | Sunol | JB3 | A052907 | 8th Nov 13 |
| 0335 | 1-18 GHz Horn Antenna | EMCO | 3117 | 00066580 | 7th Nov 13 |
| 0252 | SMA Cable | Megaphase | Sucoflex 104 | None | N/A |
| 0293 | BNC Cable | Megaphase | 1689 1GVT4 | 15F50B001 | N/A |
| 0307 | BNC Cable | Megaphase | 1689 1GVT4 | 15F50B002 | N/A |
| 0310 | 2m SMA Cable | Micro-Coax | UFA210A-0-0787-3G03G0 | 209089-001 | N/A |
| 0312 | 3m SMA Cable | Micro-Coax | UFA210A-1-1181-3G0300 | 209092-001 | N/A |
| 0314 | 30dB N-Type Attenuator | ARRA | N9444-30 | 1623 | N/A |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