Test of Access One Network OWS2400

To: FCC 47 CFR Part 90

Test Report Serial No.: STRX10-A4 Rev C

# TEST REPORT

FROM


Test of Access One Network OWS2400

To FCC 47 CFR Part 90

Test Report Serial No.: STRX10-A4 Rev C

This report supersedes STRX1-A4 Rev B

**Manufacturer:** Strix Systems, Inc
26610 Agoura Road
Calabasas
California 91302, USA

**Product Function:** Wireless Mesh Router Operating at 4.9 GHz

**Copy No:** pdf **Issue Date:** 16th February '07

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

**MiCOM Labs, Inc.**
440 Boulder Court, Suite 200
Pleasanton, CA 94566 USA
Phone: +1 (925) 462-0304
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CERTIFICATE #2381.01

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

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## ACCREDITATION & LISTINGS

MiCOM Labs, Inc. an accredited laboratory complies with the international standard BS 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

THE AMERICAN
ASSOCIATION
FOR LABORATORY
ACCREDITATION

**ACCREDITED LABORATORY**

A2LA has accredited

**MICOM LABS**
**Pleasanton, CA**

for technical competence in the field of

**Electrical Testing**

The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified field of testing.

Presented this 14th day of September 2005.

American Association for Laboratory Accreditation
Corporate SEAL 1978 District of Columbia
A2LA

President
For the Accreditation Council
Certificate Number 2381.01
Valid to: November 30, 2007

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

## LISTINGS

MiCOM Labs test facilities are listed by the following organizations;

***North America***

**United States of America**
Federal Communications Commission (FCC) Listing #: 102167

## DOCUMENT HISTORY

| Document History | | |
|---|---|---|
| Revision | Date | Comments |
| Draft | | |
| Rev A | 24th December '06 | Initial Release |
| Rev B | 31st December '06 | Modified Section 3.7 Equipment Modifications |
| Rev C | 16th February'07 | Recalculation of MPE |

# 1. TEST RESULT CERTIFICATE

| | | | |
|---|---|---|---|
| Manufacturer: | Strix Systems, Inc<br>26610 Agoura Road,<br>Calabasas<br>California 91302, USA | Tested By: | MiCOM Labs, Inc.<br>440 Boulder Court,<br>Suite 200, Pleasanton<br>California, 94566,<br>USA |
| EUT: | Wireless Access Point<br>Operating at 4.9 GHz | Telephone: | +1 925 462 0304 |
| Model(s): | OWS 2400-10<br>OWS 2400-20<br>OWS 2400-30 | Fax: | +1 925 462 0306 |
| S/N: | 200816 | | |
| Test Date(s): | 8th Dec to 13th Dec '06 | Website: | www.micomlabs.com |

| STANDARD(S) | TEST RESULTS |
|---|---|
| FCC 47 CFR Part 90 | 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.

ACCREDITED
CERTIFICATE #2381.01

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

Graeme Grieve
Quality Manager MiCOM Labs,

Gordon Hurst
President & CEO MiCOM Labs, Inc.

# 2. REFERENCES AND MEASUREMENT UNCERTAINTY

## 2.1. Normative References

| Ref. | Publication | Year | Title |
|---|---|---|---|
| (i) | FCC 47 CFR Part 90 | 2004 | Code of Federal Regulations |
| (ii) | FCC 47 CFR Part 90<br>Sect 90.210<br>Sect 90.1215 | 18th May 2005 | 90.210 Emission Masks (Revised requirements)<br>90.1215 Power Limits (Revised requirements) |
| (iii) | ANSI C63.4 | 2003 | 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 |
| (iv) | CISPR 22/<br>EN 55022 | 1997<br>1998 | Limits and Methods of Measurements of Radio Disturbance Characteristics of Information Technology Equipment |
| (v) | M 3003 | Edition 1<br>Dec. 1997 | Expression of Uncertainty and Confidence in Measurements |
| (vi) | LAB34 | Edition 1<br>Aug 2002 | The expression of uncertainty in EMC Testing |
| (vii) | ETSI TR 100 028 | 2001 | Parts 1 and 2<br>Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics |
| (viii) | A2LA | 14th September 2005 | Reference to A2LA Accreditation Status – A2LA Advertising Policy |

## 2.2. 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 Strix Systems Inc Access One Network OWS2400 to FCC 47 CFR Part 90 Subpart Y regulations |
| Applicant: | As Manufacturer |
| Manufacturer: | Strix Systems, Inc<br>26610 Agoura Road<br>Calabasas California 91302, USA |
| Laboratory performing the tests: | MiCOM Labs, Inc.<br>440 Boulder Court, Suite 200<br>Pleasanton, California 94566 USA |
| Test report reference number: | STRX10-A4 Rev C |
| Date EUT received: | 8TH December 2006 |
| Standard(s) applied: | FCC 47 CFR Part 90 (Public Safety Band) |
| Dates of test (from - to): | 8th Dec to 13th Dec '06 |
| No of Units Tested: | 1 |
| Type of Equipment: | Wireless Access Point |
| Manufacturers Trade Name: | Access One Network |
| Model(s): | OWS 2400-10<br>OWS 2400-20<br>OWS 2400-30 |
| Location for use: | Outdoor use only. |
| Declared Frequency Range(s): | 4940 - 4990 MHz |
| Declared Nominal Output Power: | +23 dBm (average) |
| Type of Modulation: | OFDM |
| EUT Modes of Operation: | Per 802.11 – DBPSK, DQPSK, CCK, OFDM |
| Transmit/Receive Operation: | TDD |
| Rated Input Voltage and Current: | 100 to 240 VAC. Single Phase, 50-60 Hz, 1 amp max. |
| Operating Temperature Range: | Declared range -30 to +55ºC |
| ITU Emission Designator: | 4.9 GHz - 21M2W7D |
| Microprocessor(s) Model: | Atheros AR5312 |
| Clock/Oscillator(s): | 25 MHz, 40 MHz. |
| Frequency Stability: | ±20 ppm |
| Equipment Dimensions: | 14”x12”x8” |
| Weight: | 16.5 lbs |
| Primary function of equipment: | Wireless Access Mesh Networks |

## 3.2. Scope of Test Program

The scope of the test program was to test Strix Systems Access One Network OWS2400 to;-

FCC 47 CFR Part 90, Subpart Y regulatory requirements.

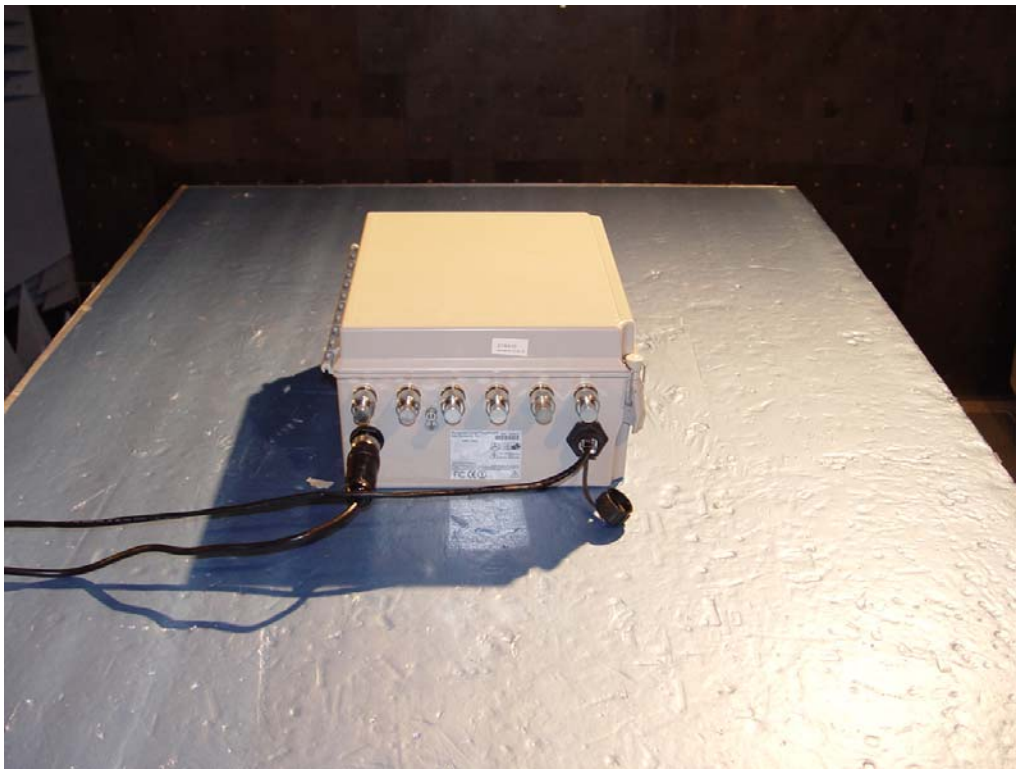
18th May 2005 revision of FCC 47 CFR Part 90;-

| | |
|---|---|
| Sub Section 90.210 | Emission Masks (revised requirements) |
| Sub Section 90.1215 | Power Limits (revised requirements) |

The OWS2400 is a Wireless Access Point operating in the 4.9 GHz Public Safety Band Radio employing OFDM modulation at 20 MHz bandwidths in the frequency range 4940 to 4990 MHz.

The OWS2400 series of tests considers three product variants OWS2400-10, OWS2400-20 and OWS 2400-30. The OWS2400-30 is manufactured with three identical 802.11abg wireless cards that are inserted into a common chassis and power supply conditioning system. The OWS2400-20 has two wireless cards and the OWS2400-10 has a single wireless card. As the OWS2400-10/20/30 utilize the same wireless 802.11abg wireless card. One conducted test was completed on the OWS3600-30, (MiCOM Labs test report STRX10-A2) and results ported to cover the 2400 variants. Radiated test results were measured on all OWS2400 models.

Strix Systems Inc
Access One Network OWS 2400



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

| Type (EUT/ Support) | Equipment Description (Including Brand Name) | Manufacturer | Model No. | Serial No. |
|---|---|---|---|---|
| EUT | Access One Network Microwave Radio 4.9 GHz | Strix Systems Inc | OWS 2400 | 200816 |
| EUT | AC Power Cord 115/240V | 6' | | |
| Support | Laptop | IBM | | |

## 3.4. Antenna Details

| Antenna Type | Gain (dBi) | Manufacturer | Model No. | Serial No. |
|---|---|---|---|---|
| | | | | |

No antennas were submitted for test purposes. An 11 dBi gain antenna was utilized for the calculation of MPE (Maximum Permissible Exposure) in Section 5.1.4.

## 3.5. Cabling and I/O Ports

Number and type of I/O ports

1. ODU - single cable for power
2. Ethernet 10/100 Base T

## 3.6. Test Configurations

Matrix of test configurations

| Parameter | Operational Mode | Test Conditions | Bandwidths (MHz) |
|---|---|---|---|
| Occupied BW & Emission Mask | Modulated | Ambient | 20 |
| Peak Output power | Modulated | Ambient | 20 |
| Peak Power Spectral Density | Modulated | Ambient | 20 |
| Frequency Stability | CW | Temperature Variations and Voltage Variations | -- |
| Conducted Emissions | Modulated | Ambient | 20 |
| Radiated Emissions | Modulated | Ambient | 20 |
| AC Wireline Emissions | Modulated | Ambient | 20 |

Only worst case plots are provided for each test parameter are identified within this report. Plots not included are held on file by the test laboratory and available upon request with client permission.

## 3.7. Equipment Modifications

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

1. NONE

## 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 90**, **Subpart Y (except Section 5.1.4)**

| Section(s) | Test Items | Description | Condition | Result | Test Report Section |
|---|---|---|---|---|---|
| **2.1049; 90.210(m)** | 26 dB Occupied BW & Emission Mask | Emission mask and bandwidth measurement(s) | Conducted | Complies | 5.1.1 |
| **2.1046; 90.1215 (a)** | Peak Output Power | Modulated Output Power | Conducted | Complies | 5.1.2 |
| **2.1046; 90.1215 (a)** | Peak Power Spectral Density | Maximum Spectral Density | Conducted | Complies | 5.1.3 |
| **Subpart C 90.1217** | Maximum Permissible Exposure | Exposure to radio frequency energy levels | Radiated | Complies | 5.1.4 |
| **2.1055(a)(1); 90.213** | Frequency Stability | Includes temperature and voltage variations | Conducted | Complies | 5.1.5 |
| **2.1051; 90.210(m)** | Conducted Spurious Emissions at Antenna Port | Emissions from the antenna port<br><br>30 MHz – 40 GHz | Conducted | Complies | 5.1.6 |
| **2.1053; 90.210(m)** | Radiated Spurious Emissions | Spurious emissions 30 MHz – 40 GHz<br>OWS2400-30<br>OWS2400-20<br>OWS2400-10 | Radiated | Complies | 5.1.7 |
| **15.207** | AC Wireline Emissions | Conducted Emissions | Conducted | Complies | 5.1.8 |

***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. Occupied Bandwidth and Emission Mask

**FCC 47 CFR Part 90, Subpart Y; 2.1049; §90.210(m)**

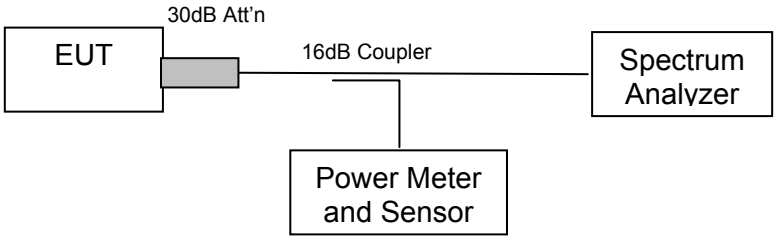
**Test Procedure**

The transmitter terminal of EUT was connected to the input of the spectrum analyzer set to measure the 26 dB occupied bandwidth and emission mask for the radio. The system highest power setting was selected with modulation ON and duty cycle set for 100% i.e. continuous operation at all times.

For emission masks the zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz.

The EUT is not equipped with an audio low-pass filter.

**Test Measurement Set up**

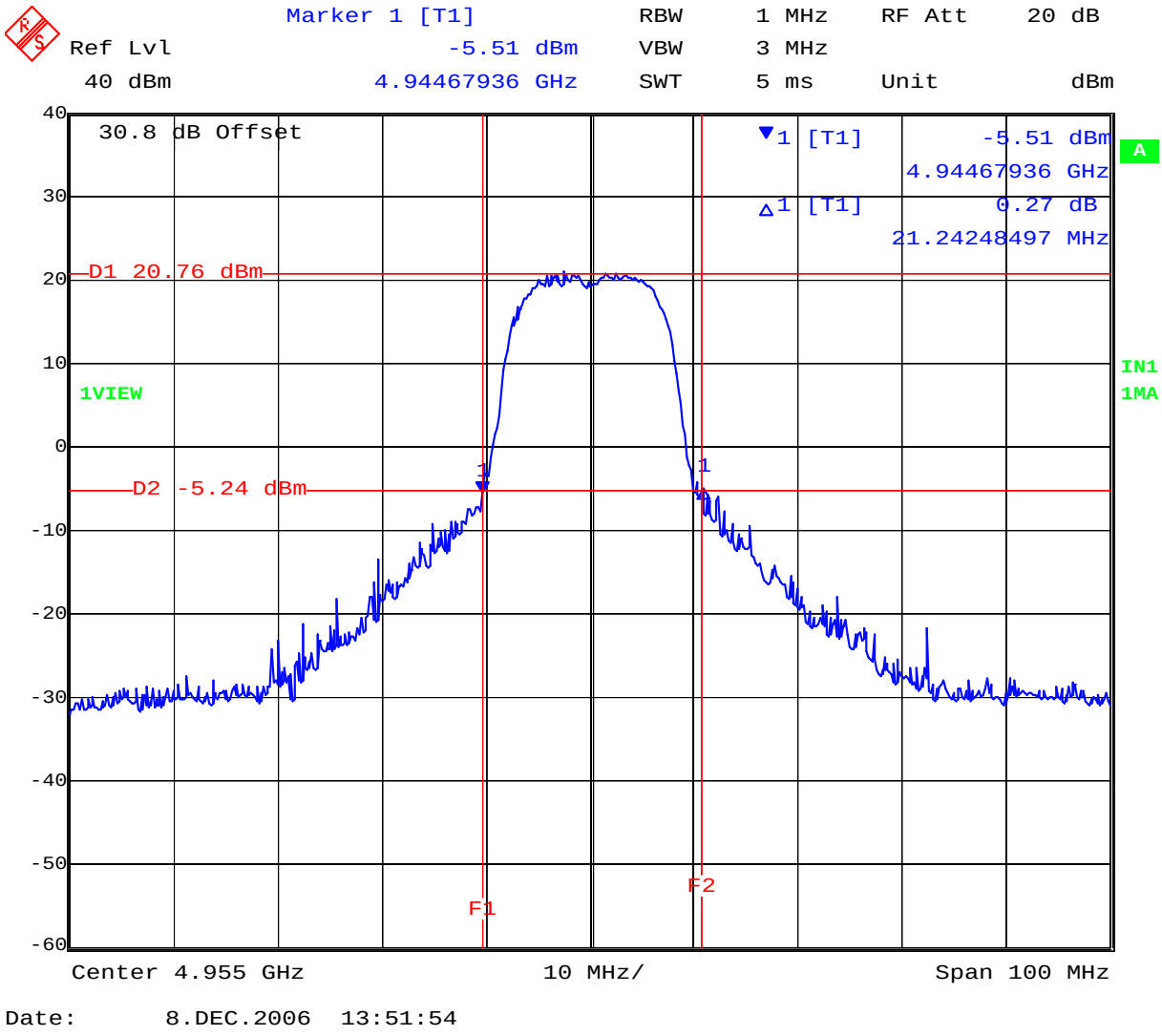



Test set up for Occupied Bandwidth and Emission Mask measurement

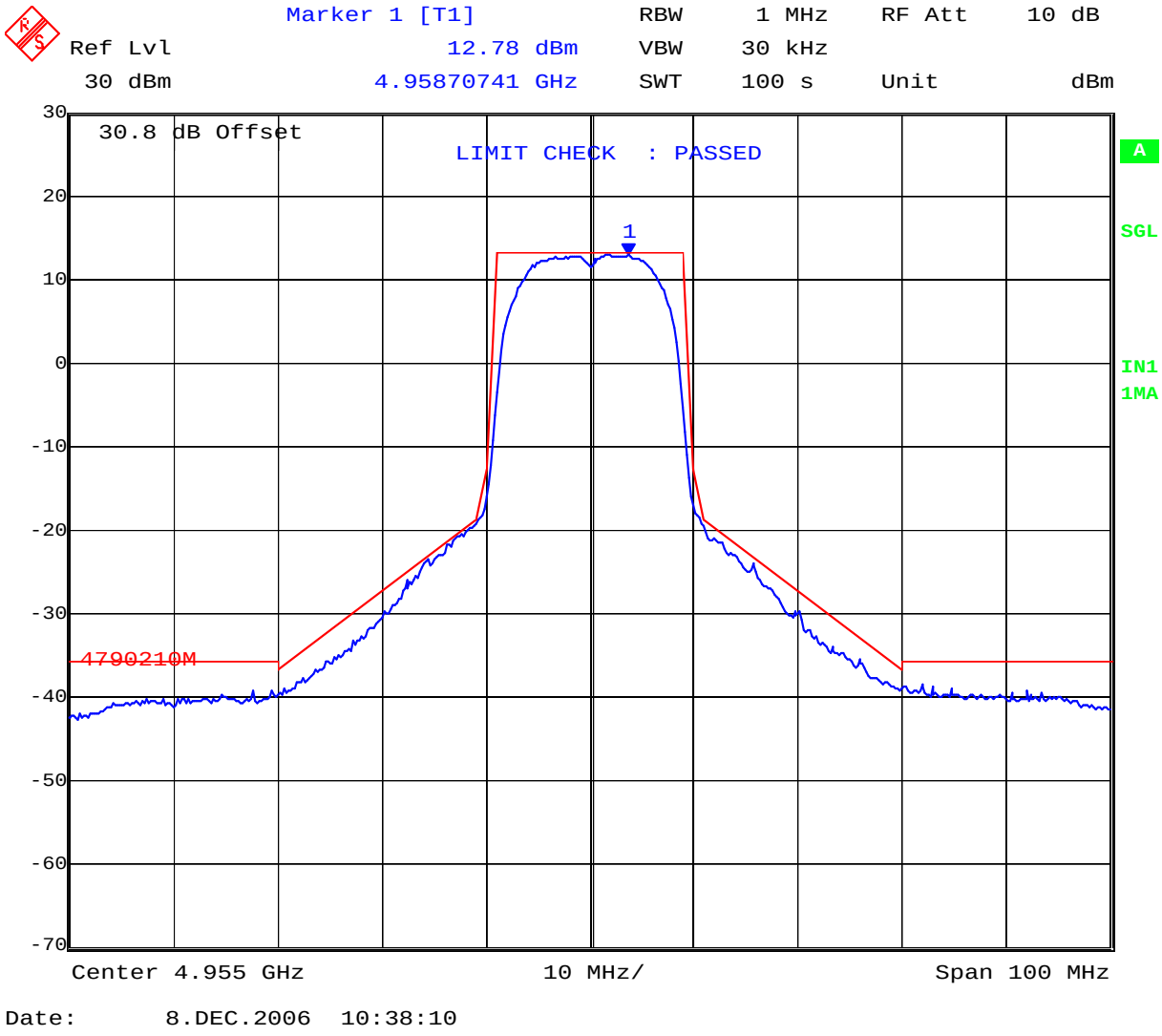
Ambient conditions.
Temperature: 17 to 23 °C Relative humidity: 31 to 57 % Pressure: 999 to 1012 mbar

TABLE OF RESULTS – 20 MHz 26 dB Bandwidth(s)

| Center Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---|---|
| 4,955.0 | 21.24248497 |




26 dB Bandwidth 20 MHz Channel Freq 4955 MHz

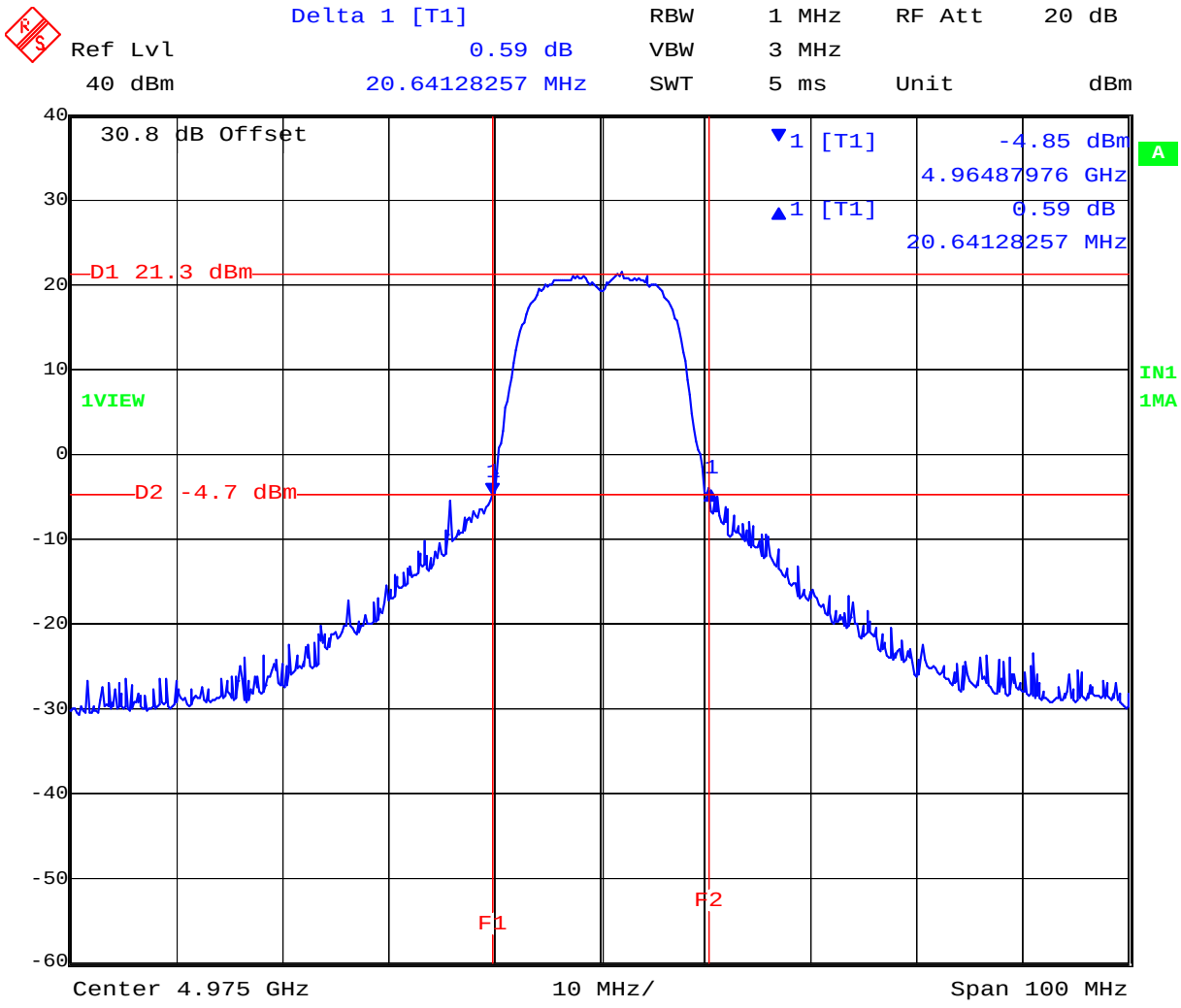



Emission Mask for 20 MHz BW Channel Freq 4955 MHz

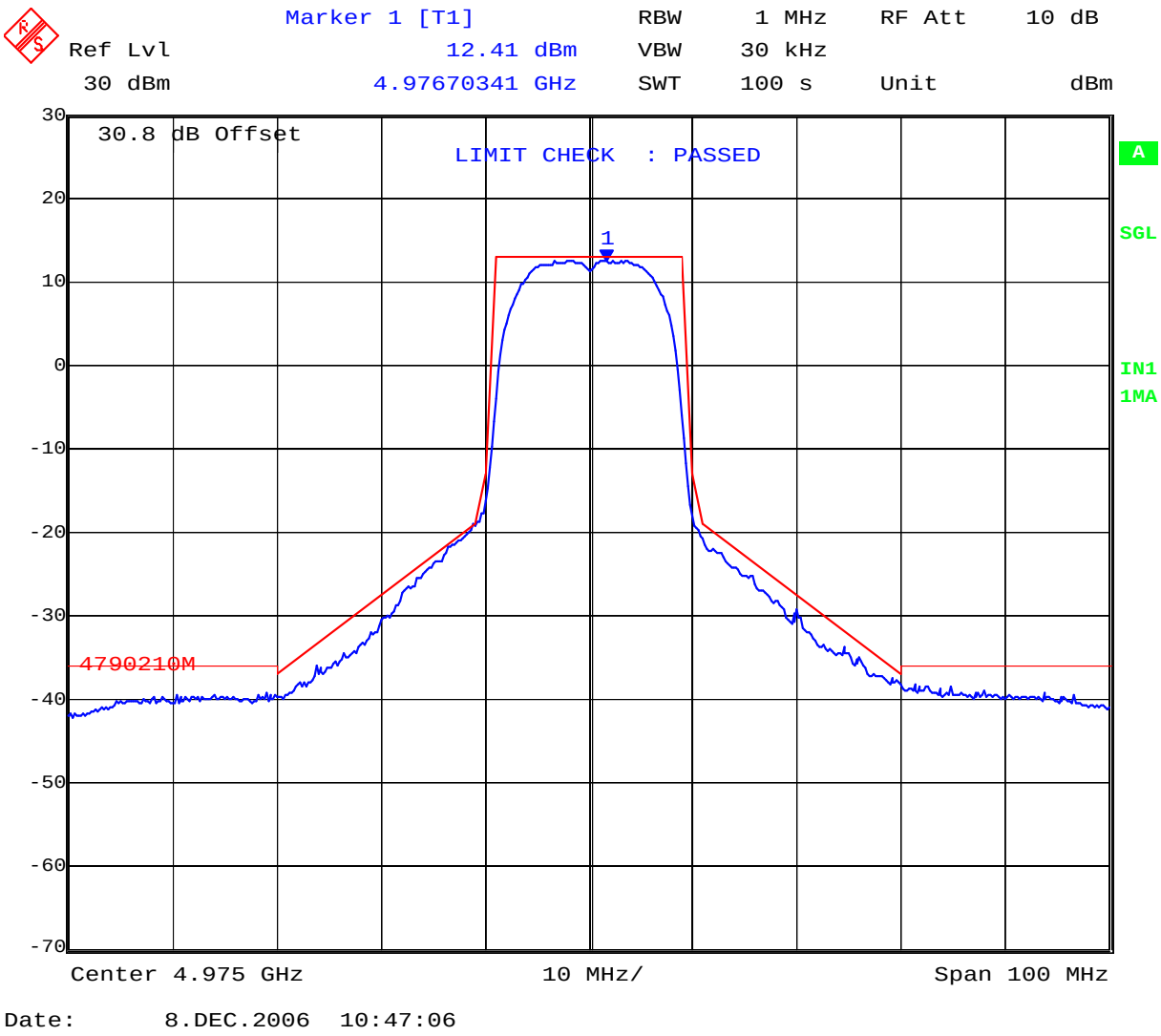
Note: Maximum Average Output Power to meet spectrum mask limits: **+22.75 dBm**

TABLE OF RESULTS – 20 MHz Bandwidth

| Center Frequency (MHz) | 26 dB Bandwidth (MHz) |
|---|---|
| 4,975.0 | 20.64128257 |




26 dB Bandwidth 20 MHz Channel Freq 4975 MHz




Emission Mask for 20 MHz BW Channel Freq 4975 MHz

Note: Maximum Average Output Power to meet spectrum mask limits: **+22.31 dBm**

**Specification Limits**
**FCC Part §90.210**

**Limits for Authorized Bandwidth**

| Frequency Band (MHz) and Related Documents | Spectrum Masks with Audio Filter | Without Audio Filter |
|---|---|---|
| 4950 – 4990 MHz | L or M | L or M |

Reference to the emission masks are provided below

**Limits Emission Masks**
**90.210(L)**, Emission Mask L. For low power transmitters (20 dBm of less) operating in the 4940 – 4990 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0 – 45% of the authorized bandwidth (BW) : 0dB.

(2) On any frequency removed from the assigned frequency between 45 – 50 % of the authorized bandwidth: 219 log (% of (BW)/45) dB.

(3) On any frequency removed from the assigned frequency between 50 – 55 % of the authorized bandwidth: 10 + 242 log (% of (BW)/50) dB.

(4) On any frequency removed from the assigned frequency between 55 – 100 % of the authorized bandwidth: 20 + 31 log (% of (BW)/55) dB attenuation.

(5) On any frequency removed from the assigned frequency between 100 – 150 % of the authorized bandwidth: 28 + 68 log (% of (BW)/100) dB attenuation.

(6) On any frequency removed from the assigned frequency above 150 % of the authorized bandwidth: 50 dB.

(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

**Limits Emission Masks (continued)**

**90.210(m)**, Emission Mask M. For high power transmitters (greater than 20 dBm) operating in the 4940 – 4900 MHz frequency band, the power spectral density of the emissions must be attenuated below the output power of the transmitter as follows:

(1) On any frequency removed from the assigned frequency between 0 – 45% of the authorized bandwidth (BW) : 0dB.

(2) On any frequency removed from the assigned frequency between 45 – 50 % of the authorized bandwidth: 568 log (% of (BW)/45) dB.

(3) On any frequency removed from the assigned frequency between 50 – 55 % of the authorized bandwidth: 26 + 145 log (% of (BW)/50) dB.

(4) On any frequency removed from the assigned frequency between 55 – 100 % of the authorized bandwidth: 32 + 31 log (% of (BW)/55) dB attenuation.

(5) On any frequency removed from the assigned frequency between 100 – 150 % of the authorized bandwidth: 40 + 57 log (% of (BW)/100) dB attenuation.

(6) On any frequency removed from the assigned frequency between above 150 % of the authorized bandwidth: 50 dB or 55 + 10 log (P) dB, whichever is the lesser attenuation.

(7) The zero dB reference is measured relative to the highest average power of the fundamental emission measured across the designated channel bandwidth using a resolution bandwidth of at least one percent of the occupied bandwidth of the fundamental emission and a video bandwidth of 30 kHz. The power spectral density is the power measured within the resolution bandwidth of the measurement device divided by the resolution bandwidth of the measurement device. Emission levels are also based on the use of measurement instrumentation employing a resolution bandwidth of at least one percent of the occupied bandwidth.

Note to paragraph m: Low power devices may as an option, comply with paragraph (m).

**Laboratory Measurement Uncertainty for Power Measurements**

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

**Traceability**

| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-03 'Measurement of RF Spectrum Mask' | 0070, 0116, 0158, 0193, 0252, 0313, 0314. |

### 5.1.2. Peak Output Power

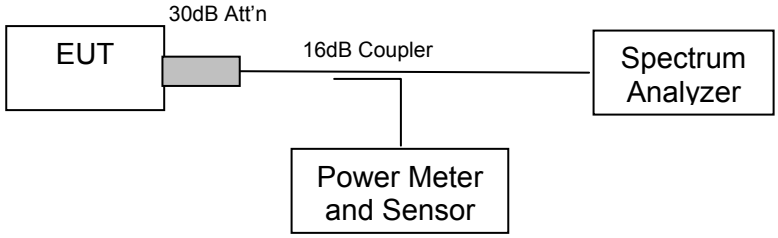
**FCC 47 CFR Part 90, Subpart Y; 2.1046; §90.1215**

**Test Procedure**

Average power measurements were measured with the use of an average power head. Peak power measurements were recorded via the spectrum analyzer. The system highest power setting was selected with modulation ON and duty cycle set for 100% i.e. continuous operation at all times.

The 26 dB emission bandwidth (see Section 5.1.1) was used by the spectrum analyzer to measure the peak output power.

**Test Measurement Set up**

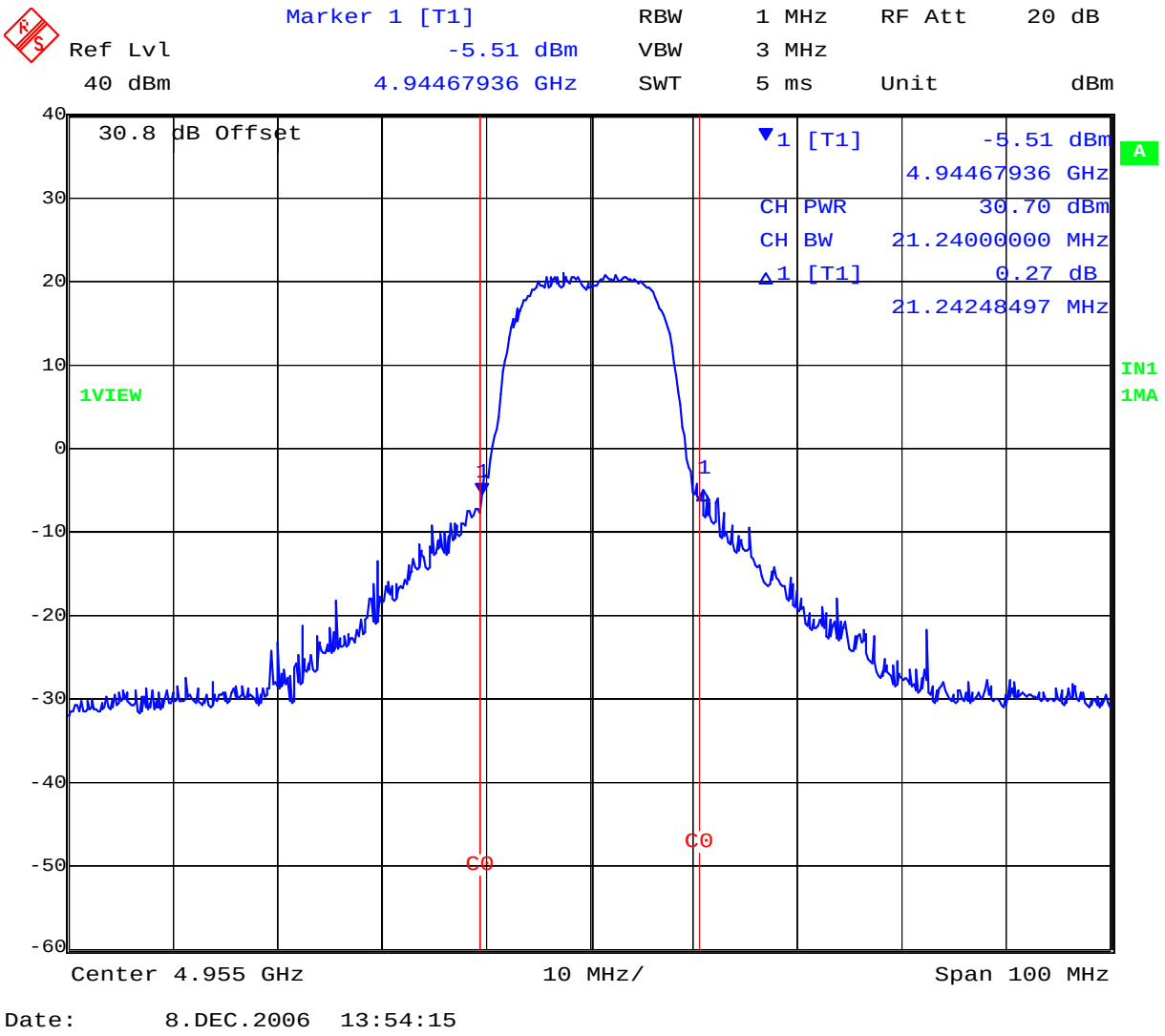



Test set up for modulated output power measurement

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

TABLE OF RESULTS – 20 MHz Bandwidth Modulated Carrier

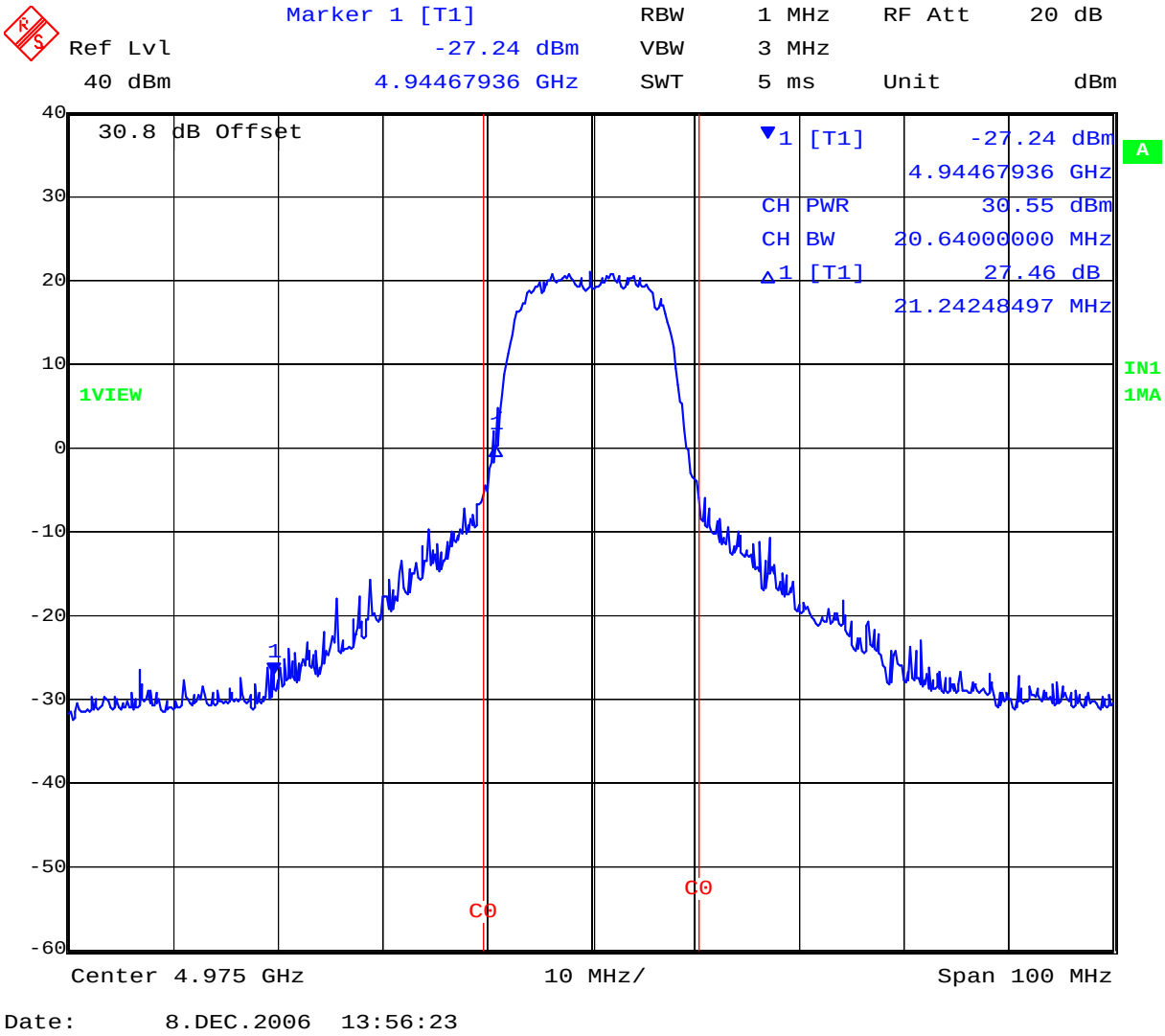
| Center Frequency (MHz) | Peak Power (dBm) | Average Power (dBm) |
|---|---|---|
| 4955.0 | +30.70 | +22.75 |




## Peak Power 20 MHz BW Channel Freq 4955 MHz

TABLE OF RESULTS – 20 MHz Bandwidth Modulated Carrier

| Center Frequency (MHz) | Peak Power (dBm) | Average Power (dBm) |
|---|---|---|
| 4975.0 | +30.55 | +22.31 |




## Peak Power 20 MHz BW Channel Freq 4975 MHz

**Specification Limits**

**FCC Part §90.1215(a)**

Power limits.

The transmitting power of stations operating in the 4940-4990 MHz band must not exceed the maximum limits in this section.

(a) The peak transmit power should not exceed:

| Channel Bandwidth (MHz) | Low power peak transmitter power (dBm) | High power peak transmitter power (dBm) |
|---|---|---|
| 1 | 7 | 20 |
| 5 | 14 | 27 |
| 10 | 17 | 30 |
| 15 | 18.8 | 31.8 |
| 20 | 20 | 33 |

High power devices are also limited to a peak power spectral density of 21 dBm per one MHz. High power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 21 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the peak transmit power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi. However, high power point-to-point or point-to-multipoint operation (both fixed and temporary-fixed rapid deployment) may employ transmitting antennas with directional gain up to 26 dBi without any corresponding reduction in the transmitter power or spectral density. Corresponding reduction in the peak transmit power and peak power spectral density should be the amount in decibels that the directional gain of the antenna exceeds 26 dBi.

(b) Low power devices are also limited to a peak power spectral density of 8 dBm per one MHz. Low power devices using channel bandwidths other than those listed above are permitted; however, they are limited to a peak power spectral density of 8 dBm/MHz. If transmitting antennas of directional gain greater than 9 dBi are used, both the peak transmit power and the peak power spectral density should be reduced by the amount in decibels that the directional gain of the antenna exceeds 9 dBi.

(c) The peak transmit power is measured as a conducted emission over any interval of continuous transmission calibrated in terms of an RMS-equivalent voltage. If the device cannot be connected directly, alternative techniques acceptable to the Commission may be used. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement conforming to the definitions in this paragraph for the emission in question.

(d) The peak power spectral density is measured as conducted emission by direct connection of a calibrated test instrument to the equipment under test. If the device cannot be connected

directly, alternative techniques acceptable to the Commission may be used. Measurements are made over a bandwidth of one MHz or the 26 dB emission bandwidth of the device, whichever is less. A resolution bandwidth less than the measurement bandwidth can be used, provided that the measured power is integrated to show total power over the measurement bandwidth. If the resolution bandwidth is approximately equal to the measurement bandwidth, and much less than the emission bandwidth of the equipment under test, the measured results shall be corrected to account for any difference between the resolution bandwidth of the test instrument and its actual noise bandwidth.

**Laboratory Measurement Uncertainty for Power Measurement**

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

**Traceability**

| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-03 'Measurement of RF Output Power' | 0070, 0116, 0158, 0193, 0252, 0313, 0314. |

### 5.1.3. Peak Power Spectral Density (PPSD)

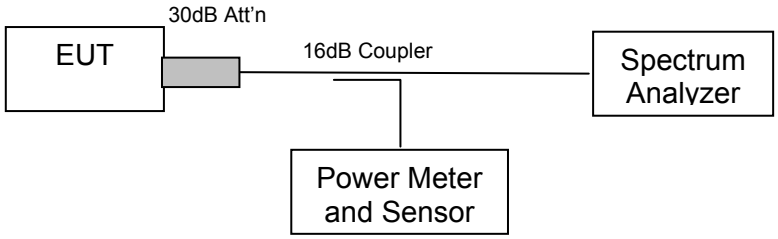
**FCC 47 CFR Part 90, Subpart Y; 2.1046; §90.1215**

**Test Procedure**

The test methodology used for this measurement was determined to provide the highest possible PPSD readings.

Peak power spectral density measurements were performed via the spectrum analyzer and plots were recorded. Modulation was ON and the system duty cycle was set for 100% i.e. continuous operation at all times. The system highest power setting was selected with modulation ON and duty cycle set for 100% i.e. continuous operation at all times.

**Test Measurement Set up**

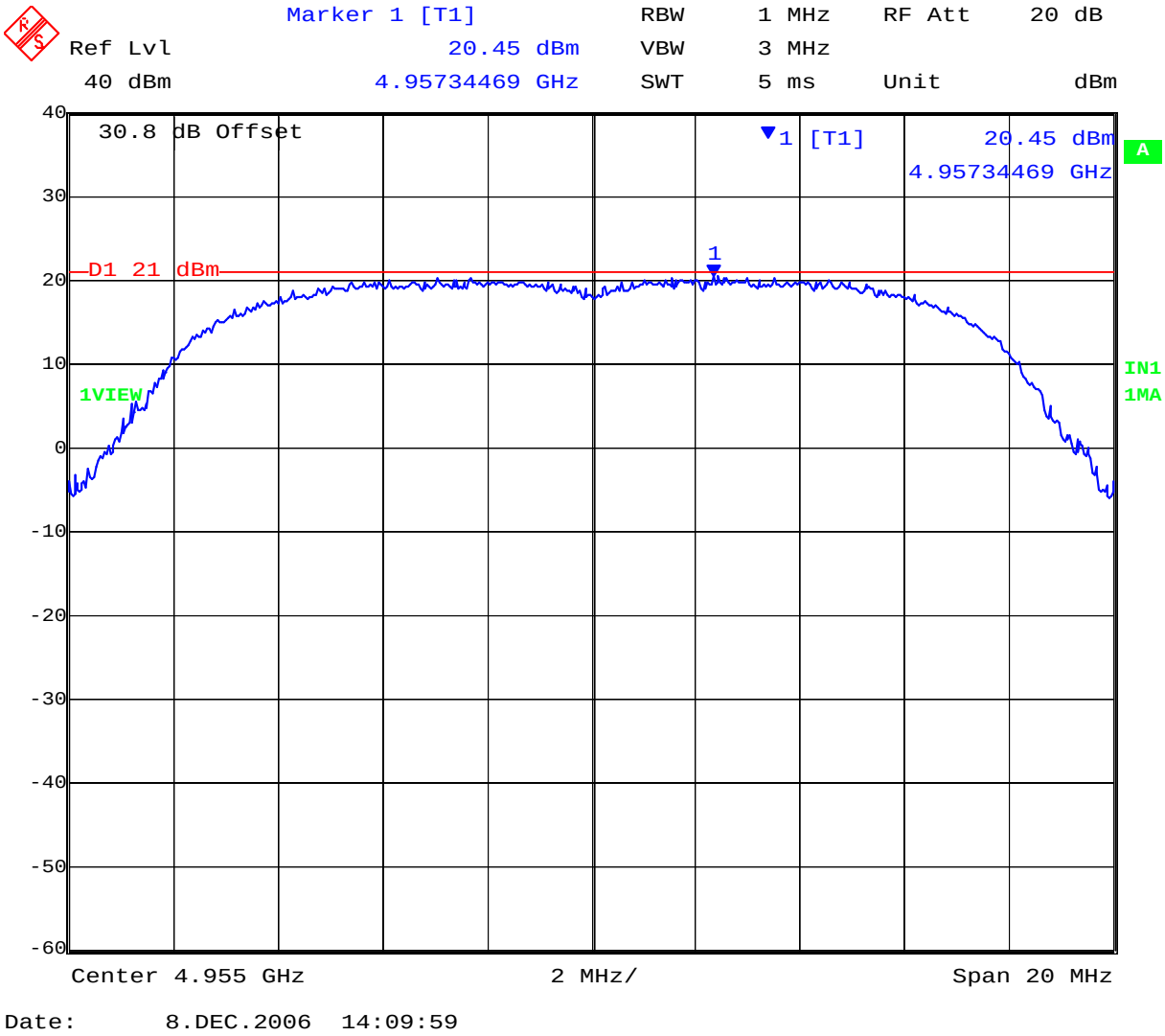



Test set up for Peak Power Spectral Density measurement(s)

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

TABLE OF RESULTS – PPSD 20 MHz Bandwidth Modulated Carrier

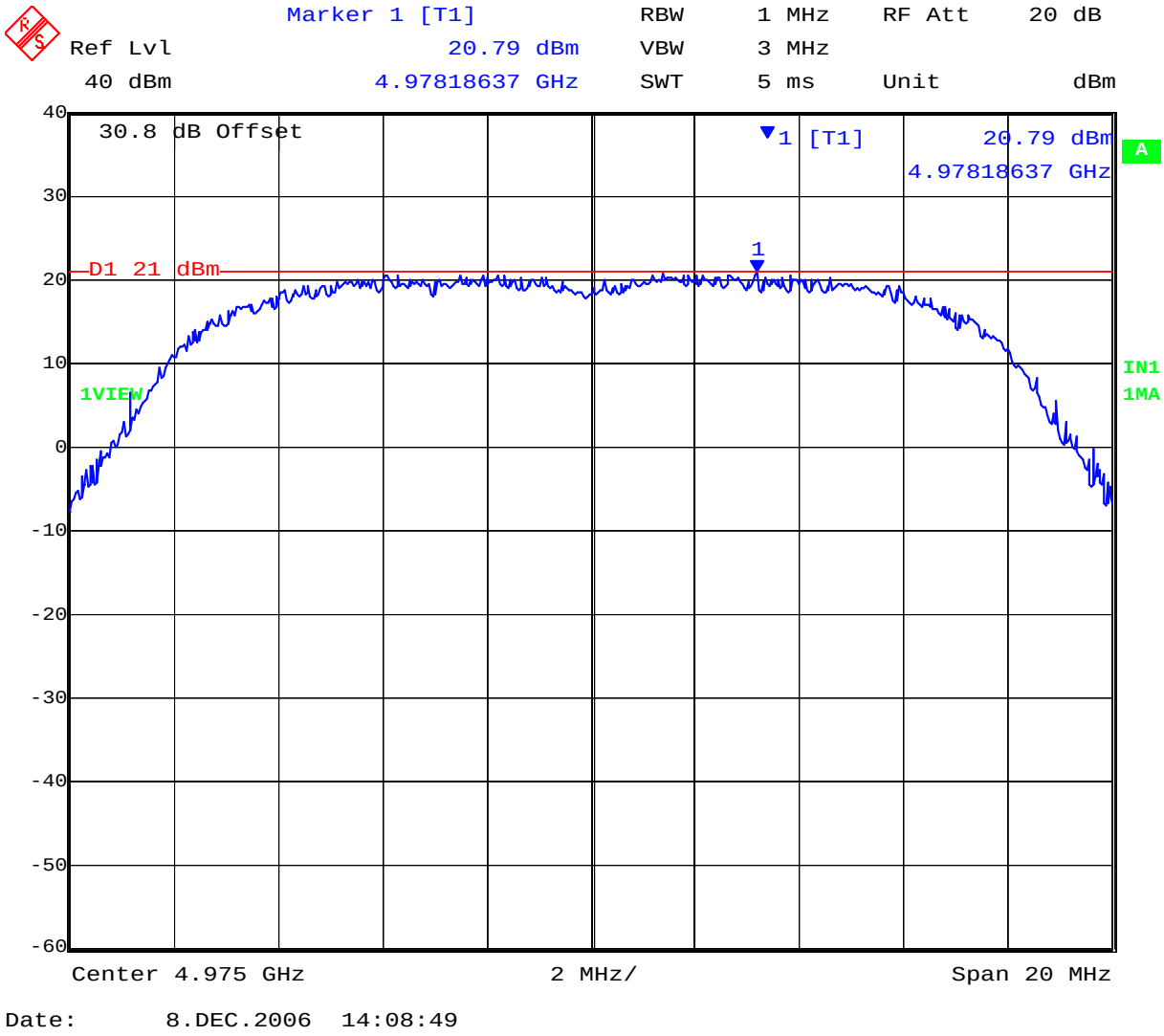
| Center Frequency (MHz) | Peak Power Spectral Density (dBm/ MHz) |
|---|---|
| 4955.0 | 20.45 |




## Peak Power Spectral Density 20 MHz BW Channel Freq 4955 MHz

TABLE OF RESULTS – PPSD 10 MHz Bandwidth Modulated Carrier

| Center Frequency (MHz) | Peak Power Spectral Density (dBm/MHz) |
|---|---|
| 4975.0 | 20.79 |




Peak Power Spectral Density 20 MHz BW Channel Freq 4975 MHz

**Specification Limits**
**FCC Part §90.1215**

Refer to the Power Limits Specification in Section 5.1.2 of this report.

**Laboratory Measurement Uncertainty for Power Measurement**

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

**Traceability**

| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-03 'Measurement of RF Output Power' | 0070, 0116, 0158, 0193, 0252, 0313, 0314. |

### 5.1.4. Maximum Permissible Exposure

**FCC, Part 90 Subpart C §90.1217**

**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)

4 9 GHz 20 MHz Channel = Max. Peak Output Power +30.70 dBm, 1174.89 mW
Max. Antenna Gain = 11.0 dBi, **12.59 numeric**

The EUT belongs to the Occupational/Controlled Exposure class of devices; power density limit is 5.0mW/cm$^2$

Maximum Gain Antennas – Calculated Safe Distance @ 5 mW/cm$^2$

| Antenna Gain (Numeric) | Peak Output Power (mW) | Calculated Safe Distance at 5 mW/cm$^2$ (cm) | Limit (mW/cm$^2$) |
|---|---|---|---|
| 12.59 | 1174.89 | 15.34 | 5.0 |

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

**§90.1217** Systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency levels in excess of the Commission's guidelines. See §1.1307 (b)(1) of this chapter.

Limit S = 5mW / cm$^2$ from 1.310 Table 1

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

**Laboratory Measurement Uncertainty for Power Measurements**

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

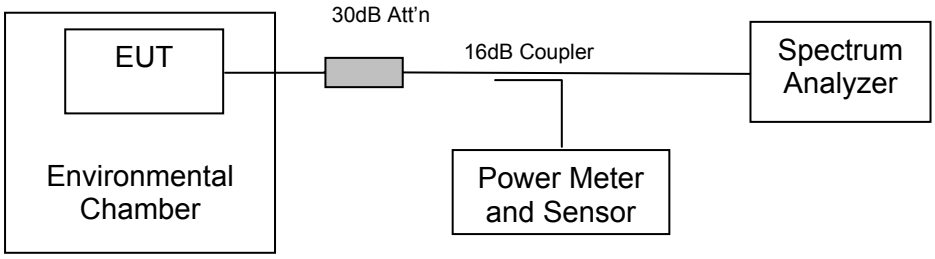
### 5.1.5. Frequency Stability; Temperature Variations, and Voltage Variations

**FCC 47 CFR Part 90, Subpart Y; 2.1055(a)(1); §90.213**

**Test Procedure**

The transmitter output was connected to a spectrum analyzer and the frequency stability was measured in an un-modulated state. Frequency stability was measured through the extremes of temperature on the mid channel only. Before measurements were taken at each temperature the equipment waited until thermal balance was obtained.

**Test Measurement Set up**




Measurement set up for Frequency Stability

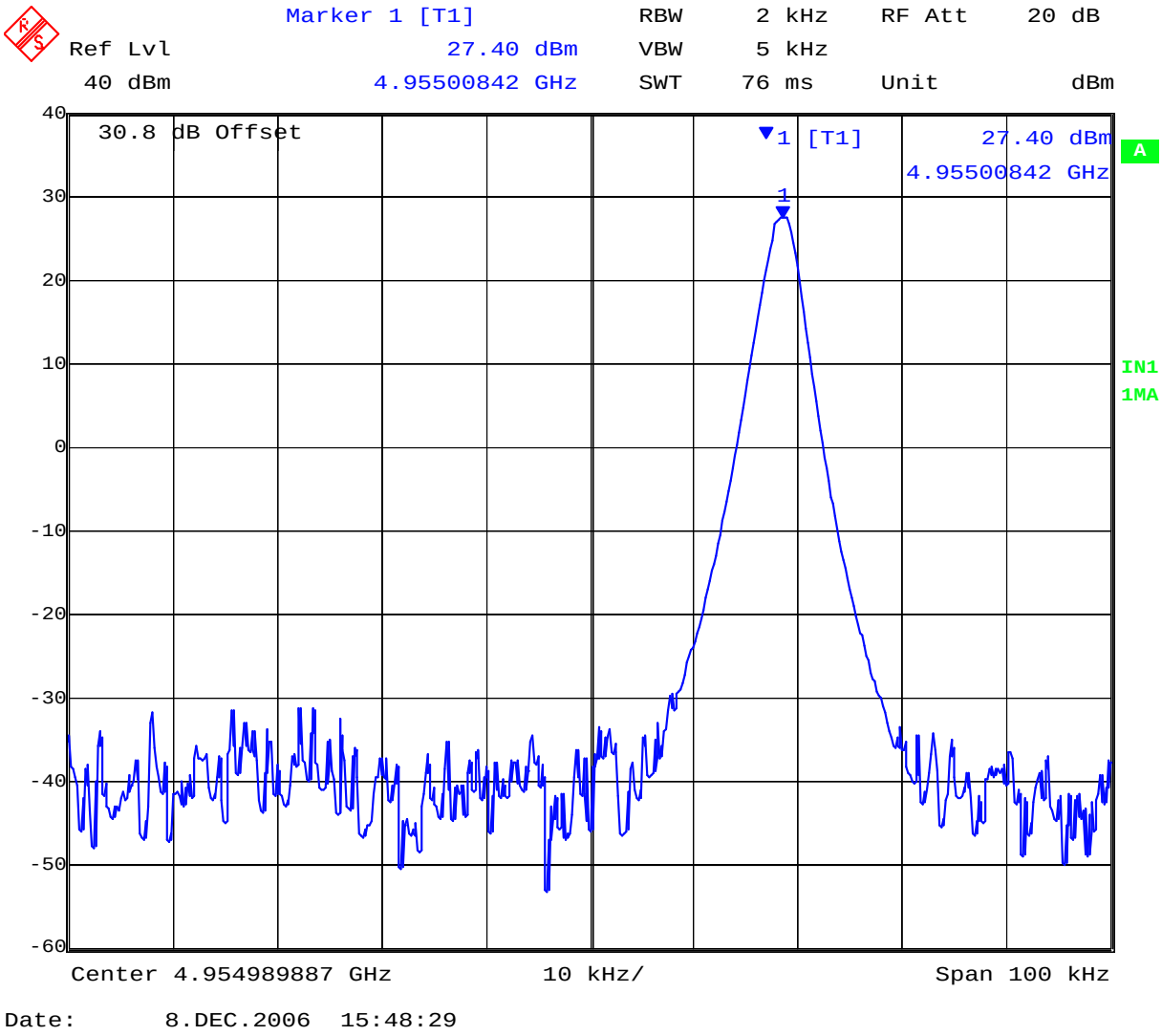
Ambient conditions.
Temperature: 17 to 23 °C  Relative humidity: 31 to 57 %  Pressure: 999 to 1012 mbar

TABLE OF RESULTS Frequency Stability;-

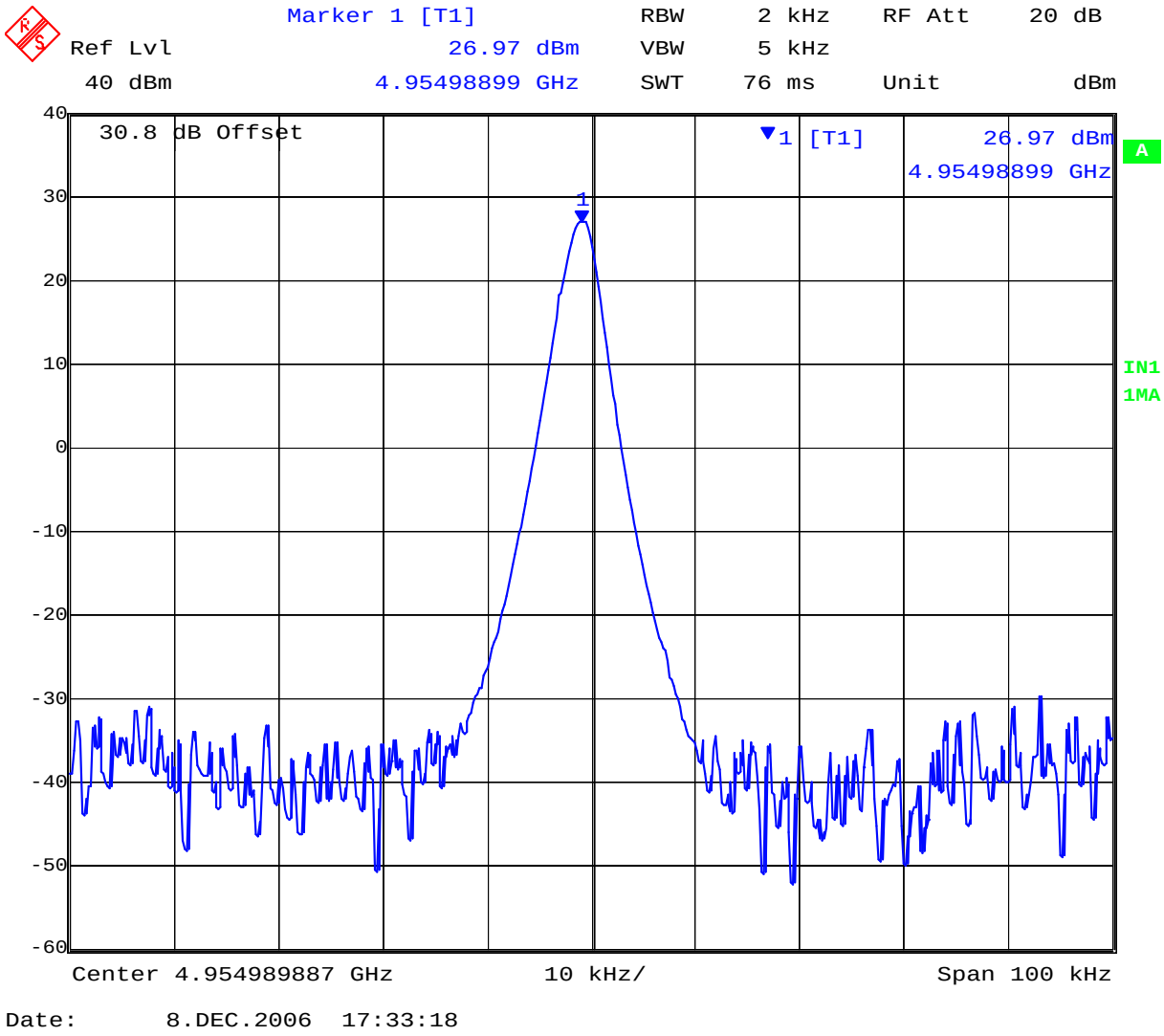
Temperature Variations

| Voltage (Vac, 60 Hz) | Temperature(°C) | FREQUENCY (MHz) |
|---|---|---|
| | | Channel 4955 MHz |
| 115 | -33 | 4955.00702 |
| | -30 | 4955.00562 |
| | -20 | 4955.00842 Note 1 |
| | -10 | 4955.00762 |
| | 0 | 4955.00602 |
| | +10 | 4955.00241 |
| | +20 | 4954.99379 |
| | +30 | 4954.98899 Note 1 |
| | +40 | 4954.99119 |
| | +50 | 4954.99720 |
| | +55 | 4955.00722 |
| Maximum Frequency Drift | | +8.42kHz / -11.01kHz<br>+1.70ppm / -2.22ppm |

Note 1 Results for Maximum frequency drift




Highest Frequency - Drift @-20°C, +8.42 kHz (+1.70 ppm)




Lowest Frequency - Drift @ +30°C, -11.01 kHz (-2.22 ppm)

TABLE OF RESULTS Frequency Stability V's Voltage Variation;

Voltage Variations at Ambient CW

| Temperature | Voltage (Vac, 60 Hz) | FREQUENCY (MHz) |
|---|---|---|
| | | Channel 4955 MHz |
| Ambient | +100 | 4954.99379 |
| | +115 | 4954.99379 |
| | +240 | 4954.99379 |
| Maximum Frequency Drift | | -0.00 / +0.00 |

Frequency stability did not change with voltage variation per the voltages identified in the above table.

**Manufacturers Specification for Frequency Stability**

As no apparent frequency stability limits were provided the manufacturer's specification was used ±20 ppm.

**Laboratory Measurement Uncertainty for Frequency Stability**

| | |
|---|---|
| Measurement uncertainty | ±0.866 ppm |

**Traceability**

| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-02 'Frequency Measurement' | 0070, 0116, 0158, 0193, 0252, 0313, 0314. |

### 5.1.6. Spurious Emissions at Antenna Terminals - Transmitter

**FCC 47 CFR Part 90, Subpart Y; 2.1051; §90.210(m)**

**Test Procedure**
Transmitter conducted spurious emissions were measured for each bandwidth. Measurement were made while EUT was operating in a modulated transmit mode of operation, at the appropriate center frequency, 100% duty cycle and maximum power at all times. Conducted spurious emissions were measured to 40 GHz.

Limit calculation depended on average transmit power level(s). See test report Section 5.1.2 for maximum power level measurements.

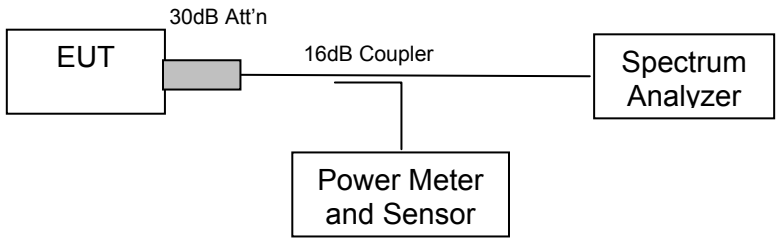
Worst case power measurement: +22.75 dBm

From FCC Part 90.210 (m)
On any frequency removed from the assigned frequency between above 150 % of the authorized bandwidth: 50 dB or 55 + 10 log (P) dB, whichever is the lesser attenuation.

Attenuation
55 + 10 log (P) dB for 20 MHz bandwidth = 47.75 dB attenuation where P is Watts

Limit: +22.75 – 47.75 = -25.0 dBm

**Test Measurement Set up**



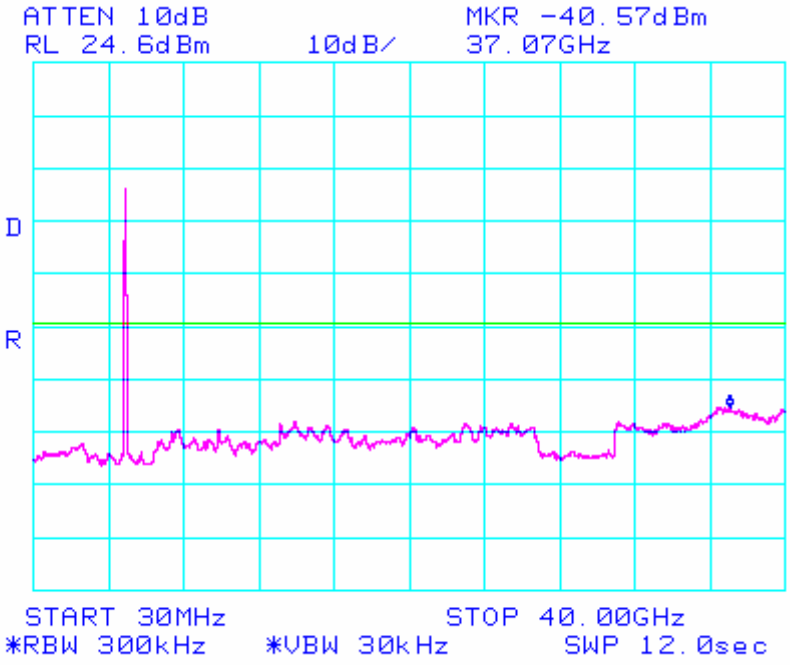

Conducted spurious emission test configuration

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

TABLE OF RESULTS

**Channel 4,955 MHz, Limit: -25.0 dBm**

| Frequency (MHz) | | | | |
|---|---|---|---|---|
| **Start (MHz)** | **Stop (MHz)** | **Freq of Maximum Emission (MHz)** | **Emission Amplitude (dBm)** | **Margin (dB)** |
| 30 | 40,000 | 37,070.00 | -40.57 | -15.57 |

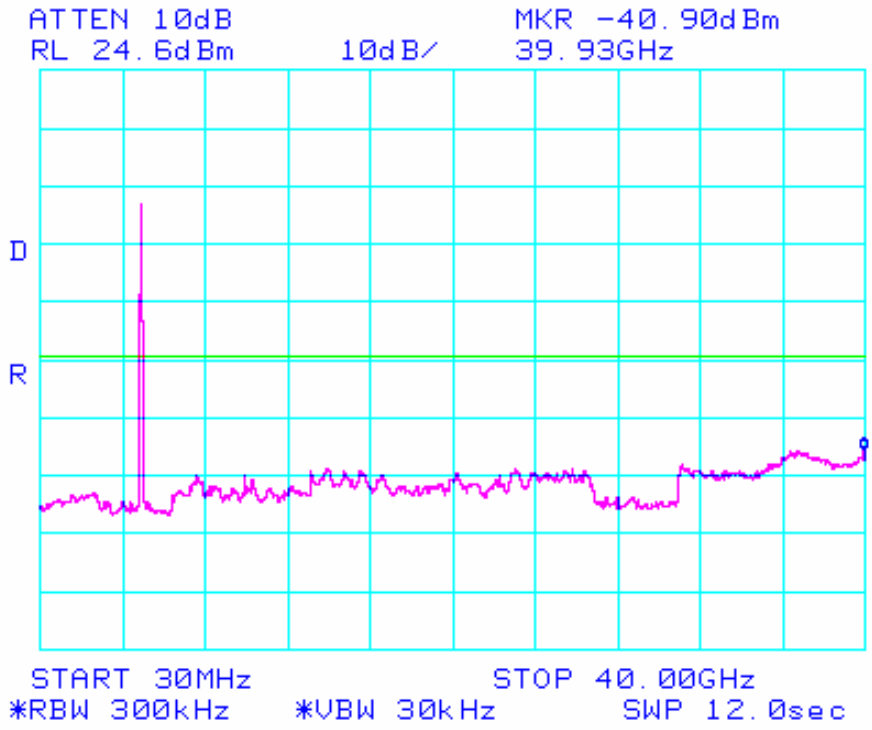



Transmitter Channel 4955 MHz 20 MHz Channel Spacing, 30 – 40,000 MHz

Worst case Conducted Spurious Emissions shown.

**Channel 4,975 MHz, Limit: -25.0 dBm**

| Frequency (MHz) | | | | |
|---|---|---|---|---|
| **Start (MHz)** | **Stop (MHz)** | **Freq of Maximum Emission (MHz)** | **Emission Amplitude (dBm)** | **Margin (dB)** |
| 30 | 40,000 | 39,930.00 | -40.90 | -15.9 |




Transmitter Channel 4975 MHz 20 MHz Spacing, 30 – 40,000 MHz

Worst case Conducted Spurious Emissions shown.

**Specification Limits**

**Conducted Spurious Emission at Antenna Terminals – Transmitter Limits FCC Part §90.210**

| Emission Mask (m) |
|---|
| (6) On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 50 dB or 55 + 10log(P) dB, whichever is the lesser attenuation. |

**Laboratory Measurement Uncertainty for Conducted Spurious Emissions**

| | |
|---|---|
| Measurement uncertainty | ±2.37 dB |

**Traceability**

| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-05 'Measurement of Spurious Emissions' | 0070, 0116, 0158, 0088, 0252, 0313, 0314 |

### 5.1.7. Radiated Spurious Emissions

**FCC 47 CFR Part 90, Subpart Y; 2.1053; §90.210(m)**

**Test Procedure**
Measurements were made while EUT was operating in a modulated transmit mode of operation, at the appropriate center frequency, 100% duty cycle and maximum power at all times. Substitution was performed on any emissions observed within 6 dB of the limit line. The antenna port was attenuated with a 50 Ω termination.

The measurement equipment was set to measure in peak hold mode. The emissions were measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode.

The highest emissions relative to the limit are listed for each frequency spanned.

Measurements below 1 GHz utilized 100 KHz RBW, measurements above 1 GHz were performed using a minimum RBW of 1 MHz.

Limit calculation depended on average transmit power level(s). See test report Section 5.1.2 for maximum power level measurements.

Worst case power measurement: +22.75 dBm

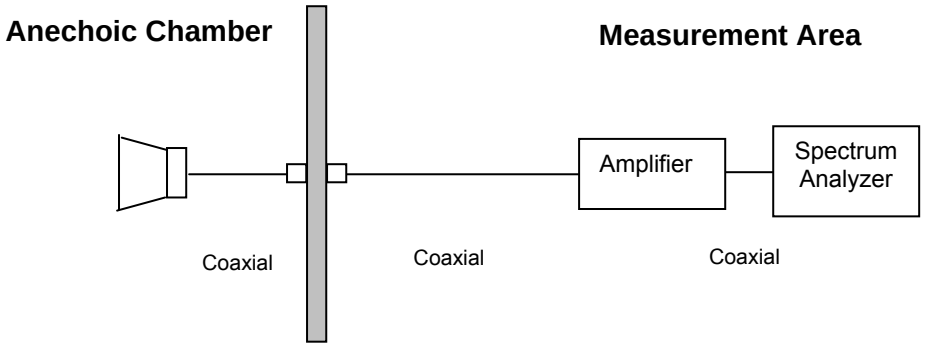
From FCC Part 90.210 (m)
On any frequency removed from the assigned frequency between above 150 % of the authorized bandwidth: 50 dB or 55 + 10 log (P) dB, whichever is the lesser attenuation.

Attenuation
55 + 10 log (P) dB for 20 MHz bandwidth = 47.75 dB attenuation where P is Watts

Limit: +22.75 – 47.75 = -25.0 dBm

The -25 dBm limit was verified using a substitution method.

**Test Measurement Set up**




Measurement set up for Radiated Emission Test

Radio parameters.
**OWS2400-30**

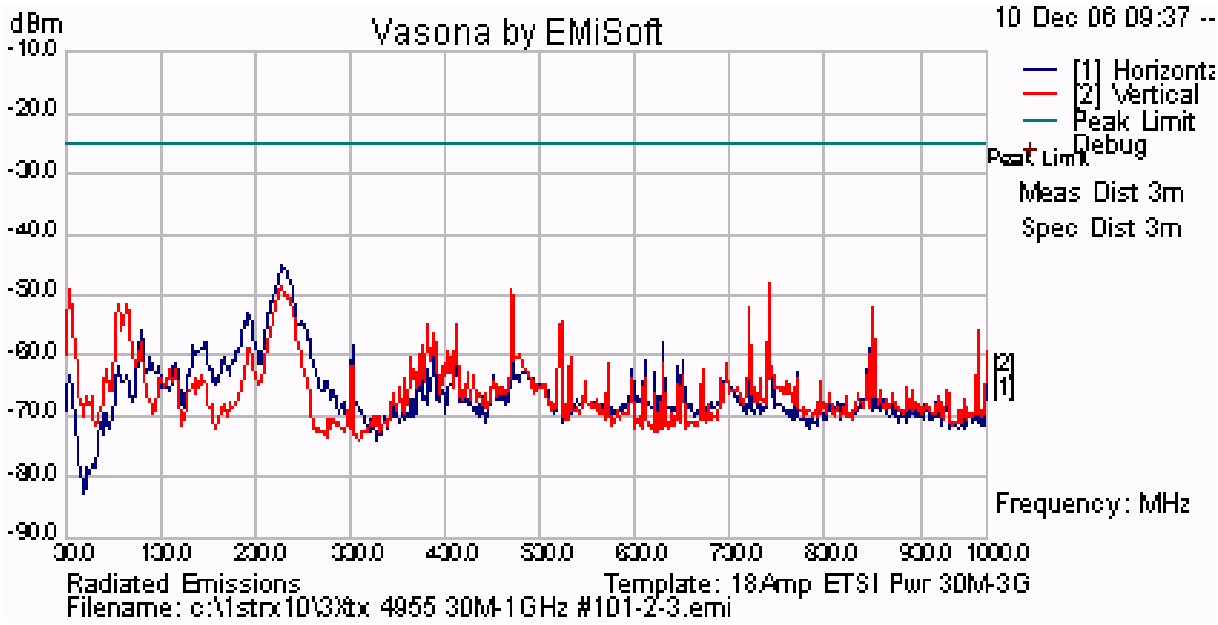
**Channel Freq 4,955 MHz Results**

OWS2400-30, all three transmitters were operational. Power setting = +23 dBm, 50 Ohm load on each output

| INITIAL INVESTIGATION | | | | SUBSTITUTION RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Pol. | Raw (dBuV) | Res BW (KHz) | Pwr @ Antenna (dBm) | Ant. Gain (dB) | EIRP (dBm) | Limit (dBm) | Margin (dB) |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |

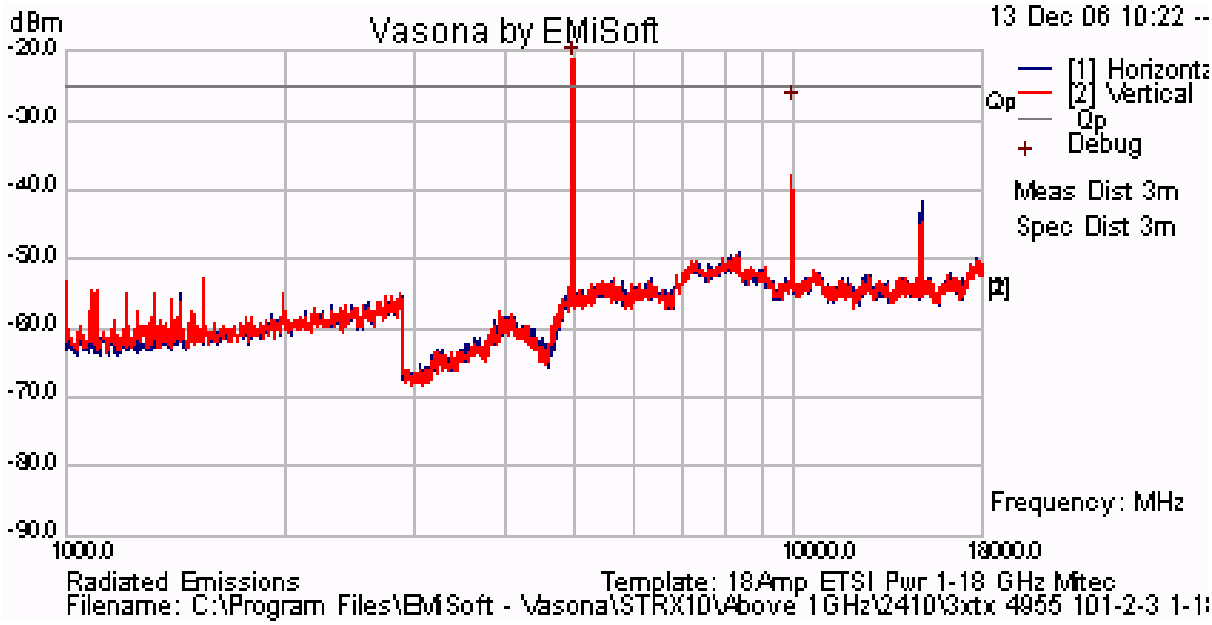
No emissions were found within 6 dB of the limit

**Channel Freq 4,955 MHz Results 30MHz to 1GHz**



**OWS2400-30**

**Channel Freq 4,955 MHz Results 1GHz to 18GHz**




The emission breaking the limit line is the fundamental emission i.e carrier

**OWS2400-30**

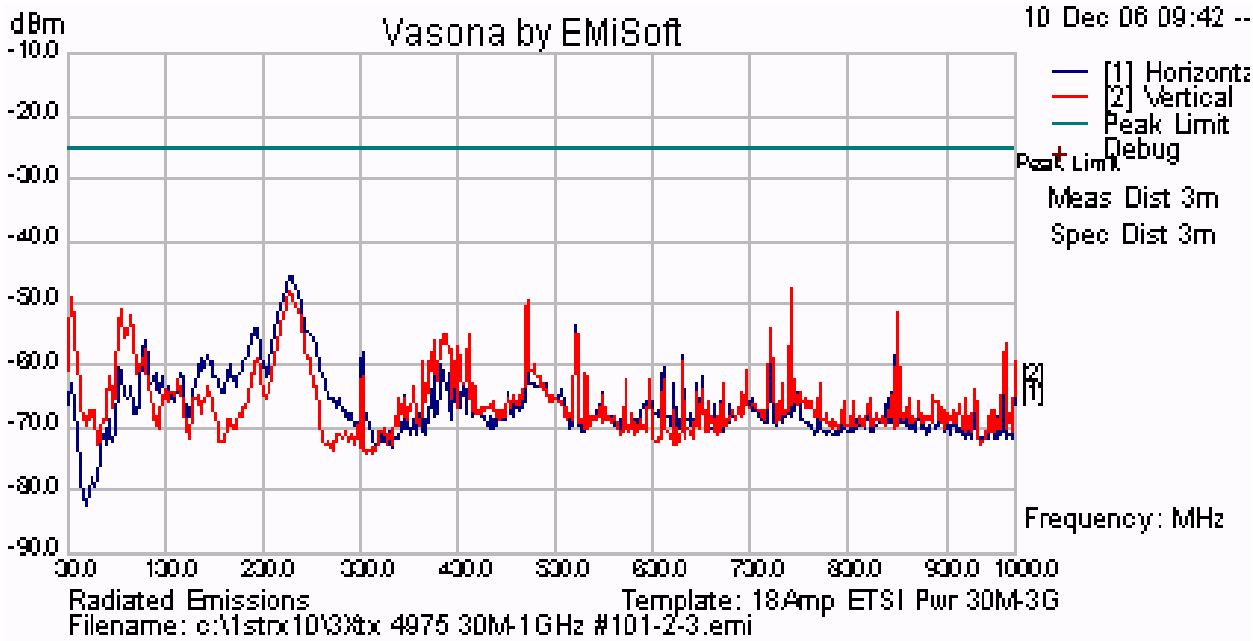
**Channel Freq 4,975 MHz Results**

OWS2400-30, all three transmitters were operational. Power setting = +23 dBm, 50 Ohm load on each output

| INITIAL INVESTIGATION | | | | SUBSTITUTION RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Pol. | Raw (dBuV) | Res BW (KHz) | Pwr @ Antenna (dBm) | Ant. Gain (dB) | EIRP (dBm) | Limit (dBm) | Margin (dB) |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |

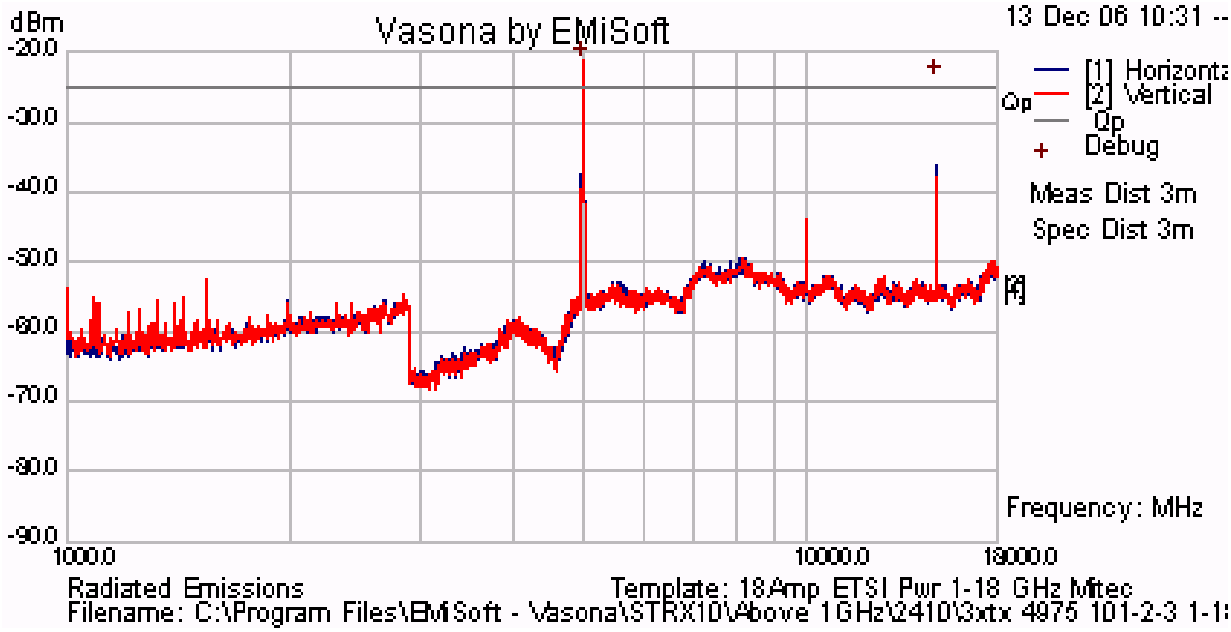
No emissions were found within 6 dB of the limit

**Channel Freq 4,975 MHz Results 30MHz to 1GHz**



**OWS2400-30**

**Channel Freq 4,975 MHz Results 1GHz to 18GHz**




The emission breaking the limit line is the fundamental emission i.e carrier

Radio parameters.
**OWS2400-20**

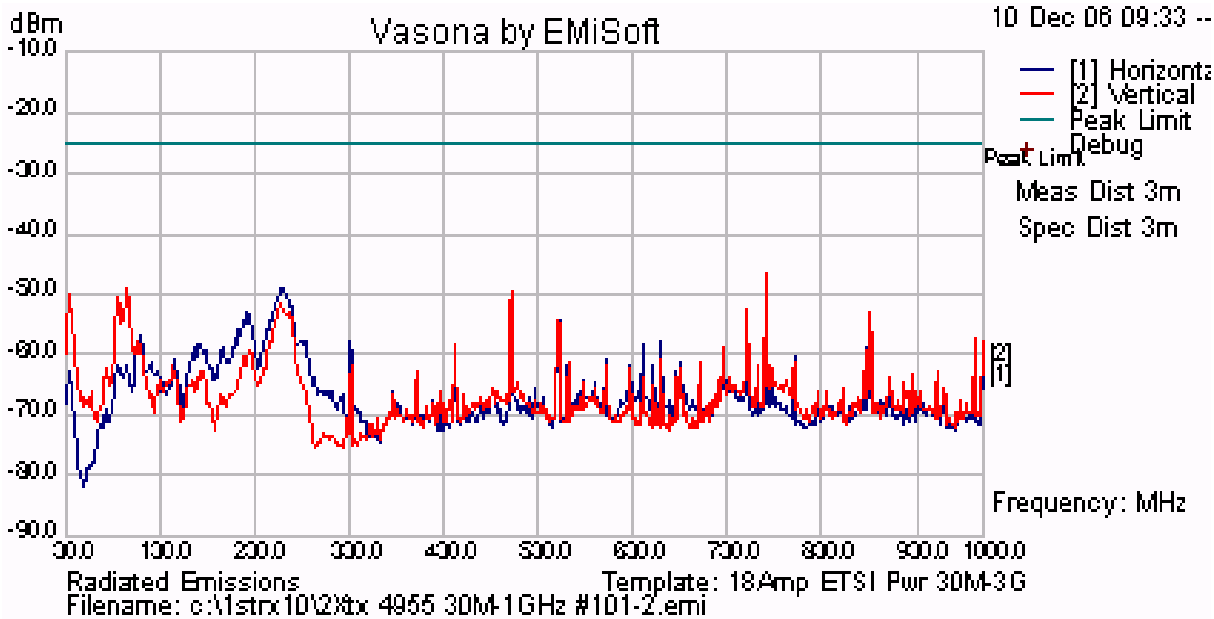
**Channel Freq 4,955 MHz Results**

OWS2400-20, two transmitters were operational simultaneously. Power setting = +23 dBm, 50 Ohm load on each output

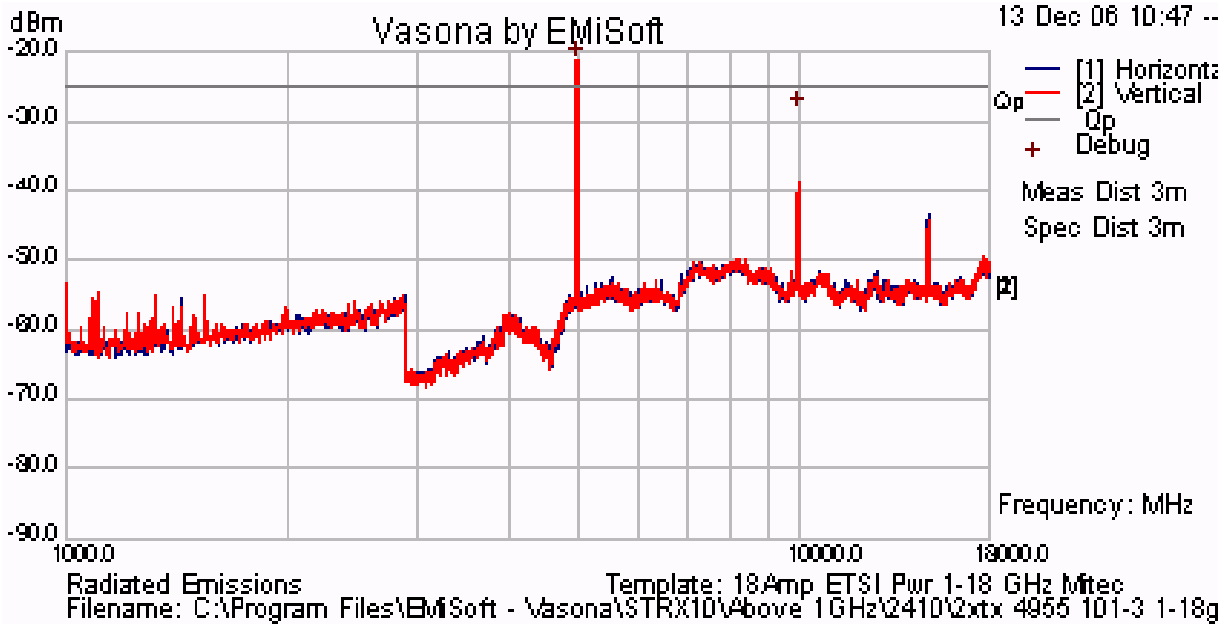
| INITIAL INVESTIGATION | | | | SUBSTITUTION RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Pol. | Raw (dBuV) | Res BW (KHz) | Pwr @ Antenna (dBm) | Ant. Gain (dB) | EIRP (dBm) | Limit (dBm) | Margin (dB) |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |

No emissions were found within 6 dB of the limit

**Channel Freq 4,955 MHz Results 30MHz to 1GHz**



**Channel Freq 4,955 MHz Results 1GHz to 18GHz**




The emission breaking the limit line is the fundamental emission i.e carrier

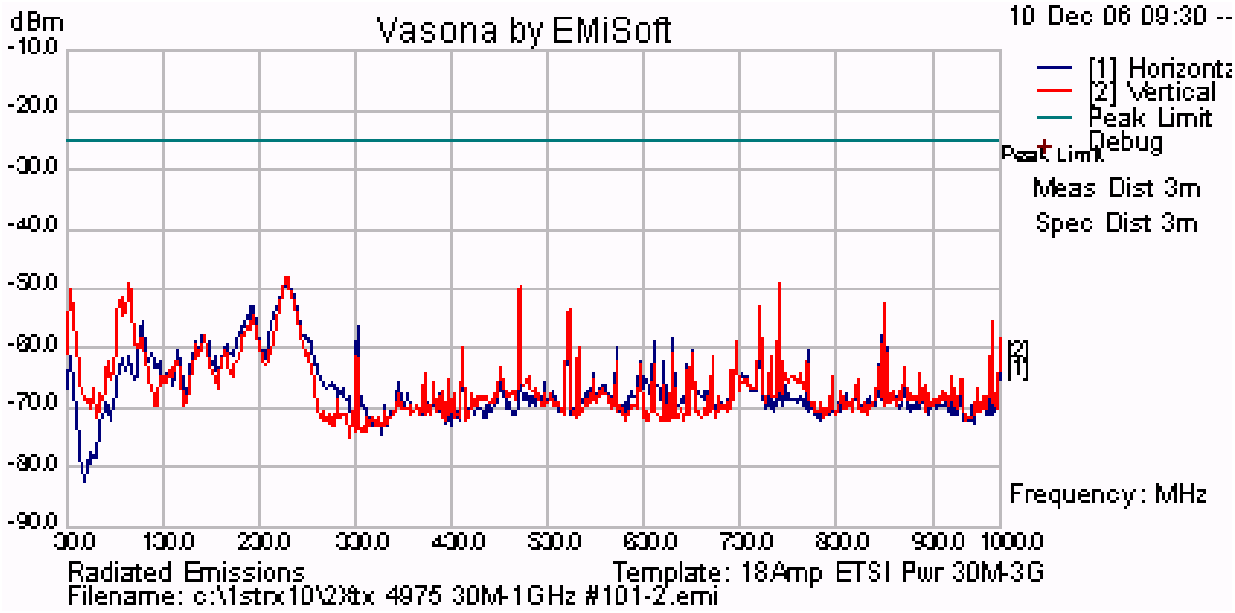
Radio parameters.
**OWS2400-20**

**Channel Freq 4,975 MHz Results**
OWS2400-20, two transmitters were operational simultaneously. Power setting = +23 dBm, 50 Ohm load on each output

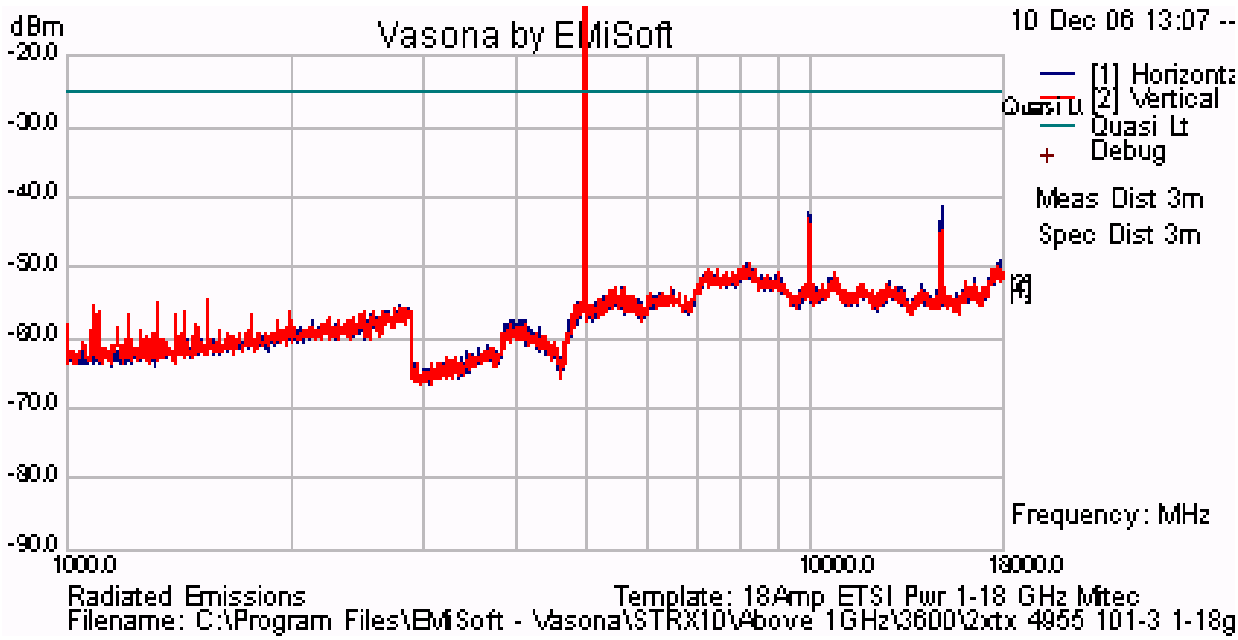
| INITIAL INVESTIGATION | | | | SUBSTITUTION RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Pol. | Raw (dBuV) | Res BW (KHz) | Pwr @ Antenna (dBm) | Ant. Gain (dB) | EIRP (dBm) | Limit (dBm) | Margin (dB) |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |

No emissions were found within 6 dB of the limit

**Channel Freq 4,975 MHz Results 30MHz to 1GHz**



**Channel Freq 4,975 MHz Results 1GHz to 18GHz**




The emission breaking the limit line is the fundamental emission i.e carrier

**OWS2400-10**

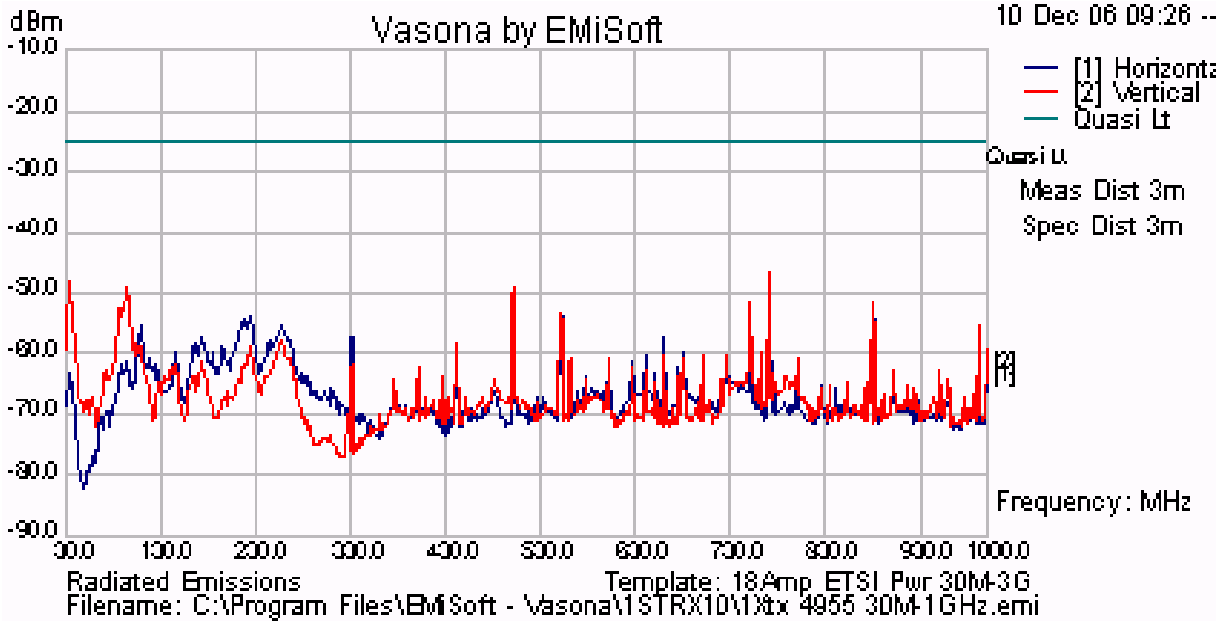
**Channel Freq 4,955 MHz Results**

OWS2400-10, single transmitter operating. Power setting = +23 dBm, 50 Ohm load on the output

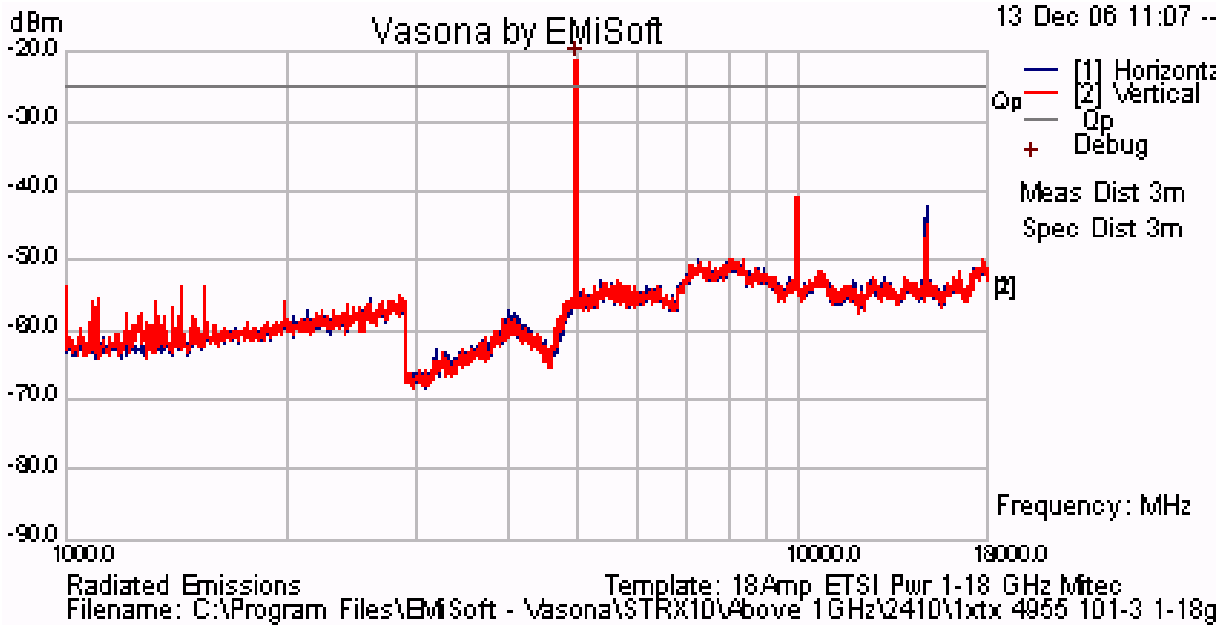
| INITIAL INVESTIGATION | | | | SUBSTITUTION RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Pol. | Raw (dBuV) | Res BW (KHz) | Pwr @ Antenna (dBm) | Ant. Gain (dB) | EIRP (dBm) | Limit (dBm) | Margin (dB) |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |

No emissions were found within 6 dB of the limit

**Channel Freq 4,975 MHz Results 30MHz to 1GHz**



**Channel Freq 4,955 MHz Results 1GHz to 18GHz**




The emission breaking the limit line is the fundamental emission i.e carrier

**OWS2400-10**

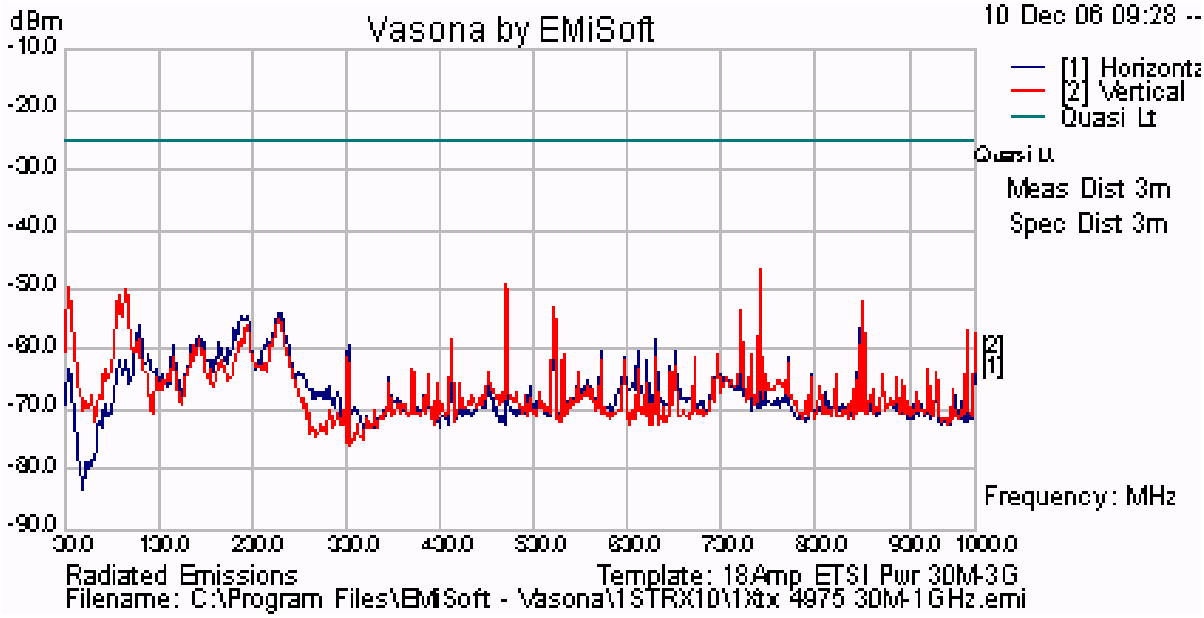
**Channel Freq 4,975 MHz Results**

OWS2400-10, single transmitter operating. Power setting = +23 dBm, 50 Ohm load on the output

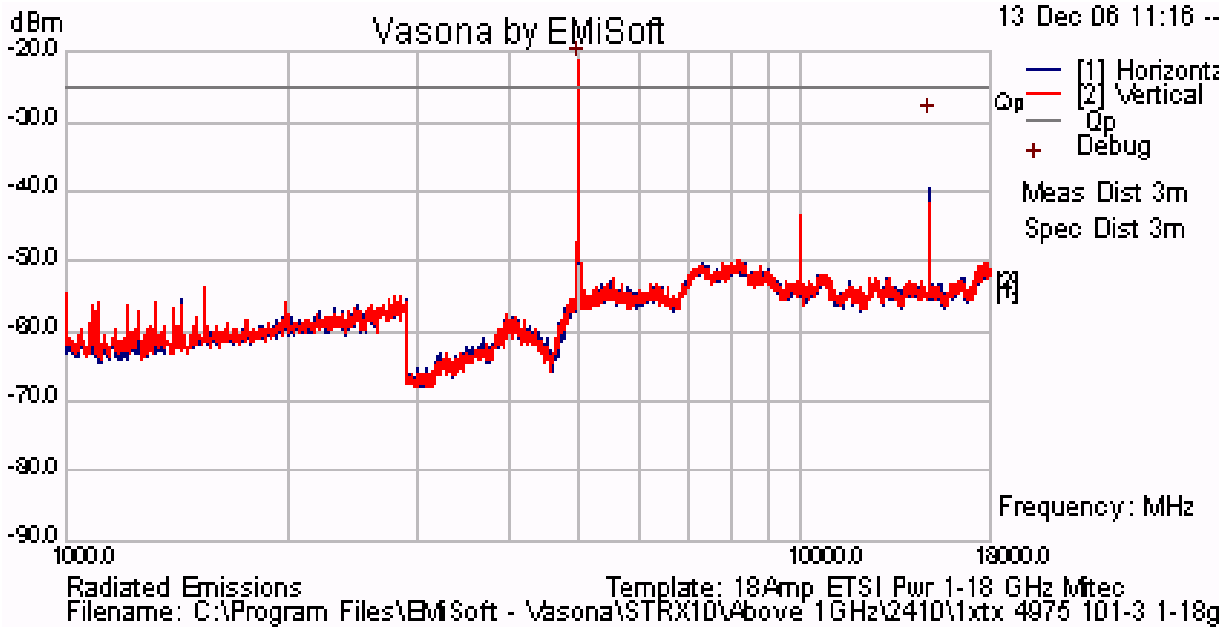
| INITIAL INVESTIGATION | | | | SUBSTITUTION RESULTS | | | | |
|---|---|---|---|---|---|---|---|---|
| Freq. (MHz) | Pol. | Raw (dBuV) | Res BW (KHz) | Pwr @ Antenna (dBm) | Ant. Gain (dB) | EIRP (dBm) | Limit (dBm) | Margin (dB) |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |
| | | | | | | | -25.0 | |

No emissions were found within 6 dB of the limit

**Channel Freq 4,975 MHz Results 30MHz to 1GHz**



**Channel Freq 4,975 MHz Results 1GHz to 18GHz**




The emission breaking the limit line is the fundamental emission i.e carrier

## Transmitter Limits

**Limits FCC Part §90.210 (m)**

| Emission Mask M |
|---|
| (6) On any frequency removed from the assigned frequency above 150% of the authorized bandwidth: 50 dB or 55 + 10 log (P) dB, whichever is the lesser attenuation. |

## 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, 0104, 0158, 0134, 0310, 0312, Dipole. |

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

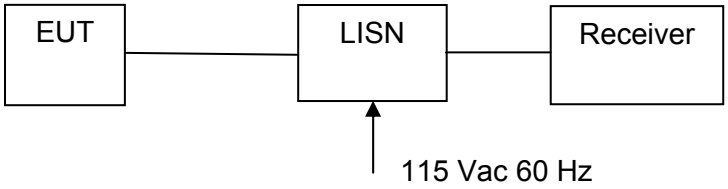
**FCC, Part 15 Subpart C §15.207**

**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.

All six transmitters were operational and terminated into a 50Ω load.

**Test Measurement Set up**




Measurement set up for AC Wireline Conducted Emissions Test

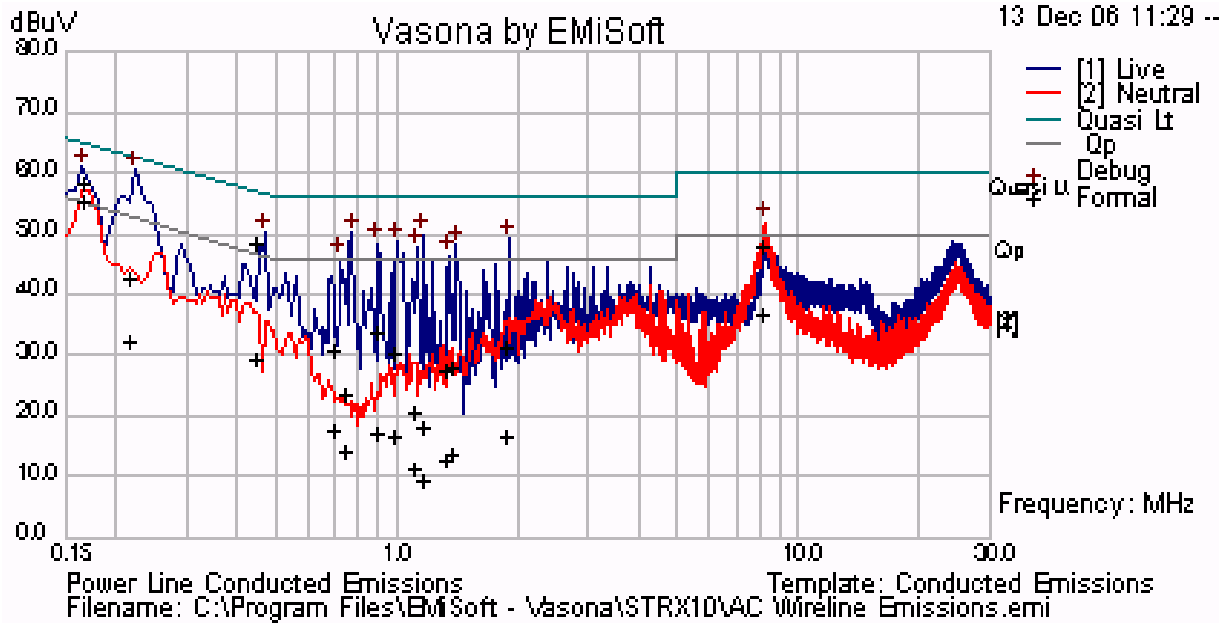
**Measurement Results for AC Wireline Conducted Emissions (150 kHz – 30 MHz)**

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

Radio parameters.
Data Rate(s): 802.11a, 6 MBit/s, +17 dBm output power

TABLE OF RESULTS
**LINE – LIVE and NEUTRAL**

| Freq (MHz) | Line | Peak (dBµV) | QP (dBµV) | QP Limit (dBµV) | QP Margin (dB) | Ave. (dBµV) | Ave. Limit (dBµV) | Ave. Margin (dB) |
|---|---|---|---|---|---|---|---|---|
| 0.17 | L | 60.95 | 56.18 | 64.97 | -8.79 | 52.83 | 54.97 | -2.14 |
| 0.22 | L | 60.41 | 40.2 | 62.82 | -22.61 | 29.74 | 52.82 | -23.08 |
| 0.456 | L | 50.17 | 46.05 | 56.77 | -10.72 | 27.2 | 46.77 | -19.57 |
| 0.711 | L | 46.04 | 28.64 | 56 | -27.36 | 15.13 | 46 | -30.87 |
| 0.914 | L | 48.36 | 31.21 | 56 | -24.79 | 14.9 | 46 | -31.1 |
| 8.276 | N | 51.92 | 45.73 | 60 | -14.27 | 34.17 | 50 | -15.83 |



## 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.

### §15.207 (a) 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

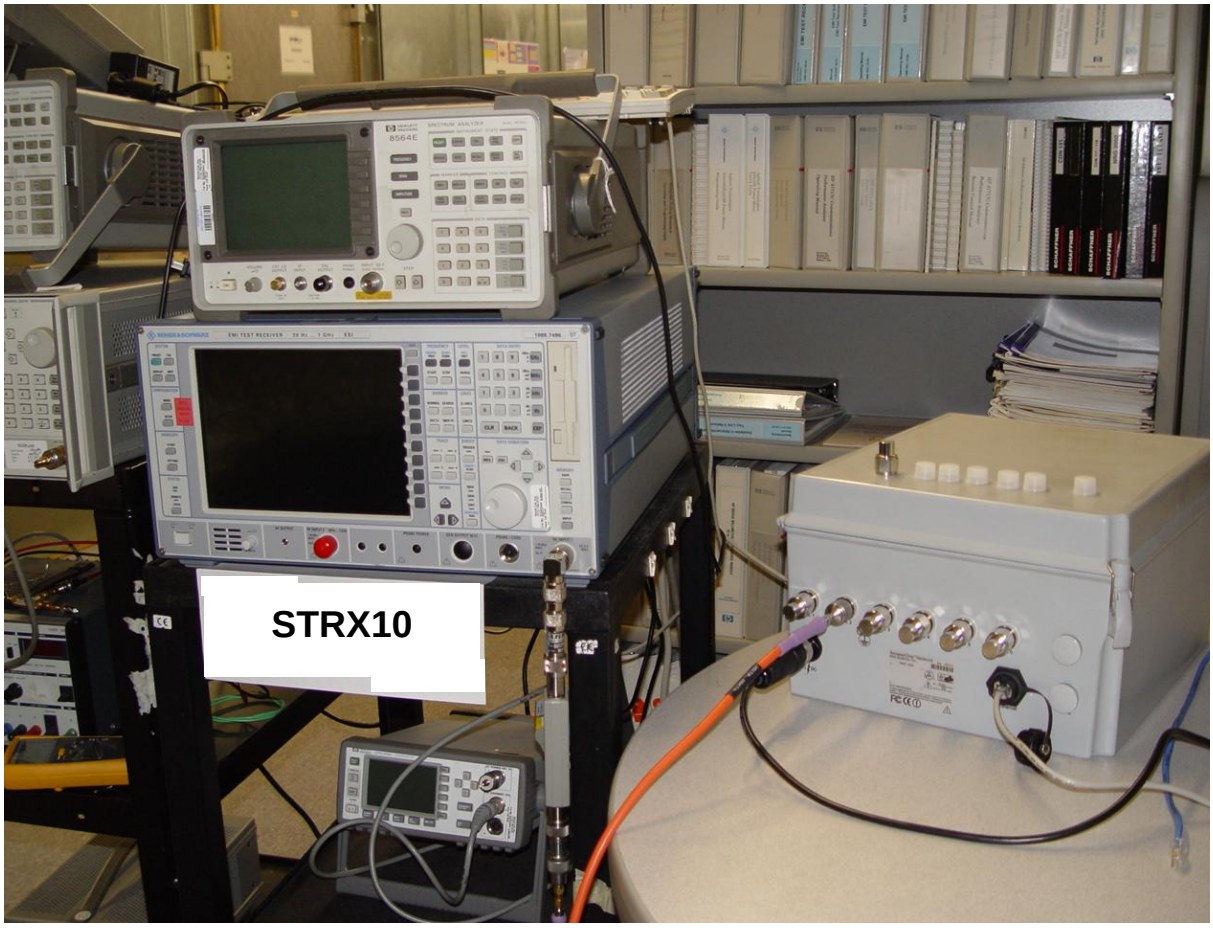
| | |
|---|---|
| Measurement uncertainty | ±2.64 dB |

### Traceability

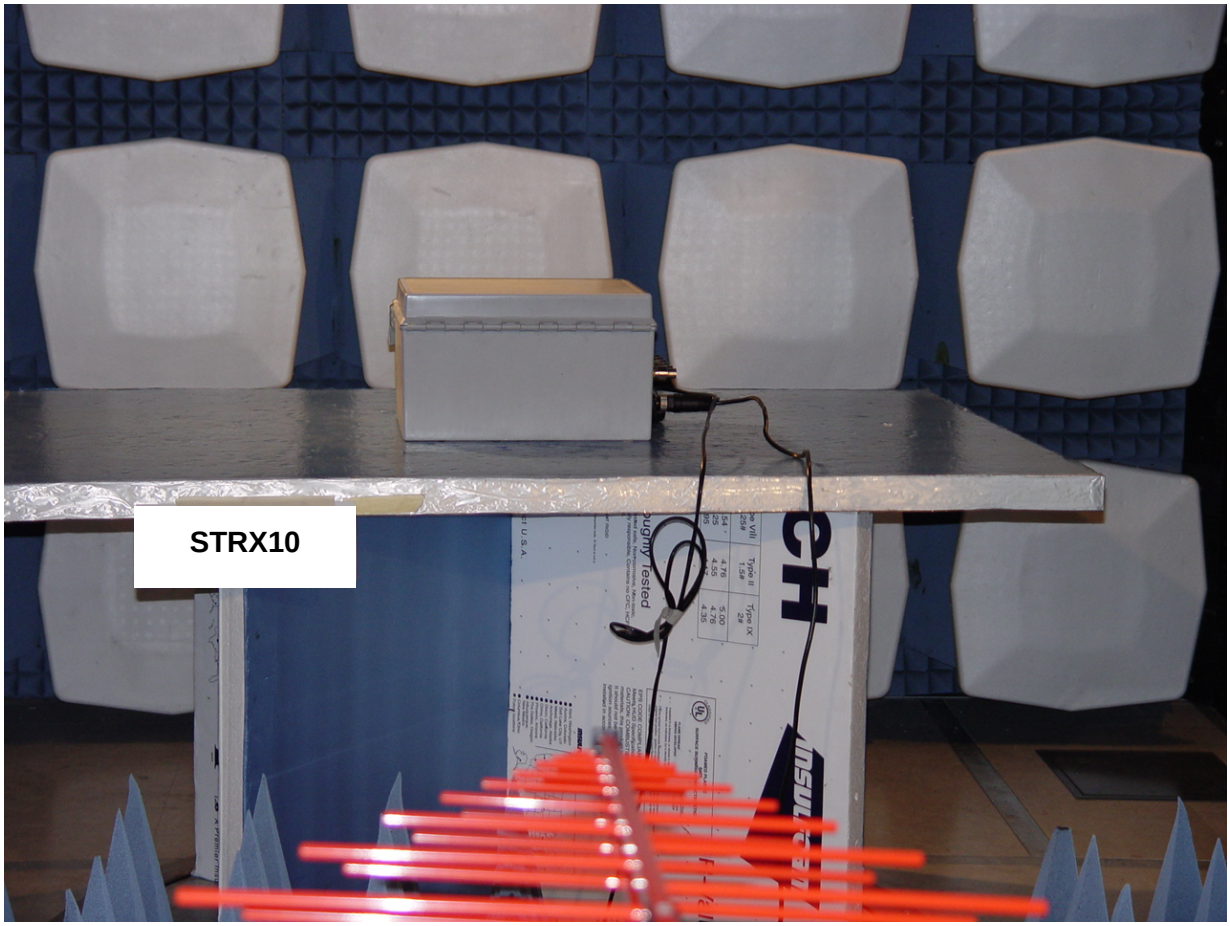
| Method | Test Equipment Used |
|---|---|
| Measurements were made per work instruction WI-EMC-01 'Measurement of Conducted Emissions' | 0158, 0184, 0193, 0190, 0293, 0307 |

# 6. TEST SET-UP PHOTOGRAPHS

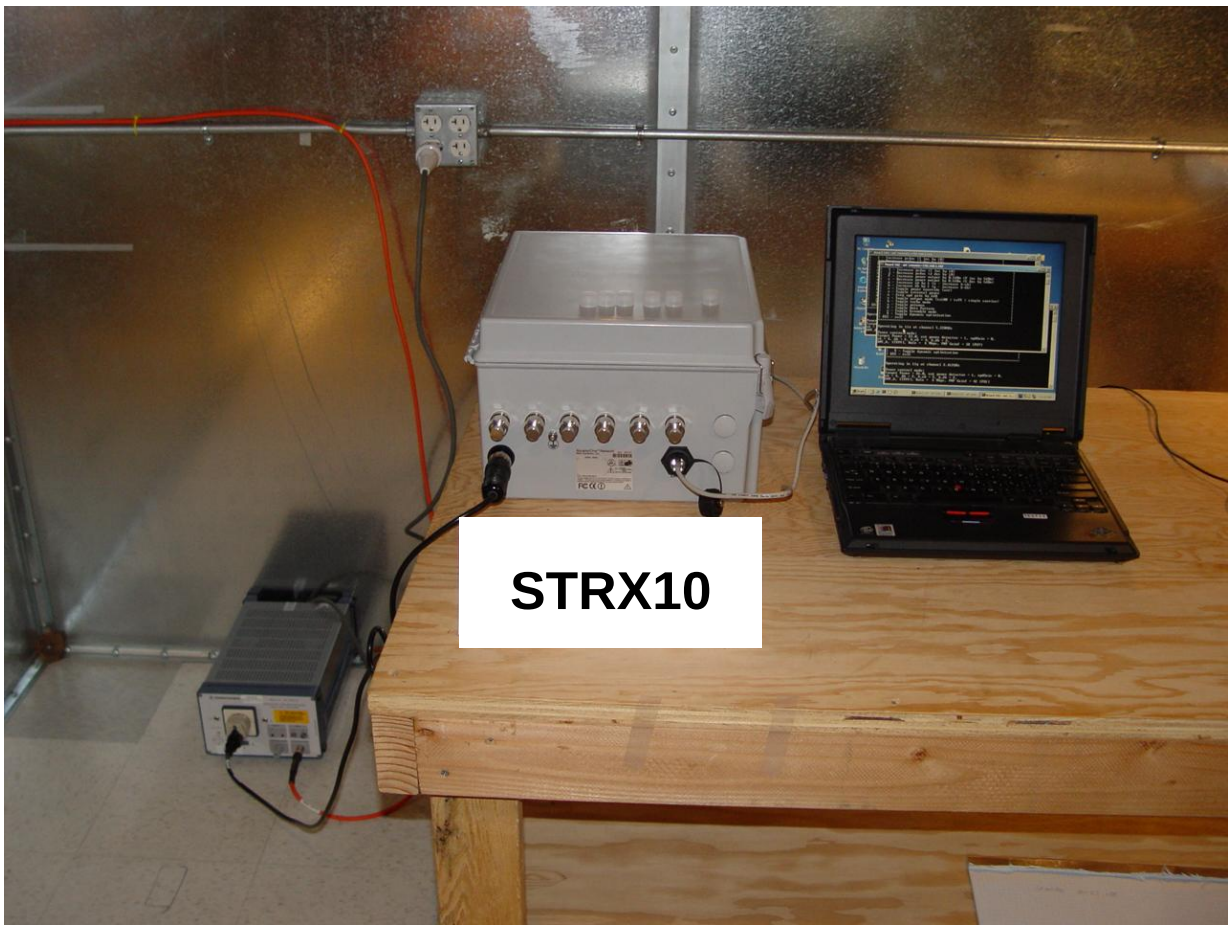
## 6.1. General Measurement Test Set-Up



## 6.2. Radiated Spurious Emissions



## 6.3. AC Wireline Emissions (150 kHz - 30 MHz)



## 7. TEST EQUIPMENT DETAILS

| Asset # | Instrument | Manufacturer | Part # | Calibration Due Date | Serial # |
|---|---|---|---|---|---|
| 0088 | Spectrum Analyzer | Hewlett Packard | 8564E | 20th June '07 | 3410A00141 |
| 0104 | 1-18GHz Horn Antenna | The Electro-Mechanics Company | 3115 | 21st Oct '07 | 9205-3882 |
| 0134 | Amplifier | Com Power | PA 122 | 1st Dec '07 | 181910 |
| 0158 | Barometer /Thermometer | Control Co. | 4196 | 26th Aug '07 | E2846 |
| 0193 | EMI Receiver | Rhode & Schwartz | ESI 7 | 17th Aug 07 | 838496/007 |
| 0252 | SMA Cable | Megaphase | Sucoflex 104 | 11th Jun '07 | None |
| 0304 | 2.4GHzHz Notch Filter | Micro-Tronics | -- | 1st Dec 07 | 001 |
| 0310 | 2m SMA Cable | Micro-Coax | UFA210A-0-0787-3G03G0 | 7th Dec '07 | 209089-001 |
| 0312 | 3m SMA Cable | Micro-Coax | UFA210A-1-1181-3G0300 | 9h Dec '07 | 209092-001 |
| 0313 | Coupler | Hewlett Packard | 86205A | N/A | 3140A01285 |
| 0314 | 30dB N-Type Attenuator | ARRA | N9444-30 | N/A | 1623 |
| 0223 | Power Meter | Hewlett Packard | EPM-442A | 16th Aug 07 | 3125U11552 |
| 0116 | Power Sensor | Hewlett Packard | 8485A | 16th Aug 07 | 3318A19694 |
| 0117 | Power Sensor | Hewlett Packard | 8487D | 20th June 07 | 3318A00371 |
| 0184 | Pulse Limiter | Rhode & Schwartz | ESH3Z2 | 3RD Oct 07 | 357.8810.52 |
| 0190 | LISN | Rhode & Schwartz | ESH3Z5 | 22nd Jun 07 | 836679/006 |
| 0293 | BNC Cable | Megaphase | 1689 1GVT4 | 13TH Jul 07 | 15F50B001 |
| 0307 | BNC Cable | Megaphase | 1689 1GVT4 | 13th Jul 07 | 15F50B002 |
| | Dipole Antenna | EMCO | 3121C | 30th Dec '06 | 9009 - 605 |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