Lab Code: 200167-0

# FCC PART 15.255
# MEASUREMENT AND TEST REPORT

For

## ComoTech Corporation

1-908, Ulsan APT-Bldg.,
812-1, Hyomun-Dong, Buk-Gu,
Ulsan City, 683-360 Korea

FCC ID: RL3ALME1000

| Report Type: | Product Type: |
|---|---|
| ☒ Original Report | 60 GHz Point-to-Point Transceiver |

| | |
|---|---|
| **Test Engineer:** | James Ma |
| **Report Number:** | R0709283 |
| **Report Date:** | 2007-10-15 |
| **Reviewed By:** | Choon Sian Ooi: Test Engineer |
| **Prepared By: (J8)** | Bay Area Compliance Laboratories Corp. (BACL)<br>1274 Anvilwood Ave.<br>Sunnyvale, CA 94089, USA<br>Tel: (408) 732-9162<br>Fax: (408) 732-9164 |

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# 1 GENERAL INFORMATION

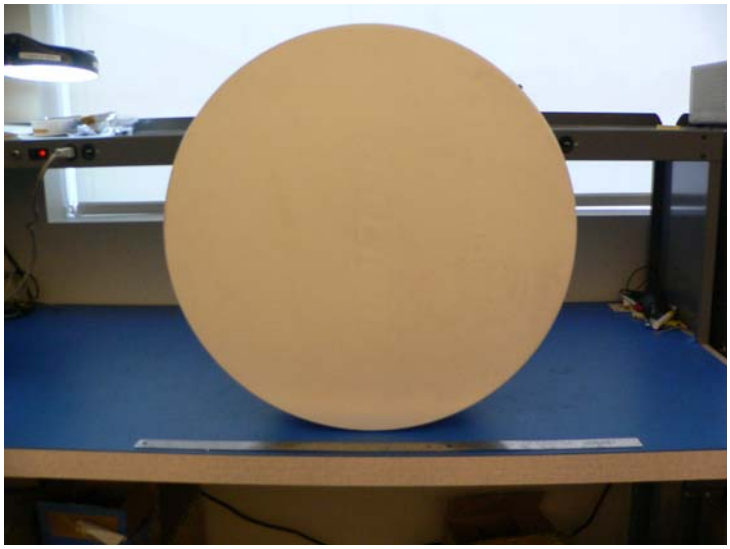
## 1.1 Product Description for Equipment Under Test (EUT)

The *ComoTech Corporation* product, FCC ID: RL3ALME1000, Models: Airlight ME1000C-xx or the "EUT" as referred to in this report are 60 GHz Point-to-Point Millimeter Wave Transceiver Systems. The EUT operates in the 60 GHz band. The Airlight ME1000C-xx applies to two models; Model: Airlight ME1000C-12 which employs a 12" 43 dBi antenna and Model: Airlight ME1000C-24 which employs a 24" 47 dBi antenna. They are designed for use in an outdoor setting with clear line-of-sight between points. This product requires a license for implementation and is generally designed for light to heavy industrial or commercial deployment.

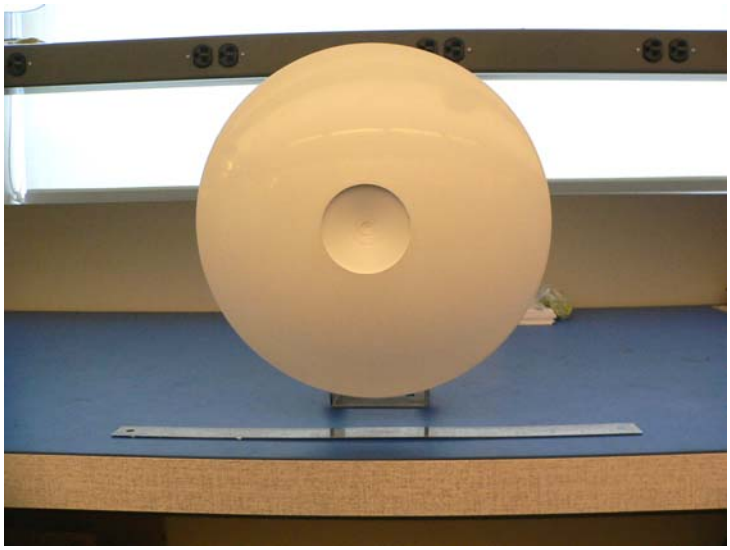
** The test data gathered are from typical productions samples, serial number: S0310700003 for 12" sample unit and S0320700003 for24" sample unit provided by the manufacturer.*

## 1.2 Mechanical Description of EUT

The EUT are devices meant for permanent attachment with approximate measurements of: 505 mm (L) x 625 mm (W) x 625 mm (H); 17 kg total weight for model: ME1000C-24 Antenna, and 405 mm (L) x 310 mm (W) x 310 mm (H); 6 kg total weight for model: ME1000C-12 which both operates at 58.8 GHz or 62.3 GHz.



*Model: ME1000C-24 (24" Antenna)*



*Model: ME1000C-12 (12" Antenna)*

*Please refer to Exhibit C for more EUT photographs*

## 1.4 Objective

The following original report is prepared on behalf of Commotech Corp. in accordance with FCC 15.255, rule for operation in the 57 GHz to 64 GHz band.

The objective is to determine compliance with the FCC 15.255 rule's requirements for operation within the 57 – 64 GHz band.

In order to determine compliance, the manufacturer or a contracted laboratory makes measurements and takes the necessary steps to ensure that the equipment complies with the appropriate technical standards.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product maybe which result in lowering the immunity should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing and/or I/O cable changes, etc.).

## 1.5 Related Submittal(s)/Grant(s)

NA.

## 1.6 Test Methodology

All measurements contained in this report were conducted in accordance with FCC rules for equipment operating in the 57 GHz to 64 GHz band.

## 1.7 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in the field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the values ranging from $\pm$2.0 dB for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL Corp.

Detailed instrumentation measurement uncertainties can be found in BACL Corp. report QAP-018.

## 1.8 Test Facility

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test sites at BACL have been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission, Industry Canada, and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464, IC registration number: 3062A, and VCCI Registration Number: C-2463 and R-2698. The test site has been approved by the FCC, IC, and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at http://ts.nist.gov/ts/htdocs/210/214/scopes/2001670.htm

# 2 SYSTEM TEST CONFIGURATION

## 2.1 Justification

The host system was configured for testing in accordance to FCC Rules.

The EUT was tested in the normal (native) operating mode to represent *worst*-case results during the final qualification test.

## 2.2 Equipment Modifications

No modifications were made to the EUT.

## 2.3 EUT Exercise Software

N/A

## 2.4 Local Support Equipment List and Details

| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| OPHIT | Optical Gigabit Media Converter – 1000Base – TX/FX | OMC – 1000M | E-E013-03-3476A |

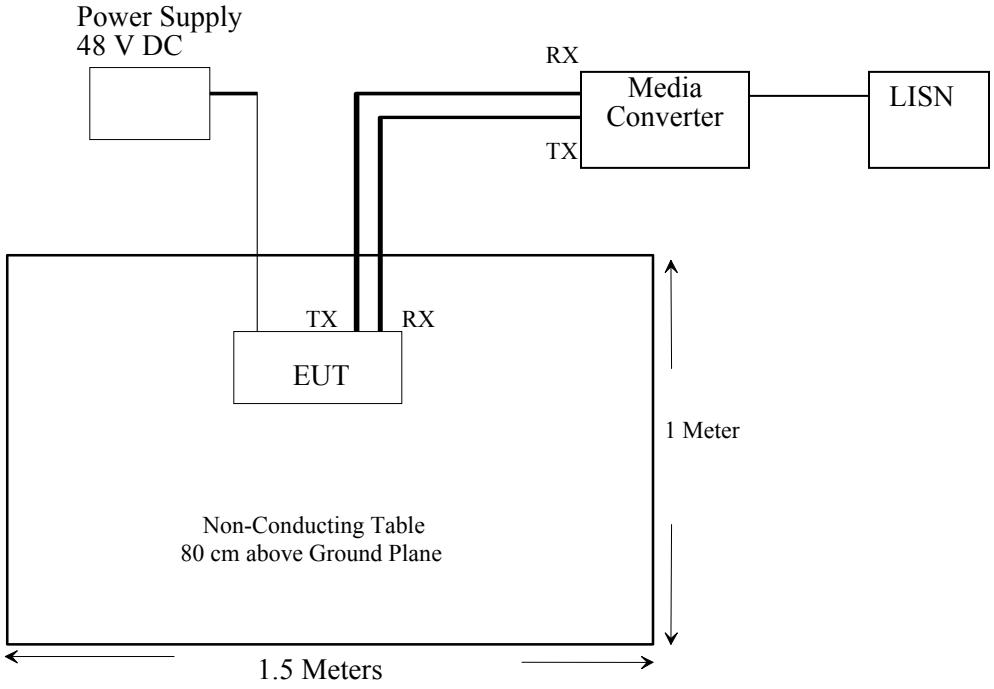
## 2.5 Power Supply Information

| Manufacturer | Description | Model | Serial Number |
|---|---|---|---|
| BK Precision | 48 VDC Power Supply | 1740 | 26502000233 |

## 2.6 Interface Ports and Cabling

| Cable Description | Length (M) | From | To |
|---|---|---|---|
| Optical, Fiber cable | 2.0 | Optical Gigabit Media Converter – 1000Base – TX/FX | EUT |

## 2.7 Test Setup Block Diagram



# 3 SUMMARY OF TEST REPORT

Results reported relate only to the product tested.

| FCC 15.255 | Description Of Test | Results |
|---|---|---|
| §15.203 | Antenna Requirement | Compliant |
| §15.205 | Restricted bands of Operation | Exempt |
| §15.207 | Power Line Conducted Emissions | Compliant |
| §15.209, §15.255 (c),(2),(3) | Transmitter Spurious Emissions | Compliant |
| §15.255 (b),(1) | Peak Power Density | Compliant |
| §15.255 (e),(1) | 6 dB Band Width | Compliant |
| §15.255 (e),(1) | Peak Output Power | Compliant |
| §15.255 (f) | Frequency Stability | Compliant |
| §15.255 (g) | RF Exposure | Compliant |

# 4 §15.203 – Antenna Requirement

## 4.1 Applicable Standard

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

## 4.2 Result

Compliant: The antenna for this device is permanently attached and thus fulfills the requirement for unique connection type.

# 5 §15.207 – Power Line Conducted Emissions

## 5.1 Section 15.207 Conducted limits:

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 μH/50 ohms line impedance stabilization network (LISN). 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. The lower limit applies at the boundary between the frequencies ranges.

| Frequency of Emission (MHz) | Conducted Limit (dBuV) | |
|---|---|---|
| | 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.*

## 5.2 Test Setup

The measurement was performed at shield room, using the setup per ANSI C63.4 – 2003 measurement procedure. The specification used was FCC Class B limits.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The EUT was powered via connection to DC power source which was plugged into the LISN.

## 5.3 Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date |
|---|---|---|---|---|
| Solar Electronics | LISN | 9252-R-24-BNC | 511205 | 2007-07-07 |
| Rohde & Schwarz | EMI Test Receiver | ESCI 1166.595 0K03 | 100338 | 2007-04-05 |

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

## 5.4 Test Procedure

During the conducted emissions test, the power cord of the system was connected to the main outlet of the LISN-1.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the peak detection mode, quasi-peak and average. Quasi-Peak readings are distinguished with a "QP". Average readings are distinguished with an "Ave".

## 5.5 Environmental Conditions

| | |
|---|---|
| **Temperature:** | 27 °C |
| **Relative Humidity:** | 40 % |
| **ATM Pressure:** | 102.0 kPa |

**The testing was performed by James Ma from 2007-10-12.*

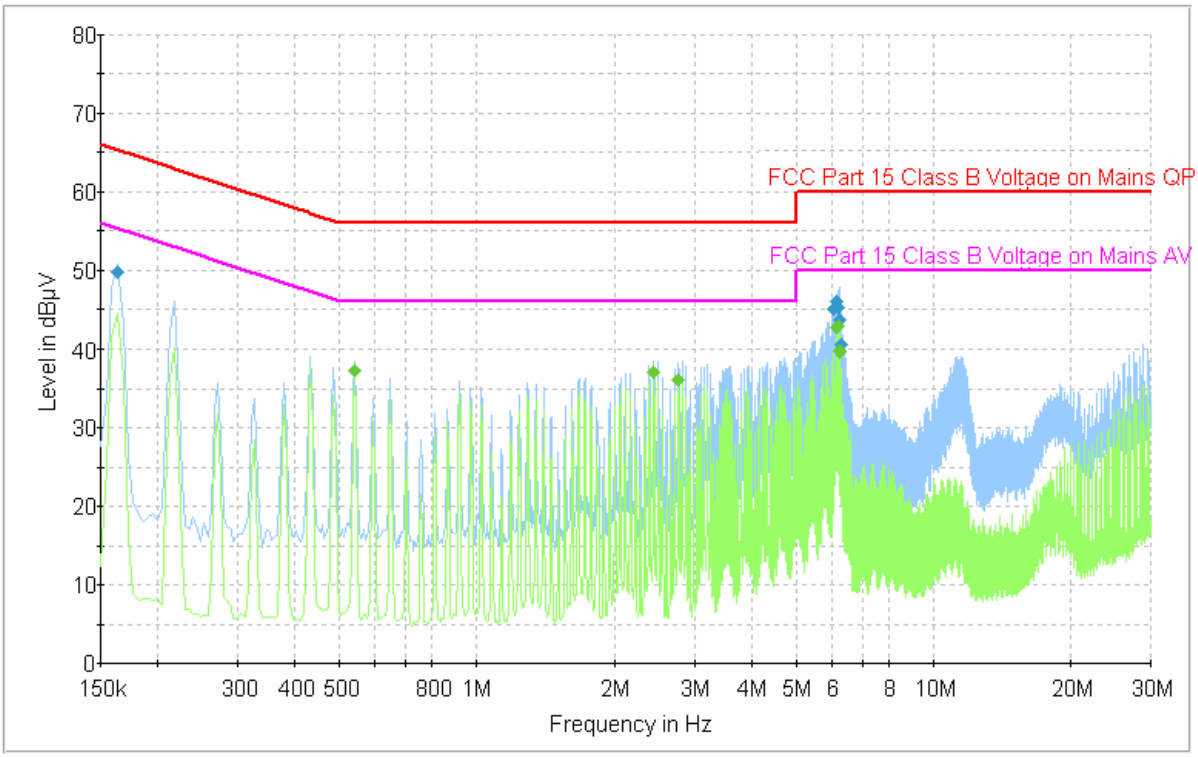
## 5.6 Summary of Test Results

According to the recorded data in following table, the EUT complied with the FCC & IC standard's conducted emissions limits for Class B devices, with the *worst* margin reading of:

| Margin (dB) | Frequency (MHz) | Conductor Mode (Line / Neutral) | Range (MHz) |
|---|---|---|---|
| -7.2 | 6.171000 | Line | 0.150 MHz to 30 MHz |

## 5.7 Conducted Emission Test Plot and Data

### Line



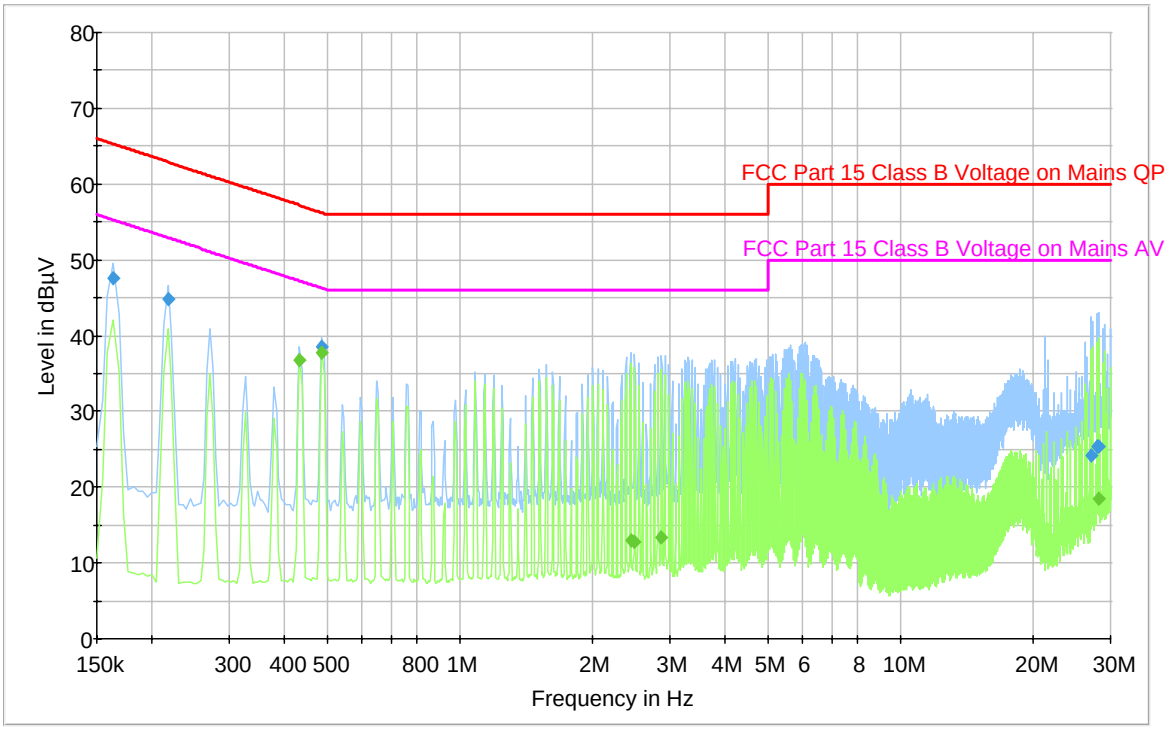

### QP Measurements

| Frequency (MHz) | QuasiPeak (dBµV) | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|
| 6.117000 | 45.9 | L1 | 10.0 | 14.1 | 60.0 |
| 6.171000 | 45.2 | L1 | 10.0 | 14.8 | 60.0 |
| 6.063000 | 44.9 | L1 | 10.0 | 15.1 | 60.0 |
| 0.163500 | 49.7 | L1 | 10.0 | 15.6 | 65.3 |
| 6.225000 | 43.6 | L1 | 10.0 | 16.4 | 60.0 |
| 6.279000 | 40.5 | L1 | 10.0 | 19.5 | 60.0 |

### Average Measurements

| Frequency (MHz) | Average (dBµV) | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|
| 6.171000 | 42.8 | L1 | 10.0 | 7.2 | 50.0 |
| 6.117000 | 42.7 | L1 | 10.0 | 7.3 | 50.0 |
| 0.541500 | 37.3 | L1 | 10.0 | 8.7 | 46.0 |
| 2.436000 | 37.2 | L1 | 10.0 | 8.8 | 46.0 |
| 2.760000 | 36.1 | L1 | 10.0 | 9.9 | 46.0 |
| 6.225000 | 39.8 | L1 | 10.0 | 10.2 | 50.0 |

## Neutral




### QP Measurements

| Frequency (MHz) | QuasiPeak (dBµV) | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|
| 0.487500 | 38.6 | N | 10.0 | 17.6 | 56.2 |
| 0.163500 | 47.5 | N | 10.0 | 17.7 | 65.3 |
| 0.217500 | 44.8 | N | 10.0 | 18.2 | 62.9 |
| 27.942000 | 25.3 | N | 10.0 | 34.7 | 60.0 |
| 28.221000 | 25.3 | N | 10.0 | 34.7 | 60.0 |
| 27.096000 | 24.2 | N | 10.0 | 35.8 | 60.0 |

### Average Measurements

| Frequency (MHz) | Average (dBµV) | Line | Corr. (dB) | Margin (dB) | Limit (dBµV) |
|---|---|---|---|---|---|
| 0.487500 | 37.7 | N | 10.0 | 8.5 | 46.2 |
| 0.433500 | 36.7 | N | 10.0 | 10.5 | 47.2 |
| 28.221000 | 18.4 | N | 10.0 | 31.6 | 50.0 |
| 2.872500 | 13.3 | N | 10.0 | 32.7 | 46.0 |
| 2.440500 | 12.9 | N | 10.0 | 33.1 | 46.0 |
| 2.494500 | 12.9 | N | 10.0 | 33.1 | 46.0 |

# 6 §15.209, §15.255 (c), (2), (3) – TRANSMITTER SPURIOUS EMISSIONS

## 6.1 Applicable Standard

As per §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:

| Frequency (MHz) | Field strength (microvolts/meter) | Measurement distance (meters) |
|---|---|---|
| 0.009–0.490 | 2400/F(kHz) | 300 |
| 0.490–1.705 | 24000/F(kHz) | 30 |
| 1.705–30.0 | 30 | 30 |
| 30–88 | 100** | 3 |
| 88–216 | 150** | 3 |
| 216–960 | 200** | 3 |
| Above 960 | 500 | 3 |

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 MHz, 76–88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241.

As per §15.255 (c), (2), and (3)

(2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209.

(3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 $pW/cm^2$ at a distance of 3 meters.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

**NA:** This device is a fixed frequency transceiver with each of two units operating at separate but fixed frequency within the range of 57000 to 64000 MHz.

## 6.2 Test Procedure

The transmitter was placed on a wooden turntable, and it was transmitting into antenna which was also placed on the turntable.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height and polarization as well as EUT azimuth were varied in order to identify the maximum level of emissions from the EUT. The test was performed by placing the EUT on 3-orthogonal axis.
The frequency range up 200 GHz.

## 6.3 Test Equipment List and Details

| Manufacturer | Description | Model | Serial Number | Calibration Date |
|---|---|---|---|---|
| OML | WR-12 harmonic Mixer with Horn antenna | M12HWD | E60120-1 | 2006-01-23 ( 2yrs ) |
| OML | WR-19 harmonic Mixer with Horn antenna | M19HWD | 11648-01 | 2006-01-23 ( 2yrs ) |
| OML | WR-05 Harmonic Mixer with Horn Antenna | M05HWD | G60106-1 | 2006-01-23 ( 2yrs ) |
| OML | WR-03 Harmonic Mixer with Horn Antenna | M03HWD | H60120-1 | 2006-01-23 ( 2yrs ) |
| OML | Diplexer for Agilent Spectrum Analyzer | DPL26 | N/A | N/A |
| Sonoma Instruments | Pre-amplifier ( 10 KHz – 2.5 GHz ) | 317 | 260407 | 2007-04-26 |
| Sunol Science Corp. | Broadband Antenna ( 30 – 3000 MHz ) | JB3 Antenna | A020106-2 | 2007-04-05 |
| HP | Pre, Amplifier (1 ~ 26.5 GHz) | 8449B | 3147A00400 | 2006-08-21( 2yrs ) |
| Agilent | Analyzer, Spectrum | E4446A | US44300386 | 2007-04-26 |
| A. R.A | Antenna, Horn, DRG | DRG-118/A | 1132 | 2007-06-18 |

**Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

## 6.4 Environmental Conditions

| | |
|---|---|
| Temperature: | 18 °C |
| Relative Humidity: | 55 % |
| ATM Pressure: | 102.0 kPa |

** The testing was performed by James Ma on 2007-10-11.*

## 6.5 Test Result

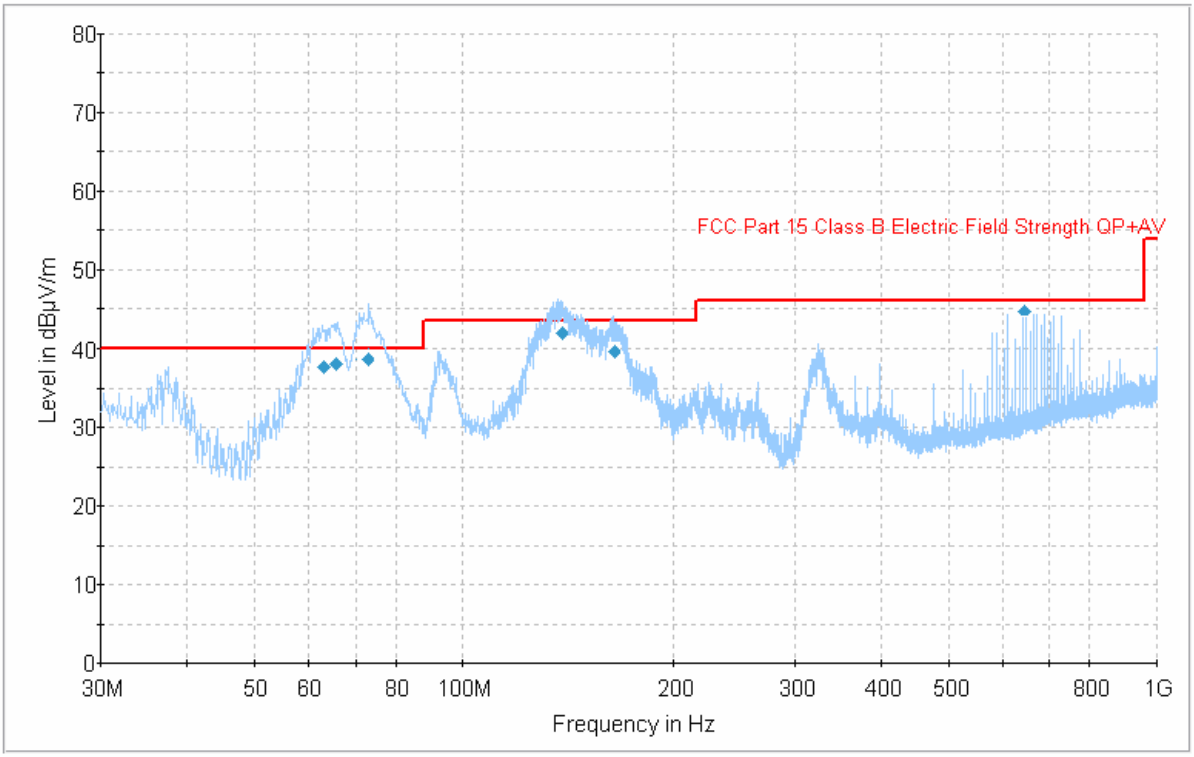
Worst case reading as follows for 24 inches Antenna measured at 3 meters:

**-1.2 dB at 73.54250 MHz (58.78 GHz)**

**-7.5 dB at 1250.17 MHz (62.26GHz)**

**Unit A, 24" Antenna**

***Final scan 30 MHz – 1 GHz, Fundamental = 58.78 GHz)*** **Measured at 3 meter**




| Frequency (MHz) | QuasiPeak (dBµV/m) | Antenna height (cm) | Polarity | Turntable position (deg) | Corr. (dB) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 73.542500 | 38.8 | 401.0 | H | 208.0 | -6.6 | 40.0 | -1.2 |
| 640.656250 | 44.3 | 134.0 | H | 222.0 | 4.0 | 46.0 | -1.7 |
| 147.951250 | 41.7 | 401.0 | H | 222.0 | -6.6 | 43.5 | -1.8 |
| 65.811250 | 38.1 | 401.0 | H | 48.0 | -7.2 | 40.0 | -1.9 |
| 62.898750 | 37.8 | 388.0 | H | 36.0 | -7.6 | 40.0 | -2.2 |
| 163.085000 | 39.9 | 401.0 | H | 196.0 | -6.6 | 43.5 | -3.6 |

***1GHz -40GHz, Fundamental = 58.78 GHz*** **Measured at 3 meter**

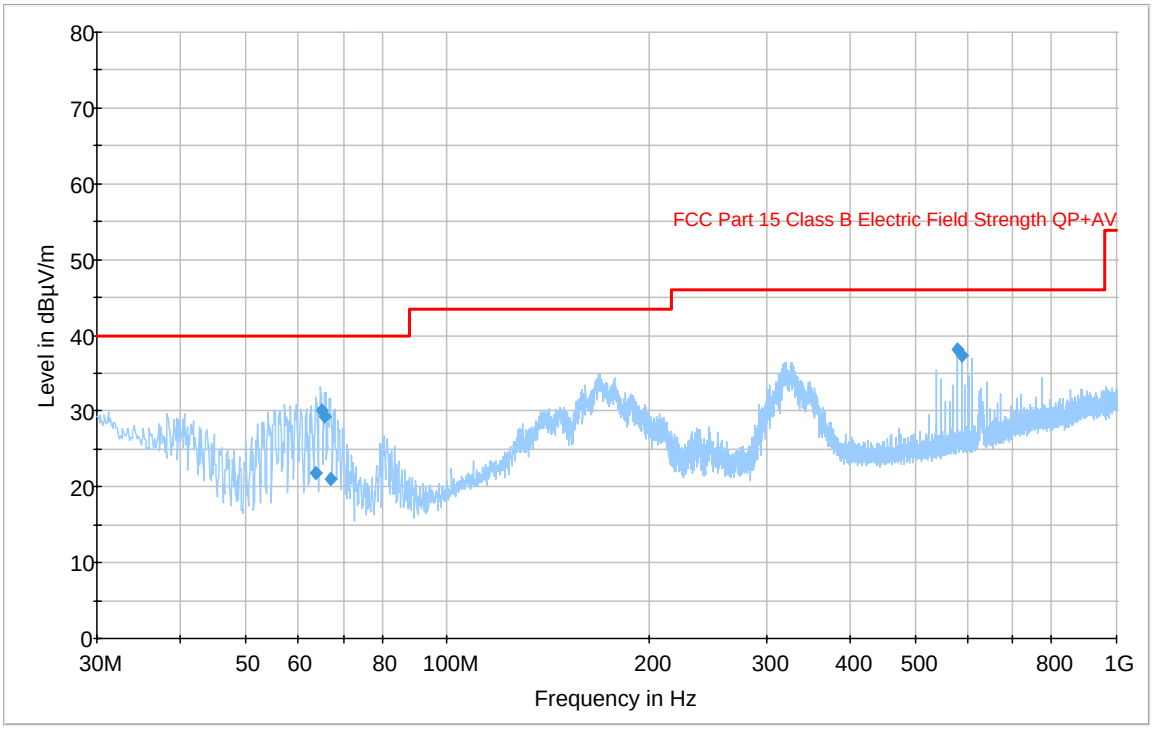
| Frequency MHz | Reading dBuV | Azimuth Degrees | Height Meters | Polar. H / V | Ant. Loss dB | Cable loss dB | Amplifier dB | Corrected Reading dBuV/m | Limit (dBuV/m) | Margin dB |
|---|---|---|---|---|---|---|---|---|---|---|
| 1253.00 | 58.5 | 170 | 1.50 | V | 23.3 | 1.3 | 36.8 | 46.24 | 54 | -7.8 |
| 1253.00 | 58.0 | 110 | 1.20 | H | 23.3 | 1.3 | 36.8 | 45.74 | 54 | -8.3 |
| 7708.00 | 30.3 | 0 | 1.30 | V | 36.6 | 4.5 | 34.5 | 36.86 | 54 | -17.1 |
| 7708.00 | 28.5 | 0 | 1.30 | H | 36.6 | 4.5 | 34.5 | 35.06 | 54 | -18.9 |
| 1253.00 | 58.8 | 170 | 1.50 | V | 23.3 | 1.3 | 36.8 | 46.54 | 74 | -27.5 |
| 1253.00 | 58.2 | 110 | 1.20 | H | 23.3 | 1.3 | 36.8 | 45.94 | 74 | -28.1 |
| 7708.00 | 35.2 | 200 | 2.00 | V | 36.6 | 4.5 | 34.5 | 41.76 | 74 | -32.2 |
| 7708.00 | 33.6 | 180 | 2.20 | H | 36.6 | 4.5 | 34.5 | 40.16 | 74 | -33.8 |

***Above 40 GHz: Measured at 0.05 m***

| Frequency MHz | Reading dBuV | Azimuth Degrees | Height Meters | Polar. H / V | Ant. Loss dB | Conversion Loss dB | Distance Factor dB | Corrected Reading dBuV/m | Limit (dBuV/m) | Margin dB |
|---|---|---|---|---|---|---|---|---|---|---|
| 117560 | 9.3 | 0 | 1.10 | V | 23.0 | 48.7 | 35.6 | 45.40 | 54 | -8.6 |
| 59340 | 17.3 | 0 | 1.10 | V | 23.0 | 40.6 | 35.6 | 45.30 | 54 | -8.7 |
| 117560 | 7.5 | 0 | 1.10 | H | 23.0 | 48.7 | 35.6 | 43.60 | 54 | -10.4 |
| 59340 | 15.3 | 0 | 1.10 | H | 23.0 | 40.6 | 35.6 | 43.30 | 54 | -10.7 |
| 59340 | 29.2 | 0 | 1.10 | V | 23.0 | 40.6 | 35.6 | 57.20 | 74 | -16.8 |
| 117560 | 18.0 | 0 | 1.10 | V | 23.0 | 48.7 | 35.6 | 54.10 | 74 | -19.9 |
| 117560 | 17.3 | 0 | 1.10 | H | 23.0 | 48.7 | 35.6 | 53.40 | 74 | -20.6 |
| 59340 | 22.1 | 0 | 1.10 | H | 23.0 | 40.6 | 35.6 | 50.10 | 74 | -23.9 |

**Unit B, 24" Antenna**

***Final scan 30 MHz – 1 GHz, Fundamental = 62.26 GHz)*** **Measured at 3 meter**




| Frequency (MHz) | QuasiPeak (dBµV/m) | Antenna height (cm) | Polarity | Turntable position (deg) | Corr. (dB) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 578.171250 | 38.1 | 218.0 | H | 180.0 | 3.3 | 46.0 | -7.9 |
| 585.972500 | 37.4 | 218.0 | H | 188.0 | 3.2 | 46.0 | -8.6 |
| 64.878750 | 30.1 | 390.0 | H | 60.0 | -7.3 | 40.0 | -9.9 |
| 65.727500 | 29.3 | 399.0 | H | 47.0 | -7.2 | 40.0 | -10.7 |
| 63.707500 | 21.9 | 301.0 | H | 36.0 | -7.5 | 40.0 | -18.1 |
| 66.858750 | 21.1 | 358.0 | H | 24.0 | -7.1 | 40.0 | -18.9 |

***Final scan 1GHz -40GHz, Fundamental = 62.26 GHz*** **Measured at 3 meter**

| Frequency MHz | Reading dBuV | Azimuth Degrees | Height Meters | Polar. H / V | Antenna Loss dB | Cable loss dB | Amplifier dB | Correction Reading dBuV/m | Limit (dBuV/m) | Margin dB |
|---|---|---|---|---|---|---|---|---|---|---|
| 1250.17 | 58.8 | 260 | 1.00 | H | 23.3 | 1.3 | 36.8 | 46.54 | 54 | -7.5 |
| 1250.17 | 57.2 | 170 | 1.00 | V | 23.3 | 1.3 | 36.8 | 44.94 | 54 | -9.1 |
| 7850.00 | 29.5 | 0 | 1.30 | V | 36.6 | 4.5 | 34.5 | 36.06 | 54 | -17.9 |
| 7850.00 | 29.2 | 0 | 1.30 | H | 36.6 | 4.5 | 34.5 | 35.76 | 54 | -18.2 |
| 1250.17 | 60.2 | 260 | 1.00 | H | 23.3 | 1.3 | 36.8 | 47.94 | 74 | -26.1 |
| 1250.17 | 57.6 | 170 | 1.00 | V | 23.3 | 1.3 | 36.8 | 45.34 | 74 | -28.7 |
| 7850.00 | 32.2 | 200 | 2.00 | V | 36.6 | 4.5 | 34.5 | 38.76 | 74 | -35.2 |
| 7850.00 | 31.8 | 180 | 2.20 | H | 36.6 | 4.5 | 34.5 | 38.36 | 74 | -35.6 |

**Above 40 GHz: Measured at 0.05 m**

| Frequency MHz | Reading dBuV | Azimuth Degrees | Height Meters | Polar. H / V | Ant. Loss dB | Conversion Loss dB | Distance Factor dB | Correction Reading dBuV/m | Limit (dBuV/m) | Margin dB |
|---|---|---|---|---|---|---|---|---|---|---|
| 124520 | 9.5 | 0 | 1.10 | V | 23.0 | 48.7 | 35.6 | 45.60 | 54 | -8.4 |
| 124520 | 7.8 | 0 | 1.10 | H | 23.0 | 48.7 | 35.6 | 43.90 | 54 | -10.1 |
| 124520 | 18.2 | 0 | 1.10 | V | 23.0 | 48.7 | 35.6 | 54.30 | 74 | -19.7 |
| 124520 | 17.6 | 0 | 1.10 | H | 23.0 | 48.7 | 35.6 | 53.70 | 74 | -20.3 |

## 6.6 Test Result

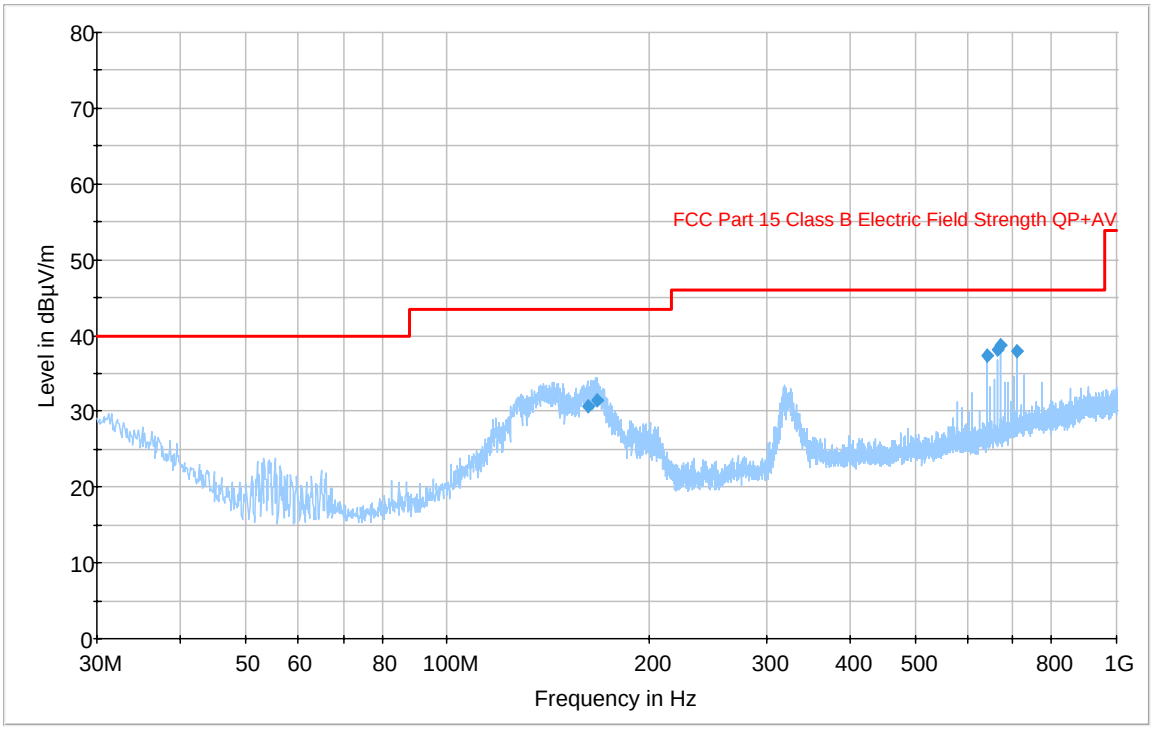
Worst case reading as follows for 12 inches Antenna measured at 3 meters:

**-7.2 dB at 671.898750 MHz (58.78 GHz)**

**-8.7 dB at 64.638750 MHz (62.26 GHz)**

**Unit A, 12" Antenna**

***Final scan 30 MHz – 1 GHz, Fundamental = 58.78 GHz)*** **Measured at 3 meter**




| Frequency (MHz) | QuasiPeak (dBµV/m) | Antenna height (cm) | Polarity | Turntable position (deg) | Corr. (dB) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 671.898750 | 38.8 | 100.0 | H | 204.0 | 4.4 | 46.0 | -7.2 |
| 664.097500 | 38.1 | 113.0 | H | 199.0 | 4.4 | 46.0 | -7.9 |
| 710.981250 | 37.9 | 127.0 | H | 151.0 | 5.4 | 46.0 | -8.1 |
| 640.656250 | 37.4 | 99.0 | H | 65.0 | 4.0 | 46.0 | -8.6 |
| 167.777500 | 31.4 | 163.0 | H | 43.0 | -2.5 | 43.5 | -12.1 |
| 162.282500 | 30.7 | 198.0 | H | 40.0 | -2.2 | 43.5 | -12.8 |

***Final scan 1GHz -40GHz, Fundamental = 58.78 GHz*** **Measured at 3 meter**

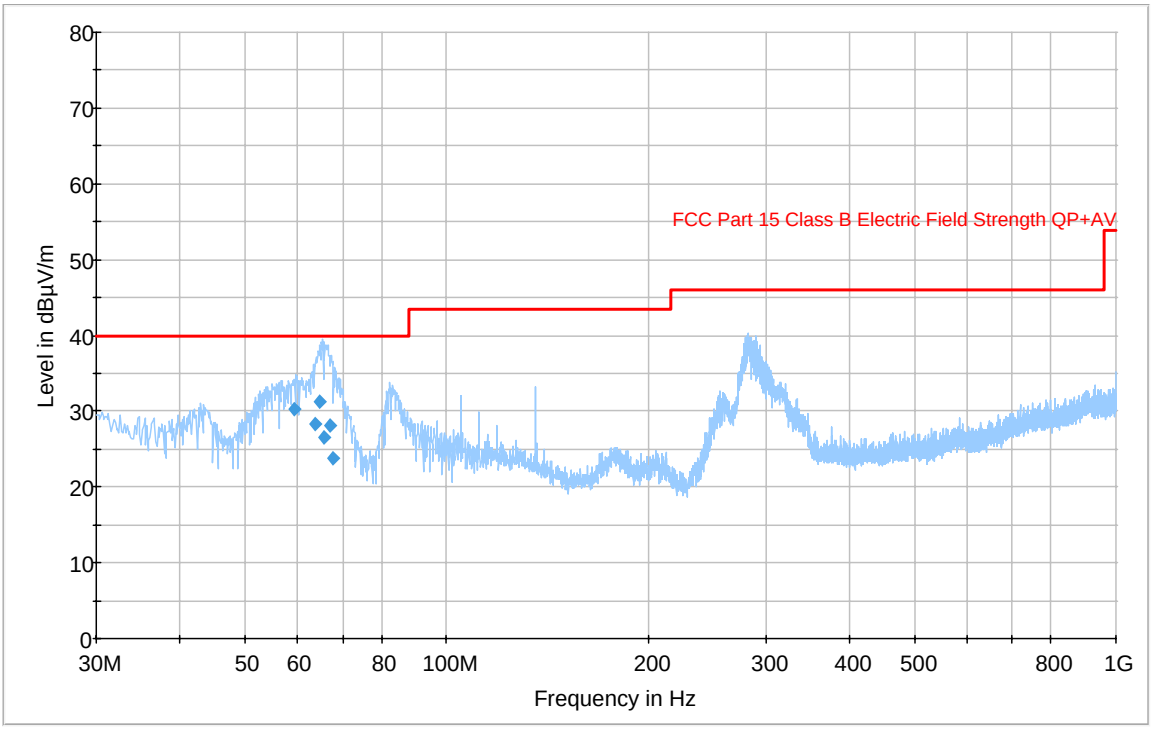
| Frequency MHz | Reading dBuV | Azimuth Degrees | Height Meters | Polar. H / V | Antenna Loss dB | Cable loss dB | Amplifier dB | Correction Reading dBuV/m | Limit (dBuV/m) | Margin dB |
|---|---|---|---|---|---|---|---|---|---|---|
| 1250.12 | 55.8 | 270 | 2.40 | V | 23.3 | 1.3 | 36.8 | 43.54 | 54 | -10.5 |
| 1250.12 | 55.1 | 180 | 2.20 | H | 23.3 | 1.3 | 36.8 | 42.84 | 54 | -11.2 |
| 8225.00 | 30.2 | 0 | 1.30 | V | 37.2 | 4.6 | 34.8 | 37.13 | 54 | -16.9 |
| 8225.00 | 28.6 | 0 | 1.30 | H | 37.2 | 4.6 | 34.8 | 35.53 | 54 | -18.5 |
| 1250.12 | 56.4 | 30 | 2.20 | V | 23.3 | 1.3 | 36.8 | 44.14 | 74 | -29.9 |
| 1250.12 | 55.6 | 180 | 2.20 | H | 23.3 | 1.3 | 36.8 | 43.34 | 74 | -30.7 |
| 8225.00 | 32.5 | 200 | 2.00 | V | 37.2 | 4.6 | 34.8 | 39.43 | 74 | -34.6 |
| 8225.00 | 31.8 | 180 | 2.20 | H | 37.2 | 4.6 | 34.8 | 38.73 | 74 | -35.3 |

**Above 40 GHz: Measured at 0.05 m**

| Frequency MHz | Reading dBuV | Azimuth Degrees | Height Meters | Polar. H / V | Ant. Loss dB | Conversion Loss dB | Distance Factor dB | Correction Reading dBuV/m | Limit (dBuV/m) | Margin dB |
|---|---|---|---|---|---|---|---|---|---|---|
| 117560 | 9.2 | 0 | 1.10 | V | 23.0 | 48.7 | 35.6 | 45.30 | 54 | -8.7 |
| 117560 | 8.8 | 0 | 1.10 | H | 23.0 | 48.7 | 35.6 | 44.90 | 54 | -9.1 |
| 59340 | 16.8 | 0 | 1.10 | V | 23.0 | 40.6 | 35.6 | 44.80 | 54 | -9.2 |
| 59340 | 15.2 | 0 | 1.10 | H | 23.0 | 40.6 | 35.6 | 43.20 | 54 | -10.8 |
| 59340 | 27.5 | 0 | 1.10 | V | 23.0 | 40.6 | 35.6 | 55.50 | 74 | -18.5 |
| 117560 | 17.8 | 0 | 1.10 | V | 23.0 | 48.7 | 35.6 | 53.90 | 74 | -20.1 |
| 117560 | 17.5 | 0 | 1.10 | H | 23.0 | 48.7 | 35.6 | 53.60 | 74 | -20.4 |
| 59340 | 21.8 | 0 | 1.10 | H | 23.0 | 40.6 | 35.6 | 49.80 | 74 | -24.2 |

**Unit B, 12" Antenna**

***Final scan 30 MHz – 1 GHz, Fundamental = 62.26 GHz)*** **Measured at 3 meter**




| Frequency (MHz) | QuasiPeak (dBµV/m) | Antenna height (cm) | Polarity | Turntable position (deg) | Corr. (dB) | Limit (dBµV/m) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| 64.638750 | 31.3 | 361.0 | H | 36.0 | -7.3 | 40.0 | -8.7 |
| 59.385000 | 30.2 | 399.0 | H | 179.0 | -7.9 | 40.0 | -9.8 |
| 63.743750 | 28.3 | 309.0 | H | 99.0 | -7.5 | 40.0 | -11.7 |
| 66.937500 | 28.1 | 269.0 | H | 249.0 | -7.0 | 40.0 | -11.9 |
| 65.765000 | 26.6 | 340.0 | H | 25.0 | -7.2 | 40.0 | -13.4 |
| 67.793750 | 23.7 | 322.0 | H | 90.0 | -6.9 | 40.0 | -16.3 |

***Final scan 1GHz -40GHz, Fundamental = 62.26 GHz*** **Measured at 3 meter**

| Frequency MHz | Reading dBuV | Azimuth Degrees | Height Meters | Polar. H / V | Antenna Loss dB | Cable loss dB | Amplifier dB | Correction Reading dBuV/m | Limit (dBuV/m) | Margin dB |
|---|---|---|---|---|---|---|---|---|---|---|
| 1250.33 | 55.3 | 270 | 2.40 | V | 23.3 | 1.3 | 36.8 | 43.04 | 54 | -11.0 |
| 1250.33 | 55.0 | 180 | 2.20 | H | 23.3 | 1.3 | 36.8 | 42.74 | 54 | -11.3 |
| 8533.00 | 29.8 | 0 | 1.30 | V | 37.5 | 5.0 | 33.8 | 38.48 | 54 | -15.5 |
| 8533.00 | 29.5 | 0 | 1.30 | H | 37.5 | 5.0 | 33.8 | 38.18 | 54 | -15.8 |
| 1250.33 | 56.1 | 30 | 2.20 | V | 23.3 | 1.3 | 36.8 | 43.84 | 74 | -30.2 |
| 1250.33 | 55.2 | 180 | 2.20 | H | 23.3 | 1.3 | 36.8 | 42.94 | 74 | -31.1 |
| 8533.00 | 32.1 | 200 | 2.00 | V | 37.5 | 5.0 | 33.8 | 40.78 | 74 | -33.2 |
| 8533.00 | 31.6 | 180 | 2.20 | H | 37.5 | 5.0 | 33.8 | 40.28 | 74 | -33.7 |

**Above 40 GHz: Measured at 0.05 m**

| Frequency MHz | Reading dBuV | Azimuth Degrees | Height Meters | Polar. H / V | Ant. Loss dB | Conversion Loss dB | Distance Factor dB | Correction Reading dBuV/m | Limit (dBuV/m) | Margin dB |
|---|---|---|---|---|---|---|---|---|---|---|
| 124520 | 8.6 | 0 | 1.10 | V | 23.0 | 48.7 | 35.6 | 44.70 | 54 | -9.3 |
| 124520 | 7.8 | 0 | 1.10 | H | 23.0 | 48.7 | 35.6 | 43.90 | 54 | -10.1 |
| 124520 | 18.0 | 0 | 1.10 | V | 23.0 | 48.7 | 35.6 | 54.10 | 74 | -19.9 |
| 124520 | 17.4 | 0 | 1.10 | H | 23.0 | 48.7 | 35.6 | 53.50 | 74 | -20.5 |

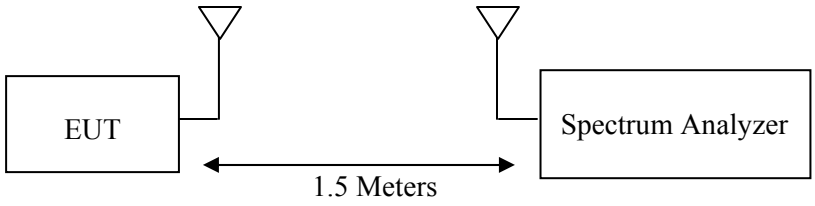
# 7 §15.255 (b), (1) – Peak Power Density

## 7.1 Applicable Standard

(b) Within the 57–64 GHz band, emission levels shall not exceed the following:

(1) For products other than fixed field disturbance sensors, the average power density of any emission, measured during the transmit interval, shall not exceed 9 $\mu W/cm^2$ , as measured 3 meters from the radiating structure, and the peak power density of any emission shall not exceed 18 $\mu W/cm^2$ , as measured 3 meters from the radiating structure.

## 7.2 Measurement Block Diagram




## 7.3 Test Equipment

| Manufacturer | Description | Model | Serial Number | Calibration Date |
|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2007-04-26 |
| OML | WR-12 harmonic Mixer with Horn antenna | M12HWD | E60120-1 | 2006-01-23 ( 2 yrs ) |
| OML | WR-19 harmonic Mixer with Horn antenna | M19HWD | 11648-01 | 2006-01-23 ( 2 yrs ) |
| OML | Diplexer for Agilent Spectrum Analyzer | DPL26 | N/A | N/R |

*** Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

## 7.4 Environmental Conditions

| | |
|---|---|
| **Temperature:** | 20 °C |
| **Relative Humidity:** | 65 % |
| **ATM Pressure:** | 102.7 kPa |

*The testing was performed by James Ma from 2007-10-10.*

## 7.5 Test Results

**12" Antenna ( 43 dBi )**

| Frequency GHz | Max. E- Field of EUT dBµV | Peak Power µW | Peak Power Density µW/ $cm^2$ | Limit µW/ $cm^2$ | |
|---|---|---|---|---|---|
| | | | | Peak PD | Ave PD |
| 58.78 | 116.08 | 1.525 | 0.0269 | 18 | 9 |
| 62.26 | 113.14 | 0.775 | 0.0137 | 18 | 9 |

**Max. E- Field of EUT: including the Antenna Loss, Cable Loss, and Conversion Loss**
**Peak Output Power of EUT ( Measured at 1.5m ) See Plots at Output Power Section**
**$P = (F*D)^2 / 30G$**

**Peak Power Density**
**Pd = ( PG / 4 Pi x $D^2$ ); D = 3m ( Spec. @ 3 meter )**
**If peak measured result meet the average limit, then the average calculation is not required**

**24" Antenna ( 47 dBi )**

| Frequency GHz | Peak Power µW | Peak Power Density µW/ $cm^2$ | Limit µW/ $cm^2$ | |
|---|---|---|---|---|
| | | | Peak PD | Ave PD |
| 58.78 | 1.525 | 0.0676 | 18 | 9 |
| 62.26 | 0.775 | 0.0343 | 18 | 9 |

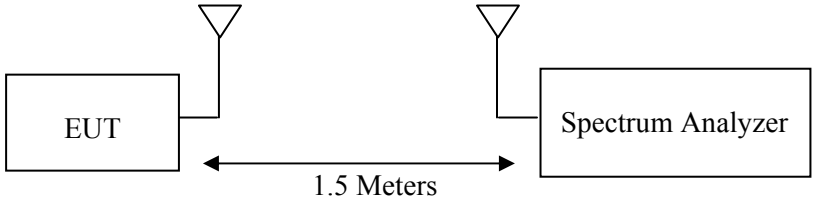
**Peak Power Density**
**Pd = ( PG / 4 Pi x D^2 ); D = 3m ( Spec. @ 3 meter )**
**If peak measured result meet the average limit, then the average calculation is not required**

# 8 §15.255 (e), (1) – 6 dB Bandwidth

## 8.1 Applicable Standard

Emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g. for frequency hopping devices).

## 8.2 Measurement Block Diagram




## 8.3 Test Equipment

| Manufacturer | Description | Model | Serial Number | Calibration Date |
|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2007-04-26 |
| OML | WR-12 harmonic Mixer with Horn antenna | M12HWD | E60120-1 | 2006-01-23 ( 2 yrs ) |
| OML | WR-19 harmonic Mixer with Horn antenna | M19HWD | 11648-01 | 2006-01-23 ( 2 yrs ) |
| OML | Diplexer for Agilent Spectrum Analyzer | DPL26 | N/A | N/R |

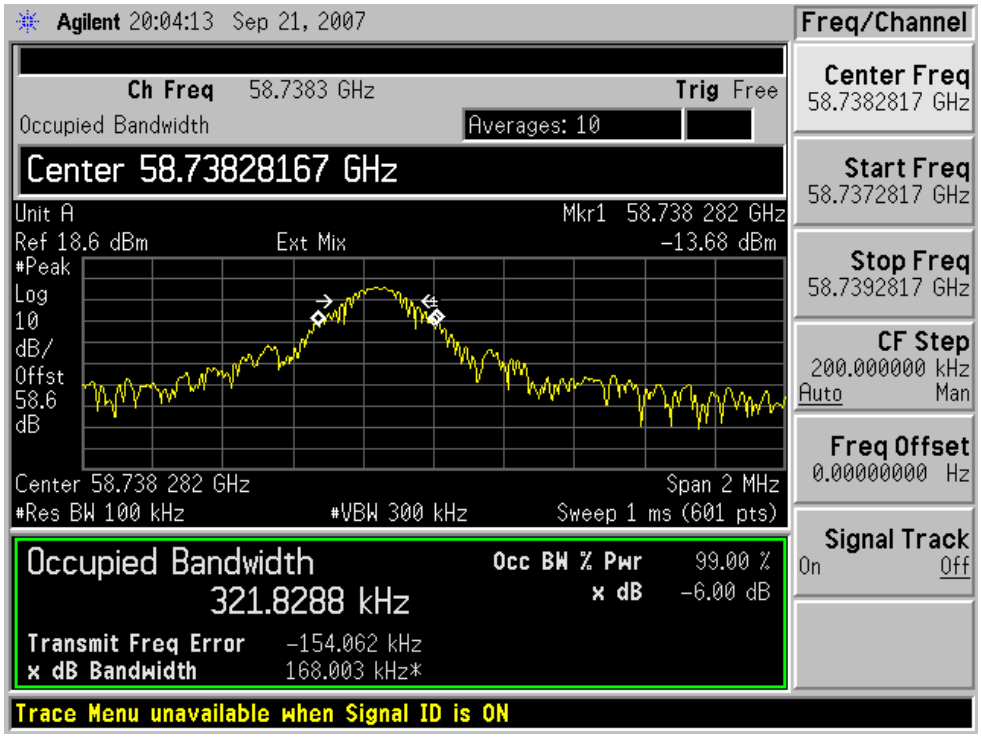
*** Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

## 8.4 Environmental Conditions

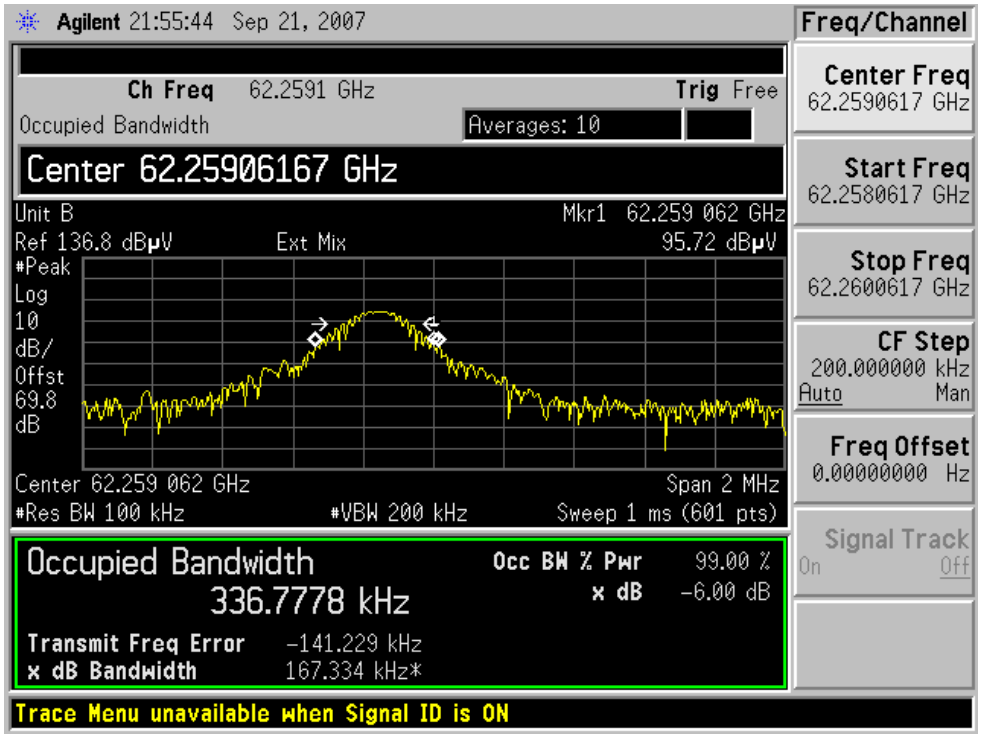
| | |
|---|---|
| **Temperature:** | 20 °C |
| **Relative Humidity:** | 65 % |
| **ATM Pressure:** | 102.7 kPa |

*The testing was performed by James Ma from 2007-10-10.*

Unit A (58.74 GHz)




Unit B (62.26 GHz)



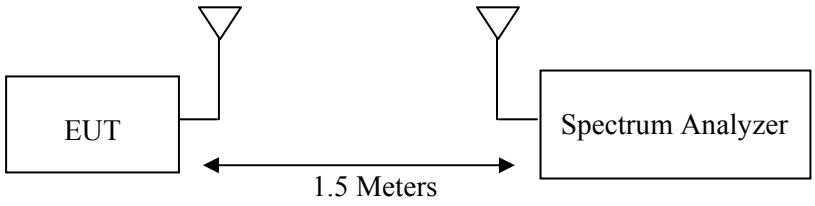
# 9 §15.255 (e), (1) – Peak Output Power

## 9.1 Applicable Standard

e) Except as specified elsewhere in this paragraph (e), the total peak transmitter output power shall not exceed 500 mW.

(1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. For the purposes of this paragraph (e)(1), emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g. for frequency hopping devices).

## 9.2 Measurement Block Diagram




## 9.3 Test Equipment

| Manufacturer | Description | Model | Serial Number | Calibration Date |
|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2007-04-26 |
| OML | WR-12 harmonic Mixer with Horn antenna | M12HWD | E60120-1 | 2006-01-23 ( 2 yrs ) |
| OML | WR-19 harmonic Mixer with Horn antenna | M19HWD | 11648-01 | 2006-01-23 ( 2 yrs ) |
| OML | Diplexer for Agilent Spectrum Analyzer | DPL26 | N/A | N/R |

*** Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

## 9.4 Environmental Conditions

| | |
|---|---|
| **Temperature:** | 20 °C |
| **Relative Humidity:** | 65 % |
| **ATM Pressure:** | 102.7 kPa |

*The testing was performed by James Ma from 2007-10-10.*

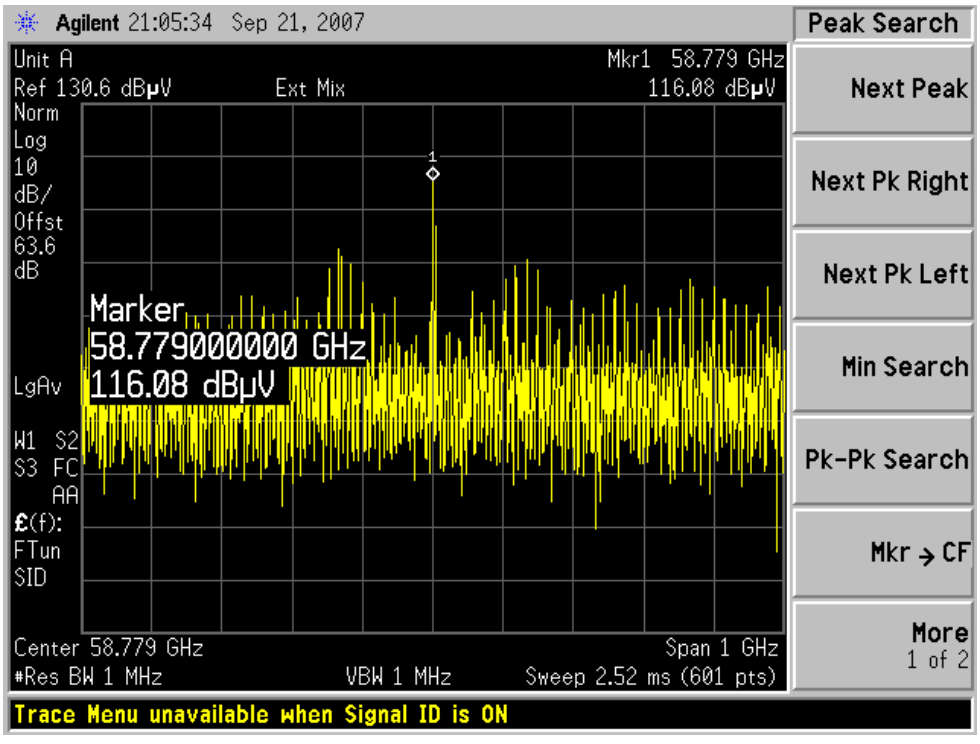
**12" Antenna ( 43 dBi )**

| Frequency GHz | Max. E- Field of EUT dBµV | Peak Power µW | Peak Power dBm | Peak Power Limit µW |
|---|---|---|---|---|
| 58.78 | 116.08 | 1.525 | -28.1700 | 840 |
| 62.26 | 113.14 | 0.775 | -31.1000 | 836 |

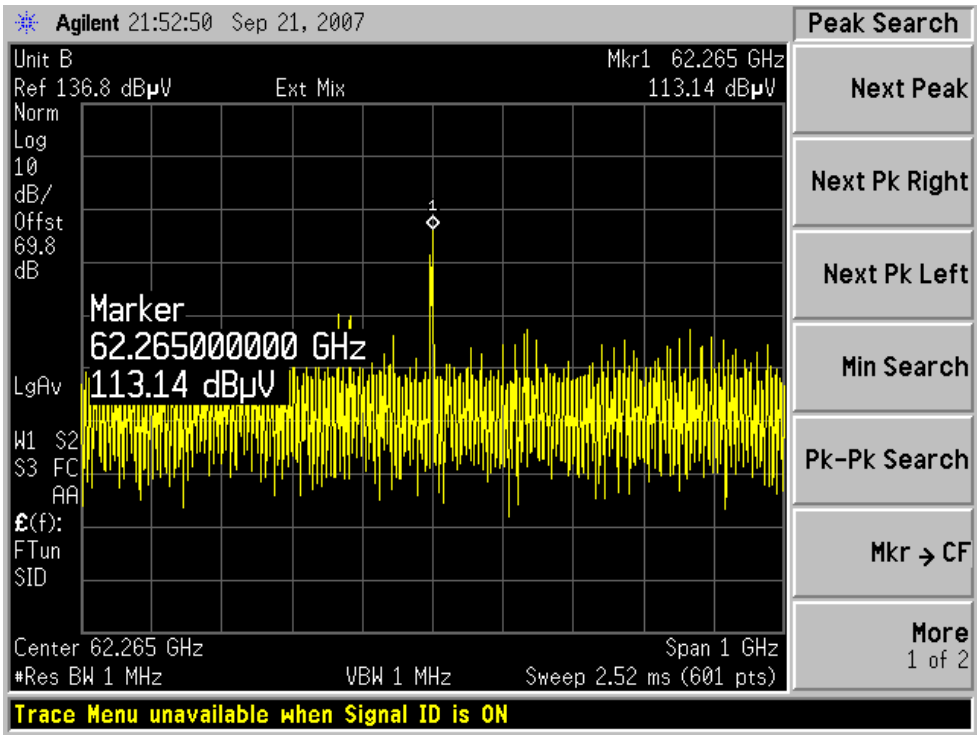
| Max. E- Field of EUT: including the Antenna Loss, Cable Loss, and Conversion Loss |
|---|
| Peak Output Power of EUT ( Measured at 1.5m ) |
| $P = (F*D)^2 / 30G$ |
| Power Limit = ( 6 dB BW x 500 mW) / 100 ) |
| **Result: 6 dB BW: Unit A = 168 kHz, Unit B = 167.33 kHz** |

Please refer to the plots attached.

**Unit A**



**Unit B**

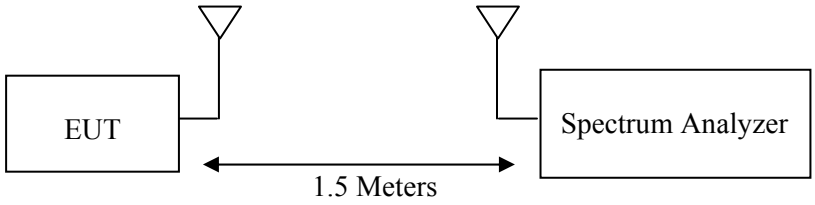

Agilent 21:52:50 Sep 21, 2007
Peak Search
Unit B
Mkr1 62.265 GHz
Ref 136.8 dBµV
Ext Mix
113.14 dBµV
Next Peak
Norm
Log
10
dB/
Offst
69.8
dB
Next Pk Right
Next Pk Left
Marker
62.265000000 GHz
113.14 dBµV
Min Search
LgAv
W1 S2
S3 FC
AA
Pk-Pk Search
£(f):
FTun
SID
Mkr → CF
Center 62.265 GHz
Span 1 GHz
More
1 of 2
#Res BW 1 MHz
VBW 1 MHz
Sweep 2.52 ms (601 pts)
Trace Menu unavailable when Signal ID is ON

# 10 §15.255 (f) – Frequency Stability

## 10.1 Applicable Standard

(f) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range −20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

## 10.2 Measurement Block Diagram




## 10.3 Test Equipment

| Manufacturer | Description | Model | Serial Number | Calibration Date |
|---|---|---|---|---|
| Agilent | Spectrum Analyzer | E4446A | US44300386 | 2007-04-26 |
| OML | WR-12 harmonic Mixer with Horn antenna | M12HWD | E60120-1 | 2006-01-23 ( 2 yrs ) |
| OML | WR-19 harmonic Mixer with Horn antenna | M12HWD | 11648-01 | 2006-01-23 ( 2 yrs ) |
| OML | Diplexer for Agilent Spectrum Analyzer | DPL26 | N/A | N/R |
| ESPEC | Oven, Temperature | ESL-4CA | 18010 | N/A |

*** Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

## 10.4 Environmental Conditions

| | |
|---|---|
| **Temperature:** | 20 °C |
| **Relative Humidity:** | 65 % |
| **ATM Pressure:** | 102.7 kPa |

*The testing was performed by James Ma from 2007-10-12.*

## 10.5 Test Results

**1) Frequency Vs. Temperature**

**Unit A**

| Reference Frequency 58.7788 GHZ | | | |
|---|---|---|---|
| Test Condition | | Frequency Measure with Time Elapsed | |
| Temperature ( °C ) | Power Supply (Vdc) | Measured Frequency (GHz) | PPM Error |
| 50 | 48.00 | 58.77463 | -70.94 |
| 20 | 48.00 | 58.77682 | -33.69 |
| 0 | 48.00 | 58.77336 | -92.55 |
| -20 | 48.00 | 58.77210 | -113.99 |

**2) Frequency Vs. Voltage**

| Reference Frequency 58.7788 GHZ | | | |
|---|---|---|---|
| Test Condition | | Frequency Measure with Time Elapsed | |
| Temperature (°C ) | Power Supply (Vdc) | Measured Frequency (GHz) | PPM Error |
| 20 | 40.80 | 58.77672 | -35.39 |
| 20 | 55.20 | 58.77664 | -36.75 |

**1) Frequency Vs. Temperature**

**Unit B**

| Reference Frequency 62.2637 GHZ | | | |
|---|---|---|---|
| Test Condition | | Frequency Measure with Time Elapsed | |
| Temperature (°C ) | Power Supply (Vdc) | Measured Frequency (GHz) | PPM Error |
| 50 | 48.00 | 62.26102 | -43.04 |
| 20 | 48.00 | 62.26284 | -13.81 |
| 0 | 48.00 | 62.25925 | -71.47 |
| -20 | 48.00 | 62.25803 | -91.06 |

**2) Frequency Vs. Voltage**

| Reference Frequency 62.2637 GHZ | | | |
|---|---|---|---|
| Test Condition | | Frequency Measure with Time Elapsed | |
| Temperature (°C ) | Power Supply (Vdc) | Measured Frequency (GHz) | PPM Error |
| 20 | 40.80 | 62.26215 | -24.89 |
| 20 | 55.20 | 62.26203 | -26.82 |

# 11 §1.1307(b)(1), §2.1091, §2.1093 & 15.255 (g) - RF EXPOSURE

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

| Frequency Range (MHz) | Electric Field Strength (V/m) | Magnetic Field Strength (A/m) | Power Density ($mW/cm^2$) | Averaging Time (minute) |
|---|---|---|---|---|
| Limits for General Population/Uncontrolled Exposure | | | | |
| 0.3-1.34 | 614 | 1.63 | *(100) | 30 |
| 1.34-30 | 824/f | 2.19/f | *($180/f^2$) | 30 |
| 30-300 | 27.5 | 0.073 | 0.2 | 30 |
| 300-1500 | / | / | f/1500 | 30 |
| 1500-100,000 | / | / | 1.0 | 30 |

f = frequency in MHz
* = Plane-wave equivalent power density

**MPE Prediction**

Predication of MPE limit at a given distance
Equation from page 18 of OET Bulletin 65, Edition 97-01

$S = PG/4\pi R^2$

Where: S = power density
P = power input to antenna
G = power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna

***58.78 GHz Transmitter***

| | |
|---|---|
| Maximum peak output power at antenna input terminal (dBm): | -28.17 |
| Maximum peak output power at antenna input terminal (mW): | 1.525 |
| Prediction distance (cm): | 20 |
| Prediction frequency (MHz): | 58780 |
| Antenna Gain, typical (dBi): | 47 |
| Maximum Antenna Gain (numeric): | 50119 |
| Power density at predication frequency at 20 cm ($mW/cm^2$): | 0.0152 |
| MPE limit for uncontrolled exposure at predication frequency ($mW/cm^2$): | 1.0 |

***62.26 GHz Transmitter***

| | |
|---|---|
| Maximum peak output power at antenna input terminal (dBm): | -31.10 |
| Maximum peak output power at antenna input terminal (mW): | 0.775 |
| Prediction distance (cm): | 20 |
| Prediction frequency (MHz): | 62260 |
| Antenna Gain, typical (dBi): | 47 |
| Maximum Antenna Gain (numeric): | 50119 |
| Power density at predication frequency at 20 cm ($mW/cm^2$): | 0.00773 |
| MPE limit for uncontrolled exposure at predication frequency ($mW/cm^2$): | 1.0 |

## 11.1 Test Result

The power density level at 20 cm is 0.0152 mW/cm² and 0.00773 mW/cm², which is below the uncontrolled exposure limit of 1 mW/cm².