Elliott Laboratories Inc.
www.elliottlabs.com
684 West Maude Avenue
Sunnyvale, CA 94085-3518
408-245-7800 Phone
408-245-3499 Fax

# *Electromagnetic Emissions Test Report In Accordance With Industry Canada Radio Standards Specification 119 Issue 9, FCC Part 90 on the GE MDS LLC Transmitter Model: TD220*

| | |
|---|---|
| FCC ID NUMBER: | E5MDS-TD220 |
| UPN: | 101D-TD220 |
| GRANTEE: | GE MDS LLC<br>175 Science Parkway<br>Rochester, NY 14620 |
| TEST SITE: | Elliott Laboratories, Inc.<br>684 W. Maude Avenue<br>Sunnyvale, CA 94086 |
| REPORT DATE: | May 9, 2008 |
| FINAL TEST DATE: | April 30, May 1, May 8 and May 9, 2008 |
| AUTHORIZED SIGNATORY: | David Bare<br>CTO |

ACCREDITED

Testing Cert #2016-01

## *REVISION HISTORY*

| Rev # | Date | Comments | Modified By |
|---|---|---|---|
| 1 | May 8, 2008 | Original issue | - |
| | | | |

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## *FCC CERTIFICATION INFORMATION*

The following information is in accordance with FCC Rules, 47CFR Part 2, Subpart J, Section 2.1033(C) & to Industry Canada RSP-100.

**2.1033(c)(1)** Applicant:

GE MDS LLC
175 Science Parkway
Rochester, NY 14620

**2.1033(c)(2) & RSP-100 (4)** FCC ID: E5MDS-TD220
UPN: 101D-TD220

**2.1033(c)(3) & RSP-100 (7.2(a)) Instructions/Installation Manual**

Please refer to Exhibit 7: User Manual

**2.1033(c)(4) & RSP-100 (7.2(b)(iii)) Type of emissions**

FCC 90 & RSS-119**: F1D**
**Necessary bandwidth (2M + 2DK): 12.5kHz channels, D=3.1, M=2.4, K=1**
2(3.1)+2(2.4) = 11.0kHz

**2.1033(c)(5) & RSP-100 (7.2(a)) Frequency Ranges**

FCC 90 & RSS-119**: 220.0125-221.9875 MHz**

**2.1033(c)(6) & RSP-100 (7.2(a)) Range of Operation Power**

FCC 90 & RSS-119**: 2 to 28.2 Watts**

**2.1033(c)(7) & RSP-100 (7.2(a)) Maximum FCC & IC Allowed Power Level**

FCC 90.729 & RSS-119**:**: Depends on frequency, antenna height and purpose of operation (land mobile or fixed).

**2.1033(c)(8) & RSP-100 (7.2(a)) Applied voltage and currents into the final transistor elements**

The final RF stage output amplifier operates at 13.8 Vdc and draws 6 Adc

**2.1033(c)(9) & RSP-100 (7.2(a)) Tune-up Procedure**

There is no tune up procedure since is a digital radio. All settings and calibration are done in the factory and stored in memory.

**2.1033(c)(10) & RSP 100 (7.2(a)) Schematic Diagram of the Transmitter**

Refer to Exhibit 6: Schematic diagram

**2.1033(c)(10) & RSP-100 (7.2(a)) Means for Frequency Stabilization**

Refer to Exhibit 4: Theory of Operation and test data for supporting measurements.

**2.1033(c)(10) & RSP-100 (7.2(a)) Means for Suppression of Spurious radiation**

Refer to Exhibits 4 and 6

**2.1033(c)(10) & RSP-100 (7.2(a)) Means for Limiting Modulation**

Refer to Exhibits 4 and 6

**2.1033(c)(10) & RSP-100 (7.2(a)) Means for Limiting Power**

Refer to Exhibit 4: Theory of Operation

**2.1033(c)(11) & RSP-100 (7.2(g)) Photographs or Drawing of the Equipment Identification Plate or Label**

Refer to Exhibit 5: Label and label location.pdf

**2.1033(c)(12) & RSP-100 (7.2(c)) Photographs of equipment**

Refer to Exhibit 6, Internal and External Photogrpahs

**2.1033(c)(14) & RSP-100 (7.2(b)(ii)) Data taken per Section 2.1046 to 2.1057 and RSS-133 issue 2, Rev. 1.**

Refer to Exhibit 2

## *DECLARATIONS OF COMPLIANCE*

Equipment Name and Model:
TD220

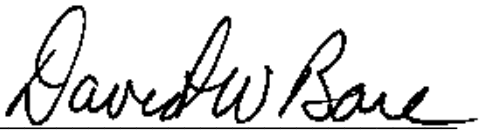
Manufacturer:
GE MDS LLC
175 Science Parkway
Rochester, NY 14620

Tested to applicable standards:
RSS-119, Issue 9 (Land Mobile and Fixed Radio Transmitters and Receivers, 27.41 to 960 MHz).
FCC Part 90 (Private Land Mobile Radio Service)

Measurement Facility Description Filed With Department of Industry:

Departmental Acknowledgement Number: IC2845A-1 Dated August 16, 2007

I declare that the testing was performed or supervised by me; that the test measurements were made in accordance with the above mentioned departmental standards (through the use of TIA/EIA-603 and the specific RSS standards applicable to this device); and that the equipment performed in accordance with the data submitted in this report.



Signature
Name David Bare
Title CTO
Elliott Laboratories Inc.
Address 684 W. Maude Ave
Sunnyvale, CA 94086
USA

Date: May 8, 2008

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

## *SCOPE*

FCC Part 90 & IC RSS-119 testing was performed for the equipment mentioned in this report. The equipment was tested in accordance with the procedures specified in Sections 2.1046 to 2.1057 of the FCC Rules & IC RSS-119. TIA-603 was also used as a test procedure guideline to perform some of the required tests.

The intentional radiator above was tested in a simulated typical installation to demonstrate compliance with the relevant FCC & RSS performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

## *OBJECTIVE*

The primary objective of the manufacturer is compliance with the FCC Part 90 & IC RSS-119. Certification of these devices is required as a prerequisite to marketing as defined in Section 2.1033 & RSP-100.

Certification is a procedure where the manufacturer or a contracted laboratory makes measurements and submits the test data and technical information to FCC & Industry Canada. FCC & Industry Canada issues a grant of equipment authorization and a certification number upon successful completion of their review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units subsequently manufactured.

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

## *SUMMARY OF TEST RESULTS*

*Part 90 and RSS-119 Test Summary*

| Measurement Required | FCC Sections | RSS-119 Section | Test Performed | Measured Value | Test Procedure Used | Result |
|---|---|---|---|---|---|---|
| Modulation Tested | - | - | - | GMSK | N/A | N/A |
| Modulation characteristics | 2.1047/ | 5.2 | - | | | |
| Conducted RF power output | 2.1046 / 90.279 & 90.205(g) 50W | 5.4 (SRSP-512 6.3) 50W | Conducted Output Power Test | 28.2 Watts | B | Complies |
| Spurious emissions at antenna Port | 2.1051/ 90.210(f) – Emissions Mask F | 5.5. 5.8 Mask F | Emission Limits and/or Unwanted Emission 30MHz – 5GHz (**Antenna Conducted**) | Complied with mask F for an aggregated channel 90.733(e) | J | Complies |
| Occupied Bandwidth | 2.1049/ 90.210(f) – Emissions Mask F | 5.5, RSS GEN | Emission Mask and 99% Bandwidth | Refer to Plots | C & D | Complies |
| Field strength of spurious radiation | 2.1053 / 90.210(f) – Emissions Mask F | 5.8 Mask F | Radiated Spurious Emissions 30MHz – 5GHz | -31.3dBm erp @ 888MHz (-6.3dB) | N | Complies |
| Frequency stability | 2.1055 / 90.213 Mobile Stations (1.5ppm) | 5.3 Table 1 | Frequency Vs. Temperature | Measured: 0.945 ppm | K | Complies |
| | | | Frequency Vs. Voltage | | L & M | Complies |
| Transient Frequency Behavior | 90.214 | 5.9 | Transient Behavior | Refer to Plots | I | Complies |
| Exposure to Mobile devices | 2.1091 | 9 | Exposure of Humans to RF Fields | To be considered at time of licensing | - | |
| Receiver | 15.109 | 5.11 RSS GEN | Receiver Spurious Emissions | 28.7dBµV/m @ 35.85MHz (-11.3dB) | N/A | Complies |

## *MEASUREMENT UNCERTAINTIES*

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below were calculated using the approach described in CISPR 16-4-2:2003 using a coverage factor of k=2, which gives a level of confidence of approximately 95%. The levels were found to be below levels of *U*cispr and therefore no adjustment of the data for measurement uncertainty is required.

| Measurement Type | Frequency Range (MHz) | Calculated Uncertainty (dB) |
|---|---|---|
| Conducted Emissions | 0.15 to 30 | ± 2.4 |
| Radiated Emissions | 30 to 1000 | ± 3.6 |

## *EQUIPMENT UNDER TEST (EUT) DETAILS*

### *GENERAL*

The GE MDS LLC model TD220 is a narrowband wireless transceiver that is designed to transmit and receive data in the 220 to 222 MHz band on aggregate channels with 12.5 kHz spacing. Normally, the EUT would be placed on a tabletop or in a rack during operation. The EUT was, therefore, placed on a table during emissions testing to simulate the end user environment. The electrical rating of the EUT is 13.8vdc, 6 Amps.

The sample was received on April 30, May 1, May 8, and May 9, 2008. The EUT consisted of the following component(s):

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| GE MDS LLC | TD220 | Digital Microwave Radio | 1764384 | E5MDS-TD220 |

### *EUT ANTENNA*

The EUT can be used with antennas up to 16.5 dBi. The antenna connector is a type N connector.

### *ENCLOSURE*

The EUT enclosure is primarily constructed of steel sheet metal. It measures approximately 14.0cm wide by 17.0cm deep by 5.0cm high.

*MODIFICATIONS*

The EUT required the following modifications during testing in order to comply with the emission specifications:

A piece of copper tape was installed as shown in Figure 1 to break up the case resonance, and in turn this shielded the Mitsubishi PA plastic case.

**Figure 1 - Modification**

*SUPPORT EQUIPMENT*

The following equipment was used as local support equipment for emissions testing:

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| IBM | Thinkpad | Laptop | L3-C3706 | DoC |
| Microwave | 44003 | 50 ohm termination | 7943 | - |

No remote support equipment for emissions testing:

*EUT INTERFACE PORTS*

The I/O cabling configuration during emissions testing was as follows:

| Port | Connected to | Description | Shielded or Unshielded | Length (m) |
|---|---|---|---|---|
| Antenna | 50 ohms Termination | - | - | - |
| Data Interface | Laptop | DB25 | Shielded | 2.0 |
| USB | Unterminated | USB | Shielded | 1.0 |
| DC Power | 13.8V DC Source | 2 wire | Unshielded | 2.0 |

Note: The DB9 console port was not connected during testing. The manufacturer stated that this is for setup purposes and therefore would not normally be connected. Either the Ethernet or the Serial DB9 port is used but not both. Emissions tests showed that the highest emissions were observed when using the Ethernet port. Therefore, final tests were done with the Ethernet cable connected.

*EUT OPERATION DURING TESTING*

During emissions testing the EUT was set to transmit mode either unmodulated or modulated as required for testing. As the radio was operating in a continuous transmit state that would not be typical of normal use an external fan was provided for cooling to prevent burn-out of the PA.

## *TEST SITE*

### *GENERAL INFORMATION*

Final test measurements were taken on April 30, May1 and May 8, 2008 at the Elliott Laboratories Open Area Test Site #1, 2 located at 684 West Maude Avenue, Sunnyvale, California. Pursuant to Section 2.948 of the FCC Rules, construction, calibration, and equipment data has been filed with the Commission. Mask plots were provided by GEMDS and were made on May 9 2008.

### *CONDUCTED EMISSIONS CONSIDERATIONS*

Conducted emissions testing are performed in conformance with Section 2 of FCC Rules. Measurements are made with the EUT connected to a spectrum analyzer through an attenuator to prevent overloading the analyzer.

### *RADIATED EMISSIONS CONSIDERATIONS*

Radiated measurements are performed in an open field environment or Anechoic Chamber. The test site is maintained free of conductive objects within the CISPR 16-1 defined elliptical area.

## *MEASUREMENT INSTRUMENTATION*

### *RECEIVER SYSTEM*

An EMI receiver as specified in CISPR 16-1 is used for emissions measurements. The receivers are capable of measuring over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the particular detector used during measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. If average measurements above 1000MHz are performed, the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz is used.

### *INSTRUMENT CONTROL COMPUTER*

A personal computer is utilized to record the receiver measurements of the field strength at the antenna, which is then compared directly with the appropriate specification limit. The receiver is programmed with appropriate factors to convert the received voltage into filed strength at the antenna. Results are printed in a graphic and/or tabular format, as appropriate.

The test receiver also provides a visual display of the signal being measured.

### *PEAK POWER METER*

A peak power meter and thermister mount may be used for output power measurements from transmitters as they provide a broadband indication of the power output.

### *FILTERS/ATTENUATORS*

External filters and precision attenuators are often connected between the receiving antenna or EUT and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transmitters and transient events.

*ANTENNAS*

A biconical antenna is used to cover the range from 30 MHz to 300 MHz and a log periodic antenna is utilized from 300 MHz to 1000 MHz. Narrowband tuned dipole antennas are used over the 30 to 1000 MHz range for precision measurements of field strength. Above 1000 MHz, a horn antenna is used. The antenna calibration factors are included in site factors programmed into the test receivers

*ANTENNA MAST AND EQUIPMENT TURNTABLE*

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor drive to vary the antenna height.

The requirements of ANSI C63.4:2003 were used for configuration of the equipment turntable. It specifies that the test height above ground for table-mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

*INSTRUMENT CALIBRATION*

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An appendix of this report contains the list of test equipment used and calibration information.

## *TEST PROCEDURES*

**General:** For Transmitters with detachable antenna, direct measurements for output power, modulation characterization, occupied bandwidth, and frequency stability are performed with the antenna port of the EUT connected to either the power meter, modulation analyzer, or spectrum analyzer via a suitable attenuator and/or filter. The attenuators and/or filters are used to ensure that the transmitter fundamental will not overload the front end of the measurement instrument.

**Procedure B – Power Measurement (Conducted Method)**: The following procedure was used for transmitters that do use external antennas.

1) Set the EUT to maximum power and to the lowest channel.
2) Either a power meter or a spectrum analyzer was used to measure the power output.
3) If a spectrum analyzer was used a resolution and video bandwidth 10kHz was used to measure the power output. Corrected for any external attenuation used for the protection of the input of analyzer. In addition, For CDMA or TDMA modulations set spectrum analyzer resolution to 1MHz and video to 30 kHz. Use video averaging with a 100-sample rate.
4) If a power meter was used, corrected for any external attenuation used for the protection of the input of the sensor head. Also set the power sensor correction by setting up the frequency range that will be measured.
5) Repeat this for the high channel and all modulations that will be used and all output ports used for transmission

**Procedure C - Occupied Bandwidth (Conducted Method):** Either for analog, digital, or data modulations, occupied bandwidth was performed. The EUT was set to transmit the appropriate modulation at maximum power. The bandwidth was measured using following methods:

1) The built-in 99% function of the spectrum analyzer was used.
2) If the built-in 99% is not available then the following method is used:

   26-dB or 20-dB was subtracted to the maximum peak of the emission. Then the display line function was used, in conjunction with the marker delta function, to measure the emissions bandwidth.

3) For the above two methods a resolution and video bandwidth of 100 or 300 Hz was used to measure the emission's bandwidth.

**Procedure D - Occupied Bandwidth (Conducted Emission Mask):** Either for analog, digital, or data modulations, emission mask was performed. The EUT was set to transmit the appropriate modulation at maximum power. The following method was used:

1) The EUT was connected directly to the spectrum analyzer and used an attenuator to protect the input of the analyzer. The EUT antenna was removable, so conducted measurements was performed. The EUT was set to transmit continuous packets of data and the Fundamental Frequency set to the middle of the EUT frequency range.

2) Since EUT is designed with a 12.5 kHz channel Section 90.210 (d)(1)(2)(3) was used to show compliance to the emission mask.

3) Any emission must be attenuated below the power (P) as follow:

90.210 (d)(1): 5.625 kHz: 0 dB

90.210(d)(2): 5.625 kHz: 20 dB
12.5 kHz: 70 dB

90.210(d)(3): more than 12.5 kHz: -20 dBm (50+10*log(P))

The following Resolution and Video bandwidth was used to show compliance for the above requirement: 100 Hz.

4) Since EUT is designed with a 25 kHz channel Section 90.210 (c)(1)(2)(3) was used to show compliance to the emission mask.

5) Any emission must be attenuated below the power (P) as follow:

90.210 (c)(1): 5 kHz but no more then 10kHz: 83*log($F_d$ / 5) dB

90.210(c)(2): 10kHz but no more then 250%: At least 29 log (fd 2/11) dB or 50 dB, whichever is the lesser attenuation

90.210(c)(3): more than 250%: -13 dBm (43+10*log(P))

The following Resolution and Video bandwidth was used to show compliance for the above requirement: 300 Hz.

**Procedure H - Other Types of Equipment:** Either digital or data modulated signals were simulated, by software or external sources, to performed the required tests. The EUT was set to transmit the appropriate digital modulation.

**Procedure J – Antenna Conducted Emissions:** For spurious emission measurements at the antenna terminal the following procedure was performed:

1) Set the transmitting signal at the middle of the operating range of the transmitter, as specified in the standard. Power is set to maximum and then to minimum.
2) Set the spectrum analyzer display line function to –20-dBm.
3) Set the spectrum analyzer bandwidth to 10kHz <1GHz and 1 MHz >1GHz.
4) For the spectrum analyzer, the start frequency was set to 30 MHz and the stop frequency set to the $10^{th}$ harmonic of the fundamental. All spurious or intermodulation emission must not exceed the –20dBm limit.
5) Steps 1 to 4 were repeated for all modulations and output ports that will be used for transmission.

**Procedure K - Frequency Stability:** The EUT is placed inside a temperature chamber with all support and test equipment located outside of the chamber. The spectrum analyzer is configured to give a 6-digit display for the marker-frequency function. The spectrum analyzer's built-in frequency counter is used to measure the maximum deviation of the fundamental frequency at each temperature. The Temperature chamber was varied from –30 to +50° C (or +60° C for some IC RSS standards, if applicable) in 10 degrees increment. The EUT was allowed enough time to stabilize for each temperature variation.

**Procedure L - Frequency Stability:** For AC or DC operated devices the nominal voltage is varied to 85% and to 115% at either room temperature or at a controlled +20°C temperature.

**Procedure M - Frequency Stability:** For battery-powered devices the voltage battery end-point is determined by reducing the dc voltage until the unit ceases to function. This is performed at either room temperature or at a controlled +20°C temperature.

**Procedure N - Field Strength Measurement:** The EUT was set on the turntable and the search antenna position 3 meters away. The output antenna terminal was terminated with a 50-ohm terminator. The EUT was set at the middle of the frequency band and set at maximum output power.

For the first scan, a pre-liminary measurement is performed. A preliminary scan of emissions is conducted in which all significant EUT frequencies are identified with the system in a nominal configuration. One or more of these is with the antenna polarized vertically while the one or more of these are with the antenna polarized horizontally. During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied and cable positions are varied to determine the highest emission relative to the limit.

For the final measurement, Substitution method is performed on spurious emissions not being 20-dB below the calculated radiated limit. Substitution method is performed by replacing the EUT with a horn antenna and signal generator. The horn antenna factors can be reference to a half-wave dipole in dBi. The signal generator power level was adjusted until a similar level, which was measured on the first scan, is achieved on the spectrum analyzer. The level on the signal generator is than added to the antenna factor, in dBi, which will give the corrected value.

**Procedure I – Transient Frequency Behavior:** The TIA/EIA 603 procedure was used to determine compliance to radio being keyed on and off.

1) Connected the Test Receiver DOP or Video Output to Channel 1 of the oscilloscope. The output of the RF crystal detector was connected to Auxiliary channel 1, which served as a trigger input. The output of the combiner was connected to the Test Receiver.

2) Set the EUT to maximum power and connected as illustrated above. Set the signal generator to the assigned transmitter frequency and modulate it with a 1 kHz tone at 6.25kHz, 12.5 kHz, or 25 kHz deviation and set its output to –100 dBm, then turn on the EUT.

3) The Combiner output side was connected to the Test Receiver, which was used to measure the Power. Used enough external attenuation so that the output at the combiner was set to 40 dB below the maximum input of the Test Receiver, then turn off the EUT.

4) Set the signal generator output to the same level in step 3. This level was maintained for the remainder of the test.

5) Set the horizontal sweep rate on the storage oscilloscope to 10 milliseconds per division and adjusted the display to continuously view the 1 kHz tone from the DOP or Video Output. Adjusted the vertical amplitude control to display the 1 kHz at +/- 4 divisions vertically centered on the display.

6) Set the oscilloscope to trigger at the AUX channel 1 input port.

7) Removed enough external attenuation so that the input to the RF detector and combiner is increased by 30 dB.

8) Turn on the transmitter and plotted the result for **Ton**, **T1**, and **T2**.

9) Set the oscilloscope to trigger in decreasing magnitude from the RF crystal detector.

10) Turn off the transmitter and plotted the result for **T3**.

## *SPECIFICATION LIMITS AND SAMPLE CALCULATIONS*

### *RADIATED EMISSIONS SPECIFICATION LIMITS*

The limits for radiated emissions are based on the power of the transmitter at the operating frequency. Data is measured in the logarithmic form of decibels relative to one milliwatt (dBm) or one microvolt/meter (dBuV/m,). The field strength of the emissions from the EUT is measured on a test site with a receiver.

Below is a formula example used to calculate the attenuation requirement, relative to the transmitters power output, in dBuV/m. For this example an operating power range of 3 watts is used. The radiated emissions limit for spurious signals outside of the assigned frequency block is $43+10\text{Log}_{10}$ (mean output power in watts) dB below the measured amplitude at the operating power.

### *CALCULATIONS – EFFECTIVE RADIATED POWER*

$$E(V/m) = \frac{\sqrt{30 * P * G}}{d}$$

E= Field Strength in V/m
P= Power in Watts (for this example we use 3 watts)
G= Gain of antenna in numeric gain (Assume 1.64 for ERP)
d= distance in meters

$$E(V/m) = \frac{\sqrt{30 * 3 \text{ watts} * 1.64 \text{ dB}}}{3 \text{ meters}}$$

20 * log (4.049 V/m * 1,000,000) = 132.14 dBuV/m @ 3 meters

FCC Rules request an attenuation of 43 + 10 log (3) or 47.8 dB for all emissions outside the assigned block, the limit for spurious and harmonic emissions is:

132.1 dBuV/m – 47.8 dB = 84.3 dBuV/m @ 3 meter.

**Note: Substitution Method is performed for spurious emission not being 20-dB below the calculated field strength.**

# *EXHIBIT 1: Test Equipment Calibration Data*

2 Pages

**Radiated Emissions, 30 - 6,500 MHz, 21-Apr-08**
**Engineer: Mehran Birgani**

| Manufacturer | Description | Model # | Asset # | Cal Due |
|---|---|---|---|---|
| Elliott Laboratories | Biconical Antenna, 30-300 MHz | EL30.300 | 54 | 26-Mar-09 |
| Elliott Laboratories | Log Periodic Antenna 300-1000 MHz | EL300.1000 | 55 | 27-Feb-09 |
| EMCO | Antenna, Horn, 1-18 GHz | 3115 | 786 | 07-Dec-08 |
| Hewlett Packard | Microwave Preamplifier, 1-26.5GHz | 8449B | 870 | 08-Nov-08 |
| Hewlett Packard | Preamplifier, 100 kHz - 1.3 GHz | 8447D OPT 010 | 1826 | 25-May-08 |
| Hewlett Packard | SpecAn 9 kHz - 40 GHz, (SA40) | 8564E | CH5273 | 20-Jul-08 |

**Conducted Emissions - AC Power Ports, 21-Apr-08**
**Engineer: Mehran Birgani**

| Manufacturer | Description | Model # | Asset # | Cal Due |
|---|---|---|---|---|
| Elliott Laboratories | LISN, FCC / CISPR | LISN-4, OATS | 362 | 18-Jul-08 |
| Rohde & Schwarz | Test Receiver, 0.009-2750 MHz | ESN | 1332 | 29-Jan-09 |
| Rohde& Schwarz | Pulse Limiter | ESH3 Z2 | 1398 | 12-Feb-09 |

**, 23-Apr-08**
**Engineer: Mehran Birgani**

| Manufacturer | Description | Model # | Asset # | Cal Due |
|---|---|---|---|---|
| EMCO | Antenna, Horn, 1-18 GHz | 3115 | 786 | 07-Dec-08 |
| Hewlett Packard | EMC Spectrum Analyzer, 9 KHz-26.5 GHz | 8593EM | 1141 | 29-Nov-08 |
| Rohde & Schwarz | Test Receiver, 9 kHz-2750 MHz | ESCS 30 | 1337 | 21-Sep-08 |
| EMCO | Log Periodic Antenna, 0.2-2 GHz | 3148 | 1347 | 17-Jan-09 |
| Miteq | Preamplifier, 1-18 GHz | AFS44 | 1540 | 12-Nov-08 |

**Radiated Emissions, 30 - 6,500 MHz, 23-Apr-08**
**Engineer: Vishal Narayan**

| Manufacturer | Description | Model # | Asset # | Cal Due |
|---|---|---|---|---|
| EMCO | Antenna, Horn, 1-18 GHz | 3115 | 487 | 24-May-08 |
| EMCO | Biconical Antenna, 30-300 MHz | 3110B | 801 | 19-Sep-09 |
| Hewlett Packard | EMC Spectrum Analyzer, 9 KHz-26.5 GHz | 8593EM | 1141 | 29-Nov-08 |
| Rohde & Schwarz | Test Receiver, 9 kHz-2750 MHz | ESCS 30 | 1337 | 21-Sep-08 |
| EMCO | Log Periodic Antenna, 0.2-2 GHz | 3148 | 1347 | 17-Jan-09 |
| Miteq | Preamplifier, 1-18 GHz | AFS44 | 1540 | 12-Nov-08 |

**Radiated Emissions, 30 - 2,200 MHz, 24-Apr-08**
**Engineer: Mehran Birgani**

| Manufacturer | Description | Model # | Asset # | Cal Due |
|---|---|---|---|---|
| Elliott Laboratories | Biconical Antenna, 30-300 MHz | EL30.300 | 54 | 26-Mar-09 |
| EMCO | Log Periodic Antenna, 0.3-1 GHz | 3146A | 364 | 13-Dec-08 |
| Hewlett Packard | EMC Spectrum Analyzer, 9 kHz - 6.5 GHz | 8595EM | 787 | 19-Feb-09 |
| Hewlett Packard | Microwave Preamplifier, 1-26.5GHz | 8449B | 870 | 08-Nov-08 |
| Hewlett Packard | Preamplifier, 100 kHz - 1.3 GHz | 8447D OPT 010 | 1826 | 25-May-08 |

**Radiated Emissions, 30 - 2,200 MHz, 30-Apr-08**
**Engineer: Mehran Birgani**

| Manufacturer | Description | Model # | Asset # | Cal Due |
|---|---|---|---|---|
| Elliott Laboratories | Biconical Antenna, 30-300 MHz | EL30.300 | 54 | 26-Mar-09 |
| EMCO | Log Periodic Antenna, 0.3-1 GHz | 3146A | 364 | 13-Dec-08 |
| Hewlett Packard | EMC Spectrum Analyzer, 9 KHz-26.5 GHz | 8593EM | 1141 | 29-Nov-08 |
| Hewlett Packard | Microwave Preamplifier 0.5-26.5 GHz | 83017A | 1257 | 28-Mar-09 |
| EMCO | Antenna, Horn, 1-18 GHz | 3117 | 1662 | 11-Apr-10 |
| Hewlett Packard | Preamplifier, 100 kHz - 1.3 GHz | 8447D OPT 010 | 1826 | 25-May-08 |

**Radio Antenna Port (Power and Spurious Emissions), 01, 08-May-08**
**Engineer: David Bare**

| Manufacturer | Description | Model # | Asset # | Cal Due |
|---|---|---|---|---|
| Hewlett Packard | Spectrum Analyzer 30 Hz -40 GHz, SV (SA40) Red | 8564E (84125C) | 1148 | 24-Aug-08 |
| Rohde & Schwarz | Test Receiver, 20-1300 MHz | ESVP | 1317 | 19-Jan-09 |
| Rohde & Schwarz | Power Meter, Dual Channel | NRVD | 1539 | 21-Aug-08 |
| Rohde & Schwarz | Power Sensor 100 uW - 10 Watts | NRV-Z53 | 1796 | 12-Apr-09 |

**Stability, 01-May-08**
**Engineer: Mehran Birgani**

| Manufacturer | Description | Model # | Asset # | Cal Due |
|---|---|---|---|---|
| Hewlett Packard | Spectrum Analyzer 30 Hz -40 GHz, SV (SA40) Red | 8564E (84125C) | 1148 | 24-Aug-08 |

**Emissions Mask, 09-May-08**
**Engineer: Thomas Hodge GEMDS**

| Manufacturer | Description | Model # | Asset # | Cal Due |
|---|---|---|---|---|
| Hewlett Packard | Spectrum Analyzer | 8561E | 3424A00695 | 12-Apr-09 |
| Bird Attenuline | 30dB attenuator | - | 1136 | 12-Apr-09 |
| JFW | Variable Attenuator | - | 119990 | 12-Apr-09 |

**Radiated Emissions, 30 - 1,000 MHz, 12-May-08**
**Engineer: Mehran Birgani**

| Manufacturer | Description | Model # | Asset # | Cal Due |
|---|---|---|---|---|
| EMCO | Biconical Antenna, 30-300 MHz | 3110B | 801 | 19-Sep-09 |
| Rohde & Schwarz | Test Receiver, 9 kHz-2750 MHz | ESCS 30 | 1337 | 21-Sep-08 |
| EMCO | Log Periodic Antenna, 0.2-2 GHz | 3148 | 1347 | 17-Jan-09 |

# *EXHIBIT 2: Test Data Log Sheets*

## *ELECTROMAGNETIC EMISSIONS*

## *TEST LOG SHEETS*

## *AND*

## *MEASUREMENT DATA*

T71417 26 Pages

Elliott

**EMC Test Data**

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | - |
| Emissions Standard(s): | RSS 119, FCC Part 90 and 15 | Class: | A |
| Immunity Standard(s): | - | Environment: | - |

# EMC Test Data

For The

# GE MDS LLC

Model

**TD220**

Date of Last Test: 5/8/2008

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manger: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Emissions Standard(s): | RSS 119, FCC Part 90 and 15 | Class: | A |
| Immunity Standard(s): | - | Environment: | - |

# EUT INFORMATION

## General Description

The EUT is a narrowband wireless transceiver which is designed to transmit and receive data in the 220 to 222 MHz band. Normally, the EUT would be placed on a tabletop or in a rack during operation. The EUT was, therefore, placed on a table during emissions testing to simulate the end user environment. The electrical rating of the EUT is 13.8vdc, 6 Amps.

## Equipment Under Test

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| GE MDS LLC | TD220 | Digital Microwave Radio | 1764384 | E5MDS-TD220 |

## Other EUT Details

None

## EUT Antenna (Intentional Radiators Only)

The EUT can be used with antennas up to 16.5 dBi.

## EUT Enclosure

The EUT enclosure is primarily constructed of steel sheet metal. It measures approximately 14.0cm wide by 17.0cm deep by 5.0cm high.

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manger: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Emissions Standard(s): | RSS 119, FCC Part 90 and 15 | Class: | A |
| Immunity Standard(s): | - | Environment: | - |

# Test Configuration #1

## FCC Part 90

### Local Support Equipment

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| IBM | Thinkpad | Laptop | L3-C3706 | DoC |
| Microwave | 44003 | 50 ohm termination | 7943 | - |

### Remote Support Equipment

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| None | - | - | - | - |

### Cabling and Ports

| Port | Connected To | Cable(s) | | |
|---|---|---|---|---|
| | | Description | Shielded or Unshielded | Length(m) |
| Antenna | 50 ohms Termination | - | - | - |
| Data Interface | Laptop | DB25 | Shielded | 2.0 |
| USB | Unterminated | USB | Shielded | 1.0 |
| DC Power | 13.8V DC Source | 2 wire | Unshielded | 2.0 |

## FCC Part 15

### Local Support Equipment

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| Microwave | 44003 | 50 ohm termination | 7943 | - |

### Remote Support Equipment

| Manufacturer | Model | Description | Serial Number | FCC ID |
|---|---|---|---|---|
| None | - | - | - | - |

### Cabling and Ports (Part 15)

| Port | Connected To | Cable(s) | | |
|---|---|---|---|---|
| | | Description | Shielded or Unshielded | Length(m) |
| Antenna | 50 ohms | Coaxial | Shielded | 1.0 |
| Data Interface | Terminated with loopback | DB25 | Shielded | 2.0 |
| USB | Unterminated | USB | Shielded | 1.0 |
| DC Power | 13.8V DC Source | 2 wire | Unshielded | 2.0 |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manger: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Emissions Standard(s): | RSS 119, FCC Part 90 and 15 | Class: | A |
| Immunity Standard(s): | - | Environment: | - |

## EUT Operation During Emissions Tests

During emissions testing the EUT was set to transmit mode either unmodulated or modulated as required for testing.

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | A |

# Radiated Emissions

## Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 5/12/2008
Test Engineer: Mehran Birgani
Test Location: SV OATS #1
Config. Used: 1
Config Change: None
EUT Voltage: 13.8VDC

## General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated emissions testing.

The test distance and extrapolation factor (if applicable) are detailed under each run description.

Note, **preliminary** testing indicates that the emissions were maximized by orientation of the EUT and elevation of the measurement antenna. **Maximized** testing indicated that the emissions were maximized by orientation of the EUT, elevation of the measurement antenna, and manipulation of the EUT's interface cables.

## Ambient Conditions:

Temperature: 21 °C
Rel. Humidity: 41 %

## Summary of Results

| Run # | Test Performed | Limit | Result | Margin |
|---|---|---|---|---|
| 2 | RE, 30 - 1000MHz Maximized Emissions | FCC | Pass | 28.7dBµV/m (27.2µV/m) @ 35.85MHz (-11.3dB) |
| 3 | RE, 1000 - 6500 MHz Maximized Emissions | FCC | Pass | 31.1dBµV/m (35.9µV/m) @ 1008.3MHz (-22.9dB) |

## Modifications Made During Testing

No modifications were made to the EUT during testing

## Deviations From The Standard

No deviations were made from the requirements of the standard.

| Frequency Range | Test Distance | Limit Distance | Extrapolation Factor |
|---|---|---|---|
| 30 - 6500 MHz | 3 | 3 | 0.0 |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | A |

**Run #2: Maximized Readings, 30-1000 MHz**

| Frequency | Level | Pol | FCC | | Detector | Azimuth | Height | Comments |
|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | V/H | Limit | Margin | Pk/QP/Avg | degrees | meters | |
| **35.850** | **28.7** | **V** | **40.0** | **-11.3** | QP | 154 | 1.0 | |
| 845.000 | 33.3 | H | 46.0 | -12.7 | QP | 142 | 1.0 | |
| 211.350 | 29.6 | V | 43.5 | -13.9 | QP | 109 | 1.0 | |
| 845.000 | 30.2 | V | 46.0 | -15.8 | QP | 132 | 1.0 | |
| 400.000 | 21.0 | H | 46.0 | -25.0 | QP | 315 | 1.0 | |
| 400.000 | 19.0 | V | 46.0 | -27.0 | QP | 74 | 1.6 | |

**Run #3: Maximized readings, 1000 - 6500 MHz**

Measurements made at 3m test distance and extrapolated to 10m using -10.5 correction factor.

| Frequency | Level | Pol | FCC | | Detector | Azimuth | Height | Comments |
|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | V/H | Limit | Margin | Pk/QP/Avg | degrees | meters | |
| **1008.255** | **31.1** | **V** | **54.0** | **-22.9** | AVG | 210 | 1.0 | |
| 1030.133 | 28.6 | V | 54.0 | -25.4 | AVG | 0 | 1.0 | |
| 1030.133 | 46.0 | V | 74.0 | -28.0 | PK | 0 | 1.0 | |
| 1008.255 | 41.4 | V | 74.0 | -32.6 | PK | 210 | 1.0 | |

| | |
|---|---|
| Note 1: | Above 1 GHz, the FCC specifies the limit as an average measurement. In addition, the FCC states that the peak reading of any emission above 1 GHz, can not exceed the average limit by more than 20 dB. |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

# Maximum Permissible Exposure

## Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 5/1/2008
Test Engineer: David Bare

## General Test Configuration

Calculation uses the free space transmission formula:

$$S = (PG)/(4 \pi d^2)$$

Where: S is power density ($W/m^2$), P is output power (W), G is antenna gain relative to isotropic, d is separation distance from the transmitting antenna (m).

## Summary of Results

| | |
|---|---|
| Device complies with Power Density requirements at 20cm separation: | No |
| If not, required separation distance (in cm): | 501 |

## Modifications Made During Testing

No modifications were made to the EUT during testing

## Deviations From The Standard

No deviations were made from the requirements of the standard.

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

Use: General Note: 50% duty cycle source based averaging for half duplex opertion
Antenna: 16.5 dBi allows 1/2 the EIRP for calculation of MPE distances

| Freq. MHz | EUT Power dBm | EUT Power mW* | Cable Loss dB | Ant Gain dBi | Power at Ant dBm | EIRP mW | Power Density (S) at 20 cm mW/cm^2 | MPE Limit at 20 cm mW/cm^2 |
|---|---|---|---|---|---|---|---|---|
| 220 | 44.5 | 28183.8 | 0 | 16.5 | 44.5 | 629462.71 | 125.228 | 0.200 |
| 222 | 44.4 | 27542.3 | 0 | 16.5 | 44.4 | 615134.39 | 122.377 | 0.200 |

For the cases where S > the MPE Limit

| Freq. MHz | Power Density (S) at 20 cm mW/cm^2 | MPE Limit at 20 cm mW/cm^2 | Distance where S <= MPE Limit cm |
|---|---|---|---|
| 220 | 125.228 | 0.200 | 500.5 |
| 222 | 122.377 | 0.200 | 494.7 |

Use: General Note: 50% duty cycle source based averaging for half duplex opertion
Antenna: 10 dBi allows 1/2 the EIRP for calculation of MPE distances

| Freq. MHz | EUT Power dBm | EUT Power mW* | Cable Loss dB | Ant Gain dBi | Power at Ant dBm | EIRP mW | Power Density (S) at 20 cm mW/cm^2 | MPE Limit at 20 cm mW/cm^2 |
|---|---|---|---|---|---|---|---|---|
| 220 | 44.5 | 28183.8 | 0 | 10 | 44.5 | 140919.15 | 28.035 | 0.200 |
| 222 | 44.4 | 27542.3 | 0 | 10 | 44.4 | 137711.44 | 27.397 | 0.200 |

For the cases where S > the MPE Limit

| Freq. MHz | Power Density (S) at 20 cm mW/cm^2 | MPE Limit at 20 cm mW/cm^2 | Distance where S <= MPE Limit cm |
|---|---|---|---|
| 220 | 28.035 | 0.200 | 236.8 |
| 222 | 27.397 | 0.200 | 234.1 |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

Use: General Note: 50% duty cycle source based averaging for half duplex opertion
Antenna: 6 dBi allows 1/2 the EIRP for calculation of MPE distances

| Freq. MHz | EUT Power dBm | EUT Power mW* | Cable Loss dB | Ant Gain dBi | Power at Ant dBm | EIRP mW | Power Density (S) at 20 cm mW/cm^2 | MPE Limit at 20 cm mW/cm^2 |
|---|---|---|---|---|---|---|---|---|
| 220 | 44.5 | 28183.8 | 0 | 6 | 44.5 | 56100.92 | 11.161 | 0.200 |
| 222 | 44.4 | 27542.3 | 0 | 6 | 44.4 | 54823.91 | 10.907 | 0.200 |

For the cases where S > the MPE Limit

| Freq. MHz | Power Density (S) at 20 cm mW/cm^2 | MPE Limit at 20 cm mW/cm^2 | Distance where S <= MPE Limit cm |
|---|---|---|---|
| 220 | 11.161 | 0.200 | 149.4 |
| 222 | 10.907 | 0.200 | 147.7 |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

# Radio Performance Test - FCC Part 90 / RSS-119
## RF Port Measurements - 220-222 MHz Band

### Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 5/1/2008 & 5/8/08
Test Engineer: David Bare
Test Location: EMC Lab

Config. Used: 1
Config Change: EUT connected via attenuator to analyzer
EUT Voltage: 13.8Vdc

### General Test Configuration

The EUT's rf port was connected to the measurement instrument's rf port, via an attenuator or dc-block if necessary.

| | | 5/1/2008 | 5/8/2008 |
|---|---|---|---|
| **Ambient Conditions:** | Temperature: | 18 °C | 19 °C |
| | Rel. Humidity: | 44 % | 42 % |

### Summary of Results

| Run # | Test Performed | Limit | Result | Limit |
|---|---|---|---|---|
| 1 | Maximum Output Power | FCC Part 90 | 44.5 dBm | Determined at time of licensing |
| 2a and 2b | Unwanted emissions (Mask) | FCC Part 90 | Pass | Mask F |
| 3b | Bandwidth | FCC Part 90 | 5.26 kHz | <= 4 kHz |
| 4 | Transmitter spurious emissions, 30MHz - 2,200MHz (rf port) | FCC Part 90 | Pass | -25dBm |
| 5 | Transient Frequency Behavior | FCC Part 90 | Within limit | See limit on plot |

### Modifications Made During Testing

No modifications were made to the EUT during testing

### Deviations From The Standard

No deviations were made from the requirements of the standard.

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

**Run #1: Maximum Power Measurements, modulated**

Power settings are H, L and XL are available corresponding to 25, 10 and 2 Watts.

| Freq. | Setting | Pmeas | Duty Cycle | Pout |
|---|---|---|---|---|
| 220 | H | 44.5 | 100% | 44.5 |
| 222 | H | 44.4 | 100% | 44.4 |

Setting: software power setting of EUT
Pmeas: Measured output power (PEP) using power meter
Duty Cycle: Duty cycle of transmissions

maximum power: **28.2** Watts

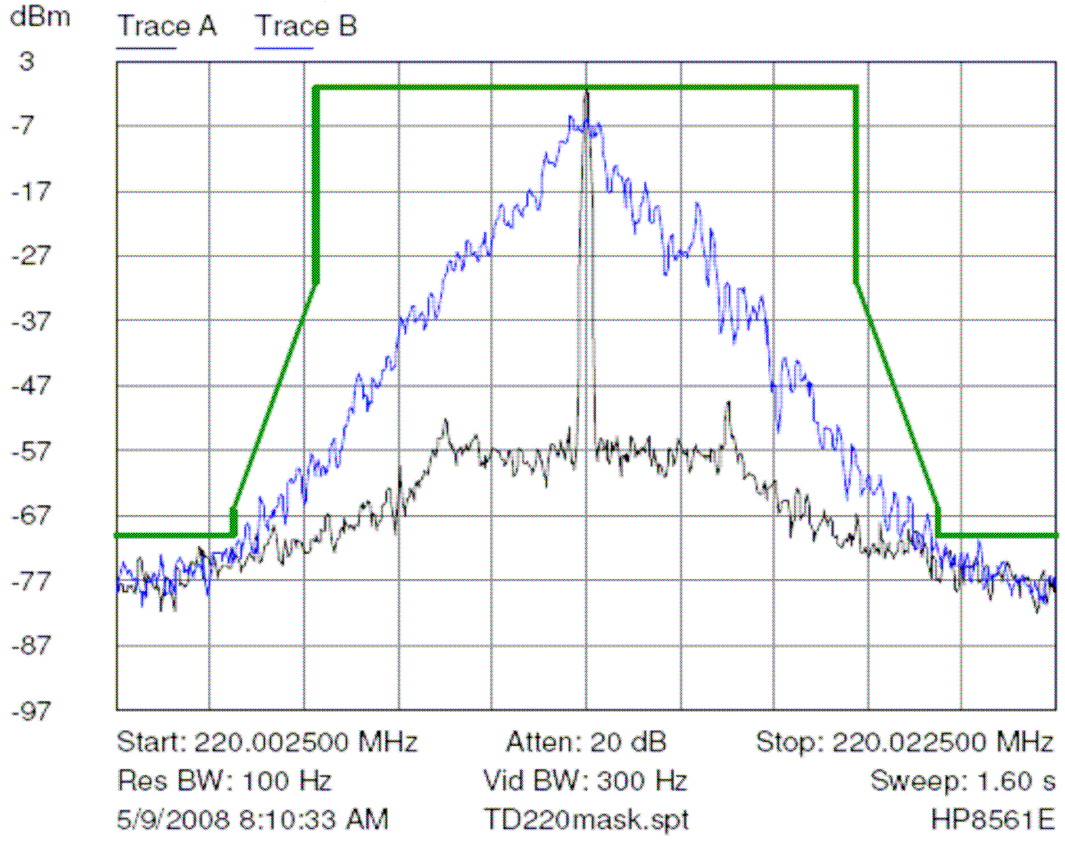
Note: The peak FM modulation deviation was 1.87kHz.

**Run #2: Mask**

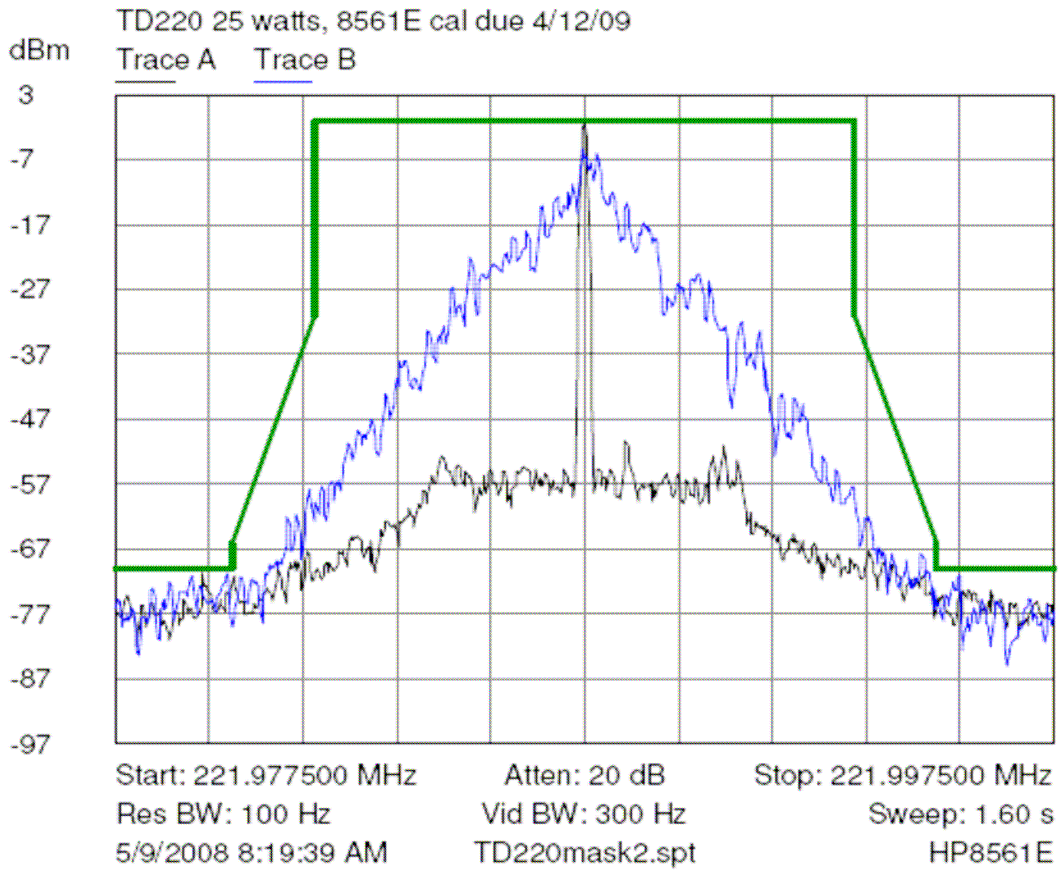
Measurement made by GEMDS, 5/9/2008 and taken on both bottom (220.0125 MHz) and top (221.9875 MHz) channels

**0dB reference level is the level of the unmodulated carrier (44.5dBm)**

**Out of band limit is -25dBm (-69.5dBc)**



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

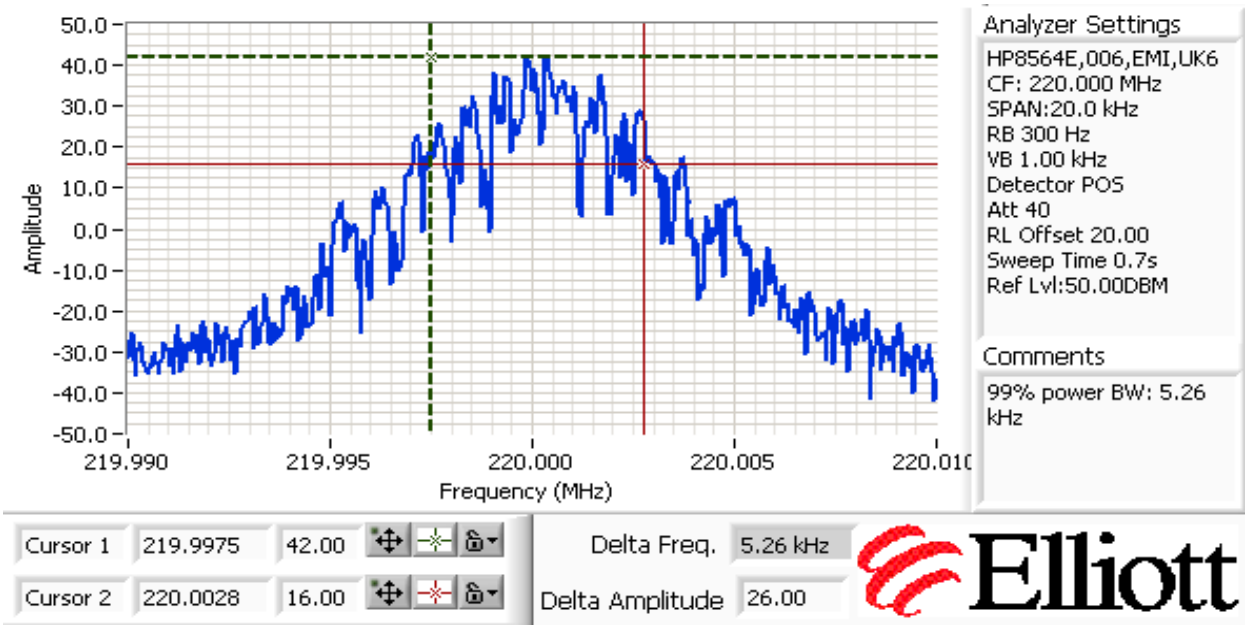


| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

**Run #3: Signal Bandwidth**

| Power Setting | Frequency (MHz) | Resolution Bandwidth | Bandwidth (MHz) | |
|---|---|---|---|---|
| | | | | 99% |
| H | 222 | 300 Hz | - | 5.26kHz |

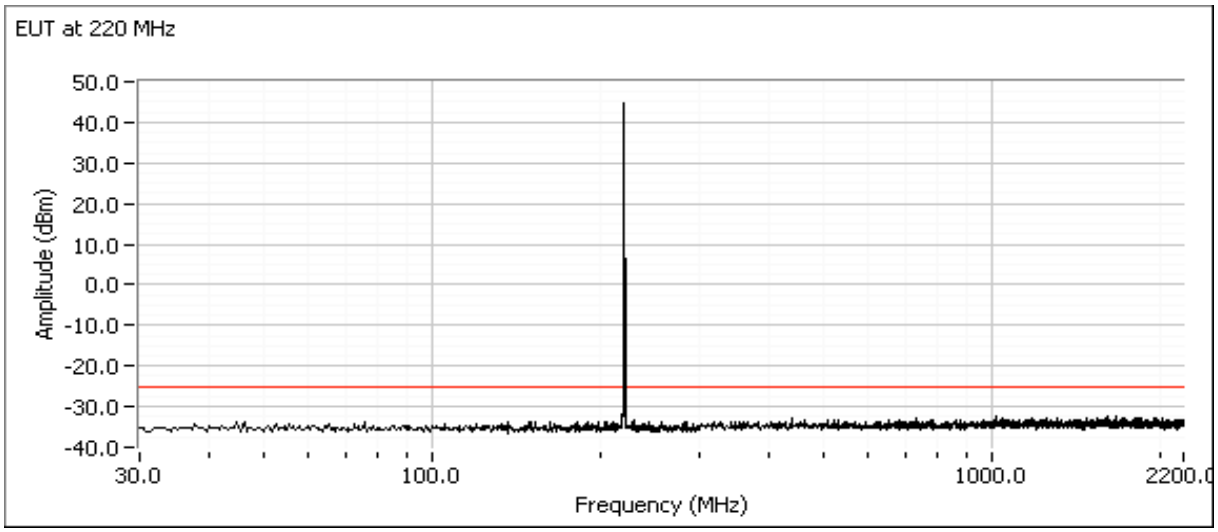
| | |
|---|---|
| Note 1: | 99% bandwidth measured in accordance with RSS GEN, with RB > 1% of the span and VB > 3xRB |

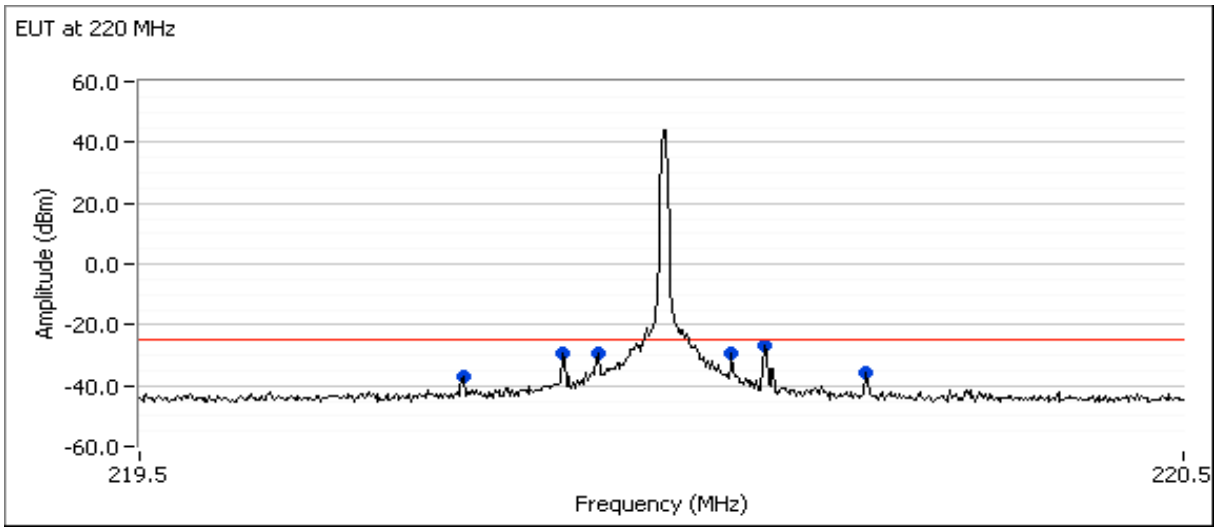


| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

**Run #4: Out of Band Spurious Emissions**

Plots for low channel, power setting(s) = H

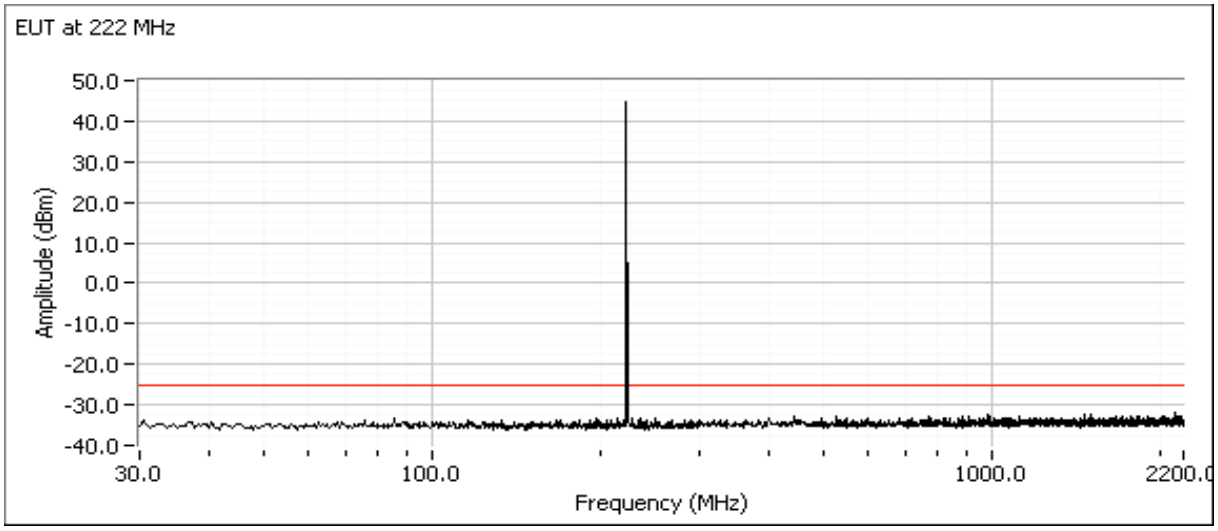


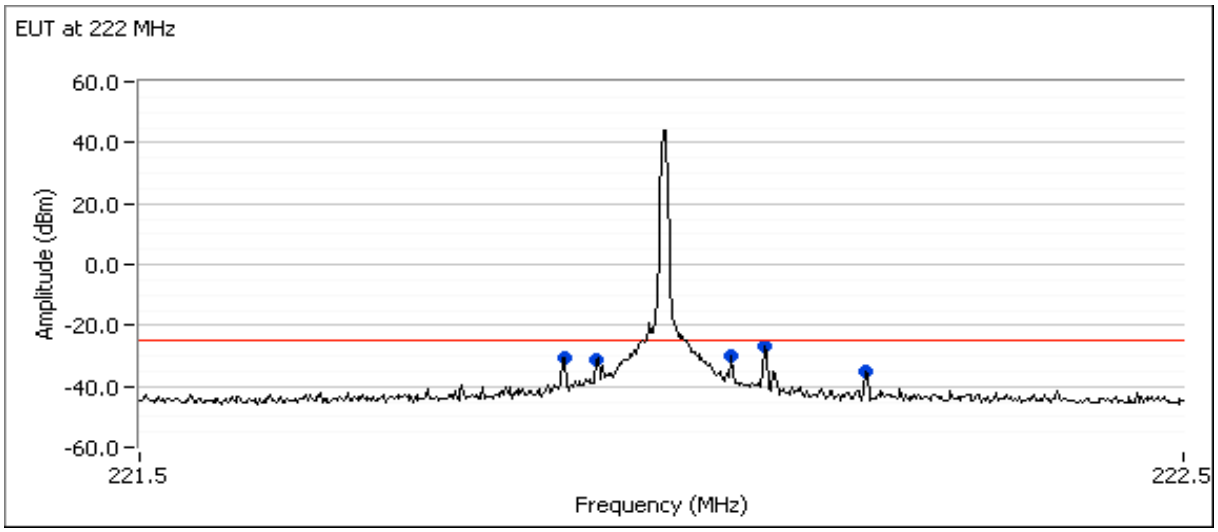




| Frequency | Level | Pol | FCC Class A | | Detector | Azimuth | Height | Comments |
|---|---|---|---|---|---|---|---|---|
| MHz | dBm | v/h | Limit | Margin | Pk/QP/Avg | degrees | meters | |
| 220.098 | -27.0 | RF Port | -25.0 | -2.0 | Peak | | | |
| 220.067 | -29.3 | RF Port | -25.0 | -4.3 | Peak | | | |
| 219.905 | -29.5 | RF Port | -25.0 | -4.5 | Peak | | | |
| 219.938 | -29.5 | RF Port | -25.0 | -4.5 | Peak | | | |
| 220.195 | -35.8 | RF Port | -25.0 | -10.8 | Peak | | | |
| 219.810 | -37.0 | RF Port | -25.0 | -12.0 | Peak | | | |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

Plots for high channel, power setting(s) = H



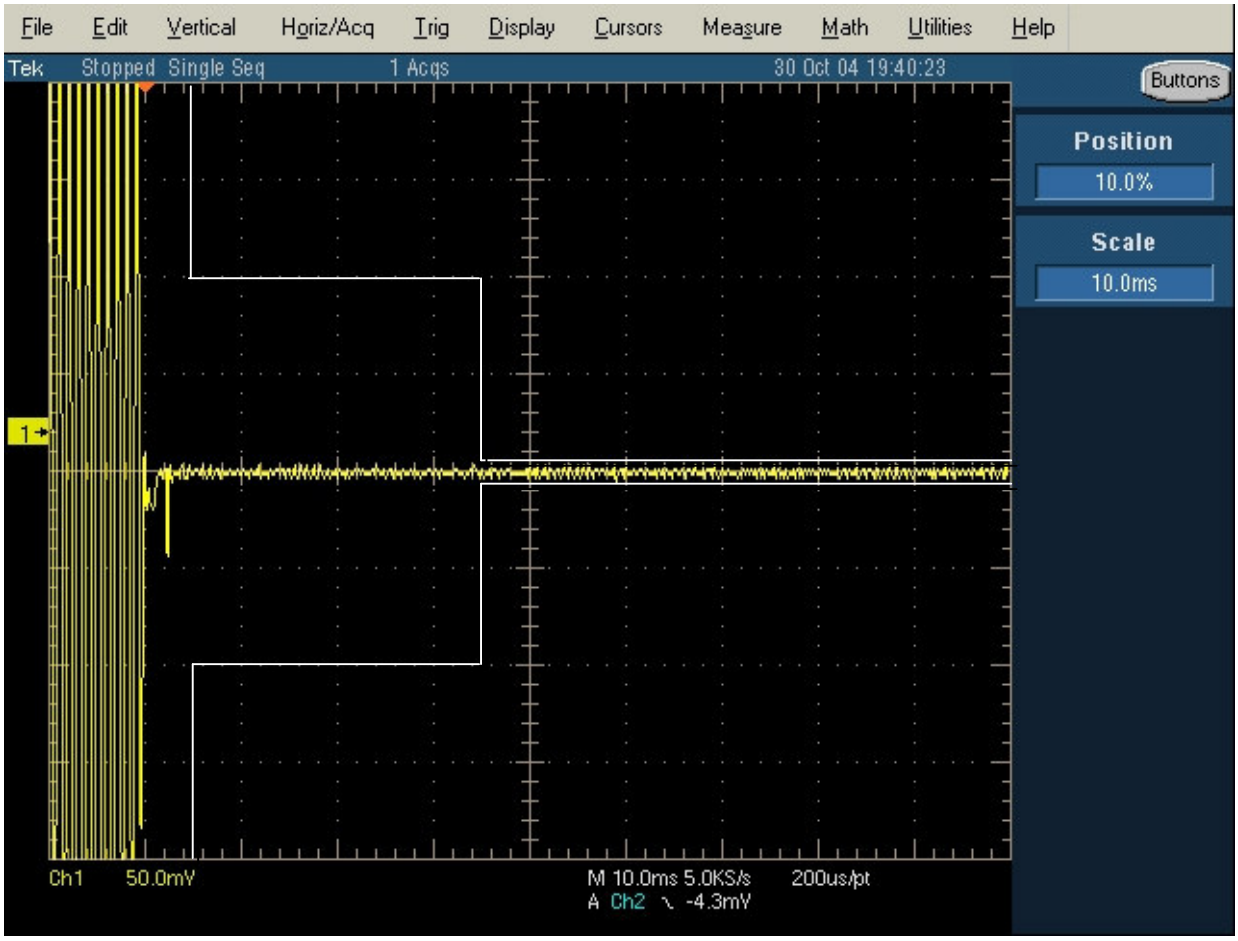




| Frequency | Level | Pol | FCC Class A | | Detector | Azimuth | Height | Comments |
|---|---|---|---|---|---|---|---|---|
| MHz | dBm | v/h | Limit | Margin | Pk/QP/Avg | degrees | meters | |
| 222.098 | -26.7 | RF Port | -25.0 | -1.7 | Peak | | | |
| 222.067 | -29.8 | RF Port | -25.0 | -4.8 | Peak | | | |
| 221.907 | -30.8 | RF Port | -25.0 | -5.8 | Peak | | | |
| 221.937 | -31.5 | RF Port | -25.0 | -6.5 | Peak | | | |
| 222.195 | -35.2 | RF Port | -25.0 | -10.2 | Peak | | | |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

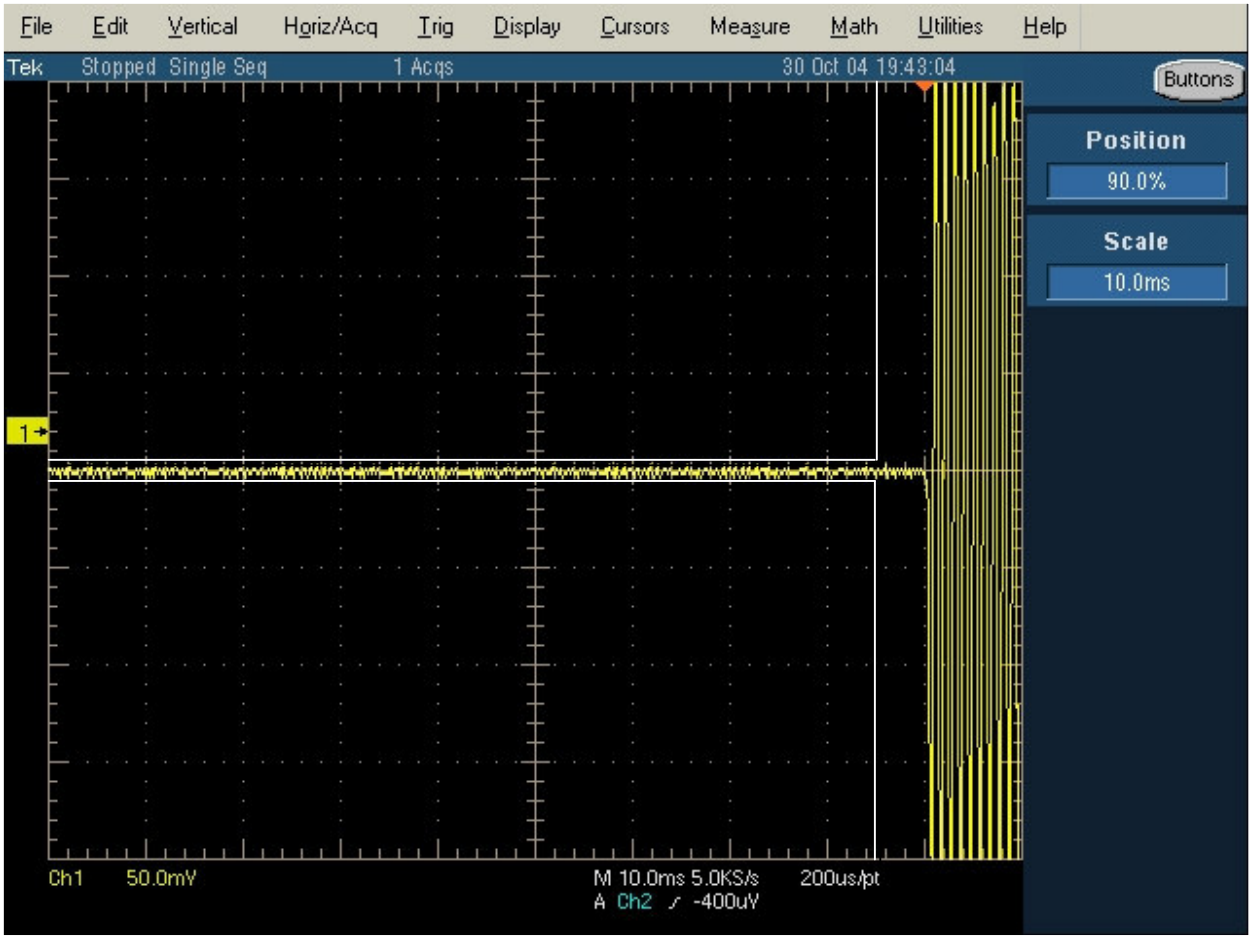
**Run# 5: Transient Frequency Behavior**

**Transient Behavior 221 MHz (12.5kHz On Key)**



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

**Transient Behavior 221 MHz (12.5kHz Off Key)**



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

# RSS 119 and FCC Part 90

## Power, Occupied Bandwidth, Frequency Stability and Spurious Emissions

### Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

### General Test Configuration

The EUT's rf port was connected to the measurement instrument's rf port, via an attenuator or dc-block if necessary. EUT was place inside an environmental chamber.

### Ambient Conditions:

Temperature: 21 °C

Rel. Humidity: 36 %

### Summary of Results

| Run # | Test Performed | Limit | Result | Value / Margin |
|---|---|---|---|---|
| 1-2 | Frequency and Voltage Stability | Part 90 - 1.5ppm | Pass | 0.945 ppm |

### Modifications Made During Testing:

No modifications were made to the EUT during testing

### Deviations From The Standard

No deviations were made from the requirements of the standard.

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

**Run #1: Temperature Vs. Frequency (mobile stations in the 220-222 MHz band)**

| Drift | Freq. | Limit |
|---|---|---|
| (ppm) | (MHz) | (Hz) |
| 1.5 | 220.00 | 330.0 |

| Temperature | Reference Frequency | Measured frequency | Drift | Limit |
|---|---|---|---|---|
| (Celsius) | (MHz) | (MHz) | (Hz) | (Hz) |
| -30 | 220.000111 | 219.999908 | 203 | 330.0 |
| -20 | 220.000111 | 219.999933 | 178 | 330.0 |
| -10 | 220.000111 | 220.000024 | 87 | 330.0 |
| 0 | 220.000111 | 220.000062 | 49 | 330.0 |
| 10 | 220.000111 | 220.000095 | 16 | 330.0 |
| 20 | 220.000111 | 220.000111 | 0 | 330.0 |
| 30 | 220.000111 | 220.000194 | 83 | 330.0 |
| 40 | 220.000111 | 220.000228 | 117 | 330.0 |
| 50 | 220.000111 | 220.000319 | 208 | 330.0 |

**Run #2: Voltage Vs. Frequency**

**Nominal Voltage is 13.8Vdc.**

| Voltage | Reference Frequency | Frequency Drift | Drift | Limit |
|---|---|---|---|---|
| (Dc) | (MHz) | (MHz) | (Hz) | (Hz) |
| 85% | 220.000111 | 220.000114 | 3 | 330.0 |
| 115% | 220.000111 | 220.000115 | 4 | 330.0 |

Worst case drift: 208 Hz
0.945 ppm

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

# RSS 119 and FCC Part 90
## Spurious Emissions

### Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

### General Test Configuration

With the exception of the radiated spurious emissions tests, all measurements are made with the EUT's rf port connected to the measurement instrument via an attenuator or dc-block if necessary. All amplitude measurements are adjusted to account for the attenuation between EUT and measuring instrument. For frequency stability measurements the EUT was place inside an environmental chamber.

Radiated measurements are made with the EUT located on a non-conductive table, 3m from the measurement antenna.

### Ambient Conditions:

Temperature: 17 °C
Rel. Humidity: 36 %

### Summary of Results

| Run # | Spacing | Data Rate | Test Performed | Limit | Pass / Fail | Result / Margin |
|---|---|---|---|---|---|---|
| 3 | - | - | Spurious emissions (radiated) (220MHz) | FCC 90.210/ RSS 119 | Pass | -31.5dBm erp @ 880MHz (-6.5dB) |
| 3 | - | - | Spurious emissions (radiated) (222MHz) | FCC 90.210/ RSS 119 | Pass | -31.3dBm erp @ 888MHz (-6.3dB) |

### Modifications Made During Testing

A piece of copper tape was installed as shown in Figure 1 to break up the case resonance, and in turn this shielded the Mitsubishi PA plastic case.

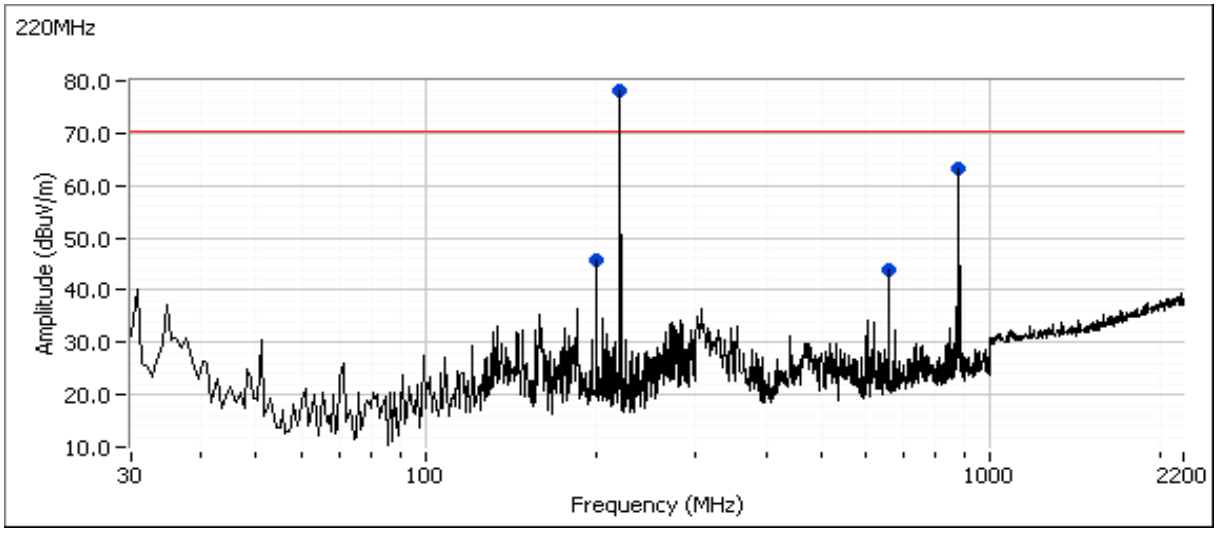
### Deviations From The Standard

No deviations were made from the requirements of the standard.

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

**Run #1: Chamber Perscan at 220MHz**

Date of Test: 4/30/2008
Test Engineer: Mehran Birgani
Test Location: Chamber #2

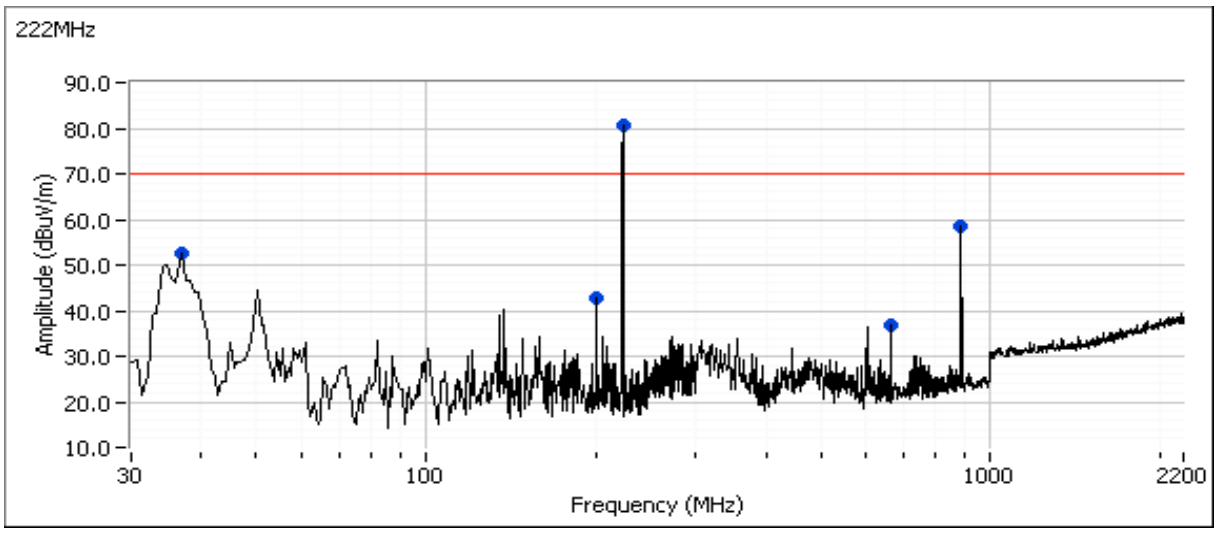



| Frequency | Level | Pol | FCC 90.210 | | Detector | Azimuth | Height | Comments | Channel |
|---|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | V/H | Limit | Margin | Pk/QP/Avg | degrees | meters | | |
| *879.250* | 63.3 | H | 70.2 | -6.9 | Peak | 267 | 1.7 | | 220 |
| *200.100* | 45.6 | V | 70.2 | -24.6 | Peak | 226 | 1.7 | | 220 |
| *660.500* | 43.7 | H | 70.2 | -26.5 | Peak | 295 | 1.7 | | 220 |
| 220.000 | 78.3 | H | - | - | Peak | 119 | 1.7 | Fundamental | 220 |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

**Run #2: Chamber Perscan at 222MHz**

Date of Test: 4/30/2008
Test Engineer: Mehran Birgani
Test Location: Chamber #2




| Frequency | Level | Pol | FCC 90.210 | | Detector | Azimuth | Height | Comments | Channel |
|---|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | V/H | Limit | Margin | Pk/QP/Avg | degrees | meters | | |
| 888.004 | 58.4 | H | 70.2 | -11.8 | Peak | 265 | 1.7 | | 222 |
| *36.750* | 52.5 | V | 70.2 | -17.7 | Peak | 360 | 1.7 | | 222 |
| *200.100* | 42.7 | H | 70.2 | -27.5 | Peak | 164 | 1.7 | | 222 |
| *665.750* | 36.6 | H | 70.2 | -33.6 | Peak | 317 | 1.7 | | 222 |
| 222.004 | 80.5 | H | - | - | Peak | 119 | 1.7 | Fundamental | 222 |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | N/A |

**Run #3: Radiated Spurious Emissions, Transmit Mode: Final Field Strength and Substitution Measurements**

| Frequency | Level | Pol | FCC 90.210 | | Detector | Azimuth | Height | Comments | Channel |
|---|---|---|---|---|---|---|---|---|---|
| MHz | dBµV/m | V/H | Limit | Margin | Pk/QP/Avg | degrees | meters | | |
| 880.000 | 67.7 | H | 70.2 | -2.5 | PK | 138 | 1.0 | | 220 |
| 888.000 | 68.2 | H | 70.2 | -2.0 | PK | 140 | 1.0 | | 222 |
| *36.750* | 32.7 | V | 70.2 | -37.5 | Peak | 10 | 1.0 | | 222 |

**Vertical**

| Frequency | Substitution measurements | | | Site | EUT measurements | | | eirp Limit | erp Limit | Margin |
|---|---|---|---|---|---|---|---|---|---|---|
| MHz | Pin[1] | Gain[2] | FS[3] | Factor[4] | FS[5] | eirp (dBm) | erp (dBm) | dBm | dBm | dB |
| | | | | | | | | | | |

**Horizontal**

| Frequency | Substitution measurements | | | Site | EUT measurements | | | eirp Limit | erp Limit | Margin |
|---|---|---|---|---|---|---|---|---|---|---|
| MHz | Pin[1] | Gain[2] | FS[3] | Factor[4] | FS[5] | eirp (dBm) | erp (dBm) | dBm | dBm | dB |
| 880.000 | -20.0 | 5.6 | 82.6 | 97.0 | 67.7 | -29.3 | -31.5 | | -25.0 | -6.5 |
| 888.000 | -20.0 | 5.7 | 83.0 | 97.3 | 68.2 | -29.1 | -31.3 | | -25.0 | -6.3 |

| | |
|---|---|
| Note 1: | Pin is the input power (dBm) to the substitution antenna |
| Note 2: | Gain is the gain (dBi) for the substitution antenna. A dipole has a nominal gain of 2.2dBi, however the dipole balun loss may reduce the gain of the substituion dipole used. |
| Note 3: | FS is the field strength (dBuV/m) measured from the substitution antenna, maximized for receive antenna height and transmit antenna azimuth. |
| Note 4: | Site Factor - this is the site factor to convert from a field strength in dBuV/m to an eirp in dBm. |
| Note 5: | EUT field strength as measured during initial run. |

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | A |

# Conducted Emissions - Power Ports

## Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 4/21/2008
Test Engineer: Mehran Birgani
Test Location: SVOATS #2

Config. Used: 1
Config Change: FCC Part 15 test setup.
EUT Voltage: 120V/60Hz

## General Test Configuration

The EUT was located on a wooden table, 40 cm from a vertical coupling plane and 80cm from the LISN.

## Ambient Conditions:

Temperature: 10 °C
Rel. Humidity: 49 %

## Summary of Results

| Run # | Test Performed | Limit | Result | Margin |
|---|---|---|---|---|
| 1 | CE, AC Power,120V/60Hz | 15.107 Class B | Pass | 63.2dBµV @ 0.157MHz (-2.4dB) |

## Modifications Made During Testing

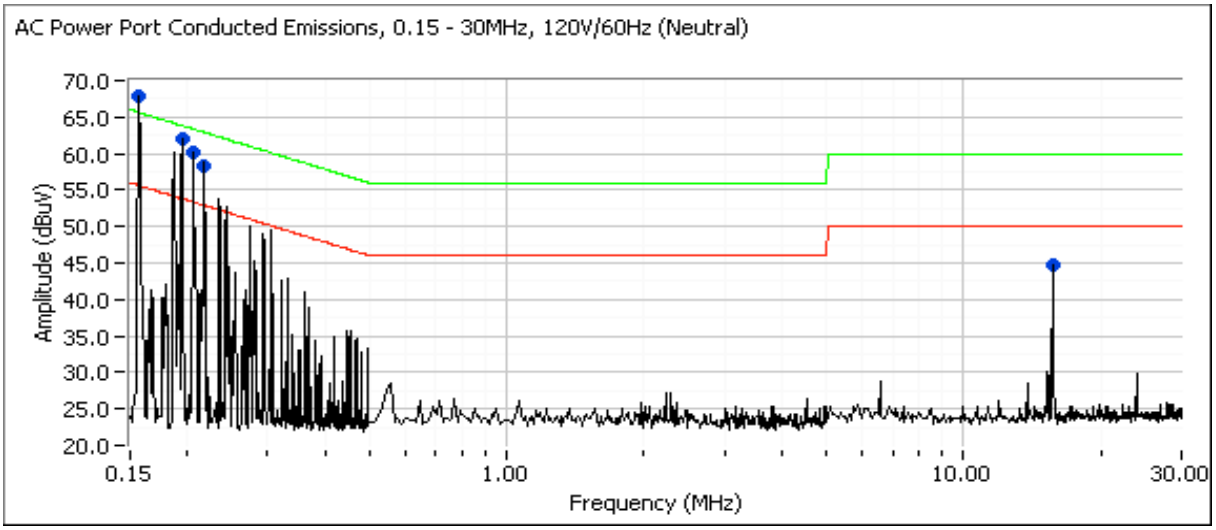
No modifications were made to the EUT during testing

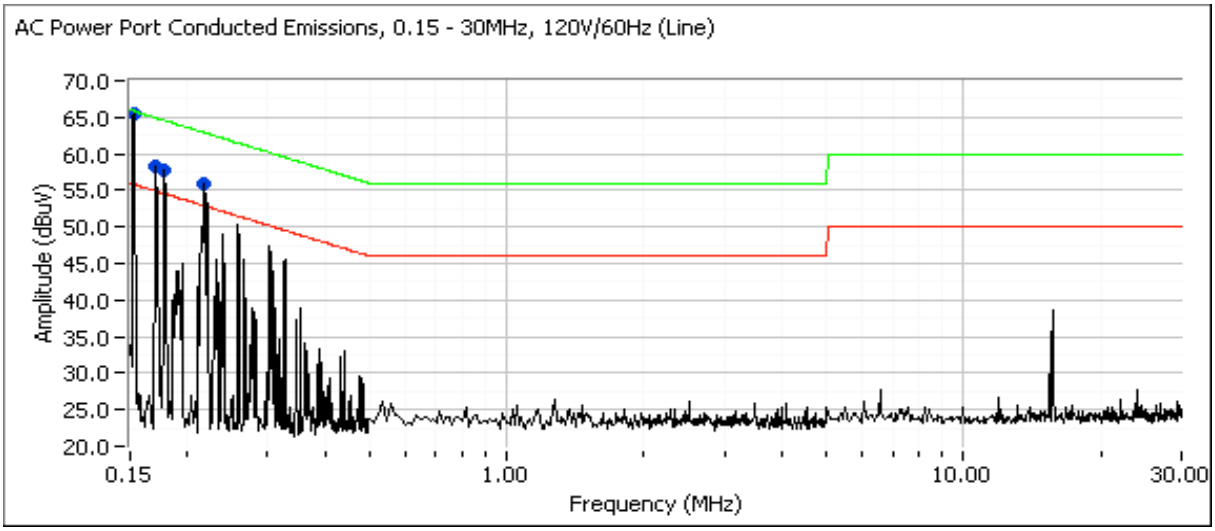
## Deviations From The Standard

No deviations were made from the requirements of the standard.

| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | A |

**Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz**



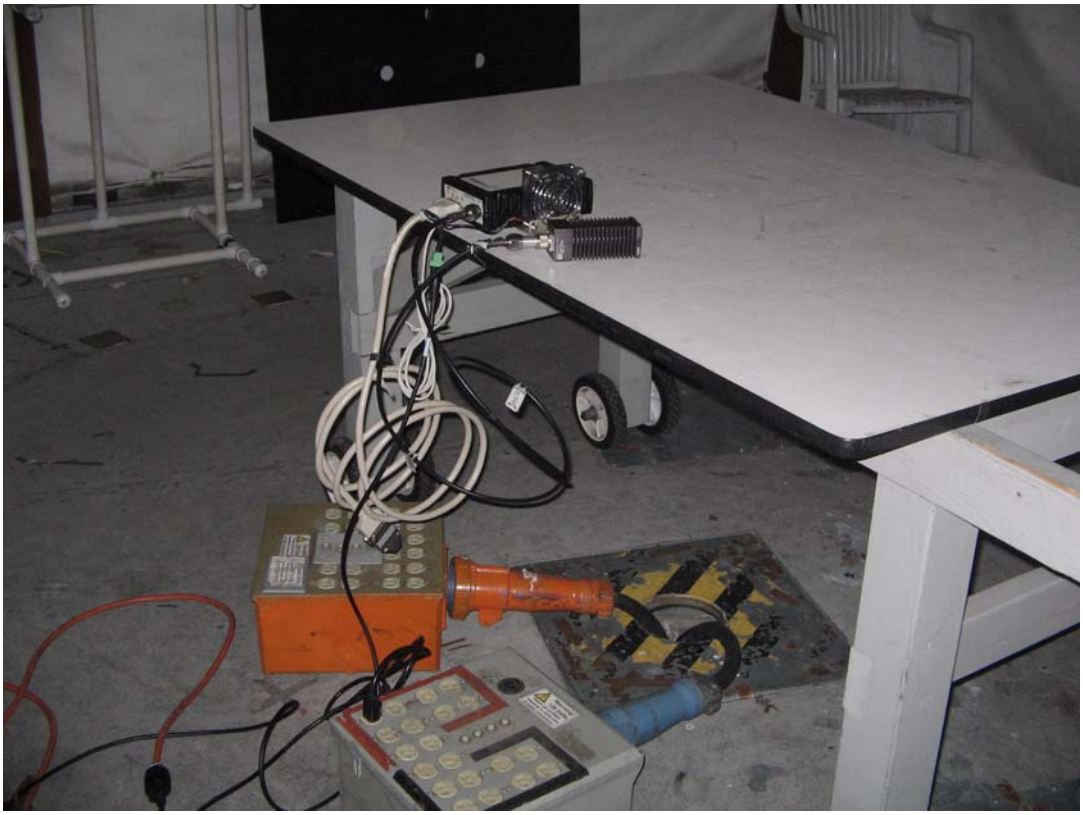



| | | | |
|---|---|---|---|
| Client: | GE MDS LLC | Job Number: | J71354 |
| Model: | TD220 | T-Log Number: | T71417 |
| | | Account Manager: | Susan Pelzl |
| Contact: | Dennis McCarthy | | |
| Standard: | RSS 119, FCC Part 90 and 15 | Class: | A |

**Run #1: AC Power Port Conducted Emissions, 0.15 - 30MHz, 120V/60Hz**

| Frequency | Level | AC | Class B | | Detector | Comments |
|---|---|---|---|---|---|---|
| MHz | dBµV | Line | Limit | Margin | QP/Ave | |
| 0.157 | 63.2 | Neutral | 65.6 | -2.4 | QP | |
| 0.171 | 61.1 | Line | 64.9 | -3.8 | QP | |
| 0.153 | 58.6 | Line | 65.8 | -7.2 | QP | |
| 0.193 | 55.7 | Neutral | 63.9 | -8.2 | QP | |
| 0.218 | 54.3 | Line | 62.9 | -8.6 | QP | |
| 0.179 | 54.3 | Line | 64.5 | -10.2 | QP | |
| 0.219 | 52.3 | Neutral | 62.8 | -10.5 | QP | |
| 15.721 | 47.0 | Neutral | 60.0 | -13.0 | QP | |
| 15.721 | 34.8 | Neutral | 50.0 | -15.2 | AVG | |
| 0.207 | 47.9 | Neutral | 63.3 | -15.4 | QP | |
| 0.157 | 36.0 | Neutral | 55.6 | -19.6 | AVG | |
| 0.171 | 34.0 | Line | 54.9 | -20.9 | AVG | |
| 0.153 | 30.7 | Line | 55.8 | -25.1 | AVG | |
| 0.218 | 27.5 | Line | 52.9 | -25.4 | AVG | |
| 0.193 | 27.3 | Neutral | 53.9 | -26.6 | AVG | |
| 0.219 | 25.4 | Neutral | 52.8 | -27.4 | AVG | |
| 0.179 | 26.5 | Line | 54.5 | -28.0 | AVG | |
| 0.207 | 22.5 | Neutral | 53.3 | -30.8 | AVG | |

## *EXHIBIT 3: Test Configuration Photographs – Radiated Emissions*



# *EXHIBIT 4: Theory of Operation GE MDS LLC Model TD220*

Uploaded as A Separate Attachment

# *EXHIBIT 5: Proposed FCC ID Label & Label Location*

Uploaded as A Separate Attachment

# *EXHIBIT 6: Detailed Photographs GE MDS LLC Model TD220*

Uploaded as A Separate Attachment

# *EXHIBIT 7: Installation Guide GE MDS LLC Model TD220*

Uploaded as A Separate Attachment

# *EXHIBIT 8: Block Diagram GE MDS LLC Model TD220*

Uploaded as A Separate Attachment

# *EXHIBIT 9: Schematic Diagrams GE MDS LLC Model TD220*

Uploaded as A Separate Attachment