Elliott Laboratories
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 6, FCC Part 90 on the GE MDS LLC Transmitter Model: TD220

FCC ID NUMBER:	E5MDS-TD220
UPN:	101D-TD220
GRANTEE:	GE MDS LLC 175 Science Parkway Rochester, CNY 14620
TEST SITE:	Elliott Laboratories 684 W. Maude Avenue Sunnyvale, CA 94086
REPORT DATE:	October 7, 2008
FINAL TEST DATE:	September 29, September 30, October 1, 2008
AUTHORIZED SIGNATORY:	David W Bare David W. Bare Chief Engineer

ACCREDITED

Testing Cert #2016-01

REVISION HISTORY

Revision #	Date	Comments	Modified By
1	November 7, 2008	First Release	-

TABLE OF CONTENTS

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, CNY 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 5: 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 Range

FCC 90 & RSS-119**: 217.0125 – 219.9875**

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

FCC 90.259 & RSS-119**: 2 watts in the 217-220 MHz band**

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

FCC 90.259 & 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

Same as original certification

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

Refer to Exhibit 4: Theory of Operation for operation in the 217-220 MHz band that supplements the original theory of operation.

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

Refer to Exhibit 4

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

Refer to Exhibit 4

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

Refer to Exhibit 4

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

Same as in original certification.

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

Same as in original certification.

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

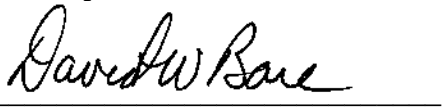
Manufacturer:
GE MDS LLC
175 Science Parkway
Rochester, CNY 14620

Tested to applicable standards:
RSS-119, Issue 6 (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: IC2845-1 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 W. Bare
Title	Chief Engineer Elliott Laboratories
Address	684 W. Maude Ave Sunnyvale, CA 94086 USA
Date:	October 7, 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 Part 2 & 90 Sections	RSS-119 Section	Test Performed	Measured Value	Test Procedure Used	Result
Modulation Tested	GMSK	GMSK	-	-	-	-
Modulation characteristics	2.1047	5.2	Modulated with appropriated signal	-	H	-
Radiated RF power output (ERP/EIRP)	2.1046 / 90.259 & 90.205(g)	6.2	Radiated Output Power Test	-	-	-
Conducted RF power output	2.1046 / 90.259 & 90.205(g) 2 W	5.4 (SRSP-512 6.3) 50W	Conducted Output Power Test	33.0dBm (2 Watts)	B	Complies
Spurious emissions at antenna Port	2.1051/ 90.210(c)	6.3 & 6.4(c)	Emission Limits and/or Unwanted Emission 30MHz – 5GHz (**Antenna Conducted**)	All spurious emissions < -13dBm	J	Complies
Occupied Bandwidth	2.1049/ 90.210(c)	6.4(c) & 6.4(c)	Emission Mask and 99% Bandwidth	Refer to Plots	C & D	Complies
Field strength of spurious radiation	2.1053 / 90.210(c)	6.3 & 6.4(c)	Radiated Spurious Emissions 30MHz – 5GHz	52.4dBµV/m (416.9µV/m) @ 879.83MHz (-29.8dB)	N	Complies
Frequency stability	2.1055 / 90.213	5.3	Frequency Vs. Temperature	No change from previous submittal		
Frequency stability	2.1055 / 90.213	5.3	Frequency Vs. Voltage			
Transient Frequency Behavior	90.214	5.9	Transient Behavior			
Exposure to Mobile devices	2.1091	9	Exposure of Humans to RF Fields	Considered at licensing	-	
Receiver	15.109	RSS-GEN 5.118	Receiver Spurious Emissions	39.3dBµV/m (92.3µV/m) @ 580.00MHz (-6.7dB)	N/A	Complies

MEASUREMENT UNCERTAINTIES

ISO Guide 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 which is designed to transmit and receive data in the 217 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.

The sample was received on September 29, 2008 and tested on September 29, September 30, October 1, 2008. The EUT consisted of the following component(s):

Manufacturer	Model	Description	Serial Number	FCC ID
GE MDS LLC	TD220	Digital Microwave Radio	1787645	E5MDS-TD220

OTHER EUT DETAILS

None

ENCLOSURE

The EUT enclosure is primarily constructed of diecast aluminum. It measures approximately 14.0cm wide by 17.0cm deep by 5.0cm high.

MODIFICATIONS

The EUT did not require modifications during testing in order to comply with the emission specifications.

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 was used during 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

EUT OPERATION DURING TESTING

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

.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken on September 29, September 30, October 1, 2008 at the Elliott Laboratories Open Area Test Site #1 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.

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

1 Page

Radiated Emissions, 30 - 2200MHz, 30-Sep-08
Engineer: Mehran Birgani

Manufacturer	Description	Model #	Asset #	Cal Due
EMCO	Log Periodic Antenna, 0.3-1 GHz	3146A	364	13-Dec-08
EMCO	Biconical Antenna, 30-300 MHz	3110B	801	19-Sep-09
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	870	08-Nov-08
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	24-Oct-08
EMCO	Antenna, Horn, 1-18 GHz	3115	1561	10-Jun-10
Hewlett Packard	Preamplifier, 100 kHz - 1.3 GHz	8447D OPT 010	1826	29-May-09

Conducted Emissions - AC Power Ports, 30-Sep-08
Engineer: Suhaila Khushzad

Manufacturer	Description	Model #	Asset #	Cal Due
Elliott Laboratories	LISN, FCC / CISPR	LISN-3, OATS	304	31-Jul-09
Hewlett Packard	EMC Spectrum Analyzer, 9 kHz - 6.5 GHz	8595EM	780	09-Oct-08
Solar Electronics	LISN	8028-50-TS-24-BNC support	904	15-Feb-09
Rohde & Schwarz	Test Receiver, 0.009-2750 MHz	ESN	1332	29-Jan-09
Rohde& Schwarz	Pulse Limiter	ESH3 Z2	1398	12-Feb-09

Radiated Emissions, 30 - 2,200 MHz, 01-Oct-08
Engineer: Mehran Birgani

Manufacturer	Description	Model #	Asset #	Cal Due
Elliott Laboratories	Log Periodic Antenna 300-1000 MHz	EL300.1000	55	27-Feb-09
Rohde & Schwarz	Test Receiver, 20-1300 MHz	ESVP	273	16-Feb-09
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	06-Jun-09
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
EMCO	Antenna, Horn, 1-18 GHz (SA40-Red)	3115	1142	15-Jul-10

EXHIBIT 2: Test Data Log Sheets

ELECTROMAGNETIC EMISSIONS

TEST LOG SHEETS

AND

MEASUREMENT DATA

T73232 17 Pages

Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		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: 10/1/2008

Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		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 217 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	1787645	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 diecast aluminum. It measures approximately 14.0cm wide by 17.0cm deep by 5.0cm high.

Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		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

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:	J73151
Model:	TD220	T-Log Number:	T73232
		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: 10/1/2008
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: 22 °C
Rel. Humidity: 41 %

Summary of Results

Run #	Test Performed	Limit	Result	Margin
2	RE, 30 - 1000MHz Maximized Emissions	FCC	Pass	39.3dBµV/m (92.3µV/m) @ 580.00MHz (-6.7dB)

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 - 1000 MHz	3	3	0.0

Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		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	
30.006	28.5	V	40.0	-11.5	QP	14	1.0	
39.999	24.4	V	40.0	-15.6	QP	0	1.0	
97.667	33.5	H	43.5	-10.0	QP	0	3.4	
159.999	31.7	H	43.5	-11.8	QP	71	4.0	
580.000	39.3	H	46.0	-6.7	QP	87	1.0	
714.167	34.7	H	46.0	-11.3	QP	358	2.4	
769.000	28.5	H	46.0	-17.5	QP	266	4.0	
910.167	30.5	H	46.0	-15.5	QP	260	1.7	

Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		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 (217 - 220 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: 9/29/2008
Test Engineer: Mehran Birgani
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.

Ambient Conditions:

9/29/2008

Temperature: 20 °C
Rel. Humidity: 39 %

Summary of Results

Run #	Test Performed	Limit	Result	Limit
1	Maximum Output Power	FCC Part 90.259	33.0 dBm	33.0 dBm
2a and 2b	Unwanted emissions (Mask)	FCC Part 90.210	Pass	Mask C
3b	Bandwidth	FCC Part 90.209	5.96 kHz	20/11.25/6 kHz
4	Transmitter spurious emissions, 30MHz - 2,200MHz (rf port)	FCC Part 90	Pass	-13dBm

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:	J73151
Model:	TD220	T-Log Number:	T73232
		Account Manager:	Susan Pelzl
Contact:	Dennis McCarthy		
Standard:	RSS 119, FCC Part 90 and 15	Class:	N/A

Run #1: Maximum Power Measurements, modulated

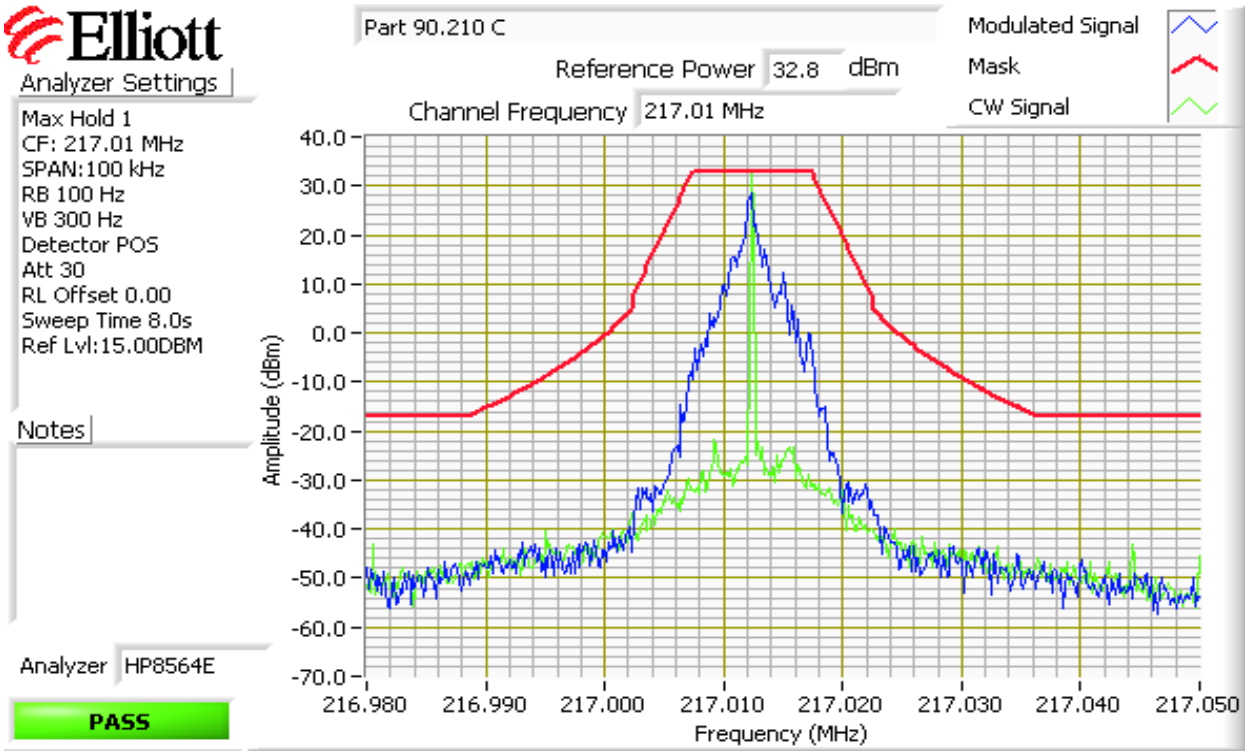
Power settings are H, L and XL are available corresponding to 25, 10 and 2 Watts.

Freq.	Setting	Pmeas	Duty Cycle	Pout
217.0125	XL	33.0	100%	33.0
218.0000	XL	32.9	100%	32.9
219.9875	XL	32.7	100%	32.7

minimum power: 2.0 Watts

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

Run #2: Mask



Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		Account Manager:	Susan Pelzl
Contact:	Dennis McCarthy		
Standard:	RSS 119, FCC Part 90 and 15	Class:	N/A

Elliott

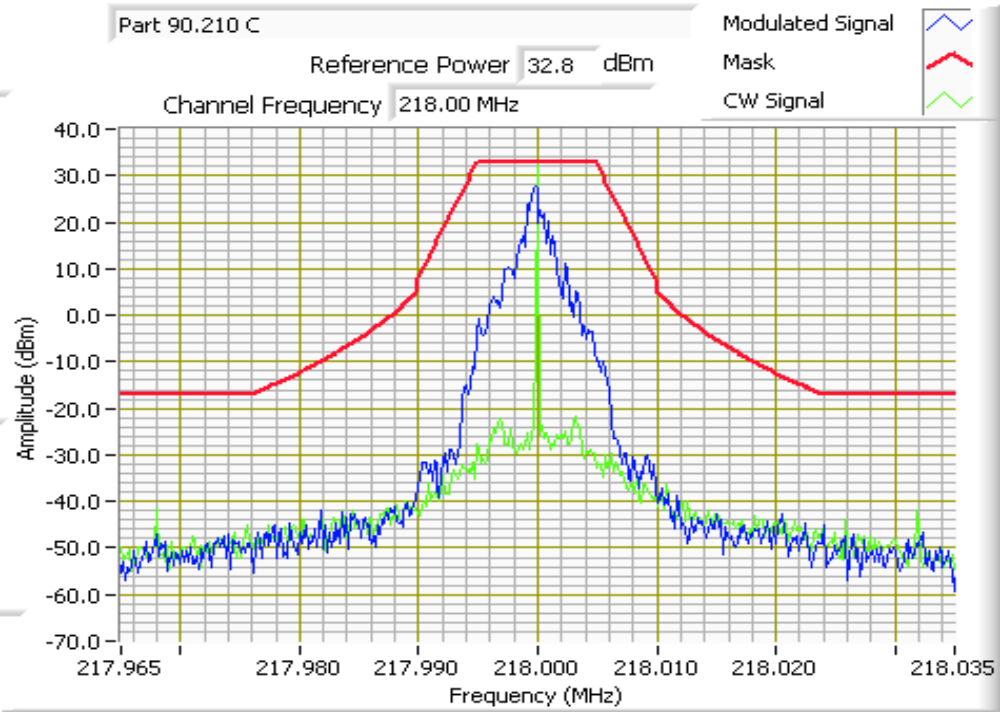
Analyzer Settings

Max Hold 1
CF: 218.00 MHz
SPAN:100 kHz
RB 100 Hz
VB 300 Hz
Detector POS
Att 30
RL Offset 0.00
Sweep Time 8.0s
Ref Lvl:15.00DBM

Notes

Analyzer HP8564E

PASS



Elliott

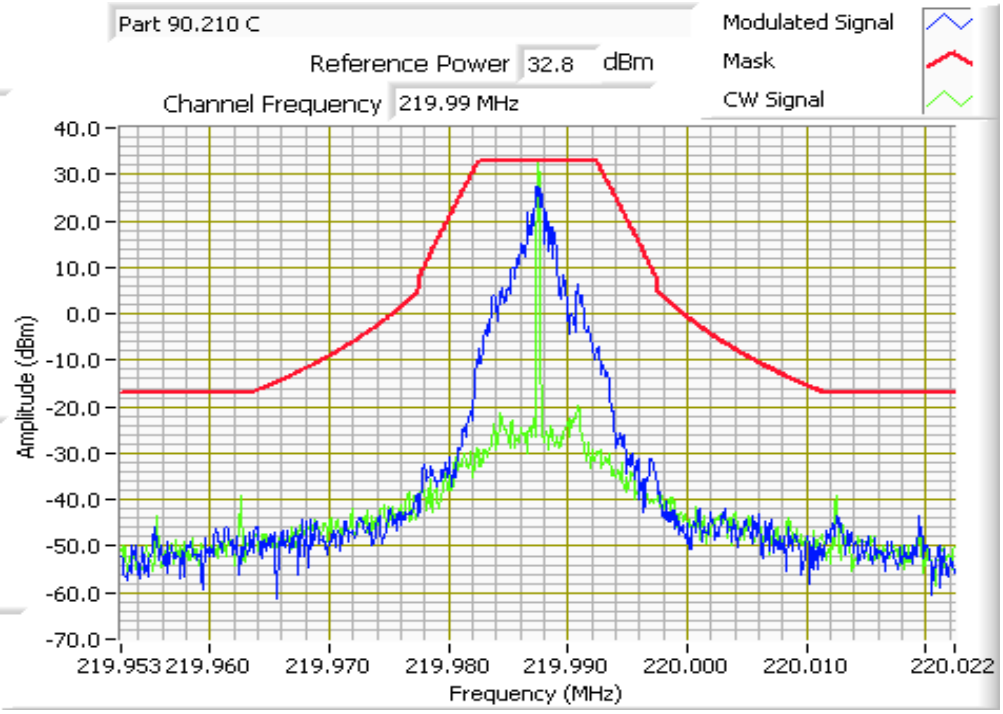
Analyzer Settings

Max Hold 1
CF: 219.99 MHz
SPAN:70 kHz
RB 100 Hz
VB 300 Hz
Detector POS
Att 30
RL Offset 0.00
Sweep Time 5.6s
Ref Lvl:15.00DBM

Notes

Analyzer HP8564E

PASS

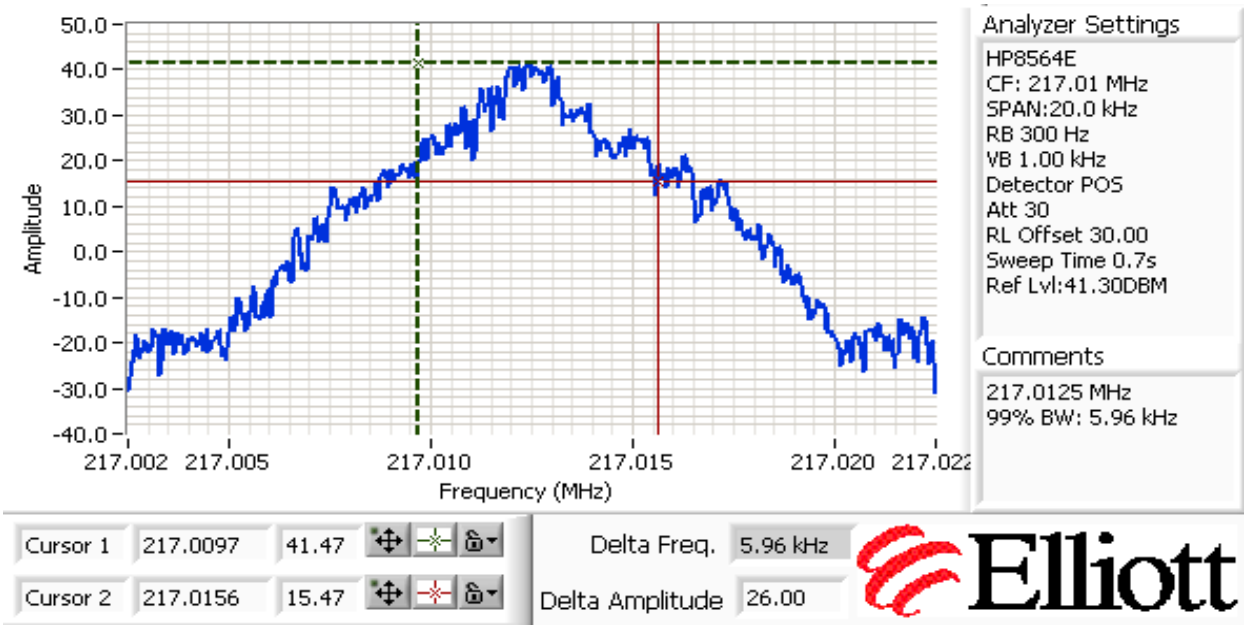


Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		Account Manager:	Susan Pelzl
Contact:	Dennis McCarthy		
Standard:	RSS 119, FCC Part 90 and 15	Class:	N/A

Run #3: Signal Bandwidth

Power Setting	Frequency (MHz)	Resolution Bandwidth	Bandwidth (kHz)	
				99%
H	217.0125	300 Hz	-	5.96
H	218.0000	300 Hz	-	5.96
H	219.9875	300 Hz	-	5.76

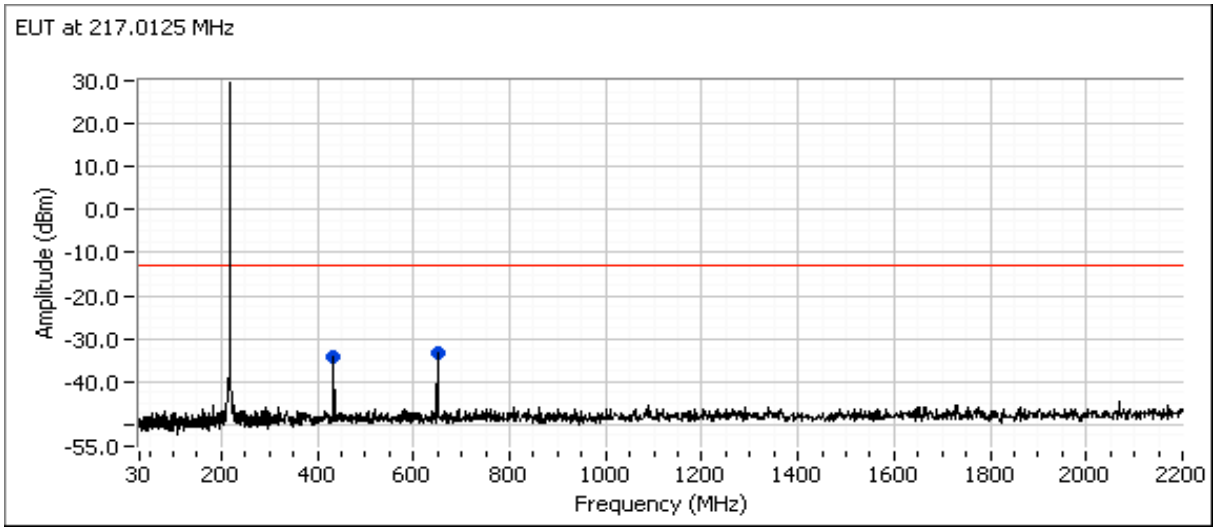
Note 1:	99% bandwidth measured in accordance with RSS GEN, with RB > 1% of the span and VB > 3xRB

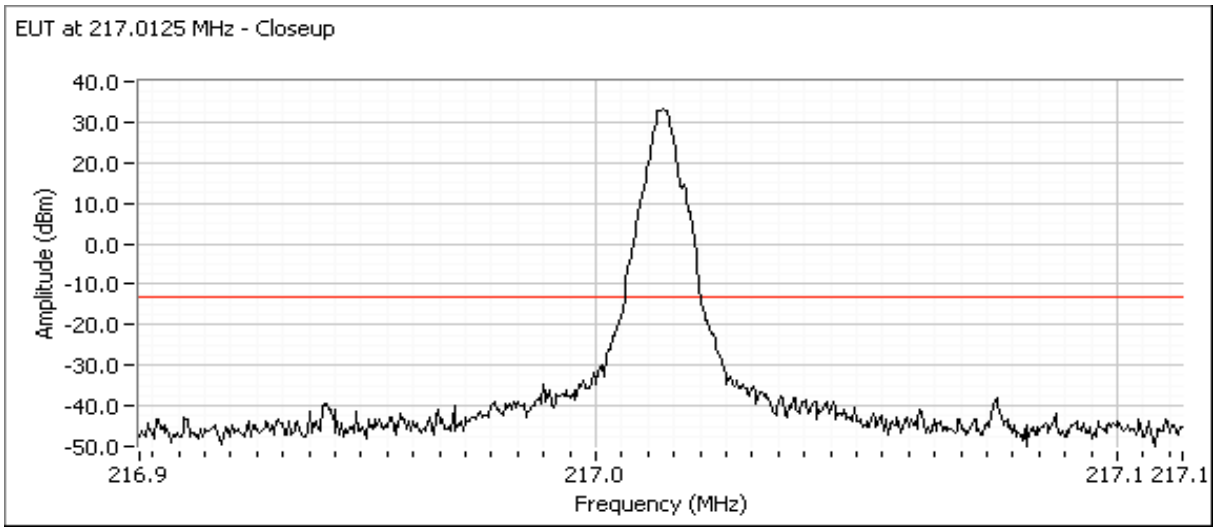


Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		Account Manager:	Susan Pelzl
Contact:	Dennis McCarthy		
Standard:	RSS 119, FCC Part 90 and 15	Class:	N/A

Run #4: Out of Band Spurious Emissions

Plots for low channel (217.0125MHz), power setting(s) = XL

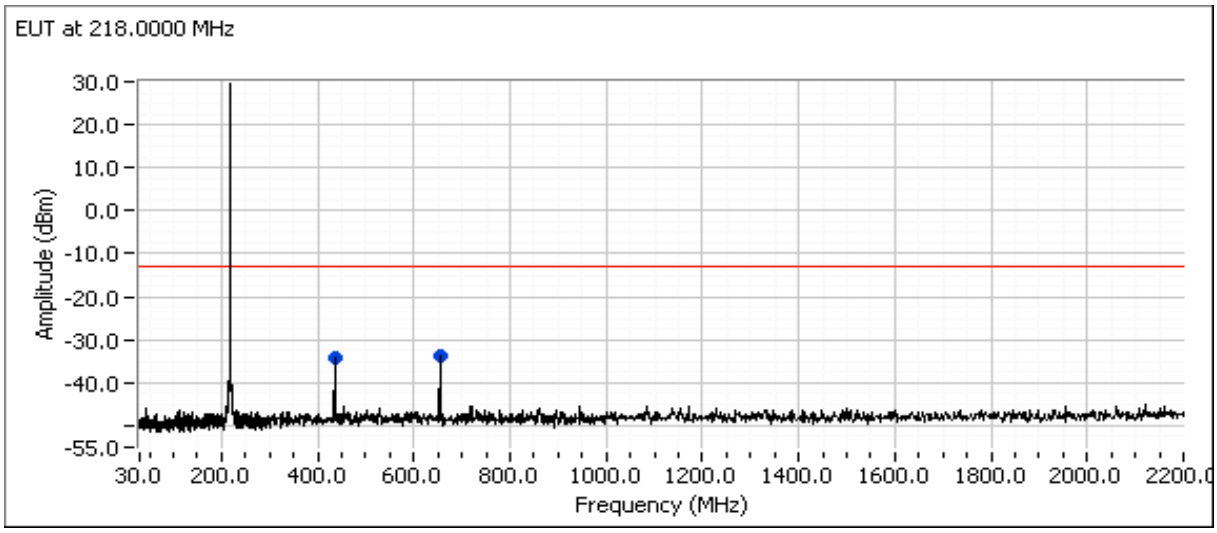


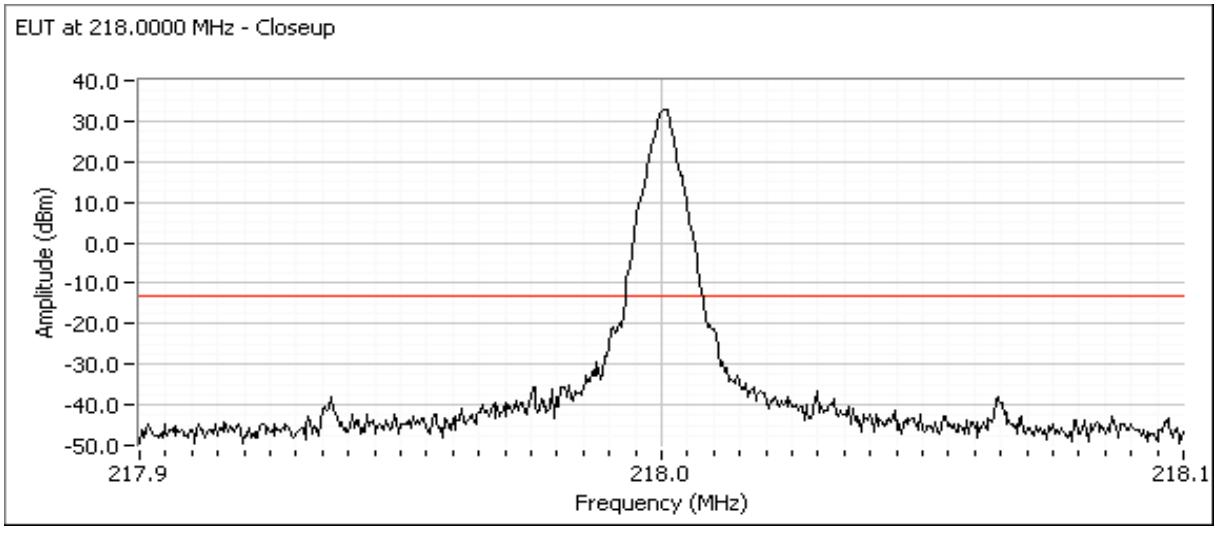


Frequency	Level	Pol	FCC Class A		Detector	Azimuth	Height	Comments
MHz	dBm	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
650.000	-33.3	RF Port	-13.0	-20.3	Peak	-	-	
434.167	-34.3	RF Port	-13.0	-21.3	Peak	-	-	

Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		Account Manager:	Susan Pelzl
Contact:	Dennis McCarthy		
Standard:	RSS 119, FCC Part 90 and 15	Class:	N/A

Plots for center channel (218.0000MHz), power setting(s) = XL

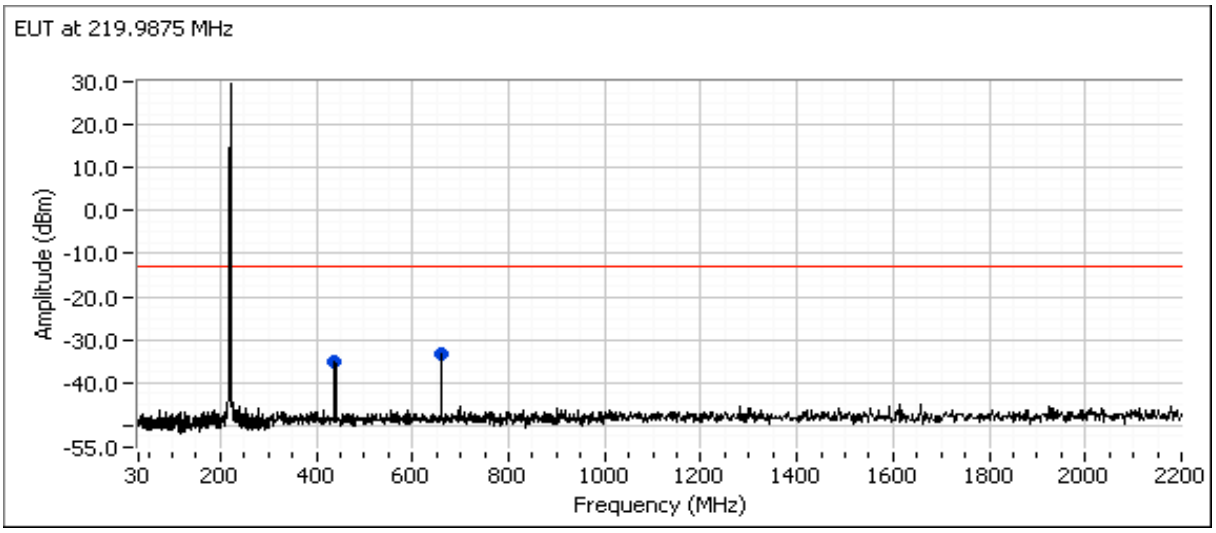


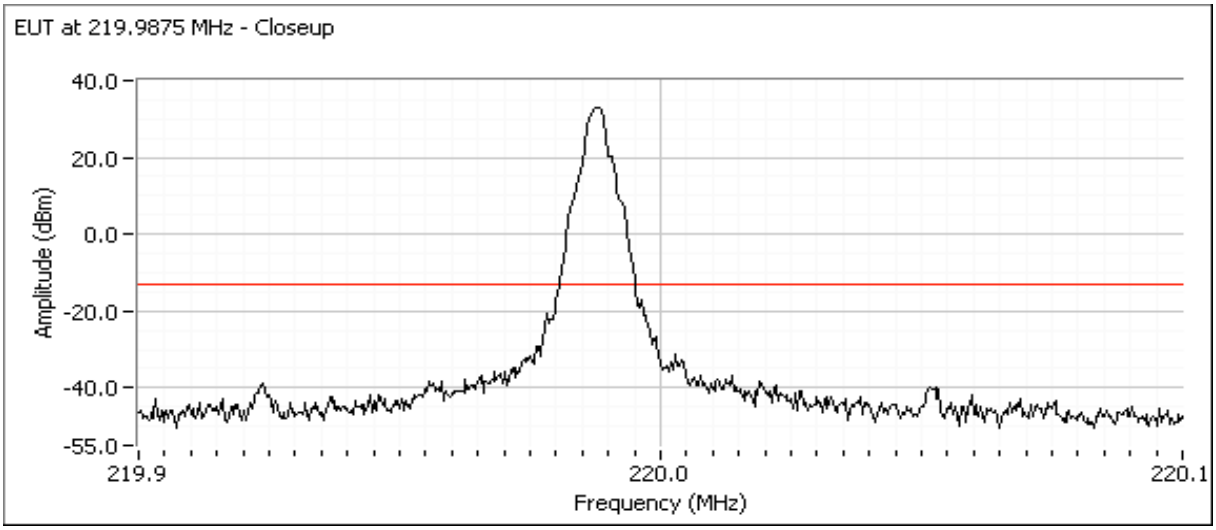


Frequency	Level	Pol	FCC Class A		Detector	Azimuth	Height	Comments
MHz	dBm	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
436.500	-34.3	RF Port	-13.0	-21.3	Peak	-	-	
653.500	-33.7	RF Port	-13.0	-20.7	Peak	-	-	

Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		Account Manager:	Susan Pelzl
Contact:	Dennis McCarthy		
Standard:	RSS 119, FCC Part 90 and 15	Class:	N/A

Plots for high channel (219.9875MHz), power setting(s) = XL





Frequency	Level	Pol	FCC Class A		Detector	Azimuth	Height	Comments
MHz	dBm	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters	
659.333	-33.3	RF Port	-13.0	-20.3	Peak	-	-	
438.833	-35.3	RF Port	-13.0	-22.3	Peak	-	-	

Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		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:

	9/29/2008	10/1/2008
Temperature:	19 °C	22 °C
Rel. Humidity:	32 %	41 %

Summary of Results

Run #	Spacing	Test Performed	Limit	Pass / Fail	Result / Margin
3	-	Spurious emissions (radiated) (217.0125MHz)	FCC 90.210 RSS 119	Pass	33.8dBµV/m (49.0µV/m) @ 434.17MHz (-48.4dB)
3	-	Spurious emissions (radiated) (218.0000MHz)	FCC 90.210 RSS 119	Pass	52.1dBµV/m (402.7µV/m) @ 218.00MHz (-30.1dB)
3	-	Spurious emissions (radiated) (219.9875MHz)	FCC 90.210 RSS 119	Pass	52.4dBµV/m (416.9µV/m) @ 879.83MHz (-29.8dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

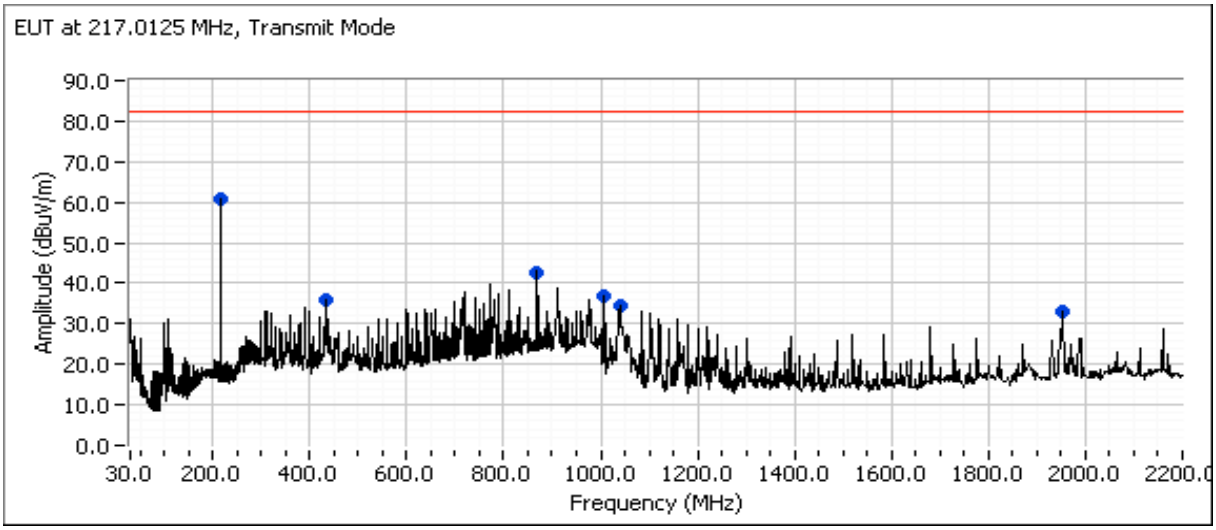
Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		Account Manager:	Susan Pelzl
Contact:	Dennis McCarthy		
Standard:	RSS 119, FCC Part 90 and 15	Class:	N/A

Run #1: Chamber Perscan at 217.0.125MHz

Date of Test: 9/29/2008 Test Location: SV Chamber #2
Test Engineer: Mehran Birgani



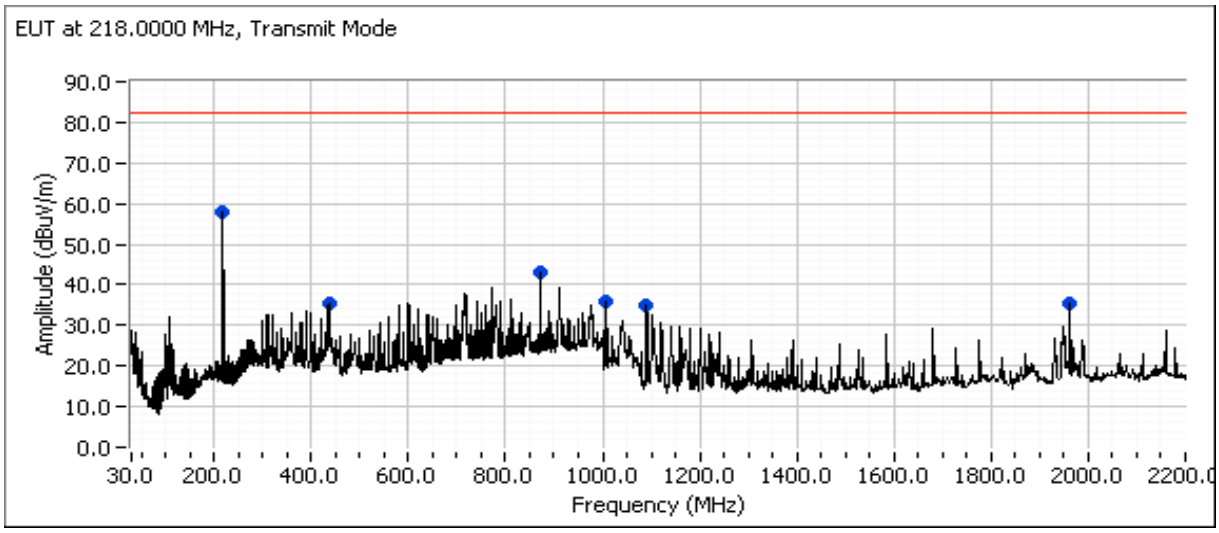
Frequency	Level	Pol	FCC 90.210		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters		
217.013	60.6	H	82.2	-21.6	Peak	269	1.7		
434.167	34.4	H	82.2	-47.8	Peak	272	1.7		
868.167	42.6	H	82.2	-39.6	Peak	159	1.7		
1008.000	37.0	H	82.2	-45.2	Peak	258	1.7		
1040.000	34.4	V	82.2	-47.8	Peak	275	1.7		
1954.000	32.9	V	82.2	-49.3	Peak	283	1.7		

Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		Account Manager:	Susan Pelzl
Contact:	Dennis McCarthy		
Standard:	RSS 119, FCC Part 90 and 15	Class:	N/A

Run #2: Chamber Perscan at 218.0000MHz

Date of Test: 9/29/2008 Test Location: SV Chamber #2

Test Engineer: Mehran Birgani

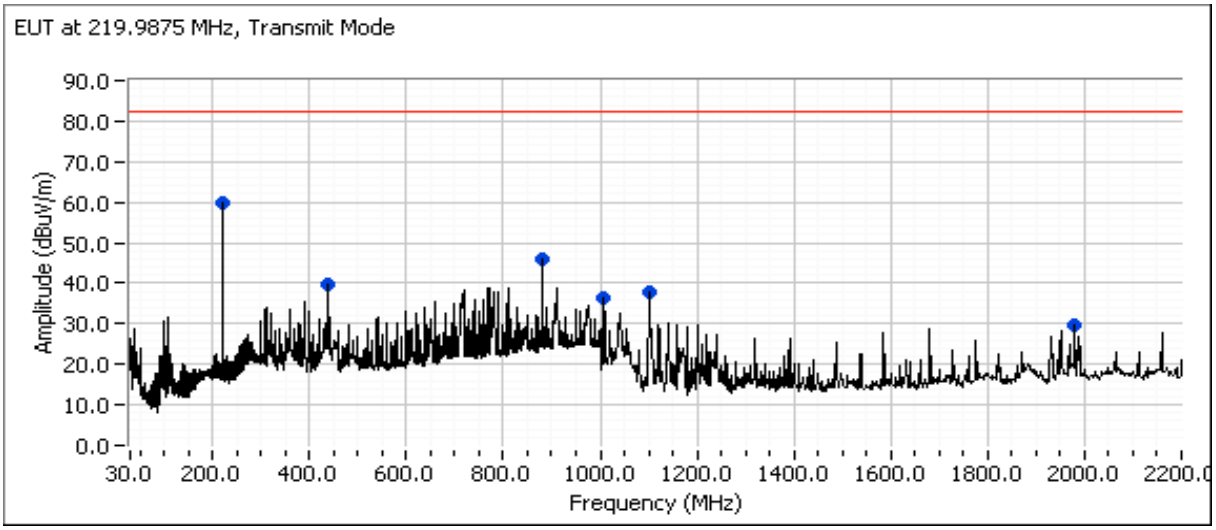


Frequency	Level	Pol	FCC 90.210		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters		
218.000	57.7	H	82.2	-24.5	Peak	121	1.7	Fundamental	
436.500	35.3	H	82.2	-46.9	Peak	268	1.7		
872.833	43.0	H	82.2	-39.2	Peak	166	1.7		
1008.000	36.0	H	82.2	-46.2	Peak	255	1.7		
1090.000	35.1	V	82.2	-47.1	Peak	276	1.7		
1962.000	35.2	V	82.2	-47.0	Peak	284	1.7		

Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		Account Manager:	Susan Pelzl
Contact:	Dennis McCarthy		
Standard:	RSS 119, FCC Part 90 and 15	Class:	N/A

Run #3: Chamber Perscan at 219.9875MHz

Date of Test: 9/29/2008 Test Location: SV Chamber #2
Test Engineer: Rafael varelas



Frequency	Level	Pol	FCC 90.210		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters		
219.988	59.8	H	82.2	-22.4	Peak	268	1.7	Fundamental	
440.000	39.8	H	82.2	-42.4	Peak	262	1.7		
879.833	46.1	H	82.2	-36.1	Peak	160	1.7		
1008.000	36.2	H	82.2	-46.0	Peak	260	1.7		
1100.000	37.9	V	82.2	-44.3	Peak	265	1.7		
1980.000	29.8	V	82.2	-52.4	Peak	294	1.7		

Client:	GE MDS LLC	Job Number:	J73151
Model:	TD220	T-Log Number:	T73232
		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

Date of Test: 10/1/2008 Test Location: SV OATS #1

Test Engineer: Mehran Birgani

Frequency	Level	Pol	FCC 90.210		Detector	Azimuth	Height	Comments	Channel
MHz	dBµV/m	V/H	Limit	Margin	Pk/QP/Avg	degrees	meters		
879.833	52.4	H	82.2	-29.8	PK	207	1.0		219.9875
218.000	52.1	H	82.2	-30.1	PK	153	1.0		218.0000
872.833	51.8	H	82.2	-30.4	PK	46	3.9		218.0000
440.000	39.7	H	82.2	-42.5	PK	292	1.0		219.9875
434.167	33.8	H	82.2	-48.4	PK	360	1.0		217.0125
868.167	29.4	H	82.2	-52.8	PK	242	3.7		217.0125
217.013	29.1	H	82.2	-53.1	PK	74	1.0		217.0125
436.000	28.0	H	82.2	-54.2	PK	0	1.0		218.0000

Note 1:	No emissions with 20dB of the calculated ERP limit, so no substitution measurtements performed.

EXHIBIT 3: Test Configuration Photographs

Uploaded as A Separate Attachment

EXHIBIT 4: Theory of Operation GE MDS LLC Model TD220

Uploaded as A Separate Attachment

EXHIBIT 5: Installation Guide GE MDS LLC Model TD220

Uploaded as A Separate Attachment